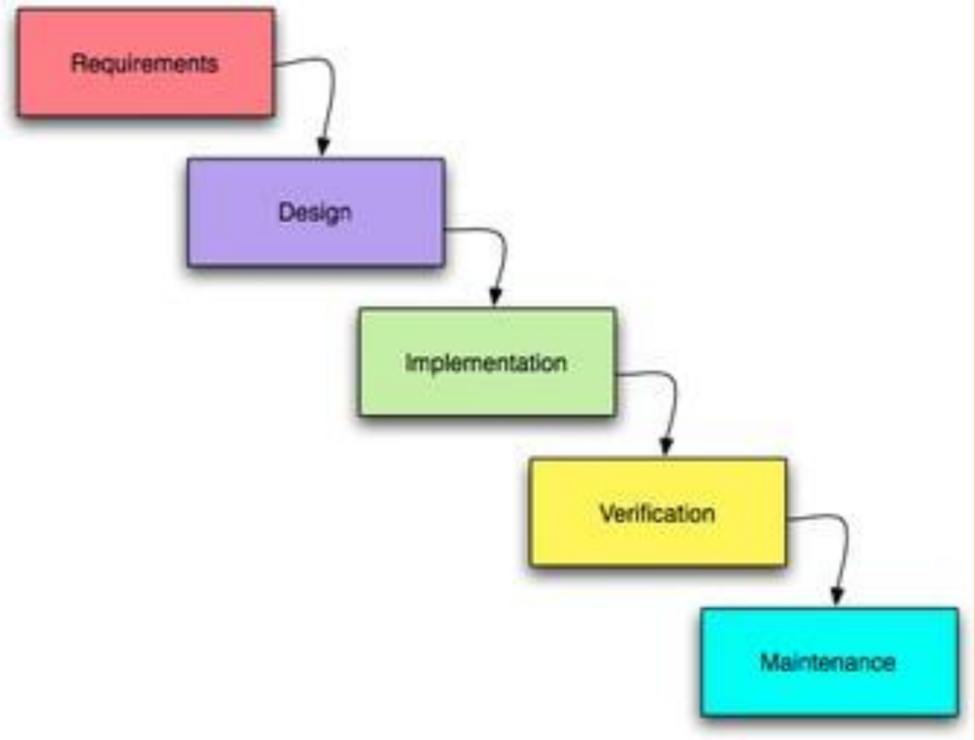
Chapter four

Introduction to Version Control

Based on material at http://svnbook.red-bean.com/
and git-scm.com/book

THE STAGES OF DEVELOPING A SOFTWARE APPLICATION

- Requirements Analysis
- High-level Design
- [Plan (SE2800)]
- Low-level Design
- ***Implementation***
- Unit Test (SE2832)
- ***Integration***
- ***System Test (SE3800)***
- Deploy (SDL)
- Maintain (SDL)

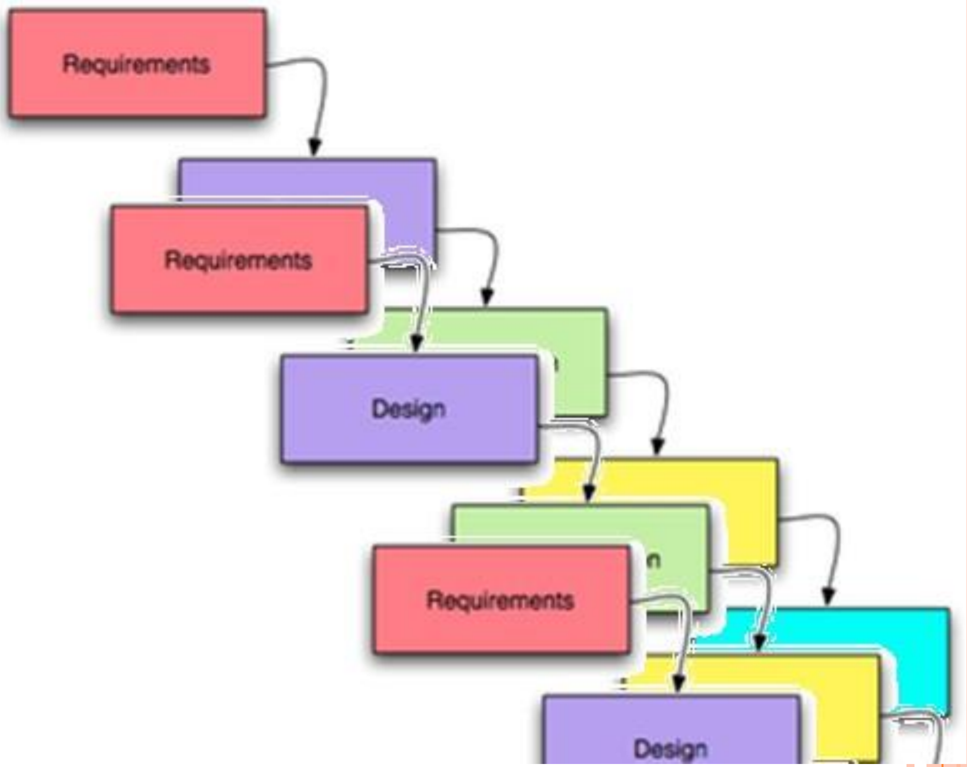


In many cases, multiple projects run concurrently

New features are typically being added to the next version

While at the same time, defects need to be corrected in existing releases

You will do this more in SDL



On a single project, a team of software engineers work together toward a release

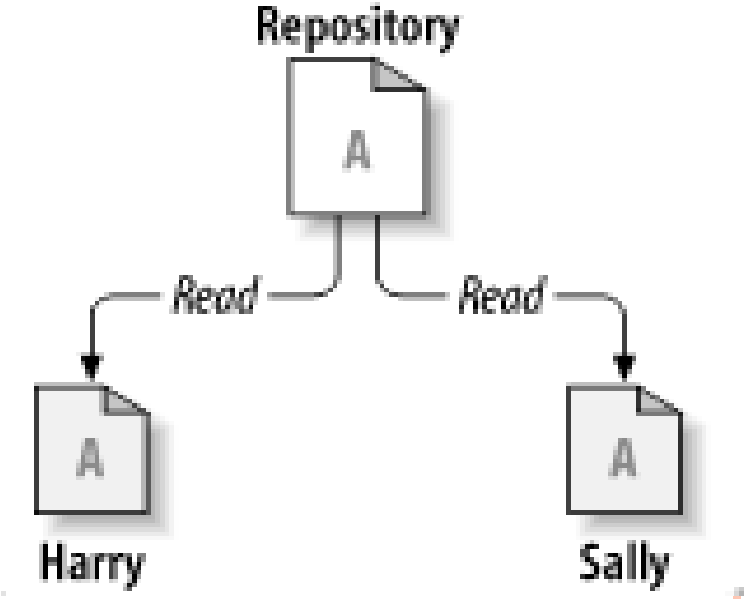
All team members work on the same code and develop their respective parts

An engineer may be responsible for an entire class

Or just a few methods within a particular class

FILES HAVE TO BE SHARED AMONG DEVELOPERS ON A TEAM PROJECT

Shared files can be kept in some type of **Repository** where they can be accessed and worked on by multiple individuals



Harry and Sally get their own respective local **Working Copies** of the Master File in the Repository

Image: http://svnbook.red-bean.com/

What might you use for a Repository?

Would any of these work?

- USB/SD drive
- Private network drive
  - E.g. shared “X:” drive
- Cloud drive
  - Google drive
  - Dropbox
  - iCloud

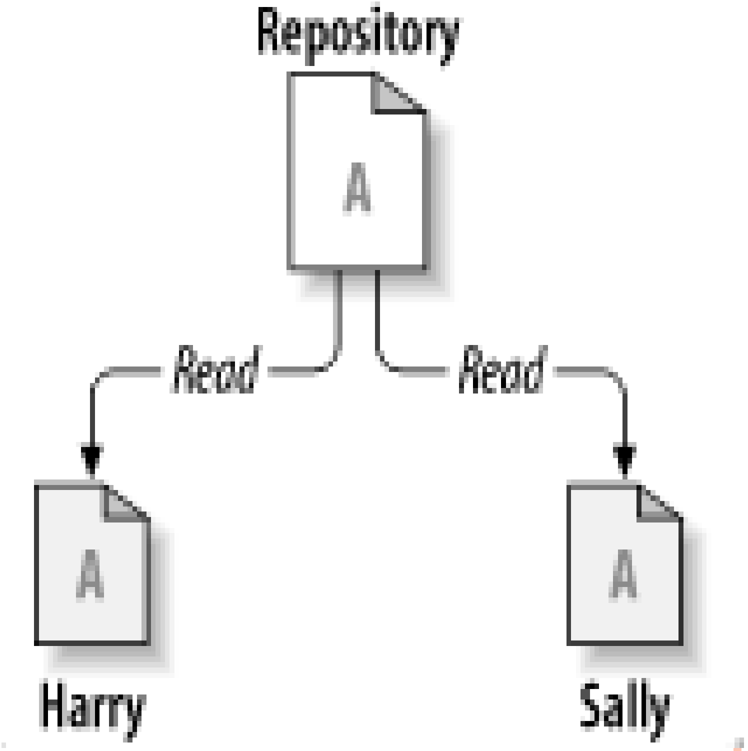
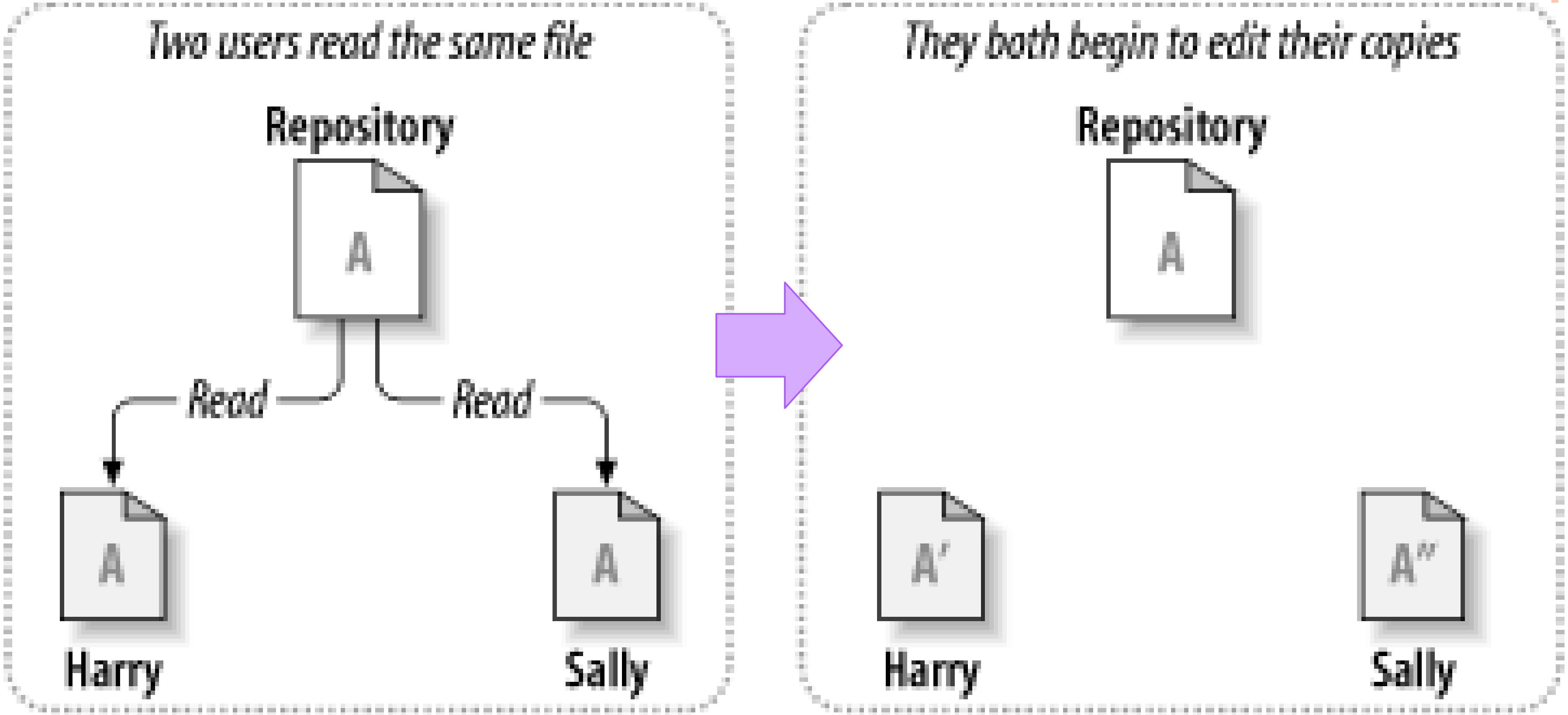


Image: http://svnbook.red-bean.com/

SHARING FILES CAN LEAD TO BIG PROBLEMS…

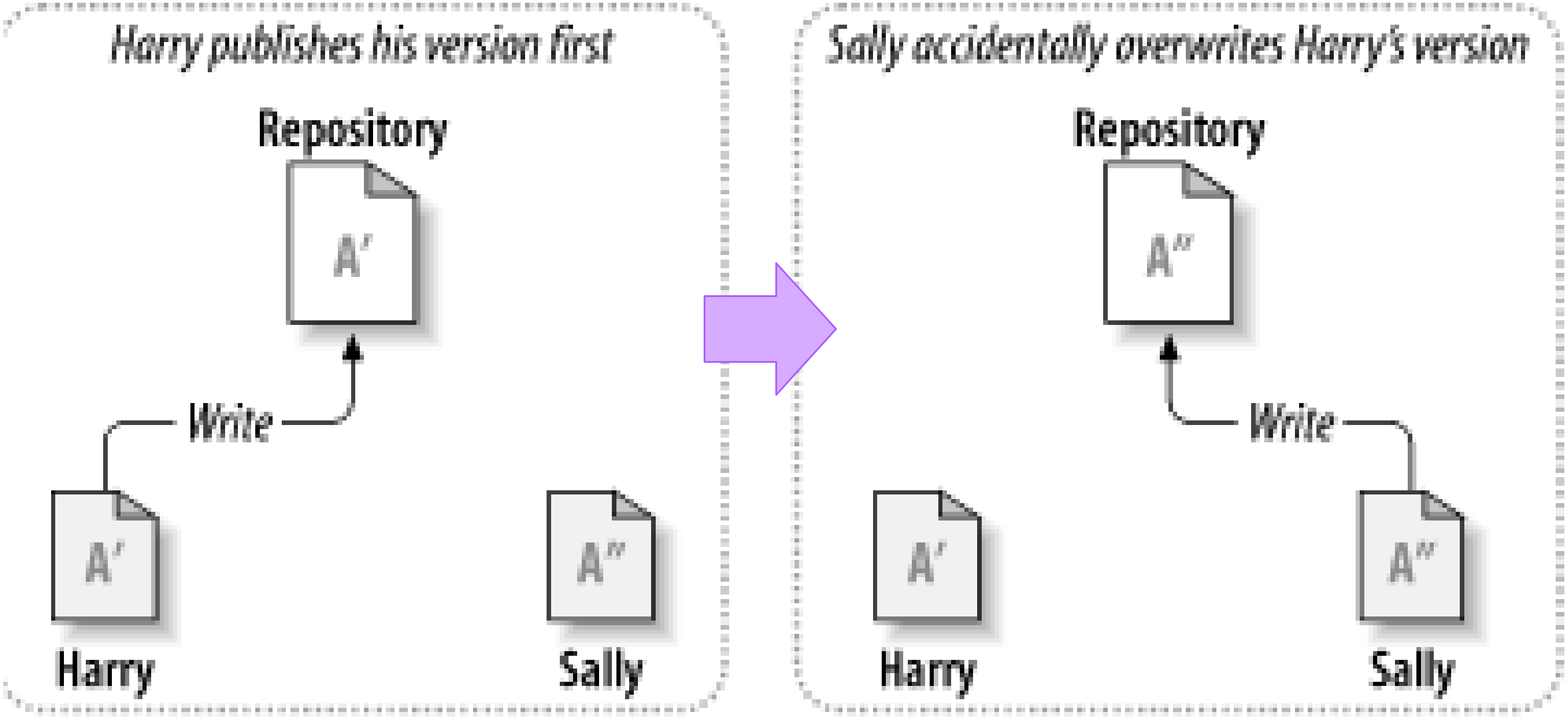

Two users read the same file
Repository
A
Read
Read
A
Harry
A
Sally
They both begin to edit their copies
Repository
A
A'
Harry
A''
Sally

Adds some method

Modifies some other method

Image: http://svnbook.red-bean.com/

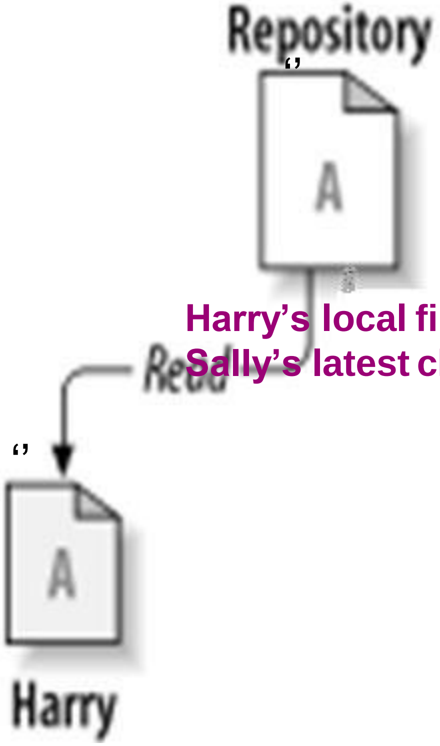
THE PROBLEM TO AVOID:


Harry publishes his version first
Repository
A′
Write
A′
A″
Harry
Sally
Sally accidentally overwrites Harry's version
Repository
A″
Write
A′
A″
Harry
Sally

Harry's changes are still held locally…

Image: http://svnbook.red-bean.com/

Harry's changes are lost



Harry's local file gets overwritten with Sally's latest changes.

Image: http://svnbook.red-bean.com/

The Issue: Effective management of software artifacts, especially code

Some acronyms:

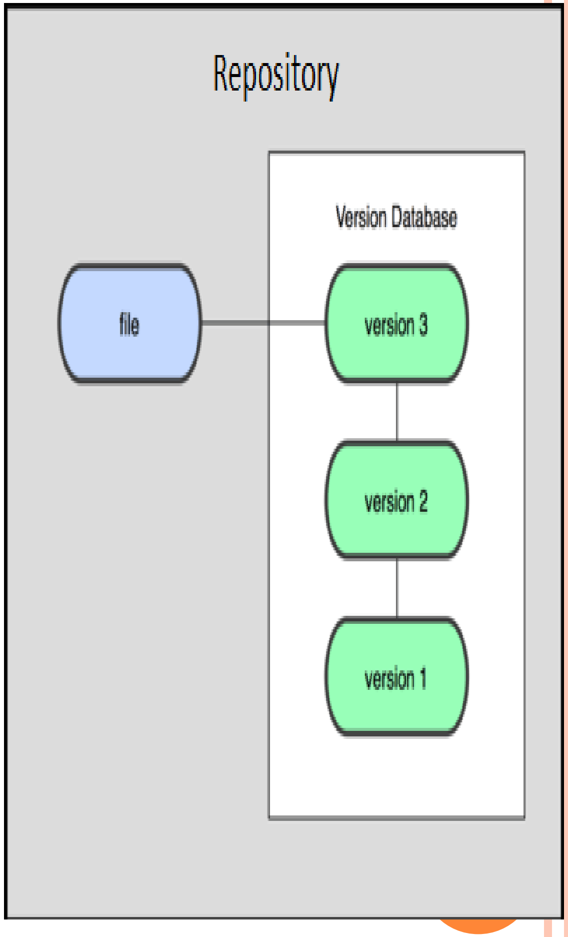
- SCM – Source Code Management
- SCCM – Source Code Configuration Management
- RCS – Revision Control System
- VCS – Version Control System
- DVCS - Distributed Version Control Systems

Revision/Version History might help

- …but USB/SD, private network drives do not maintain revision history

- Cloud drives (e.g. **Google Drive**, **Dropbox**, **iCould/Time Machine**) maintain a (limited) history of the various revisions of a file
  - Google Drive: keeps last 100 revisions or last 30 days
    - Supported in “Classic” mode only – going away?

- IF you detect a collision, you can manually merge the differences and resynchronize your work
  - Might be workable for two people – what about 5 or 10?



Any other disadvantages to Google Drive/Dropbox/iCloud

- Security?
- Support (bug fixes and new features)?
- Ownership of stored information?
- Cost?
- Ease of Use?
- Acceptance?

Special-purpose Revision Control Systems have been around a lot longer than Google Drive or Dropbox

- SCCS, 1972 (IBM)
- RCS, 1982 (Unix)
  - SourceSafe 1995 (Microsoft)
- CVS, 1986 (multi-platform)
- SVN, 2000 (multi-platform)
- Git and Mercurial, 2005 (multi-platform)

The way these work has evolved over the years

FEATURES OF VERSION CONTROL SYSTEMS

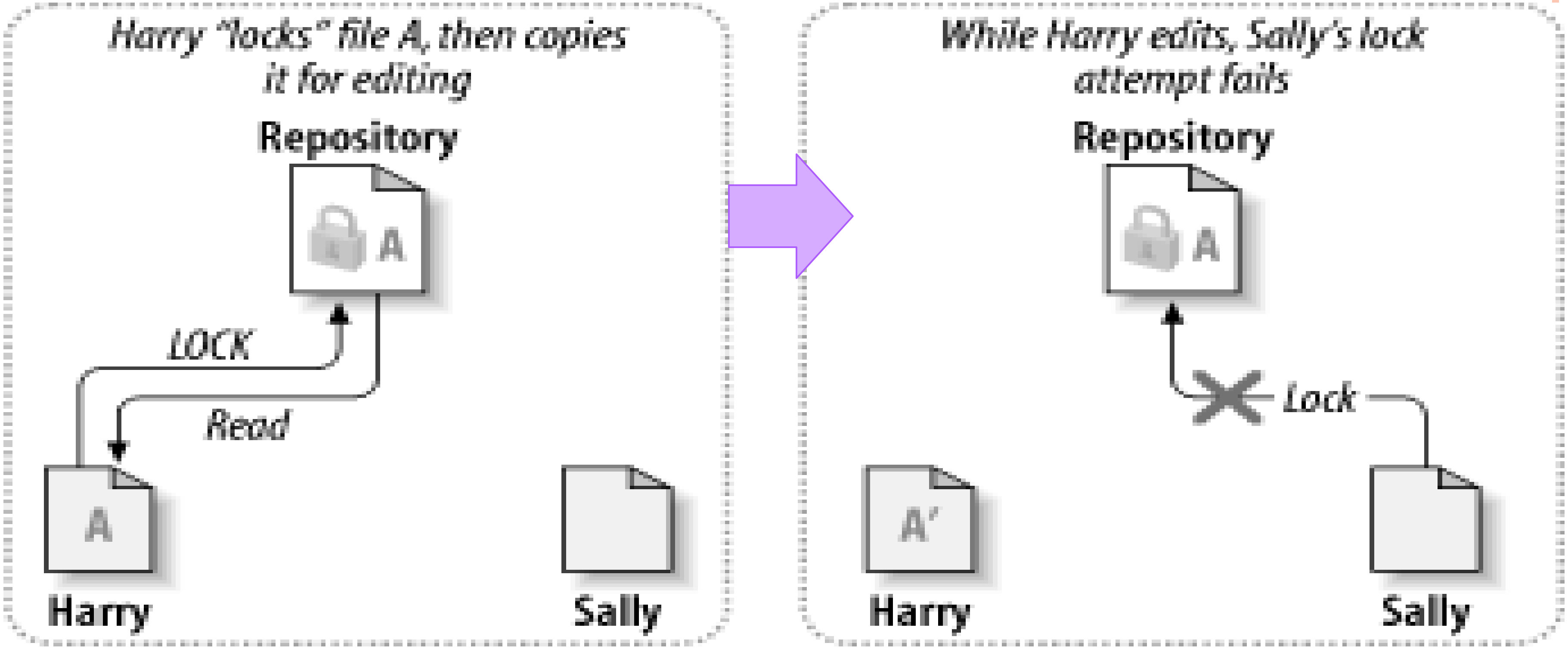
- All changes to a file are tracked
  - Version histories show **who**, **what**, **when**

- Changes can be reverted (rewound to any earlier version)

- Changes between revisions are easy to identify

The Lock-Modify-Unlock solution

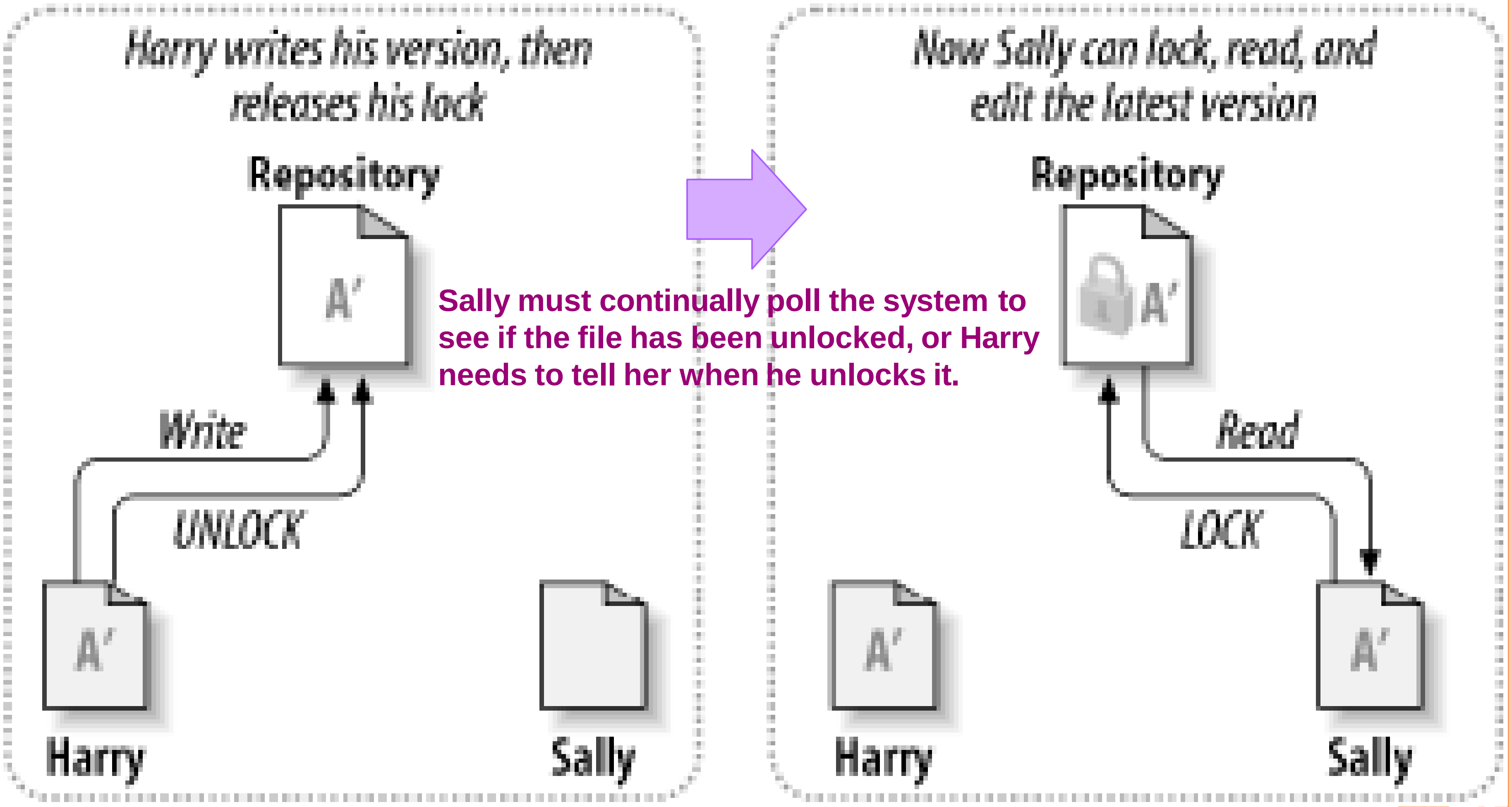
Early systems followed this model (RCS, SourceSafe)


Harry "locks" file A, then copies it for editing
Repository
A
LOCK
Read
A
Harry
Sally
While Harry edits, Sally's lock attempt fails
Repository
A
Lock
A'
Harry
Sally

Sally must wait until Harry releases the lock, although she can retrieve a "readonly" version of the file in the meantime.

Image: http://svnbook.red-bean.com/

Lock-Modify-Unlock only allows a single user to edit the file at a time

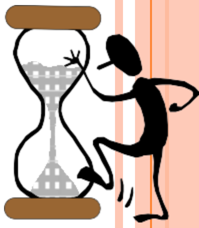

Harry writes his version, then releases his lock
Repository
A′
Write
UNLOCK
A′
Harry
Sally
Now Sally can lock, read, and edit the latest version
Repository
A′
Read
LOCK
A′
Harry
A′
Sally

Sally must continually poll the system to see if the file has been unlocked, or Harry needs to tell her when he unlocks it.

Image: http://svnbook.red-bean.com/

LOCK-MODIFY-UNLOCK HAS CERTAIN DRAWBACKS:

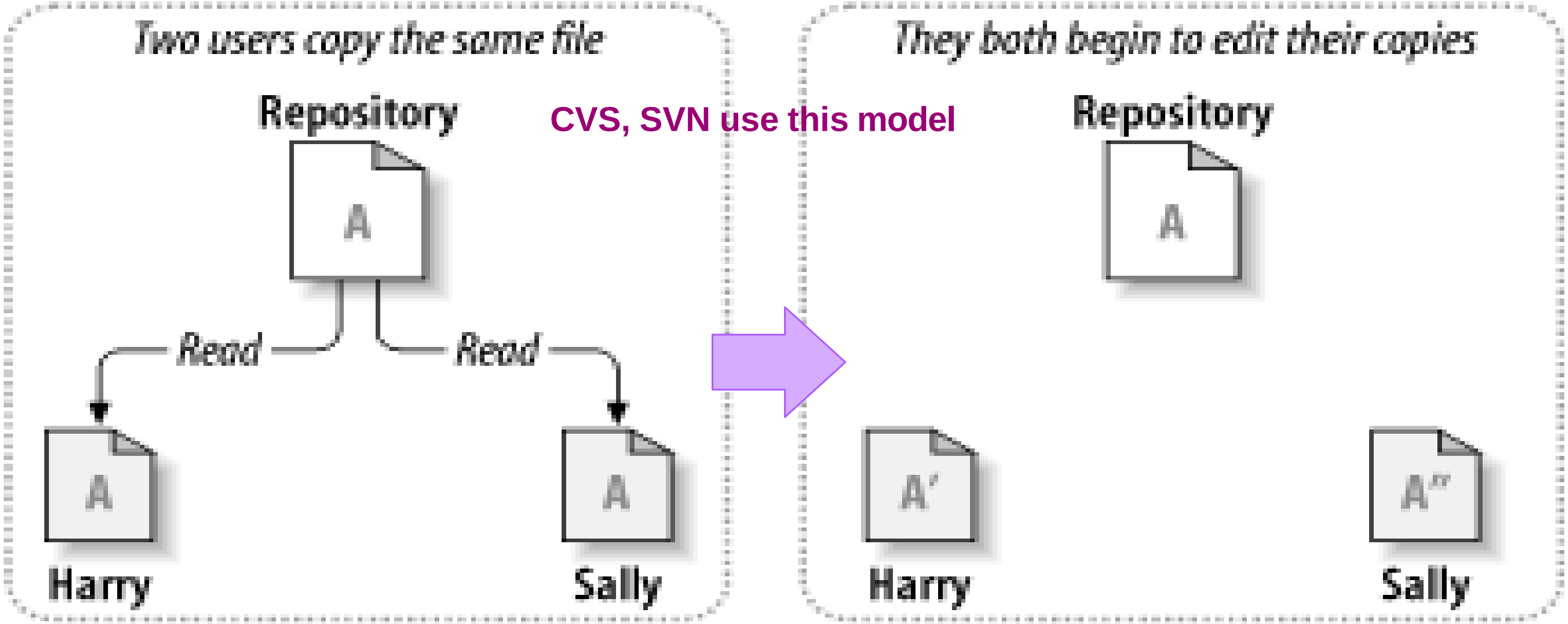
Harry has to remember to release his lock before Sally (or anyone else) can acquire the lock in order to edit



Sally has to wait for Harry to finish before editing (editing must be done sequentially)

- Harry might be adding some new methods (takes a long time)
- Harry might forget to release the lock before going home (or on vacation!)

The Copy-Modify-Merge solution allows concurrent editing


Two users copy the same file
Repository
A
Read
Read
A
Harry
A
Sally
They both begin to edit their copies
Repository
A
A'
Harry
A''
Sally

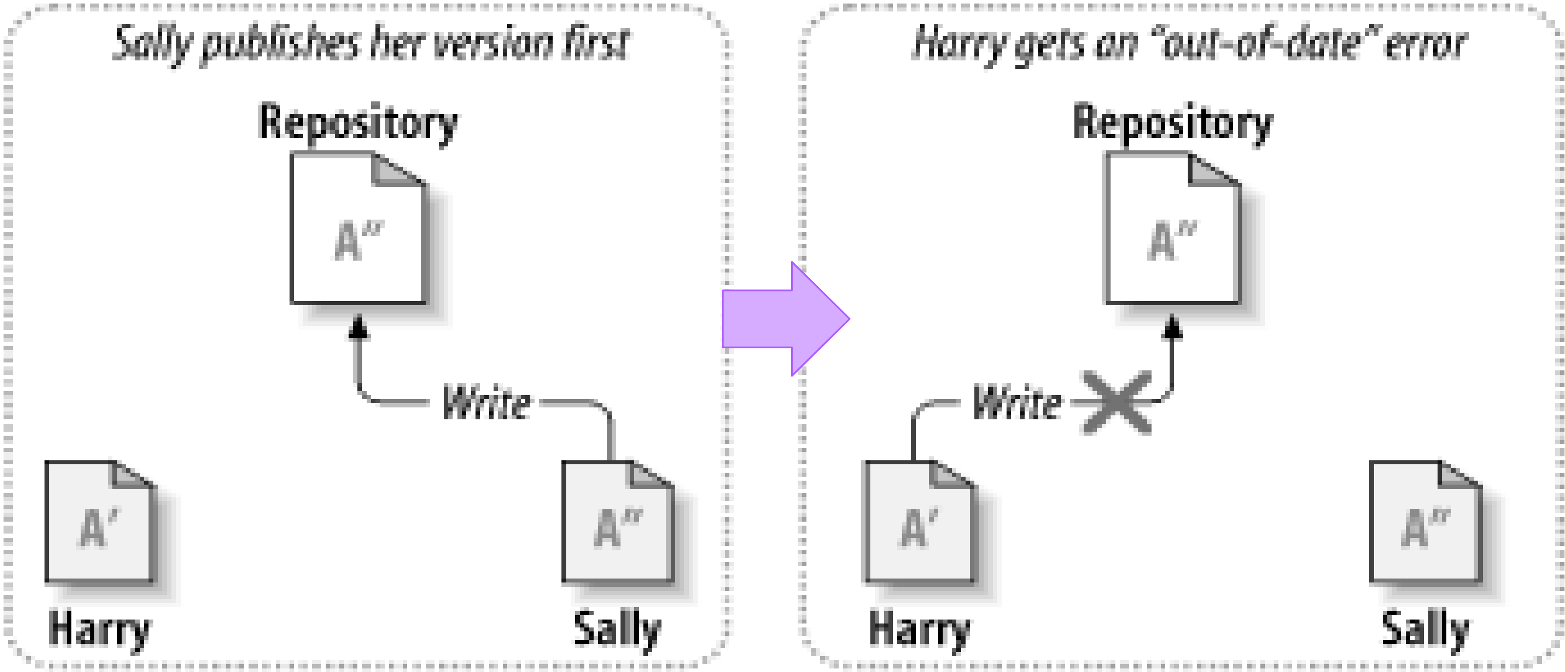
CVS, SVN use this model

Harry adds new methods

Sally adds comments

Image: http://svnbook.red-bean.com/

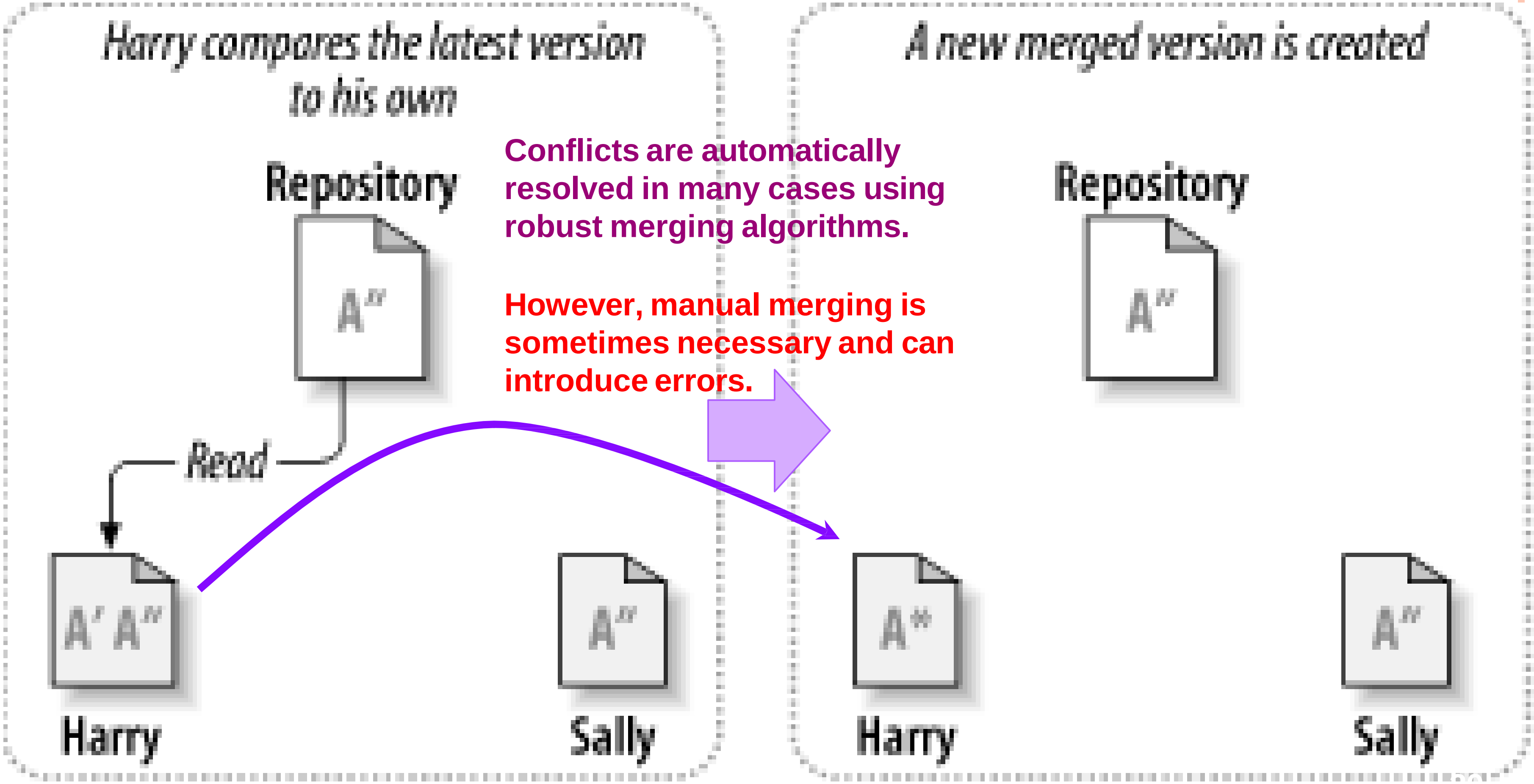
THE REPOSITORY RECOGNIZES CONFLICTS


Sally publishes her version first
Repository
A″
Write
A′
Harry
A″
Sally
Harry gets an "out-of-date" error
Repository
A″
Write
A′
Harry
A″
Sally

Harry is prevented from writing

Image: http://svnbook.red-bean.com/

Conflicting versions of the files are merged


Harry compares the latest version to his own
Repository
A''
Read
A' A''
Harry
A''
Sally
A new merged version is created
Repository
A''
A*
Harry
A''
Sally

Conflicts are automatically resolved in many cases using robust merging algorithms.

However, manual merging is sometimes necessary and can introduce errors.

Image: http://svnbook.red-bean.com/

The Repository keeps both users synchronized

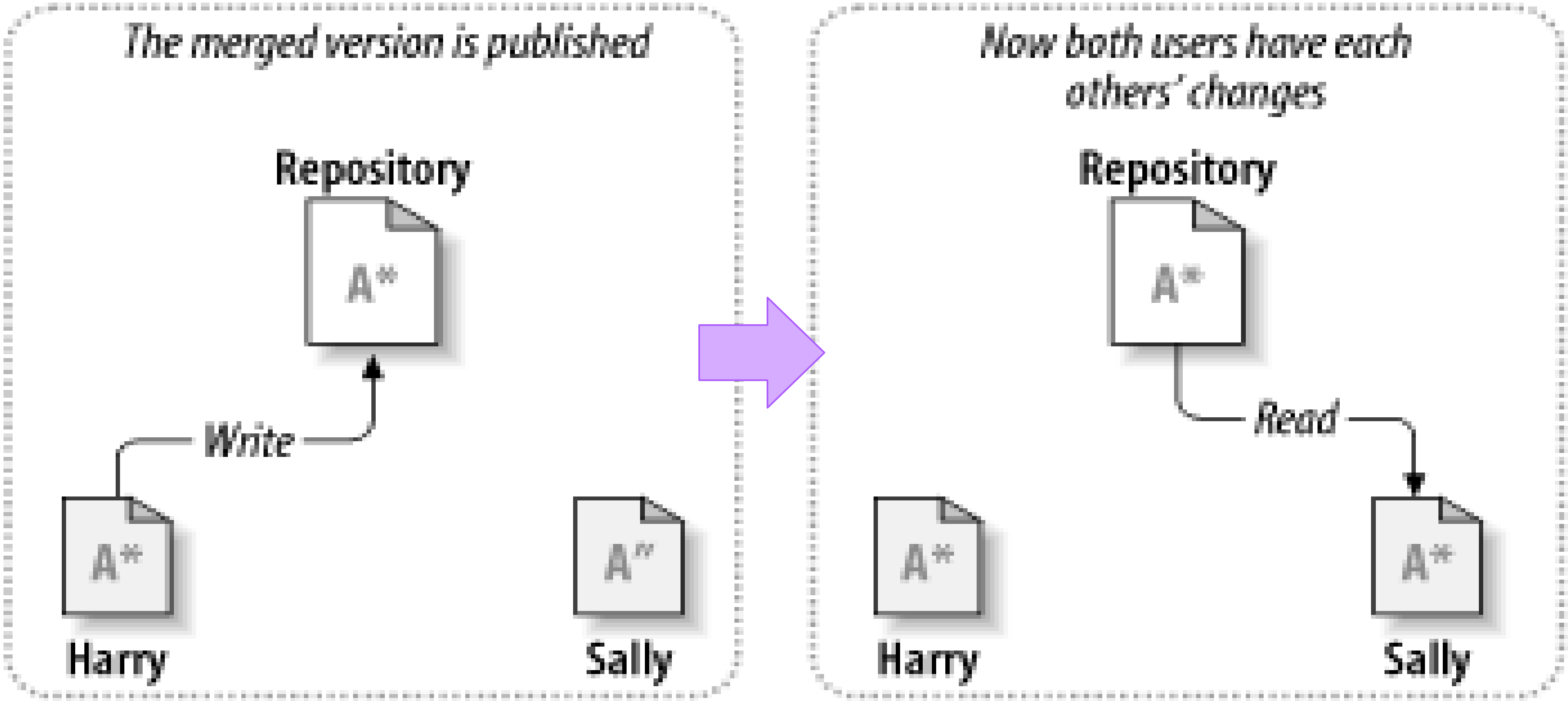

The merged version is published
Repository
A*
Write
A*
Harry
A"
Sally
Now both users have each others' changes
Repository
A*
Read
A*
Harry
A*
Sally

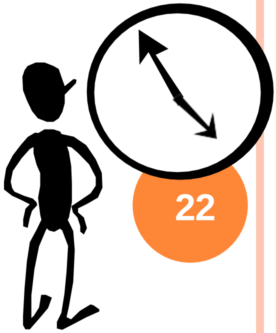
Image: http://svnbook.red-bean.com/

Copy-Modify-Merge is generally easy to use and manage

Users can work in parallel

Most of the time, concurrent changes don't overlap

- People generally don't edit exactly the same code simultaneously, so merging is done automatically in many cases
- Amount of time spent resolving conflicts is nearly always less than the time that would be spent waiting for a lock to be released



Is Lock-Modify-Unlock ever needed anymore?

When two or more people need to work on the same file, the simultaneous changes may not be mergable in all cases:

- MS Office documents
- Image documents
- Other binary files

Subversion is an open-source version control system that is available and still supported for many platforms

- Windows
- Mac
- Linux

Many current open-source projects use Subversion to maintain source code control

- http://subversion.tigris.org/
- Latest release 8/2014
- MSOE still maintains Subversion on a linux server

Subversion's main drawback is the centralized nature of the Repository

A repository is typically hosted on a server.

- Version history is on the server, not on your local PC
- If the server or network become unavailable, everyone gets stuck with the working copy they have.

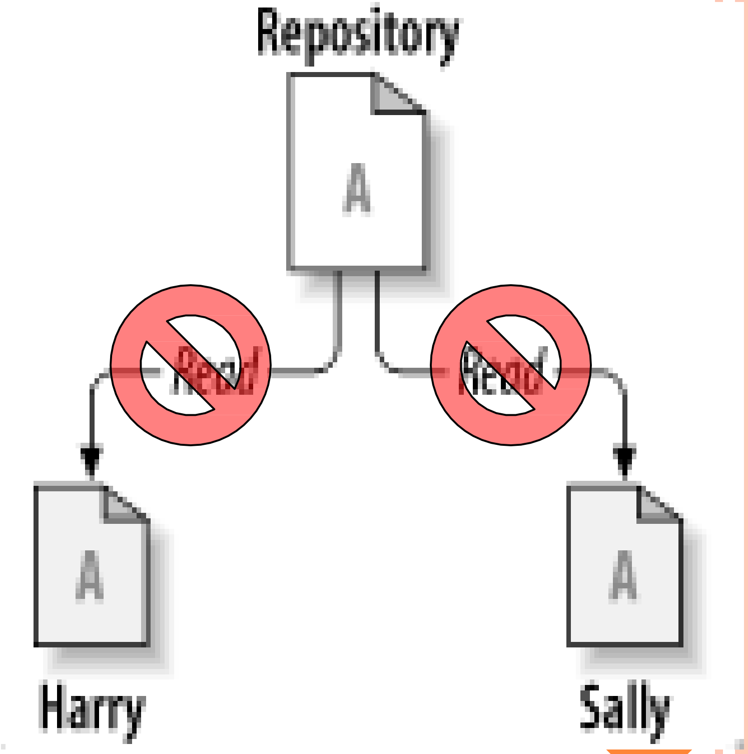
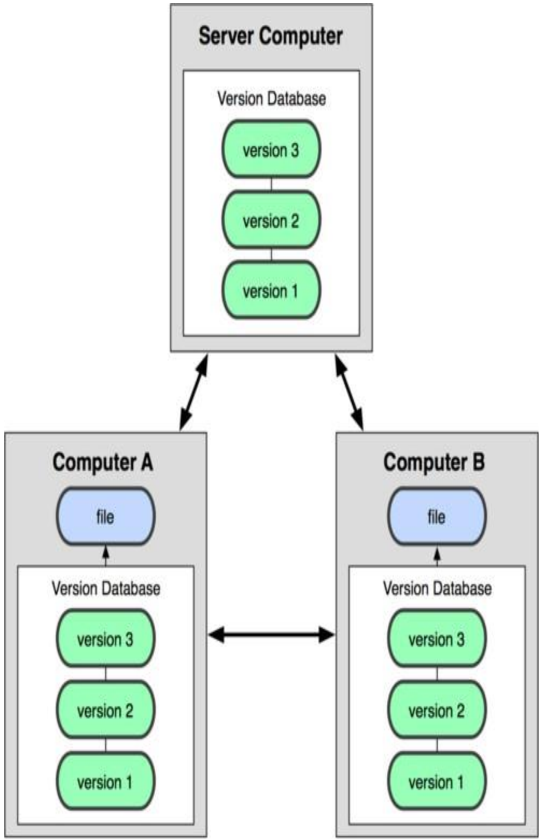


Image: http://svnbook.red-bean.com/

DISTRIBUTED VERSION CONTROL

A “remote master” repository is typically hosted on a server.

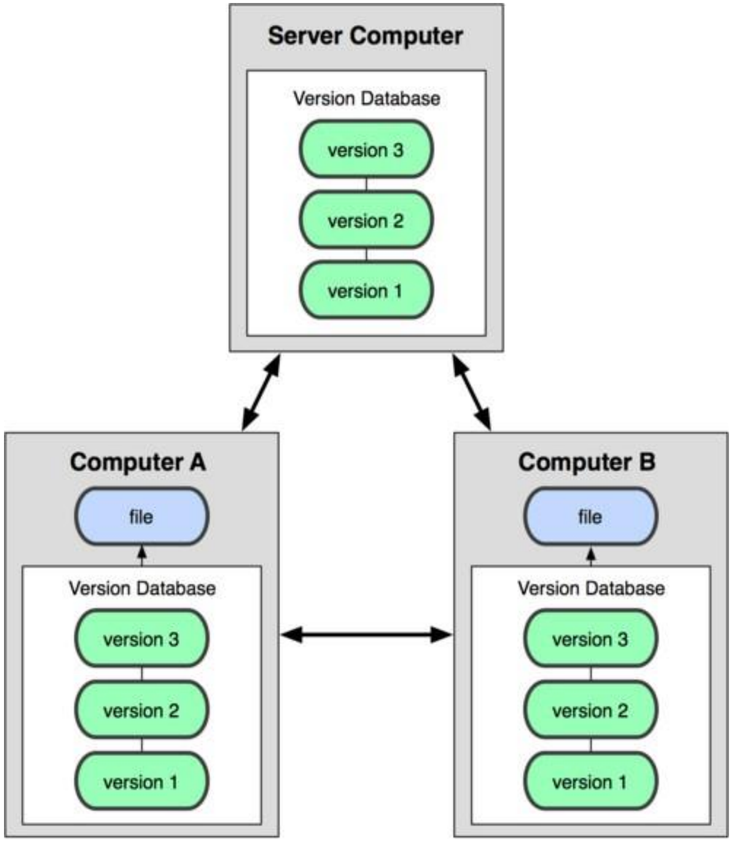
- □ Clones of the remote repository are maintained on each user’s computer
- □ If the server goes down, users can continue sharing code (provided they can connect over a network) by synch’ing to each others’ repositories
- □ If the network is unavailable, users can continue reading & writing to their own local repository – synch’ing with others later



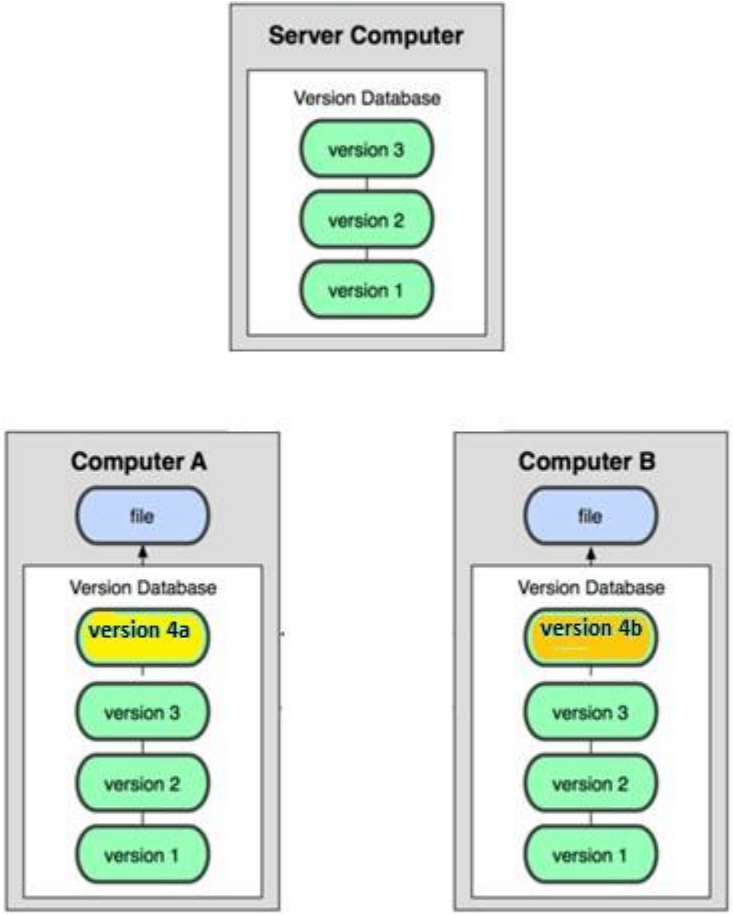
Git and Mercurial use this model

Image: http://git-scm.com/book/

Merging in a DVCS, part 1

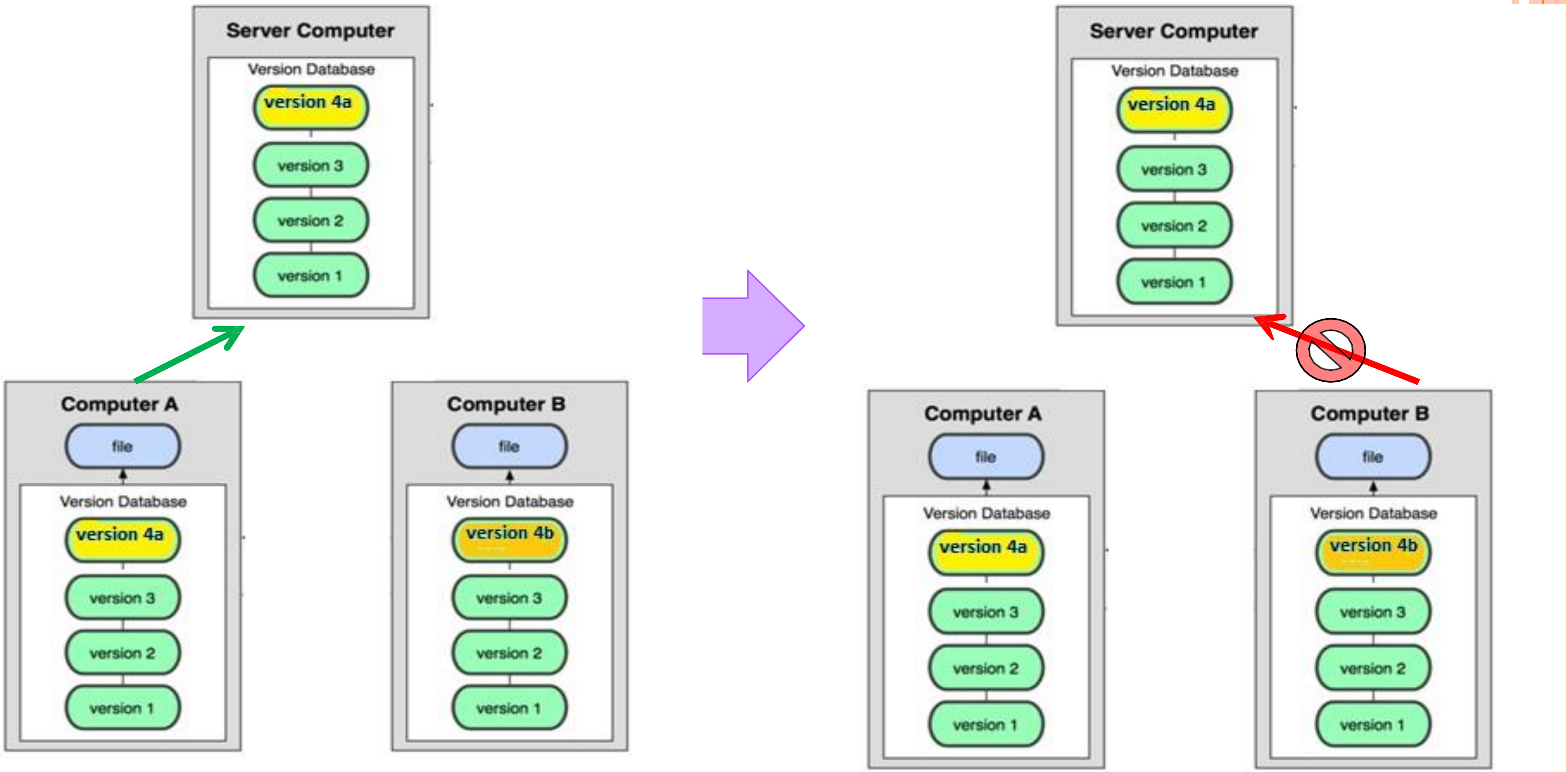


1. Initially, both users' repositories are synch'd to the remote master; All files are identical.



2. Both users edit the same file, and their local repositories reflect their changes

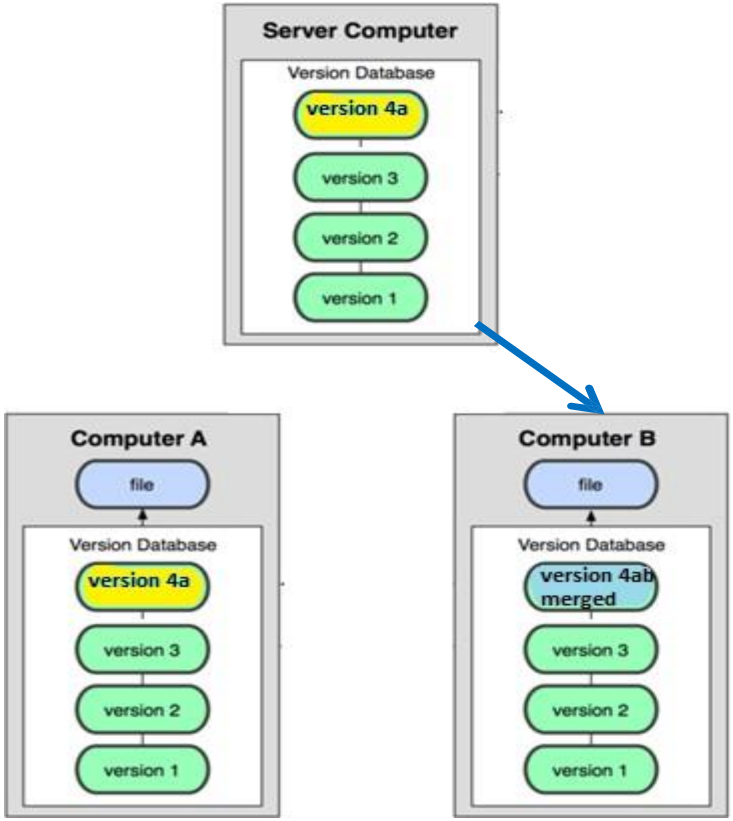
Merging in a DVCS, part 2



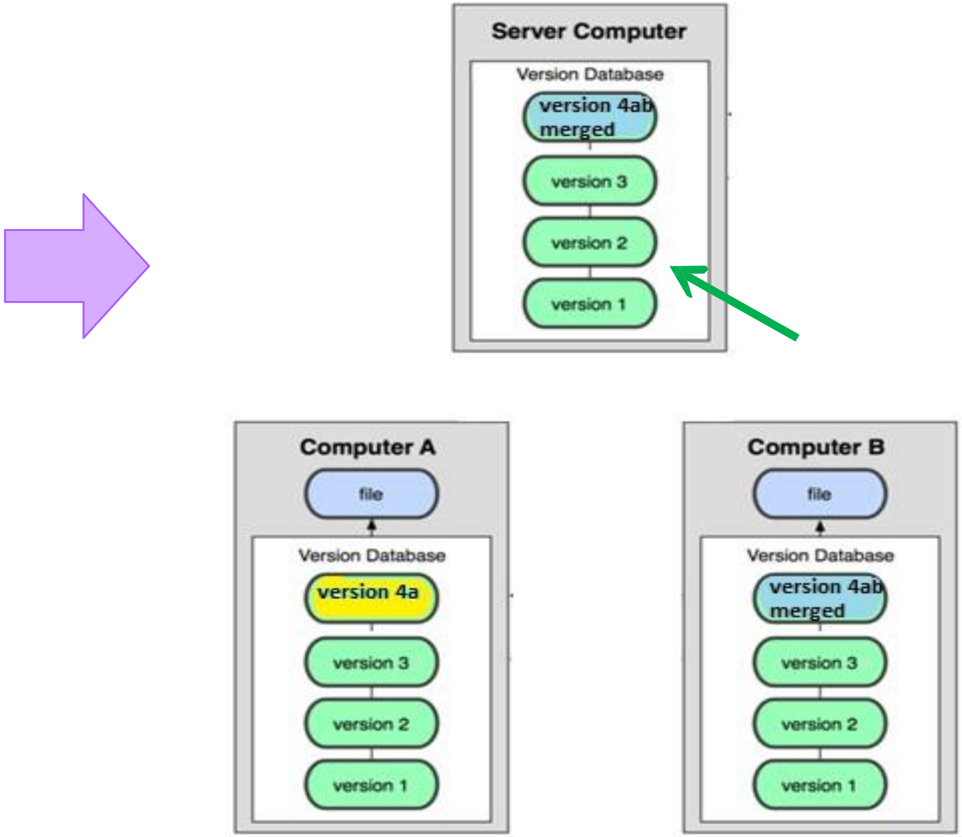
3. User A "pushes" her repository to the remote master to synch; this succeeds.

4. User B attempts to "push" his repository to the remote to synch; this fails due to User A's earlier push. Remote does not change.

MERGING IN A DVCS, PART 3

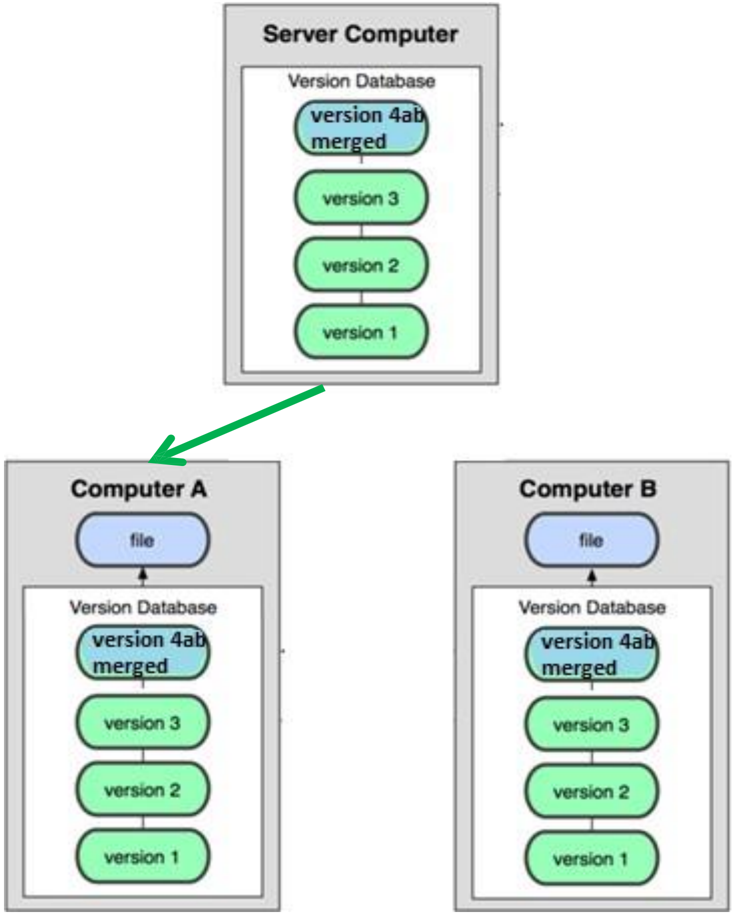


5. User B “pulls” User A’s updates from the remote master, merging A and B together. Merging is automatic with some exceptions.



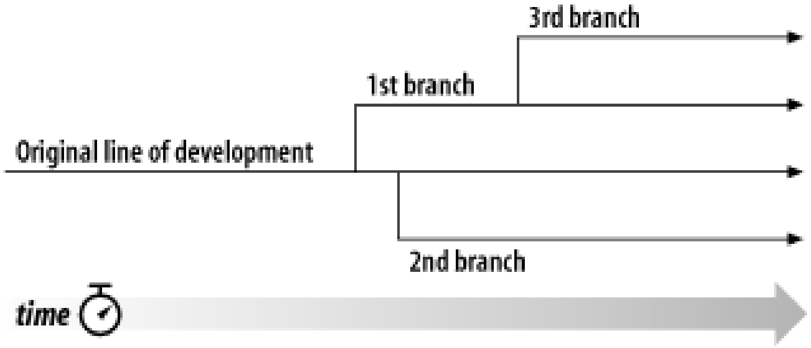
6. User B “pushes” his repository to the remote to synch; this now succeeds

MERGING IN A DVCS, PART 4



7. User B “pulls” from the remote, and everyone is in synch again.

Repositories can also manage and track differences between parallel revisions of a document



- Typically, a software product will undergo parallel development on different **branches** (e.g. for new/future features) while primary development takes place on the main (***master***) branch

Image: http://svnbook.red-bean.com/

Look for the lab material at atlassian_git_cheatsheet.pdf