How can 4 (or 4000) developers work on a product at once?


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Revision Control

- Revision Control:
  - 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..
Git Basics
Local Topology Simplified

- **Local Machine has a** ..
- **The latest code in the repo can be checked-out into the working directory.**
  - **Head**: the latest version of the code.
- **Changes to files in the working directory are committed to the local repo**
Remote Topology Simplified

- Remote Server has a Git Repo
  - Server accessed by multiple developers
  - Local repo syncs up with remote

Local Repository

Working Directory

Local Computer

Remote Repository

Remote Server
• **Distributed Version Control**
  - Git has..
    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 and 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
  - .. 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.
- ..
  - *Stages* the changes as being ready to commit.
  - Also used for adding files to Git (*tracking* them)
- ..
  - Commit all staged changes to local repo.
  - Sometimes termed “*Check-in*”
-..
  - Send committed changes to remote repo.
- ..
  - 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

- 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).

- 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 clone git@csil-git1.cs.surrey.sfu.ca:myTeam/daProject.git
    git commit

- **GUI Integrated Tools**
  - ..
  - but low-level understanding is required!
  - Can be inside IDE: **Android Studio**
  - Can be integrated into file system: **TortoiseGit**
  - **Lecture**: command line to understand the tool;
  - **Assignments**: IDE for convenience (likely).
Command-line Demo

- **Git Command Demo**
  
  *create repo on csil-git1.cs.surrey.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. ..
   – will "fast-forward" without any conflicting changes
2. ..
   – cannot pull with some uncommitted changes
3. ..
4. ..
   – automatically merges files without conflicting changes
   – manually merge conflicts when required
5. ..
   – 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:

- Example:
  Exclude .bak, build products, some IDE files
Commit Messages

• A good commit message is required!
  - Line 1: ..
    Capitalize your statement
    Use imperative: "Fix bug..." vs "fixed" or "fixes"
  - Line 2: ..
  - 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 at start:
    “[pair: bfraser] Make game state persist ....”
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 file**
  - 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 file**
  - 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
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 now!"
Revision Control Features

- **Atomic operations**
  - 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:
  - 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.. 
  - Once some work is more stable, push all the changes at once to remote repo..

- **CMPT 276**
  - Committing / pushing this frequently gives visibility to your contributions; helps for marking discussions!
  - In a ‘professional’ project, you would tailor your commits/pushes to the work you are doing, and **squash** small commits together into bigger more meaningful ones.
Coding with Source Control

- Put meaningful comments into checkins!

  // Removed Jan 2002 for V1.01
  // cout << "Dave; I wouldn't do that, Dave.\n";

- // Unneeded, but left 'cuz someone may want it...

  #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