Git + GitHub

An Introduction

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1. Git - Basics

What is Git?

- Version control software
- Used everywhere in programming related fields
- **Local** program, independent of GitHub, GitLab, BitBucket etc.

Why use Git?

- Keep track of changes you make
- Go back to old versions of your code
- Switch between different versions of your code:
  - A "main" version to use everyday
  - A "development" version where you work on a new feature
- Synchronise code between locations
- Collaborate with others

Installation and setup

- Download and run installer: https://git-scm.com/downloads
- Open the terminal (e.g. on windows `cmd.exe`)
- Set username, email:

```
git config --global user.name "YOUR NAME"
git config --global user.email YOUR.NAME@example.com
```

How to use Git?

- **C**ommand **L**ine **I**nterface (CLI)

```
git help
git status
git commit -am "Bla bla bla"
```

- GitHub Desktop
- Editor integrations
  - VS Code, RStudio, ...

Git repositories

- Git Repo = Root folder of the project
- By default, everything in the folder is part of the repo
- Can be controlled using a `.gitignore` file
- Git internals are in the (hidden) folder `.git`

Initializing a repository

- Navigate to your project folder, open a terminal **in this folder**
  - (Example how-to for windows, mac)
- Initialize the repo:

```
git init
```

- Tell git to track all files that are currently (`.`) in the folder:

```
git add .
```

- Commit the added files

```
git commit -m "Initial Commit"
```

- Git now has a copy of this initial version that you can always come back to!

Basic workflow

- Make changes (create/edit/delete files)
- Check your changes

```
git status
```

- Stage your changes

```
git add .
```

- Commit your changes

```
git commit -m "This is a meaningful message"
```

- Git has now saved a copy of this second version!

What is going on?!

- Current state of the repo:

```
git status
```

- List of past commits:

```
git log
git log --graph --all
```

- Get help:

```
git help
git help tutorial
```

  - Help for an individual command:

```
git commit -h          # Short help
git commit --help      # Detailed help
```

Don't commit everything at once!

- Stage only some of your changes

```
git add file1.txt file2.txt
```

- Revert changes you don't want to keep

```
git checkout file3.txt          # Irreversible!!!
git reset --hard                # Irreversible!!!
```

- Create a file named ".gitignore" to do this automatically

```
# <- Comments start with "#"

file4.txt       #     tell git to ignore "file4.txt"
*.temp          # *   matches anything in a filename
**/notes.txt    # **  matches any (sub)directory
!trackMe.temp   # !   reverses previous gitignore-matches
```

Going back

- Reverting uncommitted changes

```
git reset --hard        # Irreversible!!!
```

- Reverting committed changes

```
git reset HEAD~1        # Go back 1 commit
git reset <COMMIT>      # Go back to <COMMIT>
```

- Checking out past commits

```
git checkout <COMMIT>   # View all files from <COMMIT>
git switch -            # Go back to main branch
```

- Checking out individual files

```
git checkout HEAD~1 file1.txt   # copy file1.txt from previous commit
```

2. GitHub

What is GitHub?

- A website: https://github.com/
- A remote location for code tracked by git
  - Share code with others
  - Collaborate on projects
  - Use as personal mirror/cloud
- Similar to e.g. GitLab, Bitbucket, ...

Create an Account

- Go to https://github.com/signup
- Fill in your information
- You're ready to go!

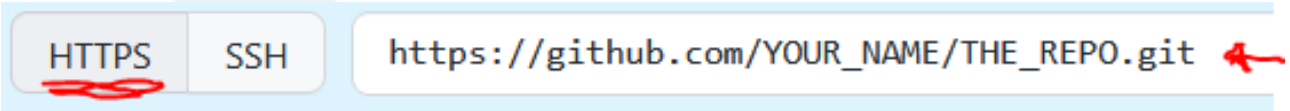
Repositories on GitHub

- Same concept as git repositories on your computer
- Accessible as website or through git
- Private repositories:
  - Only you can see and edit
  - (And collaborators you add)
- Public repositories:
  - Everyone can see
  - Only you can edit
  - (And collaborators you add)

Creating a repository

- Sign in to GitHub and click 

- Specify a name
- Select "public" or "private"
- Confirm!
- Select `HTTPS` and copy the link of the repo:



Pushing a local repo to GitHub

- Open the terminal, navigate to your repository
- Tell git about your GitHub repo

```
git remote add origin https://github.com/YOUR_NAME/THE_REPO.git
```

- Push your changes to GitHub

```
git push -u origin master     # The first time you push something

# (At this point you might be asked to sign in to GitHub!)

git push                      # Subsequent pushes
```

- Check what is going on

```
git status           # Now includes information about the remote
git remote -v        # Shows the connected GitHub repo
```

Cloning a remote repo

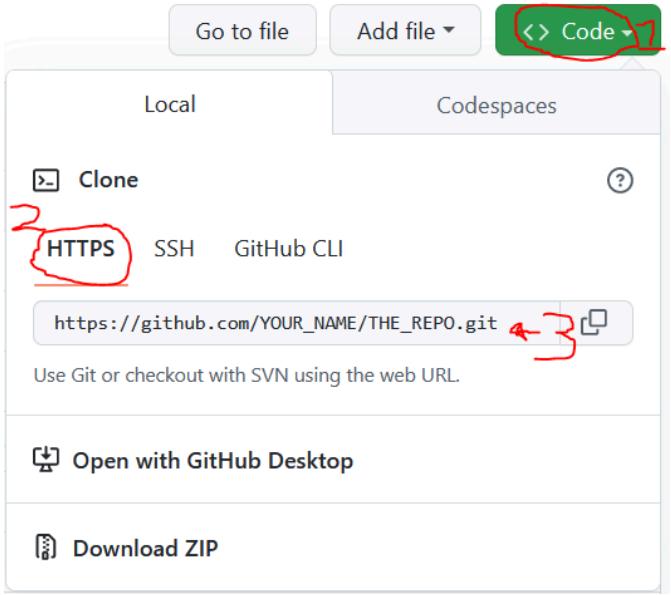
- Get the URL of the repo -->
- Open the terminal in the desired parent (!) directory
- Tell git to clone the repo

```
git clone https://github.com/YOUR_NAME/THE_REPO.git
```

- Go into the repo, check things out

```
cd THE_REPO       # (cd = "Change Directory")

git status
git remote -v
```



Simple Git/GitHub workflow

- Pull changes from GitHub

```
git pull
```

- Work on the project (**locally**)
- Commit your changes (**locally**)

```
git status
git add .
git commit -m "This is a meaningful commit message"
```

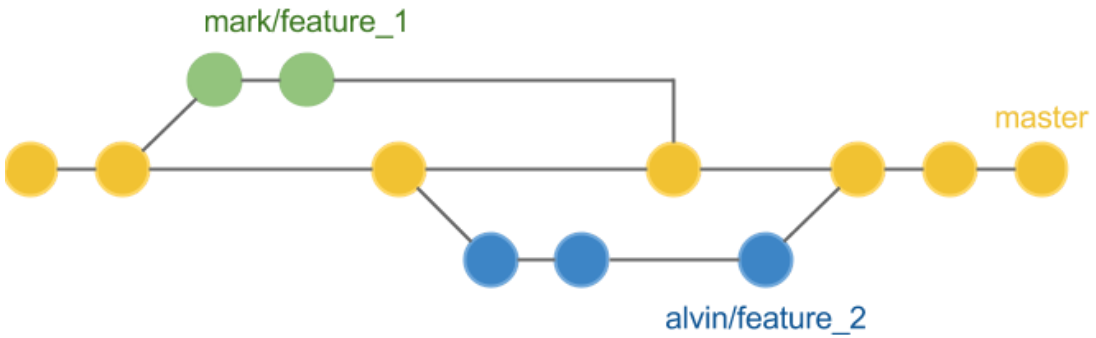
- Push your changes to GitHub

```
git push
```

3. Git - Branches

Why Branches?

- For example, collaborating on a project, you might want:
  - One main "working version" of the code
  - A "personal copy" to work on a new feature
  - Another "personal copy" for someone else




```
git branch <FEATURE BRANCH>    # Create a new branch
                               # ...do work...
git merge <FEATURE BRANCH>     # merge the branch
```

Creating branches

- Create a new branch

```
git branch myFeature    # Creates a branch called "myFeature"
git branch              # Shows that there is a new branch
```

- Switch to the branch

```
git switch myFeature    # Switches to branch "myFeature"
```

- Commit on the branch

```
git add .
git commit -m "Implementing my feature"
```

- See what's going on

```
git status                # Includes the name of the current branch
git branch -v             # Shows a bit more info about all branches
git log --graph --all     # Shows branches "graphically"
```

Merging branches

- How to get changes from `myFeature` to `master` / `main`?
- Switch back to `master` branch

```
git switch master
```

- Merge changes from `myFeature`

```
git merge myFeature
```

- Show result

```
git log --graph --all
```

- (Delete feature branch)

```
git branch -d myFeature
```

Side-note: Remote tracking branches

- Remote repositories (e.g. GitHub) are tracked by branches

```
git branch -a               # "list both remote-tracking and local branches"
```

- Pulling from a repo (`git pull`) is the same as

```
git fetch origin            # Retrieve updates from GitHub
git merge origin/master     # Merge updates into the local branch
```

Merge conflicts 😱

- Happen if the main branch and feature branch have **conflicting** changes
- Indicated in the affected files

```
<<<<<<< HEAD
1, 2, 3
=======
x, y, z
>>>>>>> myFeature
```

- To abort, run

```
git merge --abort
```

- To fix, resolve the conflicts (removing the `<<<<<`, `>>>>>`, etc.), then

```
git add .                # Stage all files
git commit --no-edit     # Commit with the default merge-commit message
```

- (Even easier using tools in the editor or on GitHub)

Closing remarks

Other things to look into

- Pull Requests, Code reviews, Issues, Actions etc. on GitHub
- Squash & merge
- GitHub CLI
- Quickly "stash" away changes: `git stash`
- Find out who wrote what: `git blame`
- Editor integrations, IDEs, GUIs
  - GitHub desktop
  - vscode
  - ...

General tips

- We just scratched the surface
- Don't hesitate to google how to do things!
- Get familiar with the basic CLI commands
  - Even if you use an IDE/GUI
- Make small commits, commit often
- Use branches for complex changes

The End