Version Control

CS 490MT/5555, Spring 2016, Yongjie Zheng

Fundamental Concepts

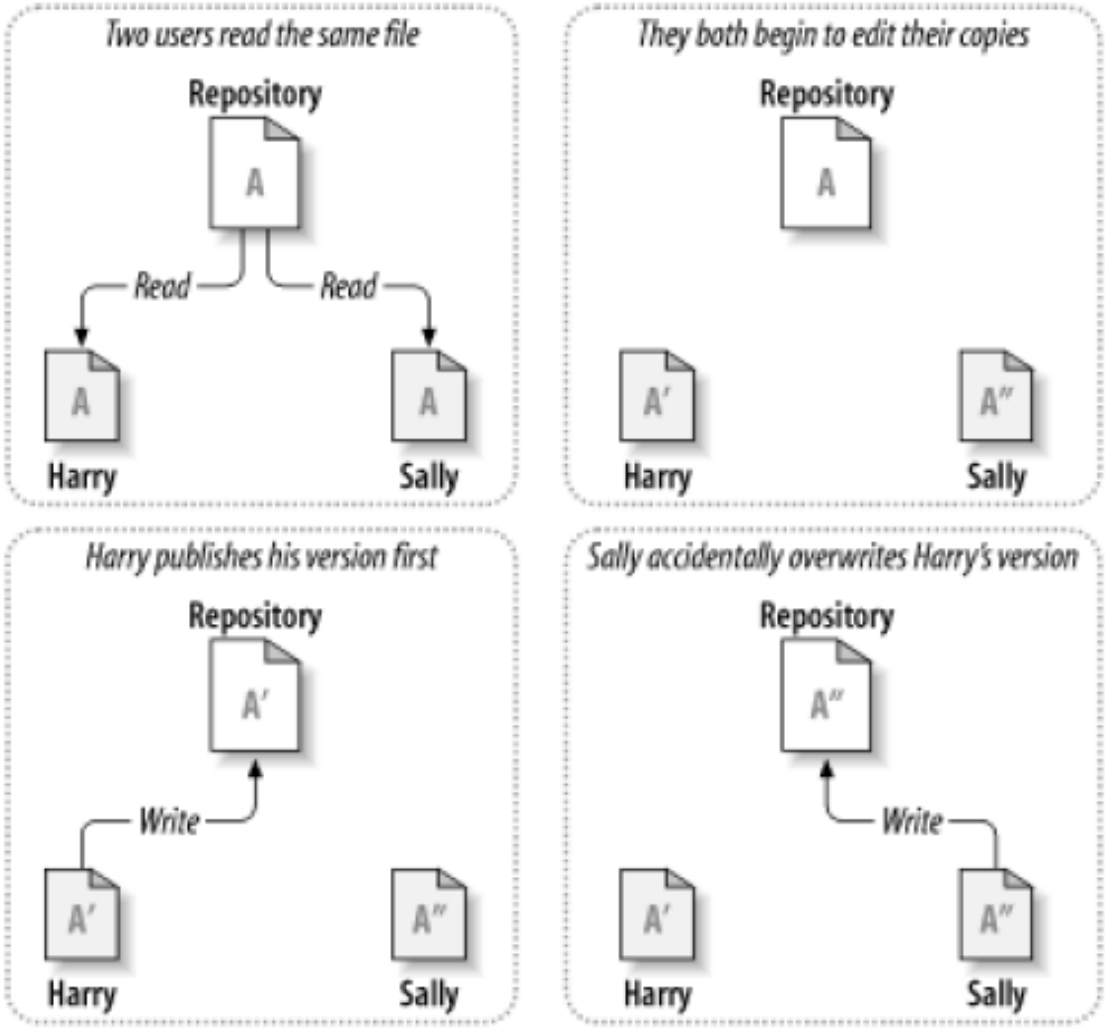
- Version Control
  - The management of evolution of software systems.
- Repository (Depot)
  - The place where all completed work is stored, including
    - The current state of the project;
    - The entire **history** (i.e. changes) of the project: when each change was made, who made it, and a text log message.
- Working copy
  - The local reflection of the repository's files and directories.
- Baseline / Trunk
  - The "primary" location for code in the repository. Think of code as a family tree — the "trunk" is the main line.

Version Control

- Mission
  - Keep track of all old versions of files
    - Every file in the system has a full history of changes, and can easily be restored to any version in its history. Each version has a unique identifier that looks like a string of letters and numbers.
  - Enable collaborative editing and sharing of data
    - How to prevent users from accidentally overwriting each other's changes?
    - Help developers communicate their changes to each other.

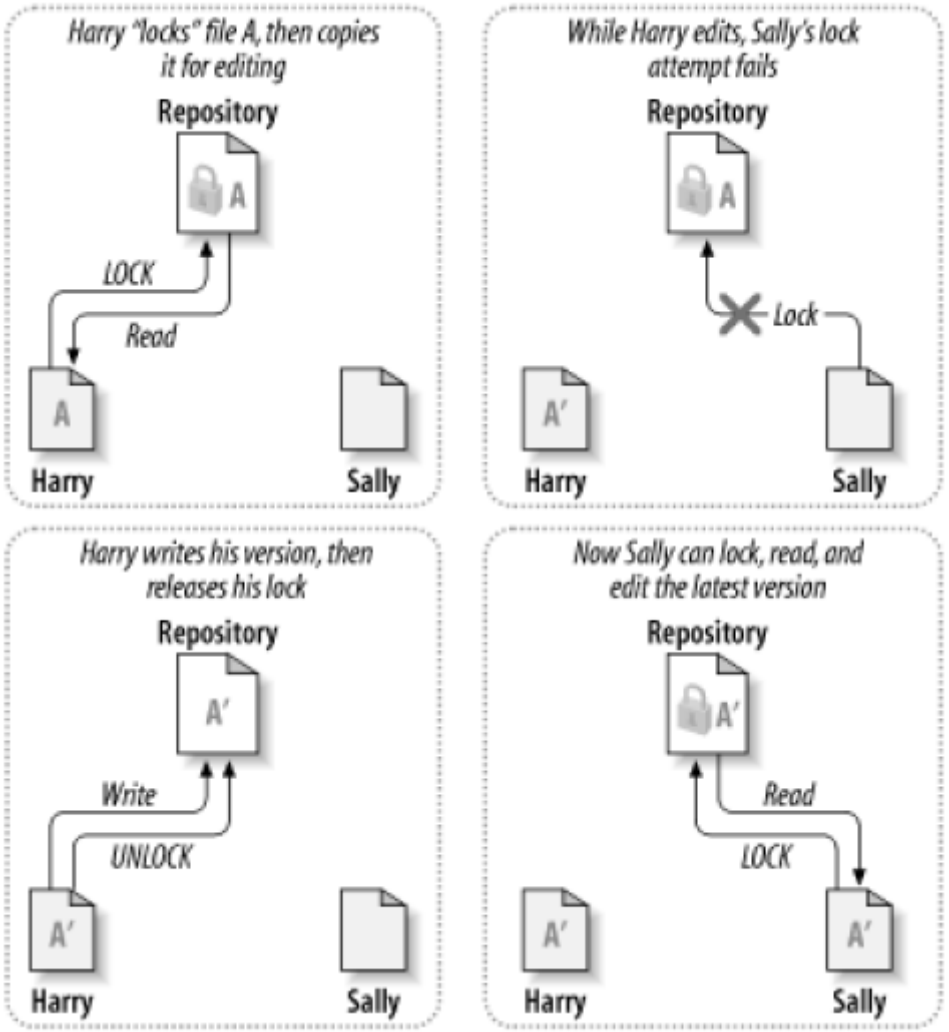
The problem of sharing

As a result, Harry's work is lost in the latest version of the file!



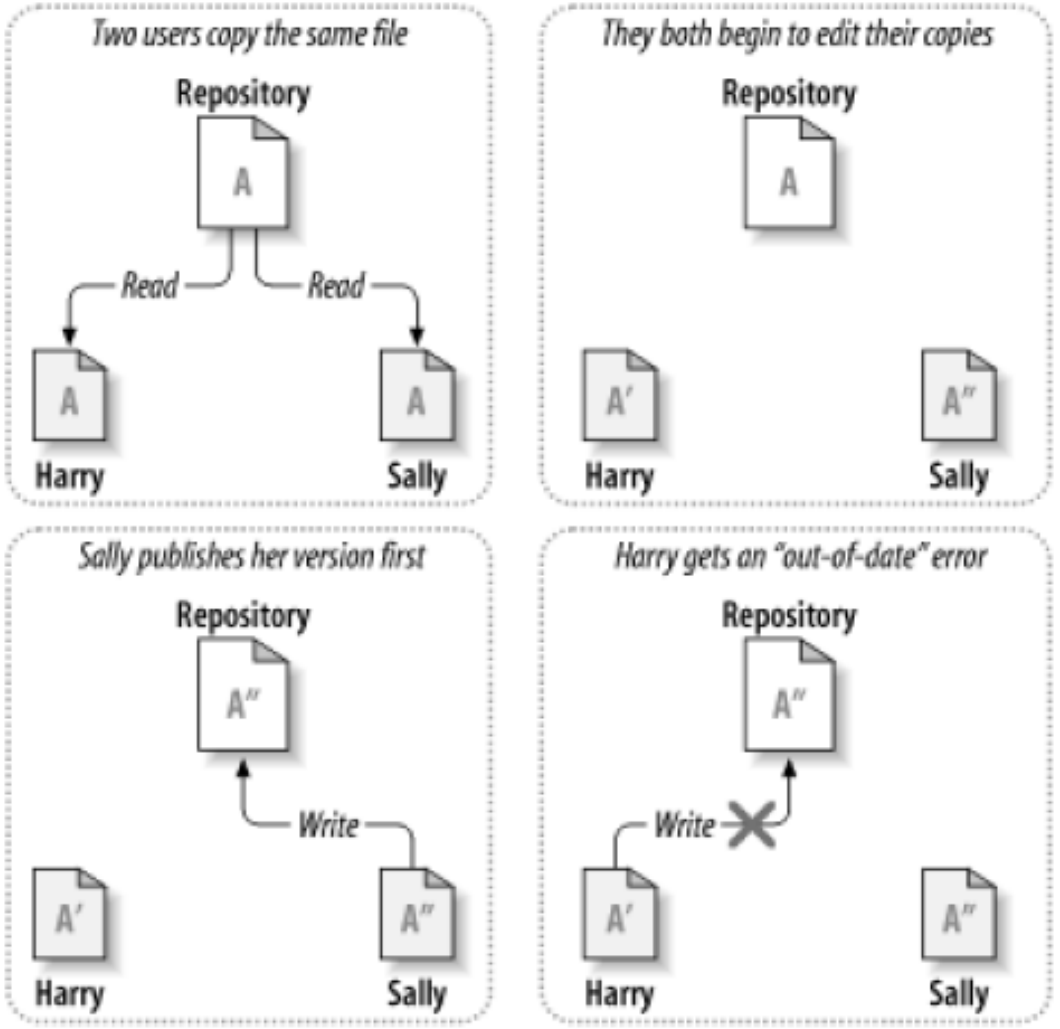
The lock-modify-unlock solution

- The repository allows only one person to change a file at a time.
- One must "lock" a file before making changes to it.
- The user can only read the file that is locked by others.



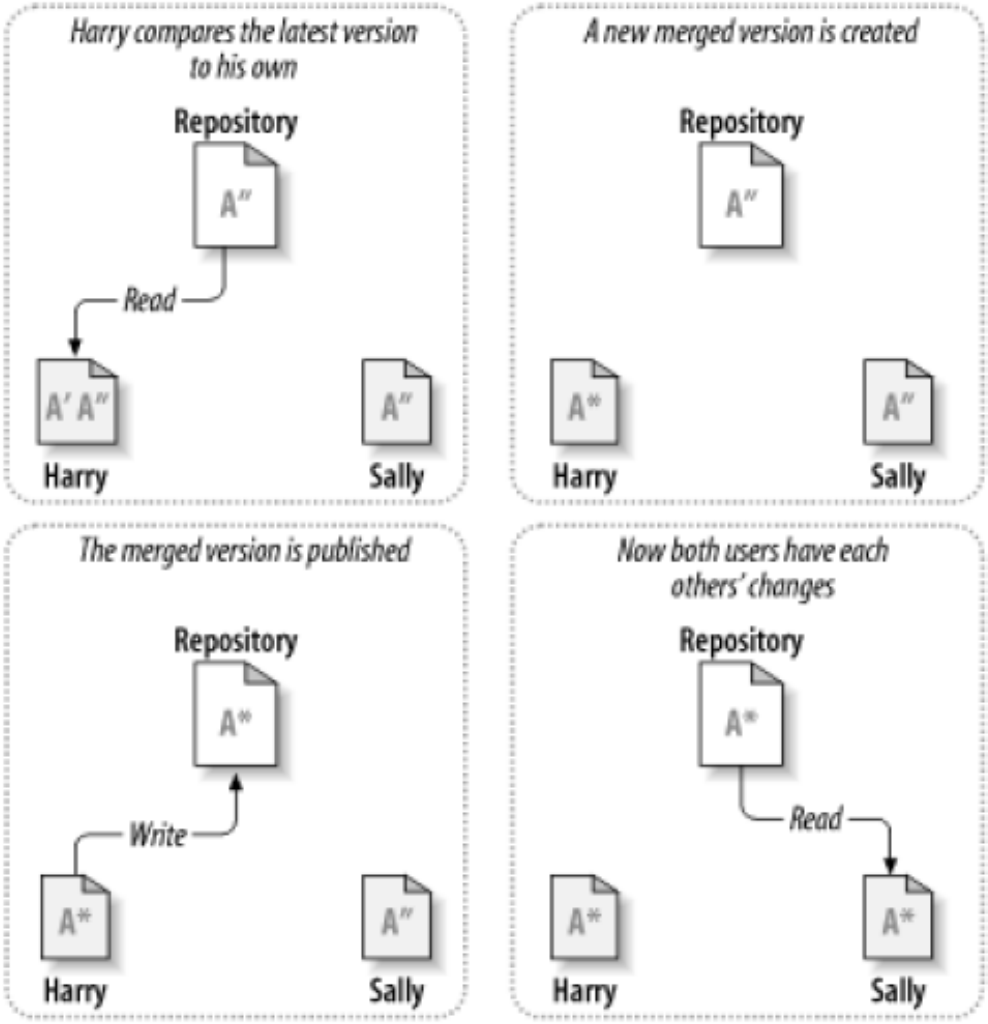
The copy-modify-merge solution

- Users can work simultaneously and independently on their private copies of the same file.
- The repository will inform the user that their file is out of date when the user is trying to upload their changes.



The copy-modify-merge solution, cont.

- In response, the user needs to *merge* any new changes from the repository into their own working copy before they can commit.
- The user may need to resolve *conflicts* in the process of merging.

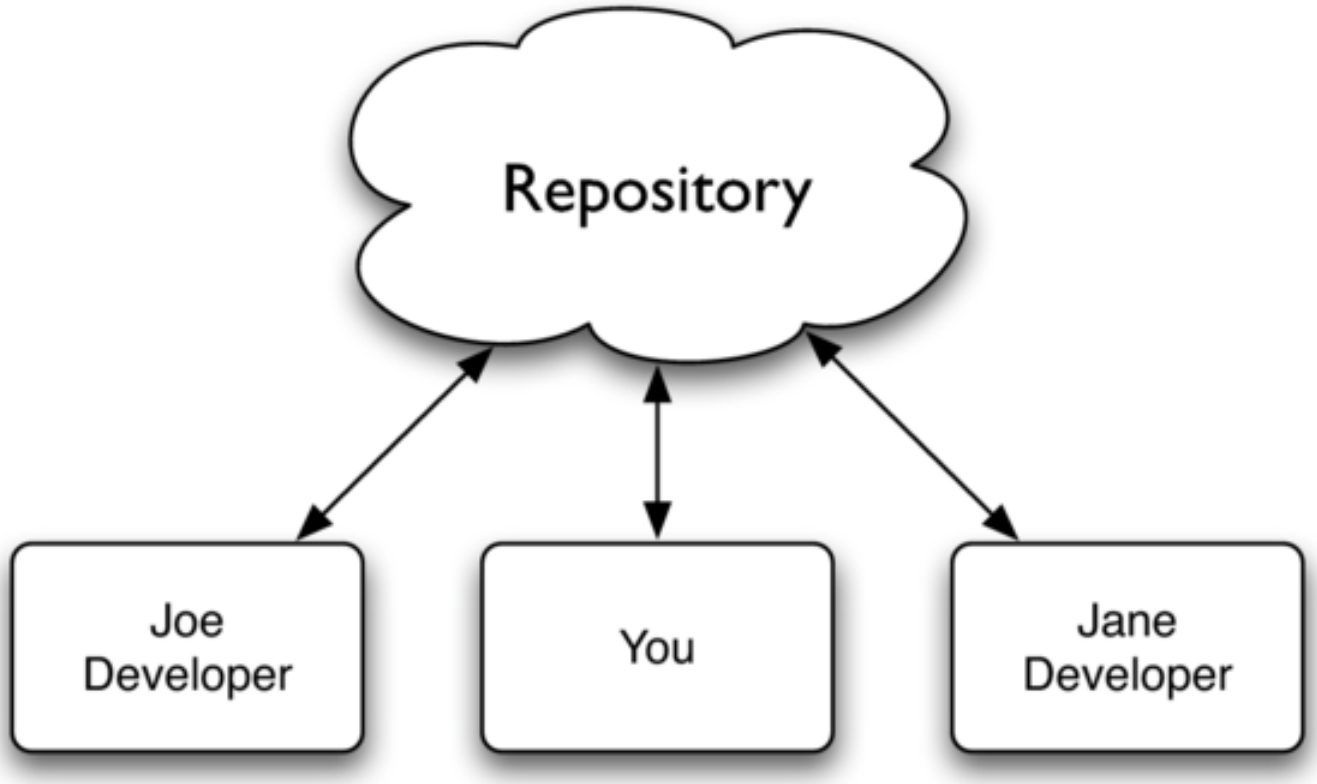


Strategies (Versioning Models)

- Lock-Modify-Unlock (Pessimistic Model)
  - Only one person is allowed to change a file at a time.
  - Problem: over restrictive, inhibit productivity.
- Copy-Modify-Merge (Optimistic Model)
  - Each user creates and edits a personal working copy, and finally copies are merged into a new version.
  - Most current version control systems use this mechanism.
  - Problem: some files are hard to merge, such as files of binary formats.

Repository Model

- Centralized (Client-Server) Repository Model

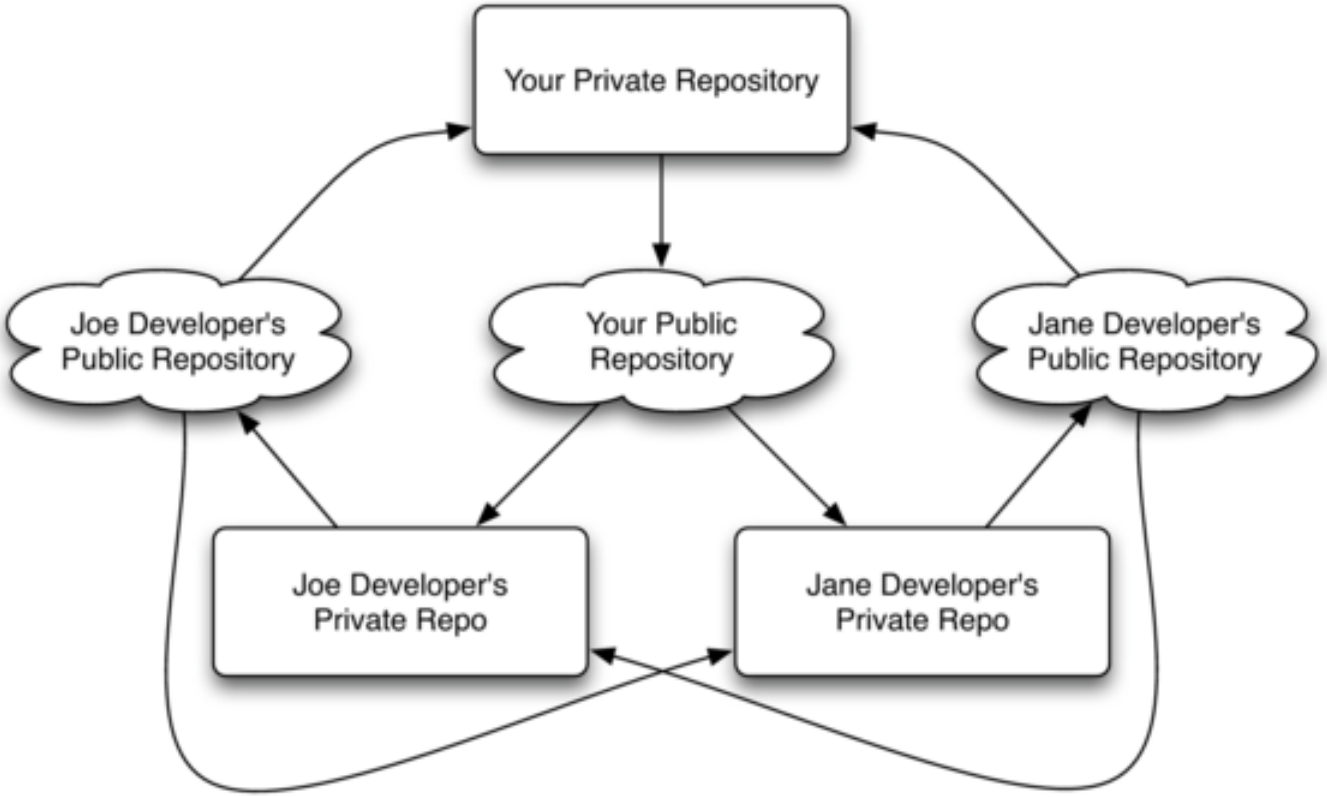


Repository Model

- Centralized (Client-Server) Repository Model
  - There is a central repository (server) that holds all of the versioned data.
  - Users (clients) change their working copies, and update the repository to incorporate those changes.
  - Users have to maintain a network connection to the central repository in order to track the changes that they make.

Repository Model

- Decentralized Repository Model



Repository Model

- Decentralized Repository Model
  - Each developer has their own copy of the repository that includes complete history.
  - Anyone can be a server.
  - Each developer has a public repository and a private repository
    - Public repository is to share changes with other developers
    - Private repository is to manage drafts that they don't want to publish
  - Network is not involved in most operations.
  - Allows users to work productively even when not connected to a network.

Version Control Systems

- Centralized
  - Open-source
    - CVS, **Subversion**
  - Commercial
    - Visual SourceSafe, Perforce
- Decentralized
  - Open-source
    - Monotone, **Git**
  - Commercial
    - TeamWare, BitKeeper

Important Operations of Version Control

- Basic Operations
  - Add
  - Check in
  - Check out
  - Update
  - Head
  - Revert
- Advanced Operations
  - Branch
  - Merge
  - Tag
  - Diff / Delta

Basic Operations

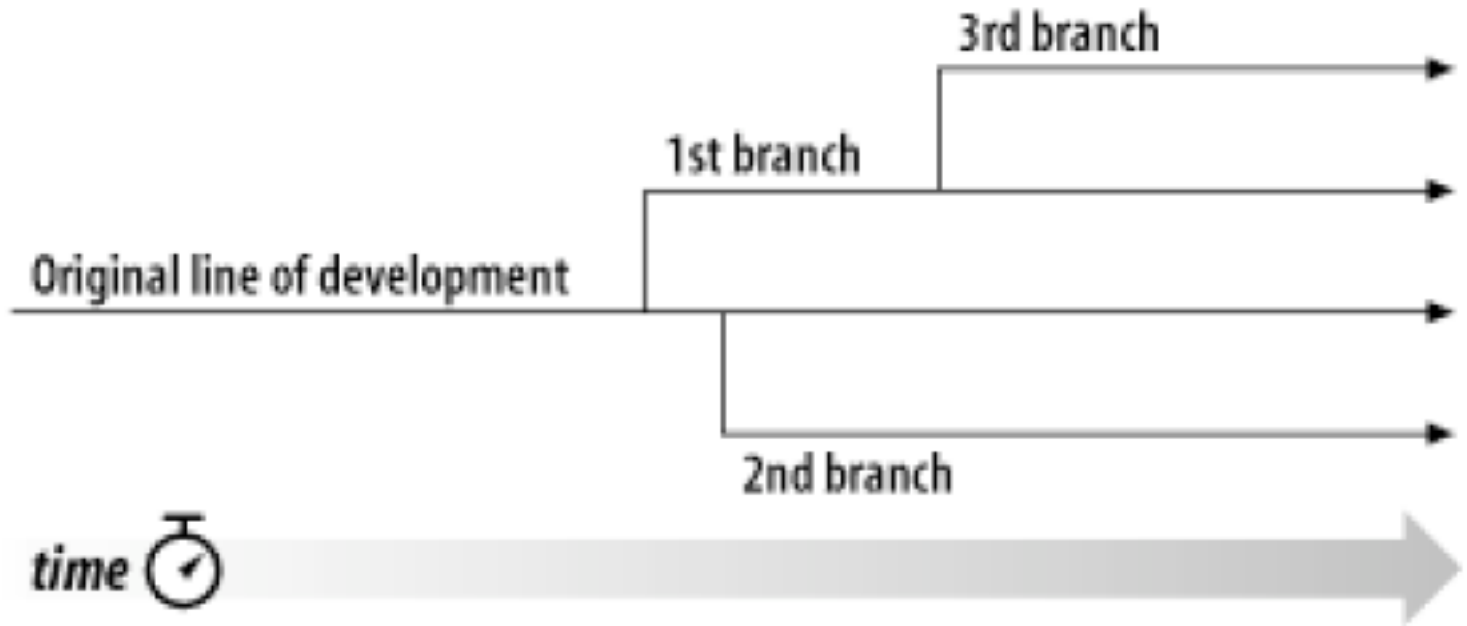
- Add
  - Put a file into the repository for the first time, i.e. begin tracking it with Version Control.
- Check out
  - Download a file from the repository. Checking out a repository creates a "working copy" of it on your local machine.
  - The working copy becomes editable (Pessimistic Model only).
- Check in (Commit)
  - Upload a file to the repository (if it has changed). The file gets a new revision number (per file v.s. per repository).
  - The working copy becomes read only (Pessimistic Model only).

Basic Operations

- Update
  - Refresh the local or working copy with any changes since checkout.
- Head
  - The latest revision in the repository (the most recent commit).
- Revert
  - Throw away your local changes and reload the latest version from the repository.

Branch

- Lines of development that exist independently and share a common history.
- Each branch generates its own history.



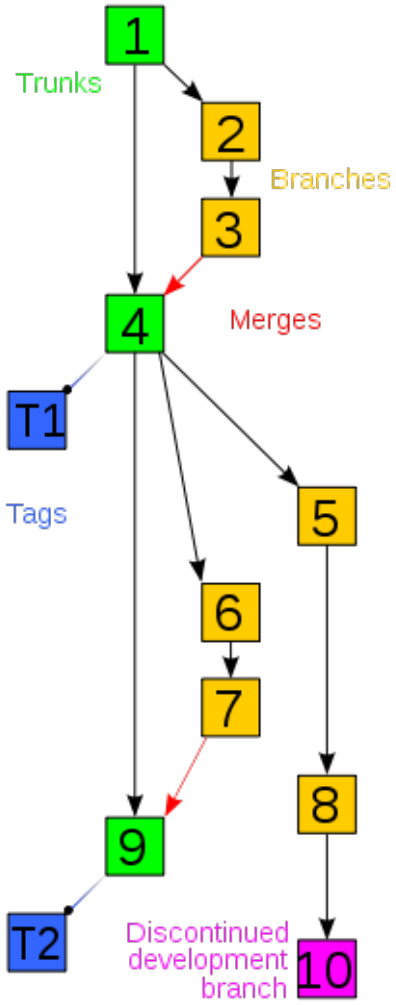
Merge

- To take some changes which were done to one branch and apply them to another branch.
- Can cause conflicts
  - Require user intervention
- Other issues
  - Merging histories
  - Repeated merge

Tag

- A "snapshot" of a project in time.
- A name that is given to a particular commit; the name that you want that particular commit to be represented by.
- Makes it easy to check out a release or configuration.

Branch, Merge, and Tag



Diff/Delta

- Diff/Delta: a specific modification to a document under version control.
- Most version control systems store diffs rather than full copies of the file to save disk space (Delta Compression).

Best Practices

- Explain your checkins completely.
- Keep in touch with the repository (update often).
- Checkin your work to the repository as often as you can without breaking the build (commit often).
- Review the merge before you commit.
- Use checkout and revert with caution.

Reference

- Pragmatic Version Control Using Git by Travis Swicegood
- Wikipedia:Revision control.
- Version Control with Subversion by Ben Collins-Sussman, Brian W. Fitzpatrick, and C. Michael Pilato.
  - Many diagrams of this lecture are from this book.
  - The book is free online: http://subversion.apache.org