Version Control

Martin Kellogg

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Today’s agenda:

- **Reading Quiz**
- How does a version control system work?
- How to use your VCS
- GitHub workflows

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Announcements:

- IP1 due on Thursday.
  - Don't overcomplicate it: implementations are (mostly) simple
  - Brief explanation of testing your tests
- Huzefa's OH changes:
  - Monday OH now 4:30-5:30
  - All OH in GITC 4234

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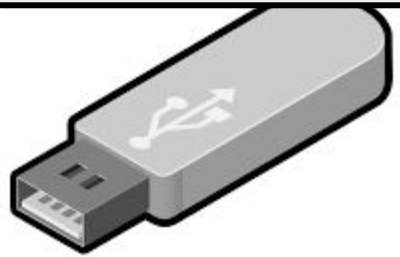

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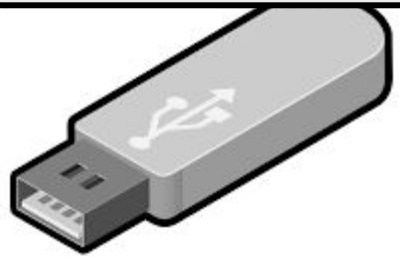
- **but not for code**



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  - Explain the purpose of each change
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- Keep a **history** of your work
  - Explain the purpose of each change
  - Checkpoint specific versions (known good state)
  - Recover specific state (fix bugs, test old versions)
- **Coordinate**/merge work between team members
  - Or yourself, on multiple computers, or multiple features

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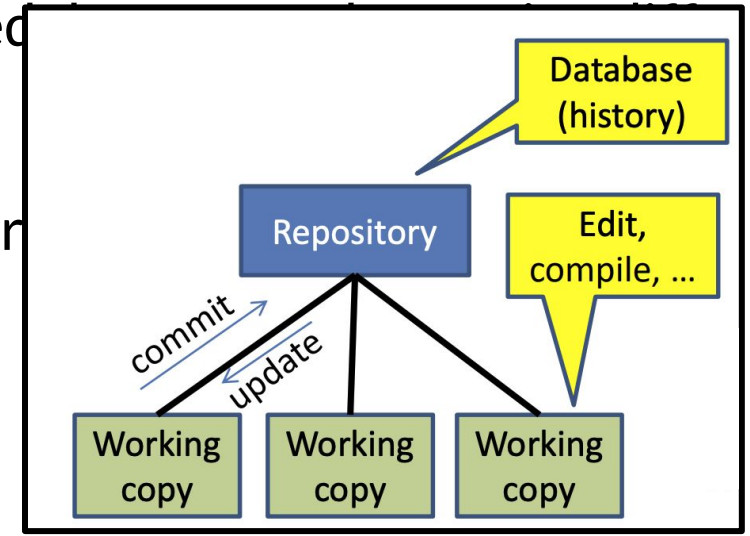

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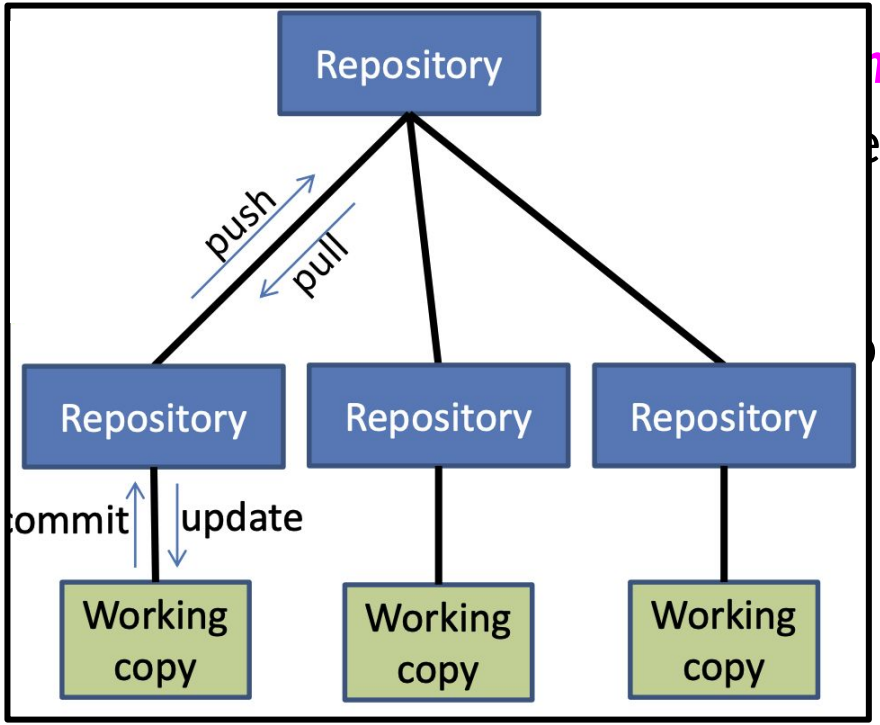

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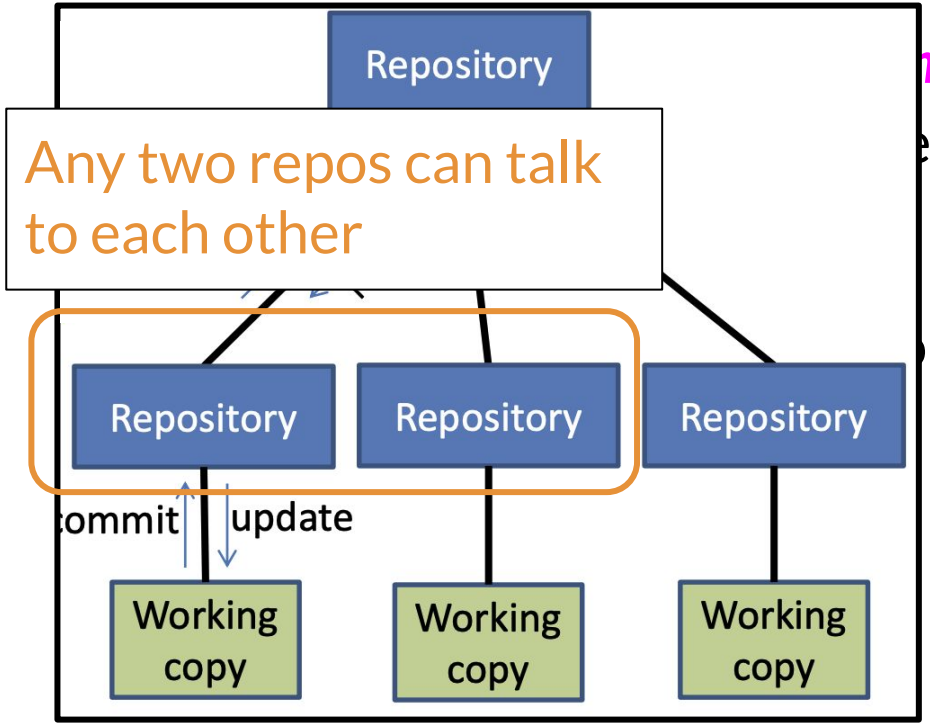

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typical setup: distributed VCS with a single, privileged main

Advantages of distributed VCS

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- commit, examine history when not connected to the network
- more accurate history
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- flexibility in repository organization and workflow
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Distributed VCS is now the **industry standard** (e.g., git, hg). (Some organizations do still use centralized, though.)

Distributed VCS prevents some operations

- No update if uncommitted changes exist: must commit first
- No push if not ahead of remote: must pull & merge first
- No partial update (e.g., updating just one directory)
  - update gets all changes in a changeset (= a commit)

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- Rationale:
  - Maintain more accurate, complete history
  - Keep all users in sync
  - Avoid painful conflicts
  - Avoid loss of work

Coordinating with others

- `pull` incorporates others' changes into your repository
  - (update brings changes into your working copy)
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  - Behind = your history is a **prefix** of master history
- If you have made changes in parallel, you must **merge**
  - Merge = create a new version incorporating all changes

Coordinating with others: rebasing

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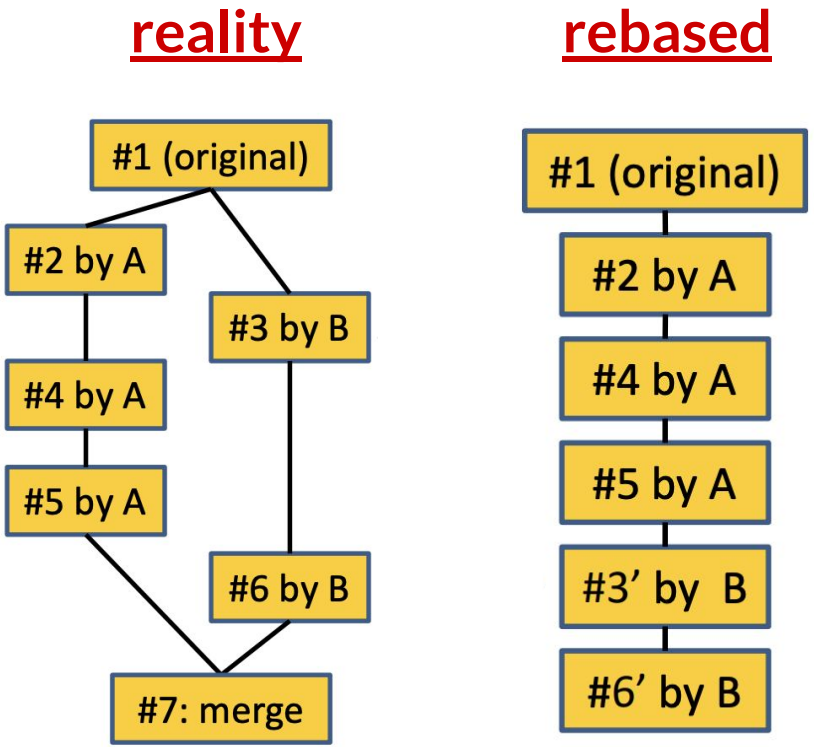

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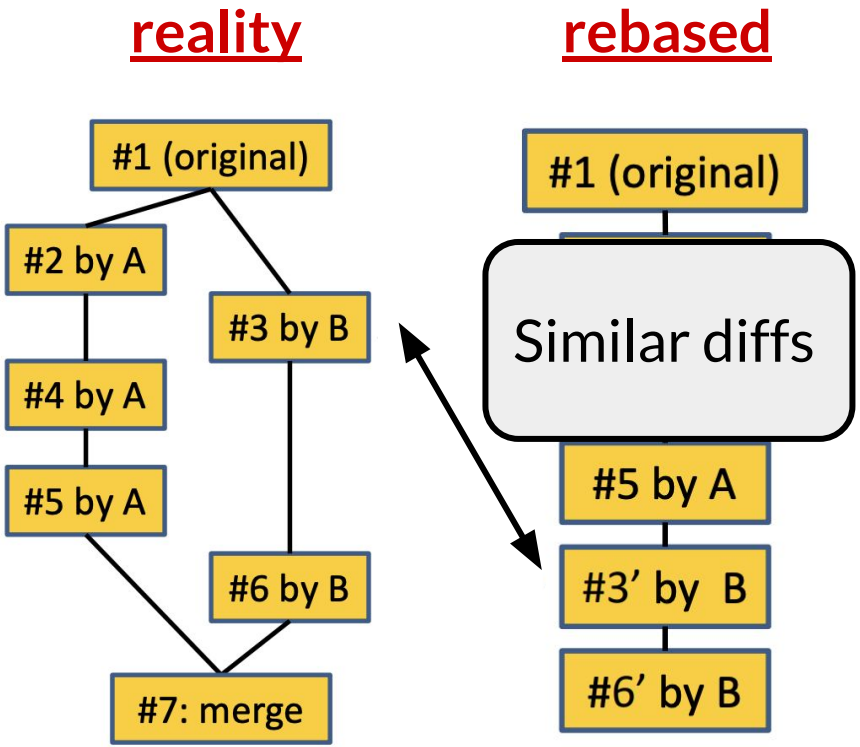

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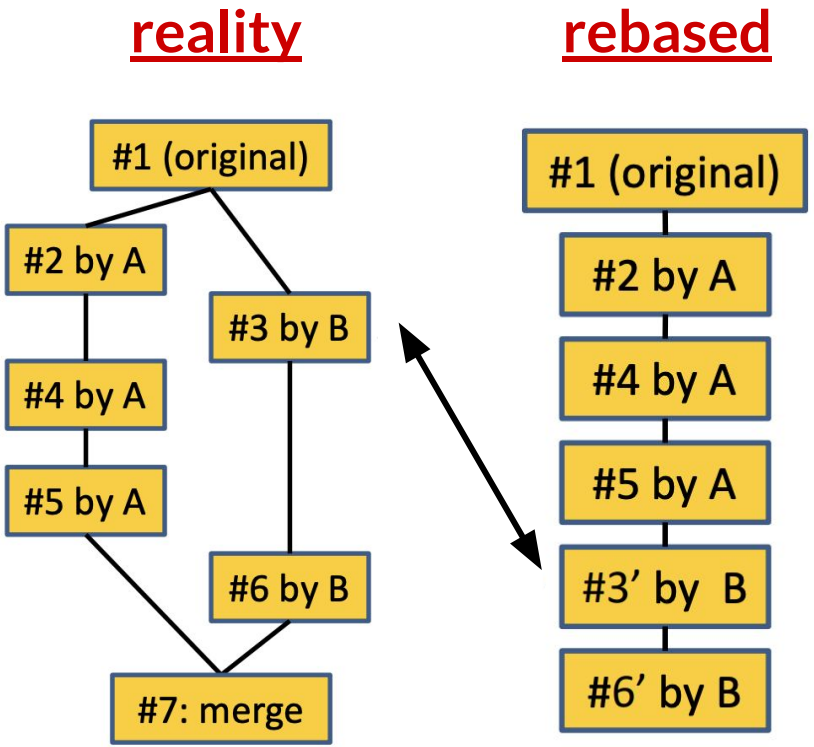

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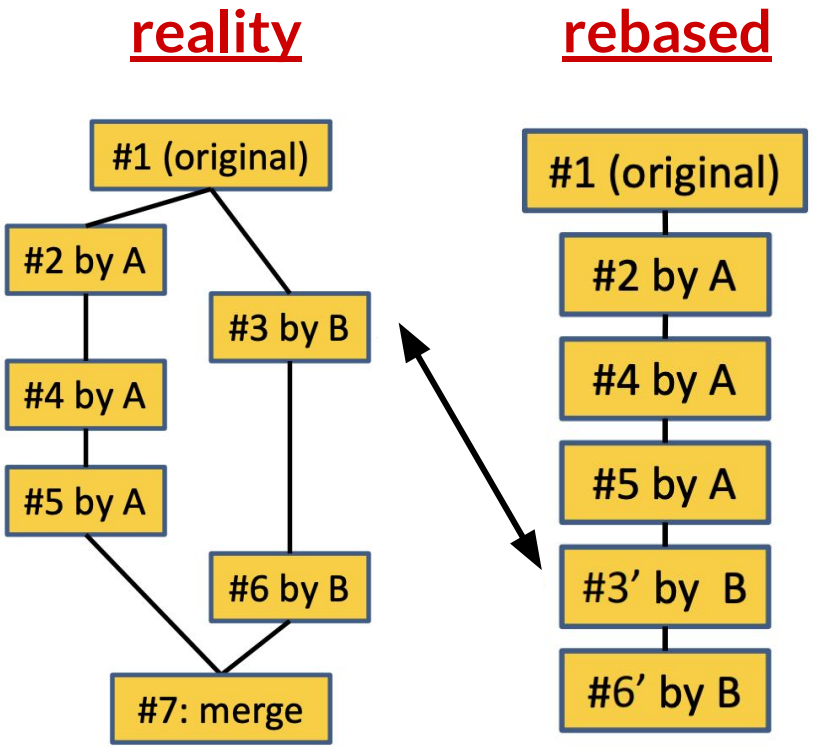
- Does not show context for change #3



Coordinating with others: rebasing

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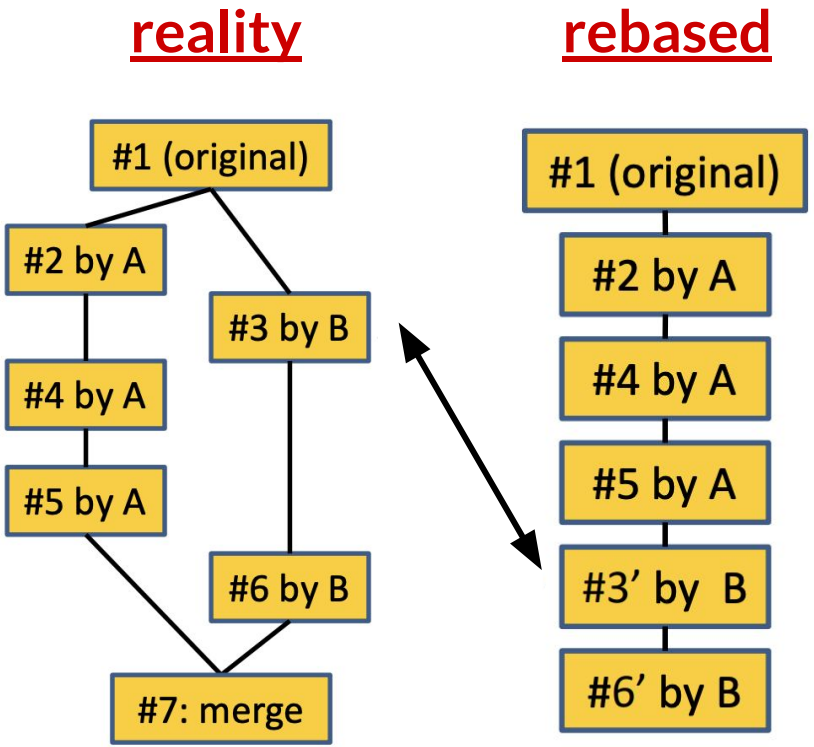
- Squash-and-merge is a safer form of rebasing



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- Could yield compile errors or test failures

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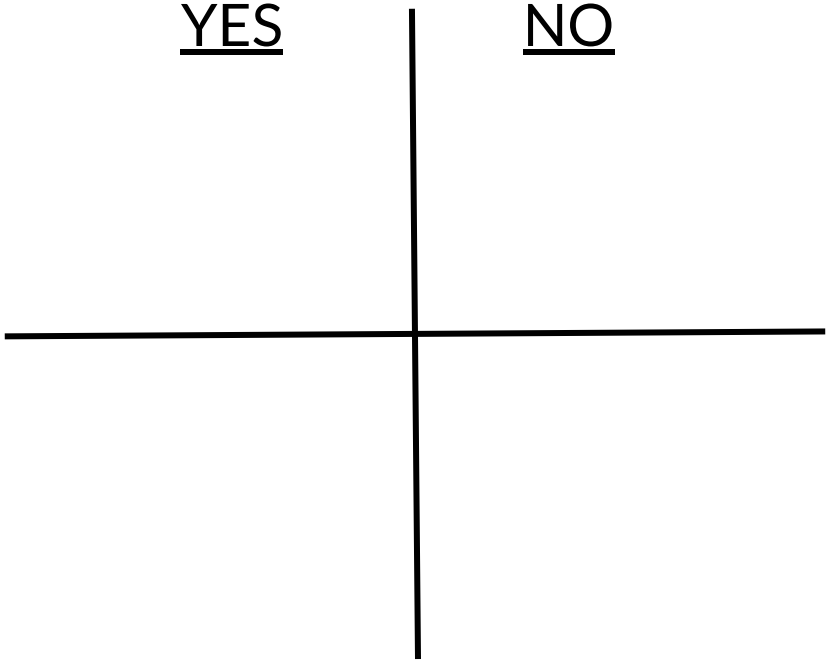
Aside: false positives and false negatives

Can X **actually** happen?



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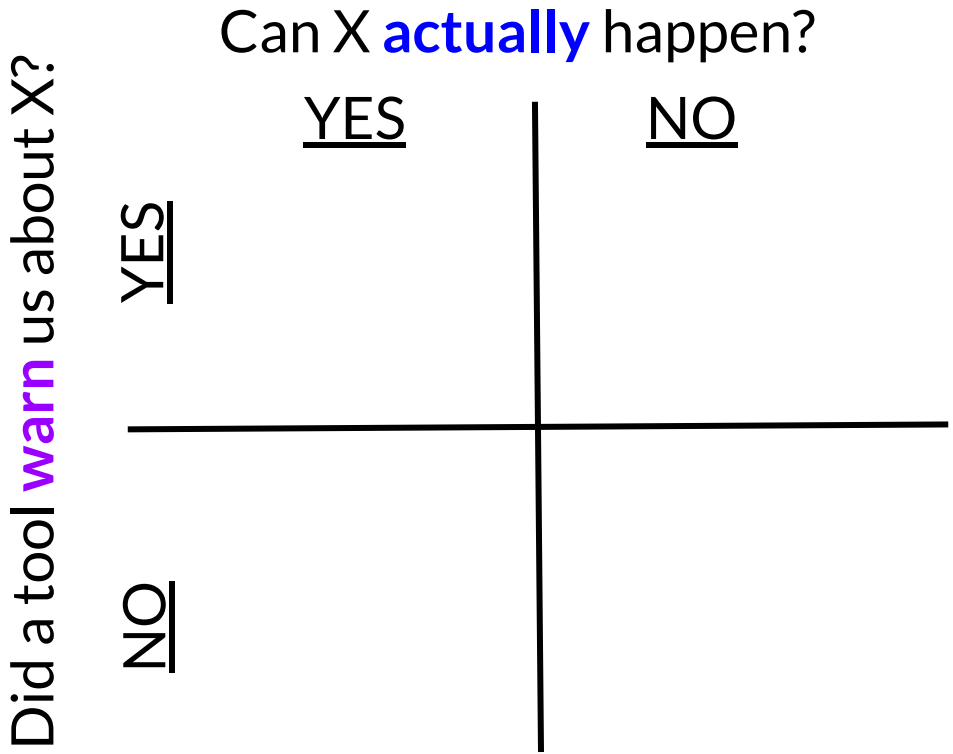

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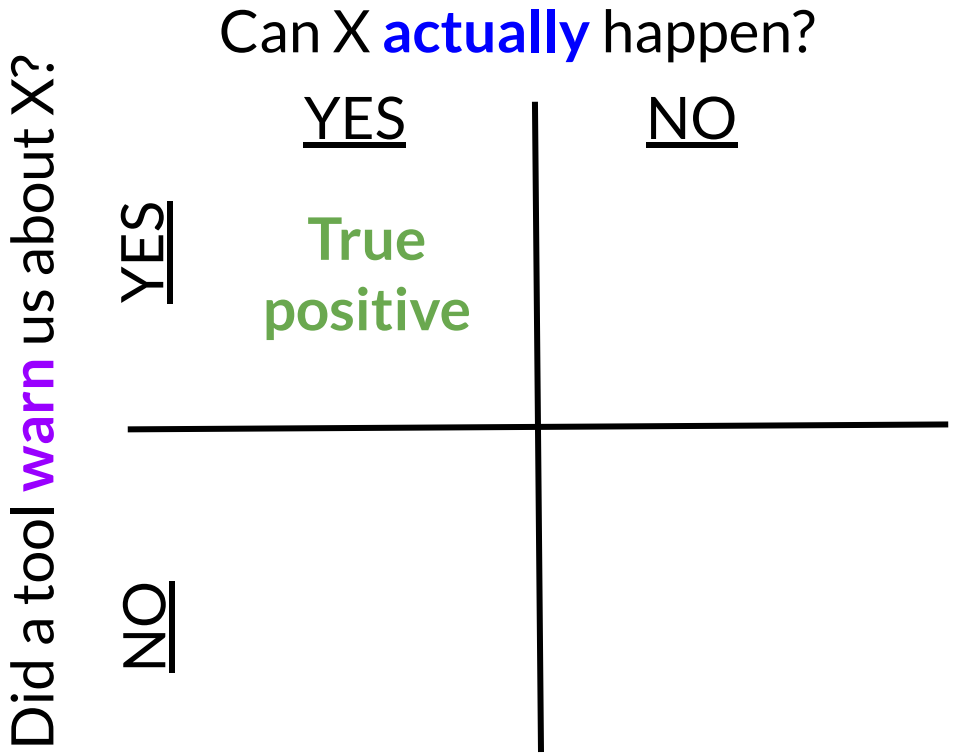

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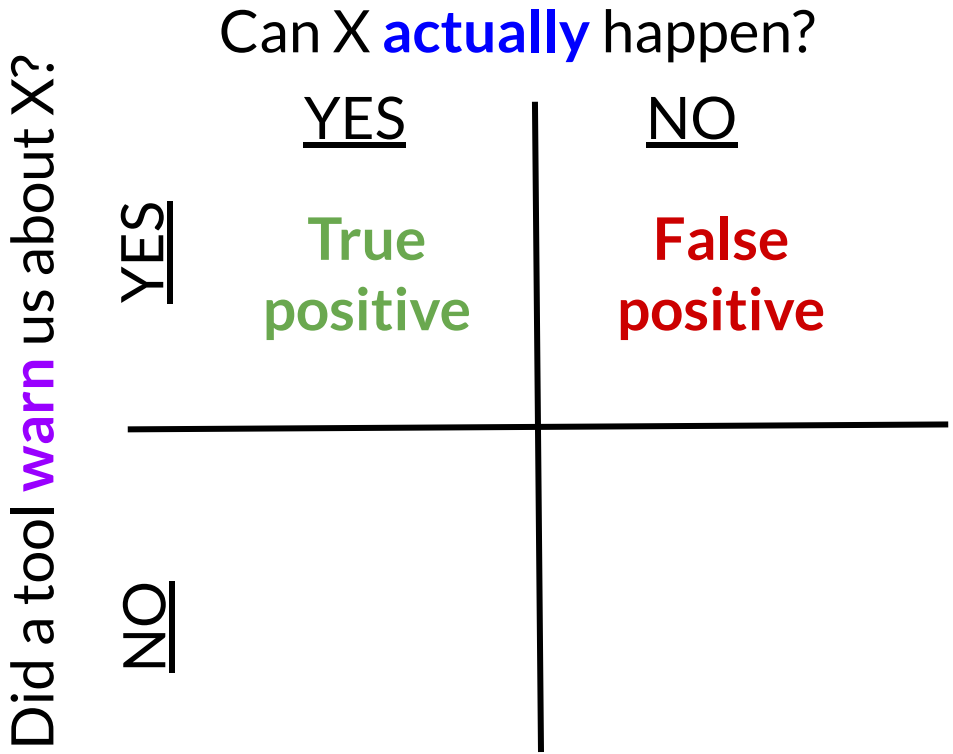

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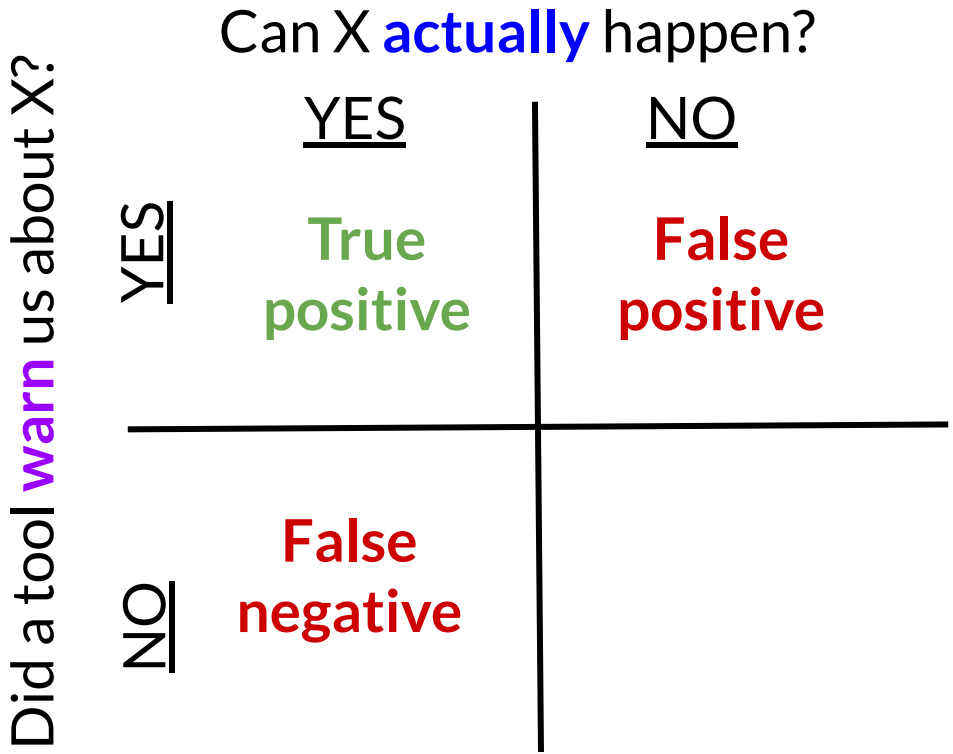

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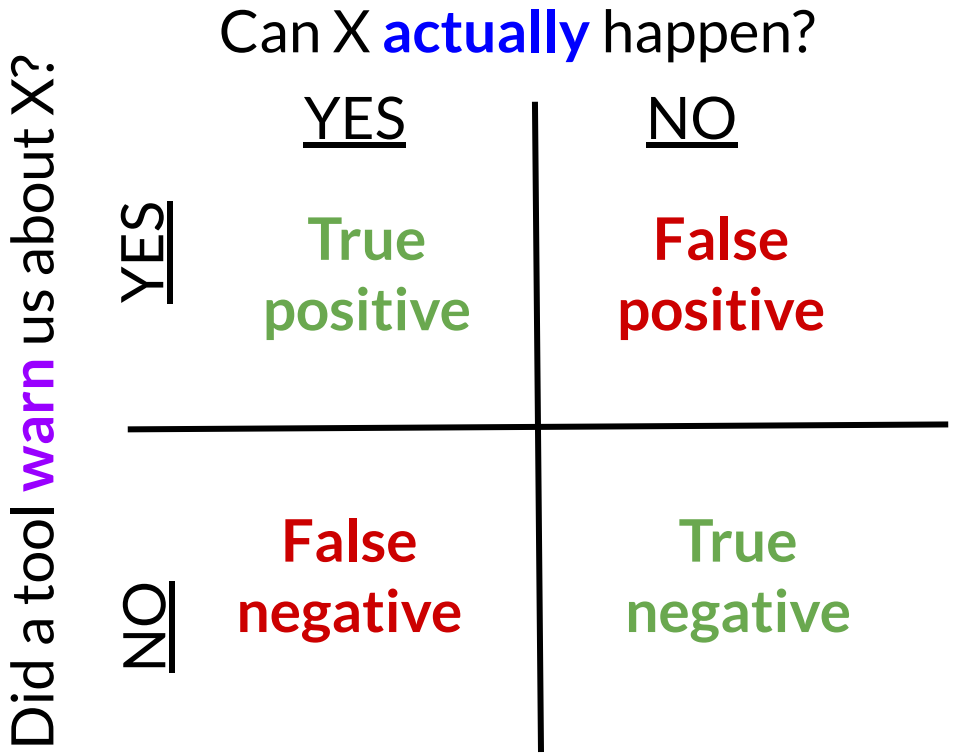

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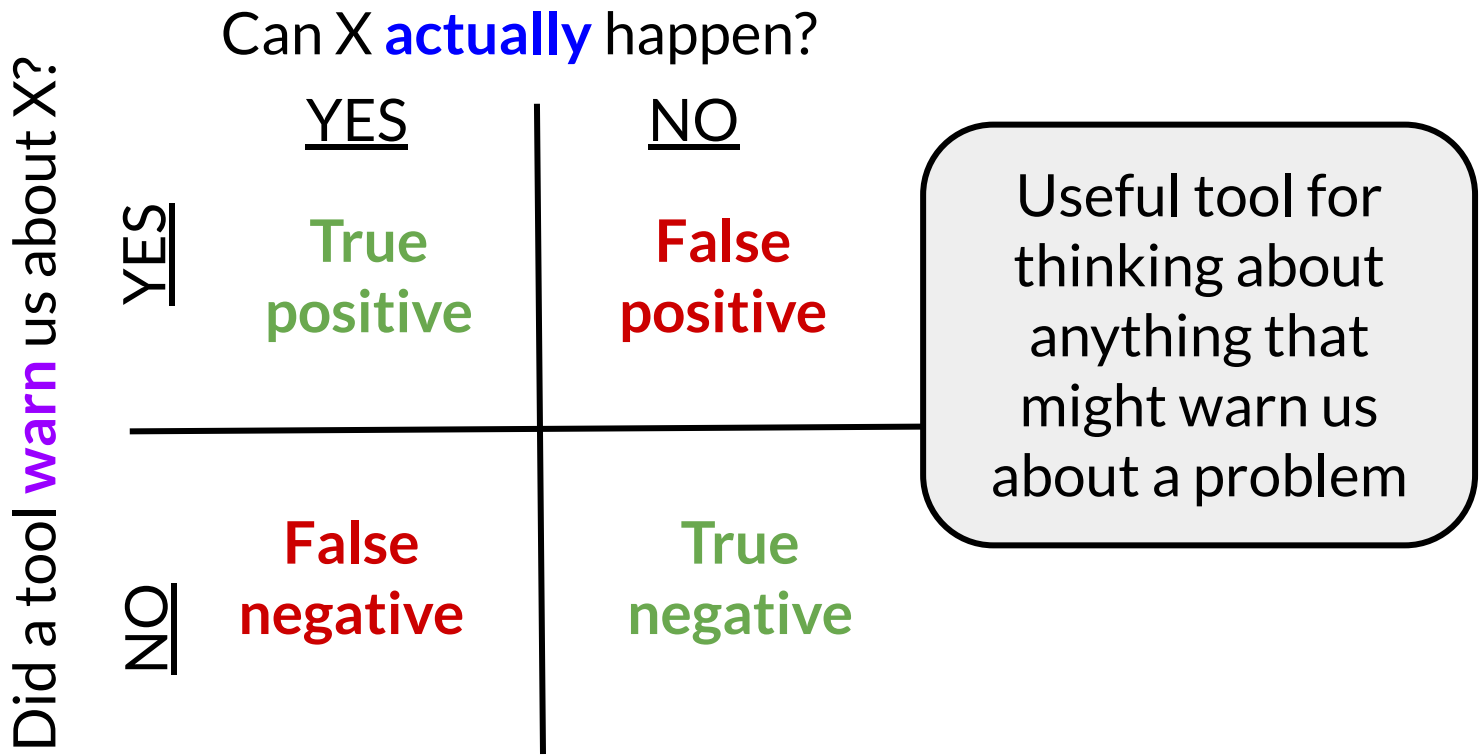

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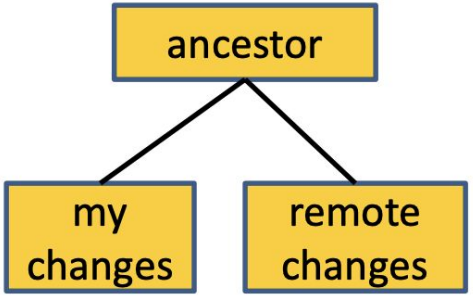

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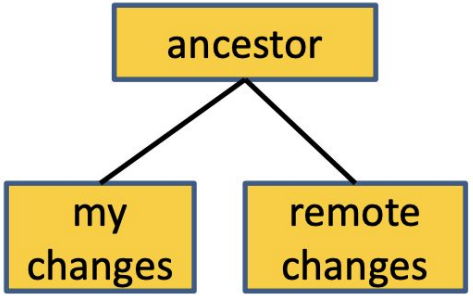

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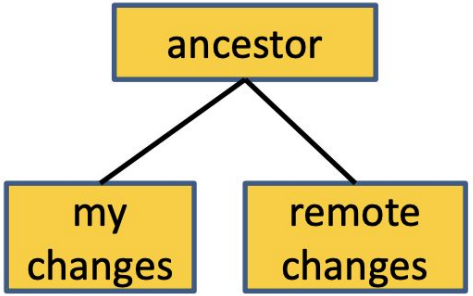
- **Don't panic!** Instead, think.
- **You can always** bail out of the merge and **start over**
  - You have the full local and remote history



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Version Control: advice and best practices

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  - Wastes space in repository
  - Causes merge conflicts

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Advice: use feature branch development model iff your team typically ships features quickly

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- Pull often
  - **Avoid getting behind** the main repo or your teammates
  - Avoid difficult and/or complex merges
- Push as often as practical
  - Don’t let your teammates get behind you!
  - Don’t destabilize the main build
  - Avoid long periods working on a branch
    - but do work in a feature branch - don’t work directly on main!

Advice: commit messages

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- **Always** write a commit message
- Commit messages should be **descriptive**
- Don’t write a novel: **summarize**. The code documentation in the commit should cover the rest.

Advice: commit messages: good or bad?

```
commit 763fe9cc335bb78ca45a608fa1f4c606713d5b44
Author:
Date:

    Simplify `getImmediateSubcheckerClasses()` implementation (#5579)
```

Advice: commit messages: good or bad?

```
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Author:
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GOOD: short and to the point. Contains link to the PR it was merged in

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```
commit 123317b24a72215071a0f02e08635ee4b5b9669a
Author:                                                    noreply.github.com>
Date:

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NOT SO GOOD:
description is vague
(looks auto-generated!)

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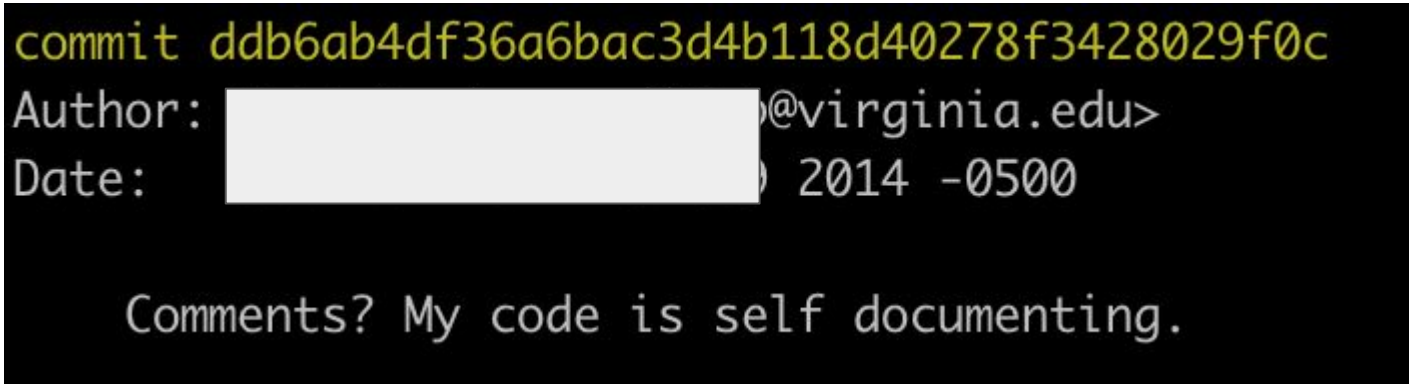

Advice: commit messages: good or bad?

```
commit ddb6ab4df36a6bac3d4b118d40278f3428029f0c
Author:                                    @virginia.edu>
Date:                                      2014 -0500

    Comments? My code is self documenting.
```

NOT SO GOOD: I know writing jokes is fun, but try to keep commit messages serious

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  - Do multiple tasks in one working copy
    - Commit only a subset of files (use Git's staging area)
    - Error-prone
  - Create a branch for each simultaneous task
    - Need to keep track of all your branches, merge
    - Easier to share unfinished work with teammates

Advice: ways to avoid merge conflicts

- **Modularize** your work
  - Divide work so that individuals or subteams "**own**" a module
  - Other team members only need to understand its specification (abstractions!)
  - Requires good documentation and testing

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  - Requires good documentation and testing
- **Communicate** about changes that may conflict
  - Don't overwhelm the team with such messages

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  - backups
  - feature branches are still useful when working on multiple parts of a system in parallel
  - sharing work across multiple computers

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  - sharing work across multiple computers
- Use **private repos** for things that should be private (e.g., your IP0/1/2 solutions…)
  - GitHub will give you free private repos because you're students

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  - feature branches are still useful when working on multiple parts of a system in parallel
  - sharing work across multiple
- Use **private repos** for things that ur IP0/1/2 solutions…)
  - GitHub will give you free priv students

I use **text-based formats** for many files so that I can version control them

Version Control

Today’s agenda:

- Reading Quiz
- How does a version control system work?
- How to use your VCS
- **GitHub workflows**

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  - reminder: what were those? (see lecture 4)
- open PR against "**main**" repository from your fork's feature branch

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I've seen people make all of these mistakes (and more)!

Takeaways: version control

- Understand what your VCS is good for (storing text files, collaboration) and what it isn’t good for (storing binaries!)
- Understand your VCS: don’t just thoughtlessly use the GUI
- Follow best practices when using your VCS:
    - don’t push straight to main
    - practice resolving merge conflicts
    - use process to try to avoid merge conflicts, if possible
    - commit early and often
    - pull as often as you can