

Version Control with Subversion

Draft Revision 8263

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

Version Control with Subversion: Draft Revision 8263

by Ben Collins-Sussman, Brian W. Fitzpatrick, and C. Michael Pilato

Published (TBA)

Table of Contents

Preface	11
Audience	11
How to Read this Book	11
Conventions Used in This Book	12
This Book is Free	12
Acknowledgments	12
1. Introduction	1
What is Subversion?	1
Subversion's History	1
Subversion's Features	1
Installing Subversion	2
Subversion's Components	2
Client Components (for the User)	3
Server Components (for the Administrator)	3
2. Basic Concepts	4
The Repository	4
Versioning Models	5
The Problem of File-Sharing	5
The Lock-Modify-Unlock Solution	5
The Copy-Modify-Merge Solution	7
Subversion in Action	9
Working Copies	9
Revisions	13
How Working Copies Track the Repository	15
The Limitations of Mixed Revisions	15
Summary	16
3. Guided Tour	17
Help!	17
Import	17
Revisions: Numbers, Keywords, and Dates, Oh My!	17
Revision Numbers	17
Revision Keywords	17
Revision Dates	18
Initial Checkout	19
Basic Work Cycle	21
Update Your Working Copy	22
Make Changes to Your Working Copy	22
Examine Your Changes	23
Resolve Conflicts (Merging Others' Changes)	28
Commit Your Changes	32
Examining History	33
svn log	33
svn diff	35
svn cat	36
svn list	37
A Final Word on History	37
Other Useful Commands	37
svn cleanup	37
svn import	38
Summary	38
4. Branching and Merging	39
What's a Branch?	39
Using Branches	40

Creating a Branch	41
Working with Your Branch	43
The Moral of the Story	45
Copying Changes Between Branches	45
Copying Specific Changes	46
The Repeated Merge Problem	48
Merging an Entire Branch	48
Removing a Change from the Repository	49
Switching a Working Copy	50
Tags	51
Creating a Simple Tag	51
Creating a Complex Tag	52
Branch Maintenance	52
Repository Layout	53
Data Lifetimes	53
Summary	54
5. Repository Administration	55
Repository Basics	55
Understanding Transactions and Revisions	55
Unversioned Properties	56
Repository Creation and Configuration	56
Hook Scripts	57
Berkeley DB Configuration	59
Repository Maintenance	59
An Administrator's Toolkit	59
Repository Cleanup	65
Repository Recovery	67
Migrating a Repository	68
Repository Backup	71
Adding Projects	73
Choosing a Repository Layout	73
Creating the Layout, and Importing Initial Data	74
Summary	75
6. Server Configuration	76
Overview	76
Network Model	76
Requests and Responses	77
Client Credentials Caching	77
svnserve, a custom server	79
Invoking the Server	79
Built-in authentication and authorization	80
SSH authentication and authorization	82
httpd, the Apache HTTP server	83
Prerequisites	84
Basic Apache Configuration	84
Authentication Options	86
Authorization Options	89
Extra Goodies	92
Using Multiple Servers	93
7. Advanced Topics	95
Runtime Configuration Area	95
Configuration Area Layout	95
Configuration and the Windows Registry	96
Configuration Options	97
Properties	100
Why Properties?	100
Manipulating Properties	101
Special properties	104

Externals Definitions	109
Vendor branches	110
General Vendor Branch Management Procedure	111
svn_load_dirs.pl	112
8. Developer Information	115
Layered Library Design	115
Repository Layer	117
Repository Access Layer	121
Client Layer	123
Using the APIs	124
The Apache Portable Runtime Library	124
URL and Path Requirements	125
Using Languages Other than C and C++	125
Inside the Working Copy Administration Area	127
The Entries File	127
Pristine Copies and Property Files	129
WebDAV	129
Programming with Memory Pools	129
Contributing to Subversion	132
Join the Community	132
Get the Source Code	132
Become Familiar with Community Policies	133
Make and Test Your Changes	133
Donate Your Changes	133
9. Subversion Complete Reference	134
The Subversion Command Line Client: svn	134
svn Switches	134
svn Subcommands	136
svnadmin	192
svnadmin Switches	192
svnadmin Subcommands	193
svnlook	202
svnlook Switches	202
svnlook Subcommands	203
A. Subversion for CVS Users	217
Revision Numbers Are Different Now	217
Directory Versions	217
More Disconnected Operations	218
Distinction Between Status and Update	218
Branches and Tags	219
Meta-data Properties	219
Conflict Resolution	220
Binary Files and Translation	220
Versioned Modules	220
B. CVS Repository Migration	221
Requirements	221
Running cvs2svn.py	221
C. Troubleshooting	222
Common Problems	222
Problems Using Subversion	222
Problems Building Subversion	224
D. WebDAV and Autoversioning	226
Basic WebDAV Concepts	226
Just Plain WebDAV	226
DeltaV Extensions	226
Subversion and DeltaV	227
Mapping Subversion to DeltaV	228
Autoversioning Support	228

The mod_dav_lock Alternative	229
Autoversioning Interoperability	229
Win32 WebFolders	230
Mac OS X	230
Unix: Nautilus 2	230
Linux davfs2	231
E. Other Subversion Clients	232
Out of One, Many	232
F. Third Party Tools	233
ViewCVS	233
SubWiki	233
Glossary	234

List of Figures

2.1. A Typical Client/Server System	4
2.2. The Problem to Avoid	5
2.3. The Lock-Modify-Unlock Solution	6
2.4. The Copy-Modify-Merge Solution	7
2.5. ... Copy-Modify-Merge Continued	8
2.6. The Repository's Filesystem	10
2.7. The Repository	13
4.1. Branches of Development	39
4.2. Starting Repository Layout	40
4.3. Repository With New Copy	42
4.4. The Branching of One File's History	44
5.1. One Suggested Repository Layout.	73
5.2. Another Suggested Repository Layout.	74
8.1. Subversion's "Big Picture"	116
8.2. Files and Directories in Two Dimensions	118
8.3. Revisioning Time—the Third Dimension!	118

List of Tables

2.1. Repository Access URLs	12
6.1. Network Server Comparison	76
8.1. A Brief Inventory of the Subversion Libraries	115
E.1. GUI Clients for Subversion	232

List of Examples

5.1. Using svnshell to Navigate the Repository	63
5.2. txn-info.sh (Reporting Outstanding Transactions)	66
5.3. Using Incremental Repository Dumps	70
7.1. Sample Registration Entries (.reg) File.	96
8.1. Using the Repository Layer	119
8.2. Using the Repository Layer with Python	125
8.3. A Simple Script to Check Out a Working Copy.	126
8.4. Contents of a Typical .svn/entries File	128
8.5. Effective Pool Usage	130

Preface

“If C gives you enough rope to hang yourself, think of Subversion as a sort of rope storage facility.” —Brian Fitzpatrick

In the world of open-source software, the Concurrent Versions System (CVS) has long been the tool of choice for version control. And rightly so. CVS itself is free software, and its wonderful “non-locking” system—which allows dozens of far-flung programmers to share their work—fits the collaborative nature of the open-source world very well. CVS and its semi-chaotic development model have become cornerstones of open-source culture.

But like many tools, CVS is starting to show its age. Subversion is a relatively new version control system designed to be the successor to CVS. The designers set out to win the hearts of CVS users in two ways: by creating an open-source system with a design (and “look and feel”) similar to CVS, and by attempting to fix most of CVS’s noticeable flaws. While the result isn’t necessarily the next great evolution in version control design, Subversion *is* very powerful, very usable, and very flexible.

Audience

This book is written for computer literate folk who want to use Subversion to manage their data. While Subversion runs on a number of different operating systems, its primary user interface is command-line based. For that reason, the examples in this book assume the reader is using a Unix-like operating system, and is relatively comfortable with Unix and command-line interfaces.

Most readers are probably programmers or sysadmins who need to track changes to source code; this is the most common use for Subversion, and therefore it is the scenario underlying all of the book’s examples. But keep in mind that Subversion can be used to manage changes to any sort of information: images, music, databases, documentation, and so on. To Subversion, all data is just data.

While this book is written with the assumption that the reader has never used version control, we’ve also tried to make it easy for former CVS users to get up to speed quickly. Special sidebars may discuss CVS from time to time, and a special appendix summarizes most of the differences between CVS and Subversion.

How to Read this Book

This book aims to be useful to people of widely different backgrounds: from people with no experience in version control, all the way up to experienced sysadmins. Depending on your own background, certain chapters may be more or less important to you.

What kind of reader are you?

- *The experienced sysadmin or computer geek.* The assumption here is that you’ve probably used CVS before, and are dying to get a Subversion server up and running ASAP. Chapters 5 and 6 will show you how to create your first repository and make it available over the network. After that’s done, chapter 3 and appendix A are the fastest routes to learning the Subversion client while drawing on your CVS experience.
- *The new user.* Your administrator has probably set up Subversion already, and you need to learn how to use the client. If you’ve never used CVS (or have never used a version control system), then chapters 2 and 3 are a vital introduction. If you’re already an old hand at CVS, chapter 3 and appendix A are the best place to start.
- *The advanced user.* Whether you’re a user or administrator, eventually your project will grow larger. You’re going to want to learn how to do more advanced things with Subversion, such as branching and merging (chapter 4), set metadata properties and configure runtime options (chapter 7), and other things. Chapters 4 and 7 aren’t vital at first, but be sure to read them once you’re comfortable with the basics.

- *The developer.* Presumably, you're already familiar with Subversion, and now want to either extend it, or build new software on top of its many APIs. Chapter 8 is just for you.

The book ends with reference material: chapter 9 is a reference guide for all Subversion commands, and the appendices cover a number of useful topics. These are the chapters you're mostly likely to come back to after you've finished the book.

Conventions Used in This Book

O'Reilly almost certainly needs to fill this in, depending on how they typeset the book.

Note that the source code examples are just that—examples. While they will compile with the proper compiler incantations, they are intended to illustrate the problem at hand, not necessarily serve as examples of good programming style.

This Book is Free

This book started out as bits of documentation written by Subversion project developers, which were then coalesced into a single work and rewritten. As such, it has always had the same free, open-source license as Subversion itself. In fact, the book was written in the public eye, as a part of Subversion. This means two things:

- You will always find the latest version of this book in Subversion's own source tree.
- You can distribute and make changes to this book however you wish — it's under a free license. Of course, rather than distribute your own private version of this book, we'd much rather you send feedback and patches to the Subversion developer community. See the section called “Contributing to Subversion” to learn about joining this community.

You can send publishing comments and questions to O'Reilly here: ###insert boilerplate.

A relatively recent online version of this book can be found at <http://svnbook.red-bean.com>.

Acknowledgments

Huge list of thanks to the many svn developers who sent patches/feedback on this book.

Also, individual-author acknowledgments to specific friends and family.

Chapter 1. Introduction

Version control is the art of managing changes to information. It has long been a critical tool for programmers, who typically spend their time making small changes to software and then undoing those changes the next day. Imagine a team of these programmers working concurrently, and you can see why a good system is needed to manage the potential chaos.

What is Subversion?

Subversion is a free/open-source version control system. That is, Subversion manages files and directories over time. A tree of files is placed into a central *repository*. The repository is much like an ordinary file server, except that it remembers every change ever made to your files and directories. This allows you to recover older versions of your data, or examine the history of how your data changed. In this regard, many people think of a version control system as a sort of “time machine”.

Some version control systems are also software configuration management (SCM) systems. These systems are specifically tailored to manage trees of source code, and have many features that are specific to software development—such as natively understanding programming languages, or supplying tools for building software. Subversion, however, is not one of these systems; it is a general system that can be used to manage *any* collection of files, including source code.

Subversion's History

In 1995, Karl Fogel and Jim Blandy founded Cyclic Software, a company for commercially supporting and improving the Concurrent Versions System (CVS). Cyclic made the first public release of a network-enabled CVS (contributed by Cygnus software). In 1999, Karl Fogel published a book about CVS and the open-source development model it enables. Karl and Jim had long talked about writing a replacement for CVS; Jim had even drafted a new, theoretical repository design, and had come up with a good project name. Finally, in February of 2000, Brian Behlendorf of CollabNet (<http://www.collab.net>) offered Karl a full-time job to write a CVS replacement. Karl gathered a team together and work began in May. Because Subversion was developed openly under a free license, it quickly attracted a community of developers.

The original design team settled on some simple goals. They decided that Subversion should be a functional replacement for CVS: it should match CVS's features, preserve the same development model, but still fix the most obvious flaws. And Subversion should be similar enough to CVS that any CVS user could start using it with little effort.

After fourteen months of coding, Subversion became “self-hosting” on August 31, 2001. That is, Subversion developers stopped using CVS to manage Subversion's own source code and started using Subversion instead.

While CollabNet is credited with initiating and funding a very large chunk of the work (it pays the salaries of a few full-time Subversion developers), the project is still a typical open-source project, governed by the usual meritocratic rules. CollabNet owns the copyright on the code, but the code is available under an Apache/BSD-style license which is fully compliant with the Debian Free Software Guidelines. In other words, anyone is free to download, modify, and redistribute Subversion as he pleases; no permission from CollabNet or anyone else is required.

Subversion's Features

How does Subversion improve upon CVS's design? Here's a short list to whet your appetite. If you're not familiar with CVS, you may not understand all of these features. Fear not: Chapter 2 will provide you with a gentle introduction to version control.

Directory versioning

CVS only tracks the history of individual files, but Subversion implements a “virtual” versioned filesystem that tracks changes to whole directory trees over time. Files *and*

	directories are versioned. As a result, there are real client-side move and copy commands that operate on files and directories.
Atomic commits	A commit either goes into the repository completely, or not at all. This allows developers to construct and commit changes as logical chunks.
Versioned metadata	Each file and directory has an invisible set of “properties” attached. You can invent and store any arbitrary key/value pairs you wish. Properties are versioned over time, just like file contents.
Choice of network layers	Subversion has an abstracted notion of repository access, making it easy for people to implement new network mechanisms. Subversion's “advanced” network server is a module for the Apache web server, which speaks a variant of HTTP called WebDAV/DeltaV. This gives Subversion a big advantage in stability and interoperability, and provides various key features for free: authentication, authorization, wire compression, and repository browsing, for example. A smaller, standalone Subversion server process is also available. This server speaks a custom protocol which can be easily tunneled over ssh.
Consistent data handling	Subversion expresses file differences using a binary differencing algorithm, which works identically on both text (human-readable) and binary (human-unreadable) files. Both types of files are stored equally compressed in the repository, and differences are transmitted in both directions across the network.
Efficient branching and tagging	The cost of branching and tagging need not be proportional to the project size. Subversion creates branches and tags by simply copying the project, using a mechanism similar to a hard-link. Thus these operations take only a very small, constant amount of time.
Hackability	Subversion has no historical baggage; it is implemented as a collection of shared C libraries with well-defined APIs. This makes Subversion extremely maintainable and usable by other applications and languages.

Installing Subversion

Subversion is built on a portability layer called APR (the Apache Portable Runtime library). This means Subversion should work 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 website (<http://subversion.tigris.org>) often has binaries 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 (rpm, deb, ports tree) to get Subversion.

Alternately, you can build Subversion directly from source code. From the website, you can 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 contains everything you need to build a command-line client capable of talking to a remote repository (in particular, the apr, apr-util, and neon libraries). But Subversion has many other dependencies, such as Berkeley DB and possibly Apache httpd. If you want to do a “full” build, make sure you have all of the packages documented in the INSTALL file. If you plan to work on Subversion itself, you can use your client program to grab the latest, bleeding-edge source code. This is documented in the section called “Get the Source Code”.

Subversion's Components

Subversion, once installed, has a number of different pieces. Here's a quick overview of what you get.

Client Components (for the User)

svn	The command-line client program. This is the main tool used to manage data, and its use is covered in Chapters 2, 3, 4, and 6.
svnversion	A program for reporting the mixed-revision state of a working copy. (See Chapter 2, <i>Basic Concepts</i> to understand mixed-revision working copies.)

Server Components (for the Administrator)

These are all discussed in Chapter 5, *Repository Administration*.

svnlook	A tool for inspecting a Subversion repository.
svnadmin	A tool for creating, tweaking or repairing a Subversion repository.
mod_dav_svn	A plug-in module for the Apache-2.X web server; used to make your repository available to others over a network.
svnserv	A standalone server program, runnable as a daemon process or invocable by SSH; another way to make your repository available to others over a network.

Assuming you have Subversion installed correctly, you should be ready to start. The next two chapters will walk you through the use of **svn**, Subversion's command-line client program.

Chapter 2. Basic Concepts

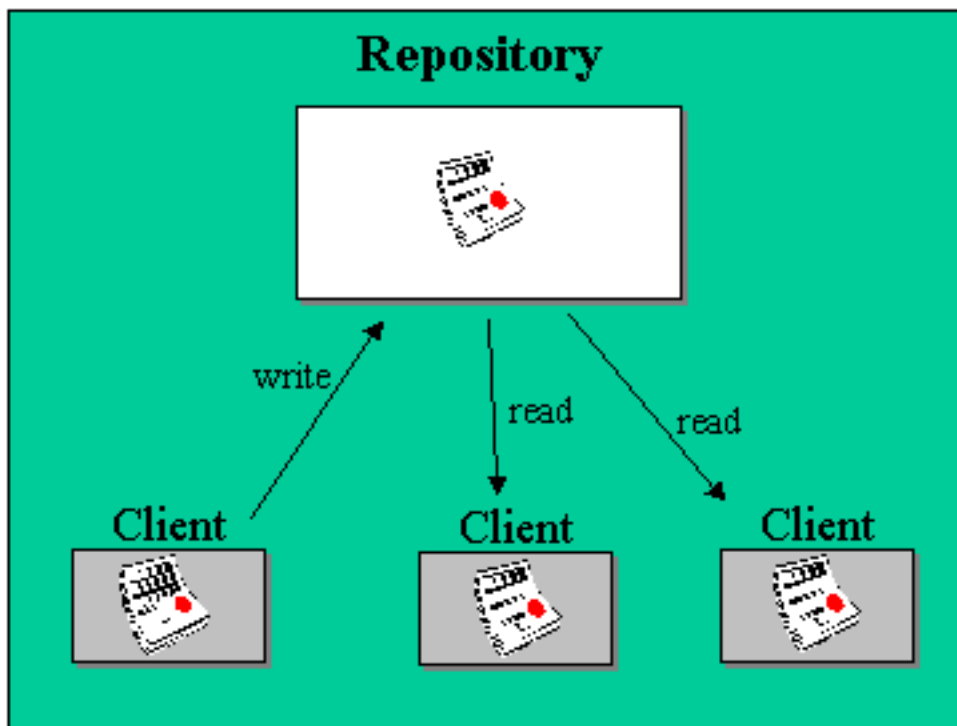
This chapter is a short, casual introduction to Subversion. If you're new to version control, this chapter is definitely for you. We begin with a discussion of general version control concepts, work our way into the specific ideas behind Subversion, and show some simple examples of Subversion in use.

Even though the examples in this chapter show people sharing collections of program source code, keep in mind that Subversion can manage any sort of file collection—it's not limited to helping computer programmers.

The Repository

Subversion is a centralized system for sharing information. At its core is a *repository*, which is a central store of data. The repository stores information in the form of a *filesystem tree*—a typical hierarchy of files and directories. Any number of *clients* connect to the repository, and then read or write to these files. By writing data, a client makes the information available to others; by reading data, the client receives information from others.

Figure 2.1. A Typical Client/Server System



So why is this interesting? So far, this sounds like the definition of a typical file server. And indeed, the repository *is* a kind of file server, but it's not your usual breed. What makes the Subversion repository special is that *it remembers every change* ever written to it: every change to every file, and even changes to the directory tree itself, such as the addition, deletion, and rearrangement of files and directories.

When a client reads data from the repository, it normally sees only the latest version of the filesystem tree. But the client also has the ability to view *previous* states of the filesystem. For example, a client can ask historical questions like, "what did this directory contain last Wednesday?", or "who was the last person to change this file, and what changes did they make?" These are the sorts of questions that are at the heart of any *version control system*: systems

that are designed to record and track changes to data over time.

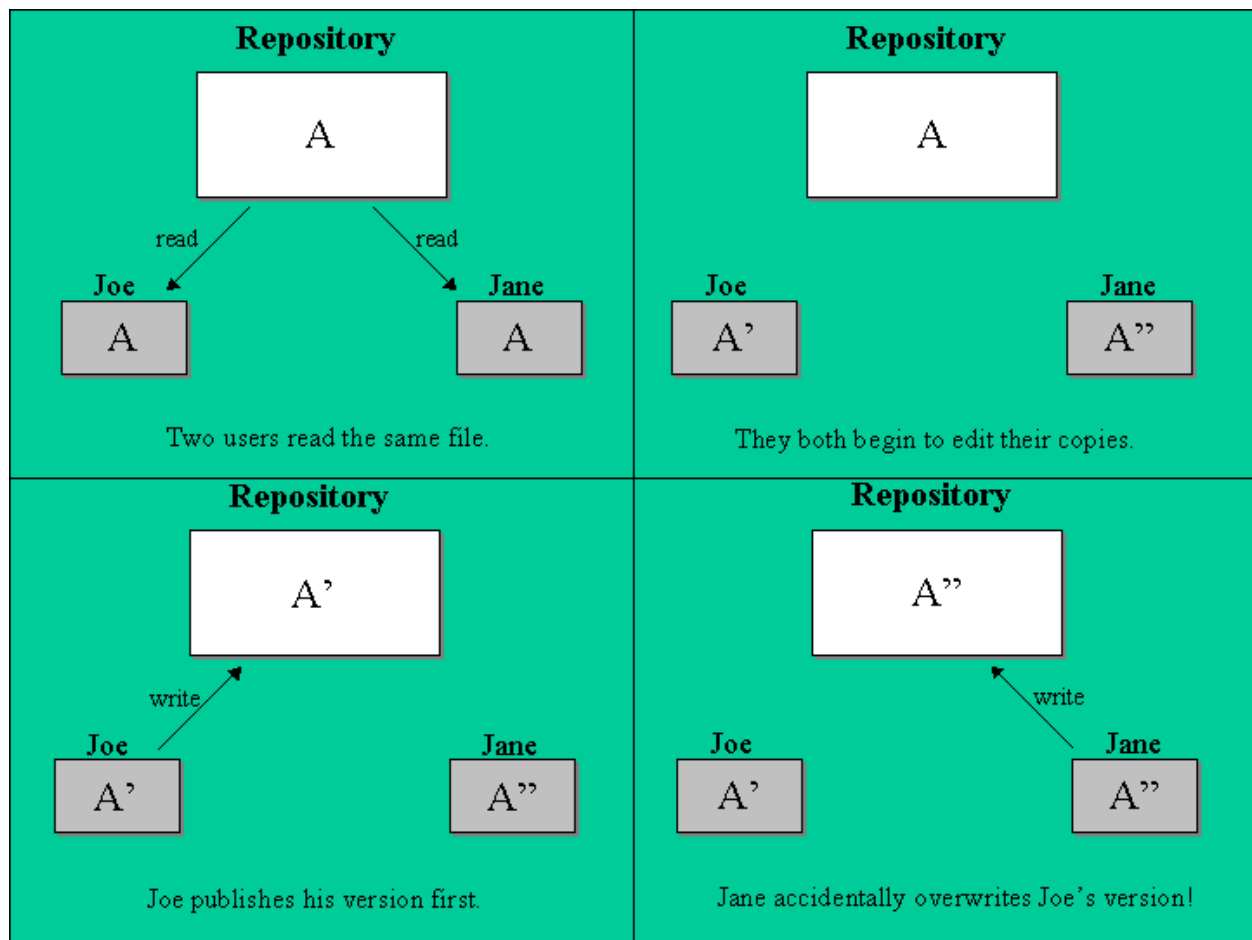
Versioning Models

The Problem of File-Sharing

All version control systems have to solve the same fundamental problem: how will the system allow users to share information, but prevent them from accidentally stepping on each other's feet? It's all too easy for users to accidentally overwrite each other's changes in the repository.

Consider this scenario: suppose we have two co-workers, Harry and Sally. They each decide to edit the same repository file at the same time. If Harry saves his changes to the repository first, then it's possible that (a few moments later) Sally could accidentally overwrite them with her own new version of the file. While Harry's version of the file won't be lost forever (because the system remembers every change), any changes Harry made *won't* be present in Sally's newer version of the file, because she never saw Harry's changes to begin with. Harry's work is still effectively lost—or at least missing from the latest version of the file—and probably by accident. This is definitely a situation we want to avoid!

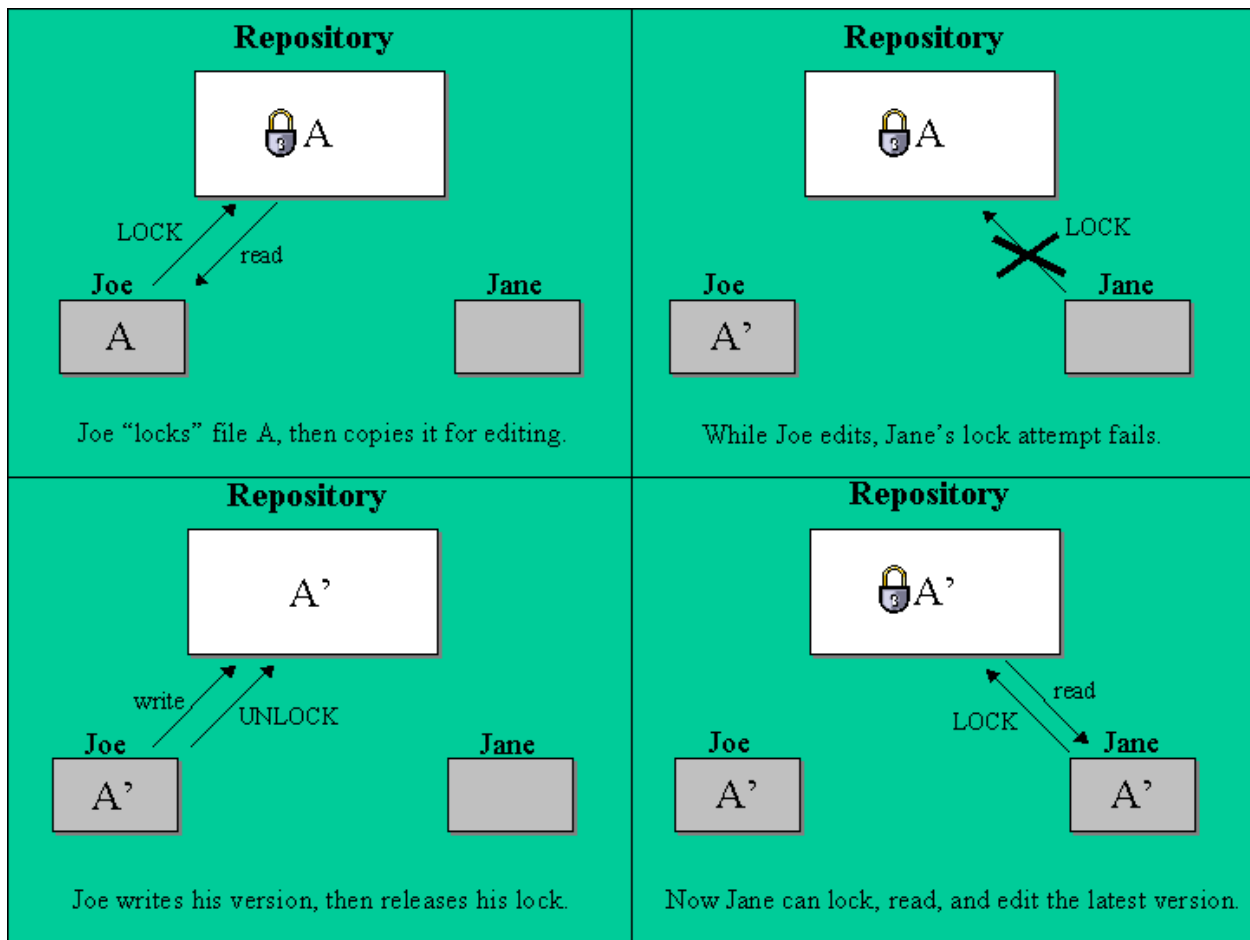
Figure 2.2. The Problem to Avoid



The Lock-Modify-Unlock Solution

Many version control systems use a *lock-modify-unlock* model to address this problem, which is a very simple solution. In such a system, the repository allows only one person to change a file at a time. First Harry must "lock" the file before he can begin making changes to it. Locking a file is a lot like borrowing a book from the library; if Harry has locked a file, then Sally cannot make any changes to it. If she tries to lock the file, the repository will deny the request. All she can do is read the file, and wait for Harry to finish his changes and release his lock. After Harry unlocks the file, his turn is over, and now Sally can take her turn by locking and editing.

Figure 2.3. The Lock-Modify-Unlock Solution



The problem with the lock-modify-unlock model is that it's a bit restrictive, and often becomes a roadblock for users:

- *Locking may cause administrative problems.* Sometimes Harry will lock a file and then forget about it. Meanwhile, because Sally is still waiting to edit the file, her hands are tied. And then Harry goes on vacation. Now Sally has to get an administrator to release Harry's lock. The situation ends up causing a lot of unnecessary delay and wasted time.
- *Locking may cause unnecessary serialization.* What if Harry is editing the beginning of a text file, and Sally simply wants to edit the end of the same file? These changes don't overlap at all. They could easily edit the file simultaneously, and no great harm would come, assuming the changes were properly merged together. There's no need for them to take turns in this situation.

- *Locking may create a false sense of security.* Pretend that Harry locks and edits file A, while Sally simultaneously locks and edits file B. But suppose that A and B depend on one another, and the changes made to each are semantically incompatible. Suddenly A and B don't work together anymore. The locking system was powerless to prevent the problem—yet it somehow provided a sense of false security. It's easy for Harry and Sally to imagine that by locking files, each is beginning a safe, insulated task, and thus inhibits them from discussing their incompatible changes early on.

The Copy-Modify-Merge Solution

Subversion, CVS, and other version control systems use a *copy-modify-merge* model as an alternative to locking. In this model, each user's client reads the repository and creates a personal *working copy* of the file or project. Users then work in parallel, modifying their private copies. Finally, the private copies are merged together into a new, final version. The version control system often assists with the merging, but ultimately a human being is responsible for making it happen correctly.

Here's an example. Say that Harry and Sally each create working copies of the same project, copied from the repository. They work concurrently, and make changes to the same file "A" within their copies. Sally saves her changes to the repository first. When Harry attempts to save his changes later, the repository informs him that his file A is *out-of-date*. In other words, that file A in the repository has somehow changed since he last copied it. So Harry asks his client to *merge* any new changes from the repository into his working copy of file A. Chances are that Sally's changes don't overlap with his own; so once he has both sets of changes integrated, he saves his working copy back to the repository.

Figure 2.4. The Copy-Modify-Merge Solution

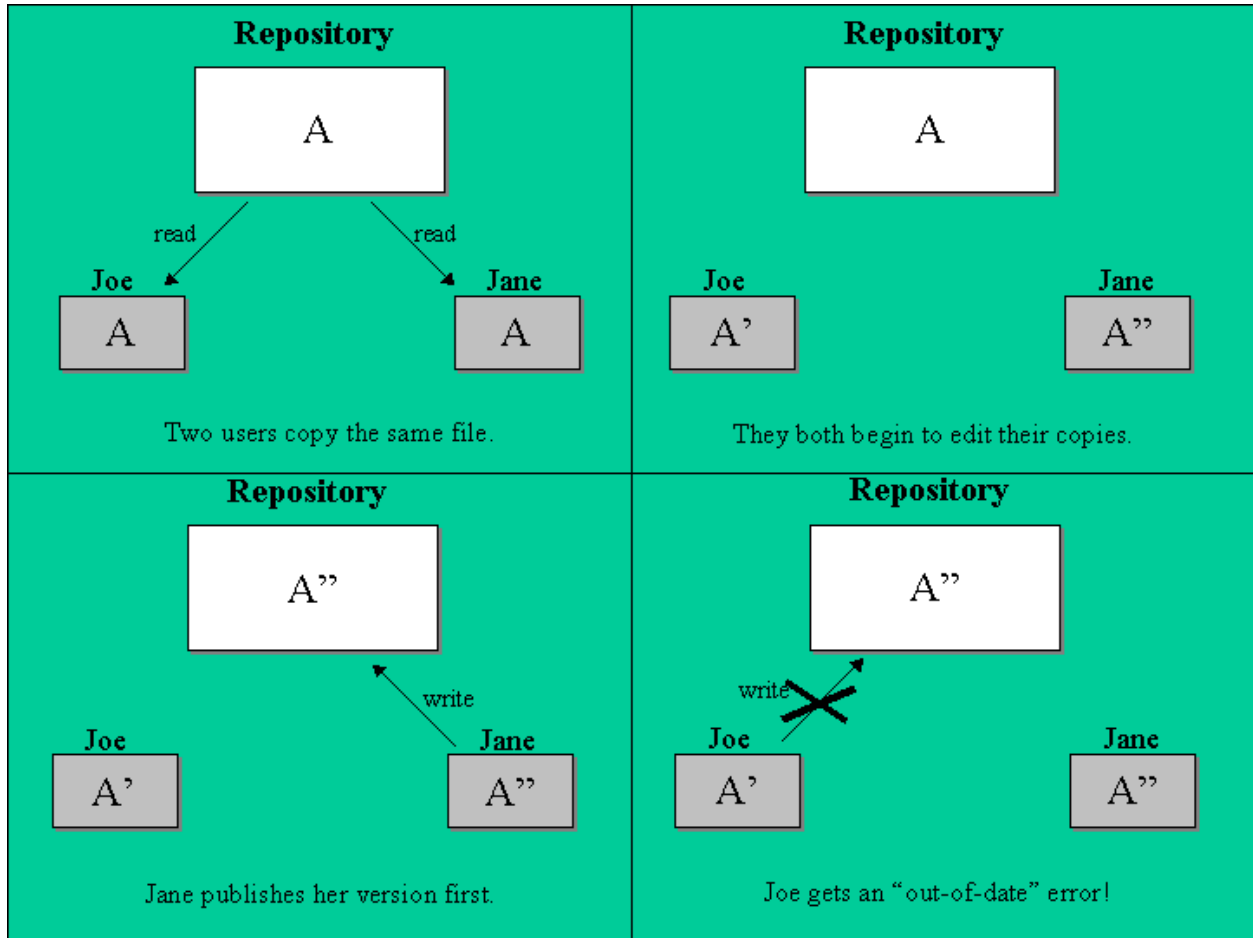
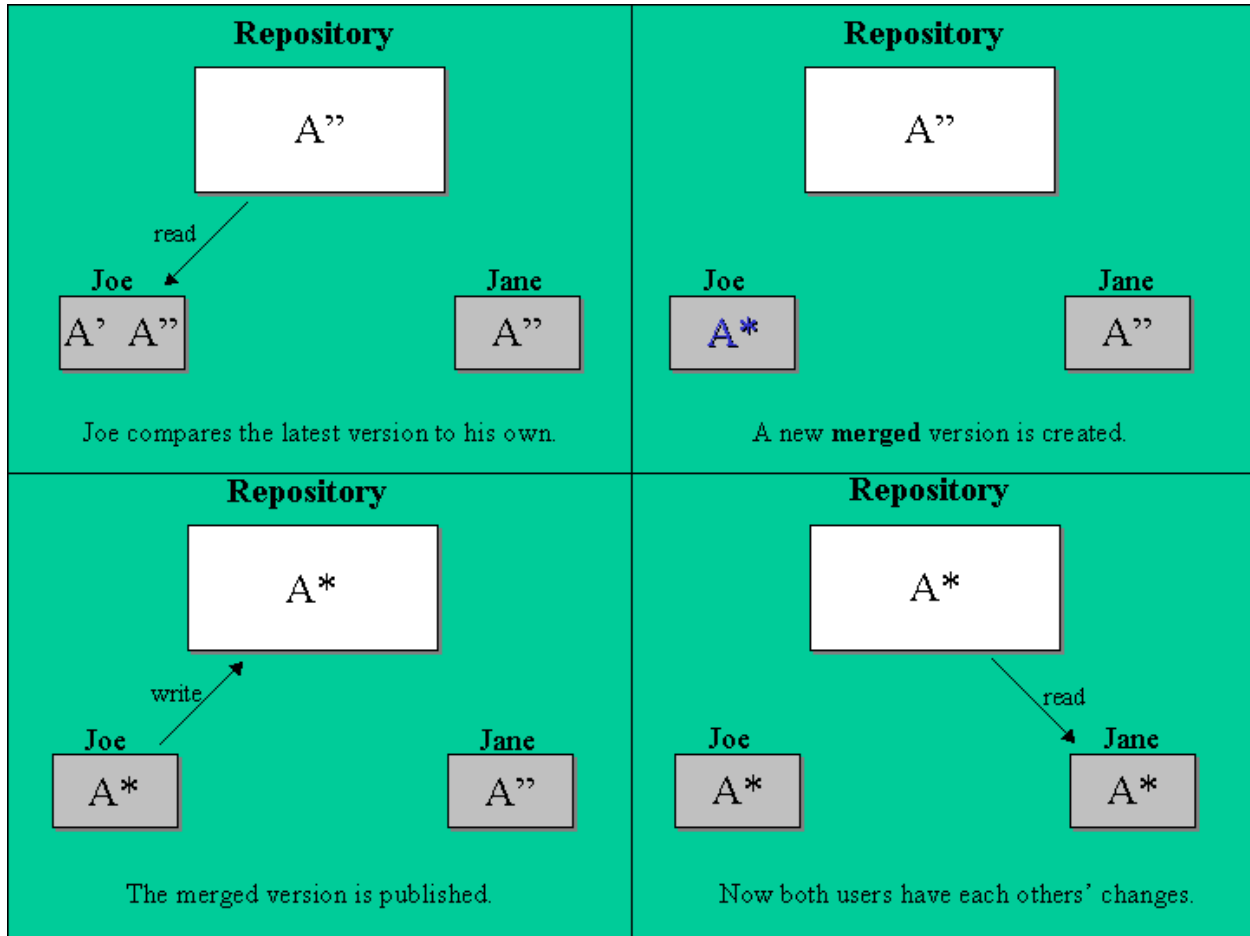


Figure 2.5. ...Copy-Modify-Merge Continued



But what if Sally's changes *do* overlap with Harry's changes? What then? This situation is called a *conflict*, and it's usually not much of a problem. When Harry asks his client to merge the latest repository changes into his working copy, his copy of file A is somehow flagged as being in a state of conflict: he'll be able to see both sets of conflicting changes, and manually choose between them. Note that software can't automatically resolve conflicts; only humans are capable of understanding and making the necessary intelligent choices. Once Harry has manually resolved the overlapping changes (perhaps by discussing the conflict with Sally!), he can safely save the merged file back to the repository.

The copy-modify-merge model may sound a bit chaotic, but in practice, it runs extremely smoothly. Users can work in parallel, never waiting for one another. When they work on the same files, it turns out that most of their concurrent changes don't overlap at all; conflicts are infrequent. And the amount of time it takes to resolve conflicts is far less than the time lost by a locking system.

In the end, it all comes down to one critical factor: user communication. When users communicate poorly, both syntactic and semantic conflicts increase. No system can force users to communicate perfectly, and no system can detect semantic conflicts. So there's no point in being lulled into a false promise that a locking system will somehow prevent conflicts; in practice, locking seems to inhibit productivity more than anything else.

Subversion in Action

Working Copies

You've already read about working copies; now we'll demonstrate how the Subversion client creates and uses them.

A Subversion working copy is an ordinary directory tree on your local system, containing a collection of files. You can edit these files however you wish, and if they're source code files, you can compile your program from them in the usual way. Your working copy is your own private work area: Subversion will never incorporate other people's changes, nor make your own changes available to others, until you explicitly tell it to do so.

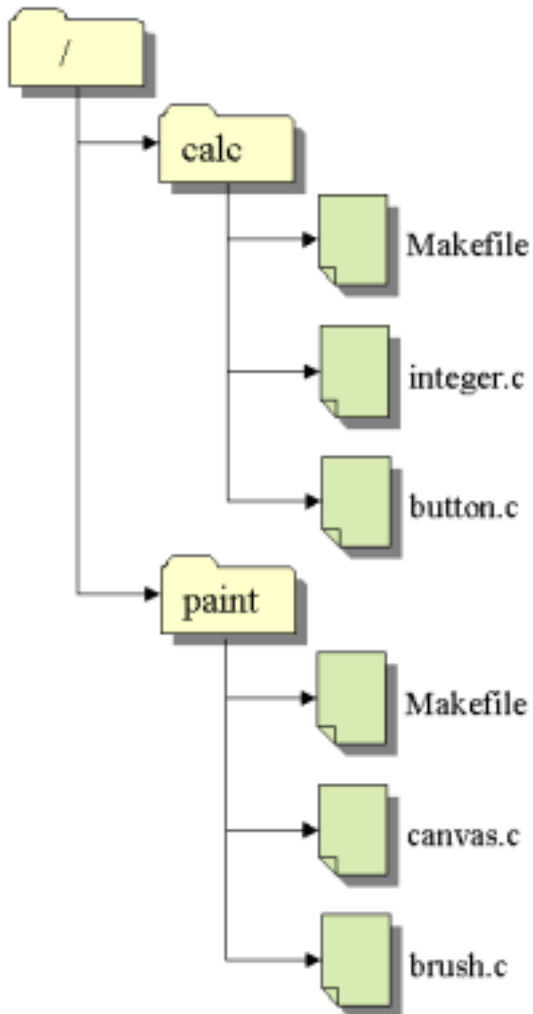
After you've made some changes to the files in your working copy and verified that they work properly, Subversion provides you with commands to "publish" your changes to the other people working with you on your project (by writing to the repository). If other people publish their own changes, Subversion provides you with commands to merge those changes into your working directory (by reading from the repository).

A working copy also contains some extra files, created and maintained by Subversion, to help it carry out these commands. In particular, each directory in your working copy contains a subdirectory named `.svn`, also known as the working copy *administrative directory*. The files in each administrative directory help Subversion recognize which files contain unpublished changes, and which files are out-of-date with respect to others' work.

A typical Subversion repository often holds the files (or source code) for several projects; usually, each project is a subdirectory in the repository's filesystem tree. In this arrangement, a user's working copy will usually correspond to a particular subtree of the repository.

For example, suppose you have a repository that contains two software projects.

Figure 2.6. The Repository's Filesystem



In other words, the repository's root directory has two subdirectories: `paint` and `calc`.

To get a working copy, you must *check out* some subtree of the repository. (The term "check out" may sound like it has something to do with locking or reserving resources, but it doesn't; it simply creates a private copy of the project for you.) For example, if you check out `/calc`, you will get a working copy like this:

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

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

The list of letter A's indicates that Subversion is adding a number of items to your working copy. You now have a personal copy of the repository's `/calc` directory, with one additional entry—`.svn`—which holds the extra information needed by Subversion, as mentioned earlier.

Repository URLs

Subversion repositories can be accessed through many different methods—on local disk, or through various network protocols. A repository location, however, is always a URL. The URL schema indicates the access method:

Table 2.1. Repository Access URLs

Schema	Access Method
file:///	direct repository access (on local disk)
http://	access via WebDAV protocol to Subversion-aware Apache server
https://	same as http://, but with SSL encryption.
svn://	access via custom protocol to an <code>svnserve</code> server
svn+ssh://	same as <code>svn://</code> , but through an SSH tunnel.

For the most part, Subversion's URLs use the standard syntax, allowing for server names and port numbers to be specified as part of the URL. Remember that the `file:` access method is valid only for locations on the same server as the client—in fact, in accordance with convention, the server name portion of the URL is required to be either absent or `localhost`:

```
$ svn checkout file:///path/to/repos
...
$ svn checkout file://localhost/path/to/repos
...
```

Also, users of the `file:` scheme on Windows platforms will need to use an unofficially “standard” syntax for accessing repositories that are on the same machine, but on a different drive than the client's current working drive. Either of the two following URL path syntaxes will work where `X` is the drive on which the repository resides:

```
C:\> svn checkout file:///X:/path/to/repos
...
C:\> svn checkout "file:///X|/path/to/repos"
...
```

In the second syntax, you need to quote the URL so that the vertical bar character is not interpreted as a pipe.

Note that a URL uses ordinary slashes even though the native (non-URL) form of a path on Windows uses backslashes.

Suppose you make changes to `button.c`. Since the `.svn` directory remembers the file's modification date and original contents, Subversion can tell that you've changed the file. However, Subversion does not make your changes public until you explicitly tell it to. The act of publishing your changes is more commonly known as *committing* (or *checking in*) changes to the repository.

To publish your changes to others, you can use Subversion's **commit** command:

```
$ svn commit button.c
Sending button.c
Transmitting file data..
```


Committed revision 57.

Now your changes to `button.c` have been committed to the repository; if another user checks out a working copy of `/calc`, they will see your changes in the latest version of the file.

Suppose you have a collaborator, Sally, who checked out a working copy of `/calc` at the same time you did. When you commit your change to `button.c`, Sally's working copy is left unchanged; Subversion only modifies working copies at the user's request.

To bring her project up to date, Sally can ask Subversion to *update* her working copy, by using the Subversion **update** command. This will incorporate your changes into her working copy, as well as any others that have been committed since she checked it out.

```
$ pwd
/home/sally/calc

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

$ svn update
U button.c
```

The output from the **svn update** command indicates that Subversion updated the contents of `button.c`. Note that Sally didn't need to specify which files to update; Subversion uses the information in the `.svn` directory, and further information in the repository, to decide which files need to be brought up to date.

Revisions

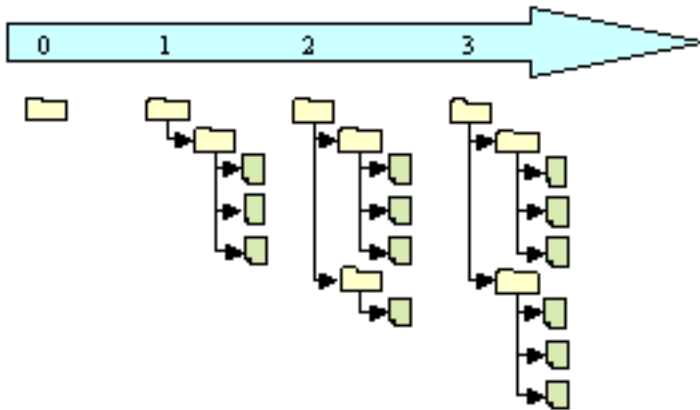
An **svn commit** operation can publish changes to any number of files and directories as a single atomic transaction. In your working copy, you can change files' contents, create, delete, rename and copy files and directories, and then commit the complete set of changes as a unit.

In the repository, each commit is treated as an atomic transaction: either all the commit's changes take place, or none of them take place. Subversion tries to retain this atomicity in the face of program crashes, system crashes, network problems, and other users' actions.

Each time the repository accepts a commit, this creates a new state of the filesystem tree, called a *revision*. Each revision is assigned a unique natural number, one greater than the number of the previous revision. The initial revision of a freshly created repository is numbered zero, and consists of nothing but an empty root directory.

A nice way to visualize the repository is as a series of trees. Imagine an array of revision numbers, starting at 0, stretching from left to right. Each revision number has a filesystem tree hanging below it, and each tree is a snapshot of the way the repository looked after each commit.

Figure 2.7. The Repository



Global Revision Numbers

Unlike those of many other version control systems, Subversion's revision numbers apply to *entire trees*, not individual files. Each revision number selects an entire tree, a particular state of the repository after some committed change. Another way to think about it is that revision N represents the state of the repository filesystem after the Nth commit. When a Subversion user talks about "revision 5 of `foo.c`", they really mean "`foo.c` as it appears in revision 5." Notice that in general, revisions N and M of a file do *not* necessarily differ! Because CVS uses per-file revisions numbers, CVS users might want to look at Appendix A, "SVN for CVS Users", for more details.

It's important to note that working copies do not always correspond to any single revision in the repository; they may contain files from several different revisions. For example, suppose you check out a working copy from a repository whose most recent revision is 4:

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

At the moment, this working directory corresponds exactly to revision 4 in the repository. However, suppose you make a change to `button.c`, and commit that change. Assuming no other commits have taken place, your commit will create revision 5 of the repository, and your working copy will now look like this:

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

Suppose that, at this point, Sally commits a change to `integer.c`, creating revision 6. If you use **svn update** to bring your working copy up to date, then it will look like this:

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

Sally's changes to `integer.c` will appear in your working copy, and your change will still be present in `button.c`. In this example, the text of `Makefile` is identical in revisions 4, 5, and 6, but Subversion will mark your working copy of `Makefile` with revision 6 to indicate that it is still current. So, after you do a clean update at the

top of your working copy, it will generally correspond to exactly one revision in the repository.

How Working Copies Track the Repository

For each file in a working directory, Subversion records two essential pieces of information in the `.svn/` administrative area:

- what revision your working file is based on (this is called the file's *working revision*), and
- a timestamp recording when the local copy was last updated by the repository.

Given this information, by talking to the repository, Subversion can tell which of the following four states a working file is in:

Unchanged, and current The file is unchanged in the working directory, and no changes to that file have been committed to the repository since its working revision. A **svn commit** of the file will do nothing, and an **svn update** of the file will do nothing.

Locally changed, and current The file has been changed in the working directory, and no changes to that file have been committed to the repository since its base revision. There are local changes that have not been committed to the repository, thus an **svn commit** of the file will succeed in publishing your changes, and an **svn update** of the file will do nothing.

Unchanged, and out-of-date The file has not been changed in the working directory, but it has been changed in the repository. The file should eventually be updated, to make it current with the public revision. An **svn commit** of the file will do nothing, and an **svn update** of the file will fold the latest changes into your working copy.

Locally changed, and out-of-date The file has been changed both in the working directory, and in the repository. An **svn commit** of the file will fail with an "out-of-date" error. The file should be updated first; an **svn update** command will attempt to merge the public changes with the local changes. If Subversion can't complete the merge in a plausible way automatically, it leaves it to the user to resolve the conflict.

This may sound like a lot to keep track of, but the **svn status** command will show you the state of any item in your working copy. For more information on that command, see the section called "svn status".

The Limitations of Mixed Revisions

As a general principle, Subversion tries to be as flexible as possible. One special kind of flexibility is the ability to have a working copy containing mixed revision numbers.

At first, it may not be entirely clear why this sort of flexibility is considered a feature, and not a liability. After completing a commit to the repository, the freshly committed files and directories are at more recent working revision than the rest of the working copy. It looks like a bit of a mess. As demonstrated earlier, the working copy can always be brought to a single working revision by running **svn update**. Why would someone *deliberately* want a mixture of working revisions?

Assuming your project is sufficiently complex, you'll discover that it's sometimes nice to forcibly "backdate" portions of your working copy to an earlier revision; you'll learn how to do that in Chapter 3. Perhaps you'd like to test an earlier version of a sub-module, contained in a subdirectory, or perhaps you'd like to examine a number of previous versions of a file in the context of the latest tree.

However you make use of mixed-revisions in your working copy, there are limitations to this flexibility.

First, you cannot commit the deletion of a file or directory which isn't fully up-to-date. If a newer version of the item exists in the repository, your attempt to delete will be rejected, to prevent you from accidentally destroying changes you've not yet seen.

Second, you cannot commit a metadata change to a directory unless it's fully up-to-date. You'll learn about attaching “properties” to items in Chapter 6. A directory's working revision defines a specific set of entries and properties, and thus committing a property change to an out-of-date directory may destroy properties you've not yet seen.

Summary

We've covered a number of fundamental Subversion concepts in this chapter:

- We've introduced the notions of the central repository, the client working copy, and the array of repository revision trees.
- We've seen some simple examples of how two collaborators can use Subversion to publish and receive changes from one another, using the 'copy-modify-merge' model.
- We've talked a bit about the way Subversion tracks and manages information in a working copy.

At this point, you should have a good idea of how Subversion works in the most general sense. Armed with this knowledge, you should now be ready to jump into the next chapter, which is a detailed tour of Subversion's commands and features.

Chapter 3. Guided Tour

Now we will go into the details of using Subversion. By the time you reach the end of this chapter, you will be able to perform almost all the tasks you need to use Subversion in a normal day's work. You'll start with an initial check-out of your code, and walk through making changes and examining those changes. You'll also see how to bring changes made by others into your working copy, examine them, and work through any conflicts that might arise.

Note that this chapter is not meant to be an exhaustive list of all Subversion's commands—rather, it's a conversational introduction to the most common Subversion tasks you'll encounter. This chapter assumes that you've read and understood Chapter 2, *Basic Concepts* and are familiar with the general model of Subversion. For a complete reference of all commands, see Chapter 9, *Subversion Complete Reference*.

Help!

Before reading on, here is the most important command you'll ever need when using Subversion: **svn help**. The Subversion command-line client is self-documenting—at any time, a quick **svn help <subcommand>** will describe the syntax, switches, and behavior of the **subcommand**.

Import

You use **svn import** to import a new project into a Subversion repository. While this is most likely the very first thing you will do when you set up your Subversion server, it's not something that happens very often. For a detailed description of import, see the section called “svn import” later in this chapter.

Revisions: Numbers, Keywords, and Dates, Oh My!

Before we go on, you should know a bit about how to identify a particular revision in your repository. As you learned in the section called “Revisions”, a revision is a “snapshot” of the repository at a particular moment in time. As you continue to commit and grow your repository, you need a mechanism for identifying these snapshots.

You specify these revisions by using the **--revision (-r)** switch plus the revision you want (**svn --revision REV**) or you can specify a range by separating two revisions with a colon (**svn --revision REV1:REV2**). And Subversion lets you refer to these revisions by number, keyword, or date.

Revision Numbers

When you create a new Subversion repository, it begins its life at revision zero and each successive commit increases the revision number by one. After your commit completes, the Subversion client informs you of the new revision number:

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

If at any point in the future you want to refer to that revision (we'll see how and why we might want to do that later in this chapter), you can refer to it as “3”.

Revision Keywords

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

Note

Each directory in your working copy contains an `.svn` administrative area. For every file in a directory, Subversion keeps a copy of each file in the administrative area. This copy is an unmodified (no keyword expansion, no end-of-line translation, no nothing) copy of the file as it existed in the last revision (called the “BASE” revision) that you updated it to in your working copy. We refer to this file as a “pristine” copy.

HEAD	The latest revision in the repository.
BASE	The “pristine” revision of an item in a working copy.
COMMITTED	The last revision in which an item changed before (or at) BASE.
PREV	The revision just <i>before</i> the last revision in which an item changed. (Technically, COMMITTED - 1.)

Here are some examples of revision keywords in action (don't worry if the commands don't make sense yet; we'll be explaining these commands as we go through the chapter):

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

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

$ svn diff --revision HEAD
# compares your working file (with local mods) to the latest version
# in the repository.

$ svn diff --revision BASE:HEAD foo.c
# compares your “pristine” foo.c (no local mods) with the
# latest version in the repository

$ svn log --revision BASE:HEAD
# shows all commit logs since you last updated

$ svn update --revision PREV foo.c
# rewinds the last change on foo.c.
# (foo.c's working revision is decreased.)
```

These keywords allow you to perform many common (and helpful) operations without having to look up specific revision numbers or remember the exact revision of your working copy.

Revision Dates

Anywhere that you specify a revision number or revision keyword, you can also specify a date by specifying the date inside curly braces “{}”. You can even access a range of changes in the repository using both dates and revisions together!

Subversion accepts an incredible number of date formats—just remember to use quotes around any date that contains spaces. Here are just a few of the formats that Subversion accepts:

```
$ svn checkout --revision {2002-02-17}
$ svn checkout --revision {2/17/02}
$ svn checkout --revision {"17 Feb"}
$ svn checkout --revision {"17 Feb 2002"}
$ svn checkout --revision {"17 Feb 2002 15:30"}
$ svn checkout --revision {"17 Feb 2002 15:30:12 GMT"}
$ svn checkout --revision {"10 days ago"}
$ svn checkout --revision {"last week"}
$ svn checkout --revision {"yesterday"}
...
```

When you specify a date as a revision, Subversion finds the most recent revision of the repository as of that date:

```
$ svn log --revision {11/28/2002}
-----
r12 | ira | 2002-11-27 12:31:51 -0600 (Wed, 27 Nov 2002) | 6 lines
...
```

Is Subversion a Day Early?

If you specify a single date as a revision without specifying a time of day (for example 11/27/02, 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, like 11/27/02, Subversion assumes a time of 00:00:00, so looking for the most recent revision won't return anything on the day of the 27th.

If you want to include the 27th in your search, you can either specify the 27th with the time ("27 Nov 2002 23:59"), or just specify the next day ("28 Nov 2002").

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

```
$ svn log --revision {2002-11-20}:{2002-11-29}
...
```

As we pointed out, you can also mix dates and revisions:

```
$ svn log -r {11/20/02}:4040
```

Initial Checkout

Most of the time, you will start using a Subversion repository by doing a *checkout* of your project. "Checking out" a repository creates a copy of it on your local machine. This copy contains the HEAD (latest revision) of the Subversion repository that you specify on the command line:

```
$ svn checkout http://svn.collab.net/repos/svn/trunk
```

```
A trunk/subversion.dsw
A trunk/svn_check.dsp
A trunk/COMMITTERS
A trunk/configure.in
A trunk/IDEAS
...
Checked out revision 2499.
```

Repository Layout

If you're wondering what `trunk` is all about in the above URL, it's part of the way we recommend you lay out your Subversion repository which we'll talk a lot more about in Chapter 4, *Branching and Merging*.

Although the above example checks out the trunk directory, you can just as easily check out any deep subdirectory of a repository by specifying the subdirectory in the checkout URL:

```
$ svn checkout http://svn.collab.net/repos/svn/trunk/doc/book/tools
A tools/readme-dblite.html
A tools/fo-stylesheet.xsl
A tools/svnbook.el
A tools/dtd
A tools/dtd/dblite.dtd
...
Checked out revision 3678.
```

Since Subversion uses a “copy-modify-merge” model instead of “lock-modify-unlock” (see Chapter 2, *Basic Concepts*), you're now ready to start making changes to the files and directories that you've checked out (known collectively as your *working copy*).

In other words, your “working copy” is now just like any other collection of files and/or directories on your system¹. You can edit and change them, move them around, you can even delete the entire working copy and forget about it.

Note

While your working copy is “just like any other collection of files and directories on your system”, you need to let Subversion know if you're going to be rearranging anything inside of your working copy. If you want to copy or move an item in a working copy, you should use **svn copy** or **svn move** instead of the copy and move commands provided by your operating system. We'll talk more about them later in this chapter.

Unless you're ready to *commit* a new file or directory, or changes to existing ones, there's no need to further notify the Subversion server that you've done anything.

What's with the `.svn` directory?

Every directory in a working copy contains an *administrative area*, a subdirectory named `.svn`. Usually, directory listing commands won't show this subdirectory, but it is nevertheless an important directory. Whatever you do, don't delete or change anything in the administrative area! Subversion depends on it to manage your working copy.

While you can certainly check out a working copy with the URL of the repository as the only argument, you can also specify a directory after your repository URL. This places your working copy into the new directory that you

¹Well, except for the fact that every directory within your “working copy” also contains a `.svn` subdirectory. But that's getting a little ahead of ourselves.

name. For example:

```
$ svn checkout http://svn.collab.net/repos/svn/trunk subv
A  subv/subversion.dsw
A  subv/svn_check.dsp
A  subv/COMMITTERS
A  subv/configure.in
A  subv/IDEAS
...
Checked out revision 2499.
```

That will place your working copy in a directory named `subv` instead of a directory named `trunk` as we did previously.

Basic Work Cycle

Subversion has numerous features, options, bells and whistles, but on a day-to-day basis, odds are that you will only use a few of them. In this section we'll run through the most common things that you might find yourself doing with Subversion in the course of a day's work.

The typical work cycle looks like this:

- Update your working copy
 - **svn update**
- Make changes
 - **svn add**
 - **svn delete**
 - **svn copy**
 - **svn move**
- Examine your changes
 - **svn status**
 - **svn diff**
 - **svn revert**
- Merge others' changes
 - **svn merge**
 - **svn resolved**

- Commit your changes
 - `svn commit`

Update Your Working Copy

When working on a project with a team, you'll want to *update* your working copy: that is, receive any changes from other developers on the project. You'll use **svn update** to bring your working copy into sync with the latest revision in the repository.

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

In this case, someone else checked in modifications to both `foo.c` and `bar.c` since the last time you updated, and Subversion has updated your working copy to include those changes.

Let's examine the output of **svn update** a bit more. When the server sends changes to your working copy, a letter code is displayed next to each item to let you know what actions Subversion performed to bring your working copy up-to-date:

U <code>foo</code>	File <code>foo</code> was Updated (received changes from the server).
A <code>foo</code>	File or directory <code>foo</code> was Added to your working copy.
D <code>foo</code>	File or directory <code>foo</code> was Deleted from your working copy.
R <code>foo</code>	File or directory <code>foo</code> was Replaced in your working copy; that is, <code>foo</code> was deleted, and a new item with the same name was added. While they may have the same name, the repository considers them to be distinct objects with distinct histories.
G <code>foo</code>	File <code>foo</code> received new changes from the repository, but your local copy of the file had your modifications. The changes did not intersect, however, so Subversion has merged the repository's changes into the file without a problem.
C <code>foo</code>	File <code>foo</code> received Conflicting changes from the server. The changes from the server directly overlap your own changes to the file. No need to panic, though. This overlap needs to be resolved by a human (you); we discuss this situation later in this chapter.

Make Changes to Your Working Copy

Now you can get to work and make changes in your working copy. It's usually most convenient to decide on a particular change (or set of changes) to make, such as writing a new feature, fixing a bug, etc. The Subversion commands that you will use here are **svn add**, **svn delete**, **svn copy**, and **svn move**. However, if you are merely editing a file (or files) that is already in Subversion, you may not need to use any of these commands until you commit. Changes you can make to your working copy:

File changes	This is the simplest sort of change. You don't need to tell Subversion that you intend
--------------	--

to change a file; just make your changes. Subversion will be able to automatically detect which files have been changed.

Tree changes

You can ask Subversion to “mark” files and directories for scheduled removal, addition, copying, or moving. While these changes may take place immediately in your working copy, no additions or removals will happen in the repository until you commit them.

To make file changes, use your text editor, word processor, graphics program, or whatever tool you would normally use. Subversion handles binary files just as easily as it handles text files—and just as efficiently too.

Here is an overview of the four Subversion subcommands that you'll use most often to make tree changes (we'll cover **svn import** and **svn mkdir** later).

svn add foo Schedule `foo` to be added to the repository. When you next commit, `foo` will become a child of its parent directory. Note that if `foo` is a directory, everything underneath `foo` will be scheduled for addition. If you only want to schedule `foo` itself, pass the `-non-recursive (-N)` switch.

svn delete foo Schedule `foo` to be deleted from the repository. If `foo` is a file, it is immediately deleted from your working copy. If `foo` is a directory, it is not deleted, but Subversion schedules it for deletion. When you commit your changes, `foo` will be removed from your working copy and the repository. ²

svn copy foo bar Create a new item `bar` as a duplicate of `foo`. `bar` is automatically scheduled for addition. When `bar` is added to the repository on the next commit, its copy-history is recorded (as having originally come from `foo`).

svn move foo bar This command is exactly the same as running **svn copy foo bar**; **svn delete foo**. That is, `bar` is scheduled for addition as a copy of `foo`, and `foo` is scheduled for removal.

Changing the Repository Without a Working Copy

Earlier in this chapter, we said that you have to commit any changes that you make in order for the repository to reflect these changes. That's not entirely true—there *are* some use-cases that immediately commit tree changes to the repository. This only happens when a subcommand is operating directly on a URL, rather than on a working-copy path. In particular, specific uses of **svn mkdir**, **svn copy**, **svn move**, and **svn delete** can work with URLs.

URL operations behave in this manner because commands that operate on a working copy can use the working copy as a sort of “staging area” to set up your changes before committing them to the repository. Commands that operate on URLs don't have this luxury, so when you operate directly on a URL, any of the above actions represent an immediate commit.

Examine Your Changes

Once you've finished making changes, you need to commit them to the repository, but before you do so, it's usually a good idea to take a look at exactly what you've changed. By examining your changes before you commit, you can make a more accurate log message. You may also discover that you've inadvertently changed a file, and this gives you a chance to revert those changes before committing. Additionally, this is a good opportunity to review and scrutinize changes before publishing them. You can see exactly what changes you've made by using **svn status**, **svn diff**, and **svn revert**. You will usually use the first two commands to find out what files have changed in your working copy, and then perhaps the third to revert some (or all) of those changes.

²Of course, nothing is ever totally deleted from the repository—just from the HEAD of the repository. You can get back anything you delete by checking out (or updating your working copy) a revision earlier than the one in which you deleted it.

Subversion has been optimized to help you with this task, and is able to do many things without communicating with the repository. In particular, your working copy contains a secret cached “pristine” copy of each version controlled file within the `.svn` area. Because of this, Subversion can quickly show you how your working files have changed, or even allow you to undo your changes without contacting the repository.

svn status

You'll probably use the `svn status` command more than any other Subversion command.

CVS Users: Hold That Update!

You're probably used to using `cvs update` to see what changes you've made to your working copy. `svn status` will give you all the information you need regarding what has changed in your working copy—without accessing the repository or potentially incorporating new changes published by other users.

In Subversion, `update` does just that—it updates your working copy with any changes committed to the repository since the last time you've updated your working copy. You'll have to break the habit of using the `update` command to see what local modifications you've made.

If you run `svn status` at the top of your working copy with no arguments, it will detect all file and tree changes you've made. This example is designed to show all the different status codes that `svn status` can return. The text following `#` is not printed by `svn status`.

```
$ svn status
L      ./abc.c           # svn has a lock in its .svn directory for abc.c
M      ./bar.c           # the content in bar.c has local modifications
M      ./baz.c           # baz.c has property but no content modifications
?      ./foo.o           # svn doesn't manage foo.o
!      ./some_dir       # svn manages this, but it's either missing or incomplete
~      ./qux             # versioned as dir, but is file, or vice versa
A +    ./moved_dir      # added with history of where it came from
M +    ./moved_dir/README # added with history and has local modifications
D      ./stuff/fish.c   # this file is scheduled for deletion
A      ./stuff/loot/bloo.h # this file is scheduled for addition
C      ./stuff/loot/lump.c # this file has conflicts from an update
      S ./stuff/squawk   # this file or dir has been switched to a branch
```

In this output format `svn status` prints five columns of characters, followed by several whitespace characters, followed by a file or directory name. The first column tells the status of a file or directory and/or its contents. The codes printed here are:

A file_or_dir	The file or directory <code>file_or_dir</code> has been scheduled for addition into the repository.
M file	The contents of file <code>file</code> have been modified.
D file_or_dir	The file or directory <code>file_or_dir</code> has been scheduled for deletion from the repository.
X dir	The directory <code>dir</code> is unversioned, but is related to a Subversion externals definition. To find out more about externals definitions, see the section called “Externals Definitions”.
? file_or_dir	The file or directory <code>file_or_dir</code> is not under version control. You can silence the

question marks by either passing the `--quiet (-q)` switch to `svn status`, or by setting the `svn:ignore` property on the parent directory. For more information on ignored files, see the section called “svn:ignore”.

- ! `file_or_dir` The file or directory `file_or_dir` is under version control but is missing or somehow incomplete. The item can be missing if it's removed using a non-Subversion command. In the case of a directory, it can be incomplete if you happened to interrupt a checkout or update. A quick **svn update** will refetch the file or directory from the repository, or **svn revert file** will restore a missing file.

- ~ `file_or_dir` The file or directory `file_or_dir` is in the repository as one kind of object, but what's actually in your working copy is some other kind. For example, Subversion might have a file in the repository, but you removed the file and created a directory in its place, without using the **svn delete** or **svn add** commands.

- C `file` `file_or_dir` is in a state of conflict. That is, changes received from the server during an update overlap with local changes that you have in your working copy. You must resolve this conflict before committing your changes to the repository.

The second column tells the status of a file or directory's properties (see the section called “Properties” for more information on properties). If an M appears in the second column, then the properties have been modified, otherwise a whitespace will be printed.

The third column will only show whitespace or an L which means that Subversion has locked the item in the `.svn` working area. You will see an L if you run `svn status` in a directory where an **svn commit** is in progress—perhaps when you are editing the log message. If Subversion is not running, then presumably Subversion was interrupted and the lock needs to be cleaned up by running **svn cleanup** (more about that later in this chapter).

The fourth column will only show whitespace or a + which means that the file or directory is scheduled to be added or modified with additional attached history. This typically happens when you **svn move** or **svn copy** a file or directory. If you see A +, this means the item is scheduled for addition-with-history. It could be a file, or the root of a copied directory. + means the item is part of a subtree scheduled for addition-with-history, i.e. some parent got copied, and it's just coming along for the ride. M + means the item is part of a subtree scheduled for addition-with-history, *and* it has local modifications. When you commit, first the parent will be added-with-history (copied), which means this file will automatically exist in the copy. Then the local modifications will be uploaded into the copy.

The fifth column will only show whitespace or an S. This signifies that the file or directory has been switched from the path of the rest of the working copy (using **svn switch**) to a branch.

If you pass a specific path to `svn status`, it gives you information about that item alone:

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

`svn status` also has a `--verbose (-v)` switch, which will show you the status of *every* item in your working copy, even if it has not been changed:

```
$ svn status --verbose
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
```

```

A          44          21    sally    ./stuff/things
           0           ?     ?       ./stuff/things/bloo.h
           44          36    harry    ./stuff/things/gloo.c

```

This is the “long form” output of **svn status**. The first column remains the same, but the second column shows the working-revision of the item. The third and fourth columns show the revision in which the item last changed, and who changed it.

None of the above invocations to **svn status** contact the repository, they work only locally by comparing the meta-data in the `.svn` directory with the working copy. Finally, there is the `--show-updates (-u)` switch, which contacts the repository and adds information about things that are *out-of-date*:

```

$ svn status --show-updates --verbose
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

```

Notice the two asterisks: if you were to run **svn update** at this point, you would receive changes to `README` and `trout.c`. This tells you some very useful information—you'll need to update and get the server changes on `README` before you commit, or the repository will reject your commit for being out-of-date. (More on this subject later.)

svn diff

Another way to examine your changes is with the **svn diff** command. You can find out *exactly* how you've modified things by running **svn diff** with no arguments, which prints out file changes in unified diff format:³

```

$ svn diff
Index: ./bar.c
=====
--- ./bar.c
+++ ./bar.c Mon Jul 15 17:58:18 2002
@@ -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
+++ ./README Mon Jul 15 17:58:18 2002
@@ -193,3 +193,4 @@
+Note to self: pick up laundry.

```

³Subversion uses its internal diff engine, which produces unified diff format, by default. If you want diff output in a different format, specify an external diff program using `--diff-cmd` and pass any flags you'd like to it using the `--extensions` switch. For example, to see local differences in file `foo.c` in context output format while ignoring whitespace changes, you might run “`svn diff --diff-cmd /usr/bin/diff --extensions '-bc' foo.c`”.

```

Index: ./stuff/fish.c
=====
--- ./stuff/fish.c
+++ ./stuff/fish.c  Mon Jul 15 17:58:18 2002
-Welcome to the file known as 'fish'.
-Information on fish will be here soon.

Index: ./stuff/things/bloo.h
=====
--- ./stuff/things/bloo.h
+++ ./stuff/things/bloo.h  Mon Jul 15 17:58:18 2002
+Here is a new file to describe
+things about bloo.

```

The **svn diff** command produces this output by comparing your working files against the cached “pristine” copies within the `.svn` area. Files scheduled for addition are displayed as all added-text, and files scheduled for deletion are displayed as all deleted text.

Output is displayed in *unified diff format*. That is, removed lines are prefaced with a `-` and added lines are prefaced with a `+`. **svn diff** also prints filename and offset information useful to the **patch** program, so you can generate “patches” by redirecting the diff output to a file:

```
$ svn diff > patchfile
```

You could, for example, email the patchfile to another developer for review or testing prior to commit.

svn revert

Now suppose you see the above diff output, and realize that your changes to `README` are a mistake; perhaps you accidentally typed that text into the wrong file in your editor.

This is a perfect opportunity to use **svn revert**.

```
$ svn revert README
Reverted ./README
```

Subversion reverts the file to its pre-modified state by overwriting it with the cached “pristine” copy from the `.svn` area. But also note that **svn revert** can undo *any* scheduled operations—for example, you might decide that you don't want to add a new file after all:

```
$ svn status foo
?      foo

$ svn add foo
A      foo

$ svn revert foo
Reverted foo

$ svn status foo
?      foo
```

Note

svn revert *ITEM* has exactly the same effect as deleting *ITEM* from your working copy and then running **svn update** *ITEM*. However, if you're reverting a file, **svn revert** has one very noticeable difference—it doesn't have to communicate with the repository to restore your file.

Or perhaps you mistakenly removed a file from version control:

```
$ svn status README
      README

$ svn delete README
D      README

$ svn revert README
Reverted README

$ svn status README
      README
```

Look Ma! No Network!

All three of these commands (**svn status**, **svn diff**, and **svn revert**) can be used without any network access. This makes it easy to manage your changes-in-progress when you are somewhere without a network connection, such as traveling on an airplane, riding a commuter train or hacking on the beach.

Subversion does this by keeping private caches of pristine versions of each versioned file inside of the `.svn` administrative areas. This allows Subversion to report—and revert—local modifications to those files *without network access*. This cache (called the "text-base") also allows Subversion to send the user's local modifications during a commit to the server as a compressed delta against the pristine version. Having this cache is a tremendous benefit—even if you have a fast net connection, it's much faster to send only a file's changes rather than the whole file to the server. At first glance, this might not seem that important, but imagine the repercussions if you try to commit a one line change to a 400MB file and have to send the whole file to the server!

Resolve Conflicts (Merging Others' Changes)

We've already seen how **svn status -u** can predict conflicts. Suppose you run **svn update** and some interesting things occur:

```
$ svn update
U ./INSTALL
G ./README
C ./bar.c
```

The U and G codes are no cause for concern; those files cleanly absorbed changes from the repository. The files marked with U contained no local changes but were Updated with changes from the repository. The G stands for merGed, which means that the file had local changes to begin with, but the changes coming from the repository didn't overlap in any way.

But the C stands for conflict. This means that the changes from the server overlapped with your own, and now you have to manually choose between them.

Whenever a conflict occurs, your Subversion client does three things:

- Subversion prints a `C` during the update, and remembers that the file is “conflicted”.
- Subversion places *conflict markers* into the file to visibly demonstrate the overlapping areas.
- For every conflicted file, Subversion places three extra files in your working copy:

<code>filename.mine</code>	This is your file as it existed in your working copy before you updated your working copy—that is, without conflict markers. This file has your latest changes in it and nothing else.
<code>filename.rOLDREV</code>	This is 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.
<code>filename.rNEWREV</code>	This is the file that your Subversion client just received from the server when you updated your working copy. This file corresponds to the HEAD revision of the repository.

Here `OLDREV` is the revision number of the file in your `.svn` directory and `NEWREV` is the revision number of the repository HEAD.

For example, Sally makes changes to the file `sandwich.txt` in the repository. Harry has just changed the file in his working copy and checked it in. Sally updates her working copy before checking in and she gets a conflict:

```
$ svn update
C sandwich.txt
Updated to revision 2.
$ ls -l
sandwich.txt
sandwich.txt.mine
sandwich.txt.r1
sandwich.txt.r2
```

At this point, Subversion will *not* allow you to commit the file `sandwich.txt` until the three temporary files are removed.

```
$ svn commit --message "Add a few more things"
svn: A conflict in the working copy obstructs the current operation
svn: Commit failed (details follow):
svn: Aborting commit: '/home/sally/svn-work/sandwich.txt' remains in conflict.
```

If you get a conflict, you need to do one of three things:

- Merge the conflicted text “by hand” (by examining and editing the conflict markers within the file).
- Copy one of the temporary files on top of your working file.
- Run `svn revert <filename>` to throw away all of your local changes.

Once you've resolved the conflict, you need to let Subversion know by running **svn resolved**. This removes the three temporary files and Subversion no longer considers the file to be in a state of conflict.⁴

```
$ svn resolved sandwich.txt
Resolved conflicted state of sandwich.txt
```

Merging Conflicts by Hand

Merging conflicts by hand can be quite intimidating the first time you attempt it, but with a little practice, it can become as easy as falling off a bike.

Here's an example. Let's say that, due to a miscommunication between you and your collaborator, Sally, both edit the file named `sandwich.txt` at the same time. Sally commits her changes, and when you go to update your working copy, you get a conflict and we're going to have to edit `sandwich.txt` to resolve the conflicts. First, let's take a look at the file:

```
$ 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
```

The strings of less-than signs, equal signs, and greater-than signs are called *conflict markers*. The text between the first two sets of markers is composed of the changes you made in the conflicting area:

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

Whereas the text between the second and third sets of conflict markers is the text from Sally's commit:

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

⁴You can always remove the temporary files yourself, but would you really want to do that when Subversion can do it for you? We didn't think so.

Usually you won't want to just delete the conflict markers and Sally's changes—she's going to be awfully surprised when the sandwich arrives and it's not what she wanted. So this is where you pick up the phone or walk across the office and explain to Sally that you can't get sauerkraut from an Italian deli.⁵ Once you've agreed on the changes you will check in, edit your file and remove the conflict markers.

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

Now run **svn resolved** and you're now ready to commit your changes:

```
$ svn resolved sandwich.txt
$ svn commit -m "Go ahead and use my sandwich, discarding Sally's edits."
```

Remember, if you ever get confused while editing the conflicted file, you can always consult the three files that Subversion creates for you in your working copy—including your file as it was before you updated.

Copying a File Onto Your Working File

If you get a conflict and decide that you want to throw out your changes, you can merely copy one of the temporary files created by Subversion over the file in your working copy:

```
$ svn update
C sandwich.txt
Updated to revision 2.
$ ls sandwich.*
sandwich.txt  sandwich.txt.mine  sandwich.txt.r2  sandwich.txt.r1
$ cp sandwich.txt.r2 sandwich.txt
$ svn resolved sandwich.txt
$ svn commit -m "Go ahead and use Sally's sandwich, discarding my edits."
```

Punting: Using `svn revert`

If you get a conflict, and upon examination decide that you want to throw out your changes and start your edits again, just revert your changes:

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

⁵And if you ask them for it, they may very well ride you out of town on a rail.

Note that when you revert a conflicted file, you don't have to run **svn resolved**.

Now you're ready to check in your changes. Note that **svn resolved**, unlike most of the other commands we've dealt with in this chapter, requires an argument. In any case, you want to be careful and only run **svn resolved** when you're certain that you've fixed the conflict in your file—once the temporary files are removed, Subversion will let you commit the file even if it still contains conflict markers.

Commit Your Changes

Finally! Your edits are finished, you've merged all changes from the server, and you're ready to commit your changes to the repository.

The **svn commit** command sends all of your changes to the repository. When you commit a change, you need to supply a *log message*, describing your change. Your log message will be attached to the new revision you create. If your log message is brief, you may wish to supply it on the command line using the `--message` (or `-m`) option:

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

However, if you've been composing your log message as you work, you may want to tell Subversion to get the message from a file by passing the filename with the `--file` switch:

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

If you fail to specify either the `--message` or `--file` switch, then Subversion will automatically launch your favorite editor (as defined in the environment variable `$EDITOR`) for composing a log message.

Tip

If you're in your editor writing a commit message and decide that you want to cancel your commit, you can just quit your editor without saving changes. If you've already saved your commit message, simply delete the text and save again.

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

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

The repository doesn't know or care if your changes make any sense as a whole; it only checks to make sure that nobody else has changed any of the same files that you did when you weren't looking. If somebody *has* done that, the entire commit will fail with a message informing you that one or more of your files is out-of-date:

```
$ svn commit --message "Add another rule"
Sending          rules.txt
svn: Transaction is out of date
svn: Commit failed (details follow):
svn: out of date: `rules.txt' in txn `g'
$
```

At this point, you need to run **svn update**, deal with any merges or conflicts that result, and attempt your commit again.

That covers the basic work cycle for using Subversion. There are many other features in Subversion that you can use to manage your repository and working copy, but you can get by quite easily using only the commands that we've discussed so far in this chapter.

Examining History

As we mentioned earlier, the repository is like a time machine. It keeps a record of every change ever committed, and allows you to explore this history by examining previous versions of files and directories as well as the metadata that accompanies them. With a single Subversion command, you can check out the repository (or restore an existing working copy) exactly as it was at any date or revision number in the past. However, sometimes you just want to *peer into* the past instead of *going into* the past.

There are several commands that can provide you with historical data from the repository:

svn log	Shows you broad information: log messages attached to revisions, and which paths changed in each revision.
svn diff	Shows you the specific details of how a file changed over time.
svn cat	This is used to retrieve any file as it existed in a particular revision number and display it on your screen.
svn list	Displays the files in a directory for any given revision.

svn log

To find out information about the history of a file or directory, use the **svn log** command. **svn log** will provide you with a record of who made changes to a file or directory, at what revision it changed, the time and date of that revision, and, if it was provided, the log message that accompanied the commit.

```
$ svn log
-----
r3 | sally | Mon, 15 Jul 2002 18:03:46 -0500 | 1 line
Added include lines and corrected # of cheese slices.
-----
r2 | harry | Mon, 15 Jul 2002 17:47:57 -0500 | 1 line
Added main() methods.
-----
r1 | sally | Mon, 15 Jul 2002 17:40:08 -0500 | 2 lines
Initial import
-----
```

Note that the log messages are printed in *reverse chronological order* by default. If you wish to see a different range of revisions in a particular order, or just a single revision, pass the `--revision (-r)` switch:

```
$ svn log --revision 5:19    # shows logs 5 through 19 in chronological order
$ svn log -r 19:5           # shows logs 5 through 19 in reverse order
$ svn log -r 8              # shows log for revision 8
```

You can also examine the log history of a single file or directory. For example:

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

These will display log messages *only* for those revisions in which the working file (or URL) changed.

If you want even more information about a file or directory, **svn log** also takes a `--verbose (-v)` switch. Because Subversion allows you to move and copy files and directories, it is important to be able to track path changes in the filesystem, so in verbose mode, **svn log** will include a list of *changed-paths* in a revision in its output:

```
$ svn log -r 8 -v
-----
r8 | sally | 2002-07-14 08:15:29 -0500 | 1 line
Changed paths:
U /trunk/code/foo.c
U /trunk/code/bar.h
A /trunk/code/doc/README

Frozzled the sub-space winch.
-----
```

Why Does svn log Give Me an Empty Response?

After working with Subversion for a bit, most users will come across something like this:

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

At first glance, this seems like an error, but you need to remember that while revisions are repository-wide, **svn log** operates on a path in the repository (if you supply no path, Subversion defaults to `" . "`). As a result, if you're operating in a subdirectory of your working copy and attempt to log a revision where nothing beneath your current directory changed, Subversion will give you an empty log. If you want to see what changed in that revision, try running the same command from the top directory of your working copy.

svn diff

We've already seen **svn diff** before—it displays file differences in unified diff format; it was used to show the local modifications made to our working copy before committing to the repository.

In fact, it turns out that there are *three* distinct uses of **svn diff**:

- Examine local changes
- Compare your working copy to the repository
- Compare repository to repository

Examining Local Changes

As we've seen, invoking **svn diff** with no switches will compare your working files to the cached “pristine” copies in the `.svn` area:

```
$ 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
$
```

Comparing Working Copy to Repository

If a single `--revision (-r)` number is passed, then your working copy is compared to the specified revision in the repository.

```
$ svn diff --revision 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
$
```

Comparing Repository to Repository

If two revision numbers, separated by a colon, are passed via `--revision (-r)`, then the two revisions are directly compared.

```
$ svn diff --revision 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 closed
$
```

Not only can you use **svn diff** to compare files in your working copy to the repository, but if you supply a URL argument, you can examine the differences between items in the repository without even having a working copy. This is especially useful if you wish to inspect changes in a file when you don't have a working copy on your local machine:

```
$ svn diff --revision 4:5 http://svn.red-bean.com/repos/example/trunk/text/rules.txt
...
$
```

svn cat

If you want to examine an earlier version of a file and not necessarily the differences between two files, you can use **svn cat**:

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

You can also redirect the output directly into a file:

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

You're probably wondering why we don't just use **svn update --revision** to update the file to the older revision. There are a few reasons why we might prefer to use **svn cat**.

First, you may want to see the differences between two revisions of a file using an external diff program (perhaps a graphical one, or perhaps your file is in such a format that the output of unified diff is nonsensical). In this case, you'll need to grab a copy of the old revision, redirect it to a file, and pass both that and the file in your working copy to your external diff program.

Sometimes it's easier to look at an older version of a file in its entirety as opposed to just the differences between it and another revision.

svn list

The **svn list** command shows you what files are in a repository directory without actually downloading the files to your local machine:

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

If you want a more detailed listing, pass the `--verbose (-v)` flag to get output like this.

```
$ svn list --verbose http://svn.collab.net/repos/svn
 2755 harry          1331 Jul 28 02:07 README
 2773 sally          Jul 29 15:07 branches/
 2769 sally          Jul 29 12:07 clients/
 2698 harry          Jul 24 18:07 tags/
 2785 sally          Jul 29 19:07 trunk/
```

The columns tell you the revision at which the file or directory was last modified, the user who modified it, the size if it is a file, the date it was last modified, and the item's name.

A Final Word on History

In addition to all of the above commands, you can use **svn update** and **svn checkout** with the `--revision` switch to take an entire working copy “back in time” 6:

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

Other Useful Commands

While not as frequently used as the commands previously discussed in this chapter, you will occasionally need these commands.

svn cleanup

When Subversion modifies your working copy (or any information within `.svn`), it tries to do so as safely as possible. Before changing anything, it writes its intentions to a log file, executes the commands in the log file, then removes the log file (this is similar in design to a journaled filesystem). If a Subversion operation is interrupted (if you

⁶See? We told you that Subversion was a time machine.

hit Control-C, or if the machine crashes, for example), the log files remain on disk. By re-executing the log files, Subversion can complete the previously started operation, and your working copy can get itself back into a consistent state.

And this is exactly what **svn cleanup** does: it searches your working copy and runs any leftover logs, removing locks in the process. If Subversion ever tells you that some part of your working copy is “locked”, then this is the command that you should run. Also, **svn status** will display an L next to locked items:

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

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

svn import

The **svn import** command is a quick way to copy an unversioned tree of files into a repository.

```
$ svnadmin create /usr/local/svn/newrepos
$ svn import mytree file:///usr/local/svn/newrepos/fooproject
Adding mytree/foo.c
Adding mytree/bar.c
Adding mytree/subdir
Adding mytree/subdir/quux.h
Transmitting file data....
Committed revision 1.
```

The above example copied the contents of directory `mytree` under the directory `fooproject` in the repository:

```
/fooproject/foo.c
/fooproject/bar.c
/fooproject/subdir
/fooproject/subdir/quux.h
```

Summary

Now we've covered most of the Subversion client commands. Notable exceptions are those dealing with branching and merging (see Chapter 4, *Branching and Merging*) and properties (see the section called “Properties”). However, you may want to take a moment to skim through Chapter 9, *Subversion Complete Reference* to get an idea of all the many different commands that Subversion has—and how you can use them to make your work easier.

Chapter 4. Branching and Merging

Branching, tagging, and merging are concepts common to almost all version control systems. If you're not familiar with these ideas, we provide a good introduction in this chapter. If you are familiar, then hopefully you'll find it interesting to see how Subversion implements these ideas.

Branching is a fundamental part of version control. If you're going to allow Subversion to manage your data, then this is a feature you'll eventually come to depend on. This chapter assumes that you're already familiar with Subversion's basic concepts (Chapter 2, *Basic Concepts*).

What's a Branch?

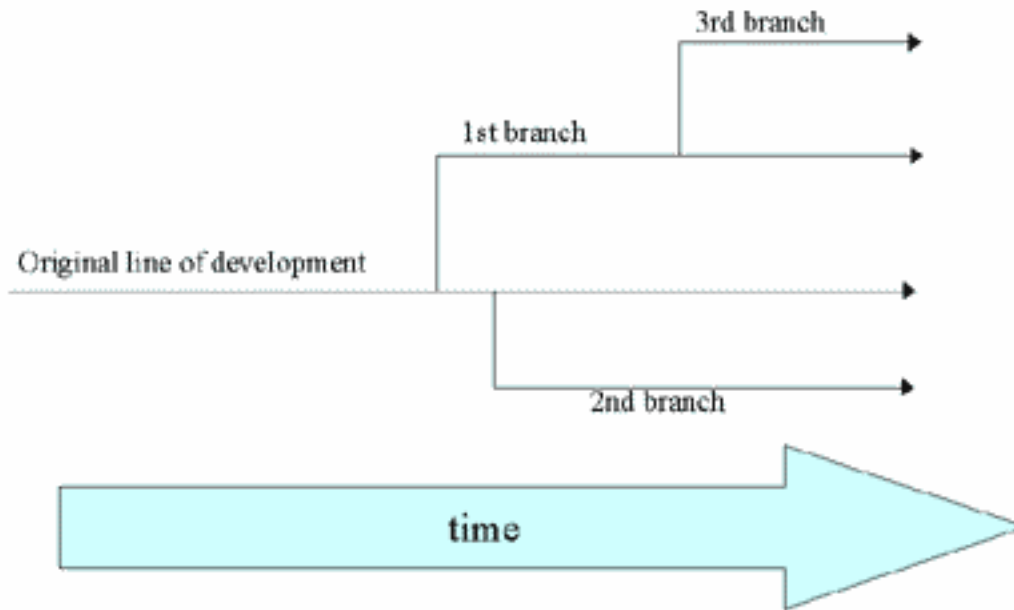
Suppose it's your job to maintain a document for a division in your company, a handbook of some sort. One day a different division asks you for the same handbook, but with a few parts 'tweaked' for them, since they do things slightly differently.

What do you do in this situation? You do the obvious thing: you make a second copy of your document, and begin maintaining the two copies separately. As each department asks you to make small changes, you incorporate them into one copy or the other.

You often want to make the same change to both copies. For example, if you discover a typo in the first copy, it's very likely that the same typo exists in the second copy. The two documents are almost the same, after all; they only differ in small, specific ways.

This is the basic concept of a *branch* — namely, a line of development that exists independently of another line, yet still shares a common history if you look far enough back in time. A branch always begins life as a copy of something, and moves on from there, generating its own history.

Figure 4.1. Branches of Development



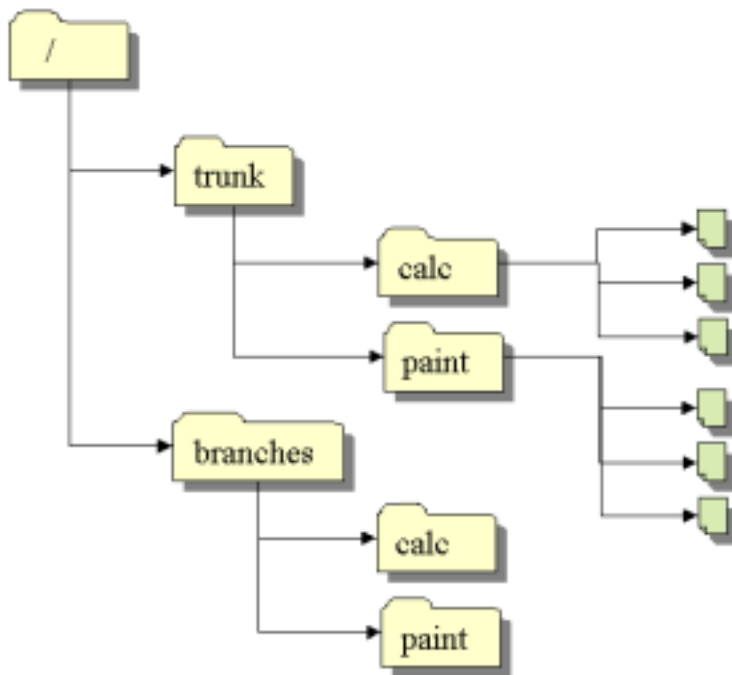
Subversion has commands to help you maintain parallel branches of your files and directories. It allows you to create branches by copying your data, and remembers that the copies are related to one another. It also helps you duplicate changes from one branch to another. Finally, it can make portions of your working copy reflect different branches, so that you can "mix and match" different lines of development in your daily work.

Using Branches

At this point, you should understand how each commit creates an entire new filesystem tree (called a "revision") in the repository. If not, go back and read about revisions in the section called "Revisions".

For this chapter, we'll go back to the same example from Chapter 2. Remember that you and your collaborator, Sally, are sharing a repository that contains two projects, `paint` and `calc`. Notice, however, that this time somebody has created two new top-level directories in the repository, called `trunk` and `branches`. The projects themselves are subdirectories of `trunk`, which we'll explain later on.

Figure 4.2. Starting Repository Layout



As before, assume that Sally and you both have working copies of the `/trunk/calc` project.

Let's say that you've been given the task of performing a radical reorganization of the project. It will take a long time to write, and will affect all the files in the project. The problem here is that you don't want to interfere with Sally, who is in the process of fixing small bugs here and there. She's depending on the fact that the latest version of the project is always usable. If you start committing your changes bit-by-bit, you'll surely break things for Sally.

One strategy is to crawl into a hole: you and Sally can stop sharing information for a week or two. That is, start gutting and reorganizing all the files in your working copy, but don't commit or update until you're completely finished with the task. There are a number of problems with this, though. First, it's not very safe. Most people like to save their work to the repository frequently, should something bad accidentally happen to their working copy. Second, it's not very flexible. If you do your work on different computers (perhaps you have a working copy of `/trunk/calc` on two different machines), you'll need to manually copy your changes back and forth, or just do all the work on a single computer. Finally, when you're finished, you might find it very difficult to commit your changes. Sally (or others) may have made many other changes in the repository that are difficult to merge into your working copy—especially all at once.

The better solution is to create your own branch, or line of development, in the repository. This allows you to save your half-broken work frequently without interfering with others, yet you can still selectively share information with your collaborators. You'll see exactly how this works later on.

Creating a Branch

Creating a branch is very simple—you make a copy of the project in the repository using the **svn copy** command. Subversion is not only able to copy single files, but whole directories as well. In this case, you want to make a copy of the `/trunk/calc` directory. Where should the new copy live? Wherever you wish—it's a matter of project policy. Let's say that your team has a policy of creating branches in the `/branches/calc` area of the repository, and you want to name your branch "my-calc-branch". You'll want to create a new directory, `/branches/calc/my-calc-branch`, which starts as a copy of `/trunk/calc`.

There are two different ways to make a copy. We'll demonstrate the messy way first, just to make the concept clear.

To begin, check out a working copy of the root (/) of the repository:

```
$ svn checkout http://svn.example.com/repos bigwc
A bigwc/branches/
A bigwc/branches/calc
A bigwc/branches/paint
A bigwc/trunk/
A bigwc/trunk/calc
A bigwc/trunk/calc/Makefile
A bigwc/trunk/calc/integer.c
A bigwc/trunk/calc/button.c
A bigwc/trunk/paint
A bigwc/trunk/paint/Makefile
A bigwc/trunk/paint/canvas.c
A bigwc/trunk/paint/brush.c
Checked out revision 340.
```

Making a copy is now simply a matter of passing two working-copy paths to the **svn copy** command:

```
$ cd bigwc
$ svn copy trunk/calc branches/calc/my-calc-branch
$ svn status
A + branches/calc/my-calc-branch
```

In this case, the **svn copy** command recursively copies the `trunk/calc` working directory to a new working directory, `branches/calc/my-calc-branch`. As you can see from the **svn status** command, the new directory is now scheduled for addition to the repository. But also notice the `+` sign next to the letter `A`. This indicates that the scheduled addition is a *copy* of something, not something new. When you commit your changes, Subversion will create `/branches/calc/my-calc-branch` in the repository by copying `/trunk/calc`, rather than resending all of the working copy data over the network:

```
$ svn commit -m "Creating a private branch of /trunk/calc."
Adding          branches/calc/my-calc-branch
Committed revision 341.
```

And now the easier method of creating a branch, which we should have told you about in the first place: **svn copy** is able to operate on two URLs.

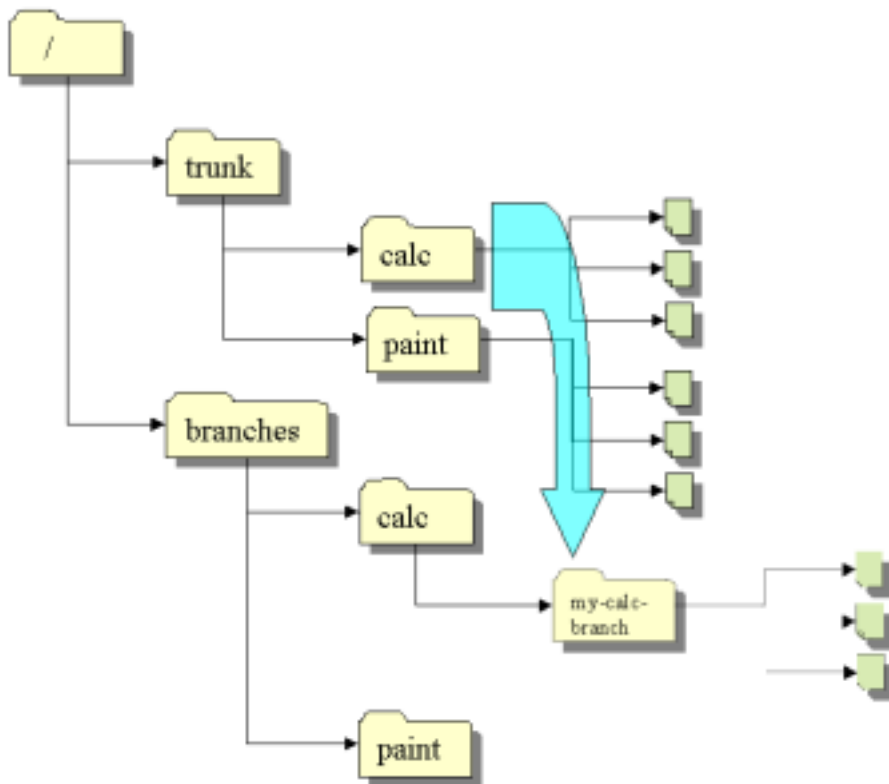
```
$ svn copy http://svn.example.com/repos/trunk/calc \
           http://svn.example.com/repos/branches/calc/my-calc-branch \
           -m "Creating a private branch of /trunk/calc"

Committed revision 341.
```

There's really no difference between these two methods. Both procedures create a new directory in revision 341, and the new directory is a copy of `/trunk/calc`. Notice that the second method, however, performs an *immediate* commit.⁷ It's an easier procedure, because it doesn't require you to check out a large mirror of the repository. In fact, this technique doesn't even require you to have a working copy at all. It can be dangerous though; you do not get a chance to undo your commit.

Figure 4.3. Repository With New Copy

⁷Subversion does not support cross-repository copying. When using URLs with **svn copy** or **svn move**, you can only copy items within the same repository.



Cheap Copies

Subversion's repository has a clever design. When you copy a directory, you don't need to worry about the repository growing huge—Subversion doesn't actually duplicate any data. Instead, it creates a new directory entry that points to an *existing* tree. If you're a Unix user, this is the same concept as a hard-link. From there, the copy is said to be "lazy". That is, if you commit a change to one file within the copied directory, then only that file changes—the rest of the files continue to exist as links to the original files in the original directory.

This is why you'll often hear Subversion users talk about "cheap copies". It doesn't matter how large the directory is—it takes a very tiny, constant amount of time to make a copy of it. In fact, this feature is the basis of how commits work in Subversion: each revision is a "cheap copy" of the previous revision, with a few items lazily changed within. (To read more about this, visit Subversion's website and read about the "bubble up" method in Subversion's design documents.)

The point here is that copies are cheap, both in time and space. Make branches as often as you want.

Working with Your Branch

Now that you've created a new branch of the project, you can check out a new working copy to start using it:

```
$ svn checkout http://svn.example.com/repos/branches/calc/my-calc-branch
A my-calc-branch/Makefile
A my-calc-branch/integer.c
A my-calc-branch/button.c
Checked out revision 341.
```

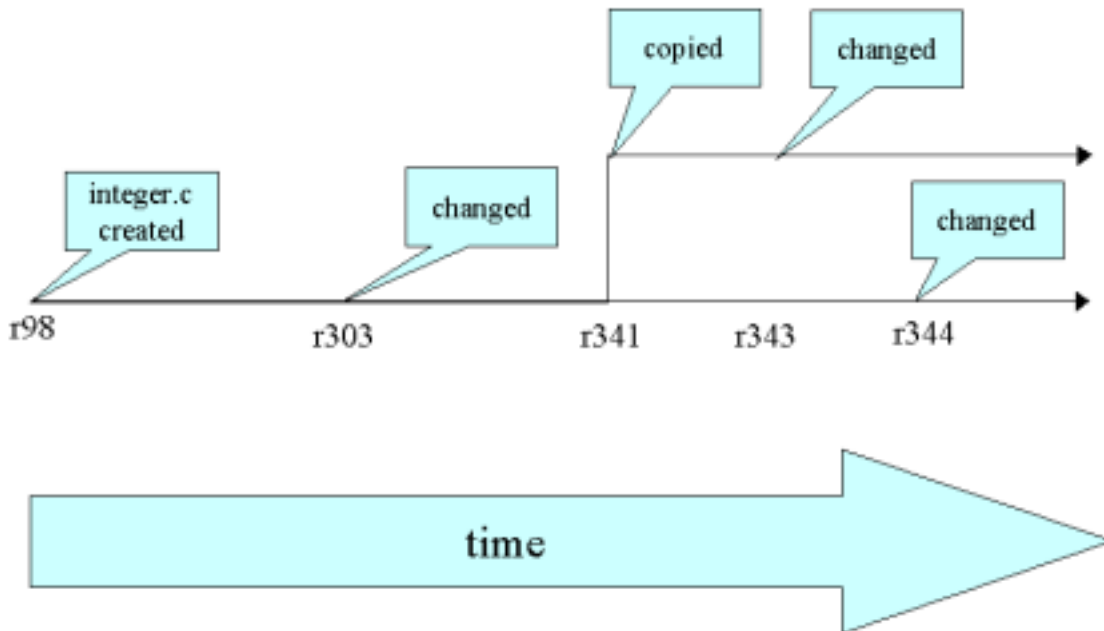
There's nothing special about this working copy; it simply mirrors a different location of the repository. When you commit changes, however, Sally won't ever see them when she updates. Her working copy is of `/trunk/calc`.

Let's pretend that a week goes by, and the following commits happen:

- You make a change to `/branches/calc/my-calc-branch/button.c`, which creates revision 342.
- You make a change to `/branches/calc/my-calc-branch/integer.c`, which creates revision 343.
- Sally makes a change to `/trunk/calc/integer.c`, which creates revision 344.

There are now two independent lines of development happening on `integer.c`:

Figure 4.4. The Branching of One File's History



Things get interesting when you look at the history of changes made to your copy of `integer.c`:

```
$ pwd
/home/user/my-calc-branch

$ svn log integer.c
-----
r343 | user | 2002-11-07 15:27:56 -0600 (Thu, 07 Nov 2002) | 2 lines
* integer.c: frozzled the wazjub.
```



```
-----  
r303 | sally | 2002-10-29 21:14:35 -0600 (Tue, 29 Oct 2002) | 2 lines  
* integer.c:  changed a docstring.
```

```
-----  
r98 | sally | 2002-02-22 15:35:29 -0600 (Fri, 22 Feb 2002) | 2 lines  
* integer.c:  adding this file to the project.
```

Notice that Subversion is tracing the history of your `integer.c` all the way back through time, traversing the point where it was copied. (Remember that your branch was created in revision 341.) Now look what happens when Sally runs the same command on her copy of the file:

```
$ pwd  
/home/sally/calcd
```

```
$ svn log integer.c
```

```
-----  
r344 | sally | 2002-11-07 15:27:56 -0600 (Thu, 07 Nov 2002) | 2 lines  
* integer.c:  fix a bunch of spelling errors.
```

```
-----  
r303 | sally | 2002-10-29 21:14:35 -0600 (Tue, 29 Oct 2002) | 2 lines  
* integer.c:  changed a docstring.
```

```
-----  
r98 | sally | 2002-02-22 15:35:29 -0600 (Fri, 22 Feb 2002) | 2 lines  
* integer.c:  adding this file to the project.
```

Sally sees her own revision 344 change, but not the change you made in revision 343. As far as Subversion is concerned, these two commits affected different files in different repository locations. However, Subversion *does* show that the two files share a common history. Before the branch-copy was made in revision 341, they used to be the same file. That's why you and Sally both see revisions 303 and 98.

The Moral of the Story

There are two important lessons that you should remember from this section.

1. Unlike many other version control systems, Subversion's branches exist as *normal filesystem directories* in the repository, not in some extra dimension.
2. Subversion has no internal concept of a "branch" — only copies. When you copy a directory, the resulting directory is only a "branch" because *you* attach that meaning to it. You may think of the directory differently, or treat it differently, but to Subversion it's just an ordinary directory that happens to have been created by copying.

Copying Changes Between Branches

Now you and Sally are working on parallel branches of the project: you're working on a private branch, and Sally is working on the *trunk*, or main line of development.

For projects that have a large number of contributors, it's common for most people to have working copies of the trunk. Whenever someone needs to make a long-running change that is likely to disrupt the trunk, a standard procedure is to create a private branch and commit changes there until all the work is complete.

So, the good news is that you and Sally aren't interfering with each other. The bad news is that it's very easy to drift *too* far apart. Remember that one of the problems with the "crawl in a hole" strategy is that by the time you're finished with your branch, it may be near-impossible to merge your changes back into the trunk without a huge number of conflicts.

Instead, you and Sally might continue to share changes as you work. It's up to you to decide which changes are worth sharing; Subversion gives you the ability to selectively "copy" changes between branches. And when you're completely finished with your branch, your entire set of branch changes can be copied back into the trunk.

Copying Specific Changes

In the previous section, we mentioned that both you and Sally made changes to `integer.c` on different branches. If you look at Sally's log message for revision 344, you can see that she fixed some spelling errors. No doubt, your copy of the same file still has the same spelling errors. It's likely that your future changes to this file will be affecting the same areas that have the spelling errors, so you're in for some potential conflicts when you merge your branch someday. It's better, then, to receive Sally's change now, *before* you start working too heavily in the same places.

It's time to use the `svn merge` command. This command, it turns out, is a very close cousin to the `svn diff` command (which you read about in Chapter 3). Both commands are able to compare any two objects in the repository and describe the differences. For example, you can ask `svn diff` to show you the exact change made by Sally in revision 344:

```
$ svn diff -r 343:344 http://svn.example.com/repos/trunk/calc
Index: integer.c
=====
--- integer.c (revision 343)
+++ integer.c (revision 344)
@@ -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, "CPM"); break;
+   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;
@@ -164,7 +164,7 @@
     low = (unsigned short) read_byte(gzfile); /* read LSB */
     high = (unsigned short) read_byte(gzfile); /* read MSB */
     high = high << 8; /* interpret MSB correctly */
-   total = low + high; /* add them together for correct total */
+   total = low + high; /* add them together for correct total */

     info->extra_header = (unsigned char *) my_malloc(total);
     fread(info->extra_header, total, 1, gzfile);
@@ -241,7 +241,7 @@
     Store the offset with ftell() ! */

     if ((info->data_offset = ftell(gzfile)) == -1) {
-   printf("error: ftell() returned -1.\n");
+   printf("error: ftell() returned -1.\n");
```

```

    exit(1);
}
@@ -249,7 +249,7 @@
printf("I believe start of compressed data is %u\n", info->data_offset);
#endif

- /* Set postion eight bytes from the end of the file. */
+ /* Set position eight bytes from the end of the file. */

if (fseek(gzfile, -8, SEEK_END)) {
    printf("error: fseek() returned non-zero\n");
}

```

The **svn merge** is almost exactly the same. Instead of printing the differences to your terminal, however, it applies them directly to your working copy as *local modifications*:

```

$ svn merge -r 343:344 http://svn.example.com/repos/trunk/calc
U integer.c

$ svn status
M integer.c

```

The output of **svn merge** shows that your copy of `integer.c` was patched. It now contains Sally's change — it has been "copied" from the trunk to your working copy of your private branch, and now exists as a local modification. At this point, it's up to you to review the local modification and make sure it works correctly.

In another scenario, it's possible that things may not have gone so well, and that `integer.c` may have entered a conflicted state. You might need to resolve the conflict using standard procedures (see Chapter 3), or if you decide that the merge was a bad idea altogether, simply give up and **svn revert** the local change.

But assuming that you've reviewed the merged change, you can **svn commit** the change as usual. At that point, the change has been merged into your repository branch. In version control terminology, this act of copying changes between branches is commonly called *porting* changes.

Why Not Use Patches Instead?

A question may be on your mind, especially if you're a Unix user: why bother to use **svn merge** at all? Why not simply use the operating system's **patch** command to accomplish the same job? For example:

```

$ svn diff -r 343:344 http://svn.example.com/repos/trunk/calc > 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

```

In this particular case, yes, there really is no difference. But **svn merge** has special abilities that surpass the **patch** program. The file format used by **patch** is quite limited; it's only able to tweak file contents. There's no way to represent changes to *trees*, such as the addition, removal, or renaming of files and directories. If Sally's change had, say, added a new directory, the output of **svn diff** wouldn't have mentioned it at all. **svn diff** only outputs the limited patch-format, so there are some ideas it simply can't express. ⁸ The **svn merge** command, however, can express tree-changes by directly applying them to your working copy.

⁸In the future, the Subversion project plans to use (or invent) an expanded patch format that describes tree-changes.

A word of warning: while **svn diff** and **svn merge** are very similar in concept, they do have different syntax in many cases. Be sure to read about them in Chapter 8 for details, or ask **svn help**. For example, **svn merge** requires a working-copy path as a target, i.e. a place where it should apply the tree-changes. If the target isn't specified, it assumes you are trying to perform one of the following common operations:

1. You want to merge directory changes into your current working directory.
2. You want to merge the changes in a specific file into a file by the same name which exists in your current working directory.

If you are merging a directory and haven't specified a target path, **svn merge** assumes the first case above and tries to apply the changes into your current directory. If you are merging a file, and that file (or a file by the same name) exists in your current working directory, **svn merge** assumes the second case and tries to apply the changes to a local file with the same name.

If you want changes applied somewhere else, you'll need to say so:

```
$ svn merge -r 343:344 http://svn.example.com/repos/trunk/calc my-calc-branch
U   my-calc-branch/integer.c
```

The Repeated Merge Problem

Merging changes sounds simple enough, but in practice it can become a headache. The problem is that if you repeatedly merge changes from one branch to another, you may accidentally merge the same change *twice*. When this happens, sometimes things will work fine. When patching a file, Subversion typically notices if the file already has the change, and does nothing. But if the already-existing change has been modified in any way, you'll get a conflict. Ideally, Subversion would automatically prevent applying changes more than once.

This is a problem that plagues many version control systems, including both CVS and Subversion. For now, the only way to avoid this problem in Subversion is to carefully keep track of which changes have been merged, and which haven't. When you create a branch directory, you need to track what revision it was created in — make a note somewhere to yourself. When you merge a revision (or range of revisions) into your working copy, you'll need to remember them as well. If you forget any of this information, you can rediscover it by examining the output of **svn log -v branch-dir**. But the point is that each subsequent merge needs to be carefully constructed by hand, making sure that previously-merged revisions aren't re-merged again.

Of course, Subversion has plans to solve this problem sometime after release 1.0. All of this merging information can be tracked in property metadata (see the section called “Properties”), and thus Subversion will someday be able to automatically avoid repeated merges.

Merging an Entire Branch

To complete our running example, we'll move forward in time. Several days have passed, and many changes have happened on both the trunk and your private branch. Suppose that you've finished working on your private branch; the feature or bugfix is finally complete, and now you want to merge all of your branch changes back into the trunk for others to enjoy.

So how do we use **svn merge** in this scenario? Remember that this command compares two trees, and applies the differences to a working copy. So to receive the changes, you need to have a working copy of the trunk. We'll assume that you still have your original one lying around (fully updated), or that you checked out a new working copy of `/trunk/calc`.

But which two trees should be compared? At first glance, the answer may seem obvious: just compare the latest trunk tree with your latest branch tree. But beware — this assumption is *wrong*, and has burned many a new user!

Since **svn merge** operates like **svn diff**, comparing the latest trunk and branch trees will *not* merely describe the set of changes you made to your branch. Such a comparison shows too many changes: it would not only show the addition of your branch changes, but also the *removal* of trunk changes that never happened on your branch.

To express only changes that happened on your branch, you need to compare the initial state of your branch to its final state. Using **svn log** on your branch, you can see that your branch was created in revision 341. And the final state of your branch is simply a matter of using the HEAD revision.

Here's the final merging procedure, then:

```
$ cd trunk/calc

$ svn merge -r 341:HEAD http://svn.example.com/repos/branches/calc/my-calc-branch
U   integer.c
U   button.c
U   Makefile

$ svn status
M   integer.c
M   button.c
M   Makefile

[examine the diffs, compile, test, etc.]

$ svn commit -m "Merged all my-calc-branch changes into the trunk."
...
```

Removing a Change from the Repository

A common use for **svn merge** is to roll back a change that has already been committed. Suppose you decide that the change made way back in revision 303, which changed `integer.c`, is completely wrong. It never should have been committed. You can use **svn merge** to "undo" the change in your working copy, and then commit the local modification to the repository. All you need to do is to specify a *reverse* difference:

```
$ svn merge -r 303:302 http://svn.example.com/trunk/calc
U   integer.c

$ svn status
M   integer.c

$ svn commit -m "Undoing change committed in r303."
Sending      integer.c
Transmitting file data .
Committed revision 350.
```

One way to think about a repository revision is as a specific group of changes (some version control systems call these *changesets*). By using the `-r` switch, you can ask **svn merge** to apply a changeset, or whole range of changesets, to your working copy. In our case of undoing a change, we're asking **svn merge** to apply changeset #303 to our working copy *backwards*.

Keep in mind that rolling back a change like this is just like any other **svn merge** operation, so you should use **svn status** and **svn diff** to confirm that your work is in the state you want it to be in, and then use **svn commit** to send the final version to the repository. After committing, this particular changeset is no longer reflected in the HEAD revision.

Again, you may be thinking: well, that really didn't undo the commit, did it? The change still exists in revision 303. If somebody checks out a version of the `calc` project between revisions 303 and 349, they'll still see the bad

change, right?

Yes, that's true. When we talk about "removing" a change, we're really talking about "removing it from HEAD". The original change still exists in the repository's history. For most situations, this is good enough. Most people are only interested in tracking the HEAD of a project anyway. There are special cases, however, where you really might want to destroy all evidence of the commit. (Perhaps somebody accidentally committed a confidential document.) This isn't so easy, it turns out, because Subversion was deliberately designed to never lose information. Revisions are immutable trees which build upon one another. Removing a revision from history would cause a domino effect, creating chaos in all subsequent revisions and possibly invalidating all working copies.⁹

Switching a Working Copy

The **svn switch** command transforms an existing working copy into a different branch. While this command isn't strictly necessary for working with branches, it provides a nice shortcut to users. 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 `/trunk/calc` to mirror the new branch location:

```
$ cd calc

$ svn info | grep URL
URL: http://svn.example.com/trunk/calc

$ svn switch http://svn.example.com/branches/calc/my-calc-branch
U   integer.c
U   button.c
U   Makefile
Updated to revision 341.

$ svn info | grep URL
URL: http://svn.example.com/branches/calc/my-calc-branch
```

After "switching" to the branch, your working copy is no different than what you would get from doing a fresh checkout of the directory. And it's usually more efficient to use this command, because often branches only differ by 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 "tip" of the branch.

Of course, most projects are more complicated than our `calc` example, containing 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 only needs to happen on a specific subdirectory, they use **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, they can continue to receive normal 'trunk' updates to most of their working copy, but the switched portions will remain immune (unless someone commits a change to their 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 a mixture of repository locations as well.

⁹The Subversion project has plans, however, to someday implement an **svnadmin obliterate** command that would accomplish the task of permanently deleting information.

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's a feature planned beyond Subversion 1.0.10

Switches and Updates

Have you noticed that the output of **svn switch** and **svn update** look 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 update command always compares two identical paths.

That is, if your working copy is a mirror of `/trunk/calc`, then **svn update** will automatically compare your working copy of `/trunk/calc` to `/trunk/calc` in the HEAD revision. If you're switching your working copy to a branch, then **svn switch** will compare your working copy of `/trunk/calc` 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. This allows you to perform all sorts of clever tricks.

For example, suppose you have a working copy of `/trunk` and make a number of changes to it. Then you suddenly realize that you meant to make the changes to a branch instead. No problem! When you **svn switch** your working copy to the branch, the local changes will remain. You can then test and commit them to the branch.

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, like "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 `/trunk/calc` exactly as it looks in the HEAD revision, then make a copy of it:

```
$ svn copy http://svn.example.com/repos/trunk/calc \  
           http://svn.example.com/repos/tags/calc/release-1.0 \  
           -m "Tagging the 1.0 release of the 'calc' project."
```

¹⁰You *can*, however, use **svn switch** with the `--relocate` switch if the URL of your server changes and you don't want to abandon an existing working copy. See the **svn switch** section in Chapter 9, *Subversion Complete Reference* for more information and an example.

Committed revision 351.

This example assumes that a `/tags/calc` directory already exists. After the copy completes, the new `release-1.0` directory is forever a snapshot of how the project 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 350 of `/trunk/calc` is exactly the snapshot you want, you can specify it by passing `-r 350` 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 in there. (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 (###cross-ref a section that demonstrates how to use these scripts?). 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 bugfixes. You can accomplish this by selectively pinning files or directories at particular revisions (using **svn update -r** liberally), or by switching files and directories to particular branches (making use of **svn switch**). 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.

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 Chapter 8), 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/tags/calc/mytag

Committed revision 352.
```

Now there is a new directory in the repository, `/tags/calc/mytag`, which is an exact snapshot of your working copy — mixed revisions, urls, 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 patchfile (which won't capture tree changes), you can instead use **svn copy** to "upload" your working copy to a private area of the repository. Your collaborator can then either checkout a verbatim copy of your working copy, or use **svn merge** to receive your exact changes.

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, then often people create these top-level directories:

```
/trunk
/branches
/tags
```

If a repository contains multiple projects, people often index their layout by branch:

```
/trunk/paint
/trunk/calc
/branches/paint
/branches/calc
/tags/paint
/tags/calc
```

...or by project:

```
/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.

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 `/trunk/calc`, there's no need for your private branch directory to stick around anymore:

```
$ svn delete http://svn.example.com/repos/branches/calc/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.

sion, no longer distracting anyone. If you look at an earlier revision (by means of **svn checkout -r**, **svn switch -r**, or **svn list -r**), 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 -r** to copy it from the old revision:

```
$ svn copy -r 374 http://svn.example.com/repos/branches/calc/my-calc-branch \  
                http://svn.example.com/repos/branches/calc/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 `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/trunk/calc \  
          http://svn.example.com/branches/calc/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 `/trunk/calc`, and you can declare a project policy that only bugfixes are to be committed to `/branches/calc/stable-1.0`. That is, as people continue to work on the trunk, a human selectively ports bugfixes 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.

Summary

We've covered a lot of ground in this chapter. We've discussed the concepts of tags and branches, and demonstrated how Subversion implements these concepts by copying directories with the **svn copy** command. We've shown how to use **svn merge** to copy changes from one branch to another, or roll back bad changes. We've gone over the use of **svn switch** to create mixed-location working copies. And we've talked about how one might manage the organization and lifetimes of branches in a repository.

Remember the Subversion mantra: branches are cheap. So use them liberally!

Chapter 5. Repository Administration

The Subversion repository is the central storehouse of versioned data for any number of projects. 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 actual problems safely resolved.

In this chapter, we'll discuss how to create and configure a Subversion repository, and how to expose that repository for network accessibility. We'll also talk about repository maintenance, including the use of the **svnlook** and **svnadmin** tools (which are 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 (that is, via a Subversion client), you can skip this chapter altogether. However, if you are, or wish to become, a Subversion repository administrator,¹¹ you should definitely pay attention to this chapter.

Of course, one cannot administer a repository unless one has a repository to administer.

Repository Basics

Understanding Transactions and Revisions

Conceptually speaking, a Subversion repository is a sequence of directory trees. Each tree is a snapshot of how the files and directories versioned in your repository looked at some point in time. These snapshots are created as a result of client operations, and are called revisions.

Every revision begins life as a transaction tree. When doing a commit, a client builds a Subversion transaction that mirrors their local changes (plus any additional changes that might have been made to the repository since the beginning of the client's commit process), and then instructs the repository to store that tree as the next snapshot in the sequence. If the commit succeeds, the transaction is effectively promoted into a new revision tree, and is assigned a new revision number. If the commit fails for some reason, the transaction is destroyed and the client is informed of the failure.

Updates work in a similar way. The client builds a temporary transaction tree that mirrors the state of the working copy. The repository then compares that transaction tree with the revision tree at the requested revision (usually the most recent, or “youngest” tree), and sends back information that informs the client about what changes are needed to transform their working copy into a replica of that revision tree. After the update completes, the temporary transaction is deleted.

The use of transaction trees is the only way to make permanent changes to a repository's versioned filesystem. However, it's important to understand that the lifetime of a transaction is completely flexible. In the case of updates, transactions are temporary trees that are immediately destroyed. In the case of commits, transactions are transformed into permanent revisions (or removed if the commit fails). In the case of an error or bug, it's possible that a transaction can be accidentally left lying around in the repository (not really affecting anything, but still taking up space).

In theory, someday whole workflow applications might revolve around more fine-grained control of transaction lifetime. It is feasible to imagine a system whereby each transaction slated to become a revision is left in stasis well after the client finishes describing its changes to repository. This would enable each new commit to be reviewed by someone else, perhaps a manager or engineering QA team, who can choose to promote the transaction into a revision, or abort it.

What does all of this have to do with repository administration? The answer is simple: if you're administering a Sub-

¹¹This 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.

version repository, you're going to have to examine revisions and transactions as part of monitoring the health of your repository.

Unversioned Properties

Transactions and revisions in the Subversion repository can have properties attached to them. These properties are generic key-to-value mappings, and are used to store information about the tree to which they are attached. The names and values of these properties are stored in the repository's filesystem, along with the rest of your tree data.

Revision and transaction properties are useful for associating information with a tree that is not strictly related to the files and directories in that tree—the kind of information that isn't managed by client working copies. For example, when a new commit transaction is created in the repository, Subversion adds a property to that transaction named `svn:date`—a timestamp representing the time that the transaction was created. By the time the commit process is finished, and the transaction is promoted to a permanent revision, the tree has also been given a property to store the username of the revision's author (`svn:author`) and a property to store the log message attached to that revision (`svn:log`).

Revision and transaction properties are *unversioned properties*—as they are modified, their previous values are permanently discarded. Also, while revision trees themselves are immutable, the properties attached to those trees are not. You can add, remove, and modify revision properties at any time in the future. If you commit a new revision and later realize that you had some misinformation or spelling error in your log message, you can simply replace the value of the `svn:log` property with a new, corrected log message.

Repository Creation and Configuration

Creating a Subversion repository is an incredibly simple task. The `svnadmin` utility, provided with Subversion, has a subcommand for doing just that. To create a new repository, just run:

```
$ svnadmin create path/to/repos
```

This creates a new repository in the directory `path/to/repos`. This new repository begins life at revision 0, which is defined to consist of nothing but the top-level root (`/`) filesystem directory. Initially, revision 0 also has a single revision property, `svn:date`, set to the time at which the repository was created.

WARNING! Avoid network shares!

Make sure you *don't* create your repository on a network share—it *cannot* exist on a remote filesystem such as NFS, AFS, or Windows SMB. BerkeleyDB requires that the underlying filesystem implement strict POSIX locking semantics, and more importantly, the ability to map files directly into process memory. Almost no network filesystems provide these features. If you attempt to use BerkeleyDB on a network share, 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.

If you need multiple computers to access the repository, then set up a server process (such as Apache or `svnserv`) to make the repository available over a network. See Chapter 6, *Server Configuration*.

You may have noticed that the path argument to `svnadmin` was 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.

So, after you've run the `svnadmin create` command, you have a shiny new Subversion repository in its own directory. Let's take a peek at what is actually created inside that subdirectory.

```
$ ls repos
dav/  db/  format  hooks/  locks/  README.txt
```

With the exception of the `README.txt` and `format` files, the repository directory is a collection of subdirectories. As in other areas of the Subversion design, modularity is given high regard, and hierarchical organization is preferred to cluttered chaos. Here is a brief description of all of the items you see in your new repository directory:

<code>dav</code>	A directory provided to Apache and <code>mod_dav_svn</code> for their private housekeeping data.
<code>db</code>	The main Berkeley DB environment, full of DB tables that comprise the data store for Subversion's filesystem (where all of your versioned data resides).
<code>format</code>	A file whose contents are a single integer value that dictates the version number of the repository layout.
<code>hooks</code>	A directory full of hook script templates (and hook scripts themselves, once you've installed some).
<code>locks</code>	A directory for Subversion's repository locking data, used for tracking accessors to the repository.
<code>README.txt</code>	A file which merely informs its readers that they are looking at a Subversion repository.

In general, you shouldn't tamper with your 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. Some exceptions exist, though, and we'll cover those here.

Hook Scripts

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. Each hook is handed enough information to tell what that event is, what target(s) it's operating on, and the username of the person who triggered the event. Depending on the hook's output or return status, the hook program may continue the action, stop it, or suspend it in some way.

The `hooks` subdirectory is, by default, filled with templates for various repository hooks.

```
$ ls repos/hooks/
post-commit.tmpl          pre-revprop-change.tmpl
post-revprop-change.tmpl  start-commit.tmpl
pre-commit.tmpl
```

There is one template for each hook that the Subversion repository implements, and by examining the contents of those template scripts, you can see what triggers each such 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 (like **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 or not 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` or `.com` for programs, and `.bat` for batch files.

Currently there are five true hooks implemented by the Subversion repository:

`start-commit` This is run before the commit transaction is even created. It is typically used to decide if the user has commit privileges at all. The repository passes two arguments to this program: the path to the repository, and username which is attempting the commit. If the program returns a non-zero exit value, the commit is stopped before the transaction is even created.

`pre-commit` This is run when the transaction is complete, but before it is committed. Typically, this hook is used to protect against commits that are disallowed due to content or location (for example, 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 non-empty). The repository passes two arguments to this program: the path to the repository, and the name of the transaction being committed. If the program returns a non-zero exit value, the commit is aborted and the transaction is removed.

The Subversion distribution includes some access control scripts (located in the `tools/hook-scripts` directory of the Subversion source tree) that can be called from **pre-commit** to implement fine-grained access control. At this time, this is the only method by which administrators can implement finer-grained access control beyond what Apache's `httpd.conf` offers. In a future version of Subversion, we plan to implement access control lists (ACLs) directly in the filesystem.

`post-commit` This 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 make a backup of the repository. The repository passes two arguments to this program: the path to the repository, and the new revision number that was created. The exit code of the program is ignored.

The Subversion distribution includes a **commit-email.pl** script (located in the `tools/hook-scripts/` directory of the Subversion source tree) that can be used to send email with (and/or append to a log file) a description of a given commit. This mail contains a list of the paths that were changed, the log message attached to the commit, the author and date of the commit, as well as a GNU diff-style display of the changes made to the various versioned files as part of the commit.

Another useful tool provided by Subversion is the **hot-backup.py** script (located in the `tools/backup/` directory of the Subversion source tree). This script performs hot backups of your Subversion repository (a feature supported by the Berkeley DB database back-end), and can be used to make a per-commit snapshot of your repository for archival or emergency recovery purposes.

`pre-revprop-change` Because Subversion's revision properties are not versioned, making modifications to such a property (for example, the `svn:log` commit message property) will overwrite the previous value of that property forever. Since data can be potentially lost here, Subversion supplies this hook (and its counterpart, `post-revprop-change`) so that repository administrators can keep records of changes to these items using some external means if they so desire.

This hook runs just before such a modification is made to the repository. The repository passes four arguments to this hook: the path to the repository, the revision on which the to-be-modified property exists, the authenticated username of the person making the change, and the name of the property itself.

`post-revprop-change` As mentioned earlier, this hook is the counterpart of the `pre-revprop-change` hook. In fact, for the sake of paranoia this script will not run unless the `pre-revprop-change` hook exists. When both of these hooks are present, the `post-revprop-change` hook runs just after a revision property has been changed, and is typically used to send an email containing the new value of the changed property. The repository passes four arguments to this hook: the path to the repository, the revision on which the property exists, the authenticated username of the person making the change, and the name of the property itself.

The Subversion distribution includes a **`propchange-email.pl`** script (located in the `tools/hook-scripts/` directory of the Subversion source tree) that can be used to send email with (and/or append to a log file) the details of a revision property change. This mail contains the revision and name of the changed property, the user who made the change, and the new property value.

Subversion will attempt to execute hooks as the same user who owns the process which is accessing the Subversion repository. In most cases, the repository is being accessed via Apache HTTP server and `mod_dav_svn`, so this user is the same user that Apache runs as. The hooks themselves will need to be configured with OS-level permissions that allow that user to execute them. Also, this means that any file or programs (including the Subversion repository itself) 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 you've written it to perform.

Berkeley DB Configuration

The Berkeley DB environment has its own set of default configuration values for things like the number of locks allowed to be taken out at any given time, or the size cutoff for Berkeley's journaling log file, etc. Subversion's filesystem code 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 folks at Sleepycat (the producers of Berkeley DB) understand that different databases have different requirements, and so they have provided a mechanism for runtime overriding of many of the configuration values for the Berkeley DB environment. Berkeley checks for the presence of a file named `DB_CONFIG` in each environment directory, and parses the options found in that file for use with that particular Berkeley environment.

The Berkeley configuration file for your repository is located in the `db` environment directory, at `repos/db/DB_CONFIG`. 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 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 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 unexpected by the rest of the Subversion code. Also, changes made to `DB_CONFIG` won't take effect until you recover the database environment (using **`svnadmin recover`**).

Repository Maintenance

An Administrator's Toolkit

`svnlook`

`svnlook` is a tool provided by Subversion for examining the various revisions and transactions in a repository. No part of this program attempts to change the repository—it's a “read-only” tool. **`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.
...
```

Nearly every one 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` and `--transaction` options to specify which revision or transaction, respectively, to examine. Note that while revision numbers appear as natural numbers, transaction names are alphanumeric strings. Keep in mind that the filesystem only allows browsing of uncommitted transactions (transactions that have not resulted in a new revision). Most repositories will have no such transactions, because transactions are usually either committed (which disqualifies them from viewing) or aborted and removed.

In the absence of both the `--revision` and `--transaction` 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 `/path/to/repos`:

```
$ svnlook info /path/to/repos
$ svnlook info /path/to/repos --revision 19
```

The only exception to these rules about subcommands is the **svnlook youngest** subcommand, which takes no options, and simply prints out the HEAD revision number.

```
$ svnlook youngest /path/to/repos
19
```

Output from **svnlook** is designed to be both human- and machine-parsable. Take as an example the output of the `info` subcommand:

```
$ svnlook info path/to/repos
sally
2002-11-04 09:29:13 -0600 (Mon, 04 Nov 2002)
27
Added the usual
Greek tree.
```

The output of the `info` subcommand is defined as:

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 like the datestamp are displayed using a textual representation instead of something more obscure (such as the number of nanoseconds since the Tasty Freeze guy drove by). But this 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.

Another common use of **svnlook** is to actually view the contents of a revision or transaction tree. Examining the output of **svnlook tree** command, which displays the directories and files in the requested tree (optionally showing the filesystem node revision IDs for each of those paths) can be extremely helpful to administrators deciding on whether or not it is safe to remove a seemingly dead transaction. It is also quite useful for Subversion developers who are diagnosing filesystem-related problems when they arise.

```
$ svnlook tree path/to/repos --show-ids
/ <0.0.1>
A/ <2.0.1>
  B/ <4.0.1>
    lambda <5.0.1>
  E/ <6.0.1>
    alpha <7.0.1>
    beta <8.0.1>
  F/ <9.0.1>
mu <3.0.1>
C/ <a.0.1>
D/ <b.0.1>
  gamma <c.0.1>
  G/ <d.0.1>
    pi <e.0.1>
    rho <f.0.1>
    tau <g.0.1>
  H/ <h.0.1>
    chi <i.0.1>
    omega <k.0.1>
    psi <j.0.1>
iota <l.0.1>
```

svnlook can perform a variety of other queries, displaying subsets of bits of information we've mentioned previously, reporting which paths were modified in a given revision or transaction, showing textual and property differences made to files and directories, and so on. The following is a brief description of the current list of subcommands accepted by **svnlook**, and the output of those subcommands:

author	Print the tree's author.
cat	Print the contents of a file in the tree.
changed	List all files and directories that changed in the tree.
date	Print the tree's datestamp.
diff	Print unified diffs of changed files.
dirs-changed	List the directories in the tree that were themselves changed, or whose file children were changed.
history	Display interesting points in the history of a versioned path (places where modifications or copies occurred).
info	Print the tree's author, datestamp, log message character count, and log message.

log	Print the tree's log message.
propget	Print the value of a property on a path in the tree.
proplist	Print the names and values of properties set on paths in the tree.
tree	Print the tree listing, optionally revealing the filesystem node revision IDs associated with each path.
uuid	Print the tree's unique user ID (UUID).
youngest	Print the youngest revision number.

svnadmin

The **svnadmin** program is the repository administrator's best friend. Besides providing the ability to create Subversion repositories, this program allows you perform several maintenance operations on those repositories. The syntax of **svnadmin** is similar to that of **svnlook**:

```
$ svnadmin help
general usage: svnadmin SUBCOMMAND REPOS_PATH [ARGS & OPTIONS ...]
Type "svnadmin help <subcommand>" for help on a specific subcommand.
```

Available subcommands:

```
  create
  deltify
  dump
  help (?, h)
```

...

We've already mentioned **svnadmin**'s `create` subcommand (see the section called “Repository Creation and Configuration”). Most of the others we will cover in more detail later in this chapter. For now, let's just take a quick glance at what each of the available subcommands offers.

create	Creates a new Subversion repository.
deltify	Run over a specified revision range, performing predecessor deltification on the paths changed in those revisions. If no revisions are specified, this command will simply deltify the HEAD revision.
dump	Dumps the contents of the repository, bounded by a given set of revisions, using a portable dump format.
hotcopy	Makes a hot copy of a repository. You can run this command at any time and make a safe copy of the repository, regardless if other processes are using the repository.
list-dblogs	Lists the paths of Berkeley DB log files associated with the repository. This list includes all log files—those still in use by Subversion, as well as those no longer in use.
list-unused-dblogs	Lists the paths of Berkeley DB log files associated with, but no longer used by, the repository. You may safely remove these log files from the repository layout, possibly archiving them for use in the event that you ever need to perform a catastrophic recovery of the repository.
load	Loads a set of revisions into a repository from a stream of data that uses the same portable dump format generated by the <code>dump</code> subcommand.

lstdxns	List the names of uncommitted Subversion transactions that currently exist in the repository.
recover	Perform recovery steps on a repository that is in need of such, generally after a fatal error has occurred that prevented a process from cleanly shutting down its communication with the repository.
rmtxns	Cleanly remove Subversion transactions from the repository (conveniently fed by output from the lstdxns subcommand).
setlog	Replace the current value of the svn:log (commit log message) property on a given revision in the repository with a new value.
verify	Verify the contents of the repository. This includes, among other things, checksum comparisons of the versioned data stored in the repository.

svnshell.py

The Subversion source tree also comes with a shell-like interface to the repository. The **svnshell.py** Python script (located in `tools/examples/` in the source tree) uses Subversion's language bindings (so you must have those properly compiled and installed in order for this script to work) to connect to the repository and filesystem libraries.

Once started, the program behaves similarly to a shell program, allowing you to browse the various directories in your repository. Initially, you are “positioned” in the root directory of the HEAD revision of the repository, and presented with a command prompt. You can use the `help` command at any time to display a list of available commands and what they do.

```
$ svnshell.py /path/to/repos
<rev: 2 />$ help
Available commands:
  cat FILE      : dump the contents of FILE
  cd DIR        : change the current working directory to DIR
  exit         : exit the shell
  ls [PATH]    : list the contents of the current directory
  lstdxns      : list the transactions available for browsing
  setrev REV   : set the current revision to browse
  settxn TXN   : set the current transaction to browse
  youngest    : list the youngest browsable revision number
<rev: 2 />$
```

Navigating the directory structure of your repository is done in the same way you would navigate a regular Unix or Windows shell—using the `cd` command. At all times, the command prompt will show you what revision (prefixed by `rev:`) or transaction (prefixed by `txn:`) you are currently examining, and at what path location in that revision or transaction. You can change your current revision or transaction with the `setrev` and `settxn` commands, respectively. As in a Unix shell, you can use the `ls` command to display the contents of the current directory, and you can use the `cat` command to display the contents of a file.

Example 5.1. Using svnshell to Navigate the Repository

```
<rev: 2 />$ ls
  REV   AUTHOR  NODE-REV-ID  SIZE  DATE NAME
-----
  1     sally <  2.0.1>      Nov 15 11:50 A/
  2     harry <  1.0.2>      56 Nov 19 08:19 iota
```

```

<rev: 2 />$ cd A
<rev: 2 /A>$ ls
  REV  AUTHOR  NODE-REV-ID  SIZE  DATE  NAME
-----
    1   sally <   4.0.1>      Nov 15 11:50 B/
    1   sally <   a.0.1>      Nov 15 11:50 C/
    1   sally <   b.0.1>      Nov 15 11:50 D/
    1   sally <   3.0.1>      23 Nov 15 11:50 mu
<rev: 2 /A>$ cd D/G
<rev: 2 /A/D/G>$ ls
  REV  AUTHOR  NODE-REV-ID  SIZE  DATE  NAME
-----
    1   sally <   e.0.1>      23 Nov 15 11:50 pi
    1   sally <   f.0.1>      24 Nov 15 11:50 rho
    1   sally <   g.0.1>      24 Nov 15 11:50 tau
<rev: 2 /A>$ cd ../..
<rev: 2 />$ cat iota
This is the file 'iota'.
Added this text in revision 2.

<rev: 2 />$ setrev 1; cat iota
This is the file 'iota'.

<rev: 1 />$ exit
$

```

As you can see in the previous example, multiple commands may be specified at a single command prompt, separated by a semicolon. Also, the shell understands the notions of relative and absolute paths, and will properly handle the "." and ".." special path components.

The `youngest` command displays the youngest revision. This is useful for determining the range of valid revisions you can use as arguments to the `setrev` command—you are allowed to browse all the revisions (recalling that they are named with integers) between 0 and the youngest, inclusively. Determining the valid browsable transactions isn't quite as pretty. Use the `lstxns` command to list the transactions that you are able to browse. The list of browsable transactions is the same list that `svnadmin lstxns` returns, and the same list that is valid for use with `svnlook's -transaction` option.

Once you've finished using the shell, you can exit cleanly by using the `exit` command. Alternatively, you can supply an end-of-file character—Control-D (though some Win32 Python distributions use the Windows Control-Z convention instead).

Berkeley DB Utilities

Currently, the Subversion repository has only one database back-end—Berkeley DB. All of your filesystem's structure and data live in a set of 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 Berkeley's database tools (you can see the documentation for these tools at SleepyCat's website, <http://www.sleepycat.com/>). For day-to-day Subversion use, these tools are unnecessary. However, they do provide some important functionality that is currently not provided by Subversion itself.

For example, because Subversion uses Berkeley DB's logging facilities, the database first writes out a description of any modifications it is about to make, and then makes the modification itself. This is to ensure that if something goes wrong, the database system can back up to a previous *checkpoint*—a location in the log files known not to be corrupt—and replay transactions until the data is restored to a usable state. This functionality is one of the main reasons why Berkeley DB was chosen as Subversion's initial database back-end.

Over time, these log files can accumulate. That is actually a feature of the database system—you should be able to recreate your entire database using nothing but the log files, so these files are important for catastrophic database recovery. But typically, you'll want to archive the log files that are no longer in use by Berkeley DB, and then remove

them from disk to conserve space. Berkeley DB provides a **db_archive** utility for, among other things, listing the log files that are associated with a given database and which are no longer in use. That way, you know which files to archive and remove. The **svnadmin** utility provides a convenient wrapper around this Berkeley DB tool:

```
$ svnadmin list-unused-dblogs /path/to/repos
/path/to/repos/log.0000000031
/path/to/repos/log.0000000032
/path/to/repos/log.0000000033

$ svnadmin list-unused-dblogs /path/to/repos | xargs rm
## disk space reclaimed!
```

Subversion's own repository uses a `post-commit` hook script, which, after performing a “hot backup” of the repository, removes these excess log files. In the Subversion source tree, the script `tools/backup/hot-backup.py` illustrates the safe way to perform a backup of a Berkeley DB database environment while it's being actively accessed: use the **svnadmin hotcopy** command.

Generally speaking, only the truly paranoid would need to backup their entire repository every time a commit occurred. However, assuming that a given repository has some other redundancy mechanism in place with relatively fine granularity (like per-commit emails), 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. For more repositories, archived commit emails alone are sufficient restoration sources, at least for the last few commits. But it's your data; protect it as much as you'd like.

Berkeley DB also comes with a pair of utilities for converting the database tables to and from flat ASCII text files. The **db_dump** and **db_load** programs write and read, respectively, a custom file format which 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.

Repository Cleanup

Your Subversion repository will generally require very little attention once it is configured to your liking. However, there are times when some manual assistance from an administrator might be in order. The **svnadmin** utility provides some helpful functionality to assist you in performing such tasks as

- modifying commit log messages,
- removing dead transactions,
- recovering “wedged” repositories, and
- migrating repository contents to a different repository.

Perhaps the most commonly used of **svnadmin**'s subcommands is `setlog`. When a transaction is committed to the repository and promoted to a revision, the descriptive log message associated with that new revision (and provided by the user) is stored as an unversioned property attached to the revision itself. In other words, the repository remembers only the latest value of the property, and discards previous ones.

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` and `post-revprop-change` hooks; see the section called “Hook Scripts”) to accept changes to this log message after the commit is finished, then the user can “fix” her log message remotely using the **svn** program's `propset` command (see Chapter 9, *Subversion Complete Reference*). 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
```

Don't Lose That Log Message!

Administrators should be aware that using **svnadmin setlog** bypasses any revision property hook scripts that might be active for the repository. Be extremely careful with this subcommand, ensuring that you are providing the correct revision number for the change.

Another common use of **svnadmin** is to query the repository for outstanding—possibly dead—Subversion transactions. In the event that a commit should fail, the transaction is usually cleaned up. That is, the transaction itself is removed from the repository, and any data associated with (and only with) that transaction is removed as well. Occasionally, though, a failure occurs in such a way that the cleanup of the transaction never happens. This could happen for several reasons: perhaps the client operation was inelegantly terminated by the user, or a network failure might have occurred in the middle of an operation, etc. Regardless of the reason, these dead transactions serve only to clutter the repository and consume resources.

You can use **svnadmin**'s `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` option) to determine who created the transaction, when it was created, what types of changes were made in the transaction—in other words, whether or not the transaction is a safe candidate for removal! If so, the transaction's name can be passed to **svnadmin rmtxns**, which will perform the cleanup of the transaction. In fact, the `rmtxns` subcommand can take its input directly from the output of `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. The following is a little bit of shell-scripting that can quickly generate information about each outstanding transaction in your repository:

Example 5.2. `txn-info.sh` (Reporting Outstanding Transactions)

```
#!/bin/sh

### Generate informational output for all outstanding transactions in
### a Subversion repository.
```

```
SVNADMIN=/usr/local/bin/svnadmin
SVNLOOK=/usr/local/bin/svnlook

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}" --transaction "${TXN}"
done
```

You can run the previous script using `/path/to/txn-info.sh /path/to/repos`. The output is basically a concatenation of several chunks of `svnlook info` output (see the section called “`svnlook`”), and will look something like:

```
$ 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
$
```

Usually, if you see a dead transaction that has no log message attached to it, this is the result of a failed update (or update-like) operation. These operations use Subversion transactions under the hood to mimic working copy state. Since they are never intended to be committed, Subversion doesn't require a log message for those transactions. Transactions that do have log messages attached are almost certainly failed commits of some sort. Also, 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, the logs of successful Subversion commits, and so on—can be employed in the decision-making process. Finally, an administrator can often simply communicate with a seemingly dead transaction's owner (via email, for example) to verify that the transaction is, in fact, in a zombie state.

Repository Recovery

In order to protect the data in your repository, the database back-end 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.

In the course of using your Subversion repository, fatal errors (such as running out of disk space or available memory) 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 back-end 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).

First, if this happens to your repository, don’t panic. Subversion’s filesystem takes advantage of database transactions and checkpoints and pre-write journaling to ensure that only the most catastrophic of events can permanently destroy a database environment. A sufficiently paranoid repository administrator will be making off-site backups of the repository data in some fashion, but don’t call your system administrator to restore a backup tape just yet.

Secondly, use the following recipe to attempt to “unwedge” your repository:

1. Make sure that there are no processes accessing (or attempting to access) the repository. For networked repositories, this means shutting down the Apache HTTP Server, too.
2. Become the user who owns and manages the repository.
3. Run the command **svnadmin recover /path/to/repos**. You should see output like this:

```
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 Subversion server.

This procedure fixes almost every case of repository lock-up. 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 recreating from scratch various database files (shared memory regions, for example). 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 unweave your repository, you should do two things. First, move your broken repository out of the way and restore your latest backup of it. Then, send an email to the Subversion developer list (at `<dev@subversion.tigris.org>`) describing your problem in detail. Data integrity is an extremely high priority to the Subversion developers.

Migrating a Repository

A Subversion filesystem has its data spread throughout various database tables 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 collected into a single, portable, flat file format. Subversion provides such a mechanism, implemented in a pair of **svnadmin** subcommands: `dump` and `load`.

The most common reason to dump and load a Subversion repository is due to changes in Subversion itself. As Subversion matures, there are times when certain changes made to the back-end database schema cause Subversion to be incompatible with previous versions of the repository. The recommended course of action when you are upgrading across one of those compatibility boundaries is a relatively simple process:

1. Using your *current* version of **svnadmin**, dump your repositories to dump files.
2. Upgrade to the new version of Subversion.
3. Move your old repositories out of the way, and create new empty ones in their place using your *new* **svnadmin**.

12e.g.: hard drive + huge electromagnet = disaster.

4. Again using your *new svnadmin*, load your dump files into their respective, just-created repositories.
5. Finally, be sure to copy any customizations from your old repositories to the new ones, including `DB_CONFIG` files and hook scripts. You'll want to pay attention to the release notes for the new release of Subversion to see if any changes since your last upgrade affect those hooks or configuration options.

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.

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) >>>
```

Note that because **svnadmin** uses standard input and output streams for the repository dump and load process, people who are feeling especially saucy can try things like this (perhaps even using different versions of **svnadmin** on

each side of the pipe):

```
$ svnadmin create newrepos
$ svnadmin dump myrepos | svnadmin load newrepos
```

We mentioned previously that **svnadmin dump** outputs a range of revisions. Use the `--revision` option to specify a single revision to dump, or a range of revisions. If you omit this option, all the existing repository revisions will be dumped.

```
$ svnadmin dump myrepos --revision 23 > rev-23.dumpfile
$ svnadmin dump myrepos --revision 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 secondly, Subversion cannot know the state of the repository into which the dump data will be loaded (if it ever, in fact, occurs). 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 --revision 0:1000 > dumpfile1
$ svnadmin dump myrepos --revision 1001:2000 --incremental > dumpfile2
$ svnadmin dump myrepos --revision 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 like the following 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.

Example 5.3. Using Incremental Repository Dumps

```
#!/usr/bin/perl -w
use strict;
```

```
my $repos_path = '/path/to/repos';
my $dumpfile   = '/usr/backup/svn-dumpfile';
my $last_dumped = '/var/log/svn-last-dumped';

# Figure out the starting revision. Use 0 if we cannot read the
# last-dumped file, else use the revision in that file incremented
# by 1.
my $new_start = 0;
if (open LASTDUMPED, $last_dumped)
{
    my $line = <LASTDUMPED>;
    if (defined $line and $line =~ /^(\d+)/)
    {
        $new_start = $1 + 1;
    }
    close LASTDUMPED;
}

# Query the youngest revision in the repos.
my $youngest = `svnlook youngest $repos_path`;
defined $youngest && $youngest =~ /^(\d+)/
    or die "$0: 'svnlook youngest $repos_path' cannot get youngest revision.\n";
chomp $youngest;

# Do the backup.
system("svnadmin dump $repos_path --revision $new_start:$youngest --incremental >> $dumpfile")
    or die "$0: svnadmin dump to '$dumpfile.tmp' failed.\n";

# Store a new last-dumped revision.
open LASTDUMPED, "> $last_dumped.tmp"
    or die "$0: cannot open '$last_dumped.tmp' for writing: $!\n";
print LASTDUMPED "$youngest\n";
close LASTDUMPED
    or die "$0: error in closing '$last_dumped.tmp' for writing: $!\n";

# Rename to final locations.
rename("$dumpfile.tmp", $dumpfile)
    or die "$0: cannot rename '$dumpfile.tmp' to '$dumpfile': $!\n";
rename("$last_dumped.tmp", $last_dumped)
    or die "$0: cannot rename '$last_dumped.tmp' to '$last_dumped': $!\n";

# All done!
```

Used like this, **svnadmin**'s dump and load commands can be a valuable means by which to backup changes to your repository over time in case of a system crash or some other catastrophic event.

Finally, another possible use of the Subversion repository dump file format is 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.

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 generally two types of backup methods available for Subversion repository administrators—incremental
13The Subversion repository dump file format resembles an RFC-822 format, the same type of format used for most email.

and full. We discussed in an earlier section of this chapter how to use **svnadmin dump --incremental** to perform an incremental backup (see the section called “Migrating a Repository”). Essentially, the idea is to only backup at a given time the changes to the repository since the last time you made a backup.

A full backup of the repository is quite literally a duplication of the entire repository directory (which includes the Berkeley database environment). Now, unless you temporarily disable all other access to your repository, simply doing a recursive directory copy runs the risk of generating a faulty backup, since someone might be currently writing to the database.

Fortunately, Sleepycat's Berkeley DB documents describe a certain order in which database files can be copied that will guarantee a valid backup copy. And better still, you don't have to implement that algorithm yourself, because the Subversion development team has already done so. The **hot-backup.py** script is found in the `tools/backup/` directory of the Subversion source distribution. Given a repository path and a backup location, **hot-backup.py** will perform the necessary steps for backing up your live repository—without requiring that you bar public repository access at all—and then will clean out the dead Berkeley log files from your live repository.

Even if you also have an incremental backup, you might want to run this program on a regular basis. For example, you might consider adding **hot-backup.py** to a program scheduler (such as **crond** on Unix systems). Or, if you prefer fine-grained backup solutions, you could have your post-commit hook script call **hot-backup.py** (see the section called “Hook Scripts”), which will then cause a new backup of your repository to occur with every new revision created. Simply add the following to the `hooks/post-commit` script in your live repository directory:

```
(cd /path/to/hook/scripts; ./hot-backup.py ${REPOS} /path/to/backups &)
```

The resulting backup is a fully functional Subversion repository, able to be dropped in as a replacement for your live repository should something go horribly wrong.

There are benefits to both types of backup methods. The easiest is by far the full backup, which will always result in a perfect working replica of your repository. This again means that 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 using the repository dump format are excellent to have on hand if the database schema changes between successive versions of Subversion itself. Since a full repository dump and load are generally required to upgrade your repository to the new schema, it's very convenient to already have half of that process (the dump part) finished. Unfortunately, the creation of—and restoration from—incremental backups takes longer, as each commit is effectively replayed into either the dumpfile or the repository.

In either 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.

Often, the best approach to repository backups is a diversified one. You can leverage combinations of full and incremental backups, plus archives of commit emails. The Subversion developers, for example, back up the Subversion source code repository after every new revision is created, and keep an archive of all the commit and property change notification emails. Your solution might be similar, but should be catered to your needs and that delicate balance of convenience with paranoia. And 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.

¹⁴**svnadmin setlog**, for example, bypasses the hook interface altogether.

¹⁵You know—the collective term for all of her “fickle fingers”.

Adding Projects

Once your repository is created and configured, all that remains is to begin using it. If you have a collection of existing data that is ready to be placed under version control, you will more than likely want to use the `svn` client program's `import` subcommand to accomplish that. Before doing this, though, you should carefully consider your long-term plans for the repository. In this section, we will offer some advice on how to plan the layout of your repository, and how to get your data arranged in that layout.

Choosing a Repository Layout

While Subversion allows you to move around versioned files and directories without any loss of information, doing so can still disrupt the workflow of those who access the repository often and come to expect things to be at certain locations. Try to peer into the future a bit; plan ahead before placing your data under version control. By “laying out” the contents of your repositories in an effective manner the first time, you can prevent a load of future headaches.

There are a few things to consider when setting up Subversion repositories. Let's assume that as repository administrator, you will be responsible for supporting the version control system for several projects. The 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 scripts, one thing to routinely backup, one thing to dump and load if Subversion releases an incompatible new version, and so on. Also, you can move data between projects easily, and without losing any historical versioning information.

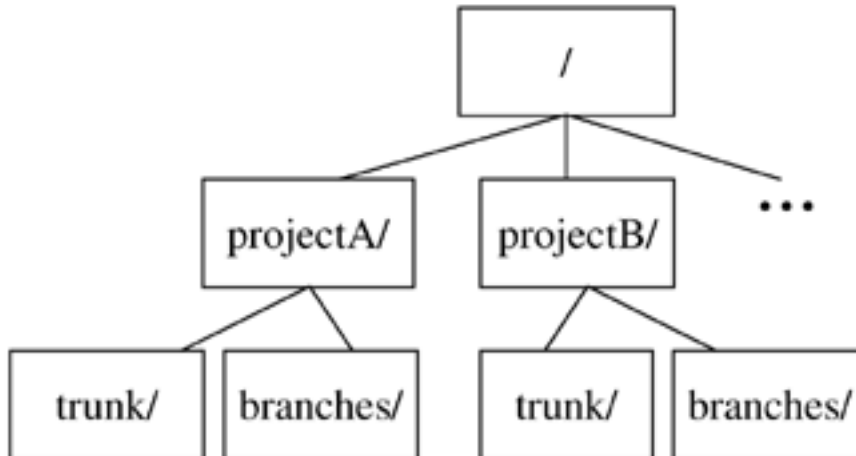
The downside of using a single repository is that different projects may have different commit mailing lists or different authentication and authorization requirements. Also, remember that Subversion uses repository-global revision numbers. Some folks don't like the fact that even though no changes have been made to their project lately, the youngest revision number for the repository keeps climbing because other projects are actively adding new revisions.

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 in the repositories themselves. Because Subversion uses regular directory copies for branching and tagging (see Chapter 4, *Branching and Merging*), the Subversion community recommends using one of two different approaches here. Both approaches employ the use of directories named `trunk`, meaning the directory under which the main project development occurs, and `branches`, which is a directory in which to create various named branches of the main development line.

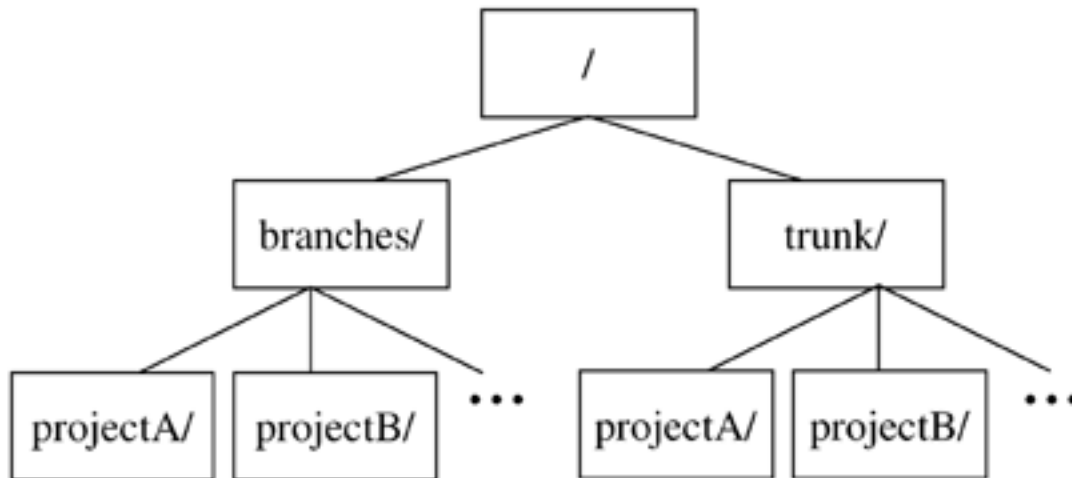
The first approach is to place each project in a subdirectory of the root filesystem directory, with `trunk` and `branches` directories immediately under each project directory, as demonstrated in Figure 5-1.

Figure 5.1. One Suggested Repository Layout.



The second is to do the reverse—to have the `trunk` and `branches` directories immediately in the top level of the filesystem, each with subdirectories for all the projects in the repository, as demonstrated in Figure 5-2.

Figure 5.2. Another Suggested Repository Layout.



Lay out your repository in whatever way you see fit. Subversion does not expect or enforce a layout schema—in its eyes, a directory is a directory is a directory. Ultimately, you should choose the repository arrangement that meets your needs and those of the projects that live there.

Creating the Layout, and Importing Initial Data

After deciding how to arrange the projects in your repository, you'll probably want to actually populate the repository with that layout and with initial project data. There are a couple of ways to do this in Subversion. You could use the `svn mkdir` command (see Chapter 9, *Subversion Complete Reference*) to create each directory in your skeletal repository layout, one-by-one. A quicker way to accomplish the same task is to use the `svn import` command (see the section called “`svn import`”). By first creating the layout in a temporary location on your drive, you can import the whole layout tree into the repository in a single commit:

```
$ mkdir tmpdir
$ cd tmpdir
$ mkdir projectA
$ mkdir projectA/trunk
$ mkdir projectA/branches
$ mkdir projectB
$ mkdir projectB/trunk
$ mkdir projectB/branches
...
$ svn import projectA file:///path/to/repos --message 'Initial repository layout'
Adding      projectA
Adding      projectA/trunk
Adding      projectA/branches
Adding      projectB
Adding      projectB/trunk
Adding      projectB/branches

Committed revision 1.
$ cd ..
$ rm -rf tmpdir
$
```

Once you have your skeletal layout in place, you can begin importing actual project data into your repository, if any such data exists yet. Once again, there are several ways to do this. You could use the **svn import** command. You could checkout a working copy from your new repository, move and arrange project data inside the working copy, and use the **svn add** and **svn commit** commands. But once we start talking about such things, we're no longer discussing repository administration. If you aren't already familiar with the **svn** client program, see Chapter 3, *Guided Tour*.

Summary

By now you should have a basic understanding of how to create, configure, and maintain Subversion repositories. We've introduced you to the various tools that will assist you with this task. Throughout the chapter, we've noted common administration pitfalls, and 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.

Chapter 6. Server Configuration

A Subversion repository can be accessed simultaneously by clients running on the same machine on which the repository resides using the `file:///` method. But the typical Subversion setup involves a single server machine being accessed from clients on computers all over the office—or, perhaps, all over the world.

This section describes how to get your Subversion repository exposed outside its host machine for use by remote clients. We will cover Subversion's currently available server mechanisms, discussing the configuration and use of each. After reading this section, you should be able to decide which networking setup is right for your needs, and understand how to enable such a setup on your host computer.

Overview

Subversion was designed with an abstract network layer. This means that a repository can be programmatically accessed by any sort of server process, and the client "repository access" API allows programmers to write plugins that speak relevant network protocols. In theory, Subversion can sport an infinite number of network implementations. In practice, there are only two servers at the time of writing.

Apache is an extremely popular webserver; using the `mod_dav_svn` module, Apache can access a repository and make it available to clients via WebDAV/DeltaV protocol, which is an extension of HTTP. In the other corner is `svnserve`: a small, standalone server program that speaks a custom protocol with clients.

Note that Subversion, as an open-source project, does not officially endorse any server as "primary" or "official". Neither network implementation is treated as a second-class citizen; each server has distinct advantages and disadvantages. In fact, it's possible for different servers to run in parallel, each accessing your repositories in its own way, and each without hindering the other (see the section called "Using Multiple Servers"). Here's a brief overview and comparison of the two available Subversion servers— as an administrator, it's up to you to choose whatever works best for you and your users.

Table 6.1. Network Server Comparison

Feature	Apache + <code>mod_dav_svn</code>	<code>svnserve</code>
Authentication options	HTTP(S) basic auth, X.509 certificates, LDAP, NTLM, or any other mechanism available to Apache httpd	CRAM-MD5 or SSH
User account options	private 'users' file	private 'users' file, or existing system (SSH) accounts
Authorization options	blanket read/write access, or per-directory access control	blanket read/write access
Encryption	via optional SSL	via optional SSH tunnel
Interoperability	partially usable by other WebDAV clients	not interoperable
Web Viewing	limited built-in support, or via 3rd-party tools such as ViewCVS	via 3rd-party tools such as ViewCVS
Speed	somewhat slower	somewhat faster
Initial setup	somewhat complex	fairly simple

Network Model

This section is a general discussion of how a Subversion client and server interact with one another, regardless of the network implementation you're using. After reading, you'll have a good understanding of how a server can behave and the different ways in which a client can be configured to respond.

Requests and Responses

The Subversion client spends most of its time managing working copies. When it needs information from a 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 schema, a particular protocol is used to contact the server (see Repository URLs). Users can run `svn --version` to see which URL schemas and protocols the client knows how to use.

When the server process receives a client request, it typically 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 the client asked for. Notice that this system is different from systems like CVS, where the client pre-emptively 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, then the server will never issue an authentication challenge when a client attempts to **svn checkout**.

If the client's network request writes new data to the repository (e.g. **svn commit**), then a new revision tree is created. If the client's request was authenticated, then the authenticated user's name is stored as the value of the `svn:author` property on the new revision (see the section called "Unversioned Properties"). If the client was not authenticated (in other words, the server never issued an authentication challenge), then the revision's `svn:author` property is empty. ¹⁶

Client Credentials Caching

Many servers are configured to require authentication on every request. This can become a big annoyance to users, who are forced to type their passwords over and over again.

Happily, the Subversion client has a remedy for this: a built-in system for caching authentication credentials on disk. By default, whenever the commandline client successfully authenticates itself to a server, it saves the credentials in the user's private runtime configuration area— in `~/.subversion/auth/` on Unix-like systems or `%APPDATA%/Subversion/auth/` on Windows. (The runtime area is covered in more detail in the section called "Runtime Configuration Area".) Successful credentials are cached on disk, keyed on a combination of host-name, port, and authentication realm.

When the client receives an authentication challenge, it first looks for the appropriate credentials in the disk cache; if not present, or if the cached credentials fail to authenticate, then the client simply prompts the user for the information.

The security-paranoid people may be thinking to themselves, "caching passwords on disk? That's terrible! You should never do that!" But please remain calm. First, the `auth/` caching area is permission-protected so that only the user (owner) can read data from it, not the world at large. If that's still not safe enough for you, you can disable credential caching. 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.
```

¹⁶This problem is actually a FAQ, resulting from a misconfigured server setup.

```
# password was not cached, so a second commit still prompts us

$ svn rm 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 your runtime config file (located next to the auth/ directory). Simply set

```
[auth]
store-auth-creds = no
```

... and no credentials will be cached on disk, ever.

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 client authentication behavior: a bit of explanation about the `--username` and `--password` options is needed. Many client subcommands accept these options; however it is important to understand 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 *only* be presented to the server if the server requests them. ¹⁷ Typically, these options are used when:

- the user wants to authenticate as a different user than her system login name, or

¹⁷Again, 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, i.e. new revisions still appear to have been committed anonymously!

- a script wants to authenticate without using cached credentials.

Here is a final summary that describes how a Subversion client behaves when it receives an authentication challenge:

1. Check whether the user specified any credentials as commandline options, via `--username` and/or `--password`. If not, or if these options fail to authenticate successfully, then
2. Look up the server's realm in the runtime `auth/` area, to see if the user already has the appropriate credentials cached. If not, or if the cached credentials fail to authenticate, then
3. Resort to prompting the user.

If the client successfully authenticates by any of the methods listed above, it will attempt to cache the credentials on disk (unless the user has disabled this behavior, as mentioned earlier.)

svnserve, a custom server

The **svnserve** program is a lightweight server, capable of speaking to clients over TCP/IP using a custom, stateful protocol. Clients contact an **svnserve** server by using URLs that begin with the `svn://` or `svn+ssh://` schema. This section will explain the different ways of running **svnserve**, how clients authenticate themselves to the server, and how to configure appropriate access control to your repositories.

Invoking the Server

There are a few different ways to invoke the **svnserve** program. If invoked with no options, you'll see nothing but a help message. However, if you're planning to have **inetd** launch the process, then you can pass the `-i` (`--inetd`) option:

```
$ svnserve -i
( success ( 1 2 ( ANONYMOUS ) ( edit-pipeline ) ) )
```

When invoked with the `--inetd` option, **svnserve** attempts to speak with a Subversion client via *stdin* and *stdout* using a custom protocol. This is the standard behavior for a program being run via **inetd**. The IANA has reserved TCP port 3690 for the Subversion protocol, so on a Unix-like system you can add a line to `/etc/services` like this (if it doesn't already exist):

```
svnserve      3690/tcp          # Subversion protocol
```

...and when a client connection comes into your server on port 3690, **inetd** will spawn an **svnserve** process to service it.

A second option is to run **svnserve** as a standalone "daemon" process. Use the `-d` option for this:

```
$ svnserve -d
$                # svnserve is now running, listening on port 3690
```

When running **svnserve** in daemon mode, you can use the `--listen-port=` and `--listen-host=` options to customize the exact port and hostname to "bind" to.

There's still a third way to invoke **svnserve**, and that's in "tunnel mode", with the `-t` option. This mode assumes that a remote-service program such as **RSH** or **SSH** has successfully authenticated a user and is now invoking a private **svnserve** process *as that user*. The **svnserve** program behaves normally (communicating via *stdin* and *stdout*), and assumes that the traffic is being automatically redirected over some sort of tunnel back to the client. When **svnserve** is invoked by a tunnel agent like this, be sure that the authenticated user has full read and write access to the repository database files. (See Servers and Permissions: A Word of Warning.) It's essentially the same as a local user accessing the repository via `file:///` URLs.

Servers and Permissions: A Word of Warning

First, remember that a Subversion repository is a collection of BerkeleyDB database files; any process which accesses the repository directly needs to have proper read and write permissions on the entire repository. If you're not careful, this can lead to a number of headaches. Be sure to read the section called "Using Multiple Servers".

Secondly, when configuring **svnserve**, Apache **httpd**, or any other server process, keep in mind that you might not want to launch the server process as the user `root` (or as any other user with unlimited permissions). Depending on the ownership and permissions of the repositories you're exporting, it's often prudent to use a different—perhaps custom—user. For example, many administrators create a new user named `svn`, grant that user exclusive ownership and rights to the exported Subversion repositories, and only run their server processes as that user.

Once the **svnserve** program is running, it makes every repository on your system available to the network. A client needs to specify an *absolute* path in the repository URL. For example, if a repository is located at `/usr/local/repositories/project1`, then a client would reach it via `svn://host.example.com/usr/local/repositories/project1`. To increase security, you can pass the `-r` option to **svnserve**, which restricts it to exporting only repositories below that path:

```
$ svnserve -d -r /usr/local/repositories
...
```

Using the `-r` option effectively modifies the location that the program treats as the root of the remote filesystem space. Clients then use URLs that have that path portion removed from them, leaving much shorter (and much less revealing) URLs:

```
$ svn checkout svn://host.example.com/project1
...
```

Built-in authentication and authorization

When a client connects to an **svnserve** process, the following things happen:

- The client selects a specific repository.
- The server processes the repository's `conf/svnserve.conf` file, and begins to enforce any authentication and authorization policies defined therein.
- Depending on the situation and authorization policies,
 - the client may be allowed to make requests anonymously, without ever receiving an authentication challenge, OR
 - the client may be challenged for authentication at any time, OR

- if operating in "tunnel mode", the client will declare itself to be already externally authenticated.

At the time of writing, the server only knows how to send a CRAM-MD5 18 authentication challenge. In essence, the server sends a bit of data to the client. The client uses its password to encrypt the data with the MD5 hash algorithm, and sends it back. The server performs the same computation with the stored password to verify that the result is identical. At no point does the actual password travel over the network.

It's also possible, of course, for the client to be externally authenticated via a tunnel agent, such as **SSH**. In that case, the server simply examines the user it's running as, and uses it as the authenticated username.

As you've already guessed, a repository's `svnserve.conf` file is the central mechanism for controlling authentication and authorization policies. The file has the same format as other configuration files (see the section called "Runtime Configuration Area"): section names are marked by [square brackets], comments begin with "#" characters, and each section contains specific variables that can be set (`variable = value`). Let's walk through this file and learn how to use them.

Create a 'users' file and realm

For now, the [general] section of the `svnserve.conf` has all the variables you need. Begin by defining a file which contains usernames and passwords, and 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 the section called "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 user 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 values `none`, `read`, or `write`. "none" restricts all access of any kind, "read" allows read-only access to the repository, and "write" allows complete read/write access to the repository. For example:

¹⁸See RFC 2195.

```
[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
```

Notice that **svnserve** only understands "blanket" access control. A user either has universal read/write access, universal read access, or no access. There is no detailed control over access to specific paths within the repository. For many projects and sites, this level of access control is more than adequate. However, if you need per-directory access control, you'll need to use Apache instead of **svnserve** as your server process.

SSH authentication and authorization

svnserve's built-in authentication 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 schema to connect:

```
$ whoami
harry

$ svn list svn+ssh://host.example.com/repos/project
harry@host.example.com's password: *****

foo
bar
baz
...
```

What's happening here is that the Subversion client is invoking a local **ssh** process, connecting to `host.example.com`, authenticating as user 'harry', then spawning a private **svnserve** process on the remote machine, running as user 'harry'. The **svnserve** command is being invoked in tunnel mode (`-t`) and all network protocol is being "tunneled" over the encrypted connection by **ssh**, the tunnel-agent. **svnserve** is aware that it's running as user 'harry', and if the client performs a commit, the authenticated username will be attributed as the author of the new revision.

When running over a tunnel, authorization is primarily controlled by operating system permissions to the reposi-

tory'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 the section called "Using Multiple Servers".) But even in the case of tunneling, the `svnserve.conf` file can still be used to block access, by simply setting `auth-access = read` or `auth-access = none`.

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 run-time `config` file (see the section called "Runtime Configuration Area".) For example, suppose you want to use RSH instead of SSH. 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 schema that matches the name of your new variable: `svn+rsh://host/path`. When using the new URL schema, the Subversion client will actually be running the command `rsh host svnserve -t` behind the scenes. If you include a username in the URL (for example, `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 a `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 non-standard port. Second, it shows how to define a custom environment variable that can override the name of the tunneling program. 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`.

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 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, is supported by numerous pieces of core operating system and third-party products, and which doesn't require network administrators to open up yet another custom port.¹⁹ 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 website 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.

¹⁹They really hate doing that.

Why Apache 2?

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 writing, Apache 1.3 is by far the most 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 only work against the Apache 1.3 API, and 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 plugin to mod_dav, which uses Subversion's libraries to access the repository, and
- 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 pre-built 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.

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 `/absolute/path/to/repository` using the following `httpd.conf` syntax:

```
<Location /repos>
  DAV svn
  SVNPath /absolute/path/to/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, the `SVNParentPath` directive, to indicate that common parent directory. For example, if you know you will be creating multiple Subversion repositories in a directory `/usr/local/svn` that would be accessed via URLs like `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 /usr/local/svn/foo
  SVNParentPath /usr/local/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 in order to create and network new repositories.

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 that your server is known by. 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. (See *Servers and Permissions: A Word of Warning*.)

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 like

```
<Location /svn>
  DAV svn
  SVNParentPath /usr/local/svn
</Location>
```

...then your repository is "anonymously" accessible to the world. Until you configure some authentication and authorization policies, the Subversion repositories you make available via the `Location` directive will be generally accessible to everyone. In other words,

- anyone can use their Subversion client to checkout a working copy of a repository URL (or any of its subdirectories),
- anyone can interactively browse the repository's latest revision simply by pointing their web browser to the repository URL, and
- anyone can commit to the repository.

Basic HTTP Authentication

The easiest way to authenticate an 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, those to whom you wish to grant special access to your Subversion repository. 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 /etc/svn-auth-file -m 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 his 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 /usr/local/svn
  AuthType Basic
  AuthName "Subversion repository"
  AuthUserFile /etc/svn-auth-file
</Location>
```

Now, at this stage, if you were to restart Apache, any Subversion operations that required authentication would harvest a username and password from the Subversion client, which would either provide previously cached values for these things, or prompt the user for the information. 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. See the next section (the section called "Authorization Options") to configure authorization policies.

One word of warning: HTTP Basic Auth passwords pass in very nearly plain-text over the network, and thus are extremely insecure. If you're worried about password snooping, 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. ²⁰ 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, then 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 *can* be covered 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 *certifying authority* (CA). If OpenSSL is unable to automatically trust the CA, or if some other problem occurs (such as an expired certificate or hostname mismatch), the Subversion commandline 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://home.example.com:443':
- The certificate is not issued by a trusted authority. Use the
```

²⁰While self-signed server certificates are still vulnerable to a "man in the middle" attack, such an attack is still much more difficult for a casual observer to pull off, compared to sniffing unprotected passwords.

```
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 run-time `auth/` area in just the same way your username and password are cached (see the section called “Client Credentials Caching”). If cached, Subversion will automatically remember to trust this certificate in future negotiations.

Your run-time `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 pre-defined 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 both a path to the certificate and the password which 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 commandline 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. 21

Authorization Options

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 which provided the correct password for their respective username, would be allowed to do anything with the Subversion repository:

```
<Location /svn>
  DAV svn
  SVNParentPath /usr/local/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 (like 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
  SVNParentPath /usr/local/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>.

²¹More security-conscious folk might not want to store the client certificate password in the runtime `servers` file.

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_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 in a specific way:

- You must use `SVNPath`. The `SVNParentPath` directive is not yet supported.
- You must unconditionally `Require valid-user`; it cannot be modified via `Limit` or `LimitExcept` directives.
- You must specify a path to an *access file*, which describes the permissions policy for the repository, via the new `AuthzSVNAccessFile` directive.

Here's a simple example:

```
<Location /svn/project>
  DAV svn
  SVNPath /usr/local/svn/project

  # 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

  # our access control policy
  AuthzSVNAccessFile /path/to/access/file
</Location>
```

At this point, you need to create the access file and define some authorization rules in it.

The format of the access file is the same familiar one used by **svnserve.conf** and runtime configuration files. Lines that start with hash (#) are ignored. In its simplest form, each “section” is a path within the repository, and the authenticated usernames are the variables. The value of each variable 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.

```
[/branches/calc/bug-142]
harry = rw
sally = r
```

In this example, user `harry` has full read and write access on the `/branches/calc/bug-142` directory, but user

sally has read-only access. Any other users are blocked from accessing this directory.

Of course, permissions “inherit” from parent to child directory. That means that we can specify a subdirectory with a different access policy for sally:

```
[/branches/calc/bug-142]
harry = rw
sally = r

# give sally write access only to the 'testing' subdir
[/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:

```
[/branches/calc/bug-142]
harry = rw
sally = r

[/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.

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; once all users have read-access to the repository, you can give explicit `rw` permission to certain users on certain subdirectories. Fortunately, the access file 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 a `@` prefix:

```
[/projects/calc]
@calc-developers = rw

[/projects/paint]
@paint-developers = rw
jane = r
```

...and that's pretty much all there is to it.

A final note about **mod_authz_svn**: because it demands an authenticated user at all times, this means your repository cannot be accessed anonymously. In the simpler authorization setup (the section called “Blanket Access Control”), it's possible for certain HTTP requests to happen without any authentication at all. But at the moment, **mod_authz_svn** requires an authenticated username to be associated with every HTTP request. As a workaround, you might want to create a “guest” user with read-access to your repository, and announce the account to the general public.

Extra Goodies

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 a GET request for that URL, and 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.

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 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 /usr/local/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 website. 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** directive is actually a URL path—browsers need to be able to read your stylesheets in order to make use of them!

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 only speaks ordinary HTTP. That means it only knows how to GET public URLs, which represent the latest versions of files and directories. According to the WebDAV/DeltaV spec, 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` 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 ViewCVS (<http://viewcvs.sourceforge.net/>). ViewCVS was originally written to display CVS repositories through the web, and the latest bleeding-edge versions (at the time of writing) are able to understand Subversion repositories as well.

Other 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. Subversion communicates with Apache using Neon, which is a generic HTTP/WebDAV library with support for such mechanisms as SSL (the Secure Socket Layer, discussed earlier) and Deflate compression (the same algorithm used by the `gzip` and `PKZIP` programs to “shrink” files into smaller chunks of data). You need only to compile support for the features you desire into Subversion and Apache, and properly configure the programs to use those features.

Deflate compression places a small burden on the client and server to compress and decompress network transmissions as a way to minimize the size of the actual transmission. In cases where network bandwidth is in short supply, this kind of compression can greatly increase the speed at which communications between server and client can be sent. In extreme cases, this minimized network transmission could be the difference between an operation timing out or completing successfully.

Less interesting, but 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 a proxy. These things are all supported by Neon, so Subversion gets that support for free.

Finally, because `mod_dav_svn` is speaking a semi-complete dialect of WebDAV/DeltaV, 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 “share”. This is a complicated topic; for details, read Appendix D, *WebDAV and Autoversioning*.

Using Multiple Servers

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/or 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 previous list have the rights to read and write the Berkeley DB 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 sets `umask 002` and then runs the real `svn` client program. You can write a similar wrapper script for the `svnservice` program, and add a `umask 002` command to Apache's own startup script, `apachectl`. For example:

```
$ cat /usr/local/bin/svn
#!/bin/sh
umask 002
/usr/local/subversion/bin/svn
```

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 `svnservice` using `localhost` for the server name in their `http://` or `svn://` URLs. And to maintain multiple server processes for your Subversion repositories is likely to be more of a headache than necessary. We recommend you choose the server that best meets your needs and stick with it!

Chapter 7. 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 checkout a working copy from a Subversion repository. You are comfortable with submitting and receiving changes using the **svn commit** and **svn update** functions. You've probably even developed a reflex which 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".

This chapter highlights some of Subversion's features that aren't quite so regularly used. In it, we will discuss Subversion's property (or "metadata") support, and how to modify Subversion's default behaviors by tweaking its runtime configuration area. We will describe how you can use externals definitions to instruct Subversion to pull data from multiple repositories. We'll cover in detail some of the additional client- and server-side tools that are part of the Subversion distribution.

Before reading this chapter, you should be familiar with the basic file and directory versioning capabilities of Subversion. If you haven't already read about those, or if you need a refresher, we recommend that you check out Chapter 2, *Basic Concepts* and Chapter 3, *Guided Tour*. Once you've mastered the basics and consumed this chapter, you'll be a Subversion power-user—or we'll refund your money! ²²

Runtime Configuration Area

Subversion provides many optional behaviors that can be controlled by the user. 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 each and 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). These files can be easily edited using your favorite text editor (such as Emacs or vi), and contain directives read by the client to determine which of several optional behaviors the user prefers.

Configuration Area Layout

The first time that 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. However, on this platform the exact location differs from system to system, and is dictated by the Windows registry. ²³ 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 does not alone 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 again 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.

²²This offer applies only to those who, like most folks, pay nothing for Subversion.

²³The `APPDATA` environment variable points to the `Application Data` area, so you can always refer to this folder as `%APPDATA%\Subversion`.

The `.subversion` directory 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 modify the desired option value. If at any time you wish to have the default settings restored to one or more of the configuration files, you can simply delete the file, and run some innocuous `svn` command, such as `svn --version`, and the missing file will be recreated in its default state.

The per-user configuration area also contains a cache of authentication data. The `auth` directory holds a set of sub-directories 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 are overridden by values found in the configuration files. In other words, configuration priority is granted in the following order on a Windows system:

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, and then double-click on that file from the Explorer shell, which will cause the data to be merged into your registry.

Example 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-auth-creds"="no"

[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\miscellany]
"#global-ignores"="*.o *.lo *.la ##. *.rej *.rej .*~ *~ .#"
"#log-encoding"=""
"#use-commit-times"=""
"#template-root"=""
"#enable-auto-props"=""

[HKEY_CURRENT_USER\Software\Tigris.org\Subversion\Config\tunnels]

[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 run-time configuration options that are currently supported by Subversion.

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 which 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 valid for the other server sections in the file (except, of course, the special `groups` section), and are as follows:

<code>http-proxy-host</code>	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.
<code>http-proxy-port</code>	This specifies the port number on the proxy host to use. It defaults to an empty value.
<code>http-proxy-username</code>	This specifies the username to supply to the proxy machine. It defaults to an empty value.
<code>http-proxy-password</code>	This specifies the password to supply to the proxy machine. It defaults to an empty value.
<code>http-timeout</code>	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 timeout, 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.
<code>http-compression</code>	This specifies whether or not Subversion should attempt to compress network requests made to DAV-ready servers. The default value is <code>yes</code> (though compression will only occur if that capability is compiled into the network layer). Set this to <code>no</code> to disable compression, such as when debugging network transmissions.
<code>neon-debug-mask</code>	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 Chapter 8, <i>Developer Information</i> .
<code>ssl-authority-files</code>	A semi-colon 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.
<code>svn-tunnel-agent</code>	This specifies the external agent program through which to tunnel SVN protocol requests.

Config

The `config` file contains the rest of the currently available Subversion run-time options, those not related to networking. There are only a few options in use at this time, 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:

store-auth-creds This instructs Subversion to cache, or not to cache, authentication credentials 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 credential 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 the section called “Client Credentials Caching”.

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 a log message during a commit operation, such as when using `svn commit` without either the `-message (-m)` or `--file (-F)` options. This program is also used with the `svn propedit` command—a temporary file is populated with the current value of the property the user wishes to edit, and the edits take place right in the editor program (see the section called “Properties”). This option's default value is empty. If the option is not set, Subversion will fall back to checking the environment variables `SVN_EDITOR`, `VISUAL`, and `EDITOR` (in that order) for an editor command.

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). The default value is the path of the GNU diff utility, as determined by the Subversion source code build system.

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. The default value is the path of the GNU diff3 utility, as determined by the Subversion source code build system.

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. Since the `diff3-cmd` option's default value is determined at compilation time, the default value for the `diff3-has-program-arg` is, too.

The `miscellany` section is where everything that doesn't belong elsewhere winds up. ²⁴ 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 the section called “svn status”). 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 which 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 .*~ *~ .#*`.

You can override this option for a single instance of the `svn status` command by using the `--no-ignore` command-line flag. For information on more fine-grained control of ignored items, see the section called “svn:ignore”.

²⁴Anyone for potluck dinner?

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 be human-readable text. 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 committing textual changes. And you receive other people's property changes as you update your working copy.

Other Properties in Subversion

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, text names and anything-you-want, binary values—except that revision properties are not versioned. See the section called “Unversioned Properties” for more information on these unversioned 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. Hopefully, you'll be convinced that Subversion properties can enhance your version control experience.

Why Properties?

Properties can be very useful additions to your working copy. In fact, Subversion itself uses properties to house special information, and as a way to denote that certain special processing might be needed. Likewise, you can use properties for your own purposes. Of course, anything you can do with properties you could also do using regular versioned files, but consider the following example of Subversion property use.

Say you wish to design a website that houses many digital photos, and displays them with captions and a timestamp. 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. You can do this with 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, like `thumbnails/image123.jpg`. You can also store your captions and timestamps in a similar fashion, again separated from the original image file. Soon, your tree of files is a mess, and grows in multiples with each new photo added to the site.

Now consider the same setup using Subversion's file properties. Imagine having a single image file, `image123.jpg`, and then properties set on that file named `caption`, `timestamp`, and even `thumbnail`. Now your working copy directory looks much more manageable—in fact, it looks 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 the section called “Using Languages Other than C and C++”) to dig out the extra information that your site needs to display without having to read an index file or play path manipulation games.

How (and if) you use Subversion properties is up to you. As we mentioned, Subversion has its own uses for properties, which we'll discuss a little later in this chapter. But first, let's discuss how to manipulate options using the **svn** program.

Manipulating Properties

The **svn** command 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 **propset** subcommand.

```
$ svn propset copyright '(c) 2003 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 multi-line textual, or even binary, property value, you probably do not want to supply that value on the command-line. So the **propset** subcommand takes a `--file (-F)` option for specifying the name of a file which contains the new property value.

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

In addition to the **propset** command, the **svn** program supplies the **propedit** command. This command uses the configured editor program (see the section called “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 which 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:

```
$ svn propset copyright '(c) 2002 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 path (or set of paths) and a property name, print the value of the property to the standard output stream.

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

```
$ svn propget copyright calc/button.c
(c) 2003 Red-Bean Software
```

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

```
$ svn proplist --verbose calc/button.c
Properties on 'calc/button.c':
  copyright : (c) 2003 Red-Bean Software
  license : =====
Copyright (c) 2003 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 **propedit** or **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 --verbose calc/button.c
Properties on 'calc/button.c':
  copyright : (c) 2003 Red-Bean Software
  license :
$
```

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

```
$ svn propdel license calc/button.c
property `license' deleted from ''.
$ svn proplist --verbose calc/button.c
Properties on 'calc/button.c':
  copyright : (c) 2003 Red-Bean Software
$
```

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—in cleanly or conflicting fashions—someone else's modifications into your own.

Modifying Revision Properties

Remember those unversioned revision properties? You can modify those, too, with the **svn** program. 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 path in this case as long as you are positioned in the working copy of the repository whose revision property you wish to modify. For example, you might want to replace the commit log message of an existing revision. 25

```
$ svn propset svn:log '* button.c: Fix a compiler warning.' -r11 --revprop
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 the section called “Hook Scripts”). Since the properties aren't versioned, you run the risk of losing information if you aren't careful with your edits. The repository administrator can setup methods to protect against this lossage, but by default, modification of unversioned properties is disabled.

And as with file contents, your property changes are local modifications, only made permanent when you commit them to the repository with **svn commit**. Your property changes can be easily undone, too—the **svn revert** command will restore your files and directories to their un-edited 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) 2003 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 modified its textual contents. Had we changed both, we would have seen M in the first column, too (see the section called “svn status”).

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 resource that clash with your own, Subversion will report that the resource is in a conflicted state.

```
% svn update calc
M calc/Makefile.in
C calc/button.c
Updated to revision 143.
$
```

Subversion will also create, in the same directory as the conflicted resource, a file with a `.prej` extension which 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 resource, and attempts to commit your local modifications will fail.

```
$ svn status calc
C      calc/button.c
?      calc/button.c.prej
```

²⁵Fixing spelling errors, grammatical gotchas, and “just-plain-wrongness” in commit log messages is perhaps the most common use-case for the `--revprop` option.

```
$ cat calc/button.c.prej
prop `linecount': user set to '1256', but update set to '1301'.
$
```

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 non-standard way that Subversion currently displays property differences. You can still run **svn diff** and redirect the 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.

As you can see, the presence of property modifications has no outstanding effect on the typical Subversion workflow. Your general patterns of updating your working copy, checking the status of your files and directories, reporting on the modifications you have made, and committing those modifications to the repository are completely immune to the presence or absence of properties. The **svn** program has some additional subcommands for actually making property changes, but that is the only noticeable asymmetry.

Special properties

Subversion has no particular policy regarding properties—you can use them for any purpose. Subversion 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. In fact, Subversion defines certain properties that have magical effects on the files and directories to which they are attached. In this section, we'll untangle the mystery, and describe how these special properties make your life just a little easier.

svn:executable

The `svn:executable` property is used to control a versioned file's filesystem-level execute permission bit in a semi-automated way. This property has no defined values—its mere presence indicates a desire that the execute permission bit be kept enabled by Subversion. Removing this property will restore full control of the execute bit back to the operating system.

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. In a working copy, new files are being created all the time as new versions of existing files are received during an update. This means that you might enable the execute bit on a file, then update your working copy, and if that file was changed as part of the update, its execute bit might get disabled. So, Subversion provides the `svn:executable` property as a way to keep the execute bit enabled.

This property has no effect on filesystems that have no concept of an executable permission bit, such as FAT32 and NTFS.²⁶ 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.

svn:mime-type

The `svn:mime-type` property serves many purposes in Subversion. Besides being a general-purpose storage location for a file's Multipurpose Internet Mail Extensions (MIME) classification, the value of this property determines several behavioral characteristics of Subversion itself.

For example, if a file's `svn:mime-type` property is set to a non-text MIME type (generally, something that doesn't begin with `text/`, though there are exceptions), Subversion will assume that the file contains binary—that is, not human-readable—data. 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 believed to contain bi-

²⁶The Windows filesystems use file extensions (such as `.EXE`, `.BAT`, and `.COM`) to denote executable files.

nary data, there is no concept of a “line”. So, for those files, 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 renamed with a `.orig` extension, and then Subversion stores a new working copy file that contains the changes received during the update, but not your own local modifications, at the original filename. 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.

Subversion assists users by running a binary-detection algorithm in the **svn import** and **svn add** subcommands. These subcommands use a heuristic to guess at a file's “binary-ness”, and then set the `svn:mime-type` property to `application/octet-stream` (the generic “this is a collection of bytes” MIME type) on any files that are deemed binary. If Subversion guesses wrong, or if you wish to set the `svn:mime-type` property to something more accurate—perhaps `image/png` or `application/x-shockwave-flash`—you can always remove or hand-edit the property.

Finally, 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 a crucial clue about how to display a file when perusing your repository with a web browser.

svn:ignore

The `svn:ignore` property contains a list of file patterns which certain Subversion operations will ignore. Perhaps the most commonly used special property, it works in conjunction with the `global-ignores` run-time configuration option (see the section called “Config”) to filter unversioned files and directories out of commands like **svn status**.

The rationale behind the `svn:ignore` property is easily explained. Subversion does not assume that every file or subdirectory in a working copy directory is intended for version control. Resources must be explicitly placed under Subversion's management using the **svn add** command. As a result, there are often many resources in a working copy that are not versioned.

Now, the **svn status** command displays as part of its output every unversioned file or subdirectory in a working copy that is not already filtered out by the `global-ignores` option (or its built-in default value). This is done so that users can see if perhaps they've forgotten to add a resource to version control.

But Subversion cannot possibly guess the names of every resource that should be ignored. Also, quite often there are things that should be ignored in *every* working copy of a particular repository. To force every user of that repository to add patterns for those resources to their run-time configuration areas would be not just a burden, but has the potential to clash with the configuration needs of other working copies that the user has checked out.

The solution is to store ignore patterns that are unique to the resources likely to appear in a given directory with the directory itself. Common examples of unversioned resources that are basically unique to a directory, yet likely to appear there, include output from program compilations. 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.

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.

For this purpose, the `svn:ignore` property is the solution. Its value is a multi-line collection of file patterns, one pattern per line. The property is set on the directory in which you wish the patterns to be applied. ²⁷ For example, 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, in this case, the latest `calculator` program that you've compiled from your source code, a source file named `data.c`, and a set of debugging output log files. Now, you know that your build system always results in the `calculator` program being generated. ²⁸ And you know that your test suite always leaves those debugging log files lying around. These facts are true for all working copies, not just your own. And you know that you aren't interested in seeing those things every time you run `svn status`. 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 the cruft is missing from the output! Of course, those files are still in your working copy. Subversion is simply not reminding you that they are present and unversioned. And now with all the trivial noise removed from the display, you are left with more interesting items— such as that source code file that you probably forgot to add to version control.

If you want to see the ignored files, you can pass the `--no-ignore` option to subversion:

```
$ svn status --no-ignore
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
```

²⁷The patterns are strictly for that directory—they do not carry recursively into subdirectories.

²⁸Isn't that the whole point of a build system?

svn:keywords

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 describe information about the last time the file was known to be modified. 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 `$KeywordName$`.

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

<code>LastChangedDate</code>	This keyword describes the last time the file was known to have been changed in the repository, and looks something like <code>\$LastChangedDate: 2002-07-22 21:42:37 -0700 (Mon, 22 Jul 2002) \$</code> . It may be abbreviated as <code>Date</code> .
<code>LastChangedRevision</code>	This keyword describes the last known revision in which this file changed in the repository, and looks something like <code>\$LastChangedRevision: 144 \$</code> . It may be abbreviated as <code>Rev</code> .
<code>LastChangedBy</code>	This keyword describes the last known user to change this file in the repository, and looks something like <code>\$LastChangedBy: harry \$</code> . It may be abbreviated as <code>Author</code> .
<code>HeadURL</code>	This keyword describes the full URL to the latest version of the file in the repository, and looks something like <code>\$HeadURL: http://svn.collab.net/repos/trunk/README \$</code> . It may be abbreviated as <code>URL</code> .
<code>Id</code>	This keyword is a compressed combination of the other keywords. Its substitution looks something like <code>\$Id: calc.c 148 2002-07-28 21:30:43Z sally \$</code> , and is interpreted to mean that the file <code>calc.c</code> was last changed in revision 148 on the evening of July 28, 2002 by the user <code>sally</code> .

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 about how to use keywords, and you don't want Subversion to substitute your beautiful examples of unsubstituted keyword anchors!

To tell Subversion whether or not 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 the keyword names or aliases found in the previous table.

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

```
Here is the latest report from the front lines.  
$LastChangedDate$  
$Rev$
```

29... or maybe even a section of a book ...

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 "LastChangedDate 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.

Keywords and Spurious Differences

The user-visible result of keyword substitution might lead you to think that every version of a file with that feature in use differs from the previous version in at least the area where the keyword anchor was placed. However, this is actually not the case. While checking for local modifications during **svn diff**, and before transmitting those local modifications during **svn commit**, Subversion “un-substitutes” any keywords that it previously substituted. The result is that the versions of the file that are stored in the repository contain only the real modifications that users make to the file.

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 bounded by the dollar sign (\$) characters. And as we predicted, the `Rev` keyword was not substituted because we didn't ask for it to be.

```
Here is the latest report from the front lines.
$LastChangedDate: 2002-07-22 21:42:37 -0700 (Mon, 22 Jul 2002) $
$Rev$
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 re-substituted with information that reflects the most recent known commit to that file.

svn:eol-style

Unless otherwise noted using a versioned file's `svn:mime-type` property, Subversion assumes the file contains human-readable data. Generally speaking, Subversion only uses this knowledge to determine if 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 use different tokens to 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—carriage return (CR) and 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 are prepared to 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. Common results are that Unix programs treat the CR character present in Windows files as a regular character (usually rendered

as ^M), and that 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 end of line.

This sensitivity to foreign EOL markers can become 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 which 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 they 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.

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 non-trivial 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 flipping with every commit that comes from a different operating system. The valid values are:

<code>native</code>	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 a <code>svn:eol-style</code> property set to <code>native</code> , that file will contain CRLF EOL markers. A unix user checking out a working copy which 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.
<code>CRLF</code>	This causes the file to contain CRLF sequences for EOL markers, regardless of the operating system in use.
<code>LF</code>	This causes the file to contain LF characters for EOL markers, regardless of the operating system in use.
<code>CR</code>	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. It was used on older Macintosh platforms (on which Subversion doesn't even run).

`svn:externals`

The `svn:externals` property contains instructions for Subversion to populate a versioned directory with one or more other checked-out Subversion working copies. For more information on this keyword and its use, see the section called “Externals Definitions”.

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 setup 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 of a versioned resource. In Subversion, you declare externals definitions in groups using the `svn:externals` property. This property is set on a versioned directory, and its value is a multi-line table of sub-directories (relative to the versioned directory on which the property is set) and Subversion repository URLs.

```
$ svn propset svn:externals calc
third-party/sounds      http://sounds.red-bean.com/repos
third-party/skins       http://skins.red-bean.com/repositories/skinproj
third-party/skins/toolkit http://svn.red-bean.com/repos/skin-maker
```

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 those nested working copy checkouts, no one else has to Subversion will, upon checkout of the original working copy, also checkout the external working copies.

Note the previous externals definition example. When someone checks out a working copy of the `calc` directory, Subversion also continues to checkout 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
...
```

If you need to change the 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 externals definition.

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 which makes use of a third-party library. Subversion has just such a relationship with the Apache Portable Runtime library (see the section called “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, there are several ways that you could attempt to synchronize that information with your own. Most painfully, you could issue oral or written instructions to all the contributors of your project, telling them to make sure that 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 the section called “Externals Definitions”).

But sometimes you want to maintain custom modifications to third-party data 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 alternate 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 data, and necessitating regeneration of those changes with each successive version of the third-party data 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 key benefits. First, by storing the currently supported vendor drop in your own version control system, 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. Secondly, 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. 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 (for example, `/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.

Perhaps 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.

```
...
$ svn import /path/to/libcomplex-1.0 \
    http://svn.example.com/repos/calc/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 the section called “Tags”) and then copy it into the main development branch so we can make our customizations to it.

```
$ svn copy http://svn.example.com/repos/calc/vendor/libcomplex/current \
    http://svn.example.com/repos/calc/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. ³⁰

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. But we'd like to upgrade to this new version without losing our customizations to the existing version. As you might have guessed, 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.

To perform this upgrade, we checkout a copy of our vendor branch, and replace the `current` version with the new libcomplex 1.1 source code. After committing this change, our `current` branch now contains the new vendor drop. We tag the new version, 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. In other words, none of the libcomplex source files would have been deleted, renamed or moved to different locations—in short, 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 can quickly degrade into a situation where we have to manually recreate 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 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 that 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.

³⁰And entirely bug-free, of course!

- 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:

```
$ svn_load_dirs.pl http://svn.example.com/repos/calc/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/calc/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, there will be no files that are 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 prompt you for how you would like 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 to match the added path against, 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`—then 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 quote characters. You can escape quote characters 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.

Chapter 8. Developer Information

Subversion is an open-source software project developed under an Apache-style software license. The project is financially backed by CollabNet, Inc., a California-based software development company. The community that has formed around the development of Subversion always welcomes new members who can donate their time and attention to the project. Volunteers are encouraged to assist in any way they can, whether that means finding and diagnosing bugs, refining existing source code, or fleshing out whole new features.

This chapter is for those who wish to assist in the continued evolution of Subversion by actually getting their hands dirty with the source code. We will cover some of the software's more intimate details, the kind of technical nitty-gritty that those developing Subversion itself—or writing entirely new tools based on the Subversion libraries—should be aware of. If you don't foresee yourself participating with the software at such a level, feel free to skip this chapter with confidence that your experience as a Subversion user will not be affected.

Layered Library Design

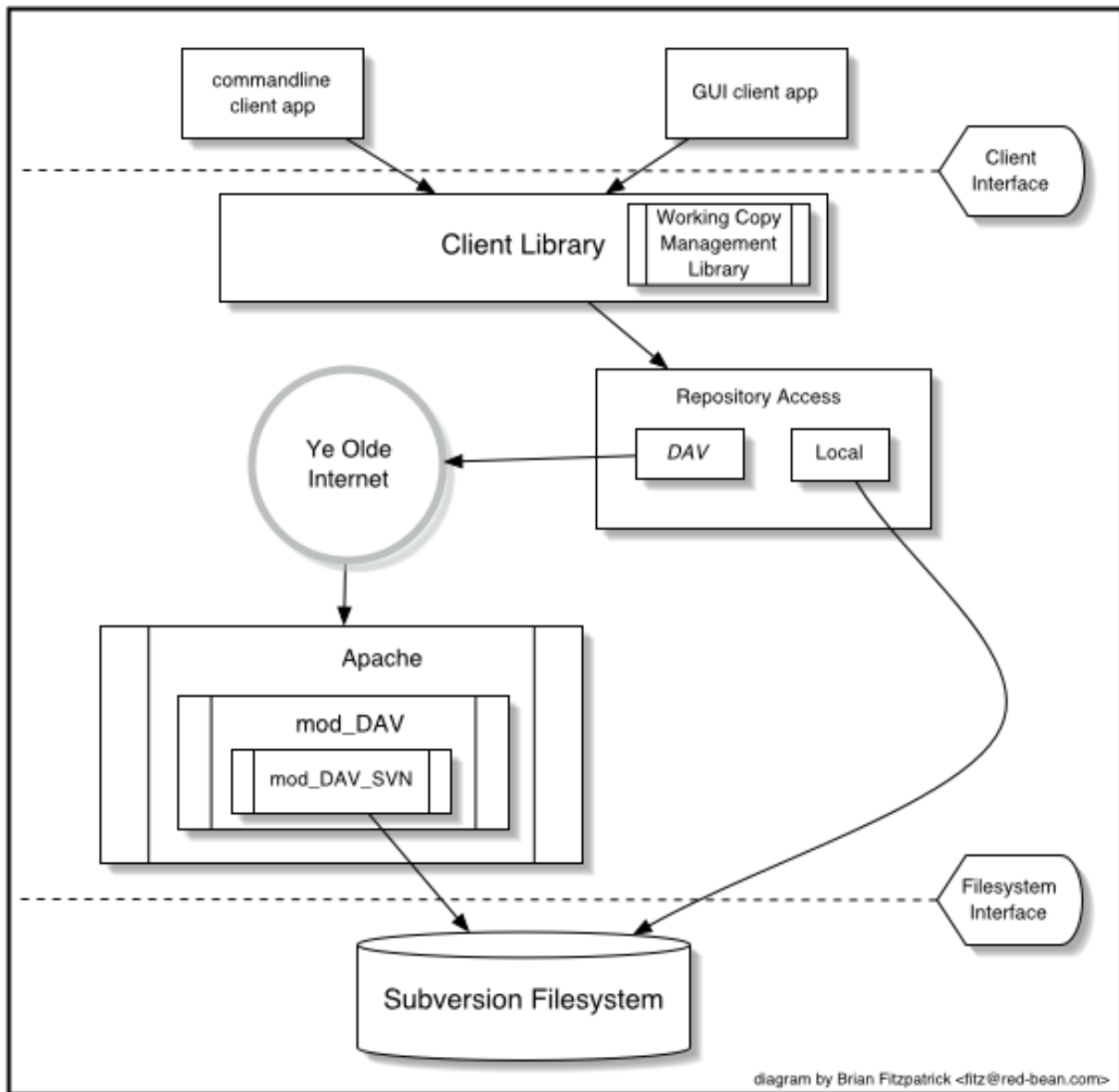
Subversion has a modular design, implemented as a collection of C libraries. Each library has a well-defined purpose and interface, and most modules are said to exist in one of three main layers—the Repository Layer, the Repository Access (RA) Layer, or the Client Layer. We will examine these layers shortly, but first, see our brief inventory of Subversion's libraries in Table 7-1. For the sake of consistency, we will refer to the libraries by their extensionless Unix library names (e.g.: `libsvn_fs`, `libsvn_wc`, `mod_dav_svn`).

Table 8.1. A Brief Inventory of the Subversion Libraries

Library	Description
<code>libsvn_client</code>	Primary interface for client programs
<code>libsvn_delta</code>	Tree and text differencing routines
<code>libsvn_fs</code>	The Subversion filesystem library
<code>libsvn_ra</code>	Repository Access commons and module loader
<code>libsvn_ra_dav</code>	The WebDAV Repository Access module
<code>libsvn_ra_local</code>	The local Repository Access module
<code>libsvn_ra_svn</code>	A proprietary protocol Repository Access module
<code>libsvn_repos</code>	Repository interface
<code>libsvn_subr</code>	Miscellaneous helpful subroutines
<code>libsvn_wc</code>	The working copy management library
<code>mod_dav_svn</code>	Apache module for mapping WebDAV operations to Subversion ones

The fact that the word "miscellaneous" only appears once in Table 7-1 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.

And what could better help a developer gain a "big picture" perspective than a big picture? To help you understand how the Subversion libraries fit together, see Figure 7-1, a diagram of Subversion's layers. Program flow begins at the top of the diagram (initiated by the user) and flows "downward".

Figure 8.1. Subversion's "Big Picture"

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_dav`, `libsvn_ra_local`, and `libsvn_ra_svn` all implement the same interface. And all three communicate with the Repository Layer— `libsvn_ra_dav` and `libsvn_ra_svn` do so across a network, and `libsvn_ra_local` connects to it directly.

The client itself also highlights modularity in the Subversion design. While Subversion currently comes with only a command-line client program, there are already a few other programs being developed by third parties to act as GUIs for Subversion. Again, these GUIs use the same APIs that the stock command-line client does. Subversion's `libsvn_client` library is the one-stop shop for most of the functionality necessary for designing a working Subversion client (see the section called “Client Layer”).

Repository Layer

When referring to Subversion's Repository Layer, we're generally talking about two libraries—the repository library, and the filesystem library. 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 accessed via the `libsvn_fs` API, and is not a kernel-level filesystem that one would install in an operating system (like the Linux `ext2` or `NTFS`), but a virtual filesystem. Rather than storing "files" and "directories" as real files and directories (as in, the kind you can navigate through using your favorite shell program), it uses a database system for its back-end storage mechanism. Currently, the database system in use is Berkeley DB.³¹ However, there has been considerable interest by the development community in giving future releases of Subversion the ability to use other back-end database systems, perhaps through a mechanism such as Open Database Connectivity (ODBC).

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 transaction. The following is a simplified general routine for modifying your filesystem:

1. Begin a Subversion 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, especially given its close proximity the database code in `libsvn_fs`, can become easily confused with the transaction support provided by the underlying database itself. 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 if *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 like making modifications to a set of files and directories which are intended to be stored as the next revision of the filesystem tree. If that isn't confusing enough, consider this: Subversion uses a database transaction during the creation of a Subversion transaction (so that if the creation of Subversion transaction fails, the database will look as if we had never attempted that creation in the first place)!

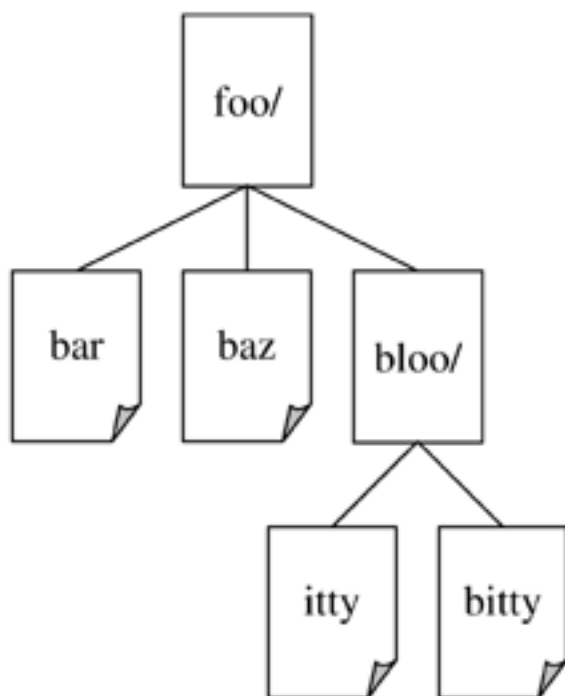
Fortunately for users of the filesystem API, the transaction support provided by the database system itself is hidden almost entirely from view (as should be expected from a properly modularized library scheme). It is only when you start digging into the implementation of the filesystem itself that such things become visible (or interesting).

³¹The choice of Berkeley DB brought several automatic features that Subversion needed, such as data integrity, atomic writes, recoverability, and hot backups.

Most of the functionality provided by the filesystem interface comes as an action that occurs on a filesystem path. That is, from outside of the filesystem, the primary mechanism for describing and accessing the individual revisions of files and directories comes through the use of path strings like `/foo/bar`, just as if 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 descending into subdirectories a downward motion. Figure 7-2 shows a typical representation of a tree as exactly that.

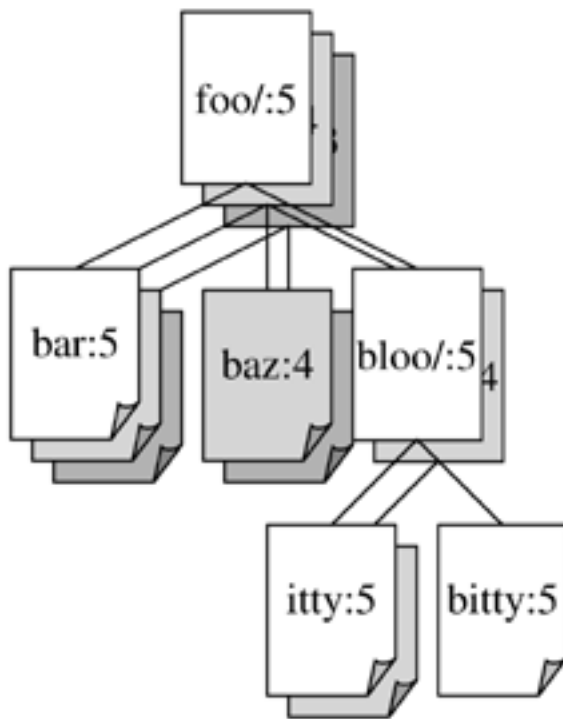
Figure 8.2. Files and Directories in Two Dimensions



Of course, the Subversion filesystem has a nifty third dimension that most filesystems do not have—Time! ³² 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 usually just a revision-to-be), and provides that third-dimensional context needed to understand the difference between `/foo/bar` in revision 32, and the same path as it exists in revision 98. Figure 7-3 shows revision history as an added dimension to the Subversion filesystem universe.

Figure 8.3. Revisioning Time—the Third Dimension!

³²We 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`) is basically a wrapper library around the filesystem functionality. This library is responsible for creating the repository layout, making sure that the underlying filesystem is initialized, and so on. `libsvn_repos` also implements a set of hooks—scripts that are executed by the repository code when certain actions take place. These scripts are useful for notification, authorization, or whatever purposes the repository administrator desires. This type of functionality, and other utility provided by the repository library, is not strictly related to implementing a versioning filesystem, which is why it was placed into its own library.

Developers who wish to use the `libsvn_repos` API will find that it is not a complete wrapper around the filesystem interface. That is, only certain major events 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. In the future, other events may be wrapped by the repository API. All of the remaining filesystem interaction will continue to occur directly with `libsvn_fs` API, though.

For example, here is a code segment that illustrates the use of both the repository and filesystem interfaces to create a new revision of the filesystem in which a directory is added. Note that in this example (and all others throughout this book), the `SVN_ERR` macro simply checks for a non-successful error return from the function it wraps, and returns that error if it exists.

Example 8.1. Using the Repository Layer

```
/* 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. */
static svn_error_t *
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. */
    SVN_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. */
    SVN_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. */
    SVN_ERR (svn_fs_begin_txn (&txn, fs, youngest_rev, pool));

    /* Now that we have started a new Subversion transaction, get a root
    object that represents that transaction. */
    SVN_ERR (svn_fs_txn_root (&txn_root, txn, pool));

    /* Create our new directory under the transaction root, at the path
    NEW_DIRECTORY. */
    SVN_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 "
               "'%' SVN_REVNUM_T_FMT "'.\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);
    }

    /* Return the result of the attempted commit to our caller. */
    return err;
}
```

In the previous code segment, calls were made to both the repository and filesystem interfaces. We 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 (like, for example, 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—`svn_repos_fs_commit_txn`. This function will actually first run the "pre-commit" hook script if one exists, then commit the transaction, and finally will run a "post-commit" hook script. The hooks provide a special kind of reporting mechanism that does not really belong in the core filesystem library itself. (For more information regarding Subversion's repository hooks, see the section called "Hook Scripts".)

The hook mechanism requirement 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:

1. create, open, destroy, and perform recovery steps on a Subversion repository and the filesystem included in that repository.
2. describe the differences between two filesystem trees.
3. 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.
4. generate a human-readable "dump" of the filesystem, a complete representation of the revisions in the filesystem.
5. 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 Layer is the line itself. Charged with marshalling 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_dav`, `libsvn_ra_local`, 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 with which `libsvn_ra_dav` communicates or `libsvn_ra_svn`'s server, **svnserv**.

Since Subversion uses URLs to identify its repository resources, the protocol portion of the URL schema (usually `file:`, `http:`, `https:`, or `svn:`) 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 0.25.0 (dev build)
  compiled Jul 18 2003, 16:25:59
```

Copyright (C) 2000-2003 CollabNet.
Subversion is open source software, see <http://subversion.tigris.org/>

The following repository access (RA) modules are available:

- * `ra_dav` : Module for accessing a repository via WebDAV (DeltaV) protocol.
 - handles 'http' schema
- * `ra_local` : Module for accessing a repository on local disk.
 - handles 'file' schema
- * `ra_svn` : Module for accessing a repository using the svn network protocol.
 - handles 'svn' schema

RA-DAV (Repository Access Using HTTP/DAV)

The `libsvn_ra_dav` library is designed for use by clients that are being run on different machines than the servers with which they communicating, specifically machines reached using URLs that contain the `http:` or `https:` protocol portions. To understand how this module works, we should first mention a couple of other key components in this particular configuration of the Repository Access Layer—the powerful Apache HTTP Server, and the Neon HTTP/WebDAV client library.

Subversion's primary network server is the Apache HTTP Server. Apache is a time-tested, extensible open-source server process that is ready for serious use. It can sustain a high network load and runs on many platforms. The Apache server supports a number of different standard authentication protocols, and can be extended through the use of modules to support many others. It also supports optimizations like network pipelining and caching. By using Apache as a server, Subversion gets all of these features for free. And since most firewalls already allow HTTP traffic to pass through, sysadmins typically don't even have to change their firewall configurations to allow Subversion to work.

Subversion uses HTTP and WebDAV (with DeltaV) to communicate with an Apache server. You can read more about this in the WebDAV section of this chapter, but in short, WebDAV and DeltaV are extensions to the standard HTTP 1.1 protocol that enable sharing and versioning of files over the web. Apache 2.0 comes with `mod_dav`, an Apache module that understands the DAV extensions to HTTP. Subversion itself supplies `mod_dav_svn`, though, which is another Apache module that works in conjunction with (really, as a back-end to) `mod_dav` to provide Subversion's specific implementations of WebDAV and DeltaV.

When communicating with a repository over HTTP, the RA loader library chooses `libsvn_ra_dav` as the proper access module. The Subversion client makes calls into the generic RA interface, and `libsvn_ra_dav` maps those calls (which embody rather large-scale Subversion actions) to a set of HTTP/WebDAV requests. Using the Neon library, `libsvn_ra_dav` transmits those requests to the Apache server. Apache receives these requests (exactly as it does generic HTTP requests that your web browser might make), notices that the requests are directed at a URL that is configured as a DAV location (using the `Location` directive in `httpd.conf`), and hands the request off to its own `mod_dav` module. When properly configured, `mod_dav` knows to use Subversion's `mod_dav_svn` for any filesystem-related needs, as opposed to the generic `mod_dav_fs` that comes with Apache. So ultimately, the client is communicating with `mod_dav_svn`, which binds directly to the Subversion Repository Layer.

That was a simplified description of the actual exchanges taking place, though. For example, the Subversion repository might be protected by Apache's authorization directives. This could result in initial attempts to communicate with the repository being rejected by Apache on authorization grounds. At this point, `libsvn_ra_dav` gets back the notice from Apache that insufficient identification was supplied, and calls back into the Client Layer to get some updated authentication data. If the data is supplied correctly, and the user has the permissions that Apache seeks, `libsvn_ra_dav`'s next automatic attempt at performing the original operation will be granted, and all will be well. If sufficient authentication information cannot be supplied, the request will ultimately fail, and the client will report the failure to the user.

By using Neon and Apache, Subversion gets free functionality in several other complex areas, too. For example, if Neon finds the OpenSSL libraries, it allows the Subversion client to attempt to use SSL-encrypted communications with the Apache server (whose own `mod_ssl` can "speak the language"). Also, both Neon itself and Apache's `mod_deflate` can understand the "deflate" algorithm (the same used by the PKZIP and gzip programs), so requests

can be sent in smaller, compressed chunks across the wire. Other complex features that Subversion hopes to support in the future include the ability to automatically handle server-specified redirects (for example, when a repository has been moved to a new canonical URL) and taking advantage of HTTP pipelining.

RA-SVN (Proprietary Protocol Repository Access)

In addition to the standard HTTP/WebDAV protocol, Subversion also provides an RA implementation that uses a proprietary protocol. The `libsvn_ra_svn` module implements its own network socket connectivity, and communicates with a stand-alone server—the `svnserve` program—on the machine that hosts the repository. Clients access the repository using the `svn://` schema.

This RA implementation lacks most of the advantages of Apache mentioned in the previous section; however, it may be appealing to some sysadmins nonetheless. It is dramatically easier to configure and run; setting up an `svnserve` process is nearly instantaneous. It is also much smaller (in terms of lines of code) than Apache, making it much easier to audit, for security reasons or otherwise. Furthermore, some sysadmins may already have an SSH security infrastructure in place, and want Subversion to use it. Clients using `ra_svn` can easily tunnel the protocol over SSH.

RA-Local (Direct Repository Access)

Not all communications with a Subversion repository require a powerhouse server process and a network layer. For users who simply wish to access the repositories on their local disk, they may do so using `file:` URLs and the functionality provided by `libsvn_ra_local`. This RA module binds directly with the repository and filesystem libraries, so no network communication is required at all.

Subversion requires the server name included as part of the `file:` URL be either `localhost` or empty, and that there be no port specification. In other words, your URLs should look like either `file://localhost/path/to/repos` or `file:///path/to/repos`.

Also, be aware that Subversion's `file:` URLs cannot be used in a regular web browser the way typical `file:` URLs can. When you attempt to view a `file:` URL in a regular web browser, it reads and displays the contents of the file at that location by examining the filesystem directly. However, Subversion's resources exist in a virtual filesystem (see the section called “Repository Layer”), and your browser will not understand how to read that filesystem.

Your RA Library Here

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 inter-process 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 which 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 which 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 the section called “Inside the Working Copy Administration Area” 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 same functionality, data, and callback mechanisms that the command-line client uses.

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, this can address potential correctness issues as well. A command-line program (like 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.

Using the APIs

Developing applications against the Subversion library APIs is fairly straightforward. All of the public header files live in the `subversion/include` directory of the source tree. These headers are copied into your system locations 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 first thing you might notice is that Subversion's datatypes and functions are namespace protected. 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. Semi-public 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 definitely help to clarify the scope of a given function or datatype.

The Apache Portable Runtime Library

Along with Subversion's own datatype, you will see many references to datatypes that begin with `apr_`—bols 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 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 are practically no OS-specific code portions in Subversion itself. Also, it means that the Subversion client compiles and runs anywhere that the 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, 33 APR gives Subversion immediate access to many custom datatypes, such as dynamic arrays and hash tables. Subversion uses these types extensively throughout the codebase. 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 schema for data passed through its API), 34 and while a person coding against the Subversion APIs is not required to do the same, they are 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 acquire a pool for use with Subversion API calls. See the section called “Programming with Memory Pools” for more information.

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, 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 re-convert 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 can be used by any program 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 script or Java application—Subversion has some initial support for this via the Simplified Wrapper and Interface Generator (SWIG). The SWIG bindings for Subversion are located in `subversion/bindings/swig` and are slowly maturing into a usable state. 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.

There is an obvious benefit to accessing the Subversion APIs via a language binding—simplicity. Generally speaking, languages such as Python and Perl are much more flexible and easy to use than C or C++. The sort of high-level datatypes and context-driven type checking provided by these languages are often better at handling information that comes from users. As you know, only a human can botch up the input to a program as well as they do, and the scripting-type language simply handle that misinformation more gracefully. Of course, often that flexibility comes at the cost of performance. That is why using a tightly-optimized, C-based interface and library suite, combined with a powerful, flexible binding language is so appealing.

Let's look at an example that uses Subversion's Python SWIG bindings. Our example will do the same thing as our last example. Note the difference in size and complexity of the function this time!

Example 8.2. Using the Repository Layer with Python

```
from svn import fs
```

³³Subversion uses ANSI system calls and datatypes as much as possible.

³⁴Neon and Berkeley DB are examples of such libraries.

```
import os.path

def crawl_filesystem_dir (root, directory, pool):
    """Recursively crawl DIRECTORY under ROOT in the filesystem, and return
    a list of all the paths at or below DIRECTORY.  Use POOL for all
    allocations."""

    # Get the directory entries for DIRECTORY.
    entries = fs.dir_entries(root, directory, pool)

    # Initialize our returned list with the directory path itself.
    paths = [directory]

    # Loop over the entries
    names = entries.keys()
    for name in names:
        # Calculate the entry's full path.
        full_path = os.path.join(basepath, 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 fs.is_dir(fsroot, full_path, pool):
            subpaths = crawl_filesystem_dir(root, full_path, pool)
            paths.extend(subpaths)

        # Else, it is a file, so add the entry's full path to the FILES list.
        else:
            paths.append(full_path)

    return paths
```

An implementation in C of the previous example would stretch on quite a bit longer. The same routine in C would need to pay close attention to memory usage, and need to use custom datatypes for representing the hash of entries and the list of paths. Python has hashes and lists (called "dictionaries" and "sequences", respectively) as built-in datatypes, and provides a wonderful selection of methods for operating on those types. And since Python uses reference counting and garbage collection, users of the language don't have to bother themselves with allocating and freeing memory.

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. The following is a brief example of how that library can be accessed via the SWIG bindings. In just a few lines of Python, you can check out a fully functional Subversion working copy!

Example 8.3. A Simple Script to Check Out a Working Copy.

```
#!/usr/bin/env python
import sys
from svn import util, _util, _client

def usage():
    print "Usage: " + sys.argv[0] + " URL PATH\n"
    sys.exit(0)

def run(url, path):
    # Initialize APR and get a POOL.
    _util.apr_initialize()
    pool = util.svn_pool_create(None)
```

```
# Checkout the HEAD of URL into PATH (silently)
_client.svn_client_checkout(None, None, url, path, -1, 1, None, pool)

# Cleanup our POOL, and shut down APR.
util.svn_pool_destroy(pool)
_util.apr_terminate()

if __name__ == '__main__':
    if len(sys.argv) != 3:
        usage()
    run(sys.argv[1], sys.argv[2])
```

Currently, it is Subversion's Python bindings that are the most complete. Some attention is also being given to the Java bindings. Once you have the SWIG interface files properly configured, generation of the specific wrappers for all the supported SWIG languages (which currently includes versions of C#, Guile, Java, Mzscheme, OCaml, Perl, PHP, Python, Ruby, and Tcl) should theoretically be trivial. Still, some extra programming is required to compensate for complex APIs that SWIG needs some help generalizing. For more information on SWIG itself, see the project's website at <http://www.swig.org>.

Inside the Working Copy Administration Area

As we mentioned earlier, each directory of a Subversion working copy contains a special subdirectory called `.svn` which houses administrative data about that working copy directory. Subversion uses the information in `.svn` to keep track of things like:

- 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 are currently present in the working copy.
- Any user-defined properties that might be attached to those files and directories.
- Pristine (un-edited) copies of the working copy files.

While there are several other bits of data stored in the `.svn` directory, we will examine only a couple of the most important items.

The Entries File

Perhaps the single most important file in the `.svn` directory is the `entries` file. The `entries` file is an XML document which contains the bulk of the administrative information about a versioned resource in a working copy directory. It is this one file which 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!

Comparing the Administrative Areas of Subversion and CVS

A glance inside the typical `.svn` directory turns up a bit more than what CVS maintains in its CVS administrative directories. The `entries` file contains XML which describes the current state of the working copy directory, and basically serves the purposes of CVS's `Entries`, `Root`, and `Repository` files combined.

The following is an example of an actual `entries` file:

Example 8.4. Contents of a Typical `.svn/entries` File

```
<?xml version="1.0" encoding="utf-8"?>
<wc-entries
  xmlns="svn:">
<entry
  committed-rev="1"
  name="svn:this_dir"
  committed-date="2002-09-24T17:12:44.064475Z"
  url="http://svn.red-bean.com/tests/.greek-repo/A/D"
  kind="dir"
  revision="1"/>
<entry
  committed-rev="1"
  name="gamma"
  text-time="2002-09-26T21:09:02.000000Z"
  committed-date="2002-09-24T17:12:44.064475Z"
  checksum="QSE4vWd9ZM0cMvr7/+YkXQ=="
  kind="file"
  prop-time="2002-09-26T21:09:02.000000Z"/>
<entry
  name="zeta"
  kind="file"
  schedule="add"
  revision="0"/>
<entry
  url="http://svn.red-bean.com/tests/.greek-repo/A/B/delta"
  name="delta"
  kind="file"
  schedule="add"
  revision="0"/>
<entry
  name="G"
  kind="dir"/>
<entry
  name="H"
  kind="dir"
  schedule="delete"/>
</wc-entries>
```

As you can see, the entries file is essentially a list of entries. Each entry tag represents one of three things: the working copy directory itself (noted by having its *name* attribute set to `svn:this-dir`), a file in that working copy directory (noted by having its *kind* attribute set to `file`), or a subdirectory in that working copy (*kind* here is set to `dir`). The files and subdirectories whose entries are stored in this file are either already under version control, or (as in the case of the file named `zeta` above) are scheduled to be added to version control when the user next commits this working copy directory's changes. Each entry has a unique name, and each entry has a node kind.

Developers should be aware of some special rules that Subversion uses when reading and writing its entries files. While each entry has a revision and URL associated with it, note that not every entry tag in the sample file has explicit *revision* or *url* attributes attached to it. Subversion allows entries to not explicitly store those two attributes when their values are the same as (in the *revision* case) or trivially calculable from 35 (in the *url* case) the data stored in the `svn:this-dir` entry. Note also that for subdirectory entries, Subversion stores only the crucial attributes—name, kind, url, revision, and schedule. In an effort to reduce duplicated information, Subversion dictates that the method for determining the full set of information about a subdirectory is to traverse down into that subdirectory, and read the `svn:this-dir` entry from its own `.svn/entries` file. However,

³⁵That is, the URL for the entry is the same as the concatenation of the parent directory's URL and the entry's name.

a reference to the subdirectory is kept in its parent's `entries` file, with enough information to permit basic versioning operations in the event that the subdirectory itself is actually missing from disk.

Pristine Copies and Property Files

As mentioned before, the `.svn` directory also holds the pristine "text-base" versions of files. Those can be found in `.svn/text-base`. The benefits of these pristine copies are multiple—network-free checks for local modifications and "diff" reporting, network-free reversion of modified or missing files, smaller transmission of changes to the server—but comes 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 they want 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. Each of these property files ("working" and "base" versions) uses a simple "hash-on-disk" file format for storing the property names and values.

WebDAV

WebDAV ("Web-based Distributed Authoring and Versioning") is an extension of the standard HTTP protocol designed to make the web into a read/write medium, instead of the basically read-only medium that exists today. The theory is that directories and files can be shared—as both readable and writable objects—over the web. RFCs 2518 and 3253 describe the WebDAV/DeltaV extensions to HTTP, and are available (along with a lot of other useful information) at <http://www.webdav.org/>.

A number of operating system file browsers are already able to mount networked directories using WebDAV. On Win32, the Windows Explorer can browse what it calls "WebFolders" (which are just WebDAV-ready network locations) as if they were regular shared folders. Mac OS X also has this capability, as do the Nautilus and Konqueror browsers (under GNOME and KDE, respectively).

How does all of this apply to Subversion? The `mod_dav_svn` Apache module uses HTTP, extended by WebDAV and DeltaV, as its primary network protocol. Rather than implementing a new proprietary protocol, the original Subversion designers decided to simply map the versioning concepts and actions used by Subversion onto the concepts exposed by RFCs 2518 and 3253. ³⁶

For a more thorough discussion of WebDAV, how it works, and how Subversion uses it, see Appendix D, *WebDAV and Autoversioning*. Among other things, that appendix discusses the degree to which Subversion adheres to the generic WebDAV specification, and how that affects interoperability with generic WebDAV clients.

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. Fortunately, the APR library that Subversion depends on for portability provides the `apr_pool_t` type, which represents a "pool" of memory.

A memory pool is an abstract representation of a chunk of memory allocated for use by a program. Rather than requesting memory directly from the OS using the standard `malloc()` and friends, programs that link against APR can simply request that a pool of memory be created (using the `apr_pool_create()` function). APR will allocate a moderately sized chunk of memory from the OS, and that memory will be instantly available for use by the program. Any time the program needs some of the pool memory, it uses one of the APR pool API functions, like `apr_palloc()`, which returns a generic memory location from the pool. The program can keep requesting bits

³⁶As it turns out, Subversion has more recently evolved a proprietary protocol anyway, implemented by the `libsvn_ra_svn` module.

and pieces of memory from the pool, and APR will keep granting the requests. Pools will automatically grow in size to accommodate programs that request more memory than the original pool contained, until of course there is no more memory available on the system.

Now, if this were the end of the pool story, it would hardly have merited special attention. Fortunately, that's not the case. Pools can not only be created; they can also be cleared and destroyed, using `apr_pool_clear()` and `apr_pool_destroy()` respectively. This gives developers the flexibility to allocate several—or several thousand—things from the pool, and then clean up all of that memory with a single function call! Further, pools have hierarchy. You can make "subpools" of any previously created pool. When you clear a pool, all of its subpools are destroyed; if you destroy a pool, it and its subpools are destroyed.

Before we go further, developers should be aware that they probably will not find many calls to the APR pool functions we just mentioned in the Subversion source code. APR pools offer some extensibility mechanisms, like the ability to have custom "user data" attached to the pool, and mechanisms for registering cleanup functions that get called when the pool is destroyed. Subversion makes use of these extensions in a somewhat non-trivial way. So, Subversion supplies (and most of its code uses) the wrapper functions `svn_pool_create()`, `svn_pool_clear()`, and `svn_pool_destroy()`.

While pools are helpful for basic memory management, the pool construct really shines in looping and recursive scenarios. Since loops are often unbounded in their iterations, and recursions in their depth, memory consumption in these areas of the code can become unpredictable. Fortunately, using nested memory pools can be a great way to easily manage these potentially hairy situations. The following example demonstrates the basic use of nested pools in a situation that is fairly common—recursively crawling a directory tree, doing some task to each thing in the tree.

Example 8.5. Effective Pool Usage

```
/* Recursively crawl over DIRECTORY, adding the paths of all its file
   children to the FILES array, and doing some task to each path
   encountered. Use POOL for the all temporary allocations, and store
   the hash paths in the same pool as the hash itself is allocated in. */
static apr_status_t
crawl_dir (apr_array_header_t *files,
          const char *directory,
          apr_pool_t *pool)
{
    apr_pool_t *hash_pool = files->pool; /* array pool */
    apr_pool_t *subpool = svn_pool_create (pool); /* iteration pool */
    apr_dir_t *dir;
    apr_finfo_t finfo;
    apr_status_t apr_err;
    apr_int32_t flags = APR_FINFO_TYPE | APR_FINFO_NAME;

    apr_err = apr_dir_open (&dir, directory, pool);
    if (apr_err)
        return apr_err;

    /* Loop over the directory entries, clearing the subpool at the top of
       each iteration. */
    for (apr_err = apr_dir_read (&finfo, flags, dir);
         apr_err == APR_SUCCESS;
         apr_err = apr_dir_read (&finfo, flags, dir))
    {
        const char *child_path;

        /* Skip entries for "this dir" ('.') and its parent ('..'). */
        if (finfo.filetype == APR_DIR)
        {
            if (finfo.name[0] == '.'
                && (finfo.name[1] == '\0'
```

```
        || (finfo.name[1] == '.' && finfo.name[2] == '\\0'))
    continue;
}

/* Build CHILD_PATH from DIRECTORY and FINFO.name. */
child_path = svn_path_join (directory, finfo.name, subpool);

/* Do some task to this encountered path. */
do_some_task (child_path, subpool);

/* Handle subdirectories by recursing into them, passing SUBPOOL
   as the pool for temporary allocations. */
if (finfo.filetype == APR_DIR)
{
    apr_err = crawl_dir (files, child_path, subpool);
    if (apr_err)
        return apr_err;
}

/* Handle files by adding their paths to the FILES array. */
else if (finfo.filetype == APR_REG)
{
    /* Copy the file's path into the FILES array's pool. */
    child_path = apr_pstrdup (hash_pool, child_path);

    /* Add the path to the array. */
    (*(const char **) apr_array_push (files)) = child_path;
}

/* Clear the per-iteration SUBPOOL. */
svn_pool_clear (subpool);
}

/* Check that the loop exited cleanly. */
if (apr_err)
    return apr_err;

/* Yes, it exited cleanly, so close the dir. */
apr_err = apr_dir_close (dir);
if (apr_err)
    return apr_err;

/* Destroy SUBPOOL. */
svn_pool_destroy (subpool);

return APR_SUCCESS;
}
```

The previous example demonstrates effective pool usage in *both* looping and recursive situations. Each recursion begins by making a subpool of the pool passed to the function. This subpool is used for the looping region, and cleared with each iteration. The result is memory usage is roughly proportional to the depth of the recursion, not to total number of file and directories present as children of the top-level directory. When the first call to this recursive function finally finishes, there is actually very little data stored in the pool that was passed to it. Now imagine the extra complexity that would be present if this function had to `alloc()` and `free()` every single piece of data used!

Pools might not be ideal for every application, but they are extremely useful in Subversion. As a Subversion developer, you'll need to grow comfortable with pools and how to wield them correctly. Memory usage bugs and bloating can be difficult to diagnose and fix regardless of the API, but the pool construct provided by APR has proven a tremendously convenient, time-saving bit of functionality.

Contributing to Subversion

The official source of information about the Subversion project is, of course, the project's website at <http://subversion.tigris.org>. There you can find information about getting access to the source code and participating on the discussion lists. The Subversion community always welcomes new members. If you are interested in participating in this community by contributing changes to the source code, here are some hints on how to get started.

Join the Community

The first step in community participation is to find a way to stay on top of the latest happenings. To do this most effectively, you will want to subscribe to the main developer discussion list ([<dev@subversion.tigris.org>](mailto:dev@subversion.tigris.org)) and commit mail list ([<svn@subversion.tigris.org>](mailto:svn@subversion.tigris.org)). By following these lists even loosely, you will have access to important design discussions, be able to see actual changes to Subversion source code as they occur, and be able to witness peer reviews of those changes and proposed changes. These email based discussion lists are the primary communication media for Subversion development. See the Mailing Lists section of the website for other Subversion-related lists you might be interested in.

But how do you know what needs to be done? It is quite common for a programmer to have the greatest intentions of helping out with the development, yet be unable to find a good starting point. After all, not many folks come to the community having already decided on a particular itch they would like to scratch. But by watching the developer discussion lists, you might see mentions of existing bugs or feature requests fly by that particularly interest you. Also, a great place to look for outstanding, unclaimed tasks is the Issue Tracking database on the Subversion website. There you will find the current list of known bugs and feature requests. If you want to start with something small, look for issues marked as "bite-sized".

Get the Source Code

To edit the code, you need to have the code. This means you need to check out a working copy from the public Subversion source repository. As straightforward as that might sound, the task can be slightly tricky. Because Subversion's source code is versioned using Subversion itself, you actually need to "bootstrap" by getting a working Subversion client via some other method. The most common methods include downloading the latest binary distribution (if such is available for your platform), or downloading the latest source tarball and building your own Subversion client. If you build from source, make sure to read the INSTALL file in the top level of the source tree for instructions.

After you have a working Subversion client, you are now poised to checkout a working copy of the Subversion source repository from <http://svn.collab.net/repos/svn/trunk>:³⁷

```
$ svn checkout http://svn.collab.net/repos/svn/trunk subversion
A HACKING
A INSTALL
A README
A autogen.sh
A build.conf
...
```

The above command will checkout the bleeding-edge, latest version of the Subversion source code into a subdirectory named `subversion` in your current working directory. Obviously, 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.

³⁷Note that the URL checked out in the example above 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.

Become Familiar with Community Policies

Now that you have a working copy containing the latest Subversion source code, you will most certainly want to take a cruise through the HACKING file in that working copy's top-level directory. The HACKING file contains general instructions for contributing to Subversion, including how to properly format your source code for consistency with the rest of the codebase, how to describe your proposed changes with an effective change log message, how to test your changes, and so on. Commit privileges on the Subversion source repository are earned—a government by meritocracy. ³⁸ The HACKING file is an invaluable resource when it comes to making sure that your proposed changes earn the praises they deserve without being rejected on technicalities.

Make and Test Your Changes

With the code and community policy understanding in hand, you are ready to make your changes. It is best to try to make smaller but related sets of changes, even tackling larger tasks in stages, instead of making huge, sweeping modifications. Your proposed changes will be easier to understand (and therefore easier to review) if you disturb the fewest lines of code possible to accomplish your task properly. After making each set of proposed changes, your Subversion tree should be in a state in which the software compiles with no warnings.

Subversion has a fairly thorough ³⁹ regression test suite, and your proposed changes are expected to not cause any of those tests to fail. By running **make check** (in Unix) from the top of the source tree, you can sanity-check your changes. The fastest way to get your code contributions rejected (other than failing to supply a good log message) is to submit changes that cause failure in the test suite.

In the best-case scenario, you will have actually added appropriate tests to that test suite which verify that your proposed changes actually work as expected. In fact, sometimes the best contribution a person can make is solely the addition of new tests. You can write regression tests for functionality that currently works in Subversion as a way to protect against future changes that might trigger failure in those areas. Also, you can write new tests that demonstrate known failures. For this purpose, the Subversion test suite allows you to specify that a given test is expected to fail (called an XFAIL), and so long as Subversion fails in the way that was expected, a test result of XFAIL itself is considered a success. Ultimately, the better the test suite, the less time wasted on diagnosing potentially obscure regression bugs.

Donate Your Changes

After making your modifications to the source code, compose a clear and concise log message to describe those changes and the reasons for them. Then, send an email to the developers list containing your log message and the output of **svn diff** (from the top of your Subversion working copy). If the community members consider your changes acceptable, someone who has commit privileges (permission to make new revisions in the Subversion source repository) will add your changes to the public source code tree. Recall that permission to directly commit changes to the repository is granted on merit—if you demonstrate comprehension of Subversion, programming competency, and a "team spirit", you will likely be awarded that permission.

³⁸While this may superficially appear as some sort of elitism, this "earn your commit privileges" notion is about efficiency—whether it costs more in time and effort to review and apply someone else's changes that are likely to be safe and useful, versus the potential costs of undoing changes that are dangerous.

³⁹You might want to grab some popcorn. "Thorough", in this instance, translates to somewhere around thirty minutes of non-interactive machine churn.

Chapter 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, you type **svn**, the subcommand you wish to use, and any switches or targets that you wish to operate on—there is no specific order that the subcommand and the switches must appear in. 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 Chapter 3, *Guided Tour* and commands for managing properties in the section called “Properties”

svn Switches

While Subversion has different switches for its subcommands, all switches are global—that is, each switch 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.

<code>--diff-cmd</code> <i>CMD</i>	Specifies an external program to use to show differences between files. When svn diff is invoked, it uses Subversion's internal diff engine, which provides unified diffs by default. If you want to use an external diff program, use <code>--diff-cmd</code> . You can pass switches to the diff program with the <code>--extensions</code> switch (more on that later in this section).
<code>--diff3-cmd</code> <i>CMD</i>	Specifies an external program to use to merge files.
<code>--dry-run</code>	Goes through all the motions of running a command, but makes no actual changes—either on disk or in the repository.
<code>--editor-cmd</code> <i>CMD</i>	Specifies an external program to use to edit a log message or a property value.
<code>--encoding</code> <i>ENC</i>	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.
<code>--extensions</code> <code>(-x)</code> " <i>ARG</i> "	Specifies an argument or arguments that Subversion should pass to an external diff command when providing differences between files. If you wish to pass multiple arguments, you must enclose all of them in quotes (for example, svn diff --diff-cmd /usr/bin/diff -x "-b -E"). This switch can <i>only</i> be used if you also pass the <code>--diff-cmd</code> switch.
<code>--file</code> <code>(-F)</code> <i>FILENAME</i>	Uses the contents of the file passed as an argument to this switch for the specified subcommand.

⁴⁰Yes, yes, you don't need a subcommand to use the `--version` switch, but we'll get to that in just a minute.

- `--force` Forces a particular command or operation to run. There are some operations that Subversion will prevent you from doing in normal usage, but you can pass the force switch to tell Subversion “I know what I'm doing as well as the possible repercussions of doing it, so let me at 'em”. This switch 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`) options 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 commands that accept log messages.
- `--help` (`-h` or `-?`) If used with one or more subcommands, shows the built-in help text for each subcommand. If used alone, it displays the general client help text.
- `--notice-ancestry` Pay attention to ancestry when calculating differences.
- `--incremental` Prints output in a format suitable for concatenation.
- `--message` (`-m`) *MESSAGE* Indicates that you will specify a commit message on the command line, following this switch. For example:
- ```
$ svn commit -m "They don't make Sunday."
```
- `--new` *ARG* Uses *ARG* as the newer target.
- `--no-auth-cache` Prevents caching of authentication information (e.g. username and password) in the Subversion administrative directories.
- `--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 `svn:ignore` property. See the section called “Config” for more information.
- `--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 of an automated script and it's more appropriate to have Subversion fail than to prompt for more information.
- `--non-recursive` (`-N`) 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.
- `--old` *ARG* Uses *ARG* as the older target.
- `--password` *PASS* Indicates that you are providing your password for authentication on the command line—otherwise, if it is needed, Subversion will prompt you for it.
- `--quiet` (`-q`) Requests that the client print only essential information while performing an operation.

- `--recursive (-R)` Makes a subcommand recurse into subdirectories. Most subcommands recurse by default.
- `--relocate FROM TO [HEAD]` Use 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.
- `--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, revision keywords or dates (in curly braces), as arguments to the revision switch. If you wish to provide 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 {12/04/01}:{2/17/02}
$ svn log -r 1729:{2/17/02}
```
- See the section called “Revision Keywords” for more information.
- `--revprop` Operates on a revision property instead of a Subversion property specific to a file or directory. This switch requires that you also pass a revision with the `--revision (-r)` switch. See the section called “Unversioned Properties” for more details on unversioned properties.
- `--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 run `svn update`.
- `--stop-on-copy` Causes a Subversion subcommand which is traversing 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 which is rather vague unless talking about specific subcommands.
- `--targets FILENAME` Tells Subversion to get the list of files that you wish to operate on from the filename you provide instead of listing all the files on the command line.
- `--username NAME` Indicates that you are providing your username for authentication on the command line—otherwise, if it is needed, Subversion will prompt you for it.
- `--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 not only includes 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.
- `--xml` Prints output in XML format.

svn Subcommands

Name

svn add -- Adds files and directories

svn add

Synopsis

svn add PATH...

Description

Adds files and directories to your working copy and schedules them 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

Switches

```
--targets FILENAME
--non-recursive (-N)
--quiet (-q)
```

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 --non-recursive otherdir
A      otherdir
```

Name

svn cat -- Outputs the contents of the specified files or URLs.

svn cat

Synopsis

svn cat TARGET...

Description

Outputs the contents of the specified files or URLs. For listing the contents of directories, see **svn list**.

Alternate Names

None

Changes

Nothing

Accesses Repository

Yes

Switches

```
--revision (-r) REV
--username USER
--password PASS
```

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.
```

Tip

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** will automatically fetch the HEAD revision when you give it a path:

```
$ cat foo.c  
This file is in my local working copy  
and has changes that I've made.
```

```
$ svn cat foo.c  
Latest revision fresh from the repository!
```


Name

svn checkout -- Checks out a working copy from a repository.

svn checkout

Synopsis

```
svn checkout URL... [PATH]
```

Description

Checks 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 sub-directory of *PATH*, with the name of the sub-directory being the basename of the URL.

Alternate Names

co

Changes

Creates a working copy.

Accesses Repository

Yes

Switches

```
--revision (-r) REV  
--quiet (-q)  
--non-recursive (-N)  
--username USER  
--password PASS  
--no-auth-cache  
--non-interactive
```

Examples

Check out a working copy into a directory called 'mine':

```
$ svn checkout file:///tmp/repos/test mine  
A mine/a  
A mine/b  
Checked out revision 2.  
$ ls  
mine
```

Check out 2 different directories into two separate working copies:

```
$ svn checkout file:///tmp/repos/test file:///tmp/repos/quiz
A test/a
A test/b
Checked out revision 2.
A quiz/l
A quiz/m
Checked out revision 2.
$ ls
quiz test
```

Check out 2 different directories into two separate working copies, but place both into a directory called 'working copies':

```
$ svn checkout file:///tmp/repos/test file:///tmp/repos/quiz working-copies
A working-copies/test/a
A working-copies/test/b
Checked out revision 2.
A working-copies/quiz/l
A working-copies/quiz/m
Checked out revision 2.
$ ls
working-copies
```

If you interrupt a checkout (or something else interrupts your checkout like 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:///tmp/repos/test test
A test/a
A test/b
^C
svn: The operation was interrupted
svn: caught SIGINT

$ svn checkout file:///tmp/repos/test test
A test/c
A test/d
^C
svn: The operation was interrupted
svn: caught SIGINT

$ cd test
$ svn update
A test/e
A test/f
Updated to revision 3.
```

Name

svn cleanup -- Recursively clean up the working copy.

svn cleanup

Synopsis

```
svn cleanup [PATH...]
```

Description

Recursively clean up the working copy, removing locks 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. See Appendix C, *Troubleshooting*.

Alternate Names

None

Changes

Working copy

Accesses Repository

No

Switches:

None

Examples

Well, there's not much to the examples here as **svn cleanup** generates no output. If you pass no PATH, '.' is used.

```
$ svn cleanup
```

```
$ svn cleanup /path/to/working-copy
```

Name

svn commit -- Send changes from your working copy to the repository.

svn commit

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` switch, **svn** will launch your editor for you to compose a commit message. See the `editor-cmd` section in the section called “Config”.

Tip

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 short for “checkout”)

Changes

Working copy, repository

Accesses Repository

Yes

Switches

```
--message (-m) TEXT
--file (-F) FILE
--quiet (-q)
--non-recursive (-N)
--targets FILENAME
--force-log
--username USER
--password PASS
--no-auth-cache
--non-interactive
--encoding ENC
```

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` switch:

```
$ 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.

svn copy

Synopsis

```
svn copy SRC DST
```

Description

Copy a file in a working copy or in the repository. 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.

Warning

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

If source or destination is in the repository, or if needed to look up the source revision number.

Switches

```
--message (-m) TEXT  
--file (-F) FILE  
--revision (-r) REV  
--quiet (-q)  
--username USER  
--password PASS
```

```
--no-auth-cache
--non-interactive
--force-log
--encoding ENC
```

Examples

Copy an item within your working copy (just 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 an item in your working copy to a URL in the repository (an immediate commit, so you must supply a commit message):

```
$ svn copy near.txt file:///tmp/repos/test/far-away.txt -m "Remote copy."
Committed revision 8.
```

Copy an item from the repository to your working copy (just schedules the copy—nothing goes into the repository until you commit):

Tip

This is the recommended way to resurrect a dead file in your repository!

```
$ svn copy file:///tmp/repos/test/far-away near-here
A      near-here
```

And finally, copying between two URLs:

```
$ svn copy file:///tmp/repos/test/far-away file:///tmp/repos/test/over-there -m "remote copy"
Committed revision 9.
```

Tip

This is the easiest way to 'tag' a revision in your repository—just **svn copy** that revision (usually HEAD) into your tags directory.

```
$ svn copy file:///tmp/repos/test/trunk file:///tmp/repos/test/tags/0.6.32-prerelease -m "tag"
Committed revision 12.
```

And don't worry if you forgot to tag—you can always specify an older revision and tag anytime:

```
$ svn copy -r 11 file:///tmp/repos/test/trunk file:///tmp/repos/test/tags/0.6.32-prereleas
```

```
Committed revision 13.
```


Name

svn delete -- Delete an item from a working copy or the repository.

svn delete

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. The command will not remove any unversioned or modified items; use the `--force` switch 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

Switches

```
--force
--force-log
--message (-m) TEXT
--file (-F) FILE
--quiet (-q)
--targets FILENAME
--username USER
--password PASS
--no-auth-cache
--non-interactive
--encoding ENC
```

Examples

Using **svn** to delete a file from your working copy merely schedules it to be deleted. 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:///tmp/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 -- Display the differences between two paths.

svn diff

Synopsis

```
svn diff [-r N[:M]] [TARGET...]
```

```
svn diff URL1[@N] URL2[@M]
```

Description

Display the differences between two paths. Each TARGET can be either a working copy path or URL. If no TARGET is specified, a value of '.' is assumed.

If TARGET is a URL, then revs N and M must be given via the `--revision`.

If TARGET is a working copy path, then the `--revision` switch means:

--revision N:M	The server compares TARGET@N and TARGET@M.
--revision N	The client compares TARGET@N against working copy.
(no --revision)	The client compares base and working copies of TARGET.

If the alternate syntax is used, the server compares URL1 and URL2 at revisions N and M respectively. If either N or M are omitted, a value of HEAD is assumed.

Alternate Names

di

Changes

Nothing

Accesses Repository

For obtaining differences against anything but BASE revision in your working copy

Switches

```
--revision (-r) REV  
--extensions (-x) "ARGS"  
--non-recursive (-N)  
--diff-cmd CMD  
--username USER
```

```
--password PASS
--no-auth-cache
--non-interactive
--no-diff-deleted
```

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 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 (you only pass 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)
```

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
>
```

Name

svn export -- Exports a clean directory tree.

svn export

Synopsis

```
svn export [-r REV] URL [PATH]
```

```
svn export PATH1 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

Switches

```
--revision (-r) REV  
--quiet (-q)  
--username USER  
--password PASS  
--no-auth-cache  
--non-interactive
```

Examples

Export from your working copy (doesn't print every file and directory):

```
$ svn export a-wc my-export
```

pantheon: /tmp>

Export directly from the repository (prints every file and directory):

```
$ svn export file:///tmp/repos my-export
A my-export/test
A my-export/quiz
...
Exported revision 15.
```

Name

svn help -- Help!

svn 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

Changes

Nothing

Accesses Repository

No

Switches

--version
--quiet (-q)

Name

svn import -- Recursively commit a copy of PATH to URL.

svn import

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.

Alternate Names

None

Changes

Repository

Accesses Repository

Yes

Switches

```
--message (-m) TEXT
--file (-F) FILE
--quiet (-q)
--non-recursive (-N)
--username USER
--password PASS
--no-auth-cache
--non-interactive
--force-log
--encoding ENC
```

Examples

This imports the local directory 'myproj' into the root of your repository:

```
$ svn import -m "New import" myproj http://svn.red-bean.com/repos/test
Adding          myproj/sample.txt
...
Transmitting file data .....
```

Committed revision 16.

This imports the local directory 'myproj' into 'trunk/vendors' in your repository. The directory 'trunk/vendors' 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/test/trunk/vendors/myproj  
Adding      myproj/sample.txt  
...  
Transmitting file data .....  
Committed revision 19.
```

Name

svn info -- Print information about PATHs.

svn info

Synopsis

svn info [PATH...]

Description

Print information about paths in your working copy, including:

- Path
- Name
- URL
- Revision
- Node Kind
- Last Changed Author
- Last Changed Revision
- Last Changed Date
- Text Last Updated
- Properties Last Updated
- Checksum

Alternate Names

None

Changes

Nothing

Accesses Repository

No

Switches

```
--targets FILENAME
--recursive (-R)
```

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
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: /3L38YwzhT93BWvgpdF6Zw==
```

It will also show information for directories:

```
$ svn info vendors
Path: trunk
URL: http://svn.red-bean.com/repos/test/vendors
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)
```

Name

svn list -- List directory entries in the repository.

svn list

Synopsis

```
svn list [TARGET...]
```

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, the following fields show the status of the item:

- Revision number of the last commit
- Author of the last commit
- Size (in bytes)
- Date and time of the last commit

Alternate Names

ls

Changes

Nothing

Accesses Repository

Yes

Switches

```
--revision (-r) REV  
--verbose (-v)  
--recursive (-R)  
--username USER  
--password PASS  
--no-auth-cache  
--non-interactive
```

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/
...
```

Like UNIX `ls`, you can also pass the `--verbose` switch for additional information:

```
svn list --verbose file:///tmp/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/
```

For further details, see the section called “`svn list`”.

Name

`svn log --` Displays commit log messages.

`svn log`

Synopsis

```
svn log [PATH]
```

```
svn log URL [PATH...]
```

Description

The default target is the path of your current directory. If no arguments are supplied, **svn log** shows the log messages for all files and directories inside of (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, then it prints log messages for everything that 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

Switches

```
--revision (-r) REV  
--quiet (-q)  
--verbose (-v)  
--targets FILENAME  
--username USER  
--password PASS  
--no-auth-cache
```

```
--non-interactive
--stop-on-copy
--incremental
--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 16:43:13 -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 16:43:13 -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 16:43:13 -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  
...
```

That is the same as explicitly placing both URLs on the command line:

```
$ svn log http://svn.red-bean.com/repos/test/foo.c \  
          http://svn.red-bean.com/repos/test/bar.c  
...
```

When you're concatenating the results of multiple calls to the log command, you may want to use the `-incremental` switch. **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 2 non-sequential 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 switch:

```
$ 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` switch provides similar output control when using the `--xml` switch.

Tip

If you run `svn log` on a specific path and provide a specific revision and get no output at all

```
$ svn log -r 20 http://svn.red-bean.com/untouched.txt  
-----
```

That just means that the path was not modified in that revision. If you log from the top of the repository, or know the file that changed in that revision, you can specify it explicitly:

```
$ 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.

svn merge

Synopsis

```
svn merge sourceURL1[@N] sourceURL2[@M] [WCPATH]
```

```
svn merge -r N:M SOURCE [PATH]
```

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, SOURCE can be a URL or working copy item, in which case the corresponding URL is used. This URL, at revisions N and M, defines the two sources to be compared.

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 which case, the differences will be applied to that file.

Alternate Names

None

Changes

Working copy

Accesses Repository

Only if working with URLs

Switches

```
--revision (-r) REV  
--non-recursive (-N)  
--quiet (-q)  
--force  
--dry-run  
--username USER  
--password PASS  
--no-auth-cache  
--non-interactive
```

Examples

Merge a branch back into the trunk (assuming that you have a working copy of the trunk):

```
$ svn merge http://svn.red-bean.com/repos/trunk/vendors \  
            http://svn.red-bean.com/repos/branches/vendors-with-fix  
U myproj/tiny.txt  
U myproj/thhgttg.txt  
U myproj/win.txt  
U myproj/flo.txt
```

If you branched at revision 23, and you want to merge changes on trunk into your branch, you could do this from inside the working copy of your branch:

```
$ svn merge -r 23:30 file:///tmp/repos/trunk/vendors  
U myproj/thhgttg.txt  
...
```

To merge changes to a single file:

```
$ cd myproj  
$ svn merge -r 30:31 thhgttg.txt  
U thhgttg.txt
```

Name

svn mkdir -- Create a new directory under version control.

svn mkdir

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.

Alternate Names

None

Changes

Working copy, repository if operating on a URL

Accesses Repository

Only if operating on a URL

Switches

```
--message (-m) TEXT  
--file (-F) FILE  
--quiet (-q)  
--username USER  
--password PASS  
--no-auth-cache  
--non-interactive  
--encoding ENC  
--force-log
```

Examples

Create a directory in your working copy:

```
$ svn mkdir newdir
A      newdir
```

Create one in the repository (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.

svn move

Synopsis

svn move SRC DST

Description

This command moves a file or directory in your working copy or in the repository.

Tip

This command is equivalent to an **svn copy** followed by **svn delete**.

Warning

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.

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

Switches

```
--message (-m) TEXT
--file (-F) FILE
--revision (-r) REV
--quiet (-q)
--force
--username USER
--password PASS
--no-auth-cache
```

```
--non-interactive  
--encoding ENC  
--force-log
```

Examples

Move a file in your working copy:

```
$ svn move foo.c bar.c  
A      bar.c  
D      foo.c
```

Move a file in the repository (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.

svn propdel

Synopsis

```
svn propdel PROPNAME [PATH...]
```

```
svn propdel PROPNAME --revprop -r REV [URL]
```

Description

This removes properties from files, directories, or revisions. The first form removes versioned properties in working copy, while the second removes unversioned remote properties on a repository revision.

Alternate Names

pdel, pd

Changes

Working copy, repository only if operating on a URL

Accesses Repository

Only if operating on a URL

Switches

```
--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.

svn propedit

Synopsis

```
svn propedit PROPNAME PATH...
```

```
svn propedit PROPNAME --revprop -r REV [URL]
```

Description

Edits one or more properties using your favorite editor. The first form edits versioned properties in your working copy, while the second edits unversioned remote properties on a repository revision.

Alternate Names

pedit, pe

Changes

Working copy, repository only if operating on a URL

Accesses Repository

Only if operating on a URL

Switches

```
--revision (-r) REV
--revprop
--encoding ENC
```

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 -- Prints the value of a property.

svn propget

Synopsis

```
svn propget PROPNAME [PATH...]
```

```
svn propget PROPNAME --revprop -r REV [URL]
```

Description

Prints 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, while the second prints unversioned remote property on a repository revision. See the section called “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

Switches

```
--recursive (-R)  
--revision (-r) REV  
--revprop
```

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.
```

Name

svn proplist -- Lists all properties.

svn proplist

Synopsis

```
svn proplist [PATH...]
```

```
svn proplist --revprop -r REV [URL]
```

Description

Lists all properties on files, directories, or revisions. The first form lists versioned properties in working copy, while the second lists unversioned remote properties on a repository revision.

Alternate Names

plist, pl

Changes

Working copy, repository only if operating on a URL

Accesses Repository

Only if operating on a URL

Switches

```
--verbose (-v)
--recursive (-R)
--revision (-r) REV
--revprop
```

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
```

Name

svn propset -- Set PROPNAME to PROPVAL on files, directories, or revisions.

svn propset

Synopsis

```
svn propset PROPNAME [PROPVAL | -F VALFILE] PATH...
```

```
svn propset PROPNAME --revprop -r REV [PROPVAL | -F VALFILE] [URL]
```

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.

Tip

Subversion has a number of “special” properties that affect its behavior. See the section called “Special properties” 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

Switches

```
--file (-F) FILE
--quiet (-q)
--revision (-r) REV
--targets FILENAME
--recursive (-R)
--revprop
--encoding ENC
```

Examples

Set the mimetype on 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'
```

Warning

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 the section called “Hook Scripts” for more information on hook scripts.

Name

svn resolved -- Remove “conflicted” state on working copy files or directories.

svn resolved

Synopsis

svn resolved PATH...

Description

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 the section called “Resolve Conflicts (Merging Others' Changes)” for an in-depth look at resolving conflicts.

Alternate Names

None

Changes

Working copy

Accesses Repository

No

Switches

```
--targets FILENAME
--recursive (-R)
--quiet (-q)
```

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.

Warning

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.

svn revert

Synopsis

svn revert PATH...

Description

Reverts any local changes to a file or directory and resolves any conflicted states. **svn revert** will not only revert 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 done (e.g. files scheduled for addition or deletion can be “unscheduled”).

Alternate Names

None

Changes

Working copy

Accesses Repository

No

Switches

```
--targets FILENAME
--recursive (-R)
--quiet (-q)
```

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 `--recursive` flag:

```
$ svn revert --recursive .
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
```

Warning

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.

`svn status`

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`, add working revision and server out-of-date information. With `-verbose`, print full revision information on every item.

The first five 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.
- 'C' Item is in conflict with updates received from the repository.
- '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 a directory, but has been replaced by a file, or vice versa

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.

- ' ' 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 the section called “Switching a Working Copy”).

' ' Item is child of its parent directory.

'S' Item is switched.

The out-of-date information appears in the eighth column (only if you pass the `--show-updates` switch).

' ' 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` switches are passed.

If the `--verbose` switch 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`

Switches

```
--show-updates (-u)
--verbose (-v)
--non-recursive (-N)
--quiet (-q)
--username USER
--password PASS
```

```
--no-auth-cache
--non-interactive
--no-ignore
```

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` switch (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
Head revision: 981
```

Warning

`--show-updates` *only* places an asterisk next to items that are out of date (that is, items that will be updated from the repository if you run **svn update**). `--show-updates` does *not* cause the status listing to reflect the repository's version of the item.

And finally, the most information you can get out of the status subcommand:

```
$ 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
```

For many more examples of **svn status**, see the section called “svn status”.

Name

svn switch -- Update working copy to a different URL.

svn switch

Synopsis

```
svn switch URL [PATH]
```

Description

This subcommand updates your working copy to mirror a new URL—usually a URL which 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. See the section called “Switching a Working Copy” for an in-depth look at switching.

Alternate Names

sw

Changes

Working copy

Accesses Repository

Yes

Switches

```
--revision (-r) REV  
--non-recursive (-N)  
--quiet (-q)  
--diff3-cmd CMD  
--relocate  
--username USER  
--password PASS  
--no-auth-cache  
--non-interactive
```

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.
```

And 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.
```

Tip

You can just switch part of your working copy to a branch if you don't want to switch your entire working copy.

If the location of your repository changes and you have an existing working copy that you'd like to continue to use, you can use **svn switch --relocate** to change your working copy from one URL to another:

```
$ svn checkout file:///tmp/repos test
A test/a
A test/b
...

$ mv repos newlocation
$ cd test/

$ svn update
svn: Couldn't open a repository.
svn: Unable to open an ra_local session to URL
svn: Unable to open repository 'file:///tmp/repos'

$ svn switch --relocate file:///tmp/repos file:///tmp/newlocation .
$ svn update
At revision 3.
```

Name

svn update -- Updates your working copy.

svn update

Synopsis

```
svn update [PATH...]
```

Description

svn update brings changes from the repository into your working copy. If no revision 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` switch.

For each updated item a line will start with a character reporting the action taken. These characters have the following meaning:

A Added

D Deleted

U Updated

C Conflict

M Merged

A character in the first column signifies an update to the actual file, while updates to the file's properties are shown in the second column.

Alternate Names

up

Changes

Working copy

Accesses Repository

Yes

Switches

```
--revision (-r) REV  
--non-recursive (-N)  
--quiet (-q)  
--username USER
```

```
--password PASS
--no-auth-cache
--non-interactive
```

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 Appendix A, *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.
```

Tip

If you want to examine an older revision of a single file, you may want to use **svn cat**.

svnadmin

svnadmin is the administrative tool for monitoring and repairing your Subversion repository. For detailed information, see the section called “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 Switches

<code>--bypass-hooks</code>	Bypass the repository hook system.
<code>--copies</code>	Follow copy history when examining a path.
<code>--in-repos-template</code>	Specify a template for the repository structure when creating a new repository.

The “in-repository” templates specify the layout of the repository itself (which lives in Berkeley DB files inside the db/ directory) like /trunk, /branches, etc. These templates can be used by an administrator or application to do an initial load of the repository (without invoking hooks). There is no default; the repository is built “empty” unless

you tell it otherwise.

`--incremental` Dump a revision only as a diff against the previous revision, instead of the usual full-text.

`--on-disk-template` *TEMPLATE* Specify a template to use for the on-disk structure (i.e. `conf/`, `hooks/`, etc.) of the repository you want to create.

The “on-disk” templates describe the repository directory itself. Each of the templates have a name, and the “default” on-disk template contains:

- `default/`
- `README.txt`
- `dav/`
- `format`
- `hooks/`
- `post-commit.tmpl`
- `post-revprop-change.tmpl`
- `pre-commit.tmpl`
- `pre-revprop-change.tmpl`
- `start-commit.tmpl`
- `locks/`
- `db.lock`

The typical usage for the on-disk structures is to predefine the hook scripts that will be created. For example, you could prepopulate the `post-commit` script with a commit mailer and backup script. Then, each time the administrator creates a new repository, she can refer to this new template which automagically includes all of the hooks.

`--revision (-r) ARG` Specify a particular revision to operate on.

svnadmin Subcommands

Name

svnadmin list-unused-dblogs -- Ask Berkeley DB which log files can be safely deleted.

svnadmin list-unused-dblogs

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. Over time, the log files accumulate, although most are no longer used and can be deleted to reclaim disk space. See the section called “Berkeley DB Utilities” for more information.

Examples

Remove all unused log files from a repository:

```
$ svnadmin list-unused-dblogs /path/to/repos  
/path/to/repos/log.0000000031  
/path/to/repos/log.0000000032  
/path/to/repos/log.0000000033
```

```
$ svnadmin list-unused-dblogs /path/to/repos | xargs rm  
## disk space reclaimed!
```

Name

svnadmin create -- Create a new, empty repository at REPOS_PATH.

svnadmin create

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.

Switches

```
--on-disk-template arg  
--in-repos-template arg
```

Examples

Creating a new repository is just this easy:

```
$ svnadmin create /usr/local/svn/repos
```

Name

svnadmin dump -- Dump the contents of filesystem to stdout.

svnadmin dump

Synopsis

```
svnadmin dump REPOS_PATH [-r LOWER[:UPPER]] [--incremental]
```

Description

Dump the contents of filesystem to stdout in a 'dumpfile' 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 the section called “Migrating a Repository” for a practical use.

Switches

```
--revision (-r)  
--incremental
```

Examples

Dump your whole repository:

```
$ svnadmin dump /usr/local/svn/repos  
SVN-fs-dump-format-version: 1  
Revision-number: 0  
* Dumped revision 0.  
Prop-content-length: 56  
Content-length: 56  
...
```

Incrementally dump a single transaction from your repository:

```
$ svnadmin dump /usr/local/svn/repos -r 21 --incremental  
* Dumped revision 21.  
SVN-fs-dump-format-version: 1  
Revision-number: 21  
Prop-content-length: 101  
Content-length: 101  
...
```


Name

svnadmin help

svnadmin 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.

Name

svnadmin load -- Read a “dumpfile-formatted” stream from stdin.

svnadmin load

Synopsis

```
svnadmin load REPOS_PATH
```

Description

Read a “dumpfile”-formatted stream from stdin, committing new revisions into the repository's filesystem. Send progress feedback to stdout.

Example

This shows the beginning of loading a repository from a backup file (made, of course, with **svn dump**):

```
$ svnadmin load /usr/local/svn/restored < repos-backup
<<< Started new txn, based on original revision 1
    * adding path : test ... done.
    * adding path : test/a ... done.
...
```

Name

svnadmin lstxns -- Print the names of all uncommitted transactions.

```
svnadmin lstxns
```

Synopsis

```
svnadmin lstxns REPOS_PATH
```

Description

Print the names of all uncommitted transactions. See the section called “Repository Cleanup” 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 /usr/local/svn/repos/  
1w  
1x
```

Name

svnadmin recover -- Recovers any lost state in a repository.

svnadmin recover

Synopsis

```
svnadmin recover REPOS_PATH
```

Description

Run this command if you get an error indicating that your repository needs to be recovered.

Warning

Only run this when you are *absolutely certain* you're the only process accessing the repository—it requires exclusive access. See the section called “Repository Recovery” for a detailed explanation of repository recovery.

Examples

Recover a hung repository:

```
$ svnadmin recover /usr/local/svn/repos/  
Acquiring exclusive lock on repository db.  
Recovery is running, please stand by...  
Recovery completed.  
The latest repos revision is 34.
```

Name

svnadmin rmtxns -- Deletes transactions from a repository.

svnadmin rmtxns

Synopsis

```
svnadmin rmtxns REPOS_PATH TXN_NAME...
```

Description

Deletes outstanding transactions from a repository. This is covered in detail in the section called “Repository Cleanup”

Examples

Remove named transactions:

```
$ svnadmin rmtxns /usr/local/svn/repos/ 1w 1x
```

Fortunately, the output of `svn lstxns` works great as the input for `rmtxns`:

```
$ svnadmin rmtxns /usr/local/svn/repos/ `svnadmin lstxns /usr/local/svn/repos/`
```

Which will remove all uncommitted transactions from your repository.

Name

svnadmin setlog -- Set the log-message on a revision.

svnadmin setlog

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 --revprop** 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.

Warning

Revision properties are not under version control, so this command will permanently overwrite the previous log message.

Switches

```
--revision (-r) ARG  
--bypass-hooks
```

Examples

Set the log message for revision 19 to the contents of the file 'msg':

```
$ svnadmin setlog /usr/local/svn/repos/ -r 19 msg
```

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 only be used 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 Switches

Switches in **svnlook** are global, just like in **svn** and **svnadmin**, however, most switches only apply to one subcommand since the functionality of **svnlook** is (intentionally) limited in scope.

- `--no-diff-deleted` Prevents **svnlook** 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.
- `--revision (-r)` Specify a particular revision number that you wish to examine.
- `--transaction (-t)` Specify a particular transaction id that you wish to examine.
- `--show-ids` Show the filesystem node revision IDs for each path in the filesystem tree.

svnlook Subcommands

Name

svnlook author -- Prints the author.

svnlook author

Synopsis

```
svnlook author REPOS_PATH
```

Description

Prints the author of a revision or transaction in the repository.

Switches

```
--revision (-r)  
--transaction (-t)
```

Examples

svnlook author is handy, but not very exciting:

```
$ svnlook author -r 40 /usr/local/svn/repos  
sally
```


Name

svnlook cat -- Print the contents of a file.

svnlook cat

Synopsis

```
svnlook cat REPOS_PATH PATH_IN_REPOS
```

Description

Print the contents of a file.

Switches

```
--revision (-r)
--transaction (-t)
```

Examples

This shows the contents of a file in transaction ax8, located at /trunk/README:

```
$ svnlook cat -t ax8 /usr/local/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.

svnlook changed

Synopsis

```
svnlook changed REPOS_PATH
```

Description

Print the paths that were changed in a particular revision or transaction, as well as an “svn update-style” status letter in the first column: A for added, D for deleted, and U for updated (modified).

Switches

```
--revision (-r)
--transaction (-t)
```

Examples

This shows a list of all the changed files in revision 39 of a test repository:

```
$ svnlook changed -r 39 /usr/local/svn/repos
A trunk/vendors/deli/
A trunk/vendors/deli/chips.txt
A trunk/vendors/deli/sandwich.txt
A trunk/vendors/deli/pickle.txt
```

Name

svnlook date -- Print the datestamp.

svnlook date

Synopsis

```
svnlook date REPOS_PATH
```

Description

Print the datestamp of a revision or transaction in a repository.

Switches

```
--revision (-r)  
--transaction (-t)
```

Examples

This shows the date of revision 40 of a test repository:

```
$ svnlook date -r 40 /tmp/repos/  
2003-02-22 17:44:49 -0600 (Sat, 22 Feb 2003)
```

Name

svnlook diff -- Prints differences of changed files and properties.

svnlook diff

Synopsis

```
svnlook diff REPOS_PATH
```

Description

Prints GNU-style differences of changed files and properties in a repository.

Switches

```
--revision (-r)
--transaction (-t)
--no-diff-deleted
```

Examples

This shows a newly added (empty) file, a deleted file, and a copied file:

```
$ svnlook diff -r 40 /usr/local/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!

Deleted: trunk/vendors/deli/chips.txt
=====

Deleted: trunk/vendors/deli/pickle.txt
=====
```

Name

svnlook dirs-changed -- Print the directories that were themselves changed.

svnlook dirs-changed

Synopsis

```
svnlook dirs-changed REPOS_PATH
```

Description

Print the directories that were themselves changed (property edits) or whose file children were changed.

Switches

```
--revision (-r)  
--transaction (-t)
```

Examples

This shows the directories that changed in revision 40 in our sample repository:

```
$ svnlook dirs-changed -r 40 /usr/local/svn/repos  
trunk/vendors/deli/
```

Name

svnlook help

svnlook 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.

Name

svnlook history -- Print information about the history of a path in the repository (or the root directory if no path is supplied).

svnlook history

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).

Switches

```
--revision (-r)
--show-ids
```

Examples

This shows the history output for the path /tags/1.0 as of revision 15 in our sample repository.

```
$ svnlook history -r 20 /usr/local/svn/repos /tags/1.0 --show-ids
REVISION  PATH <ID>
-----  -
      19  /tags/1.0 <1.2.12>
      17  /branches/1.0-rc2 <1.1.10>
      16  /branches/1.0-rc2 <1.1.x>
      14  /trunk <1.0.q>
      13  /trunk <1.0.o>
      11  /trunk <1.0.k>
       9  /trunk <1.0.g>
       8  /trunk <1.0.e>
       7  /trunk <1.0.b>
       6  /trunk <1.0.9>
       5  /trunk <1.0.7>
       4  /trunk <1.0.6>
       2  /trunk <1.0.3>
       1  /trunk <1.0.2>
```

Name

svnlook info -- Print the author, datestamp, log message size, and log message.

svnlook info

Synopsis

```
svnlook info REPOS_PATH
```

Description

Print the author, datestamp, log message size, and log message.

Switches

```
--revision (-r)  
--transaction (-t)
```

Examples

This shows the info output for revision 40 in our sample repository.

```
$ svnlook info -r 40 /usr/local/svn/repos  
sally  
2003-02-22 17:44:49 -0600 (Sat, 22 Feb 2003)  
15  
Rearrange lunch.
```


Name

svnlook log -- Print the log message.

svnlook log

Synopsis

```
svnlook log REPOS_PATH
```

Description

Print the log message.

Switches

```
--revision (-r)  
--transaction (-t)
```

Examples

This shows the log output for revision 40 in our sample repository:

```
$ svnlook log /tmp/repos/  
Rearrange lunch.
```

Name

svnlook proplist -- Print the names and values of versioned file and directory properties.

svnlook proplist

Synopsis

```
svnlook proplist REPOS_PATH PATH_IN_REPOS
```

Description

List the properties of a path in the repository. With `-v`, show the property values too.

Switches

```
--revision (-r)  
--transaction (-t)  
--verbose (-v)
```

Examples

This shows the names of properties set on the file `/trunk/README` in the HEAD revision:

```
$ svnlook proplist /usr/local/svn/repos /trunk/README  
original-author  
svn:mime-type
```

This is the same command as in the previous example, but this time showing the property values as well:

```
$ svnlook proplist /usr/local/svn/repos /trunk/README  
original-author : fitz  
svn:mime-type : text/plain
```

Name

svnlook tree -- Print the tree

svnlook 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.

Switches

```
--revision (-r)
--transaction (-t)
--show-ids
```

Examples

This shows the tree output (with node-IDs) for revision 40 in our sample repository:

```
$ svnlook tree -r 40 /usr/local/svn/repos --show-ids
/ <0.0.2j>
trunk/ <p.0.2j>
  vendors/ <q.0.2j>
    deli/ <1g.0.2j>
      egg.txt <1i.e.2j>
      soda.txt <1k.0.2j>
      sandwich.txt <1j.0.2j>
```

Name

svnlook youngest -- Print the youngest revision number.

svnlook youngest

Synopsis

```
svnlook youngest REPOS_PATH
```

Description

Print the youngest revision number of a repository.

Examples

This shows the youngest revision of our sample repository:

```
$ svnlook youngest /tmp/repos/  
42
```

Appendix A. 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 backreferences 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 uses RCS as a backend; 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”, they're 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.

For more details on this topic, see the section called “Revisions”.

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 rm** 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, because 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 the section called “The Limitations of Mixed Revisions”.

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 off-line:

svn status	Shows you any local changes you've made (see the section called “svn status”)
svn diff	Shows you the details of your changes (see the section called “svn diff”)
svn revert	Removes your local changes (see the section called “svn revert”)

Also, the cached pristine files allow the Subversion client to send differences when committing, which CVS cannot do.

The last subcommand in the list is new; it will not only remove local mods, but it will un-schedule operations such as adds and deletes. It's the preferred way to revert a file; running **rm file**; **svn update** will still work, but it blurs the purpose of updating. And, while we're on this subject...

Distinction Between Status and Update

In Subversion, we've tried to erase a lot of the confusion between the **cv status** and **cv update** commands.

The **cv 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 **cv up** to quickly see their mods. Of course, this has the side effect of merging repository changes that you may not be ready to deal with!

With Subversion, we've tried to remove this muddle by making the output of **svn status** easy to read for both humans and parsers. Also, **svn update** only prints information about files that are updated, *not* local modifications.

Here's a quick guide to **svn status**. We encourage all new Subversion users to use it early and often:

svn status Prints All Files That Have Local Modifications: The Network is not Accessed by Default

- u Add out-of-dateness information from repository.
- v Show *all* entries under version control.
- N Nonrecursive.

The 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)` switch, a longer output format is used:

```
% svn status -u
M      *      1047    ./foo.c
        *      1045    ./faces.html
        *      -      ./bloo.png
M      1050    ./bar/baz.c
Head 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 example above, 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 `-` next to `bloo.png` means that it doesn't yet exist in the working copy.)

Lastly, here's a quick summary of the most common status codes that you may 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 (comes from another
        repository. See the section called "svn:externals")
?      Resource is not under version control
!      Resource is missing or incomplete (removed by another tool than
        Subversion)
```

Subversion has combined the CVS **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 status`, see the section called “svn status”.

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 a CVS user will need to climb. Read all about it in Chapter 4, *Branching and Merging*

Meta-data Properties

A new feature of Subversion is that you can attach arbitrary metadata to files and directories. We refer to this data as *properties*, and they can be thought of as collections of arbitrary name/value pairs attached to each item 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 the section called “Properties”.

Conflict Resolution

CVS marks conflicts with in-line “conflict markers”, and prints a **C** during an update. 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 conflict-markers.

Subversion solves this problem by making conflicts more tangible. It remembers that a file is in a state of conflict, and won't allow you to commit your changes until you run **svn resolved**. See the section called “Resolve Conflicts (Merging Others' Changes)” for more details.

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. But internally, Subversion expresses differences between files using a binary-differencing algorithm, regardless of whether they contain textual or binary data. That means that all files are stored differentially (compressed) in the repository, and small differences are always sent over the network.

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 do so (see the section called “svn:keywords” and the section called “svn:eol-style” 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 that if somebody changes the definition of a module, then a call to **svn update** will update the working copy appropriately.

Subversion defines modules as a list of directories within a directory property: see the section called “Externals Definitions”.

Appendix B. CVS Repository Migration

Since Subversion aims to be the successor to CVS, it only makes sense to provide tools to help that migration. Subversion has a script that migrates data from a CVS repository to a Subversion repository. Yes, you *can* take your CVS history with you into the brave new world.

Requirements

The tool is called `cvs2svn.py`, and it's a python script that lives within Subversion's source tree in the `tools` subdirectory. In order to run this program, you need a couple of external things:

<code>python 2.0</code>	Make sure you have python 2.0 or later installed. You can get the latest from http://www.python.org/ .
<code>rcsparse.py</code>	This is a python module for parsing RCS files, and is part of the ViewCVS project. It's needed to read your CVS repository. For convenience, a copy is provided in the same directory as <code>cvs2svn.py</code> , although a more recent version may be available from the ViewCVS project— http://viewcvs.sf.net/ . Simply drop this module into a place where python can find it, somewhere like <code>/usr/local/lib/python2.2/</code> .

Running `cvs2svn.py`

Because CVS doesn't have atomic commits, `cvs2svn.py` has the difficult job of deducing them. It does this by examining RCS files and looking for per-file revisions with identical log messages. If two RCS revisions have the same log message, and were committed at nearly the same time (say, within a couple minutes of each other), then `cvs2svn.py` places them into a common change “group”, and commits the change-group to a new Subversion repository as a single revision.

The previous explanation is a bit of a simplification; there's much more bookkeeping to do than that. In fact, `cvs2svn.py` does its work in multiple “passes”, creating large amounts of temporary data on disk. If you interrupt the script, you can pass the `-p` option to script later on, indicating which pass to resume with.

Invoking the script is simple:

```
$ svnadmin create /new/svn/repos
$ cvs2svn.py -s /new/svn/repos /cvs/repos
...
```

The conversion take anywhere from several minutes to dozens of hours, depending on the size of your CVS repository. When run on Subversion's own CVS repository (the first year of Subversion's history, before it became self-hosting), it takes about 30 minutes, and commits about 3000 revisions to the Subversion repository.

Appendix C. Troubleshooting

Common Problems

There are a number of problems you may run into in the course of installing and using Subversion. Some of these will be resolved once you get a better idea of how Subversion does things, while others are caused because you're used to the way that other version control systems work. Still other problems might be unsolvable due to bugs in some of the operating systems that Subversion runs on (considering the wide array of OS'es that Subversion runs on, it's amazing that we don't encounter many more of these).

The following list has been compiled over the course of several years of Subversion usage, and they cover just about every frequently occurring problem that you'll see in Subversion—from building, to installing, to using Subversion. If you can't find the problem you're having here, or you've tried everything we recommend with no success, send mail to <users@subversion.tigris.org> with a detailed description of the problem you're having ⁴¹

Problems Using Subversion

- Every time I try to access my repository, **svn** just hangs.
- Every time I try to run **svn**, it says my working copy is locked.
- I'm getting errors finding or opening a repository, but I know my repository URL is correct.
- How can I specify a Windows drive letter in a `file://` URL?
- I'm having trouble doing write operations to a Subversion repository over a network.
- Under Windows XP, the Subversion server sometimes seems to send out corrupted data.
- What is the best method of doing a network trace of the conversation between a Subversion client and server?

Problems Building Subversion

- I just built the distribution binary, and when I try to check out Subversion, I get an error about an “Unrecognized URL scheme”.
- When I run **configure**, I get errors like `subs-1.sed line 38: Unterminated `s' command`.
- I'm having trouble building Subversion under Windows with MSVC++ 6.0.

Problems Using Subversion

Every Time I Try to Access My Repository, My Subversion Client Just Hangs.

Subversion uses Berkeley DB, which keeps your data in a series of database files. Berkeley DB is journaling system, meaning that it logs every action it is about to perform before it actually performs the action. If your client is inter-

⁴¹Remember that the amount of detail you provide about your setup and your problem is directly proportional to the likelihood of getting an answer from the mailing list. You're encouraged to include everything short of what you had for breakfast and your mother's maiden name.

rupted while in the process of talking to the database, then a lockfile is left behind in the database, along with a log file describing the unfinished actions.

Any other client that attempts to access the database will just hang, waiting for the lockfile to disappear. To awaken your repository, you need to tell Berkeley DB to either finish the work, or rewind the database to a previous state that is known to be consistent. To do this, run the following command from the machine that contains your Subversion Repository:

```
$ svnadmin recover /path/to/repos
```

Be sure that you disable all access to the repository before doing this (by shutting down httpd or svnserve). Make sure you run this command as the user that owns and manages the database, and not as root, else it will leave root-owned files in the `db/` directory which cannot be opened by the non-root user that manages the database, which is typically either you or your Apache httpd process.

Every Time I Try to Run svn, It Says My Working Copy is Locked.

Subversion's working copy, just like Berkeley DB, uses a journaling mechanism to perform all actions. That is, it logs everything it is about to do before it does so. If `svn` is interrupted while performing an action, then one or more lockfiles are left behind, along with log files describing then unfinished actions. (`svn status` will show an `L` next to locked directories.)

Any other process that attempts to access the working copy will fail when it sees the locks. To awaken your working copy, you need to tell the svn client to finish the work. To fix this, run this command from the top of your working copy:

```
$ svn cleanup working-copy
```

I'm Getting Errors Finding or Opening a Repository, but I Know My Repository URL is Correct.

See the section called “Every Time I Try to Access My Repository, My Subversion Client Just Hangs.”.

How can I specify a Windows drive letter in a file:// URL?

See Repository URLs.

I'm Having Trouble Doing Write Operations to a Subversion Repository over a Network

If import works fine over local access:

```
$ mkdir test
$ touch test/testfile
$ svn import test file:///var/svn/test -m "Initial import"
Adding          test/testfile
Transmitting file data .
Committed revision 1.
```

But not from a remote host:

```
$ svn import test http://svn.red-bean.com/test -m "Initial import"  
harry's password: xxxxxxxx
```

```
svn_error: #21110 :
```

```
The specified activity does not exist.
```

We've seen this when the `REPOS/dav/` directory is not writable by the `httpd` process. Check the permissions to ensure that Apache `httpd` can write to the `dav/` directory (and to the corresponding `db/` directory, of course).

Under Windows XP, the Subversion Server Sometimes Seems to Send Out Corrupted Data.

You need to install Window XP Service Pack 1. You can get all sorts of information about that Service Pack at <http://support.microsoft.com/default.aspx?scid=kb;EN-US;q317949> for details.

What is the Best Method of Doing a Network Trace of the Conversation Between a Subversion Client and Server?

Use Ethereal to eavesdrop on the conversation:

Note

The following instructions are specific to the graphical version of Ethereal, and may not apply to the command line version (whose binary is usually named **tethereal**).

- Pull down the Capture menu, and choose Start.
- Type port 80 for Filter, and turn off promiscuous mode.
- Run your Subversion client.
- Hit Stop. Now you have a capture. It looks like a huge list of lines.
- Click on the Protocol column to sort.
- Then, click on the first relevant TCP line to select it.
- Right click, and choose Follow TCP Stream. You'll be presented with the request/response pairs of the Subversion client's HTTP conversion.

Alternatively, you may set the `http-debug` parameter in the server's configuration file to cause neon's debugging output to appear when you run the `svn` client. The numeric value of `neon-debug` is a combination of the `NE_DBG_*` values in the header file `ne_utils.h`. Setting `http-debug` to 130 (i.e. `NE_DBG_HTTP + NE_DBG_HTTPBODY`) will cause the HTTP data to be shown.

You may well want to disable compression when doing a network trace, see the `compression` parameter in the config configuration file.

Problems Building Subversion

I Just Built the Distribution Binary, and When I Try to Check Out Subver-

tion, I Get an Error About an “Unrecognized URL Scheme”

Subversion uses a plugin system to allow access to repositories. Currently there are three of these plugins: `ra_local` allows access to a local repository, `ra_dav` which allows access to a repository via WebDAV, and `ra_svn` allows local or remote access via the `svnserve` server. When you attempt to perform an operation in Subversion, the client tries to dynamically load a plugin based on the URL scheme. A `file://` URL will try to load `ra_local`, an `http://` URL will try to load `ra_dav`, and so on.

The error you are seeing means that the dynamic linker/loader can't find the plugins to load. This normally happens when you build Subversion with shared libraries, then attempt to run it without first running `make install`. Another possible cause is that you ran `make install`, but the libraries were installed in a location that the dynamic linker/loader doesn't recognize. Under Linux, you can allow the linker/loader to find the libraries by adding the library directory to `/etc/ld.so.conf` and running `ldconfig`. If you don't wish to do this, or you don't have root access, you can also specify the library directory in the `LD_LIBRARY_PATH` environment variable.

When I Run `configure`, I Get Errors Like `subs-1.sed line 38: Unterminated `s' command`

You probably have old copies of `/usr/local/bin/apr-config` and `/usr/local/bin/apu-config` on your system. Remove them, make sure the `apr/` and `apr-util/` that you're building with are completely up-to-date, and try again.

I'm Having Trouble Building Subversion Under Windows with MSVC++ 6.0.

You need to get the latest platform SDK. The one that ships with VC++ 6.0 is not recent enough.

Appendix D. WebDAV and Autoversioning

WebDAV is an extension to HTTP, and is growing more and more popular as a standard for file-sharing. Today's operating systems are becoming extremely Web-aware, and many have now built-in support for mounting “shares” exported by WebDAV servers.

If you use Apache/mod_dav_svn as your Subversion network server, then 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.

Basic WebDAV Concepts

This section provides a very brief, very general overview to the ideas behind WebDAV. It should lay the foundation for understanding WebDAV compatibility issues between clients and servers.

Just Plain WebDAV

RFC 2518 defines a set of concepts and accompanying extension methods to HTTP 1.1 that make the web into 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 WebDAV “shares” that behave much like NFS or SMB shares.

However, it's important to note that RFC 2518 does *not* provide any sort of model for version control, despite the “V” in DAV. Basic WebDAV clients and servers assume only one version of each file or directory exists, and can be repeatedly overwritten. ⁴²

Here are the new concepts and methods introduced in basic WebDAV:

New write methods	Beyond the standard HTTP PUT method (which creates or overwrites a web resource), WebDAV defines new COPY and MOVE methods for duplicating or rearranging resources.
Collections	This is simply the WebDAV term for a grouping of resources (URIs). In most cases, it is analogous to a “directory”. You can tell something is a collection if it ends with a trailing “/”. Whereas file resources can be written or created with a PUT method, collection resources are created with the new MKCOL method.
Properties	This is same idea present in Subversion—metadata attached to files and collections. A client can list or retrieve properties attached to a resource with the new PROPFIND method, and can change them with the PROPPATCH method. Some properties are wholly created and controlled by users (e.g. a property called “color”), and others are wholly created and controlled by the WebDAV server (e.g. a property that contains the last modification time of a file). The former kind are called “dead” properties, and the latter kind are called “live” properties.
Locking	A WebDAV server may decide to offer a locking feature to clients—this part of the specification is optional, although most WebDAV servers do offer the feature. If present, then clients can use the new LOCK and UNLOCK methods to mediate access to a resource. In most cases these methods are used to create exclusive write locks (as discussed in the section called “The Lock-Modify-Unlock Solution”), although shared write locks are also possible.

DeltaV Extensions

⁴²For this reason, some people jokingly refer to generic WebDAV clients as “WebDA” clients!

Because RFC 2518 left out versioning concepts, another capable group was left with the responsibility of writing RFC 3253, which adds versioning to WebDAV. WebDAV/DeltaV clients and servers are often called just “DeltaV” clients and servers, since DeltaV implies the existence of basic WebDAV.

DeltaV introduces a whole slew of new acronyms, but don't be intimidated. The ideas are fairly straightforward. Here are the new concepts and methods introduced in DeltaV:

- Per-resource versioning Like CVS and other version-control systems, DeltaV assumes that each resource has a potentially infinite number of states. A client begins by placing a resource under version control using the new `VERSION-CONTROL` method. This creates a new Version Controlled Resource (VCR). Every time you change the VCR (via `PUT`, `PROPPATCH`, etc.), a new state of the resource is created, called a Version Resource (VR). VCRs and VRs are still ordinary web resources, defined by URLs. Specific VRs can have human-friendly names as well.
- Server-side working-copy mode Some DeltaV servers support the ability to create a virtual “workspace” on the server, where all of your work is performed. Clients use the `MKWORKSPACE` method to create a private area, then indicate they want to change specific VCRs by “checking them out” into the workspace, editing them, and “checking them in” again. In HTTP terms, the sequence of methods would be `CHECKOUT`, `PUT`, `CHECKIN`. After each `CHECKIN`, a new VR is created, and edited VCR's contents now “point to” the latest VR. Each VCR has also has a “history” resource which tracks and orders its various VR states.
- Client-side working-copy mode Some DeltaV servers also support the idea that the client may have a private working copy full of specific VRs. (This is how CVS and Subversion work.) When the client wants to commit changes to the server, it begins by creating a temporary server transaction (called an activity) with the `MKACTIVITY` method. The client then performs a `CHECKOUT` on each VR it wishes to change, which creates a number of temporary “working resources” in the activity, that can be modified using `PUT` and `PROPPATCH` methods. Finally, the client performs a `CHECKIN` on each working resource, which creates a new VR within each VCR, and the entire activity is deleted.
- Configurations DeltaV allows you define flexible collections of VCRs called “configurations”, which don't necessarily respond to particular directories. Each VCR's contents can be made to point to a specific VR using the `UPDATE` method. Once the configuration is perfect, the client can create a “snapshot” of the whole configuration, called a “baseline”. Clients use the `CHECKOUT` and `CHECKIN` methods to capture specific states of configurations, much like they use these methods to create specific VR states of VCRs.
- Extensibility DeltaV defines a new method, `REPORT`, which allows the client and server to perform customized data exchanges. The client sends a `REPORT` request with a properly-labeled XML body full of custom data; assuming the server understands the specific report-type, it responds with an equally custom XML body. This technique is very similar to XML-RPC.
- Autoversioning For many, this is the “killer” feature of DeltaV. If the DeltaV server supports this feature, then basic WebDAV clients (i.e. those unaware of versioning) can still write to the server, and the server will silently perform versioning anyway. In the simplest example, an ignorant `PUT` from a basic WebDAV client might be translated by the server as a `CHECKOUT`, `PUT`, `CHECKIN`.

Subversion and DeltaV

So how “compatible” is Subversion with other DeltaV software? In two words: not very. At least not yet, not in Sub-

version 1.0.

While `libsvn_ra_dav` sends DeltaV requests to the server, the Subversion client is *not* a general-purpose DeltaV client. In fact, it expects some custom features from the server (especially through custom `REPORT` requests). Further, `mod_dav_svn` is *not* a general-purpose DeltaV server. It only implements a strict subset of the DeltaV specification. A more general WebDAV or DeltaV client may very well be able to interoperate against it, but only if that client operates within the narrow confines of those features that the server has implemented. The Subversion development team plans to address general WebDAV interoperability in a future release of Subversion.

Mapping Subversion to DeltaV

Here is a very “high-level” description of how various Subversion client operations use DeltaV. In many cases, these explanations are gross oversimplifications. They should *not* be taken as a substitute for reading Subversion's source code or talking with its developers.

<code>svn checkout/list</code>	Perform a <code>PROPFIND</code> of depth 1 on the collection to get a list of immediate children. Perform a <code>GET</code> (and possibly a <code>PROPFIND</code>) on each child. Recurse into collections and repeat.
<code>svn commit</code>	Create an activity with <code>MKACTIVITY</code> , and do a <code>CHECKOUT</code> of each changed item, followed by a <code>PUT</code> of new data. Finally, a <code>MERGE</code> request causes an implicit <code>CHECKIN</code> of all working resources.
<code>svn update/switch/status/merge</code>	Send a custom <code>REPORT</code> request that describes the mixed-revision (and mixed-url) state of the working copy. The server sends a custom response that describes which items need updating. The client loops over the response, performing <code>GET</code> and <code>PROPFIND</code> requests as needed. For updates and switches, install the new data in the working copy. For <code>diff</code> and <code>merge</code> commands, compare the data to the working copy, possibly applying changes as local modifications.

Autoversioning Support

At the time of writing, the truth is that there are very few DeltaV clients in the world; RFC 3253 is still relatively new. However users do have access to “generic” clients, because almost every modern operating system now has an integrated basic WebDAV client. With this in mind, Subversion developers realized that if Subversion 1.0 was to have *any* interoperability features, support for DeltaV autoversioning would be the best approach.

To activate autoversioning in `mod_dav_svn`, use the `SVNAutoversioning` directive within the `httpd.conf` `Location` block, like so:

```
<Location /repos>
  DAV svn
  SVNPath /absolute/path/to/repository
  SVNAutoversioning on
</Location>
```

Normally, if a generic WebDAV client attempted a `PUT` to a path within your repository location, `mod_dav_svn` would outright reject the request. (It normally only allows such operations on “working resources” within DeltaV “activities”.) With `SVNAutoversioning` turned on, however, the server interprets the `PUT` request as an internal `MKACTIVITY`, `CHECKOUT`, `PUT`, and `CHECKIN`. A generic log message is auto-generated, and a new filesystem revision is created.

Because so many operating systems already have integrated WebDAV abilities, the use-case for this feature borders on fantastical: imagine an office of ordinary users running Microsoft Windows or Mac OS. Each computer “mounts” the Subversion repository, which appears to be an ordinary network share. They use the server as they always do:

open files from the server, edit them, and save them back to the server. But in this fantasy, the server is automatically versioning everything. Later on, a sysadmin can use a Subversion client to search and retrieve all older versions.

Is this fantasy real? Not quite. The main snag is that Subversion 1.0 has no support whatsoever for the WebDAV LOCK or UNLOCK methods. Most operating system DAV clients attempt to LOCK a resource opened directly from a DAV-mounted network share. For now, users may have to copy a file from the DAV share to local disk, edit the file, then copy it back again. Not ideal autoversioning, but still doable.

The mod_dav_lock Alternative

The mod_dav Apache module is a complex beast: it understands and parses all of the WebDAV and DeltaV methods, yet it depends on a back-end “provider” to access the resources themselves.

In its simplest incarnation, a user can use mod_dav_fs as a provider for mod_dav. mod_dav_fs uses the ordinary filesystem to store files and directories, and only understands vanilla WebDAV methods, not DeltaV.

Subversion, on the other hand, uses mod_dav_svn as a provider for mod_dav. mod_dav_svn understands all WebDAV methods except LOCK, and understands a sizable subset of DeltaV methods. It accesses data in the Subversion repository, rather than in the real filesystem. Subversion 1.0 doesn't support locking, because it would actually quite difficult to implement, since Subversion uses the copy-modify-merge model.⁴³

In Apache httpd-2.0, mod_dav supports the LOCK method by tracking locks in a private database, assuming that the provider is willing to accept them. In Apache httpd-2.1 or later, however, this locking support has been broken into an independent module, mod_dav_lock. It allows any mod_dav provider to take advantage of the lock database, including mod_dav_svn, even though mod_dav_svn doesn't actually understand locking.

Confused yet?

In a nutshell, you can use mod_dav_lock in Apache httpd-2.1 (or later) to create the *illusion* that mod_dav_svn is honoring LOCK requests. Make sure mod_dav_lock is either compiled into httpd, or being loaded in your httpd.conf. Then simply add the DavGenericLockDB directive to your Location like so:

```
<Location /repos>
  DAV svn
  SVNPath /absolute/path/to/repository
  SVNAutoversioning on
  DavGenericLockDB /path/to/store/locks
</Location>
```

This technique is a risky business; in some sense, the mod_dav_svn is now lying to the WebDAV client. It claims to accept the LOCK request, but in reality the lock isn't being enforced at all levels. If a second WebDAV client attempts to LOCK the same resource, then mod_dav_lock will notice and correctly deny the request. But there's absolutely nothing preventing an ordinary Subversion client from changing the file via a normal **svn commit!** If you use this technique, you're giving users the opportunity to stomp on each others' changes. In particular, a WebDAV client might accidentally overwrite a change committed by regular svn client.

On the other hand, if you set up your environment very carefully, you may mitigate the risk. For example, if *all* of your users are working though basic WebDAV clients (rather than svn clients), then things should be fine.

Autoversioning Interoperability

In this section, we'll describe the most common generic WebDAV clients (at the time of writing), and how well they

⁴³Subversion may someday develop a reserved-checkout locking model that can live peaceably with copy-modify-merge, but it probably won't happen soon.

operate against a `mod_dav_svn` server using the `SVNAutoversioning` directive. RFC 2518 is a bit large, and perhaps a bit too flexible. Every WebDAV client behaves slightly differently, and creates slightly different problems.

Win32 WebFolders

Windows 98, 2000, and XP have an integrated WebDAV client known as “WebFolders”. On Windows 98, the feature might need to be explicitly installed; if present, a “WebFolders” directory appears directly within My Computer. On Windows 2000 and XP, simply open My Network Places, and run the Add Network Place icon. When prompted, enter the WebDAV URL. The shared folder will appear within My Network Places.

Most write operations work fine against an autoversioning `mod_dav_svn` server, but there are few problems:

- If the computer is a member of an NT Domain, then it seems to be unable to connect to the WebDAV share. It repeatedly asks for a name and password, even when the Apache server isn't issuing an authentication challenge! Some have speculated that this might happen because WebFolders is specifically designed to operate against Microsoft's SharePoint DAV server. If the machine isn't part of an NT Domain, then the share is mounted without a problem. This mystery is not yet solved.
- A file can't be opened for direct editing from the share; it always comes up read-only. The `mod_dav_lock` technique doesn't help, because WebFolders doesn't use the `LOCK` method at all. The previously mentioned “copy, edit, re-copy” method does work, however. The file on the share can be successfully overwritten by a locally edited copy.

Mac OS X

Apple's OS X operating system has an integrated WebDAV client. From the Finder, select the “Connect to Server” item from the Go menu. Enter a WebDAV URL, and it appears as a disk on the desktop, just like any file server.⁴⁴

Unfortunately, this client refuses to work against an autoversioning `mod_dav_svn` because of its lack of `LOCK` support. Mac OS X discovers the missing `LOCK` ability during the initial `HTTP OPTIONS` feature exchange, and thus decides to mount the Subversion repository as a read-only share. After that, no write operations are possible at all. In order to mount the repository as a read-write share, you *must* use the `mod_dav_lock` trick discussed previously. Once locking seems to work, the share behaves very nicely: files can be opened directly in read/write mode, although each save operation will cause the client to do a `PUT` to a temporary location, a `DELETE` of original file, and a `MOVE` of the temporary resource to the original filename. That's three new Subversion revisions per save!

One more word of warning: OS X's WebDAV client can be overly sensitive to HTTP redirects. If you're unable to mount the repository at all, you may need to enable the `BrowserMatch` directive in your `httpd.conf`:

```
BrowserMatch "^WebDAVFS/1.[012]" redirect-carefully
```

Unix: Nautilus 2

Nautilus is the official file manager/browser for the GNOME desktop. Its main home page is at <http://www.gnome.org/projects/nautilus/>. By simply typing a WebDAV URL into the Nautilus window, the DAV share appears like a local filesystem.

In general, Nautilus 2 works reasonably well against an autoversioning `mod_dav_svn`, with the following caveats:

- Any files opened directly from the share are treated as read-only. Even the `mod_dav_lock` trick seems to have no effect. It seems that Nautilus never issues the `LOCK` method at all. The “copy locally, edit, copy back” trick does

⁴⁴Unix users can also run `mount -t webdav URL /mountpoint`.

work, however. Unfortunately, Nautilus overwrites the old file by issuing a DELETE first, which creates an extra revision.

- When overwriting or creating a file, Nautilus first does a PUT of an empty file, then overwrites it with a second PUT. This creates two Subversion filesystem revisions, rather than one.
- When deleting a collection, it issues an HTTP DELETE on each individual child instead of on the collection itself. This creates a whole bunch of new revisions.

Linux davfs2

Linux davfs2 is a filesystem module for the Linux kernel, whose development is located at <http://dav.sourceforge.net/>. Once installed, a WebDAV network share can be mounted with the usual Linux **mount** command.

The word on the street is that this DAV client doesn't work at all with mod_dav_svn's autoversioning. Every single attempt to write to the server is preceded by a LOCK request, which mod_dav_svn doesn't support. At this time, there is no data indicating whether the use of mod_dav_lock resolves this problem.

Appendix E. Other Subversion Clients

Out of One, Many

The Subversion command line client, `svn`, is the official⁴⁵ implementation of a Subversion client. Fortunately for those interested in developing additional Subversion clients, Subversion is implemented as a series of libraries. These libraries are accessible via C API, as well as other languages (see the section called “Using Languages Other than C and C++”).

This component design means that it's easy (well, at least *easier*) to write clients and utilities using these libraries. As a result, even pre-1.0, there are a number of GUI clients available for Subversion, each in various phases of development.

Table E.1. GUI Clients for Subversion

name	Language	Portable	License	URL
RapidSVN	C++	Yes, native widgets	Apache-style	http://rapidsvn.tigris.org/
gsvn	Python	Unix only, non-native widgets	GPL	http://gsvn.tigris.org/
TortoiseSVN	C++	Win32 only	GPL	http://tortoissvn.tigris.org/
svnup	Java, JNI bindings	Yes	Apache-style	http://svnup.tigris.org/
jsvn	Java, wrapping the svn command-line client	Yes	Academic Free License	http://jsvn.alternatecomputing.com

⁴⁵Because we says so, that's why.

Appendix F. Third Party Tools

Subversion's modular design (covered in the section called “Layered Library Design”) and the availability of language bindings (as described in the section called “Using Languages Other than C and C+”) make Subversion a likely candidate for use as an extension or backend to other pieces of software. In this appendix, we'll introduce you to some of the third-party tools which are using Subversion. We will not cover actual Subversion clients—see Appendix E, *Other Subversion Clients* for those.

ViewCVS

Perhaps the first—and definitely the most popular—utility to take advantage of Subversion's public API is ViewCVS. ViewCVS is essentially a CGI script which enables browsing of the files and directories of a version control system. Originally designed as a Python-based replacement for the popular cvsweb utility, ⁴⁶ ViewCVS provides a full-featured Web-based interface to CVS repositories, allowing folks to see the version control history of the files in those repositories and to perform such nifty tasks as generating differences between arbitrary versions of those files.

In the early part of 2002, the repository accessing portion of ViewCVS was modularized into a semi-generic interface, and a pair of modules were grown to provide that functionality for CVS repositories. Later that year, Subversion's Python language bindings sufficiently matured, and a Subversion repository module was written for the ViewCVS interface. Now, ViewCVS is able to browse Subversion repositories, providing essentially the same history and differencing mechanisms for those repositories as are available for CVS ones.

For more information on ViewCVS, see the project's website at <http://viewcvs.sf.net/>.

SubWiki

SubWiki is a Subversion-backed Wiki program. Wikis have sprung up on the World Wide Web as unique publishing and community tools—essentially, web-based interfaces for editing web pages. SubWiki takes the Wiki concept one step further by using a version control system for its backend storage mechanism. The result is a CGI program which allows web pages to be essentially edited in-place, yet never loses old versions of those web pages.

To learn more about SubWiki, visit that project's website at <http://subwiki.tigris.org/>.

⁴⁶CVSWeb was written in Perl.

Glossary

Add An **svn** command that is used to add a file or directory to a repository.

Colophon

Etc.