Git: Distributed Version Control

Lecture 3
Demo

- Prep: Empty (but initialized) repo
- Linear development:
  - Create, edit, rename, ls -la files
  - Git: add, status, commit, log
- Checkout (time travel, detach HEAD)
- Branch (re-attach HEAD)
- More commits, see split in history
- Merge
  - No conflict
  - Fast-forward
What Does "D" Stand For?

- Distributed version control
  - Multiple people, distributed across network
- Each person has their own repository!
  - Everyone has their own store (history)!
  - Big difference with older VCS (eg SVN)
- Units of data movement: changeset
  - Communication between teammates is to bring stores in sync
  - Basic operators: fetch and push
And Matt's Repository
Some Shared History

Sarah

Matt
Fetch: Remote Store → Local

sarah$ git fetch mt

new changesets added to store
remote branch
working tree unaffected!

HEAD
master

mt/master

wt
Remote Repository Unchanged
Workflow: Merge After Fetch

sarah$ git merge mt/master
Remote Repository Unchanged
View of DAG with All Branches

$ git log --oneline --graph --decorate --all

* 1618849 (HEAD-> master, origin/master) clean up css
* d579fa2 (alert) merge in improvements from master
\|
| * 0f10869 replace image-url helper in css
| * | b595b10 (origin/alert) add buckeye alert notes
| * | a6e8eb3 add raw buckeye alert download
|/
* b4e201c wrap osu layout around content
* e9d3686 add Rakefile and refactor schedule loop
* 515aaa3 create README.md
* eb26605 initial commit
Your Turn

- Show the state of Matt's repository after each of the following steps
  - Fetch (from Sarah)
  - Merge
Sarah and Matt's Repositories
Some Shared History
Your Turn: Fetch

matt$ git fetch sr
Your Turn: Merge

matt$ git merge sr/master
Pull: Fetch then Merge

- A "pull" combines both fetch & merge
  
  ```
  matt$ git pull sr
  ```

- Advice: Prefer explicit fetch, merge
  - After fetch, examine new work
    ```
    $ git log --all #see commit messages
    $ git checkout #see work
    $ git diff #compare
    ```
  - Then merge
  - Easier to adopt more complex workflows
    (e.g., rebasing instead of merging)
Push: Local Store → Remote

- Push sends local commits to remote store
- Usually push one branch (at a time)

  
  sarah$ git push mt fix

  - Advances Matt's fix branch
  - Advances Sarah's mt/fix remote branch

- Requires:
  1. Matt's fix branch *must not* be his HEAD
  2. Matt's fix branch *must be* ancestor of Sarah's

- Common practices:
  1. Only push to *bare* repositories (bare means no working tree, ie no HEAD)
  2. Get remote store's branch into local DAG (ie fetch, merge, commit) *before* pushing
Remote's Branch is Ancestor
Push: Local Store → Remote

sarah$ git push mt fix

Matt

Matt

HEAD

master

HEAD

fix

wt
Push: After

sarah$ git push mt fix

Sarah

Matt

HEAD

working tree unaffected!
Commit/Checkout vs Push/Fetch

Local:
- working directory
- staging area
- local repo
- git add
- git commit
- git checkout
- git merge

Remote:
- remote repo
- git push
- git fetch
Common Topology: Star

- An $n$-person team has $n+1$ repositories
  - 1 shared central repository (bare!)
  - 1 local repository / developer
- Each developer *clones* central repository
  - Cloning creates a remote called "origin"
  - Default source/destination for fetch/push
- Variations for central repository:
  - Everyone can read and write (ie push)
  - Everyone can read, but only 1 person can write (responsible for pulling and merging)
Common Topology: Star

Bare repository (no working tree)

Source: http://nvie.com/posts/a-successful-git-branching-model/
Summary

- Push/fetch to share your store with remote repositories
  - Neither working tree is affected
- Branches in history are easy to form
  - Committing when HEAD is not a leaf
  - Fetching work based on earlier commit
- Team coordination
  - One single, central repo
  - Every developer pushes/fetches from their (local) repo to this central (remote) repo