Version Control Systems (Part 2)

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Goal for today

- I'll have a walkthrough
- Feel free to play with things as you go along
- There may be time for exploration at the end

First things first

- Git uses your name and email to identify you as the author when you make a commit
  - So you need to let it know who you are
- Note: all Git commands are run by the program `git`, and the first argument is the command
  - I will leave out the "git" part in bullet points, e.g., "we will use the `config` command to set up a name and email."

```
git config --global user.name "Your Name"
git config --global user.email "foo4242@psu.edu"
```

Clone a repository

- Let's start by making a clone rather than creating our own repository.
  - This is done using the `clone` command and the URL for a repository.
  - We'll make a clone for Bob too. Don't worry, we get to be Alice first.
- Note: Git checks out the latest revision automatically when cloning. This is usually what you want.

```
git clone https://github.com/djpohly/text.git
git clone text bob
```

Make some changes

- This is your own copy, so you won't hurt anything!
  - The original version is safely kept in your repository.
- Go ahead, insert some nonsense into a song.
- To see a list of what files have changed, use the `status` command.

```
cd text
vim frozen.txt
git status
```

More detail, please

- To see *exactly* what changes have been made, use the `diff` command.
  - The output of this command is called a "diff" or a "patch," and it's one way of sharing your changes with someone else, especially if they don't have a Git repository.

```
git diff
```

Well, I tried

- Try to check in your changes using the `commit` command.
  - Nothing happens. What does Git say?
- What does the `status` command say about your changes?

```
git commit
git status
```

Git's staging area (index)

- Changes aren't committed by default
- Instead, you *stage* them
  - To stage changes: `add`
  - To unstage: `reset`
  - To be even more selective, give the `-p` (patch) flag
- Lets you decide *exactly* what goes into a commit
  - Clean commits
  - Understandable history

For real this time

- Add your changes to the staging area and commit them.
  - Never be afraid to commit. You can always undo it later.
- Describe what you changed in the *commit message*.
  - Commit message format: one line summary, a blank line, and then any further description needed.

```
git add frozen.txt
git commit
```

Okay, now what?

- Does `status` show your changes anymore?
- Use the `log` command to see the entire history.
  - Hey, there's your commit. Nice job!
  - The `-p` (patch) flag will show exactly what changed, kind of like a combined `log`/`diff`.

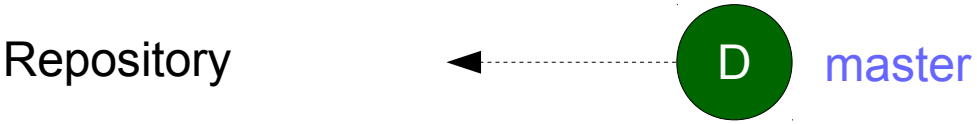
```
git status
git log
```

Commit IDs

- Look at the log output again...
  - No simple 1, 2, 3 revision numbers!
  - It's actually impossible in a distributed VCS to assign numbers like this that will be the same for everyone.
- Git uses a hash: that bunch of hex digits you see after "commit"
  - Git lets you abbreviate these to the first 4-6 characters. Try it!

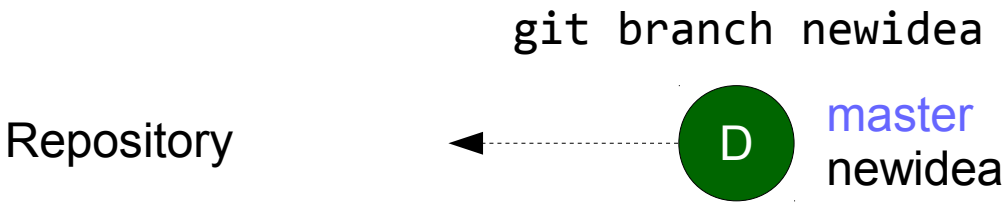
```
git log
git log ba4f
```

Local branches in Git



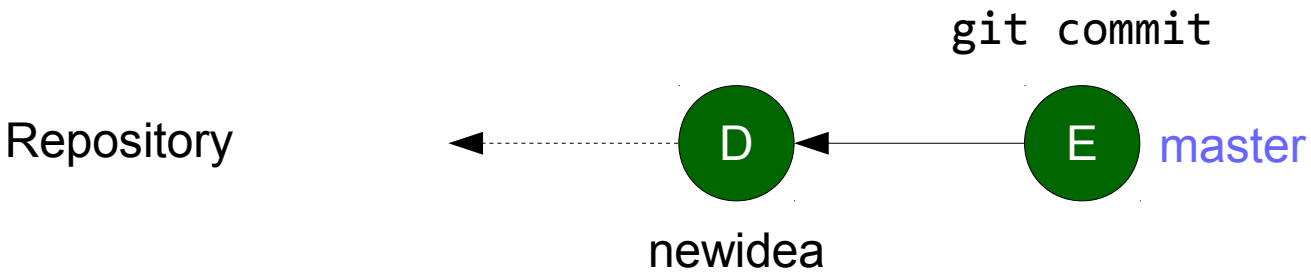
- Multiple lines of development aren't necessarily multiple people!
- We can create a branch locally with the `branch` command.

Local branches in Git



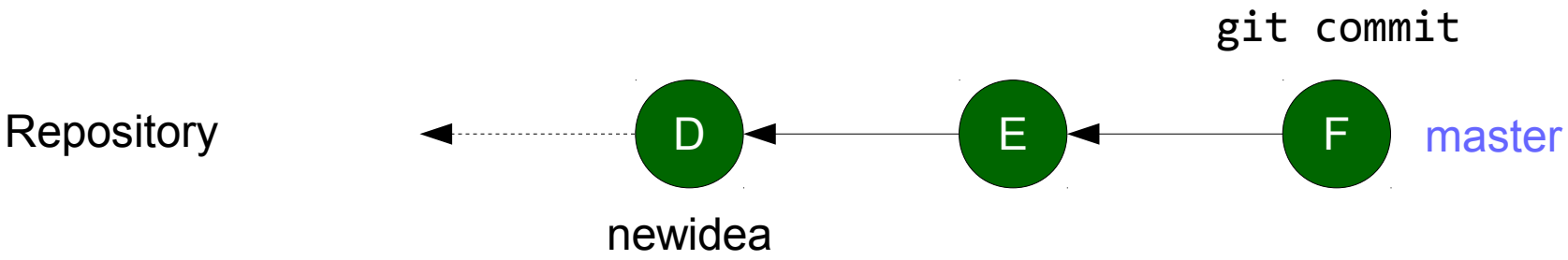
- This creates newidea, but master is still the *current branch*.
- Type the `branch` command with no arguments to see which branch we are currently on.

Local branches in Git



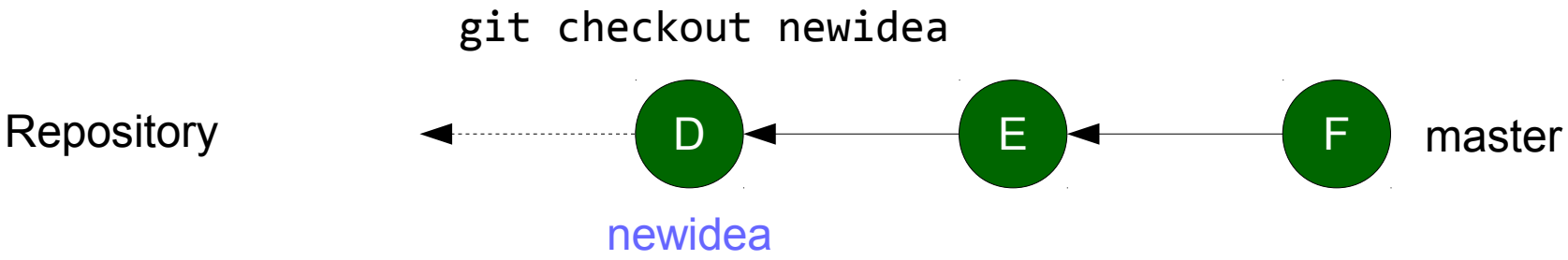
- When we make a commit, the current branch follows along to track our progress.

Local branches in Git



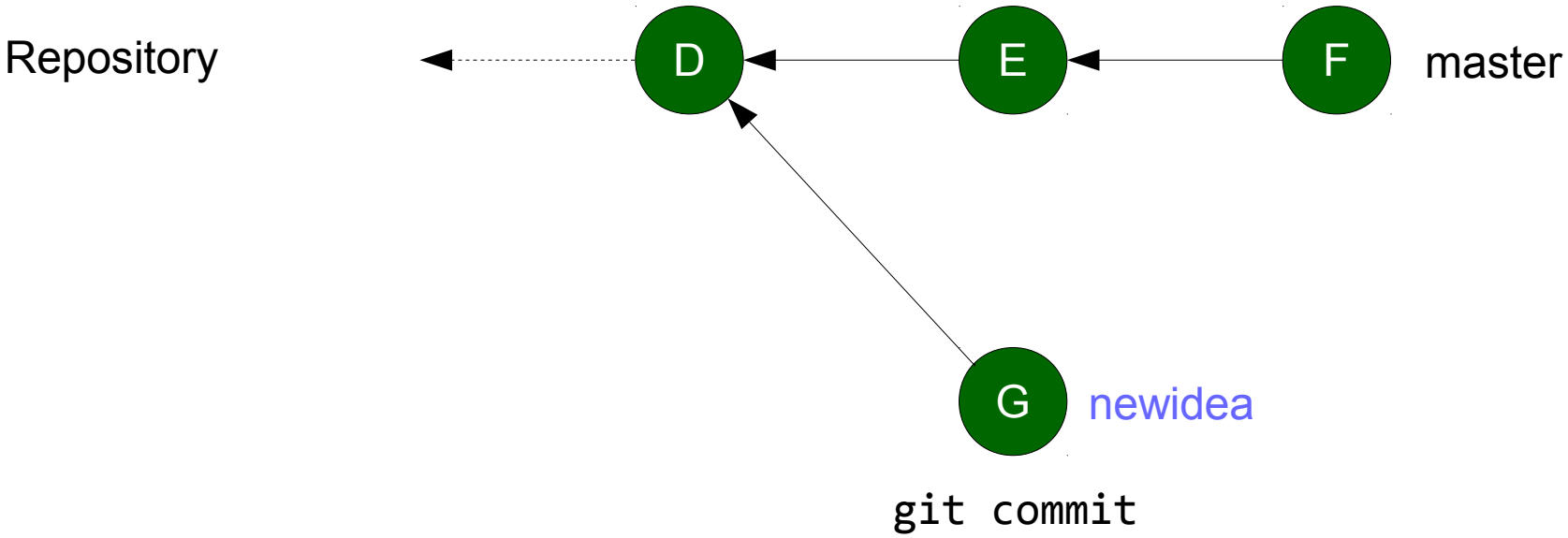
- Suppose we want to work on that other branch now.
- We can switch branches with `git checkout`.

Local branches in Git



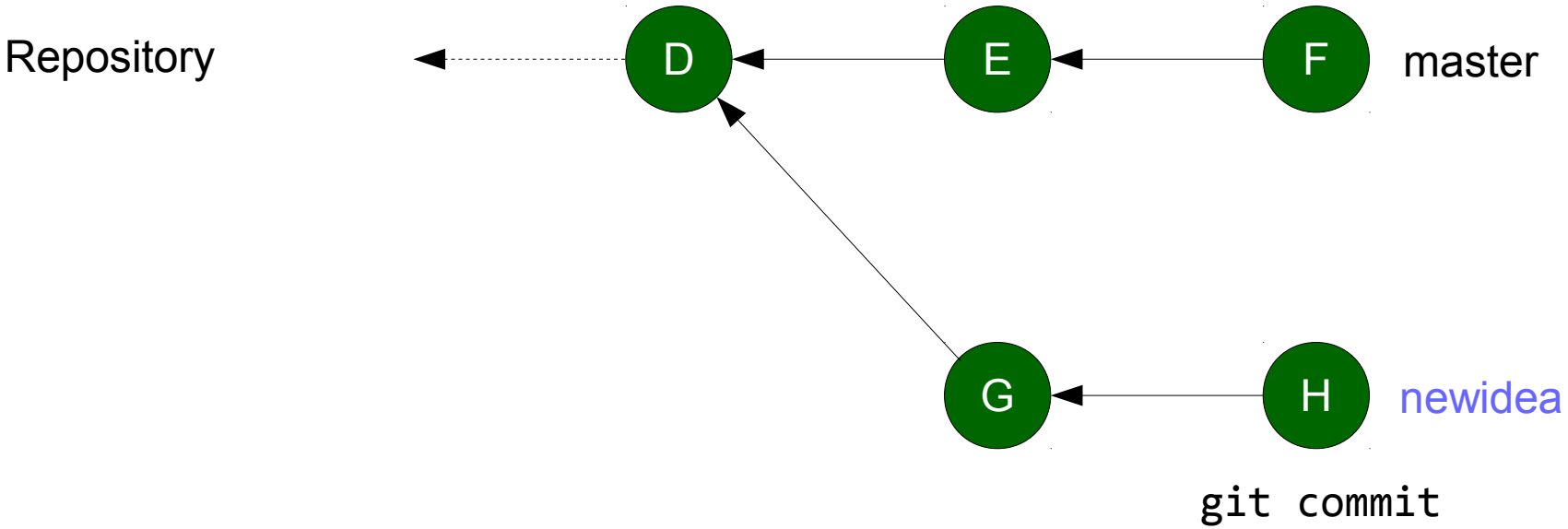
- The current branch is now newidea.

Local branches in Git



- Therefore, any new commits now follow the newidea branch.

Local branches in Git



- We can continue working on newidea even if there are other commits on master.

Local branches in Git

- Just a reference to the tip of the branch
- Work on multiple ideas simultaneously
- Follow other developers' repositories
- Save some temporary changes and throw them away later
- Many other possibilities

Make a local branch

- If you haven't already, make a newidea branch and check it out
  - PROTIP: you can combine this using `checkout -b`.
- Add a new file "hello" and commit it.
  - Check out master and notice the file isn't there.
  - Check out newidea and your changes are back.

```
git checkout -b newidea
vim hello
git add hello
git commit
git checkout master
git checkout newidea
```

Bob's turn

- OK, let's pretend to be Bob for a moment. Change directories into his repository.
- Bob adds a file called "foo" and commits it.

```
cd ../bob
vim foo
git add foo
git commit
```

Poor Bob... always second

- Now Bob is going to try to push his changes to Alice's repository.
  - Go ahead, try the `push` command. What does Git say?
- Important: you can only push a new revision if it is a descendant of the existing one!
  - Git calls this a "fast-forward" because it can just move the branch tip forward along the commits.

```
git push
```

Pull first

- Bob needs to use `pull` to get Alice's commits first.
  - Note: Git's `pull` command will attempt to merge the changes automatically. To avoid this, use `fetch` instead.
- Now take a look at the commit graph (`--oneline` gives short descriptions only): the merge revision has two parents, and one is the tip from Alice's repository.
- Bob's latest revision is a descendant of Alice's, so he can push now!

```
git pull
git log --graph --oneline
git push
```

Back to Alice

- Recall we have been working on newidea.
  - Bob pushed to the master branch, so it wasn't affected.
- We decide it's ready to be an official part of master.
  - First switch to the master branch, then use `merge` to bring in the commits from newidea.
  - Now master has both "hello" from newidea and "foo" from Bob!

```
git checkout master
git merge newidea
ls
```

Cleaning up

- Take a look at the commit graph now.
  - All of the newidea commits are part of master since we merged the branches.
- We don't need newidea anymore, so we can delete it with `branch -d`.

```
git log --graph --oneline
git branch -d newidea
```

Regret and blame

- You know, I shouldn't have added a title to Mending Wall. None of the other files have titles. Let's undo that.
  - First we have to find out what commit we want to undo. Let's use the `blame` command.
  - What's the ID of the commit in which the title was added?

```
git blame frost.txt
```

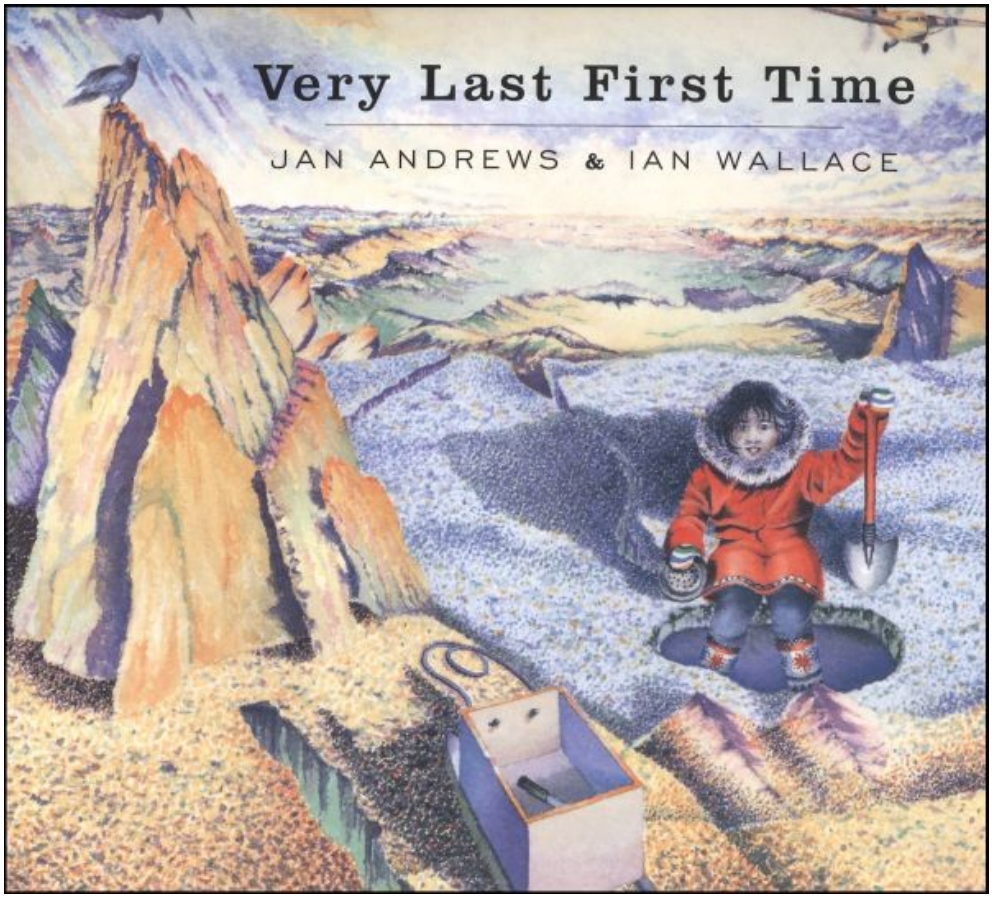
Undoing mistakes

- OK, so we want to `revert` commit `1eb8`.
- This will actually create a *new* commit which undoes the old one. None of the history is lost.
  - For example, you can revert the revert to get it back.

```
git revert 1eb8
git log
```

One last first command

- We started by cloning an existing repository
- To set up a new repository in a directory, use the `init` command.
- To convert an existing directory:
  - Change to it.
  - `git init`.
  - `git add` any files you want Git to track.
  - `git commit`.



Best practices

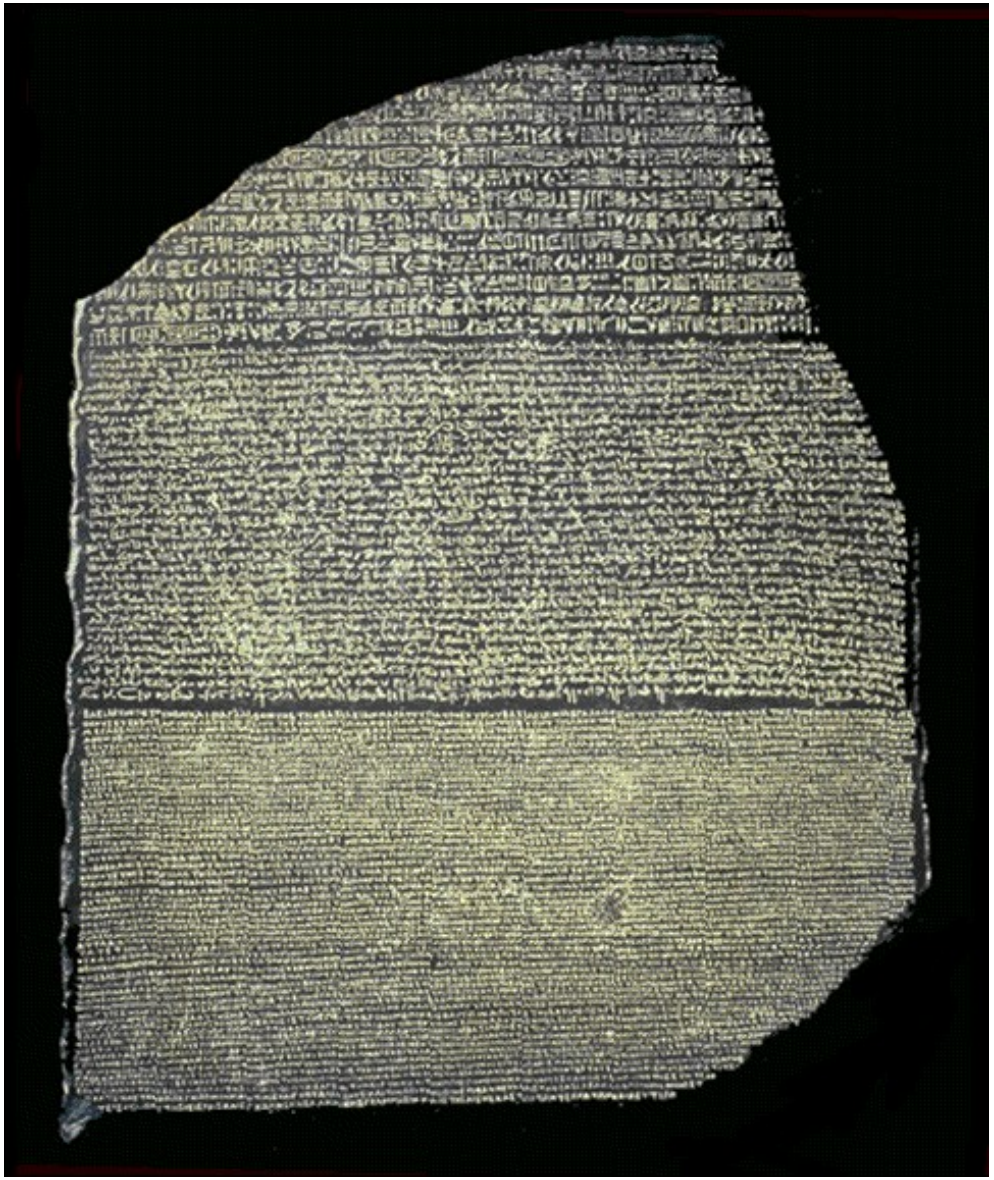
- One change per commit
  - Small commits
  - Easy to isolate problems
  - Easy to revert mistakes
- Update your code often
- Communicate!
  - Version control is a great collaborative tool, but it doesn't replace actual teamwork!

Good sources

- I referred to a number of these when making this lecture; you may find them helpful in learning VCS/Git:
  - Hands-on
    - Try Git: `try.github.io`
    - Learn Git Branching: `pcottle.github.io/learnGitBranching`
    - Git Immersion (with Ruby scripts): `gitimmersion.com`
  - Video presentation (from linux.conf.au conference)
    - Git for Ages 4 and Up: `youtu.be/1ffBJ4sVUb4`
  - Web
    - Git Magic: `www-cs-students.stanford.edu/~blynn/gitmagic`
    - Pro Git: `git-scm.com/book`
    - Version Control by Example: `ericsink.com/vcbe`

SVN-Git reference

- Caveat: Subversion and Git are fundamentally different!
- These commands are similar, but not always equivalent.
- The reference focuses on the practical aspects
  - Help Subversion users make the switch



SVN-Git reference

- First, the most important command of all:

```
svn help
git help
```

```
svn help COMMAND
git help COMMAND
```

SVN-Git reference

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- Get the source from a remote location:

```
svn checkout URL
git clone URL
```

- Update your existing copy with the latest changes:

```
svn update
git pull
```

- (Remember: git pull is the same as fetch+merge)

SVN-Git reference

- Add a new file in the next commit:

```
svn add foo.c
git add foo.c
```

- Remove a file in the next commit:

```
svn rm foo.c
git rm foo.c
```

SVN-Git reference

- Summarize the files I've changed but haven't yet committed:

```
svn status
git status
```

- Show me exactly what I've changed but haven't yet committed:

```
svn diff
git diff
```

SVN-Git reference

- Undo my uncommitted changes to a file:

```
svn revert foo.c
git checkout foo.c
```

- Undo an earlier commit that was a mistake:

```
svn merge -c -REVNUM; svn commit
git revert REVID
```

SVN-Git reference

- Commit all the changes I've made to my working copy and send them to the remote repository:

```
svn commit
```

```
git commit -a; git push
```

- Commit all local changes without sending to the remote repository (Git only):

```
git commit -a
```

SVN-Git reference

- Staging area (index) is Git-only!
- Stage certain changes and commit only those:

```
git add foo.c foo.h
...
git commit
```

- Unstage the changes made to a particular file:

```
git reset foo.c
```

SVN-Git reference

- Show a list of all commits made, most recent first:

```
svn log
git log
```

- Show line-by-line history of a file, including who changed what and when:

```
svn blame foo.c
git blame foo.c
```

Other Git commands

- Create a new lightweight local branch:

  `git branch` *BRANCHNAME*

- Create a new branch and switch to it:

  `git checkout -b` *BRANCHNAME*

- Switch to an existing branch:

  `git checkout` *BRANCHNAME*

- Merge another branch into the current one:

  `git merge` *OTHERBRANCH*