Version control for researchers with Git and GitHub

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Course materials: https://karink520.github.io/git-and-github-intro/

Why use Git and GitHub?

- Sleep better at night with version control and remote repositories
- Collaborate smoothly with teammates
- Promote and maintain quality in your code
- Increase the impact of your research
- Develop your career
- Contribute in the open source community

After this workshop you should be able to…

- Explain how version control, Git, and GitHub can help you
- Create a new project that is tracked with Git, or add Git to an existing project
- Use a simple workflow with Git and GitHub that is useful for small or individual projects
- Use a more complex workflow with branches and pull requests
- Contribute to some else’s open source project on GitHub
- Know where to go to learn more

A few key concepts

commits

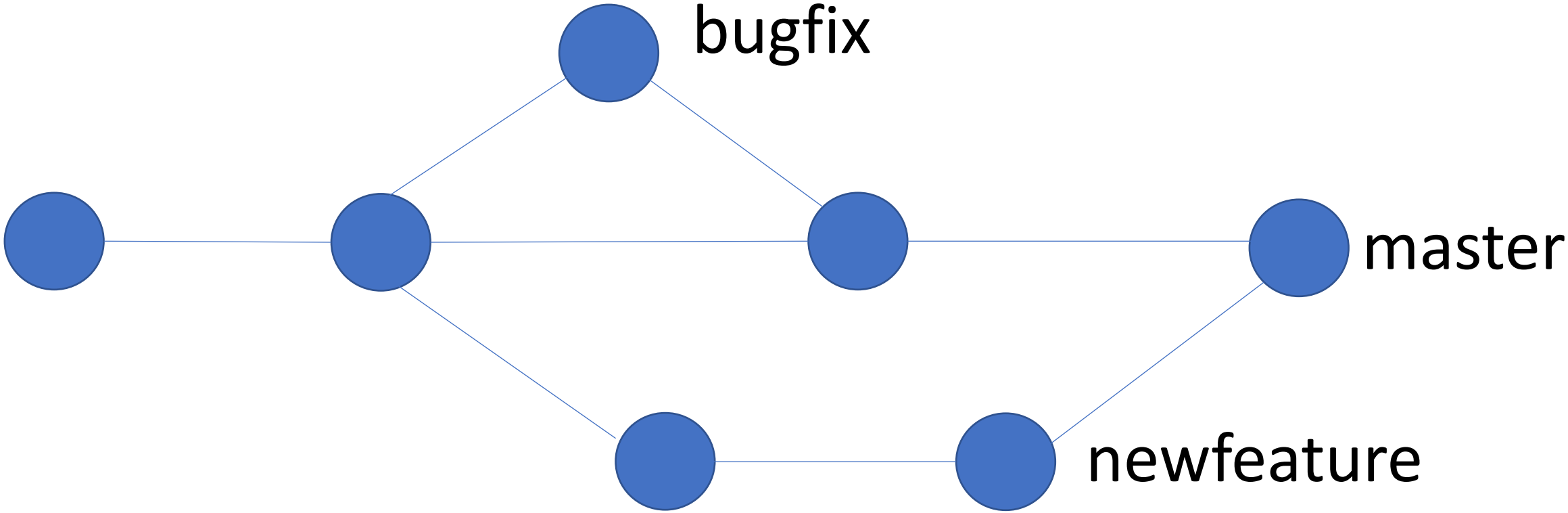
40 digit hexadecimal string that refers to each commit

metadata (author, date)
parents (other commits)
"**snapshot**" of files/directories

metadata (author, date)
parents (other commits)
"**snapshot**" of files/directories

metadata (author, date)
parents (other commits)
"**snapshot**" of files/directories

branching



Staging area

We may not want to commit *all* of files or changes. We will ***add*** files and changes to a ***staging area*** before we commit them.

Git vs. GitHub

- Git = software for version control

Will learn to use basic Git commands: `init, remote, fetch, merge, status, add, commit, merge, push, fetch, checkout`

- GitHub = a repository hosting service with a graphical interface and additional tools for collaboration and more

Will learn to put repositories on GitHub, collaborate when others' have GitHub repositories, use GitHub pull requests.

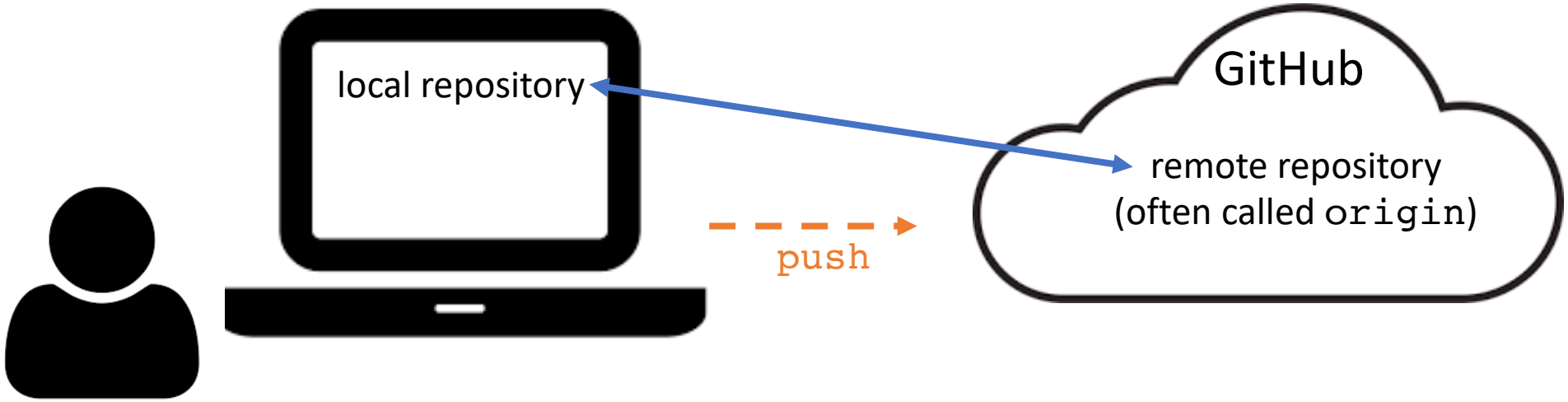
Other options: e.g. BitBucket

Set up a new repository with Git and GitHub

- Initialize with `git init` (double check that this worked with `ls –a` to see the new directory called `.git` that this command created)
- Add and commit any files you want as starting points:

```
git add <filename>
git commit –m “initial commit”
```

- Connect your repository to a remote GitHub repository with GitHub’s interface and `git remote add`
- Copy the content you created to your remote repository (hosted on GitHub) with `git push`

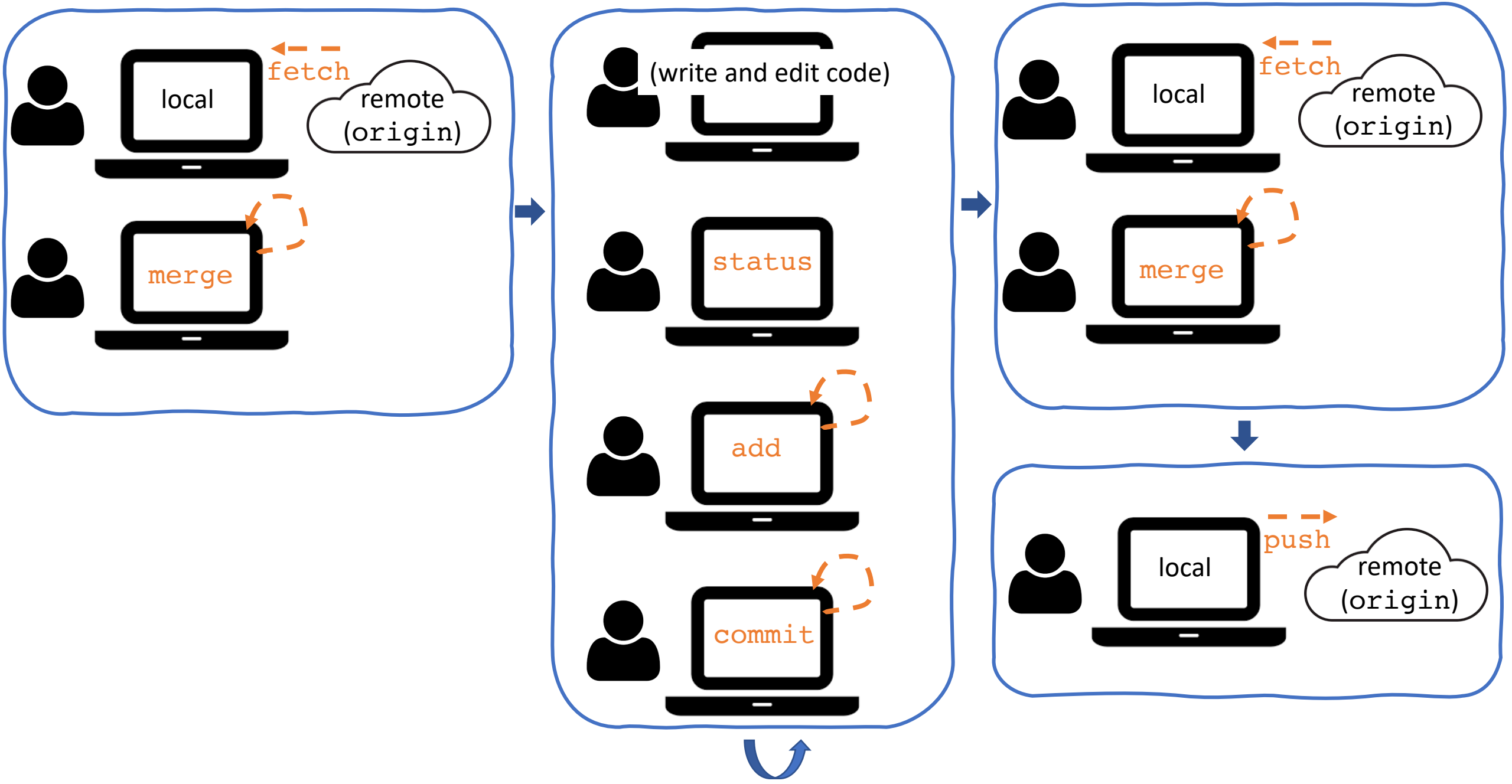


Follow the **numbered steps** in parts I and II

https://xkcd.com/1656/

git + command + flags/arguments

```
git fetch origin
git merge origin master
git add hello.py
git commit –m “my first commit”
git push -u origin master
```


local
fetch
remote
(origin)
merge
(write and edit code)
status
add
commit
local
fetch
remote
(origin)
merge
local
push
remote
(origin)

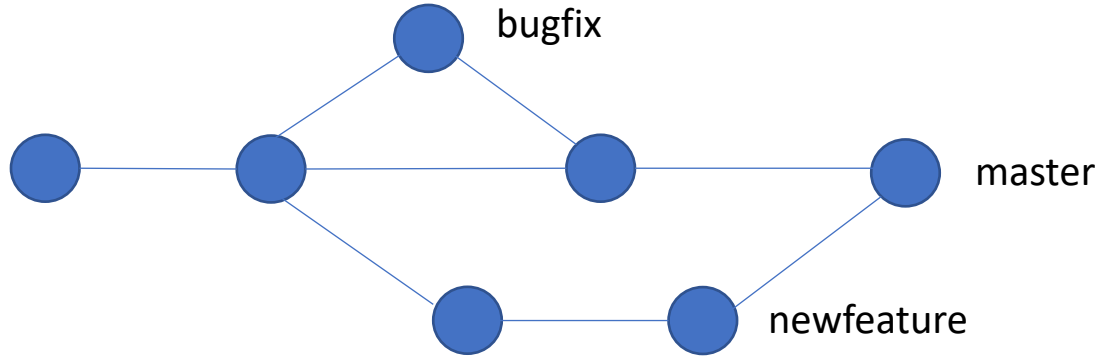
Follow the instructions in part III to practice the workflow now

https://xkcd.com/1296/

Merge conflicts

- If you and a collaborator are simultaneously changing different parts of the code and merging, no problem!
- If you change a line of code, and in the meantime some one has made a different change to **the same line** and pushed those changes, you can have a merge conflict.

Use Git branches and GitHub pull requests



- Instead of making all changes to master branch, create different branches for different features you develop.
- Make branches locally, and then create and connect them to corresponding remote branches.
- Once your feature-specific branch is where you want it to be, *then* merge the changes on this branch back into the master branch of the remote repository.
- Use GitHub's **pull requests** to get collaborator's consent and input before merging the code on feature branch into the master branch of the remote repository.
- Move between branches with the `checkout` command

(caution: `git checkout <filename>` is dangerous).

Checking out older commits

- Make sure you have committed all of your changes, and then type something like

```
git checkout 66e77
```

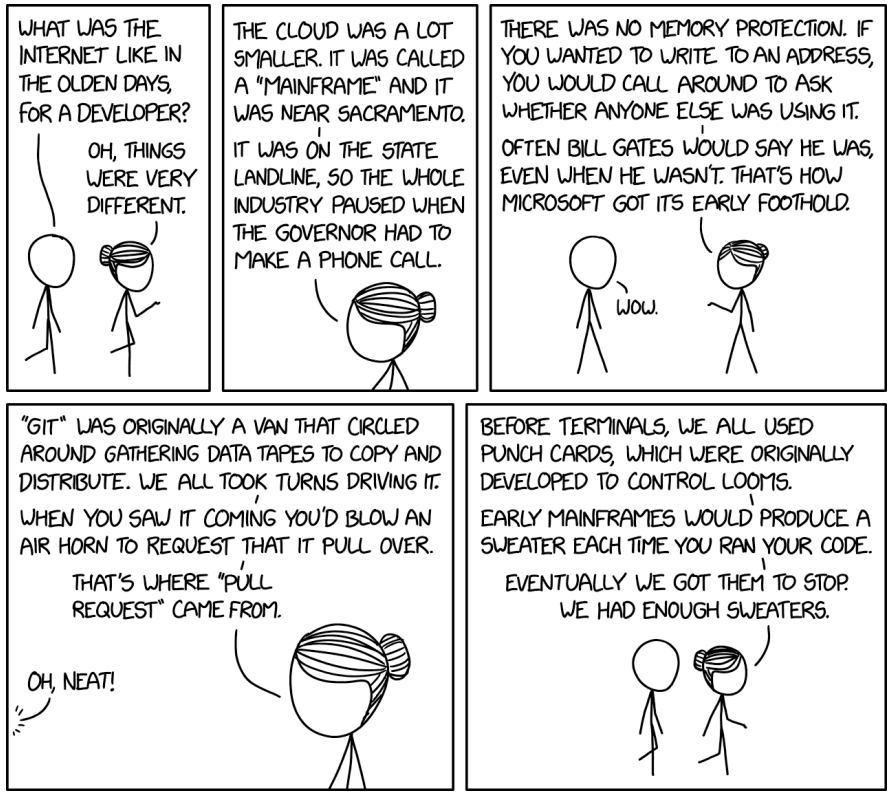
(where the numbers and digits refer to a commit – you can see the hashes for each commit by typing `git log` (or on GitHub).

- Your files will change to the state they were in for the commit you just checked out. You will then be working in a detached HEAD state, and look around and explore.
- Move back to where you were working (e.g. master the branch) to continue developing and editing with:

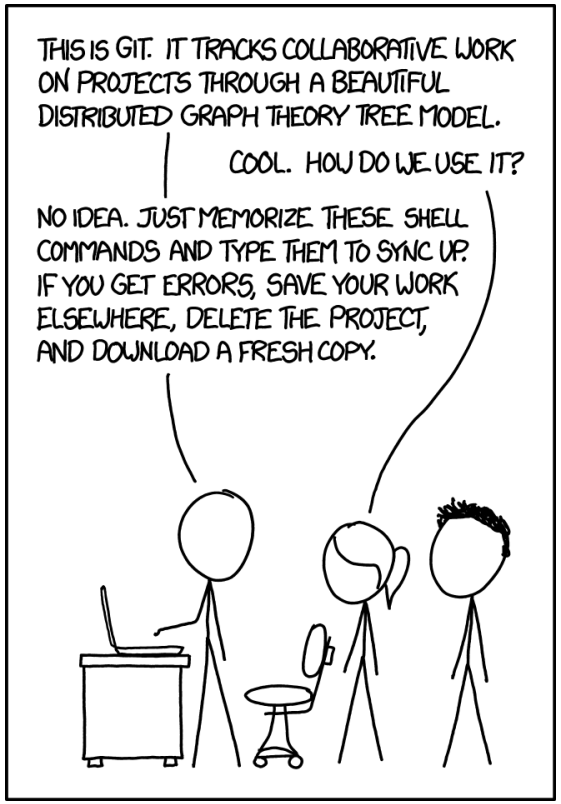
```
git checkout master
```

(CAUTION: `git checkout <filename>` is dangerous).

Follow the instructions in part V to practice the workflow now

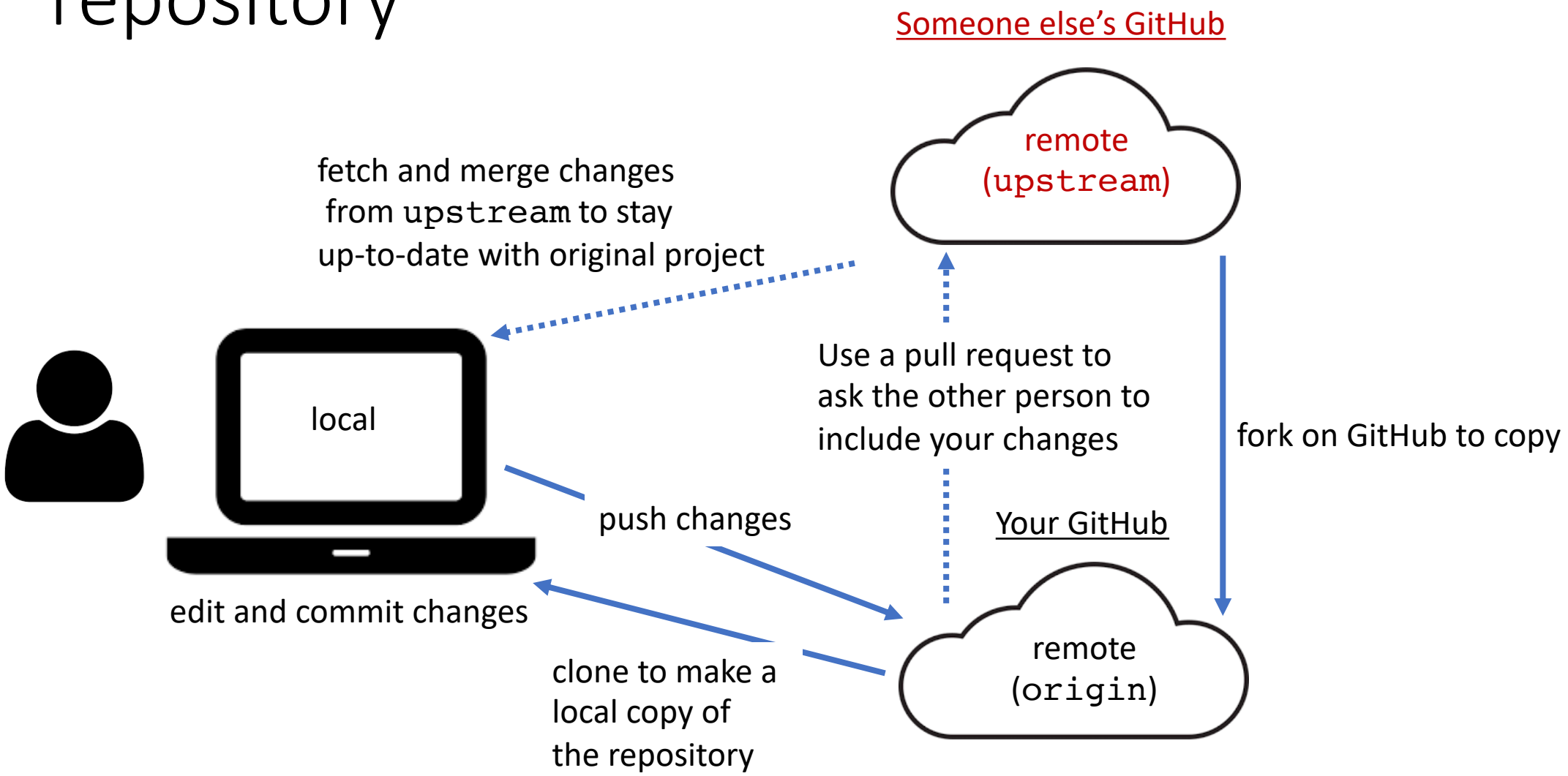


https://xkcd.com/2324/



https://xkcd.com/1597/

Using GitHub forks to build on someone else's repository



“Homework”

- Contribute to https://github.com/karink520/TuftsGitHubSampleToUpdate using the process above as outlined in part VI.

Some other important topics

- Stashing changes
- Undoing changes and reverting
- See what has changed with `git diff`
- Ignoring files you don’t want to track
- Use ssh to connect to GitHub
- GitHub actions (e.g. to automatically run tests or other checks)

(see part VII)

Resources (part VIII)

- Searches and StackOverflow
- DangitGit!? https://dangitgit.com/
- GitHub Guides https://guides.github.com/introduction/git-handbook/
- Browser game for learning about Git branching https://learngitbranching.js.org/
- "A minimal tutorial": https://kbroman.org/github_tutorial
- Atlassian tutorials https://www.atlassian.com/git/tutorials

  and Git "cheat-sheet" https://www.atlassian.com/git/tutorials/atlassian-git-cheatsheet)
- MIT CSAIL's "Missing Semester" lesson on Git:

https://missing.csail.mit.edu/2020/version-control/

- Renaming the default branch: https://dev.to/rhymu8354/git-renaming-the-master-branch-137b

Office hours:

Questions?