Version Control with Subversion

For Subversion 1.5

(Übersetzt aus der Revision 3355)

Ben Collins-Sussman
Brian W. Fitzpatrick
C. Michael Pilato

Version Control with Subversion: For Subversion 1.5: (Übersetzt aus der Revision 3355)

von Ben Collins-Sussman, Brian W. Fitzpatrick und C. Michael Pilato

Veröffentlicht (TBA)
Copyright © 2002, 2003, 2004, 2005, 2006, 2007, 2008 Ben Collins-SussmanBrian W. FitzpatrickC. Michael Pilato

This work is licensed under the Creative Commons Attribution License. To view a copy of this license, visit http://creativecommons.org/licenses/by/2.0/ or send a letter to Creative Commons, 559 Nathan Abbott Way, Stanford, California 94305, USA.

Inhaltsverzeichnis

Abbildungsverzeichnis

Tabellenverzeichnis

Beispiele

Geleitwort

Karl Fogel
Chicago, 14, März 2004.

Eine schlechte FAQ (Frequently Asked Questions) ist eine, die nicht aus den Fragen besteht, die wirklich gefragt wurden, sondern aus denen, die der Autor sich von den Fragenden *gewünscht* hätte. Vielleicht haben Sie solche schon gesehen:

> F: Wie kann ich Glorbosoft XYZ einsetzen, um die Team-Produktivität zu maximieren?
>
> A: Viele unserer Kunden wollen wissen, wie sie Ihre Produktivität mit unseren patentierten Office Groupware Innovationen maximieren können. Die Antwort ist einfach: zuerst klicken Sie auf das Menü „`Datei`“, fahren hinunter zum Eintrag „`Erhöhe Produktivität`“, und dann …

Das Problem mit solchen FAQs ist, dass sie keine FAQs im eigentlichen Sinne sind. Niemand fragt den technischen Support: „Wie können wir unsere Produktivität steigern?“ Üblicherweise fragen Leute sehr spezifische Fragen, wie: „Wie können wir das Kalendersystem so ändern, dass es die Erinnerungen zwei Tage statt einen Tag im Voraus aussendet?“ und so weiter. Aber es ist viel leichter, häufig gestellte Fragen zu erfinden, als die richtigen Fragen zu entdecken. Eine sinnvolle FAQ-Sammlung zusammenzustellen, erfordert eine ausdauernde, planvolle Anstrengung: über die Lebensdauer einer Software müssen hereinkommende Anfragen ausgewertet und Rückmeldungen evaluiert werden und zu einem konsistenten und benutzerfreundlichen Ganzen zusammengeführt werden, das die gesammelte Erfahrung der Anwendenden wiedergibt. Es erfordert die geduldige, aufmerksame Einstellung eines Naturforschers. Nicht großartige Hypothesen und visionäre Vorhersagen, sondern hauptsächlich offene Augen und genaue Aufzeichnungen sind gefragt.

Was ich an diesem Buch liebe, ist, dass es genau aus einem solchen Prozess gewachsen ist und dies auf jeder Seite sichtbar ist. Es ist das direkte Ergebnis der Begegnungen der Autoren mit Benutzern. Es begann mit Ben Collins-Sussmans Beobachtung, dass Leute immer wieder die gleichen grundlegenden Fragen auf der Subversion-Mailingliste stellten: Was sind die Standard-Arbeitsabläufe mit Subversion? Funktionieren Branches und Tags genau so wie in anderen Versionskontrollsystemen? Wie finde ich heraus, wer eine bestimmte Änderung durchgeführt hat?

Frustriert davon, Tag für Tag immer wieder die gleichen Fragen zu sehen, arbeitete Ben im Sommer 2002 über einen Monat intensiv daran, *The Subversion Handbook* zu schreiben, eine 60-seitige Anleitung, die die Grundlagen der Benutzung von Subversion beschrieb. Die Anleitung erhob keinen Anspruch auf Vollständigkeit, aber sie wurde mit Subversion verteilt und half vielen über die ersten Buckel der Lernkurve. Als O'Reilly and Associates sich entschieden, ein vollständiges Buch über Subversion herauszugeben, war der Weg des geringsten Widerstandes offensichtlich: *The Subversion Handbook* muss erweitert werden.

Die drei Co-Autoren des neuen Buches erhielten somit eine seltene Gelegenheit. Eigentlich war es ihre Aufgabe, ein Buch beginnend mit dem Inhaltsverzeichnis und einem Rohkonzept zu schreiben; jedoch hatten sie auch Zugang zu einem ständigen Strom – ja einem unkontrollierbaren Geysir – aus Quellmaterial. Subversion wurde bereits von tausenden experimentierfreudigen Menschen benutzt, und diese gaben Unmengen an Rückmeldungen – nicht nur über Subversion, sondern auch über die bestehende Dokumentation.

Während der gesamten Zeit, in der sie dieses Buch schrieben, durchstöberten Ben, Mike und Brian unablässig die Subversion-Mailinglisten und Chaträume und notierten die Probleme, die Benutzer im echten Leben hatten. Die Beobachtung derartiger

Rückmeldungen war ohnehin ein Teil ihrer Arbeit bei CollabNet, was ihnen einen Riesenvorteil verschaffte, als sie sich entschlossen, Subversion zu dokumentieren. Das Buch, das sie schrieben, gründet auf dem festen Fels der Erfahrung und nicht auf dem Treibsand des Wunschdenkens. Es vereint die Vorteile von Bedienungsanleitung und FAQ. Diese Zweigleisigkeit ist vielleicht nicht gleich zu erkennen. Von vorne nach hinten gelesen ist das Buch einfach eine Beschreibung einer Software. Es gibt die Übersicht, den obligatorischen Rundgang, das Kapitel über Administration, einige fortgeschrittene Themen und natürlich eine Funktionsübersicht sowie eine Anleitung zur Problemlösung. Erst wenn Sie es später wieder zur Hand nehmen, um die Lösung für ein bestimmtes Problem zu suchen, wird die Zuverlässigkeit des Buches offenbar: in den beschriebenen Details,die nur aus der Erfahrung mit dem Unerwarteten erwachsen konnten, in den Beispielen, die aus dem tatsächlichem Einsatz gebildet wurden, und am meisten durch das Gefühl für die Bedürfnisse und den Blickwinkel der Benutzer.

Natürlich kann niemand versprechen, dass dieses Buch alle Fragen beantwortet, die Sie über Subversion haben. Manchmal wird die Genauigkeit, mit der es Ihre Fragen erwartet, unheimlich und telepathisch erscheinen; gelegentlich werden Sie jedoch in ein Loch im Wissen der Gemeinschaft stolpern und mit leeren Händen dastehen. Wenn das passiert schreiben Sie am besten eine E-Mail an `<users@subversion.tigris.org>` und schildern Ihr Problem. Die Autoren sind nach wie vor dort und beobachten. Und das betrifft nicht nur die drei, die auf dem Umschlag erscheinen sind, sondern viele andere, die Korrekturen und neues Material beigesteuert haben. Aus der Sicht der Gemeinschaft ist die Lösung Ihres Problems lediglich ein erfreulicher Nebeneffekt eines viel größeren Projektes – nämlich das Buch und schlussendlich auch Subversion selbst immer näher an die Art und Weise anzupassen, in der es tatsächlich benutzt wird. Diese Personen sind begierig darauf, von Ihnen zu hören, nicht nur weil sie Ihnen helfen können, sondern auch weil ihnen selbst damit geholfen ist. Für Subversion – so wie für alle aktiven freien Software-Projekte – gilt: *Sie sind nicht allein*.

Lassen Sie dieses Buch Ihren ersten Begleiter sein.

Vorwort

> „Es ist wichtig, die Vollkommenheit nicht zum Feind des Guten werden zu lassen, selbst dann, wenn darüber Einigkeit besteht, was Vollkommenheit ist. Erst recht, wenn man sich nicht darüber einig ist. So unangenehm es ist, durch vergangene Fehler gefangen zu sein, kann man während des Entwurfs keinen Fortschritt erzielen, wenn man Angst vor dem eigenen Schatten hat."
>
> —Greg Hudson, Subversion-Entwickler

In der Welt der Open-Source-Software war das Concurrent Versions System (CVS) für viele Jahre das Werkzeug der Wahl für Versionskontrolle. Und das zu Recht. CVS war selbst Open-Source-Software und seine nicht-einschränkende Vorgehensweise und Unterstützung für netzbasierten Einsatz erlaubte dutzenden geografisch verteilten Programmierern, ihre Arbeit zu teilen. Es passte sehr gut zur kollaborativen Natur der Open-Source-Welt. CVS und sein halb chaotisches Entwicklungsmodell sind seitdem zu Eckpfeilern der Open-Source-Kultur geworden.

Jedoch war CVS nicht makellos, und diese Makel einfach zu beseitigen, versprach einen enormen Aufwand. Bühne frei für Subversion. Subversion wurde als Nachfolger für CVS entworfen, und seine Schöpfer zogen los, um auf zwei Wegen die Herzen der CVS-Benutzer zu gewinnen – indem ein Open-Source-System erschaffen wurde, dessen Design (und „look and feel") ähnlich wie CVS war, und indem versucht wurde, die auffälligsten Makel von CVS zu vermeiden. Obwohl das Ergebnis nicht notwendigerweise den nächsten Evolutionsschritt in Sachen Versionskontrolle darstellt, *ist* Subversion sehr mächtig, sehr brauchbar und sehr flexibel. Und größtenteils wählen nun fast alle neuen Open-Source-Projekte Subversion statt CVS.

Dieses Buch ist geschrieben worden, um die Serie 1.5 des Subversion Versionskontrollsystems zu dokumentieren. Wir haben stets versucht, die Themen gründlich zu behandeln. Jedoch hat Subversion eine florierende und tatkräftige Entwicklergemeinde, so dass bereits eine Menge an Features und Verbesserungen für künftige Versionen von Subversion geplant sind, die Änderungen mancher Kommandos und bestimmter Anmerkungen in diesem Buch bewirken könnten.

Publikum

Dieses Buch ist für computerkundige Leute geschrieben, die mit Subversion ihre Daten verwalten wollen. Obwohl Subversion unter verschiedenen Betriebssystemen läuft, ist die primäre Benutzerschnittstelle kommandozeilenbasiert. Dieses Kommandozeilenwerkzeug (**svn**) und einige Hilfsprogramme stehen im Mittelpunkt dieses Buches.

Aus Gründen der Vereinheitlichung gehen die Beispiele in diesem Buch davon aus, dass der Leser ein unixähnliches Betriebssystem benutzt und mit Unix und Kommandozeilenschnittstellen verhältnismäßig gut zurechtkommt. Nichtsdestotrotz läuft **svn** auch unter anderen Betriebssystemen als Unix, etwa Microsoft Windows. Bis auf ein paar Ausnahmen, wie z.B. die Verwendung umgekehrter Schrägstriche (`\`) statt Schrägstrichen (`/`) als Pfadtrenner, sind die Ein- und Ausgaben dieses Werkzeugs unter Windows identisch zur Unix-Version.

Die meisten Leser sind wahrscheinlich Programmierer oder Systemadministratoren, die Änderungen an Quellcode verfolgen müssen. Das ist der am meisten verbreitete Einsatzzweck von Subversion, so dass alle Beispiele in diesem Buch auf diesem Szenario beruhen. Doch Subversion kann gleichwohl dazu benutzt werden, Änderungen an allerlei Arten von Informationen zu verwalten – Bilder, Musik, Datenbanken, Dokumentation usw. Für Subversion sind alle Daten einfach Daten.

Obwohl dieses Buch unter der Annahme geschrieben worden ist, dass der Leser noch nie ein Versionskontrollsystem benutzt hat, haben wir auch versucht, für Anwender von CVS (und anderen Systemen) den Sprung zu Subversion so schmerzlos wie möglich zu machen. Ab und zu werden in Randnotizen andere Versionskontrollsysteme erwähnt, und ein besonderer Anhang fasst viele der Unterschiede zwischen CVS und Subversion zusammen.

Es sei angemerkt, dass es sich bei den Quelltexten in diesem Buch nur um Beispiele handelt. Obwohl sie sich mit den passenden Compiler-Aufrufen übersetzen ließen, sollen sie lediglich ein besonderes Szenario illustrieren und nicht als Vorlage für guten Programmierstil oder gute Programmierpraxis dienen.

Wie dieses Buch zu lesen ist

Technische Bücher stehen immer vor einem bestimmten Dilemma: ob sie *von-oben* oder *von-unten* Lernenden entgegenkommen sollen. Ein von-oben Lernender bevorzugt es, Dokumentation zu lesen oder zu überfliegen und dabei einen groben Überblick über das Funktionieren des Systems zu erhalten, bevor er beginnt, die Software zu verwenden. Ein von-unten Lernender ist eine Person, für die „Lernen durch Ausprobieren" gilt, jemand, der in die Software eintauchen möchte, um beim Ausprobieren herauszufinden, wie sie funktioniert, und wenn nötig Abschnitte im Buch nachschlägt. Die meisten Bücher werden für die eine oder andere Art dieser Personen geschrieben, wobei dieses Buch zweifellos den von-oben Lernenden entgegenkommt. (Und wenn Sie gerade diesen Abschnitt lesen, sind Sie wahrscheinlich selber ein von-oben Lernender!) Verzweifeln Sie jedoch nicht, falls Sie ein von-unten Lerner sind. Während dieses Buch als eine breite Betrachtung der Themen rund um Subversion gestaltet ist, beinhaltet jeder Abschnitt eine reichhaltige Auswahl an Beispielen, die sie ausprobieren können. Die Ungeduldigen, die einfach weitermachen wollen, können sofort zu Anhang A, *Subversion Quick-Start Guide* springen.

Ungeachtet Ihrer Lernmethode zielt dieses Buch darauf ab, für Menschen unterschiedlicher Herkunft nützlich zu sein – von Menschen ohne vorherige Erfahrung mit Versionskontrolle bis hin zu erfahrenen Systemadministratoren. Je nach Ihrer Herkunft können bestimmte Kapitel mehr oder weniger wichtig für Sie sein. Was nun folgt, kann als „Leseempfehlung" für verschiedene Typen von Lesern betrachtet werden:

Erfahrene Systemadministratoren
: Die Annahme ist, dass Sie wahrscheinlich bereits Versionskontrolle verwendet haben und darauf brennen, möglichst schnell einen Subversion-Server zum Laufen zu bekommen. Kapitel 5, *Repository Administration* und Kapitel 6, *Die Administration eines Subversion-Servers* zeigen, wie Sie Ihr erstes Repository erzeugen und es über das Netz verfügbar machen können. Danach sind Kapitel 2, *Grundlegende Benutzung* und Anhang B, *Subversion for CVS Users* die schnellsten Wege zum Lernen des Subversion-Clients.

Neulinge
: Wahrscheinlich hat Ihr Administrator Subversion bereits aufgesetzt, und Sie möchten nun lernen, wie man den Client benutzt. Falls Sie noch nie ein Versionskontrollsystem benutzt haben, ist Kapitel 1, *Grundlegende Konzepte* eine unbedingt notwendige Einführung in die Konzepte der Versionskontrolle. Kapitel 2, *Grundlegende Benutzung* ist eine Führung durch den Subversion-Client.

Fortgeschrittene
: Ob Sie ein Benutzer oder ein Administrator sind, letztendlich wird Ihr Projekt anwachsen. Sie werden lernen wollen, wie man fortgeschrittene Dinge mit Subversion machen kann, etwa Branches verwenden und Merges durchführen (Kapitel 4, *Verzweigen und Zusammenführen*), wie Subversions Property-Unterstützung (Kapitel 3, *Advanced Topics*) zu benutzen ist, wie Laufzeitoptionen konfiguriert werden können (Kapitel 7, *Customizing Your Subversion Experience*) und vieles mehr. Diese Kapitel sind zunächst nicht kritisch, jedoch sollten Sie sie lesen, sobald Sie mit den Grundlagen vertraut sind.

Entwickler
: Unter der Annahme, dass Sie bereits mit Subversion vertraut sind und es nun entweder erweitern oder neue Software basierend auf einem seiner zahlreichen APIs erstellen möchten, ist Kapitel 8, *Embedding Subversion* genau das, was sie suchen.

Das Buch schließt mit einer Referenz – Kapitel 9, *Subversion Complete Reference* ist ein Referenzhandbuch für alle Befehle von Subversion, und die Anhänge behandeln eine Anzahl nützlicher Themen. Dies sind die Kapitel, zu denen Sie sehr wahrscheinlich zurückkehren werden, wenn Sie dieses Buch beendet haben.

Konventionen in diesem Buch

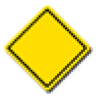
Die folgenden typografischen Konventionen werden in diesem Buch verwendet:

`Festbreitenschrift`
: Verwendet für Benutzereingaben, Befehlsausgaben und Kommandozeilenoptionen

`Kursiv`
: Verwendet für Programm- und Subversion-Unterbefehlsnamen, Datei- und Verzeichnisnamen und für neue Begriffe

`Kursive Festbreitenschrift`
: Verwendet für zu ersetzende Objekte in Code und Text

Des Weiteren haben wir besonders hilfreiche oder wichtige Informationshäppchen, wegen der besseren Auffindbarkeit optisch hervorgehoben, über das gesamte Buch verteilt (dort, wo es für den Zusammenhang bedeutsam ist). Achten Sie beim Lesen auf die folgenden Bilder:



Dieses Bild markiert einen besonders wichtigen Punkt.

Dieses Bild markiert einen nützlichen Tipp oder eine empfohlene Vorgehensweise.

Dieses Bild markiert eine Warnung. Beachten Sie diese besonders, um Probleme zu vermeiden!

Aufbau dieses Buchs

Hier sind die folgenden Kapitel und ihr Inhalt aufgeführt:

Kapitel 1, *Grundlegende Konzepte*
: Erklärt die Grundlagen von Versionskontrolle und unterschiedliche Versionierungsmodelle sowie das Repository von Subversion, Arbeitskopien und Revisionen.

Kapitel 2, *Grundlegende Benutzung*
: Ein Spaziergang durch den Tag eines Subversion-Anwenders. Es zeigt, wie ein Subversion-Client verwendet wird, um Daten zu bekommen, zu verändern und abzuliefern.

Kapitel 3, *Advanced Topics*
: Behandelt komplexere Eigenschaften, denen Benutzer letztendlich begegnen werden, wie etwa versionierte Metadaten, Dateisperren und Peg-Revisionen.

Kapitel 4, *Verzweigen und Zusammenführen*
: Behandelt Branches, Merges und Tagging inklusive empfohlener Vorgehensweisen beim Branchen und Mergen, übliche Szenarien, wie Änderungen wieder rückgängig gemacht werden können und wie einfach von einem Branch zum nächsten gewechselt werden kann.

Kapitel 5, *Repository Administration*
: Beschreibt die Grundlagen des Subversion-Repositorys, wie man ein Repository anlegt, konfiguriert und wartet sowie die Tools, die man hierfür benutzen kann

Kapitel 6, *Die Administration eines Subversion-Servers*
: Erklärt, wie man einen Subversion-Server konfiguriert und unterschiedliche Arten auf ein Repository zuzugreifen: `HTTP`, das `svn`-Protokoll und über die lokale Festplatte. Behandelt werden hier auch die Authentifizierung, die Autorisierung und der anonyme Zugriff.

Kapitel 7, *Customizing Your Subversion Experience*
: Untersucht die Subversion-Client-Konfigurationsdateien, die Handhabung internationalisierter Texte und wie man externe Tools zur Zusammenarbeit mit Subversion bringt.

Kapitel 8, *Embedding Subversion*
: Beschreibt die Interna von Subversion, das Subversion-Dateisystem und die Verwaltungsbereiche der Arbeitskopie aus der Sicht eines Programmierers. Hier wird auch gezeigt, wie die veröffentlichten APIs in einem Programm verwendet werden, das Subversion benutzt.

Kapitel 9, *Subversion Complete Reference*
: Erklärt detailreich jeden Unterbefehl von **svn**, **svnadmin** und **svnlook** mit vielen Beispielen für die ganze Familie.

Anhang A, *Subversion Quick-Start Guide*
: Für die Ungeduldigen eine Anleitung im Schnelldurchlauf für die Installation und die sofortige Benutzung. Seien Sie gewarnt!

Anhang B, *Subversion for CVS Users*
: Behandelt die Ähnlichkeiten und Unterschiede zwischen Subversion und CVS mit etlichen Vorschlägen, wie man sich all die schlechten Angewohnheiten aus jahrelangem CVS-Gebrauch wieder abgewöhnen kann. Dies beinhaltet Subversion-Revisionsnummern, versionierte Verzeichnisse, Offline-Tätigkeiten, **update** und **status**, Branches, Tags, Metadaten, Konfliktauflösung und Authentifizierung.

Anhang C, *WebDAV and Autoversioning*
: Beschreibt die Details zu WebDAV und DeltaV und wie man sein Subversion-Repository konfiguriert, damit es als freigegebenes DAV-Laufwerk schreibbar in das Dateisystem eingehängt werden kann.

Anhang D, *Copyright*
: Eine Kopie der Creative Commons Attribution License, unter der dieses Buch lizenziert ist.

Dieses Buch ist frei

Dieses Buch startete aus Dokumentationsschnipseln von Entwicklern des Subversion-Projektes, die in einem Werk gebündelt und umgeschrieben wurden. Insofern war es immer schon unter einer freien Lizenz (siehe Anhang D, *Copyright*). Tatsächlich wurde das

Buch unter den Augen der Öffentlichkeit geschrieben, ursprünglich als Teil des Subversion Projektes selbst. Das bedeutet zweierlei:

- Sie werden stets die neueste Version dieses Buchs im eigenen Subversion-Repository finden.
- Sie können an diesem Buch Änderungen vornehmen und es wie auch immer weiterverteilen – es unterliegt einer freien Lizenz. Ihre einzige Verpflichtung besteht darin, den Hinweis auf die ursprünglichen Autoren beizubehalten. Natürlich würden wir es bevorzugen, wenn Sie Rückmeldungen und Verbesserungen der Subversion-Entwicklergemeinde zukommen ließen, anstatt Ihre Privatversion zu verteilen.

Die Homepage der Entwicklungs- und Übersetzungsaktivitäten auf freiwilliger Basis ist http://svnbook.red-bean.com. Dort finden Sie Links auf die neuesten Releases und mit Tags versehene Versionen des Buchs in verschiedenen Formaten ebenso wie eine Anleitung, auf das Subversion-Repository des Buchs zuzugreifen (dort lebt sein Quellcode im DocBook-XML-Format). Rückmeldungen sind willkommen – ja sogar erwünscht. Bitte senden Sie alle Kommentare, Beschwerden und Patches für die Sourcen des Buchs an `<svnbook-dev@red-bean.com>`.

Danksagungen

Dieses Buch wäre nicht möglich (und auch nicht sehr nützlich) wenn es Subversion nicht gäbe. Dafür möchten die Autoren Brian Behrendorf danken sowie CollabNet für die Vision, solch ein riskantes und ehrgeiziges Open-Source-Projekt zu finanzieren; Jim Blandy für den ursprünglichen Namen von Subversion und sein Design – wir lieben Dich, Jim; Karl Fogel, dafür, dass er so ein guter Freund und Leiter der Gemeinde ist, in dieser Reihenfolge. [1]

Dank an O'Reilly und unsere verschiedenen Redakteure: Chuck Toporek, Linda Mui, Tatiana Apandi, Mary Brady und Mary Treseler. Ihre Geduld und Unterstützung waren enorm.

Schließlich danken wir den zahllosen Menschen, die zu diesem Buch durch informelle Rezensionen, Vorschläge, und Fehlerbehebungen beigetragen haben. Obwohl diese Liste zweifellos nicht vollständig ist, wäre dieses Buch unfertig und fehlerhaft ohne die Hilfe von: Bhuvaneswaran A, David Alber, C. Scott Ananian, David Anderson, Ariel Arjona, Seth Arnold, Jani Averbach, Charles Bailey, Ryan Barrett, Francois Beausoleil, Brian R. Becker, Yves Bergeron, Karl Berry, Jennifer Bevan, Matt Blais, Jim Blandy, Phil Bordelon, Sietse Brouwer, Tom Brown, Zack Brown, Martin Buchholz, Paul Burba, Sean Callan-Hinsvark, Branko Cibej, Archie Cobbs, Jason Cohen, Ryan Cresawn, John R. Daily, Peter Davis, Olivier Davy, Robert P. J. Day, Mo DeJong, Brian Denny, Joe Drew, Markus Dreyer, Nick Duffek, Boris Dusek, Ben Elliston, Justin Erenkrantz, Jens M. Felderhoff, Kyle Ferrio, Shlomi Fish, Julian Foad, Chris Foote, Martin Furter, Vlad Georgescu, Peter Gervai, Dave Gilbert, Eric Gillespie, David Glasser, Marcel Gosselin, Lieven Govaerts, Steve Greenland, Matthew Gregan, Tom Gregory, Maverick Grey, Art Haas, Mark E. Hamilton, Eric Hanchrow, Liam Healy, Malte Helmert, Michael Henderson, Øyvind A. Holm, Greg Hudson, Alexis Huxley, Auke Jilderda, Toby Johnson, Jens B. Jorgensen, Tez Kamihira, David Kimdon, Mark Benedetto King, Robert Kleemann, Erik Kline, Josh Knowles, Andreas J. Koenig, Axel Kollmorgen, Nuutti Kotivuori, Kalin Kozhuharov, Matt Kraai, Regis Kuckaertz, Stefan Kueng, Steve Kunkee, Scott Lamb, Wesley J. Landaker, Benjamin Landsteiner, Vincent Lefevre, Morten Ludvigsen, Dennis Lundberg, Paul Lussier, Bruce A. Mah, Jonathon Mah, Karl Heinz Marbaise, Philip Martin, Feliciano Matias, Neil Mayhew, Patrick Mayweg, Gareth McCaughan, Craig McElroy, Simon McKenna, Christophe Meresse, Jonathan Metillon, Jean-Francois Michaud, Jon Middleton, Robert Moerland, Marcel Molina Jr., Tim Moloney, Alexander Mueller, Tabish Mustufa, Christopher Ness, Roman Neuhauser, Mats Nilsson, Greg Noel, Joe Orton, Eric Paire, Dimitri Papadopoulos-Orfanos, Jerry Peek, Chris Pepper, Amy Lyn Pilato, Kevin Pilch-Bisson, Hans Polak,

[1] Oh, und Danke, Karl, dafür, dass du zu viel zu tun hattest, um das Buch selbst zu schreiben.

Dmitriy Popkov, Michael Price, Mark Proctor, Steffen Prohaska, Daniel Rall, Srinivasa Ramanujan, Jack Repenning, Tobias Ringstrom, Jason Robbins, Garrett Rooney, Joel Rosdahl, Christian Sauer, Ryan Schmidt, Jochem Schulenklopper, Jens Seidel, Daniel Shahaf, Larry Shatzer, Danil Shopyrin, Erik Sjoelund, Joey Smith, W. Snyder, Stefan Sperling, Robert Spier, M. S. Sriram, Russell Steicke, David Steinbrunner, Sander Striker, David Summers, Johan Sundstroem, Ed Swierk, John Szakmeister, Arfrever Frehtes Taifersar Arahesis, Robert Tasarz, Michael W. Thelen, Mason Thomas, Erik van der Kolk, Joshua Varner, Eric Wadsworth, Chris Wagner, Colin Watson, Alex Waugh, Chad Whitacre, Andy Whitcroft, Josef Wolf, Luke Worth, Hyrum Wright, Blair Zajac, Florian Zumbiehl, und die gesamte Subversion Gemeinde.

Von Ben Collins-Sussman

Dank meiner Frau Frances, die sich viele Monate lang „Aber, Schatz, ich arbeite noch am Buch“ anhören musste, statt des üblichen „Aber, Schatz ich bearbeite noch E-Mail“. Ich weiß nicht, woher sie all die Geduld nimmt. Sie ist der perfekte Ausgleich für mich.

Dank meiner Verwandtschaft und meinen Freunden für ihre aufrichtige Ermutigung, obwohl sie kein tatsächliches Interesse an der Materie hatten. (Sie wissen schon, diejenigen, die sagen „Oh, du hast ein Buch geschrieben?“, und wenn man ihnen erzählt, es sei ein Computerbuch, die Nase rümpfen.

Vielen Dank an meine engen Freunde, die aus mir einen sehr reichen Mann machen. Schaut mich nicht so an – Ihr wisst, wer Ihr seid.

Dank an meine Eltern für die perfekte Grundformatierung und dafür, dass sie unglaubliche Leitbilder sind. Dank an meine Kinder, für die Gelegenheit, dieses weiterzugeben.

Von Brian W. Fitzpatrick

Einen riesigen Dank an meine Frau Marie dafür, dass sie so unglaublich verständnisvoll, unterstützend und vor allem so geduldig ist. Dank an meinen Bruder Eric, der mich vor langer Zeit als erster an die Programmierung unter UNIX herangeführt hat. Dank an meine Mutter und Großmutter für ihre Unterstützung; ganz zu schweigen davon, dass sie ein Weihnachtsfest ertragen mussten, an dem ich nach Hause kam und sofort meinen Kopf hinter dem Laptop versteckte, um am Buch zu arbeiten.

An Mike und Ben: Es war ein Vergnügen, mit Euch am Buch zu arbeiten. Verdammt, es ist eine Freude mit Euch auf der Arbeit zusammenzuarbeiten.

Dank an alle in der Subversion-Gemeinde und der Apache Software Foundation, dafür, dass ihr mich in euren Bann gezogen habt. Kein Tag vergeht, ohne dass ich irgendetwas von mindestens einem von Euch lerne.

Schließlich Dank an meinen Großvater, der mir immer sagte „Freiheit bedeutet Verantwortung“. Ich muss dem voll und ganz zustimmen.

Von C. Michael Pilato

Besonderen Dank an Amy, meiner besten Freundin und Ehefrau seit mehr als zehn unglaublichen Jahren, für ihre Liebe und geduldige Unterstützung, dafür, dass sie sich mit den langen Nächten abfand und gnädig die Versionskontrollprozesse ertrug, die ich ihr aufbürdete. Keine Sorge, Liebling – binnen kurzer Zeit wirst du eine TortoiseSVN-Expertin sein.

Gavin, du kannst jetzt die Hälfte der Worte in diesem Buch selber lesen; leider liefert die andere Hälfte die Schlüsselkonzepte. Tut mir Leid, Aidan – ich habe keine Möglichkeit gefunden, Disney/Pixar-Figuren in diesen Text einzuarbeiten. Aber Daddy liebt Euch beide und kann kaum erwarten, Euch das Programmieren beizubringen.

Mutter und Vater, Dank für Eure stetige Unterstützung und Begeisterung. Schwiegereltern, Dank für dasselbe *plus* Eure sagenhafte Tochter.

Hut ab vor Shep Kendall, der mir als erster die Welt der Computer eröffnete; Ben Collins-Sussman, mein Reiseführer durch die Open-Source-Welt; Karl Fogel – Du *bist* mein `.emacs`; Greg Stein, für überquellendes praktisches Programmierwissen; und Brian Fitzpatrick – dafür, dass Du diese Schreiberfahrung mit mir teilst. Vor all den vielen Leuten, von denen ich ständig etwas neues aufnehme – lasst weiter etwas fallen!

Schließlich, vor demjenigen, der perfekt kreative Exzellenz demonstriert – Dank an Dich.

Was ist Subversion?

Subversion ist ein freies/Open-Source Versionskontrollsystem. Das bedeutet, Subversion verwaltet Dateien und Verzeichnisse und die Änderungen an ihnen im Lauf der Zeit. Das erlaubt Ihnen, alte Versionen Ihrer Daten wiederherzustellen oder die Geschichte der Änderungen zu verfolgen. Unter diesem Blickwinkel denken viele Leute bei einem Versionskontrollsystem an eine Art „Zeitmaschine“.

Subversion kann netzwerkübergreifend arbeiten, was die Benutzung durch Menschen an verschiedenen Computern ermöglicht. Auf einer bestimmten Ebene fördert die Fähigkeit unterschiedlicher Personen dieselbe Menge an Daten bearbeiten und verwalten zu können die Zusammenarbeit. Ohne auf einen einzigen Kanal, über den alle Änderungen abgewickelt werden müssen, beschränkt zu sein, kann das Vorankommen beschleunigt werden. Und weil die Arbeit versioniert ist, braucht nicht befürchtet zu werden, dass die Qualität bei Verlust dieses Kanals geopfert wird – falls irgendeine falsche Änderung an den Daten gemacht wird, kann man sie einfach zurücknehmen.

Manche Versionskontrollsysteme sind auch Software-Konfigurationsmanagement-Systeme. Diese Systeme sind maßgeschneidert, um ganze Verzeichnisbäume mit Quellcode zu verwalten und verfügen über viele Merkmale, die spezifisch für Software-Entwicklung sind – etwa das Verstehen von Programmiersprachen oder das Bereitstellen von Werkzeugen zum Bauen von Software. Jedoch gehört Subversion nicht zu diesen Systemen. Es ist ein allgemeines System, das verwendet werden kann, um *alle möglichen* Sammlungen von Dateien zu verwalten. Für Sie mag es sich dabei um Quellcode handeln – für andere mag es dabei um alles von Einkaufslisten bis zu digitalen Videomischungen und weit darüber hinaus gehen.

Ist Subversion das richtige Werkzeug?

Falls Sie ein Anwender oder Systemadministrator sind und den Einsatz von Subversion erwägen, sollte die erste Frage, die Sie sich stellen, sein: "Ist es das richtige Werkzeug für die Aufgabe?" Subversion ist ein fantastischer Hammer, achten Sie jedoch darauf, dass Sie nicht jedes Problem als einen Nagel sehen.

Falls Sie alte Datei- und Verzeichnisversionen aufbewahren, sie eventuell wiedererwecken müssen, oder Protokolle darüber auswerten möchten, wie sie sich im Lauf der Zeit geändert haben, ist Subversion das genau passende Werkzeug für Sie. Subversion ist auch geeignet, wenn Sie mit mehreren Leuten gemeinsam (üblicherweise über das Netz) an Dokumenten arbeiten und verfolgen müssen, wer welche Änderung gemacht hat. Deshalb wird Subversion so oft in Softwareentwicklungsumgebungen eingesetzt – die Arbeit in einem Entwicklerteam ist von Natur aus eine soziale Tätigkeit und Subversion vereinfacht die Zusammenarbeit mit anderen Programmierern. Natürlich ist die Benutzung von Subversion nicht umsonst zu bekommen: es kostet administrativen Aufwand. Sie müssen ein Daten-Repository verwalten, das die Informationen und ihre gesamte Geschichte speichert, und Sie müssen sich gewissenhaft um Sicherheitskopien kümmern. Wenn Sie täglich mit den Daten arbeiten, werden Sie sie nicht auf die gleiche Art kopieren, verschieben, umbenennen oder löschen können wie gewohnt. Stattdessen müssen Sie dafür Subversion verwenden.

Unter der Annahme, dass Ihnen die zusätzlichen Arbeitsabläufe nichts ausmachen, sollten Sie trotzdem sicher sein, dass Sie Subversion nicht für die Lösung eines Problems verwenden, das andere Werkzeuge besser lösen könnten. Zum Beispiel wird Subversion, weil es die Daten an alle Beteiligten verteilt, als generisches Verteilsystem missbraucht. Manchmal wird Subversion zum Verteilen von umfangreichen Bildersammlungen, digitaler Musik oder Softwarepaketen verwendet. Das Problem damit ist, dass sich diese Art Daten für gewöhnlich überhaupt nicht verändert. Die Sammlung selber wächst stetig, jedoch werden die einzelnen Dateien der Sammlung nicht verändert. In diesem Fall ist die Benutzung von Subversion zu viel des Guten.[2] Es gibt einfachere Werkzeuge, die hervorragend Daten replizieren, *ohne* dabei Änderungen mitzuverfolgen, etwa **rsync** oder **unison**.

Die Geschichte von Subversion

Anfang 2000 begann CollabNet, Inc. (http://www.collab.net) Entwickler zu suchen, die einen Ersatz für CVS schreiben sollten. CollabNet bietet eine Software-Suite namens CollabNet Enterprise Edition (CEE) für die Zusammenarbeit an, die auch eine Komponente für Versionskontrolle beinhaltet. Obwohl CEE ursprünglich CVS als Versionskontrollsystem verwendete, waren die Einschränkungen von CVS von Anfang an offensichtlich, und CollabNet war sich bewusst, dass letztendlich etwas Besseres gefunden werden musste. Unglücklicherweise war CVS der de-facto Standard in der Open-Source-Welt geworden, hauptsächlich deshalb, weil es nichts Besseres gab, zumindest nicht unter einer freien Lizenz. Also beschloss CollabNet, ein vollständig neues Versionskontrollsystem zu schreiben, welches die grundlegenden Ideen von CVS beibehalten, jedoch die Fehler und Fehlentwicklungen vermeiden sollte.

Im Februar 2000 nahmen sie Verbindung mit Karl Fogel auf, dem Autor von *Open Source Development with CVS* (Coriolis, 1999), und fragten ihn, ob er an diesem neuen Projekt mitarbeiten wolle. Zufälligerweise besprach Karl bereits einen Entwurf für ein neues Versionskontrollsystem mit seinem Freund Jim Blandy. Im Jahr 1995 gründeten die beiden Cyclic Software, eine CVS-Beratungsfirma, und sie benutzten, obwohl sie die Firma später verkauften, bei ihrer täglichen Arbeit immer noch CVS. Ihre Enttäuschung über CVS veranlasste Jim, sorgfältig über bessere Möglichkeiten zur Verwaltung versionierter Daten nachzudenken. Er hatte sich nicht nur bereits den Namen „Subversion“ ausgedacht, sondern auch den grundsätzlichen Entwurf der Subversion-Datenablage. Als CollabNet rief, stimmte Karl sofort der Mitarbeit am Projekt zu, und Karl gelang es, dass sein Arbeitgeber Red Hat Software ihn praktisch auf unbestimmte Zeit dem Projekt spendete. CollabNet stellte Karl und Ben Collins-Sussman ein und der detaillierte Entwurfsprozess begann im Mai. Dank einiger Stupser von Brian Behrendorf und Jason Robbins von CollabNet sowie Greg Stein (zu dieser Zeit als unabhängiger Entwickler aktiv im der WebDAV/DeltaV Spezifikationsprozess), zog Subversion schnell eine Gemeinde aktiver Entwickler an. Es stellte sich heraus, dass viele Leute dieselben enttäuschenden Erfahrungen mit CVS gemacht hatten und nun die Gelegenheit begrüßten, etwas daran zu ändern.

Das ursprüngliche Designteam einigte sich auf einige einfache Ziele. Sie wollten kein Neuland in Versionskontrollmethodik betreten, sondern einfach CVS reparieren. Sie beschlossen, dass Subversion dieselben Merkmale und dasselbe Entwicklungsmodell wie CVS haben solle, wobei die Fehler von CVS aber nicht noch einmal gemacht werden sollten. Und obwohl es nicht als ein hundertprozentiger Ersatz für CVS gedacht war, sollte es dennoch ähnlich genug sein, so dass ein leichter Wechsel für einen CVS-Anwender möglich wäre.

Nach vierzehn Monaten Programmierung wurde Subversion am 31. August 2001 „selbstbewirtend“, d.h., die Subversion-Entwickler hörten auf, CVS für den Quellcode von Subversion zu verwenden und benutzten stattdessen Subversion.

Obwohl CollabNet das Projekt startete und immer noch einen großen Batzen der Arbeit finanziert (sie zahlen die Gehälter einiger Vollzeit-Subversion-Entwickler), läuft Subversion

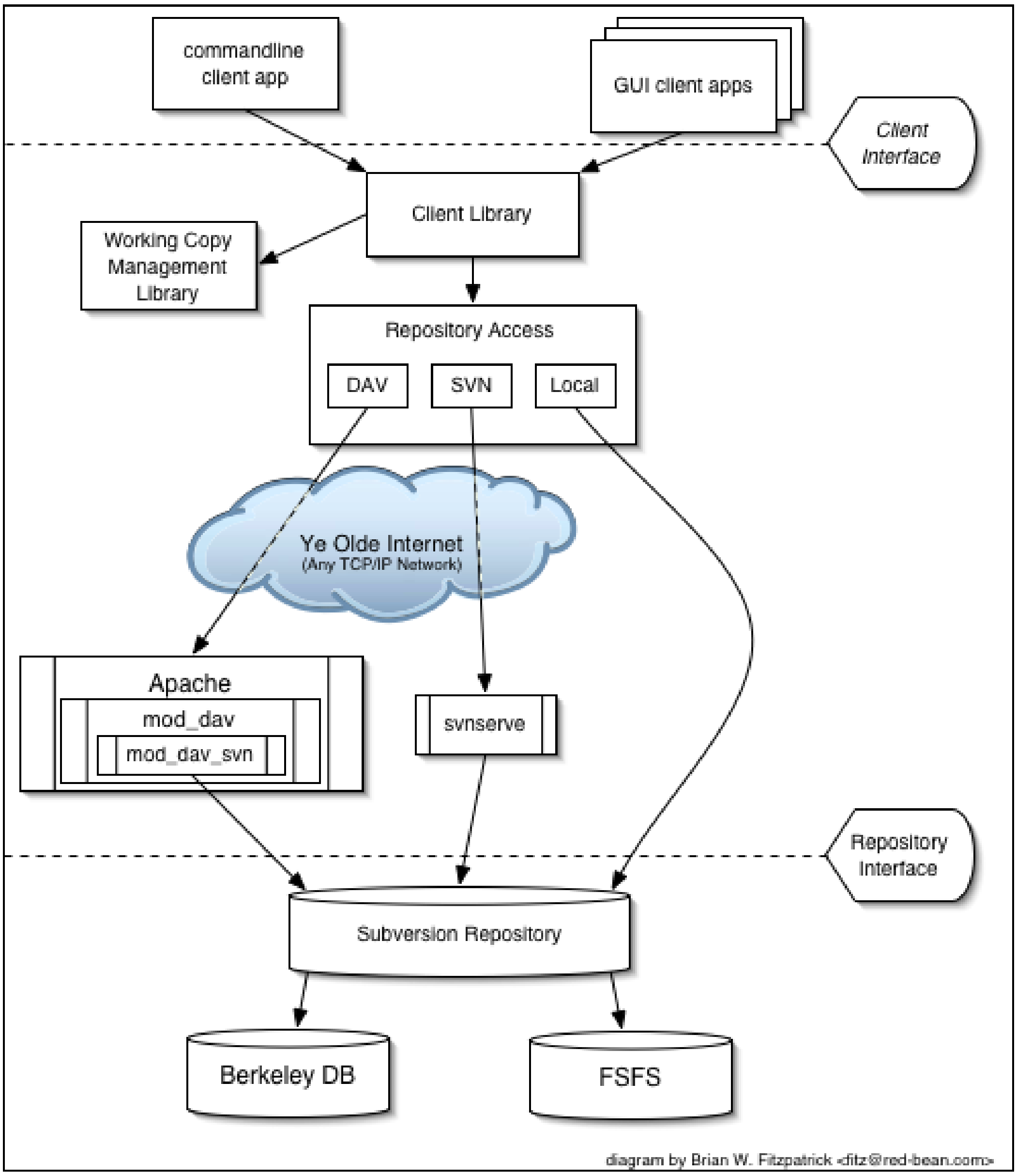
[2]Oder wie es ein Freund ausdrückt: „Eine Fliege mit einem Buick erschlagen.“

wie die meisten Open-Source-Projekte, geführt von einer Anzahl lockerer, transparenter Regeln, die die Meritokratie fördern. Die Urheberrechtslizenzen von CollabNet sind einvernehmlich mit den Debian Free Software Guidelines. Mit anderen Worten: Jeder darf Subversion nach Belieben herunterladen, ändern und weitergeben; es bedarf hierzu keinerlei Zustimmung durch CollabNet oder sonst jemanden.

Die Architektur von Subversion

Abbildung 1, „Die Architektur von Subversion" illustriert einen „kilometerhohen" Blick auf das Design von Subversion.

Abbildung 1. Die Architektur von Subversion



An einem Ende ist das Repository von Subversion, das die gesamten versionierten Daten enthält. Am anderen Ende ist das Subversion-Client-Programm, das die lokale Spiegelung von Teilen dieser versionierten Daten verwaltet („Arbeitskopien" genannt). Zwischen den entgegengesetzten Enden befinden sich mehrere Wege über verschiedene Repository-Zugriffsschichten. Einige dieser Pfade gehen über Computernetzwerke und über Netzwerkserver, die dann auf das Repository zugreifen. Andere lassen das Netz links liegen und greifen direkt auf das Repository zu.

Die Komponenten von Subversion

Sobald es installiert ist, hat Subversion eine Anzahl verschiedener Teile. Was folgt, ist ein schneller Überblick was Sie bekommen. Lassen Sie sich nicht beunruhigen, falls die kurzen Beschreibungen Sie dazu veranlassen, sich am Kopf zu kratzen – es gibt in diesem Buch *jede Menge* weiterer Seiten, die dem Ziel gewidmet sind, diese Verwirrung zu lindern.

svn
: Das Kommandozeilenprogramm

svnversion
: Ein Programm, das den Zustand einer Arbeitskopie (durch Revisionen der vorliegenden Objekte) berichtet

svnlook
: Ein Werkzeug zur direkten Untersuchung eines Subversion-Repositorys

svnadmin
: Ein Werkzeug zum Erstellen, Verändern oder Reparieren eines Repositorys

mod_dav_svn
: Ein Plug-In-Modul für den Apache-HTTP-Server, wird benötigt, um das Repository über ein Netzwerk verfügbar zu machen

svnserve
: Ein spezielles Server-Programm, dass als Hintergrundprozess laufen oder von SSH aufgerufen werden kann; eine weitere Möglichkeit, das Repository über ein Netzwerk verfügbar zu machen.

svndumpfilter
: Ein Programm zum Filtern von Subversion-Repository-Dump-Streams

svnsync
: Ein Programm zum inkrementellen Spiegeln eines Repositorys über ein Netzwerk

Was gibt es Neues in Subversion

Die erste Auflage dieses Buchs wurde 2004 herausgegeben, kurz nachdem Subversion die 1.0 erreicht hatte. Innerhalb der nächsten vier Jahre wurden fünf neue größere Versionen von Subversion freigegeben, die Fehler beseitigten und neue Features einführten. Während wir es schafften, die Online-Version dieses Buches aktuell zu halten, sind wir begeistert davon, dass die zweite Auflage von O'Reilly nun Subversion bis Release 1.5 behandelt, ein großer Meilenstein für das Projekt. Hier ist eine schnelle Zusammenfassung der größeren Änderungen seit Subversion 1.0. Beachten Sie, dass es keine komplette Liste ist; um alle Details zu sehen, besuchen Sie die Subversion-Website bei http://subversion.tigris.org.

Subversion 1.1 (September 2004)
: Release 1.1 führte FSFS ein, eine Repository-Speicheroption, die auf Dateien basiert. Obwohl das Berkeley-DB-Backend immer noch weitverbreitet ist und unterstützt wird, ist FSFS mittlerweile wegen der niedrigen Einstiegshürde und des minimalen Wartungsbedarfs die Standard-Auswahl für neu erzeugte Repositorys. Ebenfalls kam

mit diesem Release die Möglichkeit, symbolische Links unter Versionskontrolle zu stellen, das automatische Maskieren von URLs und eine sprachabhängige Benutzerschnittstelle.

Subversion 1.2 (Mai 2005)
: Mit Release 1.2 konnten serverseitige Sperren auf Dateien erzeugt und somit der Commit-Zugriff für bestimmte Ressourcen serialisiert werden. Während Subversion immer noch grundsätzlich ein gleichzeitiges Versionskontrollsystem ist, können bestimmte Arten binärer Dateien (z.B. Kunstobjekte) nicht zusammengeführt werden. Die Sperrmöglichkeit stillt den Bedarf, solche Ressourcen zu versionieren und zu schützen. Zusammen mit dem Sperren kam auch eine vollständige WebDAV-Auto-Versionierungs-Implementierung, die es erlaubt, Subversion-Repositorys als Netzwerkverzeichnisse einzuhängen. Schließlich begann Subversion 1.2 einen neuen, schnelleren binären Differenzalgorithmus zu verwenden, um alte Versionen von Dateien zu komprimieren und hervorzuholen.

Subversion 1.3 (Dezember 2005)
: Release 1.3 brachte pfadbasierte Autorisierungskontrolle für den **svnserve**-Server, was einem Merkmal entsprach, das vorher nur im Apache-Server vorzufinden war. Der Apache-Server wiederum bekam einige neue eigene Logging-Features, und die Subversion-API-Bindings für andere Sprachen machten auch große Sprünge vorwärts.

Subversion 1.4 (September 2006)
: Release 1.4 führte ein völlig neues Werkzeug – **svnsync** – ein, um eine Einbahn-Replizierung von Repositorys über das Netz vornehmen zu können. Größere Teile der Arbeitskopie-Metadaten wurden überarbeitet, so dass nicht mehr XML benutzt wurde (was sich in erhöhter Geschwindigkeit auf Client-Seite niederschlug), während das Berkeley-DB-Repository-Backend die Fähigkeit erhielt, sich nach einem Server-Crash automatisch wiederherzustellen.

Subversion 1.5 (Juni 2008)
: Release 1.5 brauchte viel länger als vorige Releases, doch das Hauptfeature war gigantisch: Halbautomatische Verfolgung des Verzweigens und Zusammenführens. Dies war eine riesige Wohltat für Anwender und schob Subversion weit jenseits der Fähigkeiten von CVS und in die Reihen kommerzieller Mitbewerber wie Perforce und Clearcase. Subversion 1.5 führte auch eine große Anzahl anderer, benutzerorientierter Features ein, wie die interaktive Auflösung von Dateikonflikten, partielle Checkouts, client-seitige Verwaltung von Änderungslisten, eine starke neue Syntax für External-Definitionen und SASL-Authentifizierungsunterstützung für den **svnserve**-Server.

Kapitel 1. Grundlegende Konzepte

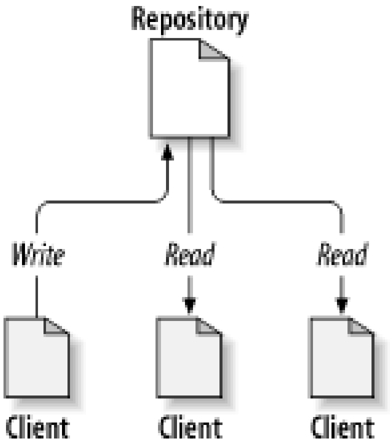
Das Kapitel ist eine kurze, lockere Einführung in Subversion. Wenn Sie noch nicht mit Versionskontrolle zu tun hatten, dann ist dieses Kapitel genau für Sie. Wir besprechen die grundlegenden Konzepte von Versionskontrolle und arbeiten uns in die Richtung von Subversion und dessen spezifischen Ideen und zeigen einfache Beispiele zur Anwendung.

Obwohl die Beispiele in diesem Kapitel Leute zeigen, die gemeinsam an Quellcode arbeiten, sei daran erinnert, dass Subversion alle möglichen Arten von Datensammlungen verwalten kann – es beschränkt sich nicht darauf, Entwicklern zu helfen.

Das Repository

Subversion ist ein zentralisiertes System zur gemeinsamen Nutzung von Informationen. In seinem Kern ist ein Repository ein zentraler Speicher von Daten. Das Repository speichert Informationen in Form eines *Dateisystembaumes*, typischerweise eine Hierarchie von Dateien und Verzeichnissen. Eine beliebige Anzahl von *Clients* verbinden sich mit dem Repository und lesen oder schreiben diese Dateien. Durch den Schreibvorgang, macht ein Client Informationen für andere verfügbar. Durch den Lesevorgang bekommt der Client Informationen von anderen zur Verfügung gestellt. Abbildung 1.1, „Ein typisches Client/ Server System“ verdeutlicht das.

Abbildung 1.1. Ein typisches Client/Server System



So, warum ist das interessant? Bis zu diesem Punkt hört sich das wie die Definition eines typischen File-Servers an. Und tatsächlich, das Repository *ist* eine Art von File-Server, aber nicht von der Art, die Sie kennen. Was das Subversion-Repository so speziell macht ist, dass es sich *jede Änderung merkt*, die jemals hineingeschrieben wurde. Jede Änderung an jeder Datei und auch Änderungen am Verzeichnisbaum selbst, wie z.B. das Hinzufügen, Löschen und Umstrukturieren von Dateien und Verzeichnissen.

Wenn ein Client Daten vom Repository liest, bekommt der Client üblicherweise nur die letzte Version des Dateisystem-Baumes zu sehen. Der Client hat aber auch die Möglichkeit, *vorherige* Zustände des Dateibaumes anzuschauen. Zum Beispiel kann ein Client somit die Frage stellen: „Was beinhaltete das Verzeichnis am letzten Mittwoch?“ und „Wer war die Person, die als letztes die Datei geändert hat und welche Änderungen hat sie gemacht?“. Diese Art von Fragen sind die Grundlage eines *Versionskontrollsystems*, Systeme, die dazu entwickelt wurden, um die Änderungen an Daten über die Zeit hin aufzuzeichnen.

Versionierungsmodelle

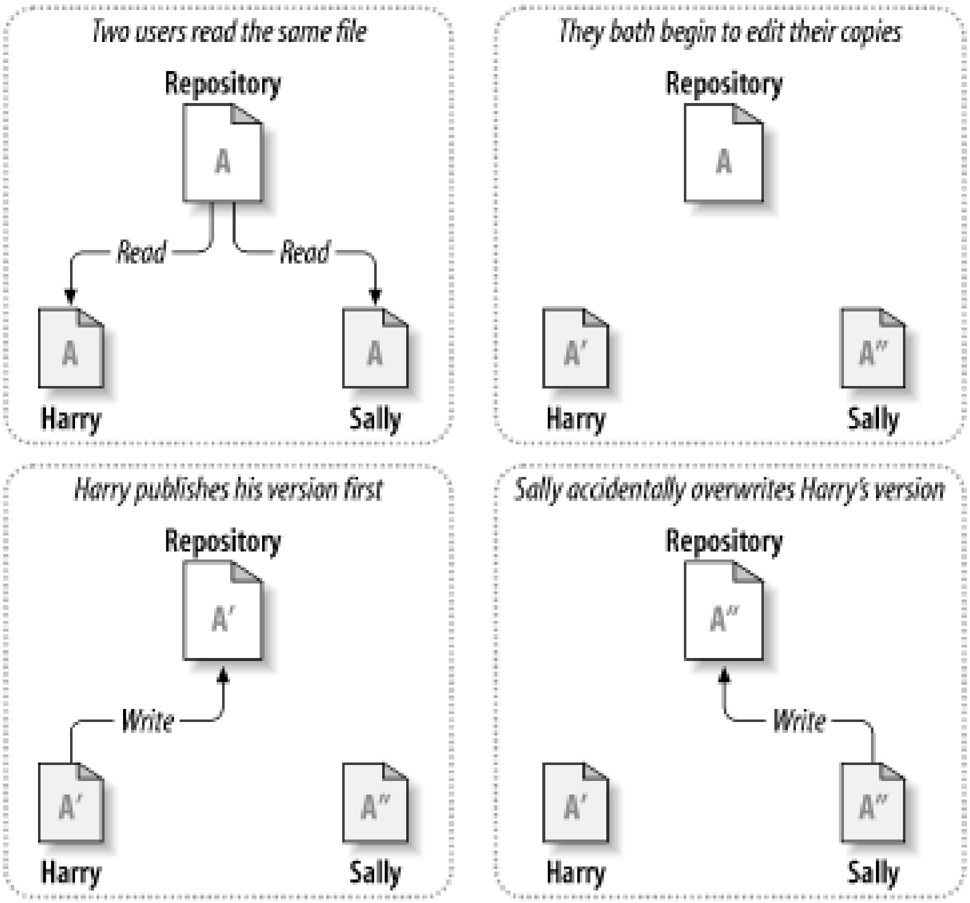
Die zentrale Aufgabe eines Versionskontrollsystems ist es, die Zusammenarbeit beim Editieren gemeinsam benutzter Daten zu ermöglichen. Jedoch verwenden unterschiedliche Systeme auch unterschiedliche Strategien, um dies zu ermöglichen. Aus einer Reihe von Gründen ist es wichtig, diese Unterschiede zu verstehen. Erstmal hilft es dabei, bestehende Versionskontrollsysteme zu vergleichen und gegenüberzustellen, falls Ihnen andere Systeme begegnen, die Subversion ähneln. Darüber hinaus wird es Ihnen helfen, Subversion effektiver zu benutzen, da Subversion selbst eine Reihe unterschiedlicher Arbeitsweisen unterstützt.

Das Problem ??The Problem of File Sharing

Alle Versionskontrollsysteme haben alle die gleichen fundamentalen Probleme zu lösen: Wie soll es Anwendern erlaubt werden Informationen zu teilen aber Sie davor bewahren, sich gegenseitig auf die Fße zu treten? Es ist allzu einfach die Änderungen eines anderen im Repository zu überschreiben?

Stellen Sie sich einmal folgendes Abbildung 1.2, „The problem to avoid“Szenario vor: Zwei Kollegen, Harry und Sally, haben sich entschieden, die gleiche Datei zur gleichen Zeit zu bearbeiten. Harry speichert seine Änderungen zuerst im Repository, es ist aber möglich, dass Sally nur einige Augenblicke später mit ihrer Datei seine überschreibt. Harrys Änderungen der Datei sind zwar nicht für immer verloren (da das System jede Änderung aufzeichnet), aber alle seine Änderungen sind in Sallys später gespeicherter Version der Datei nicht vorhanden, da Sally diese Änderungen noch gar nicht kannte. Das heißt, dass Harrys Arbeit doch verloren ist, zumindest in der neuesten Version der Datei und das nur durch einen Zufall. Eine solche Situation wollen wir auf alle Fälle vermeiden.

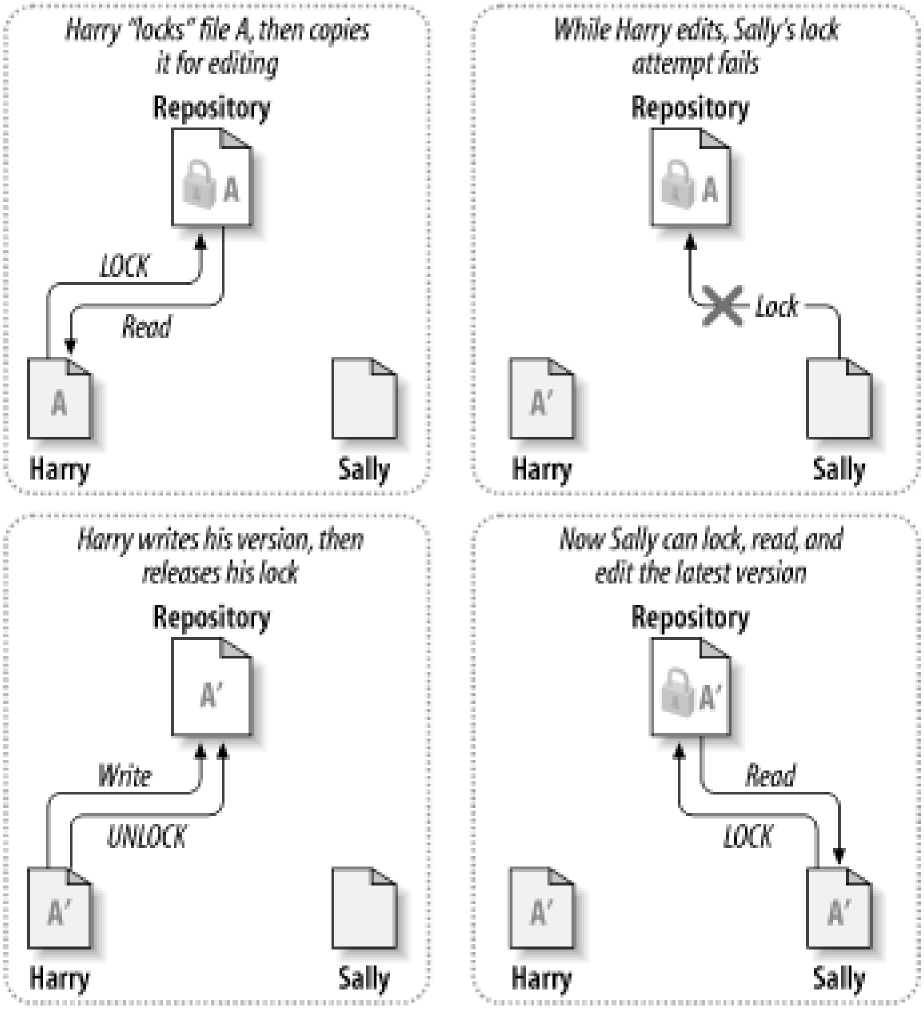
Abbildung 1.2. The problem to avoid



The Lock-Modify-Unlock Solution

Viele Versionskontrollsysteme verwenden ein *Sperren - Ändern - Entsperren*-Modell um zu verhindern, dass verschiedene Autoren sich gegenseitig die Änderungen löschen. Bei diesem Modell erlaubt das Repository nur jeweils einem Programmierer den Zugriff auf eine Datei. Harry müsste also die Datei sperren, ehe er anfängt, seine Änderungen einzugeben. Wenn Harry die Datei gesperrt hat, kann Sally sie nicht ebenfalls sperren und daher auch nichts ändern. Sie kann die Datei in der Zeit nur lesen und darauf warten, dass Harry mit seiner Arbeit fertig ist und die Datei entsperrt. Abbildung 1.3, „Die Sperren - Ändern - Entsperren - Lösung veranschaulicht diese einfache Möglichkeit"

Abbildung 1.3. Die Sperren - Ändern - Entsperren - Lösung veranschaulicht diese einfache Möglichkeit



Das Problem bei einem Sperren - Ändern - Entsperren - Modell liegt in seinen Beschränkungen, die oft zu schier unüberwindlichen Hindernissen führen können.

- *Das Sperren kann zu administrativen Problemen führen.* Vielleicht sperrt Harry eine Datei und vergisst dann, sie zu entsperren. In der Zwischenzeit sind Sally, die ebenfalls Änderungen an dieser Datei durchführen will, die Hände gebunden. Und dann geht Harry in Urlaub. Nun muss Sally sich an einen Administrator wenden, um die Datei entsperrt zu bekommen. Das Ergebnis sind unnötige Verzögerungen und vergeudete Zeit.

- *Das Sperren kann zu einer unnötigen Serialisierung führen.* Was ist, wenn Harry z. B. den Anfang einer Textdatei bearbeiten will, während Sally einfach nur das Ende ändern möchte? Diese Änderungen würden sich überhaupt nicht gegenseitig beeinflussen und könnten problemlos gleichzeitig durchgeführt werden, vorausgesetzt, sie würden anschließend vernünftig zusammengefasst. Es gibt in dieser Situation keinen Grund, der Reihe nach zu arbeiten.

- *Das Sperren kann zu einem falschen Gefühl von Sicherheit führen.* Angenommen Harry sperrt und bearbeitet Datei A, während Sally gleichzeitig Änderungen an Datei B durchführt. Was ist, wenn A und B voneinander abhängig sind und die jeweiligen Änderungen nicht kompatibel sind? Plötzlich funktioniert das Zusammenspiel zwischen A und B nicht mehr. Das System des Sperrens hat dieses Problem nicht verhindert, doch hat es fälschlicherweise zu einem Gefühl der Sicherheit geführt. Es ist leicht, sich vorzustellen, dass Harry und Sally der Meinung waren, dass jeder von ihnen eine eigenständige, voneinander unabhängige Änderung durchgeführt hat und dass das Sperren dazu geführt hat, dass sie ihre inkompatiblen Änderungen nicht vorher miteinander besprochen haben. Sperren ist oft ein Ersatz für echte Kommunikation.

Die „Kopieren – Ändern – Zusammenfassen“ - Lösung

Subversion, CVS und viele andere Versionskontrollsysteme benutzen eine „Kopieren – Ändern – Zusammenfassen“ — Version als Alternative zum Sperren. In diesem Modell erschafft jeder User sich eine eigene Arbeitskopie der im Repository vorhandenen Dateien und Verzeichnisse. Dann können die User gleichzeitig und unabhängig voneinander ihre jeweiligen Änderungen eingeben und speichern. Am Ende werden dann alle Einzelkopien zu einer neuen, aktuellen Version zusammengefasst. Das Versionskontrollsystem hilft oft bei dieser Zusammenfassung, aber letztlich ist der Mensch dafür verantwortlich, das es korrekt abläuft.

Hier ist ein Beispiel: Harry und Sally haben sich jeweils eine eigene Arbeitskopie des im Repository vorhandenen Projektes geschaffen. Beide arbeiten nun am selben File A innerhalb ihrer jeweiligen Kopien. Sally speichert ihre Version zuerst im Repository ab. Wenn Harry später ebenfalls versucht, seine Änderungen zu speichern, informiert ihn das Repository, das sein File A nicht mehr aktuell ist. Das bedeutet, dass seitdem er sich seine Kopie erschaffen hat, sind irgendwelche Änderungen aufgetreten. Also bittet Harry seinen Client darum, diese neuen Änderungen in seine Arbeitskopie des File A einzuarbeiten. Die Möglichkeit besteht, dass Sallys Änderungen mit seinen nicht überlappen, wenn er also alle Änderungen eingearbeitet hat, kann er seine Arbeitskopie zurück in das Repository speichern. Die Abbildungen Abbildung 1.4, „„Kopieren – Ändern – Zusammenfassen“ - Lösung“ und Abbildung 1.5, „„Kopieren – Ändern – Zusammenfassen“ - Lösung (Fortsetzung)“ zeigen diesen Proczess.

Abbildung 1.4. „Kopieren – Ändern – Zusammenfassen“ - Lösung

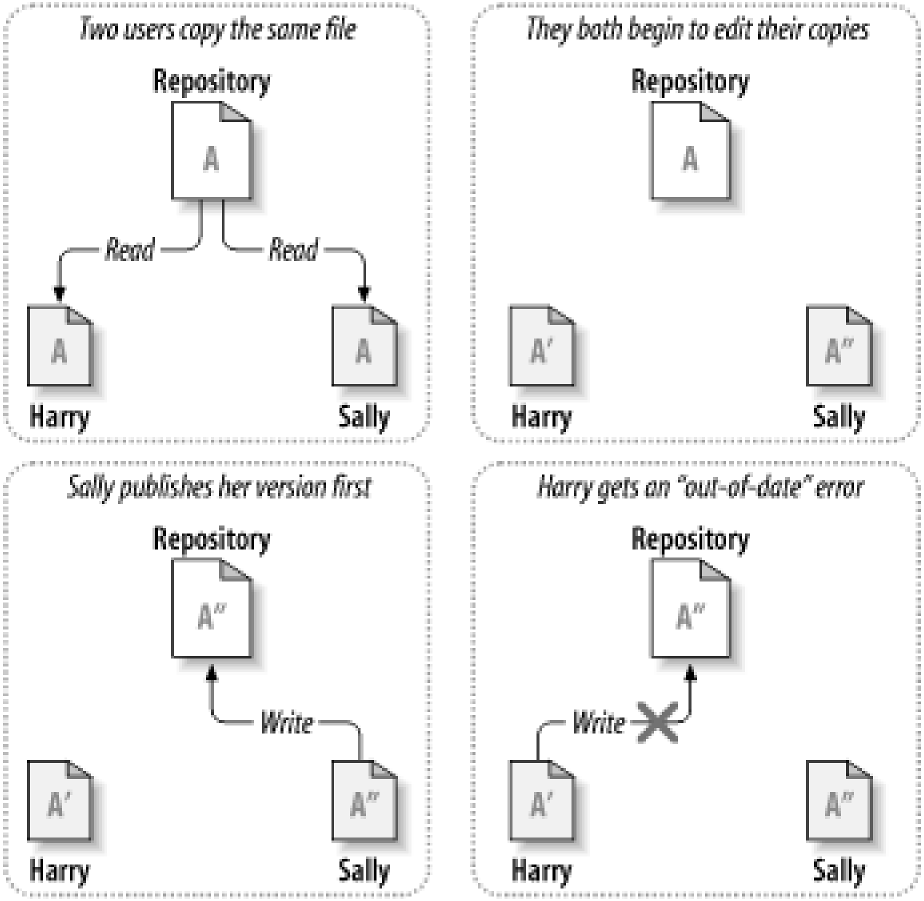
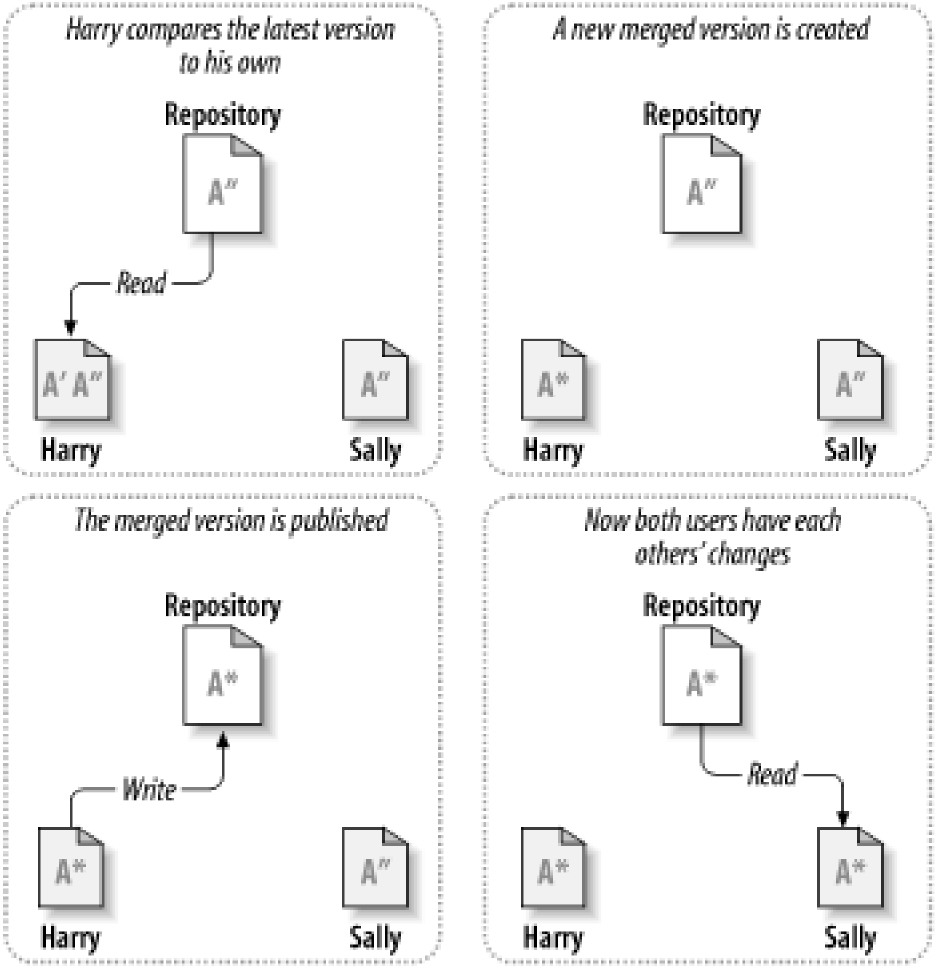


Abbildung 1.5. „Kopieren – Ändern – Zusammenfassen“ - Lösung (Fortsetzung)



Was aber passiert, *wenn* Sallys Änderungen mit Harrys kollidieren? Diese Situation wird *Konflikt* genannt und ist normalerweise kein allzugroßes Problem. Wenn Harry Sallys Änderungen in seine Datei einpflegen lassen will, werden in seiner Datei die miteinander in Konflikt stehenden Änderungen gekennzeichnet, er kann sämtliche Änderungen sehen und manuell zwischen ihnen wählen. Das Programm löst solche Konfliktsituationen nicht automatisch, nur Menschen sind in der Lage, die Probleme zu erkennnen und die nötigen intelligenten Änderungen durchzuführen. Wenn Harry die Konfliktsituationen — vielleicht nach einer kurzen Diskussion mit Sally — gelöst hat, kann er seine Datei problemlos ins Repository speichern.

Dieses *Kopieren – Ändern – Zusammenfassen* - Modell (engl. copy-modify-merge model) klingt vielleicht ein wenig chaotisch, in der Praxis aber läuft es völlig glatt. Die einzelnen User können parallel arbeiten, ohne einander in die Quere zu kommen oder unnötig warten zu müsssen. Wenn sie an den selben Dateien arbeiten, zeigt es sich meistens, dass ihre jeweiligen Änderungen einander überhaupt nicht stören, wirkliche Konflikte sind selten. Und die Zeit, die es beansprucht, eine solche Konfliktsituation zu lösen, ist meist wesentlich kürzer als der Zeitverlust, der durch das Sperren auftritt.

Am Ende läuft alles auf einen kritischen Faktor hinaus. Die Kommunikation zwischen den Usern. Wenn diese Kommunikation eher spärlich abläuft, häufen sich sowohl semantische als auch syntaktische Konflikte. Kein System kann User dazu zwingen, vernünftig miteinander zu kommnunizieren und kein System kann semantische Konflikte erkennen. Also hat es auch keinen Sinn, sich in dem falschen Gefühl von Sicherheit zu wiegen, dass das Sperren Konflikte irgendwie vermeiden könnte. In der Praxis verringert das System des Sperrens mehr als andere die Produktivität.

When Locking Is Necessary

While the lock-modify-unlock model is considered generally harmful to collaboration, sometimes locking is appropriate.

The copy-modify-merge model is based on the assumption that files are contextually mergeable—that is, that the majority of the files in the repository are line-based text files (such as program source code). But for files with binary formats, such as artwork or sound, it's often impossible to merge conflicting changes. In these situations, it really is necessary for users to take strict turns when changing the file. Without serialized access, somebody ends up wasting time on changes that are ultimately discarded.

While Subversion is primarily a copy-modify-merge system, it still recognizes the need to lock an occasional file, and thus provides mechanisms for this. We discuss this feature in „Locking“.

Subversion in Action

Es ist an der Zeit, sich vom Abstrakten zum Konkreten zu bewegen. In diesem Abschnitt werden wir echte Beispiele zur Benutzung von Subversion zeigen.

Subversion-Repository-URLs

Das ganze Buch hindurch verwendet Subversion URLs, um Dateien und Verzeichnisse in Subversion-Repositorys zu identifizieren. Meistens benutzen diese URLs die Standardsyntax, die es erlaubt, Servernamen und Portnummern als Teil des URL zu spezifizieren:

```
$ svn checkout http://svn.example.com:9834/repos
…
```

Allerdings gibt es einige bemerkenswerte Feinheiten, wie Subversion mit URLs umgeht. Beispielsweise dürfen URLs, die die `file://`-Zugriffsmethode enthalten (für lokale Repositorys verwendet), gemäß Konvention entweder den Servernamen `localhost` oder gar keinen Servernamen enthalten:

```
$ svn checkout file:///var/svn/repos
…
$ svn checkout file://localhost/var/svn/repos
…
```

Darüber hinaus müssen Benutzer des `file://` Schemas auf Windows-Plattformen eine inoffizielle „Standard“-Syntax verwenden falls auf Repositorys auf derselben Maschine aber auf einem anderen Laufwerk zugegriffen werden soll. Beide der folgenden URL-Pfad-Syntaxen funktionieren, wobei X das Laufwerk ist, wo das Repository liegt:

```
C:\> svn checkout file:///X:/var/svn/repos
…
C:\> svn checkout "file:///X|/var/svn/repos"
…
```

Bei der zweiten Syntax muss der URL in Anführungsstriche eingeschlossen werden, damit der senkrechte Strich nicht als Pipe-Symbol interpretiert wird. Beachten Sie auch, dass in einem URL Schrägstriche verwendet werden, obwohl es unter Windows üblich ist, für Pfade umgekehrte Schrägstriche zu verwenden.

Sie können die `file://` URLs von Subversion nicht in einem normalen Web-Browser auf die Art und Weise verwenden wie andere `file://` URLs. Falls Sie versuchen, einen `file://` URL in einem gewöhnlichen Web-Browser anzusehen, wird der Inhalt der Datei von der angegebenen Stelle direkt aus dem Dateisystem gelesen und angezeigt. Allerdings befinden sich die Daten von Subversion in einem virtuellen Dateisystem (siehe „Repository Layer"), und der Browser wird nicht mit diesem Dateisystem umzugehen wissen.

Zuletzt sei noch angemerkt, dass der Subversion-Client, wie ein Web-Browser, nötigenfalls automatisch URLs umwandelt. Falls zum Beispiel in einem URL Leerzeichen oder Großbuchstaben vorkommen wie hier:

```
$ svn checkout "http://host/path with space/project/españa"
```

wird Subversion die unsicheren Zeichen umwandeln, als ob Sie

```
$ svn checkout http://host/path%20with%20space/project/espa%C3%B1a
```

geschrieben hätten.

Falls ein URL Leerzeichen beinhalten sollte, stellen Sie sicher, das der URL in Anführungszeichen gesetzt wird, damit die Shell alles als ein Argument für das **svn** Programm behandelt.

Repository URLs

Sie können auf Subversion-Repositorys über viele unterschiedliche Methoden zugreifen – auf der lokalen Festplatte oder über verschiedene Protokolle, je nachdem, wie Ihr Administrator es eingerichtet hat. Ein Ort im Repository ist jedenfalls immer ein URL. Tabelle 1.1, „Repository-Zugriffs-URLs" beschreibt, wie unterschiedliche URL Schemata auf die verfügbaren Zugriffsmethoden abgebildet werden.

Tabelle 1.1. Repository-Zugriffs-URLs

Schema	Zugriffsmethode
`file:///`	Direkter Repository-Zugriff (auf lokaler Festplatte)
`http://`	Zugriff über das WebDAV-Protokoll auf Apache-Server, die Subversion unterstützen
`https://`	Wie `http://`, jedoch mit SSL-Verschlüsselung.
`svn://`	Zugriff über eigenes Protokoll auf einen `svnserve`-Server
`svn+ssh://`	Wie `svn://`, jedoch über SSH getunnelt.

Für mehr Informationen darüber, wie Subversion URLs parst, siehe „Subversion-Repository-URLs". Für weitergehende Informationen zu den unterschiedlichen Typen verfügbarer Netzwerk-Servern für Subversion, siehe Kapitel 6, *Die Administration eines Subversion-Servers*.

Arbeitskopien

Sie haben schon über Arbeitskopien gelesen; nun werden wir zeigen, wie der Subversion-Client sie erzeugt und benutzt.

Eine Subversion-Arbeitskopie ist ein gewöhnlicher Verzeichnisbaum auf Ihrem lokalen System, der eine Ansammlung von Dateien enthält. Sie können diese Dateien nach belieben bearbeiten, und wenn es sich um Quelltexte handelt, können Sie hieraus Ihr Programm auf die übliche Weise compilieren. Ihre Arbeitskopie ist Ihr privater Arbeitsbereich: nie wird Subversion weder die Änderungen von anderen einpflegen, noch Ihre eigenen Änderungen anderen zur Verfügung stellen, bis Sie es ausdrücklich dazu auffordern. Sie können sogar mehrere Arbeitskopien desselben Projektes haben.

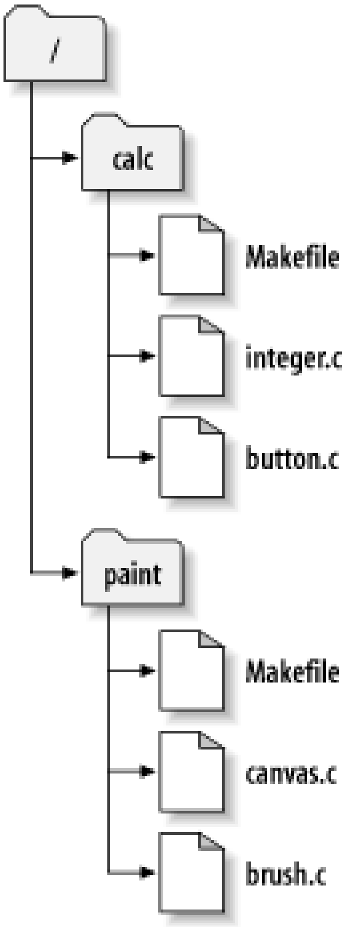
Nachdem Sie einige Änderungen an den Dateien Ihrer Arbeitskopie gemacht und sichergestellt haben, dass sie funktionieren, stellt Ihnen Subversion Befehle zur Verfügung, um Ihre Änderungen den anderen, die an Ihrem Projekt mitarbeiten, „publik“ zu machen (indem es ins Repository schreibt). Wenn die anderen ihre Änderungen veröffentlichen, stellt Ihnen Subversion Befehle zur Verfügung, um diese Änderungen in Ihr Arbeitsverzeichnis einzupflegen (indem es aus dem Repository liest).

Eine Arbeitskopie verfügt darüber hinaus über einige zusätzliche Dateien, die von Subversion erzeugt und gepflegt werden, um es bei diesen Befehlen zu unterstützen. Insbesondere enthält jedes Verzeichnis Ihrer Arbeitskopie ein Unterverzeichnis namens `.svn`, auch bekannt als das *Verwaltungsverzeichnis* der Arbeitskopie. Die Dateien in jedem Verwaltungsverzeichnis helfen Subversion dabei, zu erkennen, welche Dateien unveröffentlichte Änderungen enthalten und welche Dateien hinsichtlich der Arbeit anderer veraltet sind.

Oft enthält ein typisches Subversion-Repository die Dateien (oder den Quelltext) für verschiedene Projekte; für gewöhnlich ist jedes Projekt ein Unterverzeichnis im Dateisystembaum des Repositorys. Bei dieser Anordnung entspricht die Arbeitskopie eines Benutzers gewöhnlich einem bestimmten Unterverzeichnis des Repositorys.

Nehmen wir zum Beispiel an, Sie haben ein Repository, das zwei Software-Projekte beinhaltet, `paint` und `calc`. Jedes Projekt ist in einem eigenen Hauptverzeichnis abgelegt, wie in Abbildung 1.6, „Das Dateisystem des Repositorys“ dargestellt.

Abbildung 1.6. Das Dateisystem des Repositorys



Um eine Arbeitskopie zu erhalten, muss zunächst irgendein Teilbaum des Repositorys *ausgecheckt* werden(check out). (Der Begriff *check out* hört sich an, als habe es etwas mit dem Sperren oder Reservieren von Ressourcen zu tun, hat es aber nicht; es erzeugt lediglich eine private Kopie des Projektes für Sie.) Wenn Sie zum Beispiel `/calc` auschecken, bekommen Sie eine Arbeitskopie wie diese:

```
$ svn checkout http://svn.example.com/repos/calc
A    calc/Makefile
A    calc/integer.c
A    calc/button.c
Checked out revision 56.

$ ls -A calc
Makefile  button.c integer.c .svn/
```

Die Liste der As am linken Rand zeigt an, dass Subversion Ihrer Arbeitskopie eine Anzahl von Objekten hinzufügt (Add). Sie haben nun eine persönliche Kopie des Verzeichnisses `/calc` im Repository, mit einem zusätzlichen Eintrag – `.svn` – das, wie bereits erwähnt, die besonderen Informationen enthält, die Subversion benötigt.

Angenommen, Sie nehmen Änderungen an `button.c` vor. Da sich das Verzeichnis `.svn` den ursprünglichen Änderungszeitpunkt und den Inhalt der Datei merkt, kann Subversion erkennen, dass Sie die Datei verändert haben. Trotzdem veröffentlicht Subversion Ihre Änderungen solange nicht, bis Sie es ausdrücklich hierzu auffordern. Der Vorgang des Veröffentlichens von Änderungen über das Repository ist gemeinhin bekannter als *commit* (oder *check in*).

Um Ihre Änderungen anderen gegenüber zu veröffentlichen, können Sie den Subversion-

Befehl **svn commit** verwenden:

```
$ svn commit button.c -m "Fixed a typo in button.c."
Sending        button.c
Transmitting file data .
Committed revision 57.
```

Nun sind Ihre Änderungen an `button.c` dem Repository überstellt, mitsamt einer Notiz, die Ihre Änderung beschreibt (nämlich, dass Sie einen Tippfehler beseitigt haben). Wenn eine andere Benutzerin eine Arbeitskopie von `/calc` auscheckt, wird sie Ihre Änderungen in der letzten Version der Datei sehen können.

angenommen, Sie haben eine Mitarbeiterin, Sally, die eine Arbeitskopie von `/calc` gleichzeitig mit Ihnen ausgecheckt hat. Wenn Sie Ihre Änderung an `button.c` committen, bleibt Sallys Arbeitskopie unverändert; Subversion ändert Arbeitskopien nur auf Wunsch des Benutzers.

Um ihr Projekt auf den neuesten Stand zu bringen, kann Sally Subversion dazu auffordern, ihre Arbeitskopie zu aktualisieren, indem sie den Befehl **svn update** verwendet. Das bringt sowohl Ihre als auch alle anderen Änderungen die committet wurden seit sie ausgecheckt hatte in ihre Arbeitskopie.

```
$ pwd
/home/sally/calc

$ ls -A
Makefile button.c integer.c .svn/

$ svn update
U    button.c
Updated to revision 57.
```

Die Ausgabe des **svn update** Befehls zeigt, dass Subversion den Inhalt von `button.c` aktualisiert hat (Update). Beachten Sie, dass Sally nicht angeben musste, welche Dateien zu aktualisieren sind; Subversion benutzt die Informationen aus dem `.svn` Verzeichnis und darüber hinaus weitere Informationen im Repository, um zu entscheiden, welche Dateien auf den neuesten Stand gebracht werden müssen.

Revisionen

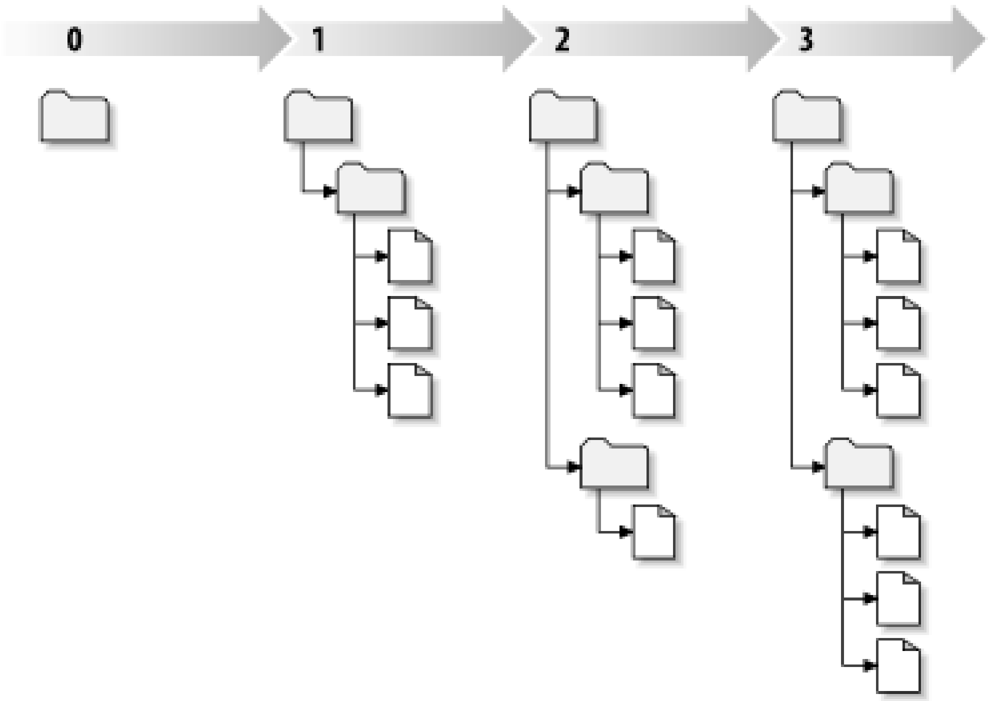
Ein **svn commit** veröffentlicht Änderungen an einer beliebigen Anzahl von Dateien und Verzeichnissen als eine einzige atomare Transaktion. In Ihrer Arbeitskopie können Sie Dateiinhalte ändern, Dateien und Verzeichnisse erzeugen, löschen, umbenennen und kopieren und dann den gesamten Umfang der Änderungen als atomare Transaktion durch ein **svn commit** in das Repository einbringen.

Eine atomare Transaktion bedeutet: entweder es gehen alle Änderungen in das Repository oder keine. Angesichts von Programmabstürzen, Systemabstürzen, Netzproblemen oder anderer Benutzeraktionen hält Subversion an dieser Atomizität fest.

Jedes Mal wenn das Repository ein Commit annimmt, wird ein neuer Zustand des Dateisystem-Baums erzeugt, der *Revision* genannt wird. Jeder Revision wird eine einmalige natürliche Zahl zugewiesen, die um eins größer ist als die Vorgänger-Revision. Die anfängliche Revision eines frisch erzeugten Repositorys bekommt die Nummer 0 und besteht lediglich aus einem leeren Wurzelverzeichnis.

Abbildung 1.7, „Das Repository“ zeigt, wie man sich das Repository vorstellen kann. Stellen Sie sich eine Reihe von Revisionsnummern vor, die bei 0 startet und von links nach rechts wächst. Jede Revisionsnummer hat einen Dateisystem-Baum unter sich hängen, der ein „Schnappschuss“ des Repositorys nach einem Commit ist.

Abbildung 1.7. Das Repository



> **Globale Revisionsnummern**
>
> Anders als die meisten Versionskontrollsysteme werden die Revisionsnummern von Subversion auf *komplette Bäume* anstatt auf einzelne Dateien angewendet. Jede Revisionsnummer wählt einen kompletten Baum aus; ein besonderer Zustand nach dem Commit einer Änderung. Man kann sich auch vorstellen, dass Revision N den Zustand des Repository-Dateisystems nach dem N-ten Commit repräsentiert. Wenn Subversion-Benutzer von „Revision 5 von `foo.c`“ sprechen, meinen sie tatsächlich „`foo.c` so wie es in Revision 5 aussieht“. Beachten Sie, dass sich im Allgemeinen die Revisionen N und M einer Datei *nicht* notwendigerweise unterscheiden! Viele andere Versionskontrollsysteme verwenden dateibezogene Revisionsnummern, so dass dieses Konzept zunächst ungewöhnlich aussieht. (Ehemalige CVS-Benutzer sollten sich für weitergehende Informationen Anhang B, *Subversion for CVS Users* ansehen.)

Es ist wichtig zu beachten, dass eine Arbeitskopie nicht immer genau einer Revision im Repository zugeordnet werden kann; sie kann Dateien aus verschiedenen Revisionen beinhalten. Nehmen wir z.B. an, Sie checken sich eine Arbeitskopie einer Datei aus einem Repository aus, deren neueste Revision 4 ist:

```
calc/Makefile:4
     integer.c:4
     button.c:4
```

In diesem Augenblick entspricht Ihre Arbeitskopie exakt der Revision im Repository. Sie machen jetzt allerdings eine Änderung an `button.c` und bringen diese Änderung mit einem Commit ins Repository. Angenommen, dass keine weiteren Commits vorgenommen wurden, wird Ihr Commit die Revision 5 im Repository erzeugen, und Ihre Arbeitskopie sieht so aus:

```
calc/Makefile:4
     integer.c:4
     button.c:5
```

Angenommen, zu diesem Zeitpunkt macht Sally einen Commit für eine Änderung an `integer.c` und erzeugt Revision 6. Wenn Sie **svn update** verwenden, um Ihre Arbeitskopie zu aktualisieren, sieht sie so aus:

```
calc/Makefile:6
     integer.c:6
     button.c:6
```

Sallys Änderung an `integer.c` erscheint in Ihrer Arbeitskopie, und Ihre Änderung ist immer noch in `button.c`. In diesem Beispiel ist der Text von `Makefile` in den Revisionen 4, 5 und 6 identisch, jedoch markiert Subversion die Arbeitskopie von `Makefile` mit Revision 6, um zu zeigen, dass es noch aktuell ist. Wenn Sie also ein sauberes Update von der Wurzel Ihrer Arbeitskopie her machen, sollte sie im Allgemeinen genau einer Revision im Repository entsprechen.

Wie Arbeitskopien das Repository verfolgen

Für jede Datei eines Arbeitsverzeichnis merkt sich Subversion zwei essentielle Informationen im `.svn/`-Verwaltungsbereich:

- Auf welcher Revision Ihre Arbeitsdatei aufbaut (das wird die *Arbeitsrevision* der Datei genannt)
- Ein Zeitstempel, der festhält, wann die lokale Kopie das letzte Mal vom Repository aktualisiert wurde.

Mit diesen Informationen kann Subversion durch Kommunikation mit dem Repository feststellen, in welchem der folgenden Zustände sich eine Arbeitsdatei befindet:

Unverändert und aktuell
: Die Datei im Arbeitsverzeichnis ist unverändert, und keinerlei Änderungen an der Datei sind seit der Arbeitsrevision an das Repository übergeben worden. Ein **svn commit** der Datei würde nichts machen, und ein **svn update** der Datei auch nicht.

Lokal geändert und aktuell
: Die Datei wurde im Arbeitsverzeichnis geändert, und keinerlei Änderungen an der Datei sind seit der letzten Aktualisierung an das Repository übergeben worden. Es gibt lokale Änderungen, die noch nicht an das Repository übergeben worden sind, so dass ein **svn commit** der Datei Ihre Änderungen erfolgreich veröffentlichen würde, und ein **svn update** der Datei nichts tun würde.

Unverändert und veraltet
: Die Datei wurde im Arbeitsverzeichnis nicht geändert, jedoch im Repository. Die Datei sollte aktualisiert werden, damit sie bezüglich der letzten öffentlichen Revision aktuell ist. Ein **svn commit** der Datei würde nichts machen, und ein **svn update** der Datei würde die letzten Änderungen in Ihre Arbeitskopie einbringen.

Lokal geändert und veraltet
: Die Datei wurde sowohl im Arbeitsverzeichnis als auch im Repository geändert. Ein **svn commit** der Datei würde mit einem „out-of-date“ Fehler abbrechen. Die Datei sollte erst aktualisiert werden; ein **svn update** Befehl würde versuchen, die

öffentlichen mit den lokalen Änderungen zusammenzuführen. Wenn Subversion diese Zusammenführung nicht plausibel automatisch durchführen kann, wird die Auflösung des Konflikts dem Benutzer überlassen.

Das hört sich an, als müsse man jede Menge mitverfolgen, aber der **svn status** Befehl zeigt Ihnen den Zustand jedes Objektes in Ihrer Arbeitskopie. Weitergehende Informationen zu diesem Befehl finden Sie unter „Verschaffen Sie sich einen Überblick über Ihre Änderungen".

Arbeitskopien mit gemischten Revisionen

Als allgemeingültiges Prinzip versucht Subversion, so flexibel wie möglich zu sein. Eine besondere Ausprägung der Flexibilität ist die Fähigkeit, eine Arbeitskopie bestehend aus Dateien und Verzeichnissen mit einer Mischung unterschiedlicher Revisionsnummern zu haben. Unglücklicherweise neigt diese Flexibilität dazu, eine Anzahl neuer Benutzer zu verwirren. Wenn Sie das vorangegangene Beispiel, das gemischte Revisionen vorgestellt hat, verwirrte, zeigen wir hier eine Einführung warum es diese Möglichkeit gibt und wie sie verwendet wird.

Updates und Commits sind getrennt

Eine der grundlegenden Regeln von Subversion ist, dass eine Aktion, die in das Repository schreibt keine Aktion zur Folge hat, die aus dem Repository liest und umgekehrt. Wenn Sie bereit sind, neue Änderungen an das Repository zu übergeben, heißt das noch lange nicht, dass Sie auch die Änderungen anderer haben möchten. Und wenn Sie noch an Änderungen arbeiten, sollte **svn update** elegant die Änderungen aus dem Repository mit Ihren Änderungen zusammenführen anstatt Sie dazu zu zwingen, Ihre Änderungen zu veröffentlichen.

Der hauptsächliche Nebeneffekt dieser Regel ist, dass eine Arbeitskopie zusätzlich buchhalten muss, um sowohl gemischte Revisionen zu verfolgen als auch diese Mischung vertragen zu können. Die Tatsache, dass auch Verzeichnisse selbst versioniert sind, verkompliziert die Sache nur.

Nehmen wir zum Beispiel an, Ihre Arbeitskopie besteht komplett aus Revision 10. Sie bearbeiten die Datei `foo.html` und führen ein **svn commit** aus, das die Revision 15 im Repository erzeugt. Nach dem erfolgreichen Commit würden viele neue Benutzer erwarten, dass die gesamte Arbeitskopie auf Revision 15 stehe, was aber nicht der Fall ist! Alle möglichen Änderungen können sich zwischen Revision 10 und 15 im Repository zugetragen haben. Der Client weiß nichts über diese Änderungen im Repository, da Sie noch nicht **svn update** aufgerufen haben, und **svn commit** zieht keine Änderungen herein. Wenn andererseits **svn commit** automatisch Änderungen hereinziehen würde, könnte die gesamte Arbeitskopie auf Revision 15 gebracht werden – doch dann wäre die grundlegende Regel verletzt, dass Lesen und Schreiben getrennte Aktionen sind. Deshalb ist das einzig Sichere, das der Subversion-Client tun kann, die eine Datei – `foo.html` – als zur Revision 15 gehörig zu kennzeichnen. Der Rest der Arbeitskopie verbleibt bei Revision 10. Nur durch **svn update** können die neuesten Änderungen hereingezogen und die gesamte Arbeitskopie als Revision 15 gekennzeichnet werden.

Gemischte Revisionen sind normal

Tatsache ist, dass *jedes Mal* wenn Sie **svn commit** aufgerufen haben, die Arbeitskopie aus irgendeiner Mischung von Revisionen besteht. Die Sachen, die Sie eben ins Repository gebracht haben, werden mit höheren Revisionsnummern gekennzeichnet als alles andere. Nach einigen Commits (ohne zwischenzeitliche Updates) ist Ihre Arbeitskopie eine Riesenmischung von Revisionen. Selbst wenn Sie die einzige Person sind, die das Repository benutzt, werden sie dieses Phänomen bemerken. Um Ihre Mischung aus Arbeitsrevisionen untersuchen zu können, verwenden Sie den Befehl **svn status** mit der `--verbose`-Option (siehe „Verschaffen Sie sich einen Überblick über Ihre Änderungen" für weitergehende Informationen).

Oft ist neuen Benutzern überhaupt nicht bewusst, das ihre Arbeitskopie gemischte Revisionen beinhaltet. Das kann zur Verwirrung führen, weil viele Client-Programme empfindlich auf die Revision des Objektes reagieren, das sie untersuchen. Beispielsweise wird der **svn log**-Befehl verwendet, um die Historie der Änderungen einer Datei oder eines Verzeichnisses darzustellen (siehe „Erzeugung einer Liste der Änderungsgeschichte“). Wenn der Benutzer diesen Befehl auf ein Objekt in der Arbeitskopie anwendet, erwartet er, die gesamte Historie des Objektes zu sehen. Wenn jedoch die Arbeitsrevision des Objektes ziemlich alt ist (oftmals weil lange Zeit kein **svn update** aufgerufen wurde), wird die Historie der *älteren* Version des Objekts angezeigt.

Gemischte Revisionen sind nützlich

Wenn Ihr Projekt hinreichend komplex ist, werden Sie entdecken, dass es manchmal ganz nett sein kann, Teile Ihrer Arbeitskopie *zurückzudatieren* (oder auf eine ältere Version als die vorliegende zu aktualisieren); wie das gemacht wird, wird in Kapitel 2, *Grundlegende Benutzung* gezeigt. Vielleicht möchten Sie eine ältere Version eines Teilmoduls in einem Unterverzeichnis testen, oder Sie möchten herausbekommen, wann ein Fehler das erste Mal in einer Datei auftauchte. Dies ist der „Zeitmaschinen“-Aspekt eines Versionskontrollsystems – die Eigenschaft, die es ermöglicht, irgendeinen Teil Ihrer Arbeitskopie zeitlich nach vorne oder nach hinten zu verschieben.

Gemischte Revisionen haben ihre Grenzen

Wie auch immer Sie gemischte Revisionen in Ihrer Arbeitskopie verwenden, diese Flexibilität hat ihre Grenzen.

Erstens kann die Löschung einer Datei oder eines Verzeichnisses nicht an das Repository übergeben werden, wenn die Datei oder das Verzeichnis nicht ganz aktuell ist. Falls eine neuere Version im Repository existiert, wird Ihr Löschversuch abgelehnt, um zu vermeiden, dass Sie versehentlich Änderungen löschen, die Sie noch nicht gesehen haben.

Zweitens können Sie keine Änderungen an Metadaten eines Verzeichnisses an das Repository übergeben, wenn das Verzeichnis nicht ganz aktuell ist. In Kapitel 3, *Advanced Topics* werden Sie lernen, wie man „Propertys“ an Objekte hängt. Die Arbeitskopie eines Verzeichnisses definiert eine bestimmte Menge von Einträgen und Propertys, so dass eine Property-Änderung an einem veralteten Verzeichnis Propertys zerstören kann, die Sie noch nicht gesehen haben.

Zusammenfassung

In diesem Kapitel haben wir eine Anzahl fundamentaler Konzepte von Subversion behandelt:

- Wir haben die Begriffe zentrales Repository, Arbeitskopie und Reihe von Revisionsbäumen des Repositorys eingeführt.
- Wir haben einige einfache Beispiele gesehen, wie zwei Mitarbeiter Subversion verwenden können, um gegenseitig Änderungen auszutauschen, indem das „kopieren-verändern-zusammenführen“-Modell benutzt wird.
- Wir haben ein wenig darüber geredet, wie Subversion Informationen in einer Arbeitskopie verfolgt und verwaltet.

An dieser Stelle sollten Sie eine gute Vorstellung haben, wie Subversion ganz allgemein arbeitet. Mit diesem Kenntnisstand sollten Sie in der Lage sein, das nächste Kapitel anzugehen, das ein detaillierter Rundgang durch die Befehle und Eigenschaften von Subversion ist.

Kapitel 2. Grundlegende Benutzung

Nun kommen wir zu den Details der Benutzung von Subversion. Bis Sie das Ende dieses Kapitels erreicht haben, werden Sie in der Lage sein, alle Aufgaben zu erledigen, die sich bei der normalen täglichen Arbeit mit Subversion stellen. Sie werden damit beginnen, Ihre Dateien in Subversion einzupflegen, gefolgt von einem initialen Checkout Ihres Codes. Dann werden wir bei unserem Rundgang zeigen, wie Änderungen gemacht und diese Änderungen untersucht werden. Sie werden auch sehen, wie Sie die Änderungen anderer in Ihre Arbeitskopie bringen, untersuchen, und sich durch eventuell auftretende Konflikte arbeiten können.

Beachten Sie jedoch, dass dieses Kapitel nicht als erschöpfende Liste aller Befehle von Subversion gedacht ist – es ist eher eine Einführung in die gebräuchlichsten Aufgaben von Subversion, denen Sie begegnen werden. Dieses Kapitel setzt voraus, dass Sie Kapitel 1, *Grundlegende Konzepte* gelesen und verstanden haben und dass Sie mit dem allgemeinen Subversion-Modell vertraut sind. Für eine vollständige Referenz aller Befehle, siehe Kapitel 9, *Subversion Complete Reference*.

Hilfe!

Bevor Sie weiter lesen: hier ist der wichtigste Befehl den Sie benötigen, wenn Sie Subversion verwenden: **svn help**. Der Subversion-Kommandozeilen-Client ist selbst-dokumentierend – jederzeit erklärt Ihnen ein schnelles **`svn help`** ***`Unterbefehl`*** die Syntax, die Optionen und das Verhalten des Unterbefehls.

```
$ svn help import
import: Commit an unversioned file or tree into the repository.
usage: import [PATH] URL

  Recursively commit a copy of PATH to URL.
  If PATH is omitted '.' is assumed.
  Parent directories are created as necessary in the repository.
  If PATH is a directory, the contents of the directory are added
  directly under URL.
  Unversionable items such as device files and pipes are ignored
  if --force is specified.

Valid options:
  -q [--quiet]             : print nothing, or only summary information
  -N [--non-recursive]     : obsolete; try --depth=files or --depth=immediates
  --depth ARG              : limit operation by depth ARG ('empty', 'files',
                             'immediates', or 'infinity')
…
```

Optionen und Schalter und Flags, oh Mann!

Der Subversion-Kommandozeilen-Client besitzt zahlreiche Befehlsmodifizierer (die wir Optionen nennen), doch davon gibt es zweierlei Arten: Kurzoptionen bestehen aus einem Bindestrich gefolgt von einem einzelnen Buchstaben, und Langoptionen bestehen aus zwei Bindestrichen gefolgt von mehr als einem Buchstaben (z.B. `-s` bzw. `--dies-ist-eine-langoption`). Jede Option besitzt ein Langformat, jedoch nur bestimmte Optionen haben zusätzlich ein Kurzformat (das sind typischerweise die meistgebrauchten Optionen). Um die Deutlichkeit zu wahren, benutzen wir in den Beispielen *gewöhnlich* die Langform, doch wenn Optionen beschrieben werden, die eine Kurzform besitzen, geben wir sowohl die Langform (um die Deutlichkeit zu verbessern) als auch die Kurzform (um sie sich leichter merken zu können) an. Sie sollten die Form benutzen, mit der Sie am besten zurechtkommen, jedoch versuchen Sie nicht, beide gleichzeitig zu benutzen.

Wie Sie Daten in Ihr Repository bekommen

Sie können neue Dateien auf zweierlei Weisen in das Subversion-Repository bekommen: **svn import** und **svn add**. Wir werden **svn import** jetzt und **svn add** später in diesem Kapitel besprechen, wenn wir einen typischen Tag mit Subversion durchnehmen.

svn import

Mit dem **svn import**-Befehl kann ein unversionierter Verzeichnisbaum schnell in ein Repository kopiert werden, wobei benötigte Zwischenverzeichnisse nach Bedarf angelegt werden. **svn import** erfordert keine Arbeitskopie und pflegt Ihre Dateien sofort in das Repository ein. Typischerweise verwenden Sie diesen Befehl, wenn bereits ein Verzeichnisbaum besteht, den Sie aber in einem Subversion-Repository pflegen möchten. Zum Beispiel:

```
$ svnadmin create /var/svn/newrepos
$ svn import mytree file:///var/svn/newrepos/some/project \
             -m "Initial import"
Adding         mytree/foo.c
Adding         mytree/bar.c
Adding         mytree/subdir
Adding         mytree/subdir/quux.h

Committed revision 1.
```

Im vorstehenden Beispiel wurde der Inhalt des Verzeichnisses `mytree` unter dem Verzeichnis `some/project` im Repository abgelegt:

```
$ svn list file:///var/svn/newrepos/some/project
bar.c
foo.c
subdir/
```

Beachten Sie, dass nach dem Import der Originalbaum *nicht* in eine Arbeitskopie umgewandelt wird. Vor Beginn der Arbeit müssen Sie noch **svn checkout** ausführen, um eine frische Arbeitskopie des Baums zu erhalten.

Empfohlene Repository Aufteilung

Obwohl die Flexibilität von Subversion es Ihnen erlaubt, Ihr Repository nach Belieben aufzuteilen, empfehlen wir, ein Verzeichnis `trunk` für die „Hauptlinie“ der Entwicklung, ein Verzeichnis `branches` für Branch-Kopien und ein Verzeichnis `tags` für Tag-Kopien. Zum Beispiel:

```
$ svn list file:///var/svn/repos
/trunk
/branches
/tags
```

In Kapitel 4, *Verzweigen und Zusammenführen* werden Sie mehr über Branches und Tags erfahren. Details über das Aufsetzen mehrerer Projekte finden Sie in „Repository Layout“, und in „Planning Your Repository Organization“ lesen Sie mehr über Wurzelverzeichnisse von Projekten.

Anfänglicher Checkout

In den meisten Fällen werden Sie ein Subversion-Repository zu nutzen beginnen, indem Sie einen *Checkout* Ihres Projektes vornehmen. Das Auschecken eines Repositorys erzeugt eine „Arbeitskopie“ desselben auf Ihrem lokalen Rechner. Diese Arbeitskopie umfasst die Revision `HEAD` (die letzte Revision) des auf der Kommandozeile angegebenen Subversion-Repositorys:

```
$ svn checkout http://svn.collab.net/repos/svn/trunk
A    trunk/Makefile.in
A    trunk/ac-helpers
A    trunk/ac-helpers/install.sh
A    trunk/ac-helpers/install-sh
A    trunk/build.conf
…
Checked out revision 8810.
```

Was steckt in einem Namen?

Subversion gibt sich alle Mühe, nicht die Art der Daten einzuschränken, die Sie unter Versionskontrolle setzen können. Der Inhalt von Dateien und Property-Werte werden als binäre Daten gespeichert und übermittelt, und „File Content Type“ sagt Ihnen, wie Sie Subversion darauf hinweisen, dass „Text“-Operationen für eine bestimmte Datei keinen Sinn ergeben. Trotzdem gibt es einige wenige Stellen, an denen Subversion Einschränkungen für gespeicherte Informationen vorsieht.

Subversion behandelt intern bestimmte Dateneinheiten – z.B. Property-Namen, Pfadnamen und Logmitteilungen – als UTF-8-kodiertes Unicode. Das heißt aber nicht, dass all Ihre Interaktionen mit Subversion in UTF-8 erfolgen müssen. Im Allgemeinen werden Subversion-Clients die Umwandlungen zwischen UTF-8 und dem auf Ihrem Computer verwendeten Kodiersystem großzügig und transparent vornehmen, sofern eine solche Umwandlung sinnvollerweise durchgeführt werden kann (was bei den meisten gebräuchlichsten Kodierungen heutzutage der Fall ist).

Darüber hinaus werden Pfadnamen sowohl bei WebDAV-Übertragungen als auch in einigen der Steuerdateien von Subversion als XML-Attributwerte verwendet. Das bedeutet, dass Pfadnamen nur aus zulässigen XML (1.0) Zeichen bestehen dürfen. Subversion verbietet ebenfalls TAB, CR und LF Zeichen in Pfadnamen, um zu verhindern, das Pfade in Vergleichen oder bei Befehlsausgaben, wie **svn log** oder **svn status** zerrissen werden.

Obwohl es sich anhört, als müsse man sich eine Menge merken, sind diese Einschränkungen selten ein Problem. Solange Ihre Locale-Einstellungen kompatibel zu UTF-8 sind und Sie keine Kontrollzeichen in den Pfadnamen verwenden, sollten Sie keine Probleme habe, mit Subversion zu kommunizieren. Der Kommandozeilen-Client bietet Ihnen noch ein wenig Extrahilfe – um „korrekte“ Versionen für den internen Gebrauch zu erzeugen, maskiert er bei Bedarf automatisch illegale Zeichen in URL-Pfaden, die Sie eingeben.

Obwohl im vorangehenden Beispiel das Verzeichnis `trunk` ausgecheckt wird, können Sie genauso leicht irgendein tiefliegendes Unterverzeichnis aus einem Repository auschecken, indem Sie das Unterverzeichnis im URL beim Checkout angeben:

```
$ svn checkout \
      http://svn.collab.net/repos/svn/trunk/subversion/tests/cmdline/
A    cmdline/revert_tests.py
A    cmdline/diff_tests.py
A    cmdline/autoprop_tests.py
A    cmdline/xmltests
A    cmdline/xmltests/svn-test.sh
…
```

```
Checked out revision 8810.
```

Da Subversion ein *copy-modify-merge*-Modell (kopieren-ändern-zusammenführen) statt eines *lock-modify-unlock*-Modells (sperren-ändern-freigeben) verwendet (siehe „Versionierungsmodelle“), können Sie sofort damit beginnen, Änderungen an den Dateien und Verzeichnissen Ihrer Arbeitskopie vorzunehmen. Ihre Arbeitskopie ist wie jede beliebige andere Ansammlung aus Dateien und Verzeichnissen auf Ihrem System. Sie können sie bearbeiten, ändern, verschieben und sie sogar löschen und vergessen.

Obwohl sich Ihre Arbeitskopie „wie jede beliebige andere Ansammlung aus Dateien und Verzeichnissen auf Ihrem System“ verhält, können Sie zwar beliebig Dateien editieren, doch Sie müssen Subversion über *alles andere* was Sie tun in Kenntnis setzen. Wenn Sie z.B. ein Objekt in der Arbeitskopie kopieren oder verschieben möchten, sollten Sie **svn copy** oder **svn move** verwenden statt der Kopier- oder Verschiebebefehle Ihres Betriebssystems. Wir werden darauf später im Kapitel näher eingehen.

Sofern Sie nicht bereit sind, das Hinzufügen einer neuen Datei oder eines neuen Verzeichnisses oder Änderungen an bestehenden Objekten an das Repository zu übergeben, besteht keine Notwendigkeit, dem Subversion-Server mitzuteilen, dass Sie irgendetwas gemacht haben.

Was hat es mit dem Verzeichnis .svn auf sich?

Jedes Verzeichnis in einer Arbeitskopie beinhaltet einen Verwaltungsbereich – ein Verzeichnis namens `.svn`. Normalerweise wird dieses Unterverzeichnis nicht vom Befehl zum Auflisten des Verzeichnisinhaltes angezeigt, trotzdem ist es ein wichtiges Verzeichnis. Egal, was Sie machen, löschen oder ändern Sie nichts im Verwaltungsbereich! Subversion ist darauf angewiesen, um Ihre Arbeitskopie zu verwalten.

Sollten Sie versehentlich das Verzeichnis `.svn` löschen, besteht die einfachste Lösung des Problems darin, das komplette darüberliegende Verzeichnis zu löschen (mit dem Betriebssystem-Löschbefehl, nicht mit **svn delete**) und dann wiederum **svn update** von einem darüberliegenden Verzeichnis aus aufzurufen. Der Subversion-Client wird das von Ihnen gelöschte Verzeichnis herunterladen und dabei auch einen neuen `.svn`-Bereich anlegen.

Obwohl Sie sicherlich eine Arbeitskopie mit dem Repository-URL als einziges Argument auschecken können, haben sie auch die Möglichkeit, ein Verzeichnis hinter dem Repository-URL anzugeben. Das erstellt Ihre Arbeitskopie in dem angegebenen Verzeichnis. Zum Beispiel:

```
$  svn checkout http://svn.collab.net/repos/svn/trunk subv
A    subv/Makefile.in
A    subv/ac-helpers
A    subv/ac-helpers/install.sh
A    subv/ac-helpers/install-sh
A    subv/build.conf
…
Checked out revision 8810.
```

Das legt Ihre Arbeitskopie in einem Verzeichnis namens `subv` ab anstatt in `trunk` so wie wir es früher schon einmal gemacht haben. Das Verzeichnis `subv` wird angelegt, sofern es nicht bereits vorhanden ist.

Das Zwischenspeichern des Passwortes abstellen

Wenn Sie eine Subversion-Operation ausführen, für die Sie sich authentifizieren müssen, speichert Subversion Ihre Zugangsdaten standardmäßig auf der Platte. Das geschieht zu Ihrer Annehmlichkeit, damit Sie bei künftigen Operationen nicht ständig Ihr Passwort eingeben müssen. Falls Sie wegen der Speicherung besorgt sein sollten [1], können Sie das Zwischenspeichern entweder dauerhaft oder von Fall zu Fall abstellen.

Um das Passwort-Caching für einen bestimmten einmaligen Befehl zu unterbinden, übergeben Sie die `--no-auth-cache`-Option auf der Kommandozeile. Um das Caching dauerhaft abzustellen, können Sie der Subversion-Konfigurationsdatei Ihres lokalen Rechners die Zeile `store-passwords = no` hinzufügen. Für Details siehe „Client Credentials Caching“.

Authentifizierung als ein anderer Anwender

Da Subversion standardmäßig Zugangsdaten speichert (sowohl den Benutzernamen als auch das Passwort), erinnert es sich bequemerweise, wer Sie das letzte Mal waren, als Sie Ihre Arbeitskopie modifizierten. Doch manchmal ist das nicht hilfreich – besonders, wenn Sie in einer gemeinsam benutzten Arbeitskopie arbeiten wie in einem Konfigurationsverzeichnis oder im Dokumenten-Wurzelverzeichnis eines Webservers. In diesem Fall brauchen Sie nur die `--username`-Option auf der Kommandozeile zu übergeben und Subversion versucht, sich als dieser Benutzer zu authentifizieren und wird Sie, wenn nötig, zur Eingabe eines Passworts auffordern.

Der grundlegende Arbeitszyklus

Subversion hat zahlreiche Features, Optionen und noch jede Menge Schnickschnack, aber für die tägliche Arbeit ist die Wahrscheinlichkeit groß, nur wenig davon zu benutzen. In diesem Abschnitt gehen wir durch die gebräuchlichsten Dinge, die Sie während des Tagesgeschäftes mit Subversion machen werden.

Der typische Arbeitszyklus sieht so aus:

1. Aktualisieren Sie Ihre Arbeitskopie.
   - **svn update**
2. Nehmen Sie Änderungen vor.
   - **svn add**
   - **svn delete**
   - **svn copy**
   - **svn move**
3. Untersuchen Sie Ihre Änderungen.
   - **svn status**
   - **svn diff**

[1] Natürlich sind Sie nicht ernsthaft besorgt – erstens, weil Sie wissen, dass Sie nichts *wirklich* aus Subversion löschen können und zweitens, weil Ihr Subversion-Passwort nicht das gleiche ist wie irgendein anderes Ihrer 3 Millionen Passwörter, nicht wahr?

4. Nehmen Sie eventuell einige Änderungen zurück.

   - **svn revert**

5. Lösen Sie Konflikte auf (arbeiten Sie die Änderungen anderer ein).

   - **svn update**
   - **svn resolve**

6. Bringen Sie Ihre Änderungen ins Repository.

   - **svn commit**

Aktualisieren Sie Ihre Arbeitskopie

Wenn Sie in einem Projekt im Team zusammenarbeiten, sollten Sie Ihre Arbeitskopie aktualisieren, um die Änderungen zu bekommen, die die anderen Entwickler im Projekt seit Ihrer letzten Aktualisierung vorgenommen haben. Benutzen Sie **svn update** um Ihre Arbeitskopie synchron mit der letzten Revision im Repository zu bekommen:

```
$ svn update
U  foo.c
U  bar.c
Updated to revision 2.
```

In diesem Fall sieht es so aus, dass jemand Änderungen sowohl an `foo.c` als auch an `bar.c` eingecheckt hat, seit Sie das letzte Mal aktualisiert haben, und Subversion hat Ihre Arbeitskopie aktualisiert, damit sie beide Änderungen enthält.

Wenn der Server über **svn update** Änderungen an Ihre Arbeitskopie schickt, wird ein Buchstabencode neben jedem Objekt angezeigt, um Ihnen anzuzeigen, was Subversion gemacht hat, um die Arbeitskopie auf den neuesten Stand zu bringen. Zur Bedeutung der Buchstaben, rufen Sie **`svn help update`** auf.

Nehmen Sie Änderungen an Ihrer Arbeitskopie vor

Nun können Sie loslegen und Änderungen an Ihrer Arbeitskopie vornehmen. Normalerweise ist es am einfachsten, sich für eine bestimmte Änderung (oder eine Menge von Änderungen) zu entscheiden, etwa ein neues Feature zu implementieren oder einen Fehler zu beseitigen usw. Die Subversion-Befehle, die Sie hierfür verwenden werden sind **svn add**, **svn delete**, **svn copy**, **svn move** und **svn mkdir**. Falls Sie jedoch größtenteils Dateien editieren, die bereits mit Subversion verwaltet werden, brauchen Sie keinen dieser Befehle, bis Sie die Änderungen committen.

Sie können zwei Arten von Änderungen an Ihrer Arbeitskopie vornehmen: *Dateiänderungen* und *Verzeichnisbaumänderungen*. Sie brauchen Subversion nicht mitzuteilen, dass Sie beabsichtigen, eine Datei zu ändern; nehmen Sie einfach die Änderungen mit Ihrem Texteditor, Textverarbeitungsprogramm, Grafikprogramm oder sonstigen Programm vor, wie Sie es gewohnt sind. Subversion stellt automatisch fest, welche Dateien sich geändert haben und behandelt dabei Binärdateien genauso einfach wie Textdateien – und genauso effizient. Für Änderungen am Verzeichnisbaum können Sie Subversion mitteilen, Dateien und Verzeichnisse zum geplanten Entfernen, Hinzufügen, Kopieren oder Verschieben „vorzumerken“. Diese Änderungen finden sofort in Ihrer Arbeitskopie statt, doch nichts wird dem Repository hinzugefügt oder daraus entfernt, bevor Sie die Änderungen committen.

Versionierung symbolischer Links

> Auf Nicht-Windows-Systemen kann Subversion den besonderen Dateityp *symbolischer Link* (oder *Symlink*) versionieren. Ein Symlink ist eine Datei, die sich wie eine transparente Referenz auf ein anderes Objekt im Dateisystem verhält, und somit Programmen die Möglichkeit bietet, indirekt auf dieses Objekt zuzugreifen, indem sie Operationen auf dem Symlink ausführen.
>
> Wenn ein Symlink in Subversion committet wird, merkt sich Subversion sowohl, dass die Datei eigentlich ein Symlink ist, als auch das Objekt, auf das der Symlink „zeigt“. Wenn dieser Symlink auf einem Nicht-Windows-System in einer anderen Arbeitskopie ausgecheckt wird, rekonstruiert Subversion aus dem versionierten Symlink einen echten Symlink auf Dateisystemebene. Jedoch beeinträchtigt das keineswegs die Benutzbarkeit von Arbeitskopien auf Systemen wie Windows, die keine Symlinks unterstützen. Auf diesen Systemen erzeugt Subversion einfach eine Textdatei, deren Inhalt der Pfad ist, auf den der ursprüngliche Symlink gezeigt hat. Obwohl diese Datei unter Windows nicht als Symlink verwendet werden kann, hindert es Windows-Benutzer nicht an der Ausübung anderer Tätigkeiten mit Subversion.

Hier ist ein Überblick der fünf Subversion-Unterbefehle, die Sie am häufigsten benutzen werden, um Änderungen am Verzeichnisbaum vorzunehmen:

`svn add foo`
: Die Datei, das Verzeichnis oder den symbolischen Link `foo` zum Hinzufügen in das Repository vormerken. Wenn Sie das nächste Mal committen, wird `foo` ein Kind seines Elternverzeichnisses. Beachten Sie, dass alles unterhalb von `foo` zum Hinzufügen vorgemerkt wird, falls `foo` ein Verzeichnis ist. Falls Sie nur `foo` selber hinzufügen möchten, geben Sie die `--depth empty`-Option an.

`svn delete foo`
: Die Datei, das Verzeichnis oder den symbolischen Link `foo` zum Löschen aus dem Repository vormerken. `foo` wird sofort aus der Arbeitskopie entfernt, falls es eine Datei oder ein Link ist. Falls `foo` ein Verzeichnis ist, wird es nicht gelöscht, sondern zum Löschen vorgemerkt. Wenn Sie Ihre Änderungen committen, wird das gesamte Verzeichnis `foo` aus der Arbeitskopie und dem Repository entfernt. [2]

`svn copy foo bar`
: Erzeuge ein neues Objekt `bar` als Duplikat von `foo` und merke `bar` automatisch zum Hinzufügen vor. Wird beim nächsten Commit `bar` dem Repository hinzugefügt, wird die Historie der Kopie mitaufgezeichnet (so wie sie ursprünglich in `foo` war). **svn copy** erzeugt keine Zwischenverzeichnisse, sofern nicht die Option `--parents` angegeben wird..

`svn move foo bar`
: Dieser Befehl macht genau das gleiche wie **`svn copy foo bar; svn delete foo`**. D.h., `bar` wird zum Hinzufügen als Kopie von `foo` und `foo` selbst zum Löschen vorgemerkt. **svn move** erzeugt keine Zwischenverzeichnisse, sofern nicht die Option `--parents` angegeben wird.

`svn mkdir blort`
: Dieser Befehl macht genau das gleiche wie **`mkdir blort; svn add blort`**. D.h., ein neues Verzeichnis namens `blort` wird angelegt und zum Hinzufügen vorgemerkt.

> **Ändern des Repositorys ohne Arbeitskopie**

[2] Selbstverständlich wird nichts jemals vollständig aus dem Repository gelöscht – lediglich aus der `HEAD`-Revision des Repositorys. Sie können alles was Sie gelöscht haben zurückholen, indem Sie eine Revision auschecken (oder hierauf aktualisieren), die älter ist, als die Revision Ihrer Löschung. Siehe auch „Zurückholen gelöschter Objekte“.

Es *gibt* einige Anwendungsfälle, die Änderungen am Verzeichnisbaum unmittelbar in das Repository übertragen. Das passiert nur, wenn ein Unterbefehl direkt auf einen URL statt auf einen Pfad in der Arbeitskopie angewendet wird. Im Einzelnen können spezielle Anwendungen der Befehle **svn mkdir**, **svn copy**, **svn move** und **svn delete** mit URLs arbeiten (und vergessen Sie nicht, dass **svn import** immer Änderungen über einen URL macht).

URL Operationen verhalten sich auf diese Weise, da Befehle, die auf einer Arbeitskopie arbeiten, diese als eine Art „Bereitstellungsraum“ verwenden, in denen Ihre Änderungen vorbereitet werden können, bevor sie in das Repository committet werden. Befehle, die auf URLs arbeiten, haben diesen Luxus nicht, so dass die Arbeit direkt mit einem URL bei den oben genannten Aktionen einen sofortigen Commit repräsentiert.

Untersuchen Sie Ihre Änderungen

Sobald Sie mit Ihren Änderungen fertig sind, müssen Sie sie ins Repository bringen; bevor Sie das jedoch machen, ist es normalerweise eine gute Idee, sich die Änderungen noch einmal anzusehen. Dadurch, dass Sie die Änderungen noch einmal begutachten, können Sie eine genauere Log-Nachricht schreiben. Sie könnten auch feststellen, dass Sie versehentlich eine Datei geändert haben, und hier haben Sie die Möglichkeit, vor dem Commit die Änderung rückgängig zu machen. Zusätzlich bietet sich hierbei eine gute Gelegenheit, die Änderungen vor der Veröffentlichung noch einmal genau durchzugehen. Sie können sich mit **svn status** einen Überblick über Ihre Änderungen verschaffen und mit **svn diff** die Änderungen im Detail anzeigen lassen.

Guck mal, Mutti, kein Netzwerk!

Sie können die Befehle **svn status**, **svn diff** und **svn revert** ohne Netzzugriff verwenden, selbst wenn das Repository im Netz *ist*. Das macht es leicht, Ihre momentanen Änderungen zu verwalten, wenn Sie irgendwo ohne Netzverbindung sind, etwa im Flugzeug, im Pendlerzug oder am Strand. [3]

Subversion bewerkstelligt das, indem es unveränderte Versionen jeder versionierten Datei in einem privaten Cache innerhalb des `.svn`-Verwaltungsbereichs vorhält. Das erlaubt Subversion, lokale Änderungen an diesen Dateien *ohne Netzzugriff* anzuzeigen – und rückgängig zu machen. Dieser Cache („Text-Base“ genannt) erlaubt es Subversion ebenfalls, bei einem Commit die lokalen Änderungen des Benutzers als komprimiertes *Delta* (oder „Differenz“) gegenüber der unveränderten Version zum Server zu senden. Diesen Cache zu haben, bedeutet einen riesigen Vorteil – selbst wenn Sie eine schnelle Internet-Verbindung haben, ist es viel schneller, nur die Änderungen an einer Datei an den Server zu übermitteln, anstatt die gesamte Datei.

Subversion ist optimiert worden, um Ihnen bei dieser Aufgabe zu helfen, und es ist in der Lage, viele Dinge zu tun, ohne mit dem Repository kommunizieren zu müssen. Im Besonderen enthält Ihre Arbeitskopie eine versteckte „unveränderte“ Kopie jeder versionskontrollierten Datei innerhalb des `.svn`-Bereichs. Deswegen kann Ihnen Subversion schnell zeigen, wie sich Ihre bearbeiteten Dateien geändert haben, und es erlaubt Ihnen sogar, Ihre Änderungen zurückzunehmen, ohne Verbindung mit dem Repository aufnehmen zu müssen.

Verschaffen Sie sich einen Überblick über Ihre Änderungen

Um einen Überblick über Ihre Änderungen zu bekommen, werden Sie den **svn status**-

[3] Und Sie haben keine WLAN-Karte. Sie dachten wohl, Sie kriegen uns, was?

Befehl verwenden. Wahrscheinlich werden Sie den Befehl **svn status** häufiger benutzen als alle anderen Subversion-Befehle.

> **CVS Anwender: Zurückhaltung mit Update!**
>
> Sehr wahrscheinlich sind Sie es gewohnt, **cvs update** zu benutzen, um zu sehen, welche Änderungen Sie an Ihrer Arbeitskopie vorgenommen haben. **svn status** stellt Ihnen alle Informationen zur Verfügung, die Sie über Änderungen an der Arbeitskopie benötigen – ohne mit dem Repository in Verbindung zu treten oder möglicherweise neue Änderungen von anderen Benutzern einzupflegen.
>
> In Subversion, macht **svn update** genau das – es aktualisiert Ihre Arbeitskopie mit jeglichen Änderungen, die seit Ihrer letzten Aktualisierung in das Repository eingebracht worden sind. Sie sollten sich abgewöhnen, **update** zu verwenden, um nachzusehen, welche lokalen Änderungen Sie gemacht haben.

Wenn Sie **svn status** ganz oben in Ihrer Arbeitskopie aufrufen, werden alle Datei- und Verzeichnisbaumänderungen erfasst, die Sie gemacht haben. Hier sind einige Beispiele der häufigsten Statuscodes, die **svn status** zurückgeben kann. (Beachten Sie, dass der Text, der # folgt, nicht von **svn status** ausgegeben wird.)

```
?       scratch.c           # Datei ist nicht versionskontrolliert
A       stuff/loot/bloo.h   # Datei ist zum Hinzufügen vorgemerkt
C       stuff/loot/lump.c   # Datei hat Konflikte durch einen Update
D       stuff/fish.c        # Datei ist zum Löschen vorgemerkt
M       bar.c               # Der Inhalt von bar.c hat lokale Änderungen
```

In diesem Ausgabeformat zeigt **svn status** sechs Spalten mit Zeichen, gefolgt von mehreren Leerzeichen, gefolgt von einem Datei- oder Verzeichnisnamen an. Die erste Spalte gibt Aufschluss über den Zustand einer Datei oder eines Verzeichnisses und/oder des entsprechenden Inhalts.

`A item`
: Die Datei, das Verzeichnis oder der symbolische Link `item` ist zum Hinzufügen in das Repository vorgemerkt.

`C item`
: Die Datei `item` befindet sich in einem Konfliktzustand. D.h., Änderungen, die vom Server bei einer Aktualisierung empfangen wurden, überlappen sich mit lokalen Änderungen, die Sie in Ihrer Arbeitskopie haben (und konnten beim Aktualisieren nicht automatisch aufgelöst werden). Sie müssen den Konflikt auflösen, bevor Sie Ihre Änderungen in das Repository committen können.

`D item`
: Die Datei, das Verzeichnis oder der symbolische Link `item` ist zum Löschen im Repository vorgemerkt.

`M item`
: Der Inhalt der Datei `item` ist geändert worden.

Wenn Sie einen speziellen Pfad an **svn status** übergeben, bekommen Sie nur Informationen über das Objekt alleine:

```
$ svn status stuff/fish.c
D      stuff/fish.c
```

svn status hat auch eine `--verbose`-Option (`-v`), die Ihnen den Zustand *jedes* Objektes in der Arbeitskopie anzeigt, selbst wenn es sich nicht geändert hat:

```
$ svn status -v
M               44        23    sally     README
                44        30    sally     INSTALL
M               44        20    harry     bar.c
                44        18    ira       stuff
                44        35    harry     stuff/trout.c
D               44        19    ira       stuff/fish.c
                44        21    sally     stuff/things
A                0         ?     ?        stuff/things/bloo.h
                44        36    harry     stuff/things/gloo.c
```

Dies ist das „lange Format“ der Ausgabe von **svn status**. Die Buchstaben in der ersten Spalte bedeuten dasselbe wie vorher, jedoch zeigt die zweite Spalte die Arbeitsrevision des Objektes an. Die dritte und vierte Spalte zeigen die Revision der letzten Änderung an und wer es geändert hat.

Keiner der vorangegangenen Aufrufe von **svn status** stellt eine Verbindung zum Repository her – stattdessen werden die Metadaten im Verzeichnis `.svn` mit der Arbeitskopie verglichen. Schließlich gibt es die `--show-updates`-Option (`-u`), die eine Verbindung zum Repository herstellt, und Informationen darüber bereitstellt, was nicht mehr aktuell ist:

```
$ svn status -u -v
M      *        44        23    sally     README
M               44        20    harry     bar.c
       *        44        35    harry     stuff/trout.c
D               44        19    ira       stuff/fish.c
A                0         ?     ?        stuff/things/bloo.h
Status against revision:   46
```

Beachten Sie die zwei Sternchen: Wenn Sie an dieser Stelle **`svn update`** aufrufen würden, erhielten Sie Änderungen an `README` und `trout.c`. Das gibt Ihnen einige sehr wichtige Informationen – Sie müssen aktualisieren, um die Änderungen auf dem Server an `README` mitzubekommen, bevor Sie committen, oder das Repository wird Ihren Commit ablehnen, da er nicht aktuell ist (mehr dazu später).

svn status kann viel mehr Informationen über Dateien und Verzeichnisse in Ihrer Arbeitskopie anzeigen als wir hier gezeigt haben – für eine erschöpfende Beschreibung von **svn status** und dessen Ausgabe, siehe svn status.

Untersuchen Sie die Details Ihrer lokalen Änderungen

Eine andere Möglichkeit, Ihre Änderungen zu untersuchen, ist, den **svn diff**-Befehl zu verwenden. Sie können *genau* herausfinden, wie sie etwas geändert haben, indem Sie **`svn diff`** ohne Argumente aufrufen, das Ihnen Dateiänderungen im *unified-diff-Format* anzeigt:

```
$ svn diff
Index: bar.c
===================================================================
--- bar.c   (revision 3)
+++ bar.c   (working copy)
@@ -1,7 +1,12 @@
+#include <sys/types.h>
+#include <sys/stat.h>
+#include <unistd.h>
+
```

```
+#include <stdio.h>

 int main(void) {
-  printf("Sixty-four slices of American Cheese...\n");
+  printf("Sixty-five slices of American Cheese...\n");
 return 0;
 }

Index: README
===================================================================
--- README  (revision 3)
+++ README  (working copy)
@@ -193,3 +193,4 @@
+Note to self:  pick up laundry.

Index: stuff/fish.c
===================================================================
--- stuff/fish.c    (revision 1)
+++ stuff/fish.c    (working copy)
-Welcome to the file known as 'fish'.
-Information on fish will be here soon.

Index: stuff/things/bloo.h
===================================================================
--- stuff/things/bloo.h (revision 8)
+++ stuff/things/bloo.h (working copy)
+Here is a new file to describe
+things about bloo.
```

Der **svn diff**-Befehl erzeugt diese Ausgabe, indem er Ihre Arbeitsdateien mit den „unveränderten" Kopien im Cache innerhalb des `.svn`-Bereichs vergleicht. Dateien, die zum Hinzufügen vorgemerkt sind, werden vollständig als hinzugefügter Text dargestellt, und Dateien, die zum Löschen vorgemerkt sind, werden vollständig als gelöschter Text dargestellt.

Die Ausgabe wird im unified-diff-Format dargestellt. D.h., gelöschte Zeilen werden mit einem vorangestellten - und hinzugefügte Zeilen mit einem vorangestellten + angezeigt. **svn diff** gibt auch Dateinamen und Offset-Informationen aus, die das **patch**-Programm verwenden kann, so dass Sie „Patches" erzeugen können, indem Sie die diff-Ausgabe in eine Datei umleiten:

```
$ svn diff > patchfile
```

Zum Beispiel können Sie die Patch-Datei vor einem Commit an einen anderen Entwickler zur Kontrolle oder zum Testen schicken.

Subversion verwendet seinen eingebauten diff-Algorithmus, der standardmäßig das unified-diff-Format benutzt. Falls Sie die Ausgabe von diff in einem anderen Format haben möchten, geben Sie ein externes diff-Programm mit der `--diff-cmd`-Option an, und übergeben Sie ihm beliebige Flags mit der `--extensions`-Option (`-x`). Um z.B. lokale Unterschiede in der Datei `foo.c` im Kontext-Ausgabeformat anzeigen zu lassen und dabei die Groß- und Kleinschreibung zu ignorieren, könnten Sie **`svn diff --diff-cmd /usr/bin/diff --extensions '-i' foo.c`** aufrufen.

Zurücknehmen von Änderungen in der Arbeitskopie

Angenommen, Sie stellen beim Ansehen der Ausgabe von **svn diff** fest, dass alle Änderungen, die Sie an einer bestimmten Datei gemacht haben, fehlerhaft waren. Vielleicht hätten Sie die Datei überhaupt nicht ändern sollen, oder es wäre einfacher, von Anfang an unterschiedliche Änderungen zu machen.

Dies ist die perfekte Gelegenheit, **svn revert** zu benutzen:

```
$ svn revert README
Reverted 'README'
```

Subversion stellt die Datei wieder so her, wie sie vor der Änderung war, indem sie mit der „unveränderten“ Kopie aus dem Cache im `.svn`-Bereich überschrieben wird. Beachten Sie aber auch, dass **svn revert** *jegliche* vorgemerkten Operationen rückgängig machen kann – z.B. könnten Sie sich entscheiden, eine neue Datei erst gar nicht hinzufügen zu wollen:

```
$ svn status foo
?      foo

$ svn add foo
A         foo

$ svn revert foo
Reverted 'foo'

$ svn status foo
?      foo
```

`svn revert` ***`item`*** hat genau denselben Effekt, wie *`item`* aus der Arbeitskopie zu löschen und dann **svn update -r BASE** *`item`* aufzurufen. Allerdings hat **svn revert** beim Rückgängigmachen einer Datei einen merklichen Unterschied – es muss beim Wiederherstellen der Datei nicht Verbindung mit dem Repository aufnehmen.

Oder vielleicht haben Sie die Datei versehentlich aus der Versionsverwaltung gelöscht:

```
$ svn status README

$ svn delete README
D         README

$ svn revert README
Reverted 'README'

$ svn status README
```

Konflikte auflösen (Änderungen anderer einarbeiten)

Wir haben bereits gesehen, wie **`svn status -u`** Konflikte vorhersagen kann. Angenommen, Sie starten **svn update** und einige interessante Dinge passieren:

```
$ svn update
U  INSTALL
G  README
Conflict discovered in 'bar.c'.
Select: (p) postpone, (df) diff-full, (e) edit,
        (h) help for more options:
```

Die Codes `U` und `G` sind kein Grund zur Beunruhigung; diese Dateien haben die Änderungen aus dem Repository sauber aufgenommen. Die mit `U` markierten Dateien enthielten keine lokalen Änderungen, wurden jedoch mit Änderungen aus dem Repository geUpdatet. Das `G` steht für merGed, was bedeutet, dass die Datei zwar lokale Änderungen enthielt, die Änderungen aus dem Repository sich aber nicht damit überschnitten haben.

Die nächsten beiden Zeilen jedoch sind Teil eines Features (neu in Subversion 1.5) namens *interaktive Konfliktauflösung*. Das bedeutet, dass die Änderungen vom Server sich mit Ihren eigenen überschneiden, uns Sie nun die Gelegenheit haben, den Konflikt aufzulösen. Die gebräuchlichsten Optionen werden angezeigt, aber alle Optionen können sie sehen, wenn Sie *h* eintippen:

```
…
  (p)  postpone    - mark the conflict to be resolved later
  (df) diff-full   - show all changes made to merged file
  (e)  edit        - change merged file in an editor
  (r)  resolved    - accept merged version of file
  (mf) mine-full   - accept my version of entire file (ignore their changes)
  (tf) theirs-full - accept their version of entire file (lose my changes)
  (l)  launch      - launch external tool to resolve conflict
  (h)  help        - show this list
```

Bevor wir im Detail erklären, was jede Option bedeutet, gehen wir noch mal eben die Optionen durch.

(p)ostpone
: Die Datei im Konfliktzustand lassen, um nach Abschluss der Aktualisierung die Konfliktauflösung durchzuführen.

(d)iff
: Die Unterschiede zwischen der Basisrevision und der Konfliktdatei im unified-diff-Format anzeigen.

(e)dit
: Die Konfliktdatei im bevorzugten Editor, wie in der Umgebungsvariablen `EDITOR` angegeben, öffnen.

(`r`)esolved
: Nach dem Bearbeiten einer Datei teilen Sie **svn** mit, dass Sie die Konflikte in der Datei aufgelöst haben und der aktuelle Inhalt übernommen werden soll.

(`m`)ine-(`f`)ull
: Die neuen vom Server erhaltenen Änderungen verwerfen und nur Ihre lokalen Änderungen an der zu überprüfenden Datei verwenden.

(`t`)heirs-(`f`)ull
: Ihre lokalen Änderungen an der zu überprüfenden Datei verwerfen und nur die neuen vom Server erhaltenen Änderungen verwenden.

(`l`)aunch
: Ein externes Programm zur Konfliktauflösung starten. Das setzt Vorbereitungen voraus.

(h)elp
: Die Liste aller bei der interaktiven Konfliktauflösung möglichen Befehle anzeigen.

Wir werden diese Befehle nun detaillierter behandeln, wobei sie nach Funktionalität gruppiert werden.

Interaktive Begutachtung der Konflikte

Bevor Sie entscheiden, wie Sie einen Konflikt beseitigen wollen, wollen Sie wahrscheinlich genau sehen, worin der Konflikt besteht, und benutzen hierfür den Befehl *diff* (**d**):

```
…
Select: (p) postpone, (df) diff-full, (e) edit,
        (h)elp for more options : d
--- .svn/text-base/sandwich.txt.svn-base      Tue Dec 11 21:33:57 2007
+++ .svn/tmp/tempfile.32.tmp     Tue Dec 11 21:34:33 2007
@@ -1 +1,5 @@
-Just buy a sandwich.
+<<<<<<< .mine
+Go pick up a cheesesteak.
+=======
+Bring me a taco!
+>>>>>>> .r32
…
```

Die erste Zeile des diff-Inhalts zeigt den vorherigen Inhalt der Arbeitskopie (die BASE-Revision), die nächste Zeile beinhaltet Ihre Änderung und die letzte Zeile ist die Änderung, die soeben vom Server empfangen worden ist (*gewöhnlich* die HEAD-Revision). Mit diesen Informationen sind Sie bereit für den nächsten Schritt.

Interaktive Konfliktauflösung

Es gibt vier verschiedene Wege, um Konflikte interaktiv aufzulösen – von denen Ihnen zwei erlauben, Änderungen selektiv zusammenzuführen und zu editieren und zwei, die es Ihnen erlauben, einfach eine Version der Datei auszuwählen und weiterzumachen.

Falls Sie eine beliebige Kombination Ihrer lokalen Änderungen auswählen wollen, können Sie den „edit“-Befehl (**e**) verwenden, um die Datei mit den Konfliktmarken manuell in einem Texteditor (der durch die Umgebungsvariable `EDITOR` bestimmt wird) zu bearbeiten. Die Datei händisch in Ihrem Lieblingseditor zu bearbeiten ist eine Art Konflikte zu beseitigen, die sich einer ziemlich schlichten Technik bedient (siehe „Manuelle Konfliktauflösung“ für einen Beispieldurchgang), so dass manche Leute lieber feinste Merge-Tools benutzen.

Um ein Merge-Tool benutzen zu können, müssen Sie entweder die Umgebungsvariable `SVN_MERGE` setzen oder die `merge-tool-cmd`-Option in Ihrer Subversion-Konfigurationsdatei definieren (siehe „Configuration Options“ für weitere Details). Subversion übergibt vier Argumente an das Merge-Tool: die BASE-Revision der Datei, die Dateirevision, die durch die Aktualisierung vom Server empfangen wurde, die Dateirevision, die Ihre lokale Bearbeitung beinhaltet und die zusammengeführte Kopie der Datei (die Konfliktmarken enthält). Falls Ihr Merge-Tool die Argumente in einer anderen Reihenfolge oder in einem anderen Format erwartet, werden Sie ein Wrapper-Script schreiben müssen, das von Subversion aufgerufen wird. Nachdem Sie die Datei bearbeitet haben und zufrieden mit Ihren Änderungen sind, können Sie Subversion mitteilen, dass für die bearbeitete Datei kein Konflikt mehr besteht, indem sie den „resolve“-Befehl (`r`) benutzen.

Falls Sie entscheiden, dass Sie keine Änderungen zusammenführen brauchen, sondern lediglich eine der beiden Dateiversionen akzeptieren wollen, können Sie entweder Ihre Änderungen (auch „meine“) mit dem „mine-full“-Befehl (**`mf`**) oder die der Anderen mit dem „theirs-full“-Befehl (**`tf`**) auswählen.

Aufschieben der Konfliktauflösung

Das hört sich vielleicht an wie ein passender Abschnitt zur Vermeidung von Ehestreitigkeiten, doch es geht immer noch um Subversion; also lesen Sie weiter. Falls Sie eine Aktualisierung vornehmen und ein Konflikt auftaucht, den Sie nicht begutachten oder auflösen können, ermöglicht Ihnen das Eingeben von **p** die Konfliktauflösung Datei für Datei aufzuschieben, wenn Sie **svn update** aufrufen. Falls Sie aktualisieren wollen, ohne Konflikte aufzulösen, können Sie die `--non-interactive`-Option an **svn update** übergeben, und jede Datei mit Konflikten wird automatisch mit einem `C` gekennzeichnet.

Das `C` bedeutet conflict. Das heißt, dass die Änderungen vom Server sich mit Ihren eigenen überschneiden, und Sie nach Abschluss der Aktualisierung manuell aus den Änderungen wählen müssen. Wenn Sie eine Konfliktauflösung verschieben, macht **svn** typischerweise drei Dinge, um Ihnen bei der Konfliktauflösung zu helfen:

- Subversion gibt ein `C` während der Aktualisierung aus und merkt sich, dass die Datei in einem Konfliktzustand ist.
- Falls Subversion die Datei als geeignet zum Zusammenführen ansieht, fügt es *Konfliktmarken* – besondere Zeichenketten, die die Konfliktregion begrenzen – in die Datei ein, um die überlappenden Bereiche besonders hervorzuheben. (Subversion verwendet das `svn:mime-type`-Property, um festzustellen, ob sich die Datei kontextuell zeilenweise zusammenführen lässt. Siehe „File Content Type“, um mehr zu erfahren.)
- Für jede Datei mit Konflikten stellt Subversion drei zusätzliche unversionierte Dateien in Ihre Arbeitskopie:

  `filename.mine`
  : Dies ist Ihre Datei aus der Arbeitskopie bevor Sie aktualisierten – d.h. ohne Konfliktmarken. Diese Datei beinhaltet nur Ihre letzten Änderungen. (Falls Subversion diese Datei als nicht-zusammenführbar erachtet, wird die `.mine`-Datei nicht erstellt, da sie identisch mit der Datei der Arbeitskopie wäre.)

  `filename.r`*`OLDREV`*
  : Dies ist die Datei, die die `BASE`-Revision war bevor Sie Ihre Arbeitskopie aktualisiert haben; also die Datei, die Sie ausgecheckt hatten, bevor Sie Ihre letzten Änderungen machten.

  `filename.r`*`NEWREV`*
  : Dies ist die Datei, die Ihr Subversion-Client soeben vom Server erhalten hat als Sie Ihre Arbeitskopie aktualisierten. Diese Datei entspricht der `HEAD`-Revision des Repositorys.

  Hierbei ist *`OLDREV`* die Revisionsnummer der Datei in Ihrem Verzeichnis `.svn`, und *`NEWREV`* ist die Revisionsnummer von `HEAD` im Repository.

Beispielsweise ändert Sally die Datei `sandwich.txt` aus dem Repository. Harry hat gerade diese Datei in seiner Arbeitskopie geändert und eingecheckt. Sally aktualisiert Ihre Arbeitskopie vor dem einchecken und bekommt einen Konflikt, den sie verschiebt:

```
$ svn update
Conflict discovered in 'sandwich.txt'.
Select: (p) postpone, (df) diff-full, (e) edit,
        (h)elp for more options : p
C  sandwich.txt
Updated to revision 2.
$ ls -1
sandwich.txt
sandwich.txt.mine
sandwich.txt.r1
sandwich.txt.r2
```

An dieser Stelle erlaubt Subversion Sally *nicht*, die Datei `sandwich.txt` an das Repository zu übergeben, solange die drei temporären Dateien nicht entfernt werden:

```
$ svn commit -m "Add a few more things"
svn: Commit failed (details follow):
svn: Aborting commit: '/home/sally/svn-work/sandwich.txt' remains in conflict
```

Falls Sie eine Konfliktauflösung aufgeschoben haben, müssen Sie den Konflikt auflösen, bevor Ihnen Subversion erlaubt, Ihre Änderungen in das Repository einzustellen. Sie werden dafür den **svn resolve**-Befehl mit einem von mehreren Argumenten für die `--accept`-Option aufrufen.

Falls Sie die Dateiversion vor Ihren Änderungen haben möchten, wählen Sie das *`base`*-Argument.

Falls Sie die Version möchten, die nur Ihre Änderungen enthält, wählen Sie das *`mine-full`*-Argument.

Falls Sie die Version möchten, die Ihre letzte Aktualisierung vom Server gezogen hat (und somit Ihre Änderungen vollständig verwerfen wollen), wählen Sie das Argument *`theirs-full`*.

Wenn Sie jedoch frei aus Ihren Änderungen und den Änderungen vom Server wählen möchten, führen Sie den konfliktbehafteten Text „händisch“ zusammen (indem Sie die Konfliktmarken in der Datei begutachten und editieren) und wählen das *`working`*-Argument.

svn resolve entfernt die drei temporären Dateien und akzeptiert die Version, die Sie mit der `--accept`-Option angeben. Subversion betrachtet die Datei nun als nicht mehr konfliktbehaftet:

```
$ svn resolve --accept working sandwich.txt
Resolved conflicted state of 'sandwich.txt'
```

Manuelle Konfliktauflösung

Das manuelle Auflösen von Konflikten kann ganz schön einschüchternd sein, wenn Sie es das erste Mal versuchen; jedoch kann es mit etwas Übung so leicht werden, wie vom Fahrrad zu fallen.

Hier ist ein Beispiel. Aufgrund einer schlechten Absprache bearbeiten Sie und Ihre Mitarbeiterin Sally gleichzeitig die Datei `sandwich.txt`. Sally übergibt ihre Änderungen an das Repository, und sobald Sie versuchen, Ihre Arbeitskopie zu aktualisieren, erhalten Sie einen Konflikt und müssen `sandwich.txt` bearbeiten, um den Konflikt aufzulösen. Zunächst wollen wir uns die Datei einmal ansehen:

```
$ cat sandwich.txt
Top piece of bread
Mayonnaise
Lettuce
Tomato
Provolone
<<<<<<< .mine
Salami
Mortadella
Prosciutto
=======
Sauerkraut
Grilled Chicken
>>>>>>> .r2
Creole Mustard
Bottom piece of bread
```

Die Zeichenketten aus Kleiner-als-Zeichen, Gleichheitszeichen und Größer-als-Zeichen sind Konfliktmarken und gehören nicht zu den eigentlichen Daten, die in Konflikt stehen. Im Allgemeinen werden Sie sicherstellen wollen, dass die Konflikte aus der Datei entfernt werden, bevor sie das nächste Mal einen Commit durchführen. Der Text zwischen den ersten beiden Marken besteht aus den Änderungen, die Sie im Konfliktbereich vorgenommen haben:

```
<<<<<<< .mine
Salami
Mortadella
Prosciutto
=======
```

Der Text zwischen der zweiten und der dritten Marke ist der Text aus Sallys Commit:

```
=======
Sauerkraut
Grilled Chicken
>>>>>>> .r2
```

Für gewöhnlich werden Sie nicht einfach die Konfliktmarken mitsamt der Änderungen von Sally löschen wollen – sie wird furchtbar überrascht sein, wenn das Sandwich kommt und nicht das drauf ist, was sie wollte. Hier ist der Zeitpunkt gekommen, zu dem Sie zum Telefon greifen oder durch das Büro gehen und Sally erklären, dass man in einem italienischen Delikatessenladen kein Sauerkraut bekommt. [4] Sobald Sie sich über die einzucheckenden Änderungen einig sind, können Sie Ihre Datei bearbeiten und die Konfliktmarken entfernen:

```
Top piece of bread
Mayonnaise
Lettuce
Tomato
Provolone
Salami
Mortadella
Prosciutto
Creole Mustard
Bottom piece of bread
```

Verwenden Sie jetzt **svn resolve**, und Sie sind bereit, Ihre Änderungen an das repository zu übergeben:

```
$ svn resolve --accept working sandwich.txt
Resolved conflicted state of 'sandwich.txt'
$ svn commit -m "Go ahead and use my sandwich, discarding Sally's edits."
```

Beachten Sie, dass **svn resolve**, anders als die meisten anderen Befehle, die wir in diesem Kapitel behandeln, erwartet, dass Sie ausdrücklich alle Dateien aufzählen, deren Konflikt Sie beseitigt haben. Auf alle Fälle sollten Sie sorgfältig vorgehen und **svn resolve** nur verwenden, falls Sie sicher sind, den Konflikt in Ihrer Datei beseitigt zu haben – sobald die temporären Dateien entfernt sind, lässt Subversion zu, dass Sie die Datei in das Repository stellen, selbst wenn sie noch Konfliktmarken enthält.

Falls Sie mal bei der Bearbeitung der konfliktbehafteten Datei verwirrt sein sollten, können Sie jederzeit in den drei Dateien nachsehen, die Subversion für Sie in der Arbeitskopie bereitstellt – dazu gehört auch Ihre Datei vor der Aktualisierung. Sie können sogar ein Merge-Tool eines Drittanbieters verwenden, um diese drei Dateien zu untersuchen.

Verwerfen Ihrer Änderungen zugunsten einer aktualisierten

[4] Und wenn Sie danach fragen, wird man Sie wahrscheinlich auf einer Schiene aus der Stadt tragen.

Revision aus dem Repository

Falls Sie einen Konflikt erhalten und entscheiden, dass Sie Ihre Änderungen verwerfen wollen, können Sie **`svn resolve --accept theirs-full`** ***`CONFLICTED-PATH`*** aufrufen, und Subversion wird Ihre Änderungen ignorieren und die temporären Dateien entfernen:

```
$ svn update
Conflict discovered in 'sandwich.txt'.
Select: (p) postpone, (df) diff-full, (e) edit,
        (h) help for more options: p
C    sandwich.txt
Updated to revision 2.
$ ls sandwich.*
sandwich.txt  sandwich.txt.mine  sandwich.txt.r2  sandwich.txt.r1
$ svn resolve --accept theirs-full sandwich.txt
Resolved conflicted state of 'sandwich.txt'
```

Die Verwendung von svn revert

Falls Sie sich entscheiden, Ihre Änderungen zu verwerfen und erneut mit der Bearbeitung zu beginnen (ob nach einem Konflikt oder sonst zu jeder Zeit), machen Sie einfach Ihre Änderungen rückgängig:

```
$ svn revert sandwich.txt
Reverted 'sandwich.txt'
$ ls sandwich.*
sandwich.txt
```

Beachten Sie, dass Sie beim Rückgängigmachen einer konfliktbehafteten Datei nicht **svn resolve** zu verwenden brauchen.

Übergeben Ihrer Änderungen

Endlich! Sie haben die Bearbeitung abgeschlossen, Sie haben alle Änderungen vom Server eingearbeitet, und Sie sind bereit, Ihre Änderungen an das Repository zu übergeben.

Der Befehl **svn commit** schickt all Ihre Änderungen zum Repository. Wenn Sie eine Änderung übergeben, müssen Sie einen *Protokolleintrag* erstellen, der die Änderung beschreibt. Dieser Eintrag wird mit der von Ihnen erzeugten neuen Revision verknüpft. Wenn Ihr Eintrag kurz ist, können Sie ihn mit der Option `--message` (oder `-m`) in der Kommandozeile angeben:

```
$ svn commit -m "Corrected number of cheese slices."
Sending        sandwich.txt
Transmitting file data .
Committed revision 3.
```

Falls Sie jedoch Ihren Protokolleintrag während der Arbeit erstellen möchten, können Sie Subversion mitteilen, sich den Eintrag aus einer Datei zu holen, indem Sie den Dateinamen mit der Option `--file` (`-F`) angeben:

```
$ svn commit -F logmsg
Sending        sandwich.txt
Transmitting file data .
Committed revision 4.
```

Sollten Sie vergessen, entweder die Option `--message` oder die `--file`-Option anzugeben, startet Subversion automatisch Ihren Lieblingseditor (siehe die Information zu `editor-cmd` in „Config“), damit Sie einen Protokolleintrag erstellen können.

Wenn Sie gerade in Ihrem Editor einen Eintrag schreiben und sich entschließen, die Übergabe abzubrechen, können Sie einfach Ihren Editor beenden, ohne die Änderungen zu sichern. Falls Sie den Eintrag bereits gesichert haben sollten, löschen Sie einfach den Text, sichern Sie erneut und brechen dann ab:

```
$ svn commit
Waiting for Emacs...Done

Log message unchanged or not specified
(a)bort, (c)ontinue, (e)dit
a
$
```

Das Repository weiß nicht, ob Ihre Änderung im Ganzen einen Sinn ergeben, es ist ihm auch egal; es überprüft lediglich, ob nicht irgendjemand anderes irgendeine derselben Dateien geändert hat wie Sie, als Sie mal weggeschaut haben. Falls jemand das gemacht *hat*, wird die gesamte Übergabe mit einer Meldung fehlschlagen, dass eine oder mehrere Ihrer Dateien nicht mehr aktuell sind:

```
$ svn commit -m "Add another rule"
Sending        rules.txt
svn: Commit failed (details follow):
svn: File '/sandwich.txt' is out of date
…
```

(Der genaue Wortlaut dieser Fehlermeldung hängt vom verwendeten Netzwerkprotokoll und vom Server ab, doch die Bedeutung ist in allen Fällen gleich.)

Zu diesem Zeitpunkt müssen Sie **`svn update`** aufrufen, sich um eventuelle Zusammenführungen oder Konflikte kümmern und die Übergabe erneut versuchen.

Das deckt den grundlegenden Arbeitszyklus für die Verwendung von Subversion ab. Subversion bietet viele andere Möglichkeiten, die Sie benutzen können, um Ihr Repository und Ihre Arbeitskopie zu verwalten, doch der größte Teil Ihrer täglichen Arbeit mit Subversion wird lediglich die in diesem Kapitel behandelten Befehle berühren. Wir werden jedoch noch ein paar mehr Befehle behandeln, die Sie ziemlich oft verwenden werden.

Geschichtsforschung

Ihr Subversion-Repository ist wie eine Zeitmaschine. Es legt einen Eintrag für jede jemals übergebene Änderung an und erlaubt Ihnen, diese Geschichte durch die Untersuchung sowohl ehemaliger Datei- und Verzeichnisversionen als auch der begleitenden Metadaten zu erforschen. Mit einem einzigen Subversion-Befehl können Sie das Repository genauso auschecken (oder eine bestehende Arbeitskopie wiederherstellen), wie es zu einem beliebigen Zeitpunkt oder einer Revisionsnummer in der Vergangenheit war. Allerdings möchten Sie manchmal nur in die Vergangenheit *spähen* anstatt dorthin zu *gehen*.

Es gibt mehrere Befehle, die Sie mit historischen Daten aus dem Repository versorgen können:

svn log
: Zeigt Ihnen grobe Informationen: Mit Revisionen verknüpfte Protokolleinträge zu Datum und Autor und welche Pfade sich in jeder Revision geändert haben.

svn diff
: Zeigt die Details einer bestimmten Änderung auf Zeilenebene

svn cat
: Holt eine Datei hervor wie sie mit einer bestimmten Revisionsnummer einmal ausgesehen hat und zeigt sie auf dem Bildschirm an

svn list
: Zeigt die Dateien in einem Verzeichnis für eine gewünschte Revision an

Erzeugung einer Liste der Änderungsgeschichte

Um Informationen über den Werdegang einer Datei oder eines Verzeichnisses zu bekommen, benutzen Sie den Befehl **svn log**. **svn log** versorgt Sie mit einem Eintrag, der Auskunft darüber gibt, wer Änderungen an einer Datei oder einem Verzeichnis gemacht hat, in welcher Revision die Änderung stattfand, zu welcher Zeit und welchem Datum die Revision entstand sowie – falls verfügbar – dem die Übergabe begleitenden Protokolleintrag:

```
$ svn log
------------------------------------------------------------------------
r3 | sally | 2008-05-15 23:09:28 -0500 (Thu, 15 May 2008) | 1 line

Added include lines and corrected # of cheese slices.
------------------------------------------------------------------------
r2 | harry | 2008-05-14 18:43:15 -0500 (Wed, 14 May 2008) | 1 line

Added main() methods.
------------------------------------------------------------------------
r1 | sally | 2008-05-10 19:50:31 -0500 (Sat, 10 May 2008) | 1 line

Initial import
------------------------------------------------------------------------
```

Beachten Sie, dass die Protokolleinträge standardmäßig in *umgekehrter zeitlicher Reihenfolge* ausgegeben werden. Falls Sie eine andere Folge von Revisionen in einer bestimmten Anordnung oder nur eine einzige Revision sehen möchten, übergeben Sie die Option `--revision` (`-r`):

```
$ svn log -r 5:19    # zeigt Protokolleintrag 5 bis 19 in chronologischer Reihe

$ svn log -r 19:5    # zeigt Protokolleintrag 5 bis 19 in umgekehrter Reihenfol

$ svn log -r 8       # zeigt Protokolleintrag für Revision 8
```

Sie können sich auch die Protokollgeschichte einer einzigen Datei oder eines einzigen Verzeichnisses ansehen. Zum Beispiel:

```
$ svn log foo.c
…
$ svn log http://foo.com/svn/trunk/code/foo.c
…
```

Diese Befehle zeigen *nur* Protokolleinträge für die Revisionen, in der sich die Arbeitsdatei (oder URL) geändert hat.

Warum zeigt mir svn log nicht, was ich gerade übergeben habe?

Wenn Sie Ihre Änderungen an das Repository übergeben und sofort **svn log** ohne Argumente eingeben, wird Ihnen vielleicht auffallen, dass Ihre letzte Änderung nicht in der Liste der Protokolleinträge auftaucht. Das liegt an der Kombination des Verhaltens von **svn commit** und dem Standardverhalten von **svn log**. Wenn Sie Änderungen an das Repository übergeben, erhöht **svn** zunächst nur die Revision der Dateien (und Verzeichnisse) die es übernimmt, so dass das Elternverzeichnis normalerweise auf der älteren Revision verbleibt (siehe „Updates und Commits sind getrennt" für die Erklärung, warum das so ist). **svn log** holt dann standardmäßig die Geschichte des Verzeichnisses in der gegenwärtigen Revision, und so kommt es, dass Sie die neu übergebenen Änderungen nicht sehen. Die Lösung besteht entweder in einer Aktualisierung Ihrer Arbeitskopie oder indem Sie dem Befehl **svn log** ausdrücklich mit der Option `--revision` (`-r`) eine Revisionsnummer mitgeben.

Wenn Sie noch mehr Informationen über eine Datei oder ein Verzeichnis benötigen, können Sie **svn log** auch die Option `--verbose` (`-v`) mitgeben. Weil Ihnen Subversion erlaubt, Dateien und Verzeichnisse zu kopieren und zu verschieben, ist es wichtig, Pfadänderungen im Dateisystem mitzuverfolgen. Daher beinhaltet bei dieser Option die Ausgabe von **svn log** eine Liste veränderter Pfade in einer Revision:

```
$ svn log -r 8 -v
------------------------------------------------------------------------
r8 | sally | 2008-05-21 13:19:25 -0500 (Wed, 21 May 2008) | 1 line
Changed paths:
   M /trunk/code/foo.c
   M /trunk/code/bar.h
   A /trunk/code/doc/README

Frozzled the sub-space winch.

------------------------------------------------------------------------
```

svn log akzeptiert ebenfalls die Option `--quiet` (`-q`), die den Protokolleintrag unterdrückt. Zusammen mit der Option `--verbose` zeigt es nur die Namen der geänderten Dateien an.

Warum gibt mir svn log eine leere Antwort?

Nach ein wenig Arbeit mit Subversion werden die meisten Benutzer soetwas begegnen:

```
$ svn log -r 2
------------------------------------------------------------------------
$
```

Auf den ersten Blick sieht es aus wie ein Fehler. Aber seien Sie daran erinnert, dass, während Revisionen über das gesamte Repository zählen, **svn log** auf einem Pfad im Repository arbeitet. Wenn Sie keinen Pfad angeben, verwendet Subversion das aktuelle Arbeitsverzeichnis als Standardargument. Deshalb zeigt Subversion Ihnen einen leeren Protokolleintrag, falls Sie in einem Unterverzeichnis Ihrer Arbeitskopie arbeiten und versuchen, sich den Protokolleintrag einer Revision anzusehen, in dem sich weder dieses Verzeichnis noch irgendein Unterverzeichnis darin geändert hat. Falls Sie sehen wollen, was sich in der Revision geändert hat, versuchen Sie **svn log** direkt auf den obersten URL Ihres Repositorys zeigen zu lassen, wie in **svn log -r 2 http://svn.collab.net/repos/svn**.

Detaillierte Untersuchung der Änderungsgeschichte

svn diff ist uns bereits begegnet – es zeigt Dateiunterschiede im unified-diff-Format; wir verwendeten es, um die lokalen Änderungen an unserer Arbeitskopie anzuzeigen, bevor wir sie dem Repository übergaben.

Tatsächlich stellt sich heraus, dass es *drei* verschiedene Verwendungsmöglichkeiten für **svn diff** gibt:

- zum Untersuchen lokaler Änderungen
- zum Vergleichen Ihrer Arbeitskopie mit dem Repository
- zum Vergleichen von Revisionen im Repository

Untersuchen lokaler Änderungen

Wie wir gesehen haben, vergleicht der Aufruf von **svn diff** ohne Optionen die Arbeitsdateien mit den zwischengespeicherten „ursprünglichen“ Kopien im `.svn`-Bereich:

```
$ svn diff
Index: rules.txt
===================================================================
--- rules.txt	(revision 3)
+++ rules.txt	(working copy)
@@ -1,4 +1,5 @@
 Be kind to others
 Freedom = Responsibility
 Everything in moderation
-Chew with your mouth open
+Chew with your mouth closed
+Listen when others are speaking
$
```

Vergleichen der Arbeitskopie mit dem Repository

Wird eine einzelne Nummer mit `--revision` (`-r`) übergeben, wird die Arbeitskopie mit der angegebenen Revision im Repository verglichen:

```
$ svn diff -r 3 rules.txt
Index: rules.txt
===================================================================
--- rules.txt	(revision 3)
+++ rules.txt	(working copy)
@@ -1,4 +1,5 @@
 Be kind to others
 Freedom = Responsibility
 Everything in moderation
-Chew with your mouth open
+Chew with your mouth closed
+Listen when others are speaking
$
```

Vergleichen von Repository mit Repository

Werden zwei Revisionsnummern durch einen Doppelpunkt getrennt mit `--revision` (`-r`) übergeben, werden die beiden Revisionen direkt miteinander verglichen:

```
$ svn diff -r 2:3 rules.txt
Index: rules.txt
===================================================================
--- rules.txt   (revision 2)
+++ rules.txt   (revision 3)
@@ -1,4 +1,4 @@
 Be kind to others
-Freedom = Chocolate Ice Cream
+Freedom = Responsibility
 Everything in moderation
 Chew with your mouth open
$
```

Eine bequemere Möglichkeit, eine Revision mit der Vorgänger-Revision zu vergleichen, bietet die Verwendung der Option `--change` (`-c`):

```
$ svn diff -c 3 rules.txt
Index: rules.txt
===================================================================
--- rules.txt   (revision 2)
+++ rules.txt   (revision 3)
@@ -1,4 +1,4 @@
 Be kind to others
-Freedom = Chocolate Ice Cream
+Freedom = Responsibility
 Everything in moderation
 Chew with your mouth open
$
```

Zu guter Letzt können Sie Revisionen im Repository auch dann vergleichen, falls Sie gar keine Arbeitskopie auf Ihrem lokalen Rechner haben, indem Sie einfach den entsprechenden URL auf der Kommandozeile angeben:

```
$ svn diff -c 5 http://svn.example.com/repos/example/trunk/text/rules.txt
…
$
```

Stöbern im Repository

Wenn Sie **svn cat** und **svn list** verwenden, können Sie sich verschiedene Revisionen von Dateien und Verzeichnissen ansehen, ohne die Revision Ihrer Arbeitskopie ändern zu müssen. Tatsächlich brauchen Sie dafür nichteinmal eine Arbeitskopie.

svn cat

Falls Sie eine frühere Version einer Datei untersuchen möchten und nicht notwendigerweise die Unterschiede zwischen zwei Dateien, können Sie **svn cat** verwenden:

```
$ svn cat -r 2 rules.txt
Be kind to others
Freedom = Chocolate Ice Cream
Everything in moderation
Chew with your mouth open
$
```

Sie können die Ausgabe auch direkt in eine Datei umleiten:

```
$ svn cat -r 2 rules.txt > rules.txt.v2
$
```

svn list

Der Befehl **svn list** zeigt Ihnen, welche Dateien sich in einem Repository-Verzeichnis befinden, ohne die Dateien auf Ihren lokalen Rechner herunterladen zu müssen:

```
$ svn list http://svn.collab.net/repos/svn
README
branches/
clients/
tags/
trunk/
```

Falls Sie eine detailliertere Auflistung wünschen, übergeben Sie die Option `--verbose` (-v), um eine Ausgabe ähnlich der folgenden zu bekommen:

```
$ svn list -v http://svn.collab.net/repos/svn
  20620 harry            1084 Jul 13  2006 README
  23339 harry                 Feb 04 01:40 branches/
  21282 sally                 Aug 27 09:41 developer-resources/
  23198 harry                 Jan 23 17:17 tags/
  23351 sally                 Feb 05 13:26 trunk/
```

Die Spalten zeigen Ihnen die Revision, in der die Datei zuletzt geändert wurde, den Benutzer, der sie änderte, die Größe, falls es sich um eine Datei handelt, sowie den Namen des Objektes.

Der Befehl **`svn list`** ohne Argumente verwendet standardmäßig den *Repository-URL* des aktuellen Arbeitsverzeichnisses und *nicht* das Verzeichnis der lokalen Arbeitskopie. Schließlich können Sie, falls Sie eine Auflistung des lokalen Verzeichnisses möchten, das einfache **ls** (oder irgendein vernünftiges nicht-unixartiges Äquivalent) benutzen.

Bereitstellung älterer Repository-Schnappschüsse

Zusätzlich zu den obigen Befehlen können Sie **svn update** und **svn checkout** mit der Option `--revision` verwenden, um eine vollständige Arbeitskopie „zeitlich zurückzusetzen“: [5]

```
$ svn checkout -r 1729 # Checks out a new working copy at r1729
…
$ svn update -r 1729 # Updates an existing working copy to r1729
…
```

[5]Sehen Sie? Wir haben Ihnen gesagt, dass Subversion eine Zeitmaschine sei.

> Viele Subversion-Neulinge versuchen das vorangehende **svn update**-Beispiel zu verwenden, um übergebene Änderungen „rückgängig“ zu machen, was allerdings nicht funktioniert, da Sie keine Änderungen übergeben können, die Sie durch das zeitliche Zurücksetzen einer Arbeitskopie erhalten haben, falls die geänderten Dateien neuere Revisionen haben. Siehe „Zurückholen gelöschter Objekte“ für eine Beschreibung, wie eine Übergabe „rückgängig“ gemacht wird.

Wenn Sie am Ende ein Release bauen und die Dateien aus Subversion zu einem Bündel schnüren möchten, ohne allerdings diese verdammten `.svn`-Verzeichnisse dabei zu haben, können Sie **svn export** verwenden, um eine lokale Kopie des gesamten oder teilweisen Repositorys ohne `.svn`-Verzeichnisse zu erhalten. Wie bei **svn update** und **svn checkout** können Sie auch hier die Option `--revision` an **svn export** übergeben:

```
$ svn export http://svn.example.com/svn/repos1 # Exports latest revision
…
$ svn export http://svn.example.com/svn/repos1 -r 1729
# Exports revision r1729
…
```

Manchmal müssen Sie einfach nur aufräumen

Nachdem wir nun die täglichen Aufgaben abgehandelt haben, für die Sie regelmäßig Subversion verwenden, gehen wir nun ein paar Verwaltungsaufgaben für Ihre Arbeitskopie durch.

Entsorgen einer Arbeitskopie

Subversion merkt sich weder den Zustand noch das Vorhandensein einer Arbeitskopie auf dem Server, so dass serverseitig kein Aufwand für Arbeitskopien anfälllt. Dementsprechend besteht keine Notwendigkeit, dem Server mitzuteilen, dass Sie vorhaben, eine Arbeitskopie zu löschen.

Falls die Wahrscheinlichkeit besteht, dass Sie eine Arbeitskopie wiederverwenden möchten, ist es nicht verkehrt, sie einfach auf der Platte zu lassen, bis Sie sie wieder benutzen wollen. Zu diesem Zeitpunkt reicht lediglich ein **svn update** zum Aktualisieren, und sie ist gebrauchsfertig.

Falls Sie die Arbeitskopie jedoch bestimmt nicht mehr verwenden möchten, können Sie sie ruhig löschen; jedoch sollten Sie vorher darin nach unversionierten Dateien suchen. Um diese Dateien zu finden, rufen Sie **`svn status`** auf und untersuchen alle Dateien, denen ein `?` voransteht, um sicherzugehen, dass sie nicht wichtig sind. Wenn Sie die Untersuchung abgeschlossen haben, können Sie Ihre Arbeitskopie ruhig löschen.

Wiederherstellung nach einer Unterbrechung

Wenn Subversion Ihre Arbeitskopie (oder irgendwelche Informationen in `.svn`) verändert, versucht es das so sicher wie möglich zu machen. Bevor die Arbeitskopie geändert wird, schreibt Subversion seine Absichten in eine Protokolldatei. Dann führt es die Befehle in der Protokolldatei aus, um die Änderungen anzuwenden, wobei es während der Arbeit den relevanten Teil der Arbeitskopie sperrt, um andere Clients davon abzuhalten, während der Änderung auf die Arbeitskopie zuzugreifen. Zuletzt entfernt Subversion die Protokolldatei. Architektonisch ist dies ähnlich wie bei einem Dateisystem mit Journal. Falls eine Subversion-Operation unterbrochen wird (z.B. wenn der Prozess abgeschossen wird oder

der Rechner abstürzt), bleibt die Protokolldatei auf der Platte. Durch das erneute Ausführen der Protokolldatei kann Subversion die vorher begonnene Operation vervollständigen und Ihre Arbeitskopie gelangt wieder in einen konsistenten Zustand.

Genau das macht **svn cleanup**: Es durchsucht Ihre Arbeitskopie und führt etwaige übriggebliebene Protokolldateien aus, wobei Sperren in der Arbeitskopie entfernt werden. Fall Ihnen Subversion jemals mitteilt, dass ein Teil Ihrer Arbeitskopie „gesperrt" ist, sollten Sie diesen Befehl aufrufen. Darüberhinaus zeigt **svn status** ein `L` neben gesperrten Objekten an:

```
$ svn status
  L    somedir
M      somedir/foo.c

$ svn cleanup
$ svn status
M      somedir/foo.c
```

Zusammenfassung

Nun haben wir die meisten der Subversion-Client-Befehle behandelt. Erwähnenswerte Ausnahmen sind diejenigen, die sich mit dem Branchen und Mergen befassen (siehe Kapitel 4, *Verzweigen und Zusammenführen*) sowie mit Propertys (siehe „Properties"). Jedoch möchten Sie vielleicht einen Augenblick damit verbringen, um durch Kapitel 9, *Subversion Complete Reference* zu blättern, um ein Gefühl für all die verschiedenen Befehle zu bekommen, über die Subversion verfügt – und wie Sie sie verwenden können, um Ihre Arbeit zu erleichtern.

Kapitel 3. Advanced Topics

If you've been reading this book chapter by chapter, from start to finish, you should by now have acquired enough knowledge to use the Subversion client to perform the most common version control operations. You understand how to check out a working copy from a Subversion repository. You are comfortable with submitting and receiving changes using the **svn commit** and **svn update** operations. You've probably even developed a reflex that causes you to run the **svn status** command almost unconsciously. For all intents and purposes, you are ready to use Subversion in a typical environment.

But the Subversion feature set doesn't stop at „common version control operations.“ It has other bits of functionality besides just communicating file and directory changes to and from a central repository.

This chapter highlights some of Subversion's features that, while important, aren't part of the typical user's daily routine. It assumes that you are familiar with Subversion's basic file and directory versioning capabilities. If you aren't, you'll want to first read Kapitel 1, *Grundlegende Konzepte* and Kapitel 2, *Grundlegende Benutzung*. Once you've mastered those basics and consumed this chapter, you'll be a Subversion power user!

Revision Specifiers

As we described in „Revisionen“, revision numbers in Subversion are pretty straightforward—integers that keep getting larger as you commit more changes to your versioned data. Still, it doesn't take long before you can no longer remember exactly what happened in each and every revision. Fortunately, the typical Subversion workflow doesn't often demand that you supply arbitrary revisions to the Subversion operations you perform. For operations that *do* require a revision specifier, you generally supply a revision number that you saw in a commit email, in the output of some other Subversion operation, or in some other context that would give meaning to that particular number.

But occasionally, you need to pinpoint a moment in time for which you don't already have a revision number memorized or handy. So besides the integer revision numbers, **svn** allows as input some additional forms of revision specifiers: *revision keywords* and revision dates.

The various forms of Subversion revision specifiers can be mixed and matched when used to specify revision ranges. For example, you can use `-r` *`REV1`*`:`*`REV2`* where *`REV1`* is a revision keyword and *`REV2`* is a revision number, or where *`REV1`* is a date and *`REV2`* is a revision keyword, and so on. The individual revision specifiers are independently evaluated, so you can put whatever you want on the opposite sides of that colon.

Revision Keywords

The Subversion client understands a number of revision keywords. These keywords can be used instead of integer arguments to the `--revision` (`-r`) option, and are resolved into specific revision numbers by Subversion:

`HEAD`
: The latest (or „youngest“) revision in the repository.

`BASE`
: The revision number of an item in a working copy. If the item has been locally modified, this refers to the way the item appears without those local modifications.

`COMMITTED`

The most recent revision prior to, or equal to, BASE, in which an item changed.

PREV
: The revision immediately *before* the last revision in which an item changed. Technically, this boils down to COMMITTED#1.

As can be derived from their descriptions, the PREV, BASE, and COMMITTED revision keywords are used only when referring to a working copy path—they don't apply to repository URLs. HEAD, on the other hand, can be used in conjunction with both of these path types.

Here are some examples of revision keywords in action:

```
$ svn diff -r PREV:COMMITTED foo.c
# shows the last change committed to foo.c

$ svn log -r HEAD
# shows log message for the latest repository commit

$ svn diff -r HEAD
# compares your working copy (with all of its local changes) to the
# latest version of that tree in the repository

$ svn diff -r BASE:HEAD foo.c
# compares the unmodified version of foo.c with the latest version of
# foo.c in the repository

$ svn log -r BASE:HEAD
# shows all commit logs for the current versioned directory since you
# last updated

$ svn update -r PREV foo.c
# rewinds the last change on foo.c, decreasing foo.c's working revision

$ svn diff -r BASE:14 foo.c
# compares the unmodified version of foo.c with the way foo.c looked
# in revision 14
```

Revision Dates

Revision numbers reveal nothing about the world outside the version control system, but sometimes you need to correlate a moment in real time with a moment in version history. To facilitate this, the --revision (-r) option can also accept as input date specifiers wrapped in curly braces ({ and }). Subversion accepts the standard ISO-8601 date and time formats, plus a few others. Here are some examples. (Remember to use quotes around any date that contains spaces.)

```
$ svn checkout -r {2006-02-17}
$ svn checkout -r {15:30}
$ svn checkout -r {15:30:00.200000}
$ svn checkout -r {"2006-02-17 15:30"}
$ svn checkout -r {"2006-02-17 15:30 +0230"}
$ svn checkout -r {2006-02-17T15:30}
$ svn checkout -r {2006-02-17T15:30Z}
$ svn checkout -r {2006-02-17T15:30-04:00}
$ svn checkout -r {20060217T1530}
$ svn checkout -r {20060217T1530Z}
$ svn checkout -r {20060217T1530-0500}
…
```

When you specify a date, Subversion resolves that date to the most recent revision of the repository as of that date, and then continues to operate against that resolved revision number:

```
$ svn log -r {2006-11-28}
------------------------------------------------------------------------
r12 | ira | 2006-11-27 12:31:51 -0600 (Mon, 27 Nov 2006) | 6 lines
…
```

> **Is Subversion a Day Early?**
>
> If you specify a single date as a revision without specifying a time of day (for example `2006-11-27`), you may think that Subversion should give you the last revision that took place on the 27th of November. Instead, you'll get back a revision from the 26th, or even earlier. Remember that Subversion will find the *most recent revision of the repository* as of the date you give. If you give a date without a timestamp, such as `2006-11-27`, Subversion assumes a time of 00:00:00, so looking for the most recent revision won't return anything on the 27th.
>
> If you want to include the 27th in your search, you can either specify the 27th with the time (`{"2006-11-27 23:59"}`), or just specify the next day (`{2006-11-28}`).

You can also use a range of dates. Subversion will find all revisions between both dates, inclusive:

```
$ svn log -r {2006-11-20}:{2006-11-29}
…
```

Since the timestamp of a revision is stored as an unversioned, modifiable property of the revision (see „Properties“), revision timestamps can be changed to represent complete falsifications of true chronology, or even removed altogether. Subversion's ability to correctly convert revision dates into real revision numbers depends on revision datestamps maintaining a sequential ordering—the younger the revision, the younger its timestamp. If this ordering isn't maintained, you will likely find that trying to use dates to specify revision ranges in your repository doesn't always return the data you might have expected.

Properties

We've already covered in detail how Subversion stores and retrieves various versions of files and directories in its repository. Whole chapters have been devoted to this most fundamental piece of functionality provided by the tool. And if the versioning support stopped there, Subversion would still be complete from a version control perspective.

But it doesn't stop there.

In addition to versioning your directories and files, Subversion provides interfaces for adding, modifying, and removing versioned metadata on each of your versioned directories and files. We refer to this metadata as *properties*, and they can be thought of as two-column tables that map property names to arbitrary values attached to each item in your working copy. Generally speaking, the names and values of the properties can be whatever you want them to be, with the constraint that the names must contain only ASCII characters. And the best part about these properties is that they, too, are versioned, just like the textual contents of your files. You can modify, commit, and revert property changes as easily as you can file content changes. And the sending and receiving of property changes occurs as part of your typical commit and update operations—you don't have to change your basic processes to accommodate them.

> Subversion has reserved the set of properties whose names begin with `svn:` as its own. While there are only a handful of such properties in use today, you should avoid creating custom properties for your own needs whose names begin with this prefix. Otherwise, you run the risk that a future release of Subversion will grow support for a feature or behavior driven by a property of the same name but with perhaps an entirely different interpretation.

Properties show up elsewhere in Subversion, too. Just as files and directories may have arbitrary property names and values attached to them, each revision as a whole may have arbitrary properties attached to it. The same constraints apply—human-readable names and anything-you-want binary values. The main difference is that revision properties are not versioned. In other words, if you change the value of, or delete, a revision property, there's no way, within the scope of Subversion's functionality, to recover the previous value.

Subversion has no particular policy regarding the use of properties. It asks only that you not use property names that begin with the prefix `svn:`. That's the namespace that it sets aside for its own use. And Subversion does, in fact, use properties—both the versioned and unversioned variety. Certain versioned properties have special meaning or effects when found on files and directories, or they house a particular bit of information about the revisions on which they are found. Certain revision properties are automatically attached to revisions by Subversion's commit process, and they carry information about the revision. Most of these properties are mentioned elsewhere in this or other chapters as part of the more general topics to which they are related. For an exhaustive list of Subversion's predefined properties, see „Subversion Properties“.

In this section, we will examine the utility—both to users of Subversion and to Subversion itself—of property support. You'll learn about the property-related **svn** subcommands and how property modifications affect your normal Subversion workflow.

Why Properties?

Just as Subversion uses properties to store extra information about the files, directories, and revisions that it contains, you might also find properties to be of similar use. You might find it useful to have a place close to your versioned data to hang custom metadata about that data.

Say you wish to design a web site that houses many digital photos and displays them with captions and a datestamp. Now, your set of photos is constantly changing, so you'd like to have as much of this site automated as possible. These photos can be quite large, so as is common with sites of this nature, you want to provide smaller thumbnail images to your site visitors.

Now, you can get this functionality using traditional files. That is, you can have your `image123.jpg` and an `image123-thumbnail.jpg` side by side in a directory. Or if you want to keep the filenames the same, you might have your thumbnails in a different directory, such as `thumbnails/image123.jpg`. You can also store your captions and datestamps in a similar fashion, again separated from the original image file. But the problem here is that your collection of files multiplies with each new photo added to the site.

Now consider the same web site deployed in a way that makes use of Subversion's file properties. Imagine having a single image file, `image123.jpg`, with properties set on that file that are named `caption`, `datestamp`, and even `thumbnail`. Now your working copy directory looks much more manageable—in fact, it looks to the casual browser like there are nothing but image files in it. But your automation scripts know better. They know that they can use **svn** (or better yet, they can use the Subversion language bindings—see

„Using the APIs“) to dig out the extra information that your site needs to display without having to read an index file or play path manipulation games.

While Subversion places few restrictions on the names and values you use for properties, it has not been designed to optimally carry large property values or large sets of properties on a given file or directory. Subversion commonly holds all the property names and values associated with a single item in memory at the same time, which can cause detrimental performance or failed operations when extremely large property sets are used.

Custom revision properties are also frequently used. One common such use is a property whose value contains an issue tracker ID with which the revision is associated, perhaps because the change made in that revision fixes a bug filed in the tracker issue with that ID. Other uses include hanging more friendly names on the revision—it might be hard to remember that revision 1935 was a fully tested revision. But if there's, say, a `test-results` property on that revision with the value `all passing`, that's meaningful information to have.

Searchability (or, Why *Not* Properties)

For all their utility, Subversion properties—or, more accurately, the available interfaces to them—have a major shortcoming: while it is a simple matter to *set* a custom property, *finding* that property later is a whole different ball of wax.

Trying to locate a custom revision property generally involves performing a linear walk across all the revisions of the repository, asking of each revision, "Do you have the property I'm looking for?" Trying to find a custom versioned property is painful, too, and often involves a recursive **svn propget** across an entire working copy. In your situation, that might not be as bad as a linear walk across all revisions. But it certainly leaves much to be desired in terms of both performance and likelihood of success, especially if the scope of your search would require a working copy from the root of your repository.

For this reason, you might choose—especially in the revision property use case—to simply add your metadata to the revision's log message using some policy-driven (and perhaps programmatically enforced) formatting that is designed to be quickly parsed from the output of **svn log**. It is quite common to see the following in Subversion log messages:

```
Issue(s): IZ2376, IZ1919
Reviewed by:  sally

This fixes a nasty segfault in the wort frabbing process
…
```

But here again lies some misfortune. Subversion doesn't yet provide a log message templating mechanism, which would go a long way toward helping users be consistent with the formatting of their log-embedded revision metadata.

Manipulating Properties

The **svn** program affords a few ways to add or modify file and directory properties. For properties with short, human-readable values, perhaps the simplest way to add a new property is to specify the property name and value on the command line of the **svn propset** subcommand:

```
$ svn propset copyright '(c) 2006 Red-Bean Software' calc/button.c
property 'copyright' set on 'calc/button.c'
$
```

But we've been touting the flexibility that Subversion offers for your property values. And if you are planning to have a multiline textual, or even binary, property value, you probably do not want to supply that value on the command line. So the **svn propset** subcommand takes a `--file` (`-F`) option for specifying the name of a file that contains the new property value.

```
$ svn propset license -F /path/to/LICENSE calc/button.c
property 'license' set on 'calc/button.c'
$
```

There are some restrictions on the names you can use for properties. A property name must start with a letter, a colon (`:`), or an underscore (_); after that, you can also use digits, hyphens (`-`), and periods (`.`). [1]

In addition to the **propset** command, the **svn** program supplies the **propedit** command. This command uses the configured editor program (see „Config“) to add or modify properties. When you run the command, **svn** invokes your editor program on a temporary file that contains the current value of the property (or that is empty, if you are adding a new property). Then, you just modify that value in your editor program until it represents the new value you wish to store for the property, save the temporary file, and then exit the editor program. If Subversion detects that you've actually changed the existing value of the property, it will accept that as the new property value. If you exit your editor without making any changes, no property modification will occur:

```
$ svn propedit copyright calc/button.c  ### exit the editor without changes
No changes to property 'copyright' on 'calc/button.c'
$
```

We should note that, as with other **svn** subcommands, those related to properties can act on multiple paths at once. This enables you to modify properties on whole sets of files with a single command. For example, we could have done the following:

```
$ svn propset copyright '(c) 2006 Red-Bean Software' calc/*
property 'copyright' set on 'calc/Makefile'
property 'copyright' set on 'calc/button.c'
property 'copyright' set on 'calc/integer.c'
…
$
```

All of this property adding and editing isn't really very useful if you can't easily get the stored property value. So the **svn** program supplies two subcommands for displaying the names and values of properties stored on files and directories. The **svn proplist** command will list the names of properties that exist on a path. Once you know the names of the properties on the node, you can request their values individually using **svn propget**. This command will, given a property name and a path (or set of paths), print the value of the property to the standard output stream.

```
$ svn proplist calc/button.c
Properties on 'calc/button.c':
  copyright
  license
```

[1] If you're familiar with XML, this is pretty much the ASCII subset of the syntax for XML "Name".

```
$ svn propget copyright calc/button.c
(c) 2006 Red-Bean Software
```

There's even a variation of the **proplist** command that will list both the name and the value for all of the properties. Simply supply the `--verbose` (`-v`) option.

```
$ svn proplist -v calc/button.c
Properties on 'calc/button.c':
  copyright : (c) 2006 Red-Bean Software
  license : ================================================================
Copyright (c) 2006 Red-Bean Software.  All rights reserved.

Redistribution and use in source and binary forms, with or without
modification, are permitted provided that the following conditions
are met:

1. Redistributions of source code must retain the above copyright
notice, this list of conditions, and the recipe for Fitz's famous
red-beans-and-rice.
…
```

The last property-related subcommand is **propdel**. Since Subversion allows you to store properties with empty values, you can't remove a property altogether using **svn propedit** or **svn propset**. For example, this command will *not* yield the desired effect:

```
$ svn propset license '' calc/button.c
property 'license' set on 'calc/button.c'
$ svn proplist -v calc/button.c
Properties on 'calc/button.c':
  copyright : (c) 2006 Red-Bean Software
  license :
$
```

You need to use the **propdel** subcommand to delete properties altogether. The syntax is similar to the other property commands:

```
$ svn propdel license calc/button.c
property 'license' deleted from 'calc/button.c'.
$ svn proplist -v calc/button.c
Properties on 'calc/button.c':
  copyright : (c) 2006 Red-Bean Software
$
```

Remember those unversioned revision properties? You can modify those, too, using the same **svn** subcommands that we just described. Simply add the `--revprop` command-line parameter and specify the revision whose property you wish to modify. Since revisions are global, you don't need to specify a target path to these property-related commands so long as you are positioned in a working copy of the repository whose revision property you wish to modify. Otherwise, you can simply provide the URL of any path in the repository of interest (including the repository's root URL). For example, you might want to replace the commit log message of an existing revision. [2] If your current working directory is part of a working copy of your repository, you can simply run the **svn propset** command with no target path:

```
$ svn propset svn:log '* button.c: Fix a compiler warning.' -r11 --revprop
property 'svn:log' set on repository revision '11'
```

[2] Fixing spelling errors, grammatical gotchas, and „just-plain-wrongness“ in commit log messages is perhaps the most common use case for the `--revprop` option.

```
$
```

But even if you haven't checked out a working copy from that repository, you can still effect the property change by providing the repository's root URL:

```
$ svn propset svn:log '* button.c: Fix a compiler warning.' -r11 --revprop \
              http://svn.example.com/repos/project
property 'svn:log' set on repository revision '11'
$
```

Note that the ability to modify these unversioned properties must be explicitly added by the repository administrator (see „Commit Log Message Correction“). That's because the properties aren't versioned, so you run the risk of losing information if you aren't careful with your edits. The repository administrator can set up methods to protect against this loss, and by default, modification of unversioned properties is disabled.

Users should, where possible, use **svn propedit** instead of **svn propset**. While the end result of the commands is identical, the former will allow them to see the current value of the property that they are about to change, which helps them to verify that they are, in fact, making the change they think they are making. This is especially true when modifying unversioned revision properties. Also, it is significantly easier to modify multiline property values in a text editor than at the command line.

Properties and the Subversion Workflow

Now that you are familiar with all of the property-related **svn** subcommands, let's see how property modifications affect the usual Subversion workflow. As we mentioned earlier, file and directory properties are versioned, just like your file contents. As a result, Subversion provides the same opportunities for merging—cleanly or with conflicts—someone else's modifications into your own.

As with file contents, your property changes are local modifications, made permanent only when you commit them to the repository with **svn commit**. Your property changes can be easily unmade, too—the **svn revert** command will restore your files and directories to their unedited states—contents, properties, and all. Also, you can receive interesting information about the state of your file and directory properties by using the **svn status** and **svn diff** commands.

```
$ svn status calc/button.c
 M     calc/button.c
$ svn diff calc/button.c
Property changes on: calc/button.c
___________________________________________________________________
Name: copyright
   + (c) 2006 Red-Bean Software

$
```

Notice how the **status** subcommand displays `M` in the second column instead of the first. That is because we have modified the properties on `calc/button.c`, but not its textual contents. Had we changed both, we would have seen `M` in the first column, too. (We cover **svn status** in „Verschaffen Sie sich einen Überblick über Ihre Änderungen“).

Property Conflicts

As with file contents, local property modifications can conflict with changes committed by someone else. If you update your working copy directory and receive property changes on a versioned object that clash with your own, Subversion will report that the object is in a conflicted state.

```
$ svn update calc
M  calc/Makefile.in
Conflict for property 'linecount' discovered on 'calc/button.c'.
Select: (p) postpone, (df) diff-full, (e) edit,
        (s) show all options: p
 C calc/button.c
Updated to revision 143.
$
```

Subversion will also create, in the same directory as the conflicted object, a file with a `.prej` extension that contains the details of the conflict. You should examine the contents of this file so you can decide how to resolve the conflict. Until the conflict is resolved, you will see a `C` in the second column of **svn status** output for that object, and attempts to commit your local modifications will fail.

```
$ svn status calc
 C     calc/button.c
?      calc/button.c.prej
$ cat calc/button.c.prej
Trying to change property 'linecount' from '1267' to '1301',
but property has been locally changed from '1267' to '1256'.
$
```

To resolve property conflicts, simply ensure that the conflicting properties contain the values that they should, and then use the **svn resolved** command to alert Subversion that you have manually resolved the problem.

You might also have noticed the nonstandard way that Subversion currently displays property differences. You can still use **svn diff** and redirect its output to create a usable patch file. The **patch** program will ignore property patches—as a rule, it ignores any noise it can't understand. This does, unfortunately, mean that to fully apply a patch generated by **svn diff**, any property modifications will need to be applied by hand.

Automatic Property Setting

Properties are a powerful feature of Subversion, acting as key components of many Subversion features discussed elsewhere in this and other chapters—textual diff and merge support, keyword substitution, newline translation, and so on. But to get the full benefit of properties, they must be set on the right files and directories. Unfortunately, that step can be easily forgotten in the routine of things, especially since failing to set a property doesn't usually result in an obvious error (at least compared to, say, failing to add a file to version control). To help your properties get applied to the places that need them, Subversion provides a couple of simple but useful features.

Whenever you introduce a file to version control using the **svn add** or **svn import** commands, Subversion tries to assist by setting some common file properties automatically. First, on operating systems whose filesystems support an execute permission bit, Subversion will automatically set the `svn:executable` property on newly added or imported files whose execute bit is enabled. (See „File Executability“ later in this chapter for more about this property.)

Second, Subversion tries to determine the file's MIME type. If you've configured a `mime-`

`types-files` runtime configuration parameter, Subversion will try to find a MIME type mapping in that file for your file's extension. If it finds such a mapping, it will set your file's `svn:mime-type` property to the MIME type it found. If no mapping file is configured, or no mapping for your file's extension could be found, Subversion runs a very basic heuristic to determine whether the file contains nontextual content. If so, it automatically sets the `svn:mime-type` property on that file to `application/octet-stream` (the generic „this is a collection of bytes“ MIME type). Of course, if Subversion guesses incorrectly, or if you wish to set the `svn:mime-type` property to something more precise—perhaps `image/png` or `application/x-shockwave-flash`—you can always remove or edit that property. (For more on Subversion's use of MIME types, see „File Content Type“ later in this chapter.)

Subversion also provides, via its runtime configuration system (see „Runtime Configuration Area“), a more flexible automatic property setting feature that allows you to create mappings of filename patterns to property names and values. Once again, these mappings affect adds and imports, and can not only override the default MIME type decision made by Subversion during those operations, but can also set additional Subversion or custom properties, too. For example, you might create a mapping that says that anytime you add JPEG files—ones whose names match the pattern `*.jpg`—Subversion should automatically set the `svn:mime-type` property on those files to `image/jpeg`. Or perhaps any files that match `*.cpp` should have `svn:eol-style` set to `native`, and `svn:keywords` set to `Id`. Automatic property support is perhaps the handiest property-related tool in the Subversion toolbox. See „Config“ for more about configuring that support.

File Portability

Fortunately for Subversion users who routinely find themselves on different computers with different operating systems, Subversion's command-line program behaves almost identically on all those systems. If you know how to wield **svn** on one platform, you know how to wield it everywhere.

However, the same is not always true of other general classes of software or of the actual files you keep in Subversion. For example, on a Windows machine, the definition of a „text file“ would be similar to that used on a Linux box, but with a key difference—the character sequences used to mark the ends of the lines of those files. There are other differences, too. Unix platforms have (and Subversion supports) symbolic links; Windows does not. Unix platforms use filesystem permission to determine executability; Windows uses filename extensions.

Because Subversion is in no position to unite the whole world in common definitions and implementations of all of these things, the best it can do is to try to help make your life simpler when you need to work with your versioned files and directories on multiple computers and operating systems. This section describes some of the ways Subversion does this.

File Content Type

Subversion joins the ranks of the many applications that recognize and make use of Multipurpose Internet Mail Extensions (MIME) content types. Besides being a general-purpose storage location for a file's content type, the value of the `svn:mime-type` file property determines some behavioral characteristics of Subversion itself.

Identifying File Types

Various programs on most modern operating systems make assumptions about the type and format of the contents of a file by the file's name, specifically its file extension. For example, files whose names end in `.txt` are generally assumed to be human-readable; that is, able to be understood by simple perusal rather than requiring complex processing to decipher. Files whose names end in `.png`, on the other hand, are assumed to be of the Portable Network Graphics type—not human-readable at all, and sensible only when interpreted by software that understands the PNG format and can render the information in that format as a raster image.

Unfortunately, some of those extensions have changed their meanings over time. When personal computers first appeared, a file named `README.DOC` would have almost certainly been a plain-text file, just like today's `.txt` files. But by the mid-1990s, you could almost bet that a file of that name would not be a plain-text file at all, but instead a Microsoft Word document in a proprietary, non-human-readable format. But this change didn't occur overnight—there was certainly a period of confusion for computer users over what exactly they had in hand when they saw a `.DOC` file. [3]

The popularity of computer networking cast still more doubt on the mapping between a file's name and its content. With information being served across networks and generated dynamically by server-side scripts, there was often no real file per se, and therefore no filename. Web servers, for example, needed some other way to tell browsers what they were downloading so that the browser could do something intelligent with that information, whether that was to display the data using a program registered to handle that datatype or to prompt the user for where on the client machine to store the downloaded data.

Eventually, a standard emerged for, among other things, describing the contents of a data stream. In 1996, RFC 2045 was published. It was the first of five RFCs describing MIME. It describes the concept of media types and subtypes and recommends a syntax for the representation of those types. Today, MIME media types—or „MIME types“—are used almost universally across email applications, web servers, and other software as the de facto mechanism for clearing up the file content confusion.

For example, one of the benefits that Subversion typically provides is contextual, line-based merging of changes received from the server during an update into your working file. But for files containing nontextual data, there is often no concept of a „line.“ So, for versioned files whose `svn:mime-type` property is set to a nontextual MIME type (generally, something that doesn't begin with `text/`, though there are exceptions), Subversion does not attempt to perform contextual merges during updates. Instead, any time you have locally modified a binary working copy file that is also being updated, your file is left untouched and Subversion creates two new files. One file has a `.oldrev` extension and contains the BASE revision of the file. The other file has a `.newrev` extension and contains the contents of the updated revision of the file. This behavior is really for the protection of the user against failed attempts at performing contextual merges on files that simply cannot be contextually merged.

The `svn:mime-type` property, when set to a value that does not indicate textual file contents, can cause some unexpected behaviors with respect to other properties. For example, since the idea of line endings (and therefore, line-ending conversion) makes no sense when applied to nontextual files, Subversion will prevent you from setting the `svn:eol-style` property on such files. This is obvious when attempted on a single file target—**svn propset** will error out. But it might not be as clear if you perform a recursive property set, where Subversion will silently skip over files that it deems unsuitable for a given property.

Beginning in Subversion 1.5, users can configure a new `mime-types-file` runtime configuration parameter, which identifies the location of a MIME types mapping file. Subversion will consult this mapping file to determine the MIME type of newly added and

[3]You think that was rough? During that same era, WordPerfect also used `.DOC` for their proprietary file format's preferred extension!

imported files.

Also, if the `svn:mime-type` property is set, then the Subversion Apache module will use its value to populate the `Content-type:` HTTP header when responding to GET requests. This gives your web browser a crucial clue about how to display a file when you use it to peruse your Subversion repository's contents.

File Executability

On many operating systems, the ability to execute a file as a command is governed by the presence of an execute permission bit. This bit usually defaults to being disabled, and must be explicitly enabled by the user for each file that needs it. But it would be a monumental hassle to have to remember exactly which files in a freshly checked-out working copy were supposed to have their executable bits toggled on, and then to have to do that toggling. So, Subversion provides the `svn:executable` property as a way to specify that the executable bit for the file on which that property is set should be enabled, and Subversion honors that request when populating working copies with such files.

This property has no effect on filesystems that have no concept of an executable permission bit, such as FAT32 and NTFS. [4] Also, although it has no defined values, Subversion will force its value to `*` when setting this property. Finally, this property is valid only on files, not on directories.

End-of-Line Character Sequences

Unless otherwise noted using a versioned file's `svn:mime-type` property, Subversion assumes the file contains human-readable data. Generally speaking, Subversion uses this knowledge only to determine whether contextual difference reports for that file are possible. Otherwise, to Subversion, bytes are bytes.

This means that by default, Subversion doesn't pay any attention to the type of *end-of-line (EOL) markers* used in your files. Unfortunately, different operating systems have different conventions about which character sequences represent the end of a line of text in a file. For example, the usual line-ending token used by software on the Windows platform is a pair of ASCII control characters—a carriage return (`CR`) followed by a line feed (`LF`). Unix software, however, just uses the `LF` character to denote the end of a line.

Not all of the various tools on these operating systems understand files that contain line endings in a format that differs from the *native line-ending style* of the operating system on which they are running. So, typically, Unix programs treat the `CR` character present in Windows files as a regular character (usually rendered as `^M`), and Windows programs combine all of the lines of a Unix file into one giant line because no carriage return-linefeed (or `CRLF`) character combination was found to denote the ends of the lines.

This sensitivity to foreign EOL markers can be frustrating for folks who share a file across different operating systems. For example, consider a source code file, and developers that edit this file on both Windows and Unix systems. If all the developers always use tools that preserve the line-ending style of the file, no problems occur.

But in practice, many common tools either fail to properly read a file with foreign EOL markers, or convert the file's line endings to the native style when the file is saved. If the former is true for a developer, he has to use an external conversion utility (such as **dos2unix** or its companion, **unix2dos**) to prepare the file for editing. The latter case requires no extra preparation. But both cases result in a file that differs from the original quite literally on every line! Prior to committing his changes, the user has two choices. Either he can use a conversion utility to restore the modified file to the same line-ending style that it was in before his edits were made, or he can simply commit the file—new EOL markers and all.

[4]The Windows filesystems use file extensions (such as `.EXE`, `.BAT`, and `.COM`) to denote executable files.

The result of scenarios like these include wasted time and unnecessary modifications to committed files. Wasted time is painful enough. But when commits change every line in a file, this complicates the job of determining which of those lines were changed in a nontrivial way. Where was that bug really fixed? On what line was a syntax error introduced?

The solution to this problem is the `svn:eol-style` property. When this property is set to a valid value, Subversion uses it to determine what special processing to perform on the file so that the file's line-ending style isn't flip-flopping with every commit that comes from a different operating system. The valid values are:

`native`
: This causes the file to contain the EOL markers that are native to the operating system on which Subversion was run. In other words, if a user on a Windows machine checks out a working copy that contains a file with an `svn:eol-style` property set to `native`, that file will contain `CRLF` EOL markers. A Unix user checking out a working copy that contains the same file will see `LF` EOL markers in his copy of the file.

  Note that Subversion will actually store the file in the repository using normalized `LF` EOL markers regardless of the operating system. This is basically transparent to the user, though.

`CRLF`
: This causes the file to contain `CRLF` sequences for EOL markers, regardless of the operating system in use.

`LF`
: This causes the file to contain `LF` characters for EOL markers, regardless of the operating system in use.

`CR`
: This causes the file to contain `CR` characters for EOL markers, regardless of the operating system in use. This line-ending style is not very common.

Ignoring Unversioned Items

In any given working copy, there is a good chance that alongside all those versioned files and directories are other files and directories that are neither versioned nor intended to be. Text editors litter directories with backup files. Software compilers generate intermediate—or even final—files that you typically wouldn't bother to version. And users themselves drop various other files and directories wherever they see fit, often in version control working copies.

It's ludicrous to expect Subversion working copies to be somehow impervious to this kind of clutter and impurity. In fact, Subversion counts it as a *feature* that its working copies are just typical directories, just like unversioned trees. But these not-to-be-versioned files and directories can cause some annoyance for Subversion users. For example, because the **svn add** and **svn import** commands act recursively by default and don't know which files in a given tree you do and don't wish to version, it's easy to accidentally add stuff to version control that you didn't mean to. And because **svn status** reports, by default, every item of interest in a working copy—including unversioned files and directories—its output can get quite noisy where many of these things exist.

So Subversion provides two ways for telling it which files you would prefer that it simply disregard. One of the ways involves the use of Subversion's runtime configuration system (see „Runtime Configuration Area“), and therefore applies to all the Subversion operations that make use of that runtime configuration—generally those performed on a particular computer or by a particular user of a computer. The other way makes use of Subversion's directory property support and is more tightly bound to the versioned tree itself, and therefore affects everyone who has a working copy of that tree. Both of the mechanisms use *file patterns* (strings of literal and special wildcard characters used to match against filenames) to decide which files to ignore.

The Subversion runtime configuration system provides an option, `global-ignores`, whose value is a whitespace-delimited collection of file patterns. The Subversion client checks these patterns against the names of the files that are candidates for addition to version control, as well as to unversioned files that the **svn status** command notices. If any file's name matches one of the patterns, Subversion will basically act as if the file didn't exist at all. This is really useful for the kinds of files that you almost never want to version, such as editor backup files such as Emacs' `*~` and `.*~` files.

File Patterns in Subversion

File patterns (also called *globs* or *shell wildcard patterns*) are strings of characters that are intended to be matched against filenames, typically for the purpose of quickly selecting some subset of similar files from a larger grouping without having to explicitly name each file. The patterns contain two types of characters: regular characters, which are compared explicitly against potential matches, and special wildcard characters, which are interpreted differently for matching purposes.

There are different types of file pattern syntaxes, but Subversion uses the one most commonly found in Unix systems implemented as the `fnmatch` system function. It supports the following wildcards, described here simply for your convenience:

`?`
: Matches any single character

`*`
: Matches any string of characters, including the empty string

`[`
: Begins a character class definition terminated by `]`, used for matching a subset of characters

You can see this same pattern matching behavior at a Unix shell prompt. The following are some examples of patterns being used for various things:

```
$ ls   ### the book sources
appa-quickstart.xml             ch06-server-configuration.xml
appb-svn-for-cvs-users.xml      ch07-customizing-svn.xml
appc-webdav.xml                 ch08-embedding-svn.xml
book.xml                        ch09-reference.xml
ch00-preface.xml                ch10-world-peace-thru-svn.xml
ch01-fundamental-concepts.xml   copyright.xml
ch02-basic-usage.xml            foreword.xml
ch03-advanced-topics.xml        images/
ch04-branching-and-merging.xml  index.xml
ch05-repository-admin.xml       styles.css
$ ls ch*   ### the book chapters
ch00-preface.xml                ch06-server-configuration.xml
ch01-fundamental-concepts.xml   ch07-customizing-svn.xml
ch02-basic-usage.xml            ch08-embedding-svn.xml
ch03-advanced-topics.xml        ch09-reference.xml
ch04-branching-and-merging.xml  ch10-world-peace-thru-svn.xml
ch05-repository-admin.xml
$ ls ch?0-*   ### the book chapters whose numbers end in zero
ch00-preface.xml  ch10-world-peace-thru-svn.xml
$ ls ch0[3578]-*   ### the book chapters that Mike is responsible for
ch03-advanced-topics.xml   ch07-customizing-svn.xml
ch05-repository-admin.xml  ch08-embedding-svn.xml
$
```

File pattern matching is a bit more complex than what we've described here, but this basic usage level tends to suit the majority of Subversion users.

When found on a versioned directory, the `svn:ignore` property is expected to contain a list of newline-delimited file patterns that Subversion should use to determine ignorable objects in that same directory. These patterns do not override those found in the `global-ignores` runtime configuration option, but are instead appended to that list. And it's worth noting again that, unlike the `global-ignores` option, the patterns found in the `svn:ignore` property apply only to the directory on which that property is set, and not to any of its subdirectories. The `svn:ignore` property is a good way to tell Subversion to ignore files that are likely to be present in every user's working copy of that directory, such as compiler output or—to use an example more appropriate to this book—the HTML, PDF, or PostScript files generated as the result of a conversion of some source DocBook XML files to a more legible output format.

Subversion's support for ignorable file patterns extends only to the one-time process of adding unversioned files and directories to version control. Once an object is under Subversion's control, the ignore pattern mechanisms no longer apply to it. In other words, don't expect Subversion to avoid committing changes you've made to a versioned file simply because that file's name matches an ignore pattern—Subversion *always* notices all of its versioned objects.

Ignore Patterns for CVS Users

The Subversion `svn:ignore` property is very similar in syntax and function to the CVS `.cvsignore` file. In fact, if you are migrating a CVS working copy to Subversion, you can directly migrate the ignore patterns by using the `.cvsignore` file as input file to the **svn propset** command:

```
$ svn propset svn:ignore -F .cvsignore .
property 'svn:ignore' set on '.'
$
```

There are, however, some differences in the ways that CVS and Subversion handle ignore patterns. The two systems use the ignore patterns at some different times, and there are slight discrepancies in what the ignore patterns apply to. Also, Subversion does not recognize the use of the `!` pattern as a reset back to having no ignore patterns at all.

The global list of ignore patterns tends to be more a matter of personal taste and ties more closely to a user's particular tool chain than to the details of any particular working copy's needs. So, the rest of this section will focus on the `svn:ignore` property and its uses.

Say you have the following output from **svn status**:

```
$ svn status calc
 M     calc/button.c
?      calc/calculator
?      calc/data.c
?      calc/debug_log
?      calc/debug_log.1
```

```
?       calc/debug_log.2.gz
?       calc/debug_log.3.gz
```

In this example, you have made some property modifications to `button.c`, but in your working copy, you also have some unversioned files: the latest `calculator` program that you've compiled from your source code, a source file named `data.c`, and a set of debugging output logfiles. Now, you know that your build system always results in the `calculator` program being generated. [5] And you know that your test suite always leaves those debugging logfiles lying around. These facts are true for all working copies of this project, not just your own. And you know that you aren't interested in seeing those things every time you run **svn status**, and you are pretty sure that nobody else is interested in them either. So you use **`svn propedit svn:ignore calc`** to add some ignore patterns to the `calc` directory. For example, you might add this as the new value of the `svn:ignore` property:

```
calculator
debug_log*
```

After you've added this property, you will now have a local property modification on the `calc` directory. But notice what else is different about your **svn status** output:

```
$ svn status
 M     calc
 M     calc/button.c
?      calc/data.c
```

Now, all that cruft is missing from the output! Your `calculator` compiled program and all those logfiles are still in your working copy; Subversion just isn't constantly reminding you that they are present and unversioned. And now with all the uninteresting noise removed from the display, you are left with more intriguing items—such as that source code file `data.c` that you probably forgot to add to version control.

Of course, this less-verbose report of your working copy status isn't the only one available. If you actually want to see the ignored files as part of the status report, you can pass the `--no-ignore` option to Subversion:

```
$ svn status --no-ignore
 M     calc
 M     calc/button.c
I      calc/calculator
?      calc/data.c
I      calc/debug_log
I      calc/debug_log.1
I      calc/debug_log.2.gz
I      calc/debug_log.3.gz
```

As mentioned earlier, the list of file patterns to ignore is also used by **svn add** and **svn import**. Both of these operations involve asking Subversion to begin managing some set of files and directories. Rather than force the user to pick and choose which files in a tree she wishes to start versioning, Subversion uses the ignore patterns—both the global and the per-directory lists—to determine which files should not be swept into the version control system as part of a larger recursive addition or import operation. And here again, you can use the `--no-ignore` option to tell Subversion ignore its ignores list and operate on all the files and directories present.

[5] Isn't that the whole point of a build system?

Even if `svn:ignore` is set, you may run into problems if you use shell wildcards in a command. Shell wildcards are expanded into an explicit list of targets before Subversion operates on them, so running **`svn`** ***`SUBCOMMAND`*** **`*`** is just like running **`svn`** ***`SUBCOMMAND`*** **`file1 file2 file3 …`**. In the case of the **svn add** command, this has an effect similar to passing the `--no-ignore` option. So instead of using a wildcard, use **`svn add --force .`** to do a bulk scheduling of unversioned things for addition. The explicit target will ensure that the current directory isn't overlooked because of being already under version control, and the `--force` option will cause Subversion to crawl through that directory, adding unversioned files while still honoring the `svn:ignore` property and `global-ignores` runtime configuration variable. Be sure to also provide the `--depth files` option to the **svn add** command if you don't want a fully recursive crawl for things to add.

Keyword Substitution

Subversion has the ability to substitute *keywords*—pieces of useful, dynamic information about a versioned file—into the contents of the file itself. Keywords generally provide information about the last modification made to the file. Because this information changes each time the file changes, and more importantly, just *after* the file changes, it is a hassle for any process except the version control system to keep the data completely up to date. Left to human authors, the information would inevitably grow stale.

For example, say you have a document in which you would like to display the last date on which it was modified. You could burden every author of that document to, just before committing their changes, also tweak the part of the document that describes when it was last changed. But sooner or later, someone would forget to do that. Instead, simply ask Subversion to perform keyword substitution on the `LastChangedDate` keyword. You control where the keyword is inserted into your document by placing a *keyword anchor* at the desired location in the file. This anchor is just a string of text formatted as `$`*`KeywordName`*`$`.

All keywords are case-sensitive where they appear as anchors in files: you must use the correct capitalization for the keyword to be expanded. You should consider the value of the `svn:keywords` property to be case-sensitive, too—certain keyword names will be recognized regardless of case, but this behavior is deprecated.

Subversion defines the list of keywords available for substitution. That list contains the following five keywords, some of which have aliases that you can also use:

`Date`
: This keyword describes the last time the file was known to have been changed in the repository, and is of the form `$Date: 2006-07-22 21:42:37 -0700 (Sat, 22 Jul 2006) $`. It may also be specified as `LastChangedDate`. Unlike the `Id` keyword, which uses UTC, the `Date` keyword displays dates using the local time zone.

`Revision`
: This keyword describes the last known revision in which this file changed in the repository, and looks something like `$Revision: 144 $`. It may also be specified as `LastChangedRevision` or `Rev`.

`Author`
: This keyword describes the last known user to change this file in the repository, and looks something like `$Author: harry $`. It may also be specified as `LastChangedBy`.

`HeadURL`
: This keyword describes the full URL to the latest version of the file in the repository,

and looks something like `$HeadURL: http://svn.collab.net/repos/trunk/README $`. It may be abbreviated as `URL`.

`Id`
: This keyword is a compressed combination of the other keywords. Its substitution looks something like `$Id: calc.c 148 2006-07-28 21:30:43Z sally $`, and is interpreted to mean that the file `calc.c` was last changed in revision 148 on the evening of July 28, 2006 by the user `sally`. The date displayed by this keyword is in UTC, unlike that of the `Date` keyword (which uses the local time zone).

Several of the preceding descriptions use the phrase „last known“ or similar wording. Keep in mind that keyword expansion is a client-side operation, and your client „knows“ only about changes that have occurred in the repository when you update your working copy to include those changes. If you never update your working copy, your keywords will never expand to different values even if those versioned files are being changed regularly in the repository.

Simply adding keyword anchor text to your file does nothing special. Subversion will never attempt to perform textual substitutions on your file contents unless explicitly asked to do so. After all, you might be writing a document [6] about how to use keywords, and you don't want Subversion to substitute your beautiful examples of unsubstituted keyword anchors!

To tell Subversion whether to substitute keywords on a particular file, we again turn to the property-related subcommands. The `svn:keywords` property, when set on a versioned file, controls which keywords will be substituted on that file. The value is a space-delimited list of keyword names or aliases.

For example, say you have a versioned file named `weather.txt` that looks like this:

```
Here is the latest report from the front lines.
$LastChangedDate$
$Rev$
Cumulus clouds are appearing more frequently as summer approaches.
```

With no `svn:keywords` property set on that file, Subversion will do nothing special. Now, let's enable substitution of the `LastChangedDate` keyword.

```
$ svn propset svn:keywords "Date Author" weather.txt
property 'svn:keywords' set on 'weather.txt'
$
```

Now you have made a local property modification on the `weather.txt` file. You will see no changes to the file's contents (unless you made some of your own prior to setting the property). Notice that the file contained a keyword anchor for the `Rev` keyword, yet we did not include that keyword in the property value we set. Subversion will happily ignore requests to substitute keywords that are not present in the file and will not substitute keywords that are not present in the `svn:keywords` property value.

Immediately after you commit this property change, Subversion will update your working file with the new substitute text. Instead of seeing your keyword anchor `$LastChangedDate$`, you'll see its substituted result. That result also contains the name of the keyword and continues to be delimited by the dollar sign ($) characters. And as we predicted, the `Rev` keyword was not substituted because we didn't ask for it to be.

Note also that we set the `svn:keywords` property to `Date Author`, yet the keyword anchor used the alias `$LastChangedDate$` and still expanded correctly:

[6] … or maybe even a section of a book …

```
Here is the latest report from the front lines.
$LastChangedDate: 2006-07-22 21:42:37 -0700 (Sat, 22 Jul 2006) $
$Rev$
Cumulus clouds are appearing more frequently as summer approaches.
```

If someone else now commits a change to `weather.txt`, your copy of that file will continue to display the same substituted keyword value as before—until you update your working copy. At that time, the keywords in your `weather.txt` file will be resubstituted with information that reflects the most recent known commit to that file.

> **Where's $GlobalRev$?**
>
> New users are often confused by how the `$Rev$` keyword works. Since the repository has a single, globally increasing revision number, many people assume that it is this number that is reflected by the `$Rev$` keyword's value. But `$Rev$` expands to show the last revision in which the file *changed*, not the last revision to which it was updated. Understanding this clears the confusion, but frustration often remains—without the support of a Subversion keyword to do so, how can you automatically get the global revision number into your files?
>
> To do this, you need external processing. Subversion ships with a tool called **svnversion**, which was designed for just this purpose. It crawls your working copy and generates as output the revision(s) it finds. You can use this program, plus some additional tooling, to embed that revision information into your files. For more information on **svnversion**, see „svnversion“.

Subversion 1.2 introduced a new variant of the keyword syntax, which brought additional, useful—though perhaps atypical—functionality. You can now tell Subversion to maintain a fixed length (in terms of the number of bytes consumed) for the substituted keyword. By using a double colon (`::`) after the keyword name, followed by a number of space characters, you define that fixed width. When Subversion goes to substitute your keyword for the keyword and its value, it will essentially replace only those space characters, leaving the overall width of the keyword field unchanged. If the substituted value is shorter than the defined field width, there will be extra padding characters (spaces) at the end of the substituted field; if it is too long, it is truncated with a special hash (#) character just before the final dollar sign terminator.

For example, say you have a document in which you have some section of tabular data reflecting the document's Subversion keywords. Using the original Subversion keyword substitution syntax, your file might look something like:

```
$Rev$:     Revision of last commit
$Author$:  Author of last commit
$Date$:    Date of last commit
```

Now, that looks nice and tabular at the start of things. But when you then commit that file (with keyword substitution enabled, of course), you see:

```
$Rev: 12 $:     Revision of last commit
$Author: harry $:  Author of last commit
$Date: 2006-03-15 02:33:03 -0500 (Wed, 15 Mar 2006) $:    Date of last commit
```

The result is not so beautiful. And you might be tempted to then adjust the file after the substitution so that it again looks tabular. But that holds only as long as the keyword values are the same width. If the last committed revision rolls into a new place value (say, from 99 to 100), or if another person with a longer username commits the file, stuff gets all crooked again. However, if you are using Subversion 1.2 or later, you can use the new fixed-length keyword syntax and define some field widths that seem sane, so your file might look like this:

```
$Rev::               $:  Revision of last commit
$Author::            $:  Author of last commit
$Date::              $:  Date of last commit
```

You commit this change to your file. This time, Subversion notices the new fixed-length keyword syntax and maintains the width of the fields as defined by the padding you placed between the double colon and the trailing dollar sign. After substitution, the width of the fields is completely unchanged—the short values for `Rev` and `Author` are padded with spaces, and the long `Date` field is truncated by a hash character:

```
$Rev:: 13            $:  Revision of last commit
$Author:: harry      $:  Author of last commit
$Date:: 2006-03-15 0#$:  Date of last commit
```

The use of fixed-length keywords is especially handy when performing substitutions into complex file formats that themselves use fixed-length fields for data, or for which the stored size of a given data field is overbearingly difficult to modify from outside the format's native application (such as for Microsoft Office documents).

Be aware that because the width of a keyword field is measured in bytes, the potential for corruption of multibyte values exists. For example, a username that contains some multibyte UTF-8 characters might suffer truncation in the middle of the string of bytes that make up one of those characters. The result will be a mere truncation when viewed at the byte level, but will likely appear as a string with an incorrect or garbled final character when viewed as UTF-8 text. It is conceivable that certain applications, when asked to load the file, would notice the broken UTF-8 text and deem the entire file corrupt, refusing to operate on the file altogether. So, when limiting keywords to a fixed size, choose a size that allows for this type of byte-wise expansion.

Sparse Directories

By default, most Subversion operations on directories act in a recursive manner. For example, **svn checkout** creates a working copy with every file and directory in the specified area of the repository, descending recursively through the repository tree until the entire structure is copied to your local disk. Subversion 1.5 introduces a feature called *sparse directories* (or *shallow checkouts*) that allows you to easily check out a working copy—or a portion of a working copy—more shallowly than full recursion, with the freedom to bring in previously ignored files and subdirectories at a later time.

For example, say we have a repository with a tree of files and directories with names of the members of a human family with pets. (It's an odd example, to be sure, but bear with us.) A regular **svn checkout** operation will give us a working copy of the whole tree:

```
$ svn checkout file:///var/svn/repos mom
A    mom/son
A    mom/son/grandson
A    mom/daughter
A    mom/daughter/granddaughter1
A    mom/daughter/granddaughter1/bunny1.txt
A    mom/daughter/granddaughter1/bunny2.txt
A    mom/daughter/granddaughter2
```

```
A    mom/daughter/fishie.txt
A    mom/kitty1.txt
A    mom/doggie1.txt
Checked out revision 1.
$
```

Now, let's check out the same tree again, but this time we'll ask Subversion to give us only the topmost directory with none of its children at all:

```
$ svn checkout file:///var/svn/repos mom-empty --depth empty
Checked out revision 1
$
```

Notice that we added to our original **svn checkout** command line a new `--depth` option. This option is present on many of Subversion's subcommands and is similar to the `--non-recursive` (`-N`) and `--recursive` (`-R`) options. In fact, it combines, improves upon, supercedes, and ultimately obsoletes these two older options. For starters, it expands the supported degrees of depth specification available to users, adding some previously unsupported (or inconsistently supported) depths. Here are the depth values that you can request for a given Subversion operation:

`--depth empty`
: Include only the immediate target of the operation, not any of its file or directory children.

`--depth files`
: Include the immediate target of the operation and any of its immediate file children.

`--depth immediates`
: Include the immediate target of the operation and any of its immediate file or directory children. The directory children will themselves be empty.

`--depth infinity`
: Include the immediate target, its file and directory children, its children's children, and so on to full recursion.

Of course, merely combining two existing options into one hardly constitutes a new feature worthy of a whole section in our book. Fortunately, there is more to this story. This idea of depth extends not just to the operations you perform with your Subversion client, but also as a description of a working copy citizen's *ambient depth*, which is the depth persistently recorded by the working copy for that item. Its key strength is this very persistence—the fact that it is *sticky*. The working copy remembers the depth you've selected for each item in it until you later change that depth selection; by default, Subversion commands operate on the working copy citizens present, regardless of their selected depth settings.

You can check the recorded ambient depth of a working copy using the **svn info** command. If the ambient depth is anything other than infinite recursion, **svn info** will display a line describing that depth value:

```
$ svn info mom-immediates | grep '^Depth:'
Depth: immediates
$
```

Our previous examples demonstrated checkouts of infinite depth (the default for **svn checkout**) and empty depth. Let's look now at examples of the other depth values:

```
$ svn checkout file:///var/svn/repos mom-files --depth files
A    mom-files/kitty1.txt
A    mom-files/doggie1.txt
Checked out revision 1.
$ svn checkout file:///var/svn/repos mom-immediates --depth immediates
A    mom-immediates/son
A    mom-immediates/daughter
A    mom-immediates/kitty1.txt
A    mom-immediates/doggie1.txt
Checked out revision 1.
$
```

As described, each of these depths is something more than only the target, but something less than full recursion.

We've used **svn checkout** as an example here, but you'll find the `--depth` option present on many other Subversion commands, too. In those other commands, depth specification is a way to limit the scope of an operation to some depth, much like the way the older `--non-recursive` (`-N`) and `--recursive` (`-R`) options behave. This means that when operating on a working copy of some depth, while requesting an operation of a shallower depth, the operation is limited to that shallower depth. In fact, we can make an even more general statement: given a working copy of any arbitrary—even mixed—ambient depth, and a Subversion command with some requested operational depth, the command will maintain the ambient depth of the working copy members while still limiting the scope of the operation to the requested (or default) operational depth.

In addition to the `--depth` option, the **svn update** and **svn switch** subcommands also accept a second depth-related option: `--set-depth`. It is with this option that you can change the sticky depth of a working copy item. Watch what happens as we take our empty-depth checkout and gradually telescope it deeper using **`svn update --set-depth`** ***`NEW-DEPTH TARGET`***:

```
$ svn update --set-depth files mom-empty
A    mom-empty/kittie1.txt
A    mom-empty/doggie1.txt
Updated to revision 1.
$ svn update --set-depth immediates mom-empty
A    mom-empty/son
A    mom-empty/daughter
Updated to revision 1.
$ svn update --set-depth infinity mom-empty
A    mom-empty/son/grandson
A    mom-empty/daughter/granddaughter1
A    mom-empty/daughter/granddaughter1/bunny1.txt
A    mom-empty/daughter/granddaughter1/bunny2.txt
A    mom-empty/daughter/granddaughter2
A    mom-empty/daughter/fishie1.txt
Updated to revision 1.
$
```

As we gradually increased our depth selection, the repository gave us more pieces of our tree.

In our example, we operated only on the root of our working copy, changing its ambient depth value. But we can independently change the ambient depth value of *any* subdirectory inside the working copy, too. Careful use of this ability allows us to flesh out only certain portions of the working copy tree, leaving other portions absent altogether (hence the „sparse“ bit of the feature's name). Here's an example of how we might build out a portion of one branch of our family's tree, enable full recursion on another branch, and keep still other pieces pruned (absent from disk).

```
$ rm -rf mom-empty
$ svn checkout file:///var/svn/repos mom-empty --depth empty
Checked out revision 1.
$ svn update --set-depth empty mom-empty/son
A    mom-empty/son
Updated to revision 1.
$ svn update --set-depth empty mom-empty/daughter
A    mom-empty/daughter
Updated to revision 1.
$ svn update --set-depth infinity mom-empty/daughter/granddaughter1
A    mom-empty/daughter/granddaughter1
A    mom-empty/daughter/granddaughter1/bunny1.txt
A    mom-empty/daughter/granddaughter1/bunny2.txt
Updated to revision 1.
$
```

Fortunately, having a complex collection of ambient depths in a single working copy doesn't complicate the way you interact with that working copy. You can still make, revert, display, and commit local modifications in your working copy without providing any new options (including `--depth` and `--set-depth`) to the relevant subcommands. Even **svn update** works as it does elsewhere when no specific depth is provided—it updates the working copy targets that are present while honoring their sticky depths.

You might at this point be wondering, „So what? When would I use this?“ One scenario where this feature finds utility is tied to a particular repository layout, specifically where you have many related or codependent projects or software modules living as siblings in a single repository location (`trunk/project1`, `trunk/project2`, `trunk/project3`, etc.). In such scenarios, it might be the case that you personally care about only a handful of those projects—maybe some primary project and a few other modules on which it depends. You can check out individual working copies of all of these things, but those working copies are disjoint and, as a result, it can be cumbersome to perform operations across several or all of them at the same time. The alternative is to use the sparse directories feature, building out a single working copy that contains only the modules you care about. You'd start with an empty-depth checkout of the common parent directory of the projects, and then update with infinite depth only the items you wish to have, like we demonstrated in the previous example. Think of it like an opt-in system for working copy citizens.

Subversion 1.5's implementation of shallow checkouts is good but does not support a couple of interesting behaviors. First, you cannot de-telescope a working copy item. Running **`svn update --set-depth empty`** in an infinite-depth working copy will not have the effect of discarding everything but the topmost directory—it will simply error out. Second, there is no depth value to indicate that you wish an item to be explicitly excluded. You have to do implicit exclusion of an item by including everything else.

Locking

Subversion's copy-modify-merge version control model lives and dies on its data merging algorithms—specifically on how well those algorithms perform when trying to resolve conflicts caused by multiple users modifying the same file concurrently. Subversion itself provides only one such algorithm: a three-way differencing algorithm that is smart enough to handle data at a granularity of a single line of text. Subversion also allows you to supplement its content merge processing with external differencing utilities (as described in „External diff3“), some of which may do an even better job, perhaps providing granularity of a word or a single character of text. But common among those algorithms is that they generally work only on text files. The landscape starts to look pretty grim when you start talking about content merges of nontextual file formats. And when you can't find a tool that can handle that type of merging, you begin to run into problems with the copy-modify-merge model.

Let's look at a real-life example of where this model runs aground. Harry and Sally are both graphic designers working on the same project, a bit of marketing collateral for an automobile mechanic. Central to the design of a particular poster is an image of a car in need of some bodywork, stored in a file using the PNG image format. The poster's layout is almost finished, and both Harry and Sally are pleased with the particular photo they chose for their damaged car—a baby blue 1967 Ford Mustang with an unfortunate bit of crumpling on the left front fender.

Now, as is common in graphic design work, there's a change in plans, which causes the car's color to be a concern. So Sally updates her working copy to HEAD, fires up her photo-editing software, and sets about tweaking the image so that the car is now cherry red. Meanwhile, Harry, feeling particularly inspired that day, decides that the image would have greater impact if the car also appears to have suffered greater impact. He, too, updates to HEAD, and then draws some cracks on the vehicle's windshield. He manages to finish his work before Sally finishes hers, and after admiring the fruits of his undeniable talent, he commits the modified image. Shortly thereafter, Sally is finished with the car's new finish and tries to commit her changes. But, as expected, Subversion fails the commit, informing Sally that her version of the image is now out of date.

Here's where the difficulty sets in. If Harry and Sally were making changes to a text file, Sally would simply update her working copy, receiving Harry's changes in the process. In the worst possible case, they would have modified the same region of the file, and Sally would have to work out by hand the proper resolution to the conflict. But these aren't text files—they are binary images. And while it's a simple matter to describe what one would expect the results of this content merge to be, there is precious little chance that any software exists that is smart enough to examine the common baseline image that each of these graphic artists worked against, the changes that Harry made, and the changes that Sally made, and then spit out an image of a busted-up red Mustang with a cracked windshield!

Of course, things would have gone more smoothly if Harry and Sally had serialized their modifications to the image—if, say, Harry had waited to draw his windshield cracks on Sally's now-red car, or if Sally had tweaked the color of a car whose windshield was already cracked. As is discussed in „Die „Kopieren – Ändern – Zusammenfassen" - Lösung", most of these types of problems go away entirely where perfect communication between Harry and Sally exists. [7] But as one's version control system is, in fact, one form of communication, it follows that having that software facilitate the serialization of nonparallelizable editing efforts is no bad thing. This is where Subversion's implementation of the lock-modify-unlock model steps into the spotlight. This is where we talk about Subversion's *locking* feature, which is similar to the „reserved checkouts" mechanisms of other version control systems.

Subversion's locking feature exists ultimately to minimize wasted time and effort. By allowing a user to programmatically claim the exclusive right to change a file in the repository, that user can be reasonably confident that any energy he invests on unmergeable changes won't be wasted—his commit of those changes will succeed. Also, because Subversion communicates to other users that serialization is in effect for a particular versioned object, those users can reasonably expect that the object is about to be changed by someone else. They, too, can then avoid wasting their time and energy on unmergeable changes that won't be committable due to eventual out-of-dateness.

When referring to Subversion's locking feature, one is actually talking about a fairly diverse collection of behaviors, which include the ability to lock a versioned file [8] (claiming the exclusive right to modify the file), to unlock that file (yielding that exclusive right to modify), to see reports about which files are locked and by whom, to annotate files for which locking before editing is strongly advised, and so on. In this section, we'll cover all of these facets of the larger locking feature.

[7] Communication wouldn't have been such bad medicine for Harry and Sally's Hollywood namesakes, either, for that matter.

[8] Subversion does not currently allow locks on directories.

The Three Meanings of „Lock“

In this section, and almost everywhere in this book, the words „lock“ and „locking“ describe a mechanism for mutual exclusion between users to avoid clashing commits. Unfortunately, there are two other sorts of „lock“ with which Subversion, and therefore this book, sometimes needs to be concerned.

The second is *working copy locks*, used internally by Subversion to prevent clashes between multiple Subversion clients operating on the same working copy. This is the sort of lock indicated by an `L` in the third column of **svn status** output, and removed by the **svn cleanup** command, as described in „Manchmal müssen Sie einfach nur aufräumen“.

Third, there are *database locks*, used internally by the Berkeley DB backend to prevent clashes between multiple programs trying to access the database. This is the sort of lock whose unwanted persistence after an error can cause a repository to be „wedged,“ as described in „Berkeley DB Recovery“.

You can generally forget about these other kinds of locks until something goes wrong that requires you to care about them. In this book, „lock“ means the first sort unless the contrary is either clear from context or explicitly stated.

Creating Locks

In the Subversion repository, a *lock* is a piece of metadata that grants exclusive access to one user to change a file. This user is said to be the *lock owner*. Each lock also has a unique identifier, typically a long string of characters, known as the *lock token*. The repository manages locks, ultimately handling their creation, enforcement, and removal. If any commit transaction attempts to modify or delete a locked file (or delete one of the parent directories of the file), the repository will demand two pieces of information—that the client performing the commit be authenticated as the lock owner, and that the lock token has been provided as part of the commit process as a form of proof that the client knows which lock it is using.

To demonstrate lock creation, let's refer back to our example of multiple graphic designers working on the same binary image files. Harry has decided to change a JPEG image. To prevent other people from committing changes to the file while he is modifying it (as well as alerting them that he is about to change it), he locks the file in the repository using the **svn lock** command.

```
$ svn lock banana.jpg -m "Editing file for tomorrow's release."
'banana.jpg' locked by user 'harry'.
$
```

The preceding example demonstrates a number of new things. First, notice that Harry passed the `--message` (`-m`) option to **svn lock**. Similar to **svn commit**, the **svn lock** command can take comments—via either `--message` (`-m`) or `--file` (`-F`)—to describe the reason for locking the file. Unlike **svn commit**, however, **svn lock** will not demand a message by launching your preferred text editor. Lock comments are optional, but still recommended to aid communication.

Second, the lock attempt succeeded. This means that the file wasn't already locked, and that Harry had the latest version of the file. If Harry's working copy of the file had been out of date, the repository would have rejected the request, forcing Harry to **svn update** and reattempt the locking command. The locking command would also have failed if the file had already been locked by someone else.

As you can see, the **svn lock** command prints confirmation of the successful lock. At this point, the fact that the file is locked becomes apparent in the output of the **svn status** and **svn info** reporting subcommands.

```
$ svn status
     K banana.jpg

$ svn info banana.jpg
Path: banana.jpg
Name: banana.jpg
URL: http://svn.example.com/repos/project/banana.jpg
Repository UUID: edb2f264-5ef2-0310-a47a-87b0ce17a8ec
Revision: 2198
Node Kind: file
Schedule: normal
Last Changed Author: frank
Last Changed Rev: 1950
Last Changed Date: 2006-03-15 12:43:04 -0600 (Wed, 15 Mar 2006)
Text Last Updated: 2006-06-08 19:23:07 -0500 (Thu, 08 Jun 2006)
Properties Last Updated: 2006-06-08 19:23:07 -0500 (Thu, 08 Jun 2006)
Checksum: 3b110d3b10638f5d1f4fe0f436a5a2a5
Lock Token: opaquelocktoken:0c0f600b-88f9-0310-9e48-355b44d4a58e
Lock Owner: harry
Lock Created: 2006-06-14 17:20:31 -0500 (Wed, 14 Jun 2006)
Lock Comment (1 line):
Editing file for tomorrow's release.

$
```

The fact that the **svn info** command, which does not contact the repository when run against working copy paths, can display the lock token reveals an important piece of information about those tokens: they are cached in the working copy. The presence of the lock token is critical. It gives the working copy authorization to make use of the lock later on. Also, the **svn status** command shows a `K` next to the file (short for locKed), indicating that the lock token is present.

Regarding Lock Tokens

A lock token isn't an authentication token, so much as an *authorization* token. The token isn't a protected secret. In fact, a lock's unique token is discoverable by anyone who runs **`svn info`** ***`URL`***. A lock token is special only when it lives inside a working copy. It's proof that the lock was created in that particular working copy, and not somewhere else by some other client. Merely authenticating as the lock owner isn't enough to prevent accidents.

For example, suppose you lock a file using a computer at your office, but leave work for the day before you finish your changes to that file. It should not be possible to accidentally commit changes to that same file from your home computer later that evening simply because you've authenticated as the lock's owner. In other words, the lock token prevents one piece of Subversion-related software from undermining the work of another. (In our example, if you really need to change the file from an alternative working copy, you would need to *break* the lock and relock the file.)

Now that Harry has locked `banana.jpg`, Sally is unable to change or delete that file:

```
$ svn delete banana.jpg
D         banana.jpg
$ svn commit -m "Delete useless file."
Deleting       banana.jpg
svn: Commit failed (details follow):
svn: Server sent unexpected return value (423 Locked) in response to DELETE\
 request for '/repos/project/!svn/wrk/64bad3a9-96f9-0310-818a-df4224ddc35d/\
```

```
banana.jpg'
$
```

But Harry, after touching up the banana's shade of yellow, is able to commit his changes to the file. That's because he authenticates as the lock owner and also because his working copy holds the correct lock token:

```
$ svn status
M    K banana.jpg
$ svn commit -m "Make banana more yellow"
Sending        banana.jpg
Transmitting file data .
Committed revision 2201.
$ svn status
$
```

Notice that after the commit is finished, **svn status** shows that the lock token is no longer present in the working copy. This is the standard behavior of **svn commit**—it searches the working copy (or list of targets, if you provide such a list) for local modifications and sends all the lock tokens it encounters during this walk to the server as part of the commit transaction. After the commit completes successfully, all of the repository locks that were mentioned are released—*even on files that weren't committed*. This is meant to discourage users from being sloppy about locking or from holding locks for too long. If Harry haphazardly locks 30 files in a directory named `images` because he's unsure of which files he needs to change, yet changes only four of those files, when he runs **`svn commit images`**, the process will still release all 30 locks.

This behavior of automatically releasing locks can be overridden with the `--no-unlock` option to **svn commit**. This is best used for those times when you want to commit changes, but still plan to make more changes and thus need to retain existing locks. You can also make this your default behavior by setting the `no-unlock` runtime configuration option (see „Runtime Configuration Area“).

Of course, locking a file doesn't oblige one to commit a change to it. The lock can be released at any time with a simple **svn unlock** command:

```
$ svn unlock banana.c
'banana.c' unlocked.
```

Discovering Locks

When a commit fails due to someone else's locks, it's fairly easy to learn about them. The easiest way is to run **`svn status --show-updates`**:

```
$ svn status -u
M              23   bar.c
M    O         32   raisin.jpg
       *       72   foo.h
Status against revision:     105
$
```

In this example, Sally can see not only that her copy of `foo.h` is out of date, but also that one of the two modified files she plans to commit is locked in the repository. The `O` symbol stands for „Other,“ meaning that a lock exists on the file and was created by somebody else. If she were to attempt a commit, the lock on `raisin.jpg` would prevent it. Sally is left wondering who made the lock, when, and why. Once again, **svn info** has the answers:

```
$ svn info http://svn.example.com/repos/project/raisin.jpg
Path: raisin.jpg
Name: raisin.jpg
URL: http://svn.example.com/repos/project/raisin.jpg
Repository UUID: edb2f264-5ef2-0310-a47a-87b0ce17a8ec
Revision: 105
Node Kind: file
Last Changed Author: sally
Last Changed Rev: 32
Last Changed Date: 2006-01-25 12:43:04 -0600 (Sun, 25 Jan 2006)
Lock Token: opaquelocktoken:fc2b4dee-98f9-0310-abf3-653ff3226e6b
Lock Owner: harry
Lock Created: 2006-02-16 13:29:18 -0500 (Thu, 16 Feb 2006)
Lock Comment (1 line):
Need to make a quick tweak to this image.
$
```

Just as you can use **svn info** to examine objects in the working copy, you can also use it to examine objects in the repository. If the main argument to **svn info** is a working copy path, then all of the working copy's cached information is displayed; any mention of a lock means that the working copy is holding a lock token (if a file is locked by another user or in another working copy, **svn info** on a working copy path will show no lock information at all). If the main argument to **svn info** is a URL, the information reflects the latest version of an object in the repository, and any mention of a lock describes the current lock on the object.

So in this particular example, Sally can see that Harry locked the file on February 16 to „make a quick tweak." It being June, she suspects that he probably forgot all about the lock. She might phone Harry to complain and ask him to release the lock. If he's unavailable, she might try to forcibly break the lock herself or ask an administrator to do so.

Breaking and Stealing Locks

A repository lock isn't sacred—in Subversion's default configuration state, locks can be released not only by the person who created them, but by anyone. When somebody other than the original lock creator destroys a lock, we refer to this as *breaking the lock*.

From the administrator's chair, it's simple to break locks. The **svnlook** and **svnadmin** programs have the ability to display and remove locks directly from the repository. (For more information about these tools, see „An Administrator's Toolkit".)

```
$ svnadmin lslocks /var/svn/repos
Path: /project2/images/banana.jpg
UUID Token: opaquelocktoken:c32b4d88-e8fb-2310-abb3-153ff1236923
Owner: frank
Created: 2006-06-15 13:29:18 -0500 (Thu, 15 Jun 2006)
Expires:
Comment (1 line):
Still improving the yellow color.

Path: /project/raisin.jpg
UUID Token: opaquelocktoken:fc2b4dee-98f9-0310-abf3-653ff3226e6b
Owner: harry
Created: 2006-02-16 13:29:18 -0500 (Thu, 16 Feb 2006)
Expires:
Comment (1 line):
Need to make a quick tweak to this image.

$ svnadmin rmlocks /var/svn/repos /project/raisin.jpg
Removed lock on '/project/raisin.jpg'.
$
```

The more interesting option is to allow users to break each other's locks over the network. To do this, Sally simply needs to pass the `--force` to the **svn unlock** command:

```
$ svn status -u
M              23   bar.c
M    O         32   raisin.jpg
       *       72   foo.h
Status against revision:     105
$ svn unlock raisin.jpg
svn: 'raisin.jpg' is not locked in this working copy
$ svn info raisin.jpg | grep URL
URL: http://svn.example.com/repos/project/raisin.jpg
$ svn unlock http://svn.example.com/repos/project/raisin.jpg
svn: Unlock request failed: 403 Forbidden (http://svn.example.com)
$ svn unlock --force http://svn.example.com/repos/project/raisin.jpg
'raisin.jpg' unlocked.
$
```

Now, Sally's initial attempt to unlock failed because she ran **svn unlock** directly on her working copy of the file, and no lock token was present. To remove the lock directly from the repository, she needs to pass a URL to **svn unlock**. Her first attempt to unlock the URL fails, because she can't authenticate as the lock owner (nor does she have the lock token). But when she passes `--force`, the authentication and authorization requirements are ignored, and the remote lock is broken.

Simply breaking a lock may not be enough. In the running example, Sally may not only want to break Harry's long-forgotten lock, but relock the file for her own use. She can accomplish this by using **svn unlock** with `--force` and then **svn lock** back-to-back, but there's a small chance that somebody else might lock the file between the two commands. The simpler thing to do is to *steal* the lock, which involves breaking and relocking the file all in one atomic step. To do this, Sally passes the `--force` option to **svn lock**:

```
$ svn lock raisin.jpg
svn: Lock request failed: 423 Locked (http://svn.example.com)
$ svn lock --force raisin.jpg
'raisin.jpg' locked by user 'sally'.
$
```

In any case, whether the lock is broken or stolen, Harry may be in for a surprise. Harry's working copy still contains the original lock token, but that lock no longer exists. The lock token is said to be *defunct*. The lock represented by the lock token has either been broken (no longer in the repository) or stolen (replaced with a different lock). Either way, Harry can see this by asking **svn status** to contact the repository:

```
$ svn status
     K raisin.jpg
$ svn status -u
     B         32   raisin.jpg
$ svn update
  B  raisin.jpg
$ svn status
$
```

If the repository lock was broken, then **`svn status --show-updates`** displays a `B` (Broken) symbol next to the file. If a new lock exists in place of the old one, then a `T` (sTolen) symbol is shown. Finally, **svn update** notices any defunct lock tokens and removes them from the working copy.

Locking Policies

Different systems have different notions of how strict a lock should be. Some folks argue that locks must be strictly enforced at all costs, releasable only by the original creator or administrator. They argue that if anyone can break a lock, chaos runs rampant and the whole point of locking is defeated. The other side argues that locks are first and foremost a communication tool. If users are constantly breaking each other's locks, it represents a cultural failure within the team and the problem falls outside the scope of software enforcement.

Subversion defaults to the „softer" approach, but still allows administrators to create stricter enforcement policies through the use of hook scripts. In particular, the `pre-lock` and `pre-unlock` hooks allow administrators to decide when lock creation and lock releases are allowed to happen. Depending on whether a lock already exists, these two hooks can decide whether to allow a certain user to break or steal a lock. The `post-lock` and `post-unlock` hooks are also available, and can be used to send email after locking actions. To learn more about repository hooks, see „Implementing Repository Hooks".

Lock Communication

We've seen how **svn lock** and **svn unlock** can be used to create, release, break, and steal locks. This satisfies the goal of serializing commit access to a file. But what about the larger problem of preventing wasted time?

For example, suppose Harry locks an image file and then begins editing it. Meanwhile, miles away, Sally wants to do the same thing. She doesn't think to run **`svn status --show-updates`**, so she has no idea that Harry has already locked the file. She spends hours editing the file, and when she tries to commit her change, she discovers that either the file is locked or that she's out of date. Regardless, her changes aren't mergeable with Harry's. One of these two people has to throw away his or her work, and a lot of time has been wasted.

Subversion's solution to this problem is to provide a mechanism to remind users that a file ought to be locked *before* the editing begins. The mechanism is a special property: `svn:needs-lock`. If that property is attached to a file (regardless of its value, which is irrelevant), Subversion will try to use filesystem-level permissions to make the file read-only—unless, of course, the user has explicitly locked the file. When a lock token is present (as a result of using **svn lock**), the file becomes read/write. When the lock is released, the file becomes read-only again.

The theory, then, is that if the image file has this property attached, Sally would immediately notice something is strange when she opens the file for editing: many applications alert users immediately when a read-only file is opened for editing, and nearly all would prevent her from saving changes to the file. This reminds her to lock the file before editing, whereby she discovers the preexisting lock:

```
$ /usr/local/bin/gimp raisin.jpg
gimp: error: file is read-only!
$ ls -l raisin.jpg
-r--r--r--   1 sally   sally   215589 Jun  8 19:23 raisin.jpg
$ svn lock raisin.jpg
svn: Lock request failed: 423 Locked (http://svn.example.com)
$ svn info http://svn.example.com/repos/project/raisin.jpg | grep Lock
Lock Token: opaquelocktoken:fc2b4dee-98f9-0310-abf3-653ff3226e6b
Lock Owner: harry
Lock Created: 2006-06-08 07:29:18 -0500 (Thu, 08 June 2006)
Lock Comment (1 line):
Making some tweaks.  Locking for the next two hours.
```

$

Users and administrators alike are encouraged to attach the `svn:needs-lock` property to any file that cannot be contextually merged. This is the primary technique for encouraging good locking habits and preventing wasted effort.

Note that this property is a communication tool that works independently from the locking system. In other words, any file can be locked, whether or not this property is present. And conversely, the presence of this property doesn't make the repository require a lock when committing.

Unfortunately, the system isn't flawless. It's possible that even when a file has the property, the read-only reminder won't always work. Sometimes applications misbehave and „hijack“ the read-only file, silently allowing users to edit and save the file anyway. There's not much that Subversion can do in this situation—at the end of the day, there's simply no substitution for good interpersonal communication. [9]

Externals Definitions

Sometimes it is useful to construct a working copy that is made out of a number of different checkouts. For example, you may want different subdirectories to come from different locations in a repository or perhaps from different repositories altogether. You could certainly set up such a scenario by hand—using **svn checkout** to create the sort of nested working copy structure you are trying to achieve. But if this layout is important for everyone who uses your repository, every other user will need to perform the same checkout operations that you did.

Fortunately, Subversion provides support for *externals definitions*. An externals definition is a mapping of a local directory to the URL—and ideally a particular revision—of a versioned directory. In Subversion, you declare externals definitions in groups using the `svn:externals` property. You can create or modify this property using **svn propset** or **svn propedit** (see „Manipulating Properties“). It can be set on any versioned directory, and its value describes both the external repository location and the client-side directory to which that location should be checked out.

The convenience of the `svn:externals` property is that once it is set on a versioned directory, everyone who checks out a working copy with that directory also gets the benefit of the externals definition. In other words, once one person has made the effort to define the nested working copy structure, no one else has to bother—Subversion will, after checking out the original working copy, automatically also check out the external working copies.

The relative target subdirectories of externals definitions *must not* already exist on your or other users' systems—Subversion will create them when it checks out the external working copy.

You also get in the externals definition design all the regular benefits of Subversion properties. The definitions are versioned. If you need to change an externals definition, you can do so using the regular property modification subcommands. When you commit a change to the `svn:externals` property, Subversion will synchronize the checked-out items against the changed externals definition when you next run **`svn update`**. The same thing will happen when others update their working copies and receive your changes to the

[9] Except, perhaps, a classic Vulcan mind-meld.

externals definition.

Because the `svn:externals` property has a multiline value, we strongly recommend that you use **svn propedit** instead of **svn propset**.

Subversion releases prior to 1.5 honor an externals definition format that is a multiline table of subdirectories (relative to the versioned directory on which the property is set), optional revision flags, and fully qualified, absolute Subversion repository URLs. An example of this might looks as follows:

```
$ svn propget svn:externals calc
third-party/sounds             http://svn.example.com/repos/sounds
third-party/skins -r148        http://svn.example.com/skinproj
third-party/skins/toolkit -r21 http://svn.example.com/skin-maker
```

When someone checks out a working copy of the `calc` directory referred to in the previous example, Subversion also continues to check out the items found in its externals definition.

```
$ svn checkout http://svn.example.com/repos/calc
A  calc
A  calc/Makefile
A  calc/integer.c
A  calc/button.c
Checked out revision 148.

Fetching external item into calc/third-party/sounds
A  calc/third-party/sounds/ding.ogg
A  calc/third-party/sounds/dong.ogg
A  calc/third-party/sounds/clang.ogg
…
A  calc/third-party/sounds/bang.ogg
A  calc/third-party/sounds/twang.ogg
Checked out revision 14.

Fetching external item into calc/third-party/skins
…
```

As of Subversion 1.5, though, a new format of the `svn:externals` property is supported. Externals definitions are still multiline, but the order and format of the various pieces of information have changed. The new syntax more closely mimics the order of arguments you might pass to **svn checkout**: the optional revision flags come first, then the external Subversion repository URL, and finally the relative local subdirectory. Notice, though, that this time we didn't say „fully qualified, absolute Subversion repository URLs.“ That's because the new format supports relative URLs and URLs that carry peg revisions. The previous example of an externals definition might, in Subversion 1.5, look like the following:

```
$ svn propget svn:externals calc
      http://svn.example.com/repos/sounds third-party/sounds
-r148 http://svn.example.com/skinproj third-party/skins
-r21  http://svn.example.com/skin-maker third-party/skins/toolkit
```

Or, making use of the peg revision syntax (which we describe in detail in „Peg and Operative Revisions“), it might appear as:

```
$ svn propget svn:externals calc
http://svn.example.com/repos/sounds third-party/sounds
http://svn.example.com/skinproj@148 third-party/skins
http://svn.example.com/skin-maker@21 third-party/skins/toolkit
```

> You should seriously consider using explicit revision numbers in all of your externals definitions. Doing so means that you get to decide when to pull down a different snapshot of external information, and exactly which snapshot to pull. Besides avoiding the surprise of getting changes to third-party repositories that you might not have any control over, using explicit revision numbers also means that as you backdate your working copy to a previous revision, your externals definitions will also revert to the way they looked in that previous revision, which in turn means that the external working copies will be updated to match the way *they* looked back when your repository was at that previous revision. For software projects, this could be the difference between a successful and a failed build of an older snapshot of your complex codebase.

For most repositories, these three ways of formatting the externals definitions have the same ultimate effect. They all bring the same benefits. Unfortunately, they all bring the same annoyances, too. Since the definitions shown use absolute URLs, moving or copying a directory to which they are attached will not affect what gets checked out as an external (though the relative local target subdirectory will, of course, move with the renamed directory). This can be confusing—even frustrating—in certain situations. For example, say you have a top-level directory named `my-project`, and you've created an externals definition on one of its subdirectories (`my-project/some-dir`) that tracks the latest revision of another of its subdirectories (`my-project/external-dir`).

```
$ svn checkout http://svn.example.com/projects .
A    my-project
A    my-project/some-dir
A    my-project/external-dir
…
Fetching external item into 'my-project/some-dir/subdir'
Checked out external at revision 11.

Checked out revision 11.
$ svn propget svn:externals my-project/some-dir
subdir http://svn.example.com/projects/my-project/external-dir

$
```

Now you use **svn move** to rename the `my-project` directory. At this point, your externals definition will still refer to a path under the `my-project` directory, even though that directory no longer exists.

```
$ svn move -q my-project renamed-project
$ svn commit -m "Rename my-project to renamed-project."
Deleting       my-project
Adding         renamed-project

Committed revision 12.
$ svn update

Fetching external item into 'renamed-project/some-dir/subdir'
svn: Target path does not exist
$
```

Also, absolute URLs can cause problems with repositories that are available via multiple URL schemes. For example, if your Subversion server is configured to allow everyone to check out the repository over `http://` or `https://`, but only allow commits to come in via `https://`, you have an interesting problem on your hands. If your externals definitions use the `http://` form of the repository URLs, you won't be able to commit anything from the working copies created by those externals. On the other hand, if they use the `https://` form of the URLs, anyone who might be checking out via `http://` because his client doesn't support `https://` will be unable to fetch the external items. Be aware, too, that if you need to reparent your working copy (using **svn switch** with the `--relocate` option), externals definitions will *not* also be reparented.

Subversion 1.5 takes a huge step in relieving these frustrations. As mentioned earlier, the URLs used in the new externals definition format can be relative, and Subversion provides syntax magic for specifying multiple flavors of URL relativity.

`../`
: Relative to the URL of the directory on which the `svn:externals` property is set

`^/`
: Relative to the root of the repository in which the `svn:externals` property is versioned

`//`
: Relative to the scheme of the URL of the directory on which the `svn:externals` property is set

`/`
: Relative to the root URL of the server on which the `svn:externals` property is versioned

So, looking a fourth time at our previous externals definition example, and making use of the new absolute URL syntax in various ways, we might now see:

```
$ svn propget svn:externals calc
^/sounds third-party/sounds
/skinproj@148 third-party/skins
//svn.example.com/skin-maker@21 third-party/skins/toolkit
```

The support that exists for externals definitions in Subversion remains less than ideal, though. An externals definition can point only to directories, not to files. Also, the local subdirectory part of the definition cannot contain `..` parent directory indicators (such as `../../skins/myskin`). Perhaps most disappointingly, the working copies created via the externals definition support are still disconnected from the primary working copy (on whose versioned directories the `svn:externals` property was actually set). And Subversion still truly operates only on nondisjoint working copies. So, for example, if you want to commit changes that you've made in one or more of those external working copies, you must run **svn commit** explicitly on those working copies—committing on the primary working copy will not recurse into any external ones.

We've already mentioned some of the additional shortcomings of the old `svn:externals` format and how the new Subversion 1.5 format improves upon it. But be careful when making use of the new format that you don't inadvertently cause problems for other folks accessing your repository who are using older Subversion clients. While Subversion 1.5 clients will continue to recognize and support the original externals definition format, older clients will *not* be able to correctly parse the new format.

Besides the **svn checkout**, **svn update**, **svn switch**, and **svn export** commands which actually manage the *disjoint* (or disconnected) subdirectories into which externals are checked out, the **svn status** command also recognizes externals definitions. It displays a status code of `X` for the disjoint external subdirectories, and then recurses into those subdirectories to display the status of the external items themselves. You can pass the `--ignore-externals` option to any of these subcommands to disable externals definition processing.

Peg and Operative Revisions

We copy, move, rename, and completely replace files and directories on our computers all the time. And your version control system shouldn't get in the way of your doing these things with your version-controlled files and directories, either. Subversion's file management support is quite liberating, affording almost as much flexibility for versioned files as you'd expect when manipulating your unversioned ones. But that flexibility means that across the lifetime of your repository, a given versioned object might have many paths, and a given path might represent several entirely different versioned objects. This introduces a certain level of complexity to your interactions with those paths and objects.

Subversion is pretty smart about noticing when an object's version history includes such „changes of address." For example, if you ask for the revision history log of a particular file that was renamed last week, Subversion happily provides all those logs—the revision in which the rename itself happened, plus the logs of relevant revisions both before and after that rename. So, most of the time, you don't even have to think about such things. But occasionally, Subversion needs your help to clear up ambiguities.

The simplest example of this occurs when a directory or file is deleted from version control, and then a new directory or file is created with the same name and added to version control. The thing you deleted and the thing you later added aren't the same thing. They merely happen to have had the same path—`/trunk/object`, for example. What, then, does it mean to ask Subversion about the history of `/trunk/object`? Are you asking about the thing currently at that location, or the old thing you deleted from that location? Are you asking about the operations that have happened to *all* the objects that have ever lived at that path? Subversion needs a hint about what you really want.

And thanks to moves, versioned object history can get far more twisted than even that. For example, you might have a directory named `concept`, containing some nascent software project you've been toying with. Eventually, though, that project matures to the point that the idea seems to actually have some wings, so you do the unthinkable and decide to give the project a name. [10] Let's say you called your software Frabnaggilywort. At this point, it makes sense to rename the directory to reflect the project's new name, so `concept` is renamed to `frabnaggilywort`. Life goes on, Frabnaggilywort releases a 1.0 version and is downloaded and used daily by hordes of people aiming to improve their lives.

It's a nice story, really, but it doesn't end there. Entrepreneur that you are, you've already got another think in the tank. So you make a new directory, `concept`, and the cycle begins again. In fact, the cycle begins again many times over the years, each time starting with that old `concept` directory, then sometimes seeing that directory renamed as the idea cures, sometimes seeing it deleted when you scrap the idea. Or, to get really sick, maybe you rename `concept` to something else for a while, but later rename the thing back to `concept` for some reason.

In scenarios like these, attempting to instruct Subversion to work with these reused paths can be a little like instructing a motorist in Chicago's West Suburbs to drive east down Roosevelt Road and turn left onto Main Street. In a mere 20 minutes, you can cross „Main Street" in Wheaton, Glen Ellyn, and Lombard. And no, they aren't the same street. Our motorist—and our Subversion—need a little more detail to do the right thing.

In version 1.1, Subversion introduced a way for you to tell it exactly which Main Street you meant. It's called the *peg revision*, and it is provided to Subversion for the sole purpose of identifying a unique line of history. Because at most, one versioned object may occupy a path at any given time—or, more precisely, in any one revision—the combination of a path and a peg revision is all that is needed to refer to a specific line of history. Peg revisions are specified to the Subversion command-line client using *at syntax*, so called because the syntax involves appending an „at sign" (`@`) and the peg revision to the end of the path with which the revision is associated.

[10] „You're not supposed to name it. Once you name it, you start getting attached to it."—Mike Wazowski

But what of the `--revision` (`-r`) of which we've spoken so much in this book? That revision (or set of revisions) is called the *operative revision* (or *operative revision range*). Once a particular line of history has been identified using a path and peg revision, Subversion performs the requested operation using the operative revision(s). To map this to our Chicagoland streets analogy, if we are told to go to 606 N. Main Street in Wheaton, [11] we can think of „Main Street“ as our path and „Wheaton“ as our peg revision. These two pieces of information identify a unique path that can be traveled (north or south on Main Street), and they keep us from traveling up and down the wrong Main Street in search of our destination. Now we throw in „606 N.“ as our operative revision of sorts, and we know *exactly* where to go.

The Peg Revision Algorithm

The Subversion command-line client performs the peg revision algorithm any time it needs to resolve possible ambiguities in the paths and revisions provided to it. Here's an example of such an invocation:

```
$ svn command -r OPERATIVE-REV item@PEG-REV
```

If *`OPERATIVE-REV`* is older than *`PEG-REV`*, the algorithm is as follows:

1. Locate *`item`* in the revision identified by *`PEG-REV`*. There can be only one such object.
2. Trace the object's history backwards (through any possible renames) to its ancestor in the revision *`OPERATIVE-REV`*.
3. Perform the requested action on that ancestor, wherever it is located, or whatever its name might be or might have been at that time.

But what if *`OPERATIVE-REV`* is *younger* than *`PEG-REV`*? Well, that adds some complexity to the theoretical problem of locating the path in *`OPERATIVE-REV`*, because the path's history could have forked multiple times (thanks to copy operations) between *`PEG-REV`* and *`OPERATIVE-REV`*. And that's not all—Subversion doesn't store enough information to performantly trace an object's history forward, anyway. So the algorithm is a little different:

1. Locate *`item`* in the revision identified by *`OPERATIVE-REV`*. There can be only one such object.
2. Trace the object's history backward (through any possible renames) to its ancestor in the revision *`PEG-REV`*.
3. Verify that the object's location (path-wise) in *`PEG-REV`* is the same as it is in *`OPERATIVE-REV`*. If that's the case, at least the two locations are known to be directly related, so perform the requested action on the location in *`OPERATIVE-REV`*. Otherwise, relatedness was not established, so error out with a loud complaint that no viable location was found. (Someday, we expect that Subversion will be able to handle this usage scenario with more flexibility and grace.)

Note that even when you don't explicitly supply a peg revision or operative revision, they are still present. For your convenience, the default peg revision is `BASE` for working copy items and `HEAD` for repository URLs. And when no operative revision is provided, it defaults to being the same revision as the peg revision.

[11] 606 N. Main Street, Wheaton, Illinois, is the home of the Wheaton *History* Center. It seemed appropriate….

Say that long ago we created our repository, and in revision 1 we added our first `concept` directory, plus an `IDEA` file in that directory talking about the concept. After several revisions in which real code was added and tweaked, we, in revision 20, renamed this directory to `frabnaggilywort`. By revision 27, we had a new concept, a new `concept` directory to hold it, and a new `IDEA` file to describe it. And then five years and thousands of revisions flew by, just like they would in any good romance story.

Now, years later, we wonder what the `IDEA` file looked like back in revision 1. But Subversion needs to know whether we are asking about how the *current* file looked back in revision 1, or whether we are asking for the contents of whatever file lived at `concepts/IDEA` in revision 1. Certainly those questions have different answers, and because of peg revisions, you can ask those questions. To find out how the current `IDEA` file looked in that old revision, you run:

```
$ svn cat -r 1 concept/IDEA
svn: Unable to find repository location for 'concept/IDEA' in revision 1
```

Of course, in this example, the current `IDEA` file didn't exist yet in revision 1, so Subversion gives an error. The previous command is shorthand for a longer notation which explicitly lists a peg revision. The expanded notation is:

```
$ svn cat -r 1 concept/IDEA@BASE
svn: Unable to find repository location for 'concept/IDEA' in revision 1
```

And when executed, it has the expected results.

The perceptive reader is probably wondering at this point whether the peg revision syntax causes problems for working copy paths or URLs that actually have at signs in them. After all, how does **svn** know whether `news@11` is the name of a directory in my tree or just a syntax for „revision 11 of `news`“? Thankfully, while **svn** will always assume the latter, there is a trivial workaround. You need only append an at sign to the end of the path, such as `news@11@`. **svn** cares only about the last at sign in the argument, and it is not considered illegal to omit a literal peg revision specifier after that at sign. This workaround even applies to paths that end in an at sign—you would use `filename@@` to talk about a file named `filename@`.

Let's ask the other question, then—in revision 1, what were the contents of whatever file occupied the address `concepts/IDEA` at the time? We'll use an explicit peg revision to help us out.

```
$ svn cat concept/IDEA@1
The idea behind this project is to come up with a piece of software
that can frab a naggily wort.  Frabbing naggily worts is tricky
business, and doing it incorrectly can have serious ramifications, so
we need to employ over-the-top input validation and data verification
mechanisms.
```

Notice that we didn't provide an operative revision this time. That's because when no operative revision is specified, Subversion assumes a default operative revision that's the same as the peg revision.

As you can see, the output from our operation appears to be correct. The text even mentions frabbing naggily worts, so this is almost certainly the file that describes the software now called Frabnaggilywort. In fact, we can verify this using the combination of an explicit peg revision and explicit operative revision. We know that in `HEAD`, the Frabnaggilywort project is located in the `frabnaggilywort` directory. So we specify that we want to see how the line of history identified in `HEAD` as the path `frabnaggilywort/IDEA` looked in revision 1.

```
$ svn cat -r 1 frabnaggilywort/IDEA@HEAD
The idea behind this project is to come up with a piece of software
that can frab a naggily wort.  Frabbing naggily worts is tricky
business, and doing it incorrectly can have serious ramifications, so
we need to employ over-the-top input validation and data verification
mechanisms.
```

And the peg and operative revisions need not be so trivial, either. For example, say `frabnaggilywort` had been deleted from `HEAD`, but we know it existed in revision 20, and we want to see the diffs for its `IDEA` file between revisions 4 and 10. We can use the peg revision 20 in conjunction with the URL that would have held Frabnaggilywort's `IDEA` file in revision 20, and then use 4 and 10 as our operative revision range.

```
$ svn diff -r 4:10 http://svn.red-bean.com/projects/frabnaggilywort/IDEA@20
Index: frabnaggilywort/IDEA
===================================================================
--- frabnaggilywort/IDEA (revision 4)
+++ frabnaggilywort/IDEA (revision 10)
@@ -1,5 +1,5 @@
-The idea behind this project is to come up with a piece of software
-that can frab a naggily wort.  Frabbing naggily worts is tricky
-business, and doing it incorrectly can have serious ramifications, so
-we need to employ over-the-top input validation and data verification
-mechanisms.
+The idea behind this project is to come up with a piece of
+client-server software that can remotely frab a naggily wort.
+Frabbing naggily worts is tricky business, and doing it incorrectly
+can have serious ramifications, so we need to employ over-the-top
+input validation and data verification mechanisms.
```

Fortunately, most folks aren't faced with such complex situations. But when you are, remember that peg revisions are that extra hint Subversion needs to clear up ambiguity.

Changelists

It is commonplace for a developer to find himself working at any given time on multiple different, distinct changes to a particular bit of source code. This isn't necessarily due to poor planning or some form of digital masochism. A software engineer often spots bugs in his peripheral vision while working on some nearby chunk of source code. Or perhaps he's halfway through some large change when he realizes the solution he's working on is best committed as several smaller logical units. Often, these logical units aren't nicely contained in some module, safely separated from other changes. The units might overlap, modifying different files in the same module, or even modifying different lines in the same file.

Developers can employ various work methodologies to keep these logical changes organized. Some use separate working copies of the same repository to hold each individual change in progress. Others might choose to create short-lived feature branches in the repository and use a single working copy that is constantly switched to point to one such branch or another. Still others use **diff** and **patch** tools to back up and restore uncommitted changes to and from patch files associated with each change. Each of these methods has its pros and cons, and to a large degree, the details of the changes being made heavily influence the methodology used to distinguish them.

Subversion 1.5 brings a new *changelists* feature that adds yet another method to the mix. Changelists are basically arbitrary labels (currently at most one per file) applied to working copy files for the express purpose of associating multiple files together. Users of many of Google's software offerings are familiar with this concept already. For example, Gmail [http://mail.google.com/] doesn't provide the traditional folders-based email organization mechanism. In Gmail, you apply arbitrary labels to emails, and multiple emails can be said to be part of the same group if they happen to share a particular label. Viewing only a group of similarly labeled emails then becomes a simple user interface trick. Many other Web 2.0 sites have similar mechanisms—consider the „tags“ used by sites such as YouTube [http://www.youtube.com/] and Flickr [http://www.flickr.com/], „categories“ applied to blog posts, and so on. Folks understand today that organization of data is critical, but that how that data is organized needs to be a flexible concept. The old files-and-folders paradigm is too rigid for some applications.

Subversion's changelist support allows you to create changelists by applying labels to files you want to be associated with that changelist, remove those labels, and limit the scope of the files on which its subcommands operate to only those bearing a particular label. In this section, we'll look in detail at how to do these things.

Creating and Modifying Changelists

You can create, modify, and delete changelists using the **svn changelist** command. More accurately, you use this command to set or unset the changelist association of a particular working copy file. A changelist is effectively created the first time you label a file with that changelist; it is deleted when you remove that label from the last file that had it. Let's examine a usage scenario that demonstrates these concepts.

Harry is fixing some bugs in the calculator application's mathematics logic. His work leads him to change a couple of files:

```
$ svn status
M      integer.c
M      mathops.c
$
```

While testing his bug fix, Harry notices that his changes bring to light a tangentially related bug in the user interface logic found in `button.c`. Harry decides that he'll go ahead and fix that bug, too, as a separate commit from his math fixes. Now, in a small working copy with only a handful of files and few logical changes, Harry can probably keep his two logical change groupings mentally organized without any problem. But today he's going to use Subversion's changelists feature as a special favor to the authors of this book.

Harry first creates a changelist and associates with it the two files he's already changed. He does this by using the **svn changelist** command to assign the same arbitrary changelist name to those files:

```
$ svn changelist math-fixes integer.c mathops.c
Path 'integer.c' is now a member of changelist 'math-fixes'.
Path 'mathops.c' is now a member of changelist 'math-fixes'.
$ svn status

--- Changelist 'math-fixes':
M      integer.c
M      mathops.c
$
```

As you can see, the output of **svn status** reflects this new grouping.

Harry now sets off to fix the secondary UI problem. Since he knows which file he'll be changing, he assigns that path to a changelist, too. Unfortunately, Harry carelessly assigns this third file to the same changelist as the previous two files:

```
$ svn changelist math-fixes button.c
Path 'button.c' is now a member of changelist 'math-fixes'.
$ svn status
```

```
--- Changelist 'math-fixes':
        button.c
M       integer.c
M       mathops.c
$
```

Fortunately, Harry catches his mistake. At this point, he has two options. He can remove the changelist association from `button.c`, and then assign a different changelist name:

```
$ svn changelist --remove button.c
Path 'button.c' is no longer a member of a changelist.
$ svn changelist ui-fix button.c
Path 'button.c' is now a member of changelist 'ui-fix'.
$
```

Or, he can skip the removal and just assign a new changelist name. In this case, Subversion will first warn Harry that `button.c` is being removed from the first changelist:

```
$ svn changelist ui-fix button.c
svn: warning: Removing 'button.c' from changelist 'math-fixes'.
Path 'button.c' is now a member of changelist 'ui-fix'.
$ svn status

--- Changelist 'ui-fix':
        button.c

--- Changelist 'math-fixes':
M       integer.c
M       mathops.c
$
```

Harry now has two distinct changelists present in his working copy, and **svn status** will group its output according to these changelist determinations. Notice that even though Harry hasn't yet modified `button.c`, it still shows up in the output of **svn status** as interesting because it has a changelist assignment. Changelists can be added to and removed from files at any time, regardless of whether they contain local modifications.

Harry now fixes the user interface problem in `button.c`.

```
$ svn status

--- Changelist 'ui-fix':
M       button.c

--- Changelist 'math-fixes':
M       integer.c
M       mathops.c
$
```

Changelists As Operation Filters

The visual grouping that Harry sees in the output of **svn status** as shown in our previous section is nice, but not entirely useful. The **status** command is but one of many operations that he might wish to perform on his working copy. Fortunately, many of Subversion's other operations understand how to operate on changelists via the use of the `--changelist` option.

When provided with a `--changelist` option, Subversion commands will limit the scope of their operation to only those files to which a particular changelist name is assigned. If Harry now wants to see the actual changes he's made to the files in his `math-fixes` changelist, he *could* explicitly list only the files that make up that changelist on the **svn diff** command line.

```
$ svn diff integer.c mathops.c
Index: integer.c
===================================================================
--- integer.c (revision 1157)
+++ integer.c (working copy)
…
Index: mathops.c
===================================================================
--- mathops.c (revision 1157)
+++ mathops.c (working copy)
…
$
```

That works okay for a few files, but what if Harry's change touched 20 or 30 files? That would be an annoyingly long list of explicitly named files. Now that he's using changelists, though, Harry can avoid explicitly listing the set of files in his changelist from now on, and instead provide just the changelist name:

```
$ svn diff --changelist math-fixes
Index: integer.c
===================================================================
--- integer.c (revision 1157)
+++ integer.c (working copy)
…
Index: mathops.c
===================================================================
--- mathops.c (revision 1157)
+++ mathops.c (working copy)
…
$
```

And when it's time to commit, Harry can again use the `--changelist` option to limit the scope of the commit to files in a certain changelist. He might commit his user interface fix by doing the following:

```
$ svn ci -m "Fix a UI bug found while working on math logic." \
      --changelist ui-fix
Sending        button.c
Transmitting file data .
Committed revision 1158.
$
```

In fact, the **svn commit** command provides a second changelists-related option: `--keep-changelists`. Normally, changelist assignments are removed from files after they are committed. But if `--keep-changelists` is provided, Subversion will leave the changelist assignment on the committed (and now unmodified) files. In any case, committing files assigned to one changelist leaves other changelists undisturbed.

```
$ svn status

--- Changelist 'math-fixes':
M      integer.c
M      mathops.c
$
```

The `--changelist` option acts only as a filter for Subversion command targets, and will not add targets to an operation. For example, on a commit operation specified as **`svn commit /path/to/dir`**, the target is the directory `/path/to/dir` and its children (to infinite depth). If you then add a changelist specifier to that command, only those files in and under `/path/to/dir` that are assigned that changelist name will be considered as targets of the commit—the commit will not include files located elsewhere (such is in `/path/to/another-dir`), regardless of their changelist assignment, even if they are part of the same working copy as the operation's target(s).

Even the **svn changelist** command accepts the `--changelist` option. This allows you to quickly and easily rename or remove a changelist:

```
$ svn changelist math-bugs --changelist math-fixes --depth infinity .
svn: warning: Removing 'integer.c' from changelist 'math-fixes'.
Path 'integer.c' is now a member of changelist 'math-bugs'.
svn: warning: Removing 'mathops.c' from changelist 'math-fixes'.
Path 'mathops.c' is now a member of changelist 'math-bugs'.
$ svn changelist --remove --changelist math-bugs --depth infinity .
Path 'integer.c' is no longer a member of a changelist.
Path 'mathops.c' is no longer a member of a changelist.
$
```

Finally, you can specify multiple instances of the `--changelist` option on a single command line. Doing so limits the operation you are performing to files found in any of the specified changesets.

Changelist Limitations

Subversion's changelist feature is a handy tool for grouping working copy files, but it does have a few limitations. Changelists are artifacts of a particular working copy, which means that changelist assignments cannot be propagated to the repository or otherwise shared with other users. Changelists can be assigned only to files—Subversion doesn't currently support the use of changelists with directories. Finally, you can have at most one changelist assignment on a given working copy file. Here is where the blog post category and photo service tag analogies break down—if you find yourself needing to assign a file to multiple changelists, you're out of luck.

Network Model

At some point, you're going to need to understand how your Subversion client communicates with its server. Subversion's networking layer is abstracted, meaning that Subversion clients exhibit the same general behaviors no matter what sort of server they are operating against. Whether speaking the HTTP protocol (`http://`) with the Apache HTTP Server or speaking the custom Subversion protocol (`svn://`) with **svnserve**, the basic network model is the same. In this section, we'll explain the basics of that network model, including how Subversion manages authentication and authorization matters.

Requests and Responses

The Subversion client spends most of its time managing working copies. When it needs information from a remote repository, however, it makes a network request, and the server responds with an appropriate answer. The details of the network protocol are hidden from the user—the client attempts to access a URL, and depending on the URL scheme, a particular protocol is used to contact the server (see the sidebar Repository URLs).

Run **`svn --version`** to see which URL schemes and protocols the client knows how to use.

When the server process receives a client request, it often demands that the client identify itself. It issues an authentication challenge to the client, and the client responds by providing *credentials* back to the server. Once authentication is complete, the server responds with the original information that the client asked for. Notice that this system is different from systems such as CVS, where the client preemptively offers credentials („logs in“) to the server before ever making a request. In Subversion, the server „pulls“ credentials by challenging the client at the appropriate moment, rather than the client „pushing“ them. This makes certain operations more elegant. For example, if a server is configured to allow anyone in the world to read a repository, the server will never issue an authentication challenge when a client attempts to **svn checkout**.

If the particular network requests issued by the client result in a new revision being created in the repository (e.g., **svn commit**), Subversion uses the authenticated username associated with those requests as the author of the revision. That is, the authenticated user's name is stored as the value of the `svn:author` property on the new revision (see „Subversion Properties“). If the client was not authenticated (i.e., if the server never issued an authentication challenge), the revision's `svn:author` property is empty.

Client Credentials Caching

Many servers are configured to require authentication on every request. This would be a big annoyance to users if they were forced to type their passwords over and over again. Fortunately, the Subversion client has a remedy for this—a built-in system for caching authentication credentials on disk. By default, whenever the command-line client successfully responds to a server's authentication challenge, it saves the credentials in the user's private runtime configuration area (`~/.subversion/auth/` on Unix-like systems or `%APPDATA%/Subversion/auth/` on Windows; see „Runtime Configuration Area“ for more details about the runtime configuration system). Successful credentials are cached on disk and keyed on a combination of the server's hostname, port, and authentication realm.

When the client receives an authentication challenge, it first looks for the appropriate credentials in the user's disk cache. If seemingly suitable credentials are not present, or if the cached credentials ultimately fail to authenticate, the client will, by default, fall back to prompting the user for the necessary information.

The security-conscious reader will suspect immediately that there is reason for concern here. „Caching passwords on disk? That's terrible! You should never do that!“

The Subversion developers recognize the legitimacy of such concerns, and so Subversion works with available mechanisms provided by the operating system and environment to try to minimize the risk of leaking this information. Here's a breakdown of what this means for users on the most common platforms:

- On Windows 2000 and later, the Subversion client uses standard Windows cryptography services to encrypt the password on disk. Because the encryption key is managed by Windows and is tied to the user's own login credentials, only the user can decrypt the cached password. (Note that if the user's Windows account password is reset by an administrator, all of the cached passwords become undecipherable. The Subversion client will behave as though they don't exist, prompting for passwords when required.)

- Similarly, on Mac OS X, the Subversion client stores all repository passwords in the login keyring (managed by the Keychain service), which is protected by the user's account password. User preference settings can impose additional policies, such as requiring that the user's account password be entered each time the Subversion password is used.

- For other Unix-like operating systems, no standard „keychain“ services exist. However, the `auth/` caching area is still permission-protected so that only the user (owner) can read data from it, not the world at large. The operating system's own file permissions protect the passwords.

Of course, for the truly paranoid, none of these mechanisms meets the test of perfection. So for those folks willing to sacrifice convenience for the ultimate in security, Subversion provides various ways of disabling its credentials caching system altogether.

To disable caching for a single command, pass the `--no-auth-cache` option:

```
$ svn commit -F log_msg.txt --no-auth-cache
Authentication realm: <svn://host.example.com:3690> example realm
Username:  joe
Password for 'joe':

Adding         newfile
Transmitting file data .
Committed revision 2324.

# password was not cached, so a second commit still prompts us

$ svn delete newfile
$ svn commit -F new_msg.txt
Authentication realm: <svn://host.example.com:3690> example realm
Username:  joe
…
```

Or, if you want to disable credential caching permanently, you can edit the `config` file in your runtime configuration area and set the `store-auth-creds` option to no. This will prevent the storing of credentials used in any Subversion interactions you perform on the affected computer. This can be extended to cover all users on the computer, too, by modifying the system-wide runtime configuration area (described in „Configuration Area Layout“).

```
[auth]
store-auth-creds = no
```

Sometimes users will want to remove specific credentials from the disk cache. To do this, you need to navigate into the `auth/` area and manually delete the appropriate cache file. Credentials are cached in individual files; if you look inside each file, you will see keys and values. The `svn:realmstring` key describes the particular server realm that the file is associated with:

```
$ ls ~/.subversion/auth/svn.simple/
5671adf2865e267db74f09ba6f872c28
3893ed123b39500bca8a0b382839198e
5c3c22968347b390f349ff340196ed39

$ cat ~/.subversion/auth/svn.simple/5671adf2865e267db74f09ba6f872c28

K 8
username
V 3
joe
K 8
password
V 4
```

```
blah
K 15
svn:realmstring
V 45
<https://svn.domain.com:443> Joe's repository
END
```

Once you have located the proper cache file, just delete it.

One last word about **svn**'s authentication behavior, specifically regarding the `--username` and `--password` options. Many client subcommands accept these options, but it is important to understand that using these options does *not* automatically send credentials to the server. As discussed earlier, the server „pulls“ credentials from the client when it deems necessary; the client cannot „push“ them at will. If a username and/or password are passed as options, they will be presented to the server only if the server requests them. These options are typically used to authenticate as a different user than Subversion would have chosen by default (such as your system login name) or when trying to avoid interactive prompting (such as when calling **svn** from a script).

A common mistake is to misconfigure a server so that it never issues an authentication challenge. When users pass `--username` and `--password` options to the client, they're surprised to see that they're never used; that is, new revisions still appear to have been committed anonymously!

Here is a final summary that describes how a Subversion client behaves when it receives an authentication challenge.

1. First, the client checks whether the user specified any credentials as command-line options (`--username` and/or `--password`). If so, the client will try to use those credentials to authenticate against the server.
2. If no command-line credentials were provided, or the provided ones were invalid, the client looks up the server's hostname, port, and realm in the runtime configuration's `auth/` area, to see whether appropriate credentials are cached there. If so, it attempts to use those credentials to authenticate.
3. Finally, if the previous mechanisms failed to successfully authenticate the user against the server, the client resorts to interactively prompting the user for valid credentials (unless instructed not to do so via the `--non-interactive` option or its client-specific equivalents).

If the client successfully authenticates by any of these methods, it will attempt to cache the credentials on disk (unless the user has disabled this behavior, as mentioned earlier).

Summary

After reading this chapter, you should have a firm grasp on some of Subversion's features that, while perhaps not used *every* time you interact with your version control system, are certainly handy to know about. But don't stop here! Read on to the following chapter, where you'll learn about branches, tags, and merging. Then you'll have nearly full mastery of the Subversion client. Though our lawyers won't allow us to promise you anything, this additional knowledge could make you measurably more cool. [12]

[12] No purchase necessary. Certains terms and conditions apply. No guarantee of coolness—implicit or otherwise—exists. Mileage may vary.

Kapitel 4. Verzweigen und Zusammenführen

„#### (Der Edle pflegt die Wurzel)“

—Konfuzius

Verzweigen (Branching), Etikettieren (Tagging) und Zusammenführen (Merging) sind Konzepte, die fast allen Versionskontrollsystemen gemein sind. Falls Sie mit diesen Begriffen nicht vertraut sein sollten, geben wir in diesem Kapitel eine gute Einführung. Falls Sie damit vertraut sind, werden Sie es hoffentlich interessant finden, zu sehen, wie Subversion diese Konzepte implementiert.

Verzweigen ist ein grundlegender Teil der Versionskontrolle. Falls Sie Subversion erlauben wollen, Ihre Daten zu verwalten, ist dies eine Fähigkeit, von der Sie letztendlich abhängig sein werden. Dieses Kapitel geht davon aus, dass Sie mit den grundlegenden Konzepten von Subversion vertraut sind (Kapitel 1, *Grundlegende Konzepte*).

Was ist ein Zweig?

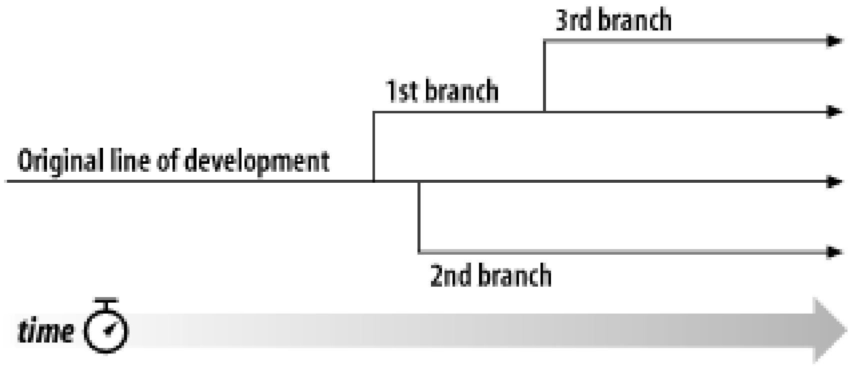
Angenommen, Ihre Aufgabe ist es, ein Dokument für eine Abteilung Ihrer Firma zu pflegen – eine Art Handbuch. Eines Tages fragt eine andere Abteilung nach dem gleichen Handbuch, jedoch an einigen Stellen für ihre Bedürfnisse „abgewandelt“, da sie auf etwas andere Weise arbeiten.

Was machen Sie in dieser Situation? Sie machen das Offensichtliche: Sie erstellen eine Kopie Ihres Dokumentes und beginnen, die beiden Kopien getrennt zu pflegen. Sobald Sie irgendeine Abteilung auffordert, kleine Änderungen vorzunehmen, pflegen Sie diese in die eine oder andere Kopie ein.

Oftmals möchten Sie die selbe Änderung in beiden Kopien machen. Wenn Sie zum Beispiel einen Schreibfehler in der ersten Kopie entdecken, ist es sehr wahrscheinlich, dass dieser Fehler auch in der zweiten Kopie vorliegt. Schließlich sind die beiden Dokumente fast gleich; sie unterscheiden sich nur in kleinen Dingen.

Das ist das Grundkonzept eines *Zweigs* (Branch) – nämlich eine Entwicklungslinie, die unabhängig von einer anderen existiert, jedoch über eine gemeinsame Geschichte verfügt, wenn lang genug in der Zeit zurück gegangen wird. Ein Zweig beginnt sein Leben stets als eine Kopie von etwas und läuft von da an weiter, wobei er seine eigene Geschichte erzeugt (siehe Abbildung 4.1, „Entwicklungszweige“).

Abbildung 4.1. Entwicklungszweige



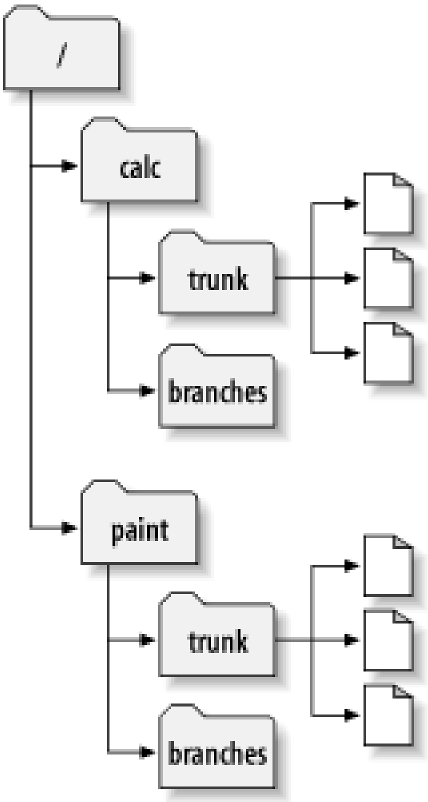
Subversion verfügt über Befehle, die Ihnen helfen, parallele Zweige Ihrer Dateien und Verzeichnisse zu verwalten. Es erlaubt Ihnen, durch das Kopieren Ihrer Daten, Zweige zu erstellen und merkt sich, dass die Zweige untereinander in Beziehung stehen. Es hilft Ihnen auch, Änderungen von einem Zweig auf den anderen zu duplizieren. Schließlich ermöglicht es, dass Teile Ihrer Arbeitskopie verschiedene Zweige repräsentieren können, was Ihnen während Ihrer täglichen Arbeit erlaubt, verschiedene Entwicklungslinien zu „mischen und gegenüberzustellen“.

Verwenden von Zweigen

An dieser Stelle sollten Sie verstehen, wie jede Übergabe an das Repository dort einen völlig neuen Dateibaum („Revision“ genannt) erzeugt. Wenn nicht, blättern Sie zurück und lesen Sie in „Revisionen“ über Revisionen nach.

Für dieses Kapitel verwenden wir das Beispiel aus Kapitel 1, *Grundlegende Konzepte*. Erinnern Sie sich, dass Sie und Ihre Mitarbeiterin Sally sich ein Repository teilen, das zwei Projekte beinhaltet: `paint` und `calc`. Beachten Sie, dass in Abbildung 4.2, „Repository-Struktur zu Beginn“ dieses Mal jedoch jedes Projektverzeichnis Unterverzeichnisse namens `trunk` und `branches` beinhaltet. Der Grund hierfür wird bald klar sein.

Abbildung 4.2. Repository-Struktur zu Beginn



Wie vorher sei hier angenommen, dass sowohl Sally als auch Sie Arbeitskopien des „calc“ Projektes besitzen. Ausdrücklich hat jeder von Ihnen eine Arbeitskopie von `/calc/trunk`. Alle Dateien des Projektes befinden sich in diesem Unterverzeichnis statt in `/calc` selber, da Ihr Team entschieden hat, dass in `/calc/trunk` die „Hauptlinie“ der Entwicklung stattfindet.

Sagen wir mal, dass Sie die Aufgabe bekommen haben, ein großes Stück Software umzusetzen. Die Erstellung benötigt eine lange Zeit und berührt alle Dateien im Projekt.

Das Problem, dass sofort auftaucht ist, dass Sie nicht Sally in die Quere kommen möchten, die gerade hier und da kleinere Fehler beseitigt. Sie ist abhängig von der Tatsache, dass die letzte Version des Projektes (in `/calc/trunk`) stets benutzbar ist. Wenn Sie nun damit beginnen, Stück für Stück Ihre Änderungen zu übergeben, werden Sie gewiss die Dinge für Sally (und auch für andere Teammitglieder) in Unordnung bringen.

Eine Strategie ist, sich in ein Loch zu verkriechen: Sie und Sally können für eine Woche oder zwei den Informationsaustausch einstellen. Das heißt, Sie fangen damit an, die Dateien Ihrer Arbeitskopie auszuräumen und umzuorganisieren, ohne Änderungen zu übergeben oder die Arbeitskopie zu aktualisieren, bevor Sie mit Ihrer Arbeit vollständig fertig sind. Das wirft allerdings einige Probleme auf. Erstens ist das nicht sehr sicher. Viele Leute möchten Ihre Arbeit regelmäßig ins Repository sichern, für den Fall, dass etwas Schlimmes mit der Arbeitskopie passieren könnte. Zweitens ist das nicht sehr flexibel. Falls Sie Ihre Arbeit an mehreren Rechnern verrichten (vielleicht haben Sie eine Arbeitskopie von `/calc/trunk` auf zwei unterschiedlichen Maschinen), müssten Sie entweder alle Änderungen manuell hin und her kopieren oder die gesamte Arbeit an nur einem Rechner erledigen. Ebenso schwierig wäre es, Ihre Änderungen mit anderen zu teilen. Eine weit verbreitete „beste Vorgehensweise" ist es, Ihren Mitarbeitern zu erlauben, während Sie mit Ihrer Arbeit fortfahren, Ihre bisherigen Ergebnisse zu überprüfen. Wenn niemand Ihre unmittelbaren Änderungen sieht, haben Sie keine möglichen Rückmeldungen und es könnte sein, dass Sie für Wochen einen falschen Weg einschlagen, bevor es jemand aus Ihrem Team bemerkt. Schließlich könnte es am Ende, wenn Sie mit Ihren Änderungen fertig sind, sehr schwierig sein, Ihr Arbeitsergebnis wieder mit dem Hauptteil der Quelltexte Ihrer Firma zusammenzuführen. Sally (und andere) hätten viele andere Änderungen ins Repository übergeben haben können, die sich schwer in Ihre Arbeitskopie einarbeiten ließen – besonders, falls Sie **svn update** nach Wochen der Isolierung ausführen.

Die bessere Lösung ist, Ihren eigenen Zweig oder Ihre eigene Entwicklungslinie im Repository zu erzeugen. Dies erlaubt Ihnen, Ihre halbfertigen Arbeitsergebnisse regelmäßig zu sichern, ohne andere zu stören; dennoch können Sie selektiv Informationen mit Ihren Kollegen teilen. Im Weiteren werden Sie sehen, wie das funktioniert.

Erzeugen eines Zweiges

Es ist sehr einfach, einen Zweig zu erzeugen – Sie erstellen mit dem Befehl **svn copy** eine Kopie des Projektes im Repository. Subversion kann nicht nur Dateien, sondern auch komplette Verzeichnisse kopieren. In diesem Fall möchten Sie eine Kopie des Verzeichnisses `/calc/trunk` machen. Wo soll die neue Kopie angelegt werden? Wo Sie wünschen – es ist eine Frage der Projektkonventionen. Sagen wir mal, dass Ihr Team die Konvention vereinbart hat, Zweige im Bereich `/calc/branches` des Repositorys anzulegen, und Sie Ihren Zweig `my-calc-branch` nennen möchten. Sie werden ein neues Verzeichnis `/calc/branches/my-calc-branch` anlegen, das als Kopie von `/calc/trunk` beginnt.

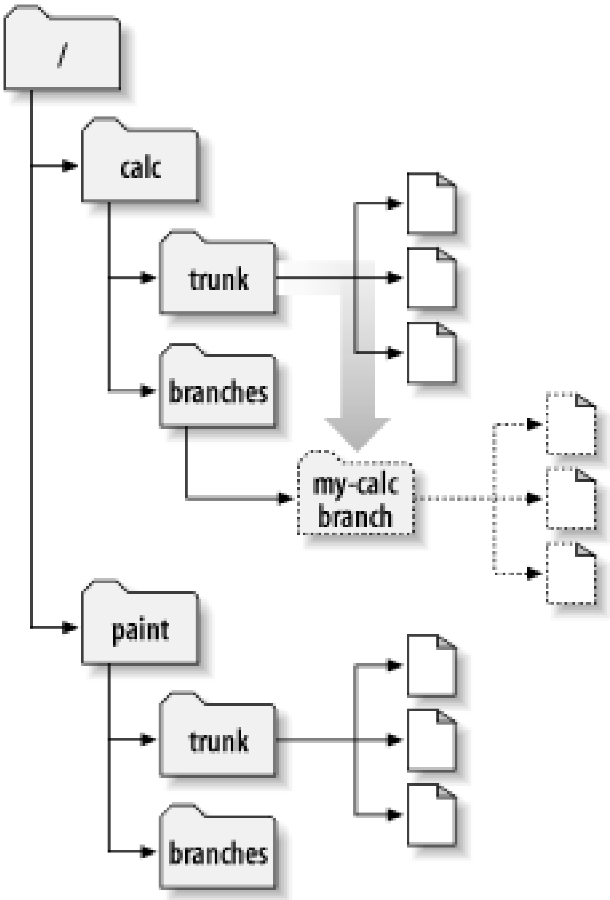
Sie haben vielleicht schon gesehen, wie mit **svn copy** in einer Arbeitskopie eine Datei auf eine andere kopiert wird. Es kann allerdings auch verwendet werden, um eine „entfernte" Kopie innerhalb des Repositorys durchzuführen. Kopieren Sie einfach einen URL auf einen anderen:

```
$ svn copy http://svn.example.com/repos/calc/trunk \
           http://svn.example.com/repos/calc/branches/my-calc-branch \
      -m "Creating a private branch of /calc/trunk."

Committed revision 341.
```

Dieser Befehl bewirkt eine fast sofortige Übergabe im Repository, wobei in Revision 341 ein neues Verzeichnis erzeugt wird. Das neue Verzeichnis ist eine Kopie von `/calc/trunk`. Dies wird in Abbildung 4.3, „Repository mit neuer Kopie" gezeigt. [1] Obwohl es auch möglich ist, einen Zweig zu erzeugen, indem **svn copy** verwendet wird, um ein Verzeichnis innerhalb der Arbeitskopie zu duplizieren, wird dieses Vorgehen nicht empfohlen. Es kann in der Tat sehr langsam sein! Das client-seitige Kopieren eines Verzeichnisses besitzt einen linearen Zeitaufwand, da wirklich jede Datei und jedes Verzeichnis auf der lokalen Platte dupliziert werden muss. Das Kopieren eines Verzeichnisses auf dem Server jedoch besitzt einen konstanten Zeitaufwand und ist die Art und Weise, auf die die meisten Leute Zweige erstellen.

Abbildung 4.3. Repository mit neuer Kopie



Billige Kopien

Das Repository von Subversion ist auf eine besondere Weise konstruiert. Wenn Sie ein Verzeichnis kopieren, brauchen Sie sich keine Gedanken darüber zu machen, dass das Repository riesengroß wird – Subversion dupliziert tatsächlich überhaupt keine Daten. Stattdessen erzeugt es einen neuen Verzeichniseintrag, der auf einen *bestehenden* Baum verweist. Falls Sie ein erfahrener Unix-Benutzer sind, werden Sie erkennen, dass es sich um dasselbe Konzept handelt wie bei einem Hardlink. Während weitere Änderungen an den Dateien und Verzeichnissen unterhalb des kopierten Verzeichnisses gemacht werden, fährt Subversion fort, dieses Konzept anzuwenden wo es geht. Es dupliziert Daten nur dann, wenn es notwendig wird, verschiedene Versionen von Objekten auseinanderzuhalten.

Deshalb hören Sie Subversion-Benutzer oft von „billigen Kopien“ sprechen. Es spielt

[1]Subversion unterstützt nicht das Kopieren zwischen verschiedenen Repositorys. Wenn Sie mit **svn copy** oder **svn move** URLs verwenden, können Sie nur Objekte innerhalb desselben Repositorys kopieren oder verschieben.

keine Rolle, wie umfangreich das Verzeichnis ist – es bedarf lediglich eines kleinen, konstanten Zeitaufwands und Speicherplatzes, um eine Kopie davon zu erstellen. Diese Fähigkeit ist tatsächlich die Grundlage für die Umsetzung von Übergaben in Subversion: Jede Revision ist eine „billige Kopie" der vorhergehenden Revision mit ein paar Dingen, die sich im Innern geändert haben. (Um mehr hierüber zu lesen, gehen Sie auf die Website von Subversion und lesen Sie in den Subversion-Design-Dokumenten über die „bubble-up"-Methode.)

Natürlich sind diese internen Mechanismen des Kopierens und Teilens vor dem Benutzer verborgen, der lediglich Kopien von Bäumen sieht. Die Hauptsache hierbei ist, das Kopien billig sind, sowohl was die Zeit als auch den Speicherplatz angeht. Wenn Sie einen Zweig komplett im Repository anlegen (durch den Aufruf von **svn copy *URL1 URL2***), handelt es sich um eine schnelle Operation mit konstanter Zeitdauer. Erstellen Sie Zweige so oft Sie wollen.

Arbeiten mit Ihrem Zweig

Da Sie nun einen Zweig des Projektes erzeugt haben, können Sie eine neue Arbeitskopie auschecken, um ihn zu benutzen:

```
$ svn checkout http://svn.example.com/repos/calc/branches/my-calc-branch
A  my-calc-branch/Makefile
A  my-calc-branch/integer.c
A  my-calc-branch/button.c
Checked out revision 341.
```

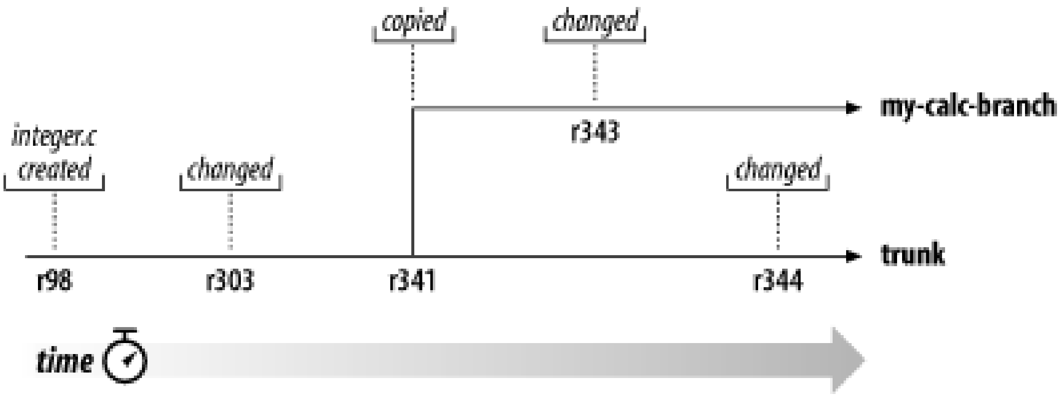
An dieser Arbeitskopie ist nichts besonders; sie spiegelt bloß ein anderes Verzeichnis im Repository wieder. Wenn Sie Änderungen übergeben, wird sie Sally jedoch nicht sehen, wenn sie aktualisiert, da sie eine Arbeitskopie von `/calc/trunk` hat. (Stellen Sie sicher, dass Sie „Traversing Branches" weiter unten in diesem Kapitel lesen: Der Befehl **svn switch** ist eine Alternative für die Bereitstellung einer Arbeitskopie eines Zweiges.)

Tun wir mal so, als ob eine Woche ins Land geht und die folgenden Übergaben stattfinden:

- Sie machen eine Änderung an `/calc/branches/my-calc-branch/button.c`, die die Revision 342 erzeugt.
- Sie machen eine Änderung an `/calc/branches/my-calc-branch/integer.c`, die die Revision 343 erzeugt.
- Sally macht eine Änderung an `/calc/trunk/integer.c`, die die Revision 344 erzeugt.

Nun finden zwei unabhängige Entwicklungslinien (siehe Abbildung 4.4, „Die Verzweigung der Geschichte einer Datei") auf `integer.c` statt.

Abbildung 4.4. Die Verzweigung der Geschichte einer Datei



Es wird interessant, wenn Sie die Geschichte der Änderungen an Ihrer Kopie von `integer.c` betrachten:

```
$ pwd
/home/user/my-calc-branch

$ svn log -v integer.c
------------------------------------------------------------------------
r343 | user | 2002-11-07 15:27:56 -0600 (Thu, 07 Nov 2002) | 2 lines
Changed paths:
   M /calc/branches/my-calc-branch/integer.c

* integer.c:  frozzled the wazjub.

------------------------------------------------------------------------
r341 | user | 2002-11-03 15:27:56 -0600 (Thu, 07 Nov 2002) | 2 lines
Changed paths:
   A /calc/branches/my-calc-branch (from /calc/trunk:340)

Creating a private branch of /calc/trunk.

------------------------------------------------------------------------
r303 | sally | 2002-10-29 21:14:35 -0600 (Tue, 29 Oct 2002) | 2 lines
Changed paths:
   M /calc/trunk/integer.c

* integer.c:  changed a docstring.

------------------------------------------------------------------------
r98 | sally | 2002-02-22 15:35:29 -0600 (Fri, 22 Feb 2002) | 2 lines
Changed paths:
   A /calc/trunk/integer.c

* integer.c:  adding this file to the project.

------------------------------------------------------------------------
```

Beachten Sie, dass Subversion die Geschichte von `integer.c` auf Ihrem Zweig über die gesamte Zeit zurück verfolgt, und dabei sogar über den Punkt hinweg geht, an dem es kopiert wurde. Es zeigt die Erzeugung des Zweigs als ein Ereignis in der Geschichte, da `integer.c` implizit kopiert wurde, als alles andere in `/calc/trunk/` kopiert wurde. Sehen Sie nun, was passiert, wenn Sally den gleichen Befehl auf Ihre Arbeitskopie der Datei anwendet:

```
$ pwd
/home/sally/calc

$ svn log -v integer.c
------------------------------------------------------------------------
```

```
r344 | sally | 2002-11-07 15:27:56 -0600 (Thu, 07 Nov 2002) | 2 lines
Changed paths:
   M /calc/trunk/integer.c

* integer.c:  fix a bunch of spelling errors.

------------------------------------------------------------------------
r303 | sally | 2002-10-29 21:14:35 -0600 (Tue, 29 Oct 2002) | 2 lines
Changed paths:
   M /calc/trunk/integer.c

* integer.c:  changed a docstring.

------------------------------------------------------------------------
r98 | sally | 2002-02-22 15:35:29 -0600 (Fri, 22 Feb 2002) | 2 lines
Changed paths:
   A /calc/trunk/integer.c

* integer.c:  adding this file to the project.

------------------------------------------------------------------------
```

Sally sieht ihre eigene Änderung in Revision 344, aber nicht die Änderung, die Sie in Revision 343 gemacht haben. Was Subversion angeht, hatten diese beiden Übergaben Auswirkungen auf unterschiedliche Dateien an unterschiedlichen Repository-Orten. Dennoch zeigt Subversion *doch*, dass die beiden Dateien einen Teil der Geschichte gemeinsam haben. Bevor die Kopie des Zweiges in Revision 341 gemacht wurde, waren die Dateien dieselbe Datei. Deshalb sehen sowohl Sie als auch Sally die Änderungen, die in den Revisionen 303 und 98 gemacht wurden.

Die Schlüsselkonzepte des Verzweigens

Sie sollten sich zwei Lektionen aus diesem Abschnitt merken. Erstens besitzt Subversion kein internes Konzept für einen Zweig – es weiß lediglich, wie Kopien angelegt werden. Wenn Sie ein Verzeichnis kopieren, ist das entstehende Verzeichnis bloß ein „Zweig“, weil *Sie* ihm diese Bedeutung geben. Sie mögen über das Verzeichnis anders denken oder es anders behandeln, doch für Subversion ist es einfach ein gewöhnliches Verzeichnis, das nebenbei mit einigen zusätzlichen historischen Informationen ausgestattet ist.

Zweitens bestehen die Zweige von Subversion, bedingt durch den Kopiermechanismus, als *normale Dateisystemverzeichnisse* im Repository. Das ist ein Unterschied zu anderen Versionskontrollsystemen, bei denen Zweige typischerweise definiert werden, indem auf einer eigenen Ebene den Dateisammlungen „Etiketten“ hinzugefügt werden. Der Ort Ihres Zweig-Verzeichnisses spielt für Subversion keine Rolle. Die meisten Teams folgen der Konvention, alle Zweige in einem Verzeichnis namens `/branches` abzulegen, jedoch steht es Ihnen frei, eine Vorgehensweise nach Ihren Wünschen zu erfinden.

Grundlegendes Zusammenführen

Nun arbeiten Sie und Sally auf parallelen Zweigen des Projektes: Sie arbeiten auf einem privaten Zweig, und Sally arbeitet auf dem *Stamm* oder dem Hauptzweig der Entwicklung.

Bei Projekten mit einer großen Zahl von Mitarbeitern haben die meisten gewöhnlich Arbeitskopien vom Stamm. Sobald jemand eine langwierige Änderung machen muss, die wahrscheinlich den Stamm stören würde, ist die Standardvorgehensweise, einen Zweig zu erzeugen und die Änderungen bis zum Abschluss der Arbeiten nach dorthin zu übergeben.

Die gute Nachricht ist also, dass Sie und Sally sich nicht in die Quere kommen. Die schlechte Nachricht ist, dass es sehr leicht ist, *zu* weit auseinander zu treiben. Erinnnern Sie sich, dass eins der Probleme bei der Strategie „sich in ein Loch zu verkriechen“ war, dass es zu dem Zeitpunkt, an dem Sie mit dem Zweig fertig sind, fast unmöglich sein kann, Ihre Änderungen ohne eine riesige Zahl an Konflikten auf den Stamm zurückzuführen.

Stattdessen könnten Sie und Sally fortfahren, während der Arbeit Änderungen gemeinsam zu verwenden. Es liegt an Ihnen, zu entscheiden, welche Änderungen teilenswert sind; Subversion bietet Ihnen die Fähigkeit, Änderungen selektiv zwischen Zweigen zu „kopieren“. Und wenn Sie mit Ihrem Zweig vollständig fertig sind, kann die gesamte Menge Ihrer Änderungen vom Zweig auf den Stamm zurück kopiert werden. In der Terminologie von Subversion heißt der allgemeine Vorgang, Änderungen von einem Zweig auf einen anderen zu übertragen *Zusammenführen* (Merging) und wird durch verschiedene Aufrufe des Befehls **svn merge** durchgeführt.

In den folgenden Beispielen gehen wir davon aus, dass sowohl auf Ihrem Subversion-Client als auch auf dem Server Subversion 1.5 (oder neuer) läuft. Falls einer von beiden älter als Version 1.5 ist, wird es komplizierter: Das System wird Änderungen nicht automatisch mitverfolgen, so dass Sie schmerzhafte manuelle Methoden anwenden müssen, um ähnliche Resultate zu erzielen. Dass heißt, dass Sie stets die detaillierte Syntax beim Zusammenführen verwenden müssen, um bestimmte Revisionsintervalle zu übertragen (siehe „Merge-Syntax: Die vollständige Enthüllung“ weiter unten in diesem Kapitel), und besonders sorgfältig verfolgen müssen, was bereits zusammengeführt ist und was nicht. Aus diesem Grund empfehlen wir Ihnen *dringend*, sicherzustellen, dass Ihr Client und Server mindestens die Version 1.5 haben.

Änderungsmengen

Bevor wir weitermachen, sollten wir Sie warnen, dass Sie auf den kommenden Seiten viele Erörterungen zum Thema „Änderungen“ erwarten. Viele mit Versionskontrollsystemen erfahrene Leute benutzen die Begriffe „Änderung“ und „Änderungsmenge“ (changeset) austauschbar, so dass wir klären sollten, was Subversion unter einer *Änderungsmenge* versteht.

Jeder scheint eine etwas unterschiedliche Definition für den Begriff Änderungsmenge zu haben oder zumindest eine unterschiedliche Erwartung darüber, was es für ein Versionskontrollsystem bedeutet, so etwas zu besitzen. Für unsere Zwecke reicht es aus, zu sagen, dass eine Änderungsmenge lediglich eine Sammlung von Änderungen mit einem eindeutigen Namen ist. Die Änderungen können aus der Bearbeitung an Textdateien, Modifizierungen an der Baumstruktur oder Justierungen an Metadaten bestehen. In einfachen Worten ist eine Änderungsmenge einfach ein Patch mit einem Namen, auf den Sie sich beziehen können.

In Subversion bezeichnet eine globale Revisionsnummer N einen Baum im Repository: Sie beschreibt das Aussehen des Repositorys nach der N-ten Übergabe. Sie ist auch der Name einer impliziten Änderungsmenge: Wenn Sie den Baum N mit dem Baum N#1 vergleichen, können Sie genau den Patch ableiten, der übergeben wurde. Daher ist es einfach, sich Revision N nicht nur als Baum sondern auch als Änderungsmenge vorzustellen. Falls Sie ein Fehlerverwaltungssystem verwenden, können Sie die Revisionsnummern benutzen, um auf bestimmte Patches zu verweisen, die Fehler beheben – zum Beispiel: „Dieser Fehler wurde durch r9238 behoben“. Dann kann jemand **`svn log -r 9238`** aufrufen, um den Protokolleintrag zu genau der Änderungsmenge zu lesen, die den Fehler behoben hat, und sich mit **`svn diff -c 9238`** den eigentlichen Patch ansehen. Und auch (wie Sie bald sehen werden) der Subversion Befehl **svn merge** kann Revisionsnummern verwenden. Sie können bestimmte Änderungsmengen von einem Zweig mit einem anderen zusammenführen, indem sie in den Argumenten zum entsprechenden Kommando benannt werden: Die Übergabe von **`-c 9238`** an **svn merge** würde das Änderungsmenge r9238 mit Ihrer Arbeitskopie zusammenführen.

Einen Zweig synchron halten

Machen wir mit unserem Beispiel weiter und nehmen an, dass eine Woche vergangen ist seitdem Sie begonnen haben, auf Ihrem privaten Zweig zu arbeiten. Ihre Arbeit ist noch nicht beendet, jedoch wissen Sie, dass gleichzeitig andere Leute in Ihrem Team weiterhin wichtige Änderungen im `/trunk` des Projektes gemacht haben. Es ist in Ihrem Interesse, diese Änderungen in Ihren Zweig zu übernehmen, um sicherzustellen, dass sie sich gut mit Ihren Änderungen vertragen. Dies ist tatsächlich eine der besten Vorgehensweisen: Ihren Zweig regelmäßig mit der Hauptentwicklungslinie zu synchronisieren hilft, „überraschende" Konflikte zu vermeiden, wenn es an der Zeit ist, Ihre Änderungen zurück auf den Stamm zu bringen.

Subversion kennt die Geschichte Ihres Zweigs und weiß, wann Sie ihn vom Stamm abgezweigt haben. Um die letzten, aktuellsten Änderungen vom Stamm auf Ihren Zweig zu bringen, sollten Sie zunächst sicherstellen, dass die Arbeitskopie des Zweigs „sauber" ist – dass sie keine lokalen Änderungen hat, die durch **svn status** angezeigt werden. Dann rufen Sie einfach die folgenden Befehle auf:

```
$ pwd
/home/user/my-calc-branch

$ svn merge http://svn.example.com/repos/calc/trunk
--- Merging r345 through r356 into '.':
U    button.c
U    integer.c
```

Diese einfache Syntax – **`svn merge`** ***`URL`*** – fordert Subversion auf, alle neuen Änderungen von dem URL mit dem aktuellen Arbeitsverzeichnis (welches typischerweise das Wurzelverzeichnis Ihrer Arbeitskopie ist) zusammenzuführen. Nach dem Ausführen des vorangegangenen Beispiels enthält Ihre Arbeitskopie nun neue lokale Änderungen, die Nachbildungen all der Änderungen auf dem Stamm seit der Erstellung Ihres Zweiges sind:

```
$ svn status
 M     .
M      button.c
M      integer.c
```

Zu diesem Zeitpunkt ist es weise, sich die Änderungen mithilfe von **svn diff** sorgfältig anzusehen, und anschliessend die Software von Ihrem Zweig zu bauen und zu testen. Beachten Sie, dass auch das aktuelle Arbeitsverzeichnis („**`.`**") verändert wurde; **svn diff** zeigt an, dass seine Eigenschaft `svn:mergeinfo` entweder angelegt oder modifiziert wurde. Das ist ein wichtiges Metadatum in Zusammenhang mit Zusammenführungen, das Sie *nicht* anfassen sollten, da es von künftigen **svn merge**-Befehlen benötigt wird. (Wir werden später in diesem Kapitel mehr über diese Metadaten erfahren.)

Nach der Übernahme kann es möglich sein, dass Sie noch einige Konflikte auflösen müssen (wie bei **svn update**) oder möglicherweise noch einige kleinere Bearbeitungen durchzuführen haben, damit alles wieder funktioniert. (Denken Sie daran, dass die Abwesenheit *syntaktischer* Konflikte nicht bedeutet, dass keine *semantischen* Konflikte vorhanden sind!) Falls ernsthafte Probleme auftauchen, können Sie jederzeit die lokalen Änderungen mit **`svn revert . -R`** wieder rückgängig machen und eine lange „was geht hier eigentlich vor"-Unterredung mit Ihren Mitarbeitern führen. Falls jedoch alles gut aussieht, können Sie die Änderungen an das Repository übergeben:

```
$ svn commit -m "Merged latest trunk changes to my-calc-branch."
Sending        .
Sending        button.c
Sending        integer.c
Transmitting file data ..
Committed revision 357.
```

An dieser Stelle ist Ihr Zweig „synchron" mit dem Stamm, und Sie können sich ruhig zurücklehnen in der Gewissheit, dass Sie sich nicht zu weit von der Arbeit aller anderen entfernen, während Sie isoliert weiterarbeiten.

Warum stattdessen keine Patches verwenden?

Eine Frage könnte Ihnen durch den Kopf gehen, besonders, falls Sie ein Unix-Benutzer sind: Warum soll ich überhaupt **svn merge** verwenden? Warum kann ich dieselbe Aufgabe nicht mit dem Betriebssystembefehl **patch** lösen? Zum Beispiel:

```
$ cd my-calc-branch
$ svn diff -r 341:HEAD http://svn.example.com/repos/calc/trunk > patchfile
$ patch -p0  < patchfile
Patching file integer.c using Plan A...
Hunk #1 succeeded at 147.
Hunk #2 succeeded at 164.
Hunk #3 succeeded at 241.
Hunk #4 succeeded at 249.
done
```

Bei diesem speziellen Beispiel gibt es wahrhaftig keinen großen Unterschied. Allerdings hat **svn merge** besondere Fähigkeiten, die über die des Programmes **patch** hinaus gehen. Das von **patch** verwendete Dateiformat ist sehr eingeschränkt; es kann lediglich Dateiinhalte verändern. Es besteht keine Möglichkeit, Änderungen an *Bäumen*, etwa das Hinzufügen, Entfernen oder Umbenennen von Dateien und Verzeichnissen abzubilden. Desweiteren bemerkt das Programm **patch** keine Änderungen an Eigenschaften. Falls Sallys Änderung etwa ein neues Verzeichnis hinzugefügt hätte, wäre es in der Ausgabe von **svn diff** überhaupt nicht erwähnt worden. **svn diff** gibt nur das eingeschränkte patch-Format aus, so dass es einige der Konzepte gar nicht wiedergeben kann.

Der Befehl **svn merge** jedoch kann Änderungen an der Baumstruktur und an Eigenschaften erfassen, indem sie direkt auf Ihre Arbeitskopie angewendet werden. Noch wichtiger ist, dass dieser Befehl alle Änderungen festhält, die auf Ihren Zweig angewendet wurden, so dass Subversion genau Bescheid weiß, welche Änderungen an welcher Stelle vorhanden sind (siehe „Mergeinfo und Vorschauen“). Dies ist eine kritische Fähigkeit, die die Verwaltung von Zweigen brauchbar macht; ohne sie müssten Benutzer sich manuelle Aufzeichnungen darüber machen, welche Änderungsmengen zusammengeführt worden sind und welche noch nicht.

Nehmen wir an, noch eine Woche sei ins Land gegangen. Sie haben weitere Änderungen an Ihren Zweig übergeben, und Ihre Kollegen haben damit weitergemacht, den Stamm zu verbessern. Nun möchten Sie mal wieder die letzten Änderungen vom Stamm mit Ihrem Zweig abgleichen, damit Sie wieder synchron sind. Starten Sie einfach noch einmal den **svn merge**-Befehl!

```
$ svn merge http://svn.example.com/repos/calc/trunk
--- Merging r357 through r380 into '.':
U    integer.c
U    Makefile
A    README
```

Subversion weiß, welche Änderungen Sie bereits mit Ihrem Zweig abgeglichen haben, so dass es sorgfältig nur die Änderungen berücksichtigt, die Sie noch nicht haben. Einmal mehr müssen Sie bauen, testen und die lokalen Änderungen an Ihren Zweig mit **svn commit** übergeben.

Was passiert jedoch, wenn Sie schließlich Ihre Arbeit abgeschlossen haben? Ihre neue Funktion ist fertig, und Sie sind bereit, die Änderungen von Ihrem Zweig zurück auf den Stamm zu überführen (so dass Ihr Team die Früchte Ihrer Arbeit genießen kann). Die Vorgehensweise ist einfach. Zunächst synchronisieren Sie Ihren Zweig noch einmal mit dem Stamm, wie Sie es bisher gemacht haben:

```
$ svn merge http://svn.example.com/repos/calc/trunk
--- Merging r381 through r385 into '.':
U    button.c
U    README

$ # bauen, testen, ...

$ svn commit -m "Final merge of trunk changes to my-calc-branch."
Sending        .
Sending        button.c
Sending        README
Transmitting file data ..
Committed revision 390.
```

Nun verwenden Sie **svn merge**, um Ihre Änderungen vom Zweig zurück auf den Stamm zu überführen. Sie benötigen eine aktuelle Arbeitskopie von `/trunk`. Sie bekommen sie entweder durch **svn checkout**, indem Sie von irgendwo auf Ihrer Platte eine alte Arbeitskopie vom Stamm hervorholen, oder den Befehl **svn switch** (siehe „Traversing Branches") verwenden. Wie auch immer Sie Ihre Arbeitskopie bereitstellen, denken Sie daran, dass Sie die Überführung in einer Arbeitskopie durchführen, die *keine* lokalen Änderungen beinhaltet und jüngst aktualisiert wurde (d.h., keine Mischung aus lokalen Revisionen ist). Falls Ihre Arbeitskopie nicht „sauber" in diesem Sinn ist, könnte es Ihnen einige unnötige konfliktbezogene Kopfschmerzen bereiten, und **svn merge** wird wahrscheinlich einen Fehler ausgeben.

Sobald Sie eine saubere Arbeitskopie des Stamms haben, sind Sie bereit, Ihren Zweig damit zusammenzuführen:

```
$ pwd
/home/user/calc-trunk

$ svn update  # (stellen Sie sicher, dass die Arbeitskopie aktuell ist)
At revision 390.

$ svn merge --reintegrate http://svn.example.com/repos/calc/branches/my-calc-br
--- Merging differences between repository URLs into '.':
U    button.c
U    integer.c
U    Makefile
 U   .

$ # bauen, testen, überprüfen, ...

$ svn commit -m "Merge my-calc-branch back into trunk!"
Sending        .
Sending        button.c
Sending        integer.c
Sending        Makefile
Transmitting file data ..
Committed revision 391.
```

Gratulation! Ihr Zweig ist nun zurück in die Hauptentwicklungslinie überführt worden. Beachten Sie, dass dieses Mal die Option `--reintegrate` verwendet wurde. Diese Option ist kritisch, wenn Änderungen von einem Zweig in die ursprüngliche Entwicklungslinie reintegriert werden – vergessen Sie sie nicht! Sie wird benötigt, da diese Art der „Rücküberführung" etwas anderes ist, als was Sie bisher gemacht haben. Vorher haben wir **svn merge** aufgefordert, die „nächste Änderungsmenge" von einer Entwicklungslinie (dem Stamm) zu holen und sie mit einer anderen (Ihrem Zweig) abzugleichen. Das ist recht überschaubar, und Subversion weiß jedesmal, wo es wieder ansetzen soll. Bei unseren vorangehenden Beispielen können Sie sehen, dass es erst die Intervalle 345:356 vom Stamm auf den Zweig überführte; später fuhr es mit dem nächsten verfügbaren aufeinanderfolgenden Intervall 356:380 fort. Wenn Sie die letzte

Synchronisierung machen, wird es das Intervall 380:385 zusammenführen.

Wenn Sie jedoch den Zweig auf den Stamm zurückführen, sehen die dem zugrundeliegenden Berechnungen ganz anders aus. Ihr Zweig ist nun ein Mischmasch aus abgeglichenen Änderungen vom Stamm und privaten Änderungen auf dem Zweig, so dass es kein einfaches, aufeinanderfolgendes Intervall mit Revisionen zum Herüberkopieren gibt. Indem Sie die Option `--reintegrate` angeben, fordern Sie Subversion auf, sorgfältig *nur* die Änderungen von Ihrem Zweig zu replizieren. (Und tatsächlich macht es das so, dass es die letzte Version auf dem Stamm mit der letzten Version auf dem Zweig vergleicht: Der Unterschied macht genau die Änderung auf dem Zweig aus!)

Nachdem nun Ihr privater Zweig mit dem Stamm zusammengeführt wurde, können Sie ihn aus dem Repository löschen:

```
$ svn delete http://svn.example.com/repos/calc/branches/my-calc-branch \
      -m "Remove my-calc-branch."
Committed revision 392.
```

Aber halt! Ist die Geschichte des Zweigs nicht wertvoll? Was, wenn jemand sich eines Tages die Evolution Ihrer Funktion ansehen möchte und hierfür auf die Änderungen des Zweiges schauen möchte? Keine Sorge! Denken Sie daran, dass, obwohl Ihr Zweig nicht mehr im Verzeichnis `/branches` sichtbar ist, seine Existenz gleichwohl ein unveränderbarer Teil der Geschichte des Repositorys ist. Ein einfacher Befehl **svn log** auf dem `/branches` URL wird die gesamte Geschichte des Zweiges anzeigen. Ihr Zweig kann eines Tages sogar wiederbelebt werden, sollten Sie dieses wünschen (siehe „Zurückholen gelöschter Objekte“).

Sobald in Subversion 1.5 eine Zusammenführung mit `--reintegrate` vom Zweig auf den Stamm durchgeführt wurde, kann der Zweig nicht mehr für weitere Arbeiten verwendet werden. Er kann weder Änderungen vom Stamm korrekt absorbieren, noch kann er ordentlich auf den Stamm zurückintegriert werden. Aus diesem Grund sollten Sie ihn zerstören und erneut aus dem Stamm erzeugen, wenn Sie weiter auf dem Zweig arbeiten wollen:

```
$ svn delete http://svn.example.com/repos/calc/branches/my-calc-branch \
      -m "Remove my-calc-branch."
Committed revision 392.

$ svn copy http://svn.example.com/repos/calc/trunk \
           http://svn.example.com/repos/calc/branches/new-branch
      -m "Create a new branch from trunk."
Committed revision 393.

$ cd my-calc-branch

$ svn switch http://svn.example.com/repos/calc/branches/new-branch
Updated to revision 393.
```

Der letzte Befehl des vorangegangenen Beispiels – **svn switch** – ist eine Art, ein bestehendes Arbeitsverzeichnis auf ein unterschiedliches Repository-Verzeichnis zu aktualisieren. Wir werden das genauer in „Traversing Branches“ besprechen.

Mergeinfo und Vorschauen

Der grundsätzliche Mechanismus, den Subversion verwendet, um Änderungsmengen zu verfolgen – d.h. welche Änderungen auf welchen Zweig übertragen worden sind – besteht aus dem Festhalten von Daten in Eigenschaften. Daten über das Zusammenführen werden speziell in der Eigenschaft `svn:mergeinfo` vermerkt, die an Dateien und Verzeichnissen hängt. (Falls Sie mit Subversion-Eigenschaften nicht vertraut sind, ist es nun an der Zeit, „Properties“ zu überfliegen.)

Sie können sich die Eigenschaft ansehen, wie jede andere auch:

```
$ cd my-calc-branch
$ svn propget svn:mergeinfo .
/trunk:341-390
```

Es wird *nicht* empfohlen, dass Sie selbst den Wert dieser Eigenschaft ändern, es sei denn, Sie wissen wirklich, was Sie tun. Diese Eigenschaft wird automatisch von Subversion gepflegt, sobald Sie den Befehl **svn merge** ausführen. Ihr Wert gibt Aufschluss darüber, welche Änderungen (von einem gegebenen Pfad) mit dem in Frage kommenden Verzeichnis abgeglichen wurden. In diesem Fall ist der Pfad `/trunk`, und das Verzeichnis, das die bestimmten Änderungen erhalten hat, ist `/branches/my-calc-branch`.

Es gibt auch einen Unterbefehl, **svn mergeinfo**, der hilfreich dabei ist, nicht nur die Änderungsmengen anzuzeigen, die ein Verzeichnis absorbiert hat, sondern auch, welche Änderungsmengen für einen Abgleich noch in Frage kommen. Das ergibt eine Art Vorschau der nächsten Änderungsmengen, die **svn merge** auf Ihren Zweig abgleichen wird.

```
$ cd my-calc-branch

# Welche Änderungen wurden bereits vom Stamm auf den Zweig abgeglichen?
$ svn mergeinfo http://svn.example.com/repos/calc/trunk
r341
r342
r343
…
r388
r389
r390

# Welche Änderungen kommen für einen Abgleich vom Stamm auf den Zweig noch in F
$ svn mergeinfo http://svn.example.com/repos/calc/trunk --show-revs eligible
r391
r392
r393
r394
r395
```

Der Befehl **svn mergeinfo** erwartet einen „Quell“-URL (woher die Änderungen kommen würden) und einen optionalen „Ziel“-URL (wohin die Änderungen abgeglichen würden). Falls kein Ziel-URL angegeben ist, wird angenommen, dass das aktuelle Arbeitsverzeichnis das Ziel ist. Weil wir im vorangegangenen Beispiel unser Arbeitsverzeichnis vom Zweig abfragen, geht der Befehl davon aus, dass wir daran interessiert sind, Änderungen für `/branches/mybranch` vom angegebenen Stamm-URL zu erhalten.

Eine andere Methode, eine genauere Vorschau auf einen Abgleich zu bekommen, ist die Verwendung der Option `--dry-run`:

```
$ svn merge http://svn.example.com/repos/calc/trunk --dry-run
U    integer.c

$ svn status
#  es wird nichts ausgegeben, die Arbeitskopie ist unverändert
```

Die Option `--dry-run` macht tatsächlich überhaupt keine lokalen Änderungen an der Arbeitskopie. Sie zeigt nur Status-Codes, die ausgegeben *würden*, wenn ein echter Abgleich stattfände. Sie ist nützlich, um eine Vorschau für einen möglichen Abgleich auf „hoher Ebene“ zu erhalten, falls **svn diff** zu detailliert wäre.

Nach dem Durchführen eines Abgleichs, aber vor der Übergabe des Ergebnisses, können Sie **`svn diff --depth=empty /pfad/zum/abgleichs/ziel`** verwenden, um nur die Änderungen am unmittelbaren Ziel des Abgleichs zu sehen. Falls das Ziel ein Verzeichnis war, werden nur Unterschiede von Eigenschaften angezeigt. Das ist eine praktische Methode, um sich die Änderungen an der Eigenschaft `svn:mergeinfo` anzusehen, die dort durch den Abgleich vermerkt wurden, und die Sie daran erinnern, was Sie eben abgeglichen haben.

Natürlich ist die beste Methode, eine Vorschau eines Abgleichs zu erhalten, ihn zu machen! Denken Sie daran, dass der Aufruf von **svn merge** an sich nichts Riskantes ist (es sei denn, sie haben lokale Änderungen an Ihrer Arbeitskopie gemacht – aber wir haben bereits betont, dass Sie in eine derartige Umgebung nicht abgleichen sollten). Falls Ihnen das Ergebnis des Abgleichs nicht gefallen sollte, rufen Sie einfach **`svn revert . -R`** auf, um die Änderungen an Ihrer Arbeitskopie rückgängig zu machen, und versuchen Sie den Befehl erneut mit unterschiedlichen Optionen. Der Abgleich ist solange nicht endgültig, bis Sie mit **svn commit** das Ergebnis übergeben.

Während es vollkommen in Ordnung ist, durch wiederholte Aufrufe von **svn merge** und **svn revert** mit Abgleichen zu experimentieren, könnte es allerdings sein, dass Sie über einige lästige (aber leicht zu umgehende) Fallstricke stolpern. Wenn zum Beispiel durch den Abgleich eine neue Datei hinzugefügt wird (d.h., sie wird zum Hinzufügen markiert), so wird **svn revert** sie nicht wirklich entfernen; es entfernt lediglich die Markierung zum Hinzufügen. Was übrig bleibt, ist eine unversionierte Datei. Wenn Sie dann den Abgleich erneut versuchen, könnten Sie einen Konflikt bekommen, weil die unversionierte Datei „im Weg steht“. Die Lösung? Nach dem Rückgängigmachen sollten Sie die Arbeitskopie aufräumen und unversionierte Dateien und Verzeichnisse entfernen. Die Ausgabe von **svn status** sollte so sauber wie möglich sein und idealerweise gar nichts anzeigen.

Änderungen rückgängig machen

Sehr häufig wird **svn merge** verwendet, um eine Änderung rückgängig zu machen, die bereits an das Repository übergeben worden war. Nehmen wir einmal an, Sie arbeiten fröhlich in einer Arbeitskopie von `/calc/trunk` und entdecken, dass die damalige Änderung an `integer.c` in Revision 303 völlig falsch war. Sie hätte nie übergeben werden sollen. Sie können **svn merge** verwenden, um die Änderung in Ihrer Arbeitskopie „zurückzunehmen“, und dann die lokale Änderung an das Repository übergeben. Alles, was Sie hierfür tun müssen, ist, eine *umgekehrte* Differenz anzugeben. (Sie machen das durch die Angabe von `--revision 303:302` oder durch das äquivalente `--change -303`.)

```
$ svn merge -c -303 http://svn.example.com/repos/calc/trunk
--- Reverse-merging r303 into 'integer.c':
U    integer.c

$ svn status
 M      .
M      integer.c

$ svn diff
…
# überprüfen, ob die Änderung entfernt wurde
…

$ svn commit -m "Undoing change committed in r303."
Sending        integer.c
```

```
Transmitting file data .
Committed revision 350.
```

Wie wir früher bereits erwähnten, kann man eine Repository-Version als eine bestimmte Änderungsmenge betrachten. Bei Verwendung der Option `-r` wird **svn merge** aufgefordert, eine Änderungsmenge oder ein ganzes Intervall von Änderungsmengen auf Ihre Arbeitskopie anzuwenden. In unserem Fall, bei dem wir eine Änderung zurücknehmen, fordern wir **svn merge** auf, die Änderungsmenge #303 *rückwärts* auf unsere Arbeitskopie anzuwenden.

Merken Sie sich, dass ein solches Rückgängigmachen wie jeder andere **svn merge**-Vorgang ist, so dass Sie **svn status** und **svn diff** benutzen sollten, um sicherzustellen, dass Ihre Arbeit in dem Zustand ist, den Sie haben möchten, und verwenden Sie anschließend **svn commit**, um die endgültige Version in das Repository zu bringen. Nach der Übergabe wird sich diese bestimmte Änderungsmenge nicht mehr in der `HEAD`-Revision wiederfinden.

Nun denken Sie vielleicht: Gut, aber das hat doch nicht wirklich die Übergabe rückgängig gemacht, oder? Die Änderung besteht immer noch in Revision 303. Falls jemand eine Version des Projektes `calc` zwischen den Revisionen 303 und 349 auscheckt, wird doch trotzdem die fehlerhafte Änderung sichtbar, oder nicht?

Ja, das stimmt. Wenn wir davon sprechen, eine Änderung zu „entfernen“, sprechen wir eigentlich darüber, sie aus der `HEAD`-Revision zu entfernen. Die ursprüngliche Änderung besteht immer noch in der Geschichte des Repositorys. Für die meisten Situationen ist das ausreichend. Die meisten Leute sind sowieso nur am `HEAD` eines Projektes interessiert. Es gibt jedoch Spezialfälle, in denen Sie wirklich alle Beweise der Übergabe vernichten möchten. (Vielleich hat jemand ein vertrauliches Dokument in das Repository übergeben.) Das ist leider nicht so einfach, da Subversion absichtlich so konstruiert wurde, dass es niemals Informationen verliert. Revisionen sind unveränderliche Bäume, die aufeinander aufbauen. Die Beseitigung einer Revision aus der Geschichte würde einen Dominoeffekt auslösen, Chaos in allen nachfolgenden Revisionen anrichten und möglicherweise alle Arbeitskopien ungültig machen. [2]

Zurückholen gelöschter Objekte

Das Tolle an Versionskontrollsystemen ist, dass Informationen nie verlorengehen. Selbst wenn Sie eine Datei oder ein Verzeichnis löschen, ist es zwar nicht mehr in der `HEAD`-Revision vorhanden, jedoch noch in früheren Revisionen. Eine der häufigsten Fragen neuer Benutzer ist: „Wie bekomme ich meine alte Datei oder mein altes Verzeichnis zurück?“

Der erste Schritt ist es, genau zu definieren *welches* Objekt Sie zurückholen möchten. Hier ist eine nützliche Metapher: Sie können sich vorstellen, dass jedes Objekt im Repository in einem zweidimensionalen Koordinatensystem befindet. Die erste Koordinate ist ein bestimmter Revisionsbaum und die zweite Koordinate ist ein Pfad innerhalb dieses Baumes. So kann jede Version Ihrer Datei oder Ihres Verzeichnisses durch ein bestimmtes Koordinatenpaar definiert werden. (Erinnern Sie sich an die Syntax einer „Peg-Revision“ – foo.c@224 – die in „Peg and Operative Revisions“ erwähnt wurde.)

Zunächt sollten Sie **svn log** benutzen, um das exakte Koordinatenpaar zu ermitteln, das Sie zurückholen wollen. Eine gute Strategie ist es, **`svn log --verbose`** in einem Verzeichnis aufzurufen, in dem das gelöschte Objekt einmal enthalten war. Die Option `--verbose` (`-v`) gibt eine Liste aller geänderten Objekte in jeder Revision aus; Sie müssen nur noch die Revision finden, in der Sie die Datei oder das Verzeichnis gelöscht haben. Sie können das visuell tun oder ein Werkzeug zur Untersuchung der Protokollausgaben einsetzen (mit **grep** oder vielleicht durch eine inkrementelle Suche in einem Editor).

[2]Allerdings gibt es im Subversion-Project Pläne, eines Tages einen Befehl zu implementieren, der die Aufgabe erledigen würde, Informationen dauerhaft zu löschen. Bis dahin, siehe „svndumpfilter“ für einen möglichen Notbehelf.

```
$ cd parent-dir
$ svn log -v
…
------------------------------------------------------------------------
r808 | joe | 2003-12-26 14:29:40 -0600 (Fri, 26 Dec 2003) | 3 lines
Changed paths:
   D /calc/trunk/real.c
   M /calc/trunk/integer.c

Added fast fourier transform functions to integer.c.
Removed real.c because code now in double.c.
…
```

In diesem Beispiel nehmen wir an, dass Sie nach der gelöschten Datei `real.c` suchen. Beim Durchsehen der Protokolle des Elternverzeichnisses haben Sie entdeckt, dass diese Datei in Revision 808 gelöscht wurde. Daher war die letzte Revision in der die Datei noch vorhanden war die unmittelbare Vorgänger-Revision. Die Schlussfolgerung: Sie möchten den Pfad `/calc/trunk/real.c` aus Revision 807 zurückholen.

Das war der schwierige Teil – die Nachforschung. Nun, da Sie wissen, was Sie wiederherstellen wollen, haben Sie die Wahl zwischen zwei verschiedenen Methoden.

Die eine Option ist, **svn merge** zu verwenden, um Revision 808 „rückwärts“ anzuwenden. (Wir haben bereits in „Änderungen rückgängig machen“ besprochen, wie Änderungen rückgängig gemacht werden.) Das hätte den Effekt, `real.c` als lokale Änderung erneut hinzuzufügen. Die Datei würde zum Hizufügen ins Repository markiert, und nach der Übergabe wäre die Datei wieder in `HEAD` vorhanden.

In diesem besonderen Beispiel ist das aber wahrscheinlich nicht die beste Strategie. Die Rückwärts-Anwendung von Revision 808 würde nicht nur `real.c` zum Hinzufügen markieren, sondern, wie aus den Protokollmeldungen hervorgeht, dass ebenso bestimmte Änderungen an `integer.c` zurücknehmen, was Sie aber nicht wollen. Sie können sicherlich Revision 808 rückwärts anwenden und dann mit **svn revert** die lokalen Änderungen an `integer.c` zurücknehmen; allerdings ist diese Technik nicht sehr effektiv. Was wäre, wenn 90 Dateien in Revision 808 geändert worden wären?

Eine zweite, zielorientiertere, Strategie ist es, den Befehl **svn merge** überhaupt nicht zu verwenden, sondern stattdessen **svn copy**. Kopieren Sie einfach das exakte „Koordinatenpaar“ aus Revision und Pfad vom Repository in Ihre Arbeitskopie:

```
$ svn copy http://svn.example.com/repos/calc/trunk/real.c@807 ./real.c

$ svn status
A  +   real.c

$ svn commit -m "Resurrected real.c from revision 807, /calc/trunk/real.c."
Adding         real.c
Transmitting file data .
Committed revision 1390.
```

Das Plus-Zeichen in der Statusausgabe zeigt an, dass das Objekt nicht bloß zu Hinzufügen vorgemerkt ist, sondern zum Hinzufügen „mit Geschichte“. Subversion merkt sich, woher es kopiert wurde. Künftig wird beim Anwenden von **svn log** auf diese Datei die gesamte Geschichte, über das Zurückholen hinweg, inklusive der Geschichte vor Revision 807 durchlaufen. In anderen Worten, dieses neue `real.c` ist nicht wirklich neu; es ist ein direkter Nachfahre der ursprünglichen, gelöschten Datei. Dies ist normalerweise eine gute und nützliche Sache. Falls Sie jedoch die Datei *ohne* geschichtliche Verbindung zur alten Datei zurückholen wollen, funktioniert diese Technik ebensogut:

```
$ svn cat http://svn.example.com/repos/calc/trunk/real.c@807 > ./real.c
```

```
$ svn add real.c
A         real.c

$ svn commit -m "Re-created real.c from revision 807."
Adding         real.c
Transmitting file data .
Committed revision 1390.
```

Obwohl unser Beispiel zeigt, wie eine Datei zurückgeholt wird, sollten sie beachten, dass dieselben Techniken auch beim Wiederherstellen von gelöschten Verzeichnissen funktionieren. Beachten Sie auch, dass die Wiederherstellung nicht unbedingt in Ihrer Arbeitskopie passieren muss – sie kann auch vollständig im Repository ausgeführt werden:

```
$ svn copy http://svn.example.com/repos/calc/trunk/real.c@807 \
           http://svn.example.com/repos/calc/trunk/ \
      -m "Resurrect real.c from revision 807."
Committed revision 1390.

$ svn update
A    real.c
Updated to revision 1390.
```

Fortgeschrittenes Zusammenführen

Hier endet die automatische Magie. Früher oder später, sobald Sie den Dreh beim Verzweigen und Zusammenführen heraus haben, werden Sie Subversion fragen müssen, *bestimmte* Änderungen von einem Ort zum anderen zusammenzuführen. Um dies tun zu können, werden Sie damit beginnen müssen, kompliziertere Argumente an **svn merge** zu übergeben. Der nächste Abschnitt beschreibt die vollständig erweiterte Syntax des Befehls und behandelt eine Anzahl verbreiteter Szenarien, die diese benötigen.

Die Rosinen herauspicken

Genauso oft wie der Begriff „Änderungsmenge“ wird die Wendung *die Rosinen herauspicken* in Versionskontrollsystemen verwendet. Das bezieht sich darauf, *eine* bestimmte Änderungsmenge von einem Zweig auszuwählen und sie auf einen anderen anzuwenden. Die Rosinen herauszupicken kann sich auch darauf beziehen, eine bestimmte Menge von (nicht notwendigerweise angrenzenden) Änderungsmengen von einem auf einen anderen Zweig zu duplizieren. Dies steht im Gegensatz zu den üblicheren Zusammenführungs-Szenarien, bei denen der „nächste“ zusammenhängende Bereich von Revisionen automatisch dupliziert wird.

Warum sollte jemand nur eine einzelne Änderung wollen? Das kommt häufiger vor, als Sie denken. Gehen wir beispielsweise einmal zurück in die Vergangenheit und stellen uns vor, dass Sie Ihren Zweig noch nicht wieder mit dem Stamm zusammengeführt hätten. In der Kaffeeküche bekommen Sie mit, dass Sally eine interessante Änderung an `integer.c` auf dem Stamm gemacht hat. Als Sie sich die Geschichte der Übergaben auf dem Stamm ansehen, entdecken Sie, dass sie in Revision 355 einen kritischen Fehler beseitigt hat, der direkte Auswirkungen auf die Funktion hat, an der Sie gerade arbeiten. Es kann sein, dass Sie noch nicht bereit sind, alle Änderungen vom Stamm zu übernehmen, jedoch benötigen Sie diese bestimmte Fehlerbehebung, um mit Ihrer Arbeit weitermachen zu können.

```
$ svn diff -c 355 http://svn.example.com/repos/calc/trunk

Index: integer.c
===================================================================
--- integer.c (revision 354)
+++ integer.c (revision 355)
```

```
@@ -147,7 +147,7 @@
     case 6:  sprintf(info->operating_system, "HPFS (OS/2 or NT)"); break;
     case 7:  sprintf(info->operating_system, "Macintosh"); break;
     case 8:  sprintf(info->operating_system, "Z-System"); break;
-    case 9:  sprintf(info->operating_system, "CP/MM");
+    case 9:  sprintf(info->operating_system, "CP/M"); break;
     case 10:  sprintf(info->operating_system, "TOPS-20"); break;
     case 11:  sprintf(info->operating_system, "NTFS (Windows NT)"); break;
     case 12:  sprintf(info->operating_system, "QDOS"); break;
```

Ebenso wie Sie **svn diff** im vorigen Beispiel benutzt haben, um sich Revision 355 anzusehen, können Sie die gleiche Option an **svn merge** übergeben:

```
$ svn merge -c 355 http://svn.example.com/repos/calc/trunk
U    integer.c

$ svn status
M      integer.c
```

Sie können nun Ihre üblichen Tests durchführen, bevor Sie diese Änderung an den Zweig übergeben. Nach der Übergabe merkt sich Subversion, dass r355 mit dem Zweig zusammengeführt wurde, so dass künftige „magische“ Zusammenführungen, die Ihren Zweig mit dem Stamm synchronisieren, r355 überspringen. (Das Zusammenführen derselben Änderung auf denselben Zweig führt fast immer zu einem Konflikt!)

```
$ cd my-calc-branch

$ svn propget svn:mergeinfo .
/trunk:341-349,355

# Notice that r355 isn't listed as "eligible" to merge, because
# it's already been merged.
$ svn mergeinfo http://svn.example.com/repos/calc/trunk --show-revs eligible
r350
r351
r352
r353
r354
r356
r357
r358
r359
r360

$ svn merge http://svn.example.com/repos/calc/trunk
--- Merging r350 through r354 into '.':
 U   .
U    integer.c
U    Makefile
--- Merging r356 through r360 into '.':
 U   .
U    integer.c
U    button.c
```

Dieser Anwendungsfall des Abgleichens (oder *Nachziehens*) von Fehlerbehebungen von einem Zweig zu einem anderen ist vielleicht der gängiste Grund für Änderungen, die Rosinen herauszupicken; es kommt ständig vor, beispielsweise, wenn ein Team einen „Software-Release-Zweig“ verwendet. (Wir erörtern dieses Muster in „Release Branches“.)

Haben Sie bemerkt, wie im letzten Beispiel der Aufruf von **svn merge** dazu geführt hat, zwei unterschiedliche Abgleichsintervalle anzuwenden? Der

Befehl führte zwei unabhängige Patches auf Ihrer Arbeitskopie aus, um die Änderungsmenge 355 zu überspringen, die Ihr Zweig bereits beinhaltete. An und für sich ist daran nichts falsch, bis auf die Tatsache, dass die Möglichkeit besteht, eine Konfliktauflösung komplizierter zu machen. Falls das erste Änderungsintervall Konflikte erzeugt, *müssen* Sie diese interaktiv auflösen, um die Zusammenführung fortzusetzen und das zweite Änderungsintervall anzuwenden. Wenn Sie die Konfliktauflösung der ersten Phase aufschieben, wird der komplette Zusammenführungsbefehl mit einer Fehlermeldung abbrechen. [3]

Ein Wort zur Warnung: Während **svn diff** und **svn merge** vom Konzept her sehr ähnlich sind, haben sie in vielen Fällen eine unterschiedliche Syntax. Gehen Sie sicher, dass Sie Details hierzu in Kapitel 9, *Subversion Complete Reference* nachlesen oder **svn help** fragen. Zum Beispiel benötigt **svn merge** einen Pfad in der Arbeitskopie als Ziel, d.h., einen Ort, an dem es den erzeugten Patch anwenden kann. Falls das Ziel nicht angegeben wird, nimmt es an, dass Sie eine der folgenden häufigen Operationen durchführen möchten:

- Sie möchten Verzeichnisänderungen auf Ihr aktuelles Arbeitsverzeichnis abgleichen.
- Sie möchten die Änderungen in einer bestimmten Datei mit einer Datei gleichen Namens in Ihrem aktuellen Arbeitsverzeichnis zusammenführen.

Falls Sie ein Verzeichnis zusammenführen und keinen Zielpfad angegeben haben, nimmt **svn merge** den ersten Fall an und versucht, die Änderungen auf Ihr aktuelles Arbeitsverzeichnis anzuwenden. Falls Sie eine Datei zusammenführen und diese Datei (oder eine gleichnamige Datei) in Ihrem aktuellen Arbeitsverzeichnis existiert, nimmt **svn merge** den zweiten Fall an und wendet die Änderungen auf eine lokale Datei gleichen Namens an.

Merge-Syntax: Die vollständige Enthüllung

Sie haben nun einige Beispiele zum Befehl **svn merge** gesehen und werden bald einige mehr sehen. Falls Sie verwirrt darüber sind, wie das Zusammenführen genau funktioniert, sind Sie nicht alleine. Viele Anwender (besonders diejenigen, für die Versionskontrolle etwas Neues ist) sind anfangs verwirrt darüber, wie die korrekte Syntax des Befehls lautet und wann das Feature verwendet werden soll. Aber, keine Angst, dieser Befehl ist tatsächlich viel einfacher als Sie denken! Es gibt eine einfache Technik, die verstehen hilft, wie sich **svn merge** genau verhält.

Die Hauptquelle der Verwirrung ist der *Name* des Befehls. Der Begriff „merge" (Zusammenführung, Mischung) deutet irgendwie an, dass Zweige miteinander verschmolzen werden, oder dass irgendeine geheimnisvolle Mischung der Daten erfolgt. Das ist nicht der Fall. Ein besserer Name für den Befehl wäre vielleicht **svn ermittele-die-Unterschiede-und-wende-sie-an** gewesen, da das alles ist, was passiert: Die Bäume im Repository werden verglichen und die Unterschiede in eine Arbeitskopie eingearbeitet.

Falls Sie **svn merge** benutzen, um einfache Kopien von Änderungen zwischen Zweigen vorzunehmen, wird es üblicherweise automatisch das Richtige machen. Beispielsweise wird ein Befehl wie der folgende:

```
$ svn merge http://svn.example.com/repos/calc/some-branch
```

versuchen, alle Änderungen, die auf `some-branch` gemacht worden sind, in Ihr aktuelles Arbeitsverzeichnis zu kopieren, welches vermutlich eine Arbeitskopie ist, die mit dem Zweig irgendeine historische Verbindung teilt. Der Befehl ist klug genug, nur die Änderungen zu kopieren, die Ihre Arbeitskopie noch nicht hat. Wenn Sie diesen Befehl

[3] Zumindest trifft das zur Zeit für Subversion 1.5 zu. Dieses Verhalten könnte sich in künftigen Versionen von Subversion verbessern.

einmal die Woche wiederholen, wird er nur die „neuesten“ Änderungen vom Zweig kopieren, die seit Ihrem letzten Zusammenführen stattfanden.

Wenn Sie den Befehl **svn merge** in seiner ganzen Pracht wählen, indem Sie ihm bestimmte Revisionsintervalle zum kopieren übergeben, benötigt der Befehl drei Hauptargumente:

1. Einen Anfangsbaum im Repository (häufig *linke Seite* des Vergleichs genannt)
2. Einen Endbaum im Repository (häufig *rechte Seite* des Vergleichs genannt)
3. Eine Arbeitskopie, die die Unterschiede als lokale Änderungen aufnimmt (häufig *Ziel* der Zusammenführung genannt)

Sobald diese drei Argumente angegeben sind, werden die zwei Bäume miteinander verglichen und die Unterschiede als lokale Änderungen auf die Ziel-Arbeitskopie angewendet. Wenn der Befehl fertig ist, sieht das Ergebnis so aus, als hätten Sie die Dateien manuell editiert oder verschiedene **svn add**- oder **svn delete**-Befehle ausgeführt. Wenn Ihnen das Ergebnis gefällt, können Sie es übergeben. Falls nicht, können Sie einfach mit **svn revert** alle Änderungen rückgängig machen.

Die Syntax von **svn merge** erlaubt Ihnen, die drei notwendigen Argumente auf eine recht flexible Weise anzugeben. Hier sind einige Beispiele:

```
$ svn merge http://svn.example.com/repos/branch1@150 \
            http://svn.example.com/repos/branch2@212 \
            my-working-copy

$ svn merge -r 100:200 http://svn.example.com/repos/trunk my-working-copy

$ svn merge -r 100:200 http://svn.example.com/repos/trunk
```

Die erste Syntax führt alle drei Argumente explizit auf, indem jeder Baum mit dem Format *URL@REV* bezeichnet und die Ziel-Arbeitskopie angegeben wird. Die zweite Syntax kann als Kurzform verwendet werden, wenn Sie zwei unterschiedliche Revisionen desselben URL vergleichen. Die letzte Syntax zeigt, dass das Arbeitskopie-Argument optional ist; entfällt es, wird das aktuelle Verzeichnis genommen.

Obwohl das erste Beispiel die „vollständige“ Syntax von **svn merge** zeigt, muss sie sehr sorgfältig verwendet werden; es können hierbei Zusammenführungen entstehen, bei denen keinerlei `svn:mergeinfo` Metadaten aufgezeichnet werden. Der nächste Abschnitt geht näher darauf ein.

Zusammenführen ohne Mergeinfo

Subversion versucht immer wenn es kann, Metadaten über das Zusammenführen zu erzeugen, um spätere Aufrufe von **svn merge** schlauer zu machen. Trotzdem gibt es Situationen, in denen `svn:mergeinfo`-Daten nicht erzeugt oder geändert werden. Denken Sie daran, vor diesen Szenarien auf der Hut zu sein:

Zusammenführen von Quellen ohne Beziehung
: Falls Sie **svn merge** dazu auffordern, zwei URLs zu vergleichen, die nicht miteinander in Beziehung stehen, wird trotzdem ein Patch erzeugt und auf die Arbeitskopie angewendet, allerdings werden keine Metadaten erzeugt. Es gibt keine gemeinsame Geschichte der zwei Quellen, und spätere „schlaue“ Zusammenführungen hängen von dieser gemeinsamen Geschichte ab.

Zusammenführen aus fremden Repositorys
: Obwohl es möglich ist, einen Befehl wie **`svn merge -r 100:200`**

http://svn.foreignproject.com/repos/trunk auszuführen, wird auch dieser resultierende Patch keine historischen Metadaten über die Zusammenführung haben. Zum gegenwärtigen Zeitpunkt hat Subversion keine Möglichkeit, unterschiedliche Repository-URLs innerhalb des `svn:mergeinfo`-Propertys zu repräsentieren.

Verwendung von `--ignore-ancestry`
: Wenn diese Option an **svn merge** übergeben wird, veranlasst das die Zusammenführungs-Logik, ohne nachzudenken Unterschiede auf dieselbe Art zu erzeugen, wie es **svn diff** macht, und ignoriert dabei irgendwelche historischen Verbindungen. Wir werden das später in diesem Kapitel in „Noticing or Ignoring Ancestry“ erörtern.

Zusammenführen rückgängig machen
: Weiter oben in diesem Kapitel („Änderungen rückgängig machen“) haben wir darüber gesprochen, wie man mit **svn merge** einen „Rückwärts-Patch“ verwendet, um Änderungen rückgängig zu machen. Wenn diese Technik dazu verwendet wird, um eine Änderung in der Geschichte eines Objektes zurückzunehmen (z.B. r5 an den Stamm übergeben, und dann sofort r5 mit **`svn merge . -c -5`** rückgängig machen), hat dies keine Auswirkungen auf die aufgezeichneten Metadaten. [4]

Mehr über Konflikte beim Zusammenführen

Wie der Befehl **svn update** wendet auch **svn merge** Änderungen auf Ihre Arbeitskopie an. Und deshalb kann er auch Konflikte erzeugen. Die von **svn merge** hervorgerufenen Konflikte sind jedoch manchmal anders geartet, und dieser Abschnitt erklärt diese Unterschiede.

Zunächst gehen wir davon aus, dass Ihre Arbeitskopie keine lokalen Änderungen enthält. Wenn Sie mit **svn update** auf eine bestimmte Revision aktualisieren, werden die vom Server gesendeten Änderungen immer „sauber“ auf Ihre Arbeitskopie angewendet. Der Server erzeugt das Delta, indem er zwei Bäume vergleicht: eine virtuelle Momentaufnahme Ihrer Arbeitskopie und der Revisionsbaum, an dem Sie interessiert sind. Da die linke Seite des Vergleichs völlig gleich zu dem ist, was Sie bereits haben, wird das Delta garantiert Ihre Arbeitskopie korrekt in den rechten Baum überführen.

svn merge jedoch kann das nicht gewährleisten und kann viel chaotischer sein: Der fortgeschrittene Benutzer kann den Server auffordern, *irgendwelche* zwei Bäume miteinander zu vergleichen, sogar solche, die nicht mit der Arbeitskopie in Beziehung stehen! Das bedeutet, dass ein hohes Potenzial für menschliche Fehler besteht. Benutzer werden manchmal die falschen zwei Bäume miteinander vergleichen, so dass ein Delta erzeugt wird, das sich nicht sauber anwenden lässt. **svn merge** wird sein Bestes geben, um soviel wie möglich vom Delta anzuwenden, doch bei einigen Teilen kann das unmöglich sein. So wie der Unix-Befehl **patch** sich manchmal über „failed hunks“ beschwert, wird sich **svn merge** ähnlich über „skipped targets“ beschweren:

```
$ svn merge -r 1288:1351 http://svn.example.com/repos/branch
U    foo.c
U    bar.c
Skipped missing target: 'baz.c'
U    glub.c
U    sputter.h

Conflict discovered in 'glorb.h'.
Select: (p) postpone, (df) diff-full, (e) edit,
        (h) help for more options:
```

[4] Interessanterweise werden wir nach dem Zurücknehmen einer Revision auf diese Art nicht in der Lage sein, diese Revision erneut mit **`svn merge . -c 5`** anzuwenden, da aus den Metadaten hervorgeht, dass r5 bereits angewendet wurde. Wir müssten die Option `--ignore-ancestry` verwenden, damit der Befehl die bestehenden Metadaten ignoriert.

Im vorangegangenen Beispiel kann es der Fall gewesen sein, dass `baz.c` in beiden Momentaufnahmen des Zweiges vorkommt, die verglichen werden, und das resultierende Delta den Inhalt der Datei verändern will, die in der Arbeitskopie aber nicht vorhanden ist. Wie auch immer, die „skipped"-Nachricht bedeutet, dass der Benutzer höchstwahrscheinlich die falschen Bäume miteinander vergleicht; es ist das klassiche Zeichen für einen Anwenderfehler. Falls dies passiert, ist es einfach, alle durch das Zusammenführen hervorgerufenen Änderungen rekursiv rückgängig zu machen (**svn revert . --recursive**), alle unversionierten Dateien oder Verzeichnisse zu löschen, die nach dem Rückgängigmachen zurückgeblieben sind, und **svn merge** noch einmal mit unterschiedlichen Argumenten aufzurufen.

Beachten Sie auch, dass das vorangegangene Beispiel einen Konflikt in `glorb.h` anzeigt. Wir bemerkten bereits, dass die Arbeitskopie keine lokalen Änderungen besitzt: Wie kann da ein Konflikt entstehen? Noch einmal: Weil der Benutzer **svn merge** dazu verwenden kann, ein altes Delta zu definieren und auf die Arbeitskopie anzuwenden, kann es sein, dass dieses alte Delta textuelle Änderungen enthält, die nicht sauber in eine Arbeitsdatei eingearbeitet werden können, selbst dann nicht, wenn die Datei keine lokalen Änderungen vorzuweisen hat.

Ein weiterer kleiner Unterschied zwischen **svn update** und **svn merge** sind die Namen der erzeugten Textdateien, falls ein Konflikt entsteht. In „Konflikte auflösen (Änderungen anderer einarbeiten)" sahen wir, dass bei einer Aktualisierung die Dateien namens `filename.mine`, `filename.rOLDREV` und `filename.rNEWREV` erzeugt werden. Falls **svn merge** einen Konflikt hervorruft, erstellt es jedoch drei Dateien namens `filename.working`, `filename.left` und `filename.right`. In diesem Fall beschreiben die Begriffe „left" (links) und „right" (rechts) von welcher Seite des Vergleichs zwischen den beiden Bäumen die Datei hergeleitet wurde. Auf alle Fälle werden Ihnen diese unterschiedlichen Namen dabei helfen, zwischen Konflikten zu unterscheiden, die durch eine Aktualisierung entstanden, und solchen die durch eine Zusammenführung hervorgerufen wurden .

Änderungen blockieren

Manchmal gibt es eine bestimmte Änderungsmenge, die Sie nicht automatisch zusammengeführt haben wollen. Beispielsweise ist vielleicht die Vorgehensweise Ihres Teams dergestalt, dass Neuentwicklungen auf `/trunk` gemacht werden, aber konservativer, wenn es darum geht, Änderungen auf einen stabilen Zweig zurückzuportieren, den sie zur Veröffentlichung benutzen. Auf der einen Seite können Sie die Rosinen in Form von einzelnen Änderungsmengen manuell aus dem Stamm herauspicken und in den Zweig einpflegen – nur die Änderungen, die stabil genug sind, um die Qualitätsprüfung zu bestehen. Vielleicht ist es ja auch nicht ganz so streng, und Sie möchten normalerweise, dass **svn merge** die meisten Änderungen vom Stamm automatisch mit dem Zweig zusammenführt. In diesem Fall könnten Sie ein Verfahren gebrauchen, dass es Ihnen erlaubt, einige bestimmte Änderungen auszulassen, d.h. zu vermeiden, dass sie automatisch in den Zweig eingebracht werden.

Die einzige Möglichkeit, mit Subversion 1.5 eine Änderungsmenge zu blockieren, besteht darin, dem System vorzugaukeln, dass die Änderung *bereits* eingearbeitet wurde. Dazu können Sie den Befehl mit der Option `--record-only` aufrufen:

```
$ cd my-calc-branch

$ svn propget svn:mergeinfo .
/trunk:1680-3305

# Let's make the metadata list r3328 as already merged.
$ svn merge -c 3328 --record-only http://svn.example.com/repos/calc/trunk

$ svn status
M     .
```

```
$ svn propget svn:mergeinfo .
/trunk:1680-3305,3328

$ svn commit -m "Block r3328 from being merged to the branch."
…
```

Diese Technik funktioniert zwar, sie ist allerdings auch ein wenig gefährlich. Das Hauptproblem ist, dass wir nicht klar unterscheiden zwischen „ich habe diese Änderung bereits“ und „ich habe diese Änderung nicht“. Wir belügen das System gewissermaßen, indem wir es glauben lassen, dass die Änderung schon eingearbeitet sei. Das schiebt die Verantwortung, sich daran zu erinnern, dass die Änderung tatsächlich gar nicht übernommen wurde sondern nicht gewünscht war, auf Sie – den Benutzer. Es gibt keine Möglichkeit, Subversion nach einer Liste „blockierter Änderungen“ zu fragen. Wenn Sie sie verfolgen möchten (so dass Sie eines Tages die Blockierung aufheben können) müssen Sie sie irgendwo in eine Textdatei schreiben oder in einem erfundenen Property festhalten. Leider ist das in Subversion 1.5 die einzige Möglichkeit mit blockierten Revisionen umzugehen; ein besseres Interface dafür ist für künftige Versionen geplant.

Protokolle und Anmerkungen, die Zusammenführungen anzeigen

Ein Hauptmerkmal jedes Versionskontrollsystems ist es, darüber Buch zu führen, wer was wann geändert hat. Die Befehle **svn log** und **svn blame** sind die geeigneten Werkzeuge hierfür: Wenn sie auf individuelle Dateien angewendet werden, zeigen sie nicht nur die Geschichte der Änderungsmengen, die in diese Datei hineinflossen, sondern auch, welcher Benutzer wann welche Zeile im Quelltext geschrieben hat.

Wenn jedoch Änderungen über Zweige hinweg dupliziert werden, wird es schnell kompliziert. Wenn Sie z.B. **svn log** nach der Geschichte Ihres Zweigs fragen, wird es Ihnen exakt jede Revision anzeigen, die je in den Zweig hineingeflossen ist:

```
$ cd my-calc-branch
$ svn log -q
------------------------------------------------------------------------
r390 | user | 2002-11-22 11:01:57 -0600 (Fri, 22 Nov 2002) | 1 line
------------------------------------------------------------------------
r388 | user | 2002-11-21 05:20:00 -0600 (Thu, 21 Nov 2002) | 2 lines
------------------------------------------------------------------------
r381 | user | 2002-11-20 15:07:06 -0600 (Wed, 20 Nov 2002) | 2 lines
------------------------------------------------------------------------
r359 | user | 2002-11-19 19:19:20 -0600 (Tue, 19 Nov 2002) | 2 lines
------------------------------------------------------------------------
r357 | user | 2002-11-15 14:29:52 -0600 (Fri, 15 Nov 2002) | 2 lines
------------------------------------------------------------------------
r343 | user | 2002-11-07 13:50:10 -0600 (Thu, 07 Nov 2002) | 2 lines
------------------------------------------------------------------------
r341 | user | 2002-11-03 07:17:16 -0600 (Sun, 03 Nov 2002) | 2 lines
------------------------------------------------------------------------
r303 | sally | 2002-10-29 21:14:35 -0600 (Tue, 29 Oct 2002) | 2 lines
------------------------------------------------------------------------
r98 | sally | 2002-02-22 15:35:29 -0600 (Fri, 22 Feb 2002) | 2 lines
------------------------------------------------------------------------
```

Aber ist das wirklich eine genaue Wiedergabe aller Änderungen, die auf dem Zweig stattgefunden haben? Was hier ausgelassen wird, ist, dass die Revisionen 390, 381 und 357 tatsächlich Ergebnisse des Zusammenführens von Änderungen aus dem Stamm waren. Wenn Sie sich eins dieser Protokolle im Detail anschauen, können Sie die verschiedenen Änderungsmengen vom Stamm, die die Änderungen auf dem Zweig ausmachen, nirgendwo sehen:

```
$ svn log -v -r 390
------------------------------------------------------------------------
r390 | user | 2002-11-22 11:01:57 -0600 (Fri, 22 Nov 2002) | 1 line
Changed paths:
   M /branches/my-calc-branch/button.c
   M /branches/my-calc-branch/README

Final merge of trunk changes to my-calc-branch.
```

Wir wissen, dass diese Zusammenführung in den Zweig nichts anderes war als eine Zusammenführung von Änderungen vom Stamm. Wie können wir zusätzlich diese Änderungen sehen? Die Antwort lautet, die Option `--use-merge-history` (`-g`) zu verwenden. Diese Option expandiert diejenigen „Teil"-Änderungen, aus denen die Zusammenführung bestand.

```
$ svn log -v -r 390 -g
------------------------------------------------------------------------
r390 | user | 2002-11-22 11:01:57 -0600 (Fri, 22 Nov 2002) | 1 line
Changed paths:
   M /branches/my-calc-branch/button.c
   M /branches/my-calc-branch/README

Final merge of trunk changes to my-calc-branch.
------------------------------------------------------------------------
r383 | sally | 2002-11-21 03:19:00 -0600 (Thu, 21 Nov 2002) | 2 lines
Changed paths:
   M /branches/my-calc-branch/button.c
Merged via: r390

Fix inverse graphic error on button.
------------------------------------------------------------------------
r382 | sally | 2002-11-20 16:57:06 -0600 (Wed, 20 Nov 2002) | 2 lines
Changed paths:
   M /branches/my-calc-branch/README
Merged via: r390

Document my last fix in README.
```

Dadurch, dass wir die Protokoll-Operation aufgefordert haben, die Geschichte der Zusammenführungen zu verwenden, sehen wir nicht nur die Revision, die wir abgefragt haben (r390), sondern auch die zwei Revisionen, die hier mitkamen – ein paar Änderungen, die Sally auf dem Stamm gemacht hat. Das ist ein wesentlich vollständigeres Bild der Geschichte!

Auch der **svn blame**-Befehl versteht die Option `--use-merge-history` (`-g`). Falls diese Option vergessen wird, könnte jemand, der sich die zeilenweisen Anmerkungen von `button.c` ansieht, fälschlicherweise davon ausgehen, dass Sie für die Zeilen verantwortlich sind, die einen bestimmten Fehler beseitigt haben:

```
$ svn blame button.c
…
   390    user    retval = inverse_func(button, path);
   390    user    return retval;
   390    user    }
…
```

Obwohl es zutrifft, dass Sie diese drei Zeilen in Revision 390 übergeben haben, sind zwei davon tatsächlich von Sally in Revision 383 geschrieben worden:

```
$ svn blame button.c -g
```

```
…
G    383    sally   retval = inverse_func(button, path);
G    383    sally   return retval;
     390    user    }
…
```

Nun wissen wir, wer *wirklich* für die zwei Zeilen Quelltext verantwortlich ist!

Noticing or Ignoring Ancestry

When conversing with a Subversion developer, you might very likely hear reference to the term *ancestry*. This word is used to describe the relationship between two objects in a repository: if they're related to each other, one object is said to be an ancestor of the other.

For example, suppose you commit revision 100, which includes a change to a file `foo.c`. Then `foo.c@99` is an „ancestor" of `foo.c@100`. On the other hand, suppose you commit the deletion of `foo.c` in revision 101, and then add a new file by the same name in revision 102. In this case, `foo.c@99` and `foo.c@102` may appear to be related (they have the same path), but in fact are completely different objects in the repository. They share no history or „ancestry."

The reason for bringing this up is to point out an important difference between **svn diff** and **svn merge**. The former command ignores ancestry, while the latter command is quite sensitive to it. For example, if you asked **svn diff** to compare revisions 99 and 102 of `foo.c`, you would see line-based diffs; the **diff** command is blindly comparing two paths. But if you asked **svn merge** to compare the same two objects, it would notice that they're unrelated and first attempt to delete the old file, then add the new file; the output would indicate a deletion followed by an add:

```
D    foo.c
A    foo.c
```

Most merges involve comparing trees that are ancestrally related to one another; therefore, **svn merge** defaults to this behavior. Occasionally, however, you may want the **merge** command to compare two unrelated trees. For example, you may have imported two source-code trees representing different vendor releases of a software project (see „Vendor Branches"). If you ask **svn merge** to compare the two trees, you'd see the entire first tree being deleted, followed by an add of the entire second tree! In these situations, you'll want **svn merge** to do a path-based comparison only, ignoring any relations between files and directories. Add the `--ignore-ancestry` option to your **merge** command, and it will behave just like **svn diff**. (And conversely, the `--notice-ancestry` option will cause **svn diff** to behave like the **svn merge** command.)

Merges and Moves

A common desire is to refactor source code, especially in Java-based software projects. Files and directories are shuffled around and renamed, often causing great disruption to everyone working on the project. Sounds like a perfect case to use a branch, doesn't it? Just create a branch, shuffle things around, and then merge the branch back to the trunk, right?

Alas, this scenario doesn't work so well right now and is considered one of Subversion's current weak spots. The problem is that Subversion's **svn update** command isn't as robust as it should be, particularly when dealing with copy and move operations.

When you use **svn copy** to duplicate a file, the repository remembers where the new file came from, but it fails to transmit that information to the client which is running **svn update** or **svn merge**. Instead of telling the client, „Copy that file you already have to this new location,“ it sends down an entirely new file. This can lead to problems, especially because the same thing happens with renamed files. A lesser-known fact about Subversion is that it lacks „true renames“—the **svn move** command is nothing more than an aggregation of **svn copy** and **svn delete**.

For example, suppose that while working on your private branch, you rename `integer.c` to `whole.c`. Effectively you've created a new file in your branch that is a copy of the original file, and deleted the original file. Meanwhile, back on `trunk`, Sally has committed some improvements to `integer.c`. Now you decide to merge your branch to the trunk:

```
$ cd calc/trunk

$ svn merge --reintegrate http://svn.example.com/repos/calc/branches/my-calc-br
--- Merging differences between repository URLs into '.':
D   integer.c
A   whole.c
U   .
```

This doesn't look so bad at first glance, but it's also probably not what you or Sally expected. The merge operation has deleted the latest version of the `integer.c` file (the one containing Sally's latest changes), and blindly added your new `whole.c` file—which is a duplicate of the *older* version of `integer.c`. The net effect is that merging your „rename“ to the branch has removed Sally's recent changes from the latest revision!

This isn't true data loss. Sally's changes are still in the repository's history, but it may not be immediately obvious that this has happened. The moral of this story is that until Subversion improves, be very careful about merging copies and renames from one branch to another.

Blocking Merge-Unaware Clients

If you've just upgraded your server to Subversion 1.5 or later, there's a significant risk that pre-1.5 Subversion clients can mess up your automated merge tracking. Why is this? When a pre-1.5 Subversion client performs **svn merge**, it doesn't modify the value of the `svn:mergeinfo` property at all. So the subsequent commit, despite being the result of a merge, doesn't tell the repository about the duplicated changes—that information is lost. Later on, when „merge-aware“ clients attempt automatic merging, they're likely to run into all sorts of conflicts resulting from repeated merges.

If you and your team are relying on the merge-tracking features of Subversion, you may want to configure your repository to prevent older clients from committing changes. The easy way to do this is by inspecting the „capabilities“ parameter in the `start-commit` hook script. If the client reports itself as having `mergeinfo` capabilities, the hook script can allow the commit to start. If the client doesn't report that capability, have the hook deny the commit. We'll learn more about hook scripts in the next chapter; see „Implementing Repository Hooks“ and start-commit for details.

The Final Word on Merge Tracking

The bottom line is that Subversion's merge-tracking feature has an extremely complex internal implementation, and the `svn:mergeinfo` property is the only window the user has into the machinery. Because the feature is relatively new, a numbers of edge cases and possible unexpected behaviors may pop up.

For example, sometimes mergeinfo will be generated when running a simple **svn copy** or **svn move** command. Sometimes mergeinfo will appear on files that you didn't expect to be touched by an operation. Sometimes mergeinfo won't be generated at all, when you expect it to. Furthermore, the management of mergeinfo metadata has a whole set of taxonomies and behaviors around it, such as „explicit“ versus „implicit“ mergeinfo, „operative“ versus

„inoperative“ revisions, specific mechanisms of mergeinfo „elision,“ and even „inheritance“ from parent to child directories.

We've chosen not to cover these detailed topics in this book for a couple of reasons. First, the level of detail is absolutely overwhelming for a typical user. Second, as Subversion continues to improve, we feel that a typical user *shouldn't* have to understand these concepts; they'll eventually fade into the background as pesky implementation details. All that said, if you enjoy this sort of thing, you can get a fantastic overview in a paper posted at CollabNet's website: http://www.collab.net/community/subversion/articles/merge-info.html.

For now, if you want to steer clear of bugs and odd behaviors in automatic merging, the CollabNet article recommends that you stick to these simple best practices:

- For short-term feature branches, follow the simple procedure described throughout „Grundlegendes Zusammenführen“.
- For long-lived release branches (as described in „Common Branching Patterns“), perform merges only on the root of the branch, not on subdirectories.
- Never merge into working copies with a mixture of working revision numbers, or with „switched“ subdirectories (as described next in „Traversing Branches“). A merge target should be a working copy which represents a *single* location in the repository at a single point in time.
- Don't ever edit the `svn:mergeinfo` property directly; use **svn merge** with the `--record-only` option to effect a desired change to the metadata (as demonstrated in „Änderungen blockieren“).
- Always make sure you have complete read access to all of your merge sources, and that your target working copy has no sparse directories.

Traversing Branches

The **svn switch** command transforms an existing working copy to reflect a different branch. While this command isn't strictly necessary for working with branches, it provides a nice shortcut. In our earlier example, after creating your private branch, you checked out a fresh working copy of the new repository directory. Instead, you can simply ask Subversion to change your working copy of `/calc/trunk` to mirror the new branch location:

```
$ cd calc

$ svn info | grep URL
URL: http://svn.example.com/repos/calc/trunk

$ svn switch http://svn.example.com/repos/calc/branches/my-calc-branch
U   integer.c
U   button.c
U   Makefile
Updated to revision 341.

$ svn info | grep URL
URL: http://svn.example.com/repos/calc/branches/my-calc-branch
```

„Switching“ a working copy that has no local modifications to a different branch results in the working copy looking just as it would if you'd done a fresh checkout of the directory. It's usually more efficient to use this command, because often branches differ by only a small degree. The server sends only the minimal set of changes necessary to make your working copy reflect the branch directory.

The **svn switch** command also takes a `--revision` (`-r`) option, so you need not always move your working copy to the `HEAD` of the branch.

Of course, most projects are more complicated than our `calc` example, and contain multiple subdirectories. Subversion users often follow a specific algorithm when using branches:

1. Copy the project's entire „trunk“ to a new branch directory.
2. Switch only *part* of the trunk working copy to mirror the branch.

In other words, if a user knows that the branch work needs to happen on only a specific subdirectory, she uses **svn switch** to move only that subdirectory to the branch. (Or sometimes users will switch just a single working file to the branch!) That way, the user can continue to receive normal „trunk“ updates to most of her working copy, but the switched portions will remain immune (unless someone commits a change to her branch). This feature adds a whole new dimension to the concept of a „mixed working copy“—not only can working copies contain a mixture of working revisions, but they can also contain a mixture of repository locations as well.

If your working copy contains a number of switched subtrees from different repository locations, it continues to function as normal. When you update, you'll receive patches to each subtree as appropriate. When you commit, your local changes will still be applied as a single, atomic change to the repository.

Note that while it's okay for your working copy to reflect a mixture of repository locations, these locations must all be within the *same* repository. Subversion repositories aren't yet able to communicate with one another; that feature is planned for the future. [5]

Switches and Updates

Have you noticed that the output of **svn switch** and **svn update** looks the same? The switch command is actually a superset of the update command.

When you run **svn update**, you're asking the repository to compare two trees. The repository does so, and then sends a description of the differences back to the client. The only difference between **svn switch** and **svn update** is that the latter command always compares two identical repository paths.

That is, if your working copy is a mirror of `/calc/trunk`, **svn update** will automatically compare your working copy of `/calc/trunk` to `/calc/trunk` in the `HEAD` revision. If you're switching your working copy to a branch, **svn switch** will compare your working copy of `/calc/trunk` to some *other* branch directory in the `HEAD` revision.

In other words, an update moves your working copy through time. A switch moves your working copy through time *and* space.

Because **svn switch** is essentially a variant of **svn update**, it shares the same behaviors; any local modifications in your working copy are preserved when new data arrives from the repository.

Have you ever found yourself making some complex edits (in your `/trunk` working copy) and suddenly realized, „Hey, these changes ought to be in their own branch?“ A great technique to do this can be summarized in two steps:

[5] You *can*, however, use **svn switch** with the `--relocate` option if the URL of your server changes and you don't want to abandon an existing working copy. See svn switch for more information and an example.

```
$ svn copy http://svn.example.com/repos/calc/trunk \
           http://svn.example.com/repos/calc/branches/newbranch \
      -m "Create branch 'newbranch'."
Committed revision 353.
$ svn switch http://svn.example.com/repos/calc/branches/newbranch
At revision 353.
```

The **svn switch** command, like **svn update**, preserves your local edits. At this point, your working copy is now a reflection of the newly created branch, and your next **svn commit** invocation will send your changes there.

Tags

Another common version control concept is a *tag*. A tag is just a „snapshot" of a project in time. In Subversion, this idea already seems to be everywhere. Each repository revision is exactly that—a snapshot of the filesystem after each commit.

However, people often want to give more human-friendly names to tags, such as `release-1.0`. And they want to make snapshots of smaller subdirectories of the filesystem. After all, it's not so easy to remember that release 1.0 of a piece of software is a particular subdirectory of revision 4822.

Creating a Simple Tag

Once again, **svn copy** comes to the rescue. If you want to create a snapshot of `/calc/trunk` exactly as it looks in the `HEAD` revision, make a copy of it:

```
$ svn copy http://svn.example.com/repos/calc/trunk \
           http://svn.example.com/repos/calc/tags/release-1.0 \
      -m "Tagging the 1.0 release of the 'calc' project."

Committed revision 902.
```

This example assumes that a `/calc/tags` directory already exists. (If it doesn't, you can create it using **svn mkdir**.) After the copy completes, the new `release-1.0` directory is forever a snapshot of how the `/trunk` directory looked in the `HEAD` revision at the time you made the copy. Of course, you might want to be more precise about exactly which revision you copy, in case somebody else may have committed changes to the project when you weren't looking. So if you know that revision 901 of `/calc/trunk` is exactly the snapshot you want, you can specify it by passing `-r 901` to the **svn copy** command.

But wait a moment: isn't this tag creation procedure the same procedure we used to create a branch? Yes, in fact, it is. In Subversion, there's no difference between a tag and a branch. Both are just ordinary directories that are created by copying. Just as with branches, the only reason a copied directory is a „tag" is because *humans* have decided to treat it that way: as long as nobody ever commits to the directory, it forever remains a snapshot. If people start committing to it, it becomes a branch.

If you are administering a repository, there are two approaches you can take to managing tags. The first approach is „hands off": as a matter of project policy, decide where your tags will live, and make sure all users know how to treat the directories they copy. (That is, make sure they know not to commit to them.) The second approach is more paranoid: you can use one of the access control scripts provided with Subversion to prevent anyone from doing anything but creating new copies in the tags area (see Kapitel 6, *Die Administration eines Subversion-Servers*). The paranoid approach, however, isn't usually necessary. If a user accidentally commits a change to a tag directory, you can simply undo the change as discussed in the previous section. This is version control, after all!

Creating a Complex Tag

Sometimes you may want your „snapshot“ to be more complicated than a single directory at a single revision.

For example, pretend your project is much larger than our `calc` example: suppose it contains a number of subdirectories and many more files. In the course of your work, you may decide that you need to create a working copy that is designed to have specific features and bug fixes. You can accomplish this by selectively backdating files or directories to particular revisions (using **svn update** with the `-r` option liberally), by switching files and directories to particular branches (making use of **svn switch**), or even just by making a bunch of local changes. When you're done, your working copy is a hodgepodge of repository locations from different revisions. But after testing, you know it's the precise combination of data you need to tag.

Time to make a snapshot. Copying one URL to another won't work here. In this case, you want to make a snapshot of your exact working copy arrangement and store it in the repository. Luckily, **svn copy** actually has four different uses (which you can read about in Kapitel 9, *Subversion Complete Reference*), including the ability to copy a working copy tree to the repository:

```
$ ls
my-working-copy/

$ svn copy my-working-copy \
           http://svn.example.com/repos/calc/tags/mytag \
           -m "Tag my existing working copy state."

Committed revision 940.
```

Now there is a new directory in the repository, `/calc/tags/mytag`, which is an exact snapshot of your working copy—mixed revisions, URLs, local changes, and all.

Other users have found interesting uses for this feature. Sometimes there are situations where you have a bunch of local changes made to your working copy, and you'd like a collaborator to see them. Instead of running **svn diff** and sending a patch file (which won't capture directory, symlink, or property changes), you can use **svn copy** to „upload“ your working copy to a private area of the repository. Your collaborator can then either check out a verbatim copy of your working copy or use **svn merge** to receive your exact changes.

While this is a nice method for uploading a quick snapshot of your working copy, note that this is *not* a good way to initially create a branch. Branch creation should be an event unto itself, and this method conflates the creation of a branch with extra changes to files, all within a single revision. This makes it very difficult (later on) to identify a single revision number as a branch point.

Branch Maintenance

You may have noticed by now that Subversion is extremely flexible. Because it implements branches and tags with the same underlying mechanism (directory copies), and because branches and tags appear in normal filesystem space, many people find Subversion intimidating. It's almost *too* flexible. In this section, we'll offer some suggestions for arranging and managing your data over time.

Repository Layout

There are some standard, recommended ways to organize a repository. Most people create a `trunk` directory to hold the „main line“ of development, a `branches` directory to contain branch copies, and a `tags` directory to contain tag copies. If a repository holds only one project, often people create these top-level directories:

```
/trunk
/branches
/tags
```

If a repository contains multiple projects, admins typically index their layout by project (see „Planning Your Repository Organization“ to read more about „project roots“):

```
/paint/trunk
/paint/branches
/paint/tags
/calc/trunk
/calc/branches
/calc/tags
```

Of course, you're free to ignore these common layouts. You can create any sort of variation, whatever works best for you or your team. Remember that whatever you choose, it's not a permanent commitment. You can reorganize your repository at any time. Because branches and tags are ordinary directories, the **svn move** command can move or rename them however you wish. Switching from one layout to another is just a matter of issuing a series of server-side moves; if you don't like the way things are organized in the repository, just juggle the directories around.

Remember, though, that while moving directories may be easy to do, you need to be considerate of your users as well. Your juggling can be disorienting to users with existing working copies. If a user has a working copy of a particular repository directory, your **svn move** operation might remove the path from the latest revision. When the user next runs **svn update**, she will be told that her working copy represents a path that no longer exists, and the user will be forced to **svn switch** to the new location.

Data Lifetimes

Another nice feature of Subversion's model is that branches and tags can have finite lifetimes, just like any other versioned item. For example, suppose you eventually finish all your work on your personal branch of the `calc` project. After merging all of your changes back into `/calc/trunk`, there's no need for your private branch directory to stick around anymore:

```
$ svn delete http://svn.example.com/repos/calc/branches/my-calc-branch \
             -m "Removing obsolete branch of calc project."

Committed revision 375.
```

And now your branch is gone. Of course, it's not really gone: the directory is simply missing from the `HEAD` revision, no longer distracting anyone. If you use **svn checkout**, **svn switch**, or **svn list** to examine an earlier revision, you'll still be able to see your old branch.

If browsing your deleted directory isn't enough, you can always bring it back. Resurrecting data is very easy in Subversion. If there's a deleted directory (or file) that you'd like to bring back into `HEAD`, simply use **svn copy** to copy it from the old revision:

```
$ svn copy http://svn.example.com/repos/calc/branches/my-calc-branch@374 \
           http://svn.example.com/repos/calc/branches/my-calc-branch \
```

```
           -m "Restore my-calc-branch."

Committed revision 376.
```

In our example, your personal branch had a relatively short lifetime: you may have created it to fix a bug or implement a new feature. When your task is done, so is the branch. In software development, though, it's also common to have two „main“ branches running side by side for very long periods. For example, suppose it's time to release a stable version of the `calc` project to the public, and you know it's going to take a couple of months to shake bugs out of the software. You don't want people to add new features to the project, but you don't want to tell all developers to stop programming either. So instead, you create a „stable“ branch of the software that won't change much:

```
$ svn copy http://svn.example.com/repos/calc/trunk \
           http://svn.example.com/repos/calc/branches/stable-1.0 \
           -m "Creating stable branch of calc project."

Committed revision 377.
```

And now developers are free to continue adding cutting-edge (or experimental) features to `/calc/trunk`, and you can declare a project policy that only bug fixes are to be committed to `/calc/branches/stable-1.0`. That is, as people continue to work on the trunk, a human selectively ports bug fixes over to the stable branch. Even after the stable branch has shipped, you'll probably continue to maintain the branch for a long time—that is, as long as you continue to support that release for customers. We'll discuss this more in the next section.

Common Branching Patterns

There are many different uses for branching and **svn merge**, and this section describes the most common.

Version control is most often used for software development, so here's a quick peek at two of the most common branching/merging patterns used by teams of programmers. If you're not using Subversion for software development, feel free to skip this section. If you're a software developer using version control for the first time, pay close attention, as these patterns are often considered best practices by experienced folk. These processes aren't specific to Subversion; they're applicable to any version control system. Still, it may help to see them described in Subversion terms.

Release Branches

Most software has a typical life cycle: code, test, release, repeat. There are two problems with this process. First, developers need to keep writing new features while quality assurance teams take time to test supposedly stable versions of the software. New work cannot halt while the software is tested. Second, the team almost always needs to support older, released versions of software; if a bug is discovered in the latest code, it most likely exists in released versions as well, and customers will want to get that bug fix without having to wait for a major new release.

Here's where version control can help. The typical procedure looks like this:

1. *Developers commit all new work to the trunk.* Day-to-day changes are committed to `/trunk`: new features, bug fixes, and so on.

2. *The trunk is copied to a „release“ branch.* When the team thinks the software is ready for release (say, a 1.0 release), `/trunk` might be copied to `/branches/1.0`.

3. *Teams continue to work in parallel.* One team begins rigorous testing of the release branch, while another team continues new work (say, for version 2.0) on `/trunk`. If bugs are discovered in either location, fixes are ported back and forth as necessary. At some point, however, even that process stops. The branch is „frozen“ for final testing right before a release.

4. *The branch is tagged and released.* When testing is complete, `/branches/1.0` is copied to `/tags/1.0.0` as a reference snapshot. The tag is packaged and released to customers.

5. *The branch is maintained over time.* While work continues on `/trunk` for version 2.0, bug fixes continue to be ported from `/trunk` to `/branches/1.0`. When enough bug fixes have accumulated, management may decide to do a 1.0.1 release: `/branches/1.0` is copied to `/tags/1.0.1`, and the tag is packaged and released.

This entire process repeats as the software matures: when the 2.0 work is complete, a new 2.0 release branch is created, tested, tagged, and eventually released. After some years, the repository ends up with a number of release branches in „maintenance“ mode, and a number of tags representing final shipped versions.

Feature Branches

A *feature branch* is the sort of branch that's been the dominant example in this chapter (the one you've been working on while Sally continues to work on `/trunk`). It's a temporary branch created to work on a complex change without interfering with the stability of `/trunk`. Unlike release branches (which may need to be supported forever), feature branches are born, used for a while, merged back to the trunk, and then ultimately deleted. They have a finite span of usefulness.

Again, project policies vary widely concerning exactly when it's appropriate to create a feature branch. Some projects never use feature branches at all: commits to `/trunk` are a free-for-all. The advantage to this system is that it's simple—nobody needs to learn about branching or merging. The disadvantage is that the trunk code is often unstable or unusable. Other projects use branches to an extreme: no change is *ever* committed to the trunk directly. Even the most trivial changes are created on a short-lived branch, carefully reviewed, and merged to the trunk. Then the branch is deleted. This system guarantees an exceptionally stable and usable trunk at all times, but at the cost of tremendous process overhead.

Most projects take a middle-of-the-road approach. They commonly insist that `/trunk` compile and pass regression tests at all times. A feature branch is required only when a change requires a large number of destabilizing commits. A good rule of thumb is to ask this question: if the developer worked for days in isolation and then committed the large change all at once (so that `/trunk` were never destabilized), would it be too large a change to review? If the answer to that question is „yes,“ the change should be developed on a feature branch. As the developer commits incremental changes to the branch, they can be easily reviewed by peers.

Finally, there's the issue of how to best keep a feature branch in „sync“ with the trunk as work progresses. As we mentioned earlier, there's a great risk to working on a branch for weeks or months; trunk changes may continue to pour in, to the point where the two lines of development differ so greatly that it may become a nightmare trying to merge the branch back to the trunk.

This situation is best avoided by regularly merging trunk changes to the branch. Make up a policy: once a week, merge the last week's worth of trunk changes to the branch.

At some point, you'll be ready to merge the „synchronized“ feature branch back to the trunk. To do this, begin by doing a final merge of the latest trunk changes to the branch. When that's done, the latest versions of branch and trunk will be absolutely identical except for your branch changes. You would then merge back with the `--reintegrate` option:

```
$ cd trunk-working-copy

$ svn update
At revision 1910.

$ svn merge --reintegrate http://svn.example.com/repos/calc/branches/mybranch
--- Merging differences between repository URLs into '.':
U    real.c
U    integer.c
A    newdirectory
A    newdirectory/newfile
 U   .
…
```

Another way of thinking about this pattern is that your weekly sync of trunk to branch is analogous to running **svn update** in a working copy, while the final merge step is analogous to running **svn commit** from a working copy. After all, what else *is* a working copy but a very shallow private branch? It's a branch that's capable of storing only one change at a time.

Vendor Branches

As is especially the case when developing software, the data that you maintain under version control is often closely related to, or perhaps dependent upon, someone else's data. Generally, the needs of your project will dictate that you stay as up to date as possible with the data provided by that external entity without sacrificing the stability of your own project. This scenario plays itself out all the time—anywhere that the information generated by one group of people has a direct effect on that which is generated by another group.

For example, software developers might be working on an application that makes use of a third-party library. Subversion has just such a relationship with the Apache Portable Runtime (APR) library (see „The Apache Portable Runtime Library“). The Subversion source code depends on the APR library for all its portability needs. In earlier stages of Subversion's development, the project closely tracked APR's changing API, always sticking to the „bleeding edge“ of the library's code churn. Now that both APR and Subversion have matured, Subversion attempts to synchronize with APR's library API only at well-tested, stable release points.

Now, if your project depends on someone else's information, you could attempt to synchronize that information with your own in several ways. Most painfully, you could issue oral or written instructions to all the contributors of your project, telling them to make sure they have the specific versions of that third-party information that your project needs. If the third-party information is maintained in a Subversion repository, you could also use Subversion's externals definitions to effectively „pin down“ specific versions of that information to some location in your own working copy directory (see „Externals Definitions“).

But sometimes you want to maintain custom modifications to third-party code in your own version control system. Returning to the software development example, programmers might need to make modifications to that third-party library for their own purposes. These modifications might include new functionality or bug fixes, maintained internally only until they become part of an official release of the third-party library. Or the changes might never be relayed back to the library maintainers, existing solely as custom tweaks to make the library further suit the needs of the software developers.

Now you face an interesting situation. Your project could house its custom modifications to the third-party data in some disjointed fashion, such as using patch files or full-fledged alternative versions of files and directories. But these quickly become maintenance headaches, requiring some mechanism by which to apply your custom changes to the third-party code and necessitating regeneration of those changes with each successive version of the third-party code that you track.

The solution to this problem is to use *vendor branches*. A vendor branch is a directory tree in your own version control system that contains information provided by a third-party entity, or vendor. Each version of the vendor's data that you decide to absorb into your project is called a *vendor drop*.

Vendor branches provide two benefits. First, by storing the currently supported vendor drop in your own version control system, you ensure that the members of your project never need to question whether they have the right version of the vendor's data. They simply receive that correct version as part of their regular working copy updates. Second, because the data lives in your own Subversion repository, you can store your custom changes to it in-place—you have no more need of an automated (or worse, manual) method for swapping in your customizations.

General Vendor Branch Management Procedure

Managing vendor branches generally works like this: first, you create a top-level directory (such as `/vendor`) to hold the vendor branches. Then you import the third-party code into a subdirectory of that top-level directory. You then copy that subdirectory into your main development branch (e.g., `/trunk`) at the appropriate location. You always make your local changes in the main development branch. With each new release of the code you are tracking, you bring it into the vendor branch and merge the changes into `/trunk`, resolving whatever conflicts occur between your local changes and the upstream changes.

An example will help to clarify this algorithm. We'll use a scenario where your development team is creating a calculator program that links against a third-party complex number arithmetic library, libcomplex. We'll begin with the initial creation of the vendor branch and the import of the first vendor drop. We'll call our vendor branch directory `libcomplex`, and our code drops will go into a subdirectory of our vendor branch called `current`. And since **svn import** creates all the intermediate parent directories it needs, we can actually accomplish both of these steps with a single command:

```
$ svn import /path/to/libcomplex-1.0 \
             http://svn.example.com/repos/vendor/libcomplex/current \
             -m 'importing initial 1.0 vendor drop'
…
```

We now have the current version of the libcomplex source code in `/vendor/libcomplex/current`. Now, we tag that version (see „Tags“) and then copy it into the main development branch. Our copy will create a new directory called `libcomplex` in our existing `calc` project directory. It is in this copied version of the vendor data that we will make our customizations:

```
$ svn copy http://svn.example.com/repos/vendor/libcomplex/current  \
           http://svn.example.com/repos/vendor/libcomplex/1.0      \
           -m 'tagging libcomplex-1.0'
…
$ svn copy http://svn.example.com/repos/vendor/libcomplex/1.0  \
           http://svn.example.com/repos/calc/libcomplex        \
           -m 'bringing libcomplex-1.0 into the main branch'
…
```

We check out our project's main branch—which now includes a copy of the first vendor drop—and we get to work customizing the libcomplex code. Before we know it, our modified version of libcomplex is now completely integrated into our calculator program. [6]

A few weeks later, the developers of libcomplex release a new version of their library—version 1.1—which contains some features and functionality that we really want. We'd like to upgrade to this new version, but without losing the customizations we made to the existing version. What we essentially would like to do is to replace our current baseline version of libcomplex 1.0 with a copy of libcomplex 1.1, and then re-apply the custom modifications we previously made to that library to the new version. But we actually approach the problem from the other direction, applying the changes made to libcomplex between versions 1.0 and 1.1 to our modified copy of it.

To perform this upgrade, we check out a copy of our vendor branch and replace the code in the `current` directory with the new libcomplex 1.1 source code. We quite literally copy new files on top of existing files, perhaps exploding the libcomplex 1.1 release tarball atop our existing files and directories. The goal here is to make our `current` directory contain only the libcomplex 1.1 code and to ensure that all that code is under version control. Oh, and we want to do this with as little version control history disturbance as possible.

After replacing the 1.0 code with 1.1 code, **svn status** will show files with local modifications as well as, perhaps, some unversioned files. If we did what we were supposed to do, the unversioned files are only those new files introduced in the 1.1 release of libcomplex—we run **svn add** on those to get them under version control. If the 1.1 code no longer has certain files that were in the 1.0 tree, it may be hard to notice them; you'd have to compare the two trees with some external tool and then **svn delete** any files present in 1.0 but not in 1.1. (Although it might also be just fine to let these same files live on in unused obscurity!) Finally, once our `current` working copy contains only the libcomplex 1.1 code, we commit the changes we made to get it looking that way.

Our `current` branch now contains the new vendor drop. We tag the new version as 1.1 (in the same way we previously tagged the version 1.0 vendor drop), and then merge the differences between the tag of the previous version and the new current version into our main development branch:

```
$ cd working-copies/calc
$ svn merge http://svn.example.com/repos/vendor/libcomplex/1.0      \
            http://svn.example.com/repos/vendor/libcomplex/current  \
            libcomplex
… # resolve all the conflicts between their changes and our changes
$ svn commit -m 'merging libcomplex-1.1 into the main branch'
…
```

In the trivial use case, the new version of our third-party tool would look, from a files-and-directories point of view, just like the previous version. None of the libcomplex source files would have been deleted, renamed, or moved to different locations—the new version would contain only textual modifications against the previous one. In a perfect world, our modifications would apply cleanly to the new version of the library, with absolutely no complications or conflicts.

But things aren't always that simple, and in fact it is quite common for source files to get moved around between releases of software. This complicates the process of ensuring that our modifications are still valid for the new version of code, and things can quickly degrade into a situation where we have to manually re-create our customizations in the new version. Once Subversion knows about the history of a given source file—including all its previous locations—the process of merging in the new version of the library is pretty simple. But we are responsible for telling Subversion how the source file layout changed from vendor drop to vendor drop.

svn_load_dirs.pl

Vendor drops that contain more than a few deletes, additions, and moves complicate the

[6] And is entirely bug-free, of course!

process of upgrading to each successive version of the third-party data. So Subversion supplies the **svn_load_dirs.pl** script to assist with this process. This script automates the importing steps we mentioned in the general vendor branch management procedure to make sure mistakes are minimized. You will still be responsible for using the merge commands to merge the new versions of the third-party data into your main development branch, but **svn_load_dirs.pl** can help you more quickly and easily arrive at that stage.

In short, **svn_load_dirs.pl** is an enhancement to **svn import** that has several important characteristics:

- It can be run at any point in time to bring an existing directory in the repository to exactly match an external directory, performing all the necessary adds and deletes, and optionally performing moves, too.
- It takes care of complicated series of operations between which Subversion requires an intermediate commit—such as before renaming a file or directory twice.
- It will optionally tag the newly imported directory.
- It will optionally add arbitrary properties to files and directories that match a regular expression.

svn_load_dirs.pl takes three mandatory arguments. The first argument is the URL to the base Subversion directory to work in. This argument is followed by the URL—relative to the first argument—into which the current vendor drop will be imported. Finally, the third argument is the local directory to import. Using our previous example, a typical run of **svn_load_dirs.pl** might look like this:

```
$ svn_load_dirs.pl http://svn.example.com/repos/vendor/libcomplex \
                   current                                        \
                   /path/to/libcomplex-1.1
…
```

You can indicate that you'd like **svn_load_dirs.pl** to tag the new vendor drop by passing the `-t` command-line option and specifying a tag name. This tag is another URL relative to the first program argument.

```
$ svn_load_dirs.pl -t libcomplex-1.1                              \
                   http://svn.example.com/repos/vendor/libcomplex \
                   current                                        \
                   /path/to/libcomplex-1.1
…
```

When you run **svn_load_dirs.pl**, it examines the contents of your existing „current" vendor drop and compares them with the proposed new vendor drop. In the trivial case, no files will be in one version and not the other, and the script will perform the new import without incident. If, however, there are discrepancies in the file layouts between versions, **svn_load_dirs.pl** will ask you how to resolve those differences. For example, you will have the opportunity to tell the script that you know that the file `math.c` in version 1.0 of libcomplex was renamed to `arithmetic.c` in libcomplex 1.1. Any discrepancies not explained by moves are treated as regular additions and deletions.

The script also accepts a separate configuration file for setting properties on files and directories matching a regular expression that are *added* to the repository. This configuration file is specified to **svn_load_dirs.pl** using the `-p` command-line option. Each line of the configuration file is a whitespace-delimited set of two or four values: a Perl-style regular expression against which to match the added path, a control keyword (either `break` or `cont`), and then optionally a property name and value.

```
\.png$              break   svn:mime-type   image/png
\.jpe?g$            break   svn:mime-type   image/jpeg
\.m3u$              cont    svn:mime-type   audio/x-mpegurl
\.m3u$              break   svn:eol-style   LF
.*                  break   svn:eol-style   native
```

For each added path, the configured property changes whose regular expression matches the path are applied in order, unless the control specification is `break` (which means that no more property changes should be applied to that path). If the control specification is `cont`—an abbreviation for `continue`—matching will continue with the next line of the configuration file.

Any whitespace in the regular expression, property name, or property value must be surrounded by either single or double quotes. You can escape quotes that are not used for wrapping whitespace by preceding them with a backslash (\) character. The backslash escapes only quotes when parsing the configuration file, so do not protect any other characters beyond what is necessary for the regular expression.

Summary

We covered a lot of ground in this chapter. We discussed the concepts of tags and branches and demonstrated how Subversion implements these concepts by copying directories with the **svn copy** command. We showed how to use **svn merge** to copy changes from one branch to another or roll back bad changes. We went over the use of **svn switch** to create mixed-location working copies. And we talked about how one might manage the organization and lifetimes of branches in a repository.

Remember the Subversion mantra: branches and tags are cheap. So don't be afraid to use them when needed!

As a helpful reminder of all the operations we discussed, here is handy reference table you can consult as you begin to make use of branches.

Tabelle 4.1. Branching and merging commands

Action	Command
Create a branch or tag	`svn copy` ***`URL1 URL2`***
Switch a working copy to a branch or tag	`svn switch` ***`URL`***
Synchronize a branch with trunk	`svn merge` ***`trunkURL`***`; svn commit`
See merge history or eligible changesets	`svn mergeinfo target --from-source=`***`URL`***
Merge a branch back into trunk	`svn merge --reintegrate` ***`branchURL`***`; svn commit`
Merge one specific change	`svn merge -c` ***`REV URL`***`; svn commit`
Merge a range of changes	`svn merge -r` ***`REV1`***`:`***`REV2 URL`***`; svn commit`
Block a change from automatic merging	`svn merge -c` ***`REV`*** `--record-only` ***`URL`***`; svn commit`
Preview a merge	`svn merge` ***`URL`*** `--dry-run`
Abandon merge results	`svn revert -R .`
Resurrect something from history	`svn copy` ***`URL@REV localPATH`***
Undo a committed change	`svn merge -c` ***`-REV URL`***`; svn commit`

Action	Command
Examine merge-sensitive history	**svn log -g; svn blame -g**
Create a tag from a working copy	**svn copy . *tagURL***
Rearrange a branch or tag	**svn mv *URL1 URL2***
Remove a branch or tag	**svn rm *URL***

Kapitel 5. Repository Administration

The Subversion repository is the central storehouse of all your versioned data. As such, it becomes an obvious candidate for all the love and attention an administrator can offer. While the repository is generally a low-maintenance item, it is important to understand how to properly configure and care for it so that potential problems are avoided, and so actual problems are safely resolved.

In this chapter, we'll discuss how to create and configure a Subversion repository. We'll also talk about repository maintenance, providing examples of how and when to use the **svnlook** and **svnadmin** tools provided with Subversion. We'll address some common questions and mistakes and give some suggestions on how to arrange the data in the repository.

If you plan to access a Subversion repository only in the role of a user whose data is under version control (i.e., via a Subversion client), you can skip this chapter altogether. However, if you are, or wish to become, a Subversion repository administrator, [1] this chapter is for you.

The Subversion Repository, Defined

Before jumping into the broader topic of repository administration, let's further define what a repository is. How does it look? How does it feel? Does it take its tea hot or iced, sweetened, and with lemon? As an administrator, you'll be expected to understand the composition of a repository both from a literal, OS-level perspective—how a repository looks and acts with respect to non-Subversion tools—and from a logical perspective—dealing with how data is represented *inside* the repository.

Seen through the eyes of a typical file browser application (such as Windows Explorer) or command-line based filesystem navigation tools, the Subversion repository is just another directory full of stuff. There are some subdirectories with human-readable configuration files in them, some subdirectories with some not-so-human-readable data files, and so on. As in other areas of the Subversion design, modularity is given high regard, and hierarchical organization is preferred to cluttered chaos. So a shallow glance into a typical repository from a nuts-and-bolts perspective is sufficient to reveal the basic components of the repository:

```
$ ls repos
conf/  dav/  db/  format  hooks/  locks/  README.txt
```

Here's a quick fly-by overview of what exactly you're seeing in this directory listing. (Don't get bogged down in the terminology—detailed coverage of these components exists elsewhere in this and other chapters.)

conf
: A directory containing configuration files

dav
: A directory provided to `mod_dav_svn` for its private housekeeping data

db
: The data store for all of your versioned data

[1] This may sound really prestigious and lofty, but we're just talking about anyone who is interested in that mysterious realm beyond the working copy where everyone's data hangs out.

format
: A file that contains a single integer that indicates the version number of the repository layout

hooks
: A directory full of hook script templates (and hook scripts themselves, once you've installed some)

locks
: A directory for Subversion's repository lock files, used for tracking accessors to the repository

README.txt
: A file whose contents merely inform its readers that they are looking at a Subversion repository

Of course, when accessed via the Subversion libraries, this otherwise unremarkable collection of files and directories suddenly becomes an implementation of a virtual, versioned filesystem, complete with customizable event triggers. This filesystem has its own notions of directories and files, very similar to the notions of such things held by real filesystems (such as NTFS, FAT32, ext3, etc.). But this is a special filesystem—it hangs these directories and files from revisions, keeping all the changes you've ever made to them safely stored and forever accessible. This is where the entirety of your versioned data lives.

Strategies for Repository Deployment

Due largely to the simplicity of the overall design of the Subversion repository and the technologies on which it relies, creating and configuring a repository are fairly straightforward tasks. There are a few preliminary decisions you'll want to make, but the actual work involved in any given setup of a Subversion repository is pretty basic, tending toward mindless repetition if you find yourself setting up multiples of these things.

Some things you'll want to consider beforehand, though, are:

- What data do you expect to live in your repository (or repositories), and how will that data be organized?
- Where will your repository live, and how will it be accessed?
- What types of access control and repository event reporting do you need?
- Which of the available types of data store do you want to use?

In this section, we'll try to help you answer those questions.

Planning Your Repository Organization

While Subversion allows you to move around versioned files and directories without any loss of information, and even provides ways of moving whole sets of versioned history from one repository to another, doing so can greatly disrupt the workflow of those who access the repository often and come to expect things to be at certain locations. So before creating a new repository, try to peer into the future a bit; plan ahead before placing your data under version control. By conscientiously „laying out“ your repository or repositories and their versioned contents ahead of time, you can prevent many future headaches.

Let's assume that as repository administrator, you will be responsible for supporting the version control system for several projects. Your first decision is whether to use a single repository for multiple projects, or to give each project its own repository, or some compromise of these two.

There are benefits to using a single repository for multiple projects, most obviously the lack of duplicated maintenance. A single repository means that there is one set of hook programs, one thing to routinely back up, one thing to dump and load if Subversion releases an incompatible new version, and so on. Also, you can move data between projects easily, without losing any historical versioning information.

The downside of using a single repository is that different projects may have different requirements in terms of the repository event triggers, such as needing to send commit notification emails to different mailing lists, or having different definitions about what does and does not constitute a legitimate commit. These aren't insurmountable problems, of course—it just means that all of your hook scripts have to be sensitive to the layout of your repository rather than assuming that the whole repository is associated with a single group of people. Also, remember that Subversion uses repository-global revision numbers. While those numbers don't have any particular magical powers, some folks still don't like the fact that even though no changes have been made to their project lately, the youngest revision number for the repository keeps climbing because other projects are actively adding new revisions. [2]

A middle-ground approach can be taken, too. For example, projects can be grouped by how well they relate to each other. You might have a few repositories with a handful of projects in each repository. That way, projects that are likely to want to share data can do so easily, and as new revisions are added to the repository, at least the developers know that those new revisions are at least remotely related to everyone who uses that repository.

After deciding how to organize your projects with respect to repositories, you'll probably want to think about directory hierarchies within the repositories themselves. Because Subversion uses regular directory copies for branching and tagging (see Kapitel 4, *Verzweigen und Zusammenführen*), the Subversion community recommends that you choose a repository location for each *project root*—the „topmost" directory that contains data related to that project—and then create three subdirectories beneath that root: `trunk`, meaning the directory under which the main project development occurs; `branches`, which is a directory in which to create various named branches of the main development line; and `tags`, which is a collection of tree snapshots that are created, and perhaps destroyed, but never changed. [3]

For example, your repository might look like this:

```
/
   calc/
      trunk/
      tags/
      branches/
   calendar/
      trunk/
      tags/
      branches/
   spreadsheet/
      trunk/
      tags/
      branches/
   …
```

Note that it doesn't matter where in your repository each project root is. If you have only one project per repository, the logical place to put each project root is at the root of that

[2] Whether founded in ignorance or in poorly considered concepts about how to derive legitimate software development metrics, global revision numbers are a silly thing to fear, and *not* the kind of thing you should weigh when deciding how to arrange your projects and repositories.
[3] The `trunk`, `tags`, and `branches` trio is sometimes referred to as „the TTB directories."

project's respective repository. If you have multiple projects, you might want to arrange them in groups inside the repository, perhaps putting projects with similar goals or shared code in the same subdirectory, or maybe just grouping them alphabetically. Such an arrangement might look like this:

```
/
   utils/
      calc/
         trunk/
         tags/
         branches/
      calendar/
         trunk/
         tags/
         branches/
      …
   office/
      spreadsheet/
         trunk/
         tags/
         branches/
      …
```

Lay out your repository in whatever way you see fit. Subversion does not expect or enforce a particular layout—in its eyes, a directory is a directory is a directory. Ultimately, you should choose the repository arrangement that meets the needs of the people who work on the projects that live there.

In the name of full disclosure, though, we'll mention another very common layout. In this layout, the `trunk`, `tags`, and `branches` directories live in the root directory of your repository, and your projects are in subdirectories beneath those, like so:

```
/
   trunk/
      calc/
      calendar/
      spreadsheet/
      …
   tags/
      calc/
      calendar/
      spreadsheet/
      …
   branches/
      calc/
      calendar/
      spreadsheet/
      …
```

There's nothing particularly incorrect about such a layout, but it may or may not seem as intuitive for your users. Especially in large, multiproject situations with many users, those users may tend to be familiar with only one or two of the projects in the repository. But the projects-as-branch-siblings approach tends to deemphasize project individuality and focus on the entire set of projects as a single entity. That's a social issue, though. We like our originally suggested arrangement for purely practical reasons—it's easier to ask about (or modify, or migrate elsewhere) the entire history of a single project when there's a single repository path that holds the entire history—past, present, tagged, and branched—for that project and that project alone.

Deciding Where and How to Host Your Repository

Before creating your Subversion repository, an obvious question you'll need to answer is where the thing is going to live. This is strongly connected to myriad other questions involving how the repository will be accessed (via a Subversion server or directly), by whom (users behind your corporate firewall or the whole world out on the open Internet), what other services you'll be providing around Subversion (repository browsing interfaces, email-based commit notification, etc.), your data backup strategy, and so on.

We cover server choice and configuration in Kapitel 6, *Die Administration eines Subversion-Servers*, but the point we'd like to briefly make here is simply that the answers to some of these other questions might have implications that force your hand when deciding where your repository will live. For example, certain deployment scenarios might require accessing the repository via a remote filesystem from multiple computers, in which case (as you'll read in the next section) your choice of a repository backend data store turns out not to be a choice at all because only one of the available backends will work in this scenario.

Addressing each possible way to deploy Subversion is both impossible and outside the scope of this book. We simply encourage you to evaluate your options using these pages and other sources as your reference material and to plan ahead.

Choosing a Data Store

As of version 1.1, Subversion provides two options for the type of underlying data store—often referred to as „the backend“ or, somewhat confusingly, „the (versioned) filesystem“—that each repository uses. One type of data store keeps everything in a Berkeley DB (or BDB) database environment; repositories that use this type are often referred to as being „BDB-backed.“ The other type stores data in ordinary flat files, using a custom format. Subversion developers have adopted the habit of referring to this latter data storage mechanism as *FSFS* [4] —a versioned filesystem implementation that uses the native OS filesystem directly—rather than via a database library or some other abstraction layer—to store data.

Tabelle 5.1, „Repository data store comparison“ gives a comparative overview of Berkeley DB and FSFS repositories.

Tabelle 5.1. Repository data store comparison

Category	Feature	Berkeley DB	FSFS
Reliability	Data integrity	When properly deployed, extremely reliable; Berkeley DB 4.4 brings auto-recovery	Older versions had some rarely demonstrated, but data-destroying bugs
	Sensitivity to interruptions	Very; crashes and permission problems can leave the database „wedged,“ requiring journaled recovery procedures	Quite insensitive

[4] Often pronounced „fuzz-fuzz,“ if Jack Repenning has anything to say about it. (This book, however, assumes that the reader is thinking „eff-ess-eff-ess.“)

Category	Feature	Berkeley DB	FSFS
Accessibility	Usable from a read-only mount	No	Yes
	Platform-independent storage	No	Yes
	Usable over network filesystems	Generally, no	Yes
	Group permissions handling	Sensitive to user umask problems; best if accessed by only one user	Works around umask problems
Scalability	Repository disk usage	Larger (especially if logfiles aren't purged)	Smaller
	Number of revision trees	Database; no problems	Some older native filesystems don't scale well with thousands of entries in a single directory
	Directories with many files	Slower	Faster
Performance	Checking out latest revision	No meaningful difference	No meaningful difference
	Large commits	Slower overall, but cost is amortized across the lifetime of the commit	Faster overall, but finalization delay may cause client timeouts

There are advantages and disadvantages to each of these two backend types. Neither of them is more „official“ than the other, though the newer FSFS is the default data store as of Subversion 1.2. Both are reliable enough to trust with your versioned data. But as you can see in Tabelle 5.1, „Repository data store comparison“, the FSFS backend provides quite a bit more flexibility in terms of its supported deployment scenarios. More flexibility means you have to work a little harder to find ways to deploy it incorrectly. Those reasons—plus the fact that not using Berkeley DB means there's one fewer component in the system—largely explain why today almost everyone uses the FSFS backend when creating new repositories.

Fortunately, most programs that access Subversion repositories are blissfully ignorant of which backend data store is in use. And you aren't even necessarily stuck with your first choice of a data store—in the event that you change your mind later, Subversion provides ways of migrating your repository's data into another repository that uses a different backend data store. We talk more about that later in this chapter.

The following subsections provide a more detailed look at the available backend data store types.

Berkeley DB

When the initial design phase of Subversion was in progress, the developers decided to use Berkeley DB for a variety of reasons, including its open source license, transaction support, reliability, performance, API simplicity, thread safety, support for cursors, and so on.

Berkeley DB provides real transaction support—perhaps its most powerful feature. Multiple processes accessing your Subversion repositories don't have to worry about accidentally clobbering each other's data. The isolation provided by the transaction system is such that for any given operation, the Subversion repository code sees a static view of the database—not a database that is constantly changing at the hand of some other process—and can make decisions based on that view. If the decision made happens to conflict with what another process is doing, the entire operation is rolled back as though it never happened, and Subversion gracefully retries the operation against a new, updated (and yet still static) view of the database.

Another great feature of Berkeley DB is *hot backups*—the ability to back up the database environment without taking it „offline.“ We'll discuss how to back up your repository later in this chapter (in „Repository Backup“), but the benefits of being able to make fully functional copies of your repositories without any downtime should be obvious.

Berkeley DB is also a very reliable database system when properly used. Subversion uses Berkeley DB's logging facilities, which means that the database first writes to on-disk logfiles a description of any modifications it is about to make, and then makes the modification itself. This is to ensure that if anything goes wrong, the database system can back up to a previous *checkpoint*—a location in the logfiles known not to be corrupt—and replay transactions until the data is restored to a usable state. See „Managing Disk Space“ later in this chapter for more about Berkeley DB logfiles.

But every rose has its thorn, and so we must note some known limitations of Berkeley DB. First, Berkeley DB environments are not portable. You cannot simply copy a Subversion repository that was created on a Unix system onto a Windows system and expect it to work. While much of the Berkeley DB database format is architecture-independent, other aspects of the environment are not. Second, Subversion uses Berkeley DB in a way that will not operate on Windows 95/98 systems—if you need to house a BDB-backed repository on a Windows machine, stick with Windows 2000 or later.

While Berkeley DB promises to behave correctly on network shares that meet a particular set of specifications, [5] most networked filesystem types and appliances do *not* actually meet those requirements. And in no case can you allow a BDB-backed repository that resides on a network share to be accessed by multiple clients of that share at once (which quite often is the whole point of having the repository live on a network share in the first place).

If you attempt to use Berkeley DB on a noncompliant remote filesystem, the results are unpredictable—you may see mysterious errors right away, or it may be months before you discover that your repository database is subtly corrupted. You should strongly consider using the FSFS data store for repositories that need to live on a network share.

Finally, because Berkeley DB is a library linked directly into Subversion, it's more sensitive to interruptions than a typical relational database system. Most SQL systems, for example, have a dedicated server process that mediates all access to tables. If a program accessing the database crashes for some reason, the database daemon notices the lost connection and cleans up any mess left behind. And because the database daemon is the only process accessing the tables, applications don't need to worry about permission conflicts. These things are not the case with Berkeley DB, however. Subversion (and programs using Subversion libraries) access the database tables directly, which means that a program crash can leave the database in a temporarily inconsistent, inaccessible state. When this happens, an administrator needs to ask Berkeley DB to restore to a checkpoint, which is a bit of an annoyance. Other things can cause a repository to „wedge“ besides crashed processes, such as programs conflicting over ownership and permissions on the database files.

Berkeley DB 4.4 brings (to Subversion 1.4 and later) the ability for Subversion to automatically and transparently recover Berkeley DB environments in need

[5] Berkeley DB requires that the underlying filesystem implement strict POSIX locking semantics, and more importantly, the ability to map files directly into process memory.

of such recovery. When a Subversion process attaches to a repository's Berkeley DB environment, it uses some process accounting mechanisms to detect any unclean disconnections by previous processes, performs any necessary recovery, and then continues on as though nothing happened. This doesn't completely eliminate instances of repository wedging, but it does drastically reduce the amount of human interaction required to recover from them.

So while a Berkeley DB repository is quite fast and scalable, it's best used by a single server process running as one user—such as Apache's **httpd** or **svnserve** (see Kapitel 6, *Die Administration eines Subversion-Servers*)—rather than accessing it as many different users via `file://` or `svn+ssh://` URLs. If you're accessing a Berkeley DB repository directly as multiple users, be sure to read „Supporting Multiple Repository Access Methods“ later in this chapter.

FSFS

In mid-2004, a second type of repository storage system—one that doesn't use a database at all—came into being. An FSFS repository stores the changes associated with a revision in a single file, and so all of a repository's revisions can be found in a single subdirectory full of numbered files. Transactions are created in separate subdirectories as individual files. When complete, the transaction file is renamed and moved into the revisions directory, thus guaranteeing that commits are atomic. And because a revision file is permanent and unchanging, the repository also can be backed up while „hot,“ just like a BDB-backed repository.

The FSFS revision files describe a revision's directory structure, file contents, and deltas against files in other revision trees. Unlike a Berkeley DB database, this storage format is portable across different operating systems and isn't sensitive to CPU architecture. Because no journaling or shared-memory files are being used, the repository can be safely accessed over a network filesystem and examined in a read-only environment. The lack of database overhead also means the overall repository size is a bit smaller.

FSFS has different performance characteristics, too. When committing a directory with a huge number of files, FSFS is able to more quickly append directory entries. On the other hand, FSFS writes the latest version of a file as a delta against an earlier version, which means that checking out the latest tree is a bit slower than fetching the full-texts stored in a Berkeley DB HEAD revision. FSFS also has a longer delay when finalizing a commit, which could in extreme cases cause clients to time out while waiting for a response.

The most important distinction, however, is FSFS's imperviousness to wedging when something goes wrong. If a process using a Berkeley DB database runs into a permissions problem or suddenly crashes, the database can be left in an unusable state until an administrator recovers it. If the same scenarios happen to a process using an FSFS repository, the repository isn't affected at all. At worst, some transaction data is left behind.

The only real argument against FSFS is its relative immaturity compared to Berkeley DB. Unlike Berkeley DB, which has years of history, its own dedicated development team, and, now, Oracle's mighty name attached to it, [6] FSFS is a newer bit of engineering. Prior to Subversion 1.4, it was still shaking out some pretty serious data integrity bugs, which, while triggered in only very rare cases, nonetheless did occur. That said, FSFS has quickly become the backend of choice for some of the largest public and private Subversion repositories, and it promises a lower barrier to entry for Subversion across the board.

Creating and Configuring Your Repository

[6] Oracle bought Sleepycat and its flagship software, Berkeley DB, on Valentine's Day in 2006.

Earlier in this chapter (in „Strategies for Repository Deployment“), we looked at some of the important decisions that should be made before creating and configuring your Subversion repository. Now, we finally get to get our hands dirty! In this section, we'll see how to actually create a Subversion repository and configure it to perform custom actions when special repository events occur.

Creating the Repository

Subversion repository creation is an incredibly simple task. The **svnadmin** utility that comes with Subversion provides a subcommand (**svnadmin create**) for doing just that.

```
$ # Create a repository
$ svnadmin create /var/svn/repos
$
```

This creates a new repository in the directory `/var/svn/repos`, and with the default filesystem data store. Prior to Subversion 1.2, the default was to use Berkeley DB; the default is now FSFS. You can explicitly choose the filesystem type using the `--fs-type` argument, which accepts as a parameter either `fsfs` or `bdb`.

```
$ # Create an FSFS-backed repository
$ svnadmin create --fs-type fsfs /var/svn/repos
$
```

```
# Create a Berkeley-DB-backed repository
$ svnadmin create --fs-type bdb /var/svn/repos
$
```

After running this simple command, you have a Subversion repository.

The path argument to **svnadmin** is just a regular filesystem path and not a URL like the **svn** client program uses when referring to repositories. Both **svnadmin** and **svnlook** are considered server-side utilities—they are used on the machine where the repository resides to examine or modify aspects of the repository, and are in fact unable to perform tasks across a network. A common mistake made by Subversion newcomers is trying to pass URLs (even „local“ `file://` ones) to these two programs.

Present in the `db/` subdirectory of your repository is the implementation of the versioned filesystem. Your new repository's versioned filesystem begins life at revision 0, which is defined to consist of nothing but the top-level root (`/`) directory. Initially, revision 0 also has a single revision property, `svn:date`, set to the time at which the repository was created.

Now that you have a repository, it's time to customize it.

While some parts of a Subversion repository—such as the configuration files and hook scripts—are meant to be examined and modified manually, you shouldn't (and shouldn't need to) tamper with the other parts of the repository „by hand.“ The **svnadmin** tool should be sufficient for any changes necessary to your repository, or you can look to third-party tools (such as Berkeley DB's tool suite) for tweaking relevant subsections of the repository. Do *not* attempt manual manipulation of your version control history by poking and prodding around in your repository's data store files!

Implementing Repository Hooks

A *hook* is a program triggered by some repository event, such as the creation of a new revision or the modification of an unversioned property. Some hooks (the so-called „pre hooks“) run in advance of a repository operation and provide a means by which to both report what is about to happen and prevent it from happening at all. Other hooks (the „post hooks“) run after the completion of a repository event and are useful for performing tasks that examine—but don't modify—the repository. Each hook is handed enough information to tell what that event is (or was), the specific repository changes proposed (or completed), and the username of the person who triggered the event.

The `hooks` subdirectory is, by default, filled with templates for various repository hooks:

```
$ ls repos/hooks/
post-commit.tmpl          post-unlock.tmpl  pre-revprop-change.tmpl
post-lock.tmpl            pre-commit.tmpl   pre-unlock.tmpl
post-revprop-change.tmpl  pre-lock.tmpl     start-commit.tmpl
$
```

There is one template for each hook that the Subversion repository supports; by examining the contents of those template scripts, you can see what triggers each script to run and what data is passed to that script. Also present in many of these templates are examples of how one might use that script, in conjunction with other Subversion-supplied programs, to perform common useful tasks. To actually install a working hook, you need only place some executable program or script into the `repos/hooks` directory, which can be executed as the name (such as **start-commit** or **post-commit**) of the hook.

On Unix platforms, this means supplying a script or program (which could be a shell script, a Python program, a compiled C binary, or any number of other things) named exactly like the name of the hook. Of course, the template files are present for more than just informational purposes—the easiest way to install a hook on Unix platforms is to simply copy the appropriate template file to a new file that lacks the `.tmpl` extension, customize the hook's contents, and ensure that the script is executable. Windows, however, uses file extensions to determine whether a program is executable, so you would need to supply a program whose basename is the name of the hook and whose extension is one of the special extensions recognized by Windows for executable programs, such as `.exe` for programs and `.bat` for batch files.

For security reasons, the Subversion repository executes hook programs with an empty environment—that is, no environment variables are set at all, not even `$PATH` (or `%PATH%`, under Windows). Because of this, many administrators are baffled when their hook program runs fine by hand, but doesn't work when run by Subversion. Be sure to explicitly set any necessary environment variables in your hook program and/or use absolute paths to programs.

Subversion executes hooks as the same user who owns the process that is accessing the Subversion repository. In most cases, the repository is being accessed via a Subversion server, so this user is the same user as whom the server runs on the system. The hooks themselves will need to be configured with OS-level permissions that allow that user to execute them. Also, this means that any programs or files (including the Subversion repository) accessed directly or indirectly by the hook will be accessed as the same user. In other words, be alert to potential permission-related problems that could prevent the hook from performing the tasks it is designed to perform.

There are serveral hooks implemented by the Subversion repository, and you can get details about each of them in „Repository Hooks“. As a repository administrator, you'll need to decide which hooks you wish to implement (by way of providing an appropriately named and permissioned hook program), and how. When you make this decision, keep in mind the big picture of how your repository is deployed. For example, if you are using server configuration to determine which users are permitted to commit changes to your repository, you don't need to do this sort of access control via the hook system.

There is no shortage of Subversion hook programs and scripts that are freely available either from the Subversion community itself or elsewhere. These scripts cover a wide range of utility—basic access control, policy adherence checking, issue tracker integration, email- or syndication-based commit notification, and beyond. Or, if you wish to write your own, see Kapitel 8, *Embedding Subversion*.

While hook scripts can do almost anything, there is one dimension in which hook script authors should show restraint: do *not* modify a commit transaction using hook scripts. While it might be tempting to use hook scripts to automatically correct errors, shortcomings, or policy violations present in the files being committed, doing so can cause problems. Subversion keeps client-side caches of certain bits of repository data, and if you change a commit transaction in this way, those caches become indetectably stale. This inconsistency can lead to surprising and unexpected behavior. Instead of modifying the transaction, you should simply *validate* the transaction in the `pre-commit` hook and reject the commit if it does not meet the desired requirements. As a bonus, your users will learn the value of careful, compliance-minded work habits.

Berkeley DB Configuration

A Berkeley DB environment is an encapsulation of one or more databases, logfiles, region files, and configuration files. The Berkeley DB environment has its own set of default configuration values for things such as the number of database locks allowed to be taken out at any given time, the maximum size of the journaling logfiles, and so on. Subversion's filesystem logic additionally chooses default values for some of the Berkeley DB configuration options. However, sometimes your particular repository, with its unique collection of data and access patterns, might require a different set of configuration option values.

The producers of Berkeley DB understand that different applications and database environments have different requirements, so they have provided a mechanism for overriding at runtime many of the configuration values for the Berkeley DB environment. BDB checks for the presence of a file named `DB_CONFIG` in the environment directory (namely, the repository's db subdirectory), and parses the options found in that file. Subversion itself creates this file when it creates the rest of the repository. The file initially contains some default options, as well as pointers to the Berkeley DB online documentation so that you can read about what those options do. Of course, you are free to add any of the supported Berkeley DB options to your `DB_CONFIG` file. Just be aware that while Subversion never attempts to read or interpret the contents of the file and makes no direct use of the option settings in it, you'll want to avoid any configuration changes that may cause Berkeley DB to behave in a fashion that is at odds with what Subversion might expect. Also, changes made to `DB_CONFIG` won't take effect until you recover the database environment (using **svnadmin recover**).

Repository Maintenance

Maintaining a Subversion repository can be daunting, mostly due to the complexities inherent in systems that have a database backend. Doing the task well is all about knowing the tools—what they are, when to use them, and how. This section will introduce you to the repository administration tools provided by Subversion and discuss how to wield them to accomplish tasks such as repository data migration, upgrades, backups, and cleanups.

An Administrator's Toolkit

Subversion provides a handful of utilities useful for creating, inspecting, modifying, and repairing your repository. Let's look more closely at each of those tools. Afterward, we'll briefly examine some of the utilities included in the Berkeley DB distribution that provide functionality specific to your repository's database backend not otherwise provided by Subversion's own tools.

svnadmin

The **svnadmin** program is the repository administrator's best friend. Besides providing the ability to create Subversion repositories, this program allows you to perform several maintenance operations on those repositories. The syntax of **svnadmin** is similar to that of other Subversion command-line programs:

```
$ svnadmin help
general usage: svnadmin SUBCOMMAND REPOS_PATH  [ARGS & OPTIONS ...]
Type 'svnadmin help <subcommand>' for help on a specific subcommand.
Type 'svnadmin --version' to see the program version and FS modules.

Available subcommands:
   crashtest
   create
   deltify
…
```

Previously in this chapter (in „Creating the Repository“), we were introduced to the **svnadmin create** subcommand. Most of the other **svnadmin** subcommands we will cover later in this chapter. And you can consult „svnadmin“ for a full rundown of subcommands and what each of them offers.

svnlook

svnlook is a tool provided by Subversion for examining the various revisions and *transactions* (which are revisions in the making) in a repository. No part of this program attempts to change the repository. **svnlook** is typically used by the repository hooks for reporting the changes that are about to be committed (in the case of the **pre-commit** hook) or that were just committed (in the case of the **post-commit** hook) to the repository. A repository administrator may use this tool for diagnostic purposes.

svnlook has a straightforward syntax:

```
$ svnlook help
general usage: svnlook SUBCOMMAND REPOS_PATH [ARGS & OPTIONS ...]
Note: any subcommand which takes the '--revision' and '--transaction'
      options will, if invoked without one of those options, act on
      the repository's youngest revision.
Type 'svnlook help <subcommand>' for help on a specific subcommand.
Type 'svnlook --version' to see the program version and FS modules.
…
```

Most of **svnlook**'s subcommands can operate on either a revision or a transaction tree, printing information about the tree itself, or how it differs from the previous revision of the repository. You use the `--revision` (`-r`) and `--transaction` (`-t`) options to specify which revision or transaction, respectively, to examine. In the absence of both the `--revision` (`-r`) and `--transaction` (`-t`) options, **svnlook** will examine the youngest (or `HEAD`) revision in the repository. So the following two commands do exactly the same thing when 19 is the youngest revision in the repository located at `/var/svn/repos`:

```
$ svnlook info /var/svn/repos
$ svnlook info /var/svn/repos -r 19
```

One exception to these rules about subcommands is the **svnlook youngest** subcommand, which takes no options and simply prints out the repository's youngest revision number:

```
$ svnlook youngest /var/svn/repos
19
$
```

Keep in mind that the only transactions you can browse are uncommitted ones. Most repositories will have no such transactions because transactions are usually either committed (in which case, you should access them as revision with the `--revision` (`-r`) option) or aborted and removed.

Output from **svnlook** is designed to be both human- and machine-parsable. Take, as an example, the output of the **svnlook info** subcommand:

```
$ svnlook info /var/svn/repos
sally
2002-11-04 09:29:13 -0600 (Mon, 04 Nov 2002)
27
Added the usual
Greek tree.
$
```

The output of **svnlook info** consists of the following, in the order given:

1. The author, followed by a newline
2. The date, followed by a newline
3. The number of characters in the log message, followed by a newline
4. The log message itself, followed by a newline

This output is human-readable, meaning items such as the datestamp are displayed using a textual representation instead of something more obscure (such as the number of nanoseconds since the Tastee Freez guy drove by). But the output is also machine-parsable—because the log message can contain multiple lines and be unbounded in length, **svnlook** provides the length of that message before the message itself. This allows scripts and other wrappers around this command to make intelligent decisions about the log message, such as how much memory to allocate for the message, or at least how many bytes to skip in the event that this output is not the last bit of data in the stream.

svnlook can perform a variety of other queries: displaying subsets of bits of information we've mentioned previously, recursively listing versioned directory trees, reporting which paths were modified in a given revision or transaction, showing textual and property differences made to files and directories, and so on. See „svnlook“ for a full reference of **svnlook**'s features.

svndumpfilter

While it won't be the most commonly used tool at the administrator's disposal, **svndumpfilter** provides a very particular brand of useful functionality—the ability to quickly and easily modify streams of Subversion repository history data by acting as a path-based filter.

The syntax of **svndumpfilter** is as follows:

```
$ svndumpfilter help
general usage: svndumpfilter SUBCOMMAND [ARGS & OPTIONS ...]
Type "svndumpfilter help <subcommand>" for help on a specific subcommand.
Type 'svndumpfilter --version' to see the program version.

Available subcommands:
   exclude
   include
   help (?, h)
```

There are only two interesting subcommands: **svndumpfilter exclude** and **svndumpfilter include**. They allow you to make the choice between implicit or explicit inclusion of paths in the stream. You can learn more about these subcommands and **svndumpfilter**'s unique purpose later in this chapter, in „Filtering Repository History".

svnsync

The **svnsync** program, which is new to the 1.4 release of Subversion, provides all the functionality required for maintaining a read-only mirror of a Subversion repository. The program really has one job—to transfer one repository's versioned history into another repository. And while there are few ways to do that, its primary strength is that it can operate remotely—the „source" and „sink" [7] repositories may be on different computers from each other and from **svnsync** itself.

As you might expect, **svnsync** has a syntax that looks very much like every other program we've mentioned in this chapter:

```
$ svnsync help
general usage: svnsync SUBCOMMAND DEST_URL  [ARGS & OPTIONS ...]
Type 'svnsync help <subcommand>' for help on a specific subcommand.
Type 'svnsync --version' to see the program version and RA modules.

Available subcommands:
   initialize (init)
   synchronize (sync)
   copy-revprops
   help (?, h)
$
```

We talk more about replicating repositories with **svnsync** later in this chapter (see „Repository Replication").

fsfs-reshard.py

While not an official member of the Subversion toolchain, the **fsfs-reshard.py** script (found in the `tools/server-side` directory of the Subversion source distribution) is a useful performance tuning tool for administrators of FSFS-backed Subversion repositories. FSFS repositories contain files that describe the changes made in a single revision, and files that contain the revision properties associated with a single revision. Repositories created in versions of Subversion prior to 1.5 keep these files in two directories—one for each type of file. As new revisions are committed to the repository, Subversion drops more files into these two directories—over time, the number of these files in each directory can grow to be quite large. This has been observed to cause performance problems on certain network-based filesystems.

Subversion 1.5 creates FSFS-backed repositories using a slightly modified layout in which

[7] Or is that, the „sync"?

the contents of these two directories are *sharded*, or scattered across several subdirectories. This can greatly reduce the time it takes the system to locate any one of these files, and therefore increases the overall performance of Subversion when reading from the repository. The number of subdirectories used to house these files is configurable, though, and that's where **fsfs-reshard.py** comes in. This script reshuffles the repository's file structure into a new arrangement that reflects the requested number of sharding subdirectories. This is especially useful for converting an older Subversion repository into the new Subversion 1.5 sharded layout (which Subversion will not automatically do for you) or for fine-tuning an already sharded repository.

Berkeley DB utilities

If you're using a Berkeley DB repository, all of your versioned filesystem's structure and data live in a set of database tables within the `db/` subdirectory of your repository. This subdirectory is a regular Berkeley DB environment directory and can therefore be used in conjunction with any of the Berkeley database tools, typically provided as part of the Berkeley DB distribution.

For day-to-day Subversion use, these tools are unnecessary. Most of the functionality typically needed for Subversion repositories has been duplicated in the **svnadmin** tool. For example, **svnadmin list-unused-dblogs** and **svnadmin list-dblogs** perform a subset of what is provided by the Berkeley **db_archive** utility, and **svnadmin recover** reflects the common use cases of the **db_recover** utility.

However, there are still a few Berkeley DB utilities that you might find useful. The **db_dump** and **db_load** programs write and read, respectively, a custom file format that describes the keys and values in a Berkeley DB database. Since Berkeley databases are not portable across machine architectures, this format is a useful way to transfer those databases from machine to machine, irrespective of architecture or operating system. As we describe later in this chapter, you can also use **svnadmin dump** and **svnadmin load** for similar purposes, but **db_dump** and **db_load** can do certain jobs just as well and much faster. They can also be useful if the experienced Berkeley DB hacker needs to do in-place tweaking of the data in a BDB-backed repository for some reason, which is something Subversion's utilities won't allow. Also, the **db_stat** utility can provide useful information about the status of your Berkeley DB environment, including detailed statistics about the locking and storage subsystems.

For more information on the Berkeley DB tool chain, visit the documentation section of the Berkeley DB section of Oracle's web site, located at http://www.oracle.com/technology/documentation/berkeley-db/db/.

Commit Log Message Correction

Sometimes a user will have an error in her log message (a misspelling or some misinformation, perhaps). If the repository is configured (using the `pre-revprop-change` hook; see „Implementing Repository Hooks“) to accept changes to this log message after the commit is finished, the user can „fix“ her log message remotely using **svn propset** (see svn propset). However, because of the potential to lose information forever, Subversion repositories are not, by default, configured to allow changes to unversioned properties—except by an administrator.

If a log message needs to be changed by an administrator, this can be done using **svnadmin setlog**. This command changes the log message (the `svn:log` property) on a given revision of a repository, reading the new value from a provided file.

```
$ echo "Here is the new, correct log message" > newlog.txt
$ svnadmin setlog myrepos newlog.txt -r 388
```

The **svnadmin setlog** command, by default, is still bound by the same protections against modifying unversioned properties as a remote client is—the `pre-` and `post-revprop-change` hooks are still triggered, and therefore must be set up to accept changes of this nature. But an administrator can get around these protections by passing the `--bypass-hooks` option to the **svnadmin setlog** command.

Remember, though, that by bypassing the hooks, you are likely avoiding such things as email notifications of property changes, backup systems that track unversioned property changes, and so on. In other words, be very careful about what you are changing, and how you change it.

Managing Disk Space

While the cost of storage has dropped incredibly in the past few years, disk usage is still a valid concern for administrators seeking to version large amounts of data. Every bit of version history information stored in the live repository needs to be backed up elsewhere, perhaps multiple times as part of rotating backup schedules. It is useful to know what pieces of Subversion's repository data need to remain on the live site, which need to be backed up, and which can be safely removed.

How Subversion saves disk space

To keep the repository small, Subversion uses *deltification* (or deltified storage) within the repository itself. Deltification involves encoding the representation of a chunk of data as a collection of differences against some other chunk of data. If the two pieces of data are very similar, this deltification results in storage savings for the deltified chunk—rather than taking up space equal to the size of the original data, it takes up only enough space to say, „I look just like this other piece of data over here, except for the following couple of changes.“ The result is that most of the repository data that tends to be bulky—namely, the contents of versioned files—is stored at a much smaller size than the original full-text representation of that data. And for repositories created with Subversion 1.4 or later, the space savings are even better—now those full-text representations of file contents are themselves compressed.

Because all of the data that is subject to deltification in a BDB-backed repository is stored in a single Berkeley DB database file, reducing the size of the stored values will not immediately reduce the size of the database file itself. Berkeley DB will, however, keep internal records of unused areas of the database file and consume those areas first before growing the size of the database file. So while deltification doesn't produce immediate space savings, it can drastically slow future growth of the database.

Removing dead transactions

Though they are uncommon, there are circumstances in which a Subversion commit process might fail, leaving behind in the repository the remnants of the revision-to-be that wasn't—an uncommitted transaction and all the file and directory changes associated with it. This could happen for several reasons: perhaps the client operation was inelegantly terminated by the user, or a network failure occurred in the middle of an operation. Regardless of the reason, dead transactions can happen. They don't do any real harm, other than consuming disk space. A fastidious administrator may nonetheless wish to remove them.

You can use the **svnadmin lstxns** command to list the names of the currently outstanding transactions:

```
$ svnadmin lstxns myrepos
19
```

```
3a1
a45
$
```

Each item in the resultant output can then be used with **svnlook** (and its `--transaction` (`-t`) option) to determine who created the transaction, when it was created, what types of changes were made in the transaction—information that is helpful in determining whether the transaction is a safe candidate for removal! If you do indeed want to remove a transaction, its name can be passed to **svnadmin rmtxns**, which will perform the cleanup of the transaction. In fact, **svnadmin rmtxns** can take its input directly from the output of **svnadmin lstxns**!

```
$ svnadmin rmtxns myrepos `svnadmin lstxns myrepos`
$
```

If you use these two subcommands like this, you should consider making your repository temporarily inaccessible to clients. That way, no one can begin a legitimate transaction before you start your cleanup. Beispiel 5.1, „txn-info.sh (reporting outstanding transactions)“ contains a bit of shell-scripting that can quickly generate information about each outstanding transaction in your repository.

Beispiel 5.1. txn-info.sh (reporting outstanding transactions)

```
#!/bin/sh

### Generate informational output for all outstanding transactions in
### a Subversion repository.

REPOS="${1}"
if [ "x$REPOS" = x ] ; then
  echo "usage: $0 REPOS_PATH"
  exit
fi

for TXN in `svnadmin lstxns ${REPOS}`; do
  echo "---[ Transaction ${TXN} ]-------------------------------------------"
  svnlook info "${REPOS}" -t "${TXN}"
done
```

The output of the script is basically a concatenation of several chunks of **svnlook info** output (see „svnlook“) and will look something like this:

```
$ txn-info.sh myrepos
---[ Transaction 19 ]-------------------------------------------
sally
2001-09-04 11:57:19 -0500 (Tue, 04 Sep 2001)
0
---[ Transaction 3a1 ]-------------------------------------------
harry
2001-09-10 16:50:30 -0500 (Mon, 10 Sep 2001)
39
Trying to commit over a faulty network.
---[ Transaction a45 ]-------------------------------------------
sally
2001-09-12 11:09:28 -0500 (Wed, 12 Sep 2001)
0
$
```

A long-abandoned transaction usually represents some sort of failed or interrupted commit. A transaction's datestamp can provide interesting information—for example, how likely is it that an operation begun nine months ago is still active?

In short, transaction cleanup decisions need not be made unwisely. Various sources of information—including Apache's error and access logs, Subversion's operational logs, Subversion revision history, and so on—can be employed in the decision-making process. And of course, an administrator can often simply communicate with a seemingly dead transaction's owner (via email, e.g.) to verify that the transaction is, in fact, in a zombie state.

Purging unused Berkeley DB logfiles

Until recently, the largest offender of disk space usage with respect to BDB-backed Subversion repositories were the logfiles in which Berkeley DB performs its prewrites before modifying the actual database files. These files capture all the actions taken along the route of changing the database from one state to another—while the database files, at any given time, reflect a particular state, the logfiles contain all of the many changes along the way *between* states. Thus, they can grow and accumulate quite rapidly.

Fortunately, beginning with the 4.2 release of Berkeley DB, the database environment has the ability to remove its own unused logfiles automatically. Any repositories created using **svnadmin** when compiled against Berkeley DB version 4.2 or later will be configured for this automatic logfile removal. If you don't want this feature enabled, simply pass the `--bdb-log-keep` option to the **svnadmin create** command. If you forget to do this or change your mind at a later time, simply edit the `DB_CONFIG` file found in your repository's `db` directory, comment out the line that contains the `set_flags DB_LOG_AUTOREMOVE` directive, and then run **svnadmin recover** on your repository to force the configuration changes to take effect. See „Berkeley DB Configuration“ for more information about database configuration.

Without some sort of automatic logfile removal in place, logfiles will accumulate as you use your repository. This is actually somewhat of a feature of the database system—you should be able to recreate your entire database using nothing but the logfiles, so these files can be useful for catastrophic database recovery. But typically, you'll want to archive the logfiles that are no longer in use by Berkeley DB, and then remove them from disk to conserve space. Use the **svnadmin list-unused-dblogs** command to list the unused logfiles:

```
$ svnadmin list-unused-dblogs /var/svn/repos
/var/svn/repos/log.0000000031
/var/svn/repos/log.0000000032
/var/svn/repos/log.0000000033
…
$ rm `svnadmin list-unused-dblogs /var/svn/repos`
## disk space reclaimed!
```

BDB-backed repositories whose logfiles are used as part of a backup or disaster recovery plan should *not* make use of the logfile autoremoval feature. Reconstruction of a repository's data from logfiles can only be accomplished only when *all* the logfiles are available. If some of the logfiles are removed from disk before the backup system has a chance to copy them elsewhere, the incomplete set of backed-up logfiles is essentially useless.

Berkeley DB Recovery

As mentioned in „Berkeley DB“, a Berkeley DB repository can sometimes be left in a frozen state if not closed properly. When this happens, an administrator needs to rewind the database back into a consistent state. This is unique to BDB-backed repositories, though—if you are using FSFS-backed ones instead, this won't apply to you. And for those of you using Subversion 1.4 with Berkeley DB 4.4 or later, you should find that Subversion has become much more resilient in these types of situations. Still, wedged Berkeley DB repositories do occur, and an administrator needs to know how to safely deal with this circumstance.

To protect the data in your repository, Berkeley DB uses a locking mechanism. This mechanism ensures that portions of the database are not simultaneously modified by multiple database accessors, and that each process sees the data in the correct state when that data is being read from the database. When a process needs to change something in the database, it first checks for the existence of a lock on the target data. If the data is not locked, the process locks the data, makes the change it wants to make, and then unlocks the data. Other processes are forced to wait until that lock is removed before they are permitted to continue accessing that section of the database. (This has nothing to do with the locks that you, as a user, can apply to versioned files within the repository; we try to clear up the confusion caused by this terminology collision in the sidebar The Three Meanings of „Lock".)

In the course of using your Subversion repository, fatal errors or interruptions can prevent a process from having the chance to remove the locks it has placed in the database. The result is that the backend database system gets „wedged." When this happens, any attempts to access the repository hang indefinitely (since each new accessor is waiting for a lock to go away—which isn't going to happen).

If this happens to your repository, don't panic. The Berkeley DB filesystem takes advantage of database transactions, checkpoints, and prewrite journaling to ensure that only the most catastrophic of events [8] can permanently destroy a database environment. A sufficiently paranoid repository administrator will have made off-site backups of the repository data in some fashion, but don't head off to the tape backup storage closet just yet.

Instead, use the following recipe to attempt to „unwedge" your repository:

1. Make sure no processes are accessing (or attempting to access) the repository. For networked repositories, this also means shutting down the Apache HTTP Server or svnserve daemon.

2. Become the user who owns and manages the repository. This is important, as recovering a repository while running as the wrong user can tweak the permissions of the repository's files in such a way that your repository will still be inaccessible even after it is „unwedged."

3. Run the command **svnadmin recover /var/svn/repos**. You should see output such as this:

   ```
   Repository lock acquired.
   Please wait; recovering the repository may take some time...

   Recovery completed.
   The latest repos revision is 19.
   ```

   This command may take many minutes to complete.

4. Restart the server process.

This procedure fixes almost every case of repository wedging. Make sure that you run this command as the user that owns and manages the database, not just as `root`. Part of the recovery process might involve re-creating from scratch various database files (shared

[8] For example, hard drive + huge electromagnet = disaster.

memory regions, e.g.). Recovering as `root` will create those files such that they are owned by `root`, which means that even after you restore connectivity to your repository, regular users will be unable to access it.

If the previous procedure, for some reason, does not successfully unwedge your repository, you should do two things. First, move your broken repository directory aside (perhaps by renaming it to something like `repos.BROKEN`) and then restore your latest backup of it. Then, send an email to the Subversion users mailing list (at `<users@subversion.tigris.org>`) describing your problem in detail. Data integrity is an extremely high priority to the Subversion developers.

Migrating Repository Data Elsewhere

A Subversion filesystem has its data spread throughout files in the repository, in a fashion generally understood by (and of interest to) only the Subversion developers themselves. However, circumstances may arise that call for all, or some subset, of that data to be copied or moved into another repository.

Subversion provides such functionality by way of *repository dump streams*. A repository dump stream (often referred to as a „dump file“ when stored as a file on disk) is a portable, flat file format that describes the various revisions in your repository—what was changed, by whom, when, and so on. This dump stream is the primary mechanism used to marshal versioned history—in whole or in part, with or without modification—between repositories. And Subversion provides the tools necessary for creating and loading these dump streams: the **svnadmin dump** and **svnadmin load** subcommands, respectively.

While the Subversion repository dump format contains human-readable portions and a familiar structure (it resembles an RFC 822 format, the same type of format used for most email), it is *not* a plain-text file format. It is a binary file format, highly sensitive to meddling. For example, many text editors will corrupt the file by automatically converting line endings.

There are many reasons for dumping and loading Subversion repository data. Early in Subversion's life, the most common reason was due to the evolution of Subversion itself. As Subversion matured, there were times when changes made to the backend database schema caused compatibility issues with previous versions of the repository, so users had to dump their repository data using the previous version of Subversion and load it into a freshly created repository with the new version of Subversion. Now, these types of schema changes haven't occurred since Subversion's 1.0 release, and the Subversion developers promise not to force users to dump and load their repositories when upgrading between minor versions (such as from 1.3 to 1.4) of Subversion. But there are still other reasons for dumping and loading, including re-deploying a Berkeley DB repository on a new OS or CPU architecture, switching between the Berkeley DB and FSFS backends, or (as we'll cover later in this chapter in „Filtering Repository History“) purging versioned data from repository history.

The Subversion repository dump format describes versioned repository changes only. It will not carry any information about uncommitted transactions, user locks on filesystem paths, repository or server configuration customizations (including hook scripts), and so on.

Whatever your reason for migrating repository history, using the **svnadmin dump** and **svnadmin load** subcommands is straightforward. **svnadmin dump** will output a range of repository revisions that are formatted using Subversion's custom filesystem dump format. The dump format is printed to the standard output stream, while informative messages are printed to the standard error stream. This allows you to redirect the output stream to a file while watching the status output in your terminal window. For example:

```
$ svnlook youngest myrepos
26
$ svnadmin dump myrepos > dumpfile
* Dumped revision 0.
* Dumped revision 1.
* Dumped revision 2.
…
* Dumped revision 25.
* Dumped revision 26.
```

At the end of the process, you will have a single file (`dumpfile` in the previous example) that contains all the data stored in your repository in the requested range of revisions. Note that **svnadmin dump** is reading revision trees from the repository just like any other „reader“ process would (e.g., **svn checkout**), so it's safe to run this command at any time.

The other subcommand in the pair, **svnadmin load**, parses the standard input stream as a Subversion repository dump file and effectively replays those dumped revisions into the target repository for that operation. It also gives informative feedback, this time using the standard output stream:

```
$ svnadmin load newrepos < dumpfile
<<< Started new txn, based on original revision 1
     * adding path : A ... done.
     * adding path : A/B ... done.
     …
------- Committed new rev 1 (loaded from original rev 1) >>>

<<< Started new txn, based on original revision 2
     * editing path : A/mu ... done.
     * editing path : A/D/G/rho ... done.

------- Committed new rev 2 (loaded from original rev 2) >>>

…

<<< Started new txn, based on original revision 25
     * editing path : A/D/gamma ... done.

------- Committed new rev 25 (loaded from original rev 25) >>>

<<< Started new txn, based on original revision 26
     * adding path : A/Z/zeta ... done.
     * editing path : A/mu ... done.

------- Committed new rev 26 (loaded from original rev 26) >>>
```

The result of a load is new revisions added to a repository—the same thing you get by making commits against that repository from a regular Subversion client. Just as in a commit, you can use hook programs to perform actions before and after each of the commits made during a load process. By passing the `--use-pre-commit-hook` and `--use-post-commit-hook` options to **svnadmin load**, you can instruct Subversion to execute the pre-commit and post-commit hook programs, respectively, for each loaded revision. You might use these, for example, to ensure that loaded revisions pass through the same validation steps that regular commits pass through. Of course, you should use these options with care—if your post-commit hook sends emails to a mailing list for each new commit, you might not want to spew hundreds or thousands of commit emails in rapid succession at that list! You can read more about the use of hook scripts in „Implementing Repository Hooks“.

Note that because **svnadmin** uses standard input and output streams for the repository dump and load processes, people who are feeling especially saucy can try things such as this (perhaps even using different versions of **svnadmin** on each side of the pipe):

```
$ svnadmin create newrepos
$ svnadmin dump oldrepos | svnadmin load newrepos
```

By default, the dump file will be quite large—much larger than the repository itself. That's because by default every version of every file is expressed as a full text in the dump file. This is the fastest and simplest behavior, and it's nice if you're piping the dump data directly into some other process (such as a compression program, filtering program, or loading process). But if you're creating a dump file for longer-term storage, you'll likely want to save disk space by using the `--deltas` option. With this option, successive revisions of files will be output as compressed, binary differences—just as file revisions are stored in a repository. This option is slower, but it results in a dump file much closer in size to the original repository.

We mentioned previously that **svnadmin dump** outputs a range of revisions. Use the `--revision` (`-r`) option to specify a single revision, or a range of revisions, to dump. If you omit this option, all the existing repository revisions will be dumped.

```
$ svnadmin dump myrepos -r 23 > rev-23.dumpfile
$ svnadmin dump myrepos -r 100:200 > revs-100-200.dumpfile
```

As Subversion dumps each new revision, it outputs only enough information to allow a future loader to re-create that revision based on the previous one. In other words, for any given revision in the dump file, only the items that were changed in that revision will appear in the dump. The only exception to this rule is the first revision that is dumped with the current **svnadmin dump** command.

By default, Subversion will not express the first dumped revision as merely differences to be applied to the previous revision. For one thing, there is no previous revision in the dump file! And second, Subversion cannot know the state of the repository into which the dump data will be loaded (if it ever is). To ensure that the output of each execution of **svnadmin dump** is self-sufficient, the first dumped revision is, by default, a full representation of every directory, file, and property in that revision of the repository.

However, you can change this default behavior. If you add the `--incremental` option when you dump your repository, **svnadmin** will compare the first dumped revision against the previous revision in the repository—the same way it treats every other revision that gets dumped. It will then output the first revision exactly as it does the rest of the revisions in the dump range—mentioning only the changes that occurred in that revision. The benefit of this is that you can create several small dump files that can be loaded in succession, instead of one large one, like so:

```
$ svnadmin dump myrepos -r 0:1000 > dumpfile1
$ svnadmin dump myrepos -r 1001:2000 --incremental > dumpfile2
$ svnadmin dump myrepos -r 2001:3000 --incremental > dumpfile3
```

These dump files could be loaded into a new repository with the following command sequence:

```
$ svnadmin load newrepos < dumpfile1
$ svnadmin load newrepos < dumpfile2
$ svnadmin load newrepos < dumpfile3
```

Another neat trick you can perform with this `--incremental` option involves appending to an existing dump file a new range of dumped revisions. For example, you might have a `post-commit` hook that simply appends the repository dump of the single revision that triggered the hook. Or you might have a script that runs nightly to append dump file data for all the revisions that were added to the repository since the last time the script ran. Used like this, **svnadmin dump** can be one way to back up changes to your repository over time in case of a system crash or some other catastrophic event.

The dump format can also be used to merge the contents of several different repositories into a single repository. By using the `--parent-dir` option of **svnadmin load**, you can specify a new virtual root directory for the load process. That means if you have dump files for three repositories—say `calc-dumpfile`, `cal-dumpfile`, and `ss-dumpfile`—you can first create a new repository to hold them all:

```
$ svnadmin create /var/svn/projects
$
```

Then, make new directories in the repository that will encapsulate the contents of each of the three previous repositories:

```
$ svn mkdir -m "Initial project roots" \
      file:///var/svn/projects/calc \
      file:///var/svn/projects/calendar \
      file:///var/svn/projects/spreadsheet
Committed revision 1.
$
```

Lastly, load the individual dump files into their respective locations in the new repository:

```
$ svnadmin load /var/svn/projects --parent-dir calc < calc-dumpfile
…
$ svnadmin load /var/svn/projects --parent-dir calendar < cal-dumpfile
…
$ svnadmin load /var/svn/projects --parent-dir spreadsheet < ss-dumpfile
…
$
```

We'll mention one final way to use the Subversion repository dump format—conversion from a different storage mechanism or version control system altogether. Because the dump file format is, for the most part, human-readable, it should be relatively easy to describe generic sets of changes—each of which should be treated as a new revision—using this file format. In fact, the **cvs2svn** utility (see „Converting a Repository from CVS to Subversion“) uses the dump format to represent the contents of a CVS repository so that those contents can be copied into a Subversion repository.

Filtering Repository History

Since Subversion stores your versioned history using, at the very least, binary differencing algorithms and data compression (optionally in a completely opaque database system), attempting manual tweaks is unwise if not quite difficult, and at any rate strongly discouraged. And once data has been stored in your repository, Subversion generally doesn't provide an easy way to remove that data. [9] But inevitably, there will be times when you would like to manipulate the history of your repository. You might need to strip out all instances of a file that was accidentally added to the repository (and shouldn't be there for whatever reason). [10] Or, perhaps you have multiple projects sharing a single repository, and you decide to split them up into their own repositories. To accomplish tasks such as these, administrators need a more manageable and malleable representation of the data in

[9]That's rather the reason you use version control at all, right?
[10]Conscious, cautious removal of certain bits of versioned data is actually supported by real use cases. That's why an „obliterate“ feature has been one of the most highly requested Subversion features, and one which the Subversion developers hope to soon provide.

their repositories—the Subversion repository dump format.

As we described earlier in „Migrating Repository Data Elsewhere“, the Subversion repository dump format is a human-readable representation of the changes that you've made to your versioned data over time. Use the **svnadmin dump** command to generate the dump data, and **svnadmin load** to populate a new repository with it. The great thing about the human-readability aspect of the dump format is that, if you aren't careless about it, you can manually inspect and modify it. Of course, the downside is that if you have three years' worth of repository activity encapsulated in what is likely to be a very large dump file, it could take you a long, long time to manually inspect and modify it.

That's where **svndumpfilter** becomes useful. This program acts as a path-based filter for repository dump streams. Simply give it either a list of paths you wish to keep or a list of paths you wish to not keep, and then pipe your repository dump data through this filter. The result will be a modified stream of dump data that contains only the versioned paths you (explicitly or implicitly) requested.

Let's look at a realistic example of how you might use this program. Earlier in this chapter (see „Planning Your Repository Organization“), we discussed the process of deciding how to choose a layout for the data in your repositories—using one repository per project or combining them, arranging stuff within your repository, and so on. But sometimes after new revisions start flying in, you rethink your layout and would like to make some changes. A common change is the decision to move multiple projects that are sharing a single repository into separate repositories for each project.

Our imaginary repository contains three projects: `calc`, `calendar`, and `spreadsheet`. They have been living side-by-side in a layout like this:

```
/
   calc/
      trunk/
      branches/
      tags/
   calendar/
      trunk/
      branches/
      tags/
   spreadsheet/
      trunk/
      branches/
      tags/
```

To get these three projects into their own repositories, we first dump the whole repository:

```
$ svnadmin dump /var/svn/repos > repos-dumpfile
* Dumped revision 0.
* Dumped revision 1.
* Dumped revision 2.
* Dumped revision 3.
…
$
```

Next, run that dump file through the filter, each time including only one of our top-level directories. This results in three new dump files:

```
$ svndumpfilter include calc < repos-dumpfile > calc-dumpfile
…
$ svndumpfilter include calendar < repos-dumpfile > cal-dumpfile
…
$ svndumpfilter include spreadsheet < repos-dumpfile > ss-dumpfile
…
```

```
$
```

At this point, you have to make a decision. Each of your dump files will create a valid repository, but will preserve the paths exactly as they were in the original repository. This means that even though you would have a repository solely for your `calc` project, that repository would still have a top-level directory named `calc`. If you want your `trunk`, `tags`, and `branches` directories to live in the root of your repository, you might wish to edit your dump files, tweaking the `Node-path` and `Node-copyfrom-path` headers so that they no longer have that first `calc/` path component. Also, you'll want to remove the section of dump data that creates the `calc` directory. It will look something like the following:

```
Node-path: calc
Node-action: add
Node-kind: dir
Content-length: 0
```

If you do plan on manually editing the dump file to remove a top-level directory, make sure your editor is not set to automatically convert end-of-line characters to the native format (e.g., `\r\n` to `\n`), as the content will then not agree with the metadata. This will render the dump file useless.

All that remains now is to create your three new repositories, and load each dump file into the right repository, ignoring the UUID found in the dump stream:

```
$ svnadmin create calc
$ svnadmin load --ignore-uuid calc < calc-dumpfile
<<< Started new transaction, based on original revision 1
     * adding path : Makefile ... done.
     * adding path : button.c ... done.
…
$ svnadmin create calendar
$ svnadmin load --ignore-uuid calendar < cal-dumpfile
<<< Started new transaction, based on original revision 1
     * adding path : Makefile ... done.
     * adding path : cal.c ... done.
…
$ svnadmin create spreadsheet
$ svnadmin load --ignore-uuid spreadsheet < ss-dumpfile
<<< Started new transaction, based on original revision 1
     * adding path : Makefile ... done.
     * adding path : ss.c ... done.
…
$
```

Both of **svndumpfilter**'s subcommands accept options for deciding how to deal with „empty“ revisions. If a given revision contains only changes to paths that were filtered out, that now-empty revision could be considered uninteresting or even unwanted. So to give the user control over what to do with those revisions, **svndumpfilter** provides the following command-line options:

`--drop-empty-revs`
: Do not generate empty revisions at all—just omit them.

`--renumber-revs`
: If empty revisions are dropped (using the `--drop-empty-revs` option), change the

revision numbers of the remaining revisions so that there are no gaps in the numeric sequence.

`--preserve-revprops`
: If empty revisions are not dropped, preserve the revision properties (log message, author, date, custom properties, etc.) for those empty revisions. Otherwise, empty revisions will contain only the original datestamp, and a generated log message that indicates that this revision was emptied by **svndumpfilter**.

While **svndumpfilter** can be very useful and a huge timesaver, there are unfortunately a couple of gotchas. First, this utility is overly sensitive to path semantics. Pay attention to whether paths in your dump file are specified with or without leading slashes. You'll want to look at the `Node-path` and `Node-copyfrom-path` headers.

```
…
Node-path: spreadsheet/Makefile
…
```

If the paths have leading slashes, you should include leading slashes in the paths you pass to **svndumpfilter include** and **svndumpfilter exclude** (and if they don't, you shouldn't). Further, if your dump file has an inconsistent usage of leading slashes for some reason, [11] you should probably normalize those paths so that they all have, or all lack, leading slashes.

Also, copied paths can give you some trouble. Subversion supports copy operations in the repository, where a new path is created by copying some already existing path. It is possible that at some point in the lifetime of your repository, you might have copied a file or directory from some location that **svndumpfilter** is excluding, to a location that it is including. To make the dump data self-sufficient, **svndumpfilter** needs to still show the addition of the new path—including the contents of any files created by the copy—and not represent that addition as a copy from a source that won't exist in your filtered dump data stream. But because the Subversion repository dump format shows only what was changed in each revision, the contents of the copy source might not be readily available. If you suspect that you have any copies of this sort in your repository, you might want to rethink your set of included/excluded paths, perhaps including the paths that served as sources of your troublesome copy operations, too.

Finally, **svndumpfilter** takes path filtering quite literally. If you are trying to copy the history of a project rooted at `trunk/my-project` and move it into a repository of its own, you would, of course, use the **svndumpfilter include** command to keep all the changes in and under `trunk/my-project`. But the resultant dump file makes no assumptions about the repository into which you plan to load this data. Specifically, the dump data might begin with the revision that added the `trunk/my-project` directory, but it will *not* contain directives that would create the `trunk` directory itself (because `trunk` doesn't match the include filter). You'll need to make sure that any directories that the new dump stream expects to exist actually do exist in the target repository before trying to load the stream into that repository.

Repository Replication

There are several scenarios in which it is quite handy to have a Subversion repository whose version history is exactly the same as some other repository's. Perhaps the most obvious one is the maintenance of a simple backup repository, used when the primary repository has become inaccessible due to a hardware failure, network outage, or other such annoyance. Other scenarios include deploying mirror repositories to distribute heavy Subversion load across multiple servers, use as a soft-upgrade mechanism, and so on.

[11] While **svnadmin dump** has a consistent leading slash policy (to not include them), other programs that generate dump data might not be so consistent.

As of version 1.4, Subversion provides a program for managing scenarios such as these—**svnsync**. This works by essentially asking the Subversion server to „replay“ revisions, one at a time. It then uses that revision information to mimic a commit of the same to another repository. Neither repository needs to be locally accessible to the machine on which **svnsync** is running—its parameters are repository URLs, and it does all its work through Subversion's Repository Access (RA) interfaces. All it requires is read access to the source repository and read/write access to the destination repository.

When using **svnsync** against a remote source repository, the Subversion server for that repository must be running Subversion version 1.4 or later.

Assuming you already have a source repository that you'd like to mirror, the next thing you need is an empty target repository that will actually serve as that mirror. This target repository can use either of the available filesystem data-store backends (see „Choosing a Data Store“), but it must not yet have any version history in it. The protocol that **svnsync** uses to communicate revision information is highly sensitive to mismatches between the versioned histories contained in the source and target repositories. For this reason, while **svnsync** cannot *demand* that the target repository be read-only, [12] allowing the revision history in the target repository to change by any mechanism other than the mirroring process is a recipe for disaster.

Do *not* modify a mirror repository in such a way as to cause its version history to deviate from that of the repository it mirrors. The only commits and revision property modifications that ever occur on that mirror repository should be those performed by the **svnsync** tool.

Another requirement of the target repository is that the **svnsync** process be allowed to modify revision properties. Because **svnsync** works within the framework of that repository's hook system, the default state of the repository (which is to disallow revision property changes; see pre-revprop-change) is insufficient. You'll need to explicitly implement the pre-revprop-change hook, and your script must allow **svnsync** to set and change revision properties. With those provisions in place, you are ready to start mirroring repository revisions.

It's a good idea to implement authorization measures that allow your repository replication process to perform its tasks while preventing other users from modifying the contents of your mirror repository at all.

Let's walk through the use of **svnsync** in a somewhat typical mirroring scenario. We'll pepper this discourse with practical recommendations, which you are free to disregard if they aren't required by or suitable for your environment.

As a service to the fine developers of our favorite version control system, we will be mirroring the public Subversion source code repository and exposing that mirror publicly on the Internet, hosted on a different machine than the one on which the original Subversion source code repository lives. This remote host has a global configuration that permits anonymous users to read the contents of repositories on the host, but requires users to authenticate to modify those repositories. (Please forgive us for glossing over the details of Subversion server configuration for the moment—those are covered thoroughly in Kapitel 6, *Die Administration eines Subversion-Servers*.) And for no other reason than that it makes for a more interesting example, we'll be driving the replication process from a third machine—the one that we currently find ourselves using.

First, we'll create the repository which will be our mirror. This and the next couple of steps

[12] In fact, it can't truly be read-only, or **svnsync** itself would have a tough time copying revision history into it.

do require shell access to the machine on which the mirror repository will live. Once the repository is all configured, though, we shouldn't need to touch it directly again.

```
$ ssh admin@svn.example.com \
      "svnadmin create /var/svn/svn-mirror"
admin@svn.example.com's password: ********
$
```

At this point, we have our repository, and due to our server's configuration, that repository is now „live“ on the Internet. Now, because we don't want anything modifying the repository except our replication process, we need a way to distinguish that process from other would-be committers. To do so, we use a dedicated username for our process. Only commits and revision property modifications performed by the special username `syncuser` will be allowed.

We'll use the repository's hook system both to allow the replication process to do what it needs to do and to enforce that only it is doing those things. We accomplish this by implementing two of the repository event hooks—pre-revprop-change and start-commit. Our `pre-revprop-change` hook script is found in Beispiel 5.2, „Mirror repository's pre-revprop-change hook script“, and basically verifies that the user attempting the property changes is our `syncuser` user. If so, the change is allowed; otherwise, it is denied.

Beispiel 5.2. Mirror repository's pre-revprop-change hook script

```
#!/bin/sh

USER="$3"

if [ "$USER" = "syncuser" ]; then exit 0; fi

echo "Only the syncuser user may change revision properties" >&2
exit 1
```

That covers revision property changes. Now we need to ensure that only the `syncuser` user is permitted to commit new revisions to the repository. We do this using a `start-commit` hook scripts such as the one in Beispiel 5.3, „Mirror repository's start-commit hook script“.

Beispiel 5.3. Mirror repository's start-commit hook script

```
#!/bin/sh

USER="$2"

if [ "$USER" = "syncuser" ]; then exit 0; fi

echo "Only the syncuser user may commit new revisions" >&2
exit 1
```

After installing our hook scripts and ensuring that they are executable by the Subversion server, we're finished with the setup of the mirror repository. Now, we get to actually do the mirroring.

The first thing we need to do with **svnsync** is to register in our target repository the fact that it will be a mirror of the source repository. We do this using the **svnsync initialize** subcommand. The URLs we provide point to the root directories of the target and source repositories, respectively. In Subversion 1.4, this is required—only full mirroring of repositories is permitted. In Subversion 1.5, though, you can use **svnsync** to mirror only some subtree of the repository, too.

```
$ svnsync help init
initialize (init): usage: svnsync initialize DEST_URL SOURCE_URL

Initialize a destination repository for synchronization from
another repository.
…
$ svnsync initialize http://svn.example.com/svn-mirror \
                     http://svn.collab.net/repos/svn \
                     --sync-username syncuser --sync-password syncpass
Copied properties for revision 0.
$
```

Our target repository will now remember that it is a mirror of the public Subversion source code repository. Notice that we provided a username and password as arguments to **svnsync**—that was required by the pre-revprop-change hook on our mirror repository.

In Subversion 1.4, the values given to **svnsync**'s `--username` and `--password` command-line options were used for authentication against both the source and destination repositories. This caused problems when a user's credentials weren't exactly the same for both repositories, especially when running in noninteractive mode (with the `--non-interactive` option).

This has been fixed in Subversion 1.5 with the introduction of two new pairs of options. Use `--source-username` and `--source-password` to provide authentication credentials for the source repository; use `--sync-username` and `--sync-password` to provide credentials for the destination repository. (The old `--username` and `--password` options still exist for compatibility, but we advise against using them.)

And now comes the fun part. With a single subcommand, we can tell **svnsync** to copy all the as-yet-unmirrored revisions from the source repository to the target. [13] The **svnsync synchronize** subcommand will peek into the special revision properties previously stored on the target repository, and determine both what repository it is mirroring as well as that the most recently mirrored revision was revision 0. Then it will query the source repository and determine what the latest revision in that repository is. Finally, it asks the source repository's server to start replaying all the revisions between 0 and that latest revision. As **svnsync** get the resultant response from the source repository's server, it begins forwarding those revisions to the target repository's server as new commits.

```
$ svnsync help synchronize
synchronize (sync): usage: svnsync synchronize DEST_URL

Transfer all pending revisions to the destination from the source
with which it was initialized.
…
$ svnsync synchronize http://svn.example.com/svn-mirror
Transmitting file data .......................................
Committed revision 1.
Copied properties for revision 1.
```

[13] Be forewarned that while it will take only a few seconds for the average reader to parse this paragraph and the sample output that follows it, the actual time required to complete such a mirroring operation is, shall we say, quite a bit longer.

```
Transmitting file data ..
Committed revision 2.
Copied properties for revision 2.
Transmitting file data .....
Committed revision 3.
Copied properties for revision 3.
…
Transmitting file data ..
Committed revision 23406.
Copied properties for revision 23406.
Transmitting file data .
Committed revision 23407.
Copied properties for revision 23407.
Transmitting file data ....
Committed revision 23408.
Copied properties for revision 23408.
$
```

Of particular interest here is that for each mirrored revision, there is first a commit of that revision to the target repository, and then property changes follow. This is because the initial commit is performed by (and attributed to) the user `syncuser`, and it is datestamped with the time as of that revision's creation. Also, Subversion's underlying repository access interfaces don't provide a mechanism for setting arbitrary revision properties as part of a commit. So **svnsync** follows up with an immediate series of property modifications that copy into the target repository all the revision properties found for that revision in the source repository. This also has the effect of fixing the author and datestamp of the revision to match that of the source repository.

Also noteworthy is that **svnsync** performs careful bookkeeping that allows it to be safely interrupted and restarted without ruining the integrity of the mirrored data. If a network glitch occurs while mirroring a repository, simply repeat the **svnsync synchronize** command, and it will happily pick up right where it left off. In fact, as new revisions appear in the source repository, this is exactly what you to do to keep your mirror up to date.

svnsync Bookkeeping

svnsync needs to be able to set and modify revision properties on the mirror repository because those properties are part of the data it is tasked with mirroring. As those properties change in the source repository, those changes need to be reflected in the mirror repository, too. But **svnsync** also uses a set of custom revision properties—stored in revision 0 of the mirror repository—for its own internal bookkeeping. These properties contain information such as the URL and UUID of the source repository, plus some additional state-tracking information.

One of those pieces of state-tracking information is a flag that essentially just means „there's a synchronization in progress right now.“ This is used to prevent multiple **svnsync** processes from colliding with each other while trying to mirror data to the same destination repository. Now, generally you won't need to pay any attention whatsoever to *any* of these special properties (all of which begin with the prefix `svn:sync-`). Occasionally, though, if a synchronization fails unexpectedly, Subversion never has a chance to remove this particular state flag. This causes all future synchronization attempts to fail because it appears that a synchronization is still in progress when, in fact, none is. Fortunately, recovering from this situation is as simple as removing the `svn:sync-lock` property which serves as this flag from revision 0 of the mirror repository:

```
$ svn propdel --revprop -r0 svn:sync-lock http://svn.example.com/svn-mirror
property 'svn:sync-lock' deleted from repository revision 0
$
```

That **svnsync** stores the source repository URL in a bookkeeping property on the mirror repository is the reason why you have to specify that URL only once, during **svnsync init**. Future synchronization operations against that mirror simply consult the special `svn:sync-from-url` property stored on the mirror itself to know where to synchronize from. This value is used literally by the synchronization process, though. So while from within CollabNet's network you can perhaps access our example source URL as `http://svn/repos/svn` (because that first `svn` magically gets `.collab.net` appended to it by DNS voodoo), if you later need to update that mirror from another machine outside CollabNet's network, the synchronization might fail (because the hostname `svn` is ambiguous). For this reason, it's best to use fully qualified source repository URLs when initializing a mirror repository rather than those that refer to only hostnames or IP addresses (which can change over time). But here again, if you need an existing mirror to start referring to a different URL for the same source repository, you can change the bookkeeping property which houses that information:

```
$ svn propset --revprop -r0 svn:sync-from-url NEW-SOURCE-URL \
      http://svn.example.com/svn-mirror
property 'svn:sync-from-url' set on repository revision 0
$
```

Another interesting thing about these special bookkeeping properties is that **svnsync** will not attempt to mirror any of those properties when they are found in the source repository. The reason is probably obvious, but basically boils down to **svnsync** not being able to distinguish the special properties it has merely copied from the source repository from those it needs to consult and maintain for its own bookkeeping needs. This situation could occur if, for example, you were maintaining a mirror of a mirror of a third repository. When **svnsync** sees its own special properties in revision 0 of the source repository, it simply ignores them.

There is, however, one bit of inelegance in the process. Because Subversion revision properties can be changed at any time throughout the lifetime of the repository, and because they don't leave an audit trail that indicates when they were changed, replication processes have to pay special attention to them. If you've already mirrored the first 15 revisions of a repository and someone then changes a revision property on revision 12, **svnsync** won't know to go back and patch up its copy of revision 12. You'll need to tell it to do so manually by using (or with some additional tooling around) the **svnsync copy-revprops** subcommand, which simply rereplicates all the revision properties for a particular revision or range thereof.

```
$ svnsync help copy-revprops
copy-revprops: usage: svnsync copy-revprops DEST_URL [REV[:REV2]]

Copy the revision properties in a given range of revisions to the
destination from the source with which it was initialized.
…
$ svnsync copy-revprops http://svn.example.com/svn-mirror 12
Copied properties for revision 12.
$
```

That's repository replication in a nutshell. You'll likely want some automation around such a process. For example, while our example was a pull-and-push setup, you might wish to have your primary repository push changes to one or more blessed mirrors as part of its post-commit and post-revprop-change hook implementations. This would enable the mirror to be up to date in as near to real time as is likely possible.

Also, while it isn't very commonplace to do so, **svnsync** does gracefully mirror repositories in which the user as whom it authenticates has only partial read access. It simply copies only the bits of the repository that it is permitted to see. Obviously, such a mirror is not useful as a backup solution.

In Subversion 1.5, **svnsync** grew the ability to also mirror a subset of a repository rather than the whole thing. The process of setting up and maintaining such a mirror is exactly the same as when mirroring a whole repository, except that instead of specifying the source repository's root URL when running **svnsync init**, you specify the URL of some subdirectory within that repository. Synchronization to that mirror will now copy only the bits that changed under that source repository subdirectory. There are some limitations to this support, though. First, you can't mirror multiple disjoint subdirectories of the source repository into a single mirror repository—you'd need to instead mirror some parent directory that is common to both. Second, the filtering logic is entirely path-based, so if the subdirectory you are mirroring was renamed at some point in the past, your mirror would contain only the revisions since the directory appeared at the URL you specified. And likewise, if the source subdirectory is renamed in the future, your synchronization processes will stop mirroring data at the point that the source URL you specified is no longer valid.

As far as user interaction with repositories and mirrors goes, it *is* possible to have a single working copy that interacts with both, but you'll have to jump through some hoops to make it happen. First, you need to ensure that both the primary and mirror repositories have the same repository UUID (which is not the case by default). See „Managing Repository UUIDs“ later in this chapter for more about this.

Once the two repositories have the same UUID, you can use **svn switch** with the `--relocate` option to point your working copy to whichever of the repositories you wish to operate against, a process that is described in svn switch. There is a possible danger here, though, in that if the primary and mirror repositories aren't in close synchronization, a working copy up to date with, and pointing to, the primary repository will, if relocated to point to an out-of-date mirror, become confused about the apparent sudden loss of revisions it fully expects to be present, and it will throw errors to that effect. If this occurs, you can relocate your working copy back to the primary repository and then either wait until the mirror repository is up to date, or backdate your working copy to a revision you know is present in the sync repository, and then retry the relocation.

Finally, be aware that the revision-based replication provided by **svnsync** is only that—replication of revisions. Only information carried by the Subversion repository dump file format is available for replication. As such, **svnsync** has the same sorts of limitations that the repository dump stream has, and does not include such things as the hook implementations, repository or server configuration data, uncommitted transactions, or information about user locks on repository paths.

Repository Backup

Despite numerous advances in technology since the birth of the modern computer, one thing unfortunately rings true with crystalline clarity—sometimes things go very, very awry. Power outages, network connectivity dropouts, corrupt RAM, and crashed hard drives are but a taste of the evil that Fate is poised to unleash on even the most conscientious administrator. And so we arrive at a very important topic—how to make backup copies of your repository data.

There are two types of backup methods available for Subversion repository administrators—full and incremental. A full backup of the repository involves squirreling away in one sweeping action all the information required to fully reconstruct that repository in the event of a catastrophe. Usually, it means, quite literally, the duplication of the entire repository directory (which includes either a Berkeley DB or FSFS environment). Incremental backups are lesser things: backups of only the portion of the repository data that has changed since the previous backup.

As far as full backups go, the naïve approach might seem like a sane one, but unless you temporarily disable all other access to your repository, simply doing a recursive directory copy runs the risk of generating a faulty backup. In the case of Berkeley DB, the documentation describes a certain order in which database files can be copied that will guarantee a valid backup copy. A similar ordering exists for FSFS data. But you don't have to implement these algorithms yourself, because the Subversion development team has already done so. The **svnadmin hotcopy** command takes care of the minutia involved in making a hot backup of your repository. And its invocation is as trivial as the Unix **cp** or Windows **copy** operations:

```
$ svnadmin hotcopy /var/svn/repos /var/svn/repos-backup
```

The resultant backup is a fully functional Subversion repository, able to be dropped in as a replacement for your live repository should something go horribly wrong.

When making copies of a Berkeley DB repository, you can even instruct **svnadmin hotcopy** to purge any unused Berkeley DB logfiles (see „Purging unused Berkeley DB logfiles“) from the original repository upon completion of the copy. Simply provide the `--clean-logs` option on the command line.

```
$ svnadmin hotcopy --clean-logs /var/svn/bdb-repos /var/svn/bdb-repos-backup
```

Additional tooling around this command is available, too. The `tools/backup/` directory of the Subversion source distribution holds the **hot-backup.py** script. This script adds a bit of backup management atop **svnadmin hotcopy**, allowing you to keep only the most recent configured number of backups of each repository. It will automatically manage the names of the backed-up repository directories to avoid collisions with previous backups and will „rotate off“ older backups, deleting them so that only the most recent ones remain. Even if you also have an incremental backup, you might want to run this program on a regular basis. For example, you might consider using **hot-backup.py** from a program scheduler (such as **cron** on Unix systems), which can cause it to run nightly (or at whatever granularity of time you deem safe).

Some administrators use a different backup mechanism built around generating and storing repository dump data. We described in „Migrating Repository Data Elsewhere“ how to use **svnadmin dump** with the `--incremental` option to perform an incremental backup of a given revision or range of revisions. And of course, you can achieve a full backup variation of this by omitting the `--incremental` option to that command. There is some value in these methods, in that the format of your backed-up information is flexible—it's not tied to a particular platform, versioned filesystem type, or release of Subversion or Berkeley DB. But that flexibility comes at a cost, namely that restoring that data can take a long time—longer with each new revision committed to your repository. Also, as is the case with so many of the various backup methods, revision property changes that are made to already backed-up revisions won't get picked up by a nonoverlapping, incremental dump generation. For these reasons, we recommend against relying solely on dump-based backup approaches.

As you can see, each of the various backup types and methods has its advantages and disadvantages. The easiest is by far the full hot backup, which will always result in a perfect working replica of your repository. Should something bad happen to your live repository, you can restore from the backup with a simple recursive directory copy. Unfortunately, if you are maintaining multiple backups of your repository, these full copies will each eat up just as much disk space as your live repository. Incremental backups, by contrast, tend to be quicker to generate and smaller to store. But the restoration process can be a pain, often involving applying multiple incremental backups. And other methods have their own peculiarities. Administrators need to find the balance between the cost of making the backup and the cost of restoring it.

The **svnsync** program (see „Repository Replication“) actually provides a rather handy middle-ground approach. If you are regularly synchronizing a read-only mirror with your main repository, in a pinch your read-only mirror is probably a good candidate for replacing that main repository if it falls over. The primary disadvantage of this method is that only the versioned repository data gets synchronized—repository configuration files, user-specified repository path locks, and other items that might live in the physical repository directory but not *inside* the repository's virtual versioned filesystem are not handled by **svnsync**.

In any backup scenario, repository administrators need to be aware of how modifications to unversioned revision properties affect their backups. Since these changes do not themselves generate new revisions, they will not trigger post-commit hooks, and may not even trigger the pre-revprop-change and post-revprop-change hooks. [14] And since you can change revision properties without respect to chronological order—you can change any revision's properties at any time—an incremental backup of the latest few revisions might not catch a property modification to a revision that was included as part of a previous backup.

Generally speaking, only the truly paranoid would need to back up their entire repository, say, every time a commit occurred. However, assuming that a given repository has some other redundancy mechanism in place with relatively fine granularity (such as per-commit emails or incremental dumps), a hot backup of the database might be something that a repository administrator would want to include as part of a system-wide nightly backup. It's your data—protect it as much as you'd like.

Often, the best approach to repository backups is a diversified one that leverages combinations of the methods described here. The Subversion developers, for example, back up the Subversion source code repository nightly using **hot-backup.py** and an off-site **rsync** of those full backups; keep multiple archives of all the commit and property change notification emails; and have repository mirrors maintained by various volunteers using **svnsync**. Your solution might be similar, but should be catered to your needs and that delicate balance of convenience with paranoia. And whatever you do, validate your backups from time to time—what good is a spare tire that has a hole in it? While all of this might not save your hardware from the iron fist of Fate, [15] it should certainly help you recover from those trying times.

Managing Repository UUIDs

Subversion repositories have a universally unique identifier (UUID) associated with them. This is used by Subversion clients to verify the identity of a repository when other forms of verification aren't good enough (such as checking the repository URL, which can change over time). Most Subversion repository administrators rarely, if ever, need to think about repository UUIDs as anything more than a trivial implementation detail of Subversion. Sometimes, however, there is cause for attention to this detail.

As a general rule, you want the UUIDs of your live repositories to be unique. That is, after all, the point of having UUIDs. But there are times when you want the repository UUIDs of two repositories to be exactly the same. For example, if you make a copy of a repository for backup purposes, you want the backup to be a perfect replica of the original so that, in the event that you have to restore that backup and replace the live repository, users don't suddenly see what looks like a different repository. When dumping and loading repository history (as described earlier in „Migrating Repository Data Elsewhere“), you get to decide whether to apply the UUID encapsulated in the data dump stream to the repository in which you are loading the data. The particular circumstance will dictate the correct behavior.

There are a couple of ways to set (or reset) a repository's UUID, should you need to. As of Subversion 1.5, this is as simple as using the **svnadmin setuuid** command. If you provide this subcommand with an explicit UUID, it will validate that the UUID is well-formed and then set the repository UUID to that value. If you omit the UUID, a brand-new UUID will be generated for your repository.

[14] **svnadmin setlog** can be called in a way that bypasses the hook interface altogether.
[15] You know—the collective term for all of her „fickle fingers.“

```
$ svnlook uuid /var/svn/repos
cf2b9d22-acb5-11dc-bc8c-05e83ce5dbec
$ svnadmin setuuid /var/svn/repos   # generate a new UUID
$ svnlook uuid /var/svn/repos
3c3c38fe-acc0-11dc-acbc-1b37ff1c8e7c
$ svnadmin setuuid /var/svn/repos \
           cf2b9d22-acb5-11dc-bc8c-05e83ce5dbec  # restore the old UUID
$ svnlook uuid /var/svn/repos
cf2b9d22-acb5-11dc-bc8c-05e83ce5dbec
$
```

For folks using versions of Subversion earlier than 1.5, these tasks are a little more complicated. You can explicitly set a repository's UUID by piping a repository dump file stub that carries the new UUID specification through **`svnadmin load --force-uuid`** ***`REPOS-PATH`***.

```
$ svnadmin load --force-uuid /var/svn/repos <<EOF
SVN-fs-dump-format-version: 2

UUID: cf2b9d22-acb5-11dc-bc8c-05e83ce5dbec
EOF
$ svnlook uuid /var/svn/repos
cf2b9d22-acb5-11dc-bc8c-05e83ce5dbec
$
```

Having older versions of Subversion generate a brand-new UUID is not quite as simple to do, though. Your best bet here is to find some other way to generate a UUID, and then explicitly set the repository's UUID to that value.

Moving and Removing Repositories

Subversion repository data is wholly contained within the repository directory. As such, you can move a Subversion repository to some other location on disk, rename a repository, copy a repository, or delete a repository altogether using the tools provided by your operating system for manipulating directories—**mv**, **cp -a**, and **rm -r** on Unix platforms; **copy**, **move**, and **rmdir /s /q** on Windows; vast numbers of mouse and menu gyrations in various graphical file explorer applications, and so on.

Of course, there's often still more to be done when trying to cleanly affect changes such as this. For example, you might need to update your Subversion server configuration to point to the new location of a relocated repository or to remove configuration bits for a now-deleted repository. If you have automated processes that publish information from or about your repositories, they may need to be updated. Hook scripts might need to be reconfigured. Users may need to be notified. The list can go on indefinitely, or at least to the extent that you've built processes and procedures around your Subversion repository.

In the case of a copied repository, you should also consider the fact that Subversion uses repository UUIDs to distinguish repositories. If you copy a Subversion repository using a typical shell recursive copy command, you'll wind up with two repositories that are identical in every way—including their UUIDs. In some circumstances, this might be desirable. But in the instances where it is not, you'll need to generate a new UUID for one of these identical repositories. See „Managing Repository UUIDs“ for more about managing repository UUIDs.

Summary

By now you should have a basic understanding of how to create, configure, and maintain Subversion repositories. We introduced you to the various tools that will assist you with this task. Throughout the chapter, we noted common administration pitfalls and offered suggestions for avoiding them.

All that remains is for you to decide what exciting data to store in your repository, and finally, how to make it available over a network. The next chapter is all about networking.

Kapitel 6. Die Administration eines Subversion-Servers

Der Zugriff auf ein Subversion-Repository kann problemlos von mehreren Clients, welche auf demselben Rechner wie Subversion laufen, gleichzeitig erfolgen – unter Verwendung der `file://`-Methode. Aber typischerweise läuft der Subversion-Server auf einem separaten Rechner, und der Zugriff erfolgt von Clients auf vielen verschiedenen Computern aus der ganzen Firma – ja sogar der ganzen Welt.

In diesem Kapitel erklären wir, wie Sie ihr Subversion-Repository für den Fernzugriff von Clients fit machen. Wir werden ausführlich auf alle aktuell verfügbaren Servermechanismen von Subversion eingehen und über ihre Konfiguration und Verwendung reden. Nach dem Lesen dieses Kapitels sollten Sie in der Lage sein, zu entscheiden, welche Netzwerk-Konfiguration Ihren Bedürfnissen entspricht und wie diese auf ihrem Server eingerichtet wird.

Überblick

Subversion wurde mit einer abstrakten Netzwerkschicht entworfen. Dies bedeutet, dass auf ein Repository automatisiert von beliebigen Server-Prozessen zugegriffen werden kann, und die für Clients vorhandene „Repository-Access“-API (Programmierschnittstelle) erlaubt es Programmierern, Plugins zu entwickeln, die relevante Netzwerkprotokolle verstehen. Theoretisch ermöglicht dies Subversion, eine unbegrenzte Zahl an Netzwerkprotokollen zu verwenden. Zum Zeitpunkt an dem dies geschrieben wird, gibt es aber nur zwei Server.

Apache ist ein sehr beliebter Webserver, welcher mittels des **mod_dav_svn**-Moduls auf Repositorys zugreifen und diese für Clients verfügbar machen kann. Verwendet wird dabei das WebDAV/DeltaV-Protokoll, welches eine Erweiterung von HTTP ist. Da Apache ein stark erweiterbarer Webserver ist, bietet er eine Menge an „frei verfügbaren“ Funktionen/ Modulen, wie SSL-verschlüsselte Verbindungen, Logging, sowie die Integration diverser Authentifikationssysteme von Drittanbietern und einen eingeschränkten Web-Browser-gestützten Repository-Lesezugriff.

In der anderen Ecke befindet sich **svnserve**: ein kleiner, leichtgewichtiger Server, der ein einfaches Netzwerkprotokoll für die Zugriffe der Clients verwendet. Da dieses Protokoll für die Verwendung mit Subversion entwickelt wurde und, im Gegensatz zu HTTP, zustandsorientiert ist, bietet es einen deutlich schnelleren Netzwerkzugriff – spart allerdings auch einige wichtige Funktionen aus. So bietet er eine SASL-basierte Verschlüsselung und Authentifikation, hat aber keine Logging-Funktionen oder eingebauten Web-Browser-Zugriff. Wie auch immer, er ist extrem einfach einzurichten und für kleinere Teams, welche einfach nur schnell mit Subversion "loslegen" wollen, die beste Wahl.

Ein dritte Möglichkeit ist, **svnserve** durch SSH-Verbindungen zu tunneln. Auch wenn in diesem Fall weiterhin **svnserve** verwendet wird, so unterscheidet sich die Funktionalität ziemlich von der normalen Nutzung von **svnserve**. SSH wird zur Verschlüsselung der gesamten Kommunikation verwendet. Ebenso zur Authentifizierung, was die Verwendung von realen Nutzerkonten auf dem Subversions-Server notwendig macht (anders als beim einfachen **svnserve**, der seine eigene Nutzerverwaltung hat). Des weiteren ist es notwendig – da jeder angemeldete Nutzer einen eigenen **svnserve**-Prozess startet – einer Gruppe von lokalen Nutzern (aus Sicht der Rechtevergabe) vollen Zugriff auf das Repository via `file://` URLs zu ermöglichen. Pfad-basierte Zugriffskontrolle schließt sich in diesem Fall aus, da die Nutzer direkt auf die Datenbank-Dateien zugreifen.

Tabelle 6.1, „Vergleich der Serveroptionen für Subversion“ zeigt eine kurze Zusammenfassung der drei typischen Server-Konfigurationen.

Tabelle 6.1. Vergleich der Serveroptionen für Subversion

Funktionen	**Apache + mod_dav_svn**	**svnserve**	**svnserve via SSH**
Authentifizierungsmöglichkeiten	HTTP(S) basic auth, X.509 Zertifikate, LDAP, NTLM, oder jede andere für den Apache Webserver verfügbare Methode	CRAM-MD5 als Voreinstellung, LDAP, NTLM oder jede andere für SASL verfügbare Methode	SSH
Nutzerkonfigurationen	private `users` Datei oder jede andere für den Apache Webserver verfügbare Methode (LDAP, SQL, etc)	private `users` Datei, oder jede andere für SASL verfügbare Methode (LDAP, SQL, etc.)	lokale Nutzerkonten auf dem Server
Autorisierungsmöglichkeiten	Lese-/Schreibzugriff auf das komplette Repository oder pfadbasierte Rechtevergabe	Lese-/Schreibzugriff auf das komplette Repository oder pfadbasierte Rechtevergabe	Lese-/Schreibzugriff nur auf ganzes Repository einstellbar
Verschlüsselung	optional mit SSL	optional mit der SASL-Funktionen	Bestandteil der SSH-Verbindung
Loggen	Apache-seitiges Loggen aller HTTP-Anfragen, optionales „High-Level“-Loggen aller Client-Operationen	kein Loggen	kein Loggen
Interoperabilität	Zugriff durch andere WebDAV-Clients	Verbindung nur mit SVN-Clients möglich	Verbindung nur mit SVN-Clients möglich
webbasierte Anzeige des Repositorys	eingeschränkte Unterstützung, alternativ mittels Programmen von Drittanbietern, wie etwa ViewVC, erweiterbar	nur mittels Programmen von Drittanbietern, wie etwa ViewVC	nur mittels Programmen von Drittanbietern, wie etwa ViewVC
Master-Slave-Server Replikationen	transparenter Schreib-Proxy vom Slave zum Master	beschränkt auf nur lesbare Slave-Server	beschränkt auf nur lesbare Slave-Server
Geschwindigkeit	ein wenig langsamer	ein wenig schneller	ein wenig schneller
Erstkonfiguration	eher komplexer	sehr einfach	durchschnittlich

Auswahl einer Serverkonfiguration

Also dann, welchen Server sollten Sie nun verwenden? Welcher ist der beste?

Auf diese Frage gibt es offensichtlich nicht die eine, richtige Antwort. Denn jedes Team stellt andere Anforderungen, und die verschieden Server bieten unterschiedliche Funktionen und Voraussetzungen. Das Subversion-Projekt selbst bevorzugt keinen der genannten Server oder betrachtet einen als etwas „offizieller“ als die anderen.

Wir beleuchten nun die einzelnen Gründe, die für die eine oder andere Konstellation sprechen, ebenso auch Gründe, welche vielleicht *gegen* eine der Möglichkeiten sprechen.

Der svnserve-Server

Gründe, die für eine Nutzung sprechen:

- Das Aufsetzen geht schnell und einfach.
- Das verwendete Netzwerkprotokoll ist zustandsorientiert und merklich schneller als WebDAV.
- Es müssen keine lokalen Nutzerkonten auf dem Server eingerichtet werden.
- Das Passwort wird nicht über das Netzwerk übertragen.

Gründe, warum Sie svnserve eventuell nicht verwenden wollen:

- Es gibt standardmäßig nur eine Authentifizierungsmethode, das Netzwerkprotokoll ist unverschlüsselt und das Passwort wird vom Server im Klartext gespeichert. (Mit SASL können diese Probleme zwar umgangen werden, dies erfordert aber eine etwas aufwendigere Konfiguration.)
- Es wird nichts geloggt, auch keine Fehler.
- Keinen eingebauten Webbrowser-gestützten Lesezugriff. (Wenn Sie dies wünschen, müssen Sie einen eigenständigen Webserver sowie Repository-Browser-Software installieren.)

svnserve über SSH

Gründe, die für eine Nutzung sprechen:

- Das verwendete Netzwerkprotokoll ist zustandsorientiert und merklich schneller als WebDAV.
- Sie können bestehende Nutzerzugänge des SSH-Servers verwenden.
- Der gesamte Netzwerkverkehr ist verschlüsselt.

Gründe, warum Sie auf diese Konstellation eventuell verzichten wollen:

- Es steht nur eine Authentifizierungsmöglichkeit zur Verfügung.
- Es wird nichts geloggt, auch keine Fehler.
- Die verwendeten Nutzer müssen in derselben Nutzergruppe (auf dem Server) sein, oder sich einen SSH-Key teilen.
- Bei unsachgemäßer Verwendung kann es zu Problemen mit den Dateirechten kommen.

Der Apache HTTP Server

Gründe, die für eine Nutzung sprechen:

- Subversion hat damit Zugriff auf alle für den Apache verfügbaren Authentifizierungsmethoden (und das sind viele).

- Es müssen auf dem Server keine Nutzerkonten angelegt werden.
- Apache loggt nach Wunsch (fast) alles.
- Der Netzwerkverkehr kann mittels SSL verschlüsselt werden.
- In der Regel lässt sich das HTTP(S)-Protokoll problemlos durch Firewalls routen.
- Auf das Repository kann lesend auch via Webbrowser zugegriffen werden.
- Das Repository lässt sich als Netzlaufwerk einhängen (mounten). Änderungen an den Dateien unterliegen trotzdem der Versionskontrolle. (siehe „Autoversioning".)

Was gegen den Apache Webserver spricht:

- Er ist merklich langsamer als **svnserve**, da HTTP als zustandsloses Protokoll eine höhere Netzwerklast verursacht.
- Die Ersteinrichtung kann etwas schwierig sein.

Empfehlungen

Im Allgemeinen empfehlen die Autoren dieses Buches eine einfache **svnserve**-Installation für kleine Teams, denen an einer schnellen und unkomplizierten Nutzung von Subversion gelegen ist. Dies ist die Variante, welche sich am einfachsten einrichten und administrieren lässt. Sollte später Bedarf bestehen, so kann immer noch auf eine komplexere Servervariante gewechselt werden.

Es folgen einige allgemeine Empfehlungen und Tipps, basierend auf mehrjähriger Erfahrung in der Nutzerbetreuung:

- Falls Sie für ihr Team die einfachste Servervariante suchen, dann kommen Sie mit einer Standard-**svnserve**-Installation am schnellsten ans Ziel. Beachten Sie aber, dass der Inhalt ihres Repositorys im Klartext über das Netzwerk übertragen wird. Wenn Sie nur innerhalb ihres Firmennetzwerks oder eines VPNs arbeiten, so ist dies kein Beinbruch. Ist ihr Repository allerdings vom Internet aus erreichbar, so sollten Sie eventuell sicherstellen, dass darin keine sensiblen Daten vorhanden sind (z.B. nur Open-Source Code o.ä.), oder Sie legen noch einmal Hand an und verschlüsseln mittels SASL die Netzwerkverbindung zur ihrem Repository.
- Wenn Sie bereits über Systeme zur Authentifizierung (LDAP, Active Directory, NTLM, X.509 etc.) verfügen und Subversion in diese integrieren möchten, so bleibt Ihnen die Wahl zwischen einer Apache-gestützten Variante oder eines mit SASL vermählten **svnserve**. Stehen serverseitige Logs zur Aufzeichnung von Client-Aktivitäten und Serverfehlern auf Ihrer Wunschliste, dann ist Apache die einzige Option.
- Wenn Sie sich für die Verwendung von Apache oder eines Standard-**svnserve** entschieden haben, dann legen Sie auf ihrem System einen einfachen **svn**-Nutzer an und lassen den Serverprozess unter diesem Nutzer laufen. Stellen Sie zudem sicher, dass das gesamte Verzeichnis mit dem Repository nur diesem **svn**-Nutzer gehört. Damit wird der Zugriff auf ihr Repository durch das Dateisystem des Serverbetriebssystems verwaltet, und nur der Serverprozess kann noch Änderungen daran vornehmen.
- Wenn Sie bereits über eine aus SSH-Zugängen bestehende Infrastruktur verfügen, und Ihre Nutzer auf dem Subversion-Server schon lokale Zugänge haben, dann ist die Verwendung einer **svnserve**-über-SSH-Lösung sinnvoll. Wir empfehlen diese Variante allerdings nur sehr ungern. Es ist im Allgemeinen sicherer, Ihren Nutzern nur durch **svnserve** oder Apache verwaltete Zugänge den Zugriff auf Ihr Repository zu ermöglichen und eben nicht mittels vollwertiger Nutzerzugänge auf dem Serversystem. Falls der Wunsch nach einer starken Netzwerkverschlüsselung Sie auf die Verwendung

des SSH gebracht hat, dann empfehlen wir Ihnen stattdessen die Verwendung von Apache und SSL, bzw. die Kombination aus **svnserve** und SASL-Verschlüsselung.

- Lassen Sie sich bitte *nicht* von der Idee verführen, allen Ihren Nutzern direkten Zugriff auf das Repository mittels der `file://`-Methode zu geben. Auch wenn der Zugriff auf das Repository durch eine Netzwerkfreigabe erfolgt, bleibt es immmer noch eine schlechte Idee. Dadurch wird jeglicher Sicherheitspuffer zwischen dem Nutzer und dem Repository entfernt: Ein Anwender kann ohne (oder auch mit) Absicht die Datenbank des Repositorys beschädigen. Es wird zudem schwierig, das Repository offline zu nehmen um eine Inspektion oder ein Upgrade durchzuführen. Zudem kann es Ihnen eine Menge Probleme mit den Dateirechten einbringen (siehe „Supporting Multiple Repository Access Methods“). Beachten Sie bitte auch, dass dies einer der Gründe ist, warum wir vor der Verwendung der `svn+ssh://`-Methode für den Repository-Zugriff warnen. Vom Standpunkt der Sicherheit ist dies effektiv dasselbe wie die Verwendung von `file://` für den Zugriff durch lokale Benutzer und kann zu denselben Problemen führen, wenn der Administrator nicht alle Vorsicht walten läßt.

svnserve, ein maßgefertigter Server

Das Programm **svnserve** ist ein leichtgewichtiger Server, welcher für die Kommunikation mit den Clients ein auf TCP/IP basierendes, zustandsorientiertes Protokoll verwendet. Um sich mit dem Server zu verbinden, verwenden die Clients entweder das `svn://`- oder das `svn+ssh://`-Schema. In diesem Abschnitt behandeln wir die unterschiedlichen Möglichkeiten, **svnserve** einzusetzen, wie sich die Clients am Server authentifizieren und wie die passenden Zugangsrechte zum Repository korrekt eingerichtet werden.

Der Serverstart

Es gibt mehrere Möglichkeiten, **svnserve** zu starten:

- **svnserve** als eigenständigen Dienst (engl. daemon) starten und auf Anfragen von Clients reagieren lassen.
- **svnserve** bei Bedarf mit Hilfe des Unix-Dienstes **inetd** starten, wenn auf einem festgelegten Port Anfragen eines SVN-Clients ankommen.
- Einen SSH-Server verwenden, um **svnserve** fallweise über einen verschlüsselten SSH-Tunnel zu betreiben.
- **svnserve** als Microsoft-Windows-Dienst laufen lassen.

svnserve als Unix-Dienst

Die einfachste Variante ist, **svnserve** als eigenständigen (Unix-)Dienst laufen zu lassen. Verwenden Sie hierfür die `-d` Option beim Aufruf:

```
$ svnserve -d
$               # svnserve läuft nun als Dienst und lauscht auf Port 3690
```

Wird **svnserve** als Dienst betrieben, können Sie mit den Optionen `--listen-port` und `--listen-host` festlegen, auf welchem Port und unter welchem Hostnamen er lauschen soll.

Wurde **svnserve** auf diese Weise erfolgreich gestartet, stehen nun alle Repositorys auf dem Server für Nutzer im Netzwerk zur Verfügung. Für einen Zugriff muss ein Client den *absoluten* Pfad zum Repository im URL angeben. Ist das Repository beispielsweise im

Verzeichnis `/var/svn/project1` gespeichert, so sieht ein entsprechender URL für den Zugriff folgendermaßen aus: `svn://host.example.com/var/svn/project1`. Um die Sicherheit zu erhöhen, kann **svnserve** beim Start mit der Option `-r` auf ein bestimmtes Verzeichnis beschränkt werden, so dass nur noch die darin liegenden Repositorys im Netz verfügbar sind. Ein Beispiel:

```
$ svnserve -d -r /var/svn
…
```

Mit der `-r`-Option wird festgelegt, welches Verzeichnis vom **svnserve** bei Anfragen als Wurzelverzeichnis (engl. root) verwendet wird. Ein Client muss nun in seiner URL nur noch den Pfad relativ zum neuen Wurzelverzeichnis angeben, was die URL erheblich verkürzt und die Verzeichnisstruktur etwas verschleiert:

```
$ svn checkout svn://host.example.com/project1
…
```

svnserve über inetd starten

Wenn Sie **inetd** zum Starten des Prozesses verwenden wollen, so übergeben Sie **svnserve** beim Aufruf die Option `-i` (`--inetd`). Im folgenden Beispiel sehen wir die Ausgaben beim Aufruf von `svnserve -i` auf der Kommandozeile. Beachten Sie aber, dass dies nicht der Weg ist, wie der Dienst normalerweise gestartet wird – eine genaue Beschreibung, wie **svnserve** über **inetd** gestartet wird, folgt anschließend.

```
$ svnserve -i
( success ( 1 2 ( ANONYMOUS ) ( edit-pipeline ) ) )
```

Mit der `--inetd`-Option versucht **svnserve** mit dem Subversion-Client unter Verwendung eines speziellen Protokolls via `stdin` und `stdout` zu sprechen. Dies ist der normale Weg für ein Programm, welches über **inetd** gestartet wurde. Die IANA (Internet Assigned Numbers Authority) hat für das Subversion-Protokoll den Port 3690 reserviert – auf einem Unix-ähnlichen System fügen Sie einfach folgende Zeilen (wenn noch nicht vorhanden) in die Datei `/etc/services` ein:

```
svn           3690/tcp   # Subversion
svn           3690/udp   # Subversion
```

Wenn Sie den klassischen Unix-**inetd** verwenden, können Sie die folgende Zeile in die Datei `/etc/inetd.conf` einfügen:

```
svn stream tcp nowait svnowner /usr/bin/svnserve svnserve -i
```

Stellen Sie sicher, dass „svnowner“ der Nutzer ist, welcher alle notwendigen Zugriffsrechte auf ihre Repositorys hat. Kommt nun eine Anfrage eines Subversion-Clients auf Port 3690 herein, so wird **inetd** einen **svnserve**-Prozess starten, um die Anfrage zu bedienen. Wahrscheinlich möchten Sie noch die `-r`-Option zur oben genannten Zeile hinzufügen, um einzuschränken, welche Repositorys exportiert werden dürfen.

svnserve über einen Tunnel

Eine dritte Möglichkeit ist, **svnserve** mittels der `-t`-Option im Tunnel-Modus aufzurufen. Bei diesem Aufruf wird vorausgesetzt, dass ein anderes Programm für den Remote-Zugriff – etwa **rsh** oder **ssh** – den Nutzer bereits erfolgreich authentifiziert hat, um nun einen privaten **svnserve**-Prozess als *dieser Nutzer* zu starten. (Beachten Sie, dass für Sie als Nutzer selten bis nie die Notwendigkeit bestehen wird, **svnserve** mit der `-t`-Option von Hand auf der Kommandozeile aufzurufen – der SSH-Dienst wird dies in der Regel für Sie machen.) **svnserve** wird sich nun normal verhalten (Abwicklung der Kommunikation über `stdin` und `stdout`) und davon ausgehen, dass alle Daten mit Hilfe des Tunnels zum Client weitergeleitet werden. Wird **svnserve** wie in diesem Fall durch ein Tunnel-Programm aufgerufen, ist es notwendig, dass der aufrufende Nutzer volle Lese- und Schreibrechte auf die Dateien der Repository-Datenbank hat. Es verhält sich dabei im Grunde genommen so, als wenn der Nutzer mit einem `file://`-URL auf ein Repository zugreifen würde.

Wir werden diese Option noch genauer in diesem Kapitel behandeln, und zwar in „Tunneling over SSH“.

svnserve als Dienst unter Windows

Gehört ihr Windows zur NT-Familie (2000, 2003, XP oder Vista), so können Sie **svnserve** auch als normalen Windows-Dienst laufen lassen. Dies ist wesentlich sinnvoller, als die Option `--daemon` (`-d`) zu verwenden und ihn als selbstständigen Dienst zu betreiben. Sie müssten dann immer eine Konsole (cmd) öffnen, den passenden Befehl aufrufen und die Konsole anschließend die ganze Zeit geöffnet lassen. Ein Windows-Dienst dagegen läuft im Hintergrund, kann bereits beim Hochfahren automatisch starten und läßt sich wie jeder andere Windows-Dienst mit demselben Administrationsprogramm starten und stoppen.

Es ist notwendig, den neuen Windows-Dienst unter Verwendung des Kommandozeilenprogramms **SC.EXE** einzurichten. Ähnlich der **inetd**-Konfigurationszeile müssen Sie den genauen Aufruf für den Start von **svnserve** festlegen:

```
C:\> sc create svn
        binpath= "C:\svn\bin\svnserve.exe --service -r C:\repos"
        displayname= "Subversion Server"
        depend= Tcpip
        start= auto
```

Hiermit erzeugen Sie einen neuen Windows-Dienst mit dem Namen „svn“, welcher jedesmal das Programm **svnserve.exe** startet (und in diesem Fall `C:\repos` als Wurzelverzeichnis verwendet). In diesem Beispiel müssen jedoch einige wichtige Punkte beachtet werden.

Als erstes ist es wichtig, dass das Programm **svnserve.exe** immer mit der Option `--service` aufgerufen wird. Alle weiteren Optionen müssen in derselben Zeile folgen, allerdings dürfen sich widersprechende Option nicht verwendet werden – wie etwa `--daemon` (`-d`), `--tunnel` oder `--inetd` (`-i`). Optionen wie `-r` oder `--listen-port` sind hingegen in Ordnung. Zweitens, seien Sie beim Aufruf von **SC.EXE** mit Leerzeichen vorsichtig: Beim Schreiben der `Schlüssel= Wert`-Zeile darf zwischen `Schlüssel` und = kein Leerzeichen stehen, vor `Wert` muss genau ein Leerzeichen stehen. Seien Sie zuletzt auch bei der Verwendung von Leerzeichen innerhalb ihres Kommandozeilenaufrufes vorsichtig. Sollten Verzeichnisangaben etwa Leerzeichen (oder andere zu schützende Zeichen) enthalten, so umschließen Sie sie mit zusätzlichen doppelten Anführungszeichen:

```
C:\> sc create svn
        binpath= "\"C:\program files\svn\bin\svnserve.exe\" --service -r C:\repo
        displayname= "Subversion Server"
        depend= Tcpip
        start= auto
```

Beachten Sie bitte auch, dass das Wort `binpath` etwas irreführend ist – sein Wert ist eine *Kommandozeile* und nicht der Pfad zu einem Programm. Dies ist der Grund, warum Sie vorhandene Leerzeichen mit doppelten Anführungszeichen schützen müssen.

Ist der Dienst erstmal eingerichtet, können Sie ihn mit Hilfe von grafischen Programmen (etwa der Microsoft Management Console) stoppen, starten oder seinen Status abfragen. Alternativ steht ihnen auch die Kommandozeile zur Verfügung:

```
C:\> net stop svn
C:\> net start svn
```

Der Dienst kann natürlich auch wieder deinstalliert werden, indem Sie den Befehl **`sc delete svn`** aufrufen. Stoppen Sie den Dienst aber vorher! Das Programm **SC.EXE** kennt noch etliche andere nützliche Optionen und Parameter, ein Aufruf von **`sc /?`** verrät ihnen, welche das sind.

Integrierte Authentifikation und Autorisation

Wenn sich ein Subversionsclient mit einem laufendem **svnserve**- Prozess verbindet, geschieht folgendes:

- Der Client wählt ein bestimmtes Repository.
- Der Server liest die zum Repository gehörende Datei `conf/svnserve.conf` und führt die darin enthaltenden Regeln für die Authentifikation (Legitimation, Identitätsprüfung) und die Autorisation (Berechtigungen, Befugnisse) aus.
- Je nach festlegten Regeln und Einstellungen geht es mit einen der folgenden Punkten weiter:
  - Der Client kann seine Anfragen anonym, also ohne eine vorhergehende Authentifikationsanfrage senden.
  - Der Client kann jederzeit eine Anmeldeaufforderung erhalten.
  - Läuft die Verbindung über einen Tunnel, so erklärt der Client, dass eine externe Anmeldung stattgefunden hat (meistens durch SSH).

Der **svnserve** - Server beherrscht als Standardeinstellung nur den CRAM-MD5 [1] - Anmeldedialog. Im Kern läuft dieser wie folgt ab: Der Server sendet einen kleinen Datensatz als Anfrage an den Client. Dieser erzeugt mittels des MD5-Hash-Algorithmus einen Fingerprint/Hash des Passwortes zusammen mit dem Datensatz und sendet diesen Fingerprint als Antwort zurück an den Server. Der Server vollzieht nun dieselbe Operation mit dem Passwort und dem Datensatz und vergleicht anschließend seinen Fingerprint mit dem des Clients. *Während des ganzen Vorgangs wird das eigentliche Passwort nicht einmal über das Netzwerk gesendet.*

Enthält ihr **svnserve -** Server Unterstützung für SASL, so beherrscht er nicht nur die CRAM-MD5-Anmeldung, sondern noch eine Menge an anderen Verfahren zur Authentifikation. Lesen Sie „Using **svnserve** with SASL" weiter unten um zu lernen wie die einzelnen Möglichkeiten zur Authentifikation und Verschlüsselung in SASL eingerichtet werden.

Es ist selbstverständlich auch möglich, dass sich der Client über ein eigenständiges Tunnel-Programm anmeldet, etwa **ssh**. In einem solchem Fall stellt der Server nur fest unter welchem Nutzer er gestartet wurde, und verwendet diesen für die weitere Anmeldung. Mehr dazu im Kapitel „Tunneling over SSH".

Wie Sie sicher bereits bemerkt haben, ist die Datei `svnserve.conf` in jedem Repository die zentrale Anlaufstelle für alle Regeln im Rahmen der Nutzeranmeldung und

[1] See RFC 2195.

Rechtevergabe. Die Datei hat dasselbe Format wie die anderen Konfigurationsdateien auch (siehe „Runtime Configuration Area"): Die Abschnittsbezeichnugen sind von eckigen Klammern umschlossen ([und]), Kommentare werden mit Rauten (#) eingeleitet und jeder Abschnitt enthält spezielle Variablen denen Werte zugewiesen werden (variable = value). Lassen Sie uns einen Blick in diese Dateien werfen um zu sehen wie sie verwendet werden.

Create a users file and realm

For now, the [general] section of svnserve.conf has all the variables you need. Begin by changing the values of those variables: choose a name for a file that will contain your usernames and passwords and choose an authentication realm:

```
[general]
password-db = userfile
realm = example realm
```

The realm is a name that you define. It tells clients which sort of „authentication namespace" they're connecting to; the Subversion client displays it in the authentication prompt and uses it as a key (along with the server's hostname and port) for caching credentials on disk (see „Client Credentials Caching"). The password-db variable points to a separate file that contains a list of usernames and passwords, using the same familiar format. For example:

```
[users]
harry = foopassword
sally = barpassword
```

The value of password-db can be an absolute or relative path to the users file. For many admins, it's easy to keep the file right in the conf/ area of the repository, alongside svnserve.conf. On the other hand, it's possible you may want to have two or more repositories share the same users file; in that case, the file should probably live in a more public place. The repositories sharing the users file should also be configured to have the same realm, since the list of users essentially defines an authentication realm. Wherever the file lives, be sure to set the file's read and write permissions appropriately. If you know which user(s) **svnserve** will run as, restrict read access to the users file as necessary.

Set access controls

There are two more variables to set in the svnserve.conf file: they determine what unauthenticated (anonymous) and authenticated users are allowed to do. The variables anon-access and auth-access can be set to the value none, read, or write. Setting the value to none prohibits both reading and writing; read allows read-only access to the repository, and write allows complete read/write access to the repository. For example:

```
[general]
password-db = userfile
realm = example realm

# anonymous users can only read the repository
anon-access = read

# authenticated users can both read and write
auth-access = write
```

The example settings are, in fact, the default values of the variables, should you forget to define them. If you want to be even more conservative, you can block anonymous access completely:

```
[general]
password-db = userfile
realm = example realm

# anonymous users aren't allowed
anon-access = none

# authenticated users can both read and write
auth-access = write
```

The server process understands not only these „blanket“ access controls to the repository, but also finer-grained access restrictions placed on specific files and directories within the repository. To make use of this feature, you need to define a file containing more detailed rules, and then set the `authz-db` variable to point to it:

```
[general]
password-db = userfile
realm = example realm

# Specific access rules for specific locations
authz-db = authzfile
```

We discuss the syntax of the `authzfile` file in detail later in this chapter, in „Path-Based Authorization“. Note that the `authz-db` variable isn't mutually exclusive with the `anon-access` and `auth-access` variables; if all the variables are defined at once, *all* of the rules must be satisfied before access is allowed.

Using svnserve with SASL

For many teams, the built-in CRAM-MD5 authentication is all they need from **svnserve**. However, if your server (and your Subversion clients) were built with the Cyrus Simple Authentication and Security Layer (SASL) library, you have a number of authentication and encryption options available to you.

What Is SASL?

The Cyrus Simple Authentication and Security Layer is open source software written by Carnegie Mellon University. It adds generic authentication and encryption capabilities to any network protocol, and as of Subversion 1.5 and later, both the **svnserve** server and **svn** client know how to make use of this library. It may or may not be available to you: if you're building Subversion yourself, you'll need to have at least version 2.1 of SASL installed on your system, and you'll need to make sure that it's detected during Subversion's build process. If you're using a prebuilt Subversion binary package, you'll have to check with the package maintainer as to whether SASL support was compiled in. SASL comes with a number of pluggable modules that represent different authentication systems: Kerberos (GSSAPI), NTLM, One-Time-Passwords (OTP), DIGEST-MD5, LDAP, Secure-Remote-Password (SRP), and others. Certain mechanisms may or may not be available to you; be sure to check which modules are provided.

You can download Cyrus SASL (both code and documentation) from http://asg.web.cmu.edu/sasl/sasl-library.html.

Normally, when a subversion client connects to **svnserve**, the server sends a greeting that advertises a list of the capabilities it supports, and the client responds with a similar list of capabilities. If the server is configured to require authentication, it then sends a challenge that lists the authentication mechanisms available; the client responds by choosing one of the mechanisms, and then authentication is carried out in some number of round-trip messages. Even when SASL capabilities aren't present, the client and server inherently know how to use the CRAM-MD5 and ANONYMOUS mechanisms (see „Integrierte Authentifikation und Autorisation“). If server and client were linked against SASL, a number of other authentication mechanisms may also be available. However, you'll need to explicitly configure SASL on the server side to advertise them.

Authenticating with SASL

To activate specific SASL mechanisms on the server, you'll need to do two things. First, create a `[sasl]` section in your repository's `svnserve.conf` file with an initial key-value pair:

```
[sasl]
use-sasl = true
```

Second, create a main SASL configuration file called `svn.conf` in a place where the SASL library can find it—typically in the directory where SASL plug-ins are located. You'll have to locate the plug-in directory on your particular system, such as `/usr/lib/sasl2/` or `/etc/sasl2/`. (Note that this is *not* the `svnserve.conf` file that lives within a repository!)

On a Windows server, you'll also have to edit the system registry (using a tool such as **regedit**) to tell SASL where to find things. Create a registry key named `[HKEY_LOCAL_MACHINE\SOFTWARE\Carnegie Mellon\Project Cyrus\SASL Library]`, and place two keys inside it: a key called `SearchPath` (whose value is a path to the directory containing the SASL `sasl*.dll` plug-in libraries), and a key called `ConfFile` (whose value is a path to the parent directory containing the `svn.conf` file you created).

Because SASL provides so many different kinds of authentication mechanisms, it would be foolish (and far beyond the scope of this book) to try to describe every possible server-side configuration. Instead, we recommend that you read the documentation supplied in the `doc/` subdirectory of the SASL source code. It goes into great detail about every mechanism and how to configure the server appropriately for each. For the purposes of this discussion, we'll just demonstrate a simple example of configuring the DIGEST-MD5 mechanism. For example, if your `subversion.conf` (or `svn.conf`) file contains the following:

```
pwcheck_method: auxprop
auxprop_plugin: sasldb
sasldb_path: /etc/my_sasldb
mech_list: DIGEST-MD5
```

you've told SASL to advertise the DIGEST-MD5 mechanism to clients and to check user passwords against a private password database located at `/etc/my_sasldb`. A system administrator can then use the **saslpasswd2** program to add or modify usernames and passwords in the database:

```
$ saslpasswd2 -c -f /etc/my_sasldb -u realm username
```

A few words of warning: first, make sure the „realm“ argument to **saslpasswd2** matches the same realm you've defined in your repository's `svnserve.conf` file; if they don't match, authentication will fail. Also, due to a shortcoming in SASL, the common realm must be a string with no space characters. Finally, if you decide to go with the standard SASL password database, make sure the **svnserve** program has read access to the file (and possibly write access as well, if you're using a mechanism such as OTP).

This is just one simple way of configuring SASL. Many other authentication mechanisms are available, and passwords can be stored in other places such as in LDAP or a SQL database. Consult the full SASL documentation for details.

Remember that if you configure your server to only allow certain SASL authentication mechanisms, this forces all connecting clients to have SASL support as well. Any Subversion client built without SASL support (which includes all pre-1.5 clients) will be unable to authenticate. On the one hand, this sort of restriction may be exactly what you want („My clients must all use Kerberos!“). However, if you still want non-SASL clients to be able to authenticate, be sure to advertise the CRAM-MD5 mechanism as an option. All clients are able to use CRAM-MD5, whether they have SASL capabilities or not.

SASL encryption

SASL is also able to perform data encryption if a particular mechanism supports it. The built-in CRAM-MD5 mechanism doesn't support encryption, but DIGEST-MD5 does, and mechanisms such as SRP actually require use of the OpenSSL library. To enable or disable different levels of encryption, you can set two values in your repository's `svnserve.conf` file:

```
[sasl]
use-sasl = true
min-encryption = 128
max-encryption = 256
```

The `min-encryption` and `max-encryption` variables control the level of encryption demanded by the server. To disable encryption completely, set both values to 0. To enable simple checksumming of data (i.e., prevent tampering and guarantee data integrity without encryption), set both values to 1. If you wish to allow—but not require—encryption, set the minimum value to 0, and the maximum value to some bit length. To require encryption unconditionally, set both values to numbers greater than 1. In our previous example, we require clients to do at least 128-bit encryption, but no more than 256-bit encryption.

Tunneling over SSH

svnserve's built-in authentication (and SASL support) can be very handy, because it avoids the need to create real system accounts. On the other hand, some administrators already have well-established SSH authentication frameworks in place. In these situations, all of the project's users already have system accounts and the ability to „SSH into“ the server machine.

It's easy to use SSH in conjunction with **svnserve**. The client simply uses the `svn+ssh://` URL scheme to connect:

```
$ whoami
harry

$ svn list svn+ssh://host.example.com/repos/project
harryssh@host.example.com's password:  *****

foo
bar
baz
…
```

In this example, the Subversion client is invoking a local **ssh** process, connecting to `host.example.com`, authenticating as the user `harryssh` (according to SSH user configuration), then spawning a private **svnserve** process on the remote machine running as the user `harryssh`. The **svnserve** command is being invoked in tunnel mode (`-t`), and its network protocol is being „tunneled“ over the encrypted connection by **ssh**, the tunnel agent. If the client performs a commit, the authenticated username `harryssh` will be used as the author of the new revision.

The important thing to understand here is that the Subversion client is *not* connecting to a running **svnserve** daemon. This method of access doesn't require a daemon, nor does it notice one if present. It relies wholly on the ability of **ssh** to spawn a temporary **svnserve** process, which then terminates when the network connection is closed.

When using `svn+ssh://` URLs to access a repository, remember that it's the **ssh** program prompting for authentication, and *not* the **svn** client program. That means there's no automatic password-caching going on (see „Client Credentials Caching“). The Subversion client often makes multiple connections to the repository, though users don't normally notice this due to the password caching feature. When using `svn+ssh://` URLs, however, users may be annoyed by **ssh** repeatedly asking for a password for every outbound connection. The solution is to use a separate SSH password-caching tool such as **ssh-agent** on a Unix-like system, or **pageant** on Windows.

When running over a tunnel, authorization is primarily controlled by operating system permissions to the repository's database files; it's very much the same as if Harry were accessing the repository directly via a `file://` URL. If multiple system users are going to be accessing the repository directly, you may want to place them into a common group, and you'll need to be careful about umasks (be sure to read „Supporting Multiple Repository Access Methods“ later in this chapter). But even in the case of tunneling, you can still use the `svnserve.conf` file to block access, by simply setting `auth-access = read` or `auth-access = none`. [2]

You'd think that the story of SSH tunneling would end here, but it doesn't. Subversion allows you to create custom tunnel behaviors in your runtime `config` file (see „Runtime Configuration Area“.) For example, suppose you want to use RSH instead of SSH. [3] In the `[tunnels]` section of your `config` file, simply define it like this:

```
[tunnels]
rsh = rsh
```

And now, you can use this new tunnel definition by using a URL scheme that matches the name of your new variable: `svn+rsh://host/path`. When using the new URL scheme, the Subversion client will actually be running the command **`rsh host svnserve -t`** behind the scenes. If you include a username in the URL (e.g., `svn+rsh://username@host/path`), the client will also include that in its command (**`rsh username@host svnserve -t`**). But you can define new tunneling schemes to be much more clever than that:

```
[tunnels]
joessh = $JOESSH /opt/alternate/ssh -p 29934
```

This example demonstrates a couple of things. First, it shows how to make the Subversion client launch a very specific tunneling binary (the one located at `/opt/alternate/ssh`) with specific options. In this case, accessing an `svn+joessh://` URL would invoke the particular SSH binary with `-p 29934` as arguments—useful if you want the tunnel program to connect to a nonstandard port.

Second, it shows how to define a custom environment variable that can override the name of the tunneling program. Setting the `SVN_SSH` environment variable is a convenient way to override the default SSH tunnel agent. But if you need to have several different overrides for different servers, each perhaps contacting a different port or passing a

[2] Note that using any sort of **svnserve**-enforced access control at all is a bit pointless; the user already has direct access to the repository database.

[3] We don't actually recommend this, since RSH is notably less secure than SSH.

different set of options to SSH, you can use the mechanism demonstrated in this example. Now if we were to set the JOESSH environment variable, its value would override the entire value of the tunnel variable—**$JOESSH** would be executed instead of **/opt/alternate/ssh -p 29934**.

SSH configuration tricks

It's possible to control not only the way in which the client invokes **ssh**, but also to control the behavior of **sshd** on your server machine. In this section, we'll show how to control the exact **svnserve** command executed by **sshd**, as well as how to have multiple users share a single system account.

Initial setup

To begin, locate the home directory of the account you'll be using to launch **svnserve**. Make sure the account has an SSH public/private keypair installed, and that the user can log in via public-key authentication. Password authentication will not work, since all of the following SSH tricks revolve around using the SSH authorized_keys file.

If it doesn't already exist, create the authorized_keys file (on Unix, typically ~/.ssh/authorized_keys). Each line in this file describes a public key that is allowed to connect. The lines are typically of the form:

```
ssh-dsa AAAABtce9euch… user@example.com
```

The first field describes the type of key, the second field is the base64-encoded key itself, and the third field is a comment. However, it's a lesser known fact that the entire line can be preceded by a command field:

```
command="program" ssh-dsa AAAABtce9euch… user@example.com
```

When the command field is set, the SSH daemon will run the named program instead of the typical tunnel-mode **svnserve** invocation that the Subversion client asks for. This opens the door to a number of server-side tricks. In the following examples, we abbreviate the lines of the file as:

```
command="program" TYPE KEY COMMENT
```

Controlling the invoked command

Because we can specify the executed server-side command, it's easy to name a specific **svnserve** binary to run and to pass it extra arguments:

```
command="/path/to/svnserve -t -r /virtual/root" TYPE KEY COMMENT
```

In this example, /path/to/svnserve might be a custom wrapper script around **svnserve** which sets the umask (see „Supporting Multiple Repository Access Methods“.) It also shows how to anchor **svnserve** in a virtual root directory, just as one often does when running **svnserve** as a daemon process. This might be done either to restrict access to parts of the system, or simply to relieve the user of having to type an absolute path in the svn+ssh:// URL.

It's also possible to have multiple users share a single account. Instead of creating a separate system account for each user, generate a public/private key pair for each person. Then place each public key into the authorized_users file, one per line, and use the -

`-tunnel-user` option:

```
  command="svnserve -t --tunnel-user=harry" TYPE1 KEY1 harry@example.com
  command="svnserve -t --tunnel-user=sally" TYPE2 KEY2 sally@example.com
```

This example allows both Harry and Sally to connect to the same account via public key authentication. Each of them has a custom command that will be executed; the `--tunnel-user` option tells **svnserve** to assume that the named argument is the authenticated user. Without `--tunnel-user`, it would appear as though all commits were coming from the one shared system account.

A final word of caution: giving a user access to the server via public-key in a shared account might still allow other forms of SSH access, even if you've set the `command` value in `authorized_keys`. For example, the user may still get shell access through SSH or be able to perform X11 or general port forwarding through your server. To give the user as little permission as possible, you may want to specify a number of restrictive options immediately after the `command`:

```
  command="svnserve -t --tunnel-user=harry",no-port-forwarding,no-agent-forw
arding,no-X11-forwarding,no-pty TYPE1 KEY1 harry@example.com
```

Note that this all must be on one line—truly on one line—since SSH `authorized_keys` files do not even allow the conventional backslash character (\) for line continuation. The only reason we've shown it with a line break is to fit it on the physical page of a book.

httpd, the Apache HTTP Server

The Apache HTTP Server is a „heavy-duty“ network server that Subversion can leverage. Via a custom module, **httpd** makes Subversion repositories available to clients via the WebDAV/DeltaV protocol, which is an extension to HTTP 1.1 (see http://www.webdav.org/ for more information). This protocol takes the ubiquitous HTTP protocol that is the core of the World Wide Web, and adds writing—specifically, versioned writing—capabilities. The result is a standardized, robust system that is conveniently packaged as part of the Apache 2.0 software, supported by numerous operating systems and third-party products, and doesn't require network administrators to open up yet another custom port. [4] While an Apache-Subversion server has more features than **svnserve**, it's also a bit more difficult to set up. With flexibility often comes more complexity.

Much of the following discussion includes references to Apache configuration directives. While some examples are given of the use of these directives, describing them in full is outside the scope of this chapter. The Apache team maintains excellent documentation, publicly available on their web site at http://httpd.apache.org. For example, a general reference for the configuration directives is located at http://httpd.apache.org/docs-2.0/mod/directives.html.

Also, as you make changes to your Apache setup, it is likely that somewhere along the way a mistake will be made. If you are not already familiar with Apache's logging subsystem, you should become aware of it. In your `httpd.conf` file are directives that specify the on-disk locations of the access and error logs generated by Apache (the `CustomLog` and `ErrorLog` directives, respectively). Subversion's **mod_dav_svn** uses Apache's error logging interface as well. You can always browse the contents of those files for information that might reveal the source of a problem that is not clearly noticeable otherwise.

Why Apache 2?

[4] They really hate doing that.

If you're a system administrator, it's very likely that you're already running the Apache web server and have some prior experience with it. At the time of this writing, Apache 1.3 is the more popular version of Apache. The world has been somewhat slow to upgrade to the Apache 2.x series for various reasons: some people fear change, especially changing something as critical as a web server. Other people depend on plug-in modules that work only against the Apache 1.3 API, and they are waiting for a 2.x port. Whatever the reason, many people begin to worry when they first discover that Subversion's Apache module is written specifically for the Apache 2 API.

The proper response to this problem is: don't worry about it. It's easy to run Apache 1.3 and Apache 2 side by side; simply install them to separate places and use Apache 2 as a dedicated Subversion server that runs on a port other than 80. Clients can access the repository by placing the port number into the URL:

```
$ svn checkout http://host.example.com:7382/repos/project
```

Prerequisites

To network your repository over HTTP, you basically need four components, available in two packages. You'll need Apache **httpd** 2.0, the **mod_dav** DAV module that comes with it, Subversion, and the **mod_dav_svn** filesystem provider module distributed with Subversion. Once you have all of those components, the process of networking your repository is as simple as:

- Getting httpd 2.0 up and running with the **mod_dav** module
- Installing the **mod_dav_svn** backend to **mod_dav**, which uses Subversion's libraries to access the repository
- Configuring your `httpd.conf` file to export (or expose) the repository

You can accomplish the first two items either by compiling **httpd** and Subversion from source code or by installing prebuilt binary packages of them on your system. For the most up-to-date information on how to compile Subversion for use with the Apache HTTP Server, as well as how to compile and configure Apache itself for this purpose, see the `INSTALL` file in the top level of the Subversion source code tree.

Basic Apache Configuration

Once you have all the necessary components installed on your system, all that remains is the configuration of Apache via its `httpd.conf` file. Instruct Apache to load the **mod_dav_svn** module using the `LoadModule` directive. This directive must precede any other Subversion-related configuration items. If your Apache was installed using the default layout, your **mod_dav_svn** module should have been installed in the `modules` subdirectory of the Apache install location (often `/usr/local/apache2`). The `LoadModule` directive has a simple syntax, mapping a named module to the location of a shared library on disk:

```
LoadModule dav_svn_module     modules/mod_dav_svn.so
```

Note that if **mod_dav** was compiled as a shared object (instead of statically linked directly to the **httpd** binary), you'll need a similar `LoadModule` statement for it, too. Be sure that it comes before the **mod_dav_svn** line:

```
LoadModule dav_module         modules/mod_dav.so
LoadModule dav_svn_module     modules/mod_dav_svn.so
```

At a later location in your configuration file, you now need to tell Apache where you keep your Subversion repository (or repositories). The `Location` directive has an XML-like notation, starting with an opening tag and ending with a closing tag, with various other configuration directives in the middle. The purpose of the `Location` directive is to instruct Apache to do something special when handling requests that are directed at a given URL or one of its children. In the case of Subversion, you want Apache to simply hand off support for URLs that point at versioned resources to the DAV layer. You can instruct Apache to delegate the handling of all URLs whose path portions (the part of the URL that follows the server's name and the optional port number) begin with `/repos/` to a DAV provider whose repository is located at `/var/svn/repository` using the following `httpd.conf` syntax:

```
<Location /repos>
  DAV svn
  SVNPath /var/svn/repository
</Location>
```

If you plan to support multiple Subversion repositories that will reside in the same parent directory on your local disk, you can use an alternative directive—`SVNParentPath`—to indicate that common parent directory. For example, if you know you will be creating multiple Subversion repositories in a directory `/var/svn` that would be accessed via URLs such as `http://my.server.com/svn/repos1`, `http://my.server.com/svn/repos2`, and so on, you could use the `httpd.conf` configuration syntax in the following example:

```
<Location /svn>
  DAV svn

  # any "/svn/foo" URL will map to a repository /var/svn/foo
  SVNParentPath /var/svn
</Location>
```

Using the previous syntax, Apache will delegate the handling of all URLs whose path portions begin with `/svn/` to the Subversion DAV provider, which will then assume that any items in the directory specified by the `SVNParentPath` directive are actually Subversion repositories. This is a particularly convenient syntax in that, unlike the use of the `SVNPath` directive, you don't have to restart Apache to create and network new repositories.

Be sure that when you define your new `Location`, it doesn't overlap with other exported locations. For example, if your main `DocumentRoot` is exported to `/www`, do not export a Subversion repository in `<Location /www/repos>`. If a request comes in for the URI `/www/repos/foo.c`, Apache won't know whether to look for a file `repos/foo.c` in the `DocumentRoot`, or whether to delegate **mod_dav_svn** to return `foo.c` from the Subversion repository. The result is often an error from the server of the form `301 Moved Permanently`.

Server Names and the COPY Request

Subversion makes use of the `COPY` request type to perform server-side copies of files and directories. As part of the sanity checking done by the Apache modules, the source of the copy is expected to be located on the same machine as the destination of the copy. To satisfy this requirement, you might need to tell **mod_dav** the name you use as the hostname of your server. Generally, you can use the `ServerName` directive in `httpd.conf` to accomplish this.

```
ServerName svn.example.com
```

If you are using Apache's virtual hosting support via the `NameVirtualHost` directive, you may need to use the `ServerAlias` directive to specify additional names by which your server is known. Again, refer to the Apache documentation for full details.

At this stage, you should strongly consider the question of permissions. If you've been running Apache for some time now as your regular web server, you probably already have a collection of content—web pages, scripts, and such. These items have already been configured with a set of permissions that allows them to work with Apache, or more appropriately, that allows Apache to work with those files. Apache, when used as a Subversion server, will also need the correct permissions to read and write to your Subversion repository.

You will need to determine a permission system setup that satisfies Subversion's requirements without messing up any previously existing web page or script installations. This might mean changing the permissions on your Subversion repository to match those in use by other things that Apache serves for you, or it could mean using the `User` and `Group` directives in `httpd.conf` to specify that Apache should run as the user and group that owns your Subversion repository. There is no single correct way to set up your permissions, and each administrator will have different reasons for doing things a certain way. Just be aware that permission-related problems are perhaps the most common oversight when configuring a Subversion repository for use with Apache.

Authentication Options

At this point, if you configured `httpd.conf` to contain something such as the following:

```
<Location /svn>
  DAV svn
  SVNParentPath /var/svn
</Location>
```

your repository is „anonymously“ accessible to the world. Until you configure some authentication and authorization policies, the Subversion repositories that you make available via the `Location` directive will be generally accessible to everyone. In other words:

- Anyone can use a Subversion client to check out a working copy of a repository URL (or any of its subdirectories).
- Anyone can interactively browse the repository's latest revision simply by pointing a web browser to the repository URL.
- Anyone can commit to the repository.

Of course, you might have already set up a `pre-commit` hook script to prevent commits (see „Implementing Repository Hooks“). But as you read on, you'll see that it's also possible to use Apache's built-in methods to restrict access in specific ways.

Setting up HTTP authentication

The easiest way to authenticate a client is via the HTTP Basic authentication mechanism, which simply uses a username and password to verify that a user is who she says she is. Apache provides an **htpasswd** utility for managing the list of acceptable usernames and passwords. Let's grant commit access to Sally and Harry. First, we need to add them to the password file:

```
$ ### First time: use -c to create the file
$ ### Use -m to use MD5 encryption of the password, which is more secure
$ htpasswd -cm /etc/svn-auth-file harry
New password: *****
Re-type new password: *****
Adding password for user harry
$ htpasswd -m /etc/svn-auth-file sally
New password: *******
Re-type new password: *******
Adding password for user sally
$
```

Next, you need to add some more `httpd.conf` directives inside your `Location` block to tell Apache what to do with your new password file. The `AuthType` directive specifies the type of authentication system to use. In this case, we want to specify the `Basic` authentication system. `AuthName` is an arbitrary name that you give for the authentication domain. Most browsers will display this name in the pop-up dialog box when the browser is querying the user for her name and password. Finally, use the `AuthUserFile` directive to specify the location of the password file you created using **htpasswd**.

After adding these three directives, your `<Location>` block should look something like this:

```
<Location /svn>
  DAV svn
  SVNParentPath /var/svn
  AuthType Basic
  AuthName "Subversion repository"
  AuthUserFile /etc/svn-auth-file
</Location>
```

This `<Location>` block is not yet complete, and it will not do anything useful. It's merely telling Apache that whenever authorization is required, Apache should harvest a username and password from the Subversion client. What's missing here, however, are directives that tell Apache *which* sorts of client requests require authorization. Wherever authorization is required, Apache will demand authentication as well. The simplest thing to do is protect all requests. Adding `Require valid-user` tells Apache that all requests require an authenticated user:

```
<Location /svn>
  DAV svn
  SVNParentPath /var/svn
  AuthType Basic
  AuthName "Subversion repository"
  AuthUserFile /etc/svn-auth-file
  Require valid-user
</Location>
```

Be sure to read the next section („Authorization Options“) for more detail on the `Require` directive and other ways to set authorization policies.

One word of warning: HTTP Basic Auth passwords pass in very nearly plain text over the network, and thus are extremely insecure.

Another option is to not use Basic authentication, but to use Digest authentication instead. Digest authentication allows the server to verify the client's identity *without* passing the plain-text password over the network. Assuming that the client and server both know the user's password, they can verify that the password is the same by using it to apply a hashing function to a one-time bit of information. The server sends a small random-ish string to the client; the client uses the user's password to hash the string; the server then looks to see whether the hashed value is what it expected.

Configuring Apache for Digest authentication is also fairly easy, and only a small variation on our prior example. Be sure to consult Apache's documentation for full details.

```
<Location /svn>
  DAV svn
  SVNParentPath /var/svn
  AuthType Digest
  AuthName "Subversion repository"
  AuthDigestDomain /svn/
  AuthUserFile /etc/svn-auth-file
  Require valid-user
</Location>
```

If you're looking for maximum security, public key cryptography is the best solution. It may be best to use some sort of SSL encryption, so that clients authenticate via `https://` instead of `http://`; at a bare minimum, you can configure Apache to use a self-signed server certificate. [5] Consult Apache's documentation (and OpenSSL documentation) about how to do that.

SSL certificate management

Businesses that need to expose their repositories for access outside the company firewall should be conscious of the possibility that unauthorized parties could be „sniffing“ their network traffic. SSL makes that kind of unwanted attention less likely to result in sensitive data leaks.

If a Subversion client is compiled to use OpenSSL, it gains the ability to speak to an Apache server via `https://` URLs. The Neon library used by the Subversion client is not only able to verify server certificates, but can also supply client certificates when challenged. When the client and server have exchanged SSL certificates and successfully authenticated one another, all further communication is encrypted via a session key.

It's beyond the scope of this book to describe how to generate client and server certificates and how to configure Apache to use them. Many other books, including Apache's own documentation, describe this task. But what we *can* cover here is how to manage server and client certificates from an ordinary Subversion client.

When speaking to Apache via `https://`, a Subversion client can receive two different types of information:

- A server certificate
- A demand for a client certificate

If the client receives a server certificate, it needs to verify that it trusts the certificate: is the server really who it claims to be? The OpenSSL library does this by examining the signer of the server certificate, or *certificate authority* (CA). If OpenSSL is unable to automatically trust the CA, or if some other problem occurs (such as an expired certificate or hostname

[5] While self-signed server certificates are still vulnerable to a „man-in-the-middle“ attack, such an attack is much more difficult for a casual observer to pull off, compared to sniffing unprotected passwords.

mismatch), the Subversion command-line client will ask you whether you want to trust the server certificate anyway:

```
$ svn list https://host.example.com/repos/project

Error validating server certificate for 'https://host.example.com:443':
 - The certificate is not issued by a trusted authority. Use the
   fingerprint to validate the certificate manually!
Certificate information:
 - Hostname: host.example.com
 - Valid: from Jan 30 19:23:56 2004 GMT until Jan 30 19:23:56 2006 GMT
 - Issuer: CA, example.com, Sometown, California, US
 - Fingerprint: 7d:e1:a9:34:33:39:ba:6a:e9:a5:c4:22:98:7b:76:5c:92:a0:9c:7b

(R)eject, accept (t)emporarily or accept (p)ermanently?
```

This dialogue should look familiar; it's essentially the same question you've probably seen coming from your web browser (which is just another HTTP client like Subversion). If you choose the `(p)`ermanent option, the server certificate will be cached in your private runtime `auth/` area in just the same way your username and password are cached (see „Client Credentials Caching“). If cached, Subversion will automatically trust this certificate in future negotiations.

Your runtime `servers` file also gives you the ability to make your Subversion client automatically trust specific CAs, either globally or on a per-host basis. Simply set the `ssl-authority-files` variable to a semicolon-separated list of PEM-encoded CA certificates:

```
[global]
ssl-authority-files = /path/to/CAcert1.pem;/path/to/CAcert2.pem
```

Many OpenSSL installations also have a predefined set of „default“ CAs that are nearly universally trusted. To make the Subversion client automatically trust these standard authorities, set the `ssl-trust-default-ca` variable to `true`.

When talking to Apache, a Subversion client might also receive a challenge for a client certificate. Apache is asking the client to identify itself: is the client really who it says it is? If all goes correctly, the Subversion client sends back a private certificate signed by a CA that Apache trusts. A client certificate is usually stored on disk in encrypted format, protected by a local password. When Subversion receives this challenge, it will ask you for a path to the certificate and the password that protects it:

```
$ svn list https://host.example.com/repos/project

Authentication realm: https://host.example.com:443
Client certificate filename: /path/to/my/cert.p12
Passphrase for '/path/to/my/cert.p12':  ********
…
```

Notice that the client certificate is a „p12“ file. To use a client certificate with Subversion, it must be in PKCS#12 format, which is a portable standard. Most web browsers are already able to import and export certificates in that format. Another option is to use the OpenSSL command-line tools to convert existing certificates into PKCS#12.

Again, the runtime `servers` file allows you to automate this challenge on a per-host basis. Either or both pieces of information can be described in runtime variables:

```
[groups]
examplehost = host.example.com
```

```
[examplehost]
ssl-client-cert-file = /path/to/my/cert.p12
ssl-client-cert-password = somepassword
```

Once you've set the `ssl-client-cert-file` and `ssl-client-cert-password` variables, the Subversion client can automatically respond to a client certificate challenge without prompting you. [6]

Authorization Options

At this point, you've configured authentication, but not authorization. Apache is able to challenge clients and confirm identities, but it has not been told how to allow or restrict access to the clients bearing those identities. This section describes two strategies for controlling access to your repositories.

Blanket access control

The simplest form of access control is to authorize certain users for either read-only access to a repository or read/write access to a repository.

You can restrict access on all repository operations by adding the `Require valid-user` directive to your `<Location>` block. Using our previous example, this would mean that only clients that claimed to be either `harry` or `sally` and that provided the correct password for their respective username would be allowed to do anything with the Subversion repository:

```
<Location /svn>
  DAV svn
  SVNParentPath /var/svn

  # how to authenticate a user
  AuthType Basic
  AuthName "Subversion repository"
  AuthUserFile /path/to/users/file

  # only authenticated users may access the repository
  Require valid-user
</Location>
```

Sometimes you don't need to run such a tight ship. For example, Subversion's own source code repository at http://svn.collab.net/repos/svn allows anyone in the world to perform read-only repository tasks (such as checking out working copies and browsing the repository with a web browser), but restricts all write operations to authenticated users. To do this type of selective restriction, you can use the `Limit` and `LimitExcept` configuration directives. Like the `Location` directive, these blocks have starting and ending tags, and you would nest them inside your `<Location>` block.

The parameters present on the `Limit` and `LimitExcept` directives are HTTP request types that are affected by that block. For example, if you wanted to disallow all access to your repository except the currently supported read-only operations, you would use the `LimitExcept` directive, passing the `GET`, `PROPFIND`, `OPTIONS`, and `REPORT` request type parameters. Then the previously mentioned `Require valid-user` directive would be placed inside the `<LimitExcept>` block instead of just inside the `<Location>` block.

```
<Location /svn>
  DAV svn
```

[6]More security-conscious folk might not want to store the client certificate password in the runtime `servers` file.

```
  SVNParentPath /var/svn

  # how to authenticate a user
  AuthType Basic
  AuthName "Subversion repository"
  AuthUserFile /path/to/users/file

  # For any operations other than these, require an authenticated user.
  <LimitExcept GET PROPFIND OPTIONS REPORT>
    Require valid-user
  </LimitExcept>
</Location>
```

These are only a few simple examples. For more in-depth information about Apache access control and the `Require` directive, take a look at the `Security` section of the Apache documentation's tutorials collection at http://httpd.apache.org/docs-2.0/misc/tutorials.html.

Per-directory access control

It's possible to set up finer-grained permissions using a second Apache httpd module, **mod_authz_svn**. This module grabs the various opaque URLs passing from client to server, asks **mod_dav_svn** to decode them, and then possibly vetoes requests based on access policies defined in a configuration file.

If you've built Subversion from source code, **mod_authz_svn** is automatically built and installed alongside **mod_dav_svn**. Many binary distributions install it automatically as well. To verify that it's installed correctly, make sure it comes right after **mod_dav_svn**'s `LoadModule` directive in `httpd.conf`:

```
LoadModule dav_module         modules/mod_dav.so
LoadModule dav_svn_module     modules/mod_dav_svn.so
LoadModule authz_svn_module   modules/mod_authz_svn.so
```

To activate this module, you need to configure your `Location` block to use the `AuthzSVNAccessFile` directive, which specifies a file containing the permissions policy for paths within your repositories. (In a moment, we'll discuss the format of that file.)

Apache is flexible, so you have the option to configure your block in one of three general patterns. To begin, choose one of these basic configuration patterns. (The following examples are very simple; look at Apache's own documentation for much more detail on Apache authentication and authorization options.)

The simplest block is to allow open access to everyone. In this scenario, Apache never sends authentication challenges, so all users are treated as „anonymous.“ (See Beispiel 6.1, „A sample configuration for anonymous access“.)

Beispiel 6.1. A sample configuration for anonymous access

```
<Location /repos>
  DAV svn
  SVNParentPath /var/svn

  # our access control policy
  AuthzSVNAccessFile /path/to/access/file
</Location>
```

On the opposite end of the paranoia scale, you can configure your block to demand authentication from everyone. All clients must supply credentials to identify themselves. Your block unconditionally requires authentication via the `Require valid-user` directive, and it defines a means to authenticate. (See Beispiel 6.2, „A sample configuration for authenticated access“.)

Beispiel 6.2. A sample configuration for authenticated access

```
<Location /repos>
  DAV svn
  SVNParentPath /var/svn

  # our access control policy
  AuthzSVNAccessFile /path/to/access/file

  # only authenticated users may access the repository
  Require valid-user

  # how to authenticate a user
  AuthType Basic
  AuthName "Subversion repository"
  AuthUserFile /path/to/users/file
</Location>
```

A third very popular pattern is to allow a combination of authenticated and anonymous access. For example, many administrators want to allow anonymous users to read certain repository directories, but want only authenticated users to read (or write) more sensitive areas. In this setup, all users start out accessing the repository anonymously. If your access control policy demands a real username at any point, Apache will demand authentication from the client. To do this, use both the `Satisfy Any` and `Require valid-user` directives together. (See Beispiel 6.3, „A sample configuration for mixed authenticated/anonymous access“.)

Beispiel 6.3. A sample configuration for mixed authenticated/anonymous access

```
<Location /repos>
  DAV svn
  SVNParentPath /var/svn

  # our access control policy
  AuthzSVNAccessFile /path/to/access/file

  # try anonymous access first, resort to real
  # authentication if necessary.
  Satisfy Any
  Require valid-user

  # how to authenticate a user
  AuthType Basic
  AuthName "Subversion repository"
  AuthUserFile /path/to/users/file
</Location>
```

Once you've settled on one of these three basic `httpd.conf` templates, you need to create your file containing access rules for particular paths within the repository. We describe this later in this chapter, in „Path-Based Authorization“.

Disabling path-based checks

The **mod_dav_svn** module goes through a lot of work to make sure that data you've marked „unreadable“ doesn't get accidentally leaked. This means it needs to closely monitor all of the paths and file-contents returned by commands such as **svn checkout** and **svn update**. If these commands encounter a path that isn't readable according to some authorization policy, the path is typically omitted altogether. In the case of history or rename tracing—for example, running a command such as **`svn cat -r OLD foo.c`** on a file that was renamed long ago—the rename tracking will simply halt if one of the object's former names is determined to be read-restricted.

All of this path checking can sometimes be quite expensive, especially in the case of **svn log**. When retrieving a list of revisions, the server looks at every changed path in each revision and checks it for readability. If an unreadable path is discovered, it's omitted from the list of the revision's changed paths (normally seen with the `--verbose` option), and the whole log message is suppressed. Needless to say, this can be time-consuming on revisions that affect a large number of files. This is the cost of security: even if you haven't configured a module such as **mod_authz_svn** at all, the **mod_dav_svn** module is still asking Apache **httpd** to run authorization checks on every path. The **mod_dav_svn** module has no idea what authorization modules have been installed, so all it can do is ask Apache to invoke whatever might be present.

On the other hand, there's also an escape hatch of sorts, which allows you to trade security features for speed. If you're not enforcing any sort of per-directory authorization (i.e., not using **mod_authz_svn** or similar module), you can disable all of this path checking. In your `httpd.conf` file, use the `SVNPathAuthz` directive as shown in Beispiel 6.4, „Disabling path checks altogether“.

Beispiel 6.4. Disabling path checks altogether

```
<Location /repos>
  DAV svn
  SVNParentPath /var/svn

  SVNPathAuthz off
</Location>
```

The `SVNPathAuthz` directive is „on“ by default. When set to „off,“ all path-based authorization checking is disabled; **mod_dav_svn** stops invoking authorization checks on every path it discovers.

Extra Goodies

We've covered most of the authentication and authorization options for Apache and **mod_dav_svn**. But there are a few other nice features that Apache provides.

Repository browsing

One of the most useful benefits of an Apache/WebDAV configuration for your Subversion repository is that the youngest revisions of your versioned files and directories are immediately available for viewing via a regular web browser. Since Subversion uses URLs to identify versioned resources, those URLs used for HTTP-based repository access can be typed directly into a web browser. Your browser will issue an HTTP `GET` request for that URL; based on whether that URL represents a versioned directory or file, **mod_dav_svn** will respond with a directory listing or with file contents.

Since the URLs do not contain any information about which version of the resource you wish to see, **mod_dav_svn** will always answer with the youngest version. This functionality has the wonderful side effect that you can pass around Subversion URLs to your peers as references to documents, and those URLs will always point at the latest manifestation of that document. Of course, you can even use the URLs as hyperlinks from other web sites, too.

Can I View Older Revisions?

With an ordinary web browser? In one word: nope. At least, not with **mod_dav_svn** as your only tool.

Your web browser speaks ordinary HTTP only. That means it knows only how to GET public URLs, which represent the latest versions of files and directories. According to the WebDAV/DeltaV specification, each server defines a private URL syntax for older versions of resources, and that syntax is opaque to clients. To find an older version of a file, a client must follow a specific procedure to „discover“ the proper URL; the procedure involves issuing a series of WebDAV PROPFIND requests and understanding DeltaV concepts. This is something your web browser simply can't do.

So, to answer the question, one obvious way to see older revisions of files and directories is by passing the `--revision` (`-r`) argument to the **svn list** and **svn cat** commands. To browse old revisions with your web browser, however, you can use third-party software. A good example of this is ViewVC (http://viewvc.tigris.org/). ViewVC was originally written to display CVS repositories through the Web, [7] and the latest releases are able to understand Subversion repositories as well.

Proper MIME type

When browsing a Subversion repository, the web browser gets a clue about how to render a file's contents by looking at the `Content-Type:` header returned in Apache's response to the HTTP `GET` request. The value of this header is some sort of MIME type. By default, Apache will tell the web browsers that all repository files are of the „default“ MIME type, typically `text/plain`. This can be frustrating, however, if a user wishes repository files to render as something more meaningful—for example, it might be nice to have a `foo.html` file in the repository actually render as HTML when browsing.

To make this happen, you need only to make sure that your files have the proper `svn:mime-type` set. We discuss this in more detail in „File Content Type“, and you can even configure your client to automatically attach proper `svn:mime-type` properties to files entering the repository for the first time; see „Automatic Property Setting“.

So in our example, if one were to set the `svn:mime-type` property to `text/html` on file `foo.html`, Apache would properly tell your web browser to render the file as HTML. One could also attach proper `image/*` MIME-type properties to image files and ultimately get an entire web site to be viewable directly from a repository! There's generally no problem with this, as long as the web site doesn't contain any dynamically generated content.

Customizing the look

You generally will get more use out of URLs to versioned files—after all, that's where the interesting content tends to lie. But you might have occasion to browse a Subversion directory listing, where you'll quickly note that the generated HTML used to display that

[7] Back then, it was called ViewCVS.

listing is very basic, and certainly not intended to be aesthetically pleasing (or even interesting). To enable customization of these directory displays, Subversion provides an XML index feature. A single `SVNIndexXSLT` directive in your repository's `Location` block of `httpd.conf` will instruct **mod_dav_svn** to generate XML output when displaying a directory listing, and to reference the XSLT stylesheet of your choice:

```
<Location /svn>
  DAV svn
  SVNParentPath /var/svn
  SVNIndexXSLT "/svnindex.xsl"
  …
</Location>
```

Using the `SVNIndexXSLT` directive and a creative XSLT stylesheet, you can make your directory listings match the color schemes and imagery used in other parts of your web site. Or, if you'd prefer, you can use the sample stylesheets provided in the Subversion source distribution's `tools/xslt/` directory. Keep in mind that the path provided to the `SVNIndexXSLT` directory is actually a URL path—browsers need to be able to read your stylesheets to make use of them!

Listing repositories

If you're serving a collection of repositories from a single URL via the `SVNParentPath` directive, then it's also possible to have Apache display all available repositories to a web browser. Just activate the `SVNListParentPath` directive:

```
<Location /svn>
  DAV svn
  SVNParentPath /var/svn
  SVNListParentPath on
  …
</Location>
```

If a user now points her web browser to the URL `http://host.example.com/svn/`, she'll see a list of all Subversion repositories sitting in `/var/svn`. Obviously, this can be a security problem, so this feature is turned off by default.

Apache logging

Because Apache is an HTTP server at heart, it contains fantastically flexible logging features. It's beyond the scope of this book to discuss all of the ways logging can be configured, but we should point out that even the most generic `httpd.conf` file will cause Apache to produce two logs: `error_log` and `access_log`. These logs may appear in different places, but are typically created in the logging area of your Apache installation. (On Unix, they often live in `/usr/local/apache2/logs/`.)

The `error_log` describes any internal errors that Apache runs into as it works. The `access_log` file records every incoming HTTP request received by Apache. This makes it easy to see, for example, which IP addresses Subversion clients are coming from, how often particular clients use the server, which users are authenticating properly, and which requests succeed or fail.

Unfortunately, because HTTP is a stateless protocol, even the simplest Subversion client operation generates multiple network requests. It's very difficult to look at the `access_log` and deduce what the client was doing—most operations look like a series of cryptic `PROPPATCH`, `GET`, `PUT`, and `REPORT` requests. To make things worse, many client operations send nearly identical series of requests, so it's even harder to tell them apart.

mod_dav_svn, however, can come to your aid. By activating an „operational logging“

feature, you can ask **mod_dav_svn** to create a separate log file describing what sort of high-level operations your clients are performing.

To do this, you need to make use of Apache's `CustomLog` directive (which is explained in more detail in Apache's own documentation). Be sure to invoke this directive *outside* your Subversion `Location` block:

```
<Location /svn>
  DAV svn
  …
</Location>

CustomLog logs/svn_logfile "%t %u %{SVN-ACTION}e" env=SVN-ACTION
```

In this example, we're asking Apache to create a special logfile, `svn_logfile`, in the standard Apache `logs` directory. The `%t` and `%u` variables are replaced by the time and username of the request, respectively. The really important parts are the two instances of `SVN-ACTION`. When Apache sees that variable, it substitutes the value of the `SVN-ACTION` environment variable, which is automatically set by **mod_dav_svn** whenever it detects a high-level client action.

So, instead of having to interpret a traditional `access_log` like this:

```
[26/Jan/2007:22:25:29 -0600] "PROPFIND /svn/calc/!svn/vcc/default HTTP/1.1" 207
[26/Jan/2007:22:25:29 -0600] "PROPFIND /svn/calc/!svn/bln/59 HTTP/1.1" 207 449
[26/Jan/2007:22:25:29 -0600] "PROPFIND /svn/calc HTTP/1.1" 207 647
[26/Jan/2007:22:25:29 -0600] "REPORT /svn/calc/!svn/vcc/default HTTP/1.1" 200 6
[26/Jan/2007:22:25:31 -0600] "OPTIONS /svn/calc HTTP/1.1" 200 188
[26/Jan/2007:22:25:31 -0600] "MKACTIVITY /svn/calc/!svn/act/e6035ef7-5df0-4ac0-
…
```

you can peruse a much more intelligible `svn_logfile` like this:

```
[26/Jan/2007:22:24:20 -0600] - get-dir /tags r1729 props
[26/Jan/2007:22:24:27 -0600] - update /trunk r1729 depth=infinity send-copyfrom
[26/Jan/2007:22:25:29 -0600] - status /trunk/foo r1729 depth=infinity
[26/Jan/2007:22:25:31 -0600] sally commit r1730
```

For an exhaustive list of all actions logged, see „High-level logging“.

Write-through proxying

One of the nice advantages of using Apache as a Subversion server is that it can be set up for simple replication. For example, suppose that your team is distributed across four offices around the globe. The Subversion repository can exist only in one of those offices, which means the other three offices will not enjoy accessing it—they're likely to experience significantly slower traffic and response times when updating and committing code. A powerful solution is to set up a system consisting of one *master* Apache server and several *slave* Apache servers. If you place a slave server in each office, users can check out a working copy from whichever slave is closest to them. All read requests go to their local slave. Write requests get automatically routed to the single master server. When the commit completes, the master then automatically „pushes“ the new revision to each slave server using the **svnsync** replication tool.

This configuration creates a huge perceptual speed increase for your users, because Subversion client traffic is typically 80–90% read requests. And if those requests are coming from a *local* server, it's a huge win.

In this section, we'll walk you through a standard setup of this single-master/multiple-slave system. However, keep in mind that your servers must be running at least Apache 2.2.0 (with **mod_proxy** loaded) and Subversion 1.5 (**mod_dav_svn**).

Configure the servers

First, configure your master server's `httpd.conf` file in the usual way. Make the repository available at a certain URI location, and configure authentication and authorization however you'd like. After that's done, configure each of your „slave“ servers in the exact same way, but add the special `SVNMasterURI` directive to the block:

```
<Location /svn>
  DAV svn
  SVNPath /var/svn/repos
  SVNMasterURI http://master.example.com/svn
  …
</Location>
```

This new directive tells a slave server to redirect all write requests to the master. (This is done automatically via Apache's **mod_proxy** module.) Ordinary read requests, however, are still serviced by the slaves. Be sure that your master and slave servers all have matching authentication and authorization configurations; if they fall out of sync, it can lead to big headaches.

Next, we need to deal with the problem of infinite recursion. With the current configuration, imagine what will happen when a Subversion client performs a commit to the master server. After the commit completes, the server uses **svnsync** to replicate the new revision to each slave. But because **svnsync** appears to be just another Subversion client performing a commit, the slave will immediately attempt to proxy the incoming write request back to the master! Hilarity ensues.

The solution to this problem is to have the master push revisions to a different `<Location>` on the slaves. This location is configured to *not* proxy write requests at all, but to accept normal commits from (and only from) the master's IP address:

```
<Location /svn-proxy-sync>
  DAV svn
  SVNPath /var/svn/repos
  Order deny,allow
  Deny from all
  # Only let the server's IP address access this Location:
  Allow from 10.20.30.40
  …
</Location>
```

Set up replication

Now that you've configured your `Location` blocks on master and slaves, you need to configure the master to replicate to the slaves. This is done the usual way— using **svnsync**. If you're not familiar with this tool, see „Repository Replication“ for details.

First, make sure that each slave repository has a `pre-revprop-change` hook script which allows remote revision property changes. (This is standard procedure for being on the receiving end of **svnsync**.) Then log into the master server and configure each of the slave repository URIs to receive data from the master repository on the local disk:

```
$ svnsync init http://slave1.example.com/svn-proxy-sync file://var/svn/repos
Copied properties for revision 0.
$ svnsync init http://slave2.example.com/svn-proxy-sync file://var/svn/repos
Copied properties for revision 0.
```

```
$ svnsync init http://slave3.example.com/svn-proxy-sync file://var/svn/repos
Copied properties for revision 0.

# Perform the initial replication

$ svnsync sync http://slave1.example.com/svn-proxy-sync
Transmitting file data ....
Committed revision 1.
Copied properties for revision 1.
Transmitting file data .......
Committed revision 2.
Copied properties for revision 2.
…

$ svnsync sync http://slave2.example.com/svn-proxy-sync
Transmitting file data ....
Committed revision 1.
Copied properties for revision 1.
Transmitting file data .......
Committed revision 2.
Copied properties for revision 2.
…

$ svnsync sync http://slave3.example.com/svn-proxy-sync
Transmitting file data ....
Committed revision 1.
Copied properties for revision 1.
Transmitting file data .......
Committed revision 2.
Copied properties for revision 2.
…
```

After this is done, we configure the master server's `post-commit` hook script to invoke **svnsync** on each slave server:

```
#!/bin/sh
# Post-commit script to replicate newly committed revision to slaves

svnsync sync http://slave1.example.com/svn-proxy-sync > /dev/null 2>&1
svnsync sync http://slave2.example.com/svn-proxy-sync > /dev/null 2>&1
svnsync sync http://slave3.example.com/svn-proxy-sync > /dev/null 2>&1
```

The extra bits on the end of each line aren't necessary, but they're a sneaky way to allow the sync commands to run in the background so that the Subversion client isn't left waiting forever for the commit to finish. In addition to this `post-commit` hook, you'll need a `post-revprop-change` hook as well so that when a user, say, modifies a log message, the slave servers get that change also:

```
#!/bin/sh
# Post-revprop-change script to replicate revprop-changes to slaves

REV=${2}
svnsync copy-revprops http://slave1.example.com/svn-proxy-sync ${REV} > /dev/nu
svnsync copy-revprops http://slave2.example.com/svn-proxy-sync ${REV} > /dev/nu
svnsync copy-revprops http://slave3.example.com/svn-proxy-sync ${REV} > /dev/nu
```

The only thing we've left out here is what to do about locks. Because locks are strictly enforced by the master server (the only place where commits happen), we don't technically need to do anything. Many teams don't use Subversion's locking features at all, so it may be a nonissue for you. However, if lock changes aren't replicated from master to slaves, it means that clients won't be able to query the status of locks (e.g., **`svn status -u`** will show no information about repository locks). If this bothers you, you can write `post-lock` and `post-unlock` hook scripts that run **svn lock** and **svn unlock** on each slave machine, presumably through a remote shell method such as SSH. That's left as an exercise for the reader!

Caveats

Your master/slave replication system should now be ready to use. A couple of words of warning are in order, however. Remember that this replication isn't entirely robust in the face of computer or network crashes. For example, if one of the automated **svnsync** commands fails to complete for some reason, the slaves will begin to fall behind. For example, your remote users will see that they've committed revision 100, but then when they run **svn update**, their local server will tell them that revision 100 doesn't yet exist! Of course, the problem will be automatically fixed the next time another commit happens and the subsequent **svnsync** is successful—the sync will replicate all waiting revisions. But still, you may want to set up some sort of out-of-band monitoring to notice synchronization failures and force **svnsync** to run when things go wrong.

> **Can We Set Up Replication with svnserve?**
>
> If you're using **svnserve** instead of Apache as your server, you can certainly configure your repository's hook scripts to invoke **svnsync** as we've shown here, thereby causing automatic replication from master to slaves. Unfortunately, at the time of this writing there is no way to make slave **svnserve** servers automatically proxy write requests back to the master server. This means your users would only be able to check out read-only working copies from the slave servers. You'd have to configure your slave servers to disallow write access completely. This might be useful for creating read-only „mirrors“ of popular open source projects, but it's not a transparent proxying system.

Other Apache features

Several of the features already provided by Apache in its role as a robust web server can be leveraged for increased functionality or security in Subversion as well. The Subversion client is able to use SSL (the Secure Sockets Layer, discussed earlier). If your Subversion client is built to support SSL, it can access your Apache server using `https://` and enjoy a high-quality encrypted network session.

Equally useful are other features of the Apache and Subversion relationship, such as the ability to specify a custom port (instead of the default HTTP port 80) or a virtual domain name by which the Subversion repository should be accessed, or the ability to access the repository through an HTTP proxy.

Finally, because **mod_dav_svn** is speaking a subset of the WebDAV/DeltaV protocol, it's possible to access the repository via third-party DAV clients. Most modern operating systems (Win32, OS X, and Linux) have the built-in ability to mount a DAV server as a standard network „shared folder.“ This is a complicated topic, but also wondrous when implemented. For details, read Anhang C, *WebDAV and Autoversioning*.

Note that there are a number of other small tweaks one can make to **mod_dav_svn** that are too obscure to mention in this chapter. For a complete list of all `httpd.conf` directives that **mod_dav_svn** responds to, see „Directives“.

Path-Based Authorization

Both Apache and **svnserve** are capable of granting (or denying) permissions to users. Typically this is done over the entire repository: a user can read the repository (or not), and she can write to the repository (or not). It's also possible, however, to define finer-grained access rules. One set of users may have permission to write to a certain directory in the repository, but not others; another directory might not even be readable by all but a few special people.

Both servers use a common file format to describe these path-based access rules. In the case of Apache, one needs to load the **mod_authz_svn** module and then add the `AuthzSVNAccessFile` directive (within the `httpd.conf` file) pointing to your own rules file. (For a full explanation, see „Per-directory access control“.) If you're using **svnserve**, you need to make the `authz-db` variable (within `svnserve.conf`) point to your rules file.

Do You Really Need Path-Based Access Control?

A lot of administrators setting up Subversion for the first time tend to jump into path-based access control without giving it a lot of thought. The administrator usually knows which teams of people are working on which projects, so it's easy to jump in and grant certain teams access to certain directories and not others. It seems like a natural thing, and it appeases the administrator's desire to maintain tight control of the repository.

Note, though, that there are often invisible (and visible!) costs associated with this feature. In the visible category, the server needs to do a lot more work to ensure that the user has the right to read or write each specific path; in certain situations, there's very noticeable performance loss. In the invisible category, consider the culture you're creating. Most of the time, while certain users *shouldn't* be committing changes to certain parts of the repository, that social contract doesn't need to be technologically enforced. Teams can sometimes spontaneously collaborate with each other; someone may want to help someone else out by committing to an area she doesn't normally work on. By preventing this sort of thing at the server level, you're setting up barriers to unexpected collaboration. You're also creating a bunch of rules that need to be maintained as projects develop, new users are added, and so on. It's a bunch of extra work to maintain.

Remember that this is a version control system! Even if somebody accidentally commits a change to something she shouldn't, it's easy to undo the change. And if a user commits to the wrong place with deliberate malice, it's a social problem anyway, and that the problem needs to be dealt with outside Subversion.

So, before you begin restricting users' access rights, ask yourself whether there's a real, honest need for this, or whether it's just something that „sounds good“ to an administrator. Decide whether it's worth sacrificing some server speed, and remember that there's very little risk involved; it's bad to become dependent on technology as a crutch for social problems. [8]

As an example to ponder, consider that the Subversion project itself has always had a notion of who is allowed to commit where, but it's always been enforced socially. This is a good model of community trust, especially for open source projects. Of course, sometimes there *are* truly legitimate needs for path-based access control; within corporations, for example, certain types of data really can be sensitive, and access needs to be genuinely restricted to small groups of people.

Once your server knows where to find your rules file, it's time to define the rules.

The syntax of the file is the same familiar one used by `svnserve.conf` and the runtime configuration files. Lines that start with a hash (#) are ignored. In its simplest form, each section names a repository and path within it, as well as the authenticated usernames are the option names within each section. The value of each option describes the user's level of access to the repository path: either `r` (read-only) or `rw` (read/write). If the user is not mentioned at all, no access is allowed.

To be more specific: the value of the section names is either of the form `[repos-name:path]` or of the form `[path]`. If you're using the `SVNParentPath`

[8] A common theme in this book!

directive, it's important to specify the repository names in your sections. If you omit them, a section such as `[/some/dir]` will match the path `/some/dir` in *every* repository. If you're using the `SVNPath` directive, however, it's fine to only define paths in your sections—after all, there's only one repository.

```
[calc:/branches/calc/bug-142]
harry = rw
sally = r
```

In this first example, the user `harry` has full read and write access on the `/branches/calc/bug-142` directory in the `calc` repository, but the user `sally` has read-only access. Any other users are blocked from accessing this directory.

Of course, permissions are inherited from parent to child directory. That means we can specify a subdirectory with a different access policy for Sally:

```
[calc:/branches/calc/bug-142]
harry = rw
sally = r

# give sally write access only to the 'testing' subdir
[calc:/branches/calc/bug-142/testing]
sally = rw
```

Now Sally can write to the `testing` subdirectory of the branch, but can still only read other parts. Harry, meanwhile, continues to have complete read/write access to the whole branch.

It's also possible to explicitly deny permission to someone via inheritance rules, by setting the username variable to nothing:

```
[calc:/branches/calc/bug-142]
harry = rw
sally = r

[calc:/branches/calc/bug-142/secret]
harry =
```

In this example, Harry has read/write access to the entire `bug-142` tree, but has absolutely no access at all to the `secret` subdirectory within it.

> The thing to remember is that the most specific path always matches first. The server tries to match the path itself, and then the parent of the path, then the parent of that, and so on. The net effect is that mentioning a specific path in the access file will always override any permissions inherited from parent directories.

By default, nobody has any access to the repository at all. That means that if you're starting with an empty file, you'll probably want to give at least read permission to all users at the root of the repository. You can do this by using the asterisk variable (`*`), which means „all users“:

```
[/]
* = r
```

This is a common setup; notice that no repository name is mentioned in the section name.

This makes all repositories world-readable to all users. Once all users have read access to the repositories, you can give explicit rw permission to certain users on specific subdirectories within specific repositories.

The asterisk variable (*) is also worth special mention because it's the *only* pattern that matches an anonymous user. If you've configured your server block to allow a mixture of anonymous and authenticated access, all users start out accessing anonymously. The server looks for a * value defined for the path being accessed; if it can't find one, it demands real authentication from the client.

The access file also allows you to define whole groups of users, much like the Unix /etc/group file:

```
[groups]
calc-developers = harry, sally, joe
paint-developers = frank, sally, jane
everyone = harry, sally, joe, frank, sally, jane
```

Groups can be granted access control just like users. Distinguish them with an „at“ (@) prefix:

```
[calc:/projects/calc]
@calc-developers = rw

[paint:/projects/paint]
jane = r
@paint-developers = rw
```

Another important fact is that the *first* matching rule is the one which gets applied to a user. In the prior example, even though Jane is a member of the paint-developers group (which has read/write access), the jane = r rule will be discovered and matched before the group rule, thus denying Jane write access.

Groups can also be defined to contain other groups:

```
[groups]
calc-developers = harry, sally, joe
paint-developers = frank, sally, jane
everyone = @calc-developers, @paint-developers
```

Subversion 1.5 brings another useful feature to the access file syntax: username aliases. Some authentication systems expect and carry relatively short usernames of the sorts we've been describing here—harry, sally, joe, and so on. But other authentication systems—such as those which use LDAP stores or SSL client certificates—may carry much more complex usernames. For example, Harry's username in an LDAP-protected system might be CN=Harold Hacker,OU=Engineers,DC=red-bean,DC=com. With usernames like that, the access file can become quite bloated with long or obscure usernames that are easy to mistype. Fortunately, username aliases allow you to have to type the correct complex username only once, in a statement which assigns to it a more easily digestable alias.

```
[aliases]
harry = CN=Harold Hacker,OU=Engineers,DC=red-bean,DC=com
sally = CN=Sally Swatterbug,OU=Engineers,DC=red-bean,DC=com
joe = CN=Gerald I. Joseph,OU=Engineers,DC=red-bean,DC=com
…
```

Once you've defined a set of aliases, you can refer to the users elsewhere in the access file via their aliases in all the same places you could have instead used their actual usernames. Simply prepend an ampersand to the alias to distinguish it from a regular username:

```
[groups]
calc-developers = &harry, &sally, &joe
paint-developers = &frank, &sally, &jane
everyone = @calc-developers, @paint-developers
```

You might also choose to use aliases if your users' usernames change frequently. Doing so allows you to need to update only the aliases table when these username changes occur, instead of doing global-search-and-replace operations on the whole access file.

Partial Readability and Checkouts

If you're using Apache as your Subversion server and have made certain subdirectories of your repository unreadable to certain users, you need to be aware of a possible nonoptimal behavior with **svn checkout**.

When the client requests a checkout or update over HTTP, it makes a single server request and receives a single (often large) server response. When the server receives the request, that is the *only* opportunity Apache has to demand user authentication. This has some odd side effects. For example, if a certain subdirectory of the repository is readable only by user Sally, and user Harry checks out a parent directory, his client will respond to the initial authentication challenge as Harry. As the server generates the large response, there's no way it can resend an authentication challenge when it reaches the special subdirectory; thus the subdirectory is skipped altogether, rather than asking the user to reauthenticate as Sally at the right moment. In a similar way, if the root of the repository is anonymously world-readable, the entire checkout will be done without authentication—again, skipping the unreadable directory, rather than asking for authentication partway through.

Supporting Multiple Repository Access Methods

You've seen how a repository can be accessed in many different ways. But is it possible—or safe—for your repository to be accessed by multiple methods simultaneously? The answer is yes, provided you use a bit of foresight.

At any given time, these processes may require read and write access to your repository:

- Regular system users using a Subversion client (as themselves) to access the repository directly via `file://` URLs
- Regular system users connecting to SSH-spawned private **svnserve** processes (running as themselves), which access the repository
- An **svnserve** process—either a daemon or one launched by **inetd**—running as a particular fixed user
- An Apache **httpd** process, running as a particular fixed user

The most common problem administrators run into is repository ownership and permissions. Does every process (or user) in the preceding list have the rights to read and write the repository's underlying data files? Assuming you have a Unix-like operating system, a straightforward approach might be to place every potential repository user into a new `svn` group, and make the repository wholly owned by that group. But even that's not enough, because a process may write to the database files using an unfriendly umask—one that prevents access by other users.

So the next step beyond setting up a common group for repository users is to force every repository-accessing process to use a sane umask. For users accessing the repository directly, you can make the **svn** program into a wrapper script that first runs **`umask 002`** and then runs the real **svn** client program. You can write a similar wrapper script for the **svnserve** program, and add a **`umask 002`** command to Apache's own startup script, `apachectl`. For example:

```
$ cat /usr/bin/svn

#!/bin/sh

umask 002
/usr/bin/svn-real "$@"
```

Another common problem is often encountered on Unix-like systems. If your repository is backed by Berkeley DB, for example, it occasionally creates new log files to journal its actions. Even if the Berkeley DB repository is wholly owned by the **svn** group, these newly created log files won't necessarily be owned by that same group, which then creates more permissions problems for your users. A good workaround is to set the group SUID bit on the repository's `db` directory. This causes all newly created log files to have the same group owner as the parent directory.

Once you've jumped through these hoops, your repository should be accessible by all the necessary processes. It may seem a bit messy and complicated, but the problems of having multiple users sharing write access to common files are classic ones that are not often elegantly solved.

Fortunately, most repository administrators will never *need* to have such a complex configuration. Users who wish to access repositories that live on the same machine are not limited to using `file://` access URLs—they can typically contact the Apache HTTP server or **svnserve** using `localhost` for the server name in their `http://` or `svn://` URL. And maintaining multiple server processes for your Subversion repositories is likely to be more of a headache than necessary. We recommend that you choose a single server that best meets your needs and stick with it!

The svn+ssh:// Server Checklist

It can be quite tricky to get a bunch of users with existing SSH accounts to share a repository without permissions problems. If you're confused about all the things that you (as an administrator) need to do on a Unix-like system, here's a quick checklist that resummarizes some of the topics discussed in this section:

- All of your SSH users need to be able to read and write to the repository, so put all the SSH users into a single group.
- Make the repository wholly owned by that group.
- Set the group permissions to read/write.
- Your users need to use a sane umask when accessing the repository, so make sure **svnserve** (`/usr/bin/svnserve`, or wherever it lives in `$PATH`) is actually a wrapper script that runs **`umask 002`** and executes the real **svnserve** binary.

- Take similar measures when using **svnlook** and **svnadmin**. Either run them with a sane umask or wrap them as just described.

Kapitel 7. Customizing Your Subversion Experience

Version control can be a complex subject, as much art as science, that offers myriad ways of getting stuff done. Throughout this book, you've read of the various Subversion command-line client subcommands and the options that modify their behavior. In this chapter, we'll look into still more ways to customize the way Subversion works for you—setting up the Subversion runtime configuration, using external helper applications, Subversion's interaction with the operating system's configured locale, and so on.

Runtime Configuration Area

Subversion provides many optional behaviors that the user can control. Many of these options are of the kind that a user would wish to apply to all Subversion operations. So, rather than forcing users to remember command-line arguments for specifying these options and to use them for every operation they perform, Subversion uses configuration files, segregated into a Subversion configuration area.

The Subversion *configuration area* is a two-tiered hierarchy of option names and their values. Usually, this boils down to a special directory that contains *configuration files* (the first tier), which are just text files in standard INI format (with „sections“ providing the second tier). You can easily edit these files using your favorite text editor (such as Emacs or vi), and they contain directives read by the client to determine which of several optional behaviors the user prefers.

Configuration Area Layout

The first time the **svn** command-line client is executed, it creates a per-user configuration area. On Unix-like systems, this area appears as a directory named `.subversion` in the user's home directory. On Win32 systems, Subversion creates a folder named `Subversion`, typically inside the `Application Data` area of the user's profile directory (which, by the way, is usually a hidden directory). However, on this platform, the exact location differs from system to system and is dictated by the Windows Registry. [1] We will refer to the per-user configuration area using its Unix name, `.subversion`.

In addition to the per-user configuration area, Subversion also recognizes the existence of a system-wide configuration area. This gives system administrators the ability to establish defaults for all users on a given machine. Note that the system-wide configuration area alone does not dictate mandatory policy—the settings in the per-user configuration area override those in the system-wide one, and command-line arguments supplied to the **svn** program have the final word on behavior. On Unix-like platforms, the system-wide configuration area is expected to be the `/etc/subversion` directory; on Windows machines, it looks for a `Subversion` directory inside the common `Application Data` location (again, as specified by the Windows Registry). Unlike the per-user case, the **svn** program does not attempt to create the system-wide configuration area.

The per-user configuration area currently contains three files—two configuration files (`config` and `servers`), and a `README.txt` file, which describes the INI format. At the time of their creation, the files contain default values for each of the supported Subversion options, mostly commented out and grouped with textual descriptions about how the values for the key affect Subversion's behavior. To change a certain behavior, you need only to load the appropriate configuration file into a text editor, and to modify the desired option's value. If at any time you wish to have the default configuration settings restored, you can simply remove (or rename) your configuration directory and then run some

[1]The `APPDATA` environment variable points to the `Application Data` area, so you can always refer to this folder as `%APPDATA%\Subversion`.

innocuous **svn** command, such as **`svn --version`**. A new configuration directory with the default contents will be created.

The per-user configuration area also contains a cache of authentication data. The `auth` directory holds a set of subdirectories that contain pieces of cached information used by Subversion's various supported authentication methods. This directory is created in such a way that only the user herself has permission to read its contents.

Configuration and the Windows Registry

In addition to the usual INI-based configuration area, Subversion clients running on Windows platforms may also use the Windows Registry to hold the configuration data. The option names and their values are the same as in the INI files. The „file/section“ hierarchy is preserved as well, though addressed in a slightly different fashion—in this schema, files and sections are just levels in the Registry key tree.

Subversion looks for system-wide configuration values under the `HKEY_LOCAL_MACHINE\Software\Tigris.org\Subversion` key. For example, the `global-ignores` option, which is in the `miscellany` section of the `config` file, would be found at `HKEY_LOCAL_MACHINE\Software\Tigris.org\Subversion\Config\Miscellany\global-ignores`. Per-user configuration values should be stored under `HKEY_CURRENT_USER\Software\Tigris.org\Subversion`.

Registry-based configuration options are parsed *before* their file-based counterparts, so they are overridden by values found in the configuration files. In other words, Subversion looks for configuration information in the following locations on a Windows system; lower-numbered locations take precedence over higher-numbered locations:

1. Command-line options
2. The per-user INI files
3. The per-user Registry values
4. The system-wide INI files
5. The system-wide Registry values

Also, the Windows Registry doesn't really support the notion of something being „commented out.“ However, Subversion will ignore any option key whose name begins with a hash (#) character. This allows you to effectively comment out a Subversion option without deleting the entire key from the Registry, obviously simplifying the process of restoring that option.

The **svn** command-line client never attempts to write to the Windows Registry and will not attempt to create a default configuration area there. You can create the keys you need using the **REGEDIT** program. Alternatively, you can create a `.reg` file (such as the one in Beispiel 7.1, „Sample registration entries (.reg) file“), and then double-click on that file's icon in the Explorer shell, which will cause the data to be merged into your Registry.

Beispiel 7.1. Sample registration entries (.reg) file

```
REGEDIT4

[HKEY_LOCAL_MACHINE\Software\Tigris.org\Subversion\Servers\groups]

[HKEY_LOCAL_MACHINE\Software\Tigris.org\Subversion\Servers\global]
```

```
"#http-proxy-host"=""
"#http-proxy-port"=""
"#http-proxy-username"=""
"#http-proxy-password"=""
"#http-proxy-exceptions"=""
"#http-timeout"="0"
"#http-compression"="yes"
"#neon-debug-mask"=""
"#ssl-authority-files"=""
"#ssl-trust-default-ca"=""
"#ssl-client-cert-file"=""
"#ssl-client-cert-password"=""

[HKEY_CURRENT_USER\Software\Tigris.org\Subversion\Config\auth]
"#store-passwords"="yes"
"#store-auth-creds"="yes"

[HKEY_CURRENT_USER\Software\Tigris.org\Subversion\Config\helpers]
"#editor-cmd"="notepad"
"#diff-cmd"=""
"#diff3-cmd"=""
"#diff3-has-program-arg"=""

[HKEY_CURRENT_USER\Software\Tigris.org\Subversion\Config\tunnels]

[HKEY_CURRENT_USER\Software\Tigris.org\Subversion\Config\miscellany]
"#global-ignores"="*.o *.lo *.la #*# .*.rej *.rej .*~ *~ .#* .DS_Store"
"#log-encoding"=""
"#use-commit-times"=""
"#no-unlock"=""
"#enable-auto-props"=""

[HKEY_CURRENT_USER\Software\Tigris.org\Subversion\Config\auto-props]
```

The previous example shows the contents of a `.reg` file, which contains some of the most commonly used configuration options and their default values. Note the presence of both system-wide (for network proxy-related options) and per-user settings (editor programs and password storage, among others). Also note that all the options are effectively commented out. You need only to remove the hash (#) character from the beginning of the option names and set the values as you desire.

Configuration Options

In this section, we will discuss the specific runtime configuration options that Subversion currently supports.

Servers

The `servers` file contains Subversion configuration options related to the network layers. There are two special section names in this file—`groups` and `global`. The `groups` section is essentially a cross-reference table. The keys in this section are the names of other sections in the file; their values are *globs*—textual tokens that possibly contain wildcard characters—that are compared against the hostnames of the machine to which Subversion requests are sent.

```
[groups]
beanie-babies = *.red-bean.com
collabnet = svn.collab.net

[beanie-babies]
…
```

```
[collabnet]
…
```

When Subversion is used over a network, it attempts to match the name of the server it is trying to reach with a group name under the `groups` section. If a match is made, Subversion then looks for a section in the `servers` file whose name is the matched group's name. From that section, it reads the actual network configuration settings.

The `global` section contains the settings that are meant for all of the servers not matched by one of the globs under the `groups` section. The options available in this section are exactly the same as those that are valid for the other server sections in the file (except, of course, the special `groups` section), and are as follows:

`http-proxy-exceptions`
: This specifies a comma-separated list of patterns for repository hostnames that should be accessed directly, without using the proxy machine. The pattern syntax is the same as is used in the Unix shell for filenames. A repository hostname matching any of these patterns will not be proxied.

`http-proxy-host`
: This specifies the hostname of the proxy computer through which your HTTP-based Subversion requests must pass. It defaults to an empty value, which means that Subversion will not attempt to route HTTP requests through a proxy computer, and will instead attempt to contact the destination machine directly.

`http-proxy-port`
: This specifies the port number on the proxy host to use. It defaults to an empty value.

`http-proxy-username`
: This specifies the username to supply to the proxy machine. It defaults to an empty value.

`http-proxy-password`
: This specifies the password to supply to the proxy machine. It defaults to an empty value.

`http-timeout`
: This specifies the amount of time, in seconds, to wait for a server response. If you experience problems with a slow network connection causing Subversion operations to time out, you should increase the value of this option. The default value is `0`, which instructs the underlying HTTP library, Neon, to use its default timeout setting.

`http-compression`
: This specifies whether Subversion should attempt to compress network requests made to DAV-ready servers. The default value is `yes` (though compression will occur only if that capability is compiled into the network layer). Set this to `no` to disable compression, such as when debugging network transmissions.

`http-library`
: Subversion provides a pair of repository access modules that understand its WebDAV network protocol. The original one, which shipped with Subversion 1.0, is `libsvn_ra_neon` (though back then it was called `libsvn_ra_dav`). Newer Subversion versions also provide `libsvn_ra_serf`, which uses a different underlying implementation and aims to support some of the newer HTTP concepts.

  At this point, `libsvn_ra_serf` is still considered experimental, though it appears to work in the common cases quite well. To encourage experimentation, Subversion provides the `http-library` runtime configuration option to allow users to specify (generally, or in a per-server-group fashion) which WebDAV access module they'd prefer to use—`neon` or `serf`.

`http-auth-types`
: This option is a semicolon-delimited list of authentication types supported by the Neon-based WebDAV repository access modules. Valid members of this list are `basic`, `digest`, and `negotiate`.

`neon-debug-mask`
: This is an integer mask that the underlying HTTP library, Neon, uses for choosing what type of debugging output to yield. The default value is `0`, which will silence all debugging output. For more information about how Subversion makes use of Neon, see Kapitel 8, *Embedding Subversion*.

`ssl-authority-files`
: This is a semicolon-delimited list of paths to files containing certificates of the certificate authorities (or CAs) that are accepted by the Subversion client when accessing the repository over HTTPS.

`ssl-trust-default-ca`
: Set this variable to `yes` if you want Subversion to automatically trust the set of default CAs that ship with OpenSSL.

`ssl-client-cert-file`
: If a host (or set of hosts) requires an SSL client certificate, you'll normally be prompted for a path to your certificate. By setting this variable to that same path, Subversion will be able to find your client certificate automatically without prompting you. There's no standard place to store your certificate on disk; Subversion will grab it from any path you specify.

`ssl-client-cert-password`
: If your SSL client certificate file is encrypted by a passphrase, Subversion will prompt you for the passphrase whenever the certificate is used. If you find this annoying (and don't mind storing the password in the `servers` file), you can set this variable to the certificate's passphrase. You won't be prompted anymore.

Config

The `config` file contains the rest of the currently available Subversion runtime options—those not related to networking. There are only a few options in use as of this writing, but they are again grouped into sections in expectation of future additions.

The `auth` section contains settings related to Subversion's authentication and authorization against the repository. It contains the following:

`store-passwords`
: This instructs Subversion to cache, or not to cache, passwords that are supplied by the user in response to server authentication challenges. The default value is `yes`. Set this to no to disable this on-disk password caching. You can override this option for a single instance of the **svn** command using the `--no-auth-cache` command-line parameter (for those subcommands that support it). For more information, see „Client Credentials Caching“.

`store-auth-creds`
: This setting is the same as `store-passwords`, except that it enables or disables on-disk caching of *all* authentication information: usernames, passwords, server certificates, and any other types of cacheable credentials.

The `helpers` section controls which external applications Subversion uses to accomplish its tasks. Valid options in this section are:

`editor-cmd`
: This specifies the program Subversion will use to query the user for certain types of textual metadata or when interactively resolving conflicts. See „Using External Editors“ for more details on using external text editors with Subversion.

`diff-cmd`
: This specifies the absolute path of a differencing program, used when Subversion generates „diff“ output (such as when using the **svn diff** command). By default, Subversion uses an internal differencing library—setting this option will cause it to perform this task using an external program. See „Using External Differencing and Merge Tools“ for more details on using such programs.

`diff3-cmd`
: This specifies the absolute path of a three-way differencing program. Subversion uses this program to merge changes made by the user with those received from the repository. By default, Subversion uses an internal differencing library—setting this option will cause it to perform this task using an external program. See „Using External Differencing and Merge Tools“ for more details on using such programs.

`diff3-has-program-arg`
: This flag should be set to `true` if the program specified by the `diff3-cmd` option accepts a `--diff-program` command-line parameter.

`merge-tool-cmd`
: This specifies the program that Subversion will use to perform three-way merge operations on your versioned files. See „Using External Differencing and Merge Tools“ for more details on using such programs.

The `tunnels` section allows you to define new tunnel schemes for use with **svnserve** and `svn://` client connections. For more details, see „Tunneling over SSH“.

The `miscellany` section is where everything that doesn't belong elsewhere winds up. [2] In this section, you can find:

`global-ignores`
: When running the **svn status** command, Subversion lists unversioned files and directories along with the versioned ones, annotating them with a ? character (see „Verschaffen Sie sich einen Überblick über Ihre Änderungen“). Sometimes it can be annoying to see uninteresting, unversioned items—for example, object files that result from a program's compilation—in this display. The `global-ignores` option is a list of whitespace-delimited globs that describe the names of files and directories that Subversion should not display unless they are versioned. The default value is `*.o *.lo *.la #*# .*.rej *.rej .*~ *~ .#* .DS_Store`.

  As well as **svn status**, the **svn add** and **svn import** commands also ignore files that match the list when they are scanning a directory. You can override this behavior for a single instance of any of these commands by explicitly specifying the filename, or by using the `--no-ignore` command-line flag.

  For information on finer-grained control of ignored items, see „Ignoring Unversioned Items“.

`enable-auto-props`
: This instructs Subversion to automatically set properties on newly added or imported files. The default value is `no`, so set this to `yes` to enable this feature. The `auto-props` section of this file specifies which properties are to be set on which files.

[2] Anyone for potluck dinner?

`log-encoding`
: This variable sets the default character set encoding for commit log messages. It's a permanent form of the `--encoding` option (see „svn Options“). The Subversion repository stores log messages in UTF-8 and assumes that your log message is written using your operating system's native locale. You should specify a different encoding if your commit messages are written in any other encoding.

`use-commit-times`
: Normally your working copy files have timestamps that reflect the last time they were touched by any process, whether your own editor or some **svn** subcommand. This is generally convenient for people developing software, because build systems often look at timestamps as a way of deciding which files need to be recompiled.

  In other situations, however, it's sometimes nice for the working copy files to have timestamps that reflect the last time they were changed in the repository. The **svn export** command always places these „last-commit timestamps“ on trees that it produces. By setting this config variable to `yes`, the **svn checkout**, **svn update**, **svn switch**, and **svn revert** commands will also set last-commit timestamps on files that they touch.

`mime-types-file`
: This option, new to Subversion 1.5, specifies the path of a MIME types mapping file, such as the `mime.types` file provided by the Apache HTTP Server. Subversion uses this file to assign MIME types to newly added or imported files. See „Automatic Property Setting“ and „File Content Type“ for more about Subversion's detection and use of file content types.

`preserved-conflict-file-exts`
: The value of this option is a space-delimited list of file extensions that Subversion should preserve when generating conflict filenames. By default, the list is empty. This option is new to Subversion 1.5.

  When Subversion detects conflicting file content changes, it defers resolution of those conflicts to the user. To assist in the resolution, Subversion keeps pristine copies of the various competing versions of the file in the working copy. By default, those conflict files have names constructed by appending to the original filename a custom extension such as `.mine` or `.`*REV* (where *REV* is a revision number). A mild annoyance with this naming scheme is that on operating systems where a file's extension determines the default application used to open and edit that file, appending a custom extension prevents the file from being easily opened by its native application. For example, if the file `ReleaseNotes.pdf` was conflicted, the conflict files might be named `ReleaseNotes.pdf.mine` or `ReleaseNotes.pdf.r4231`. While your system might be configured to use Adobe's Acrobat Reader to open files whose extensions are `.pdf`, there probably isn't an application configured on your system to open all files whose extensions are `.r4231`.

  You can fix this annoyance by using this configuration option, though. For files with one of the specified extensions, Subversion will append to the conflict file names the custom extension just as before, but then also reappend the file's original extension. Using the previous example, and assuming that `pdf` is one of the extensions configured in this list thereof, the conflict files generated for `ReleaseNotes.pdf` would instead be named `ReleaseNotes.pdf.mine.pdf` and `ReleaseNotes.pdf.r4231.pdf`. Because each file ends in `.pdf`, the correct default application will be used to view them.

`interactive-conflicts`
: This is a Boolean option that specifies whether Subversion should try to resolve conflicts interactively. If its value is `yes` (which is the default value), Subversion will prompt the user for how to handle conflicts in the manner demonstrated in „Konflikte auflösen (Änderungen anderer einarbeiten)“. Otherwise, it will simply flag the conflict and continue its operation, postponing resolution to a later time.

`no-unlock`
: This Boolean option corresponds to **svn commit**'s `--no-unlock` option, which tells Subversion not to release locks on files you've just committed. If this runtime option is set to `yes`, Subversion will never release locks automatically, leaving you to run **svn unlock** explicitly. It defaults to `no`.

The `auto-props` section controls the Subversion client's ability to automatically set properties on files when they are added or imported. It contains any number of key-value pairs in the format `PATTERN = PROPNAME=VALUE[;PROPNAME=VALUE ...]`, where `PATTERN` is a file pattern that matches one or more filenames and the rest of the line is a semicolon-delimited set of property assignments. Multiple matches on a file will result in multiple propsets for that file; however, there is no guarantee that auto-props will be applied in the order in which they are listed in the config file, so you can't have one rule „override" another. You can find several examples of auto-props usage in the `config` file. Lastly, don't forget to set `enable-auto-props` to `yes` in the `miscellany` section if you want to enable auto-props.

Localization

Localization is the act of making programs behave in a region-specific way. When a program formats numbers or dates in a way specific to your part of the world or prints messages (or accepts input) in your native language, the program is said to be *localized*. This section describes steps Subversion has made toward localization.

Understanding Locales

Most modern operating systems have a notion of the „current locale"—that is, the region or country whose localization conventions are honored. These conventions—typically chosen by some runtime configuration mechanism on the computer—affect the way in which programs present data to the user, as well as the way in which they accept user input.

On most Unix-like systems, you can check the values of the locale-related runtime configuration options by running the **locale** command:

```
$ locale
LANG=
LC_COLLATE="C"
LC_CTYPE="C"
LC_MESSAGES="C"
LC_MONETARY="C"
LC_NUMERIC="C"
LC_TIME="C"
LC_ALL="C"
$
```

The output is a list of locale-related environment variables and their current values. In this example, the variables are all set to the default `C` locale, but users can set these variables to specific country/language code combinations. For example, if one were to set the `LC_TIME` variable to `fr_CA`, programs would know to present time and date information formatted according to a French-speaking Canadian's expectations. And if one were to set the `LC_MESSAGES` variable to `zh_TW`, programs would know to present human-readable messages in Traditional Chinese. Setting the `LC_ALL` variable has the effect of changing every locale variable to the same value. The value of `LANG` is used as a default value for any locale variable that is unset. To see the list of available locales on a Unix system, run the command **`locale -a`**.

On Windows, locale configuration is done via the „Regional and Language Options" control panel item. There you can view and select the values of individual settings from the available locales, and even customize (at a sickening level of detail) several of the display formatting conventions.

Subversion's Use of Locales

The Subversion client, **svn**, honors the current locale configuration in two ways. First, it notices the value of the `LC_MESSAGES` variable and attempts to print all messages in the specified language. For example:

```
$ export LC_MESSAGES=de_DE
$ svn help cat
cat: Gibt den Inhalt der angegebenen Dateien oder URLs aus.
Aufruf: cat ZIEL[@REV]...
…
```

This behavior works identically on both Unix and Windows systems. Note, though, that while your operating system might have support for a certain locale, the Subversion client still may not be able to speak the particular language. In order to produce localized messages, human volunteers must provide translations for each language. The translations are written using the GNU gettext package, which results in translation modules that end with the `.mo` filename extension. For example, the German translation file is named `de.mo`. These translation files are installed somewhere on your system. On Unix, they typically live in `/usr/share/locale/`, while on Windows they're often found in the `share\locale\` folder in Subversion's installation area. Once installed, a module is named after the program for which it provides translations. For example, the `de.mo` file may ultimately end up installed as `/usr/share/locale/de/LC_MESSAGES/subversion.mo`. By browsing the installed `.mo` files, you can see which languages the Subversion client is able to speak.

The second way in which the locale is honored involves how **svn** interprets your input. The repository stores all paths, filenames, and log messages in Unicode, encoded as UTF-8. In that sense, the repository is *internationalized*—that is, the repository is ready to accept input in any human language. This means, however, that the Subversion client is responsible for sending only UTF-8 filenames and log messages into the repository. To do this, it must convert the data from the native locale into UTF-8.

For example, suppose you create a file named `caffè.txt`, and then when committing the file, you write the log message as „Adesso il caffè è più forte." Both the filename and the log message contain non-ASCII characters, but because your locale is set to `it_IT`, the Subversion client knows to interpret them as Italian. It uses an Italian character set to convert the data to UTF-8 before sending it off to the repository.

Note that while the repository demands UTF-8 filenames and log messages, it *does not* pay attention to file contents. Subversion treats file contents as opaque strings of bytes, and neither client nor server makes an attempt to understand the character set or encoding of the contents.

Character Set Conversion Errors

While using Subversion, you might get hit with an error related to character set conversions:

```
svn: Can't convert string from native encoding to 'UTF-8':
…
svn: Can't convert string from 'UTF-8' to native encoding:
…
```

Errors such as this typically occur when the Subversion client has received a UTF-8 string from the repository, but not all of the characters in that string can be represented using the encoding of the current locale. For example, if your locale is `en_US` but a collaborator has committed a Japanese filename, you're likely to see this error when you receive the file during an **svn update**.

The solution is either to set your locale to something that *can* represent the incoming UTF-8 data, or to change the filename or log message in the repository. (And don't forget to slap your collaborator's hand—projects should decide on common languages ahead of time so that all participants are using the same locale.)

Using External Editors

The most obvious way to get data into Subversion is through the addition of files to version control, committing changes to those files, and so on. But other pieces of information besides merely versioned file data live in your Subversion repository. Some of these bits of information—commit log messages, lock comments, and some property values—tend to be textual in nature and are provided explicitly by users. Most of this information can be provided to the Subversion command-line client using the `--message` (`-m`) and `--file` (`-F`) options with the appropriate subcommands.

Each of these options has its pros and cons. For example, when performing a commit, `--file` (`-F`) works well if you've already prepared a text file that holds your commit log message. If you didn't, though, you can use `--message` (`-m`) to provide a log message on the command line. Unfortunately, it can be tricky to compose anything more than a simple one-line message on the command line. Users want more flexibility—multiline, free-form log message editing on demand.

Subversion supports this by allowing you to specify an external text editor that it will launch as necessary to give you a more powerful input mechanism for this textual metadata. There are several ways to tell Subversion which editor you'd like use. Subversion checks the following things, in the order specified, when it wants to launch such an editor:

1. `--editor-cmd` command-line option
2. `SVN_EDITOR` environment variable
3. `editor-cmd` runtime configuration option
4. `VISUAL` environment variable
5. `EDITOR` environment variable
6. Possibly, a fallback value built into the Subversion libraries (not present in the official builds)

The value of any of these options or variables is the beginning of a command line to be executed by the shell. Subversion appends to that command line a space and the pathname of a temporary file to be edited. So, to be used with Subversion, the configured or specified editor needs to support an invocation in which its last command-line parameter is a file to be edited, and it should be able to save the file in place and return a zero exit code to indicate success.

As noted, external editors can be used to provide commit log messages to any of the committing subcommands (such as **svn commit** or **import**, **svn mkdir** or **delete** when provided a URL target, etc.), and Subversion will try to launch the editor automatically if you don't specify either of the `--message` (`-m`) or `--file` (`-F`) options. The **svn propedit** command is built almost entirely around the use of an external editor. And beginning in version 1.5, Subversion will also use the configured external text editor when the user asks it to launch an editor during interactive conflict resolution. Oddly, there doesn't appear to be a way to use external editors to interactively provide lock comments.

Using External Differencing and Merge Tools

The interface between Subversion and external two- and three-way differencing tools harkens back to a time when Subversion's only contextual differencing capabilities were built around invocations of the GNU diffutils toolchain, specifically the **diff** and **diff3** utilities. To get the kind of behavior Subversion needed, it called these utilities with more than a handful of options and parameters, most of which were quite specific to the utilities. Some time later, Subversion grew its own internal differencing library, and as a failover mechanism, the `--diff-cmd` and `--diff3-cmd` options were added to the Subversion command-line client so that users could more easily indicate that they preferred to use the GNU diff and diff3 utilities instead of the newfangled internal diff library. If those options were used, Subversion would simply ignore the internal diff library, and fall back to running those external programs, lengthy argument lists and all. And that's where things remain today.

It didn't take long for folks to realize that having such easy configuration mechanisms for specifying that Subversion should use the external GNU diff and diff3 utilities located at a particular place on the system could be applied toward the use of other differencing tools, too. After all, Subversion didn't actually verify that the things it was being told to run were members of the GNU diffutils toolchain. But the only configurable aspect of using those external tools is their location on the system—not the option set, parameter order, and so on. Subversion continues to throw all those GNU utility options at your external diff tool regardless of whether that program can understand those options. And that's where things get unintuitive for most users.

The key to using external two- and three-way differencing tools (other than GNU diff and diff3, of course) with Subversion is to use wrapper scripts, which convert the input from Subversion into something that your differencing tool can understand, and then to convert the output of your tool back into a format that Subversion expects—the format that the GNU tools would have used. The following sections cover the specifics of those expectations.

> The decision on when to fire off a contextual two- or three-way diff as part of a larger Subversion operation is made entirely by Subversion and is affected by, among other things, whether the files being operated on are human-readable as determined by their `svn:mime-type` property. This means, for example, that even if you had the niftiest Microsoft Word-aware differencing or merging tool in the universe, it would never be invoked by Subversion as long as your versioned Word documents had a configured MIME type that denoted that they were not human-readable (such as `application/msword`). For more about MIME type settings, see „File Content Type“

Subversion 1.5 introduces interactive resolution of conflicts (described in „Konflikte auflösen (Änderungen anderer einarbeiten)“), and one of the options provided to users is the ability to launch a third-party merge tool. If this action is taken, Subversion will consult the `merge-tool-cmd` runtime configuration option to find the name of an external merge tool and, upon finding one, will launch that tool with the appropriate input files. This differs from the configurable three-way differencing tool in a couple of ways. First, the differencing tool is always used to handle three-way differences, whereas the merge tool is employed only when three-way difference application has detected a conflict. Second, the interface is much cleaner—your configured merge tool need only accept as command-line parameters four path specifications: the base file, the „theirs“ file (which contains upstream changes), the „mine“ file (which contains local modifications), and the path of the file where the final resolved contents should be stored.

External diff

Subversion calls external diff programs with parameters suitable for the GNU diff utility, and expects only that the external program will return with a successful error code. For most alternative diff programs, only the sixth and seventh arguments—the paths of the files that represent the left and right sides of the diff, respectively—are of interest. Note that Subversion runs the diff program once per modified file covered by the Subversion operation, so if your program runs in an asynchronous fashion (or is „backgrounded“), you might have several instances of it all running simultaneously. Finally, Subversion expects that your program return an error code of 1 if your program detected differences, or 0 if it did not—any other error code is considered a fatal error. [3]

Beispiel 7.2, „diffwrap.py“ and Beispiel 7.3, „diffwrap.bat“ are templates for external diff tool wrappers in the Python and Windows batch scripting languages, respectively.

Beispiel 7.2. diffwrap.py

```
#!/usr/bin/env python
import sys
import os

# Configure your favorite diff program here.
DIFF = "/usr/local/bin/my-diff-tool"

# Subversion provides the paths we need as the last two parameters.
LEFT  = sys.argv[-2]
RIGHT = sys.argv[-1]

# Call the diff command (change the following line to make sense for
# your diff program).
cmd = [DIFF, '--left', LEFT, '--right', RIGHT]
os.execv(cmd[0], cmd)

# Return an errorcode of 0 if no differences were detected, 1 if some were.
# Any other errorcode will be treated as fatal.
```

Beispiel 7.3. diffwrap.bat

```
@ECHO OFF

REM Configure your favorite diff program here.
SET DIFF="C:\Program Files\Funky Stuff\My Diff Tool.exe"

REM Subversion provides the paths we need as the last two parameters.
REM These are parameters 6 and 7 (unless you use svn diff -x, in
REM which case, all bets are off).
SET LEFT=%6
SET RIGHT=%7

REM Call the diff command (change the following line to make sense for
REM your diff program).
%DIFF% --left %LEFT% --right %RIGHT%

REM Return an errorcode of 0 if no differences were detected, 1 if some were.
REM Any other errorcode will be treated as fatal.
```

[3] The GNU diff manual page puts it this way: „An exit status of 0 means no differences were found, 1 means some differences were found, and 2 means trouble.“

External diff3

Subversion calls external merge programs with parameters suitable for the GNU diff3 utility, expecting that the external program will return with a successful error code and that the full file contents that result from the completed merge operation are printed on the standard output stream (so that Subversion can redirect them into the appropriate version-controlled file). For most alternative merge programs, only the ninth, tenth, and eleventh arguments, the paths of the files which represent the „mine," „older," and „yours" inputs, respectively, are of interest. Note that because Subversion depends on the output of your merge program, your wrapper script must not exit before that output has been delivered to Subversion. When it finally does exit, it should return an error code of 0 if the merge was successful, or 1 if unresolved conflicts remain in the output—any other error code is considered a fatal error.

Beispiel 7.4, „diff3wrap.py" and Beispiel 7.5, „diff3wrap.bat" are templates for external merge tool wrappers in the Python and Windows batch scripting languages, respectively.

Beispiel 7.4. diff3wrap.py

```
#!/usr/bin/env python
import sys
import os

# Configure your favorite diff program here.
DIFF3 = "/usr/local/bin/my-merge-tool"

# Subversion provides the paths we need as the last three parameters.
MINE  = sys.argv[-3]
OLDER = sys.argv[-2]
YOURS = sys.argv[-1]

# Call the merge command (change the following line to make sense for
# your merge program).
cmd = [DIFF3, '--older', OLDER, '--mine', MINE, '--yours', YOURS]
os.execv(cmd[0], cmd)

# After performing the merge, this script needs to print the contents
# of the merged file to stdout.  Do that in whatever way you see fit.
# Return an errorcode of 0 on successful merge, 1 if unresolved conflicts
# remain in the result.  Any other errorcode will be treated as fatal.
```

Beispiel 7.5. diff3wrap.bat

```
@ECHO OFF

REM Configure your favorite diff3/merge program here.
SET DIFF3="C:\Program Files\Funky Stuff\My Merge Tool.exe"

REM Subversion provides the paths we need as the last three parameters.
REM These are parameters 9, 10, and 11.  But we have access to only
REM nine parameters at a time, so we shift our nine-parameter window
REM twice to let us get to what we need.
SHIFT
SHIFT
SET MINE=%7
SET OLDER=%8
SET YOURS=%9

REM Call the merge command (change the following line to make sense for
```

```
REM your merge program).
%DIFF3% --older %OLDER% --mine %MINE% --yours %YOURS%

REM After performing the merge, this script needs to print the contents
REM of the merged file to stdout.  Do that in whatever way you see fit.
REM Return an errorcode of 0 on successful merge, 1 if unresolved conflicts
REM remain in the result.  Any other errorcode will be treated as fatal.
```

Summary

Sometimes there's a single right way to do things; sometimes there are many. Subversion's developers understand that while the majority of its exact behaviors are acceptable to most of its users, there are some corners of its functionality where such a universally pleasing approach doesn't exist. In those places, Subversion offers users the opportunity to tell it how *they* want it to behave.

In this chapter, we explored Subversion's runtime configuration system and other mechanisms by which users can control those configurable behaviors. If you are a developer, though, the next chapter will take you one step further. It describes how you can further customize your Subversion experience by writing your own software against Subversion's libraries.

Kapitel 8. Embedding Subversion

Subversion has a modular design: it's implemented as a collection of libraries written in C. Each library has a well-defined purpose and application programming interface (API), and that interface is available not only for Subversion itself to use, but for any software that wishes to embed or otherwise programmatically control Subversion. Additionally, Subversion's API is available not only to other C programs, but also to programs written in higher-level languages such as Python, Perl, Java, and Ruby.

This chapter is for those who wish to interact with Subversion through its public API or its various language bindings. If you wish to write robust wrapper scripts around Subversion functionality to simplify your own life, are trying to develop more complex integrations between Subversion and other pieces of software, or just have an interest in Subversion's various library modules and what they offer, this chapter is for you. If, however, you don't foresee yourself participating with Subversion at such a level, feel free to skip this chapter with the confidence that your experience as a Subversion user will not be affected.

Layered Library Design

Each of Subversion's core libraries can be said to exist in one of three main layers—the Repository layer, the Repository Access (RA) layer, or the Client layer (see Abbildung 1, „Die Architektur von Subversion" in the Preface). We will examine these layers shortly, but first, let's briefly summarize Subversion's various libraries. For the sake of consistency, we will refer to the libraries by their extensionless Unix library names (`libsvn_fs`, `libsvn_wc`, `mod_dav_svn`, etc.).

libsvn_client
: Primary interface for client programs

libsvn_delta
: Tree and byte-stream differencing routines

libsvn_diff
: Contextual differencing and merging routines

libsvn_fs
: Filesystem commons and module loader

libsvn_fs_base
: The Berkeley DB filesystem backend

libsvn_fs_fs
: The native filesystem (FSFS) backend

libsvn_ra
: Repository Access commons and module loader

libsvn_ra_local
: The local Repository Access module

libsvn_ra_neon
: The WebDAV Repository Access module

libsvn_ra_serf
: Another (experimental) WebDAV Repository Access module

libsvn_ra_svn
: The custom protocol Repository Access module

libsvn_repos
: Repository interface

libsvn_subr
: Miscellaneous helpful subroutines

libsvn_wc
: The working copy management library

mod_authz_svn
: Apache authorization module for Subversion repositories access via WebDAV

mod_dav_svn
: Apache module for mapping WebDAV operations to Subversion ones

The fact that the word „miscellaneous“ appears only once in the previous list is a good sign. The Subversion development team is serious about making sure that functionality lives in the right layer and libraries. Perhaps the greatest advantage of the modular design is its lack of complexity from a developer's point of view. As a developer, you can quickly formulate that kind of „big picture“ that allows you to pinpoint the location of certain pieces of functionality with relative ease.

Another benefit of modularity is the ability to replace a given module with a whole new library that implements the same API without affecting the rest of the code base. In some sense, this happens within Subversion already. The `libsvn_ra_local`, `libsvn_ra_neon`, `libsvn_ra_serf`, and `libsvn_ra_svn` libraries each implement the same interface, all working as plug-ins to `libsvn_ra`. And all four communicate with the Repository layer—`libsvn_ra_local` connects to the repository directly; the other three do so over a network. The `libsvn_fs_base` and `libsvn_fs_fs` libraries are another pair of libraries that implement the same functionality in different ways—both are plug-ins to the common `libsvn_fs` library.

The client itself also highlights the benefits of modularity in the Subversion design. Subversion's `libsvn_client` library is a one-stop shop for most of the functionality necessary for designing a working Subversion client (see „Client Layer“). So while the Subversion distribution provides only the **svn** command-line client program, several third-party programs provide various forms of graphical client UIs. These GUIs use the same APIs that the stock command-line client does. This type of modularity has played a large role in the proliferation of available Subversion clients and IDE integrations and, by extension, to the tremendous adoption rate of Subversion itself.

Repository Layer

When referring to Subversion's Repository layer, we're generally talking about two basic concepts—the versioned filesystem implementation (accessed via `libsvn_fs`, and supported by its `libsvn_fs_base` and `libsvn_fs_fs` plug-ins), and the repository logic that wraps it (as implemented in `libsvn_repos`). These libraries provide the storage and reporting mechanisms for the various revisions of your version-controlled data. This layer is connected to the Client layer via the Repository Access layer, and is, from the perspective of the Subversion user, the stuff at the „other end of the line.“

The Subversion filesystem is not a kernel-level filesystem that one would install in an operating system (such as the Linux ext2 or NTFS), but instead is a virtual filesystem. Rather than storing „files“ and „directories“ as real files and directories (the kind you can navigate through using your favorite shell program), it uses one of two available abstract storage backends—either a Berkeley DB database environment or a flat-file representation. (To learn more about the two repository backends, see „Choosing a Data Store“.) There has even been considerable interest by the development community in giving future releases of Subversion the ability to use other backend database systems, perhaps through a mechanism such as Open Database Connectivity (ODBC). In fact, Google did something similar to this before launching the Google Code Project Hosting service: they announced in mid-2006 that members of its open source team had written a new proprietary Subversion filesystem plug-in that used Google's ultra-scalable Bigtable database for its storage.

The filesystem API exported by `libsvn_fs` contains the kinds of functionality you would expect from any other filesystem API—you can create and remove files and directories, copy and move them around, modify file contents, and so on. It also has features that are not quite as common, such as the ability to add, modify, and remove metadata („properties“) on each file or directory. Furthermore, the Subversion filesystem is a versioning filesystem, which means that as you make changes to your directory tree, Subversion remembers what your tree looked like before those changes. And before the previous changes. And the previous ones. And so on, all the way back through versioning time to (and just beyond) the moment you first started adding things to the filesystem.

All the modifications you make to your tree are done within the context of a Subversion commit transaction. The following is a simplified general routine for modifying your filesystem:

1. Begin a Subversion commit transaction.
2. Make your changes (adds, deletes, property modifications, etc.).
3. Commit your transaction.

Once you have committed your transaction, your filesystem modifications are permanently stored as historical artifacts. Each of these cycles generates a single new revision of your tree, and each revision is forever accessible as an immutable snapshot of „the way things were.“

The Transaction Distraction

The notion of a Subversion transaction can become easily confused with the transaction support provided by the underlying database itself, especially given the former's close proximity to the Berkeley DB database code in `libsvn_fs_base`. Both types of transaction exist to provide atomicity and isolation. In other words, transactions give you the ability to perform a set of actions in an all-or-nothing fashion—either all the actions in the set complete with success, or they all get treated as though *none* of them ever happened—and in a way that does not interfere with other processes acting on the data.

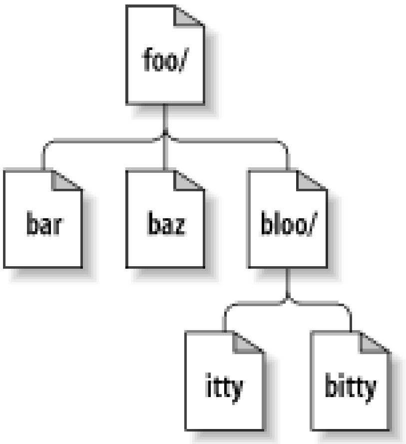
Database transactions generally encompass small operations related specifically to the modification of data in the database itself (such as changing the contents of a table row). Subversion transactions are larger in scope, encompassing higher-level operations such as making modifications to a set of files and directories that are intended to be stored as the next revision of the filesystem tree. If that isn't confusing enough, consider the fact that Subversion uses a database transaction during the creation of a Subversion transaction (so that if the creation of a Subversion transaction fails, the database will look as though we had never attempted that creation in the first place)!

Fortunately for users of the filesystem API, the transaction support provided by the database system itself is hidden almost entirely from view (as should be expected from a properly modularized library scheme). It is only when you start digging into the implementation of the filesystem itself that such things become visible (or interesting).

Most of the functionality the filesystem interface provides deals with actions that occur on individual filesystem paths. That is, from outside the filesystem, the primary mechanism for describing and accessing the individual revisions of files and directories comes through the use of path strings such as `/foo/bar`, just as though you were addressing files and directories through your favorite shell program. You add new files and directories by passing their paths-to-be to the right API functions. You query for information about them by the same mechanism.

Unlike most filesystems, though, a path alone is not enough information to identify a file or directory in Subversion. Think of a directory tree as a two-dimensional system, where a node's siblings represent a sort of left-and-right motion, and navigating into the node's subdirectories represents a downward motion. Abbildung 8.1, „Files and directories in two dimensions" shows a typical representation of a tree as exactly that.

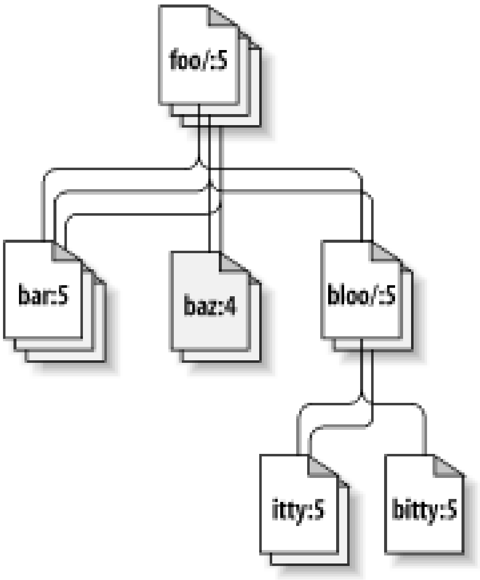
Abbildung 8.1. Files and directories in two dimensions



The difference here is that the Subversion filesystem has a nifty third dimension that most filesystems do not have—Time! [1] In the filesystem interface, nearly every function that has a *`path`* argument also expects a *`root`* argument. This `svn_fs_root_t` argument describes either a revision or a Subversion transaction (which is simply a revision in the making) and provides that third dimension of context needed to understand the difference between `/foo/bar` in revision 32, and the same path as it exists in revision 98. Abbildung 8.2, „Versioning time—the third dimension!" shows revision history as an added dimension to the Subversion filesystem universe.

Abbildung 8.2. Versioning time—the third dimension!

[1]We understand that this may come as a shock to sci-fi fans who have long been under the impression that Time was actually the *fourth* dimension, and we apologize for any emotional trauma induced by our assertion of a different theory.



As we mentioned earlier, the `libsvn_fs` API looks and feels like any other filesystem, except that it has this wonderful versioning capability. It was designed to be usable by any program interested in a versioning filesystem. Not coincidentally, Subversion itself is interested in that functionality. But while the filesystem API should be sufficient for basic file and directory versioning support, Subversion wants more—and that is where `libsvn_repos` comes in.

The Subversion repository library (`libsvn_repos`) sits (logically speaking) atop the `libsvn_fs` API, providing additional functionality beyond that of the underlying versioned filesystem logic. It does not completely wrap each and every filesystem function—only certain major steps in the general cycle of filesystem activity are wrapped by the repository interface. Some of these include the creation and commit of Subversion transactions and the modification of revision properties. These particular events are wrapped by the repository layer because they have hooks associated with them. A repository hook system is not strictly related to implementing a versioning filesystem, so it lives in the repository wrapper library.

The hooks mechanism is but one of the reasons for the abstraction of a separate repository library from the rest of the filesystem code. The `libsvn_repos` API provides several other important utilities to Subversion. These include the abilities to:

- Create, open, destroy, and perform recovery steps on a Subversion repository and the filesystem included in that repository.
- Describe the differences between two filesystem trees.
- Query for the commit log messages associated with all (or some) of the revisions in which a set of files was modified in the filesystem.
- Generate a human-readable „dump“ of the filesystem—a complete representation of the revisions in the filesystem.
- Parse that dump format, loading the dumped revisions into a different Subversion repository.

As Subversion continues to evolve, the repository library will grow with the filesystem library to offer increased functionality and configurable option support.

Repository Access Layer

If the Subversion Repository layer is at „the other end of the line," the Repository Access (RA) layer is the line itself. Charged with marshaling data between the client libraries and the repository, this layer includes the `libsvn_ra` module loader library, the RA modules themselves (which currently includes `libsvn_ra_neon`, `libsvn_ra_local`, `libsvn_ra_serf`, and `libsvn_ra_svn`), and any additional libraries needed by one or more of those RA modules (such as the `mod_dav_svn` Apache module or `libsvn_ra_svn`'s server, **svnserve**).

Since Subversion uses URLs to identify its repository resources, the protocol portion of the URL scheme (usually `file://`, `http://`, `https://`, `svn://`, or `svn+ssh://`) is used to determine which RA module will handle the communications. Each module registers a list of the protocols it knows how to „speak" so that the RA loader can, at runtime, determine which module to use for the task at hand. You can determine which RA modules are available to the Subversion command-line client, and what protocols they claim to support, by running **`svn --version`**:

```
$ svn --version
svn, version 1.5.0 (r31699)
   compiled Jun 18 2008, 09:57:36

Copyright (C) 2000-2008 CollabNet.
Subversion is open source software, see http://subversion.tigris.org/
This product includes software developed by CollabNet (http://www.Collab.Net/).

The following repository access (RA) modules are available:

* ra_neon : Module for accessing a repository via WebDAV protocol using Neon.
  - handles 'http' scheme
  - handles 'https' scheme
* ra_svn : Module for accessing a repository using the svn network protocol.
  - handles 'svn' scheme
* ra_local : Module for accessing a repository on local disk.
  - handles 'file' scheme
* ra_serf : Module for accessing a repository via WebDAV protocol using serf.
  - handles 'http' scheme
  - handles 'https' scheme

$
```

The public API exported by the RA layer contains functionality necessary for sending and receiving versioned data to and from the repository. And each of the available RA plug-ins is able to perform that task using a specific protocol—`libsvn_ra_dav` speaks HTTP/WebDAV (optionally using SSL encryption) with an Apache HTTP Server that is running the `mod_dav_svn` Subversion server module; `libsvn_ra_svn` speaks a custom network protocol with the **svnserve** program; and so on.

For those who wish to access a Subversion repository using still another protocol, that is precisely why the Repository Access layer is modularized! Developers can simply write a new library that implements the RA interface on one side and communicates with the repository on the other. Your new library can use existing network protocols or you can invent your own. You could use interprocess communication (IPC) calls, or—let's get crazy, shall we?—you could even implement an email-based protocol. Subversion supplies the APIs; you supply the creativity.

Client Layer

On the client side, the Subversion working copy is where all the action takes place. The bulk of functionality implemented by the client-side libraries exists for the sole purpose of managing working copies—directories full of files and other subdirectories that serve as a sort of local, editable „reflection" of one or more repository locations—and propagating changes to and from the Repository Access layer.

Subversion's working copy library, libsvn_wc, is directly responsible for managing the data in the working copies. To accomplish this, the library stores administrative information about each working copy directory within a special subdirectory. This subdirectory, named .svn, is present in each working copy directory and contains various other files and directories that record state and provide a private workspace for administrative action. For those familiar with CVS, this .svn subdirectory is similar in purpose to the CVS administrative directories found in CVS working copies. For more information about the .svn administrative area, see „Inside the Working Copy Administration Area“ later in this chapter.

The Subversion client library, libsvn_client, has the broadest responsibility; its job is to mingle the functionality of the working copy library with that of the Repository Access layer, and then to provide the highest-level API to any application that wishes to perform general revision control actions. For example, the function svn_client_checkout() takes a URL as an argument. It passes this URL to the RA layer and opens an authenticated session with a particular repository. It then asks the repository for a certain tree, and sends this tree into the working copy library, which then writes a full working copy to disk (.svn directories and all).

The client library is designed to be used by any application. While the Subversion source code includes a standard command-line client, it should be very easy to write any number of GUI clients on top of the client library. New GUIs (or any new client, really) for Subversion need not be clunky wrappers around the included command-line client—they have full access via the libsvn_client API to the same functionality, data, and callback mechanisms that the command-line client uses. In fact, the Subversion source code tree contains a small C program (which you can find at tools/examples/minimal_client.c) that exemplifies how to wield the Subversion API to create a simple client program.

Binding Directly—A Word About Correctness

Why should your GUI program bind directly with a libsvn_client instead of acting as a wrapper around a command-line program? Besides simply being more efficient, it can be more correct as well. A command-line program (such as the one supplied with Subversion) that binds to the client library needs to effectively translate feedback and requested data bits from C types to some form of human-readable output. This type of translation can be lossy. That is, the program may not display all of the information harvested from the API or may combine bits of information for compact representation.

If you wrap such a command-line program with yet another program, the second program has access only to already interpreted (and as we mentioned, likely incomplete) information, which it must *again* translate into *its* representation format. With each layer of wrapping, the integrity of the original data is potentially tainted more and more, much like the result of making a copy of a copy (of a copy…) of a favorite audio or video cassette.

But the most compelling argument for binding directly to the APIs instead of wrapping other programs is that the Subversion project makes compatibility promises regarding its APIs. Across minor versions of those APIs (such as between 1.3 and 1.4), no function's prototype will change. In other words, you aren't forced to update your program's source code simply because you've upgraded to a new version of Subversion. Certain functions might be deprecated, but they still work, and this gives you a buffer of time to eventually embrace the newer APIs. These kinds of compatibility promises do not exist for Subversion command-line program output, which is subject to change from release to release.

Inside the Working Copy Administration Area

As we mentioned earlier, each directory of a Subversion working copy contains a special subdirectory called `.svn` that houses administrative data about that working copy directory. Subversion uses the information in `.svn` to keep track of things such as:

- Which repository location(s) are represented by the files and subdirectories in the working copy directory
- What revision of each of those files and directories is currently present in the working copy
- Any user-defined properties that might be attached to those files and directories
- Pristine (unedited) copies of the working copy files

The Subversion working copy administration area's layout and contents are considered implementation details not really intended for human consumption. Developers are encouraged to use Subversion's public APIs, or the tools that Subversion provides, to access and manipulate the working copy data, instead of directly reading or modifying those files. The file formats employed by the working copy library for its administrative data do change from time to time—a fact that the public APIs do a great job of hiding from the average user. In this section, we expose some of these implementation details sheerly to appease your overwhelming curiosity.

The Entries File

Perhaps the single most important file in the `.svn` directory is the `entries` file. It contains the bulk of the administrative information about the versioned items in a working copy directory. This one file tracks the repository URLs, pristine revision, file checksums, pristine text and property timestamps, scheduling and conflict state information, last-known commit information (author, revision, timestamp), local copy history—practically everything that a Subversion client is interested in knowing about a versioned (or to-be-versioned) resource!

Folks familiar with CVS's administrative directories will have recognized at this point that Subversion's `.svn/entries` file serves the purposes of, among other things, CVS's `CVS/Entries`, `CVS/Root`, and `CVS/Repository` files combined.

The format of the `.svn/entries` file has changed over time. Originally an XML file, it now uses a custom—though still human-readable—file format. While XML was a great choice for early developers of Subversion who were frequently debugging the file's contents (and Subversion's behavior in light of them), the need for easy developer debugging has diminished as Subversion has matured and has been replaced by the user's need for snappier performance. Be aware that Subversion's working copy library automatically upgrades working copies from one format to another—it reads the old formats and writes the new—which saves you the hassle of checking out a new working copy, but can also complicate situations where different versions of Subversion might be trying to use the same working copy.

Pristine Copies and Property Files

As mentioned before, the `.svn` directory also holds the pristine „text-base“ versions of files. You can find those in `.svn/text-base`. The benefits of these pristine copies are multiple—network-free checks for local modifications and difference reporting, network-free reversion of modified or missing files, more efficient transmission of changes to the server—but they come at the cost of having each versioned file stored at least twice on disk. These days, this seems to be a negligible penalty for most files. However, the situation gets uglier as the size of your versioned files grows. Some attention is being given to making the presence of the „text-base“ an option. Ironically, though, it is as your versioned files' sizes get larger that the existence of the „text-base“ becomes more crucial—who wants to transmit a huge file across a network just because she wants to commit a tiny change to it?

Similar in purpose to the „text-base" files are the property files and their pristine „prop-base" copies, located in `.svn/props` and `.svn/prop-base`, respectively. Since directories can have properties too, there are also `.svn/dir-props` and `.svn/dir-prop-base` files.

Using the APIs

Developing applications against the Subversion library APIs is fairly straightforward. Subversion is primarily a set of C libraries, with header (`.h`) files that live in the `subversion/include` directory of the source tree. These headers are copied into your system locations (e.g., `/usr/local/include`) when you build and install Subversion itself from source. These headers represent the entirety of the functions and types meant to be accessible by users of the Subversion libraries. The Subversion developer community is meticulous about ensuring that the public API is well documented—refer directly to the header files for that documentation.

When examining the public header files, the first thing you might notice is that Subversion's datatypes and functions are namespace-protected. That is, every public Subversion symbol name begins with `svn_`, followed by a short code for the library in which the symbol is defined (such as `wc`, `client`, `fs`, etc.), followed by a single underscore (`_`), and then the rest of the symbol name. Semipublic functions (used among source files of a given library but not by code outside that library, and found inside the library directories themselves) differ from this naming scheme in that instead of a single underscore after the library code, they use a double underscore (`__`). Functions that are private to a given source file have no special prefixing and are declared `static`. Of course, a compiler isn't interested in these naming conventions, but they help to clarify the scope of a given function or datatype.

Another good source of information about programming against the Subversion APIs is the project's own hacking guidelines, which you can find at http://subversion.tigris.org/hacking.html. This document contains useful information, which, while aimed at developers and would-be developers of Subversion itself, is equally applicable to folks developing against Subversion as a set of third-party libraries. [2]

The Apache Portable Runtime Library

Along with Subversion's own datatypes, you will see many references to datatypes that begin with `apr_`—symbols from the Apache Portable Runtime (APR) library. APR is Apache's portability library, originally carved out of its server code as an attempt to separate the OS-specific bits from the OS-independent portions of the code. The result was a library that provides a generic API for performing operations that differ mildly—or wildly—from OS to OS. While the Apache HTTP Server was obviously the first user of the APR library, the Subversion developers immediately recognized the value of using APR as well. This means that there is practically no OS-specific code in Subversion itself. Also, it means that the Subversion client compiles and runs anywhere that the Apache HTTP Server does. Currently, this list includes all flavors of Unix, Win32, BeOS, OS/2, and Mac OS X.

In addition to providing consistent implementations of system calls that differ across operating systems, [3] APR gives Subversion immediate access to many custom datatypes, such as dynamic arrays and hash tables. Subversion uses these types extensively. But perhaps the most pervasive APR datatype, found in nearly every Subversion API prototype, is the `apr_pool_t`—the APR memory pool. Subversion uses pools internally for all its memory allocation needs (unless an external library requires a different memory management mechanism for data passed through its API), [4] and while a person coding

[2] After all, Subversion uses Subversion's APIs, too.
[3] Subversion uses ANSI system calls and datatypes as much as possible.
[4] Neon and Berkeley DB are examples of such libraries.

against the Subversion APIs is not required to do the same, she *is* required to provide pools to the API functions that need them. This means that users of the Subversion API must also link against APR, must call `apr_initialize()` to initialize the APR subsystem, and then must create and manage pools for use with Subversion API calls, typically by using `svn_pool_create()`, `svn_pool_clear()`, and `svn_pool_destroy()`.

Programming with Memory Pools

Almost every developer who has used the C programming language has at some point sighed at the daunting task of managing memory usage. Allocating enough memory to use, keeping track of those allocations, freeing the memory when you no longer need it—these tasks can be quite complex. And of course, failure to do those things properly can result in a program that crashes itself, or worse, crashes the computer.

Higher-level languages, on the other hand, either take the job of memory management away from you completely or make it something you toy with only when doing extremely tight program optimization. Languages such as Java and Python use *garbage collection*, allocating memory for objects when needed, and automatically freeing that memory when the object is no longer in use.

APR provides a middle-ground approach called *pool-based memory management*. It allows the developer to control memory usage at a lower resolution—per chunk (or „pool“) of memory, instead of per allocated object. Rather than using `malloc()` and friends to allocate enough memory for a given object, you ask APR to allocate the memory from a memory pool. When you're finished using the objects you've created in the pool, you destroy the entire pool, effectively de-allocating the memory consumed by *all* the objects you allocated from it. Thus, rather than keeping track of individual objects that need to be de-allocated, your program simply considers the general lifetimes of those objects and allocates the objects in a pool whose lifetime (the time between the pool's creation and its deletion) matches the object's needs.

URL and Path Requirements

With remote version control operation as the whole point of Subversion's existence, it makes sense that some attention has been paid to internationalization (i18n) support. After all, while „remote“ might mean „across the office,“ it could just as well mean „across the globe.“ To facilitate this, all of Subversion's public interfaces that accept path arguments expect those paths to be canonicalized—which is most easily accomplished by passing them through the `svn_path_canonicalize()` function—and encoded in UTF-8. This means, for example, that any new client binary that drives the `libsvn_client` interface needs to first convert paths from the locale-specific encoding to UTF-8 before passing those paths to the Subversion libraries, and then reconvert any resultant output paths from Subversion back into the locale's encoding before using those paths for non-Subversion purposes. Fortunately, Subversion provides a suite of functions (see `subversion/include/svn_utf.h`) that any program can use to do these conversions.

Also, Subversion APIs require all URL parameters to be properly URI-encoded. So, instead of passing `file:///home/username/My File.txt` as the URL of a file named `My File.txt`, you need to pass `file:///home/username/My%20File.txt`. Again, Subversion supplies helper functions that your application can use—`svn_path_uri_encode()` and `svn_path_uri_decode()`, for URI encoding and decoding, respectively.

Using Languages Other Than C and C++

If you are interested in using the Subversion libraries in conjunction with something other than a C program—say, a Python or Perl script—Subversion has some support for this via the Simplified Wrapper and Interface Generator (SWIG). The SWIG bindings for Subversion are located in `subversion/bindings/swig`. They are still maturing, but they are usable. These bindings allow you to call Subversion API functions indirectly, using wrappers that translate the datatypes native to your scripting language into the datatypes needed by Subversion's C libraries.

Significant efforts have been made toward creating functional SWIG-generated bindings for Python, Perl, and Ruby. To some extent, the work done preparing the SWIG interface files for these languages is reusable in efforts to generate bindings for other languages supported by SWIG (which include versions of C#, Guile, Java, MzScheme, OCaml, PHP, and Tcl, among others). However, some extra programming is required to compensate for complex APIs that SWIG needs some help translating between languages. For more information on SWIG itself, see the project's web site at http://www.swig.org/.

Subversion also has language bindings for Java. The javahl bindings (located in `subversion/bindings/java` in the Subversion source tree) aren't SWIG-based, but are instead a mixture of Java and hand-coded JNI. Javahl covers most Subversion client-side APIs and is specifically targeted at implementors of Java-based Subversion clients and IDE integrations.

Subversion's language bindings tend to lack the level of developer attention given to the core Subversion modules, but can generally be trusted as production-ready. A number of scripts and applications, alternative Subversion GUI clients, and other third-party tools are successfully using Subversion's language bindings today to accomplish their Subversion integrations.

It's worth noting here that there are other options for interfacing with Subversion using other languages: alternative bindings for Subversion that aren't provided by the Subversion development community at all. You can find links to these alternative bindings on the Subversion project's links page (at http://subversion.tigris.org/links.html), but there are a couple of popular ones we feel are especially noteworthy. First, Barry Scott's PySVN bindings (http://pysvn.tigris.org/) are a popular option for binding with Python. PySVN boasts of a more Pythonic interface than the more C-like APIs provided by Subversion's own Python bindings. And if you're looking for a pure Java implementation of Subversion, check out SVNKit (http://svnkit.com/), which is Subversion rewritten from the ground up in Java.

SVNKit Versus javahl

In 2005, a small company called TMate announced the 1.0.0 release of JavaSVN—a pure Java implementation of Subversion. Since then, the project has been renamed to SVNKit (available at http://svnkit.com/) and has seen great success as a provider of Subversion functionality to various Subversion clients, IDE integrations, and other third-party tools.

The SVNKit library is interesting in that, unlike the javahl library, it is not merely a wrapper around the official Subversion core libraries. In fact, it shares no code with Subversion at all. But while it is easy to confuse SVNKit with javahl, and easier still to not even realize which of these libraries you are using, folks should be aware that SVNKit differs from javahl in some significant ways. First, SVNKit is not developed as open source software and seems to have at any given time only a few developers working on it. Also, SVNKit's license is more restrictive than that of Subversion. Finally, by aiming to be a pure Java Subversion library, SVNKit is limited in which portions of Subversion can be reasonably cloned while still keeping up with Subversion's releases. This has already happened once—SVNKit cannot access BDB-backed Subversion repositories via the `file://` protocol because there's no pure Java implementation of Berkeley DB that is file-format-compatible with the native implementation of that library.

That said, SVNKit has a well-established track record of reliability. And a pure Java solution is much more robust in the face of programming errors—a bug in SVNKit might raise a catchable Java Exception, but a bug in the Subversion core libraries as accessed via javahl can bring down your entire Java Runtime Environment. So, weigh the costs when choosing a Java-based Subversion implementation.

Code Samples

Beispiel 8.1, „Using the Repository Layer“ contains a code segment (written in C) that illustrates some of the concepts we've been discussing. It uses both the repository and filesystem interfaces (as can be determined by the prefixes `svn_repos_` and `svn_fs_` of the function names, respectively) to create a new revision in which a directory is added. You can see the use of an APR pool, which is passed around for memory allocation purposes. Also, the code reveals a somewhat obscure fact about Subversion error handling—all Subversion errors must be explicitly handled to avoid memory leakage (and in some cases, application failure).

Beispiel 8.1. Using the Repository Layer

```
/* Convert a Subversion error into a simple boolean error code.
 *
 * NOTE:  Subversion errors must be cleared (using svn_error_clear())
 *        because they are allocated from the global pool, else memory
 *        leaking occurs.
 */
#define INT_ERR(expr)                                \
  do {                                               \
    svn_error_t *__temperr = (expr);                 \
    if (__temperr)                                   \
      {                                              \
        svn_error_clear(__temperr);                  \
        return 1;                                    \
      }                                              \
    return 0;                                        \
  } while (0)

/* Create a new directory at the path NEW_DIRECTORY in the Subversion
 * repository located at REPOS_PATH.  Perform all memory allocation in
 * POOL.  This function will create a new revision for the addition of
 * NEW_DIRECTORY.  Return zero if the operation completes
 * successfully, nonzero otherwise.
 */
static int
make_new_directory(const char *repos_path,
                   const char *new_directory,
                   apr_pool_t *pool)
{
  svn_error_t *err;
  svn_repos_t *repos;
  svn_fs_t *fs;
  svn_revnum_t youngest_rev;
  svn_fs_txn_t *txn;
  svn_fs_root_t *txn_root;
  const char *conflict_str;

  /* Open the repository located at REPOS_PATH.
   */
  INT_ERR(svn_repos_open(&repos, repos_path, pool));

  /* Get a pointer to the filesystem object that is stored in REPOS.
   */
  fs = svn_repos_fs(repos);
```

```
  /* Ask the filesystem to tell us the youngest revision that
   * currently exists.
   */
  INT_ERR(svn_fs_youngest_rev(&youngest_rev, fs, pool));

  /* Begin a new transaction that is based on YOUNGEST_REV.  We are
   * less likely to have our later commit rejected as conflicting if we
   * always try to make our changes against a copy of the latest snapshot
   * of the filesystem tree.
   */
  INT_ERR(svn_repos_fs_begin_txn_for_commit2(&txn, repos, youngest_rev,
                                             apr_hash_make(pool), pool));

  /* Now that we have started a new Subversion transaction, get a root
   * object that represents that transaction.
   */
  INT_ERR(svn_fs_txn_root(&txn_root, txn, pool));

  /* Create our new directory under the transaction root, at the path
   * NEW_DIRECTORY.
   */
  INT_ERR(svn_fs_make_dir(txn_root, new_directory, pool));

  /* Commit the transaction, creating a new revision of the filesystem
   * which includes our added directory path.
   */
  err = svn_repos_fs_commit_txn(&conflict_str, repos,
                                &youngest_rev, txn, pool);
  if (! err)
    {
      /* No error?  Excellent!  Print a brief report of our success.
       */
      printf("Directory '%s' was successfully added as new revision "
             "'%ld'.\n", new_directory, youngest_rev);
    }
  else if (err->apr_err == SVN_ERR_FS_CONFLICT)
    {
      /* Uh-oh.  Our commit failed as the result of a conflict
       * (someone else seems to have made changes to the same area
       * of the filesystem that we tried to modify).  Print an error
       * message.
       */
      printf("A conflict occurred at path '%s' while attempting "
             "to add directory '%s' to the repository at '%s'.\n",
             conflict_str, new_directory, repos_path);
    }
  else
    {
      /* Some other error has occurred.  Print an error message.
       */
      printf("An error occurred while attempting to add directory '%s' "
             "to the repository at '%s'.\n",
             new_directory, repos_path);
    }

  INT_ERR(err);
}
```

Note that in Beispiel 8.1, „Using the Repository Layer“, the code could just as easily have committed the transaction using `svn_fs_commit_txn()`. But the filesystem API knows nothing about the repository library's hook mechanism. If you want your Subversion repository to automatically perform some set of non-Subversion tasks every time you commit a transaction (e.g., sending an email that describes all the changes made in that transaction to your developer mailing list), you need to use the `libsvn_repos`-wrapped version of that function, which adds the hook triggering functionality—in this case, `svn_repos_fs_commit_txn()`. (For more information regarding Subversion's repository hooks, see „Implementing Repository Hooks“.)

Now let's switch languages. Beispiel 8.2, „Using the Repository layer with Python“ is a sample program that uses Subversion's SWIG Python bindings to recursively crawl the youngest repository revision, and to print the various paths reached during the crawl.

Beispiel 8.2. Using the Repository layer with Python

```
#!/usr/bin/python

"""Crawl a repository, printing versioned object path names."""

import sys
import os.path
import svn.fs, svn.core, svn.repos

def crawl_filesystem_dir(root, directory):
    """Recursively crawl DIRECTORY under ROOT in the filesystem, and return
    a list of all the paths at or below DIRECTORY."""

    # Print the name of this path.
    print directory + "/"

    # Get the directory entries for DIRECTORY.
    entries = svn.fs.svn_fs_dir_entries(root, directory)

    # Loop over the entries.
    names = entries.keys()
    for name in names:
        # Calculate the entry's full path.
        full_path = directory + '/' + name

        # If the entry is a directory, recurse.  The recursion will return
        # a list with the entry and all its children, which we will add to
        # our running list of paths.
        if svn.fs.svn_fs_is_dir(root, full_path):
            crawl_filesystem_dir(root, full_path)
        else:
            # Else it's a file, so print its path here.
            print full_path

def crawl_youngest(repos_path):
    """Open the repository at REPOS_PATH, and recursively crawl its
    youngest revision."""

    # Open the repository at REPOS_PATH, and get a reference to its
    # versioning filesystem.
    repos_obj = svn.repos.svn_repos_open(repos_path)
    fs_obj = svn.repos.svn_repos_fs(repos_obj)

    # Query the current youngest revision.
    youngest_rev = svn.fs.svn_fs_youngest_rev(fs_obj)

    # Open a root object representing the youngest (HEAD) revision.
    root_obj = svn.fs.svn_fs_revision_root(fs_obj, youngest_rev)

    # Do the recursive crawl.
    crawl_filesystem_dir(root_obj, "")

if __name__ == "__main__":
    # Check for sane usage.
    if len(sys.argv) != 2:
        sys.stderr.write("Usage: %s REPOS_PATH\n"
                         % (os.path.basename(sys.argv[0])))
        sys.exit(1)
```

```
    # Canonicalize the repository path.
    repos_path = svn.core.svn_path_canonicalize(sys.argv[1])

    # Do the real work.
    crawl_youngest(repos_path)
```

This same program in C would need to deal with APR's memory pool system. But Python handles memory usage automatically, and Subversion's Python bindings adhere to that convention. In C, you'd be working with custom datatypes (such as those provided by the APR library) for representing the hash of entries and the list of paths, but Python has hashes (called „dictionaries“) and lists as built-in datatypes, and it provides a rich collection of functions for operating on those types. So SWIG (with the help of some customizations in Subversion's language bindings layer) takes care of mapping those custom datatypes into the native datatypes of the target language. This provides a more intuitive interface for users of that language.

The Subversion Python bindings can be used for working copy operations, too. In the previous section of this chapter, we mentioned the `libsvn_client` interface and how it exists for the sole purpose of simplifying the process of writing a Subversion client. Beispiel 8.3, „A Python status crawler“ is a brief example of how that library can be accessed via the SWIG Python bindings to re-create a scaled-down version of the **svn status** command.

Beispiel 8.3. A Python status crawler

```
#!/usr/bin/env python

"""Crawl a working copy directory, printing status information."""

import sys
import os.path
import getopt
import svn.core, svn.client, svn.wc

def generate_status_code(status):
    """Translate a status value into a single-character status code,
    using the same logic as the Subversion command-line client."""
    code_map = { svn.wc.svn_wc_status_none        : ' ',
                 svn.wc.svn_wc_status_normal      : ' ',
                 svn.wc.svn_wc_status_added       : 'A',
                 svn.wc.svn_wc_status_missing     : '!',
                 svn.wc.svn_wc_status_incomplete  : '!',
                 svn.wc.svn_wc_status_deleted     : 'D',
                 svn.wc.svn_wc_status_replaced    : 'R',
                 svn.wc.svn_wc_status_modified    : 'M',
                 svn.wc.svn_wc_status_merged      : 'G',
                 svn.wc.svn_wc_status_conflicted  : 'C',
                 svn.wc.svn_wc_status_obstructed  : '~',
                 svn.wc.svn_wc_status_ignored     : 'I',
                 svn.wc.svn_wc_status_external    : 'X',
                 svn.wc.svn_wc_status_unversioned : '?',
               }
    return code_map.get(status, '?')

def do_status(wc_path, verbose):
    # Build a client context baton.
    ctx = svn.client.svn_client_ctx_t()

    def _status_callback(path, status):
        """A callback function for svn_client_status."""
```

```
        # Print the path, minus the bit that overlaps with the root of
        # the status crawl
        text_status = generate_status_code(status.text_status)
        prop_status = generate_status_code(status.prop_status)
        print '%s%s  %s' % (text_status, prop_status, path)

    # Do the status crawl, using _status_callback() as our callback function.
    revision = svn.core.svn_opt_revision_t()
    revision.type = svn.core.svn_opt_revision_head
    svn.client.svn_client_status2(wc_path, revision, _status_callback,
                                  svn.core.svn_depth_infinity, verbose,
                                  0, 0, 1, ctx)

def usage_and_exit(errorcode):
    """Print usage message, and exit with ERRORCODE."""
    stream = errorcode and sys.stderr or sys.stdout
    stream.write("""Usage: %s OPTIONS WC-PATH
Options:
  --help, -h    : Show this usage message
  --verbose, -v : Show all statuses, even uninteresting ones
""" % (os.path.basename(sys.argv[0])))
    sys.exit(errorcode)

if __name__ == '__main__':
    # Parse command-line options.
    try:
        opts, args = getopt.getopt(sys.argv[1:], "hv", ["help", "verbose"])
    except getopt.GetoptError:
        usage_and_exit(1)
    verbose = 0
    for opt, arg in opts:
        if opt in ("-h", "--help"):
            usage_and_exit(0)
        if opt in ("-v", "--verbose"):
            verbose = 1
    if len(args) != 1:
        usage_and_exit(2)

    # Canonicalize the repository path.
    wc_path = svn.core.svn_path_canonicalize(args[0])

    # Do the real work.
    try:
        do_status(wc_path, verbose)
    except svn.core.SubversionException, e:
        sys.stderr.write("Error (%d): %s\n" % (e.apr_err, e.message))
        sys.exit(1)
```

As was the case in Beispiel 8.2, „Using the Repository layer with Python“, this program is pool-free and uses, for the most part, normal Python datatypes. The call to `svn_client_ctx_t()` is deceiving because the public Subversion API has no such function—this just happens to be a case where SWIG's automatic language generation bleeds through a little bit (the function is a sort of factory function for Python's version of the corresponding complex C structure). Also note that the path passed to this program (like the last one) gets run through `svn_path_canonicalize()`, because to *not* do so runs the risk of triggering the underlying Subversion C library's assertions about such things, which translates into rather immediate and unceremonious program abortion.

Summary

One of Subversion's greatest features isn't something you get from running its command-line client or other tools. It's the fact that Subversion was designed modularly and provides a stable, public API so that others—like yourself, perhaps—can write custom software that drives Subversion's core logic.

In this chapter, we took a closer look at Subversion's architecture, examining its logical layers and describing that public API, the very same API that Subversion's own layers use to communicate with each other. Many developers have found interesting uses for the Subversion API, from simple repository hook scripts, to integrations between Subversion and some other application, to completely different version control systems. What unique itch will *you* scratch with it?

Kapitel 9. Subversion Complete Reference

This chapter is intended to be a complete reference to using Subversion. This includes the command-line client (**svn**) and all its subcommands, as well as the repository administration programs (**svnadmin** and **svnlook**) and their respective subcommands.

The Subversion Command-Line Client: svn

To use the command-line client, type **svn**, the subcommand you wish to use, [1] and any options or targets that you wish to operate on—the subcommand and the options need not appear in a specific order. For example, all of the following are valid ways to use **svn status**:

```
$ svn -v status
$ svn status -v
$ svn status -v myfile
```

You can find many more examples of how to use most client commands in Kapitel 2, *Grundlegende Benutzung* and commands for managing properties in „Properties“.

svn Options

While Subversion has different options for its subcommands, all options exist in a single namespace—that is, each option is guaranteed to mean the same thing regardless of the subcommand you use it with. For example, `--verbose` (`-v`) always means „verbose output,“ regardless of the subcommand you use it with.

The **svn** command-line client usually exits quickly with an error if you pass it an option which does not apply to the specified subcommand. But as of Subversion 1.5, several of the options which apply to all—or nearly all—of the subcommands have been deemed acceptable by all subcommands, even if they have no effect on some of them. They appear grouped together in the command-line client's usage messages as global options. This was done to assist folks who write scripts which wrap the command-line client. These global options are as follows:

`--config-dir` *`DIR`*
: Instructs Subversion to read configuration information from the specified directory instead of the default location (`.subversion` in the user's home directory).

`--no-auth-cache`
: Prevents caching of authentication information (e.g., username and password) in the Subversion runtime configuration directories.

`--non-interactive`
: Disables all interactive prompting. Some examples of interactive prompting include requests for authentication credentials and conflict resolution decisions. This is useful if you're running Subversion inside an automated script and it's more appropriate to have Subversion fail than to prompt you for more information.

`--password` *`PASSWD`*
: Specifies the password to use when authenticating against a Subversion server. If not provided, or if incorrect, Subversion will prompt you for this information as needed.

[1] Well, you don't need a subcommand to use the `--version` option, but we'll get to that in just a minute.

`--username` *NAME*
: Specifies the username to use when authenticating against a Subversion server. If not provided, or if incorrect, Subversion will prompt you for this information as needed.

The rest of the options apply and are accepted by only a subset of the subcommand. They are as follows:

`--accept` *ACTION*
: Specifies an action for automatic conflict resolution. Possible actions are `postpone`, `base`, `mine-full`, `theirs-full`, `edit`, and `launch`.

`--auto-props`
: Enables auto-props, overriding the `enable-auto-props` directive in the `config` file.

`--change` (`-c`) *ARG*
: Used as a means to refer to a specific „change“ (a.k.a. a revision). This option is syntactic sugar for „-r ARG-1:ARG“.

`--changelist` *ARG*
: Instructs Subversion to operate only on members of the changelist named *ARG*. You can use this option multiple times to specify sets of changelists.

`--cl` *ARG*
: An alias for the `--changelist` option.

`--depth` *ARG*
: Instructs Subversion to limit the scope of an operation to a particular tree depth. *ARG* is one of `empty`, `files`, `immediates`, or `infinity`.

`--diff-cmd` *CMD*
: Specifies an external program to use to show differences between files. When **svn diff** is invoked without this option, it uses Subversion's internal diff engine, which provides unified diffs by default. If you want to use an external diff program, use `--diff-cmd`. You can pass options to the diff program with the `--extensions` option (more on that later in this section).

`--diff3-cmd` *CMD*
: Specifies an external program to use to merge files.

`--dry-run`
: Goes through all the motions of running a command, but makes no actual changes—either on disk or in the repository.

`--editor-cmd` *CMD*
: Specifies an external program to use to edit a log message or a property value. See the `editor-cmd` section in „Config“ for ways to specify a default editor.

`--encoding` *ENC*
: Tells Subversion that your commit message is encoded in the charset provided. The default is your operating system's native locale, and you should specify the encoding if your commit message is in any other encoding.

`--extensions` (`-x`) *ARGS*
: Specifies an argument or arguments that Subversion should pass to an external diff command. This option is valid only when used with the **svn diff** or **svn merge** commands, with the `--diff-cmd` option. If you wish to pass multiple arguments, you must enclose all of them in quotes (e.g., **`svn diff --diff-cmd /usr/bin/diff -x "-b -E"`**).

`--file` (`-F`) *FILENAME*

Uses the contents of the named file for the specified subcommand, though different subcommands do different things with this content. For example, **svn commit** uses the content as a commit log, whereas **svn propset** uses it as a property value.

`--force`
Forces a particular command or operation to run. Subversion will prevent you from performing some operations in normal usage, but you can pass the force option to tell Subversion „I know what I'm doing as well as the possible repercussions of doing it, so let me at 'em.“ This option is the programmatic equivalent of doing your own electrical work with the power on—if you don't know what you're doing, you're likely to get a nasty shock.

`--force-log`
Forces a suspicious parameter passed to the `--message` (`-m`) or `--file` (`-F`) option to be accepted as valid. By default, Subversion will produce an error if parameters to these options look like they might instead be targets of the subcommand. For example, if you pass a versioned file's path to the `--file` (`-F`) option, Subversion will assume you've made a mistake, that the path was instead intended as the target of the operation, and that you simply failed to provide some other—unversioned—file as the source of your log message. To assert your intent and override these types of errors, pass the `--force-log` option to subcommands that accept log messages.

`--help` (`-h`) or `-?`)
If used with one or more subcommands, shows the built-in help text for each. If used alone, it displays the general client help text.

`--ignore-ancestry`
Tells Subversion to ignore ancestry when calculating differences (rely on path contents alone).

`--ignore-externals`
Tells Subversion to ignore externals definitions and the external working copies managed by them.

`--incremental`
Prints output in a format suitable for concatenation.

`--keep-changelists`
Tells Subversion not to delete changelists after committing.

`--keep-local`
Keeps the local copy of a file or directory (used with the **svn delete** command).

`--limit` (`-l`) *`NUM`*
Shows only the first *`NUM`* log messages.

`--message` (`-m`) *`MESSAGE`*
Indicates that you will specify either a log message or a lock comment on the command line, following this option. For example:

```
$ svn commit -m "They don't make Sunday."
```

`--new` *`ARG`*
Uses *`ARG`* as the newer target (for use with **svn diff**).

`--no-auto-props`
Disables auto-props, overriding the `enable-auto-props` directive in the `config` file.

`--no-diff-deleted`
Prevents Subversion from printing differences for deleted files. The default behavior when you remove a file is for **svn diff** to print the same differences that you would see

if you had left the file but removed all the content.

`--no-ignore`
: Shows files in the status listing that would normally be omitted since they match a pattern in the `global-ignores` configuration option or the `svn:ignore` property. See „Config“ and „Ignoring Unversioned Items“ for more information.

`--no-unlock`
: Tells Subversion not to automatically unlock files (the default commit behavior is to unlock all files listed as part of the commit). See „Locking“ for more information.

`--non-recursive` (`-N`)
: *Deprecated*. Stops a subcommand from recursing into subdirectories. Most subcommands recurse by default, but some subcommands—usually those that have the potential to remove or undo your local modifications—do not.

`--notice-ancestry`
: Pays attention to ancestry when calculating differences.

`--old` *`ARG`*
: Uses *`ARG`* as the older target (for use with **svn diff**).

`--parents`
: Creates and adds nonexistent or nonversioned parent subdirectories to the working copy or repository as part of an operation. This is useful for automatically creating multiple subdirectories where none currently exist. If performed on a URL, all the directories will be created in a single commit.

`--quiet` (`-q`)
: Requests that the client print only essential information while performing an operation.

`--record-only`
: Marks revisions as merged (for use with `--revision`).

`--recursive` (`-R`)
: Makes a subcommand recurse into subdirectories. Most subcommands recurse by default.

`--reintegrate`
: Used with the **svn merge** subcommand, merges all of the source URL's changes into the working copy. See „Einen Zweig synchron halten“ for details.

`--relocate` *`FROM TO [PATH...]`*
: Used with the **svn switch** subcommand, changes the location of the repository that your working copy references. This is useful if the location of your repository changes and you have an existing working copy that you'd like to continue to use. See **svn switch** for an example.

`--remove` *`ARG`*
: Disassociates *`ARG`* from a changelist

`--revision` (`-r`) *`REV`*
: Indicates that you're going to supply a revision (or range of revisions) for a particular operation. You can provide revision numbers, keywords, or dates (in curly braces) as arguments to the revision option. If you wish to offer a range of revisions, you can provide two revisions separated by a colon. For example:

```
$ svn log -r 1729
$ svn log -r 1729:HEAD
$ svn log -r 1729:1744
$ svn log -r {2001-12-04}:{2002-02-17}
$ svn log -r 1729:{2002-02-17}
```

See „Revision Keywords" for more information.

`--revprop`
: Operates on a revision property instead of a property specific to a file or directory. This option requires that you also pass a revision with the `--revision` (`-r`) option.

`--set-depth` *ARG*
: Sets the sticky depth on a directory in a working copy to one of `empty`, `files`, `immediates`, or `infinity`.

`--show-revs` *ARG*
: Used to make **svn mergeinfo** display either `merged` or `eligible` revisions.

`--show-updates` (`-u`)
: Causes the client to display information about which files in your working copy are out of date. This doesn't actually update any of your files—it just shows you which files will be updated if you then use **svn update**.

`--stop-on-copy`
: Causes a Subversion subcommand that traverses the history of a versioned resource to stop harvesting that historical information when a copy—that is, a location in history where that resource was copied from another location in the repository—is encountered.

`--strict`
: Causes Subversion to use strict semantics, a notion that is rather vague unless talking about specific subcommands (namely, **svn propget**).

`--targets` *FILENAME*
: Tells Subversion to get the list of files that you wish to operate on from the filename that you provide instead of listing all the files on the command line.

`--use-merge-history` (`-g`)
: Uses or displays additional information from merge history.

`--verbose` (`-v`)
: Requests that the client print out as much information as it can while running any subcommand. This may result in Subversion printing out additional fields, detailed information about every file, or additional information regarding its actions.

`--version`
: Prints the client version info. This information includes not only the version number of the client, but also a listing of all repository access modules that the client can use to access a Subversion repository. With `--quiet` (`-q`) it prints only the version number in a compact form.

`--with-all-revprops`
: Used with the `--xml` option to **svn log**, will retrieve and display all revision properties in the log output.

`--with-revprop` *ARG*
: When used with any command that writes to the repository, sets the revision property, using the *NAME=VALUE* format, *NAME* to *VALUE*. When used with **svn log** in `--xml` mode, this displays the value of *ARG* in the log output.

`--xml`
: Prints output in XML format.

svn Subcommands

Here are the various subcommands for the **svn** program. For the sake of brevity, we omit the global options (described in „svn Options“) from the subcommand descriptions which follow.

Name

svn add — Add files, directories, or symbolic links.

Synopsis

```
svn add PATH...
```

Description

Schedule files, directories, or symbolic links in your working copy for addition to the repository. They will be uploaded and added to the repository on your next commit. If you add something and change your mind before committing, you can unschedule the addition using **svn revert**.

Alternate names

None

Changes

Working copy

Accesses repository

No

Options

```
--auto-props
--depth ARG
--force
--no-auto-props
--no-ignore
--parents
--quiet (-q)
--targets FILENAME
```

Examples

To add a file to your working copy:

```
$ svn add foo.c
A         foo.c
```

When adding a directory, the default behavior of **svn add** is to recurse:

```
$ svn add testdir
A         testdir
A         testdir/a
A         testdir/b
A         testdir/c
A         testdir/d
```

You can add a directory without adding its contents:

```
$ svn add --depth=empty otherdir
A         otherdir
```

Normally, the command **svn add *** will skip over any directories that are already under version control. Sometimes, however, you may want to add every unversioned object in your working copy, including those hiding deeper. Passing the `--force` option makes **svn add** recurse into versioned directories:

```
$ svn add * --force
A         foo.c
A         somedir/bar.c
A  (bin)  otherdir/docs/baz.doc
…
```

Name

svn blame — Show author and revision information inline for the specified files or URLs.

Synopsis

```
svn blame TARGET[@REV]...
```

Description

Show author and revision information inline for the specified files or URLs. Each line of text is annotated at the beginning with the author (username) and the revision number for the last change to that line.

Alternate names

praise, **annotate**, **ann**

Changes

Nothing

Accesses repository

Yes

Options

```
--extensions (-x) ARG
--force
--incremental
--revision (-r) ARG
--use-merge-history (-g)
--verbose (-v)
--xml
```

Examples

If you want to see blame-annotated source for `readme.txt` in your test repository:

```
$ svn blame http://svn.red-bean.com/repos/test/readme.txt
     3      sally This is a README file.
     5      harry You should read this.
```

Even if **svn blame** says that Harry last modified `readme.txt` in revision 5, you'll have to examine exactly what the revision changed to be sure that Harry changed the *context* of the line—he may have adjusted just the whitespace.

If you use the `--xml` option, you can get XML output describing the blame annotations, but not the contents of the lines themselves:

```
$ svn blame --xml http://svn.red-bean.com/repos/test/readme.txt
<?xml version="1.0"?>
<blame>
<target
   path="sandwich.txt">
<entry
```

```
   line-number="1">
<commit
   revision="3">
<author>sally</author>
<date>2008-05-25T19:12:31.428953Z</date>
</commit>
</entry>
<entry
   line-number="2">
<commit
   revision="5">
<author>harry</author>
<date>2008-05-29T03:26:12.293121Z</date>
</commit>
</entry>
</target>
</blame>
```

Name

svn cat — Output the contents of the specified files or URLs.

Synopsis

```
svn cat TARGET[@REV]...
```

Description

Output the contents of the specified files or URLs. For listing the contents of directories, see **svn list** later in this chapter.

Alternate names

None

Changes

Nothing

Accesses repository

Yes

Options

```
--revision (-r) REV
```

Examples

If you want to view `readme.txt` in your repository without checking it out:

```
$ svn cat http://svn.red-bean.com/repos/test/readme.txt
This is a README file.
You should read this.
```

If your working copy is out of date (or you have local modifications) and you want to see the HEAD revision of a file in your working copy, **svn cat -r HEAD *FILENAME*** will automatically fetch the HEAD revision of the specified path:

```
$ cat foo.c
This file is in my local working copy
and has changes that I've made.

$ svn cat -r HEAD foo.c
Latest revision fresh from the repository!
```

Name

svn changelist — Associate (or deassociate) local paths with a changelist.

Synopsis

```
changelist CLNAME TARGET...
```

```
changelist --remove TARGET...
```

Description

Used for dividing files in a working copy into a changelist (logical named grouping) in order to allow users to easily work on multiple file collections within a single working copy.

Alternate names

cl

Changes

Working copy

Accesses repository

No

Options

```
--changelist ARG
--depth ARG
--quiet (-q)
--recursive (-R)
--remove
--targets ARG
```

Example

Edit three files, add them to a changelist, then commit only files in that changelist:

```
$ svn cl issue1729 foo.c bar.c baz.c
Path 'foo.c' is now a member of changelist 'issue1729'.
Path 'bar.c' is now a member of changelist 'issue1729'.
Path 'baz.c' is now a member of changelist 'issue1729'.

$ svn status
A      someotherfile.c
A      test/sometest.c

--- Changelist 'issue1729':
A      foo.c
A      bar.c
A      baz.c

$ svn commit --changelist issue1729 -m "Fixing Issue 1729."
Adding         bar.c
Adding         baz.c
Adding         foo.c
Transmitting file data ...
```

```
Committed revision 2.

$ svn status
A       someotherfile.c
A       test/sometest.c
```

Note that only the files in changelist *issue1729* were committed.

Name

svn checkout — Check out a working copy from a repository.

Synopsis

```
svn checkout URL[@REV]... [PATH]
```

Description

Check out a working copy from a repository. If *PATH* is omitted, the basename of the URL will be used as the destination. If multiple URLs are given, each will be checked out into a subdirectory of *PATH*, with the name of the subdirectory being the basename of the URL.

Alternate names

co

Changes

Creates a working copy

Accesses repository

Yes

Options

```
--depth ARG
--force
--ignore-externals
--quiet (-q)
--revision (-r) REV
```

Examples

Check out a working copy into a directory called `mine`:

```
$ svn checkout file:///var/svn/repos/test mine
A  mine/a
A  mine/b
A  mine/c
A  mine/d
Checked out revision 20.
$ ls
mine
```

Check out two different directories into two separate working copies:

```
$ svn checkout file:///var/svn/repos/test  file:///var/svn/repos/quiz
A  test/a
A  test/b
A  test/c
A  test/d
Checked out revision 20.
A  quiz/l
A  quiz/m
Checked out revision 13.
```

```
$ ls
quiz  test
```

Check out two different directories into two separate working copies, but place both into a directory called `working-copies`:

```
$ svn checkout file:///var/svn/repos/test  file:///var/svn/repos/quiz working-co
A  working-copies/test/a
A  working-copies/test/b
A  working-copies/test/c
A  working-copies/test/d
Checked out revision 20.
A  working-copies/quiz/l
A  working-copies/quiz/m
Checked out revision 13.
$ ls
working-copies
```

If you interrupt a checkout (or something else interrupts your checkout, such as loss of connectivity, etc.), you can restart it either by issuing the identical checkout command again or by updating the incomplete working copy:

```
$ svn checkout file:///var/svn/repos/test mine
A  mine/a
A  mine/b
^C
svn: The operation was interrupted
svn: caught SIGINT

$ svn checkout file:///var/svn/repos/test mine
A  mine/c
^C
svn: The operation was interrupted
svn: caught SIGINT

$ svn update mine
A  mine/d
Updated to revision 20.
```

If you wish to check out some revision other than the most recent one, you can do so by providing the `--revision` (`-r`) option to the **svn checkout** command:

```
$ svn checkout -r 2 file:///var/svn/repos/test mine
A  mine/a
Checked out revision 2.
```

Name

svn cleanup — Recursively clean up the working copy

Synopsis

```
svn cleanup [PATH...]
```

Description

Recursively clean up the working copy, removing working copy locks and resuming unfinished operations. If you ever get a `working copy locked` error, run this command to remove stale locks and get your working copy into a usable state again.

If, for some reason, an **svn update** fails due to a problem running an external diff program (e.g., user input or network failure), pass the `--diff3-cmd` to allow cleanup to complete any merging with your external diff program. You can also specify any configuration directory with the `--config-dir` option, but you should need these options extremely infrequently.

Alternate names

None

Changes

Working copy

Accesses repository

No

Options

```
--diff3-cmd CMD
```

Examples

Well, there's not much to the examples here, as **svn cleanup** generates no output. If you pass no *PATH*, then „`.`“ is used:

```
$ svn cleanup

$ svn cleanup /var/svn/working-copy
```

Name

svn commit — Send changes from your working copy to the repository.

Synopsis

```
svn commit [PATH...]
```

Description

Send changes from your working copy to the repository. If you do not supply a log message with your commit by using either the `--file` or `--message` option, **svn** will launch your editor for you to compose a commit message. See the `editor-cmd` list entry in „Config“.

svn commit will send any lock tokens that it finds and will release locks on all *PATH*s committed (recursively) unless `--no-unlock` is passed.

If you begin a commit and Subversion launches your editor to compose the commit message, you can still abort without committing your changes. If you want to cancel your commit, just quit your editor without saving your commit message and Subversion will prompt you to either abort the commit, continue with no message, or edit the message again.

Alternate names

ci (short for „check in“; not **co**, which is an alias for the **checkout** subcommand)

Changes

Working copy; repository

Accesses repository

Yes

Options

```
--changelist ARG
--depth ARG
--editor-cmd ARG
--encoding ENC
--file (-F) FILE
--force-log
--keep-changelists
--message (-m) TEXT
--no-unlock
--quiet (-q)
--targets FILENAME
--with-revprop ARG
```

Examples

Commit a simple modification to a file with the commit message on the command line and an implicit target of your current directory („`.`“):

```
$ svn commit -m "added howto section."
```

```
Sending        a
Transmitting file data .
Committed revision 3.
```

Commit a modification to the file `foo.c` (explicitly specified on the command line) with the commit message in a file named `msg`:

```
$ svn commit -F msg foo.c
Sending        foo.c
Transmitting file data .
Committed revision 5.
```

If you want to use a file that's under version control for your commit message with `--file`, you need to pass the `--force-log` option:

```
$ svn commit --file file_under_vc.txt foo.c
svn: The log message file is under version control
svn: Log message file is a versioned file; use '--force-log' to override

$ svn commit --force-log --file file_under_vc.txt foo.c
Sending        foo.c
Transmitting file data .
Committed revision 6.
```

To commit a file scheduled for deletion:

```
$ svn commit -m "removed file 'c'."
Deleting       c

Committed revision 7.
```

Name

svn copy — Copy a file or directory in a working copy or in the repository.

Synopsis

```
svn copy SRC[@REV]... DST
```

Description

Copy one or more files in a working copy or in the repository. When copying multiple sources, they will be added as children of *DST*, which must be a directory. *SRC* and *DST* can each be either a working copy (WC) path or URL:

WC # WC
: Copy and schedule an item for addition (with history).

WC # URL
: Immediately commit a copy of WC to URL.

URL # WC
: Check out URL into WC and schedule it for addition.

URL # URL
: Complete server-side copy. This is usually used to branch and tag.

When copying multiple sources, they will be added as children of *DST*, which must be a directory.

If no peg revision (i.e., *@REV*) is supplied, by default the `BASE` revision will be used for files copied from the working copy, while the `HEAD` revision will be used for files copied from a URL.

You can only copy files within a single repository. Subversion does not support cross-repository copying.

Alternate names

cp

Changes

Repository if destination is a URL; working copy if destination is a WC path

Accesses repository

Yes, if source or destination is in the repository, or if needed to look up the source revision number.

Options

```
--editor-cmd EDITOR
--encoding ENC
--file (-F) FILE
--force-log
--message (-m) TEXT
```

```
--parents
--quiet (-q)
--revision (-r) REV
--with-revprop ARG
```

Examples

Copy an item within your working copy (this schedules the copy—nothing goes into the repository until you commit):

```
$ svn copy foo.txt bar.txt
A         bar.txt
$ svn status
A  +   bar.txt
```

Copy several files in a working copy into a subdirectory:

```
$ svn cp bat.c baz.c qux.c src
A         src/bat.c
A         src/baz.c
A         src/qux.c
```

Copy revision 8 of `bat.c` into your working copy under a different name:

```
$ svn cp -r 8 bat.c ya-old-bat.c
A         ya-old-bat.c
```

Copy an item in your working copy to a URL in the repository (this is an immediate commit, so you must supply a commit message):

```
$ svn copy near.txt file:///var/svn/repos/test/far-away.txt -m "Remote copy."

Committed revision 8.
```

Copy an item from the repository to your working copy (this just schedules the copy—nothing goes into the repository until you commit):

```
$ svn copy file:///var/svn/repos/test/far-away -r 6 near-here
A         near-here
```

This is the recommended way to resurrect a dead file in your repository!

And finally, copy between two URLs:

```
$ svn copy file:///var/svn/repos/test/far-away \
           file:///var/svn/repos/test/over-there -m "remote copy."

Committed revision 9.
```

```
$ svn copy file:///var/svn/repos/test/trunk \
           file:///var/svn/repos/test/tags/0.6.32-prerelease -m "tag tree"
```

```
Committed revision 12.
```

This is the easiest way to „tag" a revision in your repository—just **svn copy** that revision (usually `HEAD`) into your `tags` directory.

And don't worry if you forgot to tag—you can always specify an older revision and tag anytime:

```
$ svn copy -r 11 file:///var/svn/repos/test/trunk \
           file:///var/svn/repos/test/tags/0.6.32-prerelease \
           -m "Forgot to tag at rev 11"

Committed revision 13.
```

Name

svn delete — Delete an item from a working copy or the repository.

Synopsis

```
svn delete PATH...
```

```
svn delete URL...
```

Description

Items specified by *PATH* are scheduled for deletion upon the next commit. Files (and directories that have not been committed) are immediately removed from the working copy unless the `--keep-local` option is given. The command will not remove any unversioned or modified items; use the `--force` option to override this behavior.

Items specified by URL are deleted from the repository via an immediate commit. Multiple URLs are committed atomically.

Alternate names

del, **remove**, **rm**

Changes

Working copy if operating on files; repository if operating on URLs

Accesses repository

Only if operating on URLs

Options

```
--editor-cmd EDITOR
--encoding ENC
--file (-F) FILE
--force
--force-log
--keep-local
--message (-m) TEXT
--quiet (-q)
--targets FILENAME
--with-revprop ARG
```

Examples

Using **svn** to delete a file from your working copy deletes your local copy of the file, but it merely schedules the file to be deleted from the repository. When you commit, the file is deleted in the repository.

```
$ svn delete myfile
D         myfile

$ svn commit -m "Deleted file 'myfile'."
Deleting       myfile
Transmitting file data .
Committed revision 14.
```

Deleting a URL, however, is immediate, so you have to supply a log message:

```
$ svn delete -m "Deleting file 'yourfile'" \
             file:///var/svn/repos/test/yourfile

Committed revision 15.
```

Here's an example of how to force deletion of a file that has local mods:

```
$ svn delete over-there
svn: Attempting restricted operation for modified resource
svn: Use --force to override this restriction
svn: 'over-there' has local modifications

$ svn delete --force over-there
D         over-there
```

Name

svn diff — This displays the differences between two revisions or paths.

Synopsis

```
diff [-c M | -r N[:M]] [TARGET[@REV]...]
```

```
diff [-r N[:M]] --old=OLD-TGT[@OLDREV] [--new=NEW-TGT[@NEWREV]] [PATH...]
```

```
diff OLD-URL[@OLDREV] NEW-URL[@NEWREV]
```

Description

- Display the differences between two paths. You can use **svn diff** in the following ways:
- Use just **svn diff** to display local modifications in a working copy.
- Display the changes made to *`TARGET`*s as they are seen in *`REV`* between two revisions. *`TARGET`*s may be all working copy paths or all *`URL`*s. If *`TARGET`*s are working copy paths, *`N`* defaults to `BASE` and *`M`* to the working copy; if *`TARGET`*s are *`URL`*s, *`N`* must be specified and *`M`* defaults to `HEAD`. The `-c M` option is equivalent to `-r N:M` where `N = M-1`. Using `-c -M` does the reverse: `-r M:N` where `N = M-1`.
- Display the differences between *`OLD-TGT`* as it was seen in *`OLDREV`* and *`NEW-TGT`* as it was seen in *`NEWREV`*. *`PATH`*s, if given, are relative to *`OLD-TGT`* and *`NEW-TGT`* and restrict the output to differences for those paths. *`OLD-TGT`* and *`NEW-TGT`* may be working copy paths or *`URL[@REV]`*. *`NEW-TGT`* defaults to *`OLD-TGT`* if not specified. `-r N` makes *`OLDREV`* default to `N`; `-r N:M` makes *`OLDREV`* default to *`N`* and *`NEWREV`* default to *`M`*.

`svn diff OLD-URL[@OLDREV] NEW-URL[@NEWREV]` is shorthand for **`svn diff --old=OLD-URL[@OLDREV] --new=NEW-URL[@NEWREV]`**.

`svn diff -r N:M URL` is shorthand for **`svn diff -r N:M --old=URL --new=URL`**.

`svn diff [-r N[:M]] URL1[@N] URL2[@M]` is shorthand for **`svn diff [-r N[:M]] --old=URL1 --new=URL2`**.

If *`TARGET`* is a URL, then revs `N` and `M` can be given either via the `--revision` option or by using the „@“ notation as described earlier.

If *`TARGET`* is a working copy path, the default behavior (when no `--revision` option is provided) is to display the differences between the base and working copies of *`TARGET`*. If a `--revision` option is specified in this scenario, though, it means:

`--revision N:M`
: The server compares *`TARGET@N`* and *`TARGET@M`*.

`--revision N`
: The client compares *`TARGET@N`* against the working copy.

If the alternate syntax is used, the server compares *`URL1`* and *`URL2`* at revisions *`N`* and *`M`*, respectively. If either *`N`* or *`M`* is omitted, a value of `HEAD` is assumed.

By default, **svn diff** ignores the ancestry of files and merely compares the contents of the two files being compared. If you use `--notice-ancestry`, the ancestry of the paths in question will be taken into consideration when comparing revisions (i.e., if you run **svn diff** on two files with identical contents but different ancestry, you will see the entire contents of the file as having been removed and added again).

Alternate names

di

Changes

Nothing

Accesses repository

For obtaining differences against anything but BASE revision in your working copy

Options

```
--change (-c) ARG
--changelist ARG
--depth ARG
--diff-cmd CMD
--extensions (-x) "ARGS"
--force
--new ARG
--no-diff-deleted
--notice-ancestry
--old ARG
--revision (-r) ARG
--summarize
--xml
```

Examples

Compare BASE and your working copy (one of the most popular uses of **svn diff**):

```
$ svn diff COMMITTERS
Index: COMMITTERS
===================================================================
--- COMMITTERS (revision 4404)
+++ COMMITTERS (working copy)
```

See what changed in the file `COMMITTERS` revision 9115:

```
$ svn diff -c 9115 COMMITTERS
Index: COMMITTERS
===================================================================
--- COMMITTERS (revision 3900)
+++ COMMITTERS (working copy)
```

See how your working copy's modifications compare against an older revision:

```
$ svn diff -r 3900 COMMITTERS
Index: COMMITTERS
===================================================================
--- COMMITTERS (revision 3900)
+++ COMMITTERS (working copy)
```

Compare revision 3000 to revision 3500 using „@“ syntax:

```
$ svn diff http://svn.collab.net/repos/svn/trunk/COMMITTERS@3000 \
           http://svn.collab.net/repos/svn/trunk/COMMITTERS@3500
Index: COMMITTERS
===================================================================
--- COMMITTERS (revision 3000)
+++ COMMITTERS (revision 3500)
…
```

Compare revision 3000 to revision 3500 using range notation (pass only the one URL in this case):

```
$ svn diff -r 3000:3500 http://svn.collab.net/repos/svn/trunk/COMMITTERS
Index: COMMITTERS
===================================================================
--- COMMITTERS (revision 3000)
+++ COMMITTERS (revision 3500)
```

Compare revision 3000 to revision 3500 of all the files in `trunk` using range notation:

```
$ svn diff -r 3000:3500 http://svn.collab.net/repos/svn/trunk
```

Compare revision 3000 to revision 3500 of only three files in `trunk` using range notation:

```
$ svn diff -r 3000:3500 --old http://svn.collab.net/repos/svn/trunk \
           COMMITTERS README HACKING
```

If you have a working copy, you can obtain the differences without typing in the long URLs:

```
$ svn diff -r 3000:3500 COMMITTERS
Index: COMMITTERS
===================================================================
--- COMMITTERS (revision 3000)
+++ COMMITTERS (revision 3500)
```

Use `--diff-cmd` *`CMD`* `-x` to pass arguments directly to the external diff program:

```
$ svn diff --diff-cmd /usr/bin/diff -x "-i -b" COMMITTERS
Index: COMMITTERS
===================================================================
0a1,2
> This is a test
>
```

Lastly, you can use the `--xml` option along with the `--summarize` option to view XML describing the changes that occurred between revisions, but not the contents of the diff itself:

```
$ svn diff --summarize --xml http://svn.red-bean.com/repos/test@r2 \
           http://svn.red-bean.com/repos/test
<?xml version="1.0"?>
<diff>
<paths>
<path
```

```
   props="none"
   kind="file"
   item="modified"&gt;http://svn.red-bean.com/repos/test/sandwich.txt&lt;/path&
<path
   props="none"
   kind="file"
   item="deleted"&gt;http://svn.red-bean.com/repos/test/burrito.txt&lt;/path&gt
<path
   props="none"
   kind="dir"
   item="added"&gt;http://svn.red-bean.com/repos/test/snacks&lt;/path&gt;
</paths>
</diff>
```

Name

svn export — Export a clean directory tree.

Synopsis

```
svn export [-r REV] URL[@PEGREV] [PATH]
```

```
svn export [-r REV] PATH1[@PEGREV] [PATH2]
```

Description

The first form exports a clean directory tree from the repository specified by *URL*—at revision *REV* if it is given; otherwise, at HEAD, into *PATH*. If *PATH* is omitted, the last component of the *URL* is used for the local directory name.

The second form exports a clean directory tree from the working copy specified by *PATH1* into *PATH2*. All local changes will be preserved, but files not under version control will not be copied.

Alternate names

None

Changes

Local disk

Accesses repository

Only if exporting from a URL

Options

```
--depth ARG
--force
--ignore-externals
--native-eol EOL
--quiet (-q)
--revision (-r) REV
```

Examples

Export from your working copy (doesn't print every file and directory):

```
$ svn export a-wc my-export
Export complete.
```

Export directly from the repository (prints every file and directory):

```
$ svn export file:///var/svn/repos my-export
A  my-export/test
A  my-export/quiz
…
Exported revision 15.
```

When rolling operating-system-specific release packages, it can be useful to export a tree that uses a specific EOL character for line endings. The `--native-eol` option will do this, but it affects only files that have `svn:eol-style = native` properties attached to them. For example, to export a tree with all CRLF line endings (possibly for a Windows `.zip` file distribution):

```
$ svn export file:///var/svn/repos my-export --native-eol CRLF
A  my-export/test
A  my-export/quiz
…
Exported revision 15.
```

You can specify `LR`, `CR`, or `CRLF` as a line-ending type with the `--native-eol` option.

Name

svn help — Help!

Synopsis

```
svn help [SUBCOMMAND...]
```

Description

This is your best friend when you're using Subversion and this book isn't within reach!

Alternate names

?, **h**

The options `-?`, `-h`, and `--help` have the same effect as using the **help** subcommand.

Changes

Nothing

Accesses repository

No

Options

Name

svn import — Commit an unversioned file or tree into the repository.

Synopsis

```
svn import [PATH] URL
```

Description

Recursively commit a copy of *PATH* to *URL*. If *PATH* is omitted, „.“ is assumed. Parent directories are created in the repository as necessary. Unversionable items such as device files and pipes are ignored even if `--force` is specified.

Alternate names

None

Changes

Repository

Accesses repository

Yes

Options

```
--auto-props
--depth ARG
--editor-cmd EDITOR
--encoding ENC
--file (-F) FILE
--force
--force-log
--message (-m) TEXT
--no-auto-props
--no-ignore
--quiet (-q)
--with-revprop ARG
```

Examples

This imports the local directory `myproj` into `trunk/misc` in your repository. The directory `trunk/misc` need not exist before you import into it—**svn import** will recursively create directories for you.

```
$ svn import -m "New import" myproj \
             http://svn.red-bean.com/repos/trunk/misc
Adding         myproj/sample.txt
…
Transmitting file data .........
Committed revision 16.
```

Be aware that this will *not* create a directory named `myproj` in the repository. If that's what you want, simply add `myproj` to the end of the URL:

```
$ svn import -m "New import" myproj \
```

```
             http://svn.red-bean.com/repos/trunk/misc/myproj
Adding          myproj/sample.txt
…
Transmitting file data .........
Committed revision 16.
```

After importing data, note that the original tree is *not* under version control. To start working, you still need to **svn checkout** a fresh working copy of the tree.

Name

svn info — Display information about a local or remote item.

Synopsis

```
svn info [TARGET[@REV]...]
```

Description

Print information about the working copy paths or URLs specified. The information shown for both may include:

- Path
- Name
- URL
- Repository root
- Repository UUID
- Revision
- Node kind
- Last changed author
- Last changed revision
- Last changed date
- Lock token
- Lock owner
- Lock created (date)
- Lock expires (date)

Additional kinds of information available only for working copy paths are:

- Schedule
- Copied from URL
- Copied from rev
- Text last updated
- Properties last updated
- Checksum
- Conflict previous base file
- Conflict previous working file

- Conflict current base file
- Conflict properties file

Alternate names

None

Changes

Nothing

Accesses repository

Only if operating on URLs

Options

```
--changelist ARG
--depth ARG
--incremental
--recursive (-R)
--revision (-r) REV
--targets FILENAME
--xml
```

Examples

svn info will show you all the useful information that it has for items in your working copy. It will show information for files:

```
$ svn info foo.c
Path: foo.c
Name: foo.c
URL: http://svn.red-bean.com/repos/test/foo.c
Repository Root: http://svn.red-bean.com/repos/test
Repository UUID: 5e7d134a-54fb-0310-bd04-b611643e5c25
Revision: 4417
Node Kind: file
Schedule: normal
Last Changed Author: sally
Last Changed Rev: 20
Last Changed Date: 2003-01-13 16:43:13 -0600 (Mon, 13 Jan 2003)
Text Last Updated: 2003-01-16 21:18:16 -0600 (Thu, 16 Jan 2003)
Properties Last Updated: 2003-01-13 21:50:19 -0600 (Mon, 13 Jan 2003)
Checksum: d6aeb60b0662ccceb6bce4bac344cb66
```

It will also show information for directories:

```
$ svn info vendors
Path: vendors
URL: http://svn.red-bean.com/repos/test/vendors
Repository Root: http://svn.red-bean.com/repos/test
Repository UUID: 5e7d134a-54fb-0310-bd04-b611643e5c25
Revision: 19
Node Kind: directory
Schedule: normal
Last Changed Author: harry
Last Changed Rev: 19
Last Changed Date: 2003-01-16 23:21:19 -0600 (Thu, 16 Jan 2003)
```

```
Properties Last Updated: 2003-01-16 23:39:02 -0600 (Thu, 16 Jan 2003)
```

svn info also acts on URLs (also note that the file `readme.doc` in this example is locked, so lock information is also provided):

```
$ svn info http://svn.red-bean.com/repos/test/readme.doc
Path: readme.doc
Name: readme.doc
URL: http://svn.red-bean.com/repos/test/readme.doc
Repository Root: http://svn.red-bean.com/repos/test
Repository UUID: 5e7d134a-54fb-0310-bd04-b611643e5c25
Revision: 1
Node Kind: file
Schedule: normal
Last Changed Author: sally
Last Changed Rev: 42
Last Changed Date: 2003-01-14 23:21:19 -0600 (Tue, 14 Jan 2003)
Lock Token: opaquelocktoken:14011d4b-54fb-0310-8541-dbd16bd471b2
Lock Owner: harry
Lock Created: 2003-01-15 17:35:12 -0600 (Wed, 15 Jan 2003)
Lock Comment (1 line):
My test lock comment
```

Lastly, **svn info** output is available in XML format by passing the`--xml` option:

```
$ svn info --xml http://svn.red-bean.com/repos/test
<?xml version="1.0"?>
<info>
<entry
   kind="dir"
   path="."
   revision="1">
<url>http://svn.red-bean.com/repos/test</url>
<repository>
<root>http://svn.red-bean.com/repos/test</root>
<uuid>5e7d134a-54fb-0310-bd04-b611643e5c25</uuid>
</repository>
<wc-info>
<schedule>normal</schedule>
<depth>infinity</depth>
</wc-info>
<commit
   revision="1">
<author>sally</author>
<date>2003-01-15T23:35:12.847647Z</date>
</commit>
</entry>
</info>
```

Name

svn list — List directory entries in the repository.

Synopsis

```
svn list [TARGET[@REV]...]
```

Description

List each *`TARGET`* file and the contents of each *`TARGET`* directory as they exist in the repository. If *`TARGET`* is a working copy path, the corresponding repository URL will be used.

The default *`TARGET`* is „**`.`**“, meaning the repository URL of the current working copy directory.

With `--verbose`, **svn list** shows the following fields for each item:

- Revision number of the last commit
- Author of the last commit
- If locked, the letter „O“ (see the preceding section on svn info for details).
- Size (in bytes)
- Date and time of the last commit

With `--xml`, output is in XML format (with a header and an enclosing document element unless `--incremental` is also specified). All of the information is present; the `--verbose` option is not accepted.

Alternate names

ls

Changes

Nothing

Accesses repository

Yes

Options

```
--depth ARG
--incremental
--recursive (-R)
--revision (-r) REV
--verbose (-v)
--xml
```

Examples

svn list is most useful if you want to see what files a repository has without downloading a working copy:

```
$ svn list http://svn.red-bean.com/repos/test/support
README.txt
INSTALL
examples/
…
```

You can pass the `--verbose` option for additional information, rather like the Unix command **ls -l**:

```
$ svn list --verbose file:///var/svn/repos
     16 sally         28361 Jan 16 23:18 README.txt
     27 sally             0 Jan 18 15:27 INSTALL
     24 harry               Jan 18 11:27 examples/
```

You can also get **svn list** output in XML format with the `--xml` option:

```
$ svn list --xml http://svn.red-bean.com/repos/test
<?xml version="1.0"?>
<lists>
<list
   path="http://svn.red-bean.com/repos/test">
<entry
   kind="dir">
<name>examples</name>
<size>0</size>
<commit
   revision="24">
<author>harry</author>
<date>2008-01-18T06:35:53.048870Z</date>
</commit>
</entry>
...
</list>
</lists>
```

For further details, see the earlier section „svn list“.

Name

svn lock — Lock working copy paths or URLs in the repository so that no other user can commit changes to them.

Synopsis

```
svn lock TARGET...
```

Description

Lock each *TARGET*. If any *TARGET* is already locked by another user, print a warning and continue locking the rest of the *TARGET*s. Use `--force` to steal a lock from another user or working copy.

Alternate names

None

Changes

Working copy, repository

Accesses repository

Yes

Options

```
--encoding ENC
--file (-F) FILE
--force
--force-log
--message (-m) TEXT
--targets FILENAME
```

Examples

Lock two files in your working copy:

```
$ svn lock tree.jpg house.jpg
'tree.jpg' locked by user 'harry'.
'house.jpg' locked by user 'harry'.
```

Lock a file in your working copy that is currently locked by another user:

```
$ svn lock tree.jpg
svn: warning: Path '/tree.jpg is already locked by user 'sally in \
     filesystem '/var/svn/repos/db'

$ svn lock --force tree.jpg
'tree.jpg' locked by user 'harry'.
```

Lock a file without a working copy:

```
$ svn lock http://svn.red-bean.com/repos/test/tree.jpg
```

```
'tree.jpg' locked by user 'harry'.
```

For further details, see „Locking“.

Name

svn log — Display commit log messages.

Synopsis

```
svn log [PATH]
```

```
svn log URL[@REV] [PATH...]
```

Description

Shows log messages from the repository. If no arguments are supplied, **svn log** shows the log messages for all files and directories inside (and including) the current working directory of your working copy. You can refine the results by specifying a path, one or more revisions, or any combination of the two. The default revision range for a local path is `BASE:1`.

If you specify a URL alone, it prints log messages for everything the URL contains. If you add paths past the URL, only messages for those paths under that URL will be printed. The default revision range for a URL is `HEAD:1`.

With `--verbose`, **svn log** will also print all affected paths with each log message. With `--quiet`, **svn log** will not print the log message body itself (this is compatible with `--verbose`).

Each log message is printed just once, even if more than one of the affected paths for that revision were explicitly requested. Logs follow copy history by default. Use `--stop-on-copy` to disable this behavior, which can be useful for determining branch points.

Alternate names

None

Changes

Nothing

Accesses repository

Yes

Options

```
--change (-c) ARG
--incremental
--limit (-l) NUM
--quiet (-q)
--revision (-r) REV
--stop-on-copy
--targets FILENAME
--use-merge-history (-g)
--verbose (-v)
--with-all-revprops
--with-revprop ARG
--xml
```

Examples

You can see the log messages for all the paths that changed in your working copy by running **`svn log`** from the top:

```
$ svn log
------------------------------------------------------------------------
r20 | harry | 2003-01-17 22:56:19 -0600 (Fri, 17 Jan 2003) | 1 line

Tweak.
------------------------------------------------------------------------
r17 | sally | 2003-01-16 23:21:19 -0600 (Thu, 16 Jan 2003) | 2 lines
…
```

Examine all log messages for a particular file in your working copy:

```
$ svn log foo.c
------------------------------------------------------------------------
r32 | sally | 2003-01-13 00:43:13 -0600 (Mon, 13 Jan 2003) | 1 line

Added defines.
------------------------------------------------------------------------
r28 | sally | 2003-01-07 21:48:33 -0600 (Tue, 07 Jan 2003) | 3 lines
…
```

If you don't have a working copy handy, you can log a URL:

```
$ svn log http://svn.red-bean.com/repos/test/foo.c
------------------------------------------------------------------------
r32 | sally | 2003-01-13 00:43:13 -0600 (Mon, 13 Jan 2003) | 1 line

Added defines.
------------------------------------------------------------------------
r28 | sally | 2003-01-07 21:48:33 -0600 (Tue, 07 Jan 2003) | 3 lines
…
```

If you want several distinct paths underneath the same URL, you can use the `URL [PATH...]` syntax:

```
$ svn log http://svn.red-bean.com/repos/test/ foo.c bar.c
------------------------------------------------------------------------
r32 | sally | 2003-01-13 00:43:13 -0600 (Mon, 13 Jan 2003) | 1 line

Added defines.
------------------------------------------------------------------------
r31 | harry | 2003-01-10 12:25:08 -0600 (Fri, 10 Jan 2003) | 1 line

Added new file bar.c
------------------------------------------------------------------------
r28 | sally | 2003-01-07 21:48:33 -0600 (Tue, 07 Jan 2003) | 3 lines
…
```

The `--verbose` option causes **svn log** to include information about the paths that were changed in each displayed revision. These paths appear, one path per line of output, with action codes that indicate what type of change was made to the path.

```
$ svn log -v http://svn.red-bean.com/repos/test/ foo.c bar.c
------------------------------------------------------------------------
r32 | sally | 2003-01-13 00:43:13 -0600 (Mon, 13 Jan 2003) | 1 line
Changed paths:
   M /foo.c
```

```
Added defines.
------------------------------------------------------------------------
r31 | harry | 2003-01-10 12:25:08 -0600 (Fri, 10 Jan 2003) | 1 line
Changed paths:
   A /bar.c

Added new file bar.c
------------------------------------------------------------------------
r28 | sally | 2003-01-07 21:48:33 -0600 (Tue, 07 Jan 2003) | 3 lines
…
```

svn log uses just a handful of action codes, and they are similar to the ones the **svn update** command uses:

`A`
: The item was added.

`D`
: The item was deleted.

`M`
: Properties or textual contents on the item were changed.

`R`
: The item was replaced by a different one at the same location.

In addition to the action codes which precede the changed paths, **svn log** with the `--verbose` option will note whether a path was added or replaced as the result of a copy operation. It does so by printing `(from` *`COPY-FROM-PATH`*`:`*`COPY-FROM-REV`*`)` after such paths.

When you're concatenating the results of multiple calls to the log command, you may want to use the `--incremental` option. **svn log** normally prints out a dashed line at the beginning of a log message, after each subsequent log message, and following the final log message. If you ran **svn log** on a range of two revisions, you would get this:

```
$ svn log -r 14:15
------------------------------------------------------------------------
r14 | …

------------------------------------------------------------------------
r15 | …

------------------------------------------------------------------------
```

However, if you wanted to gather two nonsequential log messages into a file, you might do something like this:

```
$ svn log -r 14 > mylog
$ svn log -r 19 >> mylog
$ svn log -r 27 >> mylog
$ cat mylog
------------------------------------------------------------------------
r14 | …

------------------------------------------------------------------------
------------------------------------------------------------------------
r19 | …
```

```
------------------------------------------------------------------------
------------------------------------------------------------------------
r27 | …

------------------------------------------------------------------------
```

You can avoid the clutter of the double dashed lines in your output by using the `--incremental` option:

```
$ svn log --incremental -r 14 > mylog
$ svn log --incremental -r 19 >> mylog
$ svn log --incremental -r 27 >> mylog
$ cat mylog
------------------------------------------------------------------------
r14 | …

------------------------------------------------------------------------
r19 | …

------------------------------------------------------------------------
r27 | …
```

The `--incremental` option provides similar output control when using the `--xml` option:

```
$ svn log --xml --incremental -r 1 sandwich.txt
<logentry
   revision="1">
<author>harry</author>
<date>2008-06-03T06:35:53.048870Z</date>
<msg>Initial Import.</msg>
</logentry>
```

Sometimes when you run **svn log** on a specific path and a specific revision, you see no log information output at all, as in the following:

```
$ svn log -r 20 http://svn.red-bean.com/untouched.txt
------------------------------------------------------------------------
```

That just means the path wasn't modified in that revision. To get log information for that revision, either run the log operation against the repository's root URL, or specify a path that you happen to know was changed in that revision:

```
$ svn log -r 20 touched.txt
------------------------------------------------------------------------
r20 | sally | 2003-01-17 22:56:19 -0600 (Fri, 17 Jan 2003) | 1 line

Made a change.
------------------------------------------------------------------------
```

Name

svn merge — Apply the differences between two sources to a working copy path.

Synopsis

```
svn merge sourceURL1[@N] sourceURL2[@M] [WCPATH]
```

```
svn merge sourceWCPATH1@N sourceWCPATH2@M [WCPATH]
```

```
svn merge [[-c M]... | [-r N:M]...] [SOURCE[@REV] [WCPATH]]
```

Description

In the first form, the source URLs are specified at revisions *N* and *M*. These are the two sources to be compared. The revisions default to HEAD if omitted.

In the second form, the URLs corresponding to the source working copy paths define the sources to be compared. The revisions must be specified.

In the third form, *SOURCE* can be either a URL or a working copy path (in which case its corresponding URL is used). If not specified, *SOURCE* will be the same as *WCPATH*. *SOURCE* in revision *REV* is compared as it existed between revisions *N* and *M* for each revision range provided. If *REV* is not specified, HEAD is assumed.

`-c M` is equivalent to `-r <M-1>:M`, and `-c -M` does the reverse: `-r M:<M-1>`. If no revision ranges are specified, the default range of `1:HEAD` is used. Multiple `-c` and/or `-r` instances may be specified, and mixing of forward and reverse ranges is allowed—the ranges are internally compacted to their minimum representation before merging begins (which may result in no-op).

WCPATH is the working copy path that will receive the changes. If *WCPATH* is omitted, a default value of „**.**“ is assumed, unless the sources have identical basenames that match a file within „**.**“. In this case, the differences will be applied to that file.

Subversion will internally track metadata about the merge operation only if the two sources are ancestrally related—if the first source is an ancestor of the second or vice versa. This is guaranteed to be the case when using the third form. Unlike **svn diff**, the merge command takes the ancestry of a file into consideration when performing a merge operation. This is very important when you're merging changes from one branch into another and you've renamed a file on one branch but not the other.

Alternate names

None

Changes

Working copy

Accesses repository

Only if working with URLs

Options

```
--accept ARG
--change (-c) REV
```

```
--depth ARG
--diff3-cmd CMD
--dry-run
--extensions (-x) ARG
--force
--ignore-ancestry
--quiet (-q)
--record-only
--reintegrate
--revision (-r) REV
```

Examples

Merge a branch back into the trunk (assuming that you have an up-to-date working copy of the trunk):

```
$ svn merge --reintegrate \
            http://svn.example.com/repos/calc/branches/my-calc-branch
--- Merging differences between repository URLs into '.':
U    button.c
U    integer.c
U    Makefile
 U   .

$ # build, test, verify, ...

$ svn commit -m "Merge my-calc-branch back into trunk!"
Sending        .
Sending        button.c
Sending        integer.c
Sending        Makefile
Transmitting file data ..
Committed revision 391.
```

To merge changes to a single file:

```
$ cd myproj
$ svn merge -r 30:31 thhgttg.txt
U  thhgttg.txt
```

Name

svn mergeinfo — Query merge-related information. See „Mergeinfo und Vorschauen“ for details.

Synopsis

```
svn mergeinfo SOURCE_URL[@REV] [TARGET[@REV]...]
```

Description

Query information related to merges (or potential merges) between *SOURCE-URL* and *TARGET*. If the `--show-revs` option is not provided, display revisions which have been merged from *SOURCE-URL* to *TARGET*. Otherwise, display either `merged` or `eligible` revisions as specified by the `--show-revs` option.

Alternate names

None

Changes

Nothing

Accesses repository

Yes

Options

```
--revision (-r) REV
```

Examples

Find out which changesets your trunk directory has already received as well as what changesets it's still eligible to receive:

```
$ svn mergeinfo branches/test
Path: branches/test
  Source path: /trunk
    Merged ranges: r2:13
    Eligible ranges: r13:15
```

Name

svn mkdir — Create a new directory under version control.

Synopsis

```
svn mkdir PATH...
```

```
svn mkdir URL...
```

Description

Create a directory with a name given by the final component of the *PATH* or *URL*. A directory specified by a working copy *PATH* is scheduled for addition in the working copy. A directory specified by a URL is created in the repository via an immediate commit. Multiple directory URLs are committed atomically. In both cases, all the intermediate directories must already exist unless the `--parents` option is used.

Alternate names

None

Changes

Working copy; repository if operating on a URL

Accesses repository

Only if operating on a URL

Options

```
--editor-cmd EDITOR
--encoding ENC
--file (-F) FILE
--force-log
--message (-m) TEXT
--parents
--quiet (-q)
--with-revprop ARG
```

Examples

Create a directory in your working copy:

```
$ svn mkdir newdir
A         newdir
```

Create one in the repository (this is an instant commit, so a log message is required):

```
$ svn mkdir -m "Making a new dir." http://svn.red-bean.com/repos/newdir

Committed revision 26.
```

Name

svn move — Move a file or directory.

Synopsis

```
svn move SRC... DST
```

Description

This command moves files or directories in your working copy or in the repository.

This command is equivalent to an **svn copy** followed by **svn delete**.

When moving multiple sources, they will be added as children of *DST*, which must be a directory.

Subversion does not support moving between working copies and URLs. In addition, you can only move files within a single repository—Subversion does not support cross-repository moving. Subversion supports the following types of moves within a single repository:

WC # WC
: Move and schedule a file or directory for addition (with history).

URL # URL
: Complete server-side rename.

Alternate names

mv, **rename**, **ren**

Changes

Working copy; repository if operating on a URL

Accesses repository

Only if operating on a URL

Options

```
--editor-cmd EDITOR
--encoding ENC
--file (-F) FILE
--force
--force-log
--message (-m) TEXT
--parents
--quiet (-q)
--revision (-r) REV
--with-revprop ARG
```

Examples

Move a file in your working copy:

```
$ svn move foo.c bar.c
A         bar.c
D         foo.c
```

Move several files in your working copy into a subdirectory:

```
$ svn move baz.c bat.c qux.c src
A         src/baz.c
D         baz.c
A         src/bat.c
D         bat.c
A         src/qux.c
D         qux.c
```

Move a file in the repository (this is an immediate commit, so it requires a commit message):

```
$ svn move -m "Move a file" http://svn.red-bean.com/repos/foo.c \
                            http://svn.red-bean.com/repos/bar.c

Committed revision 27.
```

Name

svn propdel — Remove a property from an item.

Synopsis

```
svn propdel PROPNAME [PATH...]
```

```
svn propdel PROPNAME --revprop -r REV [TARGET]
```

Description

This removes properties from files, directories, or revisions. The first form removes versioned properties in your working copy, and the second removes unversioned remote properties on a repository revision (*TARGET* determines only which repository to access).

Alternate names

pdel, **pd**

Changes

Working copy; repository only if operating on a URL

Accesses repository

Only if operating on a URL

Options

```
--changelist ARG
--depth ARG
--quiet (-q)
--recursive (-R)
--revision (-r) REV
--revprop
```

Examples

Delete a property from a file in your working copy:

```
$ svn propdel svn:mime-type some-script
property 'svn:mime-type' deleted from 'some-script'.
```

Delete a revision property:

```
$ svn propdel --revprop -r 26 release-date
property 'release-date' deleted from repository revision '26'
```

Name

svn propedit — Edit the property of one or more items under version control. See svn propset later in this chapter.

Synopsis

```
svn propedit PROPNAME TARGET...
```

```
svn propedit PROPNAME --revprop -r REV [TARGET]
```

Description

Edit one or more properties using your favorite editor. The first form edits versioned properties in your working copy, and the second edits unversioned remote properties on a repository revision (*TARGET* determines only which repository to access).

Alternate names

pedit, **pe**

Changes

Working copy; repository only if operating on a URL

Accesses repository

Only if operating on a URL

Options

```
--editor-cmd EDITOR
--encoding ENC
--file (-F) ARG
--force
--force-log
--message (-m) ARG
--revision (-r) REV
--revprop
--with-revprop ARG
```

Examples

svn propedit makes it easy to modify properties that have multiple values:

```
$ svn propedit svn:keywords  foo.c
    <svn will launch your favorite editor here, with a buffer open
    containing the current contents of the svn:keywords property.  You
    can add multiple values to a property easily here by entering one
    value per line.>
Set new value for property 'svn:keywords' on 'foo.c'
```

Name

svn propget — Print the value of a property.

Synopsis

```
svn propget PROPNAME [TARGET[@REV]...]
```

```
svn propget PROPNAME --revprop -r REV [URL]
```

Description

Print the value of a property on files, directories, or revisions. The first form prints the versioned property of an item or items in your working copy, and the second prints unversioned remote properties on a repository revision. See „Properties“ for more information on properties.

Alternate names

pget, **pg**

Changes

Working copy; repository only if operating on a URL

Accesses repository

Only if operating on a URL

Options

```
--changelist ARG
--depth ARG
--recursive (-R)
--revision (-r) REV
--revprop
--strict
--xml
```

Examples

Examine a property of a file in your working copy:

```
$ svn propget svn:keywords foo.c
Author
Date
Rev
```

The same goes for a revision property:

```
$ svn propget svn:log --revprop -r 20
Began journal.
```

Lastly, you can get **svn propget** output in XML format with the `--xml` option:

```
$ svn propget --xml svn:ignore .
<?xml version="1.0"?>
<properties>
<target
   path="">
<property
   name="svn:ignore">*.o
</property>
</target>
</properties>
```

Name

svn proplist — List all properties.

Synopsis

```
svn proplist [TARGET[@REV]...]
```

```
svn proplist --revprop -r REV [TARGET]
```

Description

List all properties on files, directories, or revisions. The first form lists versioned properties in your working copy, and the second lists unversioned remote properties on a repository revision (*`TARGET`* determines only which repository to access).

Alternate names

plist, **pl**

Changes

Working copy; repository only if operating on a URL

Accesses repository

Only if operating on a URL

Options

```
--changelist ARG
--depth ARG
--quiet (-q)
--recursive (-R)
--revision (-r) REV
--revprop
--verbose (-v)
--xml
```

Examples

You can use **proplist** to see the properties on an item in your working copy:

```
$ svn proplist foo.c
Properties on 'foo.c':
  svn:mime-type
  svn:keywords
  owner
```

But with the `--verbose` flag, **svn proplist** is extremely handy as it also shows you the values for the properties:

```
$ svn proplist --verbose foo.c
Properties on 'foo.c':
  svn:mime-type : text/plain
  svn:keywords : Author Date Rev
  owner : sally
```

Lastly, you can get **svn proplist** output in xml format with the `--xml` option:

```
$ svn proplist --xml
<?xml version="1.0"?>
<properties>
<target
   path=".">
<property
   name="svn:ignore"/>
</target>
</properties>
```

Name

svn propset — Set *PROPNAME* to *PROPVAL* on files, directories, or revisions.

Synopsis

```
svn propset PROPNAME [PROPVAL | -F VALFILE] PATH...
```

```
svn propset PROPNAME --revprop -r REV [PROPVAL | -F VALFILE] [TARGET]
```

Description

Set *PROPNAME* to *PROPVAL* on files, directories, or revisions. The first example creates a versioned, local property change in the working copy, and the second creates an unversioned, remote property change on a repository revision (*TARGET* determines only which repository to access).

Subversion has a number of „special" properties that affect its behavior. See „Subversion Properties" later in this chapter for more on these properties.

Alternate names

pset, *ps*

Changes

Working copy; repository only if operating on a URL

Accesses repository

Only if operating on a URL

Options

```
--changelist ARG
--depth ARG
--encoding ENC
--file (-F) FILE
--force
--quiet (-q)
--recursive (-R)
--revision (-r) REV
--revprop
--targets FILENAME
```

Examples

Set the MIME type for a file:

```
$ svn propset svn:mime-type image/jpeg foo.jpg
property 'svn:mime-type' set on 'foo.jpg'
```

On a Unix system, if you want a file to have the executable permission set:

```
$ svn propset svn:executable ON somescript
property 'svn:executable' set on 'somescript'
```

Perhaps you have an internal policy to set certain properties for the benefit of your coworkers:

```
$ svn propset owner sally foo.c
property 'owner' set on 'foo.c'
```

If you made a mistake in a log message for a particular revision and want to change it, use `--revprop` and set `svn:log` to the new log message:

```
$ svn propset --revprop -r 25 svn:log "Journaled about trip to New York."
property 'svn:log' set on repository revision '25'
```

Or, if you don't have a working copy, you can provide a URL:

```
$ svn propset --revprop -r 26 svn:log "Document nap." \
              http://svn.red-bean.com/repos
property 'svn:log' set on repository revision '25'
```

Lastly, you can tell **propset** to take its input from a file. You could even use this to set the contents of a property to something binary:

```
$ svn propset owner-pic -F sally.jpg moo.c
property 'owner-pic' set on 'moo.c'
```

By default, you cannot modify revision properties in a Subversion repository. Your repository administrator must explicitly enable revision property modifications by creating a hook named `pre-revprop-change`. See „Implementing Repository Hooks“ for more information on hook scripts.

Name

svn resolve — Resolve conflicts on working copy files or directories.

Synopsis

```
svn resolve PATH...
```

Description

Resolve „conflicted“ state on working copy files or directories. This routine does not semantically resolve conflict markers; however, it replaces *PATH* with the version specified by the `--accept` argument and then removes conflict-related artifact files. This allows *PATH* to be committed again—that is, it tells Subversion that the conflicts have been „resolved.“. You can pass the following arguments to the `--accept` command depending on your desired resolution:

`base`
: Choose the file that was the BASE revision before you updated your working copy. That is, the file that you checked out before you made your latest edits.

`working`
: Assuming that you've manually handled the conflict resolution, choose the version of the file as it currently stands in your working copy.

`mine-full`
: Resolve all conflicted files with copies of the files as they stood immediately before you ran **svn update**.

`theirs-full`
: Resolve all conflicted files with copies of the files that were fetched from the server when you ran **svn update**.

See „Konflikte auflösen (Änderungen anderer einarbeiten)“ for an in-depth look at resolving conflicts.

Alternate names

None

Changes

Working copy

Accesses repository

No

Options

```
--accept ARG
--depth ARG
--quiet (-q)
--recursive (-R)
--targets FILENAME
```

Examples

Here's an example where, after a postponed conflict resolution during update, **svn resolve** replaces the all conflicts in file `foo.c` with your edits:

```
$ svn up
Conflict discovered in 'foo.c'.
Select: (p) postpone, (df) diff-full, (e) edit,
        (h) help for more options: p
C    foo.c
Updated to revision 5.

$ svn resolve --accept mine-full foo.c
Resolved conflicted state of 'foo.c'
```

Name

svn resolved — *Deprecated*. Remove „conflicted“ state on working copy files or directories.

Synopsis

```
svn resolved PATH...
```

Description

This command has been deprecated in favor of running **`svn resolve --accept working PATH`**. See svn resolve in the preceding section for details.

Remove „conflicted“ state on working copy files or directories. This routine does not semantically resolve conflict markers; it merely removes conflict-related artifact files and allows *PATH* to be committed again; that is, it tells Subversion that the conflicts have been „resolved.“ See „Konflikte auflösen (Änderungen anderer einarbeiten)“ for an in-depth look at resolving conflicts.

Alternate names

None

Changes

Working copy

Accesses repository

No

Options

```
--depth ARG
--quiet (-q)
--recursive (-R)
--targets FILENAME
```

Examples

If you get a conflict on an update, your working copy will sprout three new files:

```
$ svn update
C  foo.c
Updated to revision 31.
$ ls
foo.c
foo.c.mine
foo.c.r30
foo.c.r31
```

Once you've resolved the conflict and `foo.c` is ready to be committed, run **svn resolved** to let your working copy know you've taken care of everything.

You *can* just remove the conflict files and commit, but **svn resolved** fixes up some bookkeeping data in the working copy administrative area in addition to removing the conflict files, so we recommend that you use this command.

Name

svn revert — Undo all local edits.

Synopsis

```
svn revert PATH...
```

Description

Reverts any local changes to a file or directory and resolves any conflicted states. **svn revert** will revert not only the contents of an item in your working copy, but also any property changes. Finally, you can use it to undo any scheduling operations that you may have performed (e.g., files scheduled for addition or deletion can be „unscheduled“).

Alternate names

None

Changes

Working copy

Accesses repository

No

Options

```
--changelist ARG
--depth ARG
--quiet (-q)
--recursive (-R)
--targets FILENAME
```

Examples

Discard changes to a file:

```
$ svn revert foo.c
Reverted foo.c
```

If you want to revert a whole directory of files, use the `--depth=infinity` option:

```
$ svn revert --depth=infinity .
Reverted newdir/afile
Reverted foo.c
Reverted bar.txt
```

Lastly, you can undo any scheduling operations:

```
$ svn add mistake.txt whoops
A         mistake.txt
A         whoops
A         whoops/oopsie.c
```

```
$ svn revert mistake.txt whoops
Reverted mistake.txt
Reverted whoops

$ svn status
?      mistake.txt
?      whoops
```

svn revert is inherently dangerous, since its entire purpose is to throw away data—namely, your uncommitted changes. Once you've reverted, Subversion provides *no way* to get back those uncommitted changes.

If you provide no targets to **svn revert**, it will do nothing—to protect you from accidentally losing changes in your working copy, **svn revert** requires you to provide at least one target.

Name

svn status — Print the status of working copy files and directories.

Synopsis

```
svn status [PATH...]
```

Description

Print the status of working copy files and directories. With no arguments, it prints only locally modified items (no repository access). With `--show-updates`, it adds working revision and server out-of-date information. With `--verbose`, it prints full revision information on every item. With `--quiet`, it prints only summary information about locally modified items.

The first six columns in the output are each one character wide, and each column gives you information about different aspects of each working copy item.

The first column indicates that an item was added, deleted, or otherwise changed:

`' '`
: No modifications.

`'A'`
: Item is scheduled for addition.

`'D'`
: Item is scheduled for deletion.

`'M'`
: Item has been modified.

`'R'`
: Item has been replaced in your working copy. This means the file was scheduled for deletion, and then a new file with the same name was scheduled for addition in its place.

`'C'`
: The contents (as opposed to the properties) of the item conflict with updates received from the repository.

`'X'`
: Item is present because of an externals definition.

`'I'`
: Item is being ignored (e.g., with the `svn:ignore` property).

`'?'`
: Item is not under version control.

`'!'`
: Item is missing (e.g., you moved or deleted it without using **svn**). This also indicates that a directory is incomplete (a checkout or update was interrupted).

`'~'`
: Item is versioned as one kind of object (file, directory, link), but has been replaced by a different kind of object.

The second column tells the status of a file's or directory's properties:

`' '`
: No modifications.

`'M'`
: Properties for this item have been modified.

`'C'`
: Properties for this item are in conflict with property updates received from the repository.

The third column is populated only if the working copy directory is locked (see „Manchmal müssen Sie einfach nur aufräumen“):

`' '`
: Item is not locked.

`'L'`
: Item is locked.

The fourth column is populated only if the item is scheduled for addition-with-history:

`' '`
: No history scheduled with commit.

`'+'`
: History scheduled with commit.

The fifth column is populated only if the item is switched relative to its parent (see „Traversing Branches“):

`' '`
: Item is a child of its parent directory.

`'S'`
: Item is switched.

The sixth column is populated with lock information:

`' '`
: When `--show-updates` is used, the file is not locked. If `--show-updates` is *not* used, this merely means that the file is not locked in this working copy.

K
: File is locked in this working copy.

O
: File is locked either by another user or in another working copy. This appears only when `--show-updates` is used.

T
: File was locked in this working copy, but the lock has been „stolen“ and is invalid. The file is currently locked in the repository. This appears only when `--show-updates` is

used.

B
: File was locked in this working copy, but the lock has been „broken“ and is invalid. The file is no longer locked. This appears only when `--show-updates` is used.

The out-of-date information appears in the seventh column (only if you pass the `--show-updates` option):

`' '`
: The item in your working copy is up to date.

`'*'`
: A newer revision of the item exists on the server.

The remaining fields are variable width and delimited by spaces. The working revision is the next field if the `--show-updates` or `--verbose` option is passed.

If the `--verbose` option is passed, the last committed revision and last committed author are displayed next.

The working copy path is always the final field, so it can include spaces.

Alternate names

stat, **st**

Changes

Nothing

Accesses repository

Only if using `--show-updates`

Options

```
--changelist ARG
--depth ARG
--ignore-externals
--incremental
--no-ignore
--quiet (-q)
--show-updates (-u)
--verbose (-v)
--xml
```

Examples

This is the easiest way to find out what changes you have made to your working copy:

```
$ svn status wc
 M     wc/bar.c
A  +   wc/qax.c
```

If you want to find out what files in your working copy are out of date, pass the `--show-updates` option (this will *not* make any changes to your working copy). Here you can see that `wc/foo.c` has changed in the repository since we last updated our working copy:

```
$ svn status --show-updates wc
 M           965    wc/bar.c
       *     965    wc/foo.c
A  +         965    wc/qax.c
Status against revision:    981
```

`--show-updates` *only* places an asterisk next to items that are out of date (i.e., items that will be updated from the repository if you later use **svn update**). `--show-updates` does *not* cause the status listing to reflect the repository's version of the item (although you can see the revision number in the repository by passing the `--verbose` option).

The most information you can get out of the status subcommand is as follows:

```
$ svn status --show-updates --verbose wc
 M           965       938 sally        wc/bar.c
       *     965       922 harry        wc/foo.c
A  +         965       687 harry        wc/qax.c
             965       687 harry        wc/zig.c
Head revision:   981
```

Lastly, you can get **svn status** output in XML format with the `--xml` option:

```
$ svn status --xml wc
<?xml version="1.0"?>
<status>
<target
   path="wc">
<entry
   path="qax.c">
<wc-status
   props="none"
   item="added"
   revision="0">
</wc-status>
</entry>
<entry
   path="bar.c">
<wc-status
   props="normal"
   item="modified"
   revision="965">
<commit
   revision="965">
<author>sally</author>
<date>2008-05-28T06:35:53.048870Z</date>
</commit>
</wc-status>
</entry>
</target>
</status>
```

For many more examples of **svn status**, see „Verschaffen Sie sich einen Überblick über Ihre Änderungen“.

Name

svn switch — Update working copy to a different URL.

Synopsis

```
svn switch URL[@PEGREV] [PATH]
```

```
switch --relocate FROM TO [PATH...]
```

Description

The first variant of this subcommand (without the `--relocate` option) updates your working copy to point to a new URL—usually a URL that shares a common ancestor with your working copy, although not necessarily. This is the Subversion way to move a working copy to a new branch. If specified, *PEGREV* determines in which revision the target is first looked up. See „Traversing Branches“ for an in-depth look at switching.

If `--force` is used, unversioned obstructing paths in the working copy do not automatically cause a failure if the switch attempts to add the same path. If the obstructing path is the same type (file or directory) as the corresponding path in the repository, it becomes versioned but its contents are left untouched in the working copy. This means that an obstructing directory's unversioned children may also obstruct and become versioned. For files, any content differences between the obstruction and the repository are treated like a local modification to the working copy. All properties from the repository are applied to the obstructing path.

As with most subcommands, you can limit the scope of the switch operation to a particular tree depth using the `--depth` option. Alternatively, you can use the `--set-depth` option to set a new „sticky“ working copy depth on the switch target. Currently, the depth of a working copy directory can only be increased (telescoped more deeply); you cannot make a directory more shallow.

The `--relocate` option causes **svn switch** to do something different: it updates your working copy to point to *the same* repository directory, only at a different URL (typically because an administrator has moved the repository to another server, or to another URL on the same server).

Alternate names

sw

Changes

Working copy

Accesses repository

Yes

Options

```
--accept ARG
--depth ARG
--diff3-cmd CMD
--force
--ignore-externals
--quiet (-q)
--relocate
```

```
--revision (-r) REV
--set-depth ARG
```

Examples

If you're currently inside the directory `vendors`, which was branched to `vendors-with-fix`, and you'd like to switch your working copy to that branch:

```
$ svn switch http://svn.red-bean.com/repos/branches/vendors-with-fix .
U  myproj/foo.txt
U  myproj/bar.txt
U  myproj/baz.c
U  myproj/qux.c
Updated to revision 31.
```

To switch back, just provide the URL to the location in the repository from which you originally checked out your working copy:

```
$ svn switch http://svn.red-bean.com/repos/trunk/vendors .
U  myproj/foo.txt
U  myproj/bar.txt
U  myproj/baz.c
U  myproj/qux.c
Updated to revision 31.
```

You can switch just part of your working copy to a branch if you don't want to switch your entire working copy.

Sometimes an administrator might change the location (or apparent location) of your repository—in other words, the content of the repository doesn't change, but the repository's root URL does. For example, the hostname may change, the URL scheme may change, or any part of the URL that leads to the repository itself may change. Rather than check out a new working copy, you can have the **svn switch** command „rewrite“ your working copy's administrative metadata to refer to the new repository location. If you use the `--relocate` option to **svn switch**, Subversion will contact the repository to validate the relocation request (looking for the repository at the new URL, of course), and then do this metadata rewriting. No file contents will be changed as the result of this type of switch operation—this is a metadata-only modification to the working copy.

```
$ svn checkout file:///var/svn/repos test
A  test/a
A  test/b
…

$ mv repos newlocation
$ cd test/

$ svn update
svn: Unable to open an ra_local session to URL
svn: Unable to open repository 'file:///var/svn/repos'

$ svn switch --relocate file:///var/svn/repos file:///tmp/newlocation .
$ svn update
At revision 3.
```

Be careful when using the `--relocate` option. If you mistype the argument, you might end up creating nonsensical URLs within your working copy that render the whole workspace unusable and tricky to fix. It's also important to understand exactly when one should or shouldn't use `--relocate`. Here's the rule of thumb:

- If the working copy needs to reflect a new directory *within* the repository, use just **svn switch**.
- If the working copy still reflects the same repository directory, but the location of the repository itself has changed, use **svn switch** with the `--relocate` option.

Name

svn unlock — Unlock working copy paths or URLs.

Synopsis

```
svn unlock TARGET...
```

Description

Unlock each *TARGET*. If any *TARGET* is locked by another user or no valid lock token exists in the working copy, print a warning and continue unlocking the rest of the *TARGET*s. Use `--force` to break a lock belonging to another user or working copy.

Alternate names

None

Changes

Working copy, repository

Accesses repository

Yes

Options

```
--force
--targets FILENAME
```

Examples

Unlock two files in your working copy:

```
$ svn unlock tree.jpg house.jpg
'tree.jpg' unlocked.
'house.jpg' unlocked.
```

Unlock a file in your working copy that is currently locked by another user:

```
$ svn unlock tree.jpg
svn: 'tree.jpg' is not locked in this working copy
$ svn unlock --force tree.jpg
'tree.jpg' unlocked.
```

Unlock a file without a working copy:

```
$ svn unlock http://svn.red-bean.com/repos/test/tree.jpg
'tree.jpg unlocked.
```

For further details, see „Locking“.

Name

svn update — Update your working copy.

Synopsis

```
svn update [PATH...]
```

Description

svn update brings changes from the repository into your working copy. If no revision is given, it brings your working copy up to date with the `HEAD` revision. Otherwise, it synchronizes the working copy to the revision given by the `--revision` option. As part of the synchronization, **svn update** also removes any stale locks (see „Manchmal müssen Sie einfach nur aufräumen“) found in the working copy.

For each updated item, it prints a line that starts with a character reporting the action taken. These characters have the following meaning:

`A`
: Added

`B`
: Broken lock (third column only)

`D`
: Deleted

`U`
: Updated

`C`
: Conflicted

`G`
: Merged

`E`
: Existed

A character in the first column signifies an update to the actual file, whereas updates to the file's properties are shown in the second column. Lock information is printed in the third column.

As with most subcommands, you can limit the scope of the update operation to a particular tree depth using the `--depth` option. Alternatively, you can use the `--set-depth` option to set a new „sticky“ working copy depth on the update target. Currently, the depth of a working copy directory can only be increased (telescoped more deeply); you cannot make a directory more shallow.

Alternate names

up

Changes

Working copy

Accesses repository

Yes

Options

```
--accept ARG
--changelist
--depth ARG
--diff3-cmd CMD
--editor-cmd ARG
--force
--ignore-externals
--quiet (-q)
--revision (-r) REV
--set-depth ARG
```

Examples

Pick up repository changes that have happened since your last update:

```
$ svn update
A  newdir/toggle.c
A  newdir/disclose.c
A  newdir/launch.c
D  newdir/README
Updated to revision 32.
```

You can also „update“ your working copy to an older revision (Subversion doesn't have the concept of „sticky“ files like CVS does; see Anhang B, *Subversion for CVS Users*):

```
$ svn update -r30
A  newdir/README
D  newdir/toggle.c
D  newdir/disclose.c
D  newdir/launch.c
U  foo.c
Updated to revision 30.
```

If you want to examine an older revision of a single file, you may want to use **svn cat** instead—it won't change your working copy.

svnadmin

svnadmin is the administrative tool for monitoring and repairing your Subversion repository. For detailed information on repository administration, see the maintenance section for „svnadmin“.

Since **svnadmin** works via direct repository access (and thus can only be used on the machine that holds the repository), it refers to the repository with a path, not a URL.

svnadmin Options

Options in **svmadin** are global, just as they are in **svn**:

`--bdb-log-keep`
: (Berkeley DB-specific.) Disable automatic log removal of database logfiles. Having

these logfiles around can be convenient if you need to restore from a catastrophic repository failure.

`--bdb-txn-nosync`
: (Berkeley DB-specific.) Disables fsync when committing database transactions. Used with the **svnadmin create** command to create a Berkeley DB-backed repository with `DB_TXN_NOSYNC` enabled (which improves speed but has some risks associated with it).

`--bypass-hooks`
: Bypass the repository hook system.

`--clean-logs`
: Remove unused Berkeley DB logs.

`--force-uuid`
: By default, when loading data into repository that already contains revisions, **svnadmin** will ignore the `UUID` from the dump stream. This option will cause the repository's `UUID` to be set to the `UUID` from the stream.

`--ignore-uuid`
: By default, when loading an empty repository, **svnadmin** will ignore the `UUID` from the dump stream. This option will force that UUID to be ignored (useful for overriding your configuration file if it has `--force-uuid` set).

`--incremental`
: Dump a revision only as a diff against the previous revision, instead of the usual fulltext.

`--parent-dir` *`DIR`*
: When loading a dump file, root paths at *`DIR`* instead of `/`.

`--pre-1.4-compatible`
: When creating a new repository, use a format that is compatible with versions of Subversion earlier than Subversion 1.4.

`--pre-1.5-compatible`
: When creating a new repository, use a format that is compatible with versions of Subversion earlier than Subversion 1.5.

`--revision` (`-r`) *`ARG`*
: Specify a particular revision to operate on.

`--quiet`
: Do not show normal progress—show only errors.

`--use-post-commit-hook`
: When loading a dump file, runs the repository's `post-commit` hook after finalizing each newly loaded revision.

`--use-post-revprop-change-hook`
: When changing a revision property, runs the repository's `post-revprop-change` hook after changing the revision property.

`--use-pre-commit-hook`
: When loading a dump file, runs the repository's `pre-commit` hook before finalizing each newly loaded revision. If the hook fails, aborts the commit and terminates the load process.

`--use-pre-revprop-change-hook`
: When changing a revision property, runs the repository's `pre-revprop-change` hook before changing the revision property. If the hook fails, aborts the modification and terminates.

svnadmin Subcommands

Here are the various subcommands for the **svnadmin** program.

Name

svnadmin crashtest — Simulate a process that crashes.

Synopsis

```
svnadmin crashtest REPOS_PATH
```

Description

Open the repository at *REPOS_PATH*, then abort, thus simulating a process that crashes while holding an open repository handle. This is used for testing automatic repository recovery (a new feature in Berkeley DB 4.4). It's unlikely that you'll need to run this command.

Options

None

Examples

```
$ svnadmin crashtest /var/svn/repos
Aborted
```

Exciting, isn't it?

Name

svnadmin create — Create a new, empty repository.

Synopsis

```
svnadmin create REPOS_PATH
```

Description

Create a new, empty repository at the path provided. If the provided directory does not exist, it will be created for you. [1] As of Subversion 1.2, **svnadmin** creates new repositories with the FSFS filesystem backend by default.

While **svnadmin create** will create the base directory for a new repository, it will not create intermediate directories. For example, if you have an empty directory named `/var/svn`, creating `/var/svn/repos` will work, while attempting to create `/var/svn/subdirectory/repos` will fail with an error.

Options

```
--bdb-log-keep
--bdb-txn-nosync
--config-dir DIR
--fs-type TYPE
--pre-1.4-compatible
--pre-1.5-compatible
```

Examples

Creating a new repository is this easy:

```
$ svnadmin create /var/svn/repos
```

In Subversion 1.0, a Berkeley DB repository is always created. In Subversion 1.1, a Berkeley DB repository is the default repository type, but an FSFS repository can be created using the `--fs-type` option:

```
$ svnadmin create /var/svn/repos --fs-type fsfs
```

[1] Remember, **svnadmin** works only with local *paths*, not *URLs*.

Name

svnadmin deltify — Deltify changed paths in a revision range.

Synopsis

```
svnadmin deltify [-r LOWER[:UPPER]] REPOS_PATH
```

Description

svnadmin deltify exists in current versions of Subversion only for historical reasons. This command is deprecated and no longer needed.

It dates from a time when Subversion offered administrators greater control over compression strategies in the repository. This turned out to be a lot of complexity for *very* little gain, and this „feature“ was deprecated.

Options

```
--quiet (-q)
--revision (-r) REV
```

Name

svnadmin dump — Dump the contents of the filesystem to `stdout`.

Synopsis

```
svnadmin dump REPOS_PATH [-r LOWER[:UPPER]] [--incremental]
```

Description

Dump the contents of the filesystem to `stdout` in a „dump file“ portable format, sending feedback to `stderr`. Dump revisions *`LOWER`* rev through *`UPPER`* rev. If no revisions are given, dump all revision trees. If only *`LOWER`* is given, dump that one revision tree. See „Migrating Repository Data Elsewhere“ for a practical use.

By default, the Subversion dump stream contains a single revision (the first revision in the requested revision range) in which every file and directory in the repository in that revision is presented as though that whole tree was added at once, followed by other revisions (the remainder of the revisions in the requested range), which contain only the files and directories that were modified in those revisions. For a modified file, the complete full-text representation of its contents, as well as all of its properties, are presented in the dump file; for a directory, all of its properties are presented.

Two useful options modify the dump file generator's behavior. The first is the `--incremental` option, which simply causes that first revision in the dump stream to contain only the files and directories modified in that revision, instead of being presented as the addition of a new tree, and in exactly the same way that every other revision in the dump file is presented. This is useful for generating a relatively small dump file to be loaded into another repository that already has the files and directories that exist in the original repository.

The second useful option is `--deltas`. This option causes **svnadmin dump** to, instead of emitting full-text representations of file contents and property lists, emit only deltas of those items against their previous versions. This reduces (in some cases, drastically) the size of the dump file that **svnadmin dump** creates. There are, however, disadvantages to using this option—deltified dump files are more CPU-intensive to create, cannot be operated on by **svndumpfilter**, and tend not to compress as well as their nondeltified counterparts when using third-party tools such as **gzip** and **bzip2**.

Options

```
--deltas
--incremental
--quiet (-q)
--revision (-r) REV
```

Examples

Dump your whole repository:

```
$ svnadmin dump /var/svn/repos > full.dump
* Dumped revision 0.
* Dumped revision 1.
* Dumped revision 2.
…
```

Incrementally dump a single transaction from your repository:

```
$ svnadmin dump /var/svn/repos -r 21 --incremental > incr.dump
* Dumped revision 21.
```

Name

svnadmin help — Help!

Synopsis

```
svnadmin help [SUBCOMMAND...]
```

Description

This subcommand is useful when you're trapped on a desert island with neither a Net connection nor a copy of this book.

Alternate names

?, **h**

Name

svnadmin hotcopy — Make a hot copy of a repository.

Synopsis

```
svnadmin hotcopy REPOS_PATH NEW_REPOS_PATH
```

Description

This subcommand makes a full „hot“ backup of your repository, including all hooks, configuration files, and, of course, database files. If you pass the `--clean-logs` option, **svnadmin** will perform a hot copy of your repository, and then remove unused Berkeley DB logs from the original repository. You can run this command at any time and make a safe copy of the repository, regardless of whether other processes are using the repository.

Options

`--clean-logs`

As described in „Berkeley DB“, hot-copied Berkeley DB repositories are *not* portable across operating systems, nor will they work on machines with a different „endianness“ than the machine where they were created.

Name

svnadmin list-dblogs — Ask Berkeley DB which logfiles exist for a given Subversion repository (applies only to repositories using the bdb backend).

Synopsis

```
svnadmin list-dblogs REPOS_PATH
```

Description

Berkeley DB creates logs of all changes to the repository, which allow it to recover in the face of catastrophe. Unless you enable DB_LOG_AUTOREMOVE, the logfiles accumulate, although most are no longer used and can be deleted to reclaim disk space. See „Managing Disk Space“ for more information.

Name

svnadmin list-unused-dblogs — Ask Berkeley DB which logfiles can be safely deleted (applies only to repositories using the bdb backend).

Synopsis

```
svnadmin list-unused-dblogs REPOS_PATH
```

Description

Berkeley DB creates logs of all changes to the repository, which allow it to recover in the face of catastrophe. Unless you enable DB_LOG_AUTOREMOVE, the logfiles accumulate, although most are no longer used and can be deleted to reclaim disk space. See „Managing Disk Space“ for more information.

Examples

Remove all unused logfiles from the repository:

```
$ svnadmin list-unused-dblogs /var/svn/repos
/var/svn/repos/log.0000000031
/var/svn/repos/log.0000000032
/var/svn/repos/log.0000000033

$ svnadmin list-unused-dblogs /var/svn/repos | xargs rm
## disk space reclaimed!
```

Name

svnadmin load — Read a repository dump stream from `stdin`.

Synopsis

```
svnadmin load REPOS_PATH
```

Description

Read a repository dump stream from `stdin`, committing new revisions into the repository's filesystem. Send progress feedback to `stdout`.

Options

```
--force-uuid
--ignore-uuid
--parent-dir
--quiet (-q)
--use-post-commit-hook
--use-pre-commit-hook
```

Examples

This shows the beginning of loading a repository from a backup file (made, of course, with **svnadmin dump**):

```
$ svnadmin load /var/svn/restored < repos-backup
<<< Started new txn, based on original revision 1
     * adding path : test ... done.
     * adding path : test/a ... done.
…
```

Or if you want to load into a subdirectory:

```
$ svnadmin load --parent-dir new/subdir/for/project \
                /var/svn/restored < repos-backup
<<< Started new txn, based on original revision 1
     * adding path : test ... done.
     * adding path : test/a ... done.
…
```

Name

svnadmin lslocks — Print descriptions of all locks.

Synopsis

```
svnadmin lslocks REPOS_PATH [PATH-IN-REPOS]
```

Description

Print descriptions of all locks in repository *REPOS_PATH* underneath the path *PATH-IN-REPOS*. If *PATH-IN-REPOS* is not provided, it defaults to the root directory of the repository.

Options

None

Examples

This lists the one locked file in the repository at /var/svn/repos:

```
$ svnadmin lslocks /var/svn/repos
Path: /tree.jpg
UUID Token: opaquelocktoken:ab00ddf0-6afb-0310-9cd0-dda813329753
Owner: harry
Created: 2005-07-08 17:27:36 -0500 (Fri, 08 Jul 2005)
Expires:
Comment (1 line):
Rework the uppermost branches on the bald cypress in the foreground.
```

Name

svnadmin lstxns — Print the names of all uncommitted transactions.

Synopsis

```
svnadmin lstxns REPOS_PATH
```

Description

Print the names of all uncommitted transactions. See „Removing dead transactions“ for information on how uncommitted transactions are created and what you should do with them.

Examples

List all outstanding transactions in a repository:

```
$ svnadmin lstxns /var/svn/repos/
1w
1x
```

Name

svnadmin recover — Bring a repository database back into a consistent state (applies only to repositories using the bdb backend). In addition, if repos/conf/passwd does not exist, it will create a default passwordfile .

Synopsis

```
svnadmin recover REPOS_PATH
```

Description

Run this command if you get an error indicating that your repository needs to be recovered.

Options

```
--wait
```

Examples

Recover a hung repository:

```
$ svnadmin recover /var/svn/repos/
Repository lock acquired.
Please wait; recovering the repository may take some time...

Recovery completed.
The latest repos revision is 34.
```

Recovering the database requires an exclusive lock on the repository. (This is a „database lock“; see the sidebar The Three Meanings of „Lock“.) If another process is accessing the repository, then **svnadmin recover** will error:

```
$ svnadmin recover /var/svn/repos
svn: Failed to get exclusive repository access; perhaps another process
such as httpd, svnserve or svn has it open?

$
```

The --wait option, however, will cause **svnadmin recover** to wait indefinitely for other processes to disconnect:

```
$ svnadmin recover /var/svn/repos --wait
Waiting on repository lock; perhaps another process has it open?

### time goes by…

Repository lock acquired.
Please wait; recovering the repository may take some time...

Recovery completed.
The latest repos revision is 34.
```

Name

svnadmin rmlocks — Unconditionally remove one or more locks from a repository.

Synopsis

```
svnadmin rmlocks REPOS_PATH LOCKED_PATH...
```

Description

Remove one or more locks from each *`LOCKED_PATH`*.

Options

None

Examples

This deletes the locks on `tree.jpg` and `house.jpg` in the repository at `/var/svn/repos`:

```
$ svnadmin rmlocks /var/svn/repos tree.jpg house.jpg
Removed lock on '/tree.jpg.
Removed lock on '/house.jpg.
```

Name

svnadmin rmtxns — Delete transactions from a repository.

Synopsis

```
svnadmin rmtxns REPOS_PATH TXN_NAME...
```

Description

Delete outstanding transactions from a repository. This is covered in detail in „Removing dead transactions“.

Options

```
--quiet (-q)
```

Examples

Remove named transactions:

```
$ svnadmin rmtxns /var/svn/repos/ 1w 1x
```

Fortunately, the output of **lstxns** works great as the input for **rmtxns**:

```
$ svnadmin rmtxns /var/svn/repos/  `svnadmin lstxns /var/svn/repos/`
```

This removes all uncommitted transactions from your repository.

Name

svnadmin setlog — Set the log message on a revision.

Synopsis

```
svnadmin setlog REPOS_PATH -r REVISION FILE
```

Description

Set the log message on revision *`REVISION`* to the contents of *`FILE`*.

This is similar to using **svn propset** with the `--revprop` option to set the `svn:log` property on a revision, except that you can also use the option `--bypass-hooks` to avoid running any pre- or post-commit hooks, which is useful if the modification of revision properties has not been enabled in the `pre-revprop-change` hook.

Revision properties are not under version control, so this command will permanently overwrite the previous log message.

Options

```
--bypass-hooks
--revision (-r) REV
```

Examples

Set the log message for revision 19 to the contents of the file `msg`:

```
$ svnadmin setlog /var/svn/repos/ -r 19 msg
```

Name

svnadmin setrevprop — Set a property on a revision.

Synopsis

```
svnadmin setrevprop REPOS_PATH -r REVISION NAME FILE
```

Description

Set the property *`NAME`* on revision *`REVISION`* to the contents of *`FILE`*. Use `--use-pre-revprop-change-hook` or `--use-post-revprop-change-hook` to trigger the revision property-related hooks (e.g., if you want an email notification sent from your `post-revprop-change-hook`).

Options

```
--revision (-r) ARG
--use-post-revprop-change-hook
--use-pre-revprop-change-hook
```

Examples

The following sets the revision property `repository-photo` to the contents of the file `sandwich.png`:

```
$svnadmin setrevprop /var/svn/repos -r 0 repository-photo sandwich.png
```

As you can see, **svnadmin setrevprop** has no output upon success.

Name

svnadmin setuuid — Reset the repository UUID.

Synopsis

```
svnadmin setuuid REPOS_PATH [NEW_UUID]
```

Description

Reset the repository UUID for the repository located at *`REPOS_PATH`*. If *`NEW_UUID`* is provided, use that as the new repository UUID; otherwise, generate a brand-new UUID for the repository.

Options

None

Examples

If you've **svnsync**ed `/var/svn/repos` to `/var/svn/repos-new` and intend to use `repos-new` as your canonical repository, you may want to change the UUID for `repos-new` to the UUID of `repos` so that your users don't have to check out a new working copy to accommodate the change:

```
$ svnadmin setuuid /var/svn/repos-new 2109a8dd-854f-0410-ad31-d604008985ab
```

As you can see, **svnadmin setuuid** has no output upon success.

Name

svnadmin upgrade — Upgrade a repository to the latest supported schema version.

Synopsis

```
svnadmin upgrade REPOS_PATH
```

Description

Upgrade the repository located at *REPOS_PATH* to the latest supported schema version.

This functionality is provided as a convenience for repository administrators who wish to make use of new Subversion functionality without having to undertake a potentially costly full repository dump and load operation. As such, the upgrade performs only the minimum amount of work needed to accomplish this while still maintaining the integrity of the repository. While a dump and subsequent load guarantee the most optimized repository state, **svnadmin upgrade** does not.

You should *always* back up your repository before upgrading.

Options

None

Examples

Upgrade the repository at path /var/repos/svn:

```
$ svnadmin upgrade /var/repos/svn
Repository lock acquired.
Please wait; upgrading the repository may take some time...

Upgrade completed.
```

Name

svnadmin verify — Verify the data stored in the repository.

Synopsis

```
svnadmin verify REPOS_PATH
```

Description

Run this command if you wish to verify the integrity of your repository. This basically iterates through all revisions in the repository by internally dumping all revisions and discarding the output—it's a good idea to run this on a regular basis to guard against latent hard disk failures and „bitrot.“ If this command fails—which it will do at the first sign of a problem—that means your repository has at least one corrupted revision, and you should restore the corrupted revision from a backup (you did make a backup, didn't you?).

Options

```
--quiet (-q)
--revision (-r) ARG
```

Examples

Verify a hung repository:

```
$ svnadmin verify /var/svn/repos/
* Verified revision 1729.
```

svnlook

svnlook is a command-line utility for examining different aspects of a Subversion repository. It does not make any changes to the repository—it's just used for „peeking.“ **svnlook** is typically used by the repository hooks, but a repository administrator might find it useful for diagnostic purposes.

Since **svnlook** works via direct repository access (and thus can be used only on the machine that holds the repository), it refers to the repository with a path, not a URL.

If no revision or transaction is specified, **svnlook** defaults to the youngest (most recent) revision of the repository.

svnlook Options

Options in **svnlook** are global, just as they are in **svn** and **svnadmin**; however, most options apply to only one subcommand since the functionality of **svnlook** is (intentionally) limited in scope:

`--copy-info`
: Causes **svnlook changed** to show detailed copy source information.

`--no-diff-deleted`
: Prevents **svnlook diff** from printing differences for deleted files. The default behavior when a file is deleted in a transaction/revision is to print the same differences that you would see if you had left the file but removed all the content.

`--no-diff-added`
: Prevents **svnlook diff** from printing differences for added files. The default behavior when you add a file is to print the same differences that you would see if you had added the entire contents of an existing (empty) file.

`--revision` (`-r`)
: Specifies a particular revision number that you wish to examine.

`--revprop`
: Operates on a revision property instead of a property specific to a file or directory. This option requires that you also pass a revision with the `--revision` (`-r`) option.

`--transaction` (`-t`)
: Specifies a particular transaction ID that you wish to examine.

`--show-ids`
: Shows the filesystem node revision IDs for each path in the filesystem tree.

svnlook Subcommands

Here are the various subcommands for the **svnlook** program.

Name

svnlook author — Print the author.

Synopsis

```
svnlook author REPOS_PATH
```

Description

Print the author of a revision or transaction in the repository.

Options

```
--revision (-r) REV
--transaction (-t) TXN
```

Examples

svnlook author is handy, but not very exciting:

```
$ svnlook author -r 40 /var/svn/repos
sally
```

Name

svnlook cat — Print the contents of a file.

Synopsis

```
svnlook cat REPOS_PATH PATH_IN_REPOS
```

Description

Print the contents of a file.

Options

```
--revision (-r) REV
--transaction (-t) TXN
```

Examples

This shows the contents of a file in transaction `ax8`, located at `/trunk/README`:

```
$ svnlook cat -t ax8 /var/svn/repos /trunk/README

               Subversion, a version control system.
               =====================================

$LastChangedDate: 2003-07-17 10:45:25 -0500 (Thu, 17 Jul 2003) $

Contents:

     I. A FEW POINTERS
    II. DOCUMENTATION
   III. PARTICIPATING IN THE SUBVERSION COMMUNITY
…
```

Name

svnlook changed — Print the paths that were changed.

Synopsis

```
svnlook changed REPOS_PATH
```

Description

Print the paths that were changed in a particular revision or transaction, as well as „svn update-style“ status letters in the first two columns:

`'A '`
: Item added to repository

`'D '`
: Item deleted from repository

`'U '`
: File contents changed

`'_U'`
: Properties of item changed; note the leading underscore

`'UU'`
: File contents and properties changed

Files and directories can be distinguished, as directory paths are displayed with a trailing „/“ character.

Options

```
--copy-info
--revision (-r) REV
--transaction (-t) TXN
```

Examples

This shows a list of all the changed files and directories in revision 39 of a test repository. Note that the first changed item is a directory, as evidenced by the trailing `/`:

```
$ svnlook changed -r 39 /var/svn/repos
A   trunk/vendors/deli/
A   trunk/vendors/deli/chips.txt
A   trunk/vendors/deli/sandwich.txt
A   trunk/vendors/deli/pickle.txt
U   trunk/vendors/baker/bagel.txt
_U  trunk/vendors/baker/croissant.txt
UU  trunk/vendors/baker/pretzel.txt
D   trunk/vendors/baker/baguette.txt
```

Here's an example that shows a revision in which a file was renamed:

```
$ svnlook changed -r 64 /var/svn/repos
A   trunk/vendors/baker/toast.txt
```

```
D   trunk/vendors/baker/bread.txt
```

Unfortunately, nothing in the preceding output reveals the connection between the deleted and added files. Use the `--copy-info` option to make this relationship more apparent:

```
$ svnlook changed -r 64 --copy-info /var/svn/repos
A + trunk/vendors/baker/toast.txt
    (from trunk/vendors/baker/bread.txt:r63)
D   trunk/vendors/baker/bread.txt
```

Name

svnlook date — Print the datestamp.

Synopsis

```
svnlook date REPOS_PATH
```

Description

Print the datestamp of a revision or transaction in a repository.

Options

```
--revision (-r) REV
--transaction (-t) TXN
```

Examples

This shows the date of revision 40 of a test repository:

```
$ svnlook date -r 40 /var/svn/repos/
2003-02-22 17:44:49 -0600 (Sat, 22 Feb 2003)
```

Name

svnlook diff — Print differences of changed files and properties.

Synopsis

```
svnlook diff REPOS_PATH
```

Description

Print GNU-style differences of changed files and properties in a repository.

Options

```
--diff-copy-from
--no-diff-added
--no-diff-deleted
--revision (-r) REV
--transaction (-t) TXN
```

Examples

This shows a newly added (empty) file, a deleted file, and a copied file:

```
$ svnlook diff -r 40 /var/svn/repos/
Copied: egg.txt (from rev 39, trunk/vendors/deli/pickle.txt)

Added: trunk/vendors/deli/soda.txt
===============================================================================

Modified: trunk/vendors/deli/sandwich.txt
===============================================================================
--- trunk/vendors/deli/sandwich.txt (original)
+++ trunk/vendors/deli/sandwich.txt 2003-02-22 17:45:04.000000000 -0600
@@ -0,0 +1 @@
+Don't forget the mayo!

Modified: trunk/vendors/deli/logo.jpg
===============================================================================
(Binary files differ)

Deleted: trunk/vendors/deli/chips.txt
===============================================================================

Deleted: trunk/vendors/deli/pickle.txt
===============================================================================
```

If a file has a nontextual `svn:mime-type` property, the differences are not explicitly shown.

Name

svnlook dirs-changed — Print the directories that were themselves changed.

Synopsis

```
svnlook dirs-changed REPOS_PATH
```

Description

Print the directories that were themselves changed (property edits) or whose file children were changed.

Options

```
--revision (-r) REV
--transaction (-t) TXN
```

Examples

This shows the directories that changed in revision 40 in our sample repository:

```
$ svnlook dirs-changed -r 40 /var/svn/repos
trunk/vendors/deli/
```

Name

svnlook help — Help!

Synopsis

```
Also svnlook -h and svnlook -?.
```

Description

Displays the help message for **svnlook**. This command, like its brother, **svn help**, is also your friend, even though you never call it anymore and forgot to invite it to your last party.

Options

None

Alternate names

?, **h**

Name

svnlook history — Print information about the history of a path in the repository (or the root directory if no path is supplied).

Synopsis

```
svnlook history REPOS_PATH [PATH_IN_REPOS]
```

Description

Print information about the history of a path in the repository (or the root directory if no path is supplied).

Options

```
--limit (-l) ARG
--revision (-r) REV
--show-ids
```

Examples

This shows the history output for the path `/branches/bookstore` as of revision 13 in our sample repository:

```
$ svnlook history -r 13 /var/svn/repos /branches/bookstore --show-ids
REVISION   PATH <ID>
--------   ---------
      13   /branches/bookstore <1.1.r13/390>
      12   /branches/bookstore <1.1.r12/413>
      11   /branches/bookstore <1.1.r11/0>
       9   /trunk <1.0.r9/551>
       8   /trunk <1.0.r8/131357096>
       7   /trunk <1.0.r7/294>
       6   /trunk <1.0.r6/353>
       5   /trunk <1.0.r5/349>
       4   /trunk <1.0.r4/332>
       3   /trunk <1.0.r3/335>
       2   /trunk <1.0.r2/295>
       1   /trunk <1.0.r1/532>
```

Name

svnlook info — Print the author, datestamp, log message size, and log message.

Synopsis

```
svnlook info REPOS_PATH
```

Description

Print the author, datestamp, log message size (in bytes), and log message, followed by a newline character.

Options

```
--revision (-r) REV
--transaction (-t) TXN
```

Examples

This shows the info output for revision 40 in our sample repository:

```
$ svnlook info -r 40 /var/svn/repos
sally
2003-02-22 17:44:49 -0600 (Sat, 22 Feb 2003)
16
Rearrange lunch.
```

Name

svnlook lock — If a lock exists on a path in the repository, describe it.

Synopsis

```
svnlook lock REPOS_PATH PATH_IN_REPOS
```

Description

Print all information available for the lock at *PATH_IN_REPOS*. If *PATH_IN_REPOS* is not locked, print nothing.

Options

None

Examples

This describes the lock on the file `tree.jpg`:

```
$ svnlook lock /var/svn/repos tree.jpg
UUID Token: opaquelocktoken:ab00ddf0-6afb-0310-9cd0-dda813329753
Owner: harry
Created: 2005-07-08 17:27:36 -0500 (Fri, 08 Jul 2005)
Expires:
Comment (1 line):
Rework the uppermost branches on the bald cypress in the foreground.
```

Name

svnlook log — Print the log message, followed by a newline character.

Synopsis

```
svnlook log REPOS_PATH
```

Description

Print the log message.

Options

```
--revision (-r) REV
--transaction (-t) TXN
```

Examples

This shows the log output for revision 40 in our sample repository:

```
$ svnlook log /var/svn/repos/
Rearrange lunch.
```

Name

svnlook propget — Print the raw value of a property on a path in the repository.

Synopsis

```
svnlook propget REPOS_PATH PROPNAME [PATH_IN_REPOS]
```

Description

List the value of a property on a path in the repository.

Alternate names

pg, **pget**

Options

```
--revision (-r) REV
--revprop
--transaction (-t) TXN
```

Examples

This shows the value of the „seasonings“ property on the file `/trunk/sandwich` in the HEAD revision:

```
$ svnlook pg /var/svn/repos seasonings /trunk/sandwich
mustard
```

Name

svnlook proplist — Print the names and values of versioned file and directory properties.

Synopsis

```
svnlook proplist REPOS_PATH [PATH_IN_REPOS]
```

Description

List the properties of a path in the repository. With `--verbose`, show the property values too.

Alternate names

pl, **plist**

Options

```
--revision (-r) REV
--revprop
--transaction (-t) TXN
--verbose (-v)
```

Examples

This shows the names of properties set on the file `/trunk/README` in the `HEAD` revision:

```
$ svnlook proplist /var/svn/repos /trunk/README
  original-author
  svn:mime-type
```

This is the same command as in the preceding example, but this time showing the property values as well:

```
$ svnlook --verbose proplist /var/svn/repos /trunk/README
  original-author : harry
  svn:mime-type : text/plain
```

Name

svnlook tree — Print the tree.

Synopsis

```
svnlook tree REPOS_PATH [PATH_IN_REPOS]
```

Description

Print the tree, starting at *PATH_IN_REPOS* (if supplied; at the root of the tree otherwise), optionally showing node revision IDs.

Options

```
--full-paths
--non-recursive (-N)
--revision (-r) REV
--show-ids
--transaction (-t) TXN
```

Example

This shows the tree output (with nodeIDs) for revision 13 in our sample repository:

```
$ svnlook tree -r 13 /var/svn/repos --show-ids
/ <0.0.r13/811>
 trunk/ <1.0.r9/551>
  button.c <2.0.r9/238>
  Makefile <3.0.r7/41>
  integer.c <4.0.r6/98>
 branches/ <5.0.r13/593>
  bookstore/ <1.1.r13/390>
   button.c <2.1.r12/85>
   Makefile <3.0.r7/41>
   integer.c <4.1.r13/109>
```

Name

svnlook uuid — Print the repository's UUID.

Synopsis

```
svnlook uuid REPOS_PATH
```

Description

Print the UUID for the repository. The UUID is the repository's *u*niversal *u*nique *id*entifier. The Subversion client uses this identifier to differentiate between one repository and another.

Options

None

Examples

```
$ svnlook uuid /var/svn/repos
e7fe1b91-8cd5-0310-98dd-2f12e793c5e8
```

Name

svnlook youngest — Print the youngest revision number.

Synopsis

```
svnlook youngest REPOS_PATH
```

Description

Print the youngest revision number of a repository.

Options

None

Examples

This shows the youngest revision of our sample repository:

```
$ svnlook youngest /var/svn/repos/
42
```

svnsync

svnsync is the Subversion remote repository mirroring tool. Put simply, it allows you to replay the revisions of one repository into another one.

In any mirroring scenario, there are two repositories: the source repository, and the mirror (or „sink“) repository. The source repository is the repository from which **svnsync** pulls revisions. The mirror repository is the destination for the revisions pulled from the source repository. Each of the repositories may be local or remote—they are only ever addressed by their URLs.

The **svnsync** process requires only read access to the source repository; it never attempts to modify it. But obviously, **svnsync** requires both read and write access to the mirror repository.

svnsync is very sensitive to changes made in the mirror repository that weren't made as part of a mirroring operation. To prevent this from happening, it's best if the **svnsync** process is the only process permitted to modify the mirror repository.

svnsync Options

Options in **svnsync** are global, just as they are in **svn** and **svnadmin**:

`--config-dir` *`DIR`*
: Instructs Subversion to read configuration information from the specified directory instead of the default location (`.subversion` in the user's home directory).

`--no-auth-cache`
: Prevents caching of authentication information (e.g., username and password) in the Subversion runtime configuration directories.

`--non-interactive`
: In the case of an authentication failure or insufficient credentials, prevents prompting for credentials (e.g., username or password). This is useful if you're running Subversion inside an automated script and it's more appropriate to have Subversion fail than to prompt for more information.

`--quiet` (`-q`)
: Requests that the client print only essential information while performing an operation.

`--source-password` *`PASSWD`*
: Specifies the password for the Subversion server from which you are syncing. If not provided, or if incorrect, Subversion will prompt you for this information as needed.

`--source-username` *`NAME`*
: Specifies the username for the Subversion server from which you are syncing. If not provided, or if incorrect, Subversion will prompt you for this information as needed.

`--sync-password` *`PASSWD`*
: Specifies the password for the Subversion server to which you are syncing. If not provided, or if incorrect, Subversion will prompt you for this information as needed.

`--sync-username` *`NAME`*
: Specifies the username for the Subversion server to which you are syncing. If not provided, or if incorrect, Subversion will prompt you for this information as needed.

svnsync Subcommands

Here are the various subcommands for the **svnsync** program.

Name

svnsync copy-revprops — Copy all revision properties for a particular revision (or range of revisions) from the source repository to the mirror repository.

Synopsis

```
svnsync copy-revprops DEST_URL [REV[:REV2]
```

Description

Because Subversion revision properties can be changed at any time, it's possible that the properties for some revision might be changed after that revision has already been synchronized to another repository. Because the **svnsync synchronize** command operates only on the range of revisions that have not yet been synchronized, it won't notice a revision property change outside that range. Left as is, this causes a deviation in the values of that revision's properties between the source and mirror repositories. **svnsync copy-revprops** is the answer to this problem. Use it to resynchronize the revision properties for a particular revision or range of revisions.

Alternate name

None

Options

```
--config-dir DIR
--no-auth-cache
--non-interactive
--quiet (-q)
--source-password ARG
--source-username ARG
--sync-password ARG
--sync-username ARG
```

Examples

Resynchronize revision properties for a single revision:

```
$ svnsync copy-revprops file:///var/svn/repos-mirror 6
Copied properties for revision 6.
$
```

Name

svnsync help — Help!

Synopsis

```
svnsync help
```

Description

This subcommand is useful when you're trapped in a foreign prison with neither a Net connection nor a copy of this book, but you do have a local Wi-Fi network running and you'd like to sync a copy of your repository over to the backup server that Ira The Knife is running over in cell block D.

Alternate name

None

Options

None

Name

svnsync initialize — Initialize a mirror repository for synchronization from the source repository.

Synopsis

```
svnsync initialize MIRROR_URL SOURCE_URL
```

Description

svnsync initialize verifies that a repository meets the requirements of a new mirror repository—that it has no previous existing version history and that it allows revision property modifications—and records the initial administrative information that associates the mirror repository with the source repository. This is the first **svnsync** operation you run on a would-be mirror repository.

Alternate name

init

Options

```
--config-dir DIR
--no-auth-cache
--non-interactive
--quiet (-q)
--source-password ARG
--source-username ARG
--sync-password ARG
--sync-username ARG
```

Examples

Fail to initialize a mirror repository due to inability to modify revision properties:

```
$ svnsync initialize file:///var/svn/repos-mirror http://svn.example.com/repos
svnsync: Repository has not been enabled to accept revision propchanges;
ask the administrator to create a pre-revprop-change hook
$
```

Initialize a repository as a mirror, having already created a `pre-revprop-change` hook that permits all revision property changes:

```
$ svnsync initialize file:///var/svn/repos-mirror http://svn.example.com/repos
Copied properties for revision 0.
$
```

Name

svnsync synchronize — Transfer all pending revisions from the source repository to the mirror repository.

Synopsis

```
svnsync synchronize DEST_URL
```

Description

The **svnsync synchronize** command does all the heavy lifting of a repository mirroring operation. After consulting with the mirror repository to see which revisions have already been copied into it, it then begins to copy any not-yet-mirrored revisions from the source repository.

svnsync synchronize can be gracefully canceled and restarted.

As of Subversion 1.5, you can limit **svnsync** to a subdirectory of the source repository by specifying the subdirectory as part of the *SOURCE_URL*.

Alternate name

sync

Options

```
--config-dir DIR
--no-auth-cache
--non-interactive
--quiet (-q)
--source-password ARG
--source-username ARG
--sync-password ARG
--sync-username ARG
```

Examples

Copy unsynchronized revisions from the source repository to the mirror repository:

```
$ svnsync synchronize file:///var/svn/repos-mirror
Committed revision 1.
Copied properties for revision 1.
Committed revision 2.
Copied properties for revision 2.
Committed revision 3.
Copied properties for revision 3.
…
Committed revision 45.
Copied properties for revision 45.
Committed revision 46.
Copied properties for revision 46.
Committed revision 47.
Copied properties for revision 47.
$
```

svnserve

svnserve allows access to Subversion repositories using Subversion's custom network protocol.

You can run **svnserve** as a standalone server process (for clients that are using the `svn://` access method); you can have a daemon such as **inetd** or **xinetd** launch it for you on demand (also for `svn://`), or you can have **sshd** launch it on demand for the `svn+ssh://` access method.

Regardless of the access method, once the client has selected a repository by transmitting its URL, **svnserve** reads a file named `conf/svnserve.conf` in the repository directory to determine repository-specific settings such as what authentication database to use and what authorization policies to apply. See „svnserve, ein maßgefertigter Server“ for details of the `svnserve.conf` file.

svnserve Options

Unlike the previous commands we've described, **svnserve** has no subcommands—it is controlled exclusively by options.

`--daemon` (`-d`)
: Causes **svnserve** to run in daemon mode. **svnserve** backgrounds itself and accepts and serves TCP/IP connections on the `svn` port (3690, by default).

`--foreground`
: When used together with `-d`, causes **svnserve** to stay in the foreground. This is mainly useful for debugging.

`--inetd` (`-i`)
: Causes **svnserve** to use the `stdin` and `stdout` file descriptors, as is appropriate for a daemon running out of **inetd**.

`--help` (`-h`)
: Displays a usage summary and exits.

`--listen-host=`*`HOST`*
: Causes **svnserve** to listen on the interface specified by *`HOST`*, which may be either a hostname or an IP address.

`--listen-once` (`-X`)
: Causes **svnserve** to accept one connection on the `svn` port, serve it, and exit. This option is mainly useful for debugging.

`--listen-port=`*`PORT`*
: Causes **svnserve** to listen on *`PORT`* when run in daemon mode. (FreeBSD daemons listen only on tcp6 by default—this option tells them to also listen on tcp4.)

`--pid-file` *`FILENAME`*
: Causes **svnserve** to write its process ID to *`FILENAME`*, which must be writable by the user under which **svnserve** is running.

`--root=`*`ROOT`* (`-r=`*`ROOT`*)
: Sets the virtual root for repositories served by **svnserve**. The pathname in URLs provided by the client will be interpreted relative to this root and will not be allowed to escape this root.

`--threads` (`-T`)
: When running in daemon mode, causes **svnserve** to spawn a thread instead of a process for each connection (e.g., for when running on Windows). The **svnserve** process still backgrounds itself at startup time.

`--tunnel` (`-t`)

Causes **svnserve** to run in tunnel mode, which is just like the **inetd** mode of operation (both modes serve one connection over `stdin`/`stdout`, and then exit), except that the connection is considered to be preauthenticated with the username of the current UID. This flag is automatically passed for you by the client when running over a tunnel agent such as **ssh**. That means there's rarely any need for *you* to pass this option to **svnserve**. So, if you find yourself typing `svnserve --tunnel` on the command line and wondering what to do next, see „Tunneling over SSH“.

`--tunnel-user NAME`
: Used in conjunction with the `--tunnel` option, tells **svnserve** to assume that *`NAME`* is the authenticated user, rather than the UID of the **svnserve** process. This is useful for users wishing to share a single system account over SSH, but to maintain separate commit identities.

`--version`
: Displays version information and a list of repository backend modules available, and then exits.

svndumpfilter

svndumpfilter is a command-line utility for removing history from a Subversion dump file by either excluding or including paths beginning with one or more named prefixes. For details, see „svndumpfilter“.

svndumpfilter Options

Options in **svndumpfilter** are global, just as they are in **svn** and **svnadmin**:

`--drop-empty-revs`
: If filtering causes any revision to be empty (i.e., causes no change to the repository), removes these revisions from the final dump file.

`--renumber-revs`
: Renumbers revisions that remain after filtering.

`--skip-missing-merge-sources`
: Skips merge sources that have been removed as part of the filtering. Without this option, **svndumpfilter** will exit with an error if the merge source for a retained path is removed by filtering.

`--preserve-revprops`
: If all nodes in a revision are removed by filtering and `--drop-empty-revs` is not passed, the default behavior of **svndumpfilter** is to remove all revision properties except for the date and the log message (which will merely indicate that the revision is empty). Passing this option will preserve existing revision properties (which may or may not make sense since the related content is no longer present in the dump file).

`--quiet`
: Does not display filtering statistics.

svndumpfilter Subcommands

Here are the various subcommands for the **svndumpfilter** program.

Name

svndumpfilter exclude — Filter out nodes with given prefixes from the dump stream.

Synopsis

```
svndumpfilter exclude PATH_PREFIX...
```

Description

This can be used to exclude nodes that begin with one or more *PATH_PREFIX*es from a filtered dump file.

Options

```
--drop-empty-revs
--preserve-revprops
--quiet
--renumber-revs
--skip-missing-merge-sources
```

Examples

If we have a dump file from a repository with a number of different picnic-related directories in it, but we want to keep everything *except* the `sandwiches` part of the repository, we'll exclude only that path:

```
$ svndumpfilter exclude sandwiches < dumpfile > filtered-dumpfile
Excluding prefixes:
   '/sandwiches'

Revision 0 committed as 0.
Revision 1 committed as 1.
Revision 2 committed as 2.
Revision 3 committed as 3.
Revision 4 committed as 4.

Dropped 1 node(s):
   '/sandwiches'
```

Name

svndumpfilter include — Filter out nodes without given prefixes from dump stream.

Synopsis

```
svndumpfilter include PATH_PREFIX...
```

Description

Can be used to include nodes that begin with one or more *PATH_PREFIX*es in a filtered dump file (thus excluding all other paths).

Options

```
--drop-empty-revs
--preserve-revprops
--quiet
--renumber-revs
--skip-missing-merge-sources
```

Example

If we have a dump file from a repository with a number of different picnic-related directories in it, but want to keep only the `sandwiches` part of the repository, we'll include only that path:

```
$ svndumpfilter include sandwiches < dumpfile > filtered-dumpfile
Including prefixes:
   '/sandwiches'

Revision 0 committed as 0.
Revision 1 committed as 1.
Revision 2 committed as 2.
Revision 3 committed as 3.
Revision 4 committed as 4.

Dropped 3 node(s):
   '/drinks'
   '/snacks'
   '/supplies'
```

Name

svndumpfilter help — Help!.

Synopsis

```
svndumpfilter help [SUBCOMMAND...]
```

Description

Displays the help message for **svndumpfilter**. Unlike other help commands documented in this chapter, there is no witty commentary for this help command. The authors of this book deeply regret the omission.

Options

None

svnversion

Name

svnversion — Summarize the local revision(s) of a working copy.

Synopsis

```
svnversion [OPTIONS] [WC_PATH [TRAIL_URL]]
```

Description

svnversion is a program for summarizing the revision mixture of a working copy. The resultant revision number, or revision range, is written to standard output.

It's common to use this output in your build process when defining the version number of your program.

`TRAIL_URL`, if present, is the trailing portion of the URL used to determine whether *`WC_PATH`* itself is switched (detection of switches within *`WC_PATH`* does not rely on *`TRAIL_URL`*).

When *`WC_PATH`* is not defined, the current directory will be used as the working copy path. *`TRAIL_URL`* cannot be defined if *`WC_PATH`* is not explicitly given.

Options

Like **svnserve**, **svnversion** has no subcommands—only options:

`--no-newline` (`-n`)
: Omits the usual trailing newline from the output.

`--committed` (`-c`)
: Uses the last-changed revisions rather than the current (i.e., highest locally available) revisions.

`--help` (`-h`)
: Prints a help summary.

`--version`
: Prints the version of **svnversion** and exit with no error.

Examples

If the working copy is all at the same revision (e.g., immediately after an update), then that revision is printed out:

```
$ svnversion
4168
```

You can add *`TRAIL_URL`* to make sure the working copy is not switched from what you expect. Note that the *`WC_PATH`* is required in this command:

```
$ svnversion . /var/svn/trunk
4168
```

For a mixed-revision working copy, the range of revisions present is printed:

```
$ svnversion
4123:4168
```

If the working copy contains modifications, a trailing "M" is added:

```
$ svnversion
4168M
```

If the working copy is switched, a trailing "S" is added:

```
$ svnversion
4168S
```

Thus, here is a mixed-revision, switched working copy containing some local modifications:

```
$ svnversion
4212:4168MS
```

If invoked on a directory that is not a working copy, **svnversion** assumes it is an exported working copy and prints "exported":

```
$ svnversion
exported
```

mod_dav_svn

Name

mod_dav_svn Configuration Directives — Apache configuration directives for serving Subversion repositories through the Apache HTTP Server.

Description

This section briefly describes each Subversion Apache configuration directive. For an in-depth description of configuring Apache with Subversion, see „httpd, the Apache HTTP Server“.)

Directives

These are the `httpd.conf` directives that apply to **mod_dav_svn**:

`DAV svn`
: Must be included in any `Directory` or `Location` block for a Subversion repository. It tells **httpd** to use the Subversion backend for `mod_dav` to handle all requests.

`SVNAllowBulkUpdates On|Off`
: Toggles support for all-inclusive responses to update-style `REPORT` requests. Subversion clients use `REPORT` requests to get information about directory tree checkouts and updates from **mod_dav_svn**. They can ask the server to send that information in one of two ways: with the entirety of the tree's information in one massive response, or with a *skelta* (a skeletal representation of a tree delta) which contains just enough information for the client to know what *additional* data to request from the server. When this directive is included with a value of `Off`, **mod_dav_svn** will only ever respond to these `REPORT` requests with skelta responses, regardless of the type of responses requested by the client.

  Most folks won't need to use this directive at all. It primarily exists for administrators who wish—for security or auditing reasons—to force Subversion clients to fetch individually all the files and directories needed for updates and checkouts, thus leaving an audit trail of `GET` and `PROPFIND` requests in Apache's logs. The default value of this directive is `On`.

`SVNAutoversioning On|Off`
: When its value is `On`, allows write requests from WebDAV clients to result in automatic commits. A generic log message is auto-generated and attached to each revision. If you enable autoversioning, you'll likely want to set `ModMimeUsePathInfo On` so that `mod_mime` can set `svn:mime-type` to the correct MIME type automatically (as best as `mod_mime` is able to, of course). For more information, see Anhang C, *WebDAV and Autoversioning*. The default value of this directive is `Off`.

`SVNPath` *`directory-path`*
: Specifies the location in the filesystem for a Subversion repository's files. In a configuration block for a Subversion repository, either this directive or `SVNParentPath` must be present, but not both.

`SVNSpecialURI` *`component`*
: Specifies the URI component (namespace) for special Subversion resources. The default is `!svn`, and most administrators will never use this directive. Set this only if there is a pressing need to have a file named `!svn` in your repository. If you change this on a server already in use, it will break all of the outstanding working copies, and your users will hunt you down with pitchforks and flaming torches.

`SVNReposName` *`name`*
: Specifies the name of a Subversion repository for use in `HTTP GET` responses. This value will be prepended to the title of all directory listings (which are served when you

navigate to a Subversion repository with a web browser). This directive is optional.

`SVNIndexXSLT` *`directory-path`*
Specifies the URI of an XSL transformation for directory indexes. This directive is optional.

`SVNParentPath` *`directory-path`*
Specifies the location in the filesystem of a parent directory whose child directories are Subversion repositories. In a configuration block for a Subversion repository, either this directive or `SVNPath` must be present, but not both.

`SVNPathAuthz On|Off|short_circuit`
Controls path-based authorization by enabling subrequests (`On`), disabling subrequests (`Off`; see „Disabling path-based checks“), or querying **mod_authz_svn** directly (`short_circuit`). The default value of this directive is `On`.

`SVNListParentPath On|Off`
When set to `On`, allows a `GET` of `SVNParentPath`, which results in a listing of all repositories under that path. The default setting is `Off`.

`SVNMasterURI` *`url`*
Specifies a URI to the master Subversion repository (used for a write-through proxy).

`SVNActivitiesDB` *`directory-path`*
Specifies the location in the filesystem where the activities database should be stored. By default, **mod_dav_svn** creates and uses a directory in the repository called `dav/activities.d`. The path specified with this option must be an absolute path.

If specified for an `SVNParentPath` area, **mod_dav_svn** appends the basename of the repository to the path specified here. For example:

```
<Location /svn>
  DAV svn

  # any "/svn/foo" URL will map to a repository in
  # /net/svn.nfs/repositories/foo
  SVNParentPath         "/net/svn.nfs/repositories"

  # any "/svn/foo" URL will map to an activities db in
  #  /var/db/svn/activities/foo
  SVNActivitiesDB       "/var/db/svn/activities"
</Location>
```

High-level logging

This is a list of Subversion action log messages produced by Apache's high-level logging mechanism, followed by an example of the log message. See „Apache logging“ for details on logging.

Checkout or export
`checkout-or-export /path r62 depth=infinity`

Commit
`commit harry r100`

Diffs
`diff /path r15:20 depth=infinity ignore-ancestry`

`diff /path1@15 /path2@20 depth=infinity ignore-ancestry`

Fetch a directory

```
get-dir /trunk r17 text
```

Fetch a file
```
get-file /path r20 props
```

Fetch a file revision
```
get-file-revs /path r12:15 include-merged-revisions
```

Fetch merge information
```
get-mergeinfo (/path1 /path2)
```

Lock
```
lock /path steal
```

Log
```
log (/path1,/path2,/path3) r20:90 discover-changed-paths
revprops=()
```

Replay revisions (svnsync)
```
replay /path r19
```

Revision property change
```
change-rev-prop r50 propertyname
```

Revision property list
```
rev-proplist r34
```

Status
```
status /path r62 depth=infinity
```

Switch
```
switch /pathA /pathB@50 depth=infinity
```

Unlock
```
unlock /path break
```

Update
```
update /path r17 send-copyfrom-args
```

mod_authz_svn

Name

mod_authz_svn Configuration Directives — Apache configuration directives for configuring path-based authorization for Subversion repositories served through the Apache HTTP Server.

Description

This section briefly describes each Apache configuration directive offered by **mod_authz_svn**. For an in-depth description of using path-based authorization in Subversion, see „Path-Based Authorization“.)

Directives

These are the `httpd.conf` directives that apply to **mod_authz_svn**:

`AuthzSVNAccessFile` *`file-path`*
: Consult *`file-path`* for access rules describing the permissions for paths in Subversion repository.

`AuthzSVNAnonymous On|Off`
: Set to `Off` to disable two special-case behaviours of this module: interaction with the `Satisfy Any` directive and enforcement of the authorization policy even when no `Require` directives are present. The default value of this directive is `On`.

`AuthzSVNAuthoritative On|Off`
: Set to `Off` to allow access control to be passed along to lower modules. The default value of this directive is `On`.

`AuthzSVNNoAuthWhenAnonymousAllowed On|Off`
: Set to `On` to suppress authentication and authorization for requests which anonymous users are allowed to perform. The default value of this directive is `On`.

Subversion Properties

Subversion allows users to invent arbitrarily named versioned properties on files and directories, as well as unversioned properties on revisions. The only restriction is on properties whose names begin with `svn:` (those are reserved for Subversion's own use). While these properties may be set by users to control Subversion's behavior, users may not invent new `svn:` properties.

Versioned Properties

These are the versioned properties that Subversion reserves for its own use:

`svn:executable`
: If present on a file, the client will make the file executable in Unix-hosted working copies. See „File Executability“.

`svn:mime-type`
: If present on a file, the value indicates the file's MIME type. This allows the client to decide whether line-based contextual merging is safe to perform during updates, and can also affect how the file behaves when fetched via a web browser. See „File Content Type“.

`svn:ignore`

If present on a directory, the value is a list of *unversioned* file patterns to be ignored by **svn status** and other subcommands. See „Ignoring Unversioned Items“.

`svn:keywords`
: If present on a file, the value tells the client how to expand particular keywords within the file. See „Keyword Substitution“.

`svn:eol-style`
: If present on a file, the value tells the client how to manipulate the file's line-endings in the working copy and in exported trees. See „End-of-Line Character Sequences“ and svn export earlier in this chapter.

`svn:externals`
: If present on a directory, the value is a multiline list of other paths and URLs the client should check out. See „Externals Definitions“.

`svn:special`
: If present on a file, indicates that the file is not an ordinary file, but a symbolic link or other special object. [1]

`svn:needs-lock`
: If present on a file, tells the client to make the file read-only in the working copy, as a reminder that the file should be locked before editing begins. See „Lock Communication“.

`svn:mergeinfo`
: Used by Subversion to track merge data. See „Mergeinfo und Vorschauen“ for details, but you should never edit this property unless you *really* know what you're doing.

Unversioned Properties

These are the unversioned properties that Subversion reserves for its own use:

`svn:author`
: If present, contains the authenticated username of the person who created the revision. (If not present, the revision was committed anonymously.)

`svn:date`
: Contains the UTC time the revision was created, in ISO 8601 format. The value comes from the *server* machine's clock, not the client's.

`svn:log`
: Contains the log message describing the revision.

`svn:autoversioned`
: If present, the revision was created via the autoversioning feature. See „Autoversioning“.

Repository Hooks

These are the repository hooks that Subversion provides:

[1] As of this writing, symbolic links are indeed the only „special“ objects. But there might be more in future releases of Subversion.

Name

start-commit — Notification of the beginning of a commit.

Description

The start-commit hook is run before the commit transaction is even created. It is typically used to decide whether the user has commit privileges at all.

If the start-commit hook program returns a nonzero exit value, the commit is stopped before the commit transaction is even created, and anything printed to `stderr` is marshalled back to the client.

Input Parameter(s)

The command-line arguments passed to the hook program, in order, are:

1. Repository path
2. Authenticated username attempting the commit
3. Colon-separated list of capabilities that a client passes to the server, including `depth`, `mergeinfo`, and `log-revprops` (new in Subversion 1.5).

Common uses

Access control (e.g., temporarily lock out commits for some reason).

A means to allow access only from clients that have certain capabilities.

Name

pre-commit — Notification just prior to commit completion.

Description

The `pre-commit` hook is run just before a commit transaction is promoted to a new revision. Typically, this hook is used to protect against commits that are disallowed due to content or location (e.g., your site might require that all commits to a certain branch include a ticket number from the bug tracker, or that the incoming log message is nonempty).

If the `pre-commit` hook program returns a nonzero exit value, the commit is aborted, the commit transaction is removed, and anything printed to `stderr` is marshalled back to the client.

Input parameter(s)

The command-line arguments passed to the hook program, in order, are:

1. Repository path
2. Commit transaction name

Common uses

Change validation and control

Name

post-commit — Notification of a successful commit.

Description

The `post-commit` hook is run after the transaction is committed and a new revision is created. Most people use this hook to send out descriptive emails about the commit or to notify some other tool (such as an issue tracker) that a commit has happened. Some configurations also use this hook to trigger backup processes.

If the `post-commit` hook returns a nonzero exit status, the commit *will not* be aborted since it has already completed. However, anything that the hook printed to `stderr` will be marshalled back to the client, making it easier to diagnose hook failures.

Input parameter(s)

The command-line arguments passed to the hook program, in order, are:

1. Repository path
2. Revision number created by the commit

Common uses

Commit notification; tool integration

Name

pre-revprop-change — Notification of a revision property change attempt.

Description

The `pre-revprop-change` hook is run immediately prior to the modification of a revision property when performed outside the scope of a normal commit. Unlike the other hooks, the default state of this one is to deny the proposed action. The hook must actually exist and return a zero exit value before a revision property modification can happen.

If the `pre-revprop-change` hook doesn't exist, isn't executable, or returns a nonzero exit value, no change to the property will be made, and anything printed to `stderr` is marshalled back to the client.

Input parameter(s)

The command-line arguments passed to the hook program, in order, are:

1. Repository path
2. Revision whose property is about to be modified
3. Authenticated username attempting the property change
4. Name of the property changed
5. Change description: `A` (added), `D` (deleted), or `M` (modified)

Additionally, Subversion passes the intended new value of the property to the hook program via standard input.

Common uses

Access control; change validation and control

Name

post-revprop-change — Notification of a successful revision property change.

Description

The `post-revprop-change` hook is run immediately after the modification of a revision property when performed outside the scope of a normal commit. As you can derive from the description of its counterpart, the `pre-revprop-change` hook, this hook will not run at all unless the `pre-revprop-change` hook is implemented. It is typically used to send email notification of the property change.

If the `post-revprop-change` hook returns a nonzero exit status, the change *will not* be aborted since it has already completed. However, anything that the hook printed to `stderr` will be marshalled back to the client, making it easier to diagnose hook failures.

Input parameter(s)

The command-line arguments passed to the hook program, in order, are:

1. Repository path
2. Revision whose property was modified
3. Authenticated username of the person making the change
4. Name of the property changed
5. Change description: `A` (added), `D` (deleted), or `M` (modified)

Additionally, Subversion passes to the hook program, via standard input, the previous value of the property.

Common uses

Property change notification

Name

pre-lock — Notification of a path lock attempt.

Description

The `pre-lock` hook runs whenever someone attempts to lock a path. It can be used to prevent locks altogether or to create a more complex policy specifying exactly which users are allowed to lock particular paths. If the hook notices a preexisting lock, it can also decide whether a user is allowed to „steal“ the existing lock.

If the `pre-lock` hook program returns a nonzero exit value, the lock action is aborted and anything printed to `stderr` is marshalled back to the client.

Input parameter(s)

The command-line arguments passed to the hook program, in order, are:

1. Repository path
2. Versioned path that is to be locked
3. Authenticated username of the person attempting the lock

Common uses

Access control

Name

post-lock — Notification of a successful path lock.

Description

The `post-lock` hook runs after one or more paths have been locked. It is typically used to send email notification of the lock event.

If the `post-lock` hook returns a nonzero exit status, the lock *will not* be aborted since it has already completed. However, anything that the hook printed to `stderr` will be marshalled back to the client, making it easier to diagnose hook failures.

Input parameter(s)

The command-line arguments passed to the hook program, in order, are:

1. Repository path
2. Authenticated username of the person who locked the paths

Additionally, the list of paths locked is passed to the hook program via standard input, one path per line.

Common uses

Lock notification

Name

pre-unlock — Notification of a path unlock attempt.

Description

The `pre-unlock` hook runs whenever someone attempts to remove a lock on a file. It can be used to create policies that specify which users are allowed to unlock particular paths. It's particularly important for determining policies about lock breakage. If user A locks a file, is user B allowed to break the lock? What if the lock is more than a week old? These sorts of things can be decided and enforced by the hook.

If the `pre-unlock` hook program returns a nonzero exit value, the unlock action is aborted and anything printed to `stderr` is marshalled back to the client.

Input parameter(s)

The command-line arguments passed to the hook program, in order, are:

1. Repository path
2. Versioned path which is to be locked
3. Authenticated username of the person attempting the lock

Common uses

Access control

Name

post-unlock — Notification of a successful path unlock.

Description

The `post-unlock` hook runs after one or more paths have been unlocked. It is typically used to send email notification of the unlock event.

If the `post-unlock` hook returns a nonzero exit status, the unlock *will not* be aborted since it has already completed. However, anything that the hook printed to `stderr` will be marshalled back to the client, making it easier to diagnose hook failures.

Input parameter(s)

The command-line arguments passed to the hook program, in order, are:

1. Repository path
2. Authenticated username of the person who unlocked the paths

Additionally, the list of paths unlocked is passed to the hook program via standard input, one path per line.

Common uses

Unlock notification

Anhang A. Subversion Quick-Start Guide

If you're eager to get Subversion up and running (and you enjoy learning by experimentation), this appendix will show you how to create a repository, import code, and then check it back out again as a working copy. Along the way, we give links to the relevant chapters of this book.

If you're new to the entire concept of version control or to the „copy-modify-merge“ model used by both CVS and Subversion, you should read Kapitel 1, *Grundlegende Konzepte* before going any further.

Installing Subversion

Subversion is built on a portability layer called APR—the Apache Portable Runtime library. The APR library provides all the interfaces that Subversion needs to function on different operating systems: disk access, network access, memory management, and so on. While Subversion is able to use Apache as one of its network server programs, its dependence on APR *does not* mean that Apache is a required component. APR is a standalone library usable by any application. It does mean, however, that like Apache, Subversion clients and servers run on any operating system that the Apache **httpd** server runs on: Windows, Linux, all flavors of BSD, Mac OS X, NetWare, and others.

The easiest way to get Subversion is to download a binary package built for your operating system. Subversion's web site (http://subversion.tigris.org) often has these packages available for download, posted by volunteers. The site usually contains graphical installer packages for users of Microsoft operating systems. If you run a Unix-like operating system, you can use your system's native package distribution system (RPMs, DEBs, the ports tree, etc.) to get Subversion.

Alternatively, you can build Subversion directly from source code, though it's not always an easy task. (If you're not experienced at building open source software packages, you're probably better off downloading a binary distribution instead!) From the Subversion web site, download the latest source code release. After unpacking it, follow the instructions in the `INSTALL` file to build it. Note that a released source package may not contain everything you need to build a command-line client capable of talking to a remote repository. Starting with Subversion 1.4 and later, the libraries Subversion depends on (apr, apr-util, and neon) are distributed in a separate source package suffixed with `-deps`. These libraries are now common enough that they may already be installed on your system. If not, you'll need to unpack the dependency package into the same directory where you unpacked the main Subversion source. Regardless, it's possible that you may want to fetch other optional dependencies such as Berkeley DB and possibly Apache **httpd**. If you want to do a complete build, make sure you have all of the packages documented in the `INSTALL` file.

If you're one of those folks that likes to use bleeding-edge software, you can also get the Subversion source code from the Subversion repository in which it lives. Obviously, you'll need to already have a Subversion client on hand to do this. But once you do, you can check out a working copy of the Subversion source repository from http://svn.collab.net/repos/svn/trunk/: [1]

```
$ svn checkout http://svn.collab.net/repos/svn/trunk subversion
```

[1]Note that the URL checked out in the example ends not with `svn`, but with a subdirectory thereof called `trunk`. See our discussion of Subversion's branching and tagging model for the reasoning behind this.

```
A    subversion/HACKING
A    subversion/INSTALL
A    subversion/README
A    subversion/autogen.sh
A    subversion/build.conf
…
```

The preceding command will create a working copy of the latest (unreleased) Subversion source code into a subdirectory named `subversion` in your current working directory. You can adjust that last argument as you see fit. Regardless of what you call the new working copy directory, though, after this operation completes, you will now have the Subversion source code. Of course, you will still need to fetch a few helper libraries (apr, apr-util, etc.)—see the `INSTALL` file in the top level of the working copy for details.

High-Speed Tutorial

> „Please make sure your seat backs are in their full, upright position and that your tray tables are stored. Flight attendants, prepare for take-off….“

What follows is a quick tutorial that walks you through some basic Subversion configuration and operation. When you finish it, you should have a general understanding of Subversion's typical usage.

The examples used in this appendix assume that you have **svn**, the Subversion command-line client, and **svnadmin**, the administrative tool, ready to go on a Unix-like operating system. (This tutorial also works at the Windows command-line prompt, assuming you make some obvious tweaks.) We also assume you are using Subversion 1.2 or later (run **`svn --version`** to check.)

Subversion stores all versioned data in a central repository. To begin, create a new repository:

```
$ svnadmin create /var/svn/repos
$ ls /var/svn/repos
conf/  dav/  db/  format  hooks/  locks/  README.txt
```

This command creates a new directory, `/var/svn/repos`, which contains a Subversion repository. This new directory contains (among other things) a collection of database files. You won't see your versioned files if you peek inside. For more information about repository creation and maintenance, see Kapitel 5, *Repository Administration*.

Subversion has no concept of a „project.“ The repository is just a virtual versioned filesystem, a large tree that can hold anything you wish. Some administrators prefer to store only one project in a repository, and others prefer to store multiple projects in a repository by placing them into separate directories. We discuss the merits of each approach in „Planning Your Repository Organization“. Either way, the repository manages only files and directories, so it's up to humans to interpret particular directories as „projects.“ So while you might see references to projects throughout this book, keep in mind that we're only ever talking about some directory (or collection of directories) in the repository.

In this example, we assume you already have some sort of project (a collection of files and directories) that you wish to import into your newly created Subversion repository. Begin by organizing your data into a single directory called `myproject` (or whatever you wish). For reasons explained in Kapitel 4, *Verzweigen und Zusammenführen*, your project's tree structure should contain three top-level directories named `branches`, `tags`, and `trunk`.

The `trunk` directory should contain all of your data, and the `branches` and `tags` directories should be empty:

```
/tmp/myproject/branches/
/tmp/myproject/tags/
/tmp/myproject/trunk/
                     foo.c
                     bar.c
                     Makefile
                     …
```

The `branches`, `tags`, and `trunk` subdirectories aren't actually required by Subversion. They're merely a popular convention that you'll most likely want to use later on.

Once you have your tree of data ready to go, import it into the repository with the **svn import** command (see „Wie Sie Daten in Ihr Repository bekommen“):

```
$ svn import /tmp/myproject file:///var/svn/repos/myproject -m "initial import"
Adding         /tmp/myproject/branches
Adding         /tmp/myproject/tags
Adding         /tmp/myproject/trunk
Adding         /tmp/myproject/trunk/foo.c
Adding         /tmp/myproject/trunk/bar.c
Adding         /tmp/myproject/trunk/Makefile
…
Committed revision 1.
$
```

Now the repository contains this tree of data. As mentioned earlier, you won't see your files by directly peeking into the repository; they're all stored within a database. But the repository's imaginary filesystem now contains a top-level directory named `myproject`, which in turn contains your data.

Note that the original `/tmp/myproject` directory is unchanged; Subversion is unaware of it. (In fact, you can even delete that directory if you wish.) To start manipulating repository data, you need to create a new „working copy“ of the data, a sort of private workspace. Ask Subversion to „check out“ a working copy of the `myproject/trunk` directory in the repository:

```
$ svn checkout file:///var/svn/repos/myproject/trunk myproject
A  myproject/foo.c
A  myproject/bar.c
A  myproject/Makefile
…
Checked out revision 1.
```

Now you have a personal copy of part of the repository in a new directory named `myproject`. You can edit the files in your working copy and then commit those changes back into the repository.

- Enter your working copy and edit a file's contents.
- Run **`svn diff`** to see unified diff output of your changes.
- Run **`svn commit`** to commit the new version of your file to the repository.
- Run **`svn update`** to bring your working copy „up to date“ with the repository.

For a full tour of all the things you can do with your working copy, read Kapitel 2, *Grundlegende Benutzung*.

At this point, you have the option of making your repository available to others over a network. See Kapitel 6, *Die Administration eines Subversion-Servers* to learn about the different sorts of server processes available and how to configure them.

Anhang B. Subversion for CVS Users

This appendix is a guide for CVS users new to Subversion. It's essentially a list of differences between the two systems as „viewed from 10,000 feet.“ For each section, we provide references to relevant chapters when possible.

Although the goal of Subversion is to take over the current and future CVS user base, some new features and design changes were required to fix certain „broken“ behaviors that CVS had. This means that, as a CVS user, you may need to break habits—ones that you forgot were odd to begin with.

Revision Numbers Are Different Now

In CVS, revision numbers are per file. This is because CVS stores its data in RCS files; each file has a corresponding RCS file in the repository, and the repository is roughly laid out according to the structure of your project tree.

In Subversion, the repository looks like a single filesystem. Each commit results in an entirely new filesystem tree; in essence, the repository is an array of trees. Each of these trees is labeled with a single revision number. When someone talks about „revision 54“, he's talking about a particular tree (and indirectly, the way the filesystem looked after the 54th commit).

Technically, it's not valid to talk about „revision 5 of `foo.c`.“ Instead, one would say „`foo.c` as it appears in revision 5.“ Also, be careful when making assumptions about the evolution of a file. In CVS, revisions 5 and 6 of `foo.c` are always different. In Subversion, it's most likely that `foo.c` did *not* change between revisions 5 and 6.

Similarly, in CVS, a tag or branch is an annotation on the file or on the version information for that individual file, whereas in Subversion, a tag or branch is a copy of an entire tree (by convention, into the `/branches` or `/tags` directories that appear at the top level of the repository, beside `/trunk`). In the repository as a whole, many versions of each file may be visible: the latest version on each branch, every tagged version, and of course the latest version on the trunk itself. So, to refine the terms even further, one would often say „`foo.c` as it appears in `/branches/REL1` in revision 5.“

For more details on this topic, see „Revisionen“.

Directory Versions

Subversion tracks tree structures, not just file contents. It's one of the biggest reasons Subversion was written to replace CVS.

Here's what this means to you, as a former CVS user:

- The **svn add** and **svn delete** commands work on directories now, just as they work on files. So do **svn copy** and **svn move**. However, these commands do *not* cause any kind of immediate change in the repository. Instead, the working items are simply „scheduled“ for addition or deletion. No repository changes happen until you run **`svn commit`**.
- Directories aren't dumb containers anymore; they have revision numbers like files. (Or more properly, it's correct to talk about „directory `foo/` in revision 5.“)

Let's talk more about that last point. Directory versioning is a hard problem; because we want to allow mixed-revision working copies, there are some limitations on how far we can abuse this model.

From a theoretical point of view, we define „revision 5 of directory `foo`“ to mean a specific collection of directory entries and properties. Now suppose we start adding and removing files from `foo`, and then commit. It would be a lie to say that we still have revision 5 of `foo`. However, if we bumped `foo`'s revision number after the commit, that would be a lie too; there may be other changes to `foo` we haven't yet received, because we haven't updated yet.

Subversion deals with this problem by quietly tracking committed adds and deletes in the `.svn` area. When you eventually run **`svn update`**, all accounts are settled with the repository, and the directory's new revision number is set correctly. *Therefore, only after an update is it truly safe to say that you have a „perfect“ revision of a directory.* Most of the time, your working copy will contain „imperfect“ directory revisions.

Similarly, a problem arises if you attempt to commit property changes on a directory. Normally, the commit would bump the working directory's local revision number. But again, that would be a lie, as there may be adds or deletes that the directory doesn't yet have, because no update has happened. *Therefore, you are not allowed to commit property changes on a directory unless the directory is up to date.*

For more discussion about the limitations of directory versioning, see „Arbeitskopien mit gemischten Revisionen“.

More Disconnected Operations

In recent years, disk space has become outrageously cheap and abundant, but network bandwidth has not. Therefore, the Subversion working copy has been optimized around the scarcer resource.

The `.svn` administrative directory serves the same purpose as the `CVS` directory, except that it also stores read-only, „pristine“ copies of your files. This allows you to do many things offline:

svn status
: Shows you any local changes you've made (see „Verschaffen Sie sich einen Überblick über Ihre Änderungen“)

svn diff
: Shows you the details of your changes (see „Untersuchen Sie die Details Ihrer lokalen Änderungen“)

svn revert
: Removes your local changes (see „Zurücknehmen von Änderungen in der Arbeitskopie“)

Also, the cached pristine files allow the Subversion client to send differences when committing, which CVS cannot do.

The last subcommand in the list—**svn revert**—is new. It will not only remove local changes, but also unschedule operations such as adds and deletes. Although deleting the file and then running **`svn update`** will still work, doing so distorts the true purpose of updating. And, while we're on this subject…

Distinction Between Status and Update

Subversion attempts to erase a lot of the confusion between the **cvs status** and **cvs update** commands.

The **cvs status** command has two purposes: first, to show the user any local modifications in the working copy, and second, to show the user which files are out of date. Unfortunately, because of CVS's hard-to-read status output, many CVS users don't take advantage of this command at all. Instead, they've developed a habit of running **`cvs update`** or **`cvs -n update`** to quickly see their changes. If users forget to use the `-n` option, this has the side effect of merging repository changes they may not be ready to deal with.

Subversion removes this muddle by making the output of **svn status** easy to read for both humans and parsers. Also, **svn update** prints only information about files that are updated, *not* local modifications.

Status

svn status prints all files that have local modifications. By default, the repository is not contacted. While this subcommand accepts a fair number of options, the following are the most commonly used ones:

`-u`
: Contact the repository to determine, and then display, out-of-dateness information.

`-v`
: Show *all* entries under version control.

`-N`
: Run nonrecursively (do not descend into subdirectories).

The **svn status** command has two output formats. In the default „short“ format, local modifications look like this:

```
$ svn status
M      foo.c
M      bar/baz.c
```

If you specify the `--show-updates` (`-u`) option, a longer output format is used:

```
$ svn status -u
M           1047   foo.c
       *    1045   faces.html
       *           bloo.png
M           1050   bar/baz.c
Status against revision:   1066
```

In this case, two new columns appear. The second column contains an asterisk if the file or directory is out of date. The third column shows the working copy's revision number of the item. In the previous example, the asterisk indicates that `faces.html` would be patched if we updated, and that `bloo.png` is a newly added file in the repository. (The absence of any revision number next to `bloo.png` means that it doesn't yet exist in the working copy.)

At this point, you should take a quick look at the list of all possible status codes in svn status. Here are a few of the more common status codes you'll see:

```
A    Resource is scheduled for Addition
D    Resource is scheduled for Deletion
M    Resource has local Modifications
C    Resource has Conflicts (changes have not been completely merged
       between the repository and working copy version)
X    Resource is eXternal to this working copy (may come from another
       repository).  See „Externals Definitions“
```

```
?    Resource is not under version control
!    Resource is missing or incomplete (removed by a tool other than
       Subversion)
```

For a more detailed discussion of **svn status**, see „Verschaffen Sie sich einen Überblick über Ihre Änderungen“.

Update

svn update updates your working copy, and prints only information about files that it updates.

Subversion has combined CVS's `P` and `U` codes into just `U`. When a merge or conflict occurs, Subversion simply prints `G` or `C`, rather than a whole sentence about it.

For a more detailed discussion of **svn update**, see „Aktualisieren Sie Ihre Arbeitskopie“.

Branches and Tags

Subversion doesn't distinguish between filesystem space and „branch“ space; branches and tags are ordinary directories within the filesystem. This is probably the single biggest mental hurdle that a CVS user will need to cross. Read all about it in Kapitel 4, *Verzweigen und Zusammenführen*.

Since Subversion treats branches and tags as ordinary directories, your project's various lines of development probably live in subdirectories of the main project directory. So remember to check out using the URL of the subdirectory that contains the particular line of development you want, not the project's root URL. If you make the mistake of checking out the root of the project, you may very well wind up with a working copy that contains a complete copy of your project's content for each and every one of its branches and tags. [1]

Metadata Properties

A new feature of Subversion is that you can attach arbitrary metadata (or „properties“) to files and directories. Properties are arbitrary name/value pairs associated with files and directories in your working copy.

To set or get a property name, use the **svn propset** and **svn propget** subcommands. To list all properties on an object, use **svn proplist**.

For more information, see „Properties“.

Conflict Resolution

CVS marks conflicts with inline „conflict markers,“ and then prints a `C` during an update or merge operation. Historically, this has caused problems, because CVS isn't doing enough. Many users forget about (or don't see) the `C` after it whizzes by on their terminal. They often forget that the conflict markers are even present, and then accidentally commit files containing those conflict markers.

Subversion solves this problem in a pair of ways. First, when a conflict occurs in a file, Subversion records the fact that the file is in a state of conflict, and won't allow you to commit changes to that file until you explicitly resolve the conflict. Second, Subversion 1.5

[1] That is, providing you don't run out of disk space before your checkout finishes.

provides interactive conflict resolution, which allows you to resolve conflicts as they happen instead of having to go back and do so after the update or merge operation completes. See „Konflikte auflösen (Änderungen anderer einarbeiten)“ for more about conflict resolution in Subversion.

Binary Files and Translation

In the most general sense, Subversion handles binary files more gracefully than CVS does. Because CVS uses RCS, it can only store successive full copies of a changing binary file. Subversion, however, expresses differences between files using a binary differencing algorithm, regardless of whether they contain textual or binary data. That means all files are stored differentially (compressed) in the repository.

CVS users have to mark binary files with `-kb` flags to prevent data from being garbled (due to keyword expansion and line-ending translations). They sometimes forget to do this.

Subversion takes the more paranoid route. First, it never performs any kind of keyword or line-ending translation unless you explicitly ask it to do so (see „Keyword Substitution“ and „End-of-Line Character Sequences“ for more details). By default, Subversion treats all file data as literal byte strings, and files are always stored in the repository in an untranslated state.

Second, Subversion maintains an internal notion of whether a file is „text“ or „binary“ data, but this notion is *only* extant in the working copy. During an **svn update**, Subversion will perform contextual merges on locally modified text files, but will not attempt to do so for binary files.

To determine whether a contextual merge is possible, Subversion examines the `svn:mime-type` property. If the file has no `svn:mime-type` property, or has a MIME type that is textual (e.g., `text/*`), Subversion assumes it is text. Otherwise, Subversion assumes the file is binary. Subversion also helps users by running a binary-detection algorithm in the **svn import** and **svn add** commands. These commands will make a good guess and then (possibly) set a binary `svn:mime-type` property on the file being added. (If Subversion guesses wrong, the user can always remove or hand-edit the property.)

Versioned Modules

Unlike CVS, a Subversion working copy is aware that it has checked out a module. That means if somebody changes the definition of a module (e.g., adds or removes components), a call to **svn update** will update the working copy appropriately, adding and removing components.

Subversion defines modules as a list of directories within a directory property; see „Externals Definitions“.

Authentication

With CVS's pserver, you are required to log in to the server (using the **cvs login** command) before performing any read or write operation—you sometimes even have to log in for anonymous operations. With a Subversion repository using Apache **httpd** or **svnserve** as the server, you don't provide any authentication credentials at the outset—if an operation that you perform requires authentication, the server will challenge you for your credentials (whether those credentials are username and password, a client certificate, or even both). So if your repository is world-readable, you will not be required to authenticate at all for read operations.

As with CVS, Subversion still caches your credentials on disk (in your `~/.subversion/auth/` directory) unless you tell it not to by using the `--no-auth-cache` option.

The exception to this behavior, however, is in the case of accessing an **svnserve** server over an SSH tunnel, using the `svn+ssh://` URL scheme. In that case, the **ssh** program unconditionally demands authentication just to start the tunnel.

Converting a Repository from CVS to Subversion

Perhaps the most important way to familiarize CVS users with Subversion is to let them continue to work on their projects using the new system. And while that can be somewhat accomplished using a flat import into a Subversion repository of an exported CVS repository, the more thorough solution involves transferring not just the latest snapshot of their data, but all the history behind it as well, from one system to another. This is an extremely difficult problem to solve; it involves deducing changesets in the absence of atomicity and translating between the systems' completely orthogonal branching policies, among other complications. Still, a handful of tools claim to at least partially support the ability to convert existing CVS repositories into Subversion ones.

The most popular (and mature) conversion tool is cvs2svn (http://cvs2svn.tigris.org/), a Python program originally created by members of Subversion's own development community. This tool is meant to run exactly once: it scans your CVS repository multiple times and attempts to deduce commits, branches, and tags as best it can. When it finishes, the result is either a Subversion repository or a portable Subversion dump file representing your code's history. See the web site for detailed instructions and caveats.

Anhang C. WebDAV and Autoversioning

WebDAV is an extension to HTTP, and it is growing more and more popular as a standard for file sharing. Today's operating systems are becoming extremely web-aware, and many now have built-in support for mounting „shares“ exported by WebDAV servers.

If you use Apache as your Subversion network server, to some extent you are also running a WebDAV server. This appendix gives some background on the nature of this protocol, how Subversion uses it, and how well Subversion interoperates with other software that is WebDAV-aware.

What Is WebDAV?

DAV stands for „Distributed Authoring and Versioning.“ RFC 2518 defines a set of concepts and accompanying extension methods to HTTP 1.1 that make the Web a more universal read/write medium. The basic idea is that a WebDAV-compliant web server can act like a generic file server; clients can „mount“ shared folders over HTTP that behave much like other network filesystems (such as NFS or SMB).

The tragedy, though, is that despite the acronym, the RFC specification doesn't actually describe any sort of version control. Basic WebDAV clients and servers assume that only one version of each file or directory exists, and that it can be repeatedly overwritten.

Because RFC 2518 left out versioning concepts, another committee was left with the responsibility of writing RFC 3253 a few years later. The new RFC adds versioning concepts to WebDAV, placing the „V“ back in „DAV“—hence the term „DeltaV.“ WebDAV/DeltaV clients and servers are often called just „DeltaV“ programs, since DeltaV implies the existence of basic WebDAV.

The original WebDAV standard has been widely successful. Every modern computer operating system has a general WebDAV client built in (details to follow), and a number of popular standalone applications are also able to speak WebDAV—Microsoft Office, Dreamweaver, and Photoshop, to name a few. On the server end, Apache HTTP Server has been able to provide WebDAV services since 1998 and is considered the de facto open source standard. Several other commercial WebDAV servers are available, including Microsoft's own IIS.

DeltaV, unfortunately, has not been so successful. It's very difficult to find any DeltaV clients or servers. The few that do exist are relatively unknown commercial products, and thus it's very difficult to test interoperability. It's not entirely clear as to why DeltaV has remained stagnant. Some opine that the specification is just too complex. Others argue that while WebDAV's features have mass appeal (even the least technical users appreciate network file sharing), its version control features just aren't interesting or necessary for most users. Finally, some believe that DeltaV remains unpopular because there's still no open source server product that implements it well.

When Subversion was still in its design phase, it seemed like a great idea to use Apache as a network server. It already had a module to provide WebDAV services. DeltaV was a relatively new specification. The hope was that the Subversion server module (**mod_dav_svn**) would eventually evolve into an open source DeltaV reference implementation. Unfortunately, DeltaV has a very specific versioning model that doesn't quite line up with Subversion's model. Some concepts were mappable; others were not.

What does this mean, then?

First, the Subversion client is not a fully implemented DeltaV client. It needs certain types of things from the server that DeltaV itself cannot provide, and thus is largely dependent on a number of Subversion-specific HTTP REPORT requests that only **mod_dav_svn** understands.

Second, **mod_dav_svn** is not a fully realized DeltaV server. Many portions of the DeltaV specification were irrelevant to Subversion, and thus were left unimplemented.

There is still some debate in the developer community as to whether or not it's worthwhile to remedy either of these situations. It's fairly unrealistic to change Subversion's design to match DeltaV, so there's probably no way the client can ever learn to get everything it needs from a general DeltaV server. On the other hand, **mod_dav_svn** *could* be further developed to implement all of DeltaV, but it's hard to find motivation to do so—there are almost no DeltaV clients to interoperate with.

Autoversioning

While the Subversion client is not a full DeltaV client, and the Subversion server is not a full DeltaV server, there's still a glimmer of WebDAV interoperability to be happy about: *autoversioning*.

Autoversioning is an optional feature defined in the DeltaV standard. A typical DeltaV server will reject an ignorant WebDAV client attempting to do a PUT to a file that's under version control. To change a version-controlled file, the server expects a series of proper versioning requests: something like MKACTIVITY, CHECKOUT, PUT, CHECKIN. But if the DeltaV server supports autoversioning, write requests from basic WebDAV clients are accepted. The server behaves as though the client *had* issued the proper series of versioning requests, performing a commit under the hood. In other words, it allows a DeltaV server to interoperate with ordinary WebDAV clients that don't understand versioning.

Because so many operating systems already have integrated WebDAV clients, the use case for this feature can be incredibly appealing to administrators working with non-technical users. Imagine an office of ordinary users running Microsoft Windows or Mac OS. Each user „mounts“ the Subversion repository, which appears to be an ordinary network folder. They use the shared folder as they always do: open files, edit them, and save them. Meanwhile, the server is automatically versioning everything. Any administrator (or knowledgeable user) can still use a Subversion client to search history and retrieve older versions of data.

This scenario isn't fiction—it's real and it works, as of Subversion 1.2 and later. To activate autoversioning in **mod_dav_svn**, use the SVNAutoversioning directive within the httpd.conf Location block, like so:

```
<Location /repos>
  DAV svn
  SVNPath /var/svn/repository
  SVNAutoversioning on
</Location>
```

When Subversion autoversioning is active, write requests from WebDAV clients result in automatic commits. A generic log message is automatically generated and attached to each revision.

Before activating this feature, however, understand what you're getting into. WebDAV clients tend to do *many* write requests, resulting in a huge number of automatically committed revisions. For example, when saving data, many clients will do a PUT of a 0-byte file (as a way of reserving a name) followed by another PUT with the real file data. The single file-write results in two separate commits. Also consider that many applications auto-save every few minutes, resulting in even more commits.

If you have a post-commit hook program that sends email, you may want to disable email generation either altogether or on certain sections of the repository; it depends on whether you think the influx of emails will still prove to be valuable notifications or not. Also, a smart post-commit hook program can distinguish between a transaction created via autoversioning and one created through a normal Subversion commit operation. The trick is to look for a revision property named `svn:autoversioned`. If present, the commit was made by a generic WebDAV client.

Another feature that may be a useful complement for Subversion's autoversioning comes from Apache's `mod_mime` module. If a WebDAV client adds a new file to the repository, there's no opportunity for the user to set the the `svn:mime-type` property. This might cause the file to appear as a generic icon when viewed within a WebDAV shared folder, not having an association with any application. One remedy is to have a sysadmin (or other Subversion-knowledgeable person) check out a working copy and manually set the `svn:mime-type` property on necessary files. But there's potentially no end to such cleanup tasks. Instead, you can use the `ModMimeUsePathInfo` directive in your Subversion `<Location>` block:

```
<Location /repos>
  DAV svn
  SVNPath /var/svn/repository
  SVNAutoversioning on

  ModMimeUsePathInfo on

</Location>
```

This directive allows `mod_mime` to attempt automatic deduction of the MIME type on new files that enter the repository via autoversioning. The module looks at the file's named extension and possibly the contents as well; if the file matches some common patterns, the file's `svn:mime-type` property will be set automatically.

Client Interoperability

All WebDAV clients fall into one of three categories—standalone applications, file-explorer extensions, or filesystem implementations. These categories broadly define the types of WebDAV functionality available to users. Tabelle C.1, „Common WebDAV clients“ gives our categorization as well as a quick description of some common pieces of WebDAV-enabled software. You can find more details about these software offerings, as well as their general category, in the sections that follow.

Tabelle C.1. Common WebDAV clients

Software	Type	Windows	Mac	Linux	Description
Adobe Photoshop	Standalone WebDAV application	X			Image editing software, allowing direct opening from, and writing to, WebDAV URLs
cadaver	Standalone WebDAV application		X	X	Command-line WebDAV client supporting file transfer, tree, and locking operations

Software	Type	Windows	Mac	Linux	Description
DAV Explorer	Standalone WebDAV application	X	X	X	Java GUI tool for exploring WebDAV shares
Macromedia Dreamweaver	Standalone WebDAV application	X			Web production software able to directly read from and write to WebDAV URLs
Microsoft Office	Standalone WebDAV application	X			Office productivity suite with several components able to directly read from and write to WebDAV URLs
Microsoft Web Folders	File-explorer WebDAV extension	X			GUI file explorer program able to perform tree operations on a WebDAV share
GNOME Nautilus	File-explorer WebDAV extension			X	GUI file explorer able to perform tree operations on a WebDAV share
KDE Konqueror	File-explorer WebDAV extension			X	GUI file explorer able to perform tree operations on a WebDAV share
Mac OS X	WebDAV filesystem implementation		X		Operating system that has built-in support for mounting WebDAV shares.
Novell NetDrive	WebDAV filesystem implementation	X			Drive-mapping program for assigning Windows

Software	Type	Windows	Mac	Linux	Description
					drive letters to a mounted remote WebDAV share
SRT WebDrive	WebDAV filesystem implementation	X			File transfer software, which, among other things, allows the assignment of Windows drive letters to a mounted remote WebDAV share
davfs2	WebDAV filesystem implementation			X	Linux filesystem driver that allows you to mount a WebDAV share

Standalone WebDAV Applications

A WebDAV application is a program that speaks WebDAV protocols with a WebDAV server. We'll cover some of the most popular programs with this kind of WebDAV support.

Microsoft Office, Dreamweaver, Photoshop

On Windows, several well-known applications contain integrated WebDAV client functionality, such as Microsoft's Office, [1] Adobe's Photoshop, and Macromedia's Dreamweaver programs. They're able to directly open and save to URLs, and tend to make heavy use of WebDAV locks when editing a file.

Note that while many of these programs also exist for Mac OS X, they do not appear to support WebDAV directly on that platform. In fact, on Mac OS X, the File#Open dialog box doesn't allow one to type a path or URL at all. It's likely that the WebDAV features were deliberately left out of Macintosh versions of these programs, since OS X already provides such excellent low-level filesystem support for WebDAV.

cadaver, DAV Explorer

cadaver is a bare-bones Unix command-line program for browsing and changing WebDAV shares. Like the Subversion client, it uses the neon HTTP library—not surprisingly, since both neon and cadaver are written by the same author. cadaver is free software (GPL license) and is available at http://www.webdav.org/cadaver/.

Using cadaver is similar to using a command-line FTP program, and thus it's extremely useful for basic WebDAV debugging. It can be used to upload or download files in a pinch, to examine properties, and to copy, move, lock, or unlock files:

[1] WebDAV support was removed from Microsoft Access for some reason, but it exists in the rest of the Office suite.

```
$ cadaver http://host/repos
dav:/repos/> ls
Listing collection `/repos/': succeeded.
Coll: > foobar                                 0  May 10 16:19
      > playwright.el                       2864  May  4 16:18
      > proofbypoem.txt                     1461  May  5 15:09
      > westcoast.jpg                      66737  May  5 15:09

dav:/repos/> put README
Uploading README to `/repos/README':
Progress: [=============================>] 100.0% of 357 bytes succeeded.

dav:/repos/> get proofbypoem.txt
Downloading `/repos/proofbypoem.txt' to proofbypoem.txt:
Progress: [=============================>] 100.0% of 1461 bytes succeeded.
```

DAV Explorer is another standalone WebDAV client, written in Java. It's under a free Apache-like license and is available at http://www.ics.uci.edu/~webdav/. It does everything cadaver does, but has the advantages of being portable and being a more user-friendly GUI application. It's also one of the first clients to support the new WebDAV Access Control Protocol (RFC 3744).

Of course, DAV Explorer's ACL support is useless in this case, since **mod_dav_svn** doesn't support it. The fact that both cadaver and DAV Explorer support some limited DeltaV commands isn't particularly useful either, since they don't allow `MKACTIVITY` requests. But it's not relevant anyway; we're assuming all of these clients are operating against an autoversioning repository.

File-Explorer WebDAV Extensions

Some popular file explorer GUI programs support WebDAV extensions that allow a user to browse a DAV share as though it was just another directory on the local computer, and to perform basic tree editing operations on the items in that share. For example, Windows Explorer is able to browse a WebDAV server as a „network place." Users can drag files to and from the desktop, or can rename, copy, or delete files in the usual way. But because it's only a feature of the file explorer, the DAV share isn't visible to ordinary applications. All DAV interaction must happen through the explorer interface.

Microsoft Web Folders

Microsoft was one of the original backers of the WebDAV specification, and first started shipping a client in Windows 98, which was known as Web Folders. This client was also shipped in Windows NT 4.0 and Windows 2000.

The original Web Folders client was an extension to Explorer, the main GUI program used to browse filesystems. It works well enough. In Windows 98, the feature might need to be explicitly installed if Web Folders aren't already visible inside My Computer. In Windows 2000, simply add a new „network place," enter the URL, and the WebDAV share will pop up for browsing.

With the release of Windows XP, Microsoft started shipping a new implementation of Web Folders, known as the WebDAV Mini-Redirector. The new implementation is a filesystem-level client, allowing WebDAV shares to be mounted as drive letters. Unfortunately, this implementation is incredibly buggy. The client usually tries to convert HTTP URLs (`http://host/repos`) into UNC share notation (`\\host\repos`); it also often tries to use Windows Domain authentication to respond to basic-auth HTTP challenges, sending usernames as `HOST\username`. These interoperability problems are severe and are documented in numerous places around the Web, to the frustration of many users. Even Greg Stein, the original author of Apache's WebDAV module, bluntly states that XP Web Folders simply can't operate against an Apache server.

Windows Vista's initial implementation of Web Folders seems to be almost the same as XP's, so it has the same sort of problems. With luck, Microsoft will remedy these issues in a Vista Service Pack.

However, there seem to be workarounds for both XP and Vista that allow Web Folders to work against Apache. Users have mostly reported success with these techniques, so we'll relay them here.

On Windows XP, you have two options. First, search Microsoft's web site for update KB90730, „Software Update for Web Folders." This may fix all your problems. If it doesn't, it seems that the original pre-XP Web Folders implementation is still buried within the system. You can unearth it by going to Network Places and adding a new network place. When prompted, enter the URL of the repository, but *include a port number* in the URL. For example, you should enter **`http://host/repos`** as **`http://host:80/repos`** instead. Respond to any authentication prompts with your Subversion credentials.

On Windows Vista, the same KB90730 update may clear everything up. But there may still be other issues. Some users have reported that Vista considers all `http://` connections insecure, and thus will always fail any authentication challenges from Apache unless the connection happens over `https://`. If you're unable to connect to the Subversion repository via SSL, you can tweak the system registry to turn off this behavior. Just change the value of the `HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\WebClient\Parameters\BasicAuthLevel` key from **`1`** to **`2`**. A final warning: be sure to set up the Web Folder to point to the repository's root directory (`/`), rather than some subdirectory such as `/trunk`. Vista Web Folders seems to work only against repository roots.

In general, while these workarounds may function for you, you might get a better overall experience using a third-party WebDAV client such as WebDrive or NetDrive.

Nautilus, Konqueror

Nautilus is the official file manager/browser for the GNOME desktop (http://www.gnome.org), and Konqueror is the manager/browser for the KDE desktop (http://www.kde.org). Both of these applications have an explorer-level WebDAV client built in, and they operate just fine against an autoversioning repository.

In GNOME's Nautilus, select the File#Open location menu item and enter the URL in the dialog box presented. The repository should then be displayed like any other filesystem.

In KDE's Konqueror, you need to use the `webdav://` scheme when entering the URL in the location bar. If you enter an `http://` URL, Konqueror will behave like an ordinary web browser. You'll likely see the generic HTML directory listing produced by **mod_dav_svn**. When you enter **`webdav://host/repos`** instead of **`http://host/repos`**, Konqueror becomes a WebDAV client and displays the repository as a filesystem.

WebDAV Filesystem Implementation

The WebDAV filesystem implementation is arguably the best sort of WebDAV client. It's implemented as a low-level filesystem module, typically within the operating system's kernel. This means that the DAV share is mounted like any other network filesystem, similar to mounting an NFS share on Unix or attaching an SMB share as a drive letter in Windows. As a result, this sort of client provides completely transparent read/write WebDAV access to all programs. Applications aren't even aware that WebDAV requests are happening.

WebDrive, NetDrive

Both WebDrive and NetDrive are excellent commercial products that allow a WebDAV share to be attached as drive letters in Windows. As a result, you can operate on the contents of these WebDAV-backed pseudodrives as easily as you can against real local hard drives, and in the same ways. You can purchase WebDrive from South River Technologies (http://www.southrivertech.com). Novell's NetDrive is freely available online, but requires users to have a NetWare license.

Mac OS X

Apple's OS X operating system has an integrated filesystem-level WebDAV client. From the Finder, select the Go#Connect to Server menu item. Enter a WebDAV URL, and it appears as a disk on the desktop, just like any other mounted volume. You can also mount a WebDAV share from the Darwin terminal by using the `webdav` filesystem type with the **mount** command:

```
$ mount -t webdav http://svn.example.com/repos/project /some/mountpoint
$
```

Note that if your **mod_dav_svn** is older than version 1.2, OS X will refuse to mount the share as read/write; it will appear as read-only. This is because OS X insists on locking support for read/write shares, and the ability to lock files first appeared in Subversion 1.2.

Also, OS X's WebDAV client can sometimes be overly sensitive to HTTP redirects. If OS X is unable to mount the repository at all, you may need to enable the `BrowserMatch` directive in the Apache server's `httpd.conf`:

```
BrowserMatch "^WebDAVFS/1.[012]" redirect-carefully
```

Linux davfs2

Linux davfs2 is a filesystem module for the Linux kernel, whose development is organized at http://dav.sourceforge.net/. Once you install davfs2, you can mount a WebDAV network share using the usual Linux mount command:

```
$ mount.davfs http://host/repos /mnt/dav
```

Anhang D. Copyright


```
Copyright (c) 2002-2008
Ben Collins-Sussman, Brian W. Fitzpatrick, C. Michael Pilato.

This work is licensed under the Creative Commons Attribution License.
To view a copy of this license, visit
http://creativecommons.org/licenses/by/2.0/ or send a letter to
Creative Commons, 559 Nathan Abbott Way, Stanford, California 94305,
USA.

A summary of the license is given below, followed by the full legal
text.

--------------------------------------------------------------------

You are free:

    * to copy, distribute, display, and perform the work
    * to make derivative works
    * to make commercial use of the work

Under the following conditions:

Attribution. You must give the original author credit.

    * For any reuse or distribution, you must make clear to others the
      license terms of this work.

    * Any of these conditions can be waived if you get permission from
      the author.

Your fair use and other rights are in no way affected by the above.

The above is a summary of the full license below.

====================================================================

Creative Commons Legal Code
Attribution 2.0

CREATIVE COMMONS CORPORATION IS NOT A LAW FIRM AND DOES NOT PROVIDE
LEGAL SERVICES. DISTRIBUTION OF THIS LICENSE DOES NOT CREATE AN
ATTORNEY-CLIENT RELATIONSHIP. CREATIVE COMMONS PROVIDES THIS
INFORMATION ON AN "AS-IS" BASIS. CREATIVE COMMONS MAKES NO WARRANTIES
REGARDING THE INFORMATION PROVIDED, AND DISCLAIMS LIABILITY FOR
DAMAGES RESULTING FROM ITS USE.

License

THE WORK (AS DEFINED BELOW) IS PROVIDED UNDER THE TERMS OF THIS
CREATIVE COMMONS PUBLIC LICENSE ("CCPL" OR "LICENSE"). THE WORK IS
PROTECTED BY COPYRIGHT AND/OR OTHER APPLICABLE LAW. ANY USE OF THE
WORK OTHER THAN AS AUTHORIZED UNDER THIS LICENSE OR COPYRIGHT LAW IS
PROHIBITED.

BY EXERCISING ANY RIGHTS TO THE WORK PROVIDED HERE, YOU ACCEPT AND
AGREE TO BE BOUND BY THE TERMS OF THIS LICENSE. THE LICENSOR GRANTS
YOU THE RIGHTS CONTAINED HERE IN CONSIDERATION OF YOUR ACCEPTANCE OF
SUCH TERMS AND CONDITIONS.

1. Definitions

   a. "Collective Work" means a work, such as a periodical issue,
      anthology or encyclopedia, in which the Work in its entirety in
```

unmodified form, along with a number of other contributions, constituting separate and independent works in themselves, are assembled into a collective whole. A work that constitutes a Collective Work will not be considered a Derivative Work (as defined below) for the purposes of this License.

b. "Derivative Work" means a work based upon the Work or upon the Work and other pre-existing works, such as a translation, musical arrangement, dramatization, fictionalization, motion picture version, sound recording, art reproduction, abridgment, condensation, or any other form in which the Work may be recast, transformed, or adapted, except that a work that constitutes a Collective Work will not be considered a Derivative Work for the purpose of this License. For the avoidance of doubt, where the Work is a musical composition or sound recording, the synchronization of the Work in timed-relation with a moving image ("synching") will be considered a Derivative Work for the purpose of this License.

c. "Licensor" means the individual or entity that offers the Work under the terms of this License.

d. "Original Author" means the individual or entity who created the Work.

e. "Work" means the copyrightable work of authorship offered under the terms of this License.

f. "You" means an individual or entity exercising rights under this License who has not previously violated the terms of this License with respect to the Work, or who has received express permission from the Licensor to exercise rights under this License despite a previous violation.

2. Fair Use Rights. Nothing in this license is intended to reduce, limit, or restrict any rights arising from fair use, first sale or other limitations on the exclusive rights of the copyright owner under copyright law or other applicable laws.

3. License Grant. Subject to the terms and conditions of this License, Licensor hereby grants You a worldwide, royalty-free, non-exclusive, perpetual (for the duration of the applicable copyright) license to exercise the rights in the Work as stated below:

   a. to reproduce the Work, to incorporate the Work into one or more Collective Works, and to reproduce the Work as incorporated in the Collective Works;

   b. to create and reproduce Derivative Works;

   c. to distribute copies or phonorecords of, display publicly, perform publicly, and perform publicly by means of a digital audio transmission the Work including as incorporated in Collective Works;

   d. to distribute copies or phonorecords of, display publicly, perform publicly, and perform publicly by means of a digital audio transmission Derivative Works.

   e.

   For the avoidance of doubt, where the work is a musical composition:

      i. Performance Royalties Under Blanket Licenses. Licensor waives the exclusive right to collect, whether individually or via a performance rights society (e.g. ASCAP, BMI, SESAC), royalties for the public performance or public digital performance (e.g. webcast) of the Work.

ii. Mechanical Rights and Statutory Royalties. Licensor waives the exclusive right to collect, whether individually or via a music rights agency or designated agent (e.g. Harry Fox Agency), royalties for any phonorecord You create from the Work ("cover version") and distribute, subject to the compulsory license created by 17 USC Section 115 of the US Copyright Act (or the equivalent in other jurisdictions).

f. Webcasting Rights and Statutory Royalties. For the avoidance of doubt, where the Work is a sound recording, Licensor waives the exclusive right to collect, whether individually or via a performance-rights society (e.g. SoundExchange), royalties for the public digital performance (e.g. webcast) of the Work, subject to the compulsory license created by 17 USC Section 114 of the US Copyright Act (or the equivalent in other jurisdictions).

The above rights may be exercised in all media and formats whether now known or hereafter devised. The above rights include the right to make such modifications as are technically necessary to exercise the rights in other media and formats. All rights not expressly granted by Licensor are hereby reserved.

4. Restrictions.The license granted in Section 3 above is expressly made subject to and limited by the following restrictions:

   a. You may distribute, publicly display, publicly perform, or publicly digitally perform the Work only under the terms of this License, and You must include a copy of, or the Uniform Resource Identifier for, this License with every copy or phonorecord of the Work You distribute, publicly display, publicly perform, or publicly digitally perform. You may not offer or impose any terms on the Work that alter or restrict the terms of this License or the recipients' exercise of the rights granted hereunder. You may not sublicense the Work. You must keep intact all notices that refer to this License and to the disclaimer of warranties. You may not distribute, publicly display, publicly perform, or publicly digitally perform the Work with any technological measures that control access or use of the Work in a manner inconsistent with the terms of this License Agreement. The above applies to the Work as incorporated in a Collective Work, but this does not require the Collective Work apart from the Work itself to be made subject to the terms of this License. If You create a Collective Work, upon notice from any Licensor You must, to the extent practicable, remove from the Collective Work any reference to such Licensor or the Original Author, as requested. If You create a Derivative Work, upon notice from any Licensor You must, to the extent practicable, remove from the Derivative Work any reference to such Licensor or the Original Author, as requested.

   b. If you distribute, publicly display, publicly perform, or publicly digitally perform the Work or any Derivative Works or Collective Works, You must keep intact all copyright notices for the Work and give the Original Author credit reasonable to the medium or means You are utilizing by conveying the name (or pseudonym if applicable) of the Original Author if supplied; the title of the Work if supplied; to the extent reasonably practicable, the Uniform Resource Identifier, if any, that Licensor specifies to be associated with the Work, unless such URI does not refer to the copyright notice or licensing information for the Work; and in the case of a Derivative Work, a credit identifying the use of the Work in the Derivative Work (e.g., "French translation of the Work by Original Author," or "Screenplay based on original Work by Original Author"). Such credit may be implemented in any reasonable manner; provided, however, that in the case of a Derivative Work or Collective Work, at a minimum such credit will appear where any other comparable authorship credit appears and in a manner at least as prominent as such other comparable authorship credit.

5. Representations, Warranties and Disclaimer

UNLESS OTHERWISE MUTUALLY AGREED TO BY THE PARTIES IN WRITING, LICENSOR OFFERS THE WORK AS-IS AND MAKES NO REPRESENTATIONS OR WARRANTIES OF ANY KIND CONCERNING THE WORK, EXPRESS, IMPLIED, STATUTORY OR OTHERWISE, INCLUDING, WITHOUT LIMITATION, WARRANTIES OF TITLE, MERCHANTIBILITY, FITNESS FOR A PARTICULAR PURPOSE, NONINFRINGEMENT, OR THE ABSENCE OF LATENT OR OTHER DEFECTS, ACCURACY, OR THE PRESENCE OF ABSENCE OF ERRORS, WHETHER OR NOT DISCOVERABLE. SOME JURISDICTIONS DO NOT ALLOW THE EXCLUSION OF IMPLIED WARRANTIES, SO SUCH EXCLUSION MAY NOT APPLY TO YOU.

6. Limitation on Liability. EXCEPT TO THE EXTENT REQUIRED BY APPLICABLE LAW, IN NO EVENT WILL LICENSOR BE LIABLE TO YOU ON ANY LEGAL THEORY FOR ANY SPECIAL, INCIDENTAL, CONSEQUENTIAL, PUNITIVE OR EXEMPLARY DAMAGES ARISING OUT OF THIS LICENSE OR THE USE OF THE WORK, EVEN IF LICENSOR HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

7. Termination

   a. This License and the rights granted hereunder will terminate automatically upon any breach by You of the terms of this License. Individuals or entities who have received Derivative Works or Collective Works from You under this License, however, will not have their licenses terminated provided such individuals or entities remain in full compliance with those licenses. Sections 1, 2, 5, 6, 7, and 8 will survive any termination of this License.

   b. Subject to the above terms and conditions, the license granted here is perpetual (for the duration of the applicable copyright in the Work). Notwithstanding the above, Licensor reserves the right to release the Work under different license terms or to stop distributing the Work at any time; provided, however that any such election will not serve to withdraw this License (or any other license that has been, or is required to be, granted under the terms of this License), and this License will continue in full force and effect unless terminated as stated above.

8. Miscellaneous

   a. Each time You distribute or publicly digitally perform the Work or a Collective Work, the Licensor offers to the recipient a license to the Work on the same terms and conditions as the license granted to You under this License.

   b. Each time You distribute or publicly digitally perform a Derivative Work, Licensor offers to the recipient a license to the original Work on the same terms and conditions as the license granted to You under this License.

   c. If any provision of this License is invalid or unenforceable under applicable law, it shall not affect the validity or enforceability of the remainder of the terms of this License, and without further action by the parties to this agreement, such provision shall be reformed to the minimum extent necessary to make such provision valid and enforceable.

   d. No term or provision of this License shall be deemed waived and no breach consented to unless such waiver or consent shall be in writing and signed by the party to be charged with such waiver or consent.

   e. This License constitutes the entire agreement between the parties with respect to the Work licensed here. There are no

understandings, agreements or representations with respect to the Work not specified here. Licensor shall not be bound by any additional provisions that may appear in any communication from You. This License may not be modified without the mutual written agreement of the Licensor and You.

Creative Commons is not a party to this License, and makes no warranty whatsoever in connection with the Work. Creative Commons will not be liable to You or any party on any legal theory for any damages whatsoever, including without limitation any general, special, incidental or consequential damages arising in connection to this license. Notwithstanding the foregoing two (2) sentences, if Creative Commons has expressly identified itself as the Licensor hereunder, it shall have all rights and obligations of Licensor.

Except for the limited purpose of indicating to the public that the Work is licensed under the CCPL, neither party will use the trademark "Creative Commons" or any related trademark or logo of Creative Commons without the prior written consent of Creative Commons. Any permitted use will be in compliance with Creative Commons' then-current trademark usage guidelines, as may be published on its website or otherwise made available upon request from time to time.

Creative Commons may be contacted at http://creativecommons.org/.

==

Stichwortverzeichnis