

Monotone

A distributed version control system

Graydon Hoare and others

This manual is for the “monotone” distributed version control system. This edition documents version 1.1.

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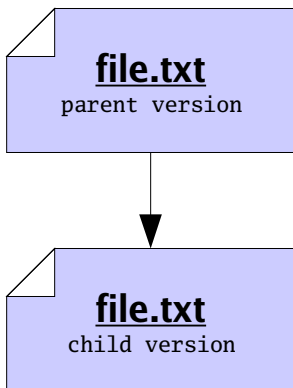
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1 Concepts

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.



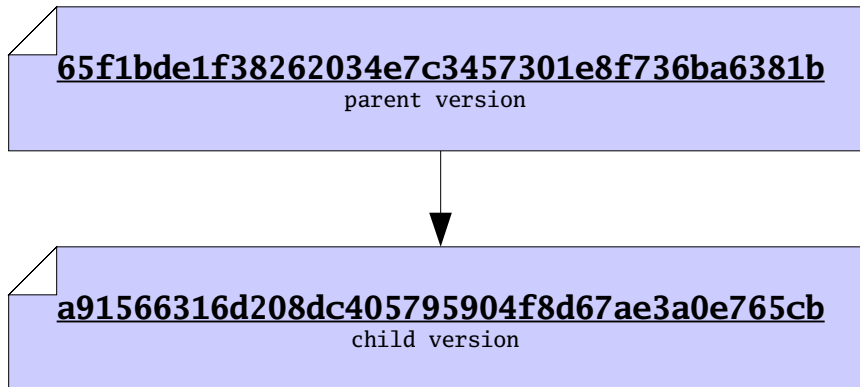
We may want to identify the parent and the child precisely, for sake of reference. To do so, we will compute a *cryptographic hash function*, called SHA1, of each version. The details of this function are beyond the scope of this document; in summary, the SHA1 function takes a version of a file and produces a short string of 20 bytes, which we will use to uniquely identify the version¹. 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.



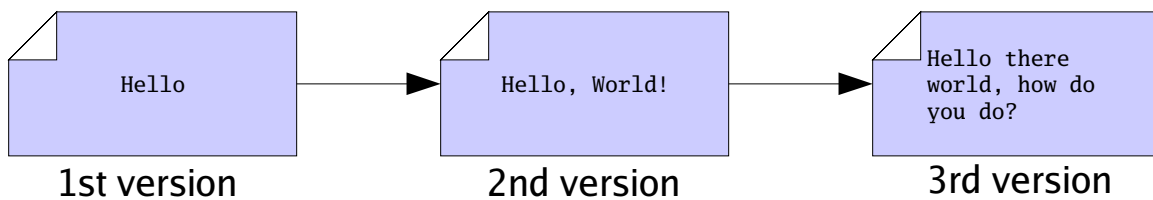
When dealing with versions of files, we will dispense with writing out “file names”, and identify versions *purely* by their SHA1 value, which we will also refer to as their *file ID*. Using IDs alone will often help us accommodate the fact that people often wish to call files

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.

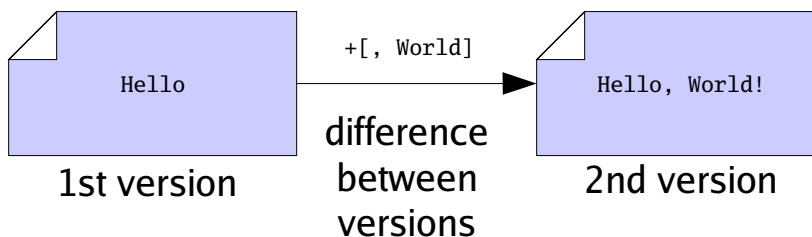


Version control systems, such as monotone, are principally concerned with the storage and management of *multiple* versions of some files. One way to store multiple versions of a file is, literally, to save a separate *complete* copy of the file, every time you make a change. When necessary, monotone 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 attributes, which we will cover later.



```
manifest
format_version "1"

dir ""

dir "fs"

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

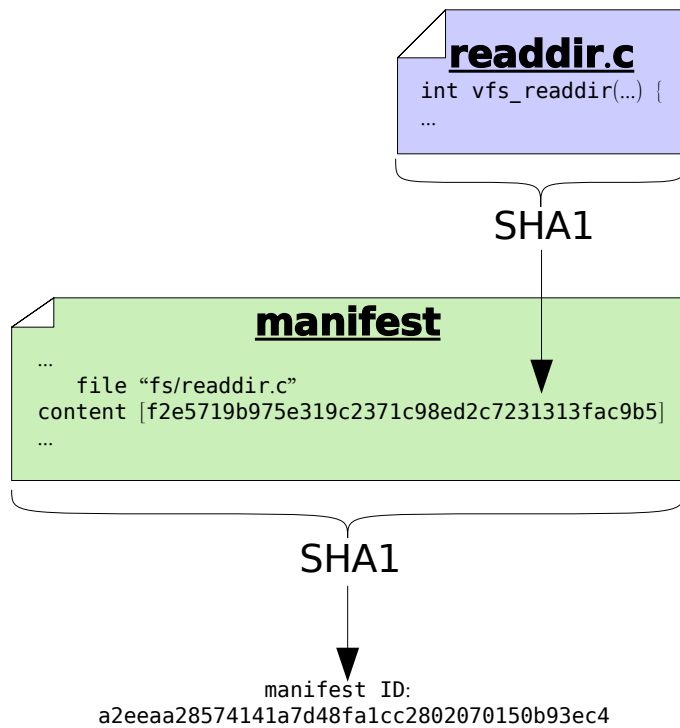
  file "fs/read_write.c"
  content [81f0c9a0df254bc8d51bb785713a9f6d0b020b22]

  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

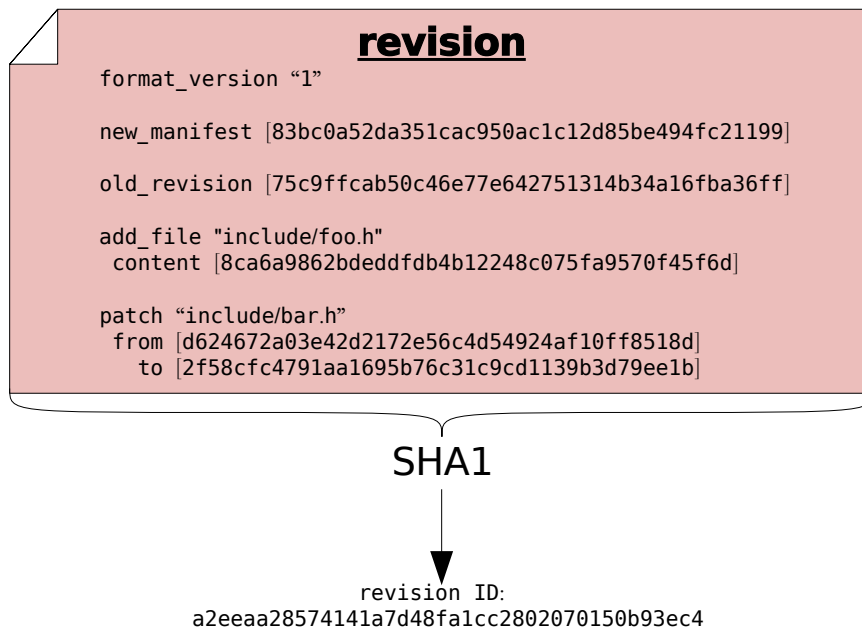
tree, combined. So we may treat manifests and their IDs as *snapshots* of a tree of files, though lacking the actual contents of the files themselves.



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:

statement

revision ID: a2eeaa28574141a7d48fa1cc2802070150b93ec4
statement name: "date"
statement value: "2003-04-04T07:39:51"

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.

certificate

revision ID: a2eeaa28574141a7d48fa1cc2802070150b93ec4
statement name: "date"
statement value: "2003-04-04T07:39:51"
signed by key: "jrh@example.com"
signature: "a02380def...0983fe90"

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.

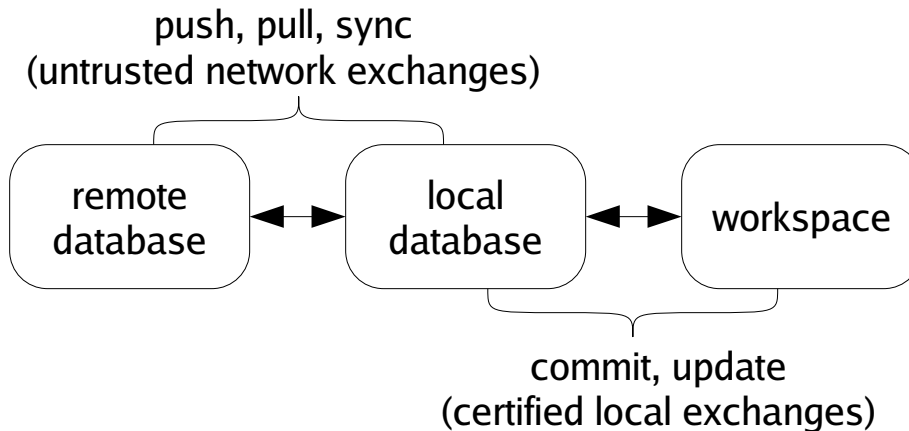
1.5 Storage and workflow

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.



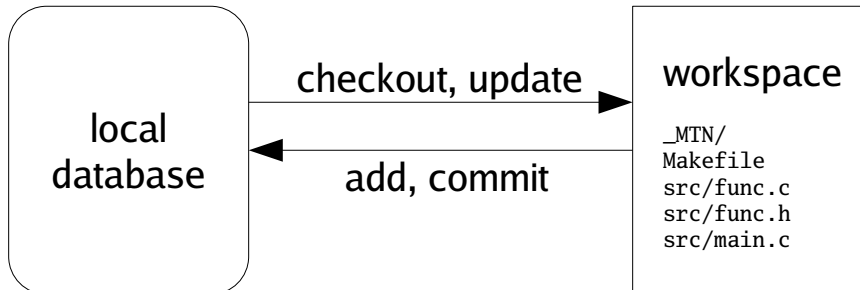
A *workspace* is a tree of files in your file system, arranged according to the list of file paths and IDs in a particular manifest. A special directory called `_MTN` exists in the root of any workspace. Monotone keeps some special files in the `_MTN` directory, in order to track changes you make to 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 this kind of change, and include them in the next commit.

If you 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. Monotone stores these changes in `_MTN/revision`; they will be part of the next commit.

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

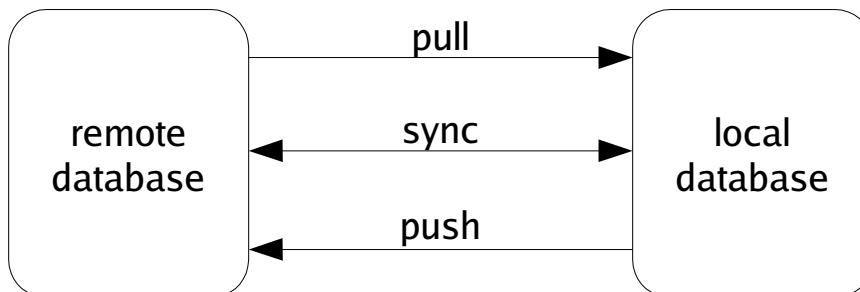
to receive changes that have arrived in a database. Committing and updating take place purely between a database and a workspace; the network is not involved.



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.

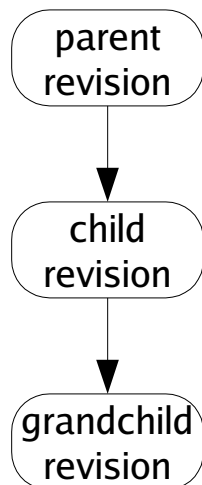
The last stage of workflow is worth clarifying: monotone does *not* blindly apply all changes it receives from a remote database to your workspace. Doing so would be very dangerous, because remote databases are not always trustworthy systems. Rather, monotone evaluates the certificates it has received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

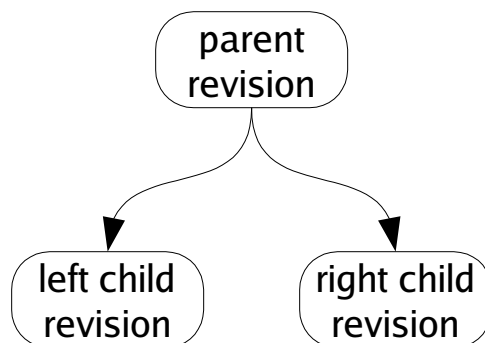
1.6 Forks and merges

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



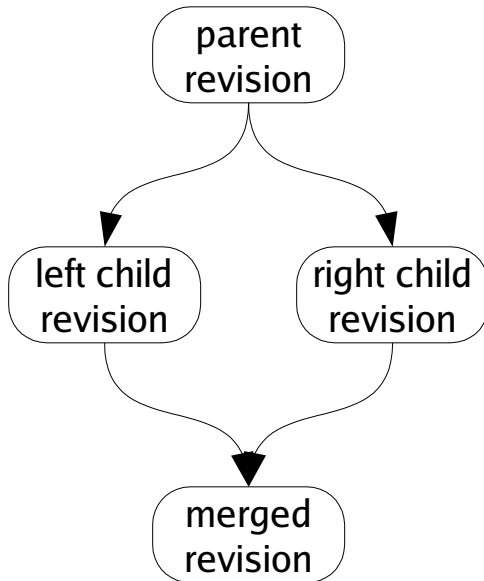
This is a rosy picture, but sometimes it does not work out this way. Sometimes when you make new revisions, other people are *simultaneously* making new revisions as well, and their revisions might be derived from the same parent as yours, or contain different changesets. Without loss of generality, 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.

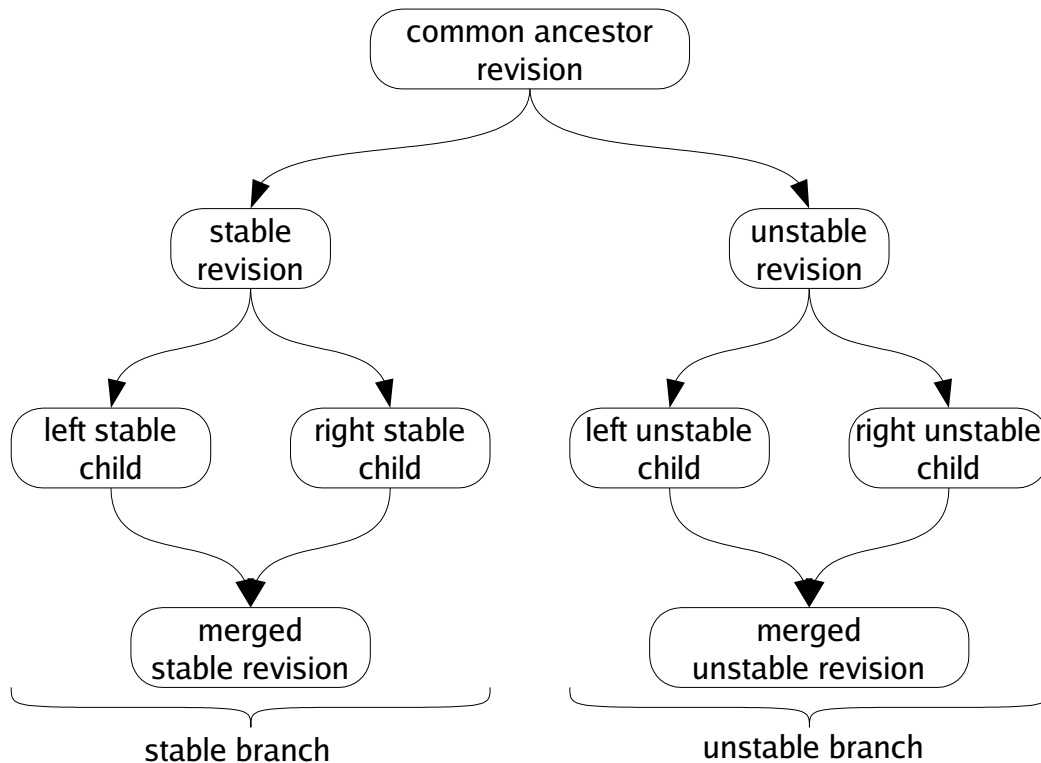
You can see all the available branches using `mtn list branches`.

1.7.1 Heads and merging

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

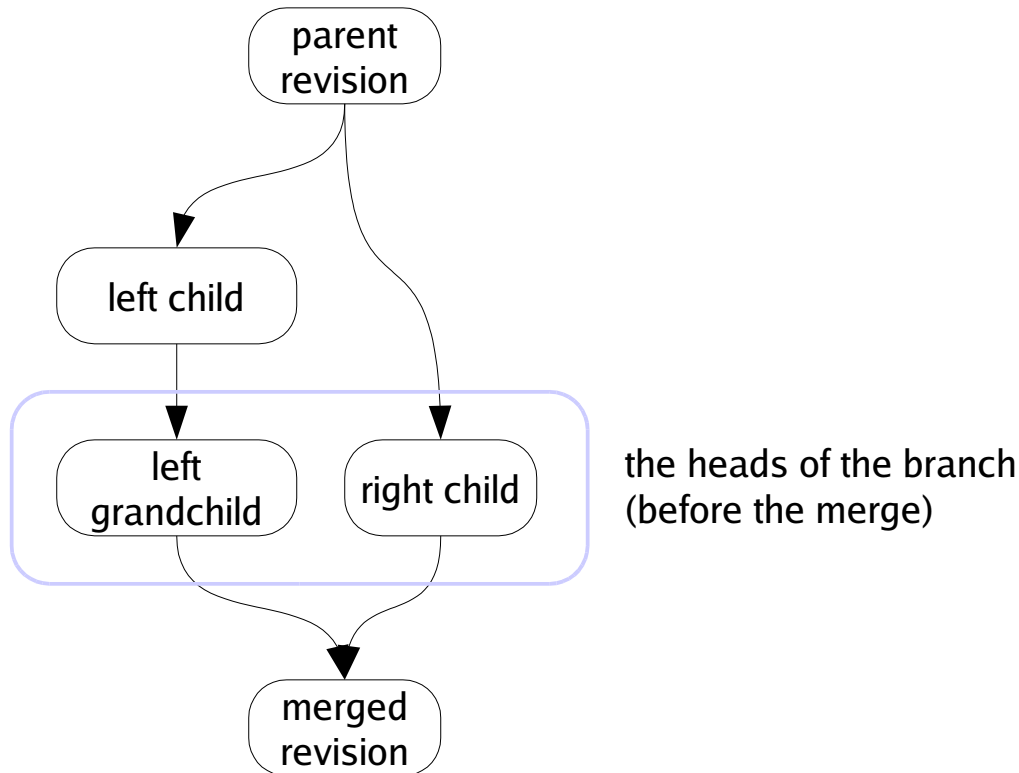
wobbler-stable and wobbler-unstable branches will not be merged together, despite having a common ancestor.



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.

1.7.2 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 should be *globally* unique, over all branches in the world. Otherwise, when your branch eventually gets distributed, you could get name collisions with other people's work.

Having two separate projects with the same monotone branch names means those projects cannot be stored in the same database. In general, monotone supports storing unrelated branches in a single database, which simplifies servers. But that requires unique branch names, so ensuring globally unique branch names allows using globally accessible monotone servers.

monotone does *not* support renaming branches (because that would be modifying history), so choosing a good branch name up front is important. It is possible to work around this by propagating from your branch to one with a better name, but that is a painful process if there are many people using the original branch name.

Even if you are *absolutely* sure that your branch will never be distributed, things could change in the future!

Fortunately, we have a handy source of globally unique names — the DNS system. When naming a branch, always prepend the reversed, fully qualified, domain 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 original 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 original 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 3.13 \[Naming Conventions\]](#), page 71).

It has to be noted that earlier versions of monotone enforced no restrictions on branch names. Newer versions, starting with 0.99, exclude a set of control characters though, which mostly denote either meta characters in monotone's URI syntax or are used in globs to resolve branch patterns. These characters are `?`, `,`, `*`, `%`, `+`, `{`, `}`, `[`, `]`, `!` and `^`. Additionally, `-` is deprecated as first character of a branch name, since it is used to denote branch exclude patterns in the aforementioned URI syntax.

monotone warns on the creation of branch names which violate one of the above restrictions and gives further directions. Future versions of monotone are likely to enforce these restrictions by disallowing such branch names completely.

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.

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
```

and Abe issues the command:

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

Beth decides to use monotone's built-in database management functionality. monotone then expects to find managed database files in a list of directories (default `$HOME/.monotone/databases` on Unix and `%APPDATA%\monotone\databases` on Windows, see [Section 3.10 \[Managed Databases\]](#), page 65 for more info) and acts upon those by knowing only their file or basename.

To create a new managed database, Beth issues the `mtn db init` command like this:

```
$ mtn db init --db=:beth
```

Beth can distinguish a managed database name from an unmanaged one by the leading colon in its name. This special alias can now be used interchangeably in every monotone invocation. If Beth wants to see where monotone actually created the database and what other databases monotone knows of, she uses the [\[mtn list databases\]](#), page 104 command (or `mtn ls dbs`) for that. We'll come back to this in a bit.

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
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: generating key-pair 'jim@juicebot.co.jp'
mtn: storing key-pair 'jim@juicebot.co.jp' in /home/jim/.monotone/keys
mtn: key 'jim@juicebot.co.jp' has hash '398cb10dcd4fadf4f7849a3734b626a83e0bb2ae'
```

Abe does something similar:

```
$ mtn genkey 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: generating key-pair 'abe@juicebot.co.jp'
mtn: storing key-pair 'abe@juicebot.co.jp' in /home/abe/.monotone/keys
mtn: key 'abe@juicebot.co.jp' has hash '62d8d1798e716868acde75c0fc4c84760003863d'
```

as does Beth:

```
$ mtn genkey 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: generating key-pair 'beth@juicebot.co.jp'
mtn: storing key-pair 'beth@juicebot.co.jp' in /home/beth/.monotone/keys
mtn: key 'beth@juicebot.co.jp' has hash 'c1d47c065a21f1e1c4fbdefaa2f37bd2c15ee4b1'
```

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]
398cb10dcd4fadf4f7849a3734b626a83e0bb2ae jim@juicebot.co.jp  (*)
(*) - only in /home/jim/.monotone/keys/

[private keys]
398cb10dcd4fadf4f7849a3734b626a83e0bb2ae 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 fingerprint, however distinct keys with equal names are possible.

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] (1234abcd...):
enter new passphrase for key ID [user@example.com] (1234abcd...):
confirm passphrase for key ID [user@example.com] (1234abcd...):
$ 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(key_identity)
    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 3.13 \[Naming Conventions\]](#), [page 71](#) 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 -R 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:


```

$ mtn diff
#
# old_revision []
#
# add_dir ""
#
# add_dir "include"
#
# add_dir "src"
#
# add_file "include/jb.h"
# content [f6996ce2dfc5d32bda8b574c3e9ce75db8d55492]
#
# add_file "src/apple.c"
# content [1ce885d2cc59842ff16785834391e864068fbc3c]
#
# add_file "src/banana.c"
# content [ad88bbb1b7507ddff26be67efd91d95e069afb6]
#
=====
--- include/jb.h          f6996ce2dfc5d32bda8b574c3e9ce75db8d55492
+++ include/jb.h          f6996ce2dfc5d32bda8b574c3e9ce75db8d55492
@ -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 1ce885d2cc59842ff16785834391e864068fbc3c
+++ src/apple.c 1ce885d2cc59842ff16785834391e864068fbc3c
@ -0,0 +1,7 @
+#include "jb.h"
+
+void
+dispense_apple_juice()
+{
+ /* Fill this in please, Abe. */
+}
=====
--- src/banana.c      ad88bbb1b7507ddff26be67efd91d95e069afb6
+++ src/banana.c      ad88bbb1b7507ddff26be67efd91d95e069afb6
@ -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 493bda86628fd72c992eb56f73899db9ead3cf6f
```

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
493bda86628fd72c992eb56f73899db9ead3cf6f
```

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 493bda86628fd72c992eb56f73899db9ead3cf6f
-----
Key   : jim@juicebot.co.jp (398cb10d...)
Sig   : ok
Name  : branch
Value : jp.co.juicebot.jb7
-----
Key   : jim@juicebot.co.jp (398cb10d...)
Sig   : ok
Name  : date
Value : 2004-10-26T02:53:08
-----
Key   : jim@juicebot.co.jp (398cb10d...)
Sig   : ok
Name  : author
Value : jim@juicebot.co.jp
-----
Key   : jim@juicebot.co.jp (398cb10d...)
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 `493bda86628fd72c992eb56f73899db9ead3cf6f` 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:  
493bda86628fd72c992eb56f73899db9ead3cf6f 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/hWgC1XE9FI0bHtjPMIx1kB0ig09AkCT7tBXM9z6iGWxTBhSR7D/qsJQGPorOD
D07xovIHthMbZZ9FnyvB/BCyiibdWgGT0Gtq940KdvCRNuT59e5v9L4pBkvajb+IzQIBEQ==
[end]
```

Beth also exports her public key:

```
$ mtn --db=:beth 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 "mtn://jim-laptop.juicebot.co.jp?jp.co.juicebot.jb7*"
mtn: connecting to mtn://jim-laptop.juicebot.co.jp
mtn: first time connecting to server mtn://jim-laptop.juicebot.co.jp
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 mtn://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 [493bda86628fd72c992eb56f73899db9ead3cf6f]
#
# patch "src/apple.c"
# from [1ce885d2cc59842ff16785834391e864068fbc3c]
# to [e2c64f6bde75a192d48d2256385df3dd7a963349]
#
=====
--- src/apple.c 1ce885d2cc59842ff16785834391e864068fbc3c
+++ src/apple.c e2c64f6bde75a192d48d2256385df3dd7a963349
@ -3,5 +3,8 @ dispense_apple_juice()
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
```

Abe neglected to provide a `--message` option specifying the change log on the command line. 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.

```

*** REMOVE THIS LINE TO CANCEL THE COMMIT ***
-- Enter a description of this change above --
-- Edit fields below to modify certificate values --
Branch:    right
Author:    tester@test.net
Date:      2010-09-11T12:03:15

-- Modifications below this line are ignored --
Changes against parent 493bda86628fd72c992eb56f73899db9ead3cf6f

    patched  src/apple.c

```

Abe enters a single line at the top of the file, saying “polling implementation of src/apple.c”. He then saves the file and quits the editor. Monotone extracts the message to be stored in the associated “changelog” cert. Returning to the shell, Abe’s commit completes:

```

mtn: beginning commit on branch 'jp.co.juicebot.jb7'
mtn: committed revision 42eae36587508faa664b111cefc291f0b85ef83a

```

Abe then sends his new revision back to Jim:

```

$ mtn sync
mtn: connecting to mtn://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 mtn://jim-laptop.juicebot.co.jp

```

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

```

$ mtn --db=:beth sync "mtn://jim-laptop.juicebot.co.jp?jp.co.juicebot.jb7*"
mtn: connecting to mtn://jim-laptop.juicebot.co.jp
mtn: first time connecting to server mtn://jim-laptop.juicebot.co.jp
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 mtn://jim-laptop.juicebot.co.jp

```

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

```

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

```

and since she is using a managed database, monotone automatically remembers the connection between the newly created workspace and the database. She now looks at the output of `mtn list databases` and sees the following:

```

$ mtn list databases
:beth.mtn (in /home/beth/.monotone/databases):
    jp.co.juicebot.jb7 (in /home/beth/juicebot)

```

Beth realizes that, whenever the database of the workspace changes, monotone will adapt the known paths for the old and the new database for her.

But let us get back to the work, Beth now start to 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 85573a54105cd3220db10aa6a0713643cdf5ce6f
```

And she syncs with Jim again:

```
$ mtn sync
mtn: connecting to mtn://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 mtn://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 493bd...
2. Abe changed revision 493bd... into revision 42eae...
3. Beth derived revision 42eae... into revision 85573...

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 85573... 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 [85573a54105cd3220db10aa6a0713643cdf5ce6f]
#
# patch "src/banana.c"
# from [d7e28a01cf6fc0f9ac04c6901dcafd77c2d32fb8]
# to [dd979c3c880e6a7221fced7148bd4afcfb3e964]
#
=====
--- src/banana.c      d7e28a01cf6fc0f9ac04c6901dcafd77c2d32fb8
+++ src/banana.c      dd979c3c880e6a7221fced7148bd4afcfb3e964
@ -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()
+{
+  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 90abe0f1bc354a73d42d3bffa1b02946559682bd9
```

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 42eae..., 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:
90abe0f1bc354a73d42d3bffa1b02946559682bd9  abe@juicebot.co.jp 2004-10-26T02:53:16
951da88860a4cf7419d66ed9094d8bf24df5fb8b  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: 2 heads on branch 'jp.co.juicebot.jb7'
mtn: merge 1 / 1:
mtn: calculating best pair of heads to merge next
mtn: [left] 90abe0f1bc354a73d42d3bffa1b02946559682bd9
mtn: [right] 951da88860a4cf7419d66ed9094d8bf24df5fb8b
mtn: [merged] 3aca69c7749bde9bd07fe4c92bb868bd69b2e421
mtn: note: 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, or Jim could have used the `conflicts` set of commands to resolve it (see [Section 4.2.1 \[Conflicts\]](#), page 89).

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

```
$ mtn update
mtn: updating along branch 'jp.co.juicebot.jb7'
mtn: selected update target 3aca69c7749bde9bd07fe4c92bb868bd69b2e421
mtn: [left] d60c18ec5e0cf1163b276f0bfdd908c1dfd53b4a
mtn: [right] 3aca69c7749bde9bd07fe4c92bb868bd69b2e421
mtn: updating src/apple.c
mtn: updating src/banana.c
mtn: updated to base revision 3aca69c7749bde9bd07fe4c92bb868bd69b2e421
```

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
```

Alternately, she could not specify a message on the command line, and edit the "Branch" field in the changelog editor.

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 2004-10-26T12:44:23 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.

If you are unsure of the name of a branch, you can list all branches using the **ls branches** command. This is very useful, but if you create a lot of branches then the list can become very long and unwieldy. To help this monotone has the **suspend** command which partially hides revisions/branches you are no longer using. Further commits on hidden branches will automatically unhide the branches.

For example, if Beth is now finished with the muffins branch, she can stop it from cluttering the list of branches by suspending the last revision in that branch:

```
$ mtn ls branches
jp.co.juicebot.jb7
jp.co.juicebot.jb7.muffins
$ mtn heads
mtn: branch 'jp.co.juicebot.jb7.muffins' is currently merged:
4e48e2c9a3d2ca8a708cb0cc545700544efb5021 beth@juicebot.co.jp 2007-07-08T02:17:37
$ mtn suspend 4e48e2c9a3d2ca8a708cb0cc545700544efb5021
$ mtn ls branches
jp.co.juicebot.jb7
```

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
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: generating key-pair 'monotone-server@www.juicebot.co.jp'
mtn: storing key-pair 'monotone-server@www.juicebot.co.jp' in /home/jim/.monotone/keys
mtn: key 'abe@juicebot.co.jp' has hash '78be08f7a2a316a9f7c6b0db544ed20673ea2190'
$ 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 [\[get_netsync_read_permitted\]](#), page 193 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 vars (see [Section 3.9 \[Vars\]](#), page 64). 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 3.8 \[Quality Assurance\]](#), [page 63](#) mechanisms and Event Notification [Section 6.1 \[Hooks\]](#), [page 186](#), 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 [Section 6.1.6 \[Trust Evaluation Hooks\]](#), [page 197](#) 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.

`ssh:` and `file:` are currently not supported on the native Win32 platform; they are supported on Cygwin and all other platforms.

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. Therefore, it must also be writable, even when monotone isn’t going to modify it, as it is the case for `pull`. 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 [Section 6.1.5 \[Netsync Transport Hooks\]](#), page 195.

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**.

Key selection

Uses selector type **k**. For example, **k:graydon@pobox.com** matches all revisions where at least one cert was signed by the key **graydon@pobox.com**. Instead of the key’s given name, the local name or the full hash ID of the key can be specified as well.

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).

Message selection

Uses selector type **m**. For example **m:*foobar*** matches **changelog** and **comment** certs where the cert value contains the glob ***foobar***.

"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**.

Parent selection

Uses selector type **p**. For example, **p:0f3a** matches the revision IDs which are the parent of the revision ID which begins with **0f3a**. If you give a bare **p**:, monotone will require you to be in a workspace, and query the parent of the base workspace revision.

Update selection

Uses selector type **u**. This selector must be used from within a workspace and must not have any associated value. It matches the base revision ID of the workspace before the last **update** command was executed. This can be useful for reviewing incoming revisions. After each update operation, or at least before the next update operation, run a command similar to the following:

```
$ mtn log --to u: --diffs
```

to log all revisions back to the last update. It can also be used for quickly jumping between two different revisions. For example, the following command:

```
$ mtn update -r u:
```

will update back to the previous update revision. Repeating this command will swap the current and previous update revision.

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.

Workspace base revision

Uses selector type **w**. This selector must be used from within a workspace and must not have any associated value. It matches the base revision ID(s) this workspace is based on.

Further selector types may be added in the future.

Composite selectors

Selectors may be combined with **and** and **or** operators and parentheses, and may be modified using a function-call style syntax. The recognized special characters are **/**, **|**, **;**, **(** and **)**, and **** (forward slash, pipe, semicolon, left and right parentheses, and backslash); to use any of these characters in a selector value, precede it with a backslash (****).

The **and** operator is the **/** character. 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 **or** operator is the **|** character. For example, the selector **h:some-feature-branch|h:other-feature-branch** can be used to select the heads of two specific branches.

There are also several selector functions defined, which take one or more selectors as arguments. The general form for these is **name ' (' selector [';' selector ...] ') '**, that is, arguments are enclosed in parentheses and separated by semicolons. These are:

difference(A;B)

Set difference; this returns all revisions selected by **A** but not by **B**. For example, **difference(a:graydon;b:net.venge.monotone)** would return all revisions which have an **author** cert beginning with **graydon** which are not in the branch **net.venge.monotone**.

not(A)

Set complement; this returns all revisions not selected by **A**. For example, **not(c:testresult)** would return all revisions which do not have any **testresult** certs. Conceptually **not(A)** is equivalent to **difference(*, A)**, where ***** selects all revisions. The previous example to return all revisions which have an **author** cert beginning with **graydon** and are not in the branch **net.venge.monotone**, can be written as **a:graydon/not(b:net.venge.monotone)**.

lca(A;B)

Least common ancestors; this is identical to **max((ancestors(A)|A)/(ancestors(B)|B))**, but it may be faster and is certainly more convenient to type. For example,

`lca(h:net.venge.monotone;h:net.venge.monotone.extended-selectors)` would return the last propagate between the given branches, or the branch point if there were no subsequent propagates yet. This could be particularly useful with the `diff` command, to see exactly what has changed on a given branch.

`max(A)` Erase ancestors; this returns all revisions selected by `A` which are not ancestors of other revisions selected by `A`. For example, `max(b:net.venge.monotone/a:graydon)` would return the latest revision(s) on branch `net.venge.monotone` which have an `author` cert beginning with `graydon`.

`min(A)` Erase descendants; this returns all revisions selected by `A` which are not descendants of other revisions selected by `A`. For example, `min(b:net.venge.monotone)` would return the earliest revision(s) on branch `net.venge.monotone`.

`ancestors(A)` Strict ancestors; returns all revisions which are an ancestor of a revision selected by `A`. For example, `ancestors(b:net.venge.monotone)` would return all revisions in branch `net.venge.monotone` except for the branch heads, and all revisions in branches which have been merged back into `net.venge.monotone`.

`descendants(A)` Strict descendants; returns all revisions which are a descendant of a revision selected by `A`. For example, `descendants(b:net.venge.monotone/a:graydon)` would return all revisions which are descended from a revision which is in branch `net.venge.monotone` and has an `author` cert beginning with `graydon`.

`parents(A)` Returns all revisions which are a parent of a revision selected by `A`. For example, `parents(m:*foobar*)` would return the parents of any revisions which have `comment` or `changelog` certs containing the word `foobar`.

`children(A)` Returns all revisions which are a child of a revision selected by `A`. For example, `children(m:*foobar*)` would return the children of any revisions which have `comment` or `changelog` certs containing the word `foobar`.

`pick(A)` Picks one of the revisions selected by `A`, and returns that. For example, `h:some-branch` is often used with `mtn update`, but will fail if `some-branch` has multiple heads. Using `pick(h:some-branch)` instead will always choose a single head, and not fail if there is more than one.

Selector expansion

Before selectors are passed to the database, they are expanded using a Lua hook: [\[expand-selector\]](#), page 201. 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 [Appendix A \[Default hooks\]](#), page 255.

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 the Lua hook [\[expand_date\]](#), page 201. 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.

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`
- `log`

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` and `--exclude=path` options. The value *n* given to `--depth` specifies the maximum number of directories to descend. For example, *n*=0 disables recursion, *n*=1 means descend at most one directory below each specified path, and so on. The `--depth` value applies individually to each path specified on the command line. The value *path* given to `--exclude` specifies a path that should be excluded from the restriction. Multiple `--exclude` options may be specified to exclude several files or subdirectories.

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.

In addition to including all of the explicitly specified paths and excluding all of the paths specified with `--exclude` options a restriction also implicitly includes the parent directories of all included paths. This is done to allow commands operating on newly added files to succeed. For example, if a new directory `a` is added and a file `a/b` is added to this directory restricting to exactly `a/b` will produce a meaningless state that doesn’t include the required parent directory `a`.

The implicit inclusion of required parent directories is done for all of the commands listed above with the exception of `revert`. This is done to allow reverting the addition of files in newly added or renamed directories without reverting the directories themselves. If the parent directories were implicitly included their addition or name changes would also be reverted.

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. The `--no-workspace` option may be used to prevent the search entirely.

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 4.11 \[Automation\]](#), page 119.

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 \[Lua Reference\]](#), page 185 for details.

3.6 Merge Conflicts

Several different types of conflicts may be encountered when merging two revisions using the database merge commands `merge`, `explicit_merge`, `propagate` and `merge_into_dir` or when using the workspace merge commands `update`, `pluck` and `merge_into_workspace`.

The `show_conflicts` and `automate show_conflicts` commands can be used to list conflicts between database revisions which would be encountered by the database merge commands. Unfortunately, these commands can't yet list conflicts between a database revision and the current workspace.

In addition, the `conflicts` set of commands can be used to specify resolutions for some conflicts. The resolutions are stored in a file, and given to the `merge` command via the `--resolve-conflicts-file=filename` or `--resolve-conflicts` option; see [Section 4.2.1 \[Conflicts\]](#), page 89.

The `merge` command normally will perform as many merges as necessary to merge all current heads of a branch. However, when `--resolve-conflicts-file` is given, the conflicts and their resolutions apply only to the first merge, so the subsequent merges are not done; the `merge` command must be repeated, possibly with new conflicts and resolutions, to merge the remaining heads.

For the special case of file content conflicts, a merge command invoked without `--resolve-conflicts` will attempt to use an internal content merger; if that fails, it will attempt to start an external interactive merge tool; the user must then resolve the conflicts and terminate the merge tool, letting monotone continue with the merge. This process is repeated for each file content conflict. See [\[File Content Conflict\]](#), page 55 below for more detail.

For other conflicts, a merge command invoked without `--resolve-conflicts` will fail.

If `conflicts` supports resolving a particular conflict, that is the simplest way to resolve it. Otherwise, resolving the different types of conflicts is accomplished by checking out one of the conflicting revisions, making changes as described below, committing these changes as a new revision and then running the merge again using this new revision as one of the merge parents. This process can be repeated as necessary to get two revisions into a state where they will merge cleanly.

The possible conflict resolutions are discussed with each conflict in the following sections.

3.6.1 Conflict Types

Monotone versions files, directories, and file attributes explicitly, and it tracks individual file and directory identity from birth to death so that name changes throughout the full life-cycle can be tracked exactly. Partly because of these qualities, monotone notices several types of conflicts that other version control systems may not.

The two most common conflicts are described first, then all other possible conflicts.

File Content Conflict

This type of conflict is generally the one encountered most commonly and represents conflicting changes made to lines of text within two versions of a single file.

When a merge command encounters changes in a file in both heads relative to the common ancestor, it first checks to see if the file has a `mtn:manual_merge` attribute with

value **true**. If not, it uses an internal merge algorithm to detect whether the changes are to the same lines of the file. If they are not, monotone will use the result of the internal merge as the new file version. Note that this may not always be what the user wants; if the same line is added at two different places in the file, it will be in the result twice.

`mtn:manual_merge` is automatically set **true** when a file is added for which the `binary_file` hook returns true; see [\[attr_init_functions\]](#), page 202. The user may also set the `mtn:manual_merge` attribute manually; see [\[mtn attr\]](#), page 91.

If `mtn:manual_merge` is present and **true**, or if the changes are to the same lines of the file, and neither `--resolve-conflicts` nor `--non-interactive` was specified, the [\[merge3\]](#), page 200 hook is called, with the content of both conflicting versions and their common ancestor. When the hook returns, the merge proceeds to the next conflict.

Alternatively, you can use your favorite merge tool asynchronously with the merge, and specify the result file in the conflicts file, using the [Section 4.2.1 \[Conflicts\]](#), page 89 command:

```
mtn conflicts resolve_first user filename
```

Then `--resolve-conflicts` is specified on the merge command line.

Finally, rather than using a merge tool it is possible to commit changes to one or both of the conflicting file versions so that they will merge cleanly. This can also be a very helpful strategy if the merge conflicts are due to sections of text in the file being moved from one location to another. Rather than struggling to merge such conflicting changes with a merge tool, similar rearrangements can be made to one of the conflicting files before redoing the merge.

Duplicate Name Conflict

A duplicate name conflict occurs when two distinct files or directories have been given the same name in the two merge parents. This can occur when each of the merge parents adds a new file or directory with the conflicting name, or when one parent adds a new file or directory with the conflicting name and the other renames an existing file or directory to the conflicting name, or when both parents rename an existing file or directory to the conflicting name.

In earlier versions of monotone (before version 0.39) this type of conflict was referred to as a *rename target conflict* although it doesn't necessarily have anything to do with renames.

There are two main situations in which duplicate name conflicts occur:

- Two people both realize a new file should be added, and commit it. In this case, the files have the right name and the right contents, but monotone reports a conflict because they were added separately.
- Two people each decide to add new files with different content, and accidentally pick the same name.

These conflicts are reported when someone tries to merge the two revisions containing the new files.

There are similar conflicts for directories; the process for resolving them is different, because we need to worry about the files in the directories.

Same file

For the first case, the conflict is resolved by dropping one file. The contents should be manually merged, in case they are slightly different. Typically, a user will have one of the files in their current workspace; the other can be retrieved via `automate get_file_of`; the revision id is shown in the merge error message.

This process can be confusing; here's a detailed example. We assume the [Section 4.2.1 \[Conflicts\]](#), page 89 commands are used to resolve this conflict, since that is supported.

Suppose Beth and Abe each commit a new file `checkout.sh`, with similar contents. When Beth attempts to merge the two heads, she gets a message like:

```
mtn: 2 heads on branch 'testbranch'
mtn: [left]  ae94e6677b8e31692c67d98744dccf5fa9ccffe5
mtn: [right] dfdf50b19fb971f502671b0cfa6d15d69a0d04bb
mtn: conflict: duplicate name 'checkout.sh'
mtn: added as a new file on the left
mtn: added as a new file on the right
mtn: error: merge failed due to unresolved conflicts
```

The file labeled `right` is the file in Beth's workspace. To start the conflict resolution process, Beth first saves the list of conflicts:

```
mtn conflicts store
```

In order to merge Beth's and Abe's file versions, Beth retrieves a copy of Abe's file:

```
mtn automate get_file_of checkout.sh \
--revision=ae94e6677b8e31692c67d98744dccf5fa9ccffe5 \
> _MTN/resolutions/checkout.sh-abe
```

Now Beth manually merges (using her favorite merge tool) `checkout.sh` and `_MTN/resolutions/checkout.sh-abe`, leaving the results in `_MTN/resolutions/checkout.sh-merge` (*not* in her copy).

Then Beth specifies the conflict resolution, and finishes the merge:

```
mtn conflicts resolve_first_left drop
mtn conflicts resolve_first_right user _MTN/resolutions/checkout.sh-merge
mtn merge --resolve-conflicts-file=_MTN/conflicts
mtn conflicts clean
mtn update
```

When Abe later syncs and updates, he will get the merged version.

Different files

The second case, where two different files accidentally have the same name, is resolved by renaming one or both of them.

Suppose Beth and Abe each start working on different thermostat models (say Honeywell and Westinghouse), but they both name the file `thermostat`. When Beth attempts to merge, she will get the same error message as in the first case. When she retrieves Abe's file, she will see that they should be different files. So she renames her file, merges, and updates (again using [Section 4.2.1 \[Conflicts\]](#), page 89 commands):

```
mtn conflicts store
mtn conflicts resolve_first_left rename thermostat-westinghouse
mtn conflicts resolve_first_right rename thermostat-honeywell
mtn merge --resolve-conflicts-file=_MTN/conflicts
mtn conflicts clean
mtn update
```

Now she has her file contents in `thermostat-honeywell`, and Abe's in `thermostat-westinghouse`.

Directories

When two directories are given the same name, there are still the two basic approaches to resolving the conflict; drop or rename. However, if a directory is dropped, all the files in it must also be dropped. Therefore, it is almost always better to first rename one of the directories to a temporary name as the conflict resolution, and then deal with the files individually, renaming or merging and dropping each. Then finally drop the temporary directory. The `conflicts` commands do not support doing this; it must be done directly.

Missing Root Conflict

Monotone's merge strategy is sometimes referred to as *die-die-die* merge, with reference to the fact that when a file or directory is deleted there is no means of resurrecting it. Merging the deletion of a file or directory will *always* result in that file or directory being deleted.

A missing root conflict occurs when some directory has been moved to the root directory in one of the merge parents and has been deleted in the other merge parent. Because of die-die-die merge the result will not contain the directory that has been moved to the root.

Missing root conflicts should be very rare because it is unlikely that a project's root directory will change. It is even more unlikely that a project's root directory will be changed to some other directory in one merge parent and that this directory will also be deleted in the other merge parent. Even still, a missing root directory conflict can be easily resolved by moving another directory to the root in the merge parent where the root directory was previously changed. Because of die-die-die merge, no change to resolve the conflict can be made to the merge parent that deleted the directory which was moved to the root in the other merge parent.

See the `pivot_root` command for more information on moving another directory to the project root.

`conflicts` does not support resolving this conflict.

Dropped/Modified file Conflict

This conflict occurs when a file is dropped in one merge parent, and modified in the other.

`conflicts` supports resolving this conflict; the possible resolutions are to drop the file in the result, keep the modified version, or keep a user supplied version.

In addition, the attribute `mtn:resolve_conflict` may be used to specify a **drop** resolution for this conflict. `--resolve-conflicts` must be specified on the merge command for the attribute to be processed. Note that a `_MTN/conflicts` file left over from a previous merge will be processed when `--resolve-conflicts` is specified; the user must delete such files when they are no longer needed.

The attribute is useful in the case where the conflict will occur again in the future, for example when a file that is maintained in an upstream branch is not needed, and therefore dropped, in a local branch. The user only needs to specify the conflict resolution once, via the attribute.

Because of the *die-die-die* policy, monotone internally must first drop the modified file, and then add a new file with the same name and the desired contents. This means history is

disconnected; when `mtn log` is later run for the file, it will stop at this merge, not showing the previous history for the file. That history is still there; the user can see it by starting `mtn log` again for the same file but in the parent of the merge.

Note that we don't need a `keep` value for the `mtn:resolve_conflict` attribute; if the local branch keeps a file that the upstream branch drops, the first keep resolution will break history, and the conflict will not occur again.

A special case occurs when the user re-adds the file after dropping it, then attempts to merge. In this case, the possible resolutions are to keep the re-added version, or keep a user modified version, replacing the re-added version (drop is not a valid resolution).

There is no such thing as a dropped/modified directory; if the directory is empty, the only possible change is rename, which is ignored.

If the directory is not empty, that creates a special case of dropped/modified file conflict; if the file is kept, it must also be renamed to an existing directory.

Invalid Name Conflict

Monotone reserves the name `_MTN` in a workspace root directory for internal use and treats this name as *illegal* for a versioned file or directory in the project root. This name is *legal* for a versioned file or directory as long as it is not in the project root directory.

An invalid name conflict occurs when some directory is moved to the project root in one of the merge parents and a file or directory that exists in this new root directory is renamed to `_MTN` or a new file or directory is added with the name `_MTN` to this directory in the other merge parent.

Invalid name conflicts should be very rare because it is unlikely that a project's root directory will change. It is even more unlikely that a project's root directory will change and the new root directory will contain a file or directory named `_MTN`. Even still, an invalid name conflict can be easily resolved in several different ways. A different root directory can be chosen, the offending `_MTN` file or directory can be renamed or deleted, or it can be moved to some other subdirectory in the project.

See the `pivot_root` command for more information on moving another directory to the project root.

`conflicts` does not yet support resolving this conflict.

Directory Loop Conflict

A directory loop conflict occurs when one directory is moved under a second in one of the merge parents and the second directory is moved under the first in the other merge parent.

Directory loop conflicts should be rare but can be easily resolved by moving one of the conflicting directories out from under the other.

`conflicts` does not yet support resolving this conflict.

Orphaned Node Conflict

An orphaned node conflict occurs when a directory and all of its contents are deleted in one of the merge parents and further files or directories are added to this deleted directory, or renamed into it, in the other merge parent.

Orphaned node conflicts do happen occasionally but can be easily resolved by renaming the orphaned files or directories out of the directory that has been deleted and into another directory that exists in both merge parents, or that has been added in the revision containing the orphaned files or directories.

`conflicts` supports resolving this conflict. However, if the orphaned node is a directory that is not empty, and the desired resolution is 'drop', the user must drop the directory contents and commit before invoking the `conflicts` commands.

Multiple Name Conflict

A multiple name conflict occurs when a single file or directory has been renamed to two different names in the two merge parents. Monotone does not allow this and requires that each file and directory has exactly one unique name.

Multiple name conflicts do happen occasionally but can be easily resolved by renaming the conflicting file or directory in one or both of the merge parents so that both agree on the name.

`conflicts` does not yet support resolving this conflict.

In earlier versions of monotone (those before version 0.39) this type of conflict was referred to as a *name conflict*.

Attribute Conflict

An attribute conflict occurs when a versioned attribute on a file or directory is set to two different values by the two merge parents or if one of the merge parents changes the attribute's value and the other deletes the attribute entirely.

Attribute conflicts may happen occasionally but can be easily resolved by ensuring that the attribute is set to the same value or is deleted in both of the merge parents. Attributes are *not* merged using the die-die-die rules and may be resurrected by simply setting their values.

`conflicts` does not yet support resolving this conflict.

3.7 Workspace Collisions

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 **added** it). Someone else has **added** and **committed** a 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.
- There is a directory which contains both versioned and unversioned files (perhaps versioned sources, and unversioned object files built from the sources). Someone else **commits** a revision that **drops** the versioned files *and* the containing directory. If you try to **update** to this revision, your directory will still contain the untracked files, and monotone will not delete them.
- You have an unversioned file in your workspace, and you're trying to **update** to a revision that **adds** 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**, **pivot_root** or **pluck**.

In order to handle such collisions safely, before changing the workspace, monotone will detect them, and the command will fail with a warning. 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.

In addition, all workspace-changing commands have an option **--move-conflicting-paths**, which moves unversioned but conflicting files and directories from the workspace into a corresponding directory under **_MTN/resolutions**. This is useful if you want to ensure that an update always succeeds and you just want to move blocking paths out of the way.

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 (monotone's internal identification of the file 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`).

3.8 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 *end-points* 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 the Lua hook `[get_revision_cert_trust]`, page 197. This hook is 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 (see `[accept_testresult_change]`, page 198). 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.

3.9 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-include-pattern

The default global 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-exclude-pattern

The default global 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-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.

delta-direction

This tells monotone whether to store `'reverse'` deltas (the default), `'forward'` deltas, or `'both'` kinds of deltas for reconstructing versions of files. Reverse deltas are faster when inspecting recent files, while forward deltas are much faster for sending over the network. This should probably be set to `'both'` for a server database, unless disk space is severely limited. Note that as *receiving* deltas involves reconstructing the file version that the delta was made against, a server using a database with only forward deltas will be somewhat slower at receiving new revisions unless your particular history graph is highly linear.

Changing this value does not affect deltas that have already been stored.

known-workspaces

Records all registered workspaces for the current databases. monotone will track the contents of this variable automatically for you in the background.

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`.

server-include

Contains server-specific branch inclusion globs. These overrule *default-include-pattern* if existent and are recorded automatically the first time you connect to a specific server or use the `--set-default` option for a netsync operation.

server-exclude

Likewise, this variable contains server-specific branch exclusion globs, which overrule *default-exclude-pattern* if existent and are also automatically set on the first connection or when the option `--set-default` is present.

3.10 Managed Databases

In monotone commands, a database name (provided to a `--db` option) starting with “:” is a “database alias”. It addresses a usual monotone database sitting in a special, “managed” location, which we therefore call a “managed database”.

The database alias is a regular file name (excluding the leading colon). Monotone searches for this file name in common locations and internally expands it to a full path once it found an unambiguous match.

Some commands, such as `[mtn clone]`, page 99 and `[mtn setup]`, page 88, work without a `--db` option; they fall back on a managed “default” database and even initialize that in case it is not existent.

To keep an overview of managed databases and their workspaces, the commands `[mtn list databases]`, page 104 and `[mtn list workspaces]`, page 106 can be used: The former shows a list of all known databases in all managed locations together with their workspaces, while the latter only shows the list of workspaces for a single, specified database.

Monotone usually keeps track of known workspaces automatically in the background and updates the references as soon as your workspace' database option in `_MTN/options` is set up or changed. There are a few cases where monotone is unable to detect changes, though, for example when a workspace is moved in the file system. To get monotone back on track in cases like this, the commands `[mtn register_workspace]`, page 109 and `[mtn unregister_workspace]`, page 110 can be used.

Finally, all this magic behaviour can be customized by a variety of lua hooks:

- `[get_default_database_locations]`, page 191 returns a list of search paths where monotone should look for managed databases. This hook defaults to a single directory; `$HOME/.monotone/databases` on Unix and `%APPDATA%\monotone\databases` on Windows.

- [\[get_default_database_glob\]](#), [page 191](#) returns a pattern which monotone uses to match and recognized database files in the configured default locations. This pattern is also used to determine if shortened database aliases, such as `:default`, should get suffixed with `.mtn` to be transformed into a valid database file name. By default this hook returns `{mtn,db}`.
- [\[get_default_database_alias\]](#), [page 191](#) returns the name of the alias of a default database that is initialized and used on demand. If more than one database locations are configured, the first location is used as save location for this database. This hook defaults to `:default.mtn`.

3.11 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 and directories

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. See [Section 7.4 \[Regexps\]](#), page 218, for the syntax of these regular expressions.

`_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/commit

If a commit fails, f.e. because a header field could not be parsed properly, then this file will contain a dump of the complete contents which have been saved through the editor. After the information has been recovered from this file, it has to be removed explicitly, since a new commit won’t be possible as long as this file exists.

_MTN/inodeprints

If this file exists, monotone considers the directory to be in [Section 3.5 \[Inodeprints\]](#), [page 54](#) 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.

_MTN/bisect

Contains the current state of an ongoing bisection. See [Section 3.19 \[Bisecting\]](#), [page 80](#) for more information.

_MTN/update

Remembers the update / previous base revision of the workspace when the `u:` selector is used. See [Section 3.2 \[Selectors\]](#), [page 47](#) for more information.

_MTN/conflicts

The default file which is used by monotone to read and write merge conflicts for conflict resolution. See [Section 4.2.1 \[Conflicts\]](#), [page 89](#) for more information.

_MTN/resolutions

The directory in which monotone moves unversioned, conflicting files from a workspace to, in case `update` or other commands are called with the `--move-conflicting-paths` option.

3.12 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 <i>many</i> 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.
suspend	This cert's value is the name of a branch (see the branch cert). This cert is generated by the suspend command. A suspended revision is removed from the list of head revisions of a branch in most cases. A branch with all its heads suspended will not appear in the list of branches. Suspended revisions can still have children, and those children are in no way affected by the suspend cert on their parent.
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.

3.13 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 original author owned the DNS domain `venge.net`.

3.14 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]`, page 91 command. 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 `[attr.functions]`, page 201. 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.

3.15 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`.

3.16 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 wobbler-checkout
```


3.17 Exporting to GIT

Monotone is capable of exporting the contents of a database to `stdout` in a form suitable to be piped to `git-fast-import(1)`:

```
$ mkdir test.git
$ cd test.git
$ git init
$ mtn --db test.mtn git_export | git fast-import
```

While this feature has been tested and verified to some extent with various “real-world” monotone databases it is important to realize that translating from one version control system to another can be a lossy process. Git represents things somewhat differently than monotone does and cannot fully represent some things that monotone can. In particular git does not treat directories as first class objects as monotone does and does not use certificates to represent `author`, `date`, `branch` and `tag` values so some differences are to be expected.

Git separates the concept of `committer` from the concept of `author` while monotone allows multiple `author` certs. In an attempt to represent these different concepts the git exporter uses the *value* of the author cert as the git author and the *key* used to sign the author cert as the git committer. When there are multiple author certs the git exporter arbitrarily chooses one of them. The full list of monotone certs may be exported in the git commit message using the `--log-certs` option described in [Section 4.12 \[VCS\], page 180](#).

Monotone author names often look like raw email addresses such as `"user@example.com"`. These are not considered valid by git which requires the display name and leading `<` and trailing `>` characters around email addresses such as `"User Name <user@example.com>"`. The git exporter deals with this difference in several ways:

- revisions that don't have any author certs will default to using `Unknown <unknown>` for both the author and committer.
- revisions that have one or more author certs will use the value of one author cert as the author and the key used to sign this cert as the committer.
- both author and committer will be looked up in the file specified by the `--authors-file` option described in [Section 4.12 \[VCS\], page 180](#) and translated to the specified value if found.
- any author or committer value not found in the authors file will be processed by the `unmapped_git_author` hook which may adjust the value so that it represents a valid value.

All git author and committer values will be validated by the `validate_git_author` hook before being written to the output stream. The export will abort if any author or committer value is rejected by the validation hook.

Branch names used by monotone are allowed to contain characters that are not considered valid by git. These may be mapped to other names using the `--branches-file` option described in [Section 4.12 \[VCS\], page 180](#)

A monotone revision may have multiple `changelog` certs and multiple `comment` certs. The git exporter deals with these by first concatenating all of the changelog certs followed by all of the comment certs into one message to use as the git commit message. Duplicate changelog or comment cert messages that may exist due to automated merges are removed.

Exporting a database may be a time consuming and involved process, depending on the size and nature of the database. A 200MB database should export in less than an hour but may take several hours or longer depending on factors such as hardware, revision sizes, roster sizes and many others. The monotone process exporting such a database should require less than 200MB of RAM but may require *considerably* more in some cases. If the exported file is written to disk it will likely be *substantially* larger than the associated database, perhaps between 400MB to 4GB in size.

Anyone using the git exporter must take full responsibility for verifying that the exported repository matches their expectations and requirements.

3.18 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 (we assume you have a key for commits already):

```
$ 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 key used to sign things
2. The file data (fdata) and file deltas (fdeltas), if any
3. The release data (rdata)
4. The certs

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

```
mtn -d A pubkey johndoe@domain.com > KEY_PACKETS
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 KEY_PACKETS PACKETS
```

Database B now contains revision a423db0ad651c74e41ab2529eca6f17513ccf714. 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 8b52d96d4fab6c1e56d6364b0a2673f4111b228e >> PACKETS2
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. We can checkout from B:

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

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

3.19 Bisecting

Bisecting is an efficient means of finding the earliest revision that introduced a bug known to exist in some later revision. Given a set of “good” earlier revisions that do not contain the bug and a set of “bad” later revisions that do contain the bug **bisect** performs a binary search over the set of revisions between these two sets to identify the specific revision that introduced the bug.

Bisection is started by marking revisions with the **bisect good** and **bisect bad** commands. Once both good and bad revisions have been specified the set of candidate revisions between the good and bad revisions is determined. The midpoint of this set is selected as the next revision to be tested and the workspace is updated to this selected revision. After the selected revision has been tested bisection continues when the revision is marked with **bisect good** or **bisect bad**. If the selected revision is marked as good, it and all of its ancestors are considered to be good and excluded from the remaining search set. If the selected revision is marked as bad, all of its descendants are considered to be bad and excluded from the remaining search set. After each selected revision is marked as good or bad the size of the remaining search set is halved.

Revisions that are untestable for some reason (e.g. they don’t compile) may be ignored with the **bisect skip** command. This excludes the specified revisions from the candidate set and allows the bisection operation to continue. Skipping revisions may cause the search to fail or end on the wrong revision if the revision being searched for is skipped.

If the workspace is updated to some unrelated revision during a bisection operation the **bisect update** command can be used to update back to the next revision selected for bisection. This command can also be used if a previous **bisect good**, **bisect bad** or **bisect skip** command fails to update the workspace due to the existence of conflicting unversioned paths.

The current status of the bisection operation and the next revision to be tested is reported by the **bisect status** command. This command can be run at any stage of the bisection operation to see how many revisions remain to be tested and how many revisions have been ruled out.

Currently **bisect** updates the workspace but does *not* update the workspace **branch** option. This may leave the workspace at a revision that is *not* in the branch specified by the workspace **branch** option and cause subsequent commits to be made to the wrong branch. To help avoid this error the **status** command will indicate when the workspace branch does not match any of the parent revision branches. Take care when committing new revisions during a bisection operation and be sure to use the **bisect reset** command once the bisection is complete to update the workspace back to the revision from which the bisection started.

The bisection operation completes successfully when the last remaining revision is marked as “bad”. If the last remaining revision is marked as “good” the bisection fails without finding the initial bad revision.

Once bisection is complete the workspace can be updated back to the starting revision with the **bisect reset** command. This command also removes all stored bisection information in preparation for future bisect operations.

4 Command Reference

Monotone has a large number of commands. To help navigate through them all, commands are grouped into logical categories. In addition, there are global options that apply to all commands.

Many command options come in pairs that affect the same value. For example, `mtn log` takes a *brief* option; this can be reversed by *no-brief*. This is convenient when building command strings automatically; `mtn log --brief --no-brief` is the same as `mtn log`.

It also helps when setting options in the *get_default_command_options* hook; those options can be overridden on the command line. For example, if *get_default_command_options* specifies *brief* for `log`, you can override that with `mtn log --no-brief`.

Command names can be abbreviated to the shortest unique strings. Some commands also have short aliases, such as `mv` for `rename`.

The command descriptions describe the most important options for each command, and only one of each pair of options. For a complete list of options, see the online help (`mtn help cmd`), or the manpage.

Many options can be specified by a single character; see the online help for those.

The Lua hook `[get_default_command_options]`, [page 190](#) can change the default value for any option.

Revision arguments to commands (but not to automate commands) may be selectors (see [Section 3.2 \[Selectors\]](#), [page 47](#)) or hex ids.

4.1 Global and Common Options

4.1.1 Global Options

These options are available on all commands.

`--confdir <arg>`

Set the location of the configuration directory (default `$HOME/.monotone` on Unix and Cygwin, `%APPDATA%\monotone%` on Windows MinGW). In this manual, references to these specific directories are actually references to the directory specified by `--confdir`.

The configuration directory is where monotone finds:

keys in `confdir/keys`; see [Section 1.4 \[Certificates\]](#), page 8, [Section 2.4 \[Generating Keys\]](#), page 22. The location of the keys directory can be overridden separately with the `--keydir` option.

monotonerc

which is a per-user configuration file containing Lua code (see [\[rcfiles\]](#), page 185) that is run each time monotone starts up.

default database

In file `confdir/databases/default.mtn`; see [Section 3.10 \[Managed Databases\]](#), page 65.

In addition, monotone may write a dump file to the configuration directory when it fails (if it can't write to `_MTN` in a workspace).

`--date-format <arg>`

`strftime(3)` format specification for printing dates. The default format is given by the [\[get_date_format_spec\]](#), page 193 hook; the default hook returns `%x` for dates, `%X` for times, `%x %X` for both.

`--db <arg>`

Set the database to use; defaults to the database specified in the current workspace (stored in `_MTN/options`; see [Section 1.5 \[Storage and workflow\]](#), page 10), or to nothing if not in a workspace. However, some commands default to a [Section 3.10 \[Managed Databases\]](#), page 65; that is specified in those commands.

An argument of `:memory:` specifies a memory-only database; any changes are not saved to a file. One use for this is on the client side of a remote automate connection to the server, if you are executing commands that don't actually need a local database but the automate command requires one.

`--dump <arg>`

File to dump debugging log to, on failure; default `confdir/dump` if not in a workspace, `_MTN/debug` if in a workspace.

`--help`

Display help information. This is the same as the `mtn help` command, but note that it can be placed at the end of a command line, while `mtn help` must be the first non-option on the command line.

`--ignore-suspend-certs`

`--no-ignore-suspend-certs`

Do not ignore revisions marked as suspended; see the `mtn suspend` command.

`--key <arg>`

`--use-default-key`

Set the key for signatures or network authentication, using either the key name or the key hash (see [Section 2.4 \[Generating Keys\], page 22](#)).

monotone determines the key to use as follows:

1. If `--key` is given, that is the key.
2. If key is given in `_MTN/options`, that is the key.
Each time `--key` is given, it will be stored in `_MTN/options` for future use.
3. For a non-netsync command, the Lua hook `[get_branch_key]`, [page 189](#) is called.
For a client-side netsync command, the Lua hook `[get_netsync_client_key]`, [page 189](#) is called.
For a command that starts a monotone server, the Lua hook `[get_netsync_server_key]`, [page 190](#) is used.
If any of the aforementioned hooks returns non-nil, the return value is the name of the key.
4. If there is only one key in the keydir, that is the key.
5. Otherwise there is no key; an error occurs.

`--keydir <arg>`

Set the key directory (where the “key store” is located); default is `confir/keys`.

`--log <arg>`

Specify a file to which the log (consisting of all debug, informational, and warning messages) is written; default is the `stderr` process output.

`--no-builtin-rcfile`

`--builtin-rcfile`

Do not load the built-in rcfile with the default hooks. This means all hooks will have null definitions (unless overridden by other [\[rcfiles\], page 185](#)).

`--no-default-confdir`

`--allow-default-confdir`

Don’t use a default confdir; `--confdir` must be specified if a configuration file is needed.

`--no-format-dates`

Don’t use the format provided by a previous `--date-format`, nor the format returned by `[get_date_format_spec]`, [page 193](#); instead, print dates in the format “yyyy-mm-ddThh:mm:ss”.

`--[no-]standard-rcfiles`

Do not load the standard rcfiles, which are `$HOME/.monotone/monotonerc` on Unix or `%APPDATA%\monotone\monotonerc` on Windows, and `_MTN/monotonerc` in the current workspace. See [\[rcfiles\], page 185](#).

--no-workspace
--allow-workspace
 Don't look for a workspace; this means options that normally get their default values from the workspace will not have those default values.

--non-interactive
--interactive
 Do not prompt the user for input; fail instead. For example, don't prompt for a key passphrase, or when doing a merge, do not start the external merger to resolve a conflict.

--quiet
--verbose
 Decrease or increase verbosity. There are four levels of verbosity; debug, information, warning, and none. The default is information.

--rcfile <arg>
 Specify an extra rcfile to load. See [\[rcfiles\]](#), page 185.

--clear-rcfiles
 Cancel all previous **--rcfile** options (standard rcfiles are still loaded). See [\[rcfiles\]](#), page 185.

--root <arg>
 Limit the search for a workspace to the specified root directory

--ssh-sign <arg>
 Controls use of ssh-agent. Valid arguments are: 'yes' to use ssh-agent to make signatures if possible, 'no' to force use of monotone's internal code, 'only' to force use of ssh-agent, 'check' to sign with both and compare.

--ticker <arg>
 Set ticker style; one of 'count', 'dot', or 'none'

--timestamps
 Show timestamps in front of error, warning, and progress messages.

--version
 Print version number, then exit; same as **mtn version**.

--xargs <arg>
-@ <arg> Insert command line arguments taken from the given file. A '-' can be used to read the arguments from standard input. e.g. **--xargs=-**

4.1.2 Common Options

These options are available on many commands.

--author Override the author cert for a commit; normally, the author is the local name of the key used for the commit. See [\[get_author\]](#), page 191, [\[--key\]](#), page 83, [\[get_local_key_name\]](#), page 191.

--branch Specify the branch for a command. This normally defaults to the workspace branch.

- `--date` Override the date cert for a commit. The date defaults to the current calendar time.
- `--message string`
Set the commit changelog message, as a string. Each command that does a commit has a different default for the message.
- `--message-file filename`
Set the commit changelog message, as a file. Each command that does a commit has a different default for the message.
- `--[no-]update`
If `--update` is given, and the command is executed in a workspace, the workspace is updated to the new head of the workspace branch if the workspace was at a head, and the command makes a new head of the workspace branch.

4.2 Tree

```

mtn checkout [--[no-]move-conflicting-paths] --revision=id directory
mtn checkout [--[no-]move-conflicting-paths] --branch=branchname directory
mtn co        co is an alias for checkout. See Section 3.2 \[Selectors\], page 47.

```

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 3.7 \[Workspace Collisions\]](#), page 61 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 conflicts
    See Section 4.2.1 \[Conflicts\], page 89

```

mtn explicit_merge [--[no-]update] *id id destbranch*

See the online help for options. See [\[-update\]](#), page 85. See [Section 3.2 \[Selectors\]](#), page 47.

This command merges exactly the two revision *ids* 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.

[Section 3.6 \[Merge Conflicts\]](#), page 55 can occur.

mtn heads [--branch=*branchname*]

This command lists the “heads” of *branchname* (defaults to the current workspace).

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 import --branch=*branch* [--message=*message*] [--[no-]dry-run] *dir*

mtn import --revision=*revision* [--message=*message*] [--[no-]dry-run] *dir*

See the online help for more options. See [Section 3.2 \[Selectors\]](#), page 47.

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 neither **--message** nor **--message-file** is given, the Lua hook [\[edit_comment\]](#), page 192 is called to provide a commit comment, with text formatted as in [\[mtn commit\]](#), page 91.

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

Roughly speaking, **mtn import** does the following:

```
$ mtn setup (with a twist)
$ mtn drop --missing
$ mtn add --unknown
$ mtn commit
```

The twist with the **mtn setup** part is that it sets the parent to be the given revision or the head of the given branch instead of the null revision.

mtn merge [--branch=*branchname*] [--message *string*] [--message-file *filename*] [--[no-]update] [--resolve-conflicts]

See the online help for more options. See [\[-update\]](#), page 85.

This command merges the “heads” of *branchname* (default the branch of the current workspace), 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.

A commit message may be provided via `--message string` or `--message-file filename`. A message stating the revision ids that were merged will be prepended to any user commit message.

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.

[Section 3.6 \[Merge Conflicts\], page 55](#) for conflicts that can occur, and the use of `--resolve-conflicts`.

mtn merge_into_dir [`--[no-]update`] *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.

[Section 3.6 \[Merge Conflicts\], page 55](#) can occur. See `[-update]`, [page 85](#).

mtn merge_into_workspace [`--[no-]move-conflicting-paths`] *revision*

Merges *revision* (see [Section 3.2 \[Selectors\], page 47](#)) into the current workspace; the result is not committed to the database. There can be no pending changes in the current workspace. The workspace's selected branch is not changed.

When a later commit is done, both *revision* and the workspace's base revision will be recorded as parents.

[Section 3.6 \[Merge Conflicts\], page 55](#) and [Section 3.7 \[Workspace Collisions\], page 61](#) can occur.

mtn migrate_workspace [*directory*]

Migrates a workspace directory's metadata to the latest format.

If no directory is given, defaults to the current workspace.

This may be needed when upgrading to a new version of monotone.

mtn propagate *sourcebranch destbranch* [`--message string`] [`--message-file filename`]

See online help for more options. See [Section 4.1.2 \[Common Options\], page 84](#).

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.

A commit message may be provided via `--message string` or `--message-file filename`. A message stating the source and target branches will be prepended to any user commit message.

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.

[Section 3.6 \[Merge Conflicts\]](#), [page 55](#) can occur.

mtn refresh_inodeprints

This command puts the current workspace into [Section 3.5 \[Inodeprints\]](#), [page 54](#) 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 setup --branch *branchname* [--db *database*] [*directory*]

This command prepares *directory* (default current directory) as a monotone workspace, by creating and populating the `_MTN` directory with basic information.

If no database is given, the configured default database is created or re-used (see [\[get_default_database_alias\]](#), [page 191](#) for more details). Both settings, branch and database name, 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**.

On Windows, workspaces cannot be located in the root directory of a device; for example, `d:/` is an invalid directory for a workspace.

4.2.1 Conflicts

The `conflicts` set of commands is used to specify conflict resolutions for merges, asynchronously from the merge command itself. This lets the user take as much time as needed to prepare all the conflict resolutions, and avoids losing work when a merge is aborted due to a complicated conflict. See [Section 3.6 \[Merge Conflicts\]](#), page 55.

These commands require a workspace, to provide a place to store the conflicts and user resolution files.

For all of these commands, if the `--conflicts-file` option is not given, the file `_MTN/conflicts` is used. If the `--conflicts-file` option is given, the file must be in the bookkeeping directory.

Files given in these commands are relative to the current working directory, or absolute. In the conflict file, they are relative to the workspace root, or absolute.

The commands are listed in the order they are typically used, not in alphabetical order. Then the conflict resolutions are discussed.

Commands

`mtn conflicts store [--conflicts-file=file] [left_rev_id right_rev_id]`

Store the conflicts encountered by merging *left_rev_id* with *right_rev_id* (revision ids; see [Section 3.2 \[Selectors\]](#), page 47), in the specified file (defaults to `_MTN/conflicts`). If *left_rev_id* and *right_rev_id* are not given, the first two heads that the `merge` command would merge are used.

The conflicts file format is as output by the `automate show_conflicts` command; see [\[mtn automate show_conflicts\]](#), page 167.

Content conflicts that can be resolved by the internal line merger have resolutions, so they will not show up in subsequent `show_first` commands.

`mtn conflicts show_first [--conflicts-file=file]`

Show the first unresolved conflict in the conflicts file, and list the possible resolutions.

`mtn conflicts show_remaining [--conflicts-file=file]`

Show remaining unresolved conflicts in the conflicts file.

`mtn conflicts resolve_first [--conflicts-file=file] resolution`

Specify a resolution for the first conflict in the conflicts file; it must be a single file conflict. The conflicts file is updated.

`mtn conflicts resolve_first_left [--conflicts-file=file] resolution`

`mtn conflicts resolve_first_right [--conflicts-file=file] resolution`

Specify a resolution for one of the files in the first conflict in the conflicts file; it must be a two file conflict. The conflicts file is updated.

`mtn conflicts clean`

Delete the default conflicts file `_MTN/conflicts`, and the directory `_MTN/resolutions`. Users may store conflict resolution files in `_MTN/resolutions`; this command provides a convenient way to clean up.

Conflict resolutions

For single and two file conflicts, there are several possible resolutions. In the conflicts file, `resolved_user_left` is used for single file conflicts.

interactive *[file]*

The Lua [\[merge3\]](#), page 200 hook is called to allow the user to manually merge the left and right files, leaving the result in the specified file.

file must be a bookkeeping path; under `_MTN`. If not specified, *file* defaults to `_MTN/resolutions/<path>`, where `<path>` is the path to the file that has the conflict.

This inserts a `resolved_user_left file` or `resolved_user_right file` conflict resolution in the conflicts file.

user *file* The file contents are replaced by the contents of the specified file.

This inserts a `resolved_user_left file` or `resolved_user_right file` conflict resolution in the conflicts file.

drop The file is dropped in the merge.

This inserts a `resolved_drop_left` or `resolved_drop_right` conflict resolution in the conflicts file.

rename *filename*

The file is renamed.

This inserts a `resolved_rename_left filename` or `resolved_rename_right filename` conflict resolution in the conflicts file.

user_rename *contents_file rename_file*

The file contents are replaced by the contents of the specified file, and renamed.

This inserts a `resolved_user_left contents_file` or `resolved_user_right contents_file` conflict resolution in the conflicts file, and a `resolved_rename_left rename_file` or `resolved_rename_right rename_file` conflict resolution.

keep The file is kept in the merge.

This inserts a `resolved_keep_left` or `resolved_keep_right` conflict resolution in the conflicts file.

monotone internals note: we don't provide an `interactive` resolution for two-file conflicts, because monotone currently does not provide a `merge2` Lua hook. two-file conflicts don't have a shared ancestor, so `merge3` is not applicable.

4.3 Workspace

```
mtn add [--no-recursive] [--no-respect-ignore] pathname...
mtn add [--no-recursive] [--no-respect-ignore] --no-unknown
[pathname...]
```

This command places **add** entries for the paths specified in *pathname...* in [\[.MTN/revision\]](#), [page 10](#); they will be part of the next **commit**. See [Section 1.5 \[Storage and workflow\]](#), [page 10](#) for more information on **add** and **commit**.

As a convenience, the **--unknown *pathname...*** option can be used; this option will cause all of the files listed by **mtn list unknown *pathname...*** to be added. However, note that the default for **list unknown** is **--recursive**, while the default for **add** is **--no-recursive**.

Adding directories, whether explicitly or using the **--unknown** option, is non-recursive by default. The **add** command can be made recursive using the **--recursive** option.

```
mtn attr Manage Section 3.14 \[File Attributes\], page 72.
```

In **drop** and **get**, if no attribute is specified, the command applies to all attributes attached to the file given in *path*. Otherwise it applies only to the attribute specified in *attr*.

```
mtn attr drop path [attr]
    Remove attributes.
```

```
mtn attr get path [attr]
    Output the attributes.
```

```
mtn attr set path attr value
    Sets attr on path to value.
```

Several attributes are reserved for mtn use; they all start with “mtn:”:

```
mtn:encoding
    Specify character encoding for the file.
```

```
mtn:execute
    File is executable.
```

```
mtn:manual_merge
    Don't use internal or external diff or merger.
```

```
mtn:resolve_conflict
    Specify drop resolution for a recurring dropped/modified conflict
    (\[dropped\_modified\_conflict\], page 58).
```

```
mtn commit
mtn commit --message=logmsg [--message=logmsg...] [pathname...]
mtn commit --message-file=logfile [pathname...]
mtn ci      ci is an alias for commit. See the online help for more options.
```

This command looks at your workspace, decides which files have changed, and saves the changes to your database. It works by loading the revision named in [\[.MTN/revision\]](#), [page 10](#), locating the base manifest for your workspace,

applying any pathname changes described, 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 your 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` 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.

If neither `--message-file` nor `--message` are given, the commit message defaults to the contents of `_MTN/log`, after processing by the Lua hook [\[edit_comment\]](#), [page 192](#). `_MTN/log` can be edited by the user during their daily work to record the changes made to the workspace.

The default definition of `edit_comment` invokes the user's editor (specified by the environment variables `VISUAL` and `EDITOR`, or `editor`, `vi`, or `notepad` on Windows).

`commit` formats the input to `edit_comment` as follows:

```
<contents of _MTN/log>

*** REMOVE THIS LINE TO CANCEL THE COMMIT ***
-- Enter a description of this change above --
-- Edit fields below to modify certificate values --
Branch:    <from _MTN/options or option>
Author:    <from key or option>
Date:      <from system clock>

-- Modifications below this line are ignored --
Changes against parent <from _MTN/revision>

<list of changes>
```

When the user quits the editor, the text is processed as follows:

- The final *logmsg* is all text up to the line “*** REMOVE THIS LINE ...” (the *cancel* line).
- If the *logmsg* is empty, the commit is aborted.
- If the cancel line is deleted or modified, the edited *logmsg* is saved in `_MTN/log`, and the commit is aborted.
- The next two lines (instructions) are confirmed to be present. If not, the commit is aborted, and the entire file is saved in `_MTN/commit`, so the user may recover.
- The *Branch*, *Author*, and *Date* fields are parsed, and the new values used for the commit. If the parsing fails, the commit is aborted, and the entire file is saved in `_MTN/commit`, so the user may recover.

The date is formatted with the spec provided by `--date-format` or Lua hook `[get_date_format_spec]`, page 193. When the date field is parsed, the same spec is used. Therefore this spec must be supported by the operating system function for parsing dates; if not, the monotone internal format of “yyyy-mm-ddThh:mm:ss” is used for both formatting and parsing.

- The rest of the text is ignored.

If the commit is successful, the `_MTN/log` file is cleared of all content making it ready for another edit/commit cycle.

As a special case, if `--message-file=_MTN/log` is specified, the contents of `_MTN/log` will be used without first invoking `edit_comment`.

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]`, page 191 hook; you may override this by passing the `--author` option to `commit`, or by editing the *Author* field in your editor. 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 date and time; you may override this by passing the `--date` option to `commit`, or by editing the *Date* field in your editor. This is useful when importing “by hand” from another version control system.
- A **changelog** cert, containing the *logmsg*.

```
mtn drop [--[no]-recursive] [--bookkeep-only] pathname...
```

```
mtn drop --missing pathname...
```

```
mtn rm      rm is an alias for drop.
```

This command places “drop” entries for the paths specified in *pathname...* in `[_MTN/revision]`, page 10 and deletes the file from the workspace. This will be

part of the next `commit`. If any of *pathname...* is a directory, and `--recursive` is not given, and the directory contains any versioned files, the command will fail. If `--recursive` is given, the versioned files will be dropped. If the directory contains unversioned files, it will be dropped from the revision, but not deleted from the disk.

If `--missing` is given, `drop` will add drop entries for any versioned paths in *pathname...* for which you have already removed the files from the filesystem.

This command also removes any attributes on *pathname*; see [Section 3.14 \[File Attributes\]](#), page 72 for more details.

If `--bookkeep-only` is given, or if a file is different from the version in the base revision, `drop` will drop remove *pathname...* from the revision at commit time, but *not* remove the file from the workspace.

See the `undrop` command for undoing a `drop` before commit.

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

This command creates directories in the filesystem relative to your current location and adds them to `[_MTN/revision]`, [page 10](#). This will be part of the next `commit`.

Normally, if any of *directory...* are in `.mtn-ignore`, this command will fail. You can use `--no-respect-ignore` to override this check. But it would be better to remove *directory* from `.mtn-ignore`.

`mtn pivot_root [--bookkeep-only] [--[no-]move-conflicting-paths] 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 3.7 \[Workspace Collisions\]](#), page 61 to occur.

`mtn pluck [--[no-]move-conflicting-paths] --revision=to`

`mtn pluck [--[no-]move-conflicting-paths] --revision=from --revision=to`

See the online help for more options. See [Section 3.2 \[Selectors\]](#), page 47.

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.

Section 3.6 [Merge Conflicts], page 55 and Section 3.7 [Workspace Collisions], page 61 can occur.

```
mtn rename [--bookkeep-only] src dst
mtn rename [--bookkeep-only] src ... dst/
mtn mv      mv is an alias for rename.
```

This command places `rename` entries for the paths specified in *src* and *dst* in `[_MTN/revision]`, page 10, and (if `--bookkeep-only` is not specified) renames the paths on the disk. This will be part of the next `commit`.

The second form renames a number of source paths (or a single source, if *dst* ends in '/') to the given destination. In this case *dst* will be created if necessary, and added to the workspace if it is not already versioned.

This command also moves any attributes on *src* to *dst*; see Section 3.14 [File Attributes], page 72 for more details.

Note that you cannot rename a branch. You can accomplish something similar by creating a new branch with the desired name, using the `[mtn approve]`, page 108 command to add a branch name to the desired revision.

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

See the online help for more options.

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 **--missing** is given it reverts any versioned files in *pathname...* that have been deleted from the workspace.

mtn undrop *pathname...*

Undoes a previous **drop**; useful when you make a mistake. If the file was deleted from the workspace, this reverts it. If it was not deleted (because it was changed or **--bookkeep-only** was given), it just removes the pending drop.

mtn update [--[no-]move-conflicting-paths] [--branch *branchname*]

mtn update [--[no-]move-conflicting-paths] --revision=*revision*

This command changes your workspace to have the a different revision as the base revision. See [Section 3.2 \[Selectors\]](#), page 47.

update performs 3 separate stages. If any of these stages fails, the update aborts, doing nothing. The first two stages select the target revision; they are skipped if **--revision** is given - that revision is the target.

In the first stage, if **--branch** is not given, the workspace branch is used. If **--branch** is given, the branch becomes the new default branch of the workspace (even if you also specify an explicit **--revision** argument).

- Examine the ancestry graph of revisions on the branch in your database, and (subject to trust evaluation; see [Section 6.1.6 \[Trust Evaluation Hooks\]](#), page 197) 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; see [\[accept.testresult.change\]](#), page 198 (defaults to all candidates). 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.

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.

[Section 3.6 \[Merge Conflicts\]](#), page 55 and [Section 3.7 \[Workspace Collisions\]](#), page 61 can occur.

4.4 Network

```

mtn serve [--bind=[address][:port]]
mtn pull [--[no-]set-default] [--[no-]dry-run] [uri]
mtn push [--[no-]set-default] [--[no-]dry-run] [--keys-to-push=key] [uri]
mtn sync [--[no-]set-default] [--[no-]dry-run] [--keys-to-push=key] [uri]
mtn pull [--[no-]set-default] [address] [glob [...]]
  [--exclude=exclude-glob]]] deprecated
mtn push [--[no-]set-default] [--keys-to-push=key] [address] [glob [...]]
  [--exclude=exclude-glob]]] deprecated
mtn sync [--[no-]set-default] [--keys-to-push=key] [address] [glob [...]]
  [--exclude=exclude-glob]]] deprecated

```

See the online help for more options. See [\[-update\]](#), page 85.

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.

If `--dry-run` is given, the connection is made, but no data is transferred. Instead, a summary of what would be transferred is output; the number of revisions, certs and keys that would be sent and received. For sent revisions, the branch names are also output.

The *uri-or-address* arguments given to `push`, `pull`, and `sync` can be of two possible forms.

If the argument is an URI, the Lua hook [\[get_netsync_connect_command\]](#), page 195 may transform it into a connection command, which is later executed as the transport channel for netsync. The URI itself consists of a connection scheme, an optional user (only used for `ssh`-related transports), a host with an optional port (which both might be optional as well, f.e. for the `file` scheme), a path and a query part, which denotes one or more branches and optionally also exclude patterns for the exchange:

```
<scheme>://[[<user>@]<host>[:<port>]][/<path>][?[-]<pattern>;[-]<pattern>]...]
```

Branches matching a pattern are excluded if the pattern is preceded by `'-'`, included otherwise.

The syntax for patterns is very simple. `*` matches 0 or more arbitrary characters. `?` matches exactly 1 arbitrary character (you need to escape that as `%3F` in a URI). `{,}` matches alternatives; `{foo,bar,baz}` matches “foo”, or “bar”, or “baz”. These can be combined arbitrarily. A backslash (`\`) escapes these special characters, to match exactly that character; this might be useful in case someone, for some odd reason, decides to put a “*” into their branch name.

Valid examples of URIs monotone accepts are:

```
mtn://my.server:4690?my.branch
mtn://my.server/project?my.other.branch*;-my.other.branch.test
mtn://my.server/project?one.branch;-one.branch.test;another.branch;-another.branch.test
mtn://my.server/project?{one.branch,another.branch};-{one.branch.test,another.branch.test}
file:///path/to/database.mtn?my.branch
ssh://joe@my.server/~db.mtn?joes.branch
```

`file:` and `ssh:` are not supported on Windows native, but they are supported on Windows Cygwin.

If the server has a multi-host setup, the path component of the URI might be used to distinguish between different databases (please ask the provider of the server for details).

For backward compatibility, if the argument is a simple hostname (with no scheme, but with optional port number), monotone will default to the `mtn:` URI scheme, i.e. use a TCP socket to the specified host and port. The `glob` parameters then indicate a set of branches to exchange. Multiple `glob` and `--exclude` options can be specified. **Important notice:** This call syntax is deprecated and subject to removal in future versions of monotone!

For both syntaxes, every branch which matches a `glob` or branch pattern exactly, and does not match an `exclude-glob` or exclude pattern, 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 "mtn://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 `uri` the first time you use one of them; monotone will store this in the database and in the future default to the same URI. 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 URI, 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.

The **serve** command doesn't care about workspaces, so even if you stand in one, you will have to give it the database to serve, the server key to use and the key directory explicitly.

In the server, different permissions can be applied to each branch; see [\[get_netsync_read_permitted\]](#), page 193 and [\[get_netsync_write_permitted\]](#), page 194.

If **--pid-file** is specified, **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.

```
mtn clone uri [--branch=branchname] [--revision=rev] [directory]
```

```
mtn clone address[:port] branchname [directory] deprecated
```

clone is a helper command that performs the roles of a number of other commands all at once. First, it constructs a new database. If no database is given, the configured default database is created or re-used (see [\[get_default_database_alias\]](#), page 191 for more details; `~/.monotone/default.mtn` by default). Then it populates this database by pulling any data which match the branch pattern in the *uri* argument from the remote database.

The branch pattern must specify a single branch; **clone** uses that to determine which branch to checkout.

Finally, **clone** copies the files out of the newly created database into a local directory, just as **checkout** would. If no *directory* is given, the *branchname* is used as directory. If **--revision** is given (see [Section 3.2 \[Selectors\]](#), page 47), that revision must be on the specified branch, and is checked out; otherwise the head of the branch is checked out.

Important notice: The *address[:port] branchname* call syntax is deprecated and subject to removal in future versions of monotone!

4.5 Informative

mtn annotate *file*

mtn annotate [--revision=*id*] [--revs-only] *file*

See [Section 3.2 \[Selectors\]](#), page 47.

Dumps an annotated copy of the file to stdout. The output is in the form:

```
<short revision id>.. by <author> <date>: <line>
```

<revision id> is the revision in which that line of the file was last edited; <author> is the author cert on that revision, <date> is the date cert on that revision.

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.

If --revs-only is specified, the output format is:

```
<revision id>: <line>
```

mtn bisect bad [--revision=*id* ...] [--[no-]move-conflicting-paths]

Mark the specified revisions as “bad” for the current bisection operation (see [Section 3.19 \[Bisecting\]](#), page 80, see [Section 3.2 \[Selectors\]](#), page 47). If no bisection operation is in progress a new bisection is initialized. If a bisection operation is in progress the next update target is selected and the workspace is updated to the selected revision.

If the update is blocked by conflicting unversioned paths existing in the workspace this command may be re-issued with the --move-conflicting-paths option. Alternatively, the **bisect update** command can be used with this option to update the workspace and move the conflicting paths out of the way.

mtn bisect good [--revision=*id* ...] [--[no-]move-conflicting-paths]

Mark the specified revisions as “good” for the current bisection operation (see [Section 3.19 \[Bisecting\]](#), page 80, see [Section 3.2 \[Selectors\]](#), page 47). If no bisection operation is in progress a new bisection is initialized. If a bisection operation is in progress the next update target is selected and the workspace is updated to the selected revision.

If the update is blocked by conflicting unversioned paths existing in the workspace this command may be re-issued with the --move-conflicting-paths option. Alternatively, the **bisect update** command can be used with this option to update the workspace and move the conflicting paths out of the way.

mtn bisect reset

Reset the current bisection operation by updating the workspace back to the revision from which the bisection was started and clearing the current bisection information.

mtn bisect skip [--revision=*id* ...] [--[no-]move-conflicting-paths]

Mark the specified revisions as “skipped” for the current bisection operation (see [Section 3.19 \[Bisecting\]](#), page 80, see [Section 3.2 \[Selectors\]](#), page 47). If no bisection operation is in progress a new bisection is initialized. If a bisection

operation is in progress the next update target is selected and the workspace is updated to the selected revision.

If the update is blocked by conflicting unversioned paths existing in the workspace this command may be re-issued with the `--move-conflicting-paths` option. Alternatively, the `bisect update` command can be used with this option to update the workspace and move the conflicting paths out of the way.

mtn bisect status

Report the status of the current bisection operation including the number of revisions that remain to be tested, the number of revisions that have been tested and the next revision that will be selected for testing.

mtn bisect update [--[no-]move-conflicting-paths]

Update the workspace to the next revision selected by the previous bisect operation (see [Section 3.19 \[Bisecting\]](#), page 80). This command can be useful when the previous bisect operation fails to update the workspace because of conflicting unversioned paths existing in the workspace.

mtn cat [--revision=*id*] *path*

Write the contents of a specific file *path* in revision *id* (see [Section 3.2 \[Selectors\]](#), page 47; default to workspace base revision) to standard output.

mtn complete file *partial-id*

mtn complete key *partial-id*

mtn complete revision *partial-id*

These commands print out all known completions of a partial SHA1 value (*not* a selector), 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**.

mtn diff [--unified] [--[no-]show-encloser]

mtn diff --context [--[no-]show-encloser]

mtn diff --external [--diff-args=*argstring*]

mtn diff *pathname...*

mtn diff [--reverse] --revision=*id*

mtn diff --revision=*id* *pathname...*

mtn diff --revision=*id1* --revision=*id2*

mtn diff --revision=*id1* --revision=*id2* *pathname...*

mtn di *di* is an alias for **diff**. See online help for more options. See [Section 3.2 \[Selectors\]](#), page 47.

These commands print out textual difference listings between various manifest versions. With no `--revision` options, `diff` will print the difference from the base revision to the current revision in the workspace.

With one `--revision` option, `diff` will print the difference from the revision *id* to the current revision in the workspace. If `--reverse` is given, the order of the diff is reversed.

With two `--revision` options `diff` will print the difference from revision *id1* to *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`, `--no-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, monotone prints the name of the top-level code construct that encloses each “hunk” of changes, unless suppressed with the `--no-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]`, page 199. For the regular expression syntax, see Section 7.4 [Regexps], page 218.

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]`, page 199.

```
mtn help [--[no-]hidden] command...
```

Displays help about commands and options.

```
mtn list branches [pattern] [--exclude=pattern]
```

```
mtn ls branches
```

`ls branches` is an alias for `list branches`.

This command lists all known branches in your database. If *pattern* is provided, it is used as a glob to select the branches listed, otherwise all branches are listed. If `-exclude` options are provided they are used as globs to exclude specified branches. In addition, branches for which the Lua hook `[ignore_branch]`, page 193 returns true are excluded.

Normally, branches that have been suspended are not listed; the global option `--ignore-suspend-certs` causes suspended branches to be listed; see `[mtn suspend]`, page 109.

```
mtn list certs id
```

```
mtn ls certs
```

`ls certs` is an alias for `list certs`.

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

- The key used to sign the certificate
- Whether the signature on the certificate is `ok` or `bad`
- 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 (10b5b36b4a...)
Sig   : ok
Name  : author
Value : graydon@dub.venge.net
-----
Key   : graydon@pobox.com (10b5b36b4a...)
Sig   : ok
Name  : branch
Value : monotone
-----
Key   : graydon@pobox.com (10b5b36b4a...)
Sig   : ok
Name  : date
Value : 2003-10-17T03:20:27
-----
Key   : graydon@pobox.com (10b5b36b4a...)
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 changed [pathname...]`

`mtn ls changed`

`ls changed` is an alias for `list changed`. See online help for more options.

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 list databases`

`mtn list dbs`

`mtn ls databases`

`mtn ls dbs`

Show all [Section 3.10 \[Managed Databases\]](#), [page 65](#) and the workspaces registered in them. The commands [\[mtn register_workspace\]](#), [page 109](#) and [\[mtn unregister_workspace\]](#), [page 110](#) can be used to explicitly register and unregister workspaces shown within this list.

`mtn list duplicates [--revision=id]`

`mtn ls duplicates`

`ls duplicates` is an alias for `list duplicates`. See [Section 3.2 \[Selectors\]](#), [page 47](#).

This command lists duplicate files in a given revision (defaults to the workspace base revision). Ignored and unknown files are excluded from the listing.

Two or more files are considered duplicates if the SHA1 hashes of their contents are equal.

`mtn list ignored [--[no-]recursive] [pathname...]`

`mtn ls ignored`

`ls ignored` is an alias for `list ignored`.

This command lists all files in your workspace that monotone is intentionally ignoring, due to the results of the [\[ignore_file\]](#), [page 192](#) 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.

Default is `--recursive`; all directories will be traversed. Specifying `--no-recursive` restricts the listing to the root directory of the specified path (or the workspace, if no path is given).

`mtn list keys [pattern]`

`mtn ls keys`

`ls keys` is an alias for `list keys`.

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 known [pathname...]
```

```
mtn ls known
```

`ls known` is an alias for `list known`.

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 missing [pathname...]
```

```
mtn ls missing
```

`ls missing` is an alias for `list missing`.

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 tags [pattern] [--exclude=pattern]
```

```
mtn ls tags
```

`ls tags` is an alias for `list tags`.

This command lists all known tags in your database that match the given *pattern* (default all tags). If `--exclude` options are provided they are used as globs to exclude specified tags.

```
mtn list unknown [--[no-]recursive] [pathname...]
```

```
mtn ls unknown
```

`ls unknown` is an alias for `list unknown`.

This command lists all files in your workspace that monotone 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.

Default is `--recursive`; all directories will be traversed. Specifying `--no-recursive` restricts the listing to the root directory of the specified path (or the workspace, if no path is given).

`mtn list vars [domain]`

`mtn ls vars`

`ls vars` is an alias for `list vars`.

This command lists all vars in your database, or all vars within a given *domain*. See [Section 3.9 \[Vars\]](#), [page 64](#) for more information.

`mtn list workspaces`

`mtn ls workspaces`

`ls workspaces` is an alias for `list workspaces`.

This command shows all registered workspaces for a database, be it managed or unmanaged. If no database is given explicitly, defaults to the workspace's database in which the command is executed. The commands [\[mtn register_workspace\]](#), [page 109](#) and [\[mtn unregister_workspace\]](#), [page 110](#) can be used to explicitly register and unregister workspaces shown within this list. See [Section 3.10 \[Managed Databases\]](#), [page 65](#) for more information.

`mtn log`

`mtn log [--last=n] [--next=n] [--from=id [...]] [--clear-from] [--to=id [...]]`
`[--clear-to] [--revision=id [...]] [--[no-]brief] [--[no-]merges]`
`[--[no-]files] [--[no-]graph] [--[no-]diffs] [pathname...]`

See the online help for more options. See [Section 3.2 \[Selectors\]](#), [page 47](#).

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

If `--brief` is given, the output consists of two lines per revision with the revision ID, the author, the date and the branches (separated with commas). If the `--no-graph` option is also given the output contains only one line per revision.

If `--last=n` is given, at most *n* log entries will be given and log will trace through history in reverse-ancestry order, from newer revisions to older revisions.

If `--next=n` is given, at most *n* log entries will be given and log will trace through history in forward-ancestry order, from older revisions to newer revisions. This is useful to review changes that will be applied to the workspace when `update` is run.

If `--from=id` is given, log starts tracing through history from the specified revisions, otherwise it starts from the base revision of your workspace. Log will stop when it reaches the end of the revision history or revisions specified by the `--to` option.

`--clear-from` erases the effect of all previous `--from` options. `--clear-to` erases the effect of all previous `--to` options.

When tracing through history in reverse-ancestry order and `--to=id` is given, log will stop when it reaches the specified revisions or any of their ancestors or the end of the revision history. When tracing through history in forward-ancestry order log will stop when it reaches the specified revisions or any of their descendants or the end of the revision history.

If `--revision=id` is given, log will print only the specified revisions.

If both `--from` and `--revision` are given only revisions included by both options will be logged. Revisions specified by `--revision` that are beyond the starting points specified by `--from` will be excluded.

Additionally, each of the `--from`, `--to` and `--revision` options accept selectors, see [Section 3.2 \[Selectors\], page 47](#). These can be used in various ways to log interesting revisions. For example:

```
$ mtn log --revision b:
$ mtn log --revision today
$ mtn log --revision bob
```

will log all revisions from the current branch, all revisions dated today and all revisions with bob as the author, respectively.

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.

If `--no-graph` is given, the log output excludes the ASCII revision graph prefix on log output lines.

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 manpage [--formatted/--plain] [--[no-]hidden]

The manpage command generates a complete (and if monotone is available in your language, also localized) manual page for all available commands, including all user-defined Lua commands.

The default for `--formatted/--plain` depends on whether `mtn manpage` is run from a terminal, or from a shell script. From a terminal, the default is `--formatted`; from a script, it is `--plain`.

If `--formatted`, the output is formatted and displayed using the command given by the Lua hook `[get_man_page_formatter_command]`, [page 193](#) (defaults to `nroff | less`).

If `--plain`, the output is nroff markup.

The option `--hidden` additionally enables the output of hidden commands and options, which is deactivated by default.

mtn show_conflicts rev rev

This command shows what conflicts would need to be resolved in order to merge the given revisions; see [Section 3.6 \[Merge Conflicts\], page 55](#), see [Section 3.2 \[Selectors\], page 47](#).

Note that this does not show conflicts due to update commands, since in that case one revision is the workspace.

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 version [--full | --concise]

Shows the program version.

The concise version is one line, for example:

```
monotone 1.0dev (base revision: c91edf22b20f5a8b750a8a02af763412d6b936e8)
```

The full version gives more information, including a changelist of the monotone source tree from the base revision at the time the executable was compiled.

4.6 Review

mtn approve rev [--branch=*branchname*] [--[no-]update]

This command puts *rev* on the branch *branchname* (defaults to the workspace branch).

This command is a synonym for **mtn cert rev branch** *branchname*.

See [\[-update\]](#), [page 85](#).

mtn comment rev [*comment*]

This adds a new comment to a committed revision (see [Section 3.2 \[Selectors\]](#), [page 47](#)). If *comment* is not provided, it is obtained from the Lua hook [\[edit_comment\]](#), [page 192](#); the hook is passed an empty string.

This command is a synonym for **mtn cert rev comment** *comment*.

mtn disapprove [--[no-]update] [*parent*] *child*

See online help for more options; see [Section 4.1.2 \[Common Options\]](#), [page 84](#).

See [\[-update\]](#), [page 85](#).

This command records a disapproval of the changes between *parent*’s ancestor and *child*. *parent* and *child* are revision ids (see [Section 3.2 \[Selectors\]](#), [page 47](#)).

If *parent* is omitted, only *child* is disapproved. The command does the disapproval by committing the *inverse* changes as a new revision descending from *child*.

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 all changesets from *parent* to *child* have exactly one ancestor (that is, none are the result of a merge), since it hasn't been worked out how to generate such a descendant in the multi-ancestor case.

mtn suspend [--[no-]update] [--branch *branchname*] *rev*

See [\[-update\]](#), page 85.

This makes *rev* (a revision id; see [Section 3.2 \[Selectors\]](#), page 47) invisible as a head of branch *branchname* (defaults to the current workspace branch). Any operation that looks for heads will not count *rev*; this includes [\[mtn list branches\]](#), page 102 as well as [\[mtn merge\]](#), page 86 etc.

If *rev* is not a head, **suspend** has no effect.

suspend is not inherited; if a new revision is committed as the child of a **suspended** revision, the new revision will be visible as a head.

This command is a synonym for **mtn cert rev suspend branchname**.

mtn tag rev tagname

This command associates the symbolic name *tagname* with the revision *rev* (a revision id; see [Section 3.2 \[Selectors\]](#), page 47), so that symbolic name can later be used in selectors for specifying revisions.

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

mtn testresult rev {pass | fail | true | false | yes | no | 1 | 0}

This command adds a **testresult** certificate to *rev*, with a value of 0 or 1. **pass**, **true**, **yes** give a value of 1; **fail**, **false**, **no** give a value of 0. See [Section 3.8 \[Quality Assurance\]](#), page 63.

4.7 Variables

mtn cleanup_workspace_list

Removes all invalid workspaces from the list of registered workspaces of the current database. A workspace is considered invalid if its path does either not contain an **_MTN** directory anymore or if the configured database for the workspace is a different from the current database.

mtn register_workspace [*workspace_path*]

Registers the given workspace (default the current workspace) in the current database, so that it will show up in the output of [\[mtn list databases\]](#), page 104 (the database has to be in a managed location for **list databases** to work; see [Section 3.10 \[Managed Databases\]](#), page 65).

`mtn set domain name value`

Associates *value* to *name* in domain *domain*. See [Section 3.9 \[Vars\]](#), page 64 for more information.

`mtn unregister_workspace [workspace_path]`

Unregisters the given workspace (default the current workspace) from the current database, so that it will no longer show up in the output of `[mtn list databases]`, page 104.

`mtn unset domain name`

Deletes any value associated with *name* in *domain*. See [Section 3.9 \[Vars\]](#), page 64 for more information.

4.8 Key and Cert

mtn cert selector certname [certval]

Create a new certificate with name *certname*, for all revisions matching *selector* (see [Section 3.2 \[Selectors\]](#), page 47).

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

mtn dropkey keyid

Drop the public and/or private key. This command should be used with caution as changes are irreversible without a backup of the key(s) that were dropped.

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.keyhash*. The key's hash is printed out after the key has been created.

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(key_identity)` (see [\[get_passphrase\]](#), page 190), but this significantly increases the risk of a key compromise on your local computer. Be careful using this hook.

Another way to avoid entering the private key passphrase each time it is needed is to export it to ssh-agent; see [\[mtn ssh_agent_export\]](#), page 112, [\[mtn ssh_agent_add\]](#), page 111.

The public key is stored in the database; the public and private keys are stored in the keystore. This allows copying the database without copying the private key.

The location of the keystore is specified by `--keydir`; it defaults to the value stored in `_MTN/options` for commands executed in a workspace, or to the system default (`$HOME/.monotone/keys` on Unix and Cygwin, `%APPDATA%/monotone/keys` on native Win32).

mtn passphrase keyid

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

mtn ssh_agent_add

This command will add your monotone keys to your current ssh-agent session. You will be asked for the passphrase for each of your monotone private keys and they will be added to the ssh-agent. Once this is done you should be able to type `ssh-add -l` and see your monotone key listed. When you subsequently use these keys through monotone it will use ssh-agent for signing without asking you for your passphrase.

On Windows native, monotone only supports the PuTTY ssh-agent implementation. On Windows Cygwin and Unix, any standard ssh-agent implementation can be used.

This command is mainly for use in a session script as monotone will automatically add your keys to ssh-agent on first use if it is available. For example the following two examples are equivalent:

```
$ mtn ssh_agent_add
enter passphrase for key ID [user@example.com]:
$ mtn ci -m"Changed foo to bar"
$ mtn push -k user@example.com

$ mtn ci -m"Changed foo to bar"
enter passphrase for key ID [user@example.com]:
$ mtn push -k user@example.com
```

In the second example, monotone automatically added the key to ssh-agent, making entering the passphrase not needed during the push.

`mtn ssh_agent_export [filename]`

This command will export your private key in a format that ssh-agent can read (PKCS8, PEM), to *filename* (defaults to standard output). You will be asked for your current key's monotone password and a new password to encrypt the key with (the ssh passphrase). 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] (1234abcd...):
enter new passphrase for key ID [user@example.com] (1234abcd...):
confirm passphrase for key ID [user@example.com] (1234abcd...):
$ 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 -k user@example.com
```

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.

`mtn trusted id certname certval signers`

This command lets you test your revision trust hook [\[get_revision_cert_trust\]](#), [page 197](#). You pass it a revision ID (see [Section 3.2 \[Selectors\]](#), [page 47](#)), a certificate name, a certificate value, and one or more key IDs or key names, 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.

The specified keys must exist either in your keystore or in the database.

4.9 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 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 [file...]`

This command reads packets from files or `stdin` and stores them in your database.

4.10 Database

All of these commands require that the database is specified, either via `--db` or the current workspace.

mtn db changesetify [`--db=dbfile`]

Converts the database to the changeset format.

This is only needed when upgrading very old monotone databases, created with monotone versions less than 0.15.

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 rosters 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 **local kill_revision**, 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 serious 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`.

- branches not used or with incorrect head count or missing in the cache of branch heads. This is a serious problem; it suggests the presence of a bug in monotone's caching system, but does not involve data loss; please report this on the monotone mailing list. You can fix it by running `db regenerate_caches`.

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

`mtn db dump [--db=dbfile]`

This command dumps a sequence of SQL instructions 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 execute [--db=dbfile] 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.

`mtn db fix_certs [--db=dbfile] [--drop-bad-certs]`

Attempt to fix bad certs.

Older monotone versions could sometimes associate certs with the wrong key. This fixes such certs if you have the correct key, and if `--drop-bad-certs` is given, drops any certs that you don't have the correct key for. This should only be needed if you had such certs in your db when upgrading from monotone 0.44 or earlier, or if you loaded such certs with 'mtn read'.

`mtn db info [--db=dbfile] [--full | --concise]`

This command prints information about the monotone database *dbfile*, including its schema version and various table size statistics. `--full` prints additional info about timestamps; the default is `--concise`.

`mtn db init [--db=dbfile]`

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

`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 regenerate_caches`

Regenerates the caches stored in the database.

This is only needed to recover from a newly discovered bug in monotone, or if your database becomes corrupted for some other reason.

`mtn db rosterify`

Converts the database to the rosters format.

This is only needed when upgrading very old monotone databases, created with monotone versions less than 0.15.

`mtn db set_epoch branch epoch`

Sets the branch's epoch. See [Section 7.3 \[Rebuilding ancestry\]](#), page 216 for discussion of epochs.

`mtn db version [--db=dbfile]`

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

`mtn local kill_certs selector certname [certval]`

This command deletes certs with the given name on revisions that match the given selector (see [Section 3.2 \[Selectors\]](#), page 47). If a value is given, it restricts itself to only delete certs that also have that same value. Like [\[mtn local kill_revision\]](#), page 117, it is a very dangerous command; it permanently and irrevocably deletes historical information from your database. Also like [kill_revision](#), this only deletes the certs from your local database; if there are other databases that you sync with which have these certs they will reappear when you sync, unless the owners of those databases also delete those certificates locally.

Early versions of monotone had `db kill_tag_locally` and `db kill_branch_certs_locally` commands. These can be emulated with `local kill_certs i: tag TAG` and `local kill_certs i: branch BRANCH`, respectively.

`mtn local kill_revision id`

This command “kills”, i.e., deletes, a given revision (see [Section 3.2 \[Selectors\]](#), page 47), as well as any certs attached to it. It is a very dangerous command; it permanently and irrevocably deletes historical information from your database. If you execute this command in a workspace, whose parent revision is the one you are about to delete, the killed revision is re-applied to this workspace which makes it possible for you to fix a problem and commit again later on easily. For this to work, the workspace may not have any changes and/or missing files.

There are a number of other caveats with this command:

- 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 “local” 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 roster". 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.

4.11 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.

When run under `[mtn automate stdio]`, page 173, there are five output streams available; main, error, warning, progress, and ticker. When run under `mtn automate`, the main stream goes to `stdout`, and the error, warning, progress, and ticker streams all go to `stderr`.

Many commands produce output in a format called `basic_io`; for more information, see Chapter 5 [Formats], page 183.

Revision arguments to automate commands must be hex ids, not selectors.

`mtn automate ancestors rev...`

Arguments:

One or more revision IDs.

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 the specified revisions, except if one of them is an ancestor of another.

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 [old...]`

Arguments:

A “new” revision ID *new*, followed by zero or more “old” revision IDs *old...*

Added in:

0.1

Purpose:

Prints all ancestors of the new revision, that are not also ancestors of one of the old revisions. For purposes of this command, “ancestor” is an inclusive term; each revision is an ancestor of itself.

For example, if *new* is an ancestor of any of *old...*, *new* will not be printed; but if *new* is not an ancestor of any of the “old” revisions, then it will be. Similarly, none of *old...* will be printed.

The reason for the names *new* and *old* is that if *new* is a newer revision than *old...*, then this command tells you which all revisions that are newer than *old...*, and are also ancestors of *new*.

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 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]`, [page 193](#).

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 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 variant of `[mtn cert]`, [page 111](#).

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.

```
mtn automate certs id
```

Arguments:

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

Changes:

- 11.0 – Keys are now listed by hash instead of name.
- 1.0 – Added.

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'
    the hex-encoded hash of 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 [5cd3b3a7ad2e8645e8887af193ee522dc59112e4]
signature "ok"
name "author"
value "emile@alumni.reed.edu"
trust "trusted"

key [5cd3b3a7ad2e8645e8887af193ee522dc59112e4]
signature "ok"
```

```

        name "branch"
        value "net.venge.monotone"
        trust "trusted"

        key [5cd3b3a7ad2e8645e8887af193ee522dc59112e4]
signature "ok"
        name "changelog"
        value "propagate from branch 'net.venge.monotone.annotate' (head 76
            to branch 'net.venge.monotone' (head 2490479a4e4e99243fead6
"
        trust "trusted"

        key [5cd3b3a7ad2e8645e8887af193ee522dc59112e4]
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 checkout [--[no-]move-conflicting-paths] [--revision=id]
[--branch=branchname] directory

```

Arguments:

Options and arguments are the same as [\[mtn checkout\]](#), page 85.

Changes:

13.0 – initial

Purpose:

Create a new workspace containing the given revision; see [\[mtn checkout\]](#), page 85.

Sample output:

None.

Output format:

None.

Error conditions:

see [\[mtn checkout\]](#), page 85.

```

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 `[mtn automate descendents]`, page 124.

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 common_ancestors rev...
```

Arguments:

One or more revision IDs.

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 content_diff [--revision=id1 [--revision=id2]] [--reverse]
[file...]
```

Arguments:

See the online help for more options.

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 from the parent (base) revision of this workspace to the workspace revision.
- one revision: the diff is done from the given revision `id1` to the workspace revision. If `--reverse` is given, the order is reversed.
- two revisions: the diff is done from `id1` to `id2`; no workspace is needed in this case.

Changes:

- 9.0 – added `--with-header` option
- 4.0 – initial

Purpose:

Prints the content changes between two revisions or a revision and the current workspace. This command differs from `mtn diff` in that it only outputs content changes and keeps quiet on renames or drops by default, as the header of `mtn diff` is omitted unless `--with-header` is given and is omitted regardless if there are no changes.

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 descendants rev...`

Arguments:

One or more revision IDs.

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 *rev...*, unless one of them is a descendent of another.

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 drop_attribute path [key]
```

Arguments:

A path and an attribute key (optional).

Added in:

5.0

Purpose:

Automate variant of `[mtn attr drop]`, page 91.

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.

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 drop_db_variables domain [name]
```

Arguments:

The *domain* and *name* specify the database variable which should be dropped. If *name* is omitted, all database variables in the *domain* are dropped.

Added in:

7.0

Purpose:

Drops one or more database variables; see [Section 3.9 \[Vars\]](#), [page 64](#).

Sample usage:

```
mtn automate drop_db_variables known-servers
```

Output format:

No output.

Error conditions:

If the specific variable or any variables in the given domain are not found, prints to stderr and exits with status 1.

```
mtn automate drop_public_key keyid
```

Arguments:

keyid identifies the key to drop, by name or hash.

Changes:

- 13.0 – initial

Purpose:

Drop a public key from the database (*not* the private key from the keystore). Signatures made with the key can no longer be verified. This command should be used with caution as changes are irreversible without a backup of the key(s) that were dropped. You may wish to use the **k:** selector to check if the key is used in a signature.

Note that public keys that are used to sign a revision may be restored to the database by a future sync.

Keys in the keystore are not dropped because that is very dangerous on a server. The only way to drop private keys on a server is via the command [\[mtn dropkey\]](#), [page 111](#).

Sample output:

None.

Output format:

None on the main stream; progress message on the progress stream.

Error conditions:

If the key does not exist, an error message is printed on the error stream.

```
mtn automate erase_ancestors [rev...]
```

Arguments:

One or more revision IDs.

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 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 erase_descendants [rev...]
```

Arguments:

One or more revision IDs.

Added in:

13.1

Purpose:

Prints all arguments, except those that are a descendant 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 “parent of” relation. Another way to think of it is if the arguments formed a branch, then we would print the roots 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 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 file_merge left-rid left-path right-rid right-path`

Arguments:

left-rid, *left-fid*, *right-rid*, *right-fid* specify two files to merge, by revision and file path.

Added in:

9.0

Purpose:

Prints the result of the internal line merge on the contents of the specified files.

This command does not just take two file ids, because the revision ids and paths are needed to check for manual merge and file encoding attributes.

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 merge results are output without modification.

Error conditions:

If either revision id is unknown or invalid, or if either path does not exist, or if the internal line merger fails, prints an error message to stderr and exits with status 1.

`mtn automate generate_key name passphrase`

Arguments

name is the name to associate with the new key, and *passphrase* is the passphrase that will be used to encrypt the private half.

Changes:

- 13.0 – renamed from `genkey` to `generate_key`
- 10.0 – The separate hashes for the private half of a key really didn't make much sense; have one `hash [...]` line instead of separate `public_hash [...]` and `private_hash [...]` lines.
- 3.1 – initial

Purpose:

Generate a key with the given name and passphrase.

Sample output:

```
name "tbrownaw@gmail.com"
hash [475055ec71ad48f5dfaf875b0fea597b5cbb64]
public_location "database" "keystore"
private_location "keystore"
```

Output format:

A `basic_io` stanza. 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.

Error conditions:

Error conditions: If the passphrase is empty or the key already exists, prints an error message to `stderr` and exits with status 1.

```
mtn automate get_attributes [--revision=id] path
```

Arguments:

The argument *path* determines which path's attributes should be printed.

Changes:

- 13.1 – add the possibility to specify a revision for the operation
- 11.0 – removed the `format_version` stanza
- 5.0 – renamed from `attributes` to `get_attributes`
- 3.0 – initial

Purpose:

Prints all attributes of the given file in the given revision (default current workspace revision), and the attribute states.

Sample output:

```
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).

If attributes from a specific revision are queried, then all the file's attribute states are set to **unchanged**.

The complete format:

```
'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 workspace, 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 base revision id of the current workspace. 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 is found, prints an error message to stderr, and exits with status 1.

```
mtn automate get_content_changed rev file
```

Arguments:

The *rev* 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:

4.0

Purpose:

Returns a list of revision IDs in which the content was most recently changed, relative to the revision ID specified as *rev*. This equates to a content mark following the *-merge algorithm.

Sample output:

```
content_mark [276264b0b3f1e70fc1835a700e6e61bdb4c3f2f]
```

Output format:

Zero or more `basic.io` stanzas, each specifying a revision ID in which a content mark is set:

- No content mark is returned if *file* is a directory.
- One content mark is returned if *file* is a file and has recently been changed exclusively in one revision (be it by a commit or merge).
- Multiple content marks are returned if *file* is a file and has recently been part of a clean merge case. A clean merge happens when the same change to *file* is made on both sides of the particular merge, together with other unrelated changes, which make the resulting revisions not collapse into one revision.

Error conditions:

If *rev* 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 extant. and *file* specifies the file whose name in *target_id* is to be determined; *target_id* specifies a revision ID.

Added in:

4.0

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` lines. Zero lines 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 line is output.

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 get_current_revision [--exclude excl] [--depth=depth] [path...]`

Arguments:

One or more *path* arguments restrict the revision to these paths, otherwise all changes in workspace are taken into account.
See online help for more options.

Added in:

7.0

Purpose:

Prints change information for the current workspace, optionally restricted by one or more paths.

Sample output:

See [\[mtn automate get_revision\]](#), page 138

Output format:

See [\[mtn automate get_revision\]](#), page 138

Error conditions:

If the command is executed outside of a workspace, or the restriction is invalid, 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 is found, prints an error message to stderr, and exits with status 1.

`mtn automate get_db_variables [domain]`

Arguments:

The optional *domain* restricts the output to variables only within this domain.

Changes:

- 7.0 – converted output to `basic_io`, renamed to `'get_db_variables'`
- 4.1 – added as `'db-get'`

Purpose:

Outputs database variable domains, names and values. For more information about variables, see [Section 3.9 \[Vars\]](#), page 64.

Sample output:

```
domain "database"
  entry "default-exclude-pattern" ""
  entry "default-include-pattern" "net.venge.monotone*"
  entry "default-server" "mtn://code.monotone.ca/monotone"

domain "known-servers"
  entry "mtn://code.monotone.ca/monotone" "2c88403f0ed546df96ccec57ab307"
```

Output format:

`basic_io`-formatted stanzas. Each stanza starts with a `'domain'`, followed by one or more `'entry'` lines. Each `'entry'` contains the *name* and the *value* of the respective database variable.

Error conditions:

If the domain is unknown or no variables were found, prints an error message to `stderr` and exits with status 1.

```
mtn automate get_extended_manifest_of revid
```

Arguments:

The *revid* specifies the revision for which the extended manifest should be printed.

Changes:

13.0 – initial

Purpose:

Prints the contents of the extended manifest associated with the given revision.

Sample output:

```
dir ""
  birth [0cd607d6dda3a2df18f777112947f3c70811581e]
  path_mark [0cd607d6dda3a2df18f777112947f3c70811581e]

dir "dir"
dormant_attr "dirprop"
  birth [0cd607d6dda3a2df18f777112947f3c70811581e]
  path_mark [0cd607d6dda3a2df18f777112947f3c70811581e]
  attr_mark "dirprop" [a7a71d7cc0d526165e7362b8a87393d8609f40c2]
```

```

        file "file"
    content [d3395867d05cc4c27f013d6e6f48d644e96d8241]
        size "8"
        attr "fileprop" "value"
        birth [0cd607d6dda3a2df18f777112947f3c70811581e]
    path_mark [0cd607d6dda3a2df18f777112947f3c70811581e]
    content_mark [a7a71d7cc0d526165e7362b8a87393d8609f40c2]
    attr_mark "fileprop" [a7a71d7cc0d526165e7362b8a87393d8609f40c2]

```

Output format:

There is one `basic_io` stanza for each file or directory in the extended manifest.

The `'dir'` and `'file'` lines are the first in every stanza and specify its type as follows:

`'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`)

occurs: zero or more times

In addition, both `'dir'` and `'file'` stanzas include more information on the particular node:

`'birth'`:

The revision id in which the node was added ("born").

format: (`'birth'`, `revision id`)

occurs: once per node

`'path_mark'`:

The revision id in which the node was last renamed.

format: (`'path_mark'`, `revision id`)

occurs: once per node

`'content'`:

The id of the file node, i.e. the hash of its contents.

format: (`'content'`, `file id`)

occurs: once per file node

`'content_mark'`:

The revision id in which the node's content was changed at last.

format: (`'content_mark'`, `revision id`)

occurs: once per file node

`'size'`:

The recorded file size, in bytes.

format: (`'size'`, `size in bytes`)

occurs: once per file node

Finally, attributes are also part of the format:

```

'attr':
    The name and the value of a specific attribute.
    format: ('attr', attribute name, attribute value)
    occurs: zero or more times per node
'dormant_attr':
    The name of a previously deleted attribute.
    format: ('dormant_attr', attribute name)
    occurs: zero or more times per node
'attr_mark':
    The revision id in which a particular attribute's value was
    changed at last.
    format: ('attr_mark', attribute name, revision id)
    occurs: zero or more times per node

```

All 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_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 base 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_file_size id
```

Arguments:

The *id* argument specifies the file hash of the file for which the size should be printed.

Changes:

13.0 – initial

Purpose:

Prints the recorded file size of the specified file.

If you need to know the file sizes of multiple files of the same revision, its usually faster to use the `[mtn automate get_extended_manifest_of]`, page 133 command.

Sample output:

1241

Output format:The size of the file in bytes followed by a linefeed character (`'\n'`).**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_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.

Added in:

2.0

Purpose:

Prints the contents of the manifest associated with the given revision.

Sample output:

```
format_version "1"

dir ""

    file ".htaccess"
content [e3915658cb464d05f21332e03d30dca5d94fe776]

    file "AUTHORS"
content [80d8f3f75c9b517ec462233e155f7dfb93379f67]

    file "ChangeLog"
content [fc74a48c7f73eedcbe1ea709755fbe819b29736c]
```

Output format:

There is one basic_io stanza for each file or directory in the manifest.

```
'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.

`mtm 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 get_public_key keyid
```

Arguments:

keyid identifies the key to display, by name or hash.

Added in: 13.0

Purpose:

Same as `[mtn pubkey]`, page 113; print the key in packet format, suitable for reading by `[mtn automate put_public_key]`, page 162.

Sample output:

```
[pubkey foo@bar.com]
MIGfMAOGCSqGSib3DQEBAQUAA4GNADCBiQKBgQDQs40EcqULwepph05Rsb/aSLpiEryGtEk
[end]
```

Output format:

See example.

Error conditions:

If the key does not exist, an error message is printed on the error stream.

```
mtn automate get_revision id
```

Arguments:

The argument *id* specifies the revision id for which the changeset information should be printed.

Changes:

- 7.0 – *id* is now mandatory
- 1.0 – initial

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.

```

'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_workspace_root`

Arguments:

None.

Added in:

8.0

Purpose:

Print the path of the workspace root for the current directory.

Sample output:

/home/jim/juice

Output format:

A path.

Error conditions:

If the current directory isn't part of a workspace, prints an error 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 `[mtn automate parents]`, [page 157](#)) 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 heads [branch]`

Arguments:

One branch name. If none is given, the workspace 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 does not exist, an error message is printed.

`mtn automate identify path`

Arguments:

A file path.

Added in:

4.3

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 new-line.

Error conditions:

If the file does not exist, is a special file or not readable, prints an error message to stderr and exits with status 1. A single file path only consisting of "-" is disallowed since it collides with the UNIX stdin marker.

`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 any 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. The first decimal number is the major version, the second is the minor version.

Error conditions:

None.

`mtn automate inventory [options...] [files...]`

Arguments:

One or more file paths (optional). If present, only show an inventory for the given files or directories (and their sub-directories); otherwise, show an inventory for the current workspace.

`--depth=n`

Maximum number of directories to descend.

`--exclude=exclude-glob`

File or directory to exclude.

`--[no-]corresponding-renames`

If restricted to a renamed path, do not output the corresponding old / new paths for this restriction.

`--[no-]ignored`

Don't output ignored files or directories.

```
--[no-]unchanged
    Don't output files that are known but not changed in
    any way.

--[no-]unknown
    Don't output unknown directories.
```

Changes:

- 8.0 – added the output of the `birth` key
- 7.0 – added options `--no-ignored`, `--no-unknown`, `--no-unchanged` and `--no-corresponding-renames`
- 6.0 – converted to `basic_io` format (restriction support, various fixes)
- 1.0 – initial, line-based format

Purpose:

Prints information on every file found in the workspace or its associated base and revision manifests.

Sample output:

All basic status cases:

```
    path "added"
new_type "file"
fs_type "file"
status "added" "known"
changes "content"

    path "attributes_altered"
old_type "file"
new_type "file"
fs_type "file"
birth [cb271687054afd3c2b873c8994f206f08fb240d3]
status "known"
changes "attrs"

    path "dropped"
old_type "file"
fs_type "none"
birth [cb271687054afd3c2b873c8994f206f08fb240d3]
status "dropped"

    path "ignored~"
fs_type "file"
status "ignored"

    path "missing"
old_type "file"
new_type "file"
```

```

fs_type "none"
  birth [cb271687054afd3c2b873c8994f206f08fb240d3]
  status "missing"

    path "original"
old_type "file"
new_path "renamed"
fs_type "none"
  birth [cb271687054afd3c2b873c8994f206f08fb240d3]
  status "rename_source"

    path "patched"
old_type "file"
new_type "file"
fs_type "file"
  birth [cb271687054afd3c2b873c8994f206f08fb240d3]
  status "known"
  changes "content"

    path "patched_and_attributes_altered"
old_type "file"
new_type "file"
fs_type "file"
  birth [cb271687054afd3c2b873c8994f206f08fb240d3]
  status "known"
  changes "content" "attrs"

    path "renamed"
new_type "file"
old_path "original"
fs_type "file"
  birth [cb271687054afd3c2b873c8994f206f08fb240d3]
  status "rename_target" "known"

    path "unchanged"
old_type "file"
new_type "file"
fs_type "file"
  birth [cb271687054afd3c2b873c8994f206f08fb240d3]
  status "known"

    path "unknown"
fs_type "file"
  status "unknown"

```

Two files swapped in both the revision manifest and the workspace:

```

  path "original"

```

```

old_type "file"
new_path "unchanged"
new_type "file"
old_path "unchanged"
fs_type "file"
  birth [cb271687054afd3c2b873c8994f206f08fb240d3]
  status "rename_source" "rename_target" "known"

```

```

  path "unchanged"
old_type "file"
new_path "original"
new_type "file"
old_path "original"
fs_type "file"
  birth [cb271687054afd3c2b873c8994f206f08fb240d3]
  status "rename_source" "rename_target" "known"

```

Recorded in the revision manifest that two files were swapped, but they were not actually swapped in the workspace. Thus they both appear as patched:

```

  path "original"
old_type "file"
new_path "unchanged"
new_type "file"
old_path "unchanged"
fs_type "file"
  birth [cb271687054afd3c2b873c8994f206f08fb240d3]
  status "rename_source" "rename_target" "known"
changes "content"

```

```

  path "unchanged"
old_type "file"
new_path "original"
new_type "file"
old_path "original"
fs_type "file"
  birth [cb271687054afd3c2b873c8994f206f08fb240d3]
  status "rename_source" "rename_target" "known"
changes "content"

```

Rename (in the manifest and the workspace) `foo` to `bar`; add (in the manifest and the workspace) new file `foo`:

```

  path "foo"
old_type "file"
new_path "bar"
new_type "file"
fs_type "file"

```

```

    birth [cb271687054afd3c2b873c8994f206f08fb240d3]
    status "rename_source" "added" "known"

```

```

    path "bar"
    new_type "file"
    old_path "foo"
    fs_type "file"
    birth [cb271687054afd3c2b873c8994f206f08fb240d3]
    status "rename_target" "known"

```

Rotated files foo -> bar -> baz -> foo (in the manifest and the workspace):

```

    path "foo"
    old_type "file"
    new_path "bar"
    new_type "file"
    old_path "baz"
    fs_type "file"
    birth [cb271687054afd3c2b873c8994f206f08fb240d3]
    status "rename_source" "rename_target" "known"

```

```

    path "bar"
    old_type "file"
    new_path "baz"
    new_type "file"
    old_path "foo"
    fs_type "file"
    birth [cb271687054afd3c2b873c8994f206f08fb240d3]
    status "rename_source" "rename_target" "known"

```

```

    path "baz"
    old_type "file"
    new_path "foo"
    new_type "file"
    old_path "bar"
    fs_type "file"
    birth [cb271687054afd3c2b873c8994f206f08fb240d3]
    status "rename_source" "rename_target" "known"

```

Recorded in the revision manifest 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:

```

    path "foo"
    old_type "file"
    new_path "bar"
    new_type "file"
    old_path "baz"
    fs_type "file"

```



```

    birth [cb271687054afd3c2b873c8994f206f08fb240d3]
    status "rename_source" "rename_target" "known"
    changes "content"

```

```

    path "bar"
    old_type "file"
    new_path "baz"
    new_type "file"
    old_path "foo"
    fs_type "file"
    birth [cb271687054afd3c2b873c8994f206f08fb240d3]
    status "rename_source" "rename_target" "known"
    changes "content"

```

```

    path "baz"
    old_type "file"
    new_path "foo"
    new_type "file"
    old_path "bar"
    fs_type "file"
    birth [cb271687054afd3c2b873c8994f206f08fb240d3]
    status "rename_source" "rename_target" "known"
    changes "content"

```

Dropped from the manifest but not removed in the workspace and thus unknown:

```

    path "dropped"
    old_type "file"
    fs_type "file"
    birth [cb271687054afd3c2b873c8994f206f08fb240d3]
    status "dropped" "unknown"

```

Added in the manifest but not in the workspace, and thus missing:

```

    path "added"
    new_type "file"
    fs_type "none"
    status "added" "missing"

```

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

```

    path "original"
    old_type "file"
    new_path "renamed"
    fs_type "file"
    birth [cb271687054afd3c2b873c8994f206f08fb240d3]
    status "rename_source" "unknown"

```

```

    path "renamed"
    new_type "file"

```

```
old_path "original"
fs_type "none"
  birth [cb271687054afd3c2b873c8994f206f08fb240d3]
  status "rename_target" "missing"
```

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

```
  path "original"
old_type "file"
new_type "file"
fs_type "none"
status "missing"
```

```
  path "renamed"
fs_type "file"
status "unknown"
```

Renamed in the manifest and the workspace and patched:

```
  path "original"
old_type "file"
new_path "renamed"
fs_type "none"
  birth [cb271687054afd3c2b873c8994f206f08fb240d3]
status "rename_source"
```

```
  path "renamed"
new_type "file"
old_path "original"
fs_type "file"
  birth [cb271687054afd3c2b873c8994f206f08fb240d3]
status "rename_target" "known"
changes "content"
```

Renamed and restricted to original or renamed:

```
  path "original"
old_type "file"
new_path "renamed"
fs_type "none"
  birth [cb271687054afd3c2b873c8994f206f08fb240d3]
status "rename_source"
```

```
  path "renamed"
new_type "file"
old_path "original"
fs_type "file"
  birth [cb271687054afd3c2b873c8994f206f08fb240d3]
status "rename_target" "known"
changes "content"
```

Renamed and restricted to original with the `--no-corresponding-renames` option:

```
path "original"
old_type "file"
new_path "renamed"
fs_type "none"
birth [cb271687054afd3c2b873c8994f206f08fb240d3]
status "rename_source"
```

Renamed and restricted to renamed with the `--no-corresponding-renames` option:

```
path "renamed"
new_type "file"
old_path "original"
fs_type "file"
birth [cb271687054afd3c2b873c8994f206f08fb240d3]
status "rename_target" "known"
changes "content"
```

File is missing, an unversioned directory is in the way:

```
path "missing_file"
old_type "file"
new_type "file"
fs_type "directory"
birth [cb271687054afd3c2b873c8994f206f08fb240d3]
status "invalid"
changes "content"
```

Directory is missing, an unversioned file is in the way:

```
path "missing_directory"
old_type "directory"
new_type "directory"
fs_type "file"
status "invalid"
```

Directory source renamed to target, target is missing, an unversioned file is in the way:

```
path "source"
old_type "directory"
new_path "target"
fs_type "none"
birth [cb271687054afd3c2b873c8994f206f08fb240d3]
status "rename_source"
```

```
path "source/a"
old_type "file"
new_path "target/a"
fs_type "none"
birth [cb271687054afd3c2b873c8994f206f08fb240d3]
```

```

    status "rename_source"

    path "target"
    new_type "directory"
    old_path "source"
    fs_type "file"
    birth [cb271687054afd3c2b873c8994f206f08fb240d3]
    status "rename_target" "invalid"

    path "target/a"
    new_type "file"
    old_path "source/a"
    fs_type "none"
    birth [cb271687054afd3c2b873c8994f206f08fb240d3]
    status "rename_target" "missing"

```

Output format:

Each path is printed in one `basic_io` stanza. Stanzas are separated by a blank line. Each stanza starts with a `path` line, and contains up to seven lines.

<code>path</code>	The file or directory path, relative to the workspace root. The file either exists in the workspace, or is listed in the base or revision manifest. <code>path</code> is always output.
<code>old_type</code>	The type of the node in the base manifest. “type” is either <code>file</code> or <code>directory</code> . <code>old_type</code> is output for all old nodes (i.e. unchanged or dropped paths and rename sources).
<code>new_type</code>	The type of the node in the revision manifest. “type” is either <code>file</code> or <code>directory</code> . <code>new_type</code> is output for all new nodes (i.e. unchanged or added paths and rename targets).
<code>fs_type</code>	The type of the node in the workspace (also called the filesystem). “type” is either <code>file</code> , <code>directory</code> or <code>none</code> (if the path does not exist in the file system). <code>fs_type</code> is always output.
<code>old_path</code>	The old path for the node, if it has been renamed in the revision manifest. <code>old_path</code> is only output for rename targets.
<code>new_path</code>	The new path for the node, if it has been renamed in the revision manifest. <code>new_path</code> is only output for rename sources.
<code>birth</code>	The identify of the revision that the node was first added in. <code>birth</code> is only output if it exists in a committed revision.

status	status is always output. Its value is one or more of:
rename_source	<i>path</i> is part of a rename and denotes the old name of a renamed node.
rename_target	<i>path</i> is part of a rename and denotes the new name of a renamed node.
added	<i>path</i> has been added in the revision manifest, but not existent in the base manifest.
dropped	<i>path</i> has been deleted in the revision manifest and the workspace.
missing	<i>path</i> has been deleted in the workspace, but still exists in the revision manifest. A file will also be labeled missing if it is in a directory that is ignored due to a regular expression in .mtn-ignore , but is also in the revision manifest. A warning is issued in this case.
ignored	<i>path</i> is ignored by monotone.
known	<i>path</i> exists in the workspace, and in the revision manifest.
unknown	<i>path</i> exists in the workspace, but not in the revision manifest, i.e. is unversioned.
invalid	<i>path</i> is versioned and exists in the workspace and revision manifest, but with incompatible types (a versioned missing file is replaced by an unversioned directory and vice versa).
changes	
content	The contents of a file have been changed.
attrs	The attributes of a path (file or directory) have been changed.

Error conditions:

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

mtn automate keys

Arguments:

None.

Changes:

- 11.0 – Instead of having a "name" item, there are "given_name" and "local_name" items.
- 10.0 – The separate hashes for the private half of a key really didn't make much sense; have one `hash [...]` line instead of separate `public_hash [...]` and `private_hash [...]` lines.
- 1.1 – initial

Purpose:

Print all keys in basic_io format.

Sample output:

```

        hash [475055ec71ad48f5dfaf875b0fea597b5cbbee64]
        given_name "tbrownaw@gmail.com"
        local_name "tbrownaw@gmail.com"
        public_location "database" "keystore"
        private_location "keystore"

        hash [3ac4afcd86af28413b0a23b7d22b9401e15027fc]
        given_name "tomfa@debian.org"
        local_name "tomfa@debian.org"
        public_location "database"

        hash [115fdc73d87a5e9901d018462b21a1f53eca33a1]
        given_name "underwater@fishtank.net"
        local_name "underwater@fishtank.net"
        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. `given_name` is the name provided when the key was created, and `local_name` is the name returned by the `[get_local_key_name]`, page 191 hook.

The keys are ordered by hash value.

Error conditions:

None.

`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 `[mtn automate heads]`, page 141, 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 log [options] [pathname...]
```

Arguments:

`[-depth=n] [-exclude=path...] [-last=n] [-next=n] [-from=id...] [-clear-from] [-to=id...] [-clear-to] [-[no-]merges] [pathname...]`

Same as `mtn log`, but without the output control options; see `[mtn log]`, page 106.

Added in:

12.2

Purpose:

Print the selected revisions on stdout, in topological order. The user can then use other automate commands to retrieve additional information about each revision.

Sample output:

```
233afb8c4832bf33d5f5734225164de5f5a6278c
4a368a6b217c40b2ff3b12bb7cfa00987e0f191c
233afb8c4832bf33d5f5734225164de5f5a6278c
```

Output format:

One revision per line.

Error conditions:

See `[mtn log]`, page 106.

```
mtn automate lua function_name [function_args...]
```

Arguments:

A valid Lua function name and zero or more function arguments. Note that string arguments need to be wrapped in another pair of

quotes, i.e. "foo" or 'foo' will not work, but "'foo'" or '"foo"' will.

A function arguments can be any valid Lua expression, including nested tables and functions, like f.e. `{1,true,{['func']=function(...) return ... end }}`

Added in:

9.0

Purpose:

Call Lua functions, like monotone hooks, in the monotone context, f.e. to retrieve user defaults like keys, passwords, ignorable files and more.

Output format:

A string dump of the return value of the function, in Lua code. The Lua types `function`, `thread`, `userdata` and `lightuserdata` are not serialized, but set to `nil` in the dump.

Please note that `nil` values in tables are not printed since Lua does not distinguish between unset and not existing entries in a table like other programming languages do.

Sample output:

A single string return value:

```
[1] = "Output";
```

Two numeric return values:

```
[1] = 3;
```

```
[2] = 4.4;
```

A nested table:

```
[1] = {
  ["bar"] = {
    [1] = 1;
    [2] = 2;
    [3] = 3;
  };
};
```

};

A callback function:

```
[1] = nil --[[function]];
```

Error conditions:

This command prints an error message and exists with status 1 if the function does not exist, one or more function arguments could not be evaluated or the function could not be called for another reason.

```
mtn automate packet_for_fdata id
```

Arguments:

The *id* specifies the file for which to output an fdata packet.

Added in:

2.0

Purpose:

Prints the file data in packet format

Sample output:

```
[fdata 229c7f621b65f7e4970ae5aaec993812b9daa1d4]
H4sIAAAAAAAAA/z20027DMBBEe51ioMaNrJzBpQAjTXKBBTW0CJPcgFw6y01DCkG62Q/em83
R9v1Rez6naPKzh2CwkipXFBjB08fn7f7HV4LQq4mMYoFzdMYSnMj1xXY/lnuoHt2kB2hQps
PREPZhaxvvchskIKkdU6xsXWvQsk76MOUquGV0lZmmh0+xxvf7JZ5jCFXbU4KZ1muYkT+K
F0ez5q6uLuh9+9eoQawhez3Fp+VtHJNkfMmDHfALzWYfcAgBAAA=
[end]
```

Output format:File data in `[mtn read]`, page 113 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:

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/OW0y0oEMRBF9/mKS2/c9LQg4t5lw+BGf6BIKtNhkpSkKop/b9II7m4900f
eHp5dnvEj/SHLOaQ75qFagcQGmcm5RXKjP3t/eP1ekWUhlTVKGeyJNXNoXU/s27AP8sf708
ZEdSSLd1JMaNKzeysY8ps4Iao4oNjM99eFdQDbMOSldDV8ZC3aSx1pxufzJF5jANx6oyS2
c0uh0+0wkpezZhCvK0bf8TVrMLZUo5zi0/I4j4UqPunGA+B+AfHvKEIPAQAA
[end]
```

Output format:

File delta data in `[mtn read]`, page 113 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 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]
H4sIAAAAAAAAA/OXQS27DMAwEOL1PIfgArb4kte62NzACg5SoJEBsF7aRurev0UVzgJl5mLa
E+/jU9ftvsymd33Xzfo9Tjzfm267GSgGwVarz6Valx0KtFYwii9VqUFCqJQ5X7puedRx1ef
r2rwHlSbi+BUSrF4xn1p0RInkmxTbmwREp/BL97LzfQfN56v+rlc+860dZnMED01jhILkUR
U10KPPGN1ueUwDHyiXF66Ywx+2IGD+OUqg8aCzikAEzZNRXPmJKlkhMxSHuNzrofx/uq2/J
6njV/bZsu/zMP01b0Y4XJSD5K0rwXGdwpDGdfotZayQHKTai5fRPqUWKcAMMIQfAjOK0nkf
6tFacjYgBPV46X4BtlpiNYUBAAA=
[end]
```

Output format:Revision data in `[mtn read]`, page 113 compatible packet format.**Error conditions:**

If *id* is unknown or invalid prints an error message to stderr and exits with status 1.

```
mtn automate packets_for_certs id
```

Arguments:The *id* specifies the revision for which to output cert packets.**Added in:**

2.0

Purpose:

Prints the certs associated with a revision in packet format

Sample output:

```
[rcert bdf3b10b5df0f17cc6c1b4b3351d84701bda59ed
branch
njs@pobox.com
bmV0LnZlbmdlLm1vbm90b251]
K90i1XHHmaMEMuwbPifFweLThJl0m7jigh2Qq6Z7TBwNJ6IM0jXWCizv73cacZ1CtzzFDVw
SlqhNWiPQWxdcMp+Uuo+V8IFMKmvxVSTuVDukLMuNAQqpGL5S+a+tEj68NMq+KLKuL8kAAP
RoFD7GQlTS35S3RHWA4cnvqn+8U=
[end]
[rcert bdf3b10b5df0f17cc6c1b4b3351d84701bda59ed
date
njs@pobox.com
MjAwNi0wNC0wOFQxMT01MDowMA==]
araz9A8x6A1K6m6UhwnhUhk7cdyxeE2nvzj2gwaDvkaBx0q4SN23/wnaPqUXx1Ddn8smzyR
HN08xloYc0yNChp3wjbqx20REcsTg3XE4rN/sgCbqqw5hVT22a5ZhqkfKDeoeJvan0R0UBa
ngKY09eLuABNlmFX2onca75JW1E=
[end]
```

```
[rcert bdf3b10b5df0f17cc6c1b4b3351d84701bda59ed
      author
      njs@pobox.com
      bmpzQHBvYm94LmNvbQ==]
BLP0YhgLsAN+w7Cw0sv9GfXnG3u7RNF1DTrWdn0AnYE1e+ptgTeMVWUI18H40GLOB7wm08r
Pvk/hvsb8fBn1Kf5HDD02pbjJ0xVzI9+p+TR0y5jJNZlVSTj+nvtPgvK9NzsdooYwnw1WmJ
b0kAzQcZb8NMh8pbQkdHbR5uzMo=
[end]
[rcert bdf3b10b5df0f17cc6c1b4b3351d84701bda59ed
      changelog
      njs@pobox.com
      MjAwNiOwNC0wOCAGTmF0aGFuaWVsIFNtaXRoICA8bmpzQHBvYm94LmNvbT4KCgkq
L3Jlc29sdmVfZ2V0aG9zdGJ5bmFtZS5jeHggKHJlc29sdmVfaG9zdG5hbWUpOiAjaWZkZWY
b3V0CglXaW4zMl1pbmNvbXBhdGlibGUgZXJyb3Igcmlvbm94LmNvbT4KCgkq
Ncl4L/oEPctzVQixTKA6FrLceeHnLiXfeyeFDNmtUFYg9BMUcjWkeyKmaWknLv0cHortxjt
K6pQ9E8S7zI+TpzFAhssg5a//rFL0+2GJU3t6pcHs6LC0Q4tbqzwKd/5+8GwT1gphbM1wm
KuzKthwqD3pp49GbgTrp8iWMTr0=
[end]
```

Output format:

Cert data in `[mtn read]`, page 113 compatible packet format.

Error conditions:

If *id* is unknown or invalid prints an error message to stderr and exits with status 1.

`mtn automate parents rev`

Arguments:

One revision ID.

Added in:

0.2

Purpose:

Prints the immediate parents of a revision. This is like a non-recursive version of `[mtn automate ancestors]`, page 119.

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 pull [--[no-]set-default] [--dry-run] [uri]
mtn automate push [--[no-]set-default] [--dry-run] [--keys-to-push=key] [uri]
mtn automate sync [--[no-]set-default] [--dry-run] [--keys-to-push=key] [uri]
mtn automate pull [--[no-]set-default] [address] [glob [...]]
  [--exclude=exclude-glob]] deprecated
mtn automate push [--[no-]set-default] [--keys-to-push=key] [address] [glob
  [...]] [--exclude=exclude-glob]] deprecated
mtn automate sync [--[no-]set-default] [--keys-to-push=key] [address] [glob
  [...]] [--exclude=exclude-glob]] deprecated

```

Arguments:

The automate versions of pull, push and sync have the same set of arguments and options as the non-automate versions. See [Section 4.4 \[Network\]](#), [page 97](#) for a full explanation.

Changes:

- 13.0 – add sent/received revision, cert, and key output; add `--dry-run`.
- 12.0 – added

Purpose:

Pushes, pulls or syncs (push & pull) revisions, certificates and keys of the given database to, from or with the given netsync server.

Sample output:

The following is example main channel data, non-dry-run:

```

receive_cert "test"
  value "value"
  key [05c26b6cb109ca39bc48bbbdce83564c97796155]
  revision [114f6aa58c7707bf83516d4080ca6268c36640ad]

receive_revision [114f6aa58c7707bf83516d4080ca6268c36640ad]

receive_cert "branch"
  value "foo"
  key [46ec58576f9e4f34a9eede521422aa5fd299dc50]
  revision [114f6aa58c7707bf83516d4080ca6268c36640ad]

receive_cert "changelog"
  value "R1
"
  key [46ec58576f9e4f34a9eede521422aa5fd299dc50]
  revision [114f6aa58c7707bf83516d4080ca6268c36640ad]

receive_cert "date"
  value "2010-09-01T12:00:00"
  key [46ec58576f9e4f34a9eede521422aa5fd299dc50]
  revision [114f6aa58c7707bf83516d4080ca6268c36640ad]

```

```

    receive_cert "author"
        value "tester@test.net"
        key [46ec58576f9e4f34a9eede521422aa5fd299dc50]
        revision [114f6aa58c7707bf83516d4080ca6268c36640ad]

receive_key [111808abc306fd7423b564f2a8ef5c09745b87d2]

send_cert "test"
    value "value"
    key [05c26b6cb109ca39bc48bbbdce83564c97796155]
    revision [114f6aa58c7707bf83516d4080ca6268c36640ad]

send_revision [2a46f4b909071fae756b4911a247ce3ff1c3c4ce]

send_cert "branch"
    value "foo2"
    key [46ec58576f9e4f34a9eede521422aa5fd299dc50]
    revision [2a46f4b909071fae756b4911a247ce3ff1c3c4ce]

send_cert "changelog"
    value "R2"
"
    key [46ec58576f9e4f34a9eede521422aa5fd299dc50]
    revision [2a46f4b909071fae756b4911a247ce3ff1c3c4ce]

send_cert "date"
    value "2010-09-01T12:00:00"
    key [46ec58576f9e4f34a9eede521422aa5fd299dc50]
    revision [2a46f4b909071fae756b4911a247ce3ff1c3c4ce]

send_cert "author"
    value "tester@test.net"
    key [46ec58576f9e4f34a9eede521422aa5fd299dc50]
    revision [2a46f4b909071fae756b4911a247ce3ff1c3c4ce]

send_key [05c26b6cb109ca39bc48bbbdce83564c97796155]

```

The following is example dry-run main channel data:

```

    estimate
receive_revision "0"
    receive_cert "0"
    receive_key "0"
send_revision "1"
    send_cert "5"
    send_key "0"
    send_branch "foo2" "1"

```

The following shows the progress and ticker data for a pull which transferred two revisions and eight certs.

Note: The linebreaks are not part of the actual format, but have been added for better readability.

```
0:p:62:doing anonymous pull; use -kKEYNAME if you need authentication
0:p:46:connecting to mtn://code.monotone.ca/monotone0:0:p:29:finding it
0:t:34:c:certificates;k:keys;r:revisions;
0:t:12:c=0;k=0;r=0;
0:t:13:c#0;k#0;r#64;
0:t:14:c#0;k#0;r#128;
[...]
0:t:6:c;k;r;
0:t:44:>:bytes in;<:bytes out;c:certs in;r:revs in;
0:t:16:>=0;<=0;c=0;r=0;
0:t:21:>#420;<#1344;c#0;r#0;
0:t:22:>#1165;<#1741;c#0;r#0;
[...]
0:t:24:>#20839;<#14882;c#0;r#1;
0:t:24:>#20839;<#14882;c#3;r#1;
0:t:24:>#20839;<#14882;c#4;r#2;
0:t:24:>#20839;<#14882;c#6;r#2;
0:t:24:>#20863;<#14930;c#8;r#2;
0:t:8:<;>;c;r;
0:p:36:successful exchange with mtn://code.monotone.ca/monotone
0:l:1:0
```

Output format:

Output consists of sent and received revisions, certs, and keys in the main stdio channel, progress messages, and ticker data for bytes, revisions, certs and keys.

For non-dry-run, all stanzas are optional; they are only output if the data they describe is transferred.

A partial order is imposed, that the parser can use in deciding how to store the data. First all certs associated with revisions that are not transferred in this sync are output, then revisions with associated certs, then keys. All received data is output before all sent data.

For each cert not associated with a transmitted revision, there is a stanza giving the cert name, value, key, and revision.

For each revision, there is a stanza containing the revision id, followed by a stanza containing the cert name, value, key, and revision id for each cert associated with the revision.

For each key, there is one stanza containing one line giving the key id.

If run outside of `automate stdio`, the progress and ticker output of these commands is equal to the normal `netsync` command progress and ticker output.

If these commands are run over `stdio`, the `stdio` ticker format is used (for a description of this format, see [\[mtn automate stdio\]](#), page 173).

The following ticker types are printed out during the refinement phase:

- **c**: The number of certs found for an upcoming synchronization
- **k**: The number of keys found for an upcoming synchronization
- **r**: The number of revisions found for an upcoming synchronization

After refinement the actual synchronization between the two nodes start. The ticker stanzas in this phase are the following:

- **>**: The number of incoming bytes
- **<**: The number of outgoing bytes
- **c**: The number of incoming certs (only pull and sync)
- **C**: The number of outgoing certs (only push and sync)
- **r**: The number of incoming revisions (only pull and sync)
- **R**: The number of outgoing revisions (only push and sync)

For dry-run, one stanza is output, with optional lines giving the revision, cert, and key counts for send and receive. Under some circumstances, the number of keys that would be received is only an estimate; in that case, the symbol `estimate` is output. For send, the branch names of sent revisions are also output. Note that in the branch list, revisions that have multiple branch certs are listed twice, so the sum of the revision counts in the branch list may be greater than the number of revisions transferred.

Error conditions:

If a `netsync` error occurs, the command outputs an error and exits with status 1.

`mtn automate put_file [base-id] contents`

Arguments:

The optional *base-id* specifies a file-id on which the contents are based. This is used for delta encoding. *contents* are the contents of the new file.

If *base-id* is not given, the file is a new file, and no delta is stored.

Added in:

4.1

Purpose:

Preparation of a workspace-less commit. See [\[mtn automate put_revision\]](#), page 162.

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_public_key key-packet-data`

Arguments:

A data packet, *key-packet-data*, as produced by `[mtn automate get_public_key]`, page 138.

Changes:

13.0 – initial

Purpose:

Store public keys into the database.

Note that this duplicates part of `[mtn automate read_packets]`, page 163; the intent is to deprecate `automate read_packets`, and only keep facilities for key packets.

Output format:

No output.

Error conditions:

An error will be produced if the argument is not a valid key packet.

`mtn automate put_revision revision-data`

Arguments:

revision-data is the new revision.

Added in:

4.1

Purpose:

Workspace-less commit.

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.

Sample argument:

[illegible]

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 read_packets packet-data
```

Arguments:

A data packet, *packet-data*, as produced by [mtn pubkey],
page 113.

Added in:

9.0

Purpose:

Store public keys (and incidentally anything else that can be represented as a packet) into the database.

Output format:

No output.

Error conditions:

An error will be produced if the argument is not a valid packet.

```
mtn automate remote [--remote-stdio-host=host] [--[no-]set-default] command
args-and-opts
```

Arguments

A command and its arguments, to execute on the remote server specified by the `--remote-stdio-host` option (defaults to server stored in the database). If options are to be passed to the command, they must be preceded by `--` to prevent them from being interpreted as local options.

Remote options **must** be given as a single token, ie `--branch=foo` or `-bfoo`. This is because the local and remote monotones may not understand exactly the same options (so the local monotone cannot

know if an option given as `--branch` or `-b` should be followed by an argument), and because the server sees this as an `automate remote_stdio` connection (so it expects the options to already be parsed).

Added in

12.0

Purpose

Permit a single `automate` command to be run against a database that is being used to serve netsync connections, without having its input and output encoded as by `automate stdio`.

Input/Output Format

This command does not accept input.

The output will be whatever output the remote command generates.

Remote diagnostic messages are written to standard error, prefixed either with `mtn: remote error:`, `mtn: remote warning:` or `mtn: remote message:` to make them distinguishable from local diagnostics. Tickers are not supported over this interface. If you need remote ticker support, see [\[mtn automate remote_stdio\]](#), [page 164](#).

Error Conditions

If the remote command returns a nonzero error code, will exit with code 1 and print "received remote error code N" to standard error, with "N" being the remote error code.

Notes

If no database is specified, a `:memory:` database is used.

On the server side the `get_remote_automate_permitted` hook has to be configured to include every command which should be executable over this interface.

Keyboard interaction is disabled on the server, just as if `--non-interactive` would have been specified on server startup. Actions which require operations on password-encrypted private keys will therefor fail unless a [\[get-passphrase\]](#), [page 190](#) hook is set up remotely.

`mtn automate remote_stdio [hostname]`

Arguments

hostname is the host (and optionally port) of the monotone server process to connect to. If not given, the default server is used.

Added in

12.0

Purpose

Permit **automate** commands to be run against a database that is being used to serve netsync connections.

Input/Output format

This command takes input and produces output in exactly the same format as **automate stdio**. Note that the commands run with **automate remote_stdio** may conform to a different *interface_version*, because they are handled by a remote instance of monotone.

There will be some extra chatter on stderr unless **--quiet** is given.

Error Conditions

If left idle for too long or there are network problems, the connection to the server may be dropped. This will not be detected while monotone is waiting for input. Instead, when a complete command has been entered and monotone tries to send it to the remote server it will print a message to stderr and exit with code 1.

Notes

If no database is specified, a **:memory:** database is used.

On the server side the **get_remote_automate_permitted** hook has to be configured to include every command which should be executable over this interface.

For both, the client and the server, keyboard interaction is disabled, just as if **--non-interactive** is specified. Actions which require operations on password-encrypted private keys will therefore fail unless the [\[get_passphrase\]](#), [page 190](#) hook is set up locally and / or remotely.

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 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 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 set_db_variable domain name value`

Arguments:

The *domain* and *name* specify the database variable which is changed to *value*.

Changes:

- 7.0 – renamed to 'set_db_variable'
- 4.1 – added as 'db_set'

Purpose:

Change a database variable; see [Section 3.9 \[Vars\]](#), page 64.

Sample usage:

```
mtn automate set_db_variable database default-server off.net
```

Output format:

No output.

Error conditions:

None.

```
mtn automate show_conflicts [--branch BRANCH] [left_rev right_rev]
```

Arguments:

Optional left and right revision ids.

If no revs are given, they default to the first two heads that would be chosen by the `merge` command for the current branch. If no workspace is present, the branch may be given by the `-branch` option.

Changes:

- FIXME: – Add reporting and resolution for dropped/modified conflicts.
- 11.0 – Add resolution for orphaned node conflicts. Deleted `resolved_user` conflict resolution; use `resolved_*_left` for single file conflicts. Add `resolved_keep_left`, `resolved_keep_right` resolutions.
- 9.0 – Added default resolution for file content conflicts, user resolutions for others. `directory_loop_created` changed to `directory_loop`.
- 8.0 – initial

Purpose:

Show all conflicts between two revisions.

This is intended to be used before a `merge`; an external tool can guide the user thru resolving each conflict in turn, then do the merge.

The same file format is output by the `conflicts store` command, which also allows specifying user conflict resolutions. The file syntax for the resolutions is given here, so an external tool can set them directly.

For more information on conflicts, see [Section 3.6 \[Merge Conflicts\]](#), page 55.

Note that this cannot be used to show conflicts that would occur in an `update`, since in that case one revision is the workspace.

Sample output:

The output starts by listing the revisions and their common ancestor:

```

    left [532ab5011ea9e64aa212d4ea52363b1b8133d5ba]
    right [b94a03a922c2c281a88d8988db64e76a32edb6a1]
    ancestor [ead03530f5fefe50c9010157c42c0ebe18086559]

```

If there are no conflicts, the ancestor revision is not output, and no conflict stanzas are output.

Attribute changed in both branches, or dropped in one:

```

    conflict attribute
    node_type "file"
    attr_name "attr1"
    ancestor_name "foo"
    ancestor_file_id [bab2022ff2ed13501a8a83bcc6bd53f5042141be]
    left_name "foo"
    left_file_id [bab2022ff2ed13501a8a83bcc6bd53f5042141be]
    left_attr_value "valueX"
    right_name "foo"
    right_file_id [bab2022ff2ed13501a8a83bcc6bd53f5042141be]
    right_attr_value "valueZ"

```

```

    conflict attribute
    node_type "file"
    attr_name "attr2"
    ancestor_name "foo"
    ancestor_file_id [bab2022ff2ed13501a8a83bcc6bd53f5042141be]
    left_name "foo"
    left_file_id [bab2022ff2ed13501a8a83bcc6bd53f5042141be]
    left_attr_value "valueY"
    right_name "foo"
    right_file_id [bab2022ff2ed13501a8a83bcc6bd53f5042141be]
    right_attr_state "dropped"

```

Missing root directory:

```

    conflict missing_root
    left_type "pivoted root"
    ancestor_name "foo"
    right_type "deleted directory"
    ancestor_name "foo"

```

Directory deleted and/or renamed:

```

    conflict orphaned_directory
    right_type "deleted directory"
    ancestor_name ""
    left_type "renamed directory"
    ancestor_name ""
    left_name "bar"

```

```

    conflict orphaned_file
    right_type "deleted directory"

```

```

ancestor_name "foo"
  left_type "added file"
  left_name "foo/baz"
  left_file_id [f5122a7f896cb2dd7ecaa84be89c94ab09c15101]

  conflict orphaned_file
  right_type "deleted directory"
  ancestor_name "foo"
  left_type "renamed file"
  ancestor_name "bar"
ancestor_file_id [ac4c6d06436632e017bb7d3ea241734e8899f8ce]
  left_name "foo/baz"
  left_file_id [ac4c6d06436632e017bb7d3ea241734e8899f8ce]

  conflict multiple_names
  left_type "renamed directory"
ancestor_name ""
  left_name "aaa"
  right_type "renamed directory"
ancestor_name ""
  right_name "bbb"

  conflict duplicate_name
  left_type "renamed directory"
ancestor_name "foo"
  left_name ""
  right_type "renamed directory"
ancestor_name "bar"
  right_name ""

  conflict multiple_names
  left_type "renamed directory"
ancestor_name "foo"
  left_name "a/foo"
  right_type "renamed directory"
ancestor_name "foo"
  right_name "b/foo"

```

Directory loop created:

```

  conflict directory_loop
  left_type "renamed directory"
ancestor_name "foo"
  left_name "bar/foo"
  right_type "renamed directory"
ancestor_name "bar"
  right_name "foo/bar"

```

File content changed (this may be resolvable by the internal line merger), file also renamed:

```

        conflict content
        node_type "file"
        ancestor_name "bar"
        ancestor_file_id [f0ef49fe92167fe2a086588019ffcff7ea561786]
        left_name "bar"
        left_file_id [08cd878106a93ce2ef036a32499c1432adb3ee0d]
        right_name "bar"
        right_file_id [0cf419dd93d38b2daaaf1f5e0f3ec647745b9690]
        resolved_internal

```

```

        conflict content
        node_type "file"
        ancestor_name "foo"
        ancestor_file_id [50bf338804db2685a575124c8c8371d06b65c523]
        left_name "bar"
        left_file_id [f1bb6fff2ad16d67143d89fc374ede7abec5d437]
        right_name "baz"
        right_file_id [b966b2d35b99e456cb0c55e4573ef0b1b155b4a9]

```

`resolved_internal` is a conflict resolution. If the file contents in the two revs can be successfully merged by the internal line merger, `resolved_internal` is output.

File added and/or renamed:

```

        conflict duplicate_name
        left_type "added file"
        left_name "bar"
        left_file_id [ba4637112ee3e55a6106d647d6c4e04a6643f8eb]
        right_type "added file"
        right_name "bar"
        right_file_id [fe6d523f607e2f2fc0f0defad3bda0351a95a337]

```

```

        conflict duplicate_name
        left_type "renamed file"
        ancestor_name "foo"
        ancestor_file_id [c6864a8456855c48afe83488a47501fe8b94bd57]
        left_name "bar"
        left_file_id [c6864a8456855c48afe83488a47501fe8b94bd57]
        right_type "added file"
        right_name "bar"
        right_file_id [c809d71002ec57a2f1d10221f05993012a491436]

```

```

        conflict duplicate_name
        left_type "renamed file"
        ancestor_name "foo"
        ancestor_file_id [918f3642b57a5e2dd13ee874e3dc2518a53ab4b4]

```



```

    left_name "abc"
    left_file_id [918f3642b57a5e2dd13ee874e3dc2518a53ab4b4]
    right_type "renamed file"
    ancestor_name "bar"
    ancestor_file_id [bdf46a521d5f1dd54c31dda15e99ff6b0c80394a]
    right_name "abc"
    right_file_id [bdf46a521d5f1dd54c31dda15e99ff6b0c80394a]

```

File renamed to different names:

```

    conflict multiple_names
    left_type "renamed file"
    ancestor_name "foo"
    ancestor_file_id [e80910e54d0bdea1b6d295ada320b87aaf9fdc23]
    left_name "bar"
    left_file_id [e80910e54d0bdea1b6d295ada320b87aaf9fdc23]
    right_type "renamed file"
    ancestor_name "foo"
    ancestor_file_id [e80910e54d0bdea1b6d295ada320b87aaf9fdc23]
    right_name "baz"
    right_file_id [e80910e54d0bdea1b6d295ada320b87aaf9fdc23]

```

File dropped and modified (and possibly renamed):

```

    conflict dropped_modified
    ancestor_name "foo"
    ancestor_file_id [e80910e54d0bdea1b6d295ada320b87aaf9fdc23]
    left_type "dropped file"
    left_rev [b0d6953684d49dd6bd345c312d6a0c8fed3078ce]
    left_name "foo"
    left_file_id [420cde699a422f7c3d2c8951c46ddfd546db66c0]
    right_type "modified file"
    right_name "baz"
    right_file_id [fe6d523f607e2f2fc0f0defad3bda0351a95a337]

```

Here left_name, left_file_id are from left_rev, just before the file was dropped.

File orphaned and modified (and possibly renamed):

```

    conflict dropped_modified
    ancestor_name "foo"
    ancestor_file_id [e80910e54d0bdea1b6d295ada320b87aaf9fdc23]
    left_type "orphaned file"
    left_rev [b0d6953684d49dd6bd345c312d6a0c8fed3078ce]
    left_name "foo"
    left_file_id [420cde699a422f7c3d2c8951c46ddfd546db66c0]
    right_type "modified file"
    right_name "baz"
    right_file_id [fe6d523f607e2f2fc0f0defad3bda0351a95a337]

```

Orphaned/modified is different from dropped/modified because the possible resolutions are different; orphaned requires a rename if the file is kept.

File dropped and recreated on one side; modified on the other (and possibly renamed):

```

      conflict dropped_modified
      ancestor_name "foo"
      ancestor_file_id [e80910e54d0bdea1b6d295ada320b87aaf9fdc23]
      left_type "recreated file"
      left_name "foo"
      left_file_id [e80910e54d0bdea1b6d295ada320b87aaf9fdc23]
      right_type "modified file"
      right_name "baz"
      right_file_id [fe6d523f607e2f2fc0f0defad3bda0351a95a337]
```

Invalid file name (_MTN in root directory):

```

      conflict invalid_name
      left_type "pivoted root"
      ancestor_name "foo"
      right_type "added directory"
      right_name "foo/_MTN"
```

```

      conflict invalid_name
      left_type "pivoted root"
      ancestor_name "foo"
      right_type "renamed file"
      ancestor_name "bad/_MTN"
      ancestor_file_id [629d9e5d254241abf4b46f108fb53189e314e41d]
      right_name "foo/_MTN"
      right_file_id [629d9e5d254241abf4b46f108fb53189e314e41d]
```

Revisions that don't share a common ancestor:

```

      left [161e426c3b0c3f98d0be225f69d6f893ce8e0442]
      right [0e3260f51acd1e98c40666557eb6c0eefeae5f02]
      ancestor []
```

```

      conflict missing_root
```

```

      conflict duplicate_name
      left_type "added directory"
      left_name ""
      right_type "added directory"
      right_name ""
```

All possible conflict resolutions:

```

      resolved_drop_left
      resolved_drop_right
      resolved_keep_left
```

```

    resolved_keep_right
    resolved_internal
    resolved_rename_left file
    resolved_rename_right file
    resolved_user_left file
    resolved_user_right file

```

For single file conflicts, the `resolved*_left` resolution name is used.

See [Section 4.2.1 \[Conflicts\]](#), page 89, for more information on conflict resolutions.

Output format:

First the revision ids of the left and right revisions, and their common ancestor, are printed in one `basic_io` stanza.

Then each conflict is listed in a `basic_io` stanza. Stanzas are separated by blank lines.

Each conflict stanza starts with a `conflict` line, and contains up to eleven lines. The order of the lines is not important, and may change in future revisions, except that the first line will always be `conflict`.

When the conflicts involve files, the file ids are output, so the file contents can be retrieved efficiently via `automate get_file`, to aid in conflict resolution.

Only the `resolved_internal` conflict resolution is output by this command; the other conflict resolutions are inserted in a conflicts file by `conflicts resolve_first` or an external tool, and read by `merge`.

Error conditions:

If the revision IDs are given, but either is unknown or invalid, prints an error message to `stderr` and exits with status 1.

```
mtn automate stdio [--automate-stdio-size <size>]
```

Arguments:

none

Changes:

- 12.0 – Introduced out of band streams ('e', 'p', 't', 'w'); the main output of a command now only happens in the 'm' stream; the 'l' stream now marks the end of all streams of a command; introduced the concept of "headers" which are output before the first command is issued; specific error codes to distinguish command from interface errors have also been introduced.
- 3.1 – Added the 'o' item to the recognized input. This change should not break anything.
- 1.0 – Initial version.

Purpose:

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

Sample input:

```
16:leaveses
17:parents40:0e3171212f34839c2e3263e7282cdeea22fc5378e
o3:key11:foo@bar.come 14:cert40:0e3171212f34839c2e3263e7282cdeea22fc537
```

Input format:

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

The input is a series of commands and options. 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. For flag options that don't take values, specify the second string as zero length; 0: . The option names do *not* include the leading --.

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:

```
format-version: 2

0:m:41:7706a422ccad41621c958affa999b1a1dd644e79
0:l:1:0
...
1:e:38:misuse: key 'test@test' already exists
1:l:1:2
...
2:w:39:skipping file '\ ' with unsupported name
2:m:144:    path ""
old_type "directory"
new_type "directory"
fs_type "directory"
    birth [276264b0b3f1e70fc1835a700e6e61bdbe4c3f2f]
    status "known"
...
3:t:34:c:certificates;k:keys;r:revisions;
3:t:12:c=0;k=0;r=0;
3:t:13:c#0;k#0;r#64;
3:t:14:c#0;k#0;r#128;
3:t:6:c;k;r;
...
```

Output format:

Right after a stdio session has been set up, header information is issued; to date the only header defined is **format-version**, which denotes the version of the stdio format used throughout the session. The original format had no such version output, so our numbering starts with "2" here.

Headers are separated from each other by single newline character '\n' and the last is separated from the following output by a pair of newline characters.

After a command has been issued, one or more packets are returned for it. A packet looks like:

```
<command number>:<stream>:<size>:<output>
```

Packet size is limited by the **--automate-stdio-size** option (default 32k bytes).

<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.

<stream> is an identifier for which output stream this packet represents, allowing multiple streams to be multiplexed over the channel. The following streams are presently defined; more streams may be added later.

- **m**: this stream represents the normal ("main") stdout automate output of the command, formatted as described in the description for that command.
- **e**: this stream represents any (unstructured) error message data.

Internally, this maps to calls to the **E()** print macros that would normally be written by the command to the program's stderr stream, if the automate sub-command had been called directly rather than via "'stdio'".

- **w**: this stream represents any (unstructured) warning message data.

Internally, this maps to calls to the **W()** print macro that would normally be written by the command to the program's stderr stream, if the automate sub-command had been called directly rather than via "'stdio'".

- **p**: this stream represents any (unstructured) progress message data.

Internally, this maps to calls to the **P()** print macro that would normally be written by the command to the program's stderr stream, if the automate sub-command had been called directly rather than via "'stdio'".

- **t**: this stream represents ticker updates, which may be used by a user interface to display the progress of a command.

The output for this channel can be described as follows:

- `<output> ::= <definition><payload><end>`
- `<definition> ::= <shortname> ':' <longname> <eol>`
- `<payload> ::= <total_count><advance>+`
- `<end> ::= <shortname> <eol>`
- `<total_count> ::= <shortname> '=' <count> <eol>`
- `<advance> ::= <shortname> '#' <count> <eol>`
- `<shortname> ::= "\w+"`
- `<longname> ::= "[^;]+"`
- `<count> ::= ['0'-'9']+`
- `<eol> ::= ';' ;`

The definition tells the implementor the short name and long name of any upcoming ticker event. The names and meanings are command-specific and are therefore explained in the sections for the particular commands which support ticker output.

The `total_count` might be 0 right at the start and can later be changed to a different number if the command later on knows a more exact value. If this is the case, this stanza is output again with this new value. A constant `total_count` of 0 means that the command may continue to run for a undefined amount of time until the end stanza appears.

The advance tells the implementor how much work has been done so far.

Finally, the end stanza is printed just before the ticker ends (i.e. the work has been done).

All counts output absolute, raw values; no modulation takes place. It is usually the case that definition, `total_count`, advance and end are output in separate stanzas. It is also possible that two or more parallel tickers output their stanzas at the same time, in this case it's ensured that the output does not get intermixed; first all definitions are output, afterwards all `total_counts`, and so on.

Note: The ticker format used for stdio is fixed and cannot be selected explicitly via the global `--ticker` option. However, if you run an automate command outside of stdio you can set a different ticker type, f.e. *count*, *dot* or *none*.

- 1: this stream marks the termination of a command and all of its streams and carries the return code of the command in the payload.

A return code "0" stands for success, "1" for an error which occurred within the stdio interface (f.e. syntax errors or missing privileges) before the command is run and finally "2" for any other command-specific error.

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

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

Error conditions:

Errors in the commands run through this interface do not affect the exit status of this command. Instead, if a badly formatted or invalid command is received, or a command is given with invalid arguments or options, an error message to the error stream is printed and the particular sub-command exits with return code "1". Other command-specific errors are returned as code "2".

Trying to run the `automate stdio` or `automate remote_stdio` sub-commands will exit the particular command with return code "1".

Notes:

Keyboard interaction is disabled, just as if `--non-interactive` is specified. Actions which require operations on password-encrypted private keys will therefore fail unless the `[get_passphrase]`, page 190 hook is set up locally.

Workspace options are read before executing each command.

Multiple streams

The multiple stream encoding allows the output of errors and warnings to be associated with the command that generated them, allows the communication path to always stay in sync, and offers the opportunity to add other stream types for other useful purposes in the future as needs arise.

`mtn automate sync`

See `[mtn automate pull]`, page 158

`mtn automate tags [branch_pattern]`

Arguments:

A branch pattern (defaults to all).

Changes:

- 11.0 – *signer* now prints the hash of the signing key, no longer the name. Also, the *format_version* stanza has been removed in favour of the global *interface_version*.
- 2.2 – added

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]`, page 193, it is neither printed, nor can it be matched by a pattern.

Sample output:

```
tag "monotree-0.1"
```

```

revision [8a121346ce2920b6f85df68b3b620de96bd14a8d]
  signer [de84b575d5e47254393eba49dce9dc4db98ed42d]
branches "net.venge.monotone.contrib" "net.venge.monotone.monotree"

    tag "monotree-0.2"
revision [5d288b39b49613b0d9dca8ece6b9a42c3773f35b]
  signer [de84b575d5e47254393eba49dce9dc4db98ed42d]
branches "net.venge.monotone.contrib.monotree"

    tag "monotree-0.3"
revision [35cff8e8ba14155f5f7ddf7965073f514fd60f61]
  signer [de84b575d5e47254393eba49dce9dc4db98ed42d]
branches "net.venge.monotone.contrib.monotree"

    tag "monotree-0.4"
revision [f1afc520474f83c58262896ede027ef77226046e]
  signer [de84b575d5e47254393eba49dce9dc4db98ed42d]
branches "net.venge.monotone.contrib.monotree"

```

Output format:

There is one `basic.io` stanza for each tag.

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 hexadecimal value 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 toposort [rev...]`

Arguments:

One or more revision IDs.

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.

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 update`

Arguments:

Same as `[mtn update]`, page 96.

Added in:

12.1

Purpose:

Update the current workspace to the latest or given revision; see `[mtn update]`, page 96.

Sample output:

Nothing on the main stream. The progress stream gives messages of the form:

```
mtn: updating along branch 'mms.work_stephe'
mtn: selected update target 233afb8c4832bf33d5f5734225164de5f5a6278c
mtn: [left] 4a368a6b217c40b2ff3b12bb7cfa00987e0f191c
mtn: [right] 233afb8c4832bf33d5f5734225164de5f5a6278c
mtn: renaming build/windows_common.make to build/utf_common.make
mtn: adding build/x86_gnu_linux_release
```

Output format:

Free form, prefixed by “mtn:”.

Error conditions:

see `[mtn update]`, page 96.

4.12 VCS

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.

mtn git_export [--authors-file=*authors-file*] [--branches-file=*branches-file*]
 [--import-marks=*marks-file*] [--export-marks=*marks-file*]
 [--log-revids] [--log-certs] [--use-one-changelog]
 [--refs=*type*]

This command exports all revisions from the current monotone database to `stdout` in a format that can be piped directly to `git fast-import`.

The `--authors-file` option may be used to map monotone author and committer names to different values in a manner similar to that documented in `git-svn(1)`. Mappings are specified in the file as:

```
loginname = Joe User <user@example.com>
```

The list of authors that might need to be mapped can be extracted from a monotone database with the following sql query:

```
$ mtn db execute 'select distinct value from revision_certs where name = "author"
```

The list of committers that might need to be mapped can be extracted from a monotone database with the following sql query:

```
$ mtn db execute 'select distinct public_keys.name
                  from public_keys
                  left join revision_certs on revision_certs.keypair_id = public_
                  where revision_certs.name = "author"'
```

The `--branches-file` option may be used to map monotone branch names to different values. This may be required as monotone allows branch names that are not valid according to git. Branch mappings are specified in the *branches-file* as:

```
monotone-branch-name = git-branch-name
```

Revisions with no author cert will use "Unknown <unknown>" for both the author and the committer. These can be mapped to other values using the *authors-file* option.

The list of branches that might need to be mapped can be extracted from a monotone database with using the `ls branches` command:

```
$ mtn ls branches --ignore-suspend-certs
```

The `--import-marks` and `--export-marks` options are similar to those documented in `git-fast-export(1)` and `git-fast-import(1)`. These may be used for

incremental exports and may also be useful for repository verification. The *marks-file* is read on startup if `--import-marks` is specified and all marked revs are excluded from the export. The *marks-file* is written on completion if `--export-marks` is specified and will contain marks for all revs that were exported in addition to any marks that were read on startup. It is safe to use the same file for both `--import-marks` and `--export-marks` but different files may also be used.

The original monotone revision ids may be included in the exported git commit messages using the `--log-revids` option. These will appear as:

```
Monotone-Parent: ...  
Monotone-Revision: ...
```

in the git commit messages and may be useful for repository verification. Merge revisions with two parents will include two **Monotone-Parent** lines.

The original monotone values for **author**, **date**, **branch** and **tag** certificates may be included in the exported git commit messages using the `--log-certs` option. These will appear as:

```
Monotone-Author: ...  
Monotone-Date: ...  
Monotone-Branch: ...  
Monotone-Tag: ...
```

in the git commit messages and may be useful for repository verification or maintaining information that is otherwise not maintained by git. In particular monotone may have several values for each of these certs and git only represents a single **author** and **date** value.

By default, the values of all changelog and comment certs on a revision are concatenated to form the git commit message for that revision. The `--use-one-changelog` option will prevent this behaviour and use the value from the first changelog cert encountered. *WARNING:* this will explicitly lose information in the exported data. Changelog certs have no implicit ordering, one will be selected arbitrarily to be used as the git commit message and all others will be excluded from the exported data. Additionally, all comment certs will be excluded from the exported data.

References to the original monotone branches and tags are exported as `refs/tags/<tag-name>` and `refs/heads/<branch-name>`. In addition, references to the original monotone revision ids, the root revisions and the leaf revisions may be exported using `--refs=revs`, `--refs=roots` and `--refs=leaves` respectively. These references are exported as `refs/mtn/revs/<id>`, `refs/mtn/roots/<id>` and `refs/mtn/leaves/<id>` and may be useful for repository verification. These additional references should probably not be maintained after the exported repository has been verified as they cause considerable clutter in tools like gitk.

5 Formats

Monotone uses three formats to output or to accept input of data (mostly structured), `basic_io`, `stdio`, and `packet`. `basic_io` is often used to represent data or for configuration, while `stdio` is used for communication with `automate stdio`.

The `stdio` format is not described here. For information on it, see [\[mtn automate stdio\], page 173](#).

The `packet` format is not described here; see [Section 4.9 \[Packet I/O\], page 113](#). For examples, see [\[mtn automate packet_for_fdelta\], page 155](#), [\[mtn automate packet_for_fdata\], page 154](#).

5.1 basic_io Format

`basic_io` is a very simple format, yet expressive, and can be described with the following ABNF (see RFC 2234) specification:

```
basic_io = *( item )

    item = *sp symbol *sp *( string / hexid ) *sp
           ; a symbol followed by zero or more strings and/or hexes.

    symbol = 1*( lcalpha / "_" )
            ; One or more letters or underscores.
    string = DQUOTE *( charnqnb / "\" / "\\" / "\\" DQUOTE ) DQUOTE
            ; A series of any character, enclosed with double quotes
            ; To include a double quote or a backslash in the string,
            ; escape it with a backslash.
    hexid = "[" 40HEXDIG "]"
            ; 40 hexadecimal characters enclosed in brackets.
            ; Note: the amount might change as we move away from sha1.

    sp = ( WSP CR LF )
    charnqnb = %x01-21 / %x23-5B / %x5D-FF
              ; All characters except NUL (%x00) , " (%x22) and \ (%x5C).
    lcalpha = %x61-7A
             ; Lower case a-z.
```

In essence, it's a stream of items, where each item is a `symbol` followed by zero or more `strings` and `hexes`.

There is an idea of stanzas, which is a group of items that logically belongs together. However, stanzas aren't defined in the `basic_io` syntax, and are instead defined in terms of order and sequence for what symbols may be part of the stream, how they may appear, and how many and what arguments should follow them. This is defined by each command or program using this format.

For example, revisions have associated data; the structure is header stanzas followed by a list of changes vs. each parent revision, with each change represented by a separate stanza; reordering the stanzas could cause a particular change to be interpreted against the wrong parent.

Another example is the `read-permissions` file that's read by the default definition of the `[get_netsync_read_permitted]`, [page 193](#) Lua hook.

Monotone will format its output in `basic_io` as follows:

- Each `symbol` begins a new line.
- Tokens on the same line are separated by a single space.
- Lines are grouped into logical `stanzas`, separated by a single empty line. Each stanza then describes a particular item, with the different lines (`symbols` followed by `string` and `hex` values) describing different aspects of that item.
- `symbols` in a stanza are right-aligned with each other; each `symbol` other than the longest is preceded by spaces. The longest `symbol` in a stanza is not preceded by spaces, even if there are longer `symbols` in other stanzas.
- Lines within stanzas have a consistent order, although some may be optional in some commands.

6 Lua Reference

Monotone makes use of the [Lua](#) programming language to customize and extend its behaviour. By writing *functions* which are loaded and evaluated at runtime, you can help monotone to make a particular decision, set a suitable default or preference or perform a certain action.

Lua functions are defined in “rcfiles” which will be read every time monotone runs. rcfiles consist of:

- `$HOME/.monotone/monotonerc` on Unix or `%APPDATA%\monotone\monotonerc` on Windows
- `_MTN/monotonerc` in the current workspace
- Files given in the `--rcfile=file` option on the command line.
- All files in a directory given by `--rcfile=directory` on the command line.

The files are loaded in the order `.monotone/monotonerc`, `_MTN/monotonerc`, `--rcfile` in the command line order. Definitions loaded later shadow (override) earlier definitions.

There are two uses for Lua functions; hooks and user-defined commands. This section documents hooks; see [\[register_command\]](#), [page 206](#) for user-defined commands. The source distribution contains some example user commands in the `contrib/command` directory.

Hooks are Lua functions that are called from monotone code in many places. Monotone provides default definitions for some hooks; see [Appendix A \[Default hooks\]](#), [page 255](#) for their complete source. For other hooks, if no definition is provided, a default return value is used. 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
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 functions default to the global scope, the new hook is seen from inside monotone.

Monotone also provides a number of helper functions to hook writers exposing functionality not available with standard Lua.

6.1 Hooks

This section documents the existing hook functions and their default definitions.

6.1.1 Common Data Types

Some hooks take arguments which are more complex than a simple string or number (they are a Lua “table”). Where multiple hooks take the same kind of argument, we generally try to make them take that kind of argument in the same format, described here.

```
key_identity
{
    id = "key hash/fingerprint, in hex",
    given_name = "name given when creating the key",
    name = "local alias of the key"
}
```

When a key is created, it is given a meaningful name. Because this is chosen by the key creator and may be unreliable, trust hooks need to be able to look at the key hash as well. This may be inconvenient, so a local alias is also provided. This alias is obtained from a Lua hook, which can provide reliable easy-to-use names based on the key hash (or however else you want).

6.1.2 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.

Hooks are presented not in alphabetic order; they are grouped by function, and then by the order they are typically called by monotone.

note_commit (*new_id*, *revision*, *certs*)

Called by monotone after the revision *new_id* is committed. *revision* is the text of the revision, what would be given by `mtn automate get_revision new_id`. *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_key*, *includes*, *excludes*)

Called by monotone just after a netsync session is started, before any of the other netsync notification hooks are called.

The arguments are:

session_id Identifies the current netsync session in case several are happening at the same time (only possible on a server).

my_role One of "client" or "server".

sync_type 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_key The identity of the key being used by the other end of the connection. The fields may be empty at the server if the key used by the client is not present at the server.

includes
excludes

The include and exclude patterns used by the client.

`note_netsync_revision_received (new_id, revision, certs, session_id)`

`note_netsync_revision_sent (rev_id, revision, certs, session_id)`

Called after the revision *new_id* is received or sent through netsync.

There are no default definitions for these hooks.

Arguments:

new_id The revision id.

revision The text of the revision; what would be given by `mtn automate get_revision new_id`.

certs 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 identity of the signing key for the cert, the name of the cert, and the value of the cert.

session_id Identifies the current netsync session.

`note_netsync_cert_received (rev_id, key_identity, name, value, session_id)`

`note_netsync_cert_sent (rev_id, key_identity, name, value, session_id)`

Called by monotone after a cert is received (or sent) through netsync, if the revision that the cert is attached to was not also received (or sent) in the same netsync operation.

There is no default definition for this hook.

Arguments:

rev_id The revision id that the cert is attached to.

key_identity The key that the cert is signed with; see [\[key_identity\]](#), page 186.

name The name of the cert.

value The cert value.

session_id Identifies the netsync session.

`note_netsync_pubkey_received (key_identity, session_id)`

`note_netsync_pubkey_sent (key_identity, session_id)`

Called by monotone after a pubkey is received or sent through netsync.

There is no default definition for this hook.

Arguments:

key_identity

The identity of the key received; see [\[key_identity\]](#), page 186.

session_id Identifies the current netsync session.

`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 a netsync session ends. 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 viewmntn.

Arguments:

session_id Identifies the current netsync session.

status 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.

bytes_in
bytes_out The number of bytes received/sent during the session.

certs_in
certs_out The number of certs received/sent during the session.

revs_in
revs_out The number of revisions received/sent during the session.

keys_in
keys_out The number of keys received/sent during the session.

`note_mtn_startup (...)`

Called by monotone when it is first started, after all command completion and option processing, before the command starts executing.

There is no default definition of this hook.

One use of this hook is to monitor usage of monotone, for user interface testing. The arguments to the hook are the command line 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
```

6.1.3 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)`

Called whenever monotone needs a key to sign a certificate, and `--key`, [page 83](#) was not given.

Returns a string which is the name or hash of a private key used to sign certificates in a particular branch *branchname*, or nil for no key.

See `--key`, [page 83](#) for a description of how monotone determines what key to use.

There is no default definition for this hook; it returns nil.

`get_netsync_client_key(server, include, exclude)`

Called by the client when a netsync connection is being established, and `--key`, [page 83](#) was not given. Returns a string which is the name or hash of the key to use to authenticate the client side of a netsync connection.

Note that netsync commands do not need a signing key; they only transmit already signed information.

See `--key`, [page 83](#) for a discussion of how monotone determines what key to use.

Arguments, when called:

- server* The scheme, user, host, port, and path fields from the URI provided on the command line. See [\[netsync uri\]](#), page 97.
- include* The include pattern in the URI provided on the command line.
- exclude* The exclude pattern in the URI provided on the command line.

`get_netsync_server_key(addresses)`

Called by the server when a new netsync server instance is created, and [\[--key\]](#), page 83 was not given. Returns a string which is the name or hash of the key to use to authenticate the server side of a netsync connection.

Note that netsync commands do not need a signing key; they only transmit already signed information.

See [\[--key\]](#), page 83 for a discussion of how monotone determines what key to use.

Arguments, when called:

- addresses* A table of addresses given to monotone via the `--bind` option that denote the addresses and / or ports monotone is listening on for connections. If the address in one of the table entries is omitted, the port must be given with a leading colon; in this case monotone listens on all interfaces on this port.

`get_default_command_options(command)`

Called after a command is completed, before the workspace options are loaded, and before the command line options are processed.

Returns a table of options. The options must be valid for the given command or global options. The returned option values overwrite the standard default options values; workspace and command line options override the new defaults as usual.

The argument is a table containing the command keywords, indexed by the integer position of the keyword in the command. For example, `mtn list branches` passes a table (1 => "list", 2 => "branches").

The default definition of this hook returns an empty table.

Simple example which enables recursive directory scanning for `mtn add` by default:

```
function get_default_command_options(command)
  local default_options = {}
  if (command[1] == "add") then
    table.insert(default_options, "--recursive")
  end
  return default_options
end
```

`get_passphrase (key_identity)`

Called whenever monotone needs to use a private key.

Returns a string which must match the passphrase used to encrypt the private [\[key_identity\]](#), page 186 in your key store.

This hook has no default definition.

If this hook is not defined or returns false, and ssh keys are not enabled (see [\[mtn ssh_agent_export\]](#), page 112), monotone will prompt you for a passphrase each time it needs to use a private key.

`get_local_key_name (key_identity)`

Called whenever monotone retrieves a key from the keystore or database, or completes a user-provided key, to provide the local alias (the *name* field in [\[key_identity\]](#), page 186).

Returns the local alias for the given *key_identity*. The *id* and *given_name* fields of *key_identity* will be populated, and the *name* field will not be. The return value indicates what the *name* field should contain.

The default implementation of this hook returns *given_name*.

`get_author (branchname, key_identity)`

Called by any command that needs an author name for an author cert for a commit, if [\[--author\]](#), page 84 is not given.

Returns a string which is the author name. If it returns nil, the key local name (as provided by [\[get_local_key_name\]](#), page 191) is used for the author name.

branchname is the branch for the commit, [\[key_identity\]](#), page 186 is the key.

There is no default definition for this hook; it returns nil.

Example definitions:

```
function get_author(branchname, key_identity)
    -- 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, key_identity)
    -- Branch name ignored.
    if (key_identity.given_name == "joe@example.com") then
        return "Joe Random <joe@example.com>"
    end
    return key_identity
end
```

`get_default_database_locations ()`

Called whenever monotone converts a database name to an absolute path.

Returns a table of paths where monotone should look for [Section 3.10 \[Managed Databases\]](#), page 65.

The default implementation returns a table with a single entry, `$HOME/.monotone/databases` on Unix and `%APPDATA%\monotone\databases` on Windows.

`get_default_database_alias ()`

Called whenever monotone converts a database name to an absolute path.

Returns the alias of the managed database which should be used as default. See [Section 3.10 \[Managed Databases\]](#), page 65.

The default implementation returns `:default.mtn`.

get_default_database_glob ()

Returns a pattern to let monotone distinguish a valid from an invalid database file name. This pattern is used in two places:

- When monotone scans for database files in its default database locations, it will skip all files which do not match the pattern returned from this hook.
- When a partial database alias is validated and the alias' name does not match the pattern returned from this hook, `.mtn` is appended to the alias' name.

The default implementation returns `*.{mtn,db}`.

edit_comment (user_log_message)

Called by [\[mtn comment\], page 108](#), [\[mtn commit\], page 91](#), [\[mtn import\], page 86](#) when a comment is not provided on the command line.

Returns a commit comment for the command. `user_log_message` depends on the calling command; see the command definitions.

This hook is intended to interface with some sort of editor, so that you can interactively document each change you make.

The default definition of `edit_comment` invokes the user's editor (specified by the environment variables `VISUAL` and `EDITOR`, or `editor`, `vi`, or `notepad` on Windows). See [Appendix A \[Default hooks\], page 255](#).

persist_phrase_ok ()

Called whenever a passphrase is provided to decrypt a private key.

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 returns `true`.

use_inodeprints ()

Called when creating a new workspace.

Returns `true` if you want monotone to automatically enable [Section 3.5 \[Inodeprints\], page 54](#) support in the workspace.

The default definition of this hook returns `false`.

ignore_file (filename)

Called by many monotone commands when considering whether to process a file in a workspace.

Returns `true` if `filename` should be ignored by the command, `false` otherwise. This is most important when performing recursive actions on directories; if `ignore_file` returns `true` for a directory, all files under that directory will be ignored.

In some commands, `--no-ignore` will cause this hook to not be called.

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. In addition, if the file `.mtn-ignore` exists in the root workspace directory, this hook will read a list of regular expressions from the file, one per line, and ignore all files matching one of these expressions. See [Appendix A \[Default hooks\]](#), page 255.

`ignore_branch (branchname)`

Called by [\[mtn automate branches\]](#), page 120, [\[mtn automate tags\]](#), page 177, [\[mtn list branches\]](#), page 102.

Returns `true` if *branchname* should be ignored by the command, otherwise returns `false`.

This hook has no default definition; it acts as if it returns `false`.

`get_date_format_spec (wanted)`

Called by commands that display dates, when neither `--date-format` nor `--no-format-dates` is given.

Returns a `strftime` format specification.

If an empty string is returned, monotone uses the date format “`yyyy-mm-ddThh:mm:ss`”.

The default definition returns ‘`%x`’ for long and short date formats, ‘`%X`’ for long and short time formats and ‘`%x %X`’ for long and short date time formats, which is equivalent to ‘`22/05/09`’, ‘`09:06:14`’ and ‘`22/05/09 09:06:14`’ in an English locale.

wanted can be one of ‘`date_long`’, ‘`date_short`’, ‘`time_long`’, ‘`time_short`’, ‘`date_time_long`’, ‘`date_time_short`’.

`get_man_page_formatter_command ()`

Called by [\[mtn manpage\]](#), page 107, if `--formatted` is specified.

Returns a command string that is passed to the operating system function `popen` to format man pages. The input to the pipe is `nroff` markup.

Note that on the native Windows build of monotone, `popen` runs the `cmd.exe` shell to execute the command string. On Unix and Windows Cygwin, `popen` runs the `sh` shell.

The default hook returns a string that runs `nroff` and pipes that output into the `less` pager, with appropriate options. On Windows native, the default hook assumes that Cygwin or equivalent is installed, and includes `sh` in the command string.

6.1.4 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 `monotonerc` file is changed.

`get_netsync_read_permitted (branch, key_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` and all files in the subdirectory `read-permissions.d` in the configuration directory. All the files are treated as if they were one file, with `read-permissions` first followed by the files in `read-permissions.d` in alphanumerical order. The files look like

```
pattern "net.example.project.{private,security}*"
allow "joe@example.net"
allow "f3f62f86eba204a3ce15174083a53349201993d6"

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 with a hash or local_name that matches 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 *key_identity* of `nil`. An empty string value must be used in `read-permissions` to represent clients connecting anonymously. e.g. `allow ""`.

`get_netsync_write_permitted (key_identity)`

Returns `true` if a peer authenticated as key *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` and all files in the subdirectory `write-permissions.d` in the configuration directory which contains a list of key hashes or local key names, 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 *key_identity* of `nil`.

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 [Section 6.1.6 \[Trust Evaluation Hooks\]](#), [page 197](#) instead.

`get_remote_automate_permitted(key_identity, command, options)`

Returns true if a peer authenticated as key *key_identity* should be allowed to execute the given *command* with the given *options*, as if through `automate stdio`.

6.1.5 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
```

6.1.6 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.

See [Section 3.8 \[Quality Assurance\]](#), page 63.

`get_revision_cert_trust(signers, id, name, val)`

Returns `true` if you *trust* the assertion *name=value* on a given revision *id*, given a valid signature from all the keys in *signers*; `false` otherwise. *signers* is a table containing a [\[key_identity\]](#), page 186 for all signatures on this cert, the other three parameters are strings.

The default definition of this hook returns `true`.

The default definition corresponds to a form of trust where every key which is defined in your database is trusted. This is a *weak* trust setting. 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.name] = 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*)

Called by **[mtn update]**, page 96.

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 hash (as 20 raw bytes) – representing a particular testsuite – to a boolean value indicating whether or not the test run was successful (calculated from the **testresult** cert). 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 returns **true** if **_MTN/wanted-testresults** does not exist. Otherwise, the file should contain a list of signing key hex-encoded hashes in lowercase (40 characters). The hook returns **false** if a listed signing key hash is present in both *old_results* and *new_results*, with the value **true** in *old_results* and **false** in *new_results*; otherwise it returns **true**.

6.1.7 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 customization of the way file differences are shown in **diff** and **log** commands.

get_encloser_pattern (*file_path*)

Called by [\[mtn diff\]](#), page 101, [\[mtn automate content_diff\]](#), page 123, [\[mtn log\]](#), page 106, [\[mtn automate log\]](#), page 153, for each file in the diff output, if `--no-show-encloser` is not given.

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 in the file that name the “top-level” constructs enclosing each “hunk” of changes.

If a null string is returned, no enclosers are shown.

See [Section 7.4 \[Regexps\]](#), page 218, for the regular expression syntax used by monotone.

The default hook treats looks at the file extension, as follows:

<code>.texi</code>	Returns a regular expression matching nodes, subsections, headings.
<code>.tex</code>	
<code>.ltx</code>	
<code>.latex</code>	Returns a regular expression matching part, chapter, [sub]sections, paragraphs.
<code>.txt</code>	Empty string.

Otherwise returns `^[[:alnum:]]$`, which is correct for many programming languages.

external_diff (*file_path*, *old_data*, *new_data*, *is_binary*, *diff_args*, *old_rev*, *new_rev*)

Called by [\[mtn diff\]](#), page 101, [\[mtn automate content_diff\]](#), page 123, [\[mtn log\]](#), page 106, [\[mtn automate log\]](#), page 153, for each file in the diff output, if `--external` is given.

The hook should run a program that displays the differences between two versions of a file. The return value of the hook is not used.

file_path is the pathname of the file that is being diffed.

old_data and *new_data* are the contents of the old and the new file (*old_data* is nil if the file is new). If the content 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.

6.1.8 External Merge Tools

These hooks allow the user to use their favorite tools when resolving [\[File Content Conflict\]](#), page 55s.

The [Appendix A \[Default hooks\]](#), page 255 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)`

Called by [\[mtn conflicts resolve_first\]](#), page 89 when `interactive` is given; by [\[mtn merge\]](#), page 86, [\[mtn explicit_merge\]](#), page 85 when `--resolve-conflicts` is not specified and the internal merger fails for a file content conflict; and by [\[mtn update\]](#), page 96 or any command that accepts `--update` for workspace file content conflicts.

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.

On success, `merge3` returns a string, which should be the new file contents, the result of merging the given texts. If nil is returned, the merge command fails; this is how the user can abort a merge.

The default definition of this hook writes the texts to temporary files, then delegates the actual merge to the result of [\[get-preferred-merge3-command\]](#), page 200. The default definition of [\[get-preferred-merge3-command\]](#), page 200 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 several popular tools that might be installed on the local system.

The default hook then invokes the merge tool, waits for it to return, and checks to see if `merged_path` was written. If not, it returns nil, and the merge command fails.

For details, see the code in [Appendix A \[Default hooks\]](#), page 255.

By redefining this hook the user can choose a preferred merge tool, or select different merge tools for different file types. For example, gimp for .png files, OpenOffice.org for .doc, and so on.

`get-preferred-merge3-command(tbl)`

Returns a table `command`, `mkey` telling [\[merge3\]](#), page 200 what external merge tool to run.

`tbl` wraps up the various arguments for each merge command and is always provided by [\[merge3\]](#), page 200. If there is a particular editor that you would like to use to perform merge3 operations, override this hook to specify it.

6.1.9 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 var-

ious 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)

Called by any command that can take a selector argument, for each element of a combined selector string (between / separators).

The input *str* is the command line argument. The hook should return a string that is a valid monotone selector.

Expansion generally means providing a type prefix for the selector, such as **a:** for authors or **d:** for dates.

The default definition of this hook attempts to recognize certs, email addresses, branch names, hex ids, and dates, and adds the appropriate prefix. See [Appendix A \[Default hooks\]](#), page 255.

expand_date (str)

Called when processing a date selector (**d:**).

The input *str* is the command line selector, after processing by **expand_selector**. The hook should return a date that can be used by a standard SQL select statement.

The default hook recognizes special words such as **yesterday** or **6 months ago** and converts them into well formed date expressions. See [Appendix A \[Default hooks\]](#), page 255.

6.1.10 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 [\[File Content Conflict\]](#), page 55), or they may represent executable scripts or programs.

Monotone allows each file (or directory) in a repository to carry arbitrary [Section 3.14 \[File Attributes\]](#), page 72. Persistent attributes are stored in 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, indexed by *attribute*. Each entry in the table **attr_functions** is a function taking a file name *filename* and an attribute value *value*. The function should “apply” the attribute to the file in the file system, possibly in a platform-specific way.

These hooks are called by any command that modifies workspace files, including [\[mtn revert\]](#), page 95, [\[mtn undrop\]](#), page 96, [\[mtn update\]](#), page 96, [\[mtn merge_into_workspace\]](#), page 87, [\[mtn pluck\]](#), page 94, [\[mtn clone\]](#), page 99 and [\[mtn checkout\]](#), page 85.

When called to set an attribute, *value* is a string representing the value of the attribute.

When called to clear an attribute, *value* is **nil**.

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. It calls platform-specific functions to mark files as executable or not. See [Appendix A \[Default hooks\]](#), page 255.

`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 returns `true` if the attribute should be set on *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
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
end
```

The `binary_file` function is also defined as a Lua hook. See [Appendix A \[Default hooks\]](#), page 255.

6.1.11 GIT Export Hooks

Exporting monotone revisions in `git-fast-import(1)` format often requires translation of monotone author cert values and associated signing keys into corresponding git author and committer values. Translation of author and committer values and validation of the results is controlled by these hooks. See [\[mtn git_export\]](#), page 180.

`unmapped_git_author(author)`

This hook is called for any git author or committer value that does not come from the current *author map* file, specified by `--authors-file`. If no *author map* file is specified this hook will be called for *every* unique git author and committer value. It may return the value unchanged or modify it in some way in an effort to ensure that it is valid. The default implementation attempts several common pattern replacements to produce valid authors from monotone authors.

validate_git_author(author)

This hook is called before the git author or committer value is written to the export output stream. The *author* value is either the mapped value from the current *author map* file or the value produced by the `unmapped_git_author` hook. This hook may return true if the author is valid or false if it is not. The export will be aborted if this hook returns false for any value.

The default definition enforces the `Name <email>` pattern.

6.1.12 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_changes(revision_text, branchname)

This hook is called by `[mtn commit]`, page 91 just after the to-be-committed changes and the branch have been logically verified and before the user enters his/her commit message. *revision_text* is the full text of the changes for this revision, which can be parsed with the `[parse_basic_io]`, page 206 function. The second parameter, *branchname*, is the branch for this commit - unless it gets changed in `[edit_comment]`, page 192 later on.

If the hook finds the changes satisfactory, it should return `true, ""`. If it finds fault, then it should return `false, reason` where *reason* is a string containing the reason the changes were rejected. By default, this hook is not defined and acts as if it returned `true, ""`.

validate_commit_message(message, revision_text, branchname)

This hook is called by `[mtn commit]`, page 91 after `[edit_comment]`, page 192. *message* is the result of `edit_comment` and *revision_text* is the full text of the changes for this revision, which can be parsed with the `[parse_basic_io]`, page 206 function. *branchname* is parsed from the result of `edit_comment`.

If the hook finds the commit message satisfactory, it should return `true, ""`. If it finds fault, then it should return `false, reason` where *reason* is a string containing the reason the message was rejected. By default, this hook is not defined and acts as if it returned `true, ""`.

6.2 Additional Lua Functions

This section documents the additional Lua functions made available to hook and user command writers.

`alias_command(original, alias)`

This function adds a new alias for a monotone command. *original* must be an existing monotone command, *alias* is the new alias.

`change_workspace(directory)`

Change to workspace *directory*, which may be absolute or relative to the directory that was current when monotone was started.

Throws an error if *directory* does not exist or is not a workspace (does not contain `_MTN`).

After calling `change_workspace`, the next operation should read the workspace options. [\[mtn_automate\]](#), page 205 does this; other Lua functions do not.

`existonpath(command)`

Return 0 if *command* (a string) exists on `$PATH` and is executable, -1 otherwise.

For example, `existonpath("xxdiff")` returns 0 if the program `xxdiff` is available.

On Windows, this function automatically appends “.exe” to the program name if it is not present. In the previous example, `existonpath` would search for “`xxdiff.exe`”.

`get_confdir()`

Returns the path to the configuration directory; see [\[--confdir\]](#), page 82.

`get_ostype()`

Returns the operating system flavor as a string.

`guess_binary_file_contents(filespec)`

Returns true if the file contains one or more of the following bytes:

0x00 thru 0x06
0x0E thru 0x1f
0x7f

`guess_terminal_width()`

Returns the size of the terminal window as number or a sane default (72) if the information cannot be retrieved.

`include(scriptfile)`

This function tries to load and execute the Lua script contained in *scriptfile*. It returns true for success and false if there is an error.

This is the same as Lua `loadfile`.

`includedir(scriptpath)`

This function loads and executes in alphabetical order all the scripts contained in the directory *scriptpath*.

If one of the scripts has an error, the function doesn't process the remaining scripts.

There is no useful return value.

`includedirpattern(scriptpath, pattern)`

This function loads and executes in alphabetical order all the scripts contained into the directory *scriptpath* that match *pattern* (a glob pattern).

If one of the scripts has an error, the functions doesn't process the remaining scripts.

There is no useful return value.

`is_executable(file)`

This function returns true if *file* is executable, false otherwise. On Windows this function always returns 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(file)`

This function marks *file* as executable. On Windows this has no effect.

`globish.match(glob, string)`

Returns `true` if *glob* matches *str*, return `false` otherwise.

`mkstemp(template)`

Returns a unique name for a writeable temporary file. Note that it does not create the file.

template should be a string that consists of contiguous, legal file and path name characters followed by six 'X's.

`mkstemp` replaces the 'X's by an alpha-numeric sequence that is unique in the directory given in *template*.

Subsequent calls to `mkstemp` within the same process each yield different file names.

Unlike other implementations, monotone `mkstemp` allows *template* 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 should use the `temp_file` function, unless you need to run monotone with the `--no-builtin-rcfiles` 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 255.

`mtn_automate(command args...)`

`mtn_automate` calls the monotone `automate command`, with *args...* (may include options). The result of the call is a pair consisting of a boolean (`true` on success), and a string containing the `stdout` output from `automate command`.

This function is not for use in ordinary Lua hooks, but rather for Lua based commands as defined by the Lua function [\[register_command\]](#), page 206.

Note that keyboard interaction is disabled, just as if `--non-interactive` is specified. Actions which require operations on password-encrypted private keys will therefor fail unless the `[get_passphrase]`, page 190 hook is set up locally.

`parse_basic_io(data)`

Parse the string *data*, which should be in `basic_io` format. Returns nil if it can't parse the string; otherwise returns a table, with each entry in the table corresponding to one `basic_io` line, consisting of a `name` element and a `values` element.

For example, given this as input:

```
thingy "foo" "bar"
thingy "baz"
spork
frob "oops"
```

The output table will be:

```
{
  1 = { name = "thingy", values = { 1 = "foo", 2 = "bar" } },
  2 = { name = "thingy", values = { 1 = "baz" } },
  3 = { name = "spork", values = { } },
  4 = { name = "frob", values = { 1 = "oops" } }
}
```

`regex.search(regex, string)`

Returns `true` if a match for *regex* is found in *str*, `false` otherwise. See [Section 7.4 \[Regexps\]](#), page 218, for the syntax of *regex*.

`register_command(name, params, abstract, description, function)`

Add a command named *name* to the user command group in monotone. When the user issues the registered command, monotone will call the lua *function* name supplied. That function would then normally use `[mtn_automate]`, page 205 calls to service the request. *params* is a string with the list of parameters for the command, *abstract* gives a brief description, *description* a longer description. *params*, *abstract*, *description* are output by `mtn help`.

`server_request_sync(what, address, include, exclude)`

Initiate a netsync connection to the server at *address*, with the given *include* and *exclude* branch patterns. *what* is one of `sync`, `push`, or `pull`, indicating netsync operation.

When called by a monotone instance which is not running the `serve` command, this function has no effect.

`server_set_listening(boolean)`

If the argument is `false`, make the server not listen for incoming connections, and exit when all existing connections have closed.

If the argument is `true`, cancel an earlier call with `false` given.

`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 `--no-builtin-rcfiles` 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.

6.3 Implementation Differences

This section documents disabled and overwritten functions from the standard Lua libraries.

`print, io.write`

Both functions are overwritten to print to standard error (instead of standard output), formatted as monotone progress message with the prefix "lua:" in front of every line.

The rationale behind this is to catch most of the informational messages from hooks which use these functions and present them via monotone's user interface. This allows them to be logged just as other progress messages, and prevents unexpected out-of-band output in the [Section 4.11 \[Automation\]](#), page 119 interface.

If you explicitly need to write to either `stdout` or `stderr`, please use `io.stdout.write` and `io.stderr.write`.

`os.execute, io.popen`

Both functions have been disabled for security reasons. You should use their replacements `spawn` and `spawn_pipe`.

The original versions do not apply any kind of shell character escaping, which might lead to serious problems f.e. when a merger is automatically invoked by such a function.

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, punyencoding, 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.

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`.
- 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 Regular Expression Syntax

Monotone expects user-provided regular expressions in `.mtn-ignore` files and as the result of the `get_encloser_pattern` Lua hook (for the `diff` command). User-written Lua hooks may also use the function `regex.search` as they see fit. All these regular expressions should be written with the same syntax, which is that expected by the Perl-Compatible Regular Expression library (PCRE).

7.4.1 Regexp Syntax Summary

This is a quick-reference summary of the regular expression syntax used in Monotone.

Quoting

`\x` where `x` is non-alphanumeric is a literal `x`
`\Q... \E` treat enclosed characters as literal

Characters

`\a` alarm, that is, the BEL character (hex 07)
`\cx` “control-`x`”, where `x` is any character
`\e` escape (hex 1B)
`\f` formfeed (hex 0C)
`\n` newline (hex 0A)
`\r` carriage return (hex 0D)
`\t` tab (hex 09)
`\ddd` character with octal code `ddd`, or backreference
`\xhh` character with hex code `hh`
`\x{hhh...}` character with hex code `hhh...`

Character Types

`.` any character except newline; in dotall mode, any character whatsoever
`\C` one byte, even in UTF-8 mode (best avoided)
`\d` a decimal digit
`\D` a character that is not a decimal digit
`\h` a horizontal whitespace character
`\H` a character that is not a horizontal whitespace character
`\p{xx}` a character with the `xx` property
`\P{xx}` a character without the `xx` property
`\R` a newline sequence

<code>\s</code>	a whitespace character
<code>\S</code>	a character that is not a whitespace character
<code>\v</code>	a vertical whitespace character
<code>\V</code>	a character that is not a vertical whitespace character
<code>\w</code>	a “word” character
<code>\W</code>	a “non-word” character
<code>\X</code>	an extended Unicode sequence

`'\d'`, `'\D'`, `'\s'`, `'\S'`, `'\w'`, and `'\W'` recognize only ASCII characters.

General category property codes for `'\p'` and `'\P'`

<code>C</code>	Other
<code>Cc</code>	Control
<code>Cf</code>	Format
<code>Cn</code>	Unassigned
<code>Co</code>	Private use
<code>Cs</code>	Surrogate
<code>L</code>	Letter
<code>Ll</code>	Lower case letter
<code>Lm</code>	Modifier letter
<code>Lo</code>	Other letter
<code>Lt</code>	Title case letter
<code>Lu</code>	Upper case letter
<code>L&</code>	Ll, Lu, or Lt
<code>M</code>	Mark
<code>Mc</code>	Spacing mark
<code>Me</code>	Enclosing mark
<code>Mn</code>	Non-spacing mark
<code>N</code>	Number
<code>Nd</code>	Decimal number
<code>Nl</code>	Letter number
<code>No</code>	Other number
<code>P</code>	Punctuation
<code>Pc</code>	Connector punctuation

Pd	Dash punctuation
Pe	Close punctuation
Pf	Final punctuation
Pi	Initial punctuation
Po	Other punctuation
Ps	Open punctuation
S	Symbol
Sc	Currency symbol
Sk	Modifier symbol
Sm	Mathematical symbol
So	Other symbol
Z	Separator
Zl	Line separator
Zp	Paragraph separator
Zs	Space separator

Script names for ‘\p’ and ‘\P’

Arabic, Armenian, Balinese, Bengali, Bopomofo, Braille, Buginese, Buhid, Canadian_Aboriginal, Cherokee, Common, Coptic, Cuneiform, Cypriot, Cyrillic, Deseret, Devanagari, Ethiopic, Georgian, Glagolitic, Gothic, Greek, Gujarati, Gurmukhi, Han, Hangul, Hanunoo, Hebrew, Hiragana, Inherited, Kannada, Katakana, Kharoshthi, Khmer, Lao, Latin, Limbu, Linear_B, Malayalam, Mongolian, Myanmar, New_Tai_Lue, Nko, Ogham, Old_Italic, Old_Persian, Oriya, Osmanya, Phags_Pa, Phoenician, Runic, Shavian, Sinhala, Syloti_Nagri, Syriac, Tagalog, Tagbanwa, Tai_Le, Tamil, Telugu, Thaana, Thai, Tibetan, Tifinagh, Ugaritic, Yi.

Character Classes

[...]	positive character class
[^...]	negative character class
[x-y]	range (can be used for hex characters)
[[:xxx:]]	positive POSIX named set
[[:^xxx:]]	negative POSIX named set
alnum	alphanumeric
alpha	alphabetic
ascii	0-127

blank	space or tab
cntrl	control character
digit	decimal digit
graph	printing, excluding space
lower	lower case letter
print	printing, including space
punct	printing, excluding alphanumeric
space	whitespace
upper	upper case letter
word	same as ‘\w’
xdigit	hexadecimal digit

In PCRE, POSIX character set names recognize only ASCII characters. You can use ‘\Q...E’ inside a character class.

Quantifiers

?	0 or 1, greedy
?+	0 or 1, possessive
??	0 or 1, lazy
*	0 or more, greedy
*+	0 or more, possessive
*?	0 or more, lazy
+	1 or more, greedy
++	1 or more, possessive
+	1 or more, lazy
{n}	exactly <i>n</i>
{n,m}	at least <i>n</i> , no more than <i>m</i> , greedy
{n,m}+	at least <i>n</i> , no more than <i>m</i> , possessive
{n,m}?	at least <i>n</i> , no more than <i>m</i> , lazy
{n,}	<i>n</i> or more, greedy
{n,}+	<i>n</i> or more, possessive
{n,}?	<i>n</i> or more, lazy

Anchors and Simple Assertions

<code>\b</code>	word boundary
<code>\B</code>	not a word boundary
<code>^</code>	start of subject also after internal newline in multiline mode
<code>\A</code>	start of subject
<code>\$</code>	end of subject also before newline at end of subject also before internal newline in multiline mode
<code>\Z</code>	end of subject also before newline at end of subject
<code>\z</code>	end of subject
<code>\G</code>	first matching position in subject

Match Point Reset

<code>\K</code>	reset start of match
-----------------	----------------------

Alternation

`expr|expr|expr...`

Capturing

<code>(...)</code>	capturing group
<code>(?<name>...)</code>	named capturing group (like Perl)
<code>(?'name'...)</code>	named capturing group (like Perl)
<code>(?P<name>...)</code>	named capturing group (like Python)
<code>(?:...)</code>	non-capturing group
<code>(? ...)</code>	non-capturing group; reset group numbers for capturing groups in each alternative

Atomic Groups

<code>(>...)</code>	atomic, non-capturing group
------------------------	-----------------------------

Comment

<code>(#....)</code>	comment (not nestable)
----------------------	------------------------

Option Setting

<code>(?i)</code>	caseless
<code>(?J)</code>	allow duplicate names

(?m)	multiline
(?s)	single line (dotall)
(?U)	default ungreedy (lazy)
(?x)	extended (ignore white space)
(?-...)	unset option(s)

Lookahead and Lookbehind Assertions

(?=...)	positive look ahead
(?!...)	negative look ahead
(?<=...)	positive look behind
(?<!...)	negative look behind

Each top-level branch of a look behind must be of a fixed length.

Backreferences

\n	reference by number (can be ambiguous)
\gn	reference by number
\g{n}	reference by number
\g{-n}	relative reference by number
\k<name>	reference by name (like Perl)
\k'name'	reference by name (like Perl)
\g{name}	reference by name (like Perl)
\k{name}	reference by name (like .NET)
(?P=name)	reference by name (like Python)

Subroutine References (possibly recursive)

(?R)	recurse whole pattern
(?n)	call subpattern by absolute number
(?+n)	call subpattern by relative number
(?-n)	call subpattern by relative number
(?&name)	call subpattern by name (like Perl)
(?P>name)	call subpattern by name (like Python)

Conditional Patterns

`(?(condition)yes-pattern)`
`(?(condition)yes-pattern|no-pattern)`
`(?(n)...` absolute reference condition
`(?(+n)...`
relative reference condition
`(?(-n)...`
relative reference condition
`(?(<name>)...`
named reference condition (like Perl)
`(?('name')...`
named reference condition (like Perl)
`(?(name)...`
named reference condition (PCRE only)
`(?(R)...` overall recursion condition
`(?(Rn)...`
specific group recursion condition
`(?(R&name)...`
specific recursion condition
`(?(DEFINE)...`
define subpattern for reference
`(?(assert)...`
assertion condition

Backtracking Control

The following act immediately they are reached:

`(*ACCEPT)`
force successful match
`(*FAIL)` force backtrack; synonym ‘`(*F)`’

The following act only when a subsequent match failure causes a backtrack to reach them. They all force a match failure, but they differ in what happens afterwards. Those that advance the start-of-match point do so only if the pattern is not anchored.

`(*COMMIT)`
overall failure, no advance of starting point
`(*PRUNE)` advance to next starting character
`(*SKIP)` advance start to current matching position
`(*THEN)` local failure, backtrack to next alternation

Newline Conventions

These are recognized only at the very start of the pattern or after a ‘`(*BSR...)`’ option.

`(*CR)`

`(*LF)`

`(*CRLF)`

`(*ANYCRLF)`

`(*ANY)`

What ‘`\R`’ Matches

These are recognized only at the very start of the pattern or after a ‘`(*...)`’ option that sets the newline convention.

`(*BSR_ANYCRLF)`

`(*BSR_UNICODE)`

7.4.2 Regexp Details

The syntax and semantics of PCRE regular expressions, as used in Monotone, are described in detail below. Regular expressions in general are covered in a number of books, some of which have copious examples. Jeffrey Friedl’s “Mastering Regular Expressions,” published by O’Reilly, covers regular expressions in great detail. This description is intended as reference material.

Characters and Metacharacters

A regular expression is a pattern that is matched against a subject string from left to right. Most characters stand for themselves in a pattern, and match the corresponding characters in the subject. As a trivial example, the pattern

`The quick brown fox`

matches a portion of a subject string that is identical to itself. When caseless matching is specified, letters are matched independently of case.

The power of regular expressions comes from the ability to include alternatives and repetitions in the pattern. These are encoded in the pattern by the use of *metacharacters*, which do not stand for themselves but instead are interpreted in some special way.

There are two different sets of metacharacters: those that are recognized anywhere in the pattern except within square brackets, and those that are recognized within square brackets. Outside square brackets, the metacharacters are as follows:

<code>\</code>	general escape character with several uses
<code>^</code>	assert start of string (or line, in multiline mode)
<code>\$</code>	assert end of string (or line, in multiline mode)
<code>.</code>	match any character except newline (by default)
<code>[</code>	start character class definition
<code> </code>	start of alternative branch

(start subpattern
)	end subpattern
?	extends the meaning of ‘(’ also 0 or 1 quantifier also quantifier minimizer
*	0 or more quantifier
+	1 or more quantifier also “possessive quantifier”
{	start min/max quantifier

Part of a pattern that is in square brackets is called a "character class". In a character class the only metacharacters are:

\	general escape character
^	negate the class, but only if the first character
-	indicates character range
[POSIX character class (only if followed by POSIX syntax)
]	terminates the character class

The following sections describe the use of each of the metacharacters.

Backslash

The backslash character has several uses. Firstly, if it is followed by a non-alphanumeric character, it takes away any special meaning that character may have. This use of backslash as an escape character applies both inside and outside character classes.

For example, if you want to match a ‘*’ character, you write ‘*’ in the pattern. This escaping action applies whether or not the following character would otherwise be interpreted as a metacharacter, so it is always safe to precede a non-alphanumeric with backslash to specify that it stands for itself. In particular, if you want to match a backslash, you write ‘\\’.

If a pattern is compiled with the ‘(?x)’ option, whitespace in the pattern (other than in a character class) and characters between a ‘#’ outside a character class and the next newline are ignored. An escaping backslash can be used to include a whitespace or ‘#’ character as part of the pattern.

If you want to remove the special meaning from a sequence of characters, you can do so by putting them between ‘\Q’ and ‘\E’. The ‘\Q... \E’ sequence is recognized both inside and outside character classes.

Non-printing Characters

A second use of backslash provides a way of encoding non-printing characters in patterns in a visible manner. There is no restriction on the appearance of non-printing characters, apart from the binary zero that terminates a pattern, but when a pattern is being prepared by text editing, it is usually easier to use one of the following escape sequences than the binary character it represents:

\a	alarm, that is, the BEL character (hex 07)
\cx	"control-x", where x is any character

<code>\e</code>	escape (hex 1B)
<code>\f</code>	formfeed (hex 0C)
<code>\n</code>	linefeed (hex 0A)
<code>\r</code>	carriage return (hex 0D)
<code>\t</code>	tab (hex 09)
<code>\ddd</code>	character with octal code <i>ddd</i> , or backreference
<code>\xhh</code>	character with hex code <i>hh</i>
<code>\x{hhh...}</code>	character with hex code <i>hhh...</i>

The precise effect of `\cx` is as follows: if *x* is a lower case letter, it is converted to upper case. Then bit 6 of the character (hex 40) is inverted. Thus `\cz` becomes hex 1A (the SUB control character, in ASCII), but `\c{}` becomes hex 3B (`';`), and `\c;` becomes hex 7B (`'{'`).

After `\x`, from zero to two hexadecimal digits are read (letters can be in upper or lower case). Any number of hexadecimal digits may appear between `\x{}` and `}`, but the value of the character code must be less than 256 in non-UTF-8 mode, and less than 2^{31} in UTF-8 mode. That is, the maximum value in hexadecimal is 7FFFFFFF. Note that this is bigger than the largest Unicode code point, which is 10FFFF.

If characters other than hexadecimal digits appear between `\x{}` and `}`, or if there is no terminating `}`, this form of escape is not recognized. Instead, the initial `\x` will be interpreted as a basic hexadecimal escape, with no following digits, giving a character whose value is zero.

Characters whose value is less than 256 can be defined by either of the two syntaxes for `\x`. There is no difference in the way they are handled. For example, `\xdc` is exactly the same as `\x{dc}`.

After `\0` up to two further octal digits are read. If there are fewer than two digits, just those that are present are used. Thus the sequence `\0\x\07` specifies two binary zeros followed by a BEL character (octal 007). Make sure you supply two digits after the initial zero if the pattern character that follows is itself an octal digit.

The handling of a backslash followed by a digit other than 0 is complicated. Outside a character class, PCRE reads it and any following digits as a decimal number. If the number is less than 10, or if there have been at least that many previous capturing left parentheses in the expression, the entire sequence is taken as a *back reference*. A description of how this works is given later, following the discussion of parenthesized subpatterns.

Inside a character class, or if the decimal number is greater than 9 and there have not been that many capturing subpatterns, PCRE re-reads up to three octal digits following the backslash, and uses them to generate a data character. Any subsequent digits stand for themselves. In non-UTF-8 mode, the value of a character specified in octal must be less than `\400`. In UTF-8 mode, values up to `\777` are permitted. For example:

<code>\040</code>	is another way of writing a space
<code>\40</code>	is the same, provided there are fewer than 40 previous capturing subpatterns

<code>\7</code>	is always a back reference
<code>\11</code>	might be a back reference, or another way of writing a tab
<code>\011</code>	is always a tab
<code>\0113</code>	is a tab followed by the character ‘3’
<code>\113</code>	might be a back reference, otherwise the character with octal code 113
<code>\377</code>	might be a back reference, otherwise the byte consisting entirely of 1 bits
<code>\81</code>	is either a back reference, or a binary zero followed by the two characters ‘8’ and ‘1’

Note that octal values of 100 or greater must not be introduced by a leading zero, because no more than three octal digits are ever read.

All the sequences that define a single character value can be used both inside and outside character classes. In addition, inside a character class, the sequence ‘`\b`’ is interpreted as the BS character (hex 08), and the sequences ‘`\R`’ and ‘`\X`’ are interpreted as the characters ‘R’ and ‘X’, respectively. Outside a character class, these sequences have different meanings (see below).

Absolute and Relative Back References

The sequence ‘`\g`’ followed by an unsigned or a negative number, optionally enclosed in braces, is an absolute or relative back reference. A named back reference can be coded as ‘`\g{name}`’.

Back references are discussed later, following the discussion of parenthesized subpatterns.

Generic character types

Another use of backslash is for specifying generic character types. The following are always recognized:

<code>\d</code>	any decimal digit
<code>\D</code>	any character that is not a decimal digit
<code>\h</code>	any horizontal whitespace character
<code>\H</code>	any character that is not a horizontal whitespace character
<code>\s</code>	any whitespace character
<code>\S</code>	any character that is not a whitespace character
<code>\v</code>	any vertical whitespace character
<code>\V</code>	any character that is not a vertical whitespace character
<code>\w</code>	any “word” character
<code>\W</code>	any “non-word” character

Each pair of escape sequences partitions the complete set of characters into two disjoint sets. Any given character matches one, and only one, of each pair.

These character type sequences can appear both inside and outside character classes. They each match one character of the appropriate type. If the current matching point is at the end of the subject string, all of them fail, since there is no character to match.

For compatibility with Perl, `\s` does not match the VT character (code 11). This makes it different from the the POSIX “space” class. The `\s` characters are TAB (9), LF (10), FF (12), CR (13), and SPACE (32).

In UTF-8 mode, characters with values greater than 128 never match `\d`, `\s`, or `\w`, and always match `\D`, `\S`, and `\W`. These sequences retain their original meanings from before UTF-8 support was available, mainly for efficiency reasons.

The sequences `\h`, `\H`, `\v`, and `\V` are Perl 5.10 features. In contrast to the other sequences, these do match certain high-valued codepoints in UTF-8 mode. The horizontal space characters are:

U+0009	Horizontal tab
U+0020	Space
U+00A0	Non-break space
U+1680	Ogham space mark
U+180E	Mongolian vowel separator
U+2000	En quad
U+2001	Em quad
U+2002	En space
U+2003	Em space
U+2004	Three-per-em space
U+2005	Four-per-em space
U+2006	Six-per-em space
U+2007	Figure space
U+2008	Punctuation space
U+2009	Thin space
U+200A	Hair space
U+202F	Narrow no-break space
U+205F	Medium mathematical space
U+3000	Ideographic space

The vertical space characters are:

U+000A	Linefeed
U+000B	Vertical tab
U+000C	Formfeed
U+000D	Carriage return

U+0085	Next line
U+2028	Line separator
U+2029	Paragraph separator

A “word” character is an underscore or any character less than 256 that is a letter or digit. The definition of letters and digits is that used for the “C” locale.

Newline Conventions

PCRE supports five different conventions for indicating line breaks in strings: a single CR (carriage return) character, a single LF (linefeed) character, the two-character sequence CRLF, any of the three preceding, or any Unicode newline sequence. The default is to match any Unicode newline sequence. It is possible to override the default newline convention by starting a pattern string with one of the following five sequences:

(*CR)	carriage return
(*LF)	linefeed
(*CRLF)	carriage return, followed by linefeed
(*ANYCRLF)	any of the three above
(*ANY)	all Unicode newline sequences

For example, the pattern

```
(*CR)a.b
```

changes the convention to CR. That pattern matches ‘a\nb’ because LF is no longer a newline. Note that these special settings, which are not Perl-compatible, are recognized only at the very start of a pattern, and that they must be in upper case. If more than one of them is present, the last one is used.

The newline convention does not affect what the ‘\R’ escape sequence matches. By default, this is any Unicode newline sequence, for Perl compatibility. However, this can be changed; see the description of ‘\R’ below. A change of ‘\R’ setting can be combined with a change of newline convention.

Newline Sequences

Outside a character class, by default, the escape sequence ‘\R’ matches any Unicode newline sequence. This is a Perl 5.10 feature. In non-UTF-8 mode ‘\R’ is equivalent to the following:

```
(?>\r\n|\n|\x0b|\f|\r|\x85)
```

This is an example of an “atomic group”, details of which are given below. This particular group matches either the two-character sequence CR followed by LF, or one of the single characters LF (linefeed, U+000A), VT (vertical tab, U+000B), FF (formfeed, U+000C), CR (carriage return, U+000D), or NEL (next line, U+0085). The two-character sequence is treated as a single unit that cannot be split. In UTF-8 mode, two additional characters whose codepoints are greater than 255 are added: LS (line separator, U+2028) and PS (paragraph separator, U+2029).

It is possible to change the meaning of ‘\R’ by starting a pattern string with one of the following sequences:

`(*BSR_ANYCRLF)`

CR, LF, or CRLF only

`(*BSR_UNICODE)`

any Unicode newline sequence (the default)

Note that these special settings, which are not Perl-compatible, are recognized only at the very start of a pattern, and that they must be in upper case. If more than one of them is present, the last one is used. They can be combined with a change of newline convention, for example, a pattern can start with:

`(*ANY)(*BSR_ANYCRLF)`

Inside a character class, `'\R'` matches the letter `'R'`.

Unicode Character Properties

Three additional escape sequences match characters with specific Unicode properties. When not in UTF-8 mode, these sequences are of course limited to testing characters whose codepoints are less than 256, but they do work in this mode. The extra escape sequences are:

`\p{xx}` a character with the `xx` property
`\P{xx}` a character without the `xx` property
`\X` an extended Unicode sequence

The property names represented by `xx` above are limited to the Unicode script names, the general category properties, and `'Any'`, which matches any character (including newline). Other properties such as `'InMusicalSymbols'` are not currently supported by PCRE. Note that `'\P{Any}'` does not match any characters, so always causes a match failure.

Sets of Unicode characters are defined as belonging to certain scripts. A character from one of these sets can be matched using a script name. For example:

`\p{Greek}`
`\P{Han}`

Those that are not part of an identified script are lumped together as “Common.” The current list of scripts is:

Arabic, Armenian, Balinese, Bengali, Bopomofo, Braille, Buginese, Buhid, Canadian_Aboriginal, Cherokee, Common, Coptic, Cuneiform, Cypriot, Cyrillic, Deseret, Devanagari, Ethiopic, Georgian, Glagolitic, Gothic, Greek, Gujarati, Gurmukhi, Han, Hangul, Hanunoo, Hebrew, Hiragana, Inherited, Kannada, Katakana, Kharoshthi, Khmer, Lao, Latin, Limbu, Linear_B, Malayalam, Mongolian, Myanmar, New_Tai_Lue, Nko, Ogham, Old_Italic, Old_Persian, Oriya, Osmanya, Phags_Pa, Phoenician, Runic, Shavian, Sinhala, Syloti_Nagri, Syriac, Tagalog, Tagbanwa, Tai_Le, Tamil, Telugu, Thaana, Thai, Tibetan, Tifinagh, Ugaritic, Yi.

Each character has exactly one general category property, specified by a two-letter abbreviation. For compatibility with Perl, negation can be specified by including a circumflex between the opening brace and the property name. For example, `'\p{~Lu}'` is the same as `'\P{Lu}'`.

If only one letter is specified with ‘\p’ or ‘\P’, it includes all the general category properties that start with that letter. In this case, in the absence of negation, the curly brackets in the escape sequence are optional; these two examples have the same effect:

```
\p{L}
\pL
```

The following general category property codes are supported:

C	Other
Cc	Control
Cf	Format
Cn	Unassigned
Co	Private use
Cs	Surrogate
L	Letter
Ll	Lower case letter
Lm	Modifier letter
Lo	Other letter
Lt	Title case letter
Lu	Upper case letter
M	Mark
Mc	Spacing mark
Me	Enclosing mark
Mn	Non-spacing mark
N	Number
Nd	Decimal number
Nl	Letter number
No	Other number
P	Punctuation
Pc	Connector punctuation
Pd	Dash punctuation
Pe	Close punctuation
Pf	Final punctuation
Pi	Initial punctuation
Po	Other punctuation
Ps	Open punctuation

S	Symbol
Sc	Currency symbol
Sk	Modifier symbol
Sm	Mathematical symbol
So	Other symbol
Z	Separator
Zl	Line separator
Zp	Paragraph separator
Zs	Space separator

The special property ‘**L&**’ is also supported: it matches a character that has the ‘**Lu**’, ‘**Ll**’, or ‘**Lt**’ property, in other words, a letter that is not classified as a modifier or “other.”

The ‘**Cs**’ (Surrogate) property applies only to characters in the range **U+D800** to **U+DFFF**. Such characters are not valid in UTF-8 strings (see RFC 3629) and so cannot be tested by PCRE.

The long synonyms for these properties that Perl supports (such as ‘**\p{Letter}**’) are not supported by PCRE, nor is it permitted to prefix any of these properties with ‘**Is**’.

No character that is in the Unicode table has the ‘**Cn**’ (unassigned) property. Instead, this property is assumed for any code point that is not in the Unicode table.

Specifying caseless matching does not affect these escape sequences. For example, ‘**\p{Lu}**’ always matches only upper case letters.

The ‘**\X**’ escape matches any number of Unicode characters that form an extended Unicode sequence. ‘**\X**’ is equivalent to

```
(?>\PM\pM*)
```

That is, it matches a character without the “mark” property, followed by zero or more characters with the “mark” property, and treats the sequence as an atomic group (see below). Characters with the “mark” property are typically accents that affect the preceding character. None of them have codepoints less than 256, so in non-UTF-8 mode ‘**\X**’ matches any one character.

Matching characters by Unicode property is not fast, because PCRE has to search a structure that contains data for over fifteen thousand characters. That is why the traditional escape sequences such as ‘**\d**’ and ‘**\w**’ do not use Unicode properties in PCRE.

Resetting the Match Start

The escape sequence ‘**\K**’, which is a Perl 5.10 feature, causes any previously matched characters not to be included in the final matched sequence. For example, the pattern:

```
foo\Kbar
```

matches ‘**foobar**’, but reports that it has matched ‘**bar**’. This feature is similar to a lookbehind assertion (described below). However, in this case, the part of the subject before the real match does not have to be of fixed length, as lookbehind assertions do. The use of ‘**\K**’ does not interfere with the setting of captured substrings. For example, when the pattern

`(foo)\Kbar`

matches `'foobar'`, the first substring is still set to `'foo'`.

Simple assertions

The final use of backslash is for certain simple assertions. An assertion specifies a condition that has to be met at a particular point in a match, without consuming any characters from the subject string. The use of subpatterns for more complicated assertions is described below. The backslashed assertions are:

<code>\b</code>	matches at a word boundary
<code>\B</code>	matches when not at a word boundary
<code>\A</code>	matches at the start of the subject
<code>\Z</code>	matches at the end of the subject also matches before a newline at the end of the subject
<code>\z</code>	matches only at the end of the subject
<code>\G</code>	matches at the first matching position in the subject

These assertions may not appear in character classes (but note that `'\b'` has a different meaning, namely the backspace character, inside a character class).

A word boundary is a position in the subject string where the current character and the previous character do not both match `'\w'` or `'\W'` (i.e. one matches `'\w'` and the other matches `'\W'`), or the start or end of the string if the first or last character matches `'\w'`, respectively.

The `'\A'`, `'\Z'`, and `'\z'` assertions differ from the traditional circumflex and dollar (described in the next section) in that they only ever match at the very start and end of the subject string, whatever options are set. Thus, they are independent of multiline mode. The difference between `'\Z'` and `'\z'` is that `'\Z'` matches before a newline at the end of the string as well as at the very end, whereas `'\z'` matches only at the end.

The `'\G'` assertion is true only when the current matching position is at the start point of the match. As used in Monotone, `'\G'` is always equal to `'\A'`.

Circumflex and Dollar

Outside a character class, in the default matching mode, the circumflex character, `'^'`, is an assertion that is true only if the current matching point is at the start of the subject string. Inside a character class, circumflex has an entirely different meaning (see below).

Circumflex need not be the first character of the pattern if a number of alternatives are involved, but it should be the first thing in each alternative in which it appears if the pattern is ever to match that branch. If all possible alternatives start with a circumflex, that is, if the pattern is constrained to match only at the start of the subject, it is said to be an “anchored” pattern. (There are also other constructs that can cause a pattern to be anchored.)

A dollar character, `'$'`, is an assertion that is true only if the current matching point is at the end of the subject string, or immediately before a newline at the end of the string (by default). Dollar need not be the last character of the pattern if a number of alternatives

are involved, but it should be the last item in any branch in which it appears. Dollar has no special meaning in a character class.

The meanings of the circumflex and dollar characters are changed if the ‘(?m)’ option is set. When this is the case, a circumflex matches immediately after internal newlines as well as at the start of the subject string. It does not match after a newline that ends the string. A dollar matches before any newlines in the string, as well as at the very end, when ‘(?m)’ is set. When newline is specified as the two-character sequence `CRLF`, isolated `CR` and `LF` characters do not indicate newlines.

For example, the pattern ‘`^abc$`’ matches the subject string ‘`def\nabc`’ (where ‘`\n`’ represents a newline) in multiline mode, but not otherwise. Consequently, patterns that are anchored in single line mode because all branches start with `^` are not anchored in multiline mode.

Note that the sequences ‘`\A`’, ‘`\Z`’, and ‘`\z`’ can be used to match the start and end of the subject in both modes, and if all branches of a pattern start with ‘`\A`’ it is always anchored.

Full Stop (Period, Dot)

Outside a character class, a dot in the pattern matches any one character in the subject string except (by default) a character that signifies the end of a line. In UTF-8 mode, the matched character may be more than one byte long.

When a line ending is defined as a single character, dot never matches that character; when the two-character sequence `CRLF` is used, dot does not match `CR` if it is immediately followed by `LF`, but otherwise it matches all characters (including isolated `CR`s and `LF`s). When any Unicode line endings are being recognized, dot does not match `CR` or `LF` or any of the other line ending characters.

The behaviour of dot with regard to newlines can be changed. If the ‘(?s)’ option is set, a dot matches any one character, without exception. If the two-character sequence `CRLF` is present in the subject string, it takes two dots to match it.

The handling of dot is entirely independent of the handling of circumflex and dollar, the only relationship being that they both involve newlines. Dot has no special meaning in a character class.

Matching a Single Byte

Outside a character class, the escape sequence ‘`\C`’ matches any one byte, both in and out of UTF-8 mode. Unlike a dot, it always matches any line-ending characters. The feature is provided in Perl in order to match individual bytes in UTF-8 mode. Because it breaks up UTF-8 characters into individual bytes, what remains in the string may be a malformed UTF-8 string. For this reason, the ‘`\C`’ escape sequence is best avoided.

PCRE does not allow ‘`\C`’ to appear in lookbehind assertions (described below), because in UTF-8 mode this would make it impossible to calculate the length of the lookbehind.

Square Brackets and Character Classes

An opening square bracket introduces a character class, terminated by a closing square bracket. A closing square bracket on its own is not special. If a closing square bracket is required as a member of the class, it should be the first data character in the class (after an initial circumflex, if present) or escaped with a backslash.

A character class matches a single character in the subject. In UTF-8 mode, the character may occupy more than one byte. A matched character must be in the set of characters defined by the class, unless the first character in the class definition is a circumflex, in which case the subject character must not be in the set defined by the class. If a circumflex is actually required as a member of the class, ensure it is not the first character, or escape it with a backslash.

For example, the character class `[aeiou]` matches any lower case vowel, while `[^aeiou]` matches any character that is not a lower case vowel. Note that a circumflex is just a convenient notation for specifying the characters that are in the class by enumerating those that are not. A class that starts with a circumflex is not an assertion: it still consumes a character from the subject string, and therefore it fails if the current pointer is at the end of the string.

In UTF-8 mode, characters with values greater than 255 can be included in a class as a literal string of bytes, or by using the `\x{}` escaping mechanism.

When caseless matching is set, any letters in a class represent both their upper case and lower case versions, so for example, a caseless `[aeiou]` matches `'A'` as well as `'a'`, and a caseless `[^aeiou]` does not match `'A'`, whereas a careful version would. In UTF-8 mode, PCRE always understands the concept of case for characters whose values are less than 128, so caseless matching is always possible. For characters with higher values, the concept of case is supported if PCRE is compiled with Unicode property support, but not otherwise. If you want to use caseless matching for characters 128 and above, you must ensure that PCRE is compiled with Unicode property support as well as with UTF-8 support.

Characters that might indicate line breaks are never treated in any special way when matching character classes, whatever line-ending sequence is in use, and whatever setting of the `(?s)` and `(?m)` options is used. A class such as `[^a]` always matches one of these characters.

The minus (hyphen) character can be used to specify a range of characters in a character class. For example, `[d-m]` matches any letter between `'d'` and `'m'`, inclusive. If a minus character is required in a class, it must be escaped with a backslash or appear in a position where it cannot be interpreted as indicating a range, typically as the first or last character in the class.

It is not possible to have the literal character `']'` as the end character of a range. A pattern such as `[W-]46]` is interpreted as a class of two characters (`'W'` and `'-'`) followed by a literal string `'46']`, so it would match `'W46']` or `'-46']`. However, if the `']'` is escaped with a backslash it is interpreted as the end of range, so `[W-\]46]` is interpreted as a class containing a range followed by two other characters. The octal or hexadecimal representation of `']'` can also be used to end a range.

Ranges operate in the collating sequence of character values. They can also be used for characters specified numerically, for example `[\000-\037]`. In UTF-8 mode, ranges can include characters whose values are greater than 255, for example `[\x{100}-\x{2ff}]`.

If a range that includes letters is used when caseless matching is set, it matches the letters in either case. For example, `[W-c]` is equivalent to `[[] [\^_ 'wxyzabc]`, matched caselessly.

The character types `'\d'`, `'\D'`, `'\p'`, `'\P'`, `'\s'`, `'\S'`, `'\w'`, and `'\W'` may also appear in a character class, and add the characters that they match to the class. For example,

`[\dABCDEF]` matches any hexadecimal digit. A circumflex can conveniently be used with the upper case character types to specify a more restricted set of characters than the matching lower case type. For example, the class `[\W_]` matches any letter or digit, but not underscore.

The only metacharacters that are recognized in character classes are backslash, hyphen (only where it can be interpreted as specifying a range), circumflex (only at the start), opening square bracket (only when it can be interpreted as introducing a POSIX class name—see the next section), and the terminating closing square bracket. However, escaping other non-alphanumeric characters does no harm.

POSIX Character Classes

Perl supports the POSIX notation for character classes. This uses names enclosed by `[:]` and `:]` within the enclosing square brackets. PCRE also supports this notation. For example,

```
[01[:alpha:]]
```

matches `'0'`, `'1'`, any alphabetic character, or `'%'`. The supported class names are

<code>alnum</code>	letters and digits
<code>alpha</code>	letters
<code>ascii</code>	character codes 0 – 127
<code>blank</code>	space or tab only
<code>cntrl</code>	control characters
<code>digit</code>	decimal digits (same as <code>'\d'</code>)
<code>graph</code>	printing characters, excluding space
<code>lower</code>	lower case letters
<code>print</code>	printing characters, including space
<code>punct</code>	printing characters, excluding letters and digits
<code>space</code>	white space (not quite the same as <code>'\s'</code>)
<code>upper</code>	upper case letters
<code>word</code>	“word” characters (same as <code>'\w'</code>)
<code>xdigit</code>	hexadecimal digits

The “space” characters are HT (9), LF (10), VT (11), FF (12), CR (13), and space (32). Notice that this list includes the VT character (code 11). This makes “space” different to `'\s'`, which does not include VT (for Perl compatibility).

The name “word” is a Perl extension, and “blank” is a GNU extension from Perl 5.8. Another Perl extension is negation, which is indicated by a `^` character after the colon. For example,

```
[12[:^digit:]]
```

matches `'1'`, `'2'`, or any non-digit. PCRE (and Perl) also recognize the POSIX syntax `[.ch.]` and `[=ch=]` where *ch* is a “collating element,” but these are not supported, and an error is given if they are encountered.

In UTF-8 mode, characters with values greater than 128 do not match any of the POSIX character classes.

Vertical Bar

Vertical bar characters are used to separate alternative patterns. For example, the pattern

```
gilbert|sullivan
```

matches either `'gilbert'` or `'sullivan'`. Any number of alternatives may appear, and an empty alternative is permitted (matching the empty string). The matching process tries each alternative in turn, from left to right, and the first one that succeeds is used. If the alternatives are within a subpattern (defined below), "succeeds" means matching the rest of the main pattern as well as the alternative in the subpattern.

Internal Option Setting

The behavior of the matching engine can be adjusted from within the pattern by a sequence of option letters enclosed between `'(?'` and `)'`. The option letters are

- | | |
|---|--|
| i | Caseless: characters in one case match the corresponding characters in other cases as well. |
| m | Multiline: <code>'^'</code> and <code>'\$'</code> match at newlines as well as at beginning and end of string. |
| s | Dotall: dot matches any character, including newline characters. |
| x | Extended syntax: unescaped white space is ignored and embedded comments are possible. |
| J | Dupnames: names for capturing subpattern need not be unique. |
| U | Ungreedy: quantifiers match as few times as possible by default. |
| X | Extra: for forward compatibility, give an error if any escape sequence with no defined meaning appears. |

For example, `'(?im)'` sets caseless, multiline matching. It is also possible to unset these options by preceding the letters with a hyphen, and a combined setting and unsetting such as `'(?im-sx)'` is also permitted. (This would set the caseless and multiline options while unsetting the dotall and extended-syntax options.) If a letter appears both before and after the hyphen, the option is unset. The lowercase option letters are Perl-compatible; the uppercase ones are PCRE only.

When an option change occurs at top level (that is, not inside subpattern parentheses), the change applies to the remainder of the pattern that follows. An option change within a subpattern (see below for a description of subpatterns) affects only that part of the current pattern that follows it, so

```
(a(?i)b)c
```

matches `'abc'` and `'aBc'` and no other strings. By this means, options can be made to have different settings in different parts of the pattern. Any changes made in one alternative do carry on into subsequent branches within the same subpattern. For example,

```
(a(?i)b|c)
```

matches ‘ab’, ‘aB’, ‘c’, and ‘C’, even though when matching ‘C’ the first branch is abandoned before the option setting. This is because the effects of option settings happen when the pattern is parsed. There would be some very weird behaviour otherwise.

Note: Unlike these options, the similar, PCRE-specific option sequences that start with ‘(*)’ may appear only at the very beginning of the pattern. Details of these sequences are given in the section entitled “Newline sequences,” above.

Subpatterns

Subpatterns are delimited by parentheses (round brackets), which can be nested. Turning part of a pattern into a subpattern does two things:

1. It localizes a set of alternatives. For example, the pattern

```
cat(aract|erpillar|)
```

matches one of the words ‘cat’, ‘cactaract’, or ‘caterpillar’. Without the parentheses, it would match ‘cactaract’, ‘erpillar’ or an empty string.

2. It sets up the subpattern as a capturing subpattern. As used in Monotone this only means that during matching, the portion of the subject string that matched the subpattern is available for back references. Captured subpatterns are, for instance, not available to callers of `regex.search`. Opening parentheses are counted from left to right (starting from 1) to obtain numbers for the capturing subpatterns.

For example, if the string ‘the red king’ is matched against the pattern

```
the ((red|white) (king|queen))
```

the captured substrings are ‘red king’, ‘red’, and ‘king’, and are numbered 1, 2, and 3, respectively.

The fact that plain parentheses fulfil two functions is not always helpful. There are often times when a grouping subpattern is required without a capturing requirement. If an opening parenthesis is followed by a question mark and a colon, the subpattern does not do any capturing, and is not counted when computing the number of any subsequent capturing subpatterns. For example, if the string ‘the white queen’ is matched against the pattern

```
the ((?:red|white) (king|queen))
```

the captured substrings are ‘white queen’ and ‘queen’, and are numbered 1 and 2. The maximum number of capturing subpatterns is 65535.

As a convenient shorthand, if any option settings are required at the start of a non-capturing subpattern, the option letters may appear between the ‘?’ and the ‘:’. Thus the two patterns

```
(?i:saturday|sunday)
(?:(?i)saturday|sunday)
```

match exactly the same set of strings. Because alternative branches are tried from left to right, and options are not reset until the end of the subpattern is reached, an option setting in one branch does affect subsequent branches, so the above patterns match ‘SUNDAY’ as well as ‘Saturday’.

Duplicate Subpattern Numbers

Perl 5.10 introduced a feature whereby each alternative in a subpattern uses the same numbers for its capturing parentheses. Such a subpattern starts with ‘(?!’ and is itself a non-capturing subpattern. For example, consider this pattern:

```
(?!(Sat)ur|(Sun))day
```

Because the two alternatives are inside a ‘(?!’ group, both sets of capturing parentheses are numbered one. Thus, when the pattern matches, you can look at captured substring number one, whichever alternative matched. This construct is useful when you want to capture part, but not all, of one of a number of alternatives. Inside a ‘(?!’ group, parentheses are numbered as usual, but the number is reset at the start of each branch. The numbers of any capturing buffers that follow the subpattern start after the highest number used in any branch. The following example is taken from the Perl documentation. The numbers underneath show in which buffer the captured content will be stored.

```
# before -----branch-reset----- after
/ ( a ) (?! x ( y ) z | (p (q) r) | (t) u (v) ) ( z ) /x
# 1           2           2 3           2     3     4
```

A backreference or a recursive call to a numbered subpattern always refers to the first one in the pattern with the given number.

An alternative approach to using this “branch reset” feature is to use duplicate named subpatterns, as described in the next section.

Named Subpatterns

Identifying capturing parentheses by number is simple, but it can be very hard to keep track of the numbers in complicated regular expressions. Furthermore, if an expression is modified, the numbers may change. To help with this difficulty, PCRE supports the naming of subpatterns. This feature was not added to Perl until release 5.10. Python had the feature earlier, and PCRE introduced it at release 4.0, using the Python syntax. PCRE now supports both the Perl and the Python syntax.

In PCRE, a subpattern can be named in one of three ways: ‘(?<name>...)’ or ‘(?’name’...)’ as in Perl, or ‘(?P<name>...)’ as in Python. References to capturing parentheses from other parts of the pattern, such as backreferences, recursion, and conditions, can be made by name as well as by number.

Names consist of up to 32 alphanumeric characters and underscores. Named capturing parentheses are still allocated numbers as well as names, exactly as if the names were not present.

By default, a name must be unique within a pattern, but it is possible to relax this constraint by setting the ‘(?J)’ option. This can be useful for patterns where only one instance of the named parentheses can match. Suppose you want to match the name of a weekday, either as a 3-letter abbreviation or as the full name, and in both cases you want to extract the abbreviation. This pattern (ignoring the line breaks) does the job:

```
(?Jx)
(?<DN>Mon|Fri|Sun)(?:day)?|
(?<DN>Tue)(?:sday)?|
(?<DN>Wed)(?:nesday)?|
```

```
(?<DN>Thu)(?:rday)?|
(?<DN>Sat)(?:urday)?
```

There are five capturing substrings, but only one is ever set after a match. (An alternative way of solving this problem is to use a “branch reset” subpattern, as described in the previous section.)

Repetition

Repetition is specified by *quantifiers*, which can follow any of the following items:

- a literal data character
- the dot metacharacter
- the ‘\C’ escape sequence
- the ‘\X’ escape sequence (in UTF-8 mode with Unicode properties)
- the ‘\R’ escape sequence
- an escape such as ‘\d’ that matches a single character
- a character class
- a back reference (see next section)
- a parenthesized subpattern (unless it is an assertion)

The general repetition quantifier specifies a minimum and maximum number of permitted matches, by giving the two numbers in curly brackets (braces), separated by a comma. The numbers must be less than 65536, and the first must be less than or equal to the second. For example:

```
z{2,4}
```

matches ‘zz’, ‘zzz’, or ‘zzzz’. A closing brace on its own is not a special character. If the second number is omitted, but the comma is present, there is no upper limit; if the second number and the comma are both omitted, the quantifier specifies an exact number of required matches. Thus

```
[aeiou]{3,}
```

matches at least 3 successive vowels, but may match many more, while

```
\d{8}
```

matches exactly 8 digits. An opening curly bracket that appears in a position where a quantifier is not allowed, or one that does not match the syntax of a quantifier, is taken as a literal character. For example, ‘{,6}’ is not a quantifier, but a literal string of four characters.

In UTF-8 mode, quantifiers apply to UTF-8 characters rather than to individual bytes. Thus, for example, ‘\x{100}{2}’ matches two UTF-8 characters, each of which is represented by a two-byte sequence. Similarly, ‘\X{3}’ matches three Unicode extended sequences, each of which may be several bytes long (and they may be of different lengths).

The quantifier ‘{0}’ is permitted, causing the expression to behave as if the previous item and the quantifier were not present.

For convenience, the three most common quantifiers have single-character abbreviations:

* is equivalent to {0,}

+ is equivalent to {1,}
 ? is equivalent to {0,1}

It is possible to construct infinite loops by following a subpattern that can match no characters with a quantifier that has no upper limit, for example:

```
(a?)*
```

Earlier versions of Perl and PCRE used to give an error at compile time for such patterns. However, because there are cases where this can be useful, such patterns are now accepted, but if any repetition of the subpattern does in fact match no characters, the loop is forcibly broken.

By default, the quantifiers are *greedy*, that is, they match as much as possible (up to the maximum number of permitted times), without causing the rest of the pattern to fail. The classic example of where this gives problems is in trying to match comments in C programs. These appear between `/*` and `*/`, and within the comment, individual `*` and `/` characters may appear. An attempt to match C comments by applying the pattern

```
/\*.*\*/
```

to the string

```
/* first comment */ not comment /* second comment */
```

fails, because it matches the entire string owing to the greediness of the `.*` item.

However, if a quantifier is followed by a question mark, it ceases to be greedy, and instead matches the minimum number of times possible, so the pattern

```
/\*.*?\*/
```

does the right thing with the C comments. The meaning of the various quantifiers is not otherwise changed, just the preferred number of matches. Do not confuse this use of question mark with its use as a quantifier in its own right. Because it has two uses, it can sometimes appear doubled, as in

```
\d??\d
```

which matches one digit by preference, but can match two if that is the only way the rest of the pattern matches.

If the `(?U)` option is set (an option that is not available in Perl), the quantifiers are not greedy by default, but individual ones can be made greedy by following them with a question mark. In other words, it inverts the default behaviour.

When a parenthesized subpattern is quantified with a minimum repeat count that is greater than 1 or with a limited maximum, more memory is required for the compiled pattern, in proportion to the size of the minimum or maximum.

If a pattern starts with `.*` or `{0,}` and the `(?s)` option is set, thus allowing the dot to match newlines, the pattern is implicitly anchored, because whatever follows will be tried against every character position in the subject string, so there is no point in retrying the overall match at any position after the first. PCRE normally treats such a pattern as though it were preceded by `\A`.

In cases where it is known that the subject string contains no newlines, it is worth setting `(?s)` in order to obtain this optimization, or alternatively using `^` or `\A` to indicate anchoring explicitly.

However, there is one situation where the optimization cannot be used. When `.*` is inside capturing parentheses that are the subject of a backreference elsewhere in the pattern, a match at the start may fail where a later one succeeds. Consider, for example:

```
(.*)abc\1
```

If the subject is `'xyz123abc123'` the match point is the fourth character. For this reason, such a pattern is not implicitly anchored.

When a capturing subpattern is repeated, the value captured is the substring that matched the final iteration. For example, after

```
(tweedle[dume]{3}\s*)+
```

has matched `'tweedledum tweedledee'` the value of the captured substring is `'tweedledee'`. However, if there are nested capturing subpatterns, the corresponding captured values may have been set in previous iterations. For example, after

```
(a|(b))+
```

matches `'aba'` the value of the second captured substring is `'b'`.

Atomic Grouping and Possessive Quantifiers

With both maximizing (*greedy*) and minimizing (*ungreedy* or *lazy*) repetition, failure of what follows normally causes the repeated item to be re-evaluated to see if a different number of repeats allows the rest of the pattern to match. Sometimes it is useful to prevent this, either to change the nature of the match, or to cause it fail earlier than it otherwise might, when the author of the pattern knows there is no point in carrying on.

Consider, for example, the pattern `'\d+foo'` when applied to the subject line

```
123456bar
```

After matching all 6 digits and then failing to match `'foo'`, the normal action of the matcher is to try again with only 5 digits matching the `'\d+'` item, and then with 4, and so on, before ultimately failing. *Atomic grouping* (a term taken from Jeffrey Friedl's book) provides the means for specifying that once a subpattern has matched, it is not to be re-evaluated in this way.

If we use atomic grouping for the previous example, the matcher gives up immediately on failing to match `'foo'` the first time. The notation is a kind of special parenthesis, starting with `'(?:>'` as in this example:

```
(?>\d+)foo
```

This kind of parenthesis “locks up” the part of the pattern it contains once it has matched, and a failure further into the pattern is prevented from backtracking into it. Backtracking past it to previous items, however, works as normal. Atomic grouping subpatterns are not capturing subpatterns.

An alternative description is that a subpattern of this type matches the string of characters that an identical standalone pattern would match, if anchored at the current point in the subject string.

Simple cases such as the above example can be thought of as a maximizing repeat that must swallow everything it can. So, while both `'\d+'` and `'\d+?'` are prepared to adjust the number of digits they match in order to make the rest of the pattern match, `'(?:>\d+)'` can only match an entire sequence of digits.

Atomic groups in general can of course contain arbitrarily complicated subpatterns, and can be nested. However, when the subpattern for an atomic group is just a single repeated item, as in the example above, a simpler notation, called a *possessive quantifier*, can be used. This consists of an additional ‘+’ character following a quantifier. Using this notation, the previous example can be rewritten as

```
\d++foo
```

Note that a possessive quantifier can be used with an entire group, for example:

```
(abc|xyz){2,3}+
```

Possessive quantifiers are always greedy; the setting of the ‘(?U)’ option is ignored. They are a convenient notation for the simpler forms of atomic group. However, there is no difference in the meaning of a possessive quantifier and the equivalent atomic group, though there may be a performance difference; possessive quantifiers should be slightly faster.

The possessive quantifier syntax is an extension to the Perl 5.8 syntax. Jeffrey Friedl originated the idea (and the name) in the first edition of his book. Mike McCloskey liked it, so implemented it when he built Sun’s Java package, and PCRE copied it from there. It ultimately found its way into Perl at release 5.10.

PCRE has an optimization that automatically “possessifies” certain simple pattern constructs. For example, the sequence ‘A+B’ is treated as ‘A++B’ because there is no point in backtracking into a sequence of ‘A’s when ‘B’ must follow.

When a pattern contains an unlimited repeat inside a subpattern that can itself be repeated an unlimited number of times, the use of an atomic group is the only way to avoid some failing matches taking a very long time indeed. The pattern

```
(\D+|<\d+>)*[!?]
```

matches an unlimited number of substrings that either consist of non-digits, or digits enclosed in ‘<>’, followed by either ‘!’ or ‘?’. When it matches, it runs quickly. However, if it is applied to

```
aaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaa
```

it takes a long time before reporting failure. This is because the string can be divided between the internal ‘\D+’ repeat and the external ‘*’ repeat in a large number of ways, and all have to be tried. (The example uses ‘[!?’ rather than a single character at the end, because both PCRE and Perl have an optimization that allows for fast failure when a single character is used. They remember the last single character that is required for a match, and fail early if it is not present in the string.) If the pattern is changed so that it uses an atomic group, like this:

```
((?>\D+)|<\d+>)*[!?]
```

sequences of non-digits cannot be broken, and failure happens quickly.

Back References

Outside a character class, a backslash followed by a digit greater than 0 (and possibly further digits) is a back reference to a capturing subpattern earlier (that is, to its left) in the pattern, provided there have been that many previous capturing left parentheses.

However, if the decimal number following the backslash is less than 10, it is always taken as a back reference, and causes an error only if there are not that many capturing left parentheses in the entire pattern. In other words, the parentheses that are referenced need

not be to the left of the reference for numbers less than 10. A “forward back reference” of this type can make sense when a repetition is involved and the subpattern to the right has participated in an earlier iteration.

It is not possible to have a numerical “forward back reference” to a subpattern whose number is 10 or more using this syntax because a sequence such as ‘\50’ is interpreted as a character defined in octal. See the subsection entitled “Non-printing characters” above for further details of the handling of digits following a backslash. There is no such problem when named parentheses are used. A back reference to any subpattern is possible using named parentheses (see below).

Another way of avoiding the ambiguity inherent in the use of digits following a backslash is to use the ‘\g’ escape sequence, which is a feature introduced in Perl 5.10. This escape must be followed by an unsigned number or a negative number, optionally enclosed in braces. These examples are all identical:

```
(ring), \1
(ring), \g1
(ring), \g{1}
```

An unsigned number specifies an absolute reference without the ambiguity that is present in the older syntax. It is also useful when literal digits follow the reference. A negative number is a relative reference. Consider this example:

```
(abc(def)ghi)\g{-1}
```

The sequence ‘\g{-1}’ is a reference to the most recently started capturing subpattern before ‘\g’, that is, it is equivalent to ‘\2’. Similarly, ‘\g{-2}’ would be equivalent to ‘\1’. The use of relative references can be helpful in long patterns, and also in patterns that are created by joining together fragments that contain references within themselves.

A back reference matches whatever actually matched the capturing subpattern in the current subject string, rather than anything matching the subpattern itself (see “Subpatterns as subroutines” below for a way of doing that). So the pattern

```
(sens|respons)e and \1ibility
```

matches ‘sense and sensibility’ and ‘response and responsibility’, but not ‘sense and responsibility’. If careful matching is in force at the time of the back reference, the case of letters is relevant. For example,

```
((?i)rah)\s+\1
```

matches ‘rah rah’ and ‘RAH RAH’, but not ‘RAH rah’, even though the original capturing subpattern is matched caselessly.

There are several different ways of writing back references to named subpatterns. The .NET syntax ‘\k{name}’ and the Perl syntax ‘\k<name>’ or ‘\k’name’ are supported, as is the Python syntax ‘(?P=name)’. Perl 5.10’s unified back reference syntax, in which ‘\g’ can be used for both numeric and named references, is also supported. We could rewrite the above example in any of the following ways:

```
(?<p1>(i)rah)\s+\k<p1>
(?’p1’(i)rah)\s+\k{p1}
(?P<p1>(i)rah)\s+(?P=p1)
(?<p1>(i)rah)\s+\g{p1}
```

A subpattern that is referenced by name may appear in the pattern before or after the reference.

There may be more than one back reference to the same subpattern. If a subpattern has not actually been used in a particular match, any back references to it always fail. For example, the pattern

```
(a|(bc))\2
```

always fails if it starts to match ‘a’ rather than ‘bc’. Because there may be many capturing parentheses in a pattern, all digits following the backslash are taken as part of a potential back reference number. If the pattern continues with a digit character, some delimiter must be used to terminate the back reference. If the ‘(?x)’ option is set, this can be whitespace. Otherwise an empty comment (see “Comments” below) can be used.

A back reference that occurs inside the parentheses to which it refers fails when the subpattern is first used, so, for example, ‘(a\1)’ never matches. However, such references can be useful inside repeated subpatterns. For example, the pattern

```
(a|b\1)+
```

matches any number of ‘a’s and also ‘aba’, ‘ababbaa’ etc. At each iteration of the subpattern, the back reference matches the character string corresponding to the previous iteration. In order for this to work, the pattern must be such that the first iteration does not need to match the back reference. This can be done using alternation, as in the example above, or by a quantifier with a minimum of zero.

Assertions

An assertion is a test on the characters following or preceding the current matching point that does not actually consume any characters. The simple assertions coded as ‘\b’, ‘\B’, ‘\A’, ‘\G’, ‘\Z’, ‘\z’, ‘^’ and ‘\$’ are described above.

More complicated assertions are coded as subpatterns. There are two kinds: those that look ahead of the current position in the subject string, and those that look behind it. An assertion subpattern is matched in the normal way, except that it does not cause the current matching position to be changed.

Assertion subpatterns are not capturing subpatterns, and may not be repeated, because it makes no sense to assert the same thing several times. If any kind of assertion contains capturing subpatterns within it, these are counted for the purposes of numbering the capturing subpatterns in the whole pattern. However, substring capturing is carried out only for positive assertions, because it does not make sense for negative assertions.

Lookahead Assertions

Lookahead assertions start with ‘(?=’ for positive assertions and ‘(?!’ for negative assertions. For example,

```
\w+(?=;)
```

matches a word followed by a semicolon, but does not include the semicolon in the match, and

```
foo(?!bar)
```

matches any occurrence of ‘foo’ that is not followed by ‘bar’. Note that the apparently similar pattern

```
(?!foo)bar
```

does not find an occurrence of ‘**bar**’ that is preceded by something other than ‘**foo**’; it finds any occurrence of ‘**bar**’ whatsoever, because the assertion ‘(?!foo)’ is always true when the next three characters are ‘**bar**’. A lookbehind assertion is needed to achieve the other effect.

If you want to force a matching failure at some point in a pattern, the most convenient way to do it is with ‘(?!)’ because an empty string always matches, so an assertion that requires there not to be an empty string must always fail.

Lookbehind Assertions

Lookbehind assertions start with ‘(?<=’ for positive assertions and ‘(?<!’ for negative assertions. For example,

```
(?<!foo)bar
```

matches an occurrence of ‘**bar**’ that is not preceded by ‘**foo**’. The contents of a lookbehind assertion are restricted such that all the strings it matches must have a fixed length. However, if there are several top-level alternatives, they do not all have to have the same fixed length. Thus

```
(?<=bullock|donkey)
```

is permitted, but

```
(?<!dogs?|cats?)
```

causes an error at compile time. Branches that match different length strings are permitted only at the top level of a lookbehind assertion. This is an extension compared with Perl (at least for 5.8), which requires all branches to match the same length of string. An assertion such as

```
(?<=ab(c|de))
```

is not permitted, because its single top-level branch can match two different lengths, but it is acceptable if rewritten to use two top-level branches:

```
(?<=abc|abde)
```

In some cases, the Perl 5.10 escape sequence ‘\K’ (see above) can be used instead of a lookbehind assertion; this is not restricted to a fixed-length.

The implementation of lookbehind assertions is, for each alternative, to temporarily move the current position back by the fixed length and then try to match. If there are insufficient characters before the current position, the assertion fails.

PCRE does not allow the ‘\C’ escape (which matches a single byte in UTF-8 mode) to appear in lookbehind assertions, because it makes it impossible to calculate the length of the lookbehind. The ‘\X’ and ‘\R’ escapes, which can match different numbers of bytes, are also not permitted.

Possessive quantifiers can be used in conjunction with lookbehind assertions to specify efficient matching at the end of the subject string. Consider a simple pattern such as

```
abcd$
```

when applied to a long string that does not match. Because matching proceeds from left to right, PCRE will look for each ‘**a**’ in the subject and then see if what follows matches the rest of the pattern. If the pattern is specified as

```
^.*abcd$
```

the initial ‘`.*`’ matches the entire string at first, but when this fails (because there is no following ‘`a`’), it backtracks to match all but the last character, then all but the last two characters, and so on. Once again the search for ‘`a`’ covers the entire string, from right to left, so we are no better off. However, if the pattern is written as

```
^.*+(?<=abcd)
```

there can be no backtracking for the ‘`.*+`’ item; it can match only the entire string. The subsequent lookbehind assertion does a single test on the last four characters. If it fails, the match fails immediately. For long strings, this approach makes a significant difference to the processing time.

Using multiple assertions

Several assertions (of any sort) may occur in succession. For example,

```
(?<=\d{3})(?<!999)foo
```

matches ‘`foo`’ preceded by three digits that are not ‘`999`’. Notice that each of the assertions is applied independently at the same point in the subject string. First there is a check that the previous three characters are all digits, and then there is a check that the same three characters are not ‘`999`’. This pattern does *not* match ‘`foo`’ preceded by six characters, the first of which are digits and the last three of which are not ‘`999`’. For example, it doesn’t match ‘`123abcfoo`’. A pattern to do that is

```
(?<=\d{3}...)(?<!999)foo
```

This time the first assertion looks at the preceding six characters, checking that the first three are digits, and then the second assertion checks that the preceding three characters are not ‘`999`’.

Assertions can be nested in any combination. For example,

```
(?<=(?<!foo)bar)baz
```

matches an occurrence of ‘`baz`’ that is preceded by ‘`bar`’ which in turn is not preceded by ‘`foo`’, while

```
(?<=\d{3}(?!999)... )foo
```

is another pattern that matches ‘`foo`’ preceded by three digits and any three characters that are not ‘`999`’.

Conditional Subpatterns

It is possible to cause the matching process to obey a subpattern conditionally or to choose between two alternative subpatterns, depending on the result of an assertion, or whether a previous capturing subpattern matched or not. The two possible forms of conditional subpattern are

- `(?(condition)yes-pattern)`
- `(?(condition)yes-pattern|no-pattern)`

If the *condition* is satisfied, the *yes-pattern* is used; otherwise the *no-pattern* (if present) is used. If there are more than two alternatives in the subpattern, a compile-time error occurs.

There are four kinds of condition: references to subpatterns, references to recursion, a pseudo-condition called ‘`DEFINE`’, and assertions.

Checking for a used subpattern by number

If the text between the parentheses consists of a sequence of digits, the condition is true if the capturing subpattern of that number has previously matched. An alternative notation is to precede the digits with a plus or minus sign. In this case, the subpattern number is relative rather than absolute. The most recently opened parentheses can be referenced by ‘(?(-1))’, the next most recent by ‘(?(-2))’, and so on. In looping constructs it can also make sense to refer to subsequent groups with constructs such as ‘?(+2)’.

Consider the following pattern, which contains non-significant white space to make it more readable and to divide it into three parts for ease of discussion (assume a preceding ‘(?x)’):

```
( \ ( ) ?    [ ^ ( ) ] +    ( ? ( 1 ) \ ) )
```

The first part matches an optional opening parenthesis, and if that character is present, sets it as the first captured substring. The second part matches one or more characters that are not parentheses. The third part is a conditional subpattern that tests whether the first set of parentheses matched or not. If they did, that is, if subject started with an opening parenthesis, the condition is true, and so the yes-pattern is executed and a closing parenthesis is required. Otherwise, since no-pattern is not present, the subpattern matches nothing. In other words, this pattern matches a sequence of non-parentheses, optionally enclosed in parentheses.

If you were embedding this pattern in a larger one, you could use a relative reference:

```
...other stuff... ( \ ( ) ?    [ ^ ( ) ] +    ( ? ( - 1 ) \ ) ) ...
```

This makes the fragment independent of the parentheses in the larger pattern.

Checking for a used subpattern by name

Perl uses the syntax ‘(?(<name>)...)’ or ‘(?('name')...)’ to test for a used subpattern by name. For compatibility with earlier versions of PCRE, which had this facility before Perl, the syntax ‘(?(<name>)...)’ is also recognized. However, there is a possible ambiguity with this syntax, because subpattern names may consist entirely of digits. PCRE looks first for a named subpattern; if it cannot find one and the name consists entirely of digits, PCRE looks for a subpattern of that number, which must be greater than zero. Using subpattern names that consist entirely of digits is not recommended.

Rewriting the above example to use a named subpattern gives this:

```
( ? < OPEN > \ ( ) ?    [ ^ ( ) ] +    ( ? ( < OPEN > ) \ ) )
```

Checking for pattern recursion

If the condition is the string ‘(R)’ and there is no subpattern with the name ‘R’, the condition is true if a recursive call to the whole pattern or any subpattern has been made. If digits or a name preceded by ampersand follow the letter ‘R’, for example:

```
( ? ( R 3 ) ... ) or ( ? ( R & name ) ... )
```

the condition is true if the most recent recursion is into the subpattern whose number or name is given. This condition does not check the entire recursion stack.

At “top level,” all these recursion test conditions are false. Recursive patterns are described below.

Defining subpatterns for use by reference only

If the condition is the string ‘(DEFINE)’, and there is no subpattern with the name ‘DEFINE’, the condition is always false. In this case, there may be only one alternative in the subpattern. It is always skipped if control reaches this point in the pattern; the idea of DEFINE is that it can be used to define *subroutines* that can be referenced from elsewhere. (The use of subroutines is described below.) For example, a pattern to match an IPv4 address could be written like this (ignore whitespace and line breaks):

```
(?(DEFINE) (?<byte> 2[0-4]\d | 25[0-5] | 1\d\d | [1-9]?\d) )
\b (?&byte) (\.(?&byte)){3} \b
```

The first part of the pattern is a DEFINE group inside which a another group named "byte" is defined. This matches an individual component of an IPv4 address (a number less than 256). When matching takes place, this part of the pattern is skipped because DEFINE acts like a false condition.

The rest of the pattern uses references to the named group to match the four dot-separated components of an IPv4 address, insisting on a word boundary at each end.

Assertion conditions

If the condition is not in any of the above formats, it must be an assertion. This may be a positive or negative lookahead or lookbehind assertion. Consider this pattern, again containing non-significant white space, and with the two alternatives on the second line:

```
(?(?=[^a-z]*[a-z])
\d{2}-[a-z]{3}-\d{2} | \d{2}-\d{2}-\d{2} )
```

The condition is a positive lookahead assertion that matches an optional sequence of non-letters followed by a letter. In other words, it tests for the presence of at least one letter in the subject. If a letter is found, the subject is matched against the first alternative; otherwise it is matched against the second. This pattern matches strings in one of the two forms ‘*dd-aaa-dd*’ or ‘*dd-dd-dd*’, where *aaa* are letters and *dd* are digits.

Comments

The sequence ‘(?’ marks the start of a comment that continues up to the next closing parenthesis. Nested parentheses are not permitted. The characters that make up a comment play no part in the pattern matching at all.

If the ‘(?x)’ option is set, an unescaped ‘#’ character outside a character class introduces a comment that continues to immediately after the next newline in the pattern.

Recursive Patterns

Consider the problem of matching a string in parentheses, allowing for unlimited nested parentheses. Without the use of recursion, the best that can be done is to use a pattern that matches up to some fixed depth of nesting. It is not possible to handle an arbitrary nesting depth.

PCRE supports special syntax for recursion of the entire pattern, and also for individual subpattern recursion. After its introduction in PCRE and Python, this kind of recursion was introduced into Perl at release 5.10.

A special item that consists of ‘(?)’ followed by a number greater than zero and a closing parenthesis is a recursive call of the subpattern of the given number, provided that it occurs

inside that subpattern. (If not, it is a subroutine call, which is described in the next section.) The special item ‘(?R)’ or ‘(?0)’ is a recursive call of the entire regular expression.

In PCRE (like Python, but unlike Perl), a recursive subpattern call is always treated as an atomic group. That is, once it has matched some of the subject string, it is never re-entered, even if it contains untried alternatives and there is a subsequent matching failure.

This PCRE pattern solves the nested parentheses problem (whitespace is insignificant):

```
\( ( (?>[^\()]+) | (?R) )* \)
```

First it matches an opening parenthesis. Then it matches any number of substrings which can either be a sequence of non-parentheses, or a recursive match of the pattern itself (that is, a correctly parenthesized substring). Finally there is a closing parenthesis.

If this were part of a larger pattern, you would not want to recurse the entire pattern, so instead you could use this:

```
( \ ( ( (?>[^\()]+) | (?1) )* \ ) )
```

We have put the pattern into parentheses, and caused the recursion to refer to them instead of the whole pattern.

In a larger pattern, keeping track of parenthesis numbers can be tricky. This is made easier by the use of relative references. (A Perl 5.10 feature.) Instead of ‘(?1)’ in the pattern above you can write ‘(?-2)’ to refer to the second most recently opened parentheses preceding the recursion. In other words, a negative number counts capturing parentheses leftwards from the point at which it is encountered.

It is also possible to refer to subsequently opened parentheses, by writing references such as ‘(?+2)’. However, these cannot be recursive because the reference is not inside the parentheses that are referenced. They are always subroutine calls, as described in the next section.

An alternative approach is to use named parentheses instead. The Perl syntax for this is ‘(?&name)’; PCRE’s earlier syntax ‘(?P>name)’ is also supported. We could rewrite the above example as follows:

```
(?<pn> \ ( ( (?>[^\()]+) | (?&pn) )* \ ) )
```

If there is more than one subpattern with the same name, the earliest one is used.

This particular example pattern that we have been looking at contains nested unlimited repeats, and so the use of atomic grouping for matching strings of non-parentheses is important when applying the pattern to strings that do not match. For example, when this pattern is applied to

```
(aaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaa())
```

it fails quickly. However, if atomic grouping is not used, the match runs for a very long time indeed because there are so many different ways the ‘+’ and ‘*’ repeats can carve up the subject, and all have to be tested before failure can be reported.

At the end of a match, the values set for any capturing subpatterns are those from the outermost level of the recursion at which the subpattern value is set. If the pattern above is matched against

```
(ab(cd)ef)
```

the value for the capturing parentheses is ‘ef’, which is the last value taken on at the top level. If additional parentheses are added, giving

```
\( ( ( (?>[^( )]+) | (?R) )* ) \)
```

the string they capture is ‘ab(cd)ef’, the contents of the top level parentheses.

Do not confuse the ‘(?R)’ item with the condition ‘(?R)’, which tests for recursion. Consider this pattern, which matches text in angle brackets, allowing for arbitrary nesting. Only digits are allowed in nested brackets (that is, when recursing), whereas any characters are permitted at the outer level.

```
< (? : (?R) \d++ | [^<>]*+ ) | (?R) ) * >
```

In this pattern, ‘(?R)’ is the start of a conditional subpattern, with two different alternatives for the recursive and non-recursive cases. The ‘(?R)’ item is the actual recursive call.

Subpatterns as Subroutines

If the syntax for a recursive subpattern reference (either by number or by name) is used outside the parentheses to which it refers, it operates like a subroutine in a programming language. The called subpattern may be defined before or after the reference. A numbered reference can be absolute or relative, as in these examples:

```
(...(absolute)...)(?2)...
...(relative)...(?-1)...
...(?!+1)...(relative)...
```

An earlier example pointed out that the pattern

```
(sens|respons)e and \libility
```

matches ‘sense and sensibility’ and ‘response and responsibility’, but not ‘sense and responsibility’. If instead the pattern

```
(sens|respons)e and (?1)ibility
```

is used, it does match ‘sense and responsibility’ as well as the other two strings. Another example is given in the discussion of DEFINE above.

Like recursive subpatterns, a subroutine call is always treated as an atomic group. That is, once it has matched some of the subject string, it is never re-entered, even if it contains untried alternatives and there is a subsequent matching failure.

When a subpattern is used as a subroutine, processing options such as case-independence are fixed when the subpattern is defined. They cannot be changed for different calls. For example, consider this pattern:

```
(abc)(?i:(?-1))
```

It matches ‘abcabc’. It does not match ‘abcABC’ because the change of processing option does not affect the called subpattern.

Backtracking Control

Perl 5.10 introduced a number of special *backtracking control verbs*, which are described in the Perl documentation as “experimental and subject to change or removal in a future version of Perl.” It goes on to say: “Their usage in production code should be noted to avoid problems during upgrades.” The same remarks apply to the PCRE features described in this section.

The new verbs make use of what was previously invalid syntax: an opening parenthesis followed by an asterisk. In Perl, they are generally of the form ‘(*VERB:ARG)’ but PCRE does not support the use of arguments, so its general form is just ‘(*VERB)’. Any number of these verbs may occur in a pattern. There are two kinds:

Verbs that act immediately

The following verbs act as soon as they are encountered:

(*ACCEPT)

This verb causes the match to end successfully, skipping the remainder of the pattern. When inside a recursion, only the innermost pattern is ended immediately. PCRE differs from Perl in what happens if the ‘(*ACCEPT)’ is inside capturing parentheses. In Perl, the data so far is captured: in PCRE no data is captured. For example:

```
A(A|B(*ACCEPT)|C)D
```

This matches ‘AB’, ‘AAD’, or ‘ACD’, but when it matches ‘AB’, no data is captured.

(*FAIL) or (*F)

This verb causes the match to fail, forcing backtracking to occur. It is equivalent to ‘(?!)’ but easier to read. It is not clear whether there is any use for this without the ability to execute code in the middle of the pattern (which Perl has but PCRE in Monotone does not).

Verbs that act after backtracking

The following verbs do nothing when they are encountered. Matching continues with what follows, but if there is no subsequent match, a failure is forced. The verbs differ in exactly what kind of failure occurs.

(*COMMIT)

This verb causes the whole match to fail outright if the rest of the pattern does not match. Even if the pattern is unanchored, no further attempts to find a match by advancing the start point take place. Once (*COMMIT) has been passed, the regular expression engine is committed to finding a match at the current starting point, or not at all. For example:

```
a+(*COMMIT)b
```

This matches ‘xxaab’ but not ‘aacaab’. It can be thought of as a kind of dynamic anchor, or “I’ve started, so I must finish.”

(*PRUNE)

This verb causes the match to fail at the current position if the rest of the pattern does not match. If the pattern is unanchored, the normal “bump-along” advance to the next starting character then happens. Backtracking can occur as usual to the left of (*PRUNE), or when matching to the right of (*PRUNE), but if there is no match to the right, backtracking cannot cross (*PRUNE). In simple cases, the use of (*PRUNE) is just an alternative to an atomic group or possessive quantifier, but there are some uses of (*PRUNE) that cannot be expressed in any other way.

(*SKIP)

This verb is like **(*PRUNE)**, except that if the pattern is unanchored, the "bumpalong" advance is not to the next character, but to the position in the subject where **(*SKIP)** was encountered. **(*SKIP)** signifies that whatever text was matched leading up to it cannot be part of a successful match. Consider:

```
a+(*SKIP)b
```

If the subject is 'aaaac...', after the first match attempt fails (starting at the first character in the string), the starting point skips on to start the next attempt at 'c'. Note that a possessive quantifier does not have the same effect in this example; although it would suppress backtracking during the first match attempt, the second attempt would start at the second character instead of skipping on to 'c'.

(*THEN)

This verb causes a skip to the next alternation if the rest of the pattern does not match. That is, it cancels pending backtracking, but only within the current alternation. Its name comes from the observation that it can be used for a pattern-based if-then-else block:

```
( COND1 (*THEN) FOO
  | COND2 (*THEN) BAR
  | COND3 (*THEN) BAZ ) ...
```

If the 'COND1' pattern matches, 'FOO' is tried (and possibly further items after the end of the group if 'FOO' succeeds); on failure the matcher skips to the second alternative and tries 'COND2', without backtracking into COND1. If **(*THEN)** is used outside of any alternation, it acts exactly like **(*PRUNE)**.

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 `--no-builtin-rcfiles` is passed). It contains the default values for all hooks. See [\[rcfiles\]](#), page 185.

```
-- Copyright (C) 2003 Graydon Hoare <graydon@pobox.com>
--
-- This program is made available under the GNU GPL version 2.0 or
-- greater. See the accompanying file COPYING for details.
--
-- This program is distributed WITHOUT ANY WARRANTY; without even the
-- implied warranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR
-- PURPOSE.

-- this is the standard set of lua hooks for monotone;
-- user-provided files can override it or add to it.

-- Since Lua 5.2, unpack and loadstrings are deprecated and are either moved
-- to table.unpack() or replaced by load(). If lua was compiled without
-- LUA_COMPAT_UNPACK and/or LUA_COMPAT_LOADSTRING, these two are not
-- available and we add a similar compatibility layer, ourselves.
unpack = unpack or table.unpack
loadstring = loadstring or load

function temp_file(namehint, filemodehint)
    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.XXXXXXX", tdir)
    else
        filename = string.format("%s/mtn.%s.XXXXXXX", tdir, namehint)
    end
    local filemode
    if filemodehint == nil then
        filemode = "r+"
    else
        filemode = filemodehint
    end
    local name = mkstemp(filename)
    local file = io.open(name, filemode)
    return file, name
end
```

```

function execute(path, ...)
    local pid
    local ret = -1
    pid = spawn(path, ...)
    if (pid ~= -1) then ret, pid = wait(pid) end
    return ret
end

function execute_redirected(stdin, stdout, stderr, path, ...)
    local pid
    local ret = -1
    io.flush();
    pid = spawn_redirected(stdin, stdout, stderr, path, ...)
    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, ...)

    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
        set_executable(filename)
    else
        clear_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 portable_readline(f)
    line = f:read()
    if line ~= nil then
        line = string.gsub(line, "\r$", "") -- strip possible \r left from windows editing
    end
    return line
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 = portable_readline(ignfile)
    while (line ~= nil) do
      if line ~= "" then
        table.insert(ignored_files, line)
      end
      line = portable_readline(ignfile)
    end
    io.close(ignfile)
  end
end

local warn_reported_file = false
for i, line in pairs(ignored_files)
do
  if (line ~= nil) then
    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 wrong
      if not warn_reported_file then
        io.stderr:write("mtn: warning: while matching file '"
          .. name .. "':\n")
        warn_reported_file = true
      end
      local prefix = ".mtn-ignore:" .. i .. ": warning: "
      io.stderr:write(prefix
        .. string.gsub(result, "\n", "\n" .. prefix)
        .. "\n\t- skipping this regex for "
        .. "all remaining files.\n")
      ignored_files[i] = nil
    end
  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", "%.bzzr", "%.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(user_log_message)
    local exe = nil

    -- top priority is VISUAL, then EDITOR, then a series of hardcoded
    -- defaults, if available.

    local visual = os.getenv("VISUAL")
    local editor = os.getenv("EDITOR")
    if (visual ~= nil) then exe = visual
    elseif (editor ~= nil) then exe = editor
    elseif (program_exists_in_path("editor")) then exe = "editor"
    elseif (program_exists_in_path("vi")) then exe = "vi"
    elseif (string.sub(get_ostype(), 1, 6) ~= "CYGWIN" and
            program_exists_in_path("notepad.exe")) then exe = "notepad"
    else
        io.write(gettext("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
    tmp:write(user_log_message)
    if user_log_message == "" or string.sub(user_log_message, -1) ~= "\n" then
        tmp:write("\n")
    end
    io.close(tmp)

    -- By historical convention, VISUAL and EDITOR can contain arguments
    -- (and, in fact, arbitrarily complicated shell constructs). Since Lua
    -- has no word-splitting functionality, we invoke the shell to deal with
    -- anything more complicated than a single word with no metacharacters.

```

```

-- This, unfortunately, means we have to quote the file argument.

if (not string.find(exe, "[^%w_+--]")) then
  -- safe to call spawn directly
  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
else
  -- must use shell
  local shell = os.getenv("SHELL")
  if (shell == nil) then shell = "sh" end
  if (not program_exists_in_path(shell)) then
    io.write(string.format(gettext("Editor command '%s' needs a shell, "..
                                  "but '%s' is not to be found"),
                              exe, shell))

    os.remove(tname)
    return nil
  end

  -- Single-quoted strings in both Bourne shell and csh can contain
  -- anything but a single quote.
  local safe_tname = " '" .. string.gsub(tname, "'", "'\\'") .. "'"

  if (execute(shell, "-c", editor .. safe_tname) ~= 0) then
    io.write(string.format(gettext("Error running editor '%s' "..
                                  "to enter log message\n"),
                              exe))

    os.remove(tname)
    return nil
  end
end

tmp = io.open(tname, "r")
if (tmp == nil) then os.remove(tname); return nil end
local res = tmp:read("*a")
io.close(tmp)
os.remove(tname)
return res
end

function get_local_key_name(key_identity)
  return key_identity.given_name
end

```

```
end
```

```
function persist_phrase_ok()
  return true
end
```

```
function use_inodeprints()
  return false
end
```

```
function get_date_format_spec(wanted)
  -- Return the strftime(3) specification to be used to print dates
  -- in human-readable format after conversion to the local timezone.
  -- The default uses the preferred date and time representation for
  -- the current locale, e.g. the output looks like this: "09/08/2009
  -- 06:49:26 PM" for en_US and "date_time_long", or "08.09.2009"
  -- for de_DE and "date_short"
  --
  -- A sampling of other possible formats you might want:
  -- default for your locale: "%c" (may include a confusing timezone label)
  -- 12 hour format: "%d %b %Y, %I:%M:%S %p"
  -- like ctime(3): "%a %b %d %H:%M:%S %Y"
  -- email style: "%a, %d %b %Y %H:%M:%S"
  -- ISO 8601: "%Y-%m-%d %H:%M:%S" or "%Y-%m-%dT%H:%M:%S"
  --
  -- ISO 8601, no timezone conversion: ""
  --.
  if (wanted == "date_long" or wanted == "date_short") then
    return "%x"
  end
  if (wanted == "time_long" or wanted == "time_short") then
    return "%X"
  end
  return "%x %X"
end
```

```
-- trust evaluation hooks
```

```
function intersection(a,b)
  local s={}
  local t={}
  for k,v in pairs(a) do s[v.name] = 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

-- This is only used by migration from old manifest-style ancestry
function get_manifest_cert_trust(signers, id, name, val)
    return true
end

-- http://snippets.luacode.org/?p=snippets/String_to_Hex_String_68
function hex_dump(str, spacer)
    return (string.gsub(str, "(", function (c)
        return string.format("%02x%s", string.byte(c), spacer or "")
    end)
)
end

function accept_testresult_change_hex(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

function accept_testresult_change(old_results, new_results)
    -- Hex encode each of the key hashes to match those in 'wanted-testresults'
    local old_results_hex = {}
    for k, v in pairs(old_results) do
        old_results_hex[hex_dump(k)] = v
    end
end

```

```

    local new_results_hex = {}
    for k, v in pairs(new_results) do
        new_results_hex[hex_dump(k)] = v
    end

    return accept_testresult_change_hex(old_results_hex, new_results_hex)
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 = {}

-- This merger is designed to fail if there are any conflicts without trying to resolve them
mergers.fail = {
    cmd = function (tbl) return false end,
    available = function () return true end,
    wanted = function () return true end
}

mergers.meld = {
    cmd = function (tbl)
        io.write(string.format(
            "\nWARNING: 'meld' was chosen to perform an external 3-way merge.\n"..
            "You must merge all changes to the *CENTER* file.\n\n"
        ))
        local path = "meld"
        local ret = execute(path, tbl.lfile, tbl.afe, tbl.rfile)
        if (ret ~= 0) then
            io.write(string.format(gettext("Error running merger '%s'\n"), path))
            return false
        end
        return tbl.afe
    end ,
    available = function () return program_exists_in_path("meld") end,
    wanted = function () return true end
}

```

```
}
```

```
mergers.diffuse = {
  cmd = function (tbl)
    io.write(string.format(
      "\nWARNING: 'diffuse' was chosen to perform an external 3-way merge.\n"..
      "You must merge all changes to the *CENTER* file.\n\n"
    ))
    local path = "diffuse"
    local ret = execute(path, tbl.lfile, tbl.afe, tbl.rfile)
    if (ret ~= 0) then
      io.write(string.format(gettext("Error running merger '%s'\n"), path))
      return false
    end
    return tbl.afe
  end ,
  available = function () return program_exists_in_path("diffuse") end,
  wanted = function () return true end
}
```

```
mergers.tortoise = {
  cmd = function (tbl)
    local path = "tortoisemerge"
    local ret = execute(path,
      string.format("/base:%s", tbl.afe),
      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)
    function execute_diff3(mine, yours, out)
    local diff3_args = {
      "diff3",
      "--merge",
      "--easy-only",
    }
    table.insert(diff3_args, string.gsub(mine, "\\\"", "/") .. "")
  end
}
```



```

table.insert(diff3_args, string.gsub(tbl.affile, "\\", "/") .. "")
table.insert(diff3_args, string.gsub(yours, "\\", "/") .. "")

return execute_redirected("", string.gsub(out, "\\", "/"), "", unpack(diff3_args))
end

io.write (string.format("\nWARNING: 'vim' was chosen to perform "..
    "an external 3-way merge.\n"..
    "You must merge all changes to the "..
    "*LEFT* file.\n"))

local vim
if os.getenv ("DISPLAY") ~= nil and program_exists_in_path ("gvim") then
vim = "gvim"
else
vim = "vim"
end

local lfile_merged = tbl.lfile .. ".merged"
local rfile_merged = tbl.rfile .. ".merged"

-- first merge lfile using diff3
local ret = execute_diff3(tbl.lfile, tbl.rfile, lfile_merged)
if ret == 2 then
    io.write(string.format(gettext("Error running diff3 for merger '%s'\n"), vim))
    os.remove(lfile_merged)
return false
end

-- now merge rfile using diff3
ret = execute_diff3(tbl.rfile, tbl.lfile, rfile_merged)
if ret == 2 then
    io.write(string.format(gettext("Error running diff3 for merger '%s'\n"), vim))
    os.remove(lfile_merged)
    os.remove(rfile_merged)
return false
end

os.rename(lfile_merged, tbl.lfile)
os.rename(rfile_merged, tbl.rfile)

local ret = execute(vim, "-f", "-d", "-c", string.format("silent file %s", tbl.outfil
    tbl.lfile, tbl.rfile))
if (ret ~= 0) then
    io.write(string.format(gettext("Error running merger '%s'\n"), vim))
    return false
end
end

```

```

        return tbl.outfile
    end ,
    available =
        function ()
            return program_exists_in_path("diff3") and
                (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.afe, 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
    }

```

```

}

-- GNU diffutils based merging
mergers.diffutils = {
  -- merge procedure execution
  cmd = function (tbl)
    -- parse options
    local option = {}
    option.partial = false
    option.diff3opts = ""
    option.sdiffopts = ""
    local options = os.getenv("MTN_MERGE_DIFFUTILS")
    if options ~= nil then
      for spec in string.gmatch(options, "%s*(%w[,]*)%s*,?") do
        local name, value = string.match(spec, "^(%w+)=([,]*)")
        if name == nil then
          name = spec
          value = true
        end
        if type(option[name]) == "nil" then
          io.write("mtn: " .. string.format(gettext("invalid \"diffutils\" merg
          return false
        end
        option[name] = value
      end
    end
  end

  -- determine the diff3(1) command
  local diff3 = {
    "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),
  }
  if option.diff3opts ~= "" then
    for opt in string.gmatch(option.diff3opts, "%s*([~%s]+)%s*") do
      table.insert(diff3, opt)
    end
  end
  table.insert(diff3, string.gsub(tbl.lfile, "\\", "/") .. "")
  table.insert(diff3, string.gsub(tbl.afe, "\\", "/") .. "")
  table.insert(diff3, string.gsub(tbl.rfile, "\\", "/") .. "")

  -- dispatch according to major operation mode
  if option.partial then
    -- partial batch/non-modal 3-way merge "resolution":

```

```

-- simply merge content with help of conflict markers
io.write("mtn: " .. gettext("3-way merge via GNU diffutils, resolving conflict
local ret = execute_redirected("", string.gsub(tbl.outfile, "\\", "/"), "", unp
if ret == 2 then
    io.write("mtn: " .. gettext("error running GNU diffutils 3-way difference
    return false
end
return tbl.outfile
else
-- real interactive/modal 3/2-way merge resolution:
-- display 3-way merge conflict and perform 2-way merge resolution
io.write("mtn: " .. gettext("3-way merge via GNU diffutils, resolving conflict

-- display 3-way merge conflict (batch)
io.write("\n")
io.write("mtn: " .. gettext("---- CONFLICT SUMMARY -----
local ret = execute(unpack(diff3))
if ret == 2 then
    io.write("mtn: " .. gettext("error running GNU diffutils 3-way difference
    return false
end

-- perform 2-way merge resolution (interactive)
io.write("\n")
io.write("mtn: " .. gettext("---- CONFLICT RESOLUTION -----
local sdiff = {
    "sdiff",
    "--diff-program=diff",
    "--suppress-common-lines",
    "--minimal",
    "--output=" .. string.gsub(tbl.outfile, "\\", "/")
}
if option.sdiffopts ~= "" then
    for opt in string.gmatch(option.sdiffopts, "%s*([~%s]+)%s*") do
        table.insert(sdiff, opt)
    end
end
table.insert(sdiff, string.gsub(tbl.lfile, "\\", "/") .. "")
table.insert(sdiff, string.gsub(tbl.rfile, "\\", "/") .. "")
local ret = execute(unpack(sdiff))
if ret == 2 then
    io.write("mtn: " .. gettext("error running GNU diffutils 2-way merging to
    return false
end
return tbl.outfile
end
end,

```

```

-- merge procedure availability check
available = function ()
    -- make sure the GNU diffutils tools are available
    return program_exists_in_path("diff3") and
           program_exists_in_path("sdiff") and
           program_exists_in_path("diff");
end,

-- merge procedure request check
wanted = function ()
    -- assume it is requested (if it is available at all)
    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\")"
        -- Converting backslashes is necessary on Win32 MinGW; emacs
        -- lisp string syntax says '\\' is an escape.
        local ret = execute(emacs, "--eval",
                           string.format(elisp,
                                           string.gsub(tbl.lfile, "\\ ", "/"),
                                           string.gsub(tbl.rfile, "\\ ", "/"),
                                           string.gsub(tbl.afe, "\\ ", "/"),
                                           string.gsub(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.afe,
                                "-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, filemodehint)
  tmp, filename = temp_file(namehint, filemodehint)
  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 = {"diffuse", "kdiff3", "xxdiff", "opendiff",
                           "tortoise", "emacs", "vim", "meld", "diffutils"}
    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, mkey 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.afeile = nil
    tbl.lfile = nil
    tbl.rfile = nil
    tbl.outfile = nil
    tbl.meld_exists = false
    tbl.lfile = write_to_temporary_file (left, "left", "r+b")
    tbl.afeile = write_to_temporary_file (ancestor, "ancestor", "r+b")
    tbl.rfile = write_to_temporary_file (right, "right", "r+b")
    tbl.outfile = write_to_temporary_file ("", "merged", "r+b")

    if tbl.lfile ~= nil and tbl.rfile ~= nil and tbl.afeile ~= nil and tbl.outfile ~= nil
    then
        local cmd,mkey = get_preferred_merge3_command (tbl)
        if cmd ~=nil
        then
            io.write ("mtn:  " .. string.format(gettext("executing external 3-way merge via \
ret = cmd (tbl)
            if not ret then
                ret = nil
            else
                ret = read_contents_of_file (ret, "rb")
                if string.len (ret) == 0
                then
                    ret = nil
                end
            end
        end
    else
        if mkey then
            io.write (string.format("The possible commands for the "..mkey.." merger aren't ava
                "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.\n"))
        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"))
        end
    end
end

```

```

        end
    end
end

os.remove (tbl.lfile)
os.remove (tbl.rfile)
os.remove (tbl.afeile)
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
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("!*Y-%m-%dT%H:%M:%S", 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("!*Y-%m-%d", t)
    end

    -- "yesterday", the source of all hangovers
    if str == "yesterday"
    then
        local t = os.time(os.date('!*t'))
        return os.date("!*Y-%m-%d", 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("!!Y-%m-%dT%H:%M:%S", t - (n * trans[type]))
        else
            return os.date("!!Y-%m-%d", t - (n * trans[type]))
        end
    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_new)
    local old_file = write_to_temporary_file(data_old, nil, "r+b");
    local new_file = write_to_temporary_file(data_new, nil, "r+b");

    if diff_args == nil then diff_args = external_diff_default_args end
    execute("diff", diff_args, "--label", file_path .. "\told", old_file, "--label", file_path .. "\tnew", new_file)

    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 return true end)
    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, permfilename, state)
    if not exists(permfilename) or isdir(permfilename) then
        return false
    end
    local permfile = io.open(permfilename, "r")
    if (permfile == nil) then return false end
    local dat = permfile:read("*a")
    io.close(permfile)
    local res = parse_basic_io(dat)
end

```

```

if res == nil then
  io.stderr:write("file "..permfilename.." cannot be parsed\n")
  return false,"continue"
end
state["matches"] = state["matches"] or false
state["cont"] = state["cont"] or false
for i, item in pairs(res)
do
  -- legal names: pattern, allow, deny, continue
  if item.name == "pattern" then
    if state["matches"] and not state["cont"] then return false end
    state["matches"] = false
    state["cont"] = false
    for j, val in pairs(item.values) do
      if globish_match(val, branch) then state["matches"] = true end
    end
  elseif item.name == "allow" then if state["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 ident ~= nil and val == ident.id then return true end
      if ident ~= nil and globish_match(val, ident.name) then return true end
    end
  end
  elseif item.name == "deny" then if state["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 ident ~= nil and val == ident.id then return false end
      if ident ~= nil and globish_match(val, ident.name) then return false end
    end
  end
  elseif item.name == "continue" then if state["matches"] then
    state["cont"] = true
    for j, val in pairs(item.values) do
      if val == "false" or val == "no" then
        state["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_read_permitted(branch, ident)
  local permfilename = get_confdir() .. "/read-permissions"

```

```

    local permdirname = permfilename .. ".d"
    local state = {}
    if _get_netsync_read_permitted(branch, ident, permfilename, state) then
        return true
    end
    if isdir(permdirname) then
        local files = read_directory(permdirname)
        table.sort(files)
        for _,f in ipairs(files) do
            pf = permdirname.."/"..f
            if _get_netsync_read_permitted(branch, ident, pf, state) then
                return true
            end
        end
    end
    return false
end

function _get_netsync_write_permitted(ident, permfilename)
    if not exists(permfilename) or isdir(permfilename) then return false end
    local permfile = io.open(permfilename, "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 ln == ident.id then matches = true end
        if globish_match(ln, ident.name) then matches = true end
        line = permfile:read()
    end
    io.close(permfile)
    return matches
end

function get_netsync_write_permitted(ident)
    local permfilename = get_confdir() .. "/write-permissions"
    local permdirname = permfilename .. ".d"
    if _get_netsync_write_permitted(ident, permfilename) then return true end
    if isdir(permdirname) then
        local files = read_directory(permdirname)
        table.sort(files)
        for _,f in ipairs(files) do
            pf = permdirname.."/"..f
            if _get_netsync_write_permitted(ident, pf) then return true end
        end
    end
end

```

```

        end
    end
    return false
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 uri["scheme"] == "ssh+ux"
        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"])
    table.insert(argv, get_remote_unix_socket_command(uri["host"]))
    table.insert(argv, "-")
    table.insert(argv, "UNIX-CONNECT:" .. uri["path"])
else
    if argv then
        -- start remote monotone process

        table.insert(argv, get_mtn_command(uri["host"]))

        if args["debug"] then
            table.insert(argv, "--verbose")
        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")

        -- else scheme does not require starting a new remote
        -- process (ie mtn:)
    end
end
return argv
end

function use_transport_auth(uri)
    if uri["scheme"] == "ssh"
    or uri["scheme"] == "ssh+ux"
    or uri["scheme"] == "file" then

```



```

        return false
    else
        return true
    end
end

function get_mtn_command(host)
    return "mtn"
end

function get_remote_unix_socket_command(host)
    return "socat"
end

function get_default_command_options(command)
    local default_args = {}
    return default_args
end

function get_default_database_alias()
    return ":default.mtn"
end

function get_default_database_locations()
    local paths = {}
    table.insert(paths, get_confdir() .. "/databases")
    return paths
end

function get_default_database_glob()
    return "*. {mtn,db}"
end

hook_wrapper_dump = {}
hook_wrapper_dump.depth = 0
hook_wrapper_dump._string = function(s) return string.format("%q", s) end
hook_wrapper_dump._number = function(n) return tostring(n) end
hook_wrapper_dump._boolean = function(b) if (b) then return "true" end return "false" end
hook_wrapper_dump._userdata = function(u) return "nil --[[userdata]]" end
-- if we really need to return / serialize functions we could do it
-- like cbreak@irc.freenode.net did here: http://lua-users.org/wiki/TablePersistence
hook_wrapper_dump._function = function(f) return "nil --[[function]]" end
hook_wrapper_dump._nil = function(n) return "nil" end
hook_wrapper_dump._thread = function(t) return "nil --[[thread]]" end
hook_wrapper_dump._lightuserdata = function(l) return "nil --[[lightuserdata]]" end

hook_wrapper_dump._table = function(t)

```

```

local buf = ''
if (hook_wrapper_dump.depth > 0) then
    buf = buf .. '{\n'
end
hook_wrapper_dump.depth = hook_wrapper_dump.depth + 1;
for k,v in pairs(t) do
    buf = buf..string.format('%s[%s] = %s;\n',
        string.rep("\t", hook_wrapper_dump.depth - 1),
        hook_wrapper_dump["_ " .. type(k)](k),
        hook_wrapper_dump["_ " .. type(v)](v))
end
hook_wrapper_dump.depth = hook_wrapper_dump.depth - 1;
if (hook_wrapper_dump.depth > 0) then
    buf = buf .. string.rep("\t", hook_wrapper_dump.depth - 1) .. '}'
end
return buf
end

function hook_wrapper(func_name, ...)
    -- we have to ensure that nil arguments are restored properly for the
    -- function call, see http://lua-users.org/wiki/StoringNilsInTables
    local args = { n=select('#', ...), ... }
    for i=1,args.n do
        local val = assert(loadstring("return " .. args[i]),
            "argument "..args[i].." could not be evaluated")()
        assert(val ~= nil or args[i] == "nil",
            "argument "..args[i].." was evaluated to nil")
        args[i] = val
    end
    local res = { _G[func_name](unpack(args, 1, args.n)) }
    return hook_wrapper_dump._table(res)
end

do
    -- Hook functions are tables containing any of the following 6 items
    -- with associated functions:
    --
    -- startup           Corresponds to note_mtn_startup()
    -- start             Corresponds to note_netsync_start()
    -- revision_received Corresponds to note_netsync_revision_received()
    -- revision_sent     Corresponds to note_netsync_revision_sent()
    -- cert_received     Corresponds to note_netsync_cert_received()
    -- cert_sent         Corresponds to note_netsync_cert_sent()
    -- pubkey_received   Corresponds to note_netsync_pubkey_received()
    -- pubkey_sent       Corresponds to note_netsync_pubkey_sent()
    -- end              Corresponds to note_netsync_end()
    --

```

```

-- Those functions take exactly the same arguments as the corresponding
-- global functions, but return a different kind of value, a tuple
-- composed of a return code and a value to be returned back to monotone.
-- The codes are strings:
-- "continue" and "stop"
-- When the code "continue" is returned and there's another notifier, the
-- second value is ignored and the next notifier is called. Otherwise,
-- the second value is returned immediately.
local hook_functions = {}
local supported_items = {
    "startup",
    "start", "revision_received", "revision_sent", "cert_received", "cert_sent",
    "pubkey_received", "pubkey_sent", "end"
}

function _hook_functions_helper(f,...)
    local s = "continue"
    local v = nil
    for _,n in pairs(hook_functions) do
        if n[f] then
            s,v = n[f](...)
        end
        if s ~= "continue" then
            break
        end
    end
    return v
end

function note_mtn_startup(...)
    return _hook_functions_helper("startup",...)
end

function note_netsync_start(...)
    return _hook_functions_helper("start",...)
end

function note_netsync_revision_received(...)
    return _hook_functions_helper("revision_received",...)
end

function note_netsync_revision_sent(...)
    return _hook_functions_helper("revision_sent",...)
end

function note_netsync_cert_received(...)
    return _hook_functions_helper("cert_received",...)
end

function note_netsync_cert_sent(...)
    return _hook_functions_helper("cert_sent",...)
end

function note_netsync_pubkey_received(...)

```

```

    return _hook_functions_helper("pubkey_received",...)
end
function note_netsync_pubkey_sent(...)
    return _hook_functions_helper("pubkey_sent",...)
end
function note_netsync_end(...)
    return _hook_functions_helper("end",...)
end

function add_hook_functions(functions, precedence)
    if type(functions) ~= "table" or type(precedence) ~= "number" then
        return false, "Invalid type"
    end
    if hook_functions[precedence] then
        return false, "Precedence already taken"
    end

    local unknown_items = ""
    local warning = nil
    local is_member =
        function (s,t)
            for k,v in pairs(t) do if s == v then return true end end
            return false
        end

    for n,f in pairs(functions) do
        if type(n) == "string" then
            if not is_member(n, supported_items) then
                if unknown_items ~= "" then
                    unknown_items = unknown_items .. ","
                end
                unknown_items = unknown_items .. n
            end
            if type(f) ~= "function" then
                return false, "Value for functions item "..n.." isn't a function"
            end
        else
            warning = "Non-string item keys found in functions table"
        end
    end

    if warning == nil and unknown_items ~= "" then
        warning = "Unknown item(s) " .. unknown_items .. " in functions table"
    end

    hook_functions[precedence] = functions
    return true, warning
end

```

```

end
function push_hook_functions(functions)
    local n = #hook_functions + 1
    return add_hook_functions(functions, n)
end

-- Kept for backward compatibility
function add_netsync_notifier(notifier, precedence)
    return add_hook_functions(notifier, precedence)
end
function push_netsync_notifier(notifier)
    return push_hook_functions(notifier)
end
end

-- to ensure only mapped authors are allowed through
-- return "" from unmapped_git_author
-- and validate_git_author will fail

function unmapped_git_author(author)
    -- replace "foo@bar" with "foo <foo@bar>"
    name = author:match("^([^<>]+)@[^<>]+$")
    if name then
        return name .. " <" .. author .. ">"
    end

    -- replace "<foo@bar>" with "foo <foo@bar>"
    name = author:match("^<([^<>]+)@[^<>]+>$")
    if name then
        return name .. " " .. author
    end

    -- replace "foo" with "foo <foo>"
    name = author:match("^([^<>@]+)$")
    if name then
        return name .. " <" .. name .. ">"
    end

    return author -- unchanged
end

function validate_git_author(author)
    -- ensure author matches the "Name <email>" format git expects
    if author:match("^^[^<]+ <[^>]*>$") then
        return true
    end
end

```

```

    return false
end

function get_man_page_formatter_command()
    local term_width = guess_terminal_width() - 2
    -- The string returned is run in a process created with 'popen'
    -- (see cmd.cc manpage).
    --
    -- On Unix (and POSIX compliant systems), 'popen' runs 'sh' with
    -- the inherited path.
    --
    -- On MinGW, 'popen' runs 'cmd.exe' with the inherited path. MinGW
    -- does not (currently) provide nroff or equivalent. So we assume
    -- sh, nroff, locale and less are also installed, from Cygwin or
    -- some other toolset.
    --
    -- GROFF_ENCODING is an environment variable that, when set, tells
    -- groff (called by nroff where applicable) to use preconv to convert
    -- the input from the given encoding to something groff understands.
    -- For example, groff doesn't understand raw UTF-8 as input, but
    -- it does understand unicode, which preconv will happily provide.
    -- This doesn't help people that don't use groff, unfortunately.
    -- Patches are welcome!
    if string.sub(get_ostype(), 1, 7) == "Windows" then
        return string.format("sh -c 'GROFF_ENCODING='locale charmap' nroff -man -rLL=%dn' | less -R", term_width)
    else
        return string.format("GROFF_ENCODING='locale charmap' nroff -man -rLL=%dn | less -R", term_width)
    end
end
end

```

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