CSE 303: Concepts and Tools for Software Development

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Winter 2006

Lecture 19— Version control, shared files, `cvs`

Where are We

Learning tools and concepts relevant to multi-file, multi-person, multi-platform, multi-month projects.

Today: Managing source code

- Reliable backup of hard-to-replace information (i.e., the source code)
- Tools for managing concurrent and potentially conflicting changes from multiple people
- Version numbers, ability to "rollback" or at least see the differences with previous versions.

Note: None of this has anything to do with code. Like `make`, version-control systems are typically not language-specific.

- I use `cvs` (a version-control system) for papers I write too.
- But `cvs` is better at plain-text (for detecting differences)

Version-control systems

There are plenty: `rcs`, `cvs`, `subversion`, `sourceforge`, `SourceSafe`, ...

The terminology and commands aren't so standard, but once you know one, the others shouldn't be difficult.

`cvs` is actually a layer over `rcs`.

Weak-point of `cvs`: renaming files or (worse) directories.

The set-up

There is a cvs *repository*, where files (and past versions) are reliably stored.

- Hopefully the repository files are backed up, but that's not `cvs`'s problem.

You do *not* edit files in the repository directly. Instead:

- You *check-out* a *working copy* and edit it.
- You *commit* changes back to the repository.

You use the `cvs` program to perform any operations that need the repository.

One repository may hold many *projects*. (The repository itself just has a directory structure.)

Questions

- How do you set-up:
  - A repository (`init`)
  - A project in a repository (`import`)
  - A working copy of a project in a repository (`checkout`)
- How do you edit files:
  - Get latest updates of a project (`update`)
  - Add or remove files (`add` or `remove`)
  - Put changes back in repository (`commit`)
- How do you get information about:
  - History of revisions (`log`)
  - Difference between versions (`diff`)
- Other (branches, locks, watches, ...)

Common vs. uncommon

Learn the common cases; look up the uncommon ones:

- You will set up new repositories approx. once every 5 years
- You will add a project approx. once a year
- You will checkout a project approx. once a month
- You will update your working copy and update the repository approx. once a day.

Nonetheless, the command-structure for all these is similar:

`cvs` *`cvs-options`* `cmd` *`cmd-options filenames`*

Examples:

```
cvs -d ~djg/cvsroot checkout foo
cvs update -P foo
```

Getting started

Set up a repository and project.

- Remember, I have to look up the commands for this.

Accessing the repository:

- From the same machine, just specify the root via a path name (`-d`).
- After the checkout, the working-copy "remembers" the repository so `-d` is unnecessary.
- Can access remotely by specifying user-id and machine.
  - Must have `cvs` and `ssh` installed on your local machine
  - Will be prompted for password.
  - How I write code with people in other time zones.
  - I recommend you *not* spend the time to set this up for hw6.

File manipulation

- Add files with `cvs add`.
- Get files with `cvs update`.
- Commit changes with `cvs commit`.
  - Any number of files (no filename means all files in directory and all transitive subdirectories)
  - Added files not really added until commit (unlike directories)

Commit messages are mandatory:

- `-m "a short message"`
- `-F filename-containing-message`
- else an editor pops up
  - `vi` unless you set environment variable VISUAL (or EDITOR?)
  - learn how to quit `vi` :) (or learn `vi`)

Conflicts

This all works great if there is one working-copy: you keep old versions, can see their differences, etc.

With multiple working-copies there can be *conflicts*:

1. Your working-copy checks out version 1.7 of `foo`.
2. You edit `foo`.
3. Somebody else commits a new version (1.8) of `foo`.

You *cannot* commit; you must update `foo`. What about your changes?

- If you're nervous, make a copy of `foo` locally first.
- But `cvs` will use `diff` and `patch` to *merge* the changes between 1.7 and 1.8 into your working-copy `foo`.
- Merging is *line-based*, which is why `cvs` is better for text files.
- Conflicts indicated in the working-copy file (search for <<<<<<).

It's all just files and `diff`

There is very little magic to `cvs`; you can poke around to see how it's implemented:

- The repository just uses directories and files.
- Files are kept read-only to avoid "mistakes" (`cvs` command temporarily changes that and changes it back)
- Files are kept in terms of diffs (so small changes lead to small increase in repository size, even for large files)
- Set *group permissions* appropriately (see `chgrp` if necessary).
- Hard part of implementation is preventing simultaneous commits and other *concurrency* errors.

As for the working copy:

- All the "magic" is in the CVS subdirectory.

CVS gotchas

- To get new subdirectories do `update -P` (for hw6, one directory should be plenty).
- Do not forget to add files or your group members will be very unhappy.
- Keep in the repository *exactly what you need to build the application*!
  - Yes: foo.c foo.h Makefile
  - No: foo.o a.out
  - You don't want versions of .o files:
    * Replaceable things have no value
    * They will change a lot when .c files change a little
    * Developers on other machines can't use them

Summary

Another tool for letting the computer do what it's good at:

- Much better than manually emailing files, adding dates to filenames, etc.
- Managing versions, storing the differences
- Keeping source-code safe.
- Preventing concurrent access, detecting conflicts.

How to "cheat" and throw away somebody else's changes – don't!

```
mv foo bar
cvs update foo
mv bar foo
cvs commit -m "muhahaha" foo
```

`cvs` just knows about version numbers and `diff`; it's not magic.