STAT 1010 Lecture Notes

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# Preface

This is a book for STAT 1010: Introduction to Data Science at Auburn University at Montgomery. The book is written using Quarto.

To learn more about Quarto books visit <https://quarto.org/docs/books>.

# 1. Introduction

This is a book for STAT 1010: Introduction to Data Science offered at Auburn University at Montgomery.

This an ongoing project and updates are perpetually added.

# 2. Setting-up Python Computing Environment

## 2.1 Use Google Colab

All you need is a Google account. Sign in your Google account in a browser, and navigate to Google Colab. Google Colab supports both Python and R. Python is the default engine. Change the engine to R in Connect->change runtime type. Then you are all set. Your file will be saved to your Google Drive or you can choose to send it to your GitHub account (recommended).

### 2.1.1 How to run a project file from your Google Drive?

Many times, when you run a python file in Colab, it needs to access other files, such as data files in a subdirectory. In this case, it would be convenient to have the same file structure in the Google Colab user home directory. To do this, you can use Google Drive to store your project folder, and then mount the Google Drive in Colab.

Let’s assume the project folder name, pydata-book/.Here are the steps:

1. git clone the project folder (example: git clone https://github.com/wesm/pydata-book.git) to your local folder. This step is only needed when you want to clone some remote repo from GitHub.
2. **Upload** the folder (ex: pydata-book) to Google Drive.
3. **Open the file using Colab**. In Google Drive, double click on the ipynb file, example, ch06.ipynb (or click on the three dots on the right end, and choose open with, then Google Colaborotary), the file will be opened by Google Colab.
4. **Mount the Google Drive**. In Google Colab, with the specific file (example, ch06.ipynb) being opened, move your cursor to the first code cell, and then click on the folder icon (this should be the fourth icon) on the upper left border in the Colab browser. This will open the file explorer pane. Typically you would see a folder named sample\_data shown. On the top of the pane, click on the Google Drive icon to mount the Google Drive. Google Colab will insert the following code below the cursor in your opened ipynb file:

from google.colab import drive  
drive.mount('/content/drive')

Run this code cell by pressing SHIFT+ENTER, and follow the prompts to complete the authentication. Wait for ~10 seconds, your Google Drive will be mounted in Colab, and it will be displayed as a folder named drive in the file explorer pane. You might need to click on the Refresh folder icon to see the folder drive.

5. Open a new code cell below the above code cell, and type the code

%cd /content/drive/MyDrive/pydata-book/

This is to change the directory to the project directory on the Google Drive. Run this code cell, and you are ready to run the file ch06.ipynb from the folder pydata-book on your personal Google Drive, just like it’s on your local computer.

## 2.2 On your own computer

1. **Anaconda**: Download anaconda and install using default installation options
2. **VSC**: Download VSC and install
3. start VSC and install VSC extensions in VSC: Python, Jupyter, intellicode
4. (optional) **Quarto** for authoring: Download Quarto and install
5. Start an anaconda terminal. Navigate to the file directory.
6. Setup a conda **virtual environment**: stat1010 and install python and ipykernel engines

* conda create -n stat1010 python ipykernel

1. Activate the venv: conda activate stat1010
2. start VSC by typing code . in the anaconda terminal.
3. open/create a .ipynb or .py file.
4. Select the kernel stat1010
5. Run a code cell by pressing Shift+Enter or click the triangular play button.
6. Continue to run other cells.
7. After finishing using VSC, close the VSC, and deactivate the virtual environment in a conda terminal: conda deactivate

## 2.3 Best workflow with GitHub from Colab (or a local device)

**Pre-req**: Local repo is a clone of the GitHub repo with aligned HEAD

1. Keep sync with the upstream original owner repo. On GitHub, in the forked repo (under your account), Click on “Sinc fork”.
2. Open (or create) a notebook from G-drive to work with in Colab.
3. Then, mount the G-drive. If on a local device, use the same workflow (open or create a notebook from the project directory).
4. In a termnal of Colab (or a terminal in VSC in a local device)

* git pull or git pull --ff or (safer method: git pull --ff-only)

If permission denied on G-drive, run this first then repeat git pull.

chmod +x .git/hooks/\*

1. After editing, and before finish

git status  
git add files-to-commit  
git commit -m "commit message"  
git push # this will push the files-to-commit to your fork/main

## 2.4 Team Github workflow

## 2.5 Initial setup

1. Fork and Clone

* **Fork**: You click “Fork” on GitHub → it creates a **copy** of the repo under *your GitHub account*. Navigate to https://github.com/ywanglab/STAT4160, then click on “Fork”.
* **Clone**: You download a local copy of *your fork* to your computer. (only do this for the first time)

So after forking, you typically do (only for the first time)

git clone https://github.com/YOUR-USERNAME/REPO-NAME.git #REPO-NAME should be STAT4160  
cd REPO-NAME # the REPO-NAME should be STAT4160, cd to the current working directory

1. Add the original repo as “upstream”

Your fork is linked to your GitHub account (the “origin”). To stay in sync with the original project, add a remote for the source repository:

git remote add upstream https://github.com/ywanglab/STAT4160

Check remotes:

git remote -v  
# origin https://github.com/YOUR-USERNAME/REPO-NAME.git (push/pull)  
# upstream https://github.com/ORIGINAL-OWNER/REPO-NAME.git (pull only)

1. Create a feature branch in your fork

Never work directly on main. Instead create a new branch:

git checkout -b feature/my-contribution # or homework/your\_initial  
# edit files...  
  
# after you done your edit, push changes to origin/main  
  
git add files-to-commit # git add filename (or directoryname) use `.` rarely as it will add all files in the git directory.   
git commit -m "Fix bug in utils"  
git push origin feature/my-contribution #git push by default push changes to origin/main

1. Open a Pull Request (PR) (only do this for the contribution you want to make, such as homework)
2. Go to your fork on GitHub (https://github.com/YOUR-USERNAME/REPO-NAME).
3. GitHub will show a banner: “You recently pushed to feature/my-contribution. Do you want to open a Pull Request?”
4. Click it → select **base repository = (upstream) original owner repo**, **compare = your branch**.

Note: head repository → your fork (e.g. YOUR-USERNAME/REPO-NAME) and branch (feature/…) that contains your changes.

1. Write a good description and submit the PR.

Now the maintainers of the original repo will review it. If approved, they’ll merge it.

## 2.6 Keep your fork in sync

Before making new contributions, update your fork/main with the latest main from upstream:

Option A) Do it on GitHub: If GitHub shows something like “This branch is 1 commit behind”, “Sync Fork”.

Option B): do it via terminal:

git checkout main # checkout main  
git pull upstream main # pull from the upstream original repo  
git push origin main # update your fork on GitHub

Then branch off main again for your next feature.

# 3. Setting-up R Studio Computing Environment

## 3.1 Setting up your own computing environment on a personal computer

This is the recommended way and the advantage is that it’s easy to handle files.

* Go to the website <https://posit.co/download/rstudio-desktop/>.
* Follow the two steps:
  1. download and install R: Choose the appropriate operating system, and then choose “base” to “install R for the first time”. You can simply accept all default options.
  2. download Rstudio Desktop and Install it.

After installation, start R-Studio, and you are ready to use it.

## 3.2 Use R-Studio Cloud (No setting-up needed)

Alternatively, one can save the hassle of setting up on a personal computer and use the R-Studio Cloud for **free**. Here are the steps:

* Go to the website <https://login.rstudio.cloud>.
* Either create a new account using an email address such as your AUM email or simply “Log in using Google” or click on other log-in alternative.

After log-in to your account, you are ready to use R Studio.

# 4. Use Git and GitHub

I assume you already have an account on <https://github.com>. If not, you need to create an account there.

## 4.1 Download Git

1. Go to the website <https://git-scm.com/downloads>, select an appropriate operating system, select “Click here to download”
2. Run the downloaded setup file with a name such as Git-2.42.0.2-64-bit.exe, and accept all default options.

## 4.2 Establish a connection between a local repo and a remote GitHub repo

### 4.2.1 Clone an existing repo on GitHub

This is an easier way to establish a connection between a local repo and a remote repo if the remote repo is created ahead. We will make a connection between a remote repo in your GitHub account and a local directory. If the remote repo is not under your account, then skip steps 1 and 2.

1. Sign in to your GitHub account, and create a GitHub repo (such as named homework) on GitHub (<https://github.com>), you can add a README.md file or just choose not to add a README.md file.
2. On your local computer, open a Git Bash terminal.
3. Skip this step if you simply want the cloned repo to be in the current directory. Otherwise, In the terminal, type mkdir myfolder (create a folder named myfolder within the current directory) and then cd myfolder (change to the directory myfolder). The directory name myfolder can be any name you want.
4. git clone https://github.com/Your\_Git\_UserName/homework.git (change the remote repo path to match your actual remote repo).

|  |  |
| --- | --- |
|  | * To specify a specific folder to clone to, add the name of the folder after the repository URL, like this: git clone github-repo-URL mylocalfolder |

1. Now you have established a connection between your local directory homework and the remote repo homework on GitHub.
2. Create a new file in the current local directory homewor on your local computer, such as using your favorite editor to create a file named myfirstlocalfile.txt with any content in it. Or for the sake of demonstration, you can use the following Linux command to create this file containing the line #My first local file.

* echo "#My first local file" >> myfirstlocalfile.txt

1. In the terminal, git add . This will add all changes to the **staging area**. This lets Git start to track the changes to files in your local directory.
2. Now you are ready to **commit** the changes, which versions (takes a snapshot of) the current files in the directory. A commit is a checkpoint where you can go back to.

* git commit -m "my first commit from local"

1. Now you are ready to sync the local repo with the remote repo.

* git push
* The GitHub might ask you to sign in for the first time. Choose Sign in with your brower to sign in to complete the push.

### 4.2.2 Initializing a Git Directory Locally First

The previous approach initializes a local Git repo by cloning a remote repo. You can also initialize a local Git repo by using git init. Follow the following steps:

1. Sign in to your GitHub account.
2. Create a GitHub **empty** repo (such as named homework) on GitHub (<https://github.com>) but make sure it is empty (do not add Readme.md file)
3. Start a Git Bash Terminal window on your local computer (You could also use the Terminal Window in RStudio or VSC). Navigate to the project directory; if you haven’t yet created a project directory such as homework, do

* mkdir project\_dir Example: mkdir homework
* Use cd project\_directory\_name to enter your local project directory;
* Use ls to list all files and directories or use ls -al to include all hidden files and directories. In your local Git Terminal, (note at this moment your local project directory is empty)
* echo "# homework0" >> README.md #create a file README.md  
  git init  
  git branch -M main #rename the branch name to main  
  git add . # may use git add --all  
  git commit -m "first commit"  
  git remote add origin https://github.com/ywanglab/homework.git #(change the remote repo path to your remote repo)  
  git push -u origin main

|  |  |
| --- | --- |
|  | * 1. the general command format: git push [remote-name] [branch-name]   2. difference between git add . and git add --all:   + git add .: stages changes in the current directory and its subdirectories but does not include file deletions   + git add --all: stages changes in the entire working tree, including deletions and untracked files. It is a more aggressive option and can be useful when you want to ensure that every change, including file deletions, is included in the next commit.   + git add --all is equivalent to git add -A |

1. if your local project directory already 1) contains files and 2) had performed init git before, then

* git remote add origin https://github.com/ywanglab/homework.git` #(change the remote repo path to your remote repo path)  
  git branch -M main  
  git push -u origin main

1. in the pop-out GitHub Sign-in window, click on Sign in with your browser.
2. Note an empty folder would not be pushed to the remote repo until it has a file (even an empty file) in it. In this case, you can create an empty file such as .gitignore

## 4.3 Some other common commands

1. check git status: git status and git status --short for a compact way.
2. git commit -a -m "message" will stage and commit every changed, already tracked file without using git add changed\_file
3. git add file\_changed

* # add file\_changed to the staging environment, i.e., git repo to start track those changes.

1. use git log to check all commits. Use git log --pretty=oneline or just git log --oneline for shorter display.

* git log origin/main #check the remote repo origin/main commits

1. use git diff origin/main to show the differences between the local main and origin/main.
2. use git checkout . to revert back to the previous commit. Any changes after the previous commit will be abandoned.
3. to get to a previous commit, use git checkout seven\_character\_commit\_hash. To get back to main, use git checkout main.
4. Git commit --amend

`commit --amend` is used to modify the most recent `commit`. It combines changes in the `staging environment` with the latest `commit`, and creates a new `commit`. This new `commit` replaces the latest `commit` entirely. Adding files with `--amend` works the same way as above. Just add them to the `staging environment` before committing.  
  
One of the simplest things you can do with `--amend` is to change a `commit` message with spelling errors.

1. Git Revert HEAD:

* revert is the command we use when we want to take a previous commit and add it as a new commit, keeping the log intact. Revert the latest commit using git revert HEAD (revert the latest change, and then commit), adding the option --no-edit to skip the commit message editor (getting the default revert message):
* git revert HEAD --no-edit

|  |  |
| --- | --- |
|  | * To revert to earlier commits, use git revert HEAD~x (*x* being a number. 1 going back one more, 2 going back two more, etc.) |

1. Git Reset

* reset is the command used when we want to move the repository back to a previous commit, discarding any changes made after that commit. Let’s try and do that with reset.
* git reset seven-char-commit-hash

1. Git Undo Reset

* Even though the commits are no longer showing up in the log, it is not removed from Git. If you know the commit hash you can reset to it:
* git reset seven-char-commit-hash

1. To permanently go back to a previous commit, use

* git reset --hard seven\_char\_commit\_hash

1. to go back to a previous commit, but not changing the files in the working directory use the --soft` option.

* git reset --soft seven\_char\_commit\_hash

1. git remote -v Get the reminder of the remote repo. To rename the remote origin: git remote rename origin upsteam rename remote repo origin to upstream

|  |  |
| --- | --- |
|  | * According to Git naming conventions, it is recommended to name your own repository origin which you have read and write access; and the one you forked for upstream (which you only have read-only access.) |

1. if you want to remove the file only from the remote GitHub repository and not remove it from your local filesystem, use:

git rm -rf --cached file1.txt #This will only remote files; If intending to remove local files too, remove --cached  
git commit -m "remove file1.txt"

And then push changes to remote repo

git push origin main

1. For some operating system, such as Mac or Linux, you might be asked to tell GitHub who you are. When you are prompted, type the following two commands in your terminal window:

git config --global user.name "Your Name"   
git config --global user.mail "your@email.com"

This will change the Git configuration in a way that anytime you use Git, it will know this information. Note that **you need to use the email account that you used to open your GitHub account**. global sets the username and e-mail for **every repo** on your computer. If you want to set the username/e-mail just for the current repo, remove global.

## 4.4 Use Git help

1. git command -help See all the available options for the specific command. Use `--help instead of -help to open the relevant Git manual page.
2. git help --all See all possible commands

## 4.5 When the upstream repo changes

When Git tells you the upstream repo is ahead,

1. Do git pull or git pull origin

* This is equivalent to git fetch origin, and then git merge origin/main.Then you can commit and push a new version to the remote repo.

1. git pull will not pull a new branches on the remote repo to local, but it will inform you if there is a new branch on the remote repo. In this case, just git checkout the\_remote\_new\_branch\_name will pull the remote branch to local. Note there is **no need** to create locally the branch by git branch the\_remote\_new\_branch\_name

## 4.6 Create branch

1. To add a branch to the main branch git branch branchname

* Switch the branch git checkout branchname
* To combine the above two actions, git checkout -b branchname, create a new branch named branchname if it does not exist and move to it.

Adding a file in branch echo "#content" >> filename.txt

Then add the file and commit the file. To push the branch to the remote repo we **have to use**

git push --set-upstream origin branchname The option --set-upstream can be replaced by -u

to see all branches in both local and remote: git branch -a Or git branch -r for remote only.

## 4.7 Merge branch to main branch

1. Switch from a branch (with name such as branchname to the main using  
   git checkout main
2. on the main branch, Merge command to merge the branches  
   git merge branchname

To delete a branch:

git branch -d branchname

## 4.8 Handle large files (>= 150Mb) on GitHub

GitHub does not allow to upload a file of size greater than 150Mb. However, one can use git lfs to handle large files exceeding this size up to several Giga bytes. The first thing is to install git lfs. Head to <https://git-lfs.com>, once dowlonad and install the Git command line extension, set up Git LFS for your user account by running

git lfs install #(only need to do this the first time)

Then In each Git repository where you want to use Git LFS, select the file types you’d like Git LFS to manage (or directly edit your .gitattributes). You can configure additional file extensions at any time.

git lfs track "path/to/file"

Then do the regular git add . and git -m "message" and git push. Note one must use git lfs track a file first before doing git add and git commit.

|  |  |
| --- | --- |
|  | Note you need to track the large-size file first before you add it to the staging area. But often you will find this error after you try to push your changes to the GitHub. In this case, you will have to remove the commit history of this file first. One way to do this is to reset –soft the HEAD to the previous working HEAD, and then do git lfs track followed by git add and git commit, git push. Specifically,  git reset --soft HEAD ~1 # or the\_7-char\_commit\_hash git lfs track "path/to/large\_file" git add . git commit -m "commit message" git push  Note the --soft option allows the changes in the working directory not affected, otherwise any change after the previous commit will be removed. |

## 4.9 Contribute by forking a GitHub repo and commit to the forked repo and create a pull request

1. after forking a (foreign) GitHub repo to your own GitHub account, git clone that repo under your account to your local repo.
2. make changes in your local directory.
3. Submitting your changes for review
   1. **Commit your changes locally.** Once you are ready to submit your changes, run these commands in your terminal:
   * git add -A # Stages all changes, short for --all   
     git commit -m '[your commit message]' # Makes a git commit
   1. **Make a pull request.** (A pull request is a proposal to change) A GitHub pull request allows the owner of the forked upstream repo to review and make comments on your changes you proposed. Once approved, the upstream owner can merge your changes. Run:
   * git push origin # Push current branch to the same branch on GitHub
4. Then go to your remote forked repo in your account on the GitHub site and click **Contribute**,and then **Open pull request**, this will take you to the upstream repo. In the form, leave a message explaining the change, and **Create pull request**. **Do not** select Close pull request unless you want to cancel the pull request.

## 4.10 Project

1. First make sure you have forked the course repo https://github.com/ywanglab/stat1010.git

* to your own GitHub account.

1. Now go to your GitHub account, git clone the forked course repo

git clone https://github.com/your\_git\_user\_name/stat1010.git

to your local computer

1. add your resume file in the folder ./resume

git add, commit and push your changes to the upstream repo using

git add .  
  
git commit -m "added YourFirstName's resume"  
  
git push origin

1. Then go to your remote forked repo in your account on the GitHub site and click **Contribute**,and then **Open pull request**, this will take you to the upstream repo. In the form, leave a message explaining the change, and **Create pull request**. **Do not** select Close pull request unless you want to cancel the pull request.

## 4.11 More on git

git pull = git fetch + git merge

* **git fetch** → downloads commits from the remote into your local refs (e.g. origin/main).
* **git merge** → merges those new commits into your current branch.

## 4.12 2. What does --ff mean?

* --ff = **fast-forward if possible**.
* That means: if your branch has **no local commits** since it last matched the remote, Git will simply **move the branch pointer forward** to match the remote — no merge commit is created.

Example (before pull):

A---B---C (origin/main)  
   
A---B (main)

If you run git pull --ff and your branch is strictly behind origin/main, Git just slides main forward:

A---B---C (origin/main, main)

## 4.13 3. How is this different from the defaults?

* git pull without flags:
  + May create a **merge commit** if histories diverged.
* git pull --ff:
  + Does a fast-forward if possible.
  + If not possible (you made local commits), Git falls back to a **merge commit**.
* git pull --ff-only:
  + Does a fast-forward **only**.
  + If not possible, it **aborts** with an error (no merge commit allowed).

## 4.14 4. When to use it

* --ff is safe if you don’t mind merge commits being created when necessary.
* --ff-only is stricter (no merge bubbles, linear history).
* Teams often configure one of these globally so git pull always behaves consistently.

## 4.15 1) when there is a diverge

Recall the setup:

A──B──C (origin/main)  
 \  
 D (main)

* C and D share a common ancestor B. So Git sees:
* One branch has new work (C).
* Another branch has different new work (D).
* **D** is a **local commit** you made on main after you last pulled.
* If you run git pull --ff (or --ff-only), **fast‑forward is NOT possible** because your branch has extra work (D).
  + --ff-only → **aborts** with an error.
  + --ff → falls back to a **merge**, creating a merge commit (see next section).

### 4.15.1 git pull or git pull --ff (merge fallback)

* Git fetches origin/main at C
* Git merges C into your local main with D, producing **M**:

After pull (local):  
A──B──C  
 \ \  
 D─M (main)  
 ^  
 merge commit

When you run git merge origin/main (or git pull with merge strategy):

* Git identifies the **common ancestor** of the two branches → here, commit **B**.
* Then it looks at:
  + The changes between B → C (remote’s changes).
  + The changes between B → D (your changes).
* Git tries to combine both sets of changes into a new snapshot.

That new snapshot becomes a new commit **M**. The merge commit **M** exists only **locally** until you git push. \* When you **push**, origin/main is updated to point to **M**, and the remote history now includes that merge commit.

* Pros: Preserves exact history as it happened (no rewrite).
* Cons: Adds **merge commits**; history can get “braided”.

### 4.15.2 Option 2: git pull --rebase (**replay** your work on top of remote)

* Git rewrites your local commits onto the fetched remote tip:
  + Rewrites D into D' applied after C.

A──B──C──D' (main)  
 ^  
 rebased (new) commit

* Pros: **Linear history**, no merge commit.
* Cons: **Rewrites** your local commits (new SHAs). If you had already pushed D, you’ll need git push --force-with-lease.

## 4.16 How to set opitons gloabally

* **Team prefers linear history** → git pull --rebase (and set it as default)
* git config --global pull.rebase true  
  git config --global rebase.autoStash true
* **Keep exact history / avoid rewrite** → git pull --ff (merge when needed)
* git config --global pull.rebase false
* **Never auto-merge; be explicit** → git pull --ff-only
* git config --global pull.ff only

# 5. 1) Concrete example: what does “merge C with D to produce M” look like?

Assume the repo has one file, README.md.

### 5.0.1 Commits and changes

* **B (common ancestor)** README.md:
* Hello project
* **C (remote, on origin/main)** — someone else added a line:
* Hello project  
  Remote line
* **D (your local commit, on main)** — you added a different line:
* Hello project  
  Local line

So history diverged:

A──B──C (origin/main)  
 \  
 D (main)

### 5.0.2 You run: git pull (merge strategy) or git merge origin/main

Git computes the diff **B→C** (“add Remote line”) and **B→D** (“add Local line”), applies both, and creates **merge commit M**:

* **M (merge result)**:
* Hello project  
  Local line  
  Remote line
* (order may vary if both append—Git picks a consistent merge; if both edit *the same* line, you’ll get a conflict to resolve.)

New history:

A──B──C  
 \ \  
 D─M (main)

**M** has **two parents**: D and C. That’s a “merge commit”.

## 5.1 Option B: git pull --rebase (**replay** your work on top of remote)

Git takes your local commit(s) and **replays** them atop C, producing a *new* commit D':

A──B──C──D' (main)

* ✅ Pros: **Linear history** (no merge commits), cleaner git log, bisect/blame often simpler.
* ❗ Cons: **Rewrites** your local commit(s) (new SHAs).
  + If you had already pushed D, you must **force-push** the rewritten branch (see below).

### 5.1.1 Which should you use?

* Many teams prefer **--rebase** for a clean linear history (especially on feature branches).
* If your team forbids history rewrites on shared branches, use **merge** (git pull or git pull --ff), or make sure you only rebase commits that haven’t been pushed/shared yet.

Tip to make rebase the default:

git config --global pull.rebase true  
git config --global rebase.autoStash true

# 6. 3) What is git push --force-with-lease (and why it’s safer than --force)?

When you **rebase** local commits that were already pushed, your local branch history no longer matches the remote’s. A normal git push will be rejected. You need to overwrite the remote branch tip—i.e., a force push.

* **git push --force** overwrites the remote branch **unconditionally** (dangerous—you could clobber someone else’s new commits if they pushed while you were rebasing).
* **git push --force-with-lease** is the **safe** version:
  + It says: “Force-push **only if** the remote branch still points to the commit I think it does.”
  + If someone else has pushed new commits, **the push is rejected** instead of overwriting their work.

### 6.0.1 Typical rebase + push flow

# Update local view of remote  
git fetch  
  
# Rebase your local work onto the remote tip  
git rebase origin/main # resolve conflicts if any; git rebase --continue  
  
# Safely update the remote branch  
git push --force-with-lease

### 6.0.2 Example workflow with git stash

#### 6.0.2.1 1. Check repo status

$ git status  
On branch main  
Your branch is up to date with 'origin/main'.  
  
Changes not staged for commit:  
 (use "git add <file>..." to update what will be committed)  
 modified: app.py  
 modified: utils.py

You’ve made some edits but don’t want to commit yet.

#### 6.0.2.2 2. Stash your changes

$ git stash push -m "WIP: refactor utils"  
Saved working directory and index state WIP on main: 1a2b3c4 Add logging

Now the working directory is clean.

#### 6.0.2.3 3. Verify with status

$ git status  
On branch main  
nothing to commit, working tree clean

The changes are hidden away.

#### 6.0.2.4 4. List stashes

$ git stash list  
stash@{0}: On main: WIP: refactor utils

Your stash is safely stored.

#### 6.0.2.5 5. Switch branch, pull, or do other work

$ git switch feature-branch  
Switched to branch 'feature-branch'

#### 6.0.2.6 6. Apply the stash back

$ git stash apply stash@{0}  
On branch feature-branch  
Changes not staged for commit:  
 modified: app.py  
 modified: utils.py

Changes are back, but the stash still exists in the list.

#### 6.0.2.7 7. Or use pop to apply *and remove*

$ git stash pop  
On branch feature-branch  
Changes not staged for commit:  
 modified: app.py  
 modified: utils.py  
Dropped refs/stash@{0} (abc123def456...)

#### 6.0.2.8 8. Confirm stash list is empty

$ git stash list  
# (no output — list is empty)

\*Summary of this session\*\*

* You edited files.
* git stash push cleaned your working directory but saved changes.
* Later, git stash apply or git stash pop restored those changes.

## 6.1 Rebuild the index respecting .gitignore

If you have modified .gitignore and you already pushed some files that you did not want to push, to remove those files already pushed to Github, you need to remove them from the git index to untrach them.

git rm -r --cached .  
git add .  
git commit -m "Reindex: drop ignored files from repo"  
git push origin <your-branch>

to remove specific folder or files:

git rm -r --cached .Rhistory .Rproj.user # `-r` is needed for a directory

## 6.2 Team Git workflow

Avoid committing directly to main?

### 6.2.1 1. **Clone the repo & stay off main**

Everyone starts from:

git clone https://github.com/org/project.git  
cd project  
git checkout main

But nobody codes directly on main.

### 6.2.2 2. **Create feature branches**

When starting new work:

git checkout -b feature/login-page  
# do edits, commits...  
git push origin feature/login-page

* Each branch is **short-lived**, focused on a feature, fix, or experiment.
* Branch names like feature/, bugfix/, hotfix/ make it clear what’s happening.

### 6.2.3 3. **Push branch to GitHub and open a Pull Request (PR)**

On GitHub:

* Open a **PR from feature/login-page → main**.
* Teammates can review code, request changes, and run tests before merging.

### 6.2.4 4. **Keep your branch up-to-date**

If main has moved on while you’re coding:

git checkout main  
git pull origin main  
git checkout feature/login-page  
git merge main # or git rebase main

This keeps your branch compatible with the latest main.

### 6.2.5 Summary

* **Don’t commit directly to main.**
* Each collaborator works in their own **branch**, pushes it to GitHub, and opens a **Pull Request**.
* Merges into main only after **review + tests pass**.

This way, main always works, and the team avoids chaos.

# 7. My Jupyter Notebook

**Yi Wang** (boldfaced using \*\* \*\*)

Educator AUM

The following line is italicized using \* \*

*I am interest in data science because it is a discipline that I feel love with.*

### 7.0.1 Perform addtion

# code block  
1+1

2

### 7.0.2 Horizontal Rule

Three or more

first rule using \*\*\*

using dashes —

Using (underscores) \_\_\_

### 7.0.3 Bulet list

using \*

* Bird
* Frog
* Cat
* Dog

### 7.0.4 Numbered list

using 1. item (there is a space between 1. and item)

1. Apple
2. Pear
3. Peach

### 7.0.5 Tables

| left-aligned | centered | right-aligned |
| --- | --- | --- |
| 1/2/2020 | Mary | Apple |
| 1/3 | Johnason | Tomato |

### 7.0.6 Hyperlinks

Click [here](https://github.com/ywanglab) to access my github account.

### 7.0.7 Images

A computer monitor

A computer monitor

### 7.0.8 Code/Syntax highlighting

s = "Python syntax highlighting"  
print s

### 7.0.9 Blocked quotes

using >

Blockquotes are very handy in email to emulate reply text.

This line is part of the same quote.

### 7.0.10 Strikethrough

using ~~ before and after a phrase

~~strikethrough this~~

# 8. Homework Assignments

I will use some assignments from <https://cognitiveclass.ai>.

1. Browser Course & Projects. Search for Python for Data Science. Enroll Now the class, and Go to the Course, and Start the Course.
2. Complete the following assignments from Modules 1-4 and Part of Module 5. Excluding the API section in Module 5.

| Module | Contents | Suggested Deadlines |
| --- | --- | --- |
| Module 1 | Python Basics | 10/09/2023 |
| Module 2 | Python Data Structures | 10/09/2023 |
| Module 3 | Python Prrogramming Fundamentals | 10/09/2023 |
| Module 4 | Working with Data in Python | 10/16/2023 |
| Module 5 | Working with Numpy Arrays (Excluding Simple APIs) | 10/16/2023 |
| Final Exam | Optional |  |

* Complete all Practice Questions, Review Questions and Labs. After your completing all the assignments, click on Progress, print the page (in PDF or hard copy), and send it to me. The page should show your username on the top right corner.

1. Enroll in the course Data Anlaysis with Python.

* Complete the following assignments.

| Module | Contents | Suggested Deadlines |
| --- | --- | --- |
| Module 1 | Introduction | 10/23/2023 |
| Module 2 | Data Wrangling | 10/30/2023 |
| Module 3 | Exploratory Data Analysis | 11/06/2023 |

1. Enroll in the course Data Visualization with Python.

* Complete the following assignments.

| Module | Contents | Suggested Deadlines |
| --- | --- | --- |
| Module 1 | Introduction to Visualization | 11/13/2023 |
| Module 2 | Basic Visualization Tools | 11/20/2023 |
| Module 3 | Specialized Visualization Tools | 11/27/2023 |
| Module 4 | Advanced Visualizaiton Tools (Optional) |  |

# References