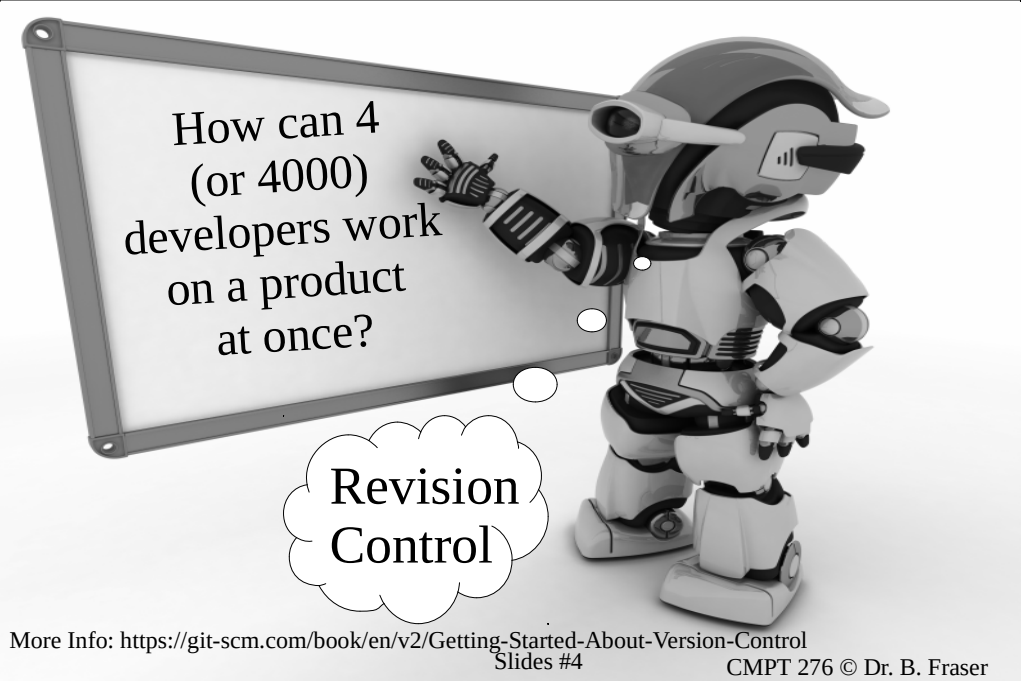


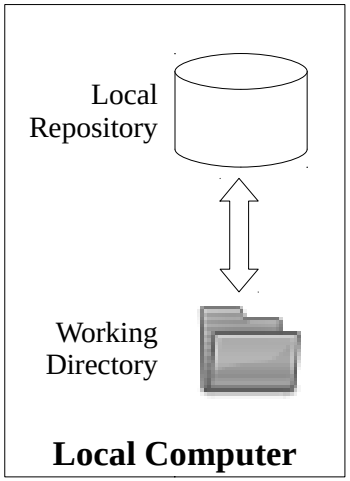
More Info: https://git-scm.com/book/en/v2/Getting-Started-About-Version-Control

Revision Control

- Revision Control:
  - **system to manage changes to electronic documents**
  - Also called version control, source control, software configuration management.
- Motivation:
  - Need to coordinate changes made by multiple developers.
  - Need a reliable system to ensure changes are
    - **not lost or incompatible**

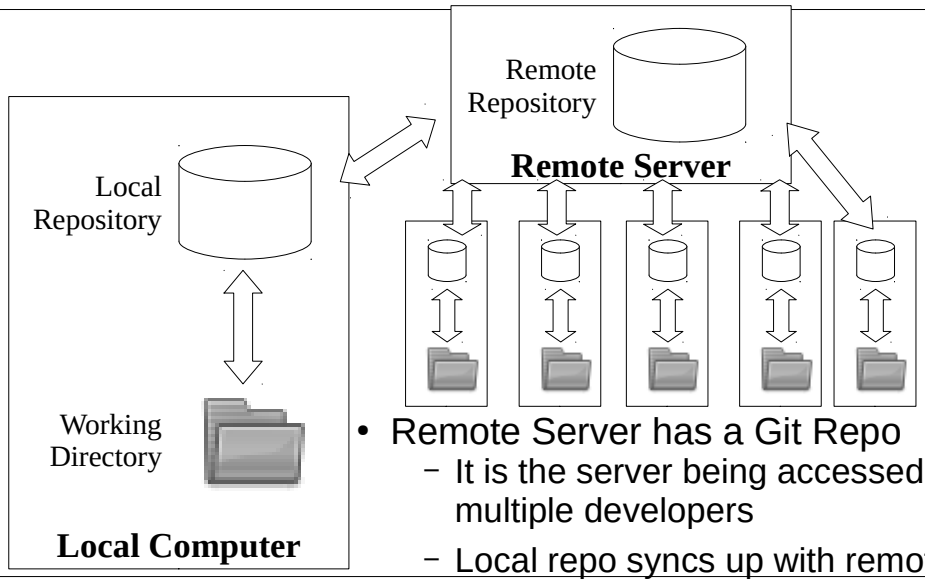
Git Basics

Local Topology Simplified



- Local Machine has a
  - **git repository (repo)**
- **checkout**
  The latest code in the repo can be checked-out into the working directory.
  - Head: the latest version of the code.
- **commit**
  Changes to files in the working directory are committed to the local repo

Remote Topology Simplified



- Remote Server has a Git Repo
  - It is the server being accessed by multiple developers
  - Local repo syncs up with remote

Distributed

- Distributed Version Control
  - Git has.. **no single centralized master repo** each “local repo” is a full and complete repo.
  - Can work off-line (on a plane) and still commit to the local repo. Later sync up with the remote repo.
- Git Servers
  - Often the remote repo is a dedicated Git server such as GitHub or GitLab.
  - These systems add extra team collaboration / discussion tools (more later).

Work Flow 1: Setup

- Associate your local repo to a remote repo by either:
  - Create a repo in GitLab (gitlab.cs.sfu.ca) and push some existing code to it; or
  - .. **Clone** an existing repo to your local PC.

Work Flow 2: Changes

- Do some work in working directory
  - create new files, change files, delete files, etc.
- .. **add**
  - Stages the changes as being ready to commit.
  - Also used for adding files to Git (tracking them)
- .. **commit**
  - Commit all staged changes to local repo.
  - Sometimes termed “Check-in”
- .. **push**
  - Transfer locally committed changes to remote repo.
- .. **status**
  - View the state of local file changes

Work Flow 3: Other's Changes

- Other team members will push some changes to the repo which you then want
  - May be new / changed / deleted files
- .. **pull**
  - Get changes from remote repo and apply them to local repo and working directory (move to head).
  - If there are any conflicting changes, may need to do a merge (more later).
- .. **log**
  - At any time, can view the changes people have made.

Git Tools

- Command Line
  - Git is very often accessed via its command-line tools
  - Git commands look like:
    git commit
    git clone git@csil-git1.cs.surrey.sfu.ca:myTeam/daProject.git
- GUI Integrated Tools **(basically git functionality**
  - .. **abstract away some low-level details**
    but low-level understanding is sometimes required!
  - Can be inside IDE: Android Studio
  - Can be integrated into file system: TortoiseGit
  - Lecture: command line for understanding the tool;
    Assignments: IDE for convenience (likely).

Command-line Demo

- Git Command Demo
  [create repo on gitlab.cs.sfu.ca]
  - **`git clone <git@csil-git1.cs....>`**

  [now edit file hello.txt]
  - **`git status`**
  - **`git add hello.txt`**
  - **`git commit`**
  - **`git push`**
  - **`git log`**
  - **`git pull`**

Git Details

Basic Git Sequence for Editing Code

0. Have a working directory with no changes
1. .. **pull**
   - will "fast-forward" without any conflicting changes
2. .. **do your work**
   - cannot pull with some uncommitted changes
3. .. **add and commit**
4. .. **pull**
   - automatically merges files without conflicting changes
   - manually merge conflicts when required
5. .. **push**
   - cannot push if others have pushed code:
     "current branch is behind master", "unable to fast-forward"

Merge Conflict Demo

- Show demo of conflicting changes being made by two team members at once
  - Pulling with uncommitted conflicts fails
  - Pushing before merging fails
  - Commit my changes
  - Pull to trigger merge
  - When merge done then add/commit/push
- Android Studio has VCS --> Update Project
  - Which works with uncommitted conflicts
  - It automatically stash changes to get around having to do extra commit

.gitignore

- .gitignore File
  - Lists file types to exclude from Git:..
    ensures only the right kind of files are added
  - Example:
    Exclude .bak, build products, some IDE files
- Tag
  - "Tag" the project's contents at a specific commit
  - Can later check-out that tag to return to the project state at that time
  - Example Uses
    - Track project code going into a release: "V1.51"

Commit Messages

- A good commit message is required!
  - Line 1: .. **short summary** (<70 characters)
    Capitalize your statement
    Use imperative: "Fix bug..." vs "fixed" or "fixes"
  - Line 2: .. **blank**
  - Line 3+: .. ; wrap your text ~70 characters

Example:

> Make game state persist between launches and rotation.
>
> Use SharedPreferences to store Game's state. Serialize using Gson library and Bundle for rotation.

- 276 Pair Programming
  - If pair programming, add pair's user ID: [pair: bfraser]

Reverting Changes

- ‘git checkout’ to revert files
  - ..
  - Overwrite file in working directory with one from local repo.
- Revert with Caution
  - Will lose all uncommitted changes in the file.
  - Normally Git does not let you lose changes.
  - If in doubt, grab a backup copy (ZIP your folder) then revert.
    - Just make sure you don’t commit the backup!

Delete, Rename

- Delete
  - Delete file normally via the OS/IDE,
    ..
    Git records it's now deleted.
  - Will be deleted on everyone else's system when they pull your changes.
- Rename
  - Rename file normally via the OS/IDE, then "add" it to Git
  - Git tracks files by their content, not by their name.

Revision Control Generalities

Merge vs Lock

2 Competing ways revision control protects files:

- Checkout-Edit-Merge
  - Merge support allows concurrent access to a file so multiple developers can work on same code at once
  - But can lead to...
- Lock-Edit-Unlock
  - Locking prevents merge conflicts by..
    - "I can't make any changes until Bob finish!"
  - Adds pressure to make changes quickly..
    - "I NEED THAT FILE! CHECK IN NOW!"

Revision Control Features

- Atomic operations **you commit all or nothing**
  - **git commit is atomic**

system left in consistent state even if operation interrupted

  - Change is applied all at once:
    no other changes applied while you're checking in.
- Tag
  - Mark certain versions of certain files as a group.
    Ex: "Files for Version 1.0 of product".
  - Able to easily..
    of the files later to fix bugs etc.
    - "Get all files exactly as the were in Version 1.0 (three year ago)".

Team Work

- Minimum requirement to committing code:

don't break the build

  - When you check in, the full system must compile and run.
  - Only under exceptional circumstances should you ever check in something which breaks the build.

Committing Frequency

- Expected Commit Frequency
  - Commit little changes to local repo very often
    .. **every hour**
  - Once some work is more stable, push all the changes at once to remote repo.. **each day**

Coding with Source Control

-
  ```
  // Removed Jan 2002 for V1.01
  // cout << "Dave; I wouldn't do that, Dave.\n";
  ```
  - Put meaningful comments into checkins!
-
  ```
  #if 0
  // Unneeded, but left 'cuz someone may want it...
  .....
  #endif
  ```
-
  ```
  // Written by Dr. Evil
  ....
  ```

Summary

- Revision control a critical tool for development.
  - Git is a distributed revision control system.
- Operations:
  - clone, add, commit, push, pull, merge (later)
- Git Details
  - Merge conflicting changes as needed.
  - .gitignore, revert (git’s checkout)
- Basic Features
  - Atomic operations, tags/Label
- Rules to Code By
  - Commit often, don’t break the build