

Introduction to Git and Github

Computing in Optimization and Statistics: Lecture 1

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Based on Slides By Jackie Baek

MIT

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What is Git and GitHub?

- ▶ **Git** is an open source, *distributed version control system*.
 - ▶ Other version control systems include mercurial, svn, perforce.
 - ▶ Git is modern (2005) and most popular.

What is a version control?

- ▶ The management of changes to documents (in a codebase)
- ▶ Can be used for projects big or small, long-term or short-term.

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- ▶ These "snapshots" are mirrored every developer's computer
- ▶ Every developer has the full history of the codebase mirrored on their computer

What is GitHub?

- ▶ **GitHub** is a service that allows you to host projects using Git.
- ▶ **Git** is a command-line tool
- ▶ **Github** is where developers store their projects as Git repositories

Why should I learn Git?

- ▶ Everyone uses it.
 - ▶ We'll be using it in this class.
- ▶ Backup (in the cloud).
- ▶ Versioning with fine granularity.
- ▶ Collaboration.
 - ▶ But useful even when working by yourself.

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- ▶ Git gives finer granularity: files vs. lines within a file.
- ▶ This granularity is essential when writing code.
- ▶ Easy to:
 - ▶ share code
 - ▶ merge code
 - ▶ retract changes
 - ▶ look at the full history of the code
 - ▶ work in an organized way as an individual and as a group

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- ▶ **branch:** an active line of development.
 - ▶ a single Git repository can track an arbitrary number of branches.
- ▶ **checking out** a branch: updates the files in the working directory to match the version stored in that branch. A way to select which line of development you're working on.
- ▶ **HEAD:** the current branch.

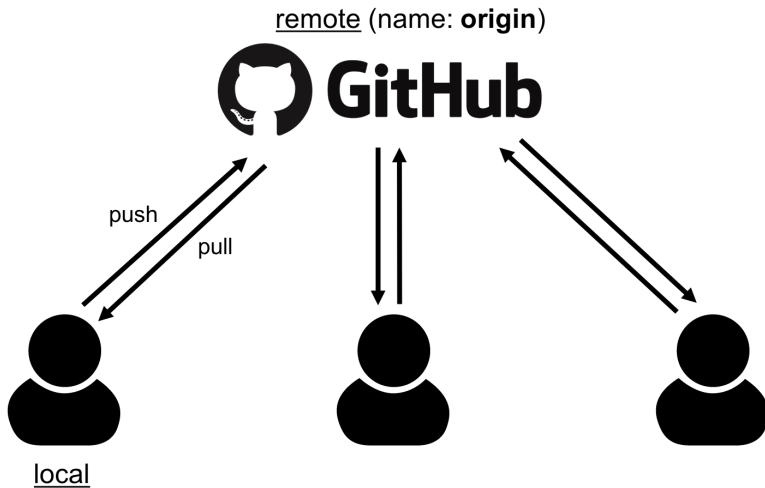
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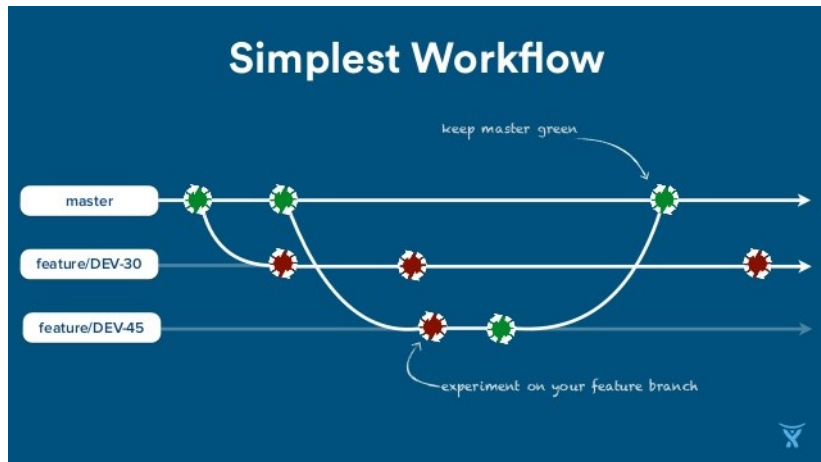
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- ▶ **HEAD:** the current branch.
- ▶ **local:** repository sitting on your local machine.
- ▶ **remote:** repository sitting on a remote machine (e.g. GitHub).
- ▶ **pull:** grab changes from remote (or other branch) to local.
 - ▶ **fetch:** downloads commits and files from a remote repository into your local repo
 - ▶ **merge:** take two lines of development and integrates them into a single branch
 - ▶ pull == fetch+merge
- ▶ **push:** update remote with local changes.

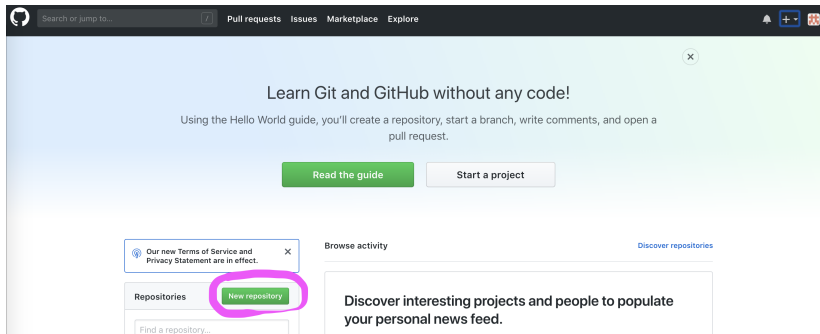
Typical Workflow



Typical Workflow



Creating a new repository



Creating a new repository

Create a new repository

A repository contains all the files for your project, including the revision history.

Owner

 galitLukin ▾

Repository name

playground ✓

Great repository names are short and memorable. Need inspiration? How about **cautious-lamp**.

Description (optional)

playground for Computing in Optimization and Statistics



Public

Anyone can see this repository. You choose who can commit.



Private

You choose who can see and commit to this repository.

☒ **Initialize this repository with a README**

This will let you immediately clone the repository to your computer. Skip this step if you're importing an existing repository.

Add .gitignore: **None** ▾

Add a license: **None** ▾



Create repository

Creating a new repository

The screenshot shows the GitHub interface for a repository named 'playground' by user 'galitLukin'. The repository is described as 'playground for Computing in Optimization and Statistics'. It has 1 commit, 1 branch, 0 releases, and 1 contributor. The 'master' branch is selected. The repository contains a single file, 'README.md', which is the initial commit. The README content includes the title 'playground' and the description 'playground for Computing in Optimization and Statistics'. The interface includes navigation tabs for Code, Issues, Pull requests, Projects, Wiki, Insights, and Settings. The top navigation bar includes a search bar and links to Pull requests, Issues, Marketplace, and Explore. The bottom navigation bar includes icons for navigation and search.

galitLukin / playground

Watch 0 Star 0 Fork 0

Code Issues 0 Pull requests 0 Projects 0 Wiki Insights Settings

playground for Computing in Optimization and Statistics [Edit](#)

[Manage topics](#)

1 commit 1 branch 0 releases 1 contributor

Branch: master New pull request Create new file Upload files Find file Clone or download

galitLukin Initial commit Latest commit 6621f1b 26 seconds from now

README.md Initial commit just now

README.md

playground

playground for Computing in Optimization and Statistics

Cloning a repository

```
$ git clone <URL>
```

- ▶ Go to any repository and copy the URL
- ▶ This will create a new directory with the same name as the repository name and clone the repo there.

```
$ git clone https://github.com/galitLukin/playground
```

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$ git clone https://github.com/galitLukin/playground
```

```
$ cd playground
```

```
$ git status
```

```
$ git config core.editor "nano"
```

Let's make some changes

- ▶ Create a new file called new_file.txt
 - ▶ Add "This is a new file"
- ▶ Modify existing_file.txt
 - ▶ interesting → uninteresting

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$ cd playground
$ nano new_file.txt
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  interesting -> uninteresting
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See what changed and your branch's status

```
$ git diff
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- ▶ Shows what changed since the last commit

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- ▶ See which changes have been staged, which haven't, and which files aren't being tracked by Git

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```
$ git log
```

- ▶ Lists the commits made in that repository in reverse chronological order

File states

- ▶ Git will notice any file in the directory of the repository.

File states

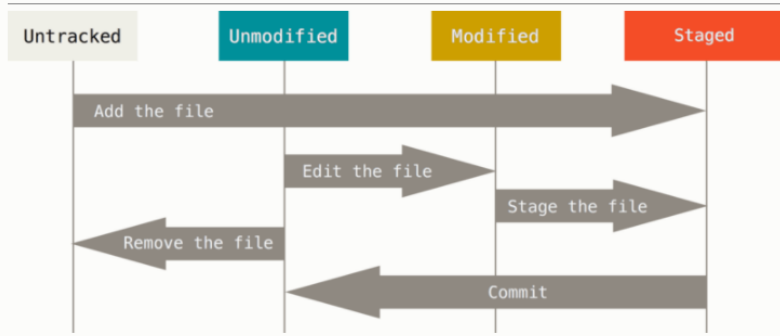
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 1. **Unmodified:** No changes since the last commit.
 2. **Modified:** Changes have been made to it since the last commit.
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Staging files

```
$ git add <filepath>
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- ▶ Any *untracked* or *modified* file that is added will be *staged*.
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```
$ git add new_file.txt  
$ git add existing_file.txt
```

Use Git add to either:

- ▶ Add a new file to the repository (untracked → staged)
- ▶ Record a change that you made to an existing file (modified → staged)

Git commit

```
$ git commit -m <commit message>
```

- ▶ This creates a new snapshot of our repository with all changes that we have staged.

Git commit

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- ▶ This creates a new snapshot of our repository with all changes that we have staged.

```
$ git commit -m "Added file and modified existing."
```

- ▶ This new snapshot (commit) is saved in our local repository.
- ▶ This *does not* push our changes to the remote repository (GitHub).

Git commit

```
$ git commit -a -m "Added file and modified existing."
```

- ▶ The `-a` tells the command to automatically stage files that have been modified and deleted
- ▶ New files that Git has not recognized are not affected.

```
$ git add .  
$ git commit -a -m "Added file and modified existing."
```

Interacting with remote

```
$ git push
```

- ▶ Update remote repository with local commits.

```
$ git pull
```

- ▶ Updates local repository with remote commits.

Merging

- ▶ When we 'git pull', Git fetches the remote repository from GitHub and *merges* the new remote updates with our local repository.
- ▶ Even if both remote and local modified the same file, Git is *usually* able to correctly merge the two copies.
- ▶ We get a **merge conflict** if both parties modified the *same parts of the same file*.

Merging

```
$ git pull
```

```
remote: Enumerating objects: 5, done.
```

```
remote: Counting objects: 100% (5/5), done.
```

```
remote: Compressing objects: 100% (2/2), done.
```

```
remote: Total 3 (delta 0), reused 0 (delta 0), pack-reused 0
```

```
Unpacking objects: 100% (3/3), done.
```

```
From https://github.com/galitLukin/playground
```

```
8bfcca0..b3207b5 master -> origin/master
```

```
Auto-merging existing_file.txt
```

```
CONFLICT (content): Merge conflict in existing_file.txt
```

```
Automatic merge failed; fix conflicts and then commit the result
```

Resolving Merge Conflicts

```
$ cat existing_file.txt
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```
<<<<<< HEAD
```

```
Did a different first edit!
```

```
=====
```

```
Did the first edit!
```

```
>>>>>> b3207b5d9cddd22934ccd2fed0a6cc16eefdab73
```

- ▶ The markers <<<<<<, =====, >>>>>> indicate the conflict.
- ▶ The section in between the first two markers is your local change (HEAD), while the bottom section indicates the update from remote.
- ▶ Must resolve conflict manually by editing the file, making sure to get rid of the conflict markers.

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```
$ nano existing_file.txt
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Resolving Merge Conflicts

- ▶ After resolving conflicts, we must add the file for staging and commit again.
- ▶ Git will automatically create a commit message: "Merge branch 'master' of <https://github.com/galitLukin/playground>"

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```
$ git add existing_file.txt  
$ git commit
```

- ▶ At this point, we can push.

Typical Workflow

Fetch remote changes.

```
$ git pull
```

(If there are any conflicts, resolve them and commit.

```
$ git add <conflicted files>
```

```
$ git commit )
```

Make changes. Stage modified and new files.

```
$ git add <files>
```

Commit changes.

```
$ git commit -m "this is my commit message"
```

(If editing took a while...

```
$ git pull
```

And if needed, resolve merge conflicts)

Push local changes to remote.

```
$ git push
```

Useful tips

- ▶ Google is your friend. (e.g. "How to undo merge in Git".)
- ▶ Almost anything can be undone, as long as it is committed.
- ▶ Commit often, pull often.
- ▶ Might take a while to get used to, but is useful knowledge that will improve productivity and collaboration.

Thank you!