CS 45, Lecture 9
Version Control I

Spring 2023

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Outline

1. Review

2. Version Control

3. Git

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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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- What we need is a “version control system”.

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2. Version Control

2.1 Version Control Systems

2.2 Comparison of VCSs

3. Git

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Version Control Systems

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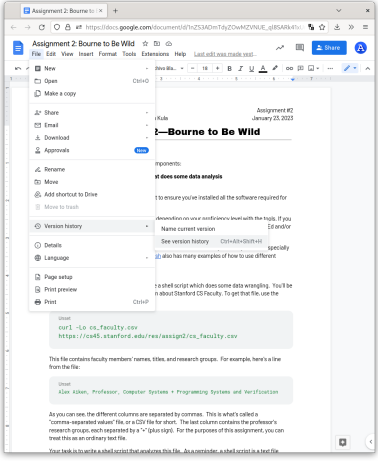
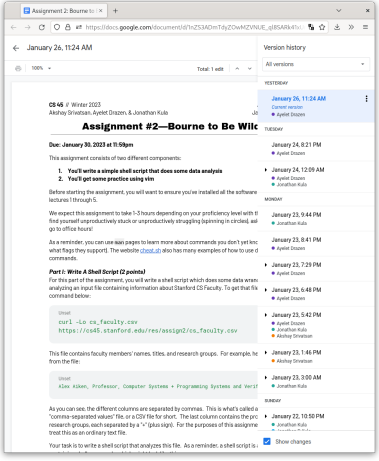
- You've seen these before!

Version Control Systems





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

Outline

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

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- 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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- 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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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

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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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3.1 Linear History

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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.

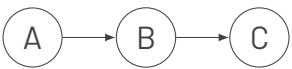
There are several ways to do this:

- `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

The simplest case of MERGING is called FAST-FORWARDING.



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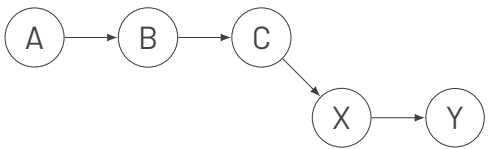

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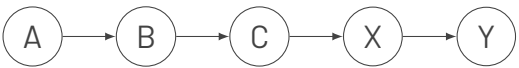

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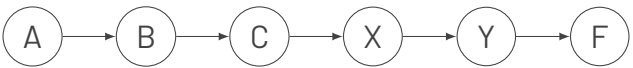

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Merging

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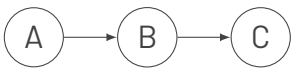

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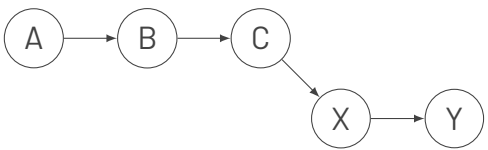

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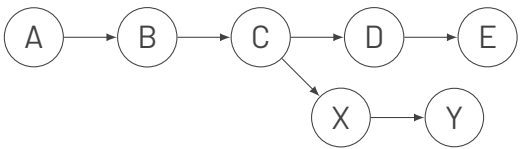

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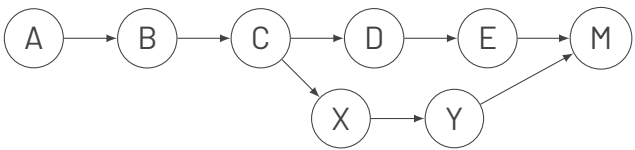

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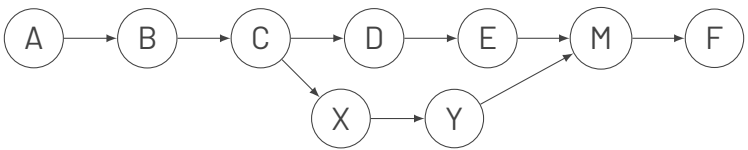

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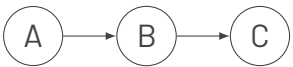

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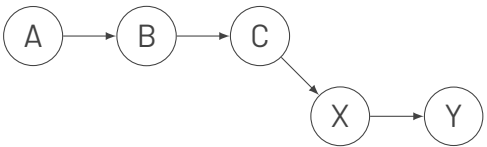

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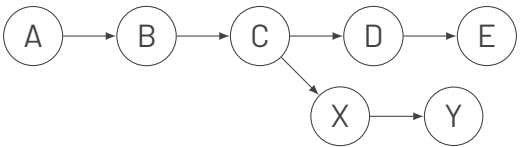

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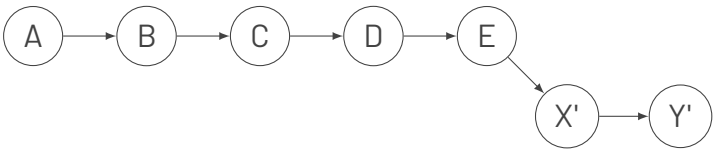

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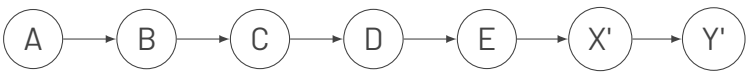

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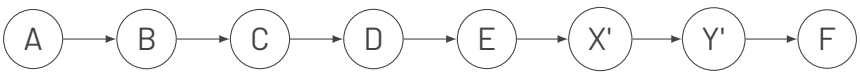
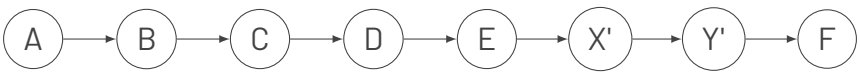


Branching Workflow

Rebasing

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



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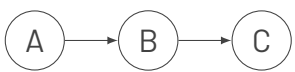

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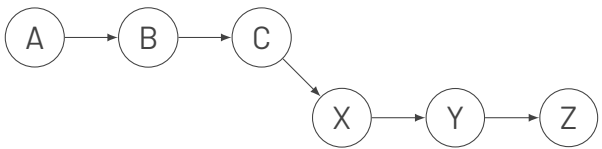

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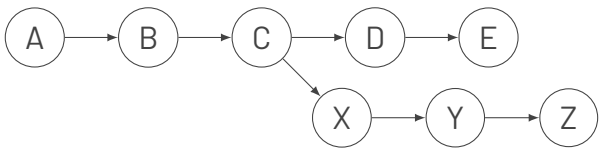

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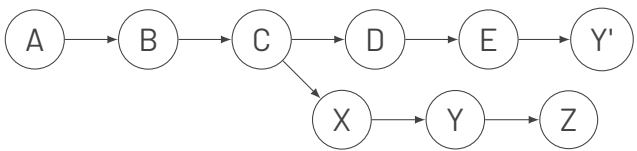

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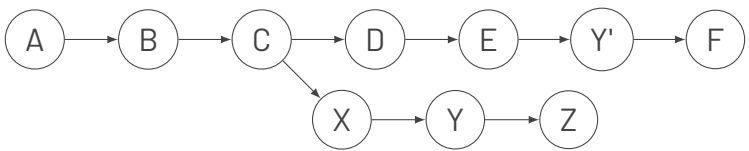

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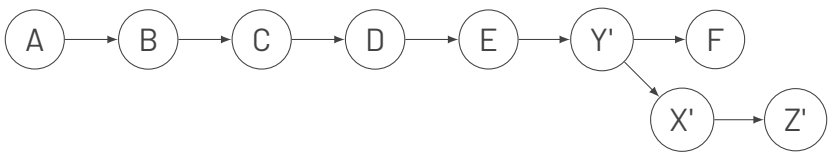
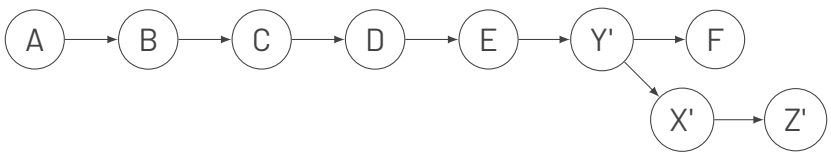


Branching Workflow

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`)[1].

[1] 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.