Lecture 9 — Version Control

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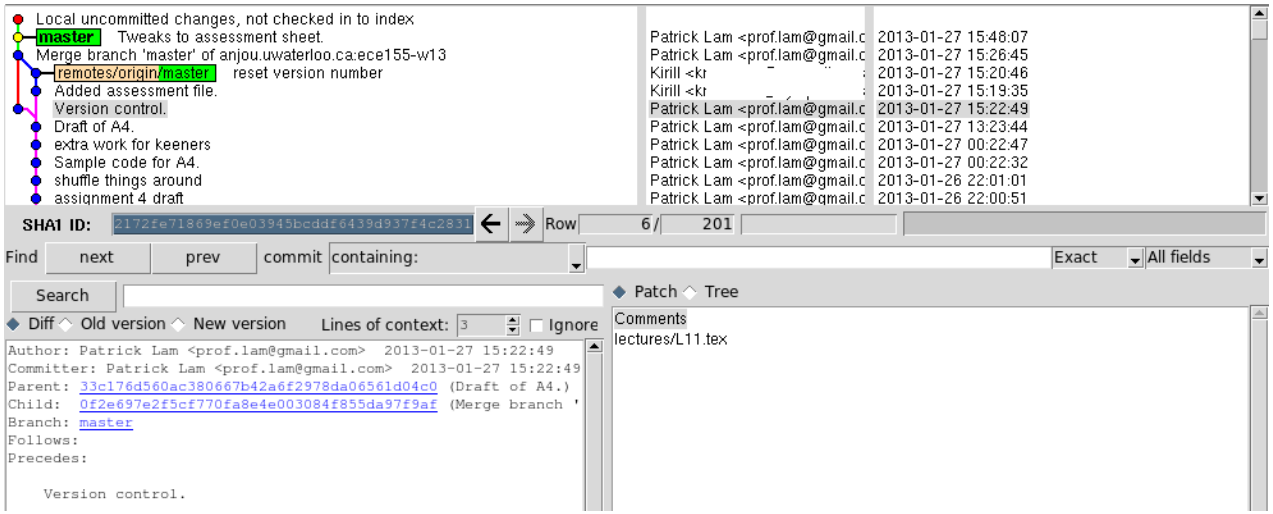
Ever wanted to undo your changes to software?

Ever needed to collaborate with others to develop software?

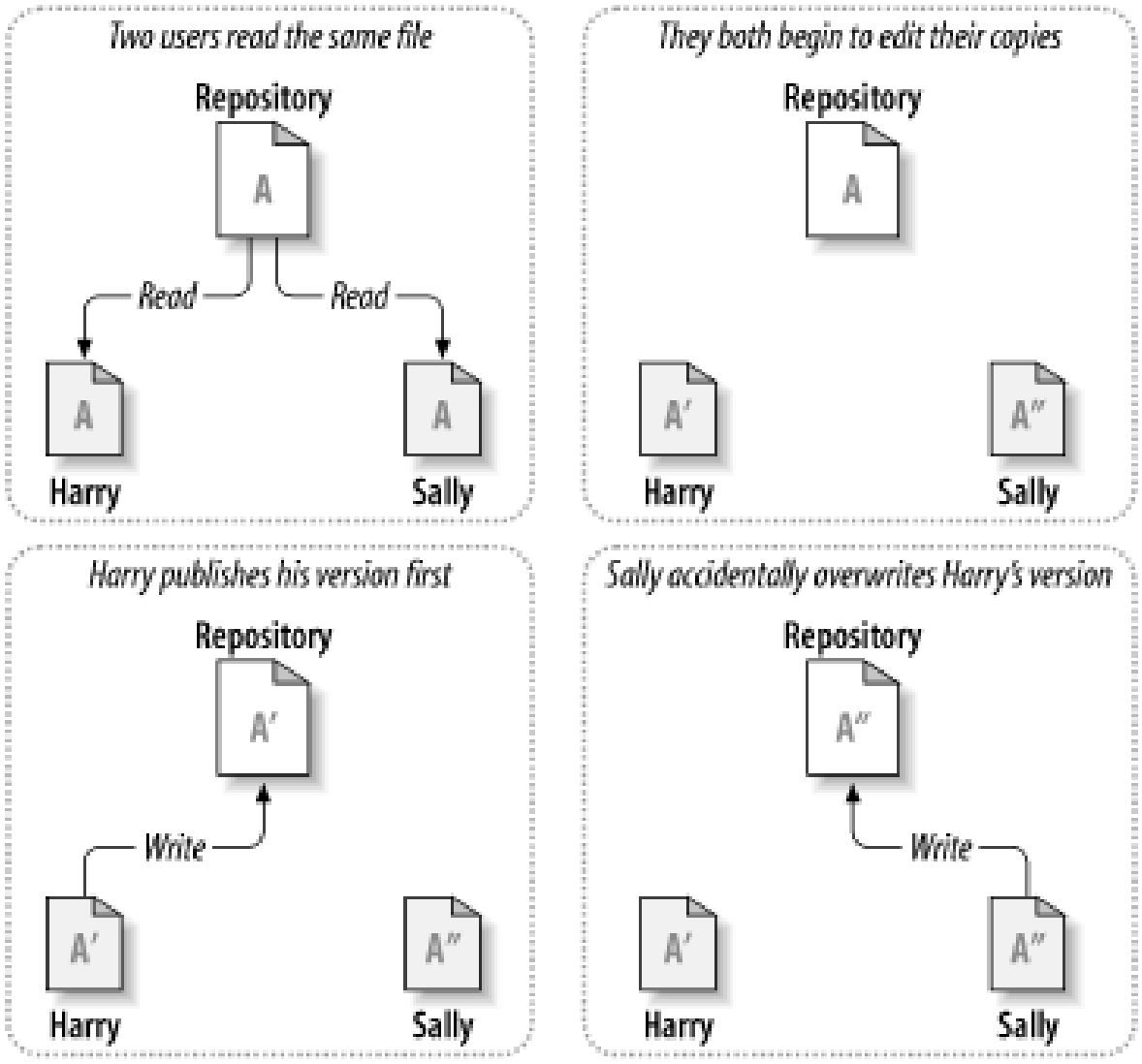
Conceptual Idea



- Store a repository of revisions.

  Each revision is a snapshot of a set of files.
- Can search by author, date, commit comment.
- Can revert to previous revisions.

Without Version Control



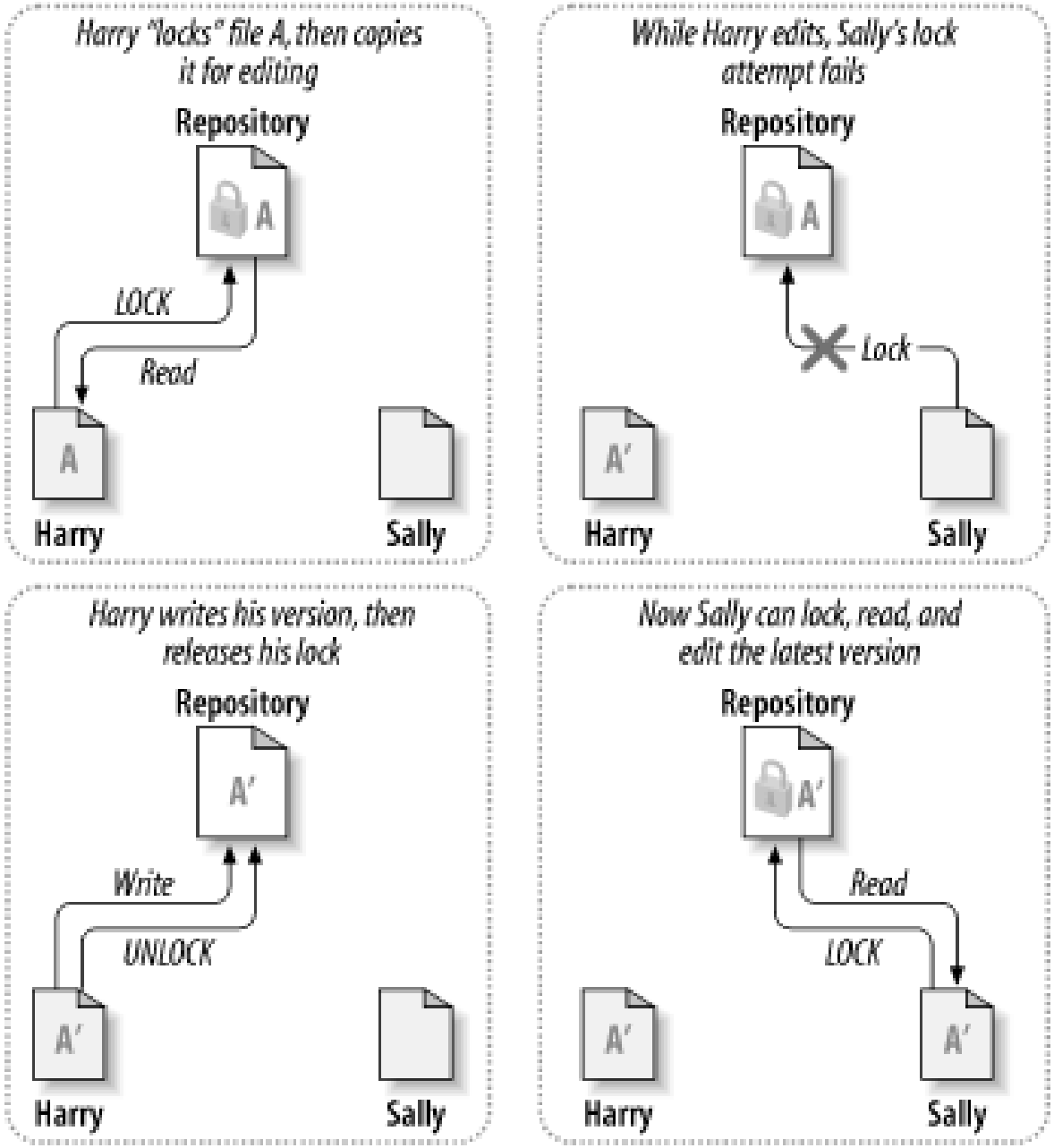
http://svnbook.red-bean.com/en/1.6/svn.basic.version-control-basics.html

Lock-Modify-Unlock

The first model: Lock-Modify-Unlock

Considered obsolete, but worth learning about.

Lock-Modify-Unlock



Problems with Lock-Modify-Unlock

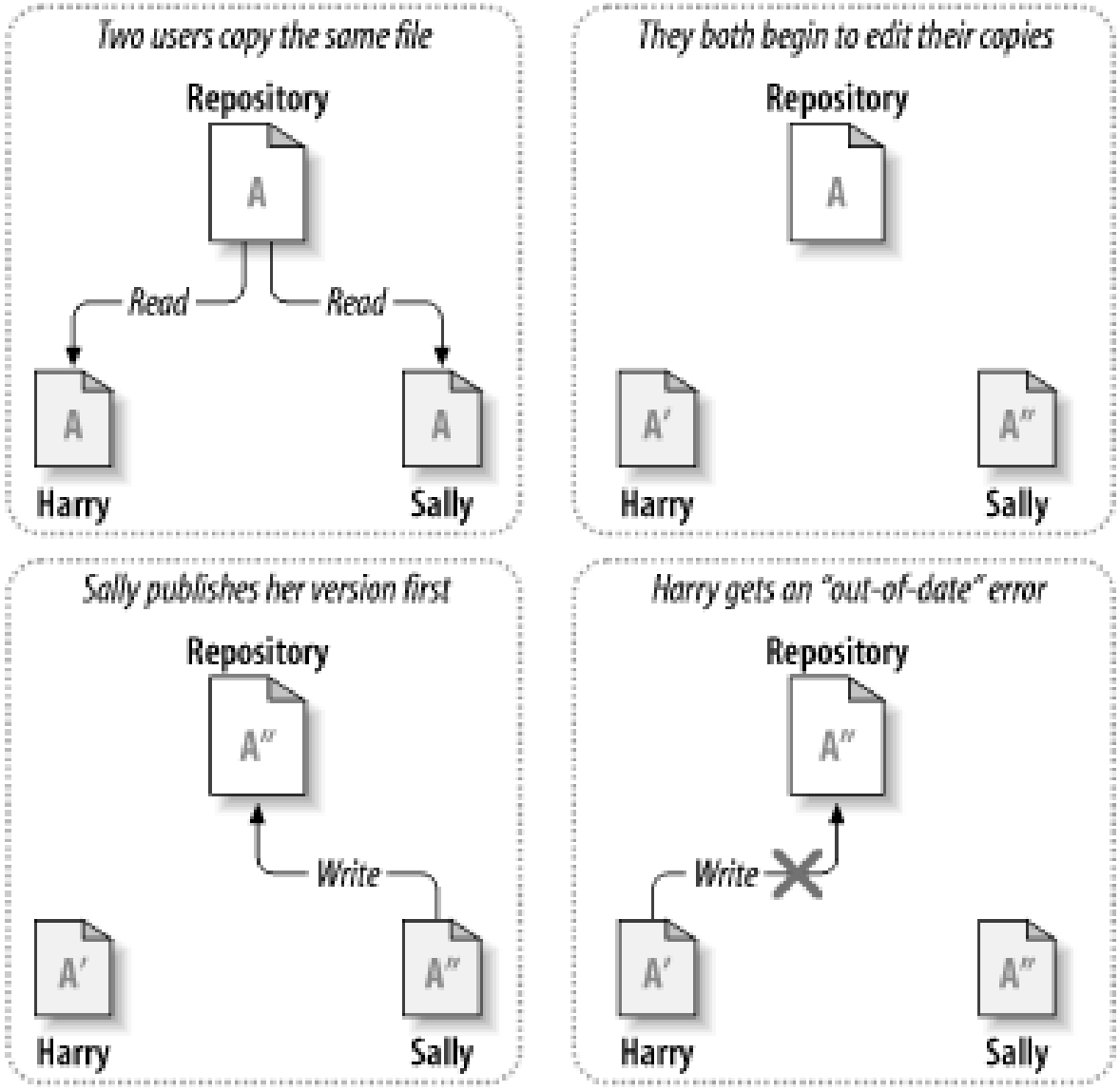
- Forgot to Unlock.
- Unnecessary Waiting
- Deadlock
- Parallel Modification

Copy-Modify-Merge

The current model: Copy-Modify-Merge

Yes, merging works. Have you tried it?

Copy-Modify-Merge



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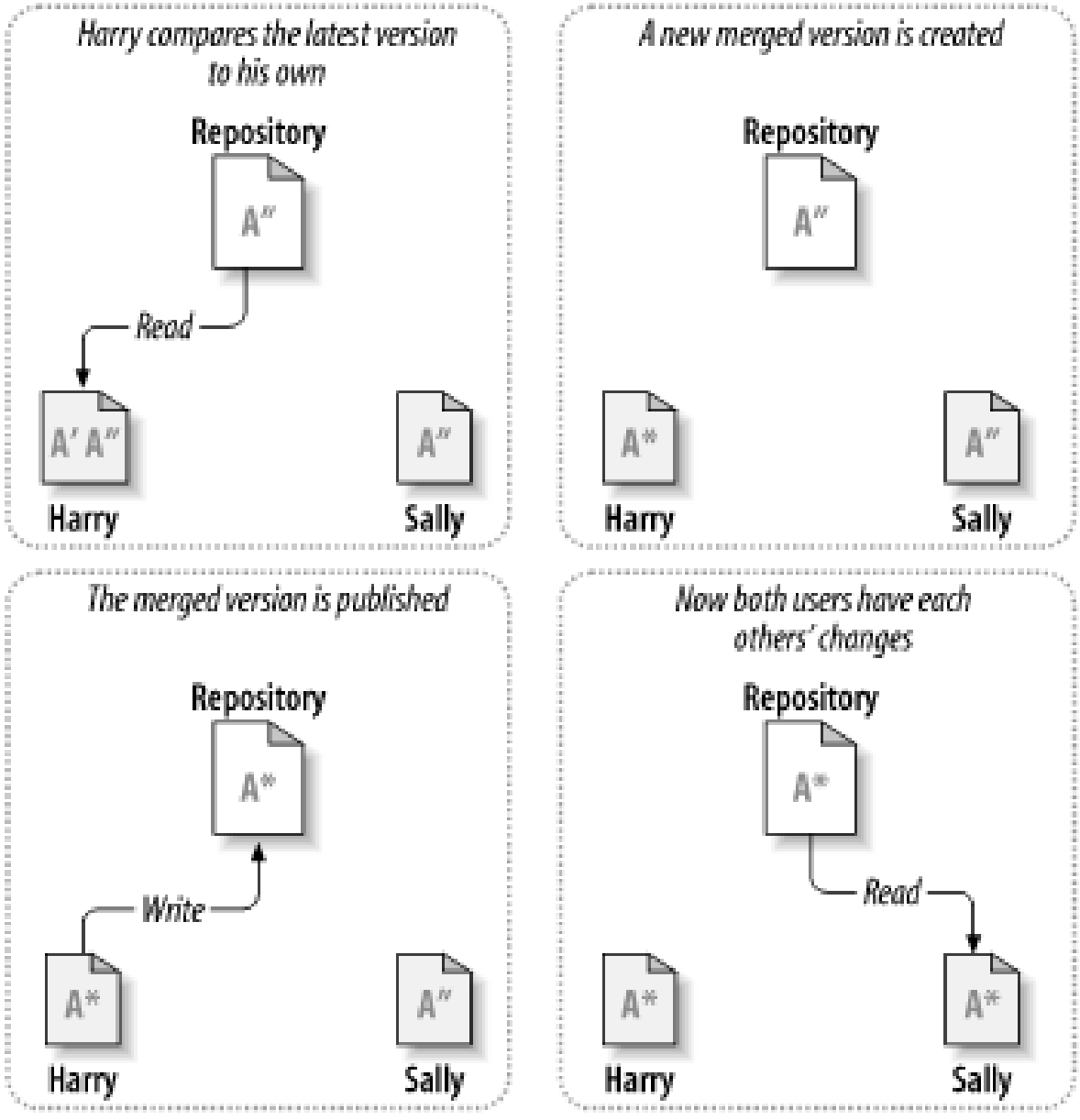
Copy-Modify-Merge



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Merging

Usually succeeds automatically.

Sometimes you will have to solve a conflict manually.

Consider: the common ancestor, your change, and the other change.

Advantage of C-M-M: More parallelism. Conflicts infrequent.

CVS

One of the first version control systems: cvs

Developed in the 1980s; mature technology

Introduced the concept of branches.

Branches split off from the trunk (mainline).

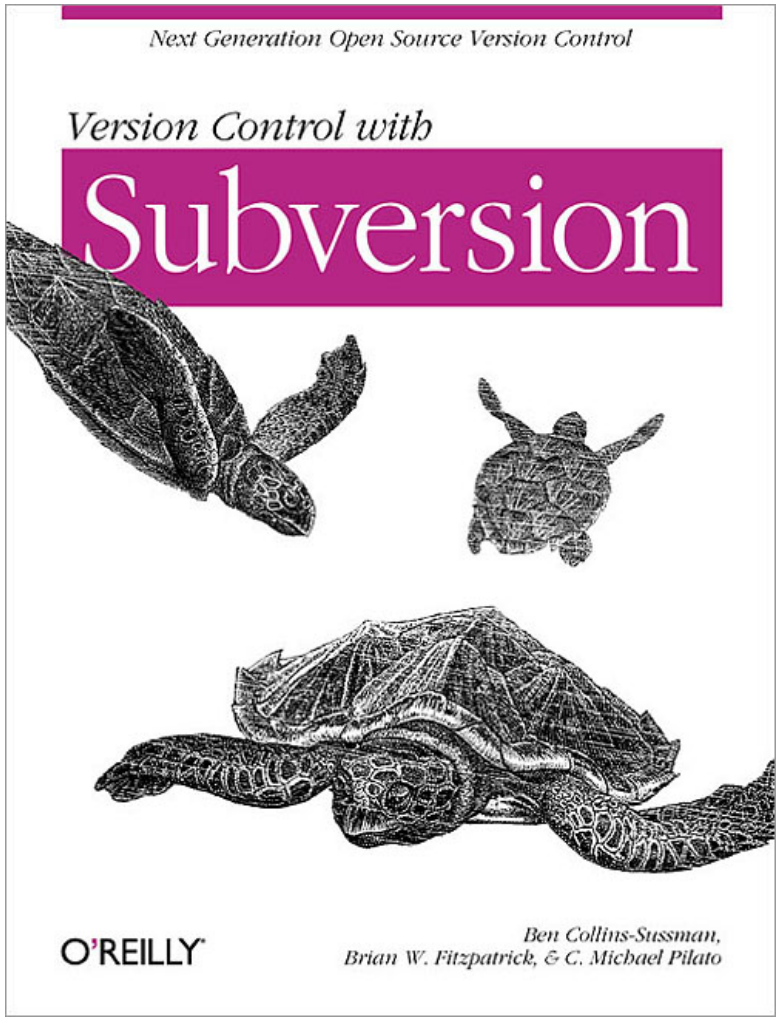
CVS: Shortcomings

- No Moving/Renaming Support
- Branches Expensive
- Commits Not Atomic

From CVS to SVN

Attempts to address these problems led to: Subversion (svn).

Case Study: Subversion



(`http://svnbook.red-bean.com/`)

You are using Subclipse; I'll talk about command-line usage.

Creating a new repository

Create one from scratch:

```
svnadmin create c:\svn\repos
```

More commonly, check out a repository:

```
svn checkout http://k9mail.googlecode.com/svn/k9mail/trunk/
    k9mail-read-only
```

- creates a working copy. (You've done this.)

Adding and Ignoring Files

You've seen how to add files to the repository
(Team > Add to Version Control).
command-line: `svn add filename`

- failure to add files: leading cause of build breakage

You've seen ignored files like `R.java`.

- Generally, do not commit generated files!

Instead, tell Subversion to ignore them,
e.g. using wildcards.

Committing Files

On SVN, a commit makes your changes available to the world.
In decentralized version control, a commit records current version.

When to commit?

- What you commit must compile!
- Generally, one feature at a time, after testing. (Varies by source control system.)

Commit Messages

- An important form of project documentation[1].

Start with a one-line summary.

Establish the specific context of the change:

- Why is it necessary?
- How does it work?
- What are the effects?

Meta-commit message[2]:

```
Summarize clearly in one line what the commit is about

Describe the problem the commit solves or the use
case for a new feature. Justify why you chose
the particular solution.
```

[1] http://who-t.blogspot.ca/2009/12/on-commit-messages.html, accessed 27Jan13

[2] https://github.com/erlang/otp/wiki/Writing-good-commit-messages, accessed 27Jan13

Updating your repository

Pull changes from the repository to your working copy.

Use `svn update` to do that. If all goes well, you'll get output like this:

```
plam@noether:~/production/11.aosd.modularity$ svn up
D    example.tex
A    studies.tex
U    introduction.tex
A    sketch.tex
U    main.tex
```

Conflicts: the bane of your existence

This is a pain:

```
plam@noether:~/production/11.aosd.modularity$ svn up
C    example.tex
```

Why?

- Both the latest version and your version differ from the common ancestor.

Example conflict

How?

1. I wrote: “Here’s a line of text”.
2. Programmer X changes it to “Here’s a line of text that I modified.”
3. I change it again to “Here’s a modified line of text.”

The result:

```
<<<<<<< HEAD
Here’s a line of text that I modified.
=======
Here’s a modified line of text.
>>>>>>> zzz
```

You need to fix it and tell SVN that you’ve fixed it.

Stepping Back in Time

Major win of version control:

- can undo sketchy changes.

Can update to a past revision number or a date/time.

How to know which version to revert to?

- your detailed log messages!

Note: you can't commit an update, but you can merge it to your working copy.

Diffs

Basic unit of version control is the diff:

- describes what's different between two versions.

Inspect your diffs before committing. Commit minimal diffs.

```
===================================================================
--- Text/abstract.tex (revision 17379)
+++ Text/abstract.tex (working copy)
@@ -1,10 +1,10 @@
 Runtime monitoring enables developers to (1) specify important program
 properties and (2) dynamically validate that these properties hold.
 In recent research, we have found that static analysis techniques can,
-in many cases, verify that runtime monitors never trigger.  In
-this paper, we describe a system which enables developers to visualize
-the remaining cases---potential
+in many cases, verify that runtime monitors never trigger.  In this
+paper, we describe a tool which enables developers to visualize the
+remaining cases---potential points
```

Basic SVN Workflow

Repeat until done:

- Update your working copy.
  (`svn update`)
- Edit files. Manipulate tracked files.
  (`svn add`, `svn rm`, `svn copy`, `svn move`)
- Examine changes.
  (`svn status`, `svn diff`)
- Undo changes, if necessary.
  (`svn revert`)
- Commit changes to the server.
  (`svn commit`)

SVN vs CVS

SVN was specifically intended to address the shortcomings of CVS. Some properties:

- Atomic Commits
- Branch Operations
- Support for Moving or Renaming

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Issues with SVN

Subversion is better than CVS, but it still has some problems:

- Centralized
- Slow

Centralized vs. Distributed

Traditionally, there was one canonical central repository for a software project.

Centralized systems work on that model.

Newer version control systems can be decentralized.

Git and Mercurial

One of those decentralized systems is `git`.

Designed to be a new model, not just “better” `svn`.

Created by Linus Torvalds (yes, of the Linux Kernel).

Decentralized – can view everything offline.

Fast!

Branch operations inexpensive and recommended workflow.

Similar to svn: add, ignore, commit, update, merge, resolve, etc.

Complex (steep learning curve)

Git Workflow

The basic work cycle of git is the following:

- Update working copy of the repository (`git pull`).
- Create a feature branch (`git checkout -b`).
- Edit files. Manipulate set of files with `git add`, `git rm`.

Git Workflow

- Examine changes (`git status`, `git diff`).
- Undo changes (`git checkout`, `git reset`).
- Commit changes (`git commit`).
- Merge your feature branch into the parent branch:
  - Check the parent branch out (`git checkout`)
  - `git pull` to update
  - merge (`git merge`).
- Finally, share your changes with others using `git push`.

Mercurial

About Mercurial (`hg`)

Distributed like `git`.

Easier to learn; similar to `svn`.

Better Windows support.

Can be used alongside git on the same repository.