Git

R11922109 趙儁同

Preparation

Environment

- Linux or MAC OS is strongly recommended.
- Windows
  - use git bash / bash / powershell.
  - Install linux (ubuntu is suggested) on virtual machine or dual system.
  - connect to CSIE workstation.
- connect to CSIE workstation
  - ssh [your school id]@linux[machine number].csie.(org/ntu.edu.tw)
    - e.g. ssh r11922109@linux10.csie.ntu.edu.tw

Useful Terminal Command (Linux/MacOS)

command	description	example
cd	Changes the directory of the command line path.	cd "path/to/directory/"
ls	Lists the contents of a directory.	ls "path/to/directory/"
cp	copy file	cp "filename" "newfilename"
mv	move a file	mv "filename" "path/to/new/file/location"
mv	rename a file	mv "path/to/filename" "path/to/newfilename"
rm	remove a file	rm “path/to/filename”
mkdir	create a directory	mkdir "path/to/new/directory"

Install Git on Linux (ubuntu)

- sudo apt update
- sudo apt install git

Install vim on Linux (ubuntu)

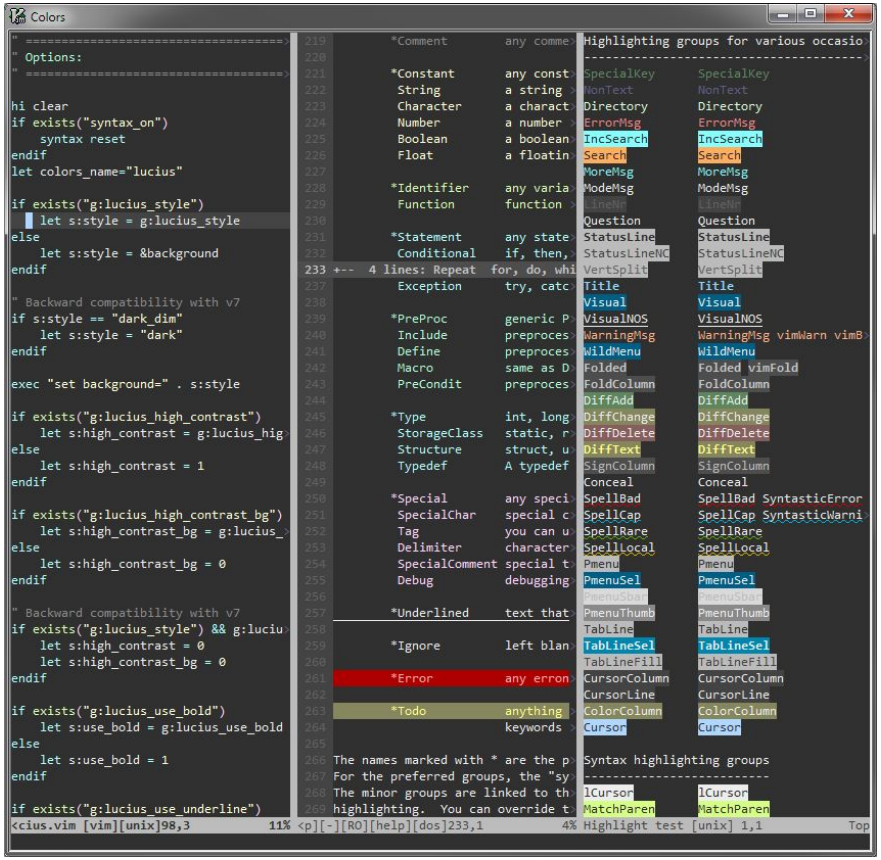
- sudo apt update
- sudo apt install vim

Suggest Editor -- Vim

- Common commands
  - “i”: insert (enter editing mode)
  - “o”: insert on the new line (enter editing mode)
  - “\esc”: escape from editing mode
  - “:w”: write to file
  - “:q”: quit vim
  - “:wq”: write and quit
  - “[number] yy”: copy [number] lines
  - “p”: paste copied lines on the current line
  - “[number] dd”: delete [number] lines
  - “v + [→, ←]”: underline messages
  - “u”: undo (need to set up undo buffer in vimrc)
  - “\ctrl r”: redo

Suggest Editor -- Vim

- Make vim more beautiful
  - Tutorial
  - Color Sceme
    - some color sceme lucius dark



https://camo.githubusercontent.com/11a2b8c9e2544000911b0f795e9c4e3175a9c757/687474703a2f2f692e696d6775722e636f6d2f65373069392e706e67

CSIE resources

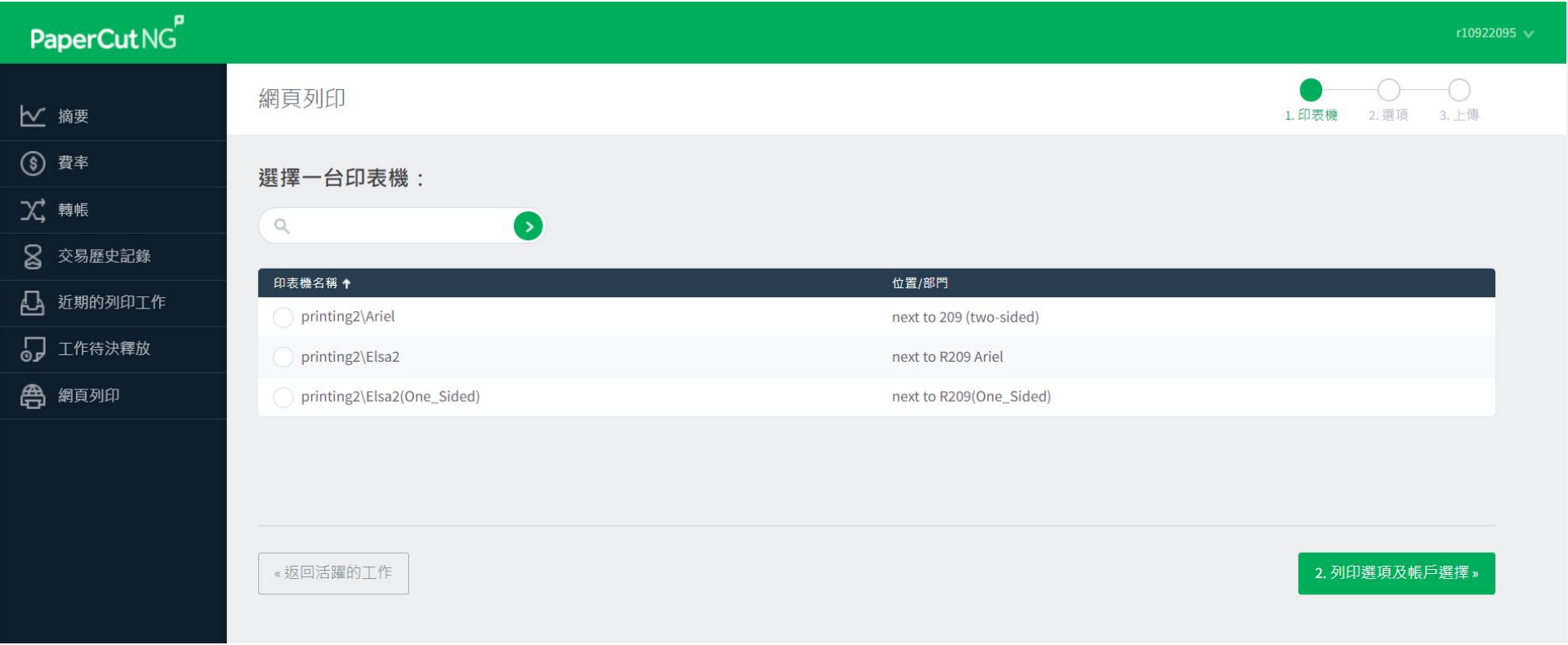
Printer

- Printing quota:
  - Each CSIE student has 500 dollars for printing every semester (can't be cumulated).
  - NTU also gives each student 100 dollars for printing every semester (can be cumulated).

- Therefore, you can print your HW without money.

CSIE printer introduction

- Log in https://printing.csie.ntu.edu.tw/user .
  Use your csie workstation account and password. You should received an email containing your workstation account and password after the enrollment.



The printer is next to 209.

Workstation

- csie workstation:
  ssh [your school id]@linux[1-10].csie.ntu.edu.tw

```
ubuntu  ~  ssh r11922109@linux10.csie.ntu.edu.tw
r11922109@linux10.csie.ntu.edu.tw's password:

#########################################################
#        Public Domain Workstation Lab (R217).          #
#########################################################
#   UNIX Login Service:                                 #
#     FreeBSD - bsd1                                    #
#     Linux   - linux1, linux2, linux3, ... linux15     #
#             - [NEW!] meow1, meow2 (with GPU)          #
#             - oasis1, oasis2, oasis3 (non-computing)  #
#     Run `ws-status` for current machine status        #
#                                                       #
#   Office open time:                                   #
#     08:30 ~ 17:00, otherwise please use accesscards   #
#                                                       #
#   Contact information:                                #
#     Web:    https://wslab.csie.ntu.edu.tw/            #
#     E-Mail (linux): ta217@csie.ntu.edu.tw             #
#     E-Mail (bsd)  : lantw44@csie.ntu.edu.tw           #
#                                                       #
########################### Last Update: Sep  26 2018 ###
Last login: Fri Oct 28 12:01:49 2022 from 140.112.29.128
mail: /var/spool/mail/r11922109: No such entry, file or directory
西元2022年10月28日 (週五) 12時02分04秒 CST

r11922109@linux10 [~]
```

- All tips and information are in https://wslab.csie.ntu.edu.tw/

Git Intro

Problem Definition

- Before we complete our codes or maybe homeworks, reports etc, we might
  - modify the contents several times
  - regret and press ctl + z
  - accidentally make situation worse

Benefits of Version Control

- A complete long-term change history of every file
  - records creation and deletion of files as well as edits to their contents
  - includes the author, date and written notes on the purpose of each change
  - able to go back any previous version you desired
- Branching and merging
  - keeps multiple streams of work independent from each other
  - provides the facility to merge works back together
- Traceability
  - being able to annotate each change with a message describing the purpose and intent of the change can help not only with root cause analysis

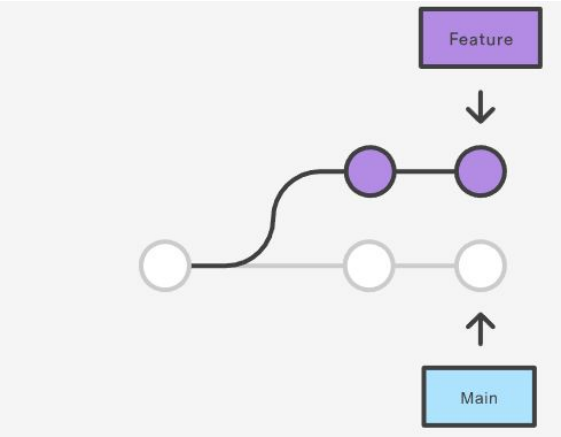
Git

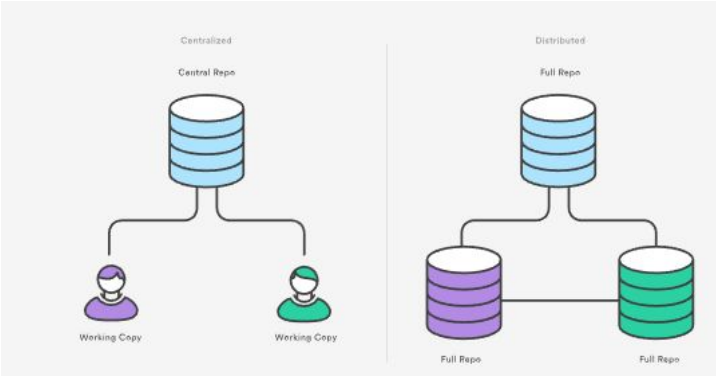
- A distributed version control system
- Free and open source
- Created by Linus Torvalds

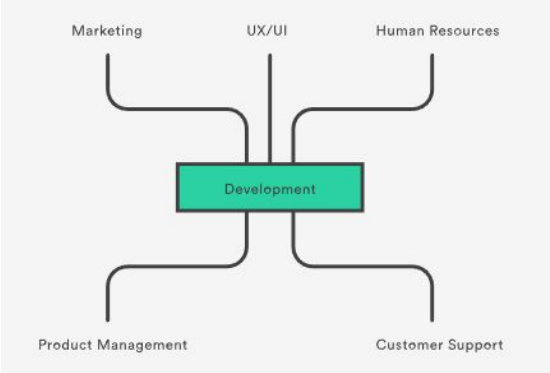
What does Git do

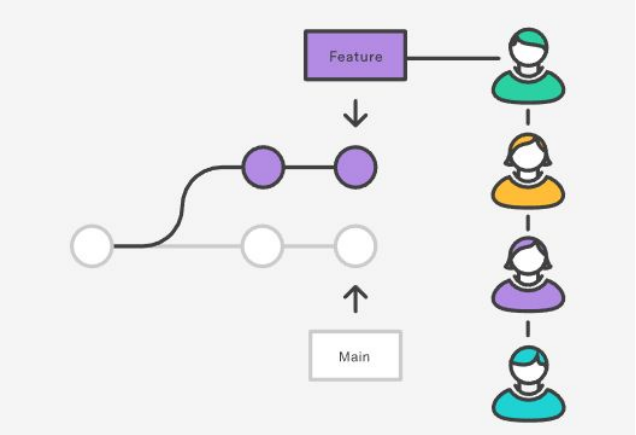
- A distributed version control system
- Free and open source
- Created by Linus Torvalds

More About Git









credits: Atlassian Git Tutorial

Github intro

Github GitHub

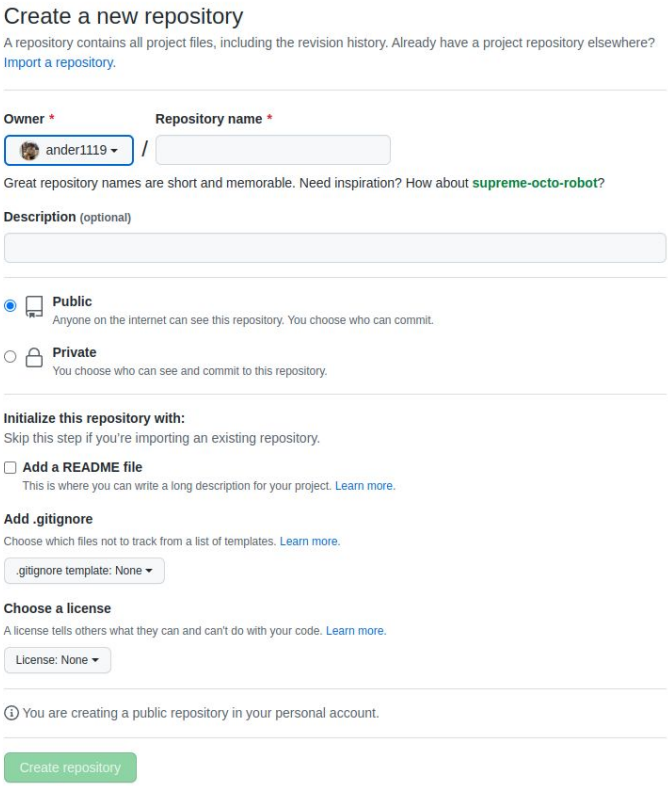
- People use GitHub to build the most advanced technologies in the world
  - It makes tools that use Git
- There's a whole set of tools on GitHub that can help you
- **You put codes on GitHub and show them to the world**
- If you are to become a software engineer,
  then GitHub is one of the basic tools you **MUST learn**.

Github

- Sign up for your account with your school email (or your email)
- If you have time, apply education pack for more functions, e.g.
  - Create private repository
  - Use advanced insight tools
- Note that this account will put all your source codes in the future, please be careful about everything you do on it.
  - For example, the username should be a decent one.
- Due to new policy, password is not allowed anymore
  - Personal access token: https://docs.github.com/en/authentication/keeping-your-account-and-data-secure/creating-a-personal-access-token
  - SSH key: https://ithelp.ithome.com.tw/articles/10205988

Tutorial -- Create Repository

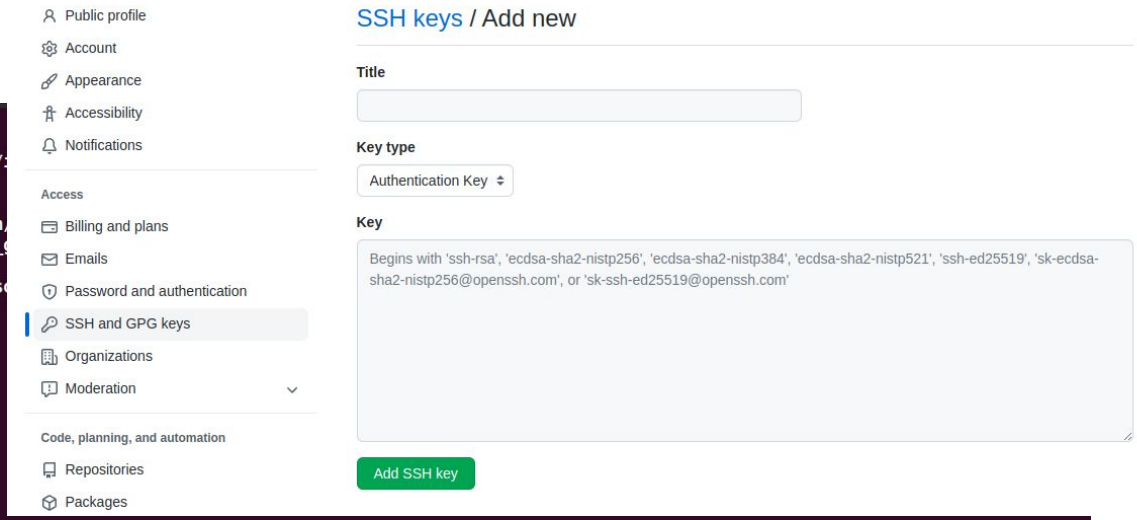
- Each of your project is put in a repository



Tutorial -- Add SSH key

- Create SSH key in local
- Copy public key and paste it onto GitHub SSH key management

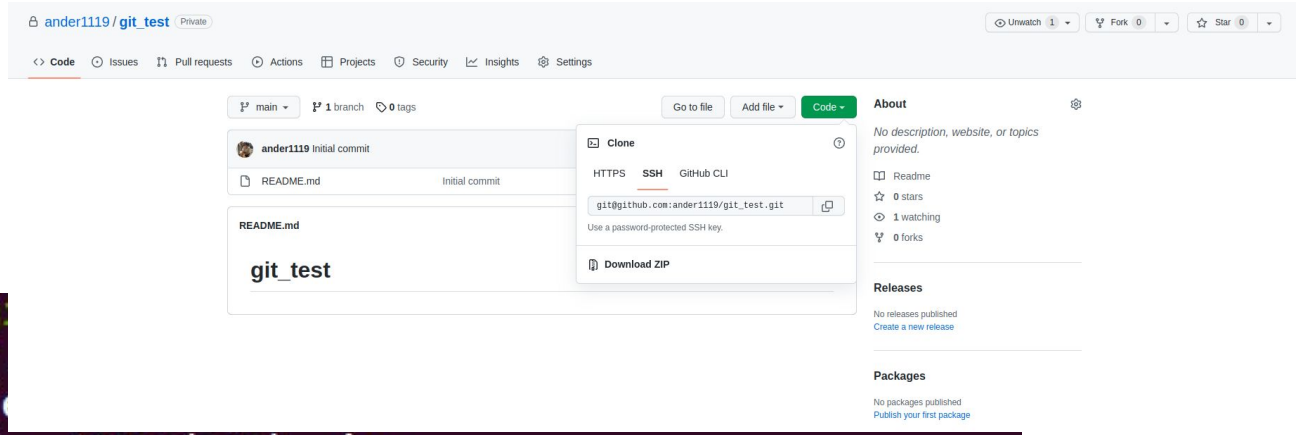
```
ubuntu ~ ssh-keygen
Generating public/private rsa key pair.
Enter file in which to save the key (/home/anderson/.ssh/
Enter passphrase (empty for no passphrase):
Enter same passphrase again:
Your identification has been saved in /home/anderson/.ssh/
Your public key has been saved in /home/anderson/.ssh/id_
The key fingerprint is:
SHA256:oYES29GPc3TI5AmcWSfD0LSiy1eWr5G6FuEUB6ales8 anders
The key's randomart image is:
+---[RSA 3072]----+
|  . .o*%*..      |
|   + B*oB*.      |
|  o = o*=.       |
|   o .=+oo       |
|  . oo.+S        |
|   o +oo o       |
|    o E.o .      |
|     ... o       |
|     .o..        |
+----[SHA256]-----+
```




```
ubuntu ~ cat /home/anderson/.ssh/id_git_test.pub                                ok 13s 14:02:31
ssh-rsa AAAAB3NzaC1yc2EAAAADAQABAAABgQCxcTE8WqKeYtpqJxdafsrUuVryVDeRJYF1BC5mYtSWyEn30zxa3sTshJ2udv0ZtpWfAq+BRFKMD5KuW1SgWVQ8RNxbpPLZfvYtijjQlb8BtwyZVwqrPE2jfTRb49AKlx
eGhP3J0RDziLrqW40zTXPiolpdaNrLBJFMeMIDcfLaQwIOmOI21mWmU66mZtGFuUt1a5/ZgwdpIGaooxpi9zT7ZbUSG6VypkLOwz5B3F4jQi7fUH6M9JampQOJCnq3lUUEqBr8YLuylhVE73Z4Dla5OKYxjiPRRrw0XW3Q
T7LTprGmWBAD85trfH9waQ/IuqZB5gVmVsjJvrVXyeQZCEkss5nU2V5GWFptnJu6fZsHtS5Di2XQmeUOKFJvOddk0YU7nf575dG6vyz5sRRznd+oAD0st4N4QI8e00LdZWWlMoYpNBkj5R41Grw/FpIp2BwodRLnqD+HUL
tJqRtcBtpHXFRb/12lud+1wQnPrGiWtaw6TYKbcVZG0jK/0nAsqWc= anderson@cmlab
```

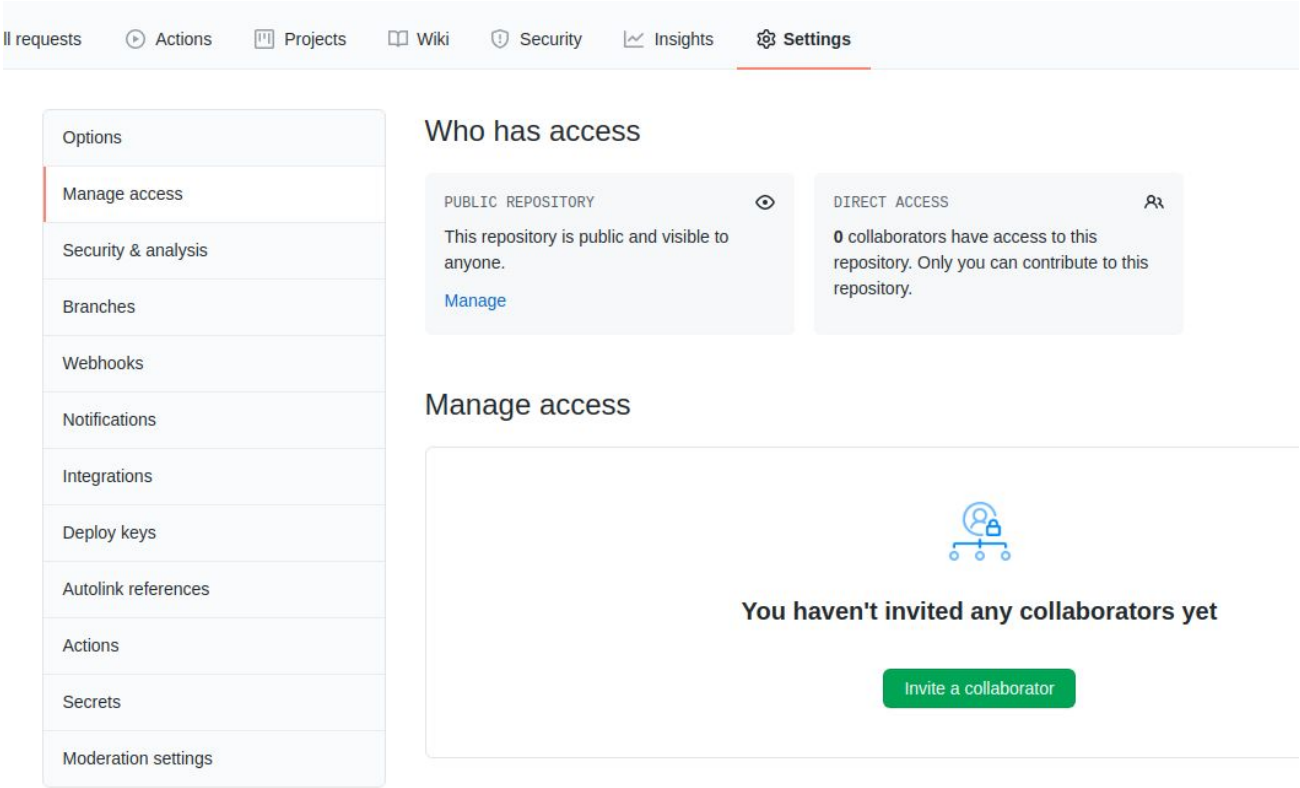
Tutorial -- Clone Repository to Local

- Copy the repo url
- Enter “git clone [url]” command in your local terminal



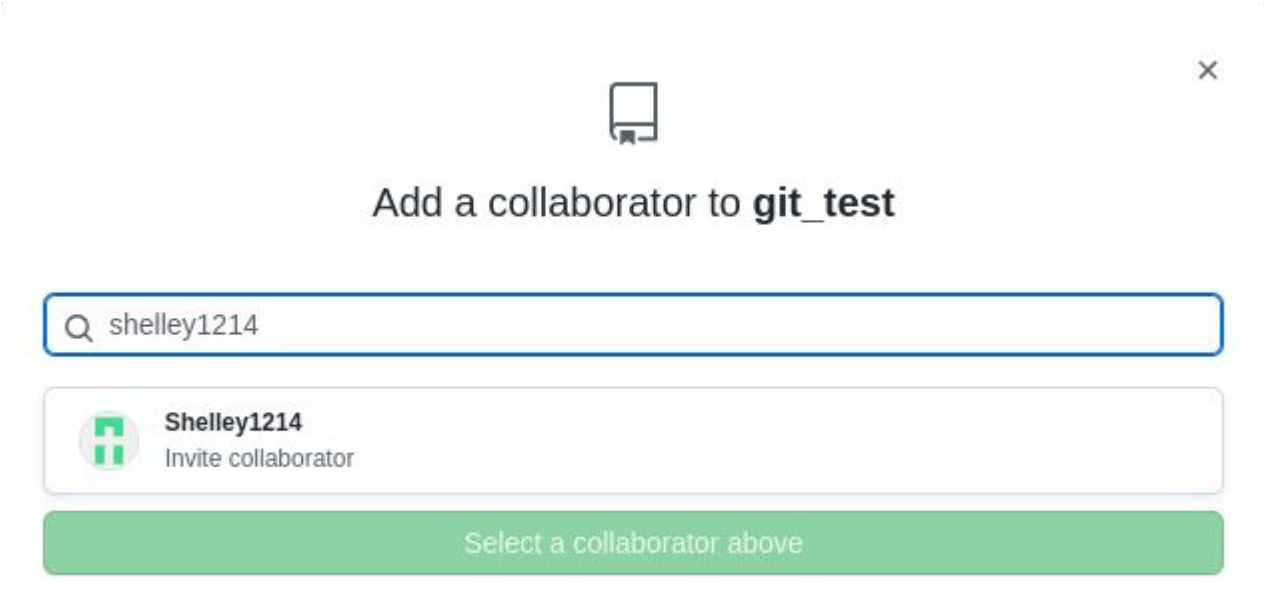

```
ubuntu  ~/Downloads  g
Cloning into 'git_test'
remote: Enumerating obj
remote: Counting objects: 100% (3/3), done.
remote: Total 3 (delta 0), reused 0 (delta 0), pack-reused 0
Receiving objects: 100% (3/3), done.
```

Add my teammate



Invite my teammate

The teammate should received an email.



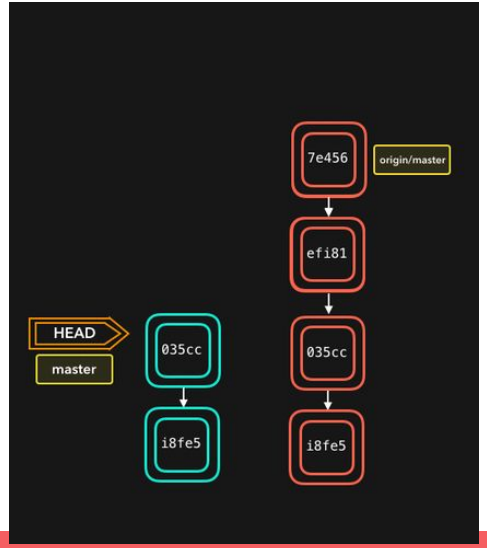
Git

v.s.

GitHub

Local v.s. Remote

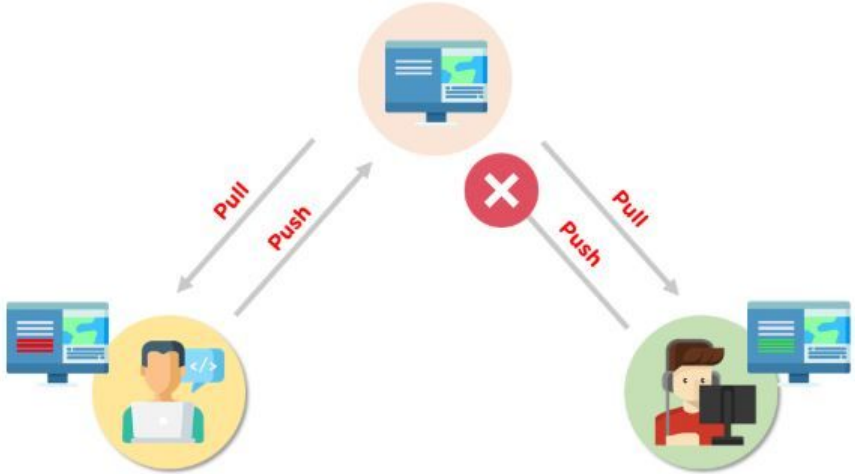
- **Local** Repo is an Git repository that stored on your own computer
  - you can modified and commit changes to it
  - nobody can see the changes until you push them to remote
  - the blue parts
- **Remote** Repo is an Git repository that stored on some remote server (GitHub)
  - used by teams as a central repository
  - everyone pushes changes from his/her local repo to remote repo
  - everyone pulls changes from remote rep to his/her own local repo
  - the orange parts (usually named as origin/[branch name])



credits: CS visualized from **Lydia Hallie**

Local and Remote

- Most of version control related work happens in local repo
  - staging, committing, viewing status or showing log
  - it's your own project, you are the only person putting into
- When it comes to sharing data with teammates, remote repo comes into play
  - deals with conflict of contents
  - how ?



Git Command

What does Git do ? (Reviews)

- Manage projects with **Repositories**
- **Clone** a project to work on a local copy
- Control and track changes with **Staging** and **Commiting**
- **Branch** and **Merge** to allow for work on different parts and versions of a project
- **Pull** the latest version of the project to a local copy
- **Push** local updates to the main project

Tutorial -- Show status

- First create a new file at local, then type **git status** to show the working tree status

```
ubuntu  ~/Downloads/git_test  main ?1  git status
On branch main
Your branch is up to date with 'origin/main'.

Untracked files:
  (use "git add <file>..." to include in what will be committed)
        test.cpp

nothing added to commit but untracked files present (use "git add" to track)
```

Tutorial -- Add modified files

- To add the modification of your file, type **git add <files>...**
- Then you can check working tree status again

```
ubuntu  ~/Downloads/git_test  main ?1  git add test.cpp
ubuntu  ~/Downloads/git_test  main +1  git status
On branch main
Your branch is up to date with 'origin/main'.

Changes to be committed:
  (use "git restore --staged <file>..." to unstage)
        new file:   test.cpp
```

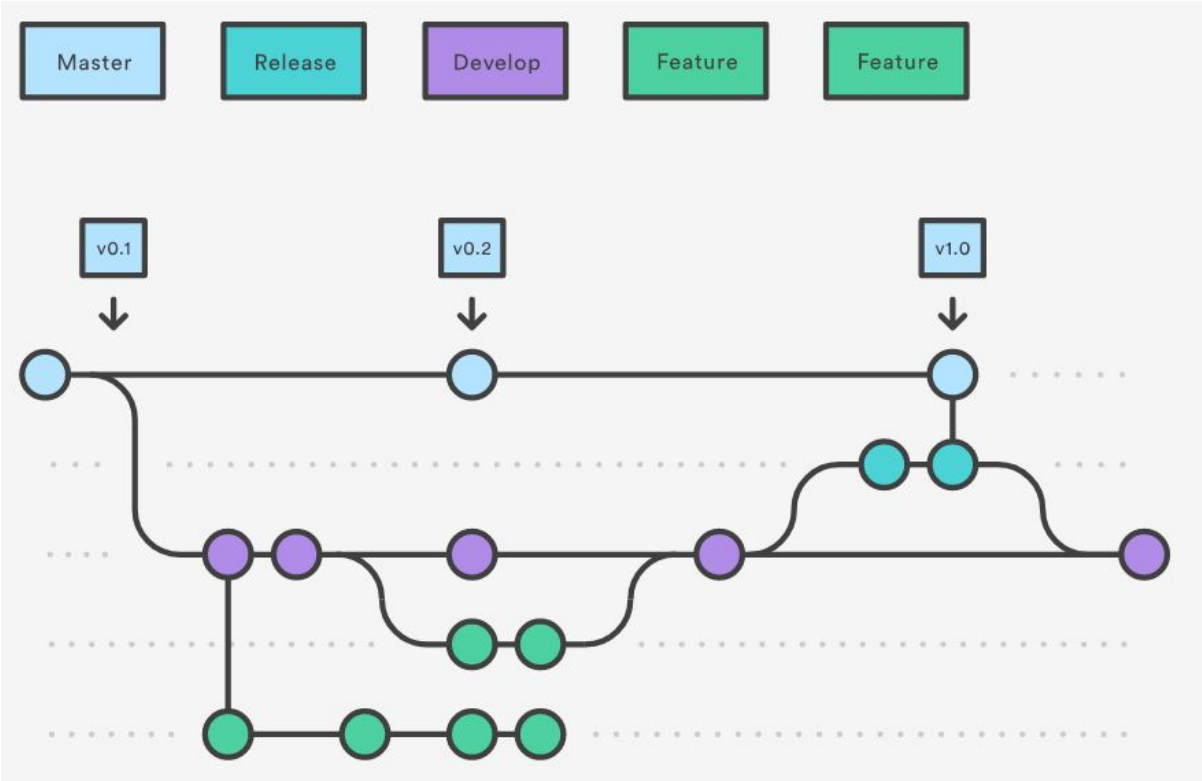
Tutorial -- Commit to your own repo

- To commit it into local repository, type **git commit -m “description message”**

```
ubuntu  ~/Downloads/git_test  main +1  git commit -m "create test.cpp"
[main 72d6016] create test.cpp
 1 file changed, 6 insertions(+)
 create mode 100644 test.cpp
ubuntu  ~/Downloads/git_test  main >1  git status
On branch main
Your branch is ahead of 'origin/main' by 1 commit.
  (use "git push" to publish your local commits)

nothing to commit, working tree clean
```

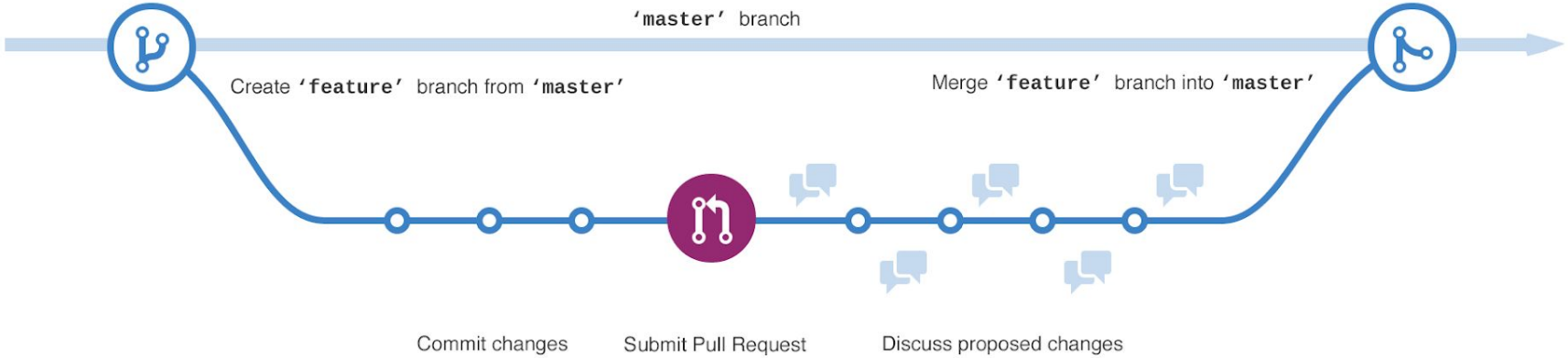
Tutorial -- Branch



- master is the product
- Add features to develop branch
- After finishing and testing the feature, merge to master

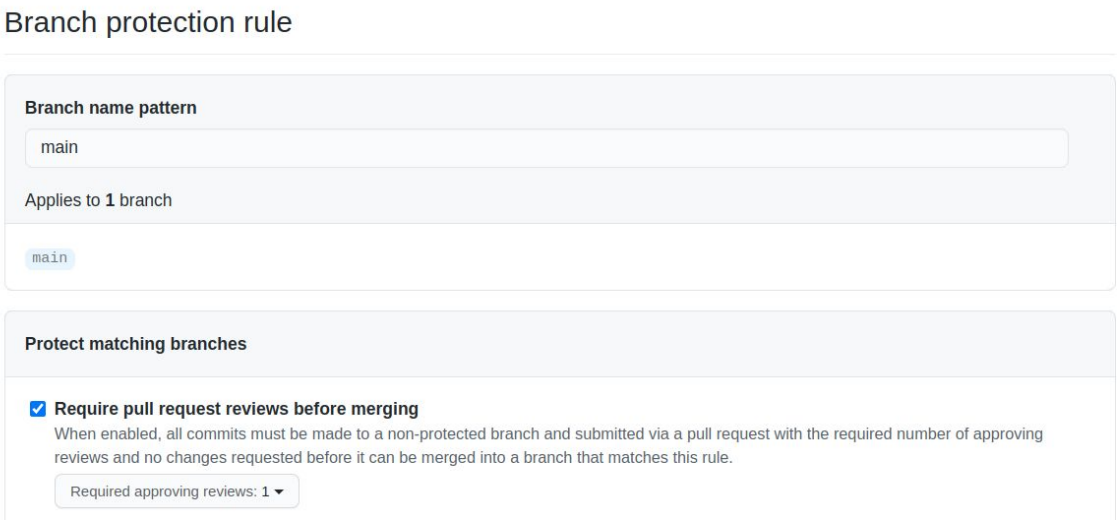
Tutorial -- Create a Branch

- Branching is the way to work on different versions at one time
- We use branches to experiment and make edits before committing them to master (main).
- master (main) branch should be clean.
- At branch master (main)
  - create branch: **git branch [branch name]**
  - delete branch: **git branch -d [branch name]**
  - change to the branch: **git checkout [branch name]**



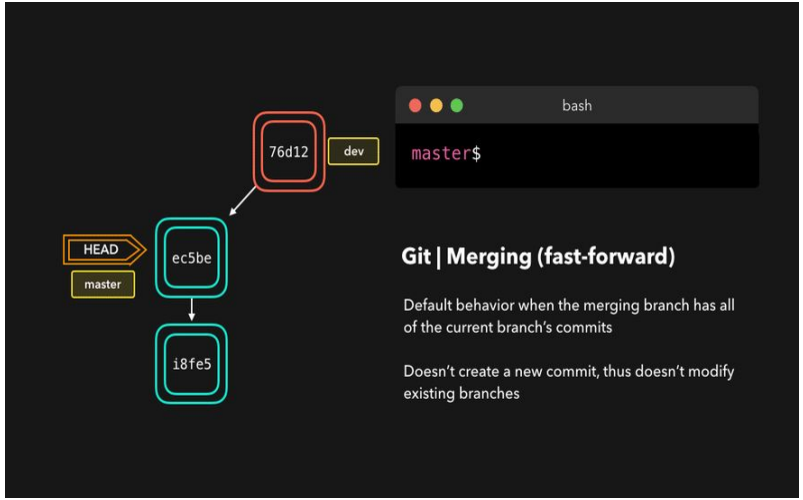
Toturial -- Protect “main” Branch

- Important when developping big projects
  - Enhance code quality without creating artificial obstructions to effective collaboration
- Setting → Branches → add rule



Tutorial -- Merge

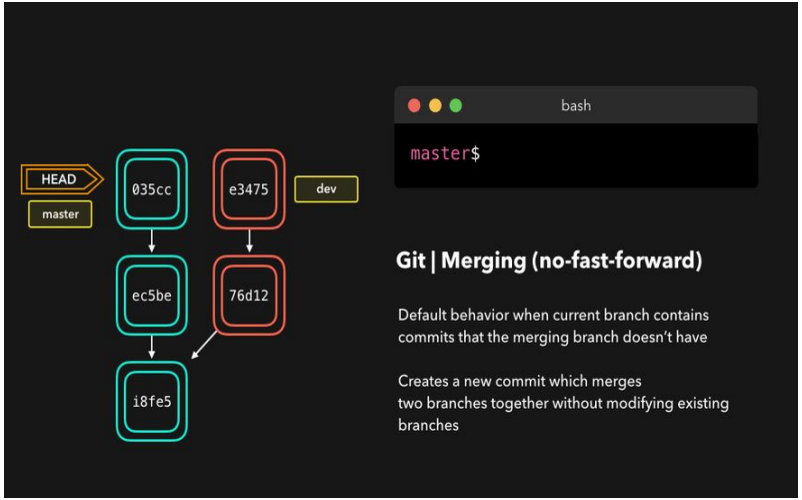
- Put a forked history back together, integrate them into a single branch
- In most use cases, **git merge [target branch]** is used to combine two branches
- Merge could be classified into
  - fast-forward
  - no-fast-forward



credits: CS visualized from **Lydia Hallie**

Tutorial -- Merge

- In **no-fast-forward** case, Git will find a common base commits between two branches, then create a new merged commit
- The merged commit contains changes of each queued commit sequence

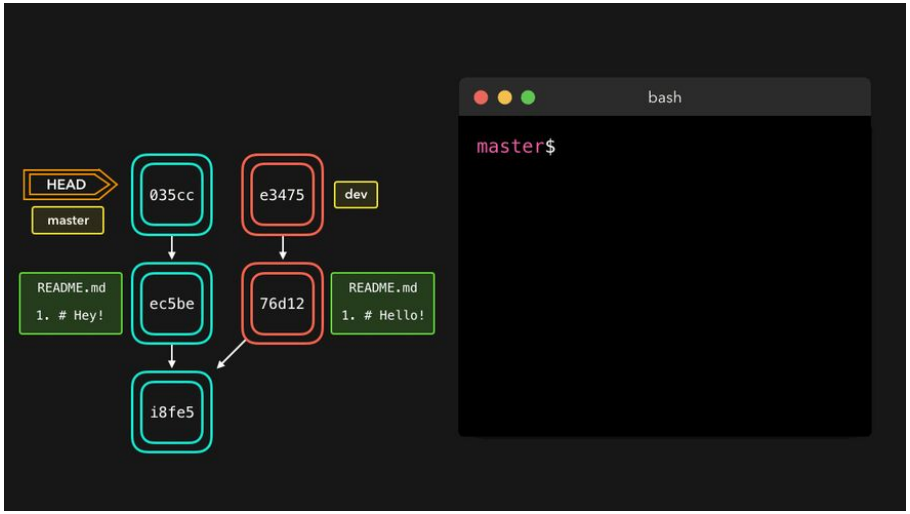


credits: CS visualized from **Lydia Hallie**

Tutorial -- Merge with Conflict

- If two branches we trying to merge both modified the same part of the file
  - Git could not figure out which part (version) to use
  - we need to handle such situation manually
- Open conflicted file and
  - reserved the part you desired
  - deleted the others

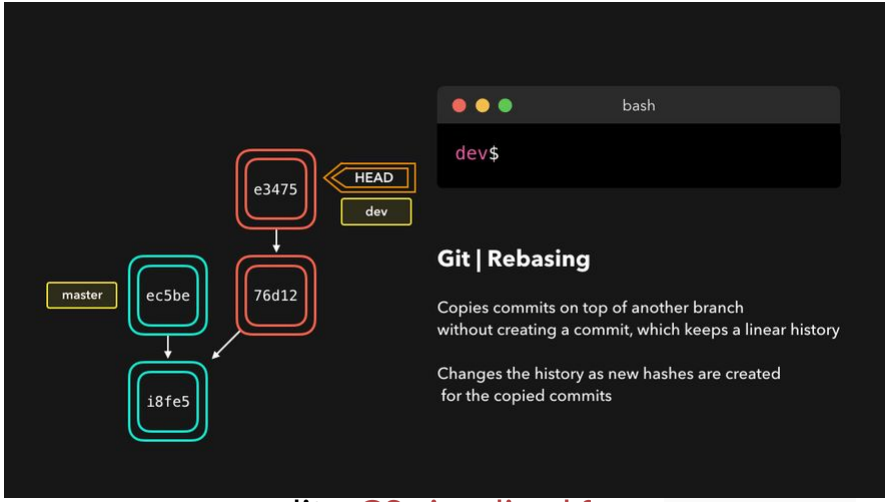
```
here is some content not affected by the conflict
<<<<<<< main
this is conflicted text from main
=======
this is conflicted text from feature branch
>>>>>>> feature branch;
```



credits: CS visualized from **Lydia Hallie**

Tutorial -- Rebase

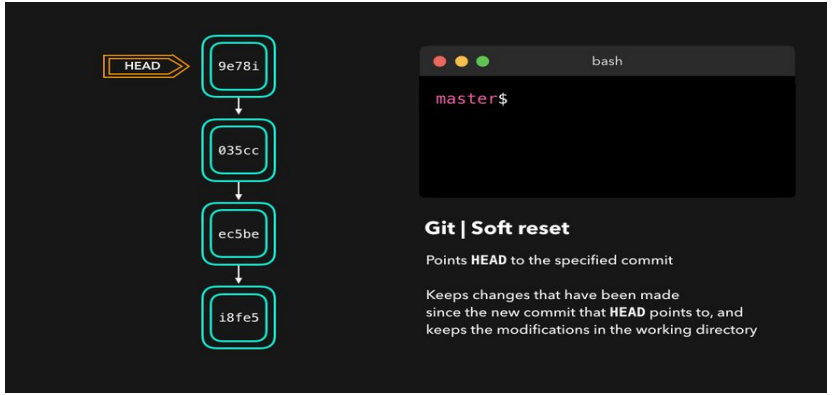
- While **git merge [target branch]** combines two branch together, the command would also reserve the target branch
  - it would be chaos when there're too many branches
- Command **git rebase [target branch]** provides us other option
  - duplicate commits in target branch to current branch
  - delete commits in target branch

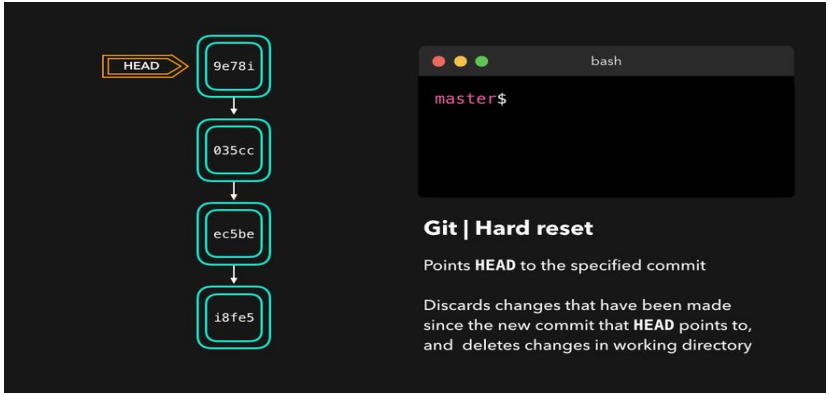


credits: CS visualized from **Lydia Hallie**

Tutorial -- Reset

- **git reset** is like a undo operation, it can get rids of all current staged files and gives us control over HEAD should point to
- There're several types of reset, all of them move our HEAD pointer ot specified commit

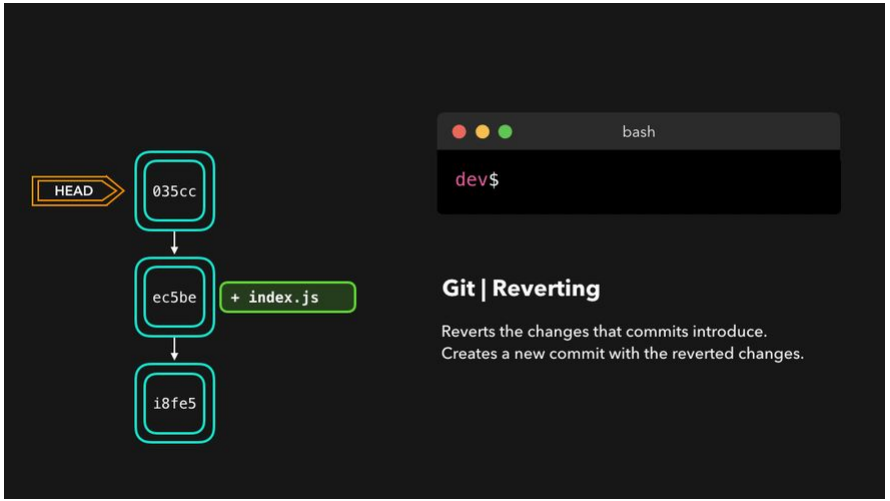




credits: CS visualized from **Lydia Hallie**

Tutorial -- Revert

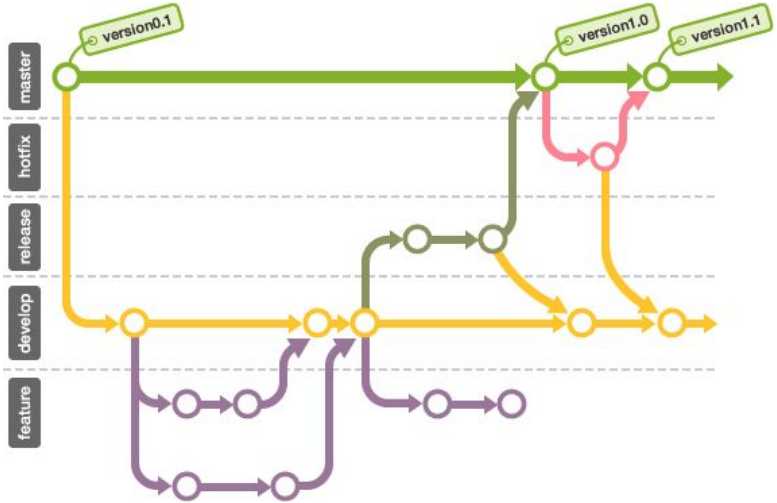
- Another way to undo changes is performing **git revert**
- Reverting a certain commit would create a new commit that contains the reverted changes



credits: CS visualized from **Lydia Hallie**

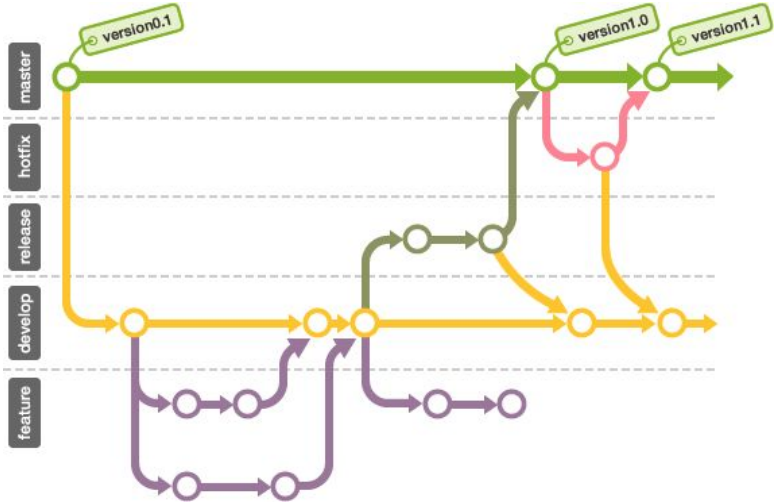
Tutorial -- Lightweight Tag

- Tags are references that point to specific commits in Git history
  - used for a marked version release (i.e. v2.1.0)
  - **git tag <tagname>** would create a lightweight tags which make linking to relevant commits more convenience
  - otherwise we have to check and copy hashes of the commits



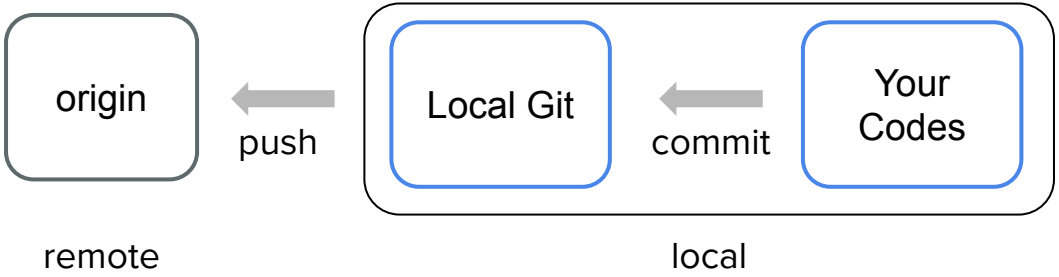
Tutorial -- Annotated Tag

- Compared to lightweight tags, annotated tags have more information, which is called metadata
  - metadata mainly stores the tagger name, email and date
  - annotated tags require more securities
  - most of the annotated tags are use for public release
  - **git tag -a <tagname>**



Tutorial -- Push codes to Origin (remote)

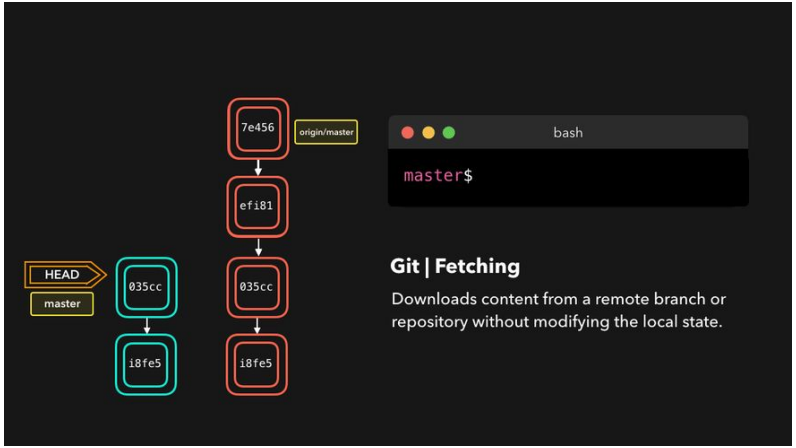
- After adding codes at local, you commit and push them to origin




```
ubuntu  ~/Downloads/git_test  main >1  git push
Enumerating objects: 4, done.
Counting objects: 100% (4/4), done.
Delta compression using up to 8 threads
Compressing objects: 100% (3/3), done.
Writing objects: 100% (3/3), 344 bytes | 344.00 KiB/s, done.
Total 3 (delta 0), reused 0 (delta 0)
To github.com:ander1119/git_test.git
   13d3b48..72d6016  main -> main
```

Tutorial -- Synchronize Codes from Origin (remote)

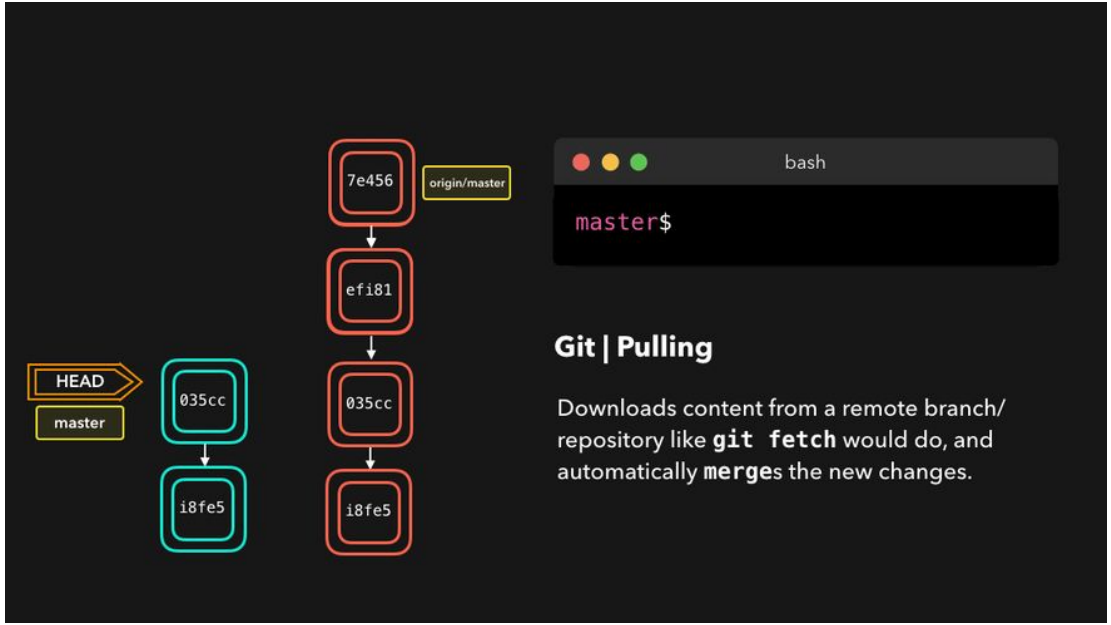
- It's important to stays up to date for all team members while working as a team on a project
  - in case of you and your teammates fix the same bug or develop the same feature simultaneously
  - to get the most recent change, use **git fetch** to update repo
  - after calling git fetch, one should call **git merge [remote branch]** to merge current branch with remote branch



credits: CS visualized from **Lydia Hallie**

Tutorial -- Synchronize Codes from Origin (remote)

- Alternatively, users can choose to simply use **git pull** instead of combination of **git fetch; git merge**



credits: CS visualized from **Lydia Hallie**

Other Useful Tools

- git status [-uno]
  - to show status of your changing files
- git diff [filename]
  - to know what you modified with [filename]
- git diff [commit hash 1] [commit hash 2] [filename]
  - to know the difference of the same file on two different commits
- git log [--graph] [--oneline]
- git reset [commit hash/HEAD[^]] [--hard]
  - reset commit to specified
  - “^” the previous commit
  - “--hard” recover commit completely

hw

Learn Git Branching

- Complete “Main” and “Remote” tasks in https://learngitbranching.js.org/ and snapshot
- Single or Multiple images is allowed

Submission Form

- Compress snapshot images with your python assignment
- Your submission should be a .zip file

```
[student_id].zip
└── [student_id] /
    ├── hw.py
    └── git /
        ├── [student_id]-0.png
        ├── [student_id]-1.png
        └── ...
```

```
r11922109.zip
└── r11922109 /
    ├── hw.py
    └── git /
        ├── r11922109-0.png
        ├── r11922109-1.png
        └── ...
```