Git & GitHub

Introduction

Git

- Git is a popular DVCS
- Initially, written by Linus Torvalds
- Industry standard
- Open-source

Git

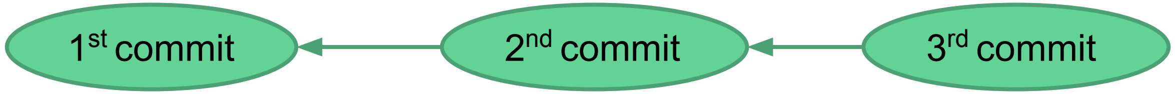
- Different from SVN (and similar systems)
    - More complex and powerful
- No need to be overwhelmed
    - Get the basic concepts
    - Learn new features as new needs arise
    - Don’t get scared by terminology

Let’s start with the basics …

Git Commits = Snapshots

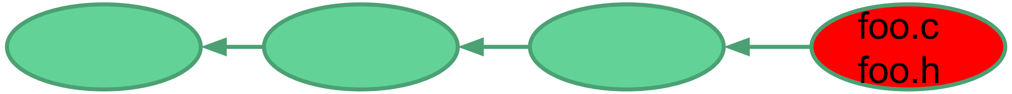
- Need to think differently about git
    - Forget about revisions to individual files
- Each *commit* is a snapshot of the full directory tree
    - That's the abstraction. Under the hood, Git stores differences (to optimize space usage)
- Git repo (repository) is a graph of commits
    - A version of the code is a node in the graph
    - History is described by paths in the graph

Repo as graph of commits



Each *commit* represents a version of the code.
A path of commits represents its history.

Repo as graph of commits



A new commit (i.e. snapshot) is created and added to the graph.

Commit changes to the repo ….

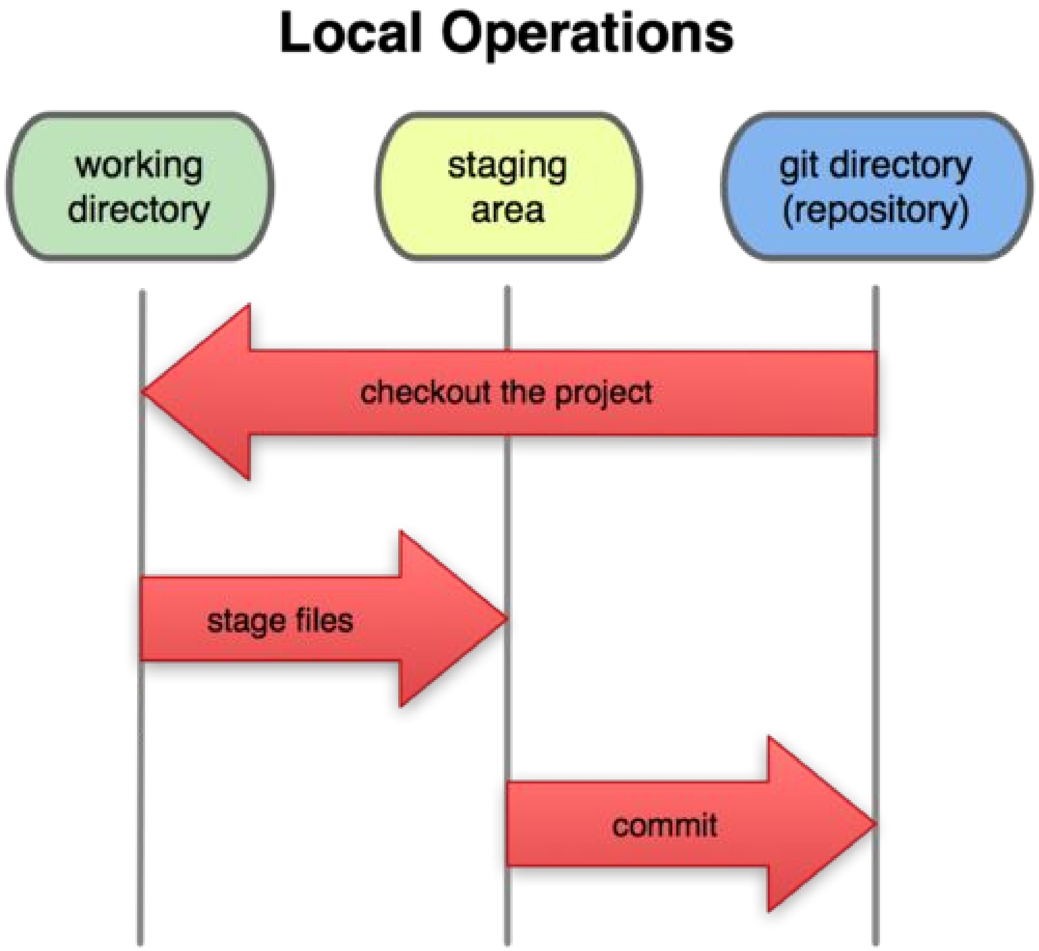
Working Locally

1. Working directory

   The actual files on your machine.
2. *Staging Area* (aka *index*)

   Intermediate storage for code changes.
3. Repository (aka *history*)

   The graph of commits.


Local Operations
working directory
staging area
git directory (repository)
checkout the project
stage files
commit

Why the extra step?

- The extra step (i.e., *staging*, before committing) gives us more granularity
    - Choose which changes you want to commit
      E.g.: Do not commit temporary changes made only for the purpose of local testing
    - When saving changes, can break them into multiple commits.
      Each commit with its own concise, meaningful message.
    - Goal: Work in a traceable manner

Basic Git commands

- `init`
- `status`
- `add`
- `commit`
- `log`

Think Outside Of The (One) Box

- The commands we just saw are local
  - That is, they are done entirely on your machine
- A more common scenario involves remote repos:
  - ***Clone*** some remote repo to your machine
  - ***Commit*** changes locally
  - When ready, ***push*** changes from your machine to the remote repo

Q: Where do we store remote repositories?

GitHub

- GitHub is a hosting service for Git repos
- Website, social layer and a rich toolset on top of Git
- Free for public projects
- Industry standard for OSS development
- Other options are Bitbucket, gitLab, private servers

Basic remote commands

Let’s see a few more basic Git commands …

- **`clone`**
- **`pull`**
- **`push`**

Commit ≠ Push

- It is important to understand the distinction between commit and push
  - `git commit` creates a node in the commit graph of your local repo
  - `git push` creates node(s) in the commit graphs of some remote repo
- Allows for more granularity
  - Make small frequent commits while working locally on your code
  - When your work is ready (and tested) push all commits to a remote repo

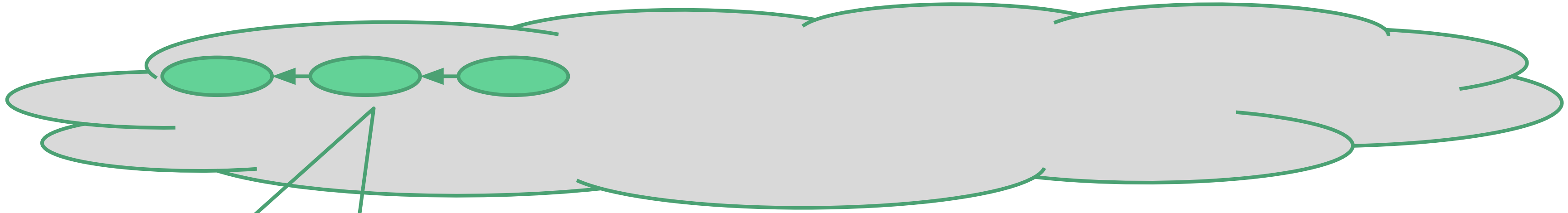
GitHub, Fork

- Forking = Cloning directly on GitHub
  - No need to clone anything to your local machine (until you want to start working locally)
  - The fork is a separate GitHub repo, associated with your GitHub account (i.e., you can read/write to it)
- More than just a clone
  - The fork inherits access permissions
  - Forks create an “implicit social layer”
  - And more …

How to do real work?

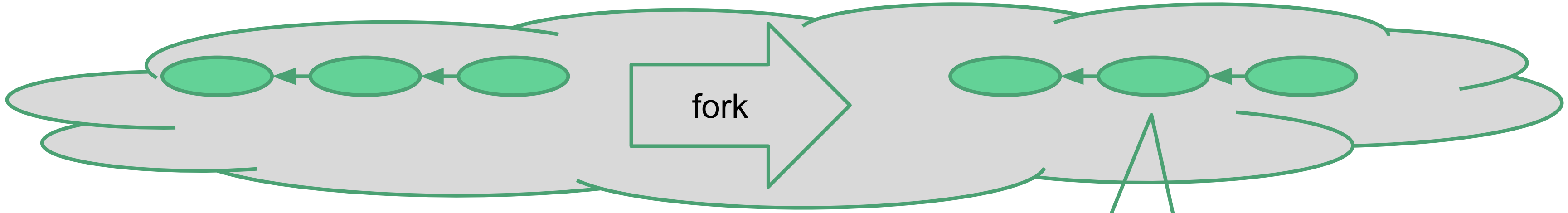
- How do you contribute work to a repo you have no write permission for?
- Create a pull request, and let someone who has write permission merge
  - This is how open-source software works
  - This is how you will submit your individual coding assignments in this course

Common Workflow



Public repo, hosted on GitHub.
Readable, but not writable, by you.

Common Workflow

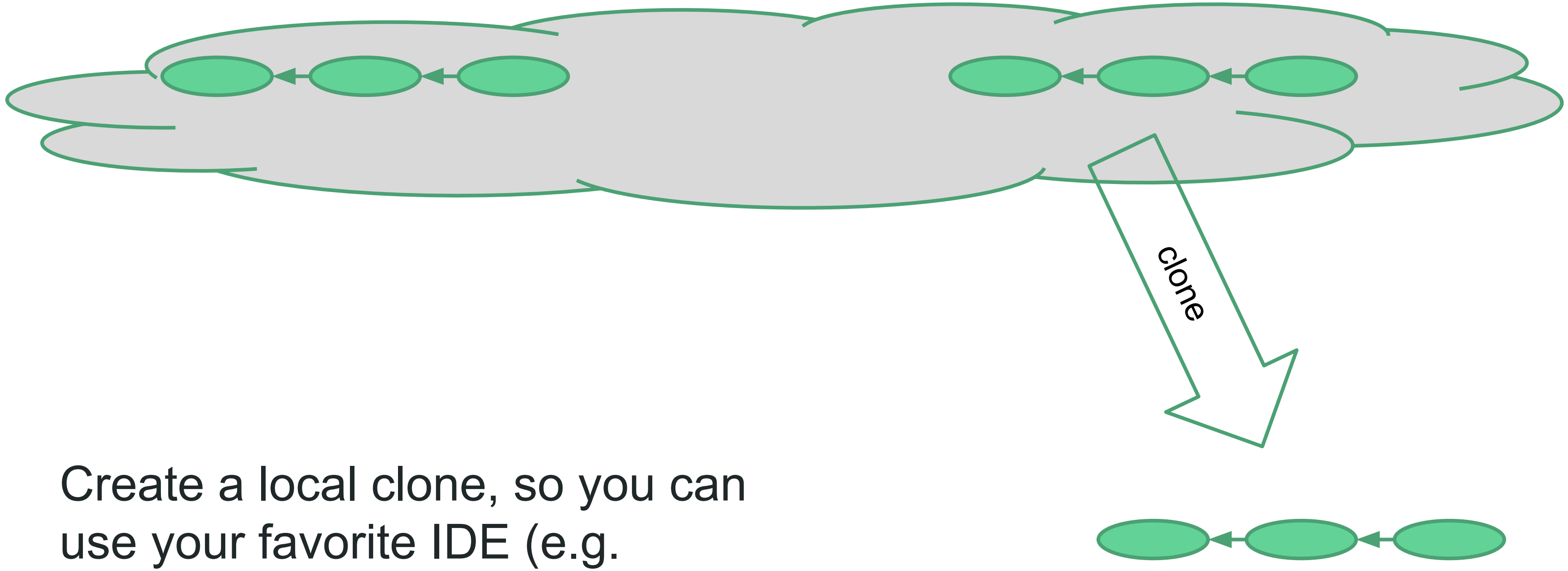


The fork, also on github, is readable and writable by you.

However, you can’t run/test your java code up on GitHub...

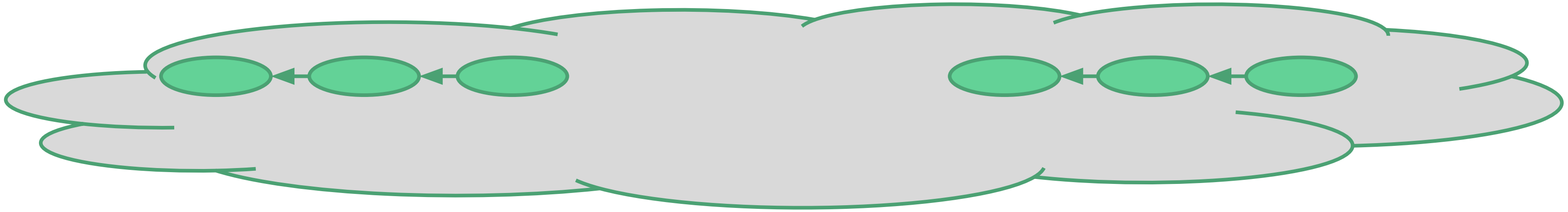
How can you contribute changes?

Common Workflow

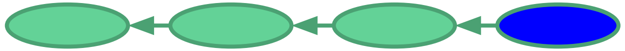


Create a local clone, so you can use your favorite IDE (e.g. Eclipse), run the code to test your changes, etc.

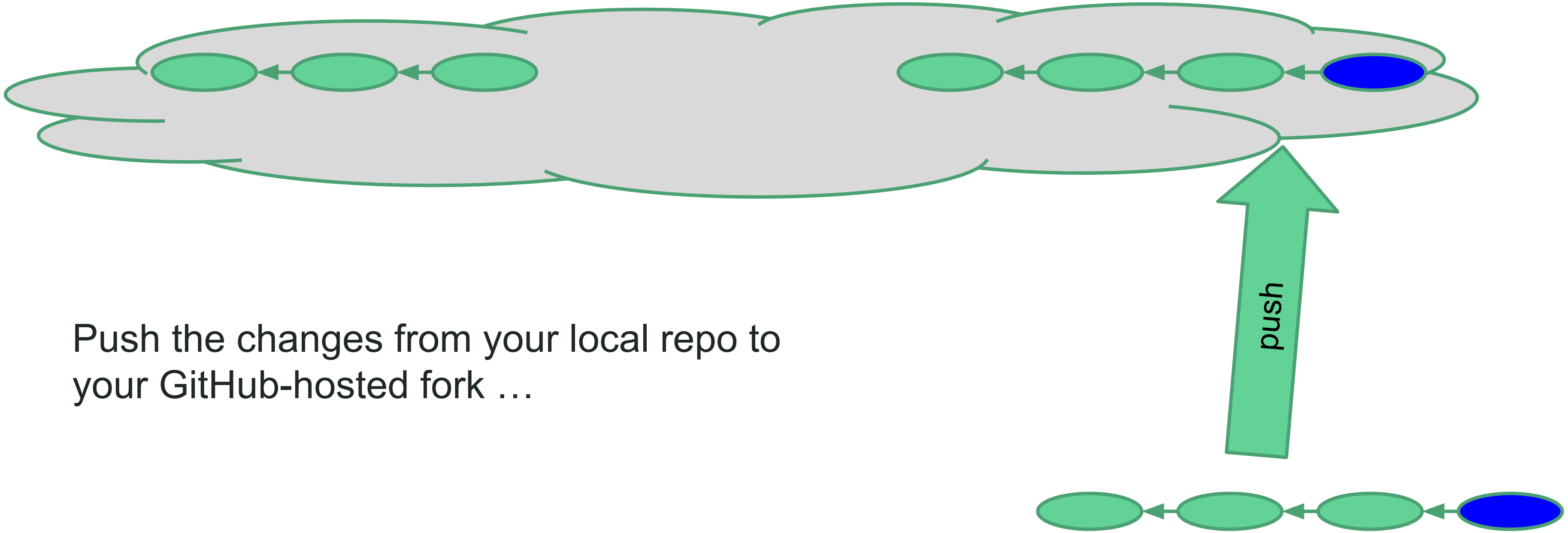
Common Workflow



Commit some changes (locally) ...

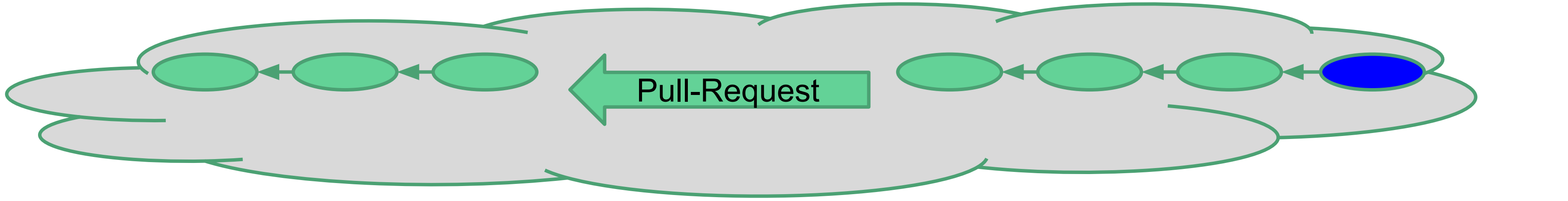


Common Workflow

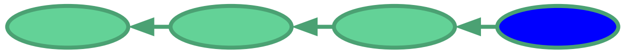


Push the changes from your local repo to your GitHub-hosted fork …

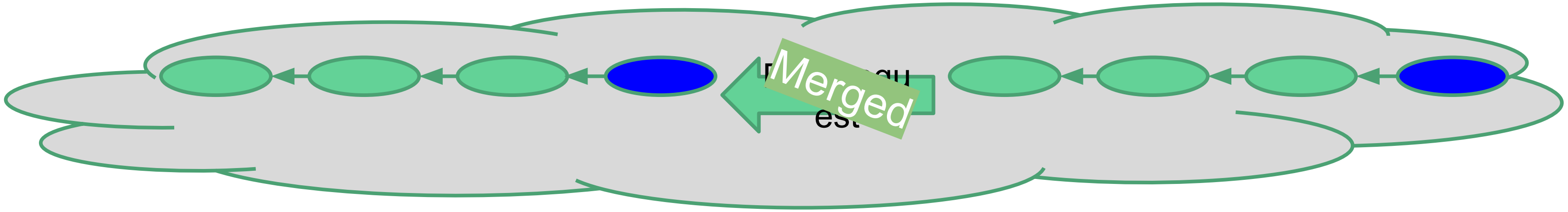
Common Workflow



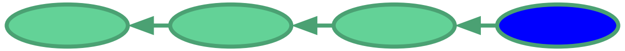
Create a *pull-request* …



Common Workflow



One of the original project's maintainers *merges your pull-request*.



GitHub - Pull Request

- Request project maintainer(s) to **pull changes from your fork into their repo**
  - An easy way to follow the Linux project’s workflow (emailing patch files)
  - Discussion is part of the pull-request
  - Automatically warn about conflicts
  - Can merge pull-requests directly from GitHub

GitHub - Pull Request

- GitHub didn’t invent pull-requests
  - Git has built-in support
  - GitHub just simplified the process and added convenient web UI on top of it
  - Not everybody likes this simplification
- For CSC301, the simplification works great
  - You will submit your homework by submitting pull-requests

Forking commands

Common workflow

1. **Fork** a repo on GitHub
2. Make a local **clone** of the fork
3. **Commit** changes locally
4. **Push** them to the fork
5. Submit a **pull request** (form the fork to the original repo we forked from)

Resources

Many great resources for learning Git and GitHub

- A Simple Guide
- Training page on GitHub and BitBucket
- An interactive tutorial
- Pro Git - A whole book on Git
- Git for Computer Scientists

That’s it for today

Don’t forget to join the course GitHub organization by Sunday at 10 pm