

Local Version Control (sccs, rcs)

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Localized Version Control

The earliest version control systems in wide use were **scs** and the open source **rcs**.

- We'll focus on **rcs**
- The “repository” of historical information is kept as a “special” subdirectory, named RCS
- Sharing of repositories is possible only via the operating system's underlying mechanism for sharing access to directories
 - permissions, linking

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Basic rcs Operations

- **ci** Check In a file from the working directory into the repository
- **co** Check Out a file from the repository into the working directory
- **rcsdiff** Compare two versions of a file.
- **rcsmerge**

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1 History

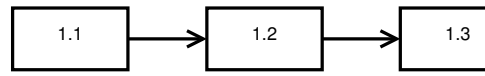
History

- `mkdir RCS`
Creates an RCS repository for the files in the current directory (only)
 - The repository is currently empty

- `ci filename`

Checks files in to the repository

- If the file is not in there yet, it is added
- If it is in there, then this becomes the new/current revision
- Each check in is assigned a new, ascending revision number
- Somewhat surprisingly, deletes the file from the current directory



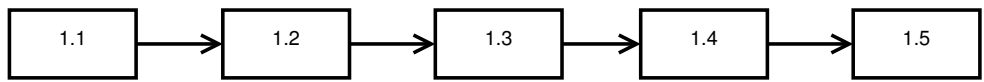
- `co -l filename`

Checks out the most recent version of that file from the repository, storing it in the working directory.

- Adding a `-r v` option allows check out of a specific revision number

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Revision Numbers



- Clearly there was an intent that revision numbers also serve as version numbers.
 - A special option allows you to force a change to the leading digit, e.g., to move from version 1.12 to 2.0
- Problem is that each file's revision number changes independently
 - So your intended release "version 2.1" might use revision 2.1, revision 2.5 of `adt.cpp`, revision 2.3 of `main.cpp`, etc.
- Versions can be checked out by date instead:
 - "check out whatever version was current as of 12/13/2012"
 - Repeated over all files, would give a coherent view of the project status as of that date

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Naming Revisions

- Revisions can be named:

```
ci -N "v1.2" -t "Public release 1.2" *.h *.cpp
```

and later checked out by name instead of by exact revision number

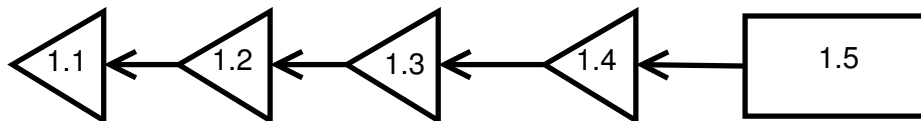
- Note also the option to add explanatory text at the time of the checkout
 - Later version managers would make this “mandatory”

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Implementation

rcs is essentially a systematic way of creating and organizing patches.

- The repository always contains the current version of the file plus enough diffs/patches to move back to any prior revision.



- The current version is always available immediately.
 - Diffs are used to go back in time
 - * Originally considered an important point in supporting efficient access to the most commonly needed file.
 - * Now, probably not so important

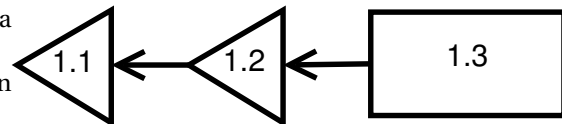
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2 Exploration

Exploring Alternatives

Suppose that we have worked through a few revisions and then get an idea that might not pay off.

We can start a *branch* to explore our idea while others continue work on the main trunk.



```
ci -r1.3.1 filename
```

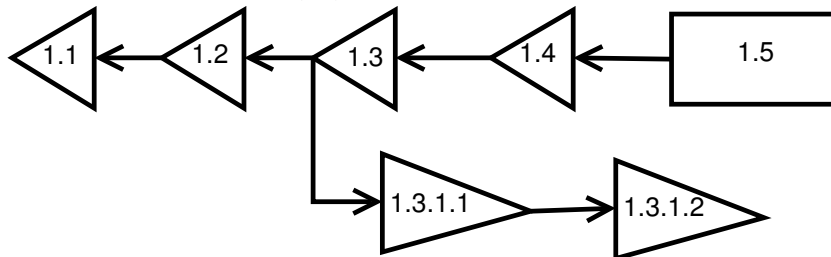
Checks in our current version of *filename* as a new branch of development, numbered 1.3.1.1

- *1.3.1.1* is the trunk version from which we branched out
- *1.3.1.1* is the branch number
- *1.3.1.1* is the revision number within the branch

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Working in a Branch

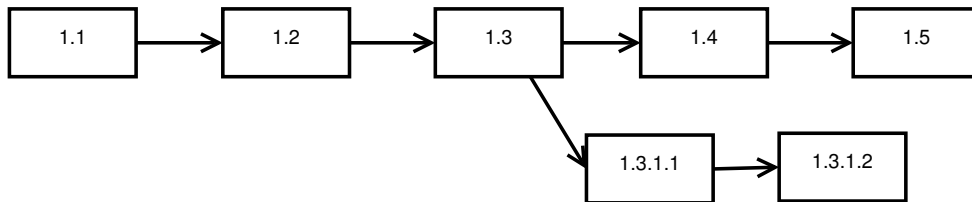
Subsequent check-ins of both the main trunk (1.3) and of our branch version will maintain separate revision numbers:



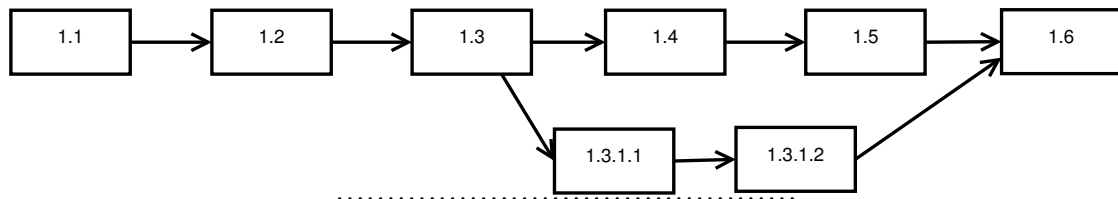
- Note that checking out the most recent version along a branch is not as efficient as checking out the most recent version on the trunk.

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Merging a Branch

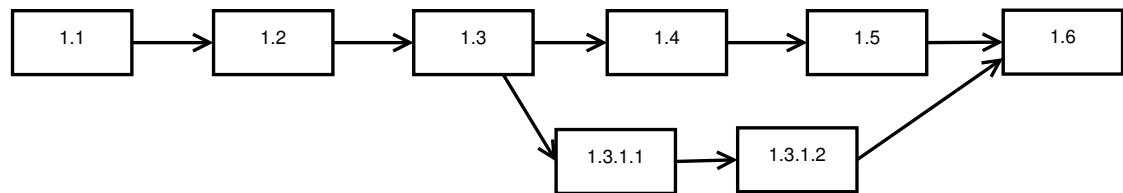


- If the idea in the branch does not pay off, the branch can simply be abandoned.
- You decide to adopt the changes in the branch, you can elect to *merge* it back into the trunk.
 - The **rcsmerge** command is used to conduct the merge,
 - * Need to resolve any conflicts introduced by continued development along the trunk.
 - then the resulting combined file checked in with a trunk number



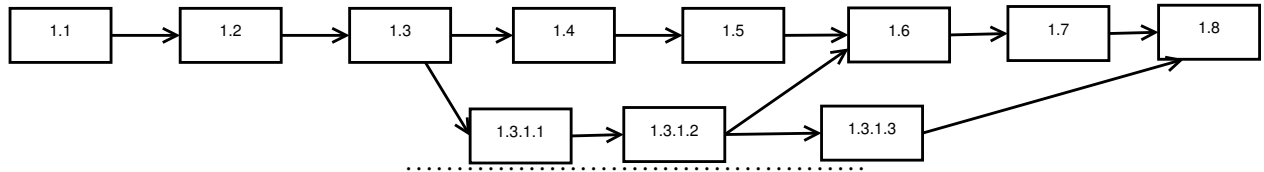
Multiple Merges

After a merge



- We might opt to discontinue using the branch

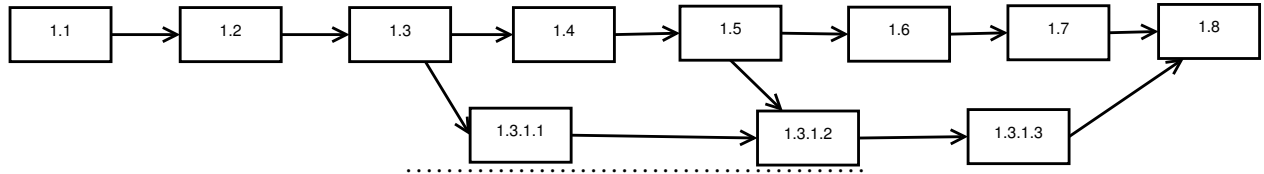
- Or we might continue working long it, eventually generating more changes to be merged into the system



Combating Drift

Over time, a long-running branch can get so far out of sync with changes being made to the trunk that the final merge becomes difficult or even impossible.

- An effective strategy for combating this is to periodically merge the trunk into the branch
 - the reverse of the “normal” merge direction



3 Collaboration

Collaboration

rcs supports collaboration by *locking* files

- Most checkouts like this

```
co filename
```

obtain a read-only copy of the file.

- *nix permissions 400
- Can be used to compile system, but cannot be changed
 - * (Of course, you can always **chmod**, but that's cheating.

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Locks

- A checkout like this

```
co -l filename
```

requests a *locked* version of the file.

- Request fails if a locked version already exists somewhere.
- If successful, programmer receives a copy with write permission.
- Lock persists until the programmer checks in changes or explicitly releases the lock (which deletes the file from their directory, forcing them to check out an unlocked, read-only version again).

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4 Strengths and Weaknesses

Strengths and Weaknesses

- **rcs** addresses history, exploration, & collaboration concerns
- but has weaknesses in each area

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History

- **rcs** tracks files in a directory.
 - Each file is tracked separately.
- No support for deletion of file
 - Unless you *know* not to request a file, you will always get the last version before it was deleted.
- No support for creation of new files
 - If you request revisions associated with very old dates, you will get version 1.1 even if the file did not actually exist as of that date.
- No support for renaming files
 - Appears to be a deletion and a subsequent creation of a new, unrelated file
- Each directory is tracked separately
 - Poor support for multi-directory projects

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Exploration Issues

- Branching and merging is often confusing.

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Collaboration Issues

- Locks are frequently abused
 - e.g., people forget to release a lock, forcing team members to wait
 - People grab locks they don't really need.
- Cheating on locks is easy
 - People get in the habit of cheating to cope with lock abuse
 - And eventually start cheating with less and less provocation.

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