

# CS 45, Lecture 9

## Version Control I

Spring 2023

Akshay Srivatsan, Ayelet Drazen, Jonathan Kula

# Outline

1. Review
2. Version Control
3. Git

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3. Git

# Learning Goals

In this (and next) lecture, we will see:

- How to safely store your files (code or text)
- How to collaborate on files with others over the internet
- **How to avoid losing your data!**

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  - Documentation
  - Markup Files

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- As you change these files over time, you'll eventually want some way to keep track of different "versions" of the file.
- What we need is a "version control system".



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1. Review

2. Version Control

2.1 Version Control Systems

2.2 Comparison of VCSs

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- A good VCS will let you look at old versions of files and restore files (or information) which you might have accidentally deleted.
- You've seen these before!

# Version Control Systems

Assignment 2: Bourne to Be Wild

File Edit View Insert Format Tools Extensions Help [Last edit was made yesterday](#) [Share](#)

- New
- Open
- Make a copy
- Share
- Email
- Download
- Approvals
- Rename
- Move
- Add shortcut to Drive
- Move to trash
- Version history
- Details
- Language
- Page setup
- Print preview
- Print

Assignment #2  
January 25, 2023

## —Bourne to Be Wild

Components

**It does some data analysis**

to ensure you've installed of the software required for

Knowledge on user proficiency level with the tools. If you

Name current version

See version history

also has many examples of how to use different

to a shell script which does some data wrangling. You'll be

about Stanford CS Faculty. To get that file, use the

```
curl -Lo cs_faculty.csv  
https://cs45.stanford.edu/res/assign2/cs_faculty.csv
```

This file contains faculty members' names, titles, and research groups. For example, here's a line from the file:

```
Alan Kiken, Professor, Computer Systems + Programming Systems and Verification
```

As you can see, the different columns are separated by commas. This is what's called a "comma-separated values" file, or a CSV file for short. The last column contains the professor's research groups, each separated by a "+" (plus sign). For the purposes of this assignment, you can treat this as an ordinary text file.

Your task is to write a shell script that analyzes this file. As a reminder, a shell script is a text file.

Assignment 2: Bourne to Be Wild

January 26, 11:24 AM

Version History

All versions

RESTORABLE

January 26, 11:24 AM

Current version

Aylett Dracen

TUESDAY

January 24, 8:21 PM

Aylett Dracen

January 24, 12:09 AM

Aylett Dracen

Jonathan Kula

MONDAY

January 23, 9:44 PM

Jonathan Kula

January 23, 8:41 PM

Aylett Dracen

Jonathan Kula

January 23, 7:28 PM

Aylett Dracen

January 23, 6:48 PM

Aylett Dracen

January 23, 5:42 PM

Aylett Dracen

Jonathan Kula

Akshay Srivastava

January 23, 1:46 PM

Akshay Srivastava

January 23, 3:00 AM

Jonathan Kula

SUNDAY

January 22, 10:50 PM

Jonathan Kula

Show changes

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Akshay Srivastava, Aylett Dracen, & Jonathan Kula

## Assignment #2—Bourne to Be Wild

**Due: January 30, 2023 at 11:59pm**

This assignment consists of two different components:

- You'll write a simple shell script that does some data analysis
- You'll get some practice using `vim`

Before starting the assignment, you will want to ensure you've installed all the software lectures 1 through 5.

We expect this assignment to take 1-3 hours depending on your proficiency level with `vim` and yourself unproductively struggling (spinning in circles), so go to office hours!

As a reminder, you can use [wiki pages](#) to learn more about commands you don't yet know what flags they support. The website [check.sh](#) also has many examples of how to use `cd` commands.

**Part I: Write A Shell Script (2 points)**

For this part of the assignment, you will write a shell script which does some data wrangling, analyzing an input file containing information about Stanford CS Faculty. To get that file, use the command below:

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https://cs45.stanford.edu/res/assign2/cs_faculty.csv
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A great version control system:

- Will let you collaborate on files with other people
- Will help you combine “branched” versions of the files produced by different people working independently

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# Google Docs

Google Docs automatically keeps track of file history in a basic VCS.

Pros:

- Great for rich text
- Allows real-time collaboration
- Saved on the cloud automatically

Cons:

- Bad for plain text (especially code)
- Requires an internet connection
- Only supports a single "current" version of a single file

# Copying Files

You can make a bunch of copies of files or folders with `cp` as a simple form of version control. You can compare versions with `diff`.

Pros:

- Works on either rich or plain text (or anything else)
- It's simple and makes it easy to move data between versions

Cons:

- It's messy and a lot of manual work
- It's hard to tell what the relationship between different versions is
- It takes a lot of hard drive space

# Zip Files

Instead of just `cp`ing folders, we could bundle them up into a Zip file (a single file which can be “unzipped” into a folder).

Pros:

- Tracks versions for an entire folder at once
- Easy to share a version with someone else (email)

Cons:

- It's still a lot of manual work
- It's hard to tell what the relationship between different versions is
- It's hard to extract a single file from an old version



# Zip Files++

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- The tool could track the relationships between different versions, so we can have multiple “current” versions at the same time.
- If we want to combine different versions, the tool can automatically do it for us (instead of us copying and pasting the parts together).

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- We can ask Git to keep track of who's working on what, so multiple people can work on different things without conflicting.
- If we want to combine multiple people's work, we can ask Git to automatically merge them together. If it can't for some reason, it'll ask us to manually merge them.

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3.1 Linear History

3.2 Branching Workflow

3.3 Combining Branches

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5. `git add` the changed files to “stage” them again
6. Repeat from 3

You can use `git log` to see your commit history, and use `git status` to see the current state of staged/unstaged/untracked changes.

# Basic Workflow

## Demo

Let's practice how to:

- Create a new Git repository
- Commit a new file
- Commit changes to files
- Revert commits
- Look at an old version of a file
- Compare two versions of files
- See your commit history

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# Branching Workflow

We can also split our “repo” into multiple BRANCHES, which are like alternate versions of a folder. This means different people can work on different things without interfering with one another.

1. Make sure your repository is “clean” (i.e., you have no uncommitted changes).
2. `git checkout -b <branch>` to create a new branch and move to it; at this point, the new branch will be identical to the old one.
3. Make changes, `git add`, `git commit` as usual
4. `git checkout` to switch between branches

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# Branching Workflow

## Combining Branches

Now that we have multiple branches, we probably want to join them back together at some point.

There are several ways to do this:

- `git merge` two branches into one
- `git merge --fast-forward` a long branch onto a shorter version of itself
- `git rebase` one branch onto another branch
- `git cherry-pick` a specific commit from one branch to another

# Branching Workflow

## Fast Forwarding

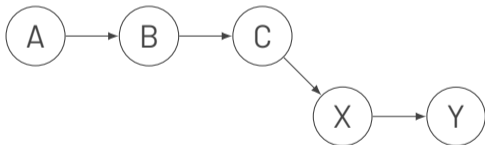
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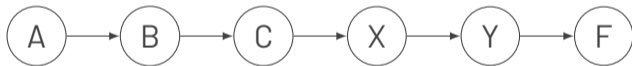
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# Branching Workflow

## Merging

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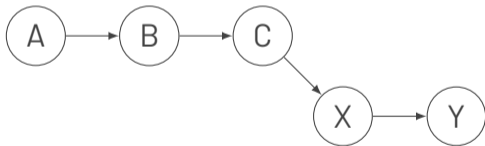




# Branching Workflow

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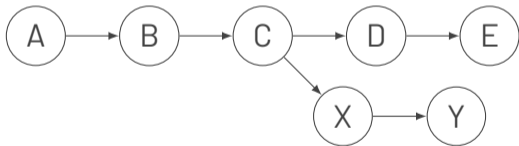
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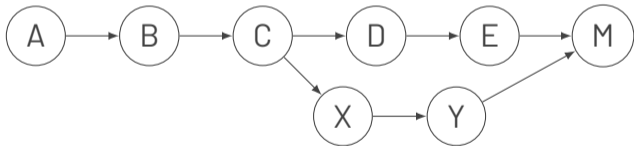
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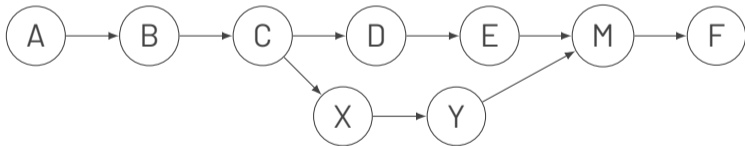
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## Rebasing

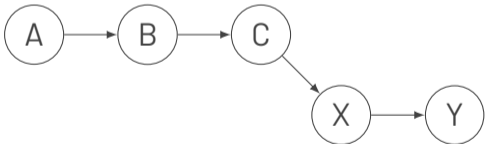
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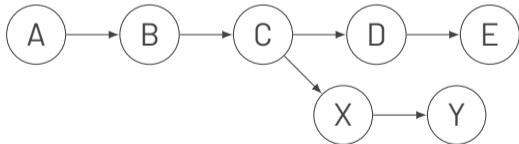
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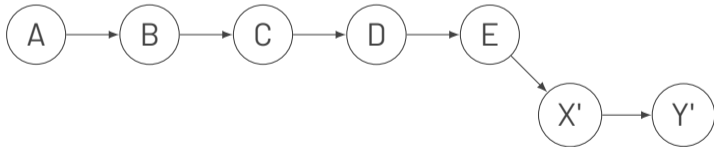
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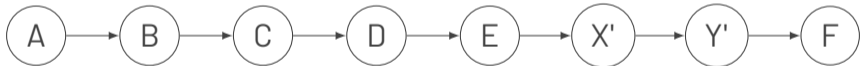
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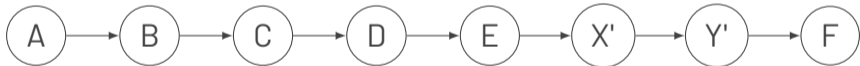
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# Branching Workflow

## Rebasing

REBASING moves the "base" of a branch to be a different commit. **REBASING** edits Git's history to make **FAST-FORWARDING** possible.



# Branching Workflow

## Cherry-Picking

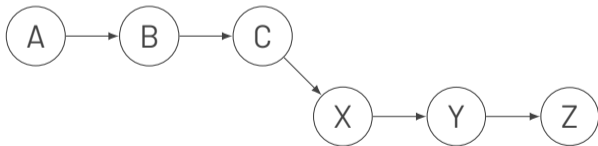
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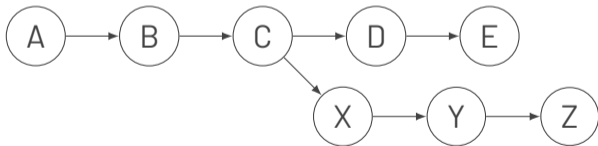
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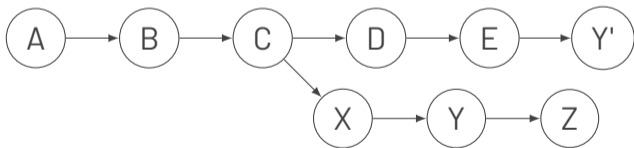
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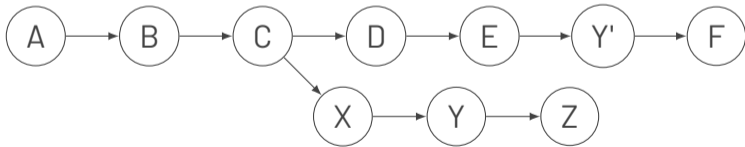
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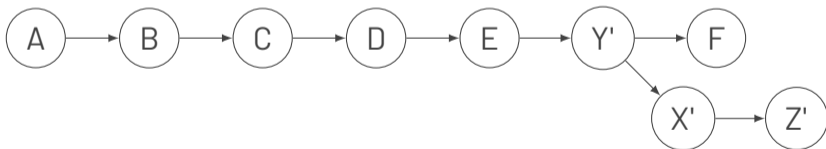




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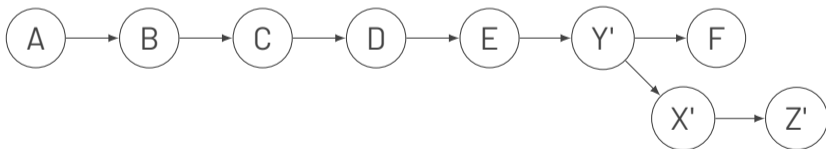


# Branching Workflow

## Cherry-Picking

CHERRY-PICKING copies a *single commit* from one branch to another branch.

CHERRY-PICKING and rebasing is a good way to move a single commit from one branch to another.



# Branching Workflow

## When to merge/rebase/cherry-pick?

- **fast-forward** when possible (`git merge --ff-only`).
- **rebase and then fast-forward** if possible, i.e., if you're the only one working on the branch; **never** rebase a branch other people are using (`git rebase` and `git merge --ff-only`).
- **merge** if neither of the above are possible (`git merge`).
- **cherry-pick** if you want to copy a specific commit to another branch (`git cherry-pick`)<sup>1</sup>.

---

<sup>1</sup>This is pretty rare, I've only used it a handful of times.

# Branching Workflow

## Branching Demo

Let's practice how to:

- Split our repository into two branches
- Switch between branches
- Make commits on either branch
- Merge two branches together

# To Be Continued...

We'll pick back up with merge conflict resolution and collaboration in Lecture 10.

Some commands which (probably) came up during class:

`git checkout`: essentially means "move to a different commit"; doesn't change your git history

`git reset`: "resets" the entire repository to the way it was in an old commit (and changes git history to match)

`git revert`: "undoes" a specific old commit by creating a new commit that does the opposite

Note that, even though Git commits are technically versions, Git's commands often operate on the *changes* between versions.