Monotone

A distributed version control system

Graydon Hoare and others

This manual is for the “monotone” distributed version control system. This edition documents version 0.36.

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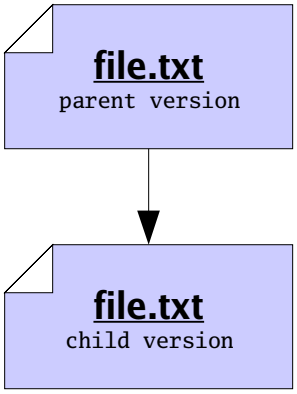
1 Concepts

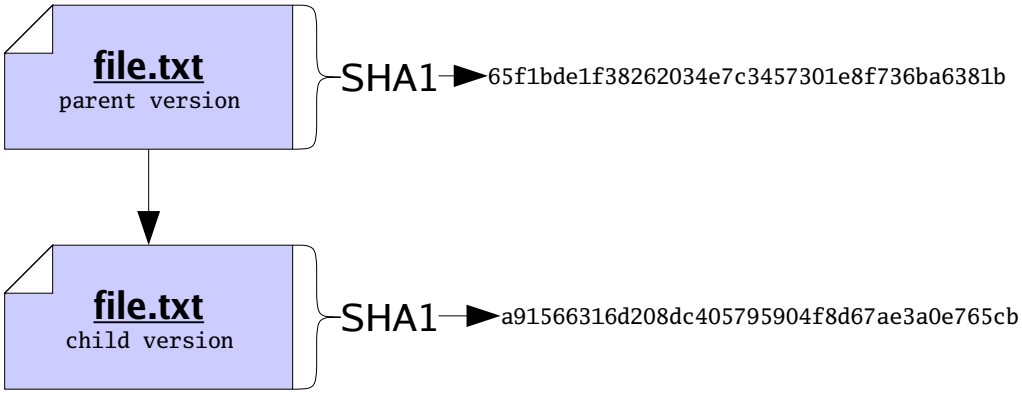
This chapter should familiarize you with the concepts, terminology, and behavior described in the remainder of the user manual. Please take a moment to read it, as later sections will assume familiarity with these terms.

1.1 Versions of files

Suppose you wish to modify a file '`file.txt`' on your computer. You begin with one *version* of the file, load it into an editor, make some changes, and save the file again. Doing so produces a new *version* of the file. We will say that the older version of the file was a *parent*, and the new version is a *child*, and that you have performed an *edit* between the parent and the child. We may draw the relationship between parent and child using a graph, where the arrow in the graph indicates the direction of the edit, from parent to child.



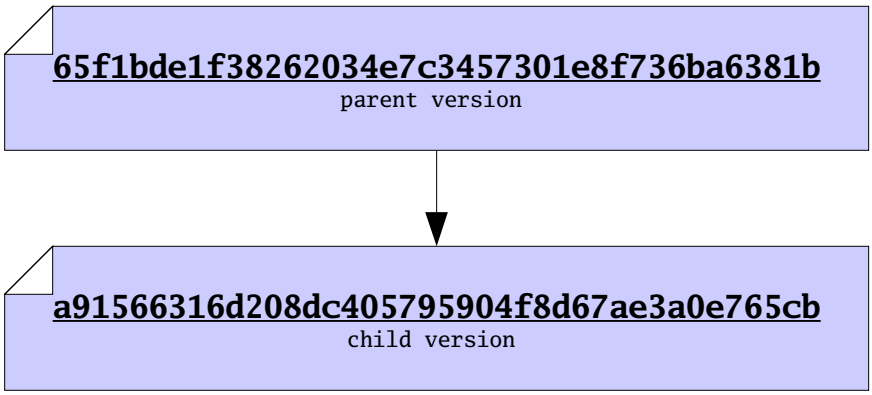
We may want to identify the parent and the child precisely, for sake of reference. To do so, we will compute a *cryptographic hash function*, called SHA1, of each version. The details of this function are beyond the scope of this document; in summary, the SHA1 function takes a version of a file and produces a short string of 20 bytes, which we will use to uniquely identify the version[1]. Now our graph does not refer to some "abstract" parent and child, but rather to the exact edit we performed between a specific parent and a specific child.



When dealing with versions of files, we will dispense with writing out "file names", and identify versions *purely* by their SHA1 value, which we will also refer to as their *file ID*. Using IDs alone will often help us accommodate the fact that people often wish to call files

[1] We say SHA1 values are "unique" here, when in fact there is a small probability of two different versions having the same SHA1 value. This probability is very small, so we discount it.

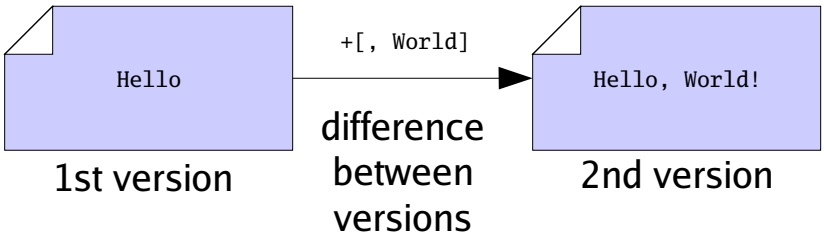
by different names. So now our graph of parent and child is just a relationship between two versions, only identified by ID.



Version control systems, such as monotone, are principally concerned with the storage and management of *multiple* versions of some files. One way to store multiple versions of a file is, literally, to save a separate *complete* copy of the file, every time you make a change. When necessary, monotone will save complete copies of your files, compressed with the `zlib` compression format.

Often we find that successive versions of a file are very similar to one another, so storing multiple complete copies is a waste of space. In these cases, rather than store *complete* copies of each version of a file, we store a compact description of only the *changes* which are made between versions. Such a description of changes is called a *delta*.

Storing deltas between files is, practically speaking, as good as storing complete versions of files. It lets you undo changes from a new version, by applying the delta backwards, and lets your friends change their old version of the file into the new version, by applying the delta forwards. Deltas are usually smaller than full files, so when possible monotone stores deltas, using a modified `xdelta` format. The details of this format are beyond the scope of this document.



1.2 Versions of trees

After you have made many different files, you may wish to capture a "snapshot" of the versions of all the files in a particular collection. Since files are typically collected into *trees* in a file system, we say that you want to capture a *version of your tree*. Doing so will permit you to undo changes to multiple files at once, or send your friend a *set* of changes to many files at once.

To make a snapshot of a tree, we begin by writing a special file called a *manifest*. In fact, monotone will write this file for us, but we could write it ourselves too. It is just a plain text file, in a structured but human-readable format used by several parts of monotone. Each file entry of a manifest binds a specific name, as a full path from the root of the workspace, to a specific file ID, as the hash of its content. In this way, the manifest collects together the snapshot of the file names and contents you have at this point in time; other snapshots with other manifests can use different names for the same file, or different contents for the same name.

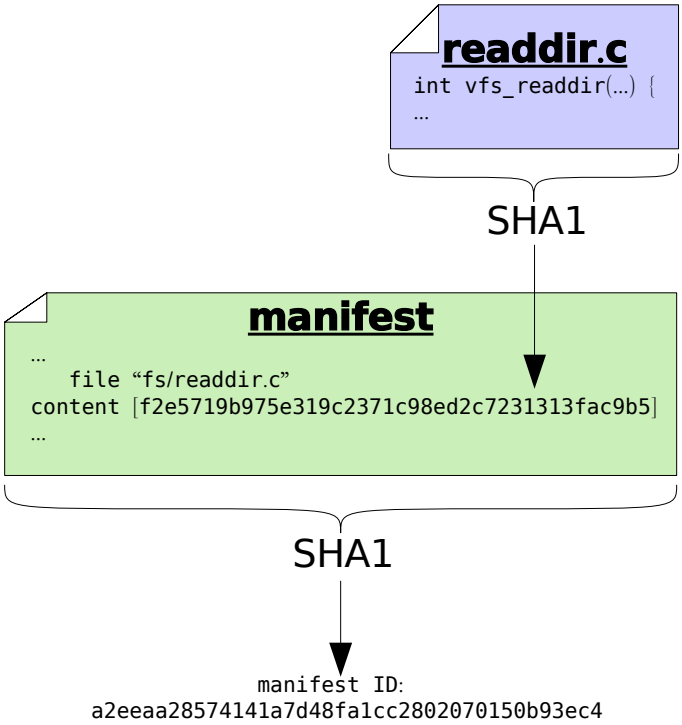
Other entries in the manifest format name directories or store file attrs, which we will cover later.

manifest

```
format_version "1"

dir ""

dir "fs"

   file "fs/readdir.c"
content [f2e5719b975e319c2371c98ed2c7231313fac9b5]

   file "fs/read_write.c"
content [81f0c9a0df254bc8d51bb785713a9f6d0b020b22]

   file "fs/pipe.c"
content [943851e7da46014cb07473b90d55dd5145f24de0]

   file "fs/inode.c"
content [8ddcfcc568f33db6205316d072825d2e5c123275]
```

Now we note that a manifest is itself a file. Therefore a manifest can serve as input to the SHA1 function, and thus every manifest has an ID of its own. By calculating the SHA1 value of a manifest, we capture the *state of our tree* in a single *manifest ID*. In other words, the ID of the manifest essentially captures all the IDs and file names of every file in our

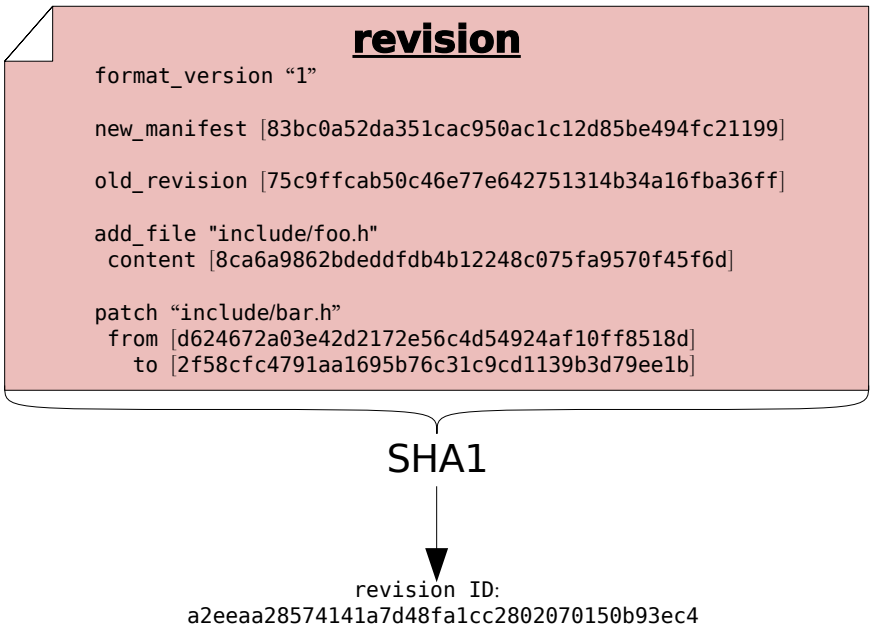
tree, combined. So we may treat manifests and their IDs as *snapshots* of a tree of files, though lacking the actual contents of the files themselves.



As with versions of files, we may decide to store manifests in their entirety, or else we may store only a compact description of changes which occur between different versions of manifests. As with files, when possible monotone stores compact descriptions of changes between manifests; when necessary it stores complete versions of manifests.

1.3 Historical records

Suppose you sit down to edit some files. Before you start working, you may record a manifest of the files, for reference sake. When you finish working, you may record another manifest. These "before and after" snapshots of the tree of files you worked on can serve as historical records of the set of changes, or *changeset*, that you made. In order to capture a "complete" view of history – both the changes made and the state of your file tree on either side of those changes – monotone builds a special composite file called a *revision* each time you make changes. Like manifests, revisions are ordinary text files which can be passed through the SHA1 function and thus assigned a *revision ID*.



The content of a revision includes one or more changesets. These changesets make reference to file IDs, to describe how the tree changed. The revision also contains manifest IDs, as another way of describing the tree "before and after" the changeset — storing this information in two forms allows monotone to detect any bugs or corrupted data before they can enter your history. Finally and crucially, revisions also make reference to *other revision IDs*. This fact – that revisions include the IDs of other revisions – causes the set of revisions to join together into a historical *chain of events*, somewhat like a "linked list". Each revision in the chain has a unique ID, which includes *by reference* all the revisions preceding it. Even if you undo a changeset, and return to a previously-visited manifest ID

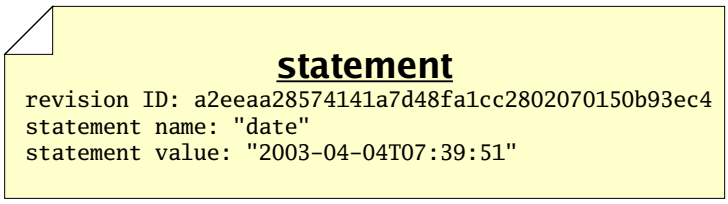
during the course of your edits, each revision will incorporate the ID of its predecessor, thus forming a new unique ID for each point in history.

1.4 Certificates

Often, you will wish to make a *statement* about a revision, such as stating the reason that you made some changes, or stating the time at which you made the changes, or stating that the revision passes a test suite. Statements such as these can be thought of, generally, as a bundle of information with three parts:

- an *ID*, indicating which revision you are making a statement about
- a *name* indicating the type of statement you are making, such as "changelog", "date" or "testresult"
- a *value* indicating the remaining detail of the statement, such as "fixed a bug", "March 9th" or "1"

For example, if you want to say that a particular revision was composed on April 4, 2003, you might make a statement like this:



In an ideal world, these are all the parts of a statement we would need in order to go about our work. In the real world, however, there are sometimes malicious people who would make false or misleading statements; so we need a way to verify that a particular person made a particular statement about a revision. We therefore will add two more pieces of information to our bundle:

- a *key* which identifies the person making a statement
- a *signature* — just a large number with particular properties — certifying the fact that the person made the statement

When these 2 items accompany a statement, we call the total bundle of 5 items a *certificate*, or *cert*. A cert makes a statement in a secure fashion. The security of the signature in a cert is derived from the RSA cryptography system, the details of which are beyond the scope of this document.

Monotone uses certs extensively. Any "extra" information which needs to be stored, transmitted or retrieved — above and beyond files, manifests, and revisions — is kept in the form of certs. This includes change logs, time and date records, branch membership,

authorship, test results, and more. When monotone makes a decision about storing, transmitting, or extracting files, manifests, or revisions, the decision is often based on certs it has seen, and the trustworthiness you assign to those certs.

The RSA cryptography system — and therefore monotone itself — requires that you exchange special "public" numbers with your friends, before they will trust certificates signed by you. These numbers are called *public keys*. Giving someone your public key does not give them the power to *impersonate* you, only to verify signatures made by you. Exchanging public keys should be done over a trusted medium, in person, or via a trusted third party. Advanced secure key exchange techniques are beyond the scope of this document.

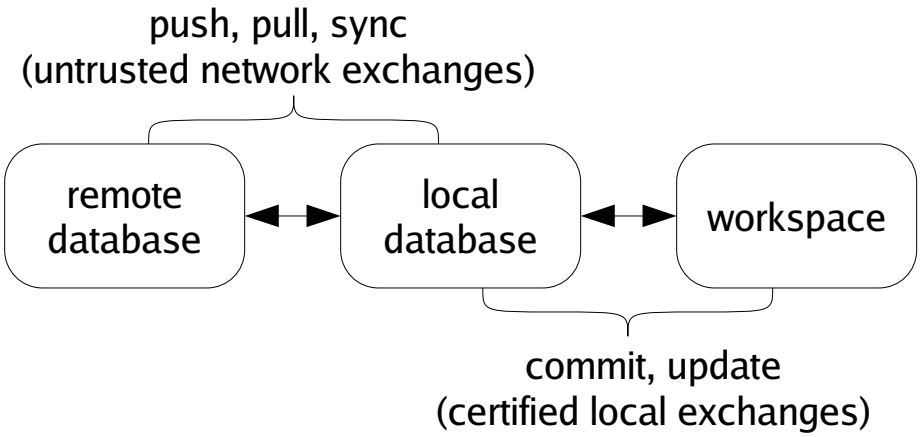
1.5 Storage and workflow

Monotone moves information in and out of four different types of storage:

- a *keystore* in your home directory
- a *workspace* in the local file system
- a *local database* in the local file system
- a *remote database* elsewhere on the internet

The *keystore* is a directory '`.monotone/keys`' in your home directory which contains copies of all your private keys. Each key is stored in a file whose name is the key identifier with some characters converted to underscores. When you use a key to sign a cert, the public half of that key is copied into your local database along with the cert.

All information passes *through* your local database, en route to some other destination. For example, when changes are made in a workspace, you may save those changes to your database, and later you may synchronize your database with someone else's. Monotone will not move information directly between a workspace and a remote database, or between workspaces. Your local database is always the "switching point" for communication.

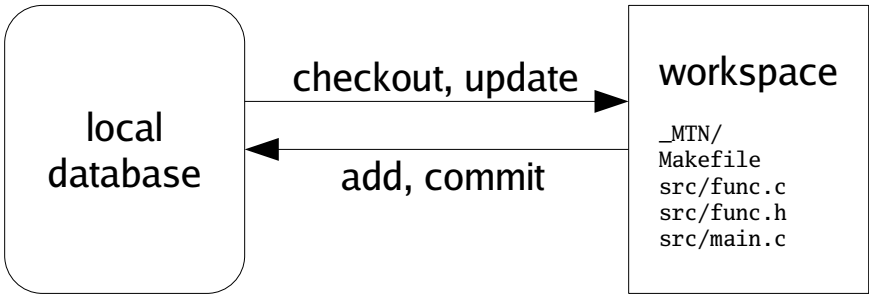


A *workspace* is a tree of files in your file system, arranged according to the list of file paths and IDs in a particular manifest. A special directory called '`_MTN`' exists in the root of any workspace. Monotone keeps some special files in the '`_MTN`' directory, in order to track changes you make to your workspace. If you ever want to know if a directory is a monotone workspace, just look for this '`_MTN`' directory.

Aside from the special '`_MTN`' directory, a workspace is just a normal tree of files. You can directly edit the files in a workspace using a plain text editor or other program; monotone will automatically notice when you make any changes. If you wish to add files, remove files, or move files within your workspace, you must tell monotone explicitly what you are doing, as these actions cannot be deduced.

If you do not yet have a workspace, you can *check out* a workspace from a database, or construct one from scratch and *add* it into a database. As you work, you will occasionally *commit* changes you have made in a workspace to a database, and *update* a workspace

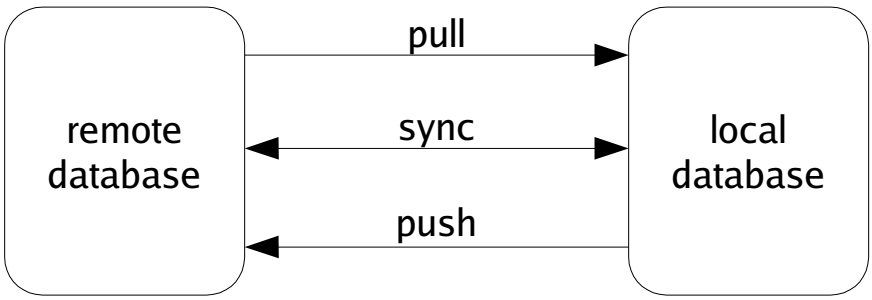
to receive changes that have arrived in a database. Committing and updating take place purely between a database and a workspace; the network is not involved.



A *database* is a single, regular file. You can copy or back it up using standard methods. Typically you keep a database in your home directory. Databases are portable between different machine types. You can have multiple databases and divide your work between them, or keep everything in a single database if you prefer. You can dump portions of your database out as text, and read them back into other databases, or send them to your friends. Underneath, databases are accessed using a standard, robust data manager, which makes using even very large databases efficient. In dire emergencies, you can directly examine and manipulate a database using a simple SQL interface.

A database contains many files, manifests, revisions, and certificates, some of which are not immediately of interest, some of which may be unwanted or even false. It is a collection of information received from network servers, workspaces, and other databases. You can inspect and modify your databases without affecting your workspaces, and vice-versa.

Monotone knows how to exchange information in your database with other remote databases, using an interactive protocol called *netsync*. It supports three modes of exchange: pushing, pulling, and synchronizing. A *pull* operation copies data from a remote database to your local database. A *push* operation copies data from your local database to a remote database. A *sync* operation copies data both directions. In each case, only the data missing from the destination is copied. The netsync protocol calculates the data to send "on the fly" by exchanging partial hash values of each database.



In general, work flow with monotone involves 3 distinct stages:

- When you *commit* changes from your workspace to your database, your database stores the changes but does not communicate with the network. Your commits happen immediately, without consulting any other party, and do not require network connectivity.

- When you are ready to *exchange* work with someone else, you can push, pull, or sync with other databases on the network. When you talk to other servers on the network, your database may change, but your workspace will not. In fact, you do not need a workspace at all when exchanging work.
- When you *update* your workspace, some (but not all) of the changes which your database received from the network are applied to your workspace. The network is not consulted during updates.

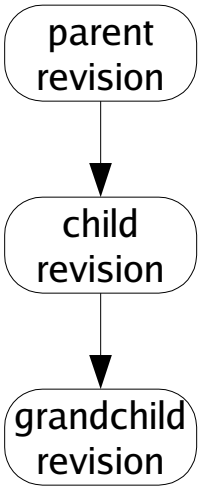
The last stage of workflow is worth clarifying: monotone does *not* blindly apply all changes it receives from a remote database to your workspace. Doing so would be very dangerous, because remote databases are not always trustworthy systems. Rather, monotone evaluates the certificates it has received along with the changes, and decides which particular changes are safe and desirable to apply to your workspace.

You can always adjust the criteria monotone uses to judge the trustworthiness and desirability of changes in your database. But keep in mind that it always uses *some* criteria; receiving changes from a remote server is a *different* activity than applying changes to a workspace. Sometimes you may receive changes which monotone judges to be untrusted or bad; such changes may stay in your database but will *not* be applied to your workspace.

Remote databases, in other words, are just untrusted "buckets" of data, which you can trade with promiscuously. There is no trust implied in communication.

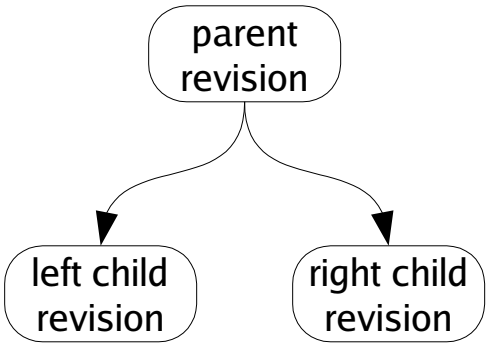
1.6 Forks and merges

So far we have been talking about revisions as though each logically follows exactly one revision before it, in a simple sequence of revisions.



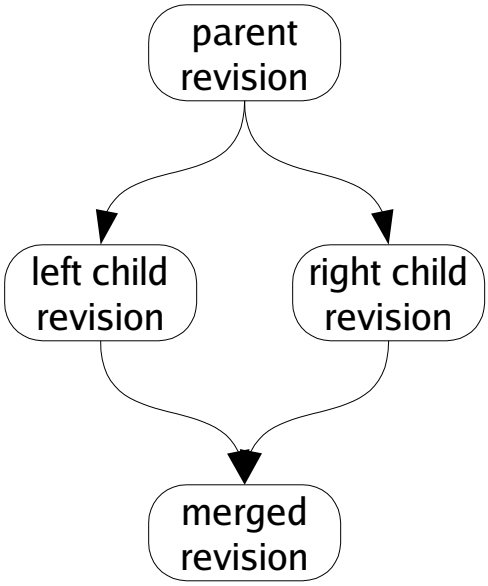
This is a rosy picture, but sometimes it does not work out this way. Sometimes when you make new revisions, other people are *simultaneously* making new revisions as well, and their revisions might be derived from the same parent as yours, or contain different changesets. Without loss of generality, we will assume simultaneous edits only happen two-at-a-time; in fact many more edits may happen at once but our reasoning will be the same.

We call this situation of simultaneous edits a *fork*, and will refer to the two children of a fork as the *left child* and *right child*. In a large collection of revisions with many people editing files, especially on many different computers spread all around the world, forks are a common occurrence.



If we analyze the changes in each child revision, we will often find that the changeset between the parent and the left child are unrelated to the changeset between the parent and

the right child. When this happens, we can usually *merge* the fork, producing a common grandchild revision which contains both changesets.



1.7 Branches

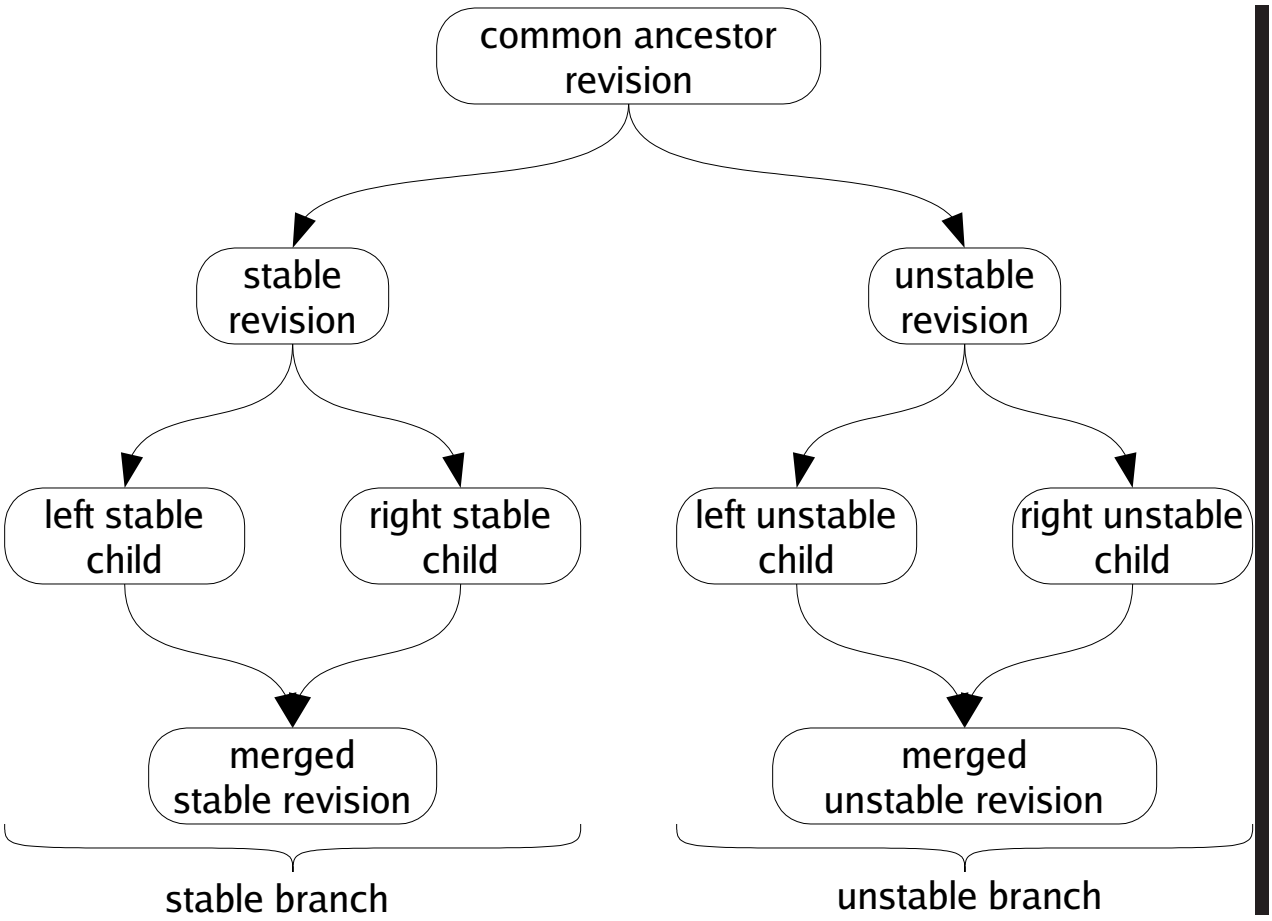
Sometimes, people intentionally produce forks which are *not supposed to be merged*; perhaps they have agreed to work independently for a time, or wish to change their files in ways which are not logically compatible with each other. When someone produces a fork which is supposed to last for a while (or perhaps permanently) we say that the fork has produced a new *branch*. Branches tell monotone which revisions you would like to merge, and which you would like to keep separate.

You can see all the available branches using `mtn list branches`.

Branches are indicated with certs. The cert name `branch` is reserved for use by monotone, for the purpose of identifying the revisions which are members of a branch. A `branch` cert has a symbolic "branch name" as its value. When we refer to "a branch", we mean all revisions with a common branch name in their `branch` certs.

For example, suppose you are working on a program called "wobbler". You might develop many revisions of wobbler and then decide to split your revisions into a "stable branch" and an "unstable branch", to help organize your work. In this case, you might call the new branches "wobbler-stable" and "wobbler-unstable". From then on, all revisions in the stable branch would get a cert with name `branch` and value `wobbler-stable`; all revisions in the unstable branch would get a cert with name `branch` and value `wobbler-unstable`. When a `wobbler-stable` revision forks, the children of the fork will be merged. When a `wobbler-unstable` revision forks, the children of the fork will be merged. However, the

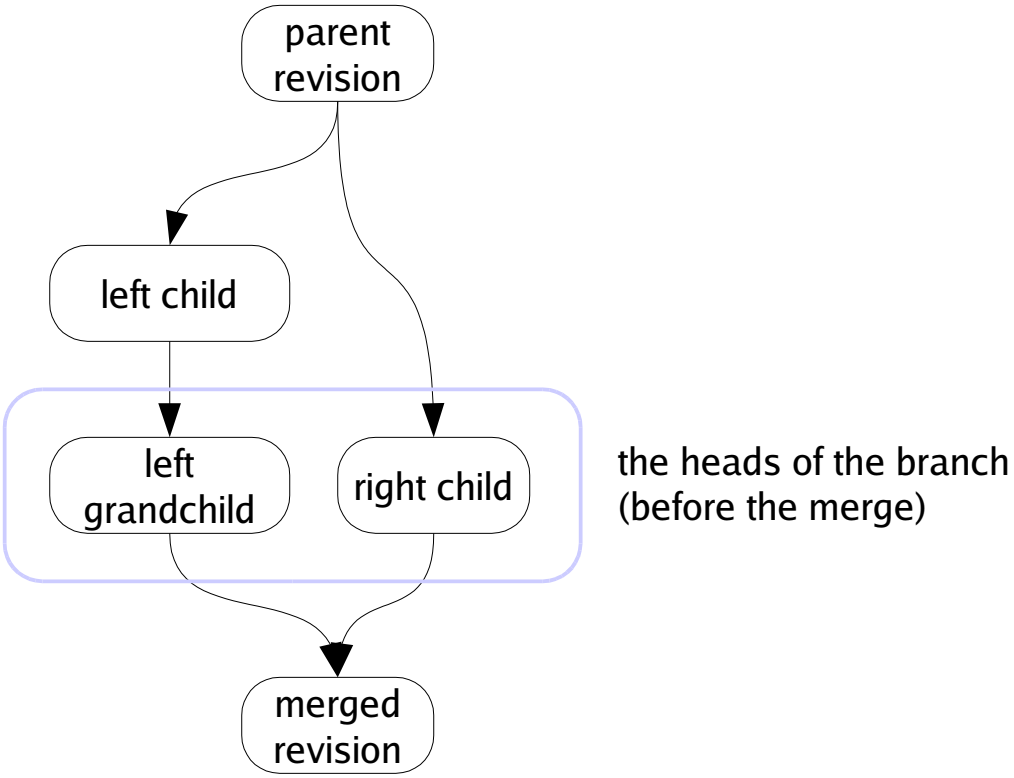
`wobbler-stable` and `wobbler-unstable` branches will not be merged together, despite having a common ancestor.



For each branch, the set of revisions with *no children* is called the *heads* of the branch. Monotone can automatically locate, and attempt to merge, the heads of a branch. If it fails to automatically merge the heads, it may ask you for assistance or else fail cleanly, leaving the branch alone.

For example, if a fork's left child has a child of its own (a "left grandchild"), monotone will merge the fork's right child with the left grandchild, since those revisions are the heads

of the branch. It will not merge the left child with the right child, because the left child is not a member of the heads.



When there is only one revision in the heads of a branch, we say that *the heads are merged*, or more generally that *the branch is merged*, since the heads is the logical set of candidates for any merging activity. If there are two or more revisions in the heads of a branch, and you ask to merge the branch, monotone will merge them two-at-a-time until there is only one.

1.7.1 Branch Names

The branch names used in the above section are fine for an example, but they would be bad to use in a real project. The reason is, monotone branch names must be *globally* unique, over all branches in the world. Otherwise, bad things can happen. Fortunately, we have a handy source of globally unique names — the DNS system.

When naming a branch, always prepend the reversed name of a host that you control or are otherwise authorized to use. For example, monotone development happens on the branch `net.venge.monotone`, because `venge.net` belongs to monotone's primary author. The idea is that this way, you can coordinate with other people using a host to make sure there are no conflicts — in the example, monotone's primary author can be certain that no-one else using `venge.net` will start up a different program named `monotone`. If you work for Yoyodyne, Inc. (owners of yoyodyne.com), then all your branch names should look like `com.yoyodyne.`*`something`*.

What the *`something`* part looks like is up to you, but usually the first part is the project name (the `monotone` in `net.venge.monotone`), and then possibly more stuff after

that to describe a particular branch. For example, monotone's win32 support was initially developed on the branch `net.venge.monotone.win32`.

(For more information, see Section 3.11 [Naming Conventions], page 61.)

2 Tutorial

This chapter illustrates the basic uses of monotone by means of an example, fictional software project.

2.1 Issues

Before we walk through the tutorial, there are two minor issues to address: standard options and revision selectors.

2.1.1 Standard Options

Before operating monotone, two important command-line options should be explained.

- Most commands operate on a *database*, which is selected with the '`--db`' option.
- Many commands operate on a subset of the database, called a *branch*, which is selected with the '`--branch`' option.

Monotone will cache the settings for these options in your workspace, so ordinarily once you have checked out a project, you will not need to specify them again. We will therefore only mention these arguments in the first example.

2.1.2 Revision Selectors

Many commands require you to supply 40-character SHA1 values as arguments, which identify revisions. These "revision IDs" are tedious to type, so monotone permits you to supply "revision selectors" rather than complete revision IDs. Selectors are a more "human friendly" way of specifying revisions by combining certificate values into unique identifiers. This "selector" mechanism can be used anywhere a revision ID would normally be used. For details on selector syntax, see Section 3.2 [Selectors], page 47.

We are now ready to explore our fictional project.

2.2 The Fictional Project

Our fictional project involves 3 programmers cooperating to write firmware for a robot, the JuiceBot 7, which dispenses fruit juice. The programmers are named Jim, Abe and Beth.

- Jim lives in Japan, and owns JuiceBot Inc. You will know when we're talking about Jim, because everything he does involves the letter "j".
- Abe lives in Australia and writes code related to apple juice. You will know when we're talking about Abe, because everything he does involves the letter "a".
- Beth lives in Brazil and writes code related to banana juice. You will know when we're talking about Beth, because everything she does involves the letter "b".

In our example the programmers work privately on laptops, and are usually *disconnected* from the network. They share no storage system. Thus when each programmer enters a command, it affects only his or her own computer, unless otherwise stated.

In the following, our fictional project team will work through several version control tasks. Some tasks must be done by each member of our example team; other tasks involve only one member.

2.3 Creating a Database

The first step Jim, Abe and Beth each need to perform is to create a new database. This is done with the `mtn db init` command, providing a '`--db`' option to specify the location of the new database. Each programmer creates their own database, which will reside in their home directory and store all the revisions, files and manifests they work on. Monotone requires this step as an explicit command, to prevent spurious creation of databases when an invalid '`--db`' option is given.

In real life, most people prefer to keep one database for each project they work on. If we followed that convention here in the tutorial, though, then all the databases would be called `juicebot.mtn`, and that would make things more confusing to read. So instead, we'll have them each name their database after themselves.

Thus Jim issues the command:

```
$ mtn db init --db=~/jim.mtn
```

Abe issues the command:

```
$ mtn db init --db=~/abe.mtn
```

And Beth issues the command:

```
$ mtn db init --db=~/beth.mtn
```

2.4 Generating Keys

Now Jim, Abe and Beth must each generate an RSA key pair for themselves. This step requires choosing a key identifier. Typical key identifiers are similar to email addresses, possibly modified with some prefix or suffix to distinguish multiple keys held by the same owner. Our example programmers will use their email addresses at the fictional "juicebot.co.jp" domain name. When we ask for a key to be generated, monotone will ask us for a passphrase. This phrase is used to encrypt the key when storing it on disk, as a security measure.

Jim does the following:

```
$ mtn genkey jim@juicebot.co.jp
mtn: generating key-pair 'jim@juicebot.co.jp'
enter passphrase for key ID [jim@juicebot.co.jp] : <Jim enters his passphrase>
confirm passphrase for key ID [jim@juicebot.co.jp]: <Jim confirms his passphrase>
mtn: storing key-pair 'jim@juicebot.co.jp' in /home/jim/.monotone/keys
```

Abe does something similar:

```
$ mtn genkey abe@juicebot.co.jp
mtn: generating key-pair 'abe@juicebot.co.jp'
enter passphrase for key ID [abe@juicebot.co.jp] : <Abe enters his passphrase>
confirm passphrase for key ID [abe@juicebot.co.jp]: <Abe confirms his passphrase>
mtn: storing key-pair 'abe@juicebot.co.jp' in /home/abe/.monotone/keys
```

as does Beth:

```
$ mtn genkey beth@juicebot.co.jp
mtn: generating key-pair 'beth@juicebot.co.jp'
enter passphrase for key ID [beth@juicebot.co.jp] : <Beth enters her passphrase>
confirm passphrase for key ID [beth@juicebot.co.jp]: <Beth confirms her passphrase>
mtn: storing key-pair 'beth@juicebot.co.jp' in /home/beth/.monotone/keys
```

Each programmer has now generated a key pair and placed it in their keystore. Each can list the keys in their keystore, to ensure the correct key was generated. For example, Jim might see this:

```
$ mtn list keys

[public keys]
9e9e9ef1d515ad58bfaa5cf282b4a872d8fda00c jim@juicebot.co.jp   (*)
(*) - only in /home/jim/.monotone/keys/


[private keys]
771ace046c27770a99e5fddfa99c9247260b5401 jim@juicebot.co.jp
```

The hexadecimal string printed out before each key name is a *fingerprint* of the key, and can be used to verify that the key you have stored under a given name is the one you intended to store. Monotone will never permit one keystore to store two keys with the same name or the same fingerprint.

This output shows one private and one public key stored under the name `jim@juicebot.co.jp`, so it indicates that Jim's key-pair has been successfully generated and stored. On subsequent commands, Jim will need to re-enter his passphrase in order to perform security-sensitive tasks.

Pretty soon Jim gets annoyed when he has to enter his passphrase every time he invokes `mtn` (and, more importantly, it simplifies the tutorial text to skip the passphrase prompts)

so he decides to use *ssh-agent* to store his key. He does this by using the `ssh_agent_export` command to export his key into a format that ssh-agent can understand and adding it with `ssh-add`.

```
$ mtn ssh_agent_export ~/.ssh/id_monotone
enter passphrase for key ID [user@example.com]:
enter new passphrase for key ID [user@example.com]:
confirm passphrase for key ID [user@example.com]:
$ chmod 600 ~/.ssh/id_monotone
```

From now on, Jim just needs to add his key to ssh-agent when he logs in and he will not need to enter his passphrase every time he uses monotone.

```
$ ssh-agent /bin/bash
$ ssh-add ~/.ssh/id_monotone
Enter passphrase for /home/user/.ssh/id_monotone:
Identity added: /home/user/.ssh/id_monotone (/home/user/.ssh/id_monotone)
$ mtn ci -m"Changed foo to bar"
$ mtn push
```

The following procedure is deprecated and not suggested for general use as it is very insecure.

Jim isn't very worried about security so he decides to store his passphrase in his '`monotonerc`' file. He does this by writing a *hook function* which returns the passphrase:

```
$ mkdir ~/.monotone
$ cat >>~/.monotone/monotonerc
function get_passphrase(keypair_id)
  return "jimsekret"
end
^D
```

Now whenever monotone needs his passphrase, it will call this function instead of prompting him to type it. Note that we are appending the new hook to the (possibly existing) file. We do this to avoid losing other changes by mistake; therefore, be sure to check that no other `get_passphrase` function appears in the configuration file.

Abe and Beth do the same, with their secret passphrases.

2.5 Starting a New Project

Before he can begin work on the project, Jim needs to create a *workspace* — a directory whose contents monotone will keep track of. Often, one works on projects that someone else has started, and creates workspaces with the `checkout` command, which you'll learn about later. Jim is starting a new project, though, so he does something a little bit different. He uses the `mtn setup` command to create a new workspace.

This command creates the named directory (if it doesn't already exist), and creates the '`_MTN`' directory within it. The '`_MTN`' directory is how monotone recognizes that a directory is a workspace, and monotone stores some bookkeeping files within it. For instance, command line values for the '`--db`', '`--branch`' or '`--key`' options to the `setup` command will be cached in a file called '`_MTN/options`', so you don't have to keep passing them to monotone all the time.

He chooses `jp.co.juicebot.jb7` as a branch name. (See Section 3.11 [Naming Conventions], page 61 for more information about appropriate branch names.) Jim then creates his workspace:

```
/home/jim$ mtn --db=jim.mtn --branch=jp.co.juicebot.jb7 setup juice
/home/jim$ cd juice
/home/jim/juice$
```

Notice that Jim has changed his current directory to his newly created workspace. For the rest of this example we will assume that everyone issues all further monotone commands from their workspace directories.

2.6 Adding Files

Next Jim decides to add some files to the project. He writes up a file containing the prototypes for the JuiceBot 7:

```
$ mkdir include
$ cat >include/jb.h
/* Standard JuiceBot hw interface */

#define FLOW_JUICE 0x1
#define POLL_JUICE 0x2
int spoutctl(int port, int cmd, void *x);

/* JuiceBot 7 API */

#define APPLE_SPOUT 0x7e
#define BANANA_SPOUT 0x7f
void dispense_apple_juice ();
void dispense_banana_juice ();
^D
```

Then adds a couple skeleton source files which he wants Abe and Beth to fill in:

```
$ mkdir src
$ cat >src/apple.c
#include "jb.h"

void
dispense_apple_juice()
{
  /* Fill this in please, Abe. */
}
^D
$ cat >src/banana.c
#include "jb.h"

void
dispense_banana_juice()
{
  /* Fill this in please, Beth. */
}
^D
```

Now Jim tells monotone to add these files to its record of his workspace. He specifies one filename and one directory; monotone recursively scans the directory and adds all its files.

```
$ mtn add include/jb.h src
mtn: adding include/jb.h to workspace manifest
mtn: adding src/apple.c to workspace manifest
mtn: adding src/banana.c to workspace manifest
```

This command produces a record of Jim's intentions in a special file called '`_MTN/revision`', stored in the workspace. The file is plain text:

```
$ cat _MTN/revision

format_version "1"

new_manifest [2098eddbe833046174de28172a813150a6cbda7b]

old_revision []

add_file "include/jb.h"
 content [3b12b2d0b31439bd50976633db1895cff8b19da0]

add_file "src/apple.c"
 content [2650ffc660dd00a08b659b883b65a060cac7e560]

add_file "src/banana.c"
 content [e8f147e5b4d5667f3228b7bba1c5c1e639f5db9f]
```

You will never have to look at this file, but it is nice to know that it is there.

Jim then gets up from his machine to get a coffee. When he returns he has forgotten what he was doing. He asks monotone:

```
$ mtn status
Current branch: jp.co.juicebot.jb7
Changes against parent :
  added   include/jb.h
  added   src/apple.c
  added   src/banana.c
```

The output of this command tells Jim that his edits, so far, constitute only the addition of some files.

Jim wants to see the actual details of the files he added, however, so he runs a command which prints out the status *and* a GNU "unified diff" of the patches involved in the changeset:

```
$ mtn diff
#
# old_revision []
#
# add_file "include/jb.h"
#  content [3b12b2d0b31439bd50976633db1895cff8b19da0]
#
# add_file "src/apple.c"
#  content [2650ffc660dd00a08b659b883b65a060cac7e560]
#
# add_file "src/banana.c"
#  content [e8f147e5b4d5667f3228b7bba1c5c1e639f5db9f]
#
================================================================================
--- include/jb.h
+++ include/jb.h 3b12b2d0b31439bd50976633db1895cff8b19da0
@ -0,0 +1,13 @@
+/* Standard JuiceBot hw interface */
+
+#define FLOW_JUICE 0x1
+#define POLL_JUICE 0x2
+#define SET_INTR 0x3
+int spoutctl(int port, int cmd, void *x);
+
+/* JuiceBot 7 API */
+
+#define APPLE_SPOUT 0x7e
+#define BANANA_SPOUT 0x7f
+void dispense_apple_juice ();
+void dispense_banana_juice ();
================================================================================
--- src/apple.c
+++ src/apple.c 2650ffc660dd00a08b659b883b65a060cac7e560
@ -0,0 +1,7 @@
+#include "jb.h"
+
+void
+dispense_apple_juice()
+{
+  /* Fill this in please, Abe. */
+}
================================================================================
--- src/banana.c
+++ src/banana.c e8f147e5b4d5667f3228b7bba1c5c1e639f5db9f
@ -0,0 +1,7 @@
+#include "jb.h"
+
+void
+dispense_banana_juice()
+{
+  /* Fill this in please, Beth. */
+}
```

2.7 Committing Work

Satisfied with the work he's done, Jim wants to save his changes. He then commits his workspace, which causes monotone to process the '`_MTN/revision`' file and record the file contents, manifest, and revision into the database. Since he provided a branch name when he ran `setup`, monotone will use this as the default branch name when he commits.

```
$ mtn commit --message="initial checkin of project"
mtn: beginning commit on branch 'jp.co.juicebot.jb7'
mtn: committed revision 2e24d49a48adf9acf3a1b6391a080008cbef9c21
```

When monotone committed Jim's revision, it updated '`_MTN/revision`' to record the workspace's new base revision ID. Jim can use this revision ID in the future, as an argument to the `checkout` command, if he wishes to return to this revision:

```
$ mtn automate get_base_revision_id
2e24d49a48adf9acf3a1b6391a080008cbef9c21
```

Monotone also generated a number of certificates attached to the new revision, and made sure that the database contained a copy of Jim's public key. These certs store metadata about the commit. Jim can ask monotone for a list of certs on this revision.

```
$ mtn ls certs 2e24d49a48adf9acf3a1b6391a080008cbef9c21
-----------------------------------------------------------------
Key   : jim@juicebot.co.jp
Sig   : ok
Name  : branch
Value : jp.co.juicebot.jb7
-----------------------------------------------------------------
Key   : jim@juicebot.co.jp
Sig   : ok
Name  : date
Value : 2004-10-26T02:53:08
-----------------------------------------------------------------
Key   : jim@juicebot.co.jp
Sig   : ok
Name  : author
Value : jim@juicebot.co.jp
-----------------------------------------------------------------
Key   : jim@juicebot.co.jp
Sig   : ok
Name  : changelog
Value : initial checkin of project
```

The output of this command has a block for each cert found. Each block has 4 significant pieces of information. The first indicates the signer of the cert, in this case `jim@juicebot.co.jp`. The second indicates whether this cert is "ok", meaning whether the RSA signature provided is correct for the cert data. The third is the cert name, and the fourth is the cert value. This list shows us that monotone has confirmed that, according to `jim@juicebot.co.jp`, the revision `2e24d49a48adf9acf3a1b6391a080008cbef9c21` is a member of the branch `jp.co.juicebot.jb7`, written by `jim@juicebot.co.jp`, with the given date and changelog.

It is important to keep in mind that revisions are not "in" or "out" of a branch in any global sense, nor are any of these cert values *true* or *false* in any global sense. Each cert indicates that *some person* – in this case Jim – would like to associate a revision with some value; it is up to you to decide if you want to accept that association.

Jim can now check the status of his branch using the "heads" command, which lists all the head revisions in the branch:

```
$ mtn heads
branch 'jp.co.juicebot.jb7' is currently merged:
2e24d49a48adf9acf3a1b6391a080008cbef9c21 jim@juicebot.co.jp 2004-10-26T02:53:08
```

The output of this command tells us that there is only one current "head" revision in the branch `jp.co.juicebot.jb7`, and it is the revision Jim just committed. A head revision is one without any descendants. Since Jim has not committed any changes to this revision yet, it has no descendants.

2.8 Basic Network Service

Jim now decides he will make his base revision available to his employees. To do this, he arranges for Abe and Beth to synchronise their databases with his, over the network. There are two pre-requisites for this: first, he has to get a copy of each of their public keys; then, he has to tell monotone that the holders of those keys are permitted to access his database. Finally, with these pre-requisites in place, he needs to tell monotone to provide network access to his database.

First, Abe exports his public key:

```
$ mtn --db=~/abe.mtn pubkey abe@juicebot.co.jp >~/abe.pubkey
```

His public key is just a plain block of ASCII text:

```
$ cat ~/abe.pubkey
[pubkey abe@juicebot.co.jp]
MIGdMA0GCSqGSIb3DQEBAQUAA4GLADCBhwKBgQCbaVff9SF78FiB/1nUdmjbU/TtPyQqe/fW
CDg7hSg1yY/hWgClXE9FI0bHtjPMIx1kBOig09AkCT7tBXM9z6iGWxTBhSR7D/qsJQGPorOD
DO7xovIHthMbZZ9FnvyB/BCyiibdWgGT0Gtq94OKdvCRNuT59e5v9L4pBkvajb+IzQIBEQ==
[end]
```

Beth also exports her public key:

```
$ mtn --db=~/beth.mtn pubkey beth@juicebot.co.jp >~/beth.pubkey
```

Then Abe and Beth both send their keys to Jim. The keys are not secret, but the team members must be relatively certain that they are exchanging keys with the person they intend to trust, and not some malicious person pretending to be a team member. Key exchange may involve sending keys over an encrypted medium, or meeting in person to exchange physical copies, or any number of techniques. All that matters, ultimately, is that Jim receives both Abe's and Beth's key in a way that he can be sure of.

So eventually, after key exchange, Jim has the public key files in his home directory. He tells monotone to read the associated key packets into his database:

```
$ cat ~/abe.pubkey ~/beth.pubkey | mtn --db=~/jim.mtn read
mtn: read 2 packets
```

Now Jim's monotone is able to identify Beth and Abe, and he is ready to give them permission to access his database. He does this by editing a pair of small files in his '`~/.monotone`' directory:

```
$ cat >>~/.monotone/read-permissions
pattern "*"
allow "abe@juicebot.co.jp"
allow "beth@juicebot.co.jp"
^D

$ cat >>~/.monotone/write-permissions
abe@juicebot.co.jp
beth@juicebot.co.jp
^D
```

These files are read by the default monotone hooks that will decide whether remote monotone users will be allowed access to Jim's database, identified by the named keys.

Jim then makes sure that his TCP port 4691 is open to incoming connections, adjusting his firewall settings as necessary, and runs the monotone `serve` command:

```
$ mtn --db=jim.mtn serve
```

This command starts monotone listening on all network interfaces of his laptop on the default port 4691, serving everything in his database.

2.9 Synchronising Databases

With Jim's server preparations done, now Abe is ready to fetch Jim's code. To do this he issues the monotone `sync` command:

```
$ mtn --db=abe.mtn sync jim-laptop.juicebot.co.jp "jp.co.juicebot.jb7*"
mtn: setting default server to jim-laptop.juicebot.co.jp
mtn: setting default branch include pattern to 'jp.co.juicebot.jb7*'
mtn: setting default branch exclude pattern to ''
mtn: connecting to jim-laptop.juicebot.co.jp
mtn: first time connecting to server jim-laptop.juicebot.co.jp:4691
mtn: I'll assume it's really them, but you might want to double-check
mtn: their key's fingerprint: 9e9e9ef1d515ad58bfaa5cf282b4a872d8fda00c
mtn: warning: saving public key for jim@juicebot.co.jp to database
mtn: finding items to synchronize:
mtn: bytes in | bytes out | revs in | revs out | revs written
mtn:     2587 |      1025 |       1 |        0 |            1
mtn: successful exchange with jim-laptop.juicebot.co.jp
```

Abe now has, in his database, a copy of everything Jim put in the branch. Therefore Abe can disconnect from the expensive network connection he's on and work locally for a while. Remember that, in monotone, work is done between workspaces in the filesystem and the local database; network connectivity is necessary only when that work is to be shared with others.

As we follow the juicebot team through the next several steps, we'll see them run the `sync` command again with Jim, and work will flow both ways. The first time you `sync` a new database, monotone remembers the server and branch patterns you use, and makes them the default for future operations.

At the end of each exchange, information about all changes in the branch known to each database have been sent to the other party - including the work of the third team member that had previously been exchanged. As well as allowing each team member to learn about the others' work, this also means that each party's laptop contains a *backup* of the others' work too.

Jim, Abe and Beth will continue working like this while they're getting started, and we'll revisit the issue of network service with them a little later as the project grows.

2.10 Making Changes

Abe decides to do some work on his part of the code. He has a copy of Jim's database contents, but cannot edit any of that data yet. He begins his editing by checking out the head of the `jp.co.juicebot.jb7` branch into a workspace, so he can edit it:

```
$ mtn --db=abe.mtn --branch=jp.co.juicebot.jb7 checkout .
```

Monotone unpacks the set of files in the head revision's manifest directly into Abe's current directory. (If he had specified something other than '`.`' at the end, monotone would have created that directory and unpacked the files into it.) Abe then opens up one of the files, '`src/apple.c`', and edits it:

```
$ vi src/apple.c
<Abe writes some apple-juice dispensing code>
```

The file '`src/apple.c`' has now been *changed*. Abe gets up to answer a phone call, and when he returns to his work he has forgotten what he changed. He can ask monotone for details:

```
$ mtn diff
#
# old_revision [2e24d49a48adf9acf3a1b6391a080008cbef9c21]
#
# patch "src/apple.c"
#  from [2650ffc660dd00a08b659b883b65a060cac7e560]
#    to [e2c418703c863eabe70f9bde988765406f885fd0]
#
============================================================================
--- src/apple.c 2650ffc660dd00a08b659b883b65a060cac7e560
+++ src/apple.c e2c418703c863eabe70f9bde988765406f885fd0
@ -1,7 +1,10 @@
 #include "jb.h"

 void
 dispense_apple_juice()
 {
-  /* Fill this in please, Abe. */
+  spoutctl(APPLE_SPOUT, FLOW_JUICE, 1);
+  while (spoutctl(APPLE_SPOUT, POLL_JUICE, 1) == 0)
+    usleep (1000);
+  spoutctl(APPLE_SPOUT, FLOW_JUICE, 0);
 }
```

Satisfied with his day's work, Abe decides to commit.

```
$ mtn commit
mtn: beginning commit on branch 'jp.co.juicebot.jb7'
```

Abe neglected to provide a '`--message`' option specifying the change log on the command line and the file '`_MTN/log`' is empty because he did not document his changes there. Monotone therefore invokes an external "log message editor" — typically an editor like `vi` — with an explanation of the changes being committed and the opportunity to enter a log message.

```
polling implementation of src/apple.c
MTN:
MTN: -----------------------------------------------------------------------
MTN: Enter Log.  Lines beginning with 'MTN:' are removed automatically
MTN:
MTN: format_version "1"
MTN:
MTN: new_manifest [b33cb337dccf21d6673f462d677a6010b60699d1]
MTN:
MTN: old_revision [2e24d49a48adf9acf3a1b6391a080008cbef9c21]
MTN:
MTN: patch "src/apple.c"
MTN: from [2650ffc660dd00a08b659b883b65a060cac7e560]
MTN:   to [e2c418703c863eabe70f9bde988765406f885fd0]
MTN:
MTN: -----------------------------------------------------------------------
MTN:
```

Abe enters a single line above the explanatory message, saying "polling implementation of src/apple.c". He then saves the file and quits the editor. Monotone deletes all the lines beginning with "MTN:" and leaves only Abe's short message. Returning to the shell, Abe's commit completes:

```
mtn: committed revision 70decb4b31a8227a629c0e364495286c5c75f979
```

Abe then sends his new revision back to Jim:

```
$ mtn sync
mtn: connecting to jim-laptop.juicebot.co.jp
mtn: finding items to synchronize:
mtn:   certs |    keys | revisions
mtn:       8 |       2 |         2
mtn: bytes in | bytes out | revs in | revs out | revs written
mtn:      615 |      2822 |       0 |        1 |            0
mtn: successful exchange with jim-laptop.juicebot.co.jp
```

Beth does a similar sequence. First she syncs her database with Jim's:

```
$ mtn --db=beth.mtn sync jim-laptop.juicebot.co.jp "jp.co.juicebot.jb7*"
mtn: setting default server to jim-laptop.juicebot.co.jp
mtn: setting default branch include pattern to 'jp.co.juicebot.jb7*'
mtn: setting default branch exclude pattern to ''
mtn: connecting to jim-laptop.juicebot.co.jp
mtn: first time connecting to server jim-laptop.juicebot.co.jp:4691
mtn: I'll assume it's really them, but you might want to double-check
mtn: their key's fingerprint: 9e9e9ef1d515ad58bfaa5cf282b4a872d8fda00c
mtn: warning: saving public key for jim@juicebot.co.jp to database
mtn: finding items to synchronize:
mtn: bytes in | bytes out | revs in | revs out | revs written
mtn:     4601 |      1239 |       2 |        0 |            1
mtn: verifying new revisions (this may take a while)
mtn: bytes in | bytes out | revs in | revs out | revs written
mtn:     4601 |      1285 |       2 |        0 |            2
mtn: successful exchange with jim-laptop.juicebot.co.jp
```

She checks out a copy of the tree from her database:

```
$ mtn --db=beth.mtn --branch=jp.co.juicebot.jb7 checkout .
```

She edits the file '`src/banana.c`':

```
$ vi src/banana.c
<Beth writes some banana-juice dispensing code>
```

and logs her changes in '`_MTN/log`' right away so she does not forget what she has done like Abe.

```
$ vi _MTN/log
* src/banana.c: Added polling implementation
```

Later, she commits her work. Monotone again invokes an external editor for her to edit her log message, but this time it fills in the messages she's written so far, and she simply checks them over one last time before finishing her commit:

```
$ mtn commit
mtn: beginning commit on branch 'jp.co.juicebot.jb7'
mtn: committed revision 80ef9c9d251d39074d37e72abf4897e0bbae1cfb
```

And she syncs with Jim again:

```
$ mtn sync
mtn: connecting to jim-laptop.juicebot.co.jp
mtn: finding items to synchronize:
mtn:   certs |    keys | revisions
mtn:      12 |       3 |         3
mtn: bytes in | bytes out | revs in | revs out | revs written
mtn:      709 |      2879 |       0 |        1 |            0
mtn: successful exchange with jim-laptop.juicebot.co.jp
```

2.11 Dealing with a Fork

Careful readers will note that, in the previous section, the JuiceBot company's work was perfectly serialized:

1. Jim did some work
2. Abe synced with Jim
3. Abe did some work
4. Abe synced with Jim
5. Beth synced with Jim
6. Beth did some work
7. Beth synced with Jim

The result of this ordering is that Jim's work entirely preceded Abe's work, which entirely preceded Beth's work. Moreover, each worker was fully informed of the "up-stream" worker's actions, and produced purely derivative, "down-stream" work:

1. Jim made revision 2e24d...
2. Abe changed revision 2e24d... into revision 70dec...
3. Beth derived revision 70dec... into revision 80ef9...

This is a simple, but sadly unrealistic, ordering of events. In real companies or work groups, people often work in parallel, *diverging* from commonly known revisions and *merging* their work together, sometime after each unit of work is complete.

Monotone supports this diverge/merge style of operation naturally; any time two revisions diverge from a common parent revision, we say that the revision graph has a *fork* in it. Forks can happen at any time, and require no coordination between workers. In fact any interleaving of the previous events would work equally well; with one exception: if forks were produced, someone would eventually have to run the `merge` command, and possibly resolve any conflicts in the fork.

To illustrate this, we return to our workers Beth and Abe. Suppose Jim sends out an email saying that the current polling juice dispensers use too much CPU time, and must be rewritten to use the JuiceBot's interrupt system. Beth wakes up first and begins working immediately, basing her work off the revision 80ef9... which is currently in her workspace:

```
$ vi src/banana.c
<Beth changes her banana-juice dispenser to use interrupts>
```

Beth finishes and examines her changes:

```
$ mtn diff
#
# old_revision [80ef9c9d251d39074d37e72abf4897e0bbae1cfb]
#
# patch "src/banana.c"
#  from [7381d6b3adfddaf16dc0fdb05e0f2d1873e3132a]
#    to [5e6622cf5c8805bcbd50921ce7db86dad40f2ec6]
#
============================================================================
--- src/banana.c 7381d6b3adfddaf16dc0fdb05e0f2d1873e3132a
+++ src/banana.c 5e6622cf5c8805bcbd50921ce7db86dad40f2ec6
@ -1,10 +1,15 @@
 #include "jb.h"

+static void
+shut_off_banana()
+{
+  spoutctl(BANANA_SPOUT, SET_INTR, 0);
+  spoutctl(BANANA_SPOUT, FLOW_JUICE, 0);
+}
+
 void
-dispense_banana_juice()
+dispense_banana_juice()
 {
+  spoutctl(BANANA_SPOUT, SET_INTR, &shut_off_banana);
   spoutctl(BANANA_SPOUT, FLOW_JUICE, 1);
-  while (spoutctl(BANANA_SPOUT, POLL_JUICE, 1) == 0)
-    usleep (1000);
-  spoutctl(BANANA_SPOUT, FLOW_JUICE, 0);
 }
```

She commits her work:

```
$ mtn commit --message="interrupt implementation of src/banana.c"
mtn: beginning commit on branch 'jp.co.juicebot.jb7'
mtn: committed revision 8b41b5399a564494993063287a737d26ede3dee4
```

And she syncs with Jim:

```
$ mtn sync
```

Unfortunately, before Beth managed to sync with Jim, Abe had woken up and implemented a similar interrupt-based apple juice dispenser, but his workspace is 70dec..., which is still "upstream" of Beth's.

```
$ vi apple.c
<Abe changes his apple-juice dispenser to use interrupts>
```

Thus when Abe commits, he unknowingly creates a fork:

```
$ mtn commit --message="interrupt implementation of src/apple.c"
```

Abe does not see the fork yet; Abe has not actually seen *any* of Beth's work yet, because he has not synchronized with Jim. Since he has new work to contribute, however, he now syncs:

```
$ mtn sync
```

Now Jim and Abe will be aware of the fork. Jim sees it when he sits down at his desk and asks monotone for the current set of heads of the branch:

```
$ mtn heads
mtn: branch 'jp.co.juicebot.jb7' is currently unmerged:
39969614e5a14316c7ffefc588771f491c709152 abe@juicebot.co.jp 2004-10-26T02:53:16
8b41b5399a564494993063287a737d26ede3dee4 beth@juicebot.co.jp 2004-10-26T02:53:15
```

Clearly there are two heads to the branch: it contains an un-merged fork. Beth will not yet know about the fork, but in this case it doesn't matter: anyone can merge the fork, and since there are no conflicts Jim does so himself:

```
$ mtn merge
mtn: starting with revision 1 / 2
mtn: merging with revision 2 / 2
mtn: [source] 39969614e5a14316c7ffefc588771f491c709152
mtn: [source] 8b41b5399a564494993063287a737d26ede3dee4
mtn: common ancestor 70decb4b31a8227a629c0e364495286c5c75f979 abe@juicebot.co.jp  2004-
10-26T:02:50:01 found
mtn: trying 3-way merge
mtn: [merged] da499b9d9465a0e003a4c6b2909102ef98bf4e6d
mtn: your workspaces have not been updated
```

The output of this command shows Jim that two heads were found, combined via a 3-way merge with their ancestor, and saved to a new revision. This happened automatically, because the changes between the common ancestor and heads did not conflict. If there had been a conflict, monotone would have invoked an external merging tool to help resolve it.

After merging, the branch has a single head again, and Jim updates his workspace.

```
$ mtn update
mtn: selected update target da499b9d9465a0e003a4c6b2909102ef98bf4e6d
mtn: updating src/apple.c to f088e24beb43ab1468d7243e36ce214a559bdc96
mtn: updating src/banana.c to 5e6622cf5c8805bcbd50921ce7db86dad40f2ec6
mtn: updated to base revision da499b9d9465a0e003a4c6b2909102ef98bf4e6d
```

The update command selected an update target — in this case the newly merged head — and performed an in-memory merge between Jim's workspace and the chosen target. The result was then written to Jim's workspace. If Jim's workspace had any uncommitted changes in it, they would have been merged with the update in exactly the same manner as the merge of multiple committed heads.

Monotone makes very little distinction between a "pre-commit" merge (an update) and a "post-commit" merge. Both sorts of merge use the exact same algorithm. The major difference concerns the recoverability of the pre-merge state: if you commit your work first, and merge after committing, then even if the merge somehow fails (due to difficulty in a manual merge step, for instance), your committed state is still safe. If you update, on the other hand, you are requesting that monotone directly modify your workspace, and while monotone will try hard not to break anything, this process is inherently more open to error. It is therefore recommended that you commit your work *first*, before merging.

If you have previously used another version control system, this may at first seem surprising; there are some systems where you are *required* to update, and risk the above problems, before you can commit. Monotone, however, was designed with this problem in mind, and thus *always* allows you to commit before merging. A good rule of thumb is to only use `update` in workspaces with no local modifications, or when you actually want to work against a different base revision (perhaps because finishing your change turns out to require some fixes made in another revision, or because you discover that you have accidentally started working against a revision that contains unrelated bugs, and need to back out to a working revision for testing).

2.12 Branching and Merging

So by now you're familiar with making changes, sharing them with other people, and integrating your changes with their changes. Sometimes, though, you may want to make some changes, and *not* integrate them with other people's — or at least not right away. One way to do this would be to simply never run `mtn merge`; but it would quickly become confusing to try and keep track of which changes were in which revisions. This is where *branches* are useful.

Continuing our example, suppose that Jim is so impressed by Beth's work on banana juice support that he assigns her to work on the JuiceBot 7's surprise new feature: muffins. In the mean time, Abe will continue working on the JuiceBot's basic juice-related functions.

The changes required to support muffins are somewhat complicated, and Beth is worried that her work might destabilize the program, and interfere with Abe's work. In fact, she isn't even sure her first attempt will turn out to be the right approach; she might work on it for a while and then decide it was a bad idea, and should be discarded. For all these reasons, she decides that she will work on a branch, and then once she is satisfied with the new code, she will merge back onto the mainline.

She decides that since main development is in branch `jp.co.juicebot.jb7`, she will use branch `jp.co.juicebot.jb7.muffins`. So, she makes the first few edits to the new muffins code, and commits it on a new branch by simply passing '`--branch`' to commit:

```
$ mtn commit --branch=jp.co.juicebot.jb7.muffins --message='autobake framework'
mtn: beginning commit on branch 'jp.co.juicebot.jb7.muffins'
mtn: committed revision d33caefd61823ecbb605c39ffb84705dec449857
```

That's all there is to it — there is now a `jp.co.juicebot.jb7.muffins` branch, with her initial checkin on it. She can make further checkins from the same workspace, and they will automatically go to the muffins branch; if anyone else wants to help her work on muffins, they can check out that branch as usual.

Of course, while Beth is working on the new muffins code, Abe is still making fixes to the main line. Occasionally, Beth wants to integrate his latest work into the muffins branch, so that her version doesn't fall too far behind. She does this by using the `propagate` command:

```
$ mtn propagate jp.co.juicebot.jb7 jp.co.juicebot.jb7.muffins
mtn: propagating jp.co.juicebot.jb7 -> jp.co.juicebot.jb7.muffins
mtn: [source] da003f115752ac6e4750b89aaca9dbba178ac80c
mtn: [target] d0e5c93bb61e5fd25a0dadf41426f209b73f40af
mtn: common ancestor 853b8c7ac5689181d4b958504adfb5d07fd959ab jim@juicebot.co.jp 2004-
10-26T:12:44:23 found
mtn: trying 3-way merge
mtn: [merged] 89585b3c5e51a5a75f5d1a05dda859c5b7dde52f
```

The `propagate` merges all of the new changes on one branch onto another.

When the muffins code is eventually stable and ready to be integrated into the main line of development, she simply propagates the other way:

```
$ mtn propagate jp.co.juicebot.jb7.muffins jp.co.juicebot.jb7
mtn: propagating jp.co.juicebot.jb7.muffins -> jp.co.juicebot.jb7
mtn: [source] 4e48e2c9a3d2ca8a708cb0cc545700544efb5021
mtn: [target] bd29b2bfd07644ab370f50e0d68f26dcfd3bb4af
mtn: common ancestor 652b1035343281a0d2a5de79919f9a31a30c9028 jim@juicebot.co.jp 2004-
10-26T:15:25:05 found
mtn: [merged] 03f7495b51cc70b76872ed019d19dee1b73e89b6
```

Monotone always records the full history of all merges, and is designed to handle an arbitrarily complicated graph of changes. You can make a branch, then branch off from that branch, propagate changes between arbitrary branches, and so on; monotone will track all of it, and do something sensible for each merge. Of course, it is still probably a good idea to come up with some organization of branches and a plan for which should be merged to which other ones. Monotone may keep track of graphs of arbitrary complexity — but you will have more trouble. Whatever arrangement of branches you come up with, though, monotone should be able to handle it.

2.13 Network Service Revisited

Up until now, Jim has been using his laptop and database as a sort of "central server" for the company; Abe and Beth have been syncing with Jim, and learning of each other's work via Jim's database. This has worked fine while the product has been in early development; Jim has good network connectivity in Japan, and has been staying home concentrating on programming. He has been able to leave his laptop connected and running all the time, while his employees in different time-zones work and sync their databases. This is now starting to change, and two problems are starting to cause occasional difficulties.

- First, Jim is finding that he has to spend more of his time travelling, demonstrating the new juicebot features to customers; thus his laptop is spending more time disconnected from the network, or connected at dynamic addresses where it's not convenient for Abe and Beth to find him and sync.

  This doesn't prevent them doing any work, but it does have some uncomfortable consequences: they're more likely to have to manually merge conflicting changes when they finally sync up and discover they've both come up with slightly different fixes for the same bug in the meantime, and they're more exposed to loss of work if one of them suffers a disk failure before they've had a chance to sync that work with another database.
- Second, because Jim has been using the one database file both for his own local work, and for serving to the others in the team, he occasionally finds that the monotone serve process (busy syncing with Abe or Beth) has a lock on the database, while he's trying to do local work like updates or commits.

  The level of project activity is picking up, and there are more and more changes to be synced in the narrower window of time while Jim is connected. He finds he sometimes needs to take down the server process to do this local work, further exacerbating the first problem.

The juicebot team are resourceful, and by now quite used to working independently. While Jim has been away travelling, Abe and Beth have come up with their own solution to the first problem: they'll run servers from their databases, setting them up just like Jim did previously. That way, if Jim's database is offline, either Beth or Abe can run the `serve` command and provide access for the other to `sync` with. Beth also has the idea to create a second database for the `serve` process, and to `sync` her development database with that server locally, avoiding locking contention between multiple monotone processes on the one database file.

When Jim reappears, the next person to `sync` with him will often pass him information about both employees' work that they've sync'ed with each other in the meantime, just as he used to do. In fact, Jim now finds it more convenient to initiate the sync with one of the other servers when he has a spare moment and dynamic connectivity from a hotel room or airport. Changes will flow between servers automatically as clients access them and trade with one another.

This gets them by for a while, but there are still occasional inconveniences. Abe and Beth live in very different time-zones, and don't always have reliable network connectivity, so sometimes Jim finds that neither of them is online to sync with when he has the chance. Jim now also has several customers interested in beta-testing the new code, and following changes as the bugs and issues they report are addressed.

Jim decides it's time for a permanent server they can all sync with; this way, everyone always knows where to go to get the latest changes, and people can push their changes out without first calling their friends and making sure that they have their servers running.

Jim has rented some web server space on a service provider's shared system for the JuiceBot Inc. public website, `www.juicebot.co.jp`; he thinks this server will be a good place to host the central monotone server too. He sets up a new monotone database on the server, generates a new key specially for the server (so he doesn't have to expose his own development private key on the shared system), and loads in the team-members' keys:

```
$ mtn --db=server.mtn db init
$ mtn genkey monotone-server@www.juicebot.co.jp
mtn: generating key-pair 'monotone-server@www.juicebot.co.jp'
enter passphrase for key ID [monotone-server@www.juicebot.co.jp] : <Jim enters a new passphrase>
confirm passphrase for key ID [monotone-server@www.juicebot.co.jp]: <Jim confirms the passphrase>
mtn: storing key-pair 'monotone-server@www.juicebot.co.jp' in /home/jim/.monotone/keys
$ cat abe.pubkey beth.pubkey jim.pubkey | mtn --db=server.mtn read
mtn: read 3 packets
```

For the team members, he sets up the permissions files on the server much like before — except that of course he needs to also grant his `jim@juicebot.co.jp` key permission to access the new server. For the beta-testers, Jim wants to allow them read-only access just to the main JuiceBot 7 development line, but not to any of the sub-branches where other experimental development is going on. He adds some lines at the top of the '`~/.monotone/read-permissions`' on the server, above the broader permissions given to team-members. See the Chapter 6 [Hook Reference], page 131 for `get_netsync_read_permitted` for more details; the resulting file looks like this:

```
comment "Provide beta-testers with specific read-only access"
pattern "jp.co.juicebot.jb7"
allow "beta1@juicebot.co.jp"
allow "beta2@juicebot.co.jp"
continue "true"

comment "Fall-through, and allow staff access to all branches"
pattern "*"
allow "abe@juicebot.co.jp"
allow "beth@juicebot.co.jp"
allow "jim@juicebot.co.jp"
```

Jim could log in and start the monotone process manually from his shell account on the server, perhaps under a program like screen to let it stay running while he's away. This would be one way of giving it the server-key's passphrase each startup, but he wants to make sure that the server is up all the time; if the host reboots while he's travelling and the monotone server is down until he next logs in, things aren't much better than before. For the server to start automatically each time, he'll need to use the `get_passphrase` hook in the server's '`.monotonerc`' file again.

Because he's running on a shared server, Jim needs to be a little more restrictive about which interfaces and addresses his new server process will listen on. He should only accept connections at the address used for his website, because some of the provider's other customers might also want to publish their own monotone projects on this host. Jim uses the '`--bind=`*`address`*`:`*`port`*' argument like so:

```
$ mtn --db=server.mtn --bind=www.juicebot.co.jp serve
```

This will start monotone listening on the default port (4691), but only on the IP address associated with `www.juicebot.co.jp`. Jim can do this because his hosting provider has given him a dedicated IP address for his website. If the hosting provider offered only a single shared IP address belonging to the server, each customer could bind a different port number on that address.

While he's first testing the setup, Jim uses '`--bind=localhost:1234`'. This causes the monotone process to listen only to port 1234 on the loopback interface 127.0.0.1, which is not accessible from the network, so Jim doesn't expose an open port to the rest of the world until he's satisfied with the permissions configuration. You can cause monotone to listen on all interfaces on port 1234 by leaving out the address part like '`--bind=:1234`'.

When he's satisfied the server is set up correctly, Jim does an initial `sync` with the new database, filling it with all the revision history currently on his laptop. While Jim has been busy setting up the server, Abe and Beth have kept working; the server will catch up with their latest changes when they next sync, too.

All of the team members now want to sync with the new monotone server by default. Previously, they had been syncing with Jim's laptop by default, even if they occasionally specified another team-member's server on the command line when Jim was away, because monotone had remembered the first server and branch patterns used in database Section 3.8 [Vars], page 57. These vars can be seen as follows:

```
$ mtn list vars
database: default-exclude-pattern
database: default-include-pattern jp.co.juicebot.jb7*
database: default-server jim-laptop.juicebot.co.jp
known-servers: jim-laptop.juicebot.co.jp 9e9e9ef1d515ad58bfaa5cf282b4a872d8fda00c
known-servers: abe-laptop.juicebot.co.jp a2bb16a183247af4133621f7f5aefb21a9d13855
known-servers: www.juicebot.co.jp 120a99ch93b4f174432c13d3e3e9f2234aa92612
```

The team members can reset their local database vars accordingly:

```
$ mtn set database default-server www.juicebot.co.jp
```

With their new server, the juicebot team have gained the convenience of a readily available common point of reference for syncs. However, they also know that this is there only as a convenience, and doesn't prevent them working as they did before:

- The team members can still sync with each other if needed.

  Hopefully, their new server won't ever be down, but sometimes they might be working together while away from ready network access — fixing up the last few issues and finalising presentation materials while travelling to a sales conference, for example. The server will learn of these changes on the next sync.

- The team members continue to discover multiple heads and changes that need merging, as before. Each team member can merge the heads, and will produce the same revision id if they merge to the same result.

  They now develop a new habit out of courtesy, though — they try not to leave multiple heads and unmerged changes on the server, at least not for long. This saves them from repeating work, and also helps prevent confusion for the beta-testers. When each team member is ready to `sync`, they develop the habit of doing a `pull` from the server first. If new revisions were received from the server, they first `merge` their new revisions with the head(s) from the server, and finally `sync` to publish their merged changes as one. If the last `sync` happens to pull in new revisions again from the server, it means someone

else has deposited new work at the same time, and another `merge` and `sync` would probably be polite.

- Jim knows he doesn't have to keep a special backup of the new server's contents; if the server should fail, all the contents of its database can be found amongst the other team members (especially because no commits are done on the server itself).

  He does, however, take a copy of the server's private key, so he can restore that if necessary.

- In fact, Jim realises that he can now commit a copy of the web site's current contents into monotone on a new branch, `jp.co.juicebot.www`, and keep a backup of that content too.

  Now he can use monotone to work on the website offline, and let other team members add and edit the content; he can also preview changes locally before updating the production content. He keeps a workspace checkout of this content in the webroot on the server, and runs a monotone `update` in there when he wants to bring the public web site up to date. Later, he'll think about using monotone's Section 3.7 [Quality Assurance], page 56 mechanisms and Event Notification Section 6.1 [Hooks], page 132, so that the web server can update itself automatically when appropriate new revisions are received.

- Jim also knows that even if someone should break into the shared hosting server and tamper with the database, they won't be able to inject malicious code into the project, because all revisions are signed by the team members, and he has set his [Trust Evaluation Hooks], page 140 so he doesn't trust the server key for signing revisions.

  In monotone, the important trust consideration is on the *signed content*, rather than on the *replication path* by which that content arrived in your database.

3 Advanced Uses

This chapter covers slightly less common aspects of using monotone. Some users of monotone will find these helpful, though possibly not all. We assume that you have read through the taxonomy and tutorial, and possibly spent some time playing with the program to familiarize yourself with its operation.

3.1 Other Transports

Monotone's database synchronization system is based on a protocol called netsync. By default, monotone transports this protocol over a plain TCP connection, but this is not the only transport monotone can use. It can also transport netsync through SSH, or any program which can provide a full-duplex connection over `stdio`.

When a monotone client initiates a push, pull, or sync operation, it parses the first command-line argument as a URI and calls a Lua hook to convert that URI into a *connection command*. If the Lua hook returns a connection command, monotone spawns the command locally and speaks netsync over a pipe connected to the command's standard I/O handles.

If the Lua hook does not return a connection command, monotone attempts to parse the command-line argument as a TCP address – a hostname with an optional port number – connects a TCP socket the host and port, and speaks netsync over the socket.

By default, monotone understands two URI schemes:

1. SSH URIs, of the form `ssh://[user@]hostname[:port]/path/to/db.mtn`, to synchronize between private databases on hosts accessible only through SSH. (These paths are absolute; to refer to a path relative to a home directory, use `ssh://host-part/~/relative/path.mtn` or `ssh://host-part/~user/relative/path.mtn`.)
2. File URIs, of the form `file:/path/to/db.mtn`, to synchronize between local databases.

In the case of SSH URIs, the `ssh` program must be in your command execution path, either *$PATH* on Unix-like systems or *%PATH%* on Windows systems. Monotone will execute `ssh` as a subprocess, running `mtn serve` on the other end of the SSH connection. You will need `mtn` to be in the command execution path of the remote shell environment.

In the case of File URIs, `mtn` is run locally, so must be in your command execution path.

In both cases, the database specified in the URI needs to exist already, and will be locked for the duration of the synchronization operation. Also note that monotone's default transport authentication is *disabled* over these transports, to reduce the complexity of configuration and eliminate redundant protocol cost.

Additional URI schemes can be supported by customization of the Lua hooks `get_netsync_connect_command` and `use_transport_auth`. For details on these hooks, see [Netsync Transport Hooks], page 137.

3.2 Selectors

Revisions can be specified on the monotone command line, precisely, by entering the entire 40-character hexadecimal SHA1 code. This can be cumbersome, so monotone also allows a more general syntax called "selectors" which is less precise but more "human friendly". Any command which expects a precise revision ID can also accept a selector in its place; in fact a revision ID is just a special type of selector which is very precise.

Simple examples

Some selector examples are helpful in clarifying the idea:

`a432` Revision IDs beginning with the string `a432`

`graydon@pobox.com/2004-04`
: Revisions written by `graydon@pobox.com` in April 2004.

`"jrh@example.org/2 weeks ago"`
: Revisions written by `jrh@example.org` 2 weeks ago.

`graydon/net.venge.monotone.win32/yesterday`
: Revisions in the `net.venge.monotone.win32` branch, written by `graydon`, yesterday.

A moment's examination reveals that these specifications are "fuzzy" and indeed may return multiple values, or may be ambiguous. When ambiguity arises, monotone will inform you that more detail is required, and list various possibilities. The precise specification of selectors follows.

Selectors in detail

A selector is a combination of a selector type, which is a single ASCII character, followed by a `:` character and a selector string. All selectors strings except for selector type `c` are just values. The value is matched against identifiers or certs, depending on its type, in an attempt to match a single revision. Selectors are matched as prefixes. The current set of selection types are:

Generic cert selector
: Uses selector type `c`. The selector string has the syntax *name* or *name*=*value*. The former syntax will select any revision that has a cert with that name, regardless of value; the latter will match any revision that has a cert with that name and value. Values to match for can have shell wildcards. For example, `c:tag` matches all revisions that have a tag, and `c:tag=monotone-0.25` will match the revision tagged `monotone-0.25`. (See also the `t` selector below.)

Author selection
: Uses selector type `a`. For example, `a:graydon` matches `author` certs where the cert value contains `graydon`.

Branch selection
: Uses selector type `b`. For example, `b:net.venge.monotone` matches `branch` certs where the cert value is `net.venge.monotone`. Values to match for can have shell wildcards. If you give a bare `b:` monotone will require you to be in a workspace, and will use the branch value recorded in your _MTN/options file.

Heads selection
: Uses selector type `h`. For example, `h:net.venge.monotone` matches `branch` certs where the cert value is `net.venge.monotone` and the associated revision is a head revision on that branch. Values to match for can have shell wildcards like the branch selector. If you give a bare `h:` monotone will require you to be in a workspace, and use the branch recorded in your _MTN/options file.

Date selection
: Uses selector type `d`. For example, `d:2004-04` matches `date` certs where the cert value begins with `2004-04`. This selector also accepts expanded date syntax (see below).

"Earlier or equal than" selection
: Uses selector type `e`. For example, `e:2004-04-25` matches `date` certs where the cert value is less or equal than `2004-04-25T00:00:00`. If the time component is unspecified, monotone will assume 00:00:00. This selector also accepts expanded date syntax (see below)

"Later than" selection
: Uses selector type `l`. For example, `l:2004-04-25` matches `date` certs where the cert value is strictly greater than `2004-04-25T00:00:00`. If the time component is unspecified, monotone will assume 00:00:00. This selector also accepts expanded date syntax (see below)

Identifier selection
: Uses selector type `i`. For example, `i:0f3a` matches revision IDs which begin with `0f3a`.

Tag selection
: Uses selector type `t`. For example, `t:monotone-0.11` matches `tag` certs where the cert value begins with `monotone-0.11`. Values to match for can have shell wildcards.

Further selector types may be added in the future.

Composite selectors

Selectors may be combined with the `/` character. The combination acts as database intersection (or logical `and`). For example, the selector `a:graydon/d:2004-04` can be used to select a revision which has an `author` cert beginning with `graydon` *as well as* a `date` cert beginning with `2004-04`. The `/` character can be escaped using the `\` character if necessary.

Selector expansion

Before selectors are passed to the database, they are expanded using a Lua hook: `expand_selector`. The default definition of this hook attempts to guess a number of common forms for selection, allowing you to omit selector types in many cases. For example, the hook guesses that the typeless selector `jrh@example.org` is an author selector, due to its syntactic form, so modifies it to read `a:jrh@example.org`. This hook will generally assign a selector type to values which "look like" partial hex strings, email addresses, branch names, or date specifications. For the complete source code of the hook, see Chapter 6 [Hook Reference], page 131.

Expanding dates

All date-related selectors (`d`, `e`, `l`) support an English-like syntax similar to CVS. This syntax is expanded to the numeric format by a Lua hook: `expand_date`. The allowed date formats are:

now
: Expands to the current date and time.

today
: Expands to today's date. `e` and `l` selectors assume time 00:00:00

yesterday
: Expands to yesterday's date. `e` and `l` selectors assume time 00:00:00

<number> {minute|hour} <ago>
: Expands to today date and time, minus the specified `number` of minutes|hours.

<number> {day|week|month|year} <ago>
: Expands to today date, minus the specified `number` of days|weeks|months|years. `e` and `l` selectors assume time 00:00:00

<year>-<month>[-day[Thour:minute:second]]
: Expands to the supplied year/month. The day and time component are optional. If missing, `e` and `l` selectors assume the first day of month and time 00:00:00. The time component, if supplied, must be complete to the second.

For the complete source code of the hook, see Chapter 6 [Hook Reference], page 131.

Typeless selection

If, after expansion, a selector still has no type, it is matched as a special "unknown" selector type, which will match either a tag, an author, or a branch. This costs slightly more database access, but often permits simple selection using an author's login name and a date. For example, the selector `graydon/net.venge.monotone.win32/yesterday` would pass through the selector `graydon` as an unknown selector; so long as there are no branches or tags beginning with the string `graydon` this is just as effective as specifying `a:graydon`.

3.3 Restrictions

Several monotone commands accept optional *pathname...* arguments in order to establish a "restriction". Restrictions are used to limit the files and directories these commands examine for changes when comparing the workspace to the revision it is based on. Restricting a command to a specified set of files or directories simply ignores changes to files or directories not included by the restriction.

The following commands all support restrictions using optional *pathname...* arguments:

- `status`
- `diff`
- `revert`
- `commit`
- `list known`
- `list unknown`
- `list ignored`
- `list missing`
- `list changed`

Including either the old or new name of a renamed file or directory will cause both names to be included in a restriction. If in doubt, the `status` command can be used to "test" a set of pathnames to ensure that the expected files are included or excluded by a restriction.

Commands which support restrictions also support the '`--depth=`*n* ' option, where *n* specifies the maximum number of directories to descend. For example, *n*=0 disables recursion, *n*=1 means descend at most one directory, and so on.

The `update` command does not allow for updates to a restricted set of files, which may be slightly different than other version control systems. Partial updates don't really make sense in monotone, as they would leave the workspace based on a revision that doesn't exist in the database, starting an entirely new line of development.

Subdirectory restrictions

The restrictions facility also allows commands to operate from within a subdirectory of the workspace. By default, the *entire workspace* is always examined for changes. However, specifying an explicit `"."` pathname to a command will restrict it to the current subdirectory. Note that this is quite different from other version control systems and may seem somewhat surprising.

The expectation is that requiring a single `"."` to restrict to the current subdirectory should be simple to use. While the alternative, defaulting to restricting to the current subdirectory, would require a somewhat complicated ../../.. sequence to remove the restriction and operate on the whole tree.

This default was chosen because monotone versions whole project trees and generally expects to commit all changes in the workspace as a single atomic unit. Other version control systems often version individual files or directories and may not support atomic commits at all.

When working from within a subdirectory of the workspace all paths specified to monotone commands must be relative to the current subdirectory.

Finding a workspace

Monotone only stores a single '`_MTN`' directory at the root of a workspace. Because of this, a search is done to find the '`_MTN`' directory in case a command is executed from within a subdirectory of a workspace. Before a command is executed, the search for a workspace directory is done by traversing parent directories until an '`_MTN`' directory is found or the filesystem root is reached. Upon finding an '`_MTN`' directory, the '`_MTN/options`' file is read for default options. The '`--root`' option may be used to stop the search early, before reaching the root of the physical filesystem.

Many monotone commands don't require a workspace and will simply proceed with no default options if no '`_MTN`' directory is found. However, some monotone commands do require a workspace and will fail if no '`_MTN`' directory can be found.

The `checkout`, `clone` and `setup` commands create a *new workspace* and initialize a new '`_MTN/options`' file based on their current option settings.

3.4 Scripting

People often want to write programs that call monotone — for example, to create a graphical interface to monotone's functionality, or to automate some task. For most programs, if you want to do this sort of thing, you just call the command line interface, and do some sort of parsing of the output. Monotone's output, however, is designed for humans: it's localized, it tries to prompt the user with helpful information depending on their request, if it detects that something unusual is happening it may give different output in an attempt to make this clear to the user, and so on. As a result, it is not particularly suitable for programs to parse.

Rather than trying to design output to work for both humans and computers, and serving neither audience well, we elected to create a separate interface to make programmatically extracting information from monotone easier. The command line interface has a command `automate`; this command has subcommands that print various sorts of information on standard output, in simple, consistent, and easily parseable form.

For details of this interface, see Section 5.9 [Automation], page 98.

3.5 Inodeprints

Fairly often, in order to accomplish its job, monotone has to look at your workspace and figure out what has been changed in it since your last commit. Commands that do this include `status`, `diff`, `update`, `commit`, and others. There are two different techniques it can use to do this. The default, which is sufficient for most projects, is to simply read every file in the workspace, compute their SHA1 hash, and compare them to the hashes monotone has stored. This is very safe and reliable, and turns out to be fast enough for most projects. However, on very large projects, ones whose source trees are many megabytes in size, it can become unacceptably slow.

The other technique, known as *inodeprints*, is designed for this situation. When running in inodeprints mode, monotone does not read the whole workspace; rather, it keeps a cache of interesting information about each file (its size, its last modification time, and so on), and skips reading any file for which these values have not changed. This is inherently somewhat less safe, and, as mentioned above, unnecessary for most projects, so it is disabled by default.

If you do determine that it is necessary to use inodeprints with your project, it is simple to enable them. Simply run `mtn refresh_inodeprints`; this will enable inodeprints mode and generate an initial cache. If you ever wish to turn them off again, simply delete the file '`_MTN/inodeprints`'. You can at any time delete or truncate the '`_MTN/inodeprints`' file; monotone uses it only as a cache and will continue to operate correctly.

Normally, instead of enabling this up on a per-workspace basis, you will want to simply define the `use_inodeprints` hook to return `true`; this will automatically enable inodeprints mode in any new workspaces you create. See Chapter 6 [Hook Reference], page 131 for details.

3.6 Workspace Collisions

Sometimes when you work on a project, several people make similar changes in parallel. When these changes occur in an existing file that is known to both sides, monotone can merge the edits when the two revisions meet (possibly after getting help to resolve content conflicts). Other kinds of changes cannot be merged so readily, especially ones that involve files in your workspace that are not tracked by monotone.

Workspace collisions can happen for many reasons; some examples include:

- You have a file in your workspace that is unknown to monotone (you have not `add`ed it). Someone else has `add`ed and `commit`ed a different file with the same name. If you try to `update` your workspace to their revision, the added file in the incoming revision will collide with your file over use of the name.
- There is a directory which contains both versioned and unversioned files (perhaps versioned sources, and unversioned object files built from the sources). Someone else `commit`s a revision that `drop`s the versioned files *and* the containing directory. If you try to `update` to this revision, your directory will still contain the untracked files, and therefore cannot be deleted.
- You have an unversioned file in your workspace, and you're trying to `update` to a revision that `add`s a directory with the same name.

These examples describe collisions on `update`; the same kinds of things can happen with other commands that can bring changes into your workspace, such as `checkout` or `pluck` too.

Monotone is careful to avoid hitting such collisions. Before changing the workspace, it will try and detect the possibility of collisions, and the command will fail, warning you about the names that collide. The file content in the database is safe and can be recovered at any time, so monotone is conservative and will refuse to destroy the information in your workspace contents.

However, monotone cannot detect all kinds of failures and collisions in your workspace. For example:

- On some systems with case-insensitive and/or internationalised filesystems, names that look distinct to monotone may in fact be considered the same by the underlying platform.
- If some other program is creating files in the workspace at the same time as monotone, the colliding file might be created after the collision check at the start.
- Other kinds of unpredictable system errors, like permissions problems or disk full conditions, might cause failures when monotone is rearranging the workspace content.

These are all hopefully very rare occurrences. If such a filesystem error *does* cause a failure part-way during a workspace alteration, monotone will stop immediately rather than risk potentially doing further damage, and your workspace may be left in an incomplete state. If this happens, you will need to resolve the issue and clean up the workspace manually. If you need to do so, understanding how monotone manipulates the workspace is helpful.

When monotone applies renaming changes to the workspace, each file is first *detached* from the workspace under its old name, then *attached* under the new name. This is done

by moving it to the '`_MTN/detached`' directory. Newly added files are created here before being moved into place, too. While inside '`_MTN/detached`', the file or directory is named as a simple integer (these numbers come from monotone's internal identification of the node). If the detached node is a directory, the directory is moved with all of its contents (including unversioned files); this can help identify which directory has been detached.

If a previous workspace alteration failed part-way, the '`_MTN/detached`' directory will still exist, and monotone will refuse to attempt another alteration while the workspace is in this inconsistent state. This also acts as a lock against multiple monotone processes performing workspace alterations (but not other programs).

The best way to avoid a messy recovery from such a failure is simply to ensure that you always `commit` before trying to `update` (or `pluck`, etc) other changes from the database into your workspace. This ensures that your current workspace contents are safely stored, and can be retrieved later (such as with `revert`).

3.7 Quality Assurance

Monotone was constructed to serve both as a version control tool and as a quality assurance tool. The quality assurance features permit users to ignore, or "filter out", versions which do not meet their criteria for quality. This section describes the way monotone represents and reasons about quality information.

Monotone often views the collection of revisions as a directed graph, in which revisions are the nodes and changes between revisions are the edges. We call this the *revision graph*. The revision graph has a number of important subgraphs, many of which overlap. For example, each branch is a subgraph of the revision graph, containing only the nodes carrying a particular `branch` cert.

Many of monotone's operations involve searching the revision graph for the ancestors or descendants of a particular revision, or extracting the "heads" of a subgraph, which is the subgraph's set of nodes with no descendants. For example, when you run the `update` command, monotone searches the subgraph consisting of descendants of the base revision of the current workspace, trying to locate a unique head to update the base revision to.

Monotone's quality assurance mechanisms are mostly based on restricting the subgraph each command operates on. There are two methods used to restrict the subgraph:

- By restricting the set of trusted `branch` certificates, you can require that specific code reviewers have approved of each edge in the subgraph you focus on.
- By restricting the set of trusted `testresult` certificates, you can require that the *endpoints* of an update operation have a certificate asserting that the revision in question passed a certain test, or testsuite.

The evaluation of trust is done on a cert-by-cert basis by calling a set of Lua hooks: `get_revision_cert_trust`, `get_manifest_cert_trust` and `get_file_cert_trust`. These hooks are only called when a cert has at least one good signature from a known key, and are passed *all* the keys which have signed the cert, as well as the cert's ID, name and value. The hook can then evaluate the set of signers, as a group, and decide whether to grant or deny trust to the assertion made by the cert.

The evaluation of testresults is controlled by the `accept_testresult_change` hook. This hook is called when selecting update candidates, and is passed a pair of tables describing the `testresult` certs present on the source and proposed destination of an update. Only if the change in test results are deemed "acceptable" does monotone actually select an update target to merge into your workspace.

For details on these hooks, see the Chapter 6 [Hook Reference], page 131.

3.8 Vars

Every monotone database has a set of *vars* associated with it. Vars are simple configuration variables that monotone refers to in some circumstances; they are used for configuration that monotone needs to be able to modify itself, and that should be per-database (rather than per-user or per-workspace, both of which are supported by '`monotonerc`' scripts). Vars are local to a database, and never transferred by netsync.

A var is a *name* = *value* pairing inside a *domain*. Domains define what the vars inside it are used for; for instance, one domain might contain database-global settings, and particular vars inside it would define things like that database's default netsync server. Another domain might contain key fingerprints for servers that monotone has interacted with in the past, to detect man-in-the-middle attacks; the vars inside this domain would map server names to their fingerprints.

You can set vars with the `set` command, delete them with the `unset` command, and see them with the `ls vars` command. See the documentation for these specific commands for more details.

Existing vars

There are several pre-defined domains that monotone knows about:

`database` Contains database-global configuration information. Defined names are:

`default-exclude-pattern`
: The default branch exclusion glob pattern for netsync operations to use. Automatically set by first use of netsync, and by any netsync that uses the '`--set-default`' option.

`default-include-pattern`
: The default branch glob pattern for netsync operations to use. Automatically set by first use of netsync, and by any netsync that uses the '`--set-default`' option.

`default-server`
: The default server for netsync operations to use. Automatically set by first use of netsync, and by any netsync that uses the '`--set-default`' option.

`known-servers`
: Contains key hashes for servers that we have netsynced with in the past. Analogous to `ssh`'s '`known_hosts`' file, this is needed to detect man-in-the-middle attacks. Automatically set the first time you netsync with any given server. If that server's key later changes, monotone will notice, and refuse to connect until you have run `mtn unset known-servers` *`server-name`*.

3.9 Reserved Files

A monotone workspace consists of control files and non-control files. Each type of file can be versioned or non-versioned. These classifications lead to four groups of files:

- versioned control files
- non-versioned control files
- versioned non-control files
- non-versioned non-control files

Control files contain special content formatted for use by monotone. Versioned files are recorded in a monotone database and have their state tracked as they are modified.

If a control file is versioned, it is considered *part of* the state of the workspace, and will be recorded as a manifest entry. If a control file is not versioned, it is used to *manage* the state of the workspace, but it not considered an intrinsic part of it.

Most files you manage with monotone will be versioned non-control files. For example, if you keep source code or documents in a monotone database, they are versioned non-control files. Non-versioned, non-control files in your workspace are generally temporary or junk files, such as backups made by editors or object files made by compilers. Such files are ignored by monotone.

Identifying control files

Control files are identified by their names. Non-control files can have any name *except* the names reserved for control files. The names of control files follow a regular pattern:

Versioned control files
: Any file name beginning with '`.mtn-`'

Non-versioned control files
: Any file in the directory '`_MTN/`'

The general intention is that versioned control files are things that you may want to edit directly. In comparison, you should never have to edit non-versioned control files directly; monotone should do that for you whenever it is appropriate. However, both are documented here, just in case a situation arises where you need to go "under the hood".

Existing control files

The following control files are currently used. More control files may be added in the future, but they will follow the patterns given above.

'`.mtn-ignore`'
: Contains a list of regular expression patterns, one per line. If it exists, any file with a name matching one of these patterns is ignored.

'`_MTN/wanted-testresults`'
: Contains a list of testresult key names, one per line. If it exists, update will only select revisions that do not have regressions according to the given testresult keys.

‘`_MTN/revision`’
: Contains the identity of the “base” revision of the workspace, and a list of additions, deletions, and renames which have occurred in the current workspace, relative to that version.

  Every workspace has a base revision, which is the revision that was originally checked out to create that workspace. When the workspace is committed, the base revision is considered to be the ancestor of the committed revision.

‘`_MTN/options`’
: Contains “sticky” command-line options such as ‘`--db`’ or ‘`--branch`’, such that you do not need to enter them repeatedly after checking out a particular workspace.

‘`_MTN/log`’
: Contains log messages to append to the “changelog” cert upon commit. The user may add content to this file while they work. Upon a successful commit monotone will empty the file making it ready for the next edit/commit cycle.

‘`_MTN/inodeprints`’
: If this file exists, monotone considers the directory to be in Section 3.5 [Inodeprints], page 53 mode, and uses this file to cache the inodeprints.

‘`_MTN/debug`’
: If monotone detects a bug in itself or crashes, then before exiting it dumps a log of its recent activity to this file, to aid in debugging.

3.10 Reserved Certs

Every certificate has a name. Some names have meaning which is built in to monotone, others may be used for customization by a particular user, site, or community. If you wish to define custom certificates, you should prefix such certificate names with `x-`. For example, if you want to make a certificate describing the existence of security vulnerabilities in a revision, you might wish to create a certificate called `x-vulnerability`. Monotone reserves all names which do not begin with `x-` for possible internal use. If an `x-` certificate becomes widely used, monotone will likely adopt it as a reserved cert name and standardize its semantics.

Most reserved certificate names have no meaning yet; some do. Usually monotone is also responsible for *generating* many of these certs as part of normal operation, such as during a `commit`. Others will be added explicitly via other commands, like `tag` or `approve`.

As well as carrying other information, certs (and combinations of certs) are useful for identifying revisions with Section 3.2 [Selectors], page 47; in particular, this is the primary purpose of the `tag` cert.

The pre-defined, reserved certificate names are:

`author` This cert's value is the name of a person who committed the revision the cert is attached to. The cert is generated when you commit a revision. It is displayed by the `log` command.

`branch` This cert's value is the name of a branch. A `branch` cert associates a revision with a branch. The revision is said to be "in the branch" named by the cert. The cert is generated when you commit a revision, either directly with the `commit` command or indirectly with the `merge` or `propagate` commands. The `branch` certs are read and directly interpreted by *many* monotone commands, and play a fundamental role in organizing work in any monotone database.

`changelog`
This cert's value is the change log message you provide when you commit a revision. It is displayed by the `log` command.

`comment` This cert's value is an additional comment, usually provided after committing, about a revision. Certs with the name `comment` will be shown together with `changelog` certs by the `log` command.

`date` This cert's value is an ISO date string indicating the time at which a revision was committed. It is displayed by the `log` command, and may be used as an additional heuristic or selection criterion in other commands in the future.

`tag` This cert's value is a symbolic name given to a revision, which may be used as a way of selecting the revision by name for later commands like `checkout`, `log` or `diff`.

`testresult`
This cert's value is interpreted as a boolean string, either `0` or `1`. It is generated by the `testresult` command and represents the results of running a particular test on the underlying revision. Typically you will make a separate signing key for each test you intend to run on revisions. This cert influences the `update` algorithm.

3.11 Naming Conventions

Some names in monotone are private to your work, such as filenames. Other names are potentially visible outside your project, such as RSA key identifiers or branch names. It is possible that if you choose such names carelessly, you will choose a name which someone else in the world is using, and subsequently you may cause confusion when your work and theirs is received simultaneously by some third party.

We therefore recommend two naming conventions:

- For RSA keys, use the name of an active email address you own. This will minimize conflicts, and also serves as a mnemonic to associate your personal *identity* with signatures made with your key. For example, monotone's primary author uses the key identifier `graydon@pobox.com`.
- For branch names, select any name you like but prefix it with the "inverted domain name" of a DNS domain you control or are otherwise authorized to use. This behavior mimics the package naming convention in the java programming language. For example, monotone itself is developed within the `net.venge.monotone` branch, because the author owns the DNS domain `venge.net`.

3.12 File Attributes

Monotone contains a support for storing *persistent attributes* on files and directories, generally known as *attrs* for short. An attr associates a simple name/value pair with a file or directory, and is stored in the manifest. Attrs are first-class versioned data; they can be changed in a workspace, and those changes will be saved when the workspace is committed. The merger knows how to intelligently merge attrs.

The attribute mechanism was originally motivated by the fact that some people like to store executable programs in version control systems, and would like the programs to remain executable when they check out a workspace. For example, the `configure` shell script commonly shipped with many programs should be executable. Similarly, some people would like to store devices, symbolic links, read-only files, and all manner of extra attributes of a file, not directly related to a file's data content.

Monotone comes with support for some attrs built-in; for instance, if an executable file is given to `mtn add`, then it will automatically mark the new file with a `mtn:execute` attr, and when the file is checked out later, the executable bit will be set automatically. (Of course, if it is checked out on Windows, which does not support the executable bit, then the executable bit will not be set. However, monotone will still know that the attr is set, and Windows users can view and modify the attr like anyone else.)

Attrs in the current workspace can be seen and modified using the `mtn attr` command; see Section 5.2 [Workspace], page 77. Attrs can also be found by examining any manifest directly.

You can tell monotone to automatically take actions based on these attributes by defining hooks; see the `attr_functions` entry in Chapter 6 [Hook Reference], page 131. Every time your workspace is written to, monotone will run the corresponding hooks registered for each attr in your workspace. This way, you can extend the vocabulary of attrs understood by monotone simply by writing new hooks.

You can make up your own attrs for anything you find useful; the mechanism is fully general. (If you make up some particularly useful ones, we may even be interested in adding support to monotone proper.) We only ask that if you do use custom attrs, you use some prefix for them besides `mtn:`; attrs beginning with `mtn:` are reserved for monotone's own use.

3.13 Merging

Monotone has two merging modes, controlled by the `manual_merge` attribute. By default all files are merged in automatic mode, unless the `manual_merge` attribute for that file is present and `true`. In automatic mode files are merged without user intervention, using monotone internal three-way merging algorithm. Only if there are conflicts or an ancestor is not available monotone switches to manual mode, essentially escalating the merging to the user. When working in manual mode, monotone invokes the `merge3` hook to start an user defined external merge tool. If the tool terminates without writing the merged file, monotone aborts the merging, reverting any changes made. By redefining the aforementioned hooks the user can not only choose a preferred merge tool, but even select different programs for different file types. For example, gimp for .png files, OpenOffice.org for .doc, and so on. Starting with monotone 0.20, the `manual_merge` attribute is automatically set at add time for all "binary" files, i.e. all files for which the `binary_file` hook returns true. Currently, this means all files with extension gif, jpeg, png, bz2, gz and zip, plus files containing at least one of the following bytes:

```
0x00 thru 0x06
0x0E thru 0x1a
0x1c thru 0x1f
```

The attribute could also be manually forced or removed using the appropriate monotone commands. Remember that monotone switches to manual merging even if only one of the files to be merged has the `manual_merge` attribute set.

3.14 Migrating and Dumping

While the state of your database is logically captured in terms of a packet stream, it is sometimes necessary or desirable (especially while monotone is still in active development) to modify the SQL table layout or storage parameters of your version database, or to make backup copies of your database in plain text. These issues are not properly addressed by generating packet streams: instead, you must use *migration* or *dumping* commands.

The `mtn db migrate` command is used to alter the SQL schema of a database. The schema of a monotone database is identified by a special hash of its generating SQL, which is stored in the database's auxiliary tables. Each version of monotone knows which schema version it is able to work with, and it will refuse to operate on databases with different schemas. When you run the `migrate` command, monotone looks in an internal list of SQL logic which can be used to perform in-place upgrades. It applies entries from this list, in order, attempting to change the database it *has* into the database it *wants*. Each step of this migration is checked to ensure no errors occurred and the resulting schema hashes to the intended value. The migration is attempted inside a transaction, so if it fails — for example if the result of migration hashes to an unexpected value — the migration is aborted.

If more drastic changes to the underlying database are made, such as changing the page size of SQLite, or if you simply want to keep a plain text version of your database on hand, the `mtn db dump` command can produce a plain ASCII SQL statement which generates the state of your database. This dump can later be reloaded using the `mtn db load` command.

Note that when reloading a dumped database, the schema of the dumped database is *included* in the dump, so you should not try to `init` your database before a `load`.

3.15 Importing from CVS

Monotone is capable of reading CVS files directly and importing them into a database. This feature is still somewhat immature, but moderately large "real world" CVS trees on the order of 1GB have successfully been imported.

Note however that the machine requirements for CVS trees of this size are not trivial: it can take several hours on a modern system to reconstruct the history of such a tree and calculate the millions of cryptographic certificates involved. We recommend experimenting with smaller trees first, to get a feel for the import process.

We will assume certain values for this example which will differ in your case:

- Your domain name, `example.net` in this example.
- Your key name, `import@example.net` in this example.
- Your project name, `wobbler` in this example.
- Your database name, '`test.mtn`' in this example.
- Your CVS repository path, '`/usr/local/cvsroot`' in this example.
- The CVS module name for your project, `wobbler` in this example.

Accounting for these differences at your site, the following is an example procedure for importing a CVS repository "from scratch", and checking the resulting head version of the import out into a workspace:

```
$ mtn --db=test.mtn db init
$ mtn --db=test.mtn genkey import@example.net
$ mtn --db=test.mtn --branch=net.example.wobbler cvs_import /usr/local/cvsroot/wobbler
$ mtn --db=test.mtn --branch=net.example.wobbler checkout wobber-checkout
```

3.16 Using packets

Suppose you made changes to your database, and want to send those changes to someone else but for some reason you cannot use netsync. Or maybe you want to extract and inject individual revisions automatically via an external program. In this case, you can convert the information into packets. Packets are a convenient way to represent revisions and other database contents as plain text with wrapped lines – just what you need if you want to send them in the body of an email.

This is a tutorial on how to transfer single revisions between databases by dumping them from one database to a text file and then reading the dump into a second database.

We will create two databases, A and B, then create a few revisions in A, and transfer part of them to B.

First we initialize the databases:

```
$ mtn -d A db init
$ mtn -d B db init
```

Now set up a branch in A:

```
$ mtn -d A setup -b test test
```

And let's put some revisions in that branch:

```
$ cd test/
$ cat > file
xyz
^D
$ mtn add file
$ mtn ci -m "One"    You may need to select a key and type a passphrase here
$ cat > file2
file 2 getting in
^D
$ cat > file
ERASE
^D
$ mtn add file2
$ mtn ci -m "Two"
$ cat > file
THIRD
^D
$ mtn ci -m "Three"
```

OK, that's enough. Let's see what we have:

```
$ cd ..
$ mtn -d A automate select i: | mtn -d A automate toposort -
a423db0ad651c74e41ab2529eca6f17513ccf714
d14e89582ad9030e1eb62f563c8721be02ca0b65
151f1fb125f19ebe11eb8bfe3a5798fcbea4e736
```

Three revisions! Let's transfer the first one to the database B. First we get the meta-information on that revision:

```
$ mtn -d A automate get_revision a423db0ad651c74e41ab2529eca6f17513ccf714
format_version "1"

new_manifest [b6dbdbbe0e7f41e44d9b72f9fe29b1f1a4f47f18]

old_revision []

add_dir ""

add_file "file"
 content [8714e0ef31edb00e33683f575274379955b3526c]
```

OK, one file was added in this revision. We'll transfer it. Now, *ORDER MATTERS*! We should transfer:

1. The file data (fdata) and file deltas (fdeltas), if any
2. The release data (rdata)
3. The certs

In that order. This is because certs make reference to release data, and release data makes reference to file data and file deltas.

```
mtn -d A automate packet_for_fdata 8714e0ef31edb00e33683f575274379955b3526c > PACKETS
mtn -d A automate packet_for_rdata a423db0ad651c74e41ab2529eca6f17513ccf714 >> PACKETS
mtn -d A automate packets_for_certs a423db0ad651c74e41ab2529eca6f17513ccf714 >> PACKETS
mtn -d B read < PACKETS
```

This revision (a423db0ad651c74e41ab2529eca6f17513ccf714) was already sent to database B. You may want to check the PACKETS file to see what the packets look like.

Now let's transfer one more revision:

```
mtn -d A automate get_revision d14e89582ad9030e1eb62f563c8721be02ca0b65
format_version "1"

new_manifest [48a03530005d46ed9c31c8f83ad96c4fa22b8b28]

old_revision [a423db0ad651c74e41ab2529eca6f17513ccf714]

add_file "file2"
 content [d2178687226560032947c1deacb39d16a16ea5c6]

patch "file"
 from [8714e0ef31edb00e33683f575274379955b3526c]
   to [8b52d96d4fab6c1e56d6364b0a2673f4111b228e]
```

From what we see, in this revision we have one new file and one patch, so we do the same we did before for them:

```
mtn -d A automate packet_for_fdata d2178687226560032947c1deacb39d16a16ea5c6 > PACKETS2
mtn -d A automate packet_for_fdelta 8714e0ef31edb00e33683f575274379955b3526c 8b52d96d4fab6c1e56d6364b0a26
mtn -d A automate packet_for_rdata d14e89582ad9030e1eb62f563c8721be02ca0b65 >> PACKETS2
mtn -d A automate packets_for_certs d14e89582ad9030e1eb62f563c8721be02ca0b65 >> PACKETS2
mtn -d B read < PACKETS2
```

Fine. The two revisions should be in the second database now. Let's take a look at what's in each database:

```
$ mtn -d A automate select i: | mtn -d A automate toposort -
a423db0ad651c74e41ab2529eca6f17513ccf714
d14e89582ad9030e1eb62f563c8721be02ca0b65
151f1fb125f19ebe11eb8bfe3a5798fcbea4e736

$ mtn -d B automate select i: | mtn -d B automate toposort -
a423db0ad651c74e41ab2529eca6f17513ccf714
d14e89582ad9030e1eb62f563c8721be02ca0b65
```

Good! B has the two first revisions (as expected), and A has all three. However, a checkout of that branch on B will not work, because the certificate signatures cannot be verified. We need to transfer the signatures too (suppose the key used had the ID `"johndoe@domain.com"`):

```
mtn -d A pubkey johndoe@domain.com > KEY_PACKETS
mtn -d B read < KEY_PACKETS
```

Done.

```
$ mtn -d B co -b test test-B
$ ls test-B
file2  _MTN  x
$ more test-B/file2
file 2 getting in
```

And that's it! The revisions were successfully transferred.

4 CVS Phrasebook

This chapter translates common CVS commands into monotone commands. It is an easy alternative to reading through the complete command reference.

Checking Out a Tree

```
$ CVSROOT=:pserver:cvs.foo.com/wobbler $ mtn pull www.foo.com com.foo.wobbler*
$ cvs -d $CVSROOT checkout -r 1.2      $ mtn checkout --revision=fe37 wobbler
```

The CVS command contacts a network server, retrieves a revision, and stores it in your workspace. There are two cosmetic differences with the monotone command: remote databases are specified by hostnames and globs, and revisions are denoted by SHA1 values (or selectors).

There is also one deep difference: pulling revisions into your database is a separate step from checking out a single revision; after you have pulled from a network server, your database will contain *several* revisions, possibly the entire history of a project. Checking out is a separate step, after communication, which only copies a particular revision out of your database and into a named directory.

Committing Changes

```
$ cvs commit -m "log message"          $ mtn commit --message="log message"
                                       $ mtn push www.foo.com com.foo.wobbler*
```

As with other networking commands, the communication step with monotone is explicit: committing changes only saves them to the local database. A separate command, `push`, sends the changes to a remote database.

Undoing Changes

```
$ cvs update -C file                   $ mtn revert file
```

Unlike CVS, monotone includes a separate `revert` command for undoing local changes and restoring the workspace to the original contents of the base revision. Because this can be dangerous, `revert` insists on an explicit argument to name the files or directories to be reverted; use the current directory "'.'" at the top of the workspace to revert everything. The `revert` command is also used to restore deleted files (with a convenient '`--missing`' option for naming these files).

In CVS, you would need to use `update` to restore missing or changed files, and you might get back a newer version of the file than you started with. In monotone, `revert` always takes you back to where you started, and the `update` command is only used to move the workspace to a different (usually newer) base revision.

Incorporating New Changes

```
$ cvs update -d                        $ mtn pull www.foo.com com.foo.wobbler*
                                       $ mtn merge
                                       $ mtn update
```

This command, like other networking commands, involves a separate communication step with monotone. The extra command, `merge`, ensures that the branch your are working on has a unique head. You can omit the `merge` step if you only want `update` to examine descendants of your base revision, and ignore other heads on your branch.

Tagging Revisions

```
$ cvs tag FOO_TAG .                    $ mtn tag h: FOO_TAG
```

With CVS, tags are placed on individual files, and the closest thing to identifying a consistent repository-wide revision is a set of files with the same tag. In monotone, all changes are part of a repository-wide revision, and some of those revisions may be tagged. Monotone has no partial tags that apply only to a subset of files.

Moving Workspace to Another Revision

```
$ cvs update -r FOO_TAG -d             $ mtn update -r 830ac1a5f033825ab364f911608ec294fe37f7bc
                                       $ mtn update -r t:FOO_TAG
```

With a revision parameter, the `update` command operates similarly in monotone and CVS. One difference is that a subsequent `commit` will be based off the chosen revision in monotone, while a `commit` in the CVS case is not possible without going back to the branch head again. This version of `update` can thus be very useful if, for example, you discover that the tree you are working against is somehow broken — you can `update` to an older non-broken version, and continue to work normally while waiting for the tree to be fixed.

Viewing Differences

```
$ cvs diff                             $ mtn diff

$ cvs diff -r 1.2 -r 1.4 myfile        $ mtn diff -r 3e7db -r 278df myfile
```

Monotone's `diff` command is modeled on that of CVS, so the main features are the same: `diff` alone prints the differences between your workspace and its base revision, whereas `diff` accompanied by two revision numbers prints the difference between those two revisions. The major difference between CVS and monotone here is that monotone's revision numbers are *revision IDs*, rather than file IDs. If one leaves off the file argument, then diff can print the difference between two entire trees.

Showing Workspace Status

```
$ cvs status                           $ mtn status
```

This command operates similarly in monotone and CVS. The only major difference is that monotone's `status` command always gives a status of the whole tree, and outputs a more compact summary than CVS.

Adding Directories and Files to Workspace

```
$ cvs add dir                          $ mtn add dir/subdir/file.txt
$ cvs add dir/subdir
$ cvs add dir/subdir/file.txt
```

Monotone does not explicitly store directories, so adding a file only involves adding the file's complete path, including any directories. Directories are created as needed, and empty directories are ignored.

Removing Directories and Files from Workspace

```
$ rm file.txt                          $ mtn drop file.txt
$ cvs remove file.txt
```

Monotone does not require that you erase a file from the workspace before you drop it. Dropping a file both removes its entry in the manifest of the current revision and removes it from the filesystem.

Viewing History

```
$ cvs log [file]                       $ mtn log [file]
```

Unlike CVS log, monotone log can also be used without a workspace; but in this case you must pass a '`--from`' revision argument to tell monotone where to start displaying the log from.

Importing a New Project

```
$ cvs import wobbler vendor start      $ mtn --db=/path/to/database.mtn -
                                       -branch=com.foo.wobbler setup .
                                       $ mtn add .
                                       $ mtn commit
```

The `setup` command turns an ordinary directory into a monotone workspace. After that, you can add your files and commit them as usual.

Initializing a Repository

```
$ cvs init -d /path/to/repository      $ mtn db init --db=/path/to/database.mtn
```

Monotone's "repository" is a single-file database, which is created and initialized by this command. This file is only ever used by you, and does not need to be in any special location, or readable by other users.

5 Command Reference

Monotone has a large number of commands. To help navigate through them all, commands are grouped into logical categories.

5.1 Tree

`mtn cat` *path*
`mtn cat --revision=`*id path*

Write the contents of a specific file *path* to standard output.

Without a '`--revision`' argument, the command outputs the contents of *path* as found in the current revision. This requires the command be executed from within a workspace.

With an explicit '`--revision`' argument, the command outputs contents of *path* at that revision.

`mtn checkout --revision=`*id directory*
`mtn co --revision=`*id directory*
`mtn --branch=`*branchname* `checkout` *directory*
`mtn --branch=`*branchname* `co` *directory*

These commands copy a revision *id* out of your database, recording the chosen revision (the *base revision*) in the file '*directory*`/_MTN/revision`'. These commands then copy every file version listed in the revision's manifest to paths under *directory*. For example, if the revision's manifest contains these entries:

```
dir ""

   file "Makefile"
content [84e2c30a2571bd627918deee1e6613d34e64a29e]

   file "include/hello.h"
content [c61af2e67eb9b81e46357bb3c409a9a53a7cdfc6]

   file "src/hello.c
content [97dfc6fd4f486df95868d85b4b81197014ae2a84]
```

Then the following files are created:

```
directory/
directory/Makefile
directory/include/hello.h
directory/src/hello.c
```

If you wish to `checkout` in the current directory, you can supply the special name '`.`' (a single period) for *directory*. When running `checkout` into an existing directory, it is sometimes possible for Section 3.6 [Workspace Collisions], page 54 to occur.

If no *id* is provided, as in the latter two commands, you *must* provide a *branchname*; monotone will attempt to infer *id* as the unique head of *branchname* if it exists.

`mtn clone --branch=`*branchname address directory*

The clone command is a helper command that performs the roles of a number of other commands all at once. Firstly, it constructs a new database. It then populates this database by `pull`ing any data in the branch *branchname* from the remote database, *address*. Finally, it copies the files out of the newly created database into a local directory, just as `checkout` would. The created database is placed in the new workspace as '*directory*`/_MTN/mtn.db`'.

`mtn disapprove` *id*

This command records a disapproval of the changes between *id*'s ancestor and *id*. It does this by committing the *inverse* changes as a new revision descending from *id*. The new revision will show up as a new head and thus a subsequent `merge` will incorporate the inverse of the disapproved changes in the other head(s).

Conceptually, `disapprove`s contract is that disapprove(A) gives a revision B such that whenever B is merged with a descendant D of A the merge will result in what D "would have looked like" if A had never happened.

Note that as a consequence of this contract the `disapprove` command only works if *id* has exactly one ancestor, since it hasn't been worked out how to generate such a descendant in the multi-ancestor case.

`mtn heads --branch=`*branchname*

This command lists the "heads" of *branchname*.

The "heads" of a branch is the set of revisions which are members of the branch, but which have no descendants. These revisions are generally the "newest" revisions committed by you or your colleagues, at least in terms of ancestry. The heads of a branch may not be the newest revisions, in terms of time, but synchronization of computer clocks is not reliable, so monotone usually ignores time.

`mtn merge [--branch=`*branchname*`]`

This command merges the "heads" of *branchname*, if there are multiple heads, and commits the results to the database, marking the resulting merged revision as a member of *branchname*. The merged revision will contain each of the head revision IDs as ancestors.

Merging is performed by repeated pairwise merges: two heads are selected, then their least common ancestor is located in the ancestry graph and these 3 revisions are provided to the built-in 3-way merge algorithm. The process then repeats for each additional head, using the result of each previous merge as an input to the next.

`mtn propagate` *sourcebranch destbranch*

This command takes a unique head from *sourcebranch* and merges it with a unique head of *destbranch*, using the least common ancestor of the two heads for a 3-way merge. The resulting revision is committed to *destbranch*. If either *sourcebranch* or *destbranch* has multiple heads, `propagate` aborts, doing nothing.

The purpose of `propagate` is to copy all the changes on *sourcebranch*, since the last `propagate`, to *destbranch*. This command supports the idea of making separate branches for medium-length development activities, such as maintenance branches for stable software releases, trivial bug fix branches, public contribution branches, or branches devoted to the development of a single module within a larger project.

`mtn explicit_merge` *id id destbranch*

This command merges exactly the two *id*s you give it, and places the result in branch *destbranch*. It is useful when you need more control over the merging

process than `propagate` or `merge` give you. For instance, if you have a branch with three heads, and you only want to merge two of them, you can use this command. Or if you have a branch with two heads, and you want to propagate one of them to another branch, again, you can use this command.

`mtn merge_into_dir` *`sourcebranch destbranch dir`*

This command takes a unique head from *sourcebranch* and merges it into a unique head of *destbranch*, as a directory. The resulting revision is committed to *destbranch*. If either *sourcebranch* or *destbranch* has multiple heads, `merge_into_dir` aborts, doing nothing.

The purpose of `merge_into_dir` is to permit a project to contain another project in such a way that `propagate` can be used to keep the contained project up-to-date. It is meant to replace the use of nested checkouts in many circumstances.

Note that `merge_into_dir` *does not* permit changes made to the contained project in *destbranch* to be propagated back to *sourcebranch*. Attempting this would lead to *sourcebranch* containing both projects nested as in *destbranch* instead of only the project originally in *sourcebranch*, which is almost certainly not what would be intended.

`mtn import --branch=`*`branch`* `[--message=`*`message`*`] [--dry-run]` *`dir`*
`mtn import --revision=`*`revision`* `[--message=`*`message`*`] [--dry-run]` *`dir`*

This command imports the contents of the given directory and commits it to the head of the given branch or as a child of the given revision (and consequently into the branch that revision resides in).

If the given branch doesn't exist, it is created automatically. If the branch already exists, any missing files are dropped and any unknown files are added before committing.

If `--dry-run` is given, no commit is done.

5.2 Workspace

`mtn setup [`*`directory`*`]`

This command prepares *directory* as a monotone workspace, by creating and populating the '`_MTN`' directory with basic information. This information must include at least the branch and the database to be used, both of which will be placed in the '`_MTN/options`' file.

This can be used with an empty directory to start a new blank project, or within an existing directory full of files, prior to using `mtn commit`. If no directory is specified, the current directory is used.

`mtn add` *`pathname...`*
`mtn add --unknown`

This command places "add" entries for the paths specified in *pathname...* in the workspace's "work list". The work list of your workspace is stored in '`_MTN/revision`', and is a list of explicit pathname changes you wish to commit at some future time, such as addition, removal or renaming of files.

As a convenience, the '`--unknown`' option can be used; this option will cause all of the files listed by `mtn list unknown` to be added.

While this command places an "add" entry on your work list, it does not immediately affect your database. When you `commit` your workspace, monotone will use the work list to build a new revision, which it will then commit to the database. The new revision will have any added entries inserted in its manifest.

`mtn [--no-respect-ignore] mkdir` *`directory...`*

This command creates a directory in the filesystem relative to your current location and adds it to your workspace's "work list". The changes are not reflected in your database until such time as you perform a commit. If you use the '`--no-respect-ignore`' flag, entries in .mtn-ignore will not be honored.

`mtn [--bookkeep-only] drop` *`pathname...`*
`mtn drop --missing`

This command places "drop" entries for the paths specified in *pathname...* in the workspace's "work list" and deletes the file from the workspace. The work list of your workspace is stored in '`_MTN/revision`', and is a list of explicit pathname changes you wish to commit at some future time, such as addition, removal, or renaming of files. This command also removes any attributes on *pathname*; see Section 3.12 [File Attributes], page 62 for more details. If you use the '`--missing`' flag it will add drop entries for any paths that monotone is tracking for which you have already removed the files from the filesystem, in addition to all those specified in *pathname...*.

While this command places a "drop" entry on your work list, it does not immediately affect your database. When you `commit` your workspace, monotone will use the work list to build a new revision, which it will then commit to the database. The new revision will have any dropped entries removed from its manifest.

There are situations in which `drop` will tell monotone to remove the file from the revision at commit time, but where it will *not* to remove the file from the

workspace immediately. One is if the '`--bookkeep-only`' option is supplied. Another is if a file has un-committed changes or if a directory is not empty.

`mtn [--bookkeep-only] rename` *`src dst`*
`mtn [--bookkeep-only] mv` *`src dst`*
`mtn [--bookkeep-only] rename` *`src1 ... dst/`*
`mtn [--bookkeep-only] mv` *`src1 ... dst/`*

This command places "rename" entries for the paths specified in *src* and *dst* in the workspace's "work list". The second form renames a number of source paths to the given destination. The work list of your workspace is stored in '`_MTN/revision`', and is a list of explicit pathname changes you wish to commit at some future time, such as addition, removal, or renaming of files. This command also moves any attributes on *src* to *dst*; see Section 3.12 [File Attributes], page 62 for more details, and, unless the '`--bookkeep-only`' option is supplied, it will rename the files immediately in the filesystem.

`mtn commit`
`mtn ci`
`mtn commit --message=`*`logmsg`* `[--message=`*`logmsg`*`...]`
`mtn ci --message=`*`logmsg`* `[--message=`*`logmsg`*`...]`
`mtn commit --message-file=`*`logfile`*
`mtn ci --message-file=`*`logfile`*
`mtn commit` *`pathname...`*
`mtn ci` *`pathname...`*
`mtn commit --message=`*`logmsg`* `[--message=`*`logmsg`*`...]` *`pathname...`*
`mtn ci --message=`*`logmsg`* `[--message=`*`logmsg`*`...]` *`pathname...`*
`mtn commit --message-file=`*`logfile pathname...`*
`mtn ci --message-file=`*`logfile pathname...`*

This command looks at your workspace, decides which files have changed, and saves the changes to your database. It does this by loading the revision named in '`_MTN/revision`', locating the base manifest for your workspace, applying any pathname changes described in '`_MTN/revision`', and then comparing the updated base manifest to the files it finds in your workspace, to determine which files have been edited.

For each edited file, a delta is copied into the database. Then the newly constructed manifest is recorded (as a delta) and finally the new revision. Once all these objects are recorded in you database, `commit` updates '`_MTN/revision`' to indicate that the base revision is now the newly created revision, and that there are no pathname changes to apply.

Specifying pathnames to `commit` restricts the set of changes that are visible and results in only a partial commit of the workspace. Changes to files not included in the specified set of pathnames will be ignored and will remain in the workspace until they are included in a future commit. With a partial commit, only the relevant entries in '`_MTN/revision`' will be removed and other entries will remain for future commits.

From within a subdirectory of the workspace the `commit` command will, by default, include *all changes* in the workspace. Specifying only the pathname

"." will restrict `commit` to files changed within the current subdirectory of the workspace.

The '`--message`' and '`--message-file`' options are mutually exclusive. Both provide a *logmsg* describing the commit. '`--message-file`' actually specifies the name of the file containing the log message, while '`--message`' provides it directly.

Multiple '`--message`' options may be provided on the command line. The log message will be formed by concatenating the '`--message`' options provided, with each one starting at the beginning of a new line.

The '`_MTN/log`' file can be edited by the user during their daily work to record the changes made to the workspace. When running the `commit` command without a *logmsg* supplied, the contents of the '`_MTN/log`' file will be read and passed to the Lua hook `edit_comment` as a second parameter named *user_log_content*. The log message will be prepended with a 'magic' string that must be removed to confirm the commit. This allows the user to easily cancel a commit, without emptying the entire log message. If the commit is successful, the '`_MTN/log`' file is cleared of all content making it ready for another edit/commit cycle.

If a '`--branch`' option is specified, the `commit` command commits to this branch (creating it if necessary). The branch becomes the new default branch of the workspace.

The `commit` command also synthesizes a number of certificates, which it attaches to the new manifest version and copies into your database:

- An `author` cert, indicating the person responsible for the changes leading to the new revision. Normally this defaults to your signing key or the return value of the `get_author` hook; you may override this by passing the '`--author`' option to commit. This is useful when committing a patch on behalf of someone else, or when importing "by hand" from another version control system.
- A `branch` cert, indicating the branch the committed revision belongs to.
- A `date` cert, indicating when the new revision was created. Normally this defaults to the current time; you may override this by passing the '`--date`' option to commit. This is useful when importing "by hand" from another version control system.
- A `changelog` cert, containing the "log message" for these changes. If you provided *logmsg* on the command line, this text will be used, otherwise `commit` will run the Lua hook `edit_comment (`*`commentary, user_log_content`*`)`, which typically invokes an external editor program, in which you can compose and/or review your log message for the change.

`mtn revert` *`pathname...`*
`mtn revert --missing` *`pathname...`*

This command changes your workspace, so that changes you have made since the last checkout or update are discarded. The command is restricted the set of files or directories given as arguments. To revert the entire workspace, use `revert "."` in the top-level directory. Specifying "." in a subdirectory will restrict `revert` to files changed within the current subdirectory.

If the flag '`--missing`' is given it reverts (ie, restores) any files which monotone has listed in its manifest, but which have been deleted from the workspace. Only missing files matching the given file or directory arguments are reverted.

`mtn update`
`mtn update --revision=`*`revision`*

Without a '`--revision`' argument, this command incorporates "recent" changes found in your database into your workspace. It does this by performing 3 separate stages. If any of these stages fails, the update aborts, doing nothing. The stages are:

- Examine the ancestry graph of revisions in your database, and (subject to trust evaluation) select the set of all descendants of your workspace's base revision. Call this set the "candidates" of the update.
- Remove any candidates which lack acceptable testresult certificates. From the remaining candidates, select the deepest child by ancestry and call it the "target" of the update.
- Merge the target of the update with the workspace, in memory, and if the merge is successful, write the result over top of the workspace.

With an explicit '`--revision`' argument, the command uses that revision as the update target instead of finding an acceptable candidate.

The effect is always to take whatever changes you have made in the workspace, and to "transpose" them onto a new revision, using monotone's 3-way merge algorithm to achieve good results. Note that with the explicit '`--revision`' argument, it is possible to update "backwards" or "sideways" in history — for example, reverting to an earlier revision, or if your branch has two heads, updating to the other. In all cases, the end result will be whatever revision you specified, with your local changes (and only your local changes) applied.

If a '`--branch`' option is specified, the `update` command tries to select the revision to update to from this branch. The branch becomes the new default branch of the workspace (even if you also specify an explicit '`--revision`' argument).

When running `update`, it is sometimes possible for Section 3.6 [Workspace Collisions], page 54 to occur.

`mtn pluck --revision=`*`to`*
`mtn pluck --revision=`*`from`* `--revision=`*`to`*

This command takes changes made at any point in history, and attempts to edit your current workspace to include those changes. The end result is identical to running `mtn diff '-r' `*`from`*` '-r' `*`to`*` | patch '-p0'`, except that this command uses monotone's merger, and thus intelligently handles renames, conflicts, and so on.

If only one revision is given, applies the changes made in *to* as compared with *to*'s parent. If two revisions are given, applies the changes made to get from *from* to *to*.

Note that this is not a true cherrypick operation. A true cherrypick, as that word is used in version control theory, involves applying some changes out of context, and then recording the identity between the original changes and the

newly applied changes for the use of later merges. This command does the first part, not the second. As far as monotone is concerned, the changes made by `mtn pluck` are exactly like those made in an editor; the command is simply a convenient way to make certain edits quickly. In practice, this is rarely a problem. `mtn pluck` should almost always be used between branches that will never be merged — for instance, backporting fixes from a development branch to a stable branch.

When you use `pluck` you are going behind monotone's back, and reducing its ability to help you keep track of what has happened in your history. Never use `pluck` where a true merging command like `merge`, `propagate`, or `explicit_merge` will do. If you find yourself using `pluck` often, you should consider carefully whether there is any way to change your workflow to reduce your need for `plucking`.

When running `pluck`, it is sometimes possible for Section 3.6 [Workspace Collisions], page 54 to occur.

`mtn refresh_inodeprints`

This command puts the current workspace into Section 3.5 [Inodeprints], page 53 mode, if it was not already, and forces a full inodeprints cache refresh. After running this command, you are guaranteed that your workspace is in inodeprints mode, and that the inodeprints cache is accurate and up to date.

`mtn pivot_root [--bookkeep-only] pivot_root` *`new_root put_old`*

Most users will never need this command. It is primarily useful in certain tricky cases where one wishes to combine several projects into one, or split one project into several. See also `merge_into_dir`.

Its effect is to rename the directory whose name is currently *new_root* to become the root directory of the versioned tree, and to at the same time rename the directory that is currently the root of the versioned tree to have the name *put_old*. Conceptually, it is equivalent to executing the following commands in the root of the workspace:

```
$ mtn rename . new_root/put_old
$ mtn rename new_root .
```

Except, of course, that these `rename` commands are illegal, because after the first command the tree has no root at all, and there is a directory loop. This illegality is the only reason for `pivot_root`'s existence; internally, the result is treated exactly like two renames, including with respect to merges and updates.

The use of '`--bookkeep-only`' with this command is not recommended. It causes the changes to be made in monotone's records, but not in the filesystem itself.

When running `pivot_root`, it is sometimes possible for Section 3.6 [Workspace Collisions], page 54 to occur.

5.3 Network

`mtn serve [--bind=[`*address*`][:`*port*`]]`
`mtn serve --stdio [--no-transport-auth]`
`mtn pull [--set-default] [`*uri-or-address*`] [`*glob* `[...]`
`[--exclude=`*exclude-glob*`]]]`
`mtn push [--set-default] [`*uri-or-address*`] [`*glob* `[...]`
`[--exclude=`*exclude-glob*`]]]`
`mtn sync [--set-default] [`*uri-or-address*`] [`*glob* `[...]`
`[--exclude=`*exclude-glob*`]]]`

These commands operate the "netsync" protocol built into monotone. This is a custom protocol for rapidly synchronizing two monotone databases using a hash tree index. The protocol is "peer to peer", but requires one peer to listen for incoming connections (the server) and the other peer (the client) to connect to the server. When run with '`--stdio`', the server listens for a single connection then terminates. When run with '`--bind`', or with neither option, the server listens for TCP connections and serves them continuously, until it is shut down.

The network *address* given to `serve` as an argument to '`--bind`' should be a host name to listen on, optionally followed by a colon and a port number. The default port number is 4691. If no '`--bind`' option is given, the server listens on port 4691 of every network interface.

If `serve` is run with '`--stdio`', a single netsync session is served over the `stdin` and `stdout` file descriptors. If '`--no-transport-auth`' is provided along with '`--stdio`', transport authentication and access control mechanisms are disabled. Only use '`--no-transport-auth`' if you are certain that the transport channel in use already provides sufficient authentication and authorization facilities.

The *uri-or-address* arguments given to `push`, `pull`, and `sync` can be of two possible forms. If the argument is a URI, a Lua hook may transform the URI into a connection command, and execute the command as a transport channel for netsync. If the argument is a simple hostname (with optional port number), monotone will use a TCP socket to the specified host and port as a transport channel for netsync.

The *glob* parameters indicate a set of branches to exchange. Multiple *glob* and '`--exclude`' options can be specified; every branch which matches a *glob* exactly, and does not match an *exclude-glob*, will be indexed and made available for synchronization.

For example, perhaps Bob and Alice wish to synchronize their `net.venge.monotone.win32` and `net.venge.monotone.i18n` branches. Supposing Alice's computer has hostname `alice.someisp.com`, then Alice might run:

```
$ mtn --bind=alice.someisp.com serve
```

And Bob might run

```
$ mtn sync alice.someisp.com "net.venge.monotone*"
```

When the operation completes, all branches matching `net.venge.monotone*` will be synchronized between Alice and Bob's databases.

The `pull`, `push`, and `sync` commands only require you pass *address* and *glob* the first time you use one of them; monotone will memorize this use and in the future default to the same server and glob. For instance, if Bob wants to `sync` with Alice again, he can simply run:

```
$ mtn sync
```

Of course, he can still `sync` with other people and other branches by passing an address or address plus globs on the command line; this will not affect his default affinity for Alice. If you ever do want to change your defaults, simply pass the '`--set-default`' option when connecting to the server and branch pattern that you want to make the new default.

In the server, different permissions can be applied to each branch; see the hooks `get_netsync_read_permitted` and `get_netsync_write_permitted` (see Chapter 6 [Hook Reference], page 131).

If a '`--pid-file`' option is specified, the command `serve` will create the specified file and record the process identifier of the server in the file. This file can then be read to identify specific monotone server processes.

The syntax for patterns is very simple. `*` matches 0 or more arbitrary characters. `?` matches exactly 1 arbitrary character. `{foo,bar,baz}` matches "foo", or "bar", or "baz". These can be combined arbitrarily. A backslash, `\`, can be prefixed to any character, to match exactly that character — this might be useful in case someone, for some odd reason, decides to put a "*" into their branch name.

5.4 Informative

`mtn status`
`mtn status` *`pathname...`*

This command prints a description of the "status" of your workspace. In particular, it prints:

- The branch currently selected in '`_MTN/options`' for the workspace.
- The revision id of the "parent" revision of the workspace, on which your in-progress changes are based.
- A list of logical changes between the base and current manifest versions, such as adds, drops, renames, and patches.

Specifying optional *pathname...* arguments to the `status` command restricts the set of changes that are visible and results in only a partial status of the workspace. Changes to files not included in the specified set of pathnames will be ignored.

From within a subdirectory of the workspace the `status` command will, by default, include *all changes* in the workspace. Specifying only the pathname `"."` will restrict `status` to files changed within the current subdirectory of the workspace.

`mtn log`
`mtn log [--last=`*`n`*`] [--next=`*`n`*`] [--from=`*`id`* `[...]] [--to=`*`id`* `[...]] [--brief] [--no-merges] [--no-files] [--diffs] [`*`file`* `[...]]`

This command prints out a log, in reverse-ancestry order, of small history summaries. Each summary contains author, date, changelog and comment information associated with a revision.

If '`--brief`' is given, the output consists of one line per revision with the revision ID, the author, the date and the branches (separated with commas).

If '`--last=`'*n* is given, at most *n* log entries will be given.

If '`--next=`'*n* is given, at most *n* log entries towards the current head revision will be given from the workspace's base revision in forward-ancestry order. This is useful to review changes that will be applied to the workspace when `update` is run.

If '`--from=`'*id* is given, the command starts tracing back through history from these revisions, otherwise it starts from the base revision of your workspace.

If '`--to=`'*id* is given, log will only print entries for revisions that would not also be printed when logging from the revisions specified in '`--to`'. This is useful for reviewing changes between two points in history.

By default, the log entries for merge nodes are shown. If '`--no-merges`' is given, the log entries for these nodes will be excluded.

If '`--no-files`' is given, the log output excludes the list of files changed in each revision.

Specifying '`--diffs`' causes the log output to include a unified diff of the changes in each revision.

If one or more files are given, the command will only log the revisions where those files are changed.

`mtn annotate` *file*
`mtn annotate [--revision=`*id*`] [--brief]` *file*

Dumps an annotated copy of the file to stdout. In the absence of the '`--brief`' flag, each line of the file is translated to <revision id>: <line> in the output, where <revision id> is the revision in which that line of the file was last edited.

If '`--brief`' is specified, the output is in the form <short revision id>.. by <author> <date>: <line> Only the first 8 characters of the revision id are displayed, the author cert value is truncated at the first `@` or space character and the date field is truncated to remove the time of day.

`mtn complete file` *partial-id*
`mtn complete [--brief] key` *partial-id*
`mtn complete [--brief] revision` *partial-id*

These commands print out all known completions of a partial SHA1 value, listing completions which are `file`, `manifest` or `revision` IDs depending on which variant is used. For example, suppose you enter this command and get this result:

```
$ mtn complete revision fa36
fa36deead87811b0e15208da2853c39d2f6ebe90
fa36b76dd0139177b28b379fe1d56b22342e5306
fa36965ec190bee14c5afcac235f1b8e2239bb2a
```

Then monotone is telling you that there are 3 revisions it knows about, in its database, which begin with the 4 hex digits `fa36`. This command is intended to be used by programmable completion systems, such as those in `bash` and `zsh`.

The complete command for keys and revisions have a '`--verbose`' option. Programmable completion systems can use '`--verbose`' output to present users with additional information about each completion option.
For example, verbose output for `revision` looks like this:

```
$ mt complete revision 01f
01f5da490941bee1f0000f0561fc62eabfb2fa23 graydon@dub.net 2003-12-03T03:14:35
01f992577bd8bcdcade0f89e724fd5dc2d2bbe8a kinetik@orcon.nz 2005-05-11T05:19:29
01faad191d8d0474777c70b4d606782942333a78 kinetik@orcon.nz 2005-04-11T04:24:01
```

`mtn diff [--unified] [--show-encloser]`
`mtn diff --context [--show-encloser]`
`mtn diff --external [--diff-args=`*argstring*`]`
`mtn diff` *pathname...*
`mtn diff --revision=`*id*
`mtn diff --revision=`*id pathname...*
`mtn diff --revision=`*id1* `--revision=`*id2*
`mtn diff --revision=`*id1* `--revision=`*id2 pathname...*

These commands print out GNU "unified diff format" textual difference listings between various manifest versions. With no '`--revision`' options, `diff` will print the differences between the base revision and the current revision in the workspace.

With one '`--revision`' option, `diff` will print the differences between the revision *id* and the current revision in the workspace. With two '`--revision`' options `diff` will print the differences between revisions *id1* and *id2*, ignoring any workspace.

In all cases, monotone will print a textual summary – identical to the summary presented by `mtn status` – of the logical differences between revisions in lines proceeding the diff. These lines begin with a single hash mark `#`, and should be ignored by a program processing the diff, such as `patch`.

Specifying pathnames to the `diff` command restricts the set of changes that are visible and results in only a partial diff between two revisions. Changes to files not included in the specified set of pathnames will be ignored.

From within a subdirectory of the workspace the `diff` command will, by default, include *all changes* in the workspace. Specifying only the pathname `"."` will restrict `diff` to files changed within the current subdirectory of the workspace.

The output format of `diff` is controlled by the options '`--unified`', '`--context`', '`--show-encloser`', and '`--external`'. By default, monotone uses its built-in diff algorithm to produce a listing in "unified diff" format (analogous to running the program `diff '-u'`); you can also explicitly request this with '`--unified`'. The built-in diff algorithm can also produce "context diff" format (analogous to `diff '-c'`), which you request by specifying '`--context`'. The short options that `diff` accepts for these modes, '`-u`' and '`-c`', also work.

In either of these modes, you can request that monotone print the name of the top-level code construct that encloses each "hunk" of changes, with '`--show-encloser`'. The options that `diff` accepts for this mode, '`-p`' and '`--show-c-function`', also work. Monotone finds the enclosing construct by scanning backward from the first changed line in each hunk for a line that matches a regular expression. The default regular expression is correct for many programming languages. You can adjust the expression used with the Lua hook `get_encloser_pattern`; Section 6.1 [Hooks], page 132.

'`--unified`' requests the "unified diff" format, the default. '`--context`' requests the "context diff" format (analogous to running the program `diff '-c'`). Both of these formats are generated directly by monotone, using its built-in diff algorithm.

Sometimes, you may want more flexibility in output formats; for these cases, you can use '`--external`', which causes monotone to invoke an external program to generate the actual output. By default, the external program is `diff`, and you can use the option '`--diff-args`' to pass additional arguments controlling formatting. The actual invocation of `diff`, default arguments passed to it, and so on, are controlled by the hook `external_diff`; see Section 6.1 [Hooks], page 132 for more details.

`mtn list certs` *id*
`mtn ls certs` *id*

These commands will print out a list of certificates associated with a particular revision *id*. Each line of the print out will indicate:

- Whether the signature on the certificate is `ok` or `bad`
- The key ID of the signer of the certificate
- The name of the certificate
- The value of the certificate

For example, this command lists the certificates associated with a particular version of monotone itself, in the monotone development branch:

```
$ mtn list certs 4a96
mtn: expanding partial id '4a96'
mtn: expanded to '4a96a230293456baa9c6e7167cafb3c5b52a8e7f'
-----------------------------------------------------------------
Key   : graydon@pobox.com
Sig   : ok
Name  : author
Value : graydon@dub.venge.net
-----------------------------------------------------------------
Key   : graydon@pobox.com
Sig   : ok
Name  : branch
Value : monotone
-----------------------------------------------------------------
Key   : graydon@pobox.com
Sig   : ok
Name  : date
Value : 2003-10-17T03:20:27
-----------------------------------------------------------------
Key   : graydon@pobox.com
Sig   : ok
Name  : changelog
Value : 2003-10-16  graydon hoare  <graydon@pobox.com>
      :
      :         * sanity.hh: Add a const version of idx().
      :         * diff_patch.cc: Change to using idx() everywhere.
      :         * cert.cc (find_common_ancestor): Rewrite to recursive
      :         form, stepping over historic merges.
      :         * tests/t_cross.at: New test for merging merges.
      :         * testsuite.at: Call t_cross.at.
      :
```

`mtn list keys`
`mtn ls keys`
`mtn list keys` *pattern*
`mtn ls keys` *pattern*

These commands list RSA keys held in your keystore and current database. They do not print out any cryptographic information; they simply list the names of public and private keys you have on hand.

If *pattern* is provided, it is used as a glob to limit the keys listed. Otherwise all keys in your database are listed.

`mtn list branches`
`mtn ls branches`

This command lists all known branches in your database.

`mtn list tags`
`mtn ls tags`
: This command lists all known tags in your database.

`mtn list vars`
`mtn ls vars`
`mtn list vars` *`domain`*
`mtn ls vars` *`domain`*
: This command lists all vars in your database, or all vars within a given *domain*. See Section 3.8 [Vars], page 57 for more information.

`mtn list known`
`mtn ls known`
`mtn list known` *`pathname...`*
`mtn ls known` *`pathname...`*
: This command lists all files which would become part of the manifest of the next revision if you committed your workspace at this point.

  Specifying pathnames to the `list known` command restricts the set of paths that are searched for manifest files. Files not included in the specified set of pathnames will not be listed.

  From within a subdirectory of the workspace the `list known` command will, by default, search the entire workspace. Specifying only the pathname `"."` will restrict the search for known files to the current subdirectory of the workspace.

`mtn list unknown`
`mtn ls unknown`
`mtn list unknown` *`pathname...`*
`mtn ls unknown` *`pathname...`*
: This command lists all files in your workspace that monotone is either ignoring or knows nothing about.

  Specifying pathnames to the `list unknown` command restricts the set of paths that are searched for unknown files. Unknown files not included in the specified set of pathnames will not be listed.

  From within a subdirectory of the workspace the `list unknown` command will, by default, search the entire workspace. Specifying only the pathname `"."` will restrict the search for unknown files to the current subdirectory of the workspace.

`mtn list ignored`
`mtn ls ignored`
`mtn list ignored` *`pathname...`*
`mtn ls ignored` *`pathname...`*
: This command lists all files in your workspace that monotone is intentionally ignoring, due to the results of the `ignore_file (`*`filename`*`)` hook.

  Specifying pathnames to the `list ignored` command restricts the set of paths that are searched for ignored files. Ignored files not included in the specified set of pathnames will not be listed.

From within a subdirectory of the workspace the `list ignored` command will, by default, search the entire workspace. Specifying only the pathname "." will restrict the search for ignored files to the current subdirectory of the workspace.

`mtn list missing`
`mtn ls missing`
`mtn list missing` *`pathname...`*
`mtn ls missing` *`pathname...`*

This command lists all files in your workspace's base manifest, which are not present in the workspace.

Specifying pathnames to the `list missing` command restricts the set of paths that are searched for missing files. Missing files not included in the specified set of pathnames will not be listed.

From within a subdirectory of the workspace the `list missing` command will, by default, search the entire workspace. Specifying only the pathname "." will restrict the search for missing files to the current subdirectory of the workspace.

`mtn list changed`
`mtn ls changed`
`mtn list changed` *`pathname...`*
`mtn ls changed` *`pathname...`*

This command lists all files in your workspace that have changed compared to the base revision, including files that are dropped, added or renamed.

Specifying pathnames to the `list changed` command restricts the set of paths that are checked for changes. Files not included in the specified set of pathnames will not be listed.

From within a subdirectory of the workspace the `list changed` command will, by default, search the entire workspace. Specifying only the pathname "." will restrict the search for known files to the current subdirectory of the workspace.

`mtn show_conflicts` *`rev rev`*

This command shows what conflicts would need to be resolved in order to merge the given revisions.

5.5 Key and Cert Trust

`mtn genkey` *keyid*

This command generates an RSA public/private key pair, using a system random number generator, and stores it in your keystore under the key name *keyid*.

The private half of the key is stored in an encrypted form, so that anyone who can read your keystore cannot extract your private key and use it. You must provide a passphrase for your key when it is generated, which is used to determine the encryption key. In the future you will need to enter this passphrase again each time you sign a certificate, which happens every time you `commit` to your database. You can tell monotone to automatically use a certain passphrase for a given key using the `get_passphrase(`*keypair_id*`)`, but this significantly increases the risk of a key compromise on your local computer. Be careful using this hook.

`mtn dropkey` *keyid*

This command drops the public and/or private key. If both exist, both are dropped, if only one exists, it is dropped. This command should be used with caution as changes are irreversible without a backup of the key(s) that were dropped.

`mtn passphrase` *id*

This command lets you change the passphrase of the private half of the key *id*.

`mtn trusted` *id certname certval signers*

This command lets you test your revision trust hook `get_revision_cert_trust` (see Chapter 6 [Hook Reference], page 131). You pass it a revision ID, a certificate name, a certificate value, and one or more key IDs, and it will tell you whether, under your current settings, Monotone would trust a cert on that revision with that value signed by those keys.

`mtn ssh_agent_export` *filename*

This command will export your private key in a format that ssh-agent can read (PKCS8, PEM). You will be asked for your current key's password and a new password to encrypt the key with. The key will be printed to stdout. Once you have put this key in a file simply add it to ssh-agent and you will only have to enter your key password once as ssh-agent will cache the key for you.

```
$ mtn ssh_agent_export ~/.ssh/id_monotone
enter passphrase for key ID [user@example.com]:
enter new passphrase for key ID [user@example.com]:
confirm passphrase for key ID [user@example.com]:
$ chmod 600 ~/.ssh/id_monotone
$ ssh-agent /bin/bash
$ ssh-add ~/.ssh/id_monotone
Enter passphrase for /home/user/.ssh/id_monotone:
Identity added: /home/user/.ssh/id_monotone (/home/user/.ssh/id_monotone)
$ mtn ci -m"Changed foo to bar"
$ mtn push
```

You can also use the '`--ssh-sign`' option to control whether ssh-agent will be used for signing. If set to *yes*, ssh-agent will be used to sign. If your key has not been added to ssh-agent monotone will fall back to its internal signing

code and ask you for your password. If set to *only*, monotone will sign only with ssh-agent. If set to *no*, monotone will always use its internal signing code even if ssh-agent is running and has your monotone key loaded. If set to *check*, monotone will sign with both ssh-agent (if your key is loaded into it) and monotone's internal signing code, then compare the results. *check* will be removed at some future time as it is meant only for testing and will not work with all signing algorithms.

5.6 Certificate

`mtn cert` *`id certname`*
`mtn cert` *`id certname certval`*

These commands create a new certificate with name *certname*, for a revision with version *id*. The *id* argument can be a selector using certs already on the revision, such as `h:`*`branchname`*.

If *certval* is provided, it is the value of the certificate. Otherwise the certificate value is read from `stdin`.

`mtn approve` *`id`*

This command is a synonym for `mtn cert` *`id`* `branch` *`branchname`* where *branchname* is the current branch name (either deduced from the workspace or from the '`--branch`' option).

`mtn comment` *`id`*
`mtn comment` *`id comment`*

These commands are synonyms for `mtn cert` *`id`* `comment` *`comment`*. If *comment* is not provided, it is read from `stdin`.

`mtn tag` *`id tagname`*

This command associates the symbolic name *tagname* with the revision *id*, so that symbolic name can later be used in Section 3.2 [Selectors], page 47 for specifying revisions for commands like `update` or `diff`.

This command is a synonym for `mtn cert` *`id`* `tag` *`tagname`*.

`mtn testresult` *`id`* `0`
`mtn testresult` *`id`* `1`

These commands are synonyms for `mtn cert` *`id`* `testresult 0` or `mtn cert` *`id`* `testresult 1`.

5.7 Packet I/O

Monotone can produce and consume data in a convenient, portable form called *packets*. A packet is a sequence of ASCII text, wrapped at 70-columns and easily sent through email or other transports. If you wish to manually transmit a piece of information – for example a public key – from one monotone database to another, it is often convenient to read and write packets.

Note: earlier versions of monotone queued and replayed packet streams for their networking system. This older networking system has been removed, as the netsync protocol has several properties which make it a superior communication system. However, the packet I/O facility will remain in monotone as a utility for moving individual data items around manually.

`mtn automate packets_for_certs` *id*
: This command prints out an `rcert` packet for each cert in your database associated with *id*. These can be used to transport certificates safely between monotone databases. See Section 5.9 [Automation], page 98 for details of this command.

`mtn automate packet_for_fdata` *id*
`mtn automate packet_for_rdata` *id*
: These commands print out an `fdata` or `rdata` packet for the file, manifest or revision *id* in your database. These can be used to transport files or revisions, in their entirety, safely between monotone databases. See Section 5.9 [Automation], page 98 for details of these commands.

`mtn automate packet_for_fdelta` *id1 id2*
: This command prints out an `fdelta` packet for the differences between file versions *id1* and *id2*, in your database. These can be used to transport file differences safely between monotone databases. See Section 5.9 [Automation], page 98 for details of this command.

`mtn privkey` *keyid*
`mtn pubkey` *keyid*
: These commands print out an `keypair` or `pubkey` packet for the RSA key *keyid*. These can be used to transport public or private keys safely between monotone databases.

`mtn read`

`mtn read` *file1 file2...*
: This command reads packets from files or `stdin` and stores them in your database.

5.8 Database

`mtn set` *`domain name value`*

Associates the value *value* to *name* in domain *domain*. See Section 3.8 [Vars], page 57 for more information.

`mtn unset` *`domain name`*

Deletes any value associated with *name* in *domain*. See Section 3.8 [Vars], page 57 for more information.

`mtn db init --db=`*`dbfile`*

This command initializes a new monotone database at *dbfile*.

`mtn db info --db=`*`dbfile`*

This command prints information about the monotone database *dbfile*, including its schema version and various table size statistics.

`mtn db version --db=`*`dbfile`*

This command prints out just the schema version of the monotone database *dbfile*.

`mtn db dump --db=`*`dbfile`*

This command dumps an SQL statement representing the entire state of *dbfile* to the standard output stream. It is a very low-level command, and produces the most "recoverable" dumps of your database possible. It is sometimes also useful when migrating databases between variants of the underlying SQLite database format.

`mtn db load --db=`*`dbfile`*

This command applies a raw SQL statement, read from the standard input stream, to the database *dbfile*. It is most useful when loading a database dumped with the `dump` command.

Note that when reloading a dumped database, the schema of the dumped database is *included* in the dump, so you should not try to `init` your database before a `load`.

`mtn db migrate --db=`*`dbfile`*

This command attempts to migrate the database *dbfile* to the newest schema known by the version of monotone you are currently running. If the migration fails, no changes should be made to the database.

If you have important information in your database, you should back up a copy of it before migrating, in case there is an untrapped error during migration.

`mtn db check --db=`*`dbfile`*

Monotone always works hard to verify the data it creates and accesses. For instance, if you have hard drive problems that corrupt data in monotone's database, and you attempt to retrieve this data, then monotone will notice the problem and stop, instead of silently giving you garbage data.

However, it's also nice to notice such problems early, and in rarely used parts of history, while you still have backups. That's what this command is for. It systematically checks the database *dbfile* to ensure that it is complete and consistent. The following problems are detected:

- missing files that are referenced by their SHA1 hash from some manifest but do not exist in the database. This is a serious problem; it means that your history is not fully reconstructible. You can fix it by finding the file with the given hash, and loading it into your database with `fload`.
- unreferenced files that exist in the database but are not referenced by their SHA1 hash from any existing manifest. In itself, this only indicates some wasted space, and is not a problem; it's possible it could arise under normal use (for instance, in some strange corner cases following an incomplete netsync). It could also arise, though, as a symptom of some other more serious problem.
- missing manifests that are referenced by their SHA1 hash from some revision but do not exist in the database. This is a serious problem; it means that your history is not fully reconstructible. You can fix it by finding a database containing the manifest, and using `mdata` on that database to create a manifest data packet, which can be loaded into your database with `read`.
- unreferenced manifests that exist in the database but are not referenced by their SHA1 hash from any existing revision. In itself, this only indicates some wasted space, and is not a problem; it's possible it could arise under normal use (for instance, if you have run `db kill_rev_locally`, or in some strange-but-harmless corner cases following an incomplete netsync). It could also arise, though, as a symptom of some other more serious problem.
- incomplete manifests that exist in the database but contain references to files that do not exist in the database. For diagnosis and solution, see "missing files" above.
- missing revisions that are referenced by their SHA1 hash from some other revision or revision cert but do not exist in the database. This may be a serious problem; it may indicate that your history is not fully reconstructible (if the reference is from another revision) or that someone is creating bogus certs (if the reference is from a cert). You can fix it by finding a database containing the revision, and using `rdata` on that database to create a revision data packet, which can be loaded into your database with `read`.
- incomplete revisions that exist in the database but contain references to missing manifests, incomplete manifests or missing revisions. This always occurs with some more detailed error; see above.
- revisions with mismatched parents that disagree with the cached revision ancestry on their parent revisions. This may cause problems in using the database, and suggests the presence of a bug in monotone's caching system, but does not involve data loss.
- revisions with mismatched children that disagree with the cached revision ancestry on their child revisions. This may cause problems in using the database, and suggests the presence of a bug in monotone's caching system, but does not involve data loss.
- revisions with bad history that exist in the database but fail monotone's normal sanity checks for consistent and correct history. This is a seri-

ous problem; it indicates that your history record is somehow malformed. This should not be possible, since monotone carefully checks every revision before storing it into the database, but if it does, then please request assistance on the monotone mailing list. Fixing this generally means you may lose some history — for instance, renames may be degraded into delete/add pairs — but the actual contents of every revision will still be reproducible.

- revisions with missing certs that exist in the database lacking at least one author, branch, changelog or date cert. All revisions are expected to have at least one of each of these certs. In itself, this is not necessarily a problem, but it is peculiar, and some operations such as netsync may behave strangely.
- revisions with mismatched certs that exist in the database with differing numbers of author, changelog and date certs. These certs are expected to appear together, as each revision committed should have an author, changelog and date associated with it. In itself, this is not a problem, but it is peculiar. All operations should behave normally.
- missing keys that have been used to sign certs but do not exist in the database. In itself, this is not a problem, except that monotone will ignore any certs signed by the missing key. You can fix it by finding a database containing the key in question, and using `pubkey` on that database to create a public key packet, which can be loaded into your database with `read`.
- certs with bad signatures that exist in the database with signatures that are invalid. In itself, this is not a problem, except that monotone will ignore any such certs. You may also wish to find out who is creating certs with bad signatures; it may indicate some kind of security attack.
- certs with unchecked signatures that exist in the database but cannot have their signatures checked because the signing key is missing. In itself, this is not a problem, except that monotone will ignore any certs signed by the missing key. You can fix it by finding a database containing the key in question, and using `pubkey` on that database to create a public key packet, which can be loaded into your database with `read`.

This command also verifies that the SHA1 hash of every file, manifest, and revision is correct.

`mtn db kill_rev_locally` *`id`*

This command "kills", i.e., deletes, a given revision, as well as any certs attached to it. It has an ugly name because it is a dangerous command; it permanently and irrevocably deletes historical information from your database. There are a number of caveats:

- It can only be applied to revisions that have no descendants. If you want to kill a revision that has descendants, you must kill all of the descendants first.
- It only removes the revision from your local database (hence the "locally" in the command name). If you have already pushed this revision out to another database, then the next time you pull from that database it may

come back again. There is no way to delete a revision from somebody else's database except to ask them to delete it for you.

- It does not actually delete the revision's files or manifest from your database. If you run this command, and then run `db check`, it will note that you have an "unreferenced manifest". If you wish to eliminate this data for good (and thus free up the space), you may use netsync to `pull` from your current database into a new database; this creates a copy of your old database, without the unreferenced data. However, having this data in your database will not cause any problems, and acts as a safety net; if you later realize that you do, after all, need to retrieve the data in *id*, then `db check` will let you see which manifest it was, and with some work you can extract *id*'s data.

`mtn db kill_branch_certs_locally` *branch*

This command "kills" a branch by deleting all branch certs with that branch name. You should consider carefully whether you want to use it, because it can irrevocably delete important information. It does not modify or delete any revisions or any of the other certificates on revisions in the branch; it simply removes the branch certificates matching the given branch name. Because of this, it can leave revisions without any branch certificate at all. As with `db kill_rev_locally`, it only deletes the information from your local database; if there are other databases that you sync with which have revisions in this branch, the branch certificates will reappear when you sync, unless the owners of those databases also delete those certificates locally.

`mtn db kill_tag_locally` *tag*

This command "kills" a tag by deleting all tag certs with that tag name. You should consider carefully whether you want to use it, because it can irrevocably delete important information. It does not modify or delete any revisions, or any of the other certificates on tagged revisions; it simply removes all tag certificates with the given name. As with `db kill_rev_locally`, it only deletes the information from your local database; if there are other databases that you sync with which have this tag, the tag certificates will reappear when you sync, unless the owners of those databases also delete those certificates locally.

`mtn db execute` *sql-statement*

This is a debugging command which executes *sql-statement* against your database, and prints any results of the expression in a tabular form. It can be used to investigate the state of your database, or help diagnose failures.

5.9 Automation

This section contains subcommands of the `mtn automate` command, used for scripting monotone. All give output on `stdout`; they may also give useful chatter on `stderr`, including warnings and error messages.

`mtn automate interface_version`

Arguments:

None.

Added in:

0.0

Purpose:

Prints version of the automation interface. Major number increments whenever a backwards incompatible change is made to the `automate` command; minor number increments whenever any change is made (but is reset when major number increments).

Sample output:

```
1.2
```

Output format:

A decimal number, followed by "." (full stop/period), followed by a decimal number, followed by a newline, followed by end-of-file. The first decimal number is the major version, the second is the minor version.

Error conditions:

None.

`mtn automate heads [`*branch*`]`

Arguments:

One branch name, *branch*. If none is given, the current default branch is used.

Added in:

0.0

Purpose:

Prints the heads of branch *branch*.

Sample output:

```
28ce076c69eadb9b1ca7bdf9d40ce95fe2f29b61
75156724e0e2e3245838f356ec373c50fa469f1f
```

Output format:

Zero or more lines, each giving the ID of one head of the given branch. Each line consists of a revision ID, in hexadecimal, followed by a newline. The lines are printed in alphabetically sorted order.

Error conditions:

If the given branch contains no members or does not exist, then no lines are printed.

`mtn automate ancestors` *rev1* [*rev2* [...]]

Arguments:

One or more revision IDs, *rev1*, *rev2*, etc.

Added in:

0.2

Purpose:

Prints the ancestors of one or more revisions.

Sample output:

```
28ce076c69eadb9b1ca7bdf9d40ce95fe2f29b61
75156724e0e2e3245838f356ec373c50fa469f1f
```

Output format:

Zero or more lines, each giving the ID of one ancestor of the given revisions. Each line consists of a revision ID, in hexadecimal, followed by a newline. The lines are printed in alphabetically sorted order.

The output does not include *rev1*, *rev2*, etc., except if *rev2* is itself an ancestor of *rev1*, then *rev2* will be included in the output.

Error conditions:

If any of the revisions do not exist, prints nothing to stdout, prints an error message to stderr, and exits with status 1.

`mtn automate common_ancestors` *rev1* [*rev2* [...]]

Arguments:

One or more revision IDs, *rev1*, *rev2*, etc.

Added in:

2.1

Purpose:

Prints all revisions which are ancestors of all of the revisions given as arguments.

Sample output:

```
28ce076c69eadb9b1ca7bdf9d40ce95fe2f29b61
75156724e0e2e3245838f356ec373c50fa469f1f
```

Output format:

Zero or more lines, each giving the ID of one common ancestor of all the given revisions. Each line consists of a revision ID, in hexadecimal, followed by a newline. The lines are printed in alphabetically sorted order.

The output will include one of the argument revisions only if that revision is an ancestor of all other revisions given as arguments.

Error conditions:

If any of the revisions do not exist, prints nothing to stdout, prints an error message to stderr, and exits with status 1.

`mtn automate parents` *rev*

Arguments:

One revision ID, *rev*.

Added in:

0.2

Purpose:

Prints the immediate parents of a revision. This is like a non-recursive version of `automate ancestors`.

Sample output:

```
28ce076c69eadb9b1ca7bdf9d40ce95fe2f29b61
75156724e0e2e3245838f356ec373c50fa469f1f
```

Output format:

Zero or more lines, each giving the ID of one parent of the given revision. Each line consists of a revision ID, in hexadecimal, followed by a newline. The lines are printed in alphabetically sorted order.

Error conditions:

If the given revision *rev* does not exist, prints nothing to stdout, prints an error message to stderr, and exits with status 1.

`mtn automate descendents` *rev1* `[`*rev2* `[...]]`

Arguments:

One or more revision IDs, *rev1*, *rev2*, etc.

Added in:

0.1

Purpose:

Prints the descendants of one or more revisions.

Sample output:

```
28ce076c69eadb9b1ca7bdf9d40ce95fe2f29b61
75156724e0e2e3245838f356ec373c50fa469f1f
```

Output format:

Zero or more lines, each giving the ID of one descendant of the given revisions. Each line consists of a revision ID, in hexadecimal, followed by a newline. The lines are printed in alphabetically sorted order.

The output does not include *rev1*, *rev2*, etc., except that if *rev2* is itself a descendant of *rev1*, then *rev2* will be included in the output.

Error conditions:

If any of the revisions do not exist, prints nothing to stdout, prints an error message to stderr, and exits with status 1.

`mtn automate children` *rev*

Arguments:

One revision ID, *rev*.

Added in:

0.2

Purpose:

Prints the immediate children of a revision. This is like a non-recursive version of `automate descendents`.

Sample output:

```
28ce076c69eadb9b1ca7bdf9d40ce95fe2f29b61
75156724e0e2e3245838f356ec373c50fa469f1f
```

Output format:

Zero or more lines, each giving the ID of one child of the given revision. Each line consists of a revision ID, in hexadecimal, followed by a newline. The lines are printed in alphabetically sorted order.

Error conditions:

If the given revision *rev* does not exist, prints nothing to stdout, prints an error message to stderr, and exits with status 1.

`mtn automate graph`

Arguments:

None.

Added in:

0.2

Purpose:

Prints out the complete ancestry graph of this database.

Sample output:

```
0c05e8ec9c6af4224672c7cc4c9ef05ae8bdb794
27ebcae50e1814e35274cb89b5031a423c29f95a 5830984dec5c41d994bcadfeab4bf1
4e284617c80bec7da03925062a84f715c1b042bd 27ebcae50e1814e35274cb89b5031a
```

Output format:

Zero or more lines, each giving ancestry information for one revision. Each line begins with a revision ID. Following this are zero or more space-prefixed revision IDs. Each revision ID after the first is a parent (in the sense of `automate parents`) of the first. For instance, in the above sample output, 0c05e8ec9c6af4224672c7cc4c9ef05ae8bdb794 is a root node, 27ebcae50e1814e35274cb89b5031a423c29f95a has one parent, and 4e284617c80bec7da03925062a84f715c1b042bd has two parents, i.e., is a merge node.

The output as a whole is alphabetically sorted by line; additionally, the parents within each line are alphabetically sorted.

Error conditions:

None.

`mtn automate erase_ancestors [`*rev1* `[`*rev2* `[...]]]`

Arguments:

One or more revision IDs, *rev1*, *rev2*, etc.

Added in:

0.1

Purpose:

Prints all arguments, except those that are an ancestor of some other argument. One way to think about this is that it prints the minimal elements of the given set, under the ordering imposed by the "child of" relation. Another way to think of it is if the arguments formed a branch, then we would print the heads of that branch. If there are no arguments, prints nothing.

Sample output:

```
28ce076c69eadb9b1ca7bdf9d40ce95fe2f29b61
75156724e0e2e3245838f356ec373c50fa469f1f
```

Output format:

Zero or more lines, each giving the ID of one descendant of the given revisions. Each line consists of a revision ID, in hexadecimal, followed by a newline. The lines are printed in alphabetically sorted order.

Error conditions:

If any of the revisions do not exist, prints nothing to stdout, prints an error message to stderr, and exits with status 1.

`mtn automate toposort [`*rev1* `[`*rev2* `[...]]]`

Arguments:

One or more revision IDs, *rev1*, *rev2*, etc.

Added in:

0.1

Purpose:

Prints all arguments, topologically sorted. I.e., if *rev1* is an ancestor of *rev2*, then *rev1* will appear before *rev2* in the output; if *rev2* is an ancestor of *rev1*, then *rev2* will appear before *rev1* in the output; and if neither is an ancestor of the other, then they may appear in either order. If there are no arguments, prints nothing.

Sample output:

```
28ce076c69eadb9b1ca7bdf9d40ce95fe2f29b61
75156724e0e2e3245838f356ec373c50fa469f1f
```

Output format:

A list of revision IDs, in hexadecimal, each followed by a newline. Revisions are printed in topologically sorted order.

Error conditions:

If any of the revisions do not exist, prints nothing to stdout, prints an error message to stderr, and exits with status 1.

`mtn automate ancestry_difference` *`new`* `[`*`old1`* `[`*`old2`* `[...]]]`

Arguments:

A "new" revision ID *new*, followed by zero or more "old" revision IDs *old1*, *old2*, etc.

Added in:

0.1

Purpose:

Prints all ancestors of the revision *new*, that are not also ancestors of one of the old revisions. For purposes of this command, "ancestor" is an inclusive term; for example, if *new* is an ancestor of *old1*, it will not be printed; but if *new* is not an ancestor of any of the "old" revisions, then it will be. Similarly, *old1* will never be printed, because it is considered to be an ancestor of itself. The reason for the names is that if *new* a new revision, and *old1*, *old2*, etc. are revisions that you have processed before, then this command tells you which revisions are new since then.

Sample output:

```
28ce076c69eadb9b1ca7bdf9d40ce95fe2f29b61
75156724e0e2e3245838f356ec373c50fa469f1f
```

Output format:

A list of revision IDs, in hexadecimal, each followed by a newline. Revisions are printed in topologically sorted order.

Error conditions:

If any of the revisions do not exist, prints nothing to stdout, prints an error message to stderr, and exits with status 1.

`mtn automate leaves`

Arguments:

None.

Added in:

0.1

Purpose:

Prints the leaves of the revision graph, i.e. all revision that have no children. This is similar, but not identical to the functionality of `heads`, which prints every revision in a branch, that has no descendants in that branch. If every revision in the database was in the same branch, then they would be identical. Generally, every leaf is the head of some branch, but not every branch head is a leaf.

Sample output:

```
28ce076c69eadb9b1ca7bdf9d40ce95fe2f29b61
```

```
75156724e0e2e3245838f356ec373c50fa469f1f
```

Output format:

Zero or more lines, each a leaf of the revision graph. Each line consists of a revision ID, in hexadecimal, followed by a newline. The lines are printed in alphabetically sorted order.

Error conditions:

None.

`mtn automate roots`

Arguments:

None.

Added in:

4.3

Purpose:

Prints the roots of the revision graph, i.e. all revisions that have no parents.

Sample output:

```
276264b0b3f1e70fc1835a700e6e61bdbe4c3f2f
```

Output format:

Zero or more lines, each a root of the revision graph. Each line consists of a revision ID, in hexadecimal, followed by a newline. The lines are printed in alphabetically sorted order.

Error conditions:

None.

`mtn automate branches`

Arguments:

None.

Added in:

2.2

Purpose:

Prints all branch certs present in the revision graph, that are not excluded by the Lua hook `ignore_branch`.

Sample output:

```
net.venge.monotone
net.venge.monotone.win32
```

Output format:

Zero or more lines, each the name of a branch. The lines are printed in alphabetically sorted order.

Error conditions:

None.

`mtn automate tags [`*`branch_pattern`*`]`

Arguments:

A branch pattern (optional).

Added in:

2.2

Purpose:

If a branch pattern is given, prints all tags that are attached to revisions on branches matched by the pattern; otherwise prints all tags of the revision graph.

If a branch name is ignored by means of the Lua hook `ignore_branch`, it is neither printed, nor can it be matched by a pattern.

Sample output:

```
format_version "1"

     tag "monotree-0.3"
revision [35cff8e8ba14155f5f7ddf7965073f514fd60f61]
  signer "njs@pobox.com"
branches "net.venge.monotone.contrib.monotree"

     tag "monotree-0.2"
revision [5d288b39b49613b0d9dca8ece6b9a42c3773f35b]
  signer "njs@pobox.com"
branches "net.venge.monotone.contrib.monotree"

     tag "monotree-0.1"
revision [8a121346ce2920b6f85df68b3b620de96bd14a8d]
  signer "njs@pobox.com"
branches "net.venge.monotone.contrib" "net.venge.monotone.contrib.monot

     tag "monotree-0.4"
revision [f1afc520474f83c58262896ede027ef77226046e]
  signer "njs@pobox.com"
branches "net.venge.monotone.contrib.monotree"
```

Output format:

There is one basic_io stanza for each tag.

All stanzas are formatted by basic_io. Stanzas are separated by a blank line. Values will be escaped, '\' to '\\' and '"' to '\"'.

Each stanza has exactly the following four entries:

`''tag''` the value of the tag cert, i.e. the name of the tag

`''revision''`
: the hexadecimal id of the revision the tag is attached to

‘’`signer`’’
: the name of the key used to sign the tag cert

‘’`branches`’’
: a (possibly empty) list of all branches the tagged revision is on

Stanzas are printed in arbitrary order.

Error conditions:
A run-time exception occurs if an illegal branch pattern is specified.

`mtn automate select` *`selector`*

Arguments:
One selector (or combined selector).

Added in:
0.2

Purpose:
Print all revisions that match the given selector.

Sample output:
```
28ce076c69eadb9b1ca7bdf9d40ce95fe2f29b61
75156724e0e2e3245838f356ec373c50fa469f1f
```

Output format:
Zero or more lines, each giving the ID of one revision that matches the given selector. Each line consists of a revision ID, in hexadecimal, followed by a newline. Revision ids are printed in alphabetically sorted order.

Error conditions:
None.

`mtn automate identify` *`path`*

Arguments:
A file path.

Added in:
4.2

Purpose:
Prints the file ID (aka hash) of the given file.

Sample output:
```
6265ab1312fbe38bdc3aafa92441139cb2b779b0
```

Output format:
A single line with the file's ID, in hexadecimal, followed by a newline.

Error conditions:
If the file does not exists, is a special file or not readable, prints an error message to stderr and exists with status 1. A single file path

only consisting of "-" is disallowed since it collides with the UNIX stdin marker.

`mtn automate inventory`

Arguments:

None.

Added in:

1.0

Purpose:

Prints the inventory of every file found in the workspace or its associated base manifest. Each unique path is listed on a line prefixed by three status characters and two numeric values used for identifying renames.

Sample output:

All basic status codes:

```
  M 0 0 missing
 AP 0 0 added
D   0 0 dropped
R   1 0 renamed-from-this
 R  0 1 renamed-to-this
  P 0 0 patched
    0 0 unchanged
  U 0 0 unknown
  I 0 0 ignored
```

Two files swapped:

```
RR  1 2 unchanged
RR  2 1 original
```

Recorded with monotone that two files were swapped, but they were not actually swapped in the filesystem. Thus they both appear as patched:

```
RRP 1 2 unchanged
RRP 2 1 original
```

Rename ‘`foo`’ to ‘`bar`’; add new file ‘`foo`’:

```
RAP 1 0 foo
 R  0 1 bar
```

Rotated files ‘`foo`’ -> ‘`bar`’ -> ‘`baz`’ -> ‘`foo`’:

```
RR  1 3 foo
RR  2 1 bar
RR  3 2 baz
```

Recorded the rotation of files ‘`foo`’ -> ‘`bar`’ -> ‘`baz`’ -> ‘`foo`’, but the actual files in the workspace were not moved, so monotone interprets all files as having been patched:

```
RRP 1 3 foo
RRP 2 1 bar
RRP 3 2 baz
```

Dropped but not removed and thus unknown:

```
D U 0 0 dropped
```

Added a non-existent file which is thus missing:

```
 AM 0 0 added
```

Recorded a rename, but not moved in the filesystem, and thus unknown source and missing target:

```
R U 1 0 original
 RM 0 1 renamed
```

Moved in the filesystem but no rename recorded, and thus missing source and unknown target:

```
  M 0 0 original
  U 0 0 renamed
```

Renamed and patched:

```
R   1 0 original
 RP 0 1 renamed
```

Output format:

Each path is printed on its own line, prefixed by three status characters described below. The status is followed by a single space and two numbers, each separated by a single space, used for identifying renames. The numbers are followed by a single space and then the pathname, which includes the rest of the line. Directory paths are identified as ending with the "/" character, file paths do not end in this character.

The three status characters are as follows.

```
column 1 pre-state
      ' ' the path was unchanged in the pre-state
      'D' the path was deleted from the pre-state
      'R' the path was renamed from the pre-state name
column 2 post-state
      ' ' the path was unchanged in the post-state
      'R' the path was renamed to the post-state name
      'A' the path was added to the post-state
column 3 file-state
      ' ' the file is known and unchanged from the current manifest ver
      'P' the file is patched to a new version
      'U' the file is unknown and not included in the current manifest
      'I' the file is ignored and not included in the current manifest
      'M' the file is missing but is included in the current manifest
```

Note that out of the 45 possible status code combinations, only 26 are valid, detailed below.

```
'   ' unchanged
'  P' patched (contents changed)
'  U' unknown (exists on the filesystem but not tracked)
'  I' ignored (exists on the filesystem but excluded by Lua hook)
'  M' missing (exists in the manifest but not on the filesystem)

' A ' added (invalid, add should have associated patch)
' AP' added and patched
' AU' added but unknown (invalid)
' AI' added but ignored (invalid, added files are no longer ignored)
' AM' added but missing from the filesystem

' R ' rename target
' RP' rename target and patched
' RU' rename target but unknown (invalid)
' RI' rename target but ignored (invalid)
' RM' rename target but missing from the filesystem

'D  ' dropped
'D P' dropped and patched (invalid)
'D U' dropped and unknown (still exists on the filesystem)
'D I' dropped and ignored
'D M' dropped and missing (invalid)

'DA ' dropped and added (invalid, add should have associated patch)
'DAP' dropped and added and patched
'DAU' dropped and added but unknown (invalid)
'DAI' dropped and added but ignored (invalid, added files are no longer
'DAM' dropped and added but missing from the filesystem

'DR ' dropped and rename target
'DRP' dropped and rename target and patched
'DRU' dropped and rename target but unknown (invalid)
'DRI' dropped and rename target but ignored (invalid)
'DRM' dropped and rename target but missing from the filesystem

'R  ' rename source
'R P' rename source and patched (invalid)
'R U' rename source and unknown (still exists on the filesystem)
'R I' rename source and ignored
'R M' rename source and missing (invalid)

'RA ' rename source and added (invalid, add should have associated patc
'RAP' rename source and added and patched
'RAU' rename source and added but unknown (invalid)
'RAI' rename source and added but ignored (invalid, added files are no
'RAM' rename source and added but missing from the filesystem
```

```
'RR ' rename source and target
'RRP' rename source and target and target patched
'RRU' rename source and target and target unknown (invalid)
'RRI' rename source and target and target ignored (invalid)
'RRM' rename source and target and target missing
```

The two numbers are used to match up the pre-state and post-state of a rename. Imagine a situation where there are two renames. `automate inventory` will print something like:

```
R   1 0 a
R   2 0 b
 R  0 2 c
 R  0 1 d
```

Here the status characters tell us that '`a`' and '`b`' were renamed, and we can tell that one was renamed to '`c`' and one was renamed to '`d`', but we can't tell which was renamed to which. To do that, we have to refer to the numbers. The numbers do not themselves mean anything; their only purpose is to let you match up the two "ends" of a rename. The 1 in the left column by '`a`' means that '`a`' was the source of a rename, and the 1 in the right column by '`d`' means that '`d`' was the target of that same rename. Similarly, the two 2's tell us that '`b`' was renamed to '`c`'.

There are two columns of numbers because the same file can simultaneously be the target and source of a rename. The number '0' is used as a meaningless placeholder in all cases where a file is not a source or target of a rename. Any non-zero number that occurs at all will occur exactly once in the first column and exactly once in the second column.

Full support for versioned directories is not yet complete and the inventory will only list entries for renamed or dropped directories.

Error conditions:

When executed from outside of a workspace directory, prints an error message to stderr, and exits with status 1.

`mtn automate certs` *id*

Arguments:

A revision ID *id*, for which any certificates will be printed.

Added in:

1.0

Purpose:

Prints all certificates associated with the given revision ID. Each certificate is contained in a basic IO stanza. For each certificate, the following values are provided:

```
'key'
```

```
      a string indicating the key used to sign this certificate.
'signature'
      a string indicating the status of the signature. Possible
      values of this string are:
            'ok'        : the signature is correct
            'bad'       : the signature is invalid
            'unknown'   : signature was made with an unknown key
'name'
      the name of this certificate
'value'
      the value of this certificate
'trust'
      is this certificate trusted by the defined trust metric?
      Possible values of this string are:
            'trusted'   : this certificate is trusted
            'untrusted' : this certificate is not trusted
```

Sample output:

```
      key "emile@alumni.reed.edu"
signature "ok"
     name "author"
    value "emile@alumni.reed.edu"
    trust "trusted"

      key "emile@alumni.reed.edu"
signature "ok"
     name "branch"
    value "net.venge.monotone"
    trust "trusted"

      key "emile@alumni.reed.edu"
signature "ok"
     name "changelog"
    value "propagate from branch 'net.venge.monotone.annotate' (head 76
            to branch 'net.venge.monotone' (head 2490479a4e4e99243fead6
"
    trust "trusted"

      key "emile@alumni.reed.edu"
signature "ok"
     name "date"
    value "2005-05-20T20:19:25"
    trust "trusted"
```

Output format:

All stanzas are formatted by basic_io. Stanzas are separated by a blank line. Values will be escaped, '\' to '\\' and '"' to '\"'.

Error conditions:

If a certificate is signed with an unknown public key, a warning message is printed to stderr. If the revision specified is unknown or invalid prints an error message to stderr and exits with status 1.

`mtn automate stdio`

Arguments:

none

Added in:

1.0

Modifications:

3.1

Added the 'o' item to the recognized input. This change should not break anything.

Purpose:

Allow multiple automate commands to be run from one instance of monotone.

Sample input:

```
l6:leavese
l7:parents40:0e3171212f34839c2e3263e7282cdeea22fc5378e
o3:key11:foo@bar.come l4:cert40:0e3171212f34839c2e3263e7282cdeea22fc537
```

Input format:

```
[ 'o' <string> <string> [ <string> <string> [ ... ] ] 'e' ]
'l' <string> [ <string> [ ... ] ] 'e'
```

The input is a series of commands. The command name plus arguments are provided as 'l' <string> [<string> ...] 'e', where <string> = <size> colon <data> . This may optionally be preceded by a set of key=value pairs (command options) as 'o' <string> <string> [<string> <string> ...] 'e', where strings come in pairs, key followed by value.

The space between the ending 'e' of one group of strings and the beginning 'l' or 'o' of the next is reserved. Any characters other than whitespace will cause an error.

Sample output:

```
0:0:l:205:0e3171212f34839c2e3263e7282cdeea22fc5378
1f4ef73c3e056883c6a5ff66728dd764557db5e6
2133c52680aa2492b18ed902bdef7e083464c0b8
23501f8afd1f9ee037019765309b0f8428567f8a
2c295fcf5fe20301557b9b3a5b4d437b5ab8ec8c
1:0:l:41:7706a422ccad41621c958affa999b1a1dd644e79
```

Output format:

The output consists of one or more packets for each command. A packet looks like:

<command number>:<err code>:<last?>:<size>:<output>

<command number> is a decimal number specifying which command this output is from. It is 0 for the first command, and increases by one each time.

<err code> is 0 for success, 1 for a syntax error, and 2 for any other error.

<last?> is 'l' if this is the last piece of output for this command, and 'm' if there is more output to come.

<size> is the number of bytes in the output.

<output> is a piece of the output of the command.

All but the last packet for a given command will have the <last?> field set to 'm'.

Error conditions:

If a badly formatted or invalid command is received, or a command is given with invalid arguments or options, prints an error message to standard error and exits with nonzero status. Errors in the commands run through this interface do not affect the exit status. Instead, the <err code> field in the output is set to 2, and the output of the command becomes whatever error message would have been given.

`mtn automate get_revision`
`mtn automate get_revision` *id*

Arguments:

Specifying the option *id* argument outputs the changeset information for the specified *id*. Otherwise, *id* is determined from the workspace.

Added in:

1.0

Purpose:

Prints change information for the specified revision id.

Sample output:

```
format_version "1"

new_manifest [bfe2df785c07bebeb369e537116ab9bb7a4b5e19]

old_revision [429fea55e9e819a046843f618d90674486695745]

patch "ChangeLog"
 from [7dc21d3a46c6ecd94685ab21e67b131b32002f12]
   to [234513e3838d423b24d5d6c98f70ce995c8bab6e]

patch "std_hooks.lua"
 from [0408707bb6b97eae7f8da61af7b35364dbd5a189]
```

```
to [d7bd0756c48ace573926197709e53eb24dae5f5f]
```

Output format:

There are several changes that are described; each of these is described by a different basic_io stanza. The first string pair of each stanza indicates the type of change represented.

All stanzas are formatted by basic_io. Stanzas are separated by a blank line. Values will be escaped, '\' to '\\' and '"' to '\"'.

Possible values of this first value are along with an ordered list of basic_io formatted stanzas that will be provided are:

```
'format_version'
      used in case this format ever needs to change.
      format: ('format_version', the string "1")
      occurs: exactly once
'new_manifest'
      represents the new manifest associated with the revision.
      format: ('new_manifest', manifest id)
      occurs: exactly one
'old_revision'
      represents a parent revision.
      format: ('old_revision', revision id)
      occurs: either one or two times
'delete
      represents a file or directory that was deleted.
      format: ('delete', path)
      occurs: zero or more times
'rename'
      represents a file or directory that was renamed.
      format: ('rename, old filename), ('to', new filename)
      occurs: zero or more times
'add_dir'
      represents a directory that was added.
      format: ('add_dir, path)
      occurs: zero or more times
'add_file'
      represents a file that was added.
      format: ('add_file', path), ('content', file id)
      occurs: zero or more times
'patch'
      represents a file that was modified.
      format: ('patch', filename), ('from', file id), ('to', file id)
      occurs: zero or more times
'clear'
      represents an attr that was removed.
      format: ('clear', filename), ('attr', attr name)
      occurs: zero or more times
'set'
```

```
represents an attr whose value was changed.
format: ('set', filename), ('attr', attr name), ('value', attr va
occurs: zero or more times
```

These stanzas will always occur in the order listed here; stanzas of the same type will be sorted by the filename they refer to. The 'delete' and following stanzas will be grouped under the corresponding 'old_revision' one.

Error conditions:

If the revision specified is unknown or invalid prints an error message to stderr and exits with status 1.

`mtn automate get_base_revision_id`

Arguments:

None.

Added in:

2.0

Purpose:

Prints the revision id the current workspace is based on. This is the "old_revision" value stored in '`_MTN/revision`'.

Sample output:

```
28ce076c69eadb9b1ca7bdf9d40ce95fe2f29b61
```

Output format:

One line containing the base revision ID of the current workspace.

Error conditions:

If no workspace book keeping _MTN directory is found, prints an error message to stderr, and exits with status 1.

`mtn automate get_current_revision_id`

Arguments:

None.

Added in:

2.0

Purpose:

Prints the revision id of the current workspace. This is the id of the revision that would be committed by an unrestricted commit in the workspace.

Sample output:

```
28ce076c69eadb9b1ca7bdf9d40ce95fe2f29b61
```

Output format:

One line containing the current revision id ID of the current workspace.

Error conditions:

If no workspace book keeping _MTN directory is found, prints an error message to stderr, and exits with status 1.

`mtn automate get_manifest_of`
`mtn automate get_manifest_of` *`revid`*

Arguments:

Specifying the optional *revid* argument outputs the manifest for the revision with the specified ID. Otherwise, outputs the manifest for the current workspace. (You can think of leaving the argument blank as meaning "give me the manifest of THIS".)

Added in:

2.0

Purpose:

Prints the contents of the manifest associated with the given roster.

Sample output:

```
format_version "1"

dir ""

   file ".htaccess"
content [e3915658cb464d05f21332e03d30dca5d94fe776]

   file "AUTHORS"
content [80d8f3f75c9b517ec462233e155f7dfb93379f67]

   file "ChangeLog"
content [fc74a48c7f73eedcbe1ea709755fbe819b29736c]

   file "LICENSE"
content [dfac199a7539a404407098a2541b9482279f690d]

   file "README"
content [440eec971e7bb61ccbb61634deb2729bb25931cd]

   file "TODO"
content [e0ea26c666b37c5f98ccf80cb933d021ee55c593]

   file "branch.psp"
content [b28ece354969314ce996f3030569215d685973d6]

   file "common.py"
content [1fdb62e05fb2a9338d2c72ddc58de3ab2b3976fe]

   file "config.py.example"
content [64cb5898e3a026b4782c343ca4386585e0c3c275]
```

```
   file "error.psp"
content [7152c3ff110418aca5d23c374ea9fb92a0e98379]

   file "fileinbranch.psp"
content [5d8536100fdf51d505b6f20bc9c16aa78d4e86a8]

   file "headofbranch.psp"
content [981df124a0b5655a9f78c42504cfa8c6f02b267a]

   file "help.psp"
content [a43d0588a69e622b2afc681678c2a5c3b3b1f342]

   file "html.py"
content [18a8bffc8729d7bfd71d2e0cb35a1aed1854fa74]

   file "index.psp"
content [c621827db187839e1a7c6e51d5f1a7f6e0aa560c]

   file "monotone.py"
content [708b61436dce59f47bd07397ce96a1cfabe81970]

   file "revision.psp"
content [a02b1c161006840ea8685e461fd07f0e9bb145a3]

   file "rss_feed.gif"
content [027515fd4558abf317d54c437b83ec6bc76e3dd8]

   file "tags.psp"
content [638140d6823eee5844de37d985773be75707fa25]

   file "tarofbranch.psp"
content [be83f459a152ffd49d89d69555f870291bc85311]

   file "test.py"
content [e65aace9237833ec775253cfde97f59a0af5bc3d]
   attr "mtn:execute" "true"

   file "utility.py"
content [fb51955563d64e628e0e67e4acca1a1abc4cd989]

   file "viewmtn.css"
content [8d04b3fc352a860b0e3240dcb539c1193705398f]

   file "viewmtn.py"
content [7cb5c6b1b1710bf2c0fa41e9631ae43b03424a35]
```

```
   file "wrapper.py"
content [530290467a99ca65f87b74f653bf462b28c6cda9]
```

Output format:

There is one basic_io stanza for each file or directory in the manifest.

All stanzas are formatted by basic_io. Stanzas are separated by a blank line. Values will be escaped, '\' to '\\' and '"' to '\"'.

Possible values of this first value are along with an ordered list of basic_io formatted stanzas that will be provided are:

```
'format_version'
      used in case this format ever needs to change.
      format: ('format_version', the string "1")
      occurs: exactly once
'dir':
      represents a directory.  The path "" (the empty string) is used
      to represent the root of the tree.
      format: ('dir', pathname)
      occurs: one or more times
'file':
      represents a file.
      format: ('file', pathname), ('content', file id)
      occurs: zero or more times
```

In addition, 'dir' and 'file' stanzas may have attr information included. These are appended to the stanza below the basic dir/file information, with one line describing each attr. These lines take the form ('attr', attr name, attr value).

Stanzas are sorted by the path string.

Error conditions:

If the revision ID specified is unknown or invalid prints an error message to stderr and exits with status 1.

`mtn automate get_attributes` *path*

Arguments:

The argument *path* determines which path's attributes should be printed.

Added in:

3.0

Renamed from `attributes` to `get_attributes` in:

5.0

Purpose:

Prints all attributes of the given file and the attribute states.

Sample output:

```
format_version "1"
```

```
 attr "foo" "bar"
state "added"

 attr "baz" "bat"
state "dropped"

 attr "foobar" "foobat"
state "unchanged"
```

Output format:

There is one basic_io stanza for each attribute of the given file.

All stanzas are formatted by basic_io. Stanzas are separated by a blank line and ordered by attribute name. Values will be escaped, '\' to '\\' and '"' to '\"'.

Each attribute stanza also contains another entry which tells the status of attribute. This entry can have one of the following four values:

- 'added': the attribute has just been added to the file
- 'dropped': the attribute has just been dropped from the file
- 'unchanged': the attribute has not been changed since the last revision
- 'changed': the attribute has been changed since the last revision

The status 'changed' can come up if an attribute foo has been dropped and added afterwards with another value, like

```
$ mtn attr drop file.txt foo ; mtn attr set file.txt foo baz
```

If an attribute has been dropped, the output will still return the previously set value of the dropped attribute for convenience (obviously this is no longer recorded in the current workspace).

The complete format:

```
'format_version'
      used in case this format ever needs to change.
      format: ('format_version', the string "1")
      occurs: exactly once
'attr':
      represents an attribute.
      format: ('attr', key, value), ('state', [unchanged|changed|added|
      occurs: zero or more times
```

Error conditions:

If the path specified is unknown in the new workspace revision, prints an error message to stderr and exits with status 1.

`mtn automate set_attribute` *`path key value`*

Arguments:

A path, an attribute key and an attribute value.

Added in:

5.0

Purpose:

Edits the current workspace revision and inserts the given attribute key and value for the specified path. Note that this change is not committed and therefor behaves exactly like `mtn attr set` *`key value`*.

Output format:

This command does not print out anything if successful.

Error conditions:

If the path specified is unknown in the new workspace revision, prints an error message to stderr and exits with status 1.

`mtn automate drop_attribute` *`path`* `[`*`key`*`]`

Arguments:

A path and an attribute key (optional).

Added in:

5.0

Purpose:

Removes an attribute from the current workspace revision for the specified path. If no attribute key is given, all attributes of this path are removed. Note that this change is not committed and therefor behaves exactly like `mtn attr drop` *`path`* `[`*`key`*`]`.

Output format:

This command does not print out anything if successful.

Error conditions:

If the path specified is unknown in the new workspace revision or the attribute key is not found for this path, prints an error message to stderr and exits with status 1.

`mtn automate content_diff [--revision=`*`id1`*` [--revision=`*`id2`*`]] [`*`files ...`*`]`

Arguments:

One or more *file* arguments restrict the diff output to these files, otherwise all changed files in the given revision(s) and/or current workspace are considered.

If zero or more revisions are given, the command behaves as follows:

- no revision: the diff is done between the workspace revision and the parent (base) revision of this workspace
- one revision: the diff is done between the workspace revision and the given revision '`id1`',
- two revisions: the diff is done between '`id1`' and '`id2`'; no workspace is needed in this case.

Added in:

4.0

Purpose:

Prints the content changes between two revisions or a revision and the current workspace. This command differs from `mtn diff` in that way that it only outputs content changes and keeps quite on renames or drops, as the header of `mtn diff` is omitted (this is what `mtn automate get_revision` already provides).

Sample output:

```
============================================================
--- guitone/res/i18n/guitone_de.ts      9857927823e1d6a0339b531c120dcaa
+++ guitone/res/i18n/guitone_de.ts      0b4715dc296b1955b0707923d45d79c
@@ -1,6 +1,14 @@
 <?xml version="1.0" encoding="utf-8"?>
 <!DOCTYPE TS><TS version="1.1">
 <context>
+    <name>AncestryGraph</name>
+    <message>
[...]
```

Output format:

The GNU unified diff format. If there have been no content changes, the output is empty.

Error conditions:

If more than two revisions are given or a workspace is required, but not found, prints to stderr and exits with status 1. If one or more file restrictions can't be applied, the command prints to stderr and exits as well.

`mtn automate get_file` *id*

Arguments:

The *id* argument specifies the file hash of the file to be output.

Added in:

1.0

Purpose:

Prints the contents of the specified file.

Sample output:

```
If you've downloaded a release, see INSTALL for installation
instructions.  If you've checked this out, the generated files are not
included, and you must use "autoreconf --install" to create them.

"make html" for docs, or read the .info file and / or man page.
```

Output format:

The file contents are output without modification.

Error conditions:

If the file id specified is unknown or invalid prints an error message to stderr and exits with status 1.

`mtn automate get_file_of` *`filename`* `[--revision=`*`id`*`]`

Arguments:

The *filename* argument specifies the filename of the file to be output.

If a revision *id* is given, the file's contents in that specific revision are printed. If no revision is given, the workspace's revision is used.

Added in:

4.0

Purpose:

Prints the contents of the specified file.

Sample output:

```
If you've downloaded a release, see INSTALL for installation
instructions.  If you've checked this out, the generated files are not
included, and you must use "autoreconf --install" to create them.

"make html" for docs, or read the .info file and / or man page.
```

Output format:

The file contents are output without modification.

Error conditions:

If the filename specified is unknown in the given revision or invalid, or if the given revision is unknown, prints an error message to stderr and exits with status 1.

`mtn automate get_option` *`option`*

Arguments:

The *option* argument specifies the option name of the option to be output.

Added in:

3.1

Purpose:

Prints an option from _MTN/option of the current workspace.

Sample output:

```
net.venge.monotone
```

Output format:

The option value is written out without modification.

Error conditions:

If the option is unknown, prints an error message to stderr and exits with status 1.

`mtn automate keys`

Arguments:

None.

Added in:

1.1

Purpose:

Print all keys in basic_io format.

Sample output:

```
                name "tbrownaw@gmail.com"
         public_hash [475055ec71ad48f5dfaf875b0fea597b5cbbee64]
        private_hash [7f76dae3f91bb48f80f1871856d9d519770b7f8a]
     public_location "database" "keystore"
    private_location "keystore"

               name "tomfa@debian.org"
        public_hash [3ac4afcd86af28413b0a23b7d22b9401e15027fc]
    public_location "database"

                name "underwater@fishtank.net"
         public_hash [115fdc73d87a5e9901d018462b21a1f53eca33a1]
        private_hash [b520d2cfe7d30e4ea1725fc4f34646fc5469b13d]
     public_location "keystore"
    private_location "keystore"
```

Output format:

For each key, a basic_io stanza is printed. The public_location and private_location items may have multiple values as shown above for public_location, one value for each place that the key is stored. If the private key does not exist, then the private_hash and private_location items will be absent. The keys are ordered alphabetically by name.

Error conditions:

None.

`mtn automate packet_for_rdata` *id*

Arguments:

The *id* specifies the revision to output an rdata packet for.

Added in:

2.0

Purpose:

Prints the revision data in packet format

Sample output:

```
[rdata bdf3b10b5df0f17cc6c1b4b3351d84701bda59ed]
```

```
H4sIAAAAAAAA/0XQS27DMAwE0L1PIfgArb4kte62NzACg5SoJEBsF7aRurev0UVzgJl5mLa
E+/jU9ftvsymd33Xzfo9Tjzfm267GSgGwVarz6Valx0KtFYwii9VqUFCqJQ5X7puedRx1ef
r2rwHlSbi+BUSrF4xn1p0RInkmxTbmwREp/BL97LzfQfN56v+rlc+860dZnMED01jhILkUR
Ul0KPpGN1ueUwDHyiXF66Ywx+2IGD+0Uqg8aCzikAEzZNRXPmJKlkhMxSHuNzrofx/uq2/J
6njV/bZsu/zMPOlbOY4XJSD5KOrwXGdwpDGdfotZayQHKTAi5fRPqUWKcAMMIQfAjOK0nkf
6tFacjYgBPV46X4BtlpiNYUBAAA=
[end]
```

Output format:

Revision data in `monotone read` compatible packet format.

Error conditions:

If *id* is unknown or invalid prints an error message to stderr and exits with status 1.

`mtn automate packet_for_certs` *id*

Arguments:

The *id* specifies the revision to output cert packets for.

Added in:

2.0

Purpose:

Prints the certs associated with a revision in packet format

Sample output:

```
[rcert bdf3b10b5df0f17cc6c1b4b3351d84701bda59ed
       branch
       njs@pobox.com
       bmV0LnZlbmdlLm1vbm90b25l]
K90i1XHHmaMEMuwbPifFweLThJl0m7jigh2Qq6Z7TBwNJ6IMOjXWCizv73cacZ1CtzxFDVw
SlqhNWiPQWxdcMp+Uuo+V8IFMKmvxVSTuVDukLMuNAQqpGL5S+a+tEj68NMq+KLKuL8kAAP
RoFD7GQlTS35S3RHWA4cnvqn+8U=
[end]
[rcert bdf3b10b5df0f17cc6c1b4b3351d84701bda59ed
       date
       njs@pobox.com
       MjAwNi0wNC0wOFQxMTo1MDowMA==]
araz9A8x6AlK6m6UhwnhUhk7cdyxeE2nvzj2gwaDvkaBxOq4SN23/wnaPqUXx1Ddn8smzyR
HNO8xloYc0yNChp3wjbqx20REcsTg3XE4rN/sgCbqqw5hVT22a5ZhqkfkDeoeJvan0R0UBa
ngKYo9eLuABNlmFX2onca75JW1E=
[end]
[rcert bdf3b10b5df0f17cc6c1b4b3351d84701bda59ed
       author
       njs@pobox.com
       bmpzQHBvYm94LmNvbQ==]
BLPOYhgLsAN+w7CwOsv9GfXnG3u7RNF1DTrWdn0AnYE1e+ptgTeMVWUI18H4OGL0B7wm08r
Pxk/hvsb8fBn1Kf5HDDO2pbjJ0xVzI9+p+TR0y5jJNZlVSTj+nvtPgvK9NzsdooYWnwlWmJ
bOkAzQcZb8NMh8pbQkdHbR5uzMo=
[end]
```

```
[rcert bdf3b10b5df0f17cc6c1b4b3351d84701bda59ed
       changelog
       njs@pobox.com
       MjAwNi0wNC0wOCAgTmF0aGFuaWVsIFNtaXRoICA8bmpzQHBvYm94LmNvbT4KCgkq
L3Jlc29sdmVfZ2V0aG9zdGJ5bmFtZS5jeHggKHJlc29sdmVfaG9zdG5hbWUpOiAjaWZkZWY
b3V0CglXaW4zMi1pbmNvbXBhdGlibGUgZXJyb3IgcmVwb3J0aW5nIGNhbGwuCg==]
Ncl4L/oEPctzVQixTKA6FrLceeHnLiXfeyeFDNmtUFYg9BMUcjWkeyKmaWknLvOcHortxjt
K6pQ9E8S7zI+TpzFAhssg5a///rFL0+2GJU3t6pcHs6LC0Q4tbqzwKd/5+8GwT1gphbM1wm
KuzKthwqD3pp49GbgTrp8iWMTr0=
[end]
```

Output format:

Cert data in `monotone read` compatible packet format.

Error conditions:

If *id* is unknown or invalid prints an error message to stderr and exits with status 1.

`mtn automate packet_for_fdata` *id*

Arguments:

The *id* specifies the file to output an fdata packet for.

Added in:

2.0

Purpose:

Prints the file data in packet format

Sample output:

```
[fdata 229c7f621b65f7e4970ae5aaec993812b9daa1d4]
H4sIAAAAAAAAA/z2OO27DMBBEe51ioMaNrJzBpQAjTXKBBTW0CJPcgFw6yO1DCkG62Q/em83
R9vlRez6naPKzh2CwkipXFBJbO8fn7f7HV4LQq4mMYoFzdMYSnMj1xXY/lnuoHt2kB2hQps
PREPZhaxvvchskIKkdU6xsXWvQsk76MOUquGVolZmmmh0+xxvf7JZ5jCFXbU4KZ1muYkT+K
FOez5q6uLuh9+9eoQawhez3Fp+VtHJNkfMmDHfALzWYfcAgBAAA=
[end]
```

Output format:

File data in `monotone read` compatible packet format.

Error conditions:

If *id* is unknown or invalid prints an error message to stderr and exits with status 1.

`mtn automate packet_for_fdelta` *from-id to-id*

Arguments:

The *from-id* specifies the file to use as the base of the delta, and *to-id* specifies the file to use as the target of the delta.

Added in:

2.0

Purpose:

Prints the file delta in packet format

Sample output:

```
[fdelta 597049a62d0a2e6af7df0b19f4945ec7d6458727
        229c7f621b65f7e4970ae5aaec993812b9daa1d4]
H4sIAAAAAAAAA/0WOy0oEMRBF9/mKS2/c9LQg4t5lw+BGf6BIKtNhkpSkKop/b9II7m49OOf
eHp5dnvEj/SHL0aQ75qFAgcQGmcm5RXKjP3t/eP1ekWUhlTVKGeyJNXoXU/s27AP8sf7O8
ZEdSSLd1JMaNKzeysY8ps4Iao4oNjM99eFdQDbMOSldDV8ZC3aSxlxpxufzJF5jANx6oyS2
c0uhO+OwkpezZhCvK0bf8TVrMLZUo5zi0/I4j4UqPunGA+B+AfHvKEIPAQAA
[end]
```

Output format:

File delta data in `monotone read` compatible packet format.

Error conditions:

If *from-id* or *to-id* is unknown or invalid prints an error message to stderr and exits with status 1.

`mtn automate get_content_changed` *`id file`*

Arguments:

The *id* specifies a revision ID, from which content change calculations will be based. and *file* specifies the file for which to calculate revisions in which it was last changed.

Added in:

3.2

Purpose:

Returns a list of revision IDs in which the content was most recently changed, relative to the revision ID specified as *id*. This equates to a content mark following the *-merge algorithm.

Sample output:

```
content_mark [276264b0b3f1e70fc1835a700e6e61bdbe4c3f2f]
```

Output format:

Zero or more basic_io stanzas, each specifying a revision ID in which a content mark is set.

The complete format:

```
'content_mark'
        the hexadecimal id of the revision the content mark is attache
```

Error conditions:

If *id* or *file* is unknown or invalid prints an error message to stderr and exits with status 1.

`mtn automate get_corresponding_path` *`source_id file target_id`*

Arguments:

The *source_id* specifies a revision ID in which *file* is current extant. and *file* specifies the file whose name in *target_id* is to be determined; *target_id* specifies a revision ID.

Added in:

3.2

Purpose:

Given a the file name *file* in the source revision *source_id*, a filename will if possible be returned naming the file in the target revision *target_id*. This allows the same file to be matched between revisions, accounting for renames and other changes.

Sample output:

```
file "foo"
```

Output format:

Zero or one basic_io stanzas. Zero stanzas will be output if the file does not exist within the target revision; this is not considered an error. If the file does exist in the target revision, a single stanza with the following details is output.

The complete format:

```
'file'
      the file name corresponding to "file name" (arg 2) in the targ
```

Error conditions:

If the revision IDs *source_id* or *target_id* are unknown or invalid prints an error message to stderr and exits with status 1. If the file path *file* does not exist in the revision *source_id* or is invalid, prints an error message to stderr and exits with status 1. Note that *file* not existing in the revision *target_id* is not an error.

`mtn automate db_get` *`domain name`*

Arguments:

The *domain* and *name* specify the database variable which is returned.

Added in:

4.1

Purpose:

Read a database variable, see also Section 3.8 [Vars], page 57.

Sample output:

```
off.net
```

Output format:

Exactly the variable's content. Since this command is mainly intended for `automate stdio` it will not add a trailing newline.

Error conditions:

If the variable is unknown prints an error message to stderr and exits with status 1.

`mtn automate db_put` *`domain name value`*

Arguments:

The *domain* and *name* specify the database variable which is changed to *value*.

Added in:

4.1

Purpose:

Change a database variable, see also Section 3.8 [Vars], page 57.

Sample usage:

```
mtn automate db_set database default-server off.net
```

Output format:

No output.

Error conditions:

None.

`mtn automate put_file [`*`base-id`*`] `*`contents`*

Arguments:

The optional *base-id* specifies a file-id on which the contents are based on. This is used for delta encoding. *contents* are the contents of the new file.

Added in:

4.1

Purpose:

Preparation of a workspace-less commit. See also `automate put_revision`. Normally used via `automate stdio`.

Sample output:

```
70a0f283898a18815a83df37c902e5f1492e9aa2
```

Output format:

The sha1 sum of the contents, hex encoded.

Error conditions:

If the optional base id is unknown prints an error message to stderr and exits with status 1.

`mtn automate put_revision `*`revision-data`*

Arguments:

revision-data is the new revision. See example below. Note that the new_manifest entry is ignored – `put_revision` will ignore whatever you put here and calculate the correct manifest id itself. (However, for now, you must put 40 hex digits here – it's just that which particular digits you put are entirely irrelevant. All zeros is a good choice.) Monotone will also canonicalize your whitespace automatically. You do not need to worry about getting just the right amount of indentation in front of each line. However, everything else about your revision must be valid.

Added in:

4.1

Purpose:

Workspace-less commit. Normally used via `automate stdio`.

Sample argument:

```
format_version "1"

new_manifest [0000000000000000000000000000000000000004]

old_revision []

add_dir ""

add_file "foo"
content [5bf1fd927dfb8679496a2e6cf00cbe50c1c87145]
```

Sample output:

```
4c2c1d846fa561601254200918fba1fd71e6795d
```

Output format:

The new revision id, hex encoded.

Error conditions:

If the changeset is invalid prints an error message to stderr and exits with status 1. May abort on invalid formats. If the revision is already present in the database, prints a message to stderr noting this fact, but otherwise works as normal.

`mtn automate cert` *`revision name value`*

Arguments:

revision is an existing revision, *name* is the certificate name and *value* its value.

Added in:

4.1

Purpose:

`automate stdio` capable variant of `mtn cert`. To sign the cert with a specific private key, use '`--key`'.

Sample usage:

```
mtn automate cert 4c2c1d846fa561601254200918fba1fd71e6795d author teste
```

Output format:

No output.

Error conditions:

If the revision is invalid prints an error message to stderr and exits with status 1.

5.10 RCS

`mtn rcs_import` *`filename...`*

This command imports all the file versions in each RCS file listed in *filename...*. These files should be raw RCS files, ending in `,v`. Monotone parses them directly and inserts them into your database. Note that this does not do any revision reconstruction, and is only useful for debugging.

`mtn cvs_import` *`pathname`*

This command imports all the file versions in each RCS file found in the tree of files starting at *pathname*, then reconstructs the tree-wide history of logical changes by comparing RCS time stamps and change log entries. For each logical tree-wide change, monotone synthesizes a manifest and revision, and commits them (along with all associated file deltas) to your database. It also copies all change log entries, author identifiers, and date stamps to manifest certificates.

In normal use, *pathname* will be a CVS module, though it is possible to point it at a directory within a module as well. Whatever directory you point it at will become the root of monotone's version of the tree.

6 Hook Reference

Monotone's behavior can be customized and extended by writing *hook functions*, which are written in the Lua programming language. At certain points in time, when monotone is running, it will call a hook function to help it make a decision or perform some action. If you provide a hook function definition which suits your preferences, monotone will execute it. This way you can modify how monotone behaves.

You can put new definitions for any of these hook functions in a file '`$HOME/.monotone/monotonerc`', or in your workspace in '`_MTN/monotonerc`', both of which will be read every time monotone runs. Definitions in '`_MTN/monotonerc`' shadow (override) definitions made in your '`$HOME/.monotone/monotonerc`'. You can also tell monotone to interpret extra hook functions from any other *file* using the '`--rcfile=`*`file`*' option; hooks defined in files specified on the command-line will shadow hooks from the the automatic files. By specifying '`--rcfile=`*`directory`*' you can automatically load all the files contained into *directory*.

Monotone provides some default hooks, see Appendix A [Default hooks], page 177 for their complete source. When writing new hooks, it may be helpful to reuse some code from the default ones. Since Lua is a lexically scoped language with closures, this can be achieved with the following code:

```
do
local old_hook = default_hook
function default_hook(arg)
if not old_hook(arg) then
-- do other stuff
end
end
end
```

Now the default hook is trapped in a variable local to this block, and can only be seen by the new hook. Since in Lua variables default to the global scope, the new hook is seen from inside monotone.

Monotone also makes available to hook writers a number of helper functions exposing functionality not available with standard Lua.

6.1 Hooks

This section documents the existing hook functions and their default definitions.

6.1.1 Event Notifications and Triggers

There are a number of hooks that are called when noteworthy events occur, such as commits or new revisions arriving over the network. These hooks can be used to feed the events into external notification systems, such as generating email.

By default, these hooks are undefined, so no special external actions are taken.

`note_commit (new_id, revision, certs)`
: Called by monotone after the version *new_id* is committed. The second parameter, *revision* is the text of the revision, what would be given by `mtn automate get_revision new_id`. The third parameter, *certs*, is a Lua table containing the set of certificate names and values committed along with this version. There is no default definition for this hook.

  Note that since the *certs* table does not contain cryptographic or trust information, and only contains one entry per cert name, it is an incomplete source of information about the committed version. This hook is only intended as an aid for integrating monotone with informal commit-notification systems such as mailing lists or news services. It should not perform any security-critical operations.

`note_netsync_start (session_id, my_role, sync_type,` *remote_host*, *remote_keyname*, *includes*, *excludes*)
: Called by monotone before any other of the netsync notification hooks are called. The *session_id* helps keep track of the current netsync session in case several are happening at the same time, and is used throughout all netsync notification hooks.

  The other arguments are:

  my_role
  : This will be either `"client"` or `"server"`.

  sync_type
  : This will be one of `"sync"`, `"push"`, or `"pull"`.

  remote_host
  : The network address of the remote host. At the client, this will be the name it was told to connect to; at the server, this will use the numerical IP address the connection was received from.

  remote_keyname
  : The name of the key being used by the other end of the connection. This may be set to `"-unknown-"` at the server if the key used by the client is not present at the server.

  includes **and** *excludes*
  : The include and exclude patterns used by the client.

`note_netsync_revision_received (new_id, revision, certs, session_id)`

Called by monotone after the revision *new_id* is received through netsync. *revision* is the text of the revision, what would be given by `mtn automate get_revision new_id`. *certs* is a Lua table containing one subtable for each cert attached to the revision *new_id*. These subtables have fields named "key", "name", and "value", containing the signing key for the cert, the name of the cert, and the value of the cert. There is no default definition for this hook. *session_id* is used together with `note_netsync_start` and `note_netsync_end`. If you're not interested in that type of tracking, you can ignore that variable entirely.

`note_netsync_cert_received (rev_id, key, name, value, session_id)`

Called by monotone after a cert is received through netsync, if the revision that the cert is attached to was not also received in the same netsync operation. *rev_id* is the revision id that the cert is attached to, *key* is the key that the cert is signed with, *name* is the name of the cert, and *value* is the cert value. There is no default definition for this hook. *session_id* is used together with `note_netsync_start` and `note_netsync_end`. If you're not interested in that type of tracking, you can ignore that variable entirely.

`note_netsync_pubkey_received (keyname, session_id)`

Called by monotone after a pubkey is received through netsync. *keyname* is the name of the key received. There is no default definition for this hook. *session_id* is used together with `note_netsync_start` and `note_netsync_end`. If you're not interested in that type of tracking, you can ignore that variable entirely.

`note_netsync_end (session_id, status,`
bytes_in, *bytes_out*, *certs_in*, *certs_out*, *revs_in*, *revs_out*, *keys_in*, *keys_out*)

Called by monotone after all other the netsync notification hooks have been called. This hook would usually be used for post-netsync purposes, like collecting all the data from all other netsync notification hooks, make some nice output from them and finally send the result somewhere. It could also be used to prepare parallel databases with all the data to be displayed through something like viewmtn.

status is a three digit integer that tells whether there was an error, and if so what kind of error it was:

200

No error, connection successful.

211

The connection was interrupted after some data may have been transferred.

212

The connection was interrupted before any data could be transferred.

412

The request is not permitted.

422

The client tried to use a key that the server doesn't know about.

432

The client and server have different epochs for a branch.

512

Protocol error (source/sink confusion).

521

Protocol error (packet received at a time when it doesn't make sense).

532

The client did not identify itself correctly. (Possible replay attack?)

In general, 2xx means there was no error, 4xx means there was a permissions error, and 5xx means there was a protocol error. xx1 means some data may have been transferred, xx2 means no data was transferred, and xx0 means all data was transferred.

`note_mtn_startup (...)`

Called by monotone when it is first started, this hook was added so that usage of monotone could be monitored for user interface testing. Note that by default, no monitoring occurs. The arguments to the hook function are the arguments to monotone, without the initial `mtn` command. They can be accessed through the lua *arg* variable as in this example:

```
function note_mtn_startup(...)
    print("Beginning note_mtn_startup")
    for i = 1,arg.n do
        print(arg[i])
    end
    print("Ending note_mtn_startup")
end
```

6.1.2 User Defaults

These are hooks that can be used to provide smart, context-sensitive default values for a number of parameters the user might otherwise be prompted for.

`get_branch_key (`*`branchname`*`)`

Returns a string which is the name of an RSA private key used to sign certificates in a particular branch *branchname*. There is no default definition for this hook. The command-line option '`--key=`*`keyname`*' overrides any value returned from this hook function. If you have only one private key in your database, you do not need to define this function or provide a '`--key=`*`keyname`*' option; monotone will guess that you want to use the unique private key.

`get_netsync_key(`*`server, include, exclude`*`)`

Returns a string which is the name of the key to use to authenticate the given netsync connection. When called by the `serve` command, *server* is the address monotone is listening on, *include* is '`"*"`', and *exclude* is '`""`'.

There is no default definition of this hook. The command-line option '`--key=`*`keyname`*' overrides any value returned from this hook function.

`get_passphrase (`*`keypair_id`*`)`

Returns a string which is the passphrase used to encrypt the private half of *keypair_id* in your database, using the ARC4 symmetric cipher. *keypair_id* is a Lua string containing the label that you used when you created your key — something like `"nicole@example.com"`. This hook has no default definition. If this hook is not defined or returns false, monotone will prompt you for a passphrase each time it needs to use a private key.

`get_author (`*`branchname`*`, `*`keypair_id`*`)`

Returns a string which is used as a value for automatically generated `author` certificates when you commit changes to *branchname* with the keypair identity *keypair_id*. Generally this hook remains undefined, and monotone selects your signing key name for the author certificate. You can use this hook to override that choice, if you like.

This hook has no default definition, but a couple of possible definitions might be:

```
function get_author(branchname, keypair_id)
        -- Key pair identity ignored.
        local user = os.getenv("USER")
        local host = os.getenv("HOSTNAME")
        if ((user == nil) or (host == nil)) then return nil end
        return string.format("%s@%s", user, host)
end

function get_author(branchname, keypair_id)
        -- Branch name ignored.
        if (keypair_id == "joe@example.com") then
                return "Joe Random <joe@example.com>"
        end
        return keypair_id
end
```

`edit_comment (`*`commentary`*`, `*`user_log_message`*`)`

Returns a log entry for a given set of changes, described in *commentary*. The commentary is identical to the output of `mtn status`. This hook is intended to interface with some sort of editor, so that you can interactively document each change you make. The result is used as the value for a `changelog` certificate, automatically generated when you commit changes.

The contents of '`_MTN/log`' are read and passed as *user_log_message*. This allows you to document your changes as you proceed instead of waiting until you are ready to commit. Upon a successful commit, the contents of '`_MTN/log`' are erased setting the system up for another edit/commit cycle.

For the default definition of this hook, see Appendix A [Default hooks], page 177.

`persist_phrase_ok ()`

Returns `true` if you want monotone to remember the passphrase of a private key for the duration of a single command, or `false` if you want monotone to prompt you for a passphrase for each certificate it generates. Since monotone often

generates several certificates in quick succession, unless you are very concerned about security you probably want this hook to return `true`.
The default definition of this hook is:

```
function persist_phrase_ok()
        return true
end
```

`use_inodeprints ()`
: Returns `true` if you want monotone to automatically enable Section 3.5 [Inodeprints], page 53 support in all workspaces. Only affects working copies created after you modify the hook.
The default definition of this hook is:

```
function use_inodeprints()
        return false
end
```

`ignore_file (`*`filename`*`)`
: Returns `true` if *filename* should be ignored while adding, dropping, or moving files. Otherwise returns `false`. This is most important when performing recursive actions on directories, which may affect multiple files simultaneously.

  The default definition of this hook recognises a number of common file types and extensions for temporary and generated file types that users typically don't want to track. If the file '`.mtn-ignore`' exists, this hook will read a list of regular expressions from the file, one per line, and ignore all files matching one of these expressions. For the default definition of this hook, see Appendix A [Default hooks], page 177.

`ignore_branch (`*`branchname`*`)`
: Returns `true` if *branchname* should be ignored while listing branches. Otherwise returns `false`. This hook has no default definition, therefore the default behavior is to list all branches.

6.1.3 Netsync Permission Hooks

These hooks are used when running a netsync server, via `mtn serve`. They are evaluated by the server for each new connection, based on the certificate used for authentication by the client. Note that a long-running server will need to be restarted in order to reload the hook definitions if the '`montonerc`' file is changed.

`get_netsync_read_permitted (`*`branch, identity`*`)`
: Returns `true` if a peer authenticated as key *identity* should be allowed to read from your database certs, revisions, manifests, and files associated with *branch*; otherwise `false`. The default definition of this hook reads a file '`read-permissions`' in the configuration directory. This file looks like

```
pattern "net.example.project.{private,security}*"
allow "joe@example.net"
allow "jim@example.net"

comment "everyone can read these branches"
pattern "net.example.{public,project}*"
allow "*"
```

  This example allows everyone access to branches `net.example.project` and `net.example.public` and their sub-branches, except for the branches in

`net.example.project.security` and `net.example.project.private`, which are only readable by Joe and Jim.

The file is divided into stanzas of one `pattern` line followed by any number of `allow` and `deny` lines, and possibly a `continue` line. Anything from the unquoted word `comment` until the next unquoted word is ignored. A stanza is processed if the argument to `pattern` is a glob that matches *branch*. Any keys which match an `allow` line are given access, and any keys which match a `deny` line are denied access. If there is a `continue "true"` line, then if the key is not granted or denied access in this stanza the next matching stanza will be processed. If there is not a `continue "true"` line, then any key which has not been given access will be denied access even if it doesn't match any `deny` lines. Thus, deny lines are redundant unless there is also a `continue "true"` line.

If a client connects anonymously, this hook will be called with a *identity* of `nil`.

Note that the *identity* value is a key ID (such as "`graydon@pobox.com`") but will correspond to a *unique* key fingerprint (hash) in your database. Monotone will not permit two keys in your database to have the same ID. Make sure you confirm the key fingerprints of each key in your database, as key ID strings are "convenience names", not security tokens.

`get_netsync_write_permitted (`*identity*`)`

Returns `true` if a peer authenticated as key *identity* should be allowed to write into your database certs, revisions, manifests, and files; otherwise `false`. The default definition of this hook reads a file '`write-permissions`' in the configuration directory which contains a list of keys, one per line, which are allowed write access. The special value `*` means to allow access to anyone whose public key we already have.

If a client connects anonymously, it will be unconditionally denied write access; this hook will *not* be called with a *identity* of `nil`.

Note that the *identity* value is a key ID (such as "`graydon@pobox.com`") but will correspond to a *unique* key fingerprint (hash) in your database. Monotone will not permit two keys in your database to have the same ID. Make sure you confirm the key fingerprints of each key in your database, as key ID strings are "convenience names", not security tokens.

Note also that, unlike the equivalent read permission hook, the write permission hook does not take a *branch* name as an argument. There is presently no way to selectively grant write access to different branches via netsync, for a number of reasons. Contributions in the database from different authors can be selectively trusted using the [Trust Evaluation Hooks], page 140 instead.

6.1.4 Netsync Transport Hooks

When a monotone client initiates a netsync connection, these hooks are called to attempt to parse the host argument provided on the command line. If the hooks fail or return nil, monotone will interpret the host argument as a network name (possibly with a port number) and open a TCP socket.

`get_netsync_connect_command (`*`uri`*`, `*`args`*`)`

Returns a table describing a command to run to connect to the specified host. The *uri* argument is a table containing between 0 and 7 components:

- `uri["scheme"]`, such as `"ssh"` or `"file"`
- `uri["user"]`, the name of a remote user
- `uri["host"]`, the name or address of a remote host
- `uri["port"]`, a network port number
- `uri["path"]`, a filesystem path
- `uri["query"]`, for additional parameters
- `uri["fragment"]`, to describe a sub-location within the remote resource

The *args* argument is a table containing between 0 and 3 components:

- `args["include"]`, the branch pattern to include
- `args["exclude"]`, the branch pattern to exclude
- `args["debug"]`, whether to run the connection in debug mode

The default definition of this hook follows:

```
function get_netsync_connect_command(uri, args)

        local argv = nil

        if uri["scheme"] == "ssh"
                and uri["host"]
                and uri["path"] then

                argv = { "ssh" }
                if uri["user"] then
                        table.insert(argv, "-l")
                        table.insert(argv, uri["user"])
                end
                if uri["port"] then
                        table.insert(argv, "-p")
                        table.insert(argv, uri["port"])
                end

                table.insert(argv, uri["host"])
        end

        if uri["scheme"] == "file" and uri["path"] then
                argv = { }
        end

        if argv then

                table.insert(argv, get_mtn_command(uri["host"]))

                if args["debug"] then
                        table.insert(argv, "--debug")
                else
                        table.insert(argv, "--quiet")
                end

                table.insert(argv, "--db")
                table.insert(argv, uri["path"])
                table.insert(argv, "serve")
                table.insert(argv, "--stdio")
                table.insert(argv, "--no-transport-auth")

                if args["include"] then
                        table.insert(argv, args["include"])
                end

                if args["exclude"] then
                        table.insert(argv, "--exclude")
                        table.insert(argv, args["exclude"])
                end
        end
        return argv
end
```

`use_transport_auth (`*uri*`)`

Returns a boolean indicating whether monotone should use transport authentication mechanisms when communicating with *uri*. If this hook fails, the return value is assumed to be `true`. The form of the *uri* argument is a table, identical to the table provided as an argument to `get_netsync_connect_command`.

Note that the return value of this hook must "match" the semantics of the command returned by `get_netsync_connect_command`. In particular, if this hook returns `false`, the `serve` command line arguments passed to the remote end of the connection should include the '`--no-transport-auth`' option. A mismatch between this hook's return value and the command line returned by `get_netsync_connect_command` will cause a communication failure, as the local and remote monotone processes will have mismatched authentication assumptions.

```
function use_transport_auth(uri)
        if uri["scheme"] == "ssh"
        or uri["scheme"] == "file" then
                return false
        else
                return true
        end
end
```

`get_mtn_command(`*host*`)`

Returns a string containing the monotone command to be executed on *host* when communicating over `ssh`. The *host* argument is a string containing the name of the host to which `ssh` is connecting, from the server URI. This is useful when there are multiple monotone binaries on the remote host, or the monotone binary is not in the default path.

```
function get_mtn_command(host)
return "mtn"
end
```

6.1.5 Trust Evaluation Hooks

Monotone makes heavy use of certs to provide descriptive information about revisions. In many projects, not all developers should have the same privileges, or be trusted for the same purposes (indeed, some signers might be automated robots, with very specific purposes).

These hooks allow the user to configure which signers will be trusted to make which kinds of assertions using certs. Monotone uses these certs when selecting available revisions for commands such as `update`.

Each user, or even each workspace, can have their own implementation of these hooks, and thus a different filtered view of valid revisions, according to their own preferences and purposes.

`get_revision_cert_trust (`*signers*`, `*id*`, `*name*`, `*val*`)`

Returns whether or not you *trust* the assertion *name=value* on a given revision *id*, given a valid signature from all the keys in *signers*. The *signers* parameter is a table containing all the key names which signed this cert, the other three parameters are strings.

The default definition of this hook simply returns `true`, which corresponds to a form of trust where every key which is defined in your database is trusted. This is a *weak* trust setting; you should change it to something stronger. A possible example of a stronger trust function (along with a utility function for computing the intersection of tables) is the following:

```
function intersection(a,b)
   local s={}
   local t={}
   for k,v in pairs(a) do s[v] = 1 end
   for k,v in pairs(b) do if s[v] ~= nil then table.insert(t,v) end end
   return t
end

function get_revision_cert_trust(signers, id, name, val)
   local trusted_signers = { "bob@happyplace.example.com",
                             "friend@trustedplace.example.com",
                             "myself@home.example.com" }
   local t = intersection(signers, trusted_signers)

   if t == nil then return false end

   if    (name ~= "branch" and table.getn(t) >= 1)
      or (name == "branch" and table.getn(t) >= 2)
   then
      return true
   else
      return false
   end
end
```

In this example, any revision certificate is trusted if it is signed by at least one of three "trusted" keys, unless it is an `branch` certificate, in which case it must be signed by *two* or more trusted keys. This is one way of requiring that the revision has been approved by an extra "reviewer" who used the `approve` command.

`accept_testresult_change (`*old_results*`,` *new_results*`)`

This hook is used by the update algorithm to determine whether a change in test results between update source and update target is acceptable. The hook is called with two tables, each of which maps a signing key – representing a particular testsuite – to a boolean value indicating whether or not the test run was successful. The function should return `true` if you consider an update from the version carrying the *old_results* to the version carrying the *new_results* to be acceptable.

The default definition of this hook follows:

```
function accept_testresult_change(old_results, new_results)
   for test,res in pairs(old_results)
   do
      if res == true and new_results[test] ~= true
      then
 return false
      end
   end
   return true
end
```

This definition accepts only those updates which preserve the set of `true` test results from update source to target. If no test results exist, this hook has no affect; but once a `true` test result is present, future updates will require it. If you want a more lenient behavior you must redefine this hook.

6.1.6 External Diff Tools

Differences between files can be shown in a number of ways, varying according to user preference and file type. These hooks allow customisation of the way file differences are shown.

`get_encloser_pattern (`*`file_path`*`)`

Called for each file when `diff` is given the '`--show-encloser`' option (and *not* the '`--external`' option). *file_path* is the pathname of the file that is being diffed. The hook should return a string constant containing a regular expression; this regular expression will be used to find lines that, in that file, name the "top-level" constructs enclosing each "hunk" of changes. The default is `^[[:alnum:]$_]`, which is correct for many programming languages; a few text authoring packages, like Texinfo, have special regular expressions that match their particular syntax. If you have a better regular expression for some language, you can add it to this hook; and if you send it to the monotone developers, we will likely make it to the default for that language.

`external_diff (`*`file_path`*`, `*`old_data`*`, `*`new_data`*`, `*`is_binary`*`,`
diff_args, *old_rev*, *new_rev*)

Called for each file when `diff` is given the '`--external`' option. *file_path* is the pathname of the file that is being diffed. *old_data* and *new_data* are the data contents of the old and the new file. If the data is binary, *is_binary* will be true, otherwise false. *old_rev* and *new_rev* are the revision IDs of the old and new data.

If an extra arguments are given via '`--diff-args`', the string will be passed in as *diff_args*. Otherwise *diff_args* will be nil.

The default implementation of this hook calls the program `diff`, and if '`--diff-args`' were not passed, takes default arguments from the Lua variable `external_diff_default_args`. You can override this variable in your configuration file, without overriding the whole hook.

6.1.7 External Merge Tools

Monotone often needs to merge together the work of multiple distributed developers, and uses these hooks to help this process when the merge does not automatically succeed. Often these hooks will be used to invoke an external interactive merge tool.

The Appendix A [Default hooks], page 177 include helper functions used by the hooks below to invoke a number of external merge tools known to monotone, and you can override or extend these hooks if you have a preferred tool, or if you have a tool specific to certain file types.

`merge3 (`*`ancestor_path`*`, `*`left_path`*`, `*`right_path`*`, `*`merged_path`*`, `*`ancestor_text`*`,`
`left_text``, `*`right_text`*`)`

This hook is called to resolve merges that monotone could not resolve automatically. The actual ancestor, left, and right contents of the file are passed in the *ancestor_text*, *left_text*, and *right_text* strings. In addition, the hook is given the names that this file had in the ancestor (*ancestor_path*), left (*left_path*), and right (*right_path*) trees, and the name it will end up having in the merged

tree (*merged_path*). These paths are useful for merge tools that can display the names of files in their GUI, since the actual path names are likely more meaningful than the temporary file names the merge tool will actually be working on.

Returns a string, which should be the merger of the given texts. The default definition of this hook delegates the actual merge to the result of [get_preferred_merge3_command], page 143. The default definition of [get_preferred_merge3_command], page 143 checks to see if the `MTN_MERGE` environment variable, or the Lua variable `merger` are set to the name of a merge tool that it recognizes, and if not, then simply searches for whatever is installed on the local system. For details, see the code in Appendix A [Default hooks], page 177.

`get_preferred_merge3_command(`*`tbl`*`)`

Returns the results of running an external merge on three strings. *tbl* wraps up the various arguments for each merge command and is always provided by [merge3], page 142. If there is a particular editor that you would like to use to perform merge3 operations, override this hook to specify it.

6.1.8 Selector Expansion

Monotone's selectors are a powerful mechanism used to refer to revisions with symbolic names or groupings. Thanks to the hooks described in this section, it is possible to use various forms of shorthand in selection strings; these hooks are designed to recognise shorthand patterns and expand them to their full form.

For more detail on the use of selectors, see Section 3.2 [Selectors], page 47.

`expand_selector (`*`str`*`)`

Attempts to expand *str* as a selector. Expansion generally means providing a type prefix for the selector, such as `a:` for authors or `d:` for dates. This hook is called once for each element of a combined selector string (between `/` separators) prior to evaluation of the selector. For the default definition of this hook, see Appendix A [Default hooks], page 177.

`expand_date (`*`str`*`)`

Attempts to expand *str* as a date expression. Expansion means recognizing and interpreting special words such as `yesterday` or `6 months ago` and converting them into well formed date expressions. For the default definition of this hook, see Appendix A [Default hooks], page 177.

6.1.9 Attribute Handling

Some files in a project are special; they may require different handling (such as binary or structured files that should always be manually merged – see Section 3.13 [Merging], page 63), or they may represent executable scripts or programs.

Monotone allows each file (or directory) in a repository to carry arbitrary Section 3.12 [File Attributes], page 62. Persistent attributes are stored each revision's manifest. The hooks in this section allow files to be automatically recognised as having certain attributes at the time they're added, and for custom triggers to be invoked on each file according to its attributes when the workspace is changed.

`attr_functions [attribute] (filename, value)`

This is not a hook function, but a *table* of hook functions. Each entry in the table `attr_functions`, at table entry *attribute*, is a function taking a file name *filename* and a attribute value *value*. The function should "apply" the attribute to the file, possibly in a platform-specific way.

Hook functions from this table are called for each existing attr, after any command which modifies the workspace. This facility can be used to extend monotone's understanding of files with platform-specific attributes, such as permission bits, access control lists, or special file types.

By default, there is only one entry in this table, for the `mtn:execute` attribute. Its definition is:

```
attr_functions["mtn:execute"] =
  function(filename, value)
        if (value == "true") then
         make_executable(filename)
      end
   end
```

`attr_init_functions [attribute] (filename)`

This is not a hook function, but a *table* of hook functions. Each entry in the table `attr_init_functions`, at table entry *attribute*, is a function taking a file (or directory) name *filename*. Each function defines the attributes that should be set on the file named *filename*. This table of hook functions is called once for each file during an *add*.

By default, there are only two entries in this table, for the `mtn:execute` and `mtn:manual_merge` attributes. Their definition is:

```
attr_init_functions["mtn:execute"] =
   function(filename)
      if (is_executable(filename)) then
        return "true"
      else
        return nil
      end
   end
attr_init_functions["mtn:manual_merge"] =
   function(filename)
      if (binary_file(filename)) then
        return "true" -- binary files must be merged manually
      else
        return nil
      end
   end
```

The `binary_file` function is also defined as a Lua hook. See Appendix A [Default hooks], page 177.

6.1.10 Validation Hooks

If there is a policy decision to make, Monotone defines certain hooks to allow a client to validate or reject certain behaviors.

`validate_commit_message (`*`message`*`, `*`revision_text`*`, `*`branchname`*`)`

This hook is called after the user has entered his/her commit message. *message* is the commit message that the user has entered and *revision_text* is the full text of the changes for this revision, which can be parsed with the parse_basic_io function. The *branchname* on which the new revision will be committed if all goes well is passed in as the third parameter. If the hook finds the commit message satisfactory, it can return `true, ""`. If it finds fault, then it can return `false, reason` where *reason* is the reason the message was rejected. By default, this hook rejects empty log messages.

6.2 Additional Lua Functions

This section documents the additional Lua functions made available to hook writers.

`existonpath(`*`possible_command`*`)`
: This function receives a string containing the name of an external program and returns 0 if it exists on path and is executable, -1 otherwise. As an example, `existonpath("xxdiff")` returns 0 if the program xxdiff is available. On Windows, this function automatically appends ".exe" to the program name. In the previous example, `existonpath` would search for "xxdiff.exe".

`get_confdir()`
: Returns the path to the configuration directory, either implied or given with '`--confdir`'.

`get_ostype()`
: Returns the operating system flavor as a string.

`guess_binary_file_contents(`*`filespec`*`)`
: Returns true if the file appears to be binary, i.e. contains one or more of the following characters:

```
0x00 thru 0x06
0x0E thru 0x1a
0x1c thru 0x1f
```

`include(`*`scriptfile`*`)`
: This function tries to load and execute the script contained into scriptfile. It returns true for success and false if there is an error.

`includedir(`*`scriptpath`*`)`
: This function loads and executes in alphabetical order all the scripts contained into the directory scriptpath. If one of the scripts has an error, the functions doesn't process the remaining scripts and immediately returns false.

`includedirpattern(`*`scriptpath, pattern`*`)`
: This function loads and executes in alphabetical order all the scripts contained into the directory scriptpath that match the given pattern. If one of the scripts has an error, the functions doesn't process the remaining scripts and immediately returns false.

`is_executable(`*`filespec`*`)`
: This function returns true if the file is executable, false otherwise. On Windows this function returns always false.

`kill(`*`pid`*` [, `*`signal`*`])`
: This function calls the kill() C library function on POSIX systems and TerminateProcess on Win32 (in that case *pid* is the process handle). If the optional *signal* parameter is missing, SIGTERM will be used. Returns 0 on success, -1 on error.

`make_executable(`*`filespec`*`)`
: This function marks the named file as executable. On Windows has no effect.

`match(`*`glob, string`*`)`
: Returns true if *glob* matches *str*, return false otherwise.

`mkstemp(`*`template`*`)`

Like its C library counterpart, mkstemp creates a unique name and returns a file descriptor for the newly created file. The value of template should be a pointer to a character buffer loaded with a null-terminated string that consists of contiguous, legal file ad path name characters followed by six Xs. The function mkstemp replaces the Xs by an alpha-numeric sequence that is chosen to ensure that no file in the chosen directory has that name. Furthermore, subsequent calls to mkstemp within the same process each yield different file names. Unlike other implementations, monotone mkstemp allows the template string to contain a complete path, not only a filename, allowing users to create temporary files outside the current directory.

Important notice:
To create a temporary file, you must use the `temp_file()` function, unless you need to run monotone with the '`--nostd`' option. `temp_file()` builds on `mkstemp()` and creates a file in the standard TMP/TEMP directories. For the definition of `temp_file()`, see Appendix A [Default hooks], page 177.

`parse_basic_io(`*`data`*`)`

Parse the string *data*, which should be in basic_io format. It returns nil if it can't parse the string; otherwise it returns a table. This will be a list of all statements, with each entry being a table having a `"name"` element that is the symbol beginning the statement and a `"values"` element that is a list of all the arguments.

For example, given this as input:

```
thingy "foo" "bar"
thingy "baz"
spork
frob "oops"
```

The output table will be:

```
{
   1 = { name = "thingy", args = { 1 = "foo", 2 = "bar" } },
   2 = { name = "thingy", args = { 1 = "baz" } },
   3 = { name = "spork", args = { } },
   4 = { name = "frob", args = { 1 = "oops" } }
}
```

`regex.search(`*`regexp`*`, `*`string`*`)`

Returns true if a match for *regexp* is found in *str*, return false otherwise.

`server_request_sync(`*`what`*`, `*`address`*`, `*`include`*`, `*`exclude`*`)`

Initiate a netsync connection to the server at *address*, with the given include and exclude patterns, of type '`sync`', '`push`', or '`pull`', as given by the *what* argument.

When called by a monotone instance which is not running the '`serve`' command, this function has no effect.

`sleep(`*`seconds`*`)`

Makes the calling process sleep for the specified number of seconds.

`spawn(`*`executable`* `[,` *`args`* `...])`

Starts the named executable with the given arguments. Returns the process PID on POSIX systems, the process handle on Win32 or -1 if there was an error. Calls fork/execvp on POSIX, CreateProcess on Win32.

Important notice:
To spawn a process and wait for its completion, use the `execute()` function, unless you need to run monotone with the '`--nostd`' option. `execute()` builds on `spawn()` and `wait()` in a standardized way.

`spawn_pipe(`*`executable`* `[,` *`args`* `...])`

Like spawn(), but returns three values, where the first two are the subprocess' standard input and standard output, and the last is the process PID on POSIX systems, the process handle on Win32 or -1 if there was an error.

`spawn_redirected(`*`infile`*`,` *`outfile`*`,` *`errfile`*`,` *`executable`* `[,` *`args`* `...])`

Like spawn(), but with standard input, standard output and standard error redirected to the given files.

`wait(`*`pid`*`)`

Wait until the process with given PID (process handle on Win32) exits. Returns two values: a result value and the exit code of the waited-for process. The exit code is meaningful only if the result value is 0.

7 Special Topics

This chapter describes some "special" issues which are not directly related to monotone's *use*, but which are occasionally of interest to people researching monotone or trying to learn the specifics of how it works. Most users can ignore these sections.

7.1 Internationalization

Monotone initially dealt with only ASCII characters, in file path names, certificate names, key names, and packets. Some conservative extensions are provided to permit internationalized use. These extensions can be summarized as follows:

- Monotone uses GNU gettext to provide localized progress and error messages. Translations may or may not exist for your locale, but the infrastructure is present to add them.
- All command-line arguments are mapped from your local character set to UTF-8 before processing. This means that monotone can *only* handle key names, file names and certificate names which map cleanly into UTF-8.
- Monotone's control files are stored in UTF-8. This includes: revisions and manifests, both inside the database and when written to the '`_MTN/`' directory of the workspace; the '`_MTN/options`' and '`_MTN/revision`' files. Converting these files to any other character set will cause monotone to break; do not do so.
- File path names in the workspace are converted to the locale's character set (determined via the LANG or CHARSET environment variables) before monotone interacts with the file system. If you are accustomed to being able to use file names in your locale's character set, this should "just work" with monotone.
- Key and cert names, and similar "name-like" entities are subject to some cleaning and normalization, and conversion into network-safe subsets of ASCII (typically ACE). Generally, you should be able to use "sensible" strings in your locale's character set as names, but they may appear mangled or escaped in certain contexts such as network transmission.
- Monotone's transmission and storage forms are otherwise unchanged. Packets and database contents are 7-bit clean ASCII.

The remainder of this section is a precise specification of monotone's internationalization behavior.

General Terms

Character set conversion
: The process of mapping a string of bytes representing wide characters from one encoding to another. Per-file character set conversions are specified by a Lua hook `get_charset_conv` which takes a filename and returns a table of two strings: the first represents the `"internal"` (database) charset, the second represents the `"external"` (file system) charset.

LDH
: Letters, digits, and hyphen: the set of ASCII bytes `0x2D`, `0x30..0x39`, `0x41..0x5A`, and `0x61..0x7A`.

stringprep
: RFC 3454, a general framework for mapping, normalizing, prohibiting and bidirectionality checking for international names prior to use in public network protocols.

nameprep
: RFC 3491, a specific profile of stringprep, used for preparing international domain names (IDNs)

punycode RFC 3492, a "bootstring" encoding of Unicode into ASCII.

IDNA RFC 3490, international domain names for applications, a combination of the above technologies (nameprep, punycoding, limiting to LDH characters) to form a specific "ASCII compatible encoding" (ACE) of Unicode, signified by the presence of an "unlikely" ACE prefix string "xn–". IDNA is intended to make it possible to use Unicode relatively "safely" over legacy ASCII-based applications. the general picture of an IDNA string is this:

```
{ACE-prefix}{LDH-sanitized(punycode(nameprep(UTF-8-string)))}
```

It is important to understand that IDNA encoding does *not* preserve the input string: it both prohibits a wide variety of possible strings and normalizes non-equal strings to supposedly "equivalent" forms.

By default, monotone does *not* decode IDNA when printing to the console (IDNA names are ASCII, which is a subset of UTF-8, so this normal form conversion can still apply, albeit oddly). this behavior is to protect users against security problems associated with malicious use of "similar-looking" characters. If the hook `display_decoded_idna` returns true, IDNA names are decoded for display.

Filenames

- Filenames are subject to normal form conversion.
- Filenames are subject to an additional normal form stage which adjusts for platform name semantics, for example changing the Windows `0x5C` '\' path separator to `0x2F` '/'. This extra processing is performed by boost::filesystem.
- FIXME: Monotone does not properly handle case insensitivity on Windows.
- A filename (in normal form) is constrained to be a nonempty sequence of path components, separated by byte `0x2F` (ASCII /), and without a leading or trailing `0x2F`.
- A path component is a nonempty sequence of any UTF-8 character codes except the path separator byte `0x2F` and any ASCII "control codes" (`0x00..0x1F` and `0x7F`).
- The path components "." and ".." are prohibited.
- Manifests and revisions are constructed from the normal form (UTF-8). The LC_COLLATE locale category is *not* used to sort manifest or revision entries.

File contents

- Files are subject to character set conversion and line ending conversion.
- File SHA1 values are calculated from the internal form of the conversions. If the external form of a file differs from the internal form, running a 3rd party program such as `sha1sum` will produce different results than those entries shown in a corresponding manifest.

UI messages

UI messages are displayed via calls to `gettext()`.

Host names

Host names are read on the command-line and subject to normal form conversion. Host names are then split at `0x2E` (ASCII '.'), each component is subject to IDNA encoding, and the components are rejoined.

After processing, host names are stored internally as ASCII. The invariant is that a host name inside monotone contains only sequences of LDH separated by `0x2E`.

Cert names

Read on the command line and subject to normal form conversion and IDNA encoding as a single component. The invariant is that a cert name inside monotone is a single LDH ASCII string.

Cert values

Cert values may be either text or binary, depending on the return value of the hook `cert_is_binary`. If binary, the cert value is never printed to the screen (the literal string `"<binary>"` is displayed, instead), and is never subjected to line ending or character conversion. If text, the cert value is subject to normal form conversion, as well as having all UTF-8 codes corresponding to ASCII control codes (`0x0..0x1F` and `0x7F`) prohibited in the normal form, except `0x0A` (ASCII LF).

Var domains

Read on the command line and subject to normal form conversion and IDNA encoding as a single component. The invariant is that a var domain inside monotone is a single LDH ASCII string.

Var names and values

Var names and values are assumed to be text, and subject to normal form conversion.

Key names

Read on the command line and subject to normal form conversion and IDNA encoding as an email address (split and joined at '.' and '`@`' characters). The invariant is that a key name inside monotone contains only LDH, `0x2E` (ASCII '.') and `0x40` (ASCII '`@`') characters.

Packets

Packets are 7-bit ASCII. The characters permitted in packets are the union of these character sets:

- The 65 characters of base64 encoding (64 coding `+` `"="` pad).
- The 16 characters of hex encoding.
- LDH, '`@`' and '.' characters, as required for key and cert names.
- '[' and ']', the packet delimiters.
- ASCII codes 0x0D (CR), 0x0A (LF), 0x09 (HT), and 0x20 (SP).

7.2 Hash Integrity

Some proponents of a competing, proprietary version control system have suggested, in a usenix paper, that the use of a cryptographic hash function such as SHA1 as an identifier for a version is unacceptably unsafe. This section addresses the argument presented in that paper and describes monotone's additional precautions.

To summarize our position:

- the analysis in the paper is wrong,
- even if it were right, monotone is sufficiently safe.

The analysis is wrong

The paper displays a fundamental lack of understanding about what a *cryptographic* hash function is, and how it differs from a normal hash function. Furthermore it confuses accidental collision with attack scenarios, and mixes up its analysis of the risk involved in each. We will try to untangle these issues here.

A cryptographic hash function such as SHA1 is more than just a uniform spread of inputs to an output range. Rather, it must be designed to withstand attempts at:

- reversal: deriving an input value from the output
- collision: finding two different inputs which hash to the same output

Collision is the problem the paper is concerned with. Formally, an n-bit cryptographic hash should cost 2^n work units to collide against a given value, and $sqrt(2^n)$ tries to find a random pair of colliding values. This latter probability is sometimes called the hash's "birthday paradox probability".

Accidental collision

One way of measuring these bounds is by measuring how single-bit changes in the input affect bits in the hash output. The SHA1 hash has a strong *avalanche property*, which means that flipping *any one bit* in the input will cause on average half the 160 bits in the output code to change. The fanciful VAL1 hash presented in the paper does not have such a property — flipping its first bit when all the rest are zero causes *no change* to any of the 160 output bits — and is completely unsuited for use as a *cryptographic hash*, regardless of the general shape of its probability distribution.

The paper also suggests that birthday paradox probability cannot be used to measure the chance of accidental SHA1 collision on "real inputs", because birthday paradox probability assumes a uniformly random sample and "real inputs" are not uniformly random. The paper is wrong: the inputs to SHA1 are not what is being measured (and in any case can be arbitrarily long); the collision probability being measured is of *output space*. On output space, the hash is designed to produce uniformly random spread, even given nearly identical inputs. In other words, it is *a primary design criterion* of such a hash that a birthday paradox probability is a valid approximation of its collision probability.

The paper's characterization of risk when hashing "non-random inputs" is similarly deceptive. It presents a fanciful case of a program which is *storing* every possible 2kb block in a file system addressed by SHA1 (the program is trying to find a SHA1 collision). While this scenario *will* very likely encounter a collision *somewhere* in the course of storing all

such blocks, the paper neglects to mention that we only expect it to collide after storing about 2^{80} of the 2^{16384} possible such blocks (not to mention the requirements for compute time to search, or disk space to store 2^{80} 2kb blocks).

Noting that monotone can only store 2^{41} bytes in a database, and thus probably some lower number (say 2^{32} or so) active rows, we consider such birthday paradox probability well out of practical sight. Perhaps it will be a serious concern when multi-yottabyte hard disks are common.

Collision attacks

Setting aside accidental collisions, then, the paper's underlying theme of vulnerability rests on the assertion that someone will break SHA1. Breaking a cryptographic hash usually means finding a way to collide it trivially. While we note that SHA1 has in fact resisted attempts at breaking for 8 years already, we cannot say that it will last forever. Someone might break it. We can say, however, that finding a way to trivially collide it only changes the resistance to *active attack*, rather than the behavior of the hash on benign inputs.

Therefore the vulnerability is not that the hash might suddenly cease to address benign blocks well, but merely that additional security precautions might become a requirement to ensure that blocks are benign, rather than malicious. The paper fails to make this distinction, suggesting that a hash becomes "unusable" when it is broken. This is plainly not true, as a number of systems continue to get useful low collision hashing behavior — just not good security behavior — out of "broken" cryptographic hashes such as MD4.

Monotone is probably safe anyways

Perhaps our arguments above are unconvincing, or perhaps you are the sort of person who thinks that practice never lines up with theory. Fair enough. Below we present *practical* procedures you can follow to compensate for the supposed threats presented in the paper.

Collision attacks

A successful collision attack on SHA1, as mentioned, does not disrupt the *probability* features of SHA1 on benign blocks. So if, at any time, you believe SHA1 is "broken", it does *not* mean that you cannot use it for your work with monotone. It means, rather, that you cannot base your *trust* on SHA1 values anymore. You must trust who you communicate with.

The way around this is reasonably simple: if you do not trust SHA1 to prevent malicious blocks from slipping into your communications, you can always augment it by enclosing your communications in more security, such as tunnels or additional signatures on your email posts. If you choose to do this, you will still have the benefit of self-identifying blocks, you will simply cease to trust such blocks unless they come with additional authentication information.

If in the future SHA1 (or, indeed, RSA) becomes accepted as broken we will naturally upgrade monotone to a newer hash or public key scheme, and provide migration commands to recalculate existing databases based on the new algorithm.

Similarly, if you do not trust our vigilance in keeping up to date with cryptography literature, you can modify monotone to use any stronger hash you like, at the cost of isolating your own communications to a group using the modified version. Monotone is free

software, and runs atop `botan`, so it is both legal and relatively simple to change it to use some other algorithm.

7.3 Rebuilding ancestry

As described in Section 1.3 [Historical records], page 6, monotone revisions contain the SHA1 hashes of their predecessors, which in turn contain the SHA1 hashes of *their* predecessors, and so on until the beginning of history. This means that it is *mathematically impossible* to modify the history of a revision, without some way to defeat SHA1. This is generally a good thing; having immutable history is the point of a version control system, after all, and it turns out to be very important to building a *distributed* version control system like monotone.

It does have one unfortunate consequence, though. It means that in the rare occasion where one *needs* to change a historical revision, it will change the SHA1 of that revision, which will change the text of its children, which will change their SHA1s, and so on; basically the entire history graph will diverge from that point (invalidating all certs in the process).

In practice there are two situations where this might be necessary:

- bugs: monotone has occasionally allowed nonsense, uninterpretable changesets to be generated and stored in the database, and this was not detected until further work had been based off of them.
- advances in crypto: if or when SHA1 is broken, we will need to migrate to a different secure hash.

Obviously, we hope neither of these things will happen, and we've taken lots of precautions against the first recurring; but it is better to be prepared.

If either of these events occur, we will provide migration commands and explain how to use them for the situation in question; this much is necessarily somewhat unpredictable. In the past we've used the (now defunct) `db rebuild` command, and more recently the `db rosterify` command, for such changes as monotone developed. These commands were used to recreate revisions with new formats. Because the revision id's changed, all the existing certs that you trust also must be reissued, signed with your key.[1]

While such commands can reconstruct the ancestry graph in *your* database, there are practical problems which arise when working in a distributed work group. For example, suppose our group consists of the fictional developers Jim and Beth, and they need to rebuild their ancestry graph. Jim performs a rebuild, and sends Beth an email telling her that he has done so, but the email gets caught by Beth's spam filter, she doesn't see it, and she blithely syncs her database with Jim's. This creates a problem: Jim and Beth have combined the pre-rebuild and post-rebuild databases. Their databases now contain two complete, parallel (but possibly overlapping) copies of their project's ancestry. The "bad" old revisions that they were trying to get rid of are still there, mixed up with the "good" new revisions.

To prevent such messy situations, monotone keeps a table of branch *epochs* in each database. An epoch is just a large bit string associated with a branch. Initially each branch's epoch is zero. Most monotone commands ignore epochs; they are relevant in only two circumstances:

[1] Regardless of who originally signed the certs, after the rebuild they will be signed by you. This means you should be somewhat careful when rebuilding, but it is unavoidable — if you could sign with other people's keys, that would be a rather serious security problem!

- When monotone rebuilds ancestry, it generates a new *random* epoch for each branch in the database.
- When monotone runs netsync between databases, it checks to make sure that all branches involved in the synchronization have the same epochs. If any epochs differ, the netsync is aborted with no changes made to either database. If either side is seeing a branch for the first time, it adopts the epoch of the other side.

Thus, when a user rebuilds their ancestry graph, they select a new epoch and thus effectively disassociate with the group of colleagues they had previously been communicating with. Other members of that group can then decide whether to follow the rebuild user into a new group — by pulling the newly rebuilt ancestry — or to remain behind in the old group.

In our example, if Jim and Beth have epochs, Jim's rebuild creates a new epoch for their branch, in his database. This causes monotone to reject netsync operations between Jim and Beth; it doesn't matter if Beth loses Jim's email. When she tries to synchronize with him, she receives an error message indicating that the epoch does not match. She must then discuss the matter with Jim and settle on a new course of action — probably pulling Jim's database into a fresh database on Beth's end – before future synchronizations will succeed.

Best practices

The previous section described the theory and rationale behind rebuilds and epochs. Here we discuss the practical consequences of that discussion.

If you decide you must rebuild your ancestry graph — generally by announcement of a bug from the monotone developers — the first thing to do is get everyone to sync their changes with the central server; if people have unshared changes when the database is rebuilt, they will have trouble sharing them afterwards.

Next, the project should pick a designated person to take down the netsync server, rebuild their database, and put the server back up with the rebuilt ancestry in it. Everybody else should then pull this history into a fresh database, check out again from this database, and continue working as normal.

In complicated situations, where people have private branches, or ancestries cross organizational boundaries, matters are more complex. The basic approach is to do a local rebuild, then after carefully examining the new revision IDs to convince yourself that the rebuilt graph is the same as the upstream subgraph, use the special `db epoch` commands to force your local epochs to match the upstream ones. (You may also want to do some fiddling with certs, to avoid getting duplicate copies of all of them; if this situation ever arises in real life we'll figure out how exactly that should work.) Be very careful when doing this; you're explicitly telling monotone to let you shoot yourself in the foot, and it will let you.

Fortunately, this process should be extremely rare; with luck, it will never happen at all. But this way we're prepared.

7.4 Mark-Merge

Monotone makes use of the Mark-Merge (also known as *-merge) algorithm. The emails reproduced below document the algorithm. Further information can be found at revctrl.org.

Initial mark-merge proposal

```
From: Nathaniel Smith <njs <at> pobox.com>
Subject: [cdv-devel] more merging stuff (bit long...)
Newsgroups: gmane.comp.version-control.codeville.devel, gmane.comp.version-control.monotone
Date: 2005-08-06 09:08:09 GMT

I set myself a toy problem a few days ago: is there a really, truly,
right way to merge two heads of an arbitrary DAG, when the object
being merged is as simple as possible: a single scalar value?

I assume that I'm given a graph, and each node in the graph has a
value, and no other annotation; I can add annotations, but they have
to be derived from the values and topology.  Oh, and I assume that no
revision has more than 2 parents; probably things can be generalized
to the case of indegree 3 or higher, but it seems like a reasonable
restriction...

So, anyway, here's what I came up with.  Perhaps you all can tell me
if it makes sense.

User model
----------

Since the goal was to be "really, truly, right", I had to figure out
what exactly that meant... basically, what I'm calling a "user model"
-- a formal definition of how the user thinks about merging, to give
an operational definition of "should conflict" and "should clean
merge".  My rules are these:
  1) whenever a user explicitly sets the value, they express a claim
     that their setting is superior to the old setting
  2) whenever a user chooses to commit a new revision, they implicitly
     affirm the validity of the decisions that led to that revision's
     parents
    Corollary of (1) and (2): whenever a user explicitly sets the
     value, they express that they consider their new setting to be
     superior to _all_ old settings
  3) A "conflict" should occur if, and only if, the settings on each
     side of the merge express parallel claims.
This in itself is not an algorithm, or anything close to it; the hope
is that it's a good description of what people actually want out of a
merge algorithm, expressed clearly enough that we can create an
algorithm that fits these desiderata.
```

```
Algorithm
---------

I'll use slightly novel notation.  Lower case letters represent values
that scalar the scalar takes.  Upper case letters represent nodes in
the graph.

Now, here's an algorithm, that is supposed to just be a transcription
of the above rules, one step more formal:
  First, we need to know where users actively expressed an intention.
  Intention is defined by (1), above.  We use * to mark where this
  occurred:

    i)      a*     graph roots are always marked

            a
    ii)     |      no mark, value was not set
            a

            a
    iii)    |      b != a, so b node marked
            b*

          a   b
    iv)    \ /
            c*
                   c is totally new, so marked
          a   a
           \ /
            c*

          a   b    we're marking places where users expressed
    v)     \ /     intention; so b should be marked iff this
            b?     was a conflict (!)

          a   a    for now I'm not special-casing the coincidental
    vi)    \ /     clean merge case, so let's consider this to be
            a?     a subclass of (v).

  That's all the cases possible.  So, suppose we go through and
  annotate our graph with *s, using the above rules; we have a graph
  with some *s peppered through it, each * representing one point that
  a user took action.

  Now, a merge algorithm per se: Let's use *(A) to mean the unique
  nearest marked ancestor of node A.  Suppose we want to merge A and
```

```
  B.  There are exactly 3 cases:
    - *(A) is an ancestor of B, but not vice versa: B wins.
    - *(B) is an ancestor of A, but not vice versa: A wins.
    - *(A) is _not_ an ancestor of B, and vice versa: conflict,
      escalate to user
  Very intuitive, right?  If B supercedes the intention that led to A,
  then B should win, and vice-versa; if not, the user has expressed
  two conflicting intentions, and that, by definition, is a conflict.

  This lets us clarify what we mean by "was a conflict" in case (v)
  above.  When we have a merge of a and b that gives b, we simple
  calculate *(a); if it is an ancestor of 'b', then we're done, but if
  it isn't, then we mark the merge node.  (Subtle point: this is
  actually not _quite_ the same as detecting whether merging 'a' and
  'b' would have given a conflict; if we somehow managed to get a
  point in the graph that would have clean merged to 'a', but in fact
  was merged to 'b', then this algorithm will still mark the merge
  node.)  For cases where the two parents differ, you have to do this
  using the losing one; for cases where the two parents are the same,
  you should check both, because it could have been a clean merge two
  different ways.  If *(a1) = *(a2), i.e., both sides have the same
  nearest marked ancestor, consider that a clean merge.

  That's all.

Examples
--------

Of course, I haven't shown you this is well-defined or anything, but
to draw out the suspense a little, have some worked examples (like
most places in this document, I draw graphs with two leaves and assume
that those are being merged):

  graph:
       a*
      / \
     a   b*
  result: *(a) is an ancestor of b, but *(b) is not an ancestor of a;
    clean merge with result 'b'.

  graph:
       a*
      / \
     b*  c*
  result: *(b) = b is not an ancestor of c, and *(c) = c is not an
    ancestor of c; conflict.
```

```
  graph:
       a*
      / \
     b*  c*  <--- these are both marked, by (iii)
     |\ /|
     | X |
     |/ \|
     b*  c*  <--- which means these were conflicts, and thus marked
  result: the two leaves are both marked, and thus generate a conflict,
    as above.

Right, enough of that.  Math time.

Math
----

Theorem: In a graph marked following the above rules, every node N
  will have a unique least marked ancestor M, and the values of M and N
  will be the same.
Proof: By downwards induction on the graph structure.  The base case
  are graph roots, which by (i) are always marked, so the statement is
  trivially true.  Proceeding by cases, (iii) and (iv) are trivially
  true, since they produce nodes that are themselves marked.  (ii) is
  almost as simple; in a graph 'a' -> 'a', the child obviously
  inherits the parent's unique least marked ancestor, which by
  inductive hypothesis exists.  The interesting case is (v) and (vi):
     a   b
      \ /
       b
  If the child is marked, then again the statement is trivial; so
  suppose it is not.  By definition, this only occurs when *(a) is an
  ancestor of 'b'.  But, by assumption, 'b' has a unique nearest
  ancestor, whose value is 'b'.  Therefore, *(a) is also an ancestor
  of *(b).  If we're in the weird edge case (vi) where a = b, then
  these may be the same ancestor, which is fine.  Otherwise, the fact
  that a != b, and that *(a)'s value = a's value, *(b)'s value = b's
  value, implies that *(a) is a strict ancestor of *(b).  Either way,
  the child has a unique least marked ancestor, and it is the same
  ULMA as its same-valued parent, so the ULMA also has the right
  value.  QED.

Corollary: *(N) is a well-defined function.

Corollary: The three cases mentioned in the merge algorithm are the
  only possible cases.  In particular, it cannot be that *(A) is an
  ancestor of B and *(B) is an ancestor of A simultaneously, unless
  the two values being merged are identical (and why are you running
```

```
  your merge algorithm then?).  Or in other words: ambiguous clean
  merge does not exist.
Proof: Suppose *(A) is an ancestor of B, and *(B) is an ancestor of A.
  *(B) is unique, so *(A) must also be an ancestor of *(B).
  Similarly, *(B) must be an ancestor of *(A).  Therefore:
    *(A) = *(B)
  We also have:
    value(*(A)) = value(A)
    value(*(B)) = value(B)
  which implies
    value(A) = value(B).  QED.

Therefore, the above algorithm is well-defined in all possible cases.

We can prove another somewhat interesting fact:
Theorem: If A and B would merge cleanly with A winning, then any
  descendent D of A will also merge cleanly with B, with D winning.
Proof: *(B) is an ancestor of A, and A is an ancestor of D, so *(B) is
  an ancestor of D.

I suspect that this is enough to show that clean merges are order
invariant, but I don't have a proof together ATM.

Not sure what other properties would be interesting to prove; any
suggestions?  It'd be nice to have some sort of proof about "once a
conflict is resolved, you don't have to resolve it again" -- which is
the problem that makes ambiguous clean merge so bad -- but I'm not
sure how to state such a property formally.  Something about it being
possible to fully converge a graph by resolving a finite number of
conflicts or something, perhaps?

Funky cases
-----------

There are two funky cases I know of.

Coincidental clean merge:
    |
    a
   / \
  b*  b*

Two people independently made the same change.  When we're talking
about textual changes, some people argue this should give a conflict
(reasoning that perhaps the same line _should_ be inserted twice).  In
our context that argument doesn't even apply, because these are just
scalars; so obviously this should be a clean merge.  Currently, the
```

only way this algorithm has to handle this is to treat it as an "automatically resolved conflict" -- there's a real conflict here, but the VCS, acting as an agent for the user, may decide to just go ahead and resolve it, because it knows perfectly well what the user will do. In this interpretation, everything works fine, all the above stuff applies; it's somewhat dissatisfying, though, because it's a violation of the user model -- the user has not necessarily looked at this merge, but we put the * of user-assertion on the result anyway. Not a show-stopper, I guess...

It's quite possible that the above stuff could be generalized to allow non-unique least marked ancestors, that could only arise in exactly this case.

I'm not actually sure what the right semantics would be, though. If we're merging:

```
    |
    a
   / \
  b   b
   \ / \
    b   c
```

Should that be a clean merge? 'b' was set twice, and only one of these settings was overridden; is that good enough?

Do you still have the same opinion if the graph is:

```
    |
    a
    |
    b
   / \
  c   b
  |  / \
  b  b  c
  \ /
   b
```

? Here the reason for the second setting of 'b' was that a change away from it was reverted; to make it extra cringe-inducing, I threw in that change being reverted was another change to 'c'... (this may just be an example of how any merge algorithm has some particular case you can construct where it will get something wrong, because it doesn't _actually_ know how to read the users's minds).

Supporting these cases may irresistably lead back to ambiguous clean, as well:

```
     |
     a
```

```
    / \
   b*  c*
  / \ / \
 c*  X   b*
  \ / \ /
   c   b
```

The other funky case is this thing (any clever name suggestions?):

```
    a
   / \
  b*  c*
   \ / \
    c*  d*
```

Merging here will give a conflict, with my algorithm; 3-way merge would resolve it cleanly. Polling people on #monotone and #revctrl, the consensus seems to be that they agree with 3-way merge, but giving a conflict is really not _that_ bad. (It also seems to cause some funky effects with darcs-merge; see zooko's comments on #revctrl and darcs-users.)

This is really a problem with the user model, rather than the algorithm. Apparently people do not interpret the act of resolving the b/c merge to be "setting" the result; They seem to interpret it as "selecting" the result of 'c'; the 'c' in the result is in some sense the "same" 'c' as in the parent. The difference between "setting" and "selecting" is the universe of possible options; if you see

```
   a   b
    \ /
     c
```

then you figure that the person doing the merge was picking from all possible resolution values; when you see

```
   a   b
    \ /
     b
```

you figure that the user was just picking between the two options given by the parents. My user model is too simple to take this into account. It's not a huge extension to the model to do so; it's quite possible that an algorithm could be devised that gave a clean merge here, perhaps by separately tracking each node's nearest marked ancestor and the original source of its value as two separate things.

Relation to other work

This algorithm is very close to the traditional codeville-merge approach to this problem; the primary algorithmic difference is the marking of conflict resolutions as being "changes". The more

important new stuff here, I think, are the user model and the proofs.

Traditionally, merge algorithms are evaluated by coming up with some set of examples, eyeballing them to make some guess as to what the "correct" answer was, comparing that to the algorithm's output, and then arguing with people whose intuitions were different. Fundamentally, merging is about deterministically guessing the user's intent in situations where the user has not expressed any intent. Humans are very good at guessing intent; we have big chunks of squishy hardware designed to form sophisticated models of others intents, and it's completely impossible for a VCS to try and duplicate that in full. My suggestion here, with my "user model", is to seriously and explicitly study this part of the problem. There are complicated trade-offs between accuracy (correctly modeling intention), conservatism (avoiding incorrectly modeling intention), and implementability (describing the user's thought processes exactly isn't so useful if you can't apply it in practice). It's hard to make an informed judgement when we don't have a name for the thing we're trying to optimize, and hard to evaluate an algorithm when we can't even say what it's supposed to be doing.

I suspect the benefit of the proofs is obvious to anyone who has spent much time banging their head against this problem; until a few days ago I was skeptical there _was_ a way to design a merge algorithm that didn't run into problems like ambiguous clean merge.

I'm still skeptical, of course, until people read this; merging is like crypto, you can't trust anything until everyone's tried to break it... so let's say I'm cautiously optimistic . If this holds up, I'm quite happy; between the user model and the proofs, I'm far more confident that this does something sensible in all cases and has no lurking edge cases than I have been in any previous algorithm. The few problem cases I know of display a pleasing conservatism -- perhaps more cautious than they need to be, but even if they do cause an occasional unnecessary conflict, once the conflict is resolved it should stay resolved.

So... do your worst!

-- Nathaniel

--
So let us espouse a less contested notion of truth and falsehood, even if it is philosophically debatable (if we listen to philosophers, we must debate everything, and there would be no end to the discussion).
  -- Serendipities, Umberto Eco

Replies and further discussion concerning this email can be found in the monotone-devel archives.

Improvements to *-merge

```
From: Nathaniel Smith <njs@...>
Subject: improvements to *-merge
Newsgroups: gmane.comp.version-control.revctrl, gmane.comp.version-control.monotone.devel
Date: 2005-08-30 09:21:18 GMT

This is a revised version of *-merge:
  http://thread.gmane.org/gmane.comp.version-control.monotone.devel/4297
that properly handles accidental clean merges.  It does not improve
any of the other parts, just the handling of accidental clean merges.
It shows a way to relax the uniqueness of the *() operator, while
still preserving the basic results from the above email.  For clarity,
I'll say 'unique-*-merge' to refer to the algorithm given above, and
'multi-*-merge' to refer to this one.

This work is totally due to Timothy Brownawell <tbrownaw@...>.
All I did was polish up the proofs and write it up.  He has a more
complex version at:
  http://article.gmane.org/gmane.comp.version-control.monotone.devel/4496
that also attempts to avoid the conflict with:
     a
    / \
   b*  c*
    \ / \
     c*  d*
and has some convergence in it, but the analysis for that is not done.

So:

User model
----------

We keep exactly the same user model as unique-*-merge:

  1) whenever a user explicitly sets the value, they express a claim
     that their setting is superior to the old setting
  2) whenever a user chooses to commit a new revision, they implicitly
     affirm the validity of the decisions that led to that revision's
     parents
    Corollary of (1) and (2): whenever a user explicitly sets the
     value, they express that they consider their new setting to be
     superior to _all_ old settings
  3) A "conflict" should occur if, and only if, the settings on each
```

```
     side of the merge express parallel claims.

The difference is that unique-*-merge does not _quite_ fulfill this
model, because in real life your algorithm will automatically resolve
coincidental clean merge cases without asking for user input; but
unique-* is not smart enough to take this into account when inferring
user intentions.

Algorithm
---------

We start by marking the graph of previous revisions.  For each node in
the graph, we either mark it (denoted by a *), or do not.  A mark
indicates our inference that a human expressed an intention at this
node.

    i)      a*      graph roots are always marked

            a1
    ii)     |       no mark, value was not set
            a2

            a
    iii)    |       b != a, so 'b' node marked
            b*

          a   b
    iv)    \ /
            c*
                    'c' is totally new, so marked
          a1  a2
           \ /
            c*

          a   b1    we're marking places where users expressed
    v)     \ /      intention; so 'b' should be marked iff this
            b2?     was a conflict

          a1  a2    'a' matches parents, and so is not marked
    vi)    \ /      (alternatively, we can say this is a special
            a3      case of (v), that is never a conflict)

Case (vi) is the only one that differs from unique-* merge.  However,
because of it, we must use a new definition of *():

Definition: By *(A), we mean we set of minimal marked ancestors of A.
"Minimal" here is used in the mathematical sense of a node in a graph
```

```
that has no descendents in that graph.

Algorithm: Given two nodes to merge, A and B, we consider four cases:
   a) value(A) = value(B): return the shared value
   b) *(A) > B: return value(B)
   c) *(B) > A: return value(A)
   d) else: conflict; escalate to user
Where "*(A) > B" means "all elements of the set *(A) are non-strict
ancestors of the revision B".  The right way to read this is as "try
(a) first, and then if that fails try (b), (c), (d) simultaneously".

Note that except for the addition of rule (a), this is a strict
generalization of the unique-* algorithm; if *(A) and *(B) are
single-element sets, then this performs _exactly_ the same
computations as the unique-* algorithm.

Now we can say what we mean by "was a conflict" in case (v) above:
given a -> b2, b1 -> b2, we leave b2 unmarked if and only if
*(a) > b1.

Examples
--------

1.
    a1*
   / \
  a2  b*

result: *(a2) = {a1}, a1 > b, so b wins.

2.
    a*
   / \
  b*  c*

result: *(b) = {b}, *(c) = {c}, neither *(b) > c nor *(c) > b, so
 conflict.

3.
    a*
   / \
  b1* b2*
   \ / \
    b3  c1*

result: *(b3) = {b1, b2}; b2 > c1, but b1 is not > c, so c does not
 win.  *(c1) = {c1}, which is not > b3.  conflict.
```

```
note: this demonstrates that this algorithm does _not_ do convergence.
Instead, it takes the conservative position that for one node to
silently beat another, the winning node must pre-empt _all_ the
intentions that created the losing node.  While it's easy to come up
with just-so stories where this is the correct thing to do (e.g., b1
and b2 each contain some other changes that independently require 'a'
to become 'b'; c1 will have fixed up b2's changes, but not b1's), this
doesn't actually mean much.  Whether this is good or bad behavior a
somewhat unresolved question, that may ultimately be answered by which
merge algorithms turn out to be more tractable...

4.
    a*
   / \
  b1* b2*
  |\ /|
  | X |
  |/ \|
  b3  c*

result: *(b3) = {b1, b2} > c.  *(c) = {c}, which is not > b3.  c wins
 cleanly.

5.
     a*
    / \
   b1* c1*
  / \ / \
 c2* X   b2*
  \ / \ /
   c3  b3

result: *(c3) = {c1, c2}; c1 > b3 but c2 is not > b3, so b3 does not
 win.  likewise, *(b3) = {b1, b2}; b1 > c3 but b2 is not > c3, so c3
 does not win either.  conflict.

6.
     a*
    / \
   b1* c1*
  / \ / \
 c2* X   b2*
  \ / \ /
   c3  b3
   |\ /|
   | X |
   |/ \|
```

```
   c4* b4*

(this was my best effort to trigger an ambiguous clean merge with this
algorithm; it fails pitifully:)
result: *(c4) = {c4}, *(b4) = {b4}, obvious conflict.

Math
----

The interesting thing about this algorithm is that all the unique-*
proofs still go through, in a generalized form.  The key one that
makes *-merge tractable is:

Theorem: In a graph marked by the above rules, given a node N, all
 nodes in *(N) will have the same value as N.
Proof: By induction.  We consider the cases (i)-(vi) above.  (i)
 through (iv) are trivially true.  (v) is interesting.  b2 is marked
 when *(a) not > b1.  b2 being marked makes that case trivial, so
 suppose *(a) > b1.  All elements of *(a) are marked, and are
 ancestors of b1; therefore, by the definition of *() and "minimal",
 they are also all ancestors of things in *(b1).  Thus no element of
 *(a) can be a minimal marked ancestor of b2.
 (vi) is also trivial, because *(a3) = *(a1) union *(a2).  QED.

We also have to do a bit of extra work because of the sets:

Corollary 1: If *(A) > B, and any element R of *(B) is R > A, then
 value(A) = value(B).
Proof: Let such an R be given.  R > A, and R marked, imply that there
 is some element S of *(A) such that R > S.
 On the other hand, *(A) > B implies that S > B.  By similar reasoning
 to the above, this means that there is some element T of *(B) such
 that S > T.  So, recapping, we have:
  nodes:   R  >  S  >  T
    from: *(B)  *(A)  *(B)
 *(B) is a set of minimal nodes, yet we have R > T and R and T both in
 *(B).  This implies that R = T.  R > S > R implies that S = R,
 because we are in a DAG.  Thus
   value(A) = value(S) = value(R) = value(B)
 QED.

Corollary 2: If *(A) > B and *(B) > A, then not only does value(A) =
 value(B), but *(A) = *(B).
Proof: By above, each element of *(B) is equal to some element of
 *(A), and vice-versa.

This is good, because it means our algorithm is well-defined.  The
```

```
only time when options (b) and (c) (in the algorithm) can
simultaneously be true, is when the two values being merged are
identical to start with.  I.e., no somewhat anomalous "4th case" of
ambiguous clean merge.

Actually, this deserves some more discussion.  With *() returning a
set, there are some more subtle "partial ambiguous clean" cases to
think about -- should we be worrying about cases where some, but not
all, of the marked ancestors are pre-empted?  This is possible, as in
example 5 above:
     a*
    / \
   b1* c1*
  / \ / \
 c2* X   b2*
  \ / \ /
   c3  b3
A hypothetical (convergence supporting?) algorithm that said A beats B
if _any_ elements of *(A) are > B would give an ambiguous clean merge
on this case.  (Maybe that wouldn't be so bad, so long as we marked
the result, but I'm in no way prepared to do any sort of sufficient
analysis right now...)

The nastiest case of this is where *(A) > B, but some elements of *(B)
are > A -- so we silently make B win, but it's really not _quite_
clear that's a good idea, since A also beat B sometimes -- and we're
ignoring those user's intentions.

This is the nice thing about Corollary 1 (and why I didn't just
collapse it into Corollary 2) -- it assures us that the only time this
_weak_ form of ambiguous clean can happen is when A and B are already
identical.  This _can_ happen, for what it's worth:
       a*
      /|\
     / | \
    /  |  \
   /   |   \
  b1*  b2*  d*
  |\   /\  /
  | \ /  \/
  |  X   b3*
  | / \ /
  |/   b4
  b5
Here *(b5) = {b3, b2}, *(b6) = {b2, b4}.  If we ignore for a moment
that b4 and b5 have the same value, this is a merge that b4 would win
and b5 would lose, even though one of b4's ancestors, i.e. b1, is
```

```
pre-empted by b5.  However, it can _only_ happen if we ignore that
they have the same value...

The one other thing we proved about unique-* merge also still applies;
the proof goes through word-for-word:
Theorem: If A and B would merge cleanly with A winning, then any
  descendent D of A will also merge cleanly with B, with D winning.
Proof: *(B) > A, and A > D, so *(B) > D.

Discussion
----------

This algorithm resolves one of the two basic problems I observed for
unique-* merge -- coincidental clean merges are now handled, well,
cleanly, and the user model is fully implemented.  However, we still
do not handle the unnamed case (you guys totally let me down when I
requested names for this case last time):
    a
   / \
  b*  c*
   \ / \
    c*  d*
which still gives a conflict.  We also, of course, continue to not
support more exotic features like convergence or implicit rollback.

Not the most exciting thing in the world.  OTOH, it does strictly
increase the complexity of algorithms that are tractable to formal
analysis.

Comments and feedback appreciated.

-- Nathaniel

--
"The problem...is that sets have a very limited range of
activities -- they can't carry pianos, for example, nor drink
beer."
```

Replies and further discussion concerning this email can be found in the monotone-devel archives.

More on "mark-merge"

```
From: Timothy Brownawell <tbrownaw@...>
Subject: more on "mark-merge"
Newsgroups: gmane.comp.version-control.revctrl, gmane.comp.version-control.monotone.devel

Prerequisite:
```

```
http://thread.gmane.org/gmane.comp.version-control.monotone.devel/4297

A user can make 2 types of merge decisions:
(1): One parent is better than the other (represented by *)
(2): Both parents are wrong (represented by ^)

Since there are 2 types of merge decisions, it would be bad to treat all
merge decisions the same. Also, in the case of merge(a, a) = a, it is
possible for there to be multiple least decision ancestors.

=====

Define: ^(A) is the set of ancestors of A that it gets its value from
(found by setting N=A and iterating N = *(N) until there is no change)
        *(A) is the set of least ancestors of A in which the user made a
decision

note that erase_ancestors(^(A)) = ^(A),
and erase_ancestors(*(A)) = *(A)

=====

& is intersection, | is union

*(A) has the same properties as before, except that it is not a single
ancestor, but a set. This set can acquire more than one member only in
the case of
   Aa    Ba
     \  /
      Ca
, where *(A) and *(B) are different; *(C) will be
erase_ancestors(*(A) | *(B))

The ancestory corollary becomes:
any ancestor C of A with value(C) != value(A) will be an ancestor of at
least one member of *(A)

When merging A and B:

# if one side knows of _all_ places that the other side was chosen, it
wins
(1)
set X = erase_ancestors(*(A) | *(B))
    if X & *(B) = {}, A wins
    if X & *(A) = {}, B wins
else, X contains members of both *(A) and *(B)
```

```
# if one side knows of _all_ places that the other side originated, it
wins
(2)
set Y = erase_ancestors(*(A) | ^(B))
set Z = erase_ancestors(*(B) | ^(A))
    if Y & ^(B) = {} and Z & ^(A) = {}, conflict
    if Y & ^(B) = {}, A wins
    if Z & ^(A) = {}, B wins

# if one side knows of _any_ places that the other side originated, it
wins
(3)
    if Y & ^(B) != ^(B) and Z & ^(A) != ^(A), conflict
    if Y & ^(B) != ^(B), A wins
    if Z & ^(A) != ^(A), B wins

# else, nobody knows anything
(4) conflict

(3) is convergence, and can be safely left out if unwanted

====

"Funky cases"

Coincidental clean does not exist; a mark is only needed when there is
user intervention.

    |
    a
   / \
  b   b
   \ / \
    b   c
and the example after it will resolve cleanly iff (3) is included.

     |
     a
    / \
   b*  c*
  / \ / \
 c*  X   b*
  \ / \ /
   c   b
will be a conflict.

    a
```

```
   / \
  b*  c*
   \ / \
    c*  d*
This ("the other funky case") is handled by (2), and resolves cleanly.

Tim
```

Replies and further discussion concerning this email can be found in the monotone-devel archives.

Appendix A Default hooks

This section contains the entire source code of the standard hook file, that is built in to the monotone executable, and read before any user hooks files (unless '`--nostd`' is passed). It contains the default values for all hooks.

```
-- this is the standard set of lua hooks for monotone;
-- user-provided files can override it or add to it.

function temp_file(namehint)
   local tdir
   tdir = os.getenv("TMPDIR")
   if tdir == nil then tdir = os.getenv("TMP") end
   if tdir == nil then tdir = os.getenv("TEMP") end
   if tdir == nil then tdir = "/tmp" end
   local filename
   if namehint == nil then
      filename = string.format("%s/mtn.XXXXXX", tdir)
   else
      filename = string.format("%s/mtn.%s.XXXXXX", tdir, namehint)
   end
   local name = mkstemp(filename)
   local file = io.open(name, "r+")
   return file, name
end

function execute(path, ...)
   local pid
   local ret = -1
   pid = spawn(path, unpack(arg))
   if (pid ~= -1) then ret, pid = wait(pid) end
   return ret
end

-- Wrapper around execute to let user confirm in the case where a subprocess
-- returns immediately
-- This is needed to work around some brokenness with some merge tools
-- (e.g. on OS X)
function execute_confirm(path, ...)
   ret = execute(path, unpack(arg))

   if (ret ~= 0)
   then
      print(gettext("Press enter"))
   else
      print(gettext("Press enter when the subprocess has completed"))
   end
```

```
   io.read()
   return ret
end

-- attributes are persistent metadata about files (such as execute
-- bit, ACLs, various special flags) which we want to have set and
-- re-set any time the files are modified. the attributes themselves
-- are stored in the roster associated with the revision. each (f,k,v)
-- attribute triple turns into a call to attr_functions[k](f,v) in lua.

if (attr_init_functions == nil) then
   attr_init_functions = {}
end

attr_init_functions["mtn:execute"] =
   function(filename)
      if (is_executable(filename)) then
        return "true"
      else
        return nil
      end
   end

attr_init_functions["mtn:manual_merge"] =
   function(filename)
      if (binary_file(filename)) then
        return "true" -- binary files must be merged manually
      else
        return nil
      end
   end

if (attr_functions == nil) then
   attr_functions = {}
end

attr_functions["mtn:execute"] =
   function(filename, value)
      if (value == "true") then
         make_executable(filename)
      end
   end

function dir_matches(name, dir)
   -- helper for ignore_file, matching files within dir, or dir itself.
   -- eg for dir of 'CVS', matches CVS/, CVS/*, */CVS/ and */CVS/*
   if (string.find(name, "^" .. dir .. "/")) then return true end
```

```
   if (string.find(name, "^" .. dir .. "$")) then return true end
   if (string.find(name, "/" .. dir .. "/")) then return true end
   if (string.find(name, "/" .. dir .. "$")) then return true end
   return false
end

function ignore_file(name)
   -- project specific
   if (ignored_files == nil) then
      ignored_files = {}
      local ignfile = io.open(".mtn-ignore", "r")
      if (ignfile ~= nil) then
         local line = ignfile:read()
         while (line ~= nil) do
            if line ~= "" then
                table.insert(ignored_files, line)
            end
            line = ignfile:read()
         end
         io.close(ignfile)
      end
   end
   for i, line in pairs(ignored_files)
   do
      local pcallstatus, result = pcall(function() return regex.search(line, name) end)
      if pcallstatus == true then
          -- no error from the regex.search call
          if result == true then return true end
      else
          -- regex.search had a problem, warn the user their .mtn-ignore file syntax is wro
          io.stderr:write("WARNING: the line '" .. line .. "' in your .mtn-ignore file caus
                          .. " while matching filename '" .. name .. "'.\nignoring this re
          table.remove(ignored_files, i)
      end
   end

   local file_pats = {
      -- c/c++
      "%.a$", "%.so$", "%.o$", "%.la$", "%.lo$", "^core$",
      "/core$", "/core%.%d+$",
      -- java
      "%.class$",
      -- python
      "%.pyc$", "%.pyo$",
      -- gettext
      "%.g?mo$",
      -- intltool
```

```
      "%.intltool%-merge%-cache$",
      -- TeX
      "%.aux$",
      -- backup files
      "%.bak$", "%.orig$", "%.rej$", "%~$",
      -- vim creates .foo.swp files
      "%.[^/]*%.swp$",
      -- emacs creates #foo# files
      "%#[^/]*%#$",
      -- other VCSes (where metadata is stored in named files):
      "%.scc$",
      -- desktop/directory configuration metadata
      "^%.DS_Store$", "/%.DS_Store$", "^desktop%.ini$", "/desktop%.ini$"
   }

   local dir_pats = {
      -- autotools detritus:
      "autom4te%.cache", "%.deps", "%.libs",
      -- Cons/SCons detritus:
      "%.consign", "%.sconsign",
      -- other VCSes (where metadata is stored in named dirs):
      "CVS", "%.svn", "SCCS", "_darcs", "%.cdv", "%.git", "%.bzr", "%.hg"
   }

   for _, pat in ipairs(file_pats) do
      if string.find(name, pat) then return true end
   end
   for _, pat in ipairs(dir_pats) do
      if dir_matches(name, pat) then return true end
   end

   return false;
end

-- return true means "binary", false means "text",
-- nil means "unknown, try to guess"
function binary_file(name)
   -- some known binaries, return true
   local bin_pats = {
      "%.gif$", "%.jpe?g$", "%.png$", "%.bz2$", "%.gz$", "%.zip$",
      "%.class$", "%.jar$", "%.war$", "%.ear$"
   }

   -- some known text, return false
   local txt_pats = {
      "%.cc?$", "%.cxx$", "%.hh?$", "%.hxx$", "%.cpp$", "%.hpp$",
      "%.lua$", "%.texi$", "%.sql$", "%.java$"
```

```
   }

   local lowname=string.lower(name)
   for _, pat in ipairs(bin_pats) do
      if string.find(lowname, pat) then return true end
   end
   for _, pat in ipairs(txt_pats) do
      if string.find(lowname, pat) then return false end
   end

   -- unknown - read file and use the guess-binary
   -- monotone built-in function
   return guess_binary_file_contents(name)
end

-- given a file name, return a regular expression which will match
-- lines that name top-level constructs in that file, or "", to disable
-- matching.
function get_encloser_pattern(name)
   -- texinfo has special sectioning commands
   if (string.find(name, "%.texi$")) then
      -- sectioning commands in texinfo: @node, @chapter, @top,
      -- @((sub)?sub)?section, @unnumbered(((sub)?sub)?sec)?,
      -- @appendix(((sub)?sub)?sec)?, @(|major|chap|sub(sub)?)heading
      return ("^@("
              .. "node|chapter|top"
              .. "|((sub)?sub)?section"
              .. "|(unnumbered|appendix)(((sub)?sub)?sec)?"
              .. "|(major|chap|sub(sub)?)?heading"
              .. ")")
   end
   -- LaTeX has special sectioning commands.  This rule is applied to ordinary
   -- .tex files too, since there's no reliable way to distinguish those from
   -- latex files anyway, and there's no good pattern we could use for
   -- arbitrary plain TeX anyway.
   if (string.find(name, "%.tex$")
       or string.find(name, "%.ltx$")
       or string.find(name, "%.latex$")) then
      return ("\\\\("
              .. "part|chapter|paragraph|subparagraph"
              .. "|((sub)?sub)?section"
              .. ")")
   end
   -- There's no good way to find section headings in raw text, and trying
   -- just gives distracting output, so don't even try.
   if (string.find(name, "%.txt$")
       or string.upper(name) == "README") then
```

```
      return ""
   end
   -- This default is correct surprisingly often -- in pretty much any text
   -- written with code-like indentation.
   return "^[[:alnum:]$_]"
end

function edit_comment(basetext, user_log_message)
   local exe = nil
   if (program_exists_in_path("vi")) then exe = "vi" end
   if (string.sub(get_ostype(), 1, 6) ~= "CYGWIN" and program_exists_in_path("notepad.exe")
   local debian_editor = io.open("/usr/bin/editor")
   if (debian_editor ~= nil) then
      debian_editor:close()
      exe = "/usr/bin/editor"
   end
   local visual = os.getenv("VISUAL")
   if (visual ~= nil) then exe = visual end
   local editor = os.getenv("EDITOR")
   if (editor ~= nil) then exe = editor end

   if (exe == nil) then
      io.write("Could not find editor to enter commit message\n"
               .. "Try setting the environment variable EDITOR\n")
      return nil
   end

   local tmp, tname = temp_file()
   if (tmp == nil) then return nil end
   basetext = "MTN: " .. string.gsub(basetext, "\n", "\nMTN: ") .. "\n"
   tmp:write(user_log_message)
   if user_log_message == "" or string.sub(user_log_message, -1) ~= "\n" then
      tmp:write("\n")
   end
   tmp:write(basetext)
   io.close(tmp)

   if (execute(exe, tname) ~= 0) then
      io.write(string.format(gettext("Error running editor '%s' to enter log message\n"),
                             exe))
      os.remove(tname)
      return nil
   end

   tmp = io.open(tname, "r")
   if (tmp == nil) then os.remove(tname); return nil end
   local res = ""
```

```
   local line = tmp:read()
   while(line ~= nil) do
      if (not string.find(line, "^MTN:")) then
         res = res .. line .. "\n"
      end
      line = tmp:read()
   end
   io.close(tmp)
   os.remove(tname)
   return res
end


function persist_phrase_ok()
   return true
end


function use_inodeprints()
   return false
end


-- trust evaluation hooks

function intersection(a,b)
   local s={}
   local t={}
   for k,v in pairs(a) do s[v] = 1 end
   for k,v in pairs(b) do if s[v] ~= nil then table.insert(t,v) end end
   return t
end

function get_revision_cert_trust(signers, id, name, val)
   return true
end

function get_manifest_cert_trust(signers, id, name, val)
   return true
end

function get_file_cert_trust(signers, id, name, val)
   return true
end

function accept_testresult_change(old_results, new_results)
   local reqfile = io.open("_MTN/wanted-testresults", "r")
```

```
   if (reqfile == nil) then return true end
   local line = reqfile:read()
   local required = {}
   while (line ~= nil)
   do
      required[line] = true
      line = reqfile:read()
   end
   io.close(reqfile)
   for test, res in pairs(required)
   do
      if old_results[test] == true and new_results[test] ~= true
      then
         return false
      end
   end
   return true
end

-- merger support

-- Fields in the mergers structure:
-- cmd       : a function that performs the merge operation using the chosen
--             program, best try.
-- available : a function that checks that the needed program is installed and
--             in $PATH
-- wanted    : a function that checks if the user doesn't want to use this
--             method, and returns false if so.  This should normally return
--             true, but in some cases, especially when the merger is really
--             an editor, the user might have a preference in EDITOR and we
--             need to respect that.
--             NOTE: wanted is only used when the user has NOT defined the
--             'merger' variable or the MTN_MERGE environment variable.
mergers = {}

mergers.meld = {
   cmd = function (tbl)
      io.write (string.format("\nWARNING: 'meld' was choosen to perform external 3-way merg
          "You should merge all changes to *CENTER* file due to limitation of program\n"..
          "arguments.\n\n"))
      local path = "meld"
      local ret = execute(path, tbl.lfile, tbl.afile, tbl.rfile)
      if (ret ~= 0) then
         io.write(string.format(gettext("Error running merger '%s'\n"), path))
         return false
      end
      return tbl.afile
```

```
   end ,
   available = function () return program_exists_in_path("meld") end,
   wanted = function () return true end
}

mergers.tortoise = {
   cmd = function (tbl)
      local path = "tortoisemerge"
      local ret = execute(path,
                          string.format("/base:%s", tbl.afile),
                          string.format("/theirs:%s", tbl.lfile),
                          string.format("/mine:%s", tbl.rfile),
                          string.format("/merged:%s", tbl.outfile))
      if (ret ~= 0) then
         io.write(string.format(gettext("Error running merger '%s'\n"), path))
         return false
      end
      return tbl.outfile
   end ,
   available = function() return program_exists_in_path ("tortoisemerge") end,
   wanted = function () return true end
}

mergers.vim = {
   cmd = function (tbl)
      io.write (string.format("\nWARNING: 'vim' was choosen to perform external 3-way merge
          "You should merge all changes to *LEFT* file due to limitation of program\n"..
          "arguments.  The order of the files is ancestor, left, right.\n\n"))
      local vim
      local exec
      if os.getenv ("DISPLAY") ~= nil and program_exists_in_path ("gvim") then
         vim = "gvim"
         exec = execute_confirm
      else
         vim = "vim"
         exec = execute
      end
      local ret = exec(vim, "-f", "-d", "-c", string.format("file %s", tbl.outfile),
                          tbl.afile, tbl.lfile, tbl.rfile)
      if (ret ~= 0) then
         io.write(string.format(gettext("Error running merger '%s'\n"), vim))
         return false
      end
      return tbl.outfile
   end ,
   available =
      function ()
```

```
         return program_exists_in_path("vim") or
            program_exists_in_path("gvim")
      end ,
   wanted =
      function ()
         local editor = os.getenv("EDITOR")
         if editor and
            not (string.find(editor, "vim") or
                 string.find(editor, "gvim")) then
            return false
         end
         return true
      end
}

mergers.rcsmerge = {
   cmd = function (tbl)
      -- XXX: This is tough - should we check if conflict markers stay or not?
      -- If so, we should certainly give the user some way to still force
      -- the merge to proceed since they can appear in the files (and I saw
      -- that). --pasky
      local merge = os.getenv("MTN_RCSMERGE")
      if execute(merge, tbl.lfile, tbl.afile, tbl.rfile) == 0 then
         copy_text_file(tbl.lfile, tbl.outfile);
         return tbl.outfile
      end
      local ret = execute("vim", "-f", "-c", string.format("file %s", tbl.outfile
),
                          tbl.lfile)
      if (ret ~= 0) then
         io.write(string.format(gettext("Error running merger '%s'\n"), "vim"))
         return false
      end
      return tbl.outfile
   end,
   available =
      function ()
         local merge = os.getenv("MTN_RCSMERGE")
         return merge and
            program_exists_in_path(merge) and program_exists_in_path("vim")
      end ,
   wanted = function () return os.getenv("MTN_RCSMERGE") ~= nil end
}

mergers.diffutils = {
   cmd = function (tbl)
      local ret = execute(
```

```
          "diff3",
          "--merge",
          "--label", string.format("%s [left]",     tbl.left_path ),
          "--label", string.format("%s [ancestor]", tbl.anc_path  ),
          "--label", string.format("%s [right]",    tbl.right_path),
          tbl.lfile,
          tbl.afile,
          tbl.rfile
      )
      if (ret ~= 0) then
         io.write(gettext("Error running GNU diffutils 3-way difference tool 'diff3'\n"))
         return false
      end
      local ret = execute(
          "sdiff",
          "--diff-program=diff",
          "--suppress-common-lines",
          "--minimal",
          "--output", tbl.outfile,
          tbl.lfile,
          tbl.rfile
      )
      if (ret == 2) then
         io.write(gettext("Error running GNU diffutils 2-two merging tool 'sdiff'\n"))
         return false
      end
      return tbl.outfile
   end,
   available =
      function ()
          return program_exists_in_path("diff3") and
                 program_exists_in_path("sdiff");
      end,
   wanted =
      function ()
           return true
      end
}

mergers.emacs = {
   cmd = function (tbl)
      local emacs
      if program_exists_in_path("xemacs") then
         emacs = "xemacs"
      else
         emacs = "emacs"
      end
```

```
      local elisp = "(ediff-merge-files-with-ancestor \"%s\" \"%s\" \"%s\" nil \"%s\")"
      local ret = execute(emacs, "--eval",
                          string.format(elisp, tbl.lfile, tbl.rfile, tbl.afile, tbl.outfile
      if (ret ~= 0) then
         io.write(string.format(gettext("Error running merger '%s'\n"), emacs))
         return false
      end
      return tbl.outfile
   end,
   available =
      function ()
         return program_exists_in_path("xemacs") or
            program_exists_in_path("emacs")
      end ,
   wanted =
      function ()
         local editor = os.getenv("EDITOR")
         if editor and
            not (string.find(editor, "emacs") or
                 string.find(editor, "gnu")) then
            return false
         end
         return true
      end
}

mergers.xxdiff = {
   cmd = function (tbl)
      local path = "xxdiff"
      local ret = execute(path,
                          "--title1", tbl.left_path,
                          "--title2", tbl.right_path,
                          "--title3", tbl.merged_path,
                          tbl.lfile, tbl.afile, tbl.rfile,
                          "--merge",
                          "--merged-filename", tbl.outfile,
                          "--exit-with-merge-status")
      if (ret ~= 0) then
         io.write(string.format(gettext("Error running merger '%s'\n"), path))
         return false
      end
      return tbl.outfile
   end,
   available = function () return program_exists_in_path("xxdiff") end,
   wanted = function () return true end
}
```

```
mergers.kdiff3 = {
   cmd = function (tbl)
      local path = "kdiff3"
      local ret = execute(path,
                          "--L1", tbl.anc_path,
                          "--L2", tbl.left_path,
                          "--L3", tbl.right_path,
                          tbl.afile, tbl.lfile, tbl.rfile,
                          "--merge",
                          "--o", tbl.outfile)
      if (ret ~= 0) then
         io.write(string.format(gettext("Error running merger '%s'\n"), path))
         return false
      end
      return tbl.outfile
   end,
   available = function () return program_exists_in_path("kdiff3") end,
   wanted = function () return true end
}

mergers.opendiff = {
   cmd = function (tbl)
      local path = "opendiff"
      -- As opendiff immediately returns, let user confirm manually
      local ret = execute_confirm(path,
                                  tbl.lfile,tbl.rfile,
                                  "-ancestor",tbl.afile,
                                  "-merge",tbl.outfile)
      if (ret ~= 0) then
         io.write(string.format(gettext("Error running merger '%s'\n"), path))
         return false
      end
      return tbl.outfile
   end,
   available = function () return program_exists_in_path("opendiff") end,
   wanted = function () return true end
}

function write_to_temporary_file(data, namehint)
   tmp, filename = temp_file(namehint)
   if (tmp == nil) then
      return nil
   end;
   tmp:write(data)
   io.close(tmp)
   return filename
end
```

```
function copy_text_file(srcname, destname)
   src = io.open(srcname, "r")
   if (src == nil) then return nil end
   dest = io.open(destname, "w")
   if (dest == nil) then return nil end

   while true do
      local line = src:read()
      if line == nil then break end
      dest:write(line, "\n")
   end

   io.close(dest)
   io.close(src)
end

function read_contents_of_file(filename, mode)
   tmp = io.open(filename, mode)
   if (tmp == nil) then
      return nil
   end
   local data = tmp:read("*a")
   io.close(tmp)
   return data
end

function program_exists_in_path(program)
   return existsonpath(program) == 0
end

function get_preferred_merge3_command (tbl)
   local default_order = {"kdiff3", "xxdiff", "opendiff", "tortoise", "emacs", "vim", "meld
   local function existmerger(name)
      local m = mergers[name]
      if type(m) == "table" and m.available(tbl) then
         return m.cmd
      end
      return nil
   end
   local function trymerger(name)
      local m = mergers[name]
      if type(m) == "table" and m.available(tbl) and m.wanted(tbl) then
         return m.cmd
      end
      return nil
   end
```

```
   -- Check if there's a merger given by the user.
   local mkey = os.getenv("MTN_MERGE")
   if not mkey then mkey = merger end
   if not mkey and os.getenv("MTN_RCSMERGE") then mkey = "rcsmerge" end
   -- If there was a user-given merger, see if it exists.  If it does, return
   -- the cmd function.  If not, return nil.
   local c
   if mkey then c = existmerger(mkey) end
   if c then return c,mkey end
   if mkey then return nil,mkey end
   -- If there wasn't any user-given merger, take the first that's available
   -- and wanted.
   for _,mkey in ipairs(default_order) do
      c = trymerger(mkey) ; if c then return c,nil end
   end
end

function merge3 (anc_path, left_path, right_path, merged_path, ancestor, left, right)
   local ret = nil
   local tbl = {}

   tbl.anc_path = anc_path
   tbl.left_path = left_path
   tbl.right_path = right_path

   tbl.merged_path = merged_path
   tbl.afile = nil
   tbl.lfile = nil
   tbl.rfile = nil
   tbl.outfile = nil
   tbl.meld_exists = false
   tbl.lfile = write_to_temporary_file (left, "left")
   tbl.afile = write_to_temporary_file (ancestor, "ancestor")
   tbl.rfile = write_to_temporary_file (right, "right")
   tbl.outfile = write_to_temporary_file ("", "merged")

   if tbl.lfile ~= nil and tbl.rfile ~= nil and tbl.afile ~= nil and tbl.outfile ~= nil
   then
      local cmd,mkey = get_preferred_merge3_command (tbl)
      if cmd ~=nil
      then
         io.write (string.format(gettext("executing external 3-way merge command\n")))
         ret = cmd (tbl)
         if not ret then
            ret = nil
         else
            ret = read_contents_of_file (ret, "r")
```

```
            if string.len (ret) == 0
            then
               ret = nil
            end
         end
      else
         if mkey then
            io.write (string.format("The possible commands for the "..mkey.." merger aren't
                "You may want to check that $MTN_MERGE or the lua variable 'merger' is set\
                "to something available.  If you want to use vim or emacs, you can also\n".
                "set $EDITOR to something appropriate"))
         else
            io.write (string.format("No external 3-way merge command found.\n"..
                "You may want to check that $EDITOR is set to an editor that supports 3-way
                "merge, set this explicitly in your get_preferred_merge3_command hook,\n"..
                "or add a 3-way merge program to your path.\n\n"))
         end
      end
   end

   os.remove (tbl.lfile)
   os.remove (tbl.rfile)
   os.remove (tbl.afile)
   os.remove (tbl.outfile)

   return ret
end

-- expansion of values used in selector completion

function expand_selector(str)

   -- something which looks like a generic cert pattern
   if string.find(str, "^[^=]*=.*$")
   then
      return ("c:" .. str)
   end

   -- something which looks like an email address
   if string.find(str, "[%w%-_]+@[%w%-_]+")
   then
      return ("a:" .. str)
   end

   -- something which looks like a branch name
   if string.find(str, "[%w%-]+%.[%w%-]+")
   then
```

```
      return ("b:" .. str)
   end

   -- a sequence of nothing but hex digits
   if string.find(str, "^%x+$")
   then
      return ("i:" .. str)
   end

   -- tries to expand as a date
   local dtstr = expand_date(str)
   if  dtstr ~= nil
   then
      return ("d:" .. dtstr)
   end

   return nil
end

-- expansion of a date expression
function expand_date(str)
   -- simple date patterns
   if string.find(str, "^19%d%d%-%d%d")
      or string.find(str, "^20%d%d%-%d%d")
   then
      return (str)
   end

   -- "now"
   if str == "now"
   then
      local t = os.time(os.date('!*t'))
      return os.date("%FT%T", t)
   end

   -- today don't uses the time         # for xgettext's sake, an extra quote
   if str == "today"
   then
      local t = os.time(os.date('!*t'))
      return os.date("%F", t)
   end

   -- "yesterday", the source of all hangovers
   if str == "yesterday"
   then
      local t = os.time(os.date('!*t'))
      return os.date("%F", t - 86400)
```

```
   end

   -- "CVS style" relative dates such as "3 weeks ago"
   local trans = {
      minute = 60;
      hour = 3600;
      day = 86400;
      week = 604800;
      month = 2678400;
      year = 31536000
   }
   local pos, len, n, type = string.find(str, "(%d+) ([minutehordaywk]+)s? ago")
   if trans[type] ~= nil
   then
      local t = os.time(os.date('!*t'))
      if trans[type] <= 3600
      then
        return os.date("%FT%T", t - (n * trans[type]))
      else
        return os.date("%F", t - (n * trans[type]))
      end
   end

   return nil
end


external_diff_default_args = "-u"

-- default external diff, works for gnu diff
function external_diff(file_path, data_old, data_new, is_binary, diff_args, rev_old, rev_ne
   local old_file = write_to_temporary_file(data_old);
   local new_file = write_to_temporary_file(data_new);

   if diff_args == nil then diff_args = external_diff_default_args end
   execute("diff", diff_args, "--label", file_path .. "\told", old_file, "--label", file_pa

   os.remove (old_file);
   os.remove (new_file);
end

-- netsync permissions hooks (and helper)

function globish_match(glob, str)
      local pcallstatus, result = pcall(function() if (globish.match(glob, str)) then retur
      if pcallstatus == true then
          -- no error
```

```
          return result
      else
          -- globish.match had a problem
          return nil
      end
end

function get_netsync_read_permitted(branch, ident)
   local permfile = io.open(get_confdir() .. "/read-permissions", "r")
   if (permfile == nil) then return false end
   local dat = permfile:read("*a")
   io.close(permfile)
   local res = parse_basic_io(dat)
   if res == nil then
      io.stderr:write("file read-permissions cannot be parsed\n")
      return false
   end
   local matches = false
   local cont = false
   for i, item in pairs(res)
   do
      -- legal names: pattern, allow, deny, continue
      if item.name == "pattern" then
         if matches and not cont then return false end
         matches = false
         cont = false
         for j, val in pairs(item.values) do
            if globish_match(val, branch) then matches = true end
         end
      elseif item.name == "allow" then if matches then
         for j, val in pairs(item.values) do
            if val == "*" then return true end
            if val == "" and ident == nil then return true end
            if globish_match(val, ident) then return true end
         end
      end elseif item.name == "deny" then if matches then
         for j, val in pairs(item.values) do
            if val == "*" then return false end
            if val == "" and ident == nil then return false end
            if globish_match(val, ident) then return false end
         end
      end elseif item.name == "continue" then if matches then
         cont = true
         for j, val in pairs(item.values) do
            if val == "false" or val == "no" then cont = false end
         end
      end elseif item.name ~= "comment" then
```

```
         io.stderr:write("unknown symbol in read-permissions: " .. item.name .. "\n")
         return false
      end
   end
   return false
end

function get_netsync_write_permitted(ident)
   local permfile = io.open(get_confdir() .. "/write-permissions", "r")
   if (permfile == nil) then
      return false
   end
   local matches = false
   local line = permfile:read()
   while (not matches and line ~= nil) do
      local _, _, ln = string.find(line, "%s*([^%s]*)%s*")
      if ln == "*" then matches = true end
      if globish_match(ln, ident) then matches = true end
      line = permfile:read()
   end
   io.close(permfile)
   return matches
end

-- This is a simple function which assumes you're going to be spawning
-- a copy of mtn, so reuses a common bit at the end for converting
-- local args into remote args. You might need to massage the logic a
-- bit if this doesn't fit your assumptions.

function get_netsync_connect_command(uri, args)

        local argv = nil

        if uri["scheme"] == "ssh"
                and uri["host"]
                and uri["path"] then

                argv = { "ssh" }
                if uri["user"] then
                        table.insert(argv, "-l")
                        table.insert(argv, uri["user"])
                end
                if uri["port"] then
                        table.insert(argv, "-p")
                        table.insert(argv, uri["port"])
                end
```

```
                -- ssh://host/~/dir/file.mtn or
                -- ssh://host/~user/dir/file.mtn should be home-relative
                if string.find(uri["path"], "^/~") then
                        uri["path"] = string.sub(uri["path"], 2)
                end

                table.insert(argv, uri["host"])
        end

        if uri["scheme"] == "file" and uri["path"] then
                argv = { }
        end

        if argv then

                table.insert(argv, get_mtn_command(uri["host"]))

                if args["debug"] then
                        table.insert(argv, "--debug")
                else
                        table.insert(argv, "--quiet")
                end

                table.insert(argv, "--db")
                table.insert(argv, uri["path"])
                table.insert(argv, "serve")
                table.insert(argv, "--stdio")
                table.insert(argv, "--no-transport-auth")

        end
        return argv
end

function use_transport_auth(uri)
        if uri["scheme"] == "ssh"
        or uri["scheme"] == "file" then
                return false
        else
                return true
        end
end

function get_mtn_command(host)
        return "mtn"
end
```

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