MR2020: Python for METOC

Module 0: Getting Started

Summer Quarter 2024

"Why do I need to code? I'm never going to use this in the fleet."

But you will use it during your time at NPS. METOC theses inherently involve data analysis—sometimes of very large amounts of data. Coding—in Python, MATLAB, Fortran, Perl, C++, JavaScript, or whatever language is suitable—is essential for completing a thesis.

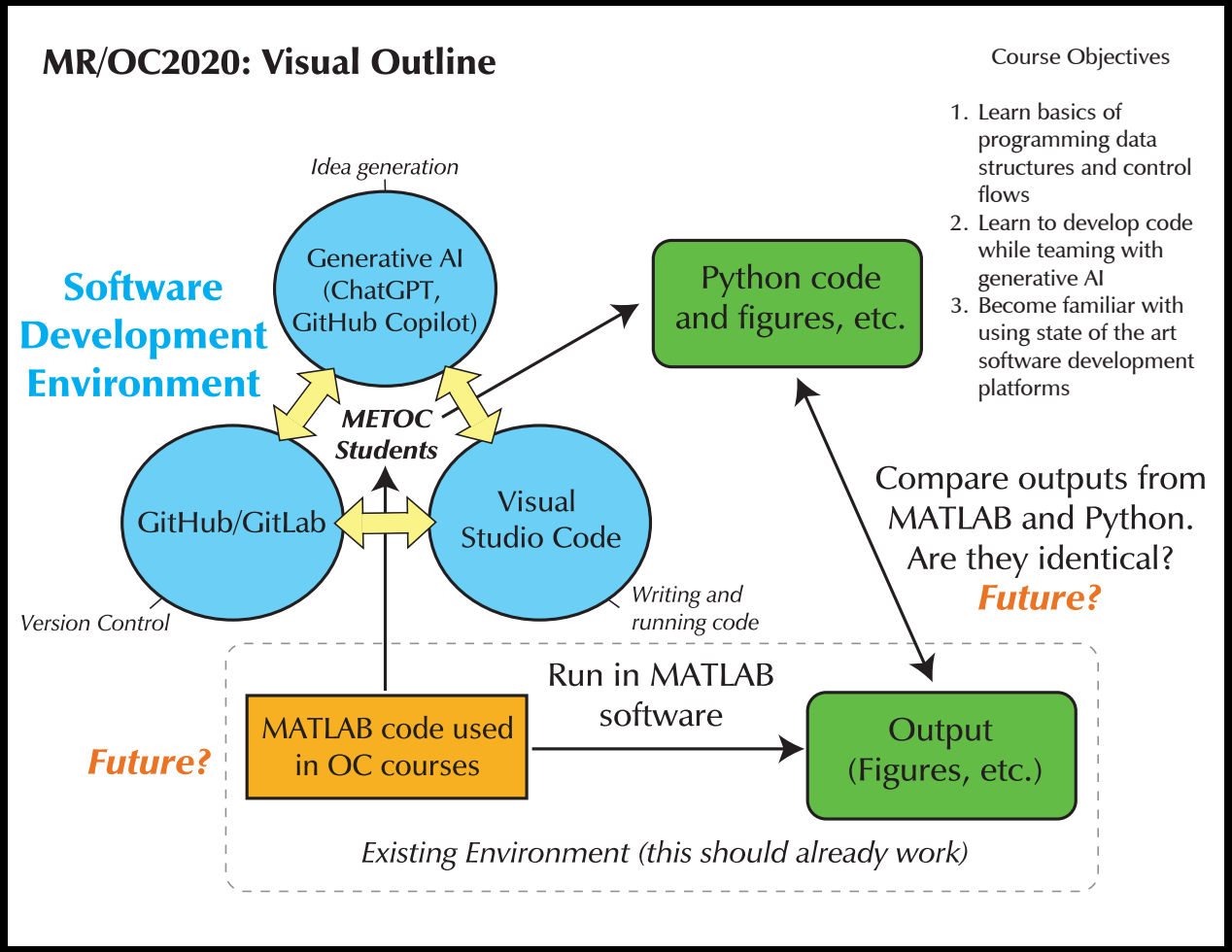
Coding is an essential skill in the 21st century. Programming languages are the underpinning that holds today's technologically dependent world together. Perhaps brushing up on this skill a little could come into use after retirement…

"Why Python?"

Python is free and open-source and has a huge community support and software development base. There is almost nothing you can think of that can't be done in Python. While there are many free, open-source languages and compilers, Python is known as an easy-to-read and intuitive language. It is also one of the preferred languages of infrastructure development for machine learning.

Some languages (e.g., MATLAB, Mathematica) are proprietary. For large users like the Navy, annual licensing can cost a significant amount. However, anything that can be done in MATLAB can also be done in Python. MATLAB's functionality is especially easy to replicate given the recent rise of generative AI such as GPT.

A few basic tools



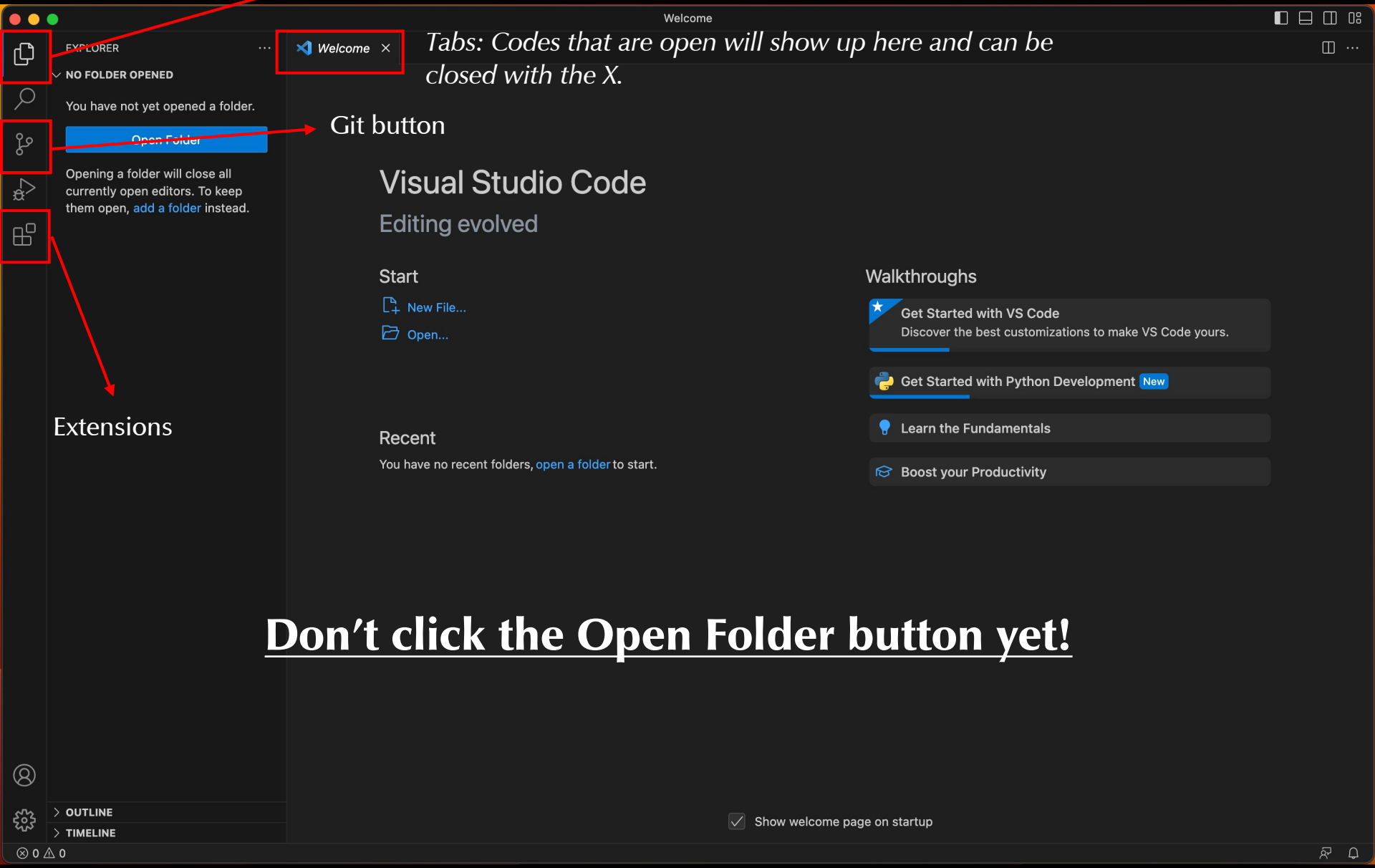
Setup

We need a few tools to get started:

1. Visual Studio Code (configure)
2. Miniconda (download then setup python environment)
3. GitLab repository (through NPS login at gitlab.nps.edu)
4. OpenAI ChatGPT account (online interface)

Please read through each slide carefully and don't just ignore stuff and jump ahead!

Click the magnifying glass in the top right of the Desktop; Type Visual Studio Code and press enter. A Visual Studio Code start screen like the one displayed below will appear.



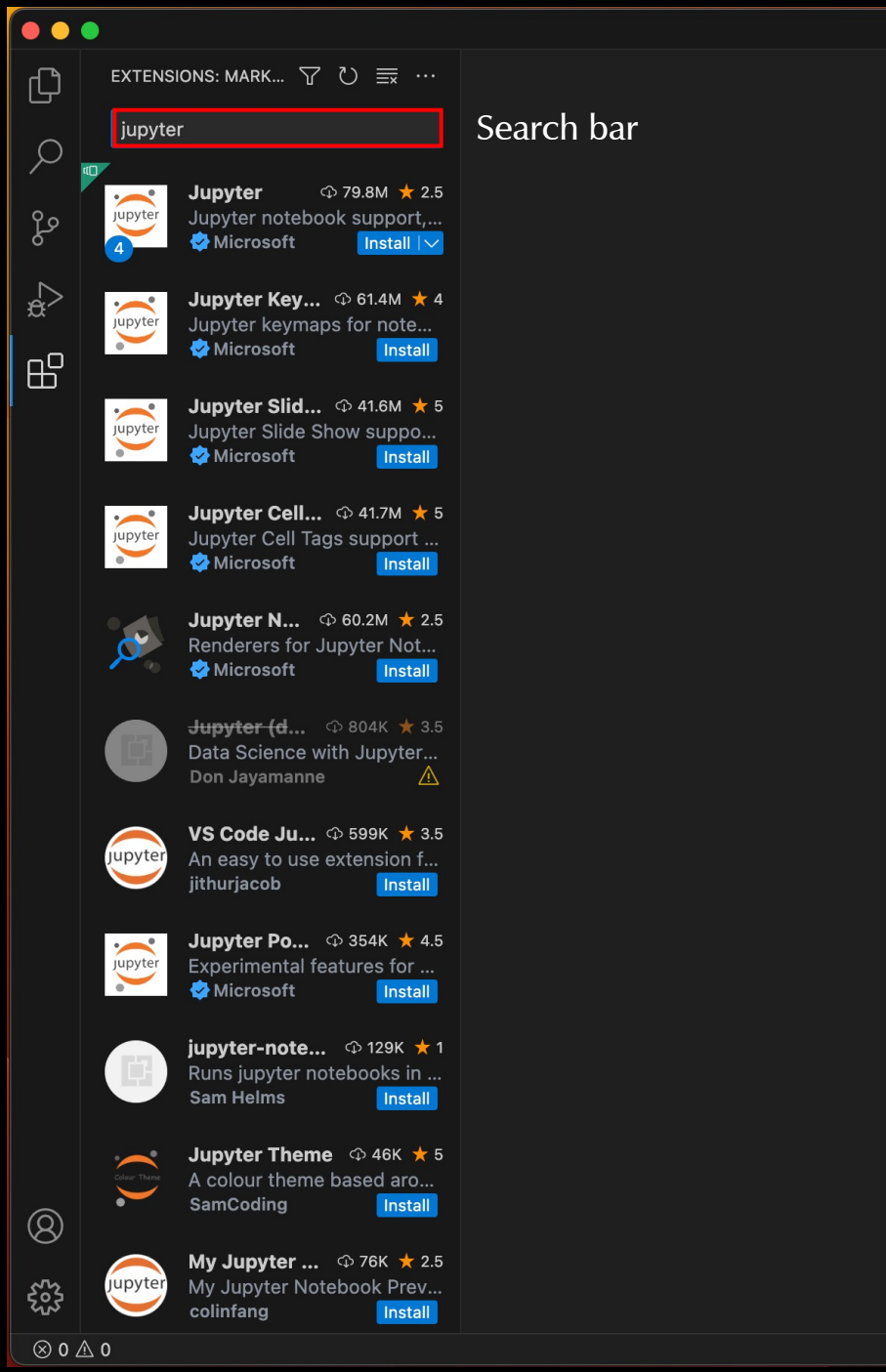
Don't click the Open Folder button yet!

Choose the extensions button on the left-hand side. Type in Python in the search bar near the top. Install the Python extension from Microsoft.

Repeat by searching for jupyter and installing. This is the example shown to the right.

Finally, install the MATLAB extension from Mathworks.

The creator of the extension (e.g., Microsoft, Mathworks) can be seen just left of the install button.



Configuring git (This is the hardest part.)

1. Open a new terminal. Type in “bash” and hit enter.

2. Enter “xcode-select --install” and hit enter. Click install and accept the license agreement and any other prompts. The download may take a few minutes. While it’s running skip to the next slide, and we’ll install miniconda while this download and install is underway.

Install miniconda

1. Close the old terminal and open a new terminal.

2. Enter ”pwd” (In this class, whenever you see “” for entering something into a Linux command terminal, don’t enter the “”). You should see something like “/Users/scott.powell” show up, replacing scott.powell with your name. If for some reason you don’t enter “cd /Users/NPSLOGIN”, replacing NPSLOGIN with your real login name.

3. Copy and paste the following code into the terminal:

```
mkdir -p ~/miniconda3
curl https://repo.anaconda.com/miniconda/Miniconda3-latest-MacOSX-arm64.sh -o ~/miniconda3/miniconda.sh
bash ~/miniconda3/miniconda.sh -b -u -p ~/miniconda3
rm -rf ~/miniconda3/miniconda.sh
```

4. You should get a message that says ”done installation finished.” **Check the next slide for what your terminal window might look like*.** If you do, copy and paste the following code (**After step 4, you should get something that looks like the screen shown in two slides.**)

```
~/miniconda3/bin/conda init bash
~/miniconda3/bin/conda init zsh
```

5. Close the terminal window.

You should see something like this between Steps 3 and 4.

Terminal — -tcsh — 80×27

```
Last login: Wed Jul  3 12:47:44 on console
[METWKC-MAC-006:~] scott.powell% pwd
/Users/scott.powell
[METWKC-MAC-006:~] scott.powell% mkdir -p ~/miniconda3
curl https://repo.anaconda.com/miniconda/Miniconda3-latest-MacOSX-arm64.sh -o ~/
miniconda3/miniconda.sh
bash ~/miniconda3/miniconda.sh -b -u -p ~/miniconda3
rm -rf ~/miniconda3/miniconda.sh[METWKC-MAC-006:~] scott.powell% curl https://re
po.anaconda.com/miniconda/Miniconda3-latest-MacOSX-arm64.sh -o ~/miniconda3/mini
conda.sh
  % Total    % Received % Xferd  Average Speed   Time    Time     Time  Current
                                 Dload  Upload   Total   Spent    Left  Speed
100  105M  100  105M    0     0  64.4M      0  0:00:01  0:00:01 --:--:-- 64.5M
[METWKC-MAC-006:~] scott.powell% bash ~/miniconda3/miniconda.sh -b -u -p ~/minic
onda3
PREFIX=/Users/scott.powell/miniconda3
Unpacking payload ...

Installing base environment...

Preparing transaction: ...working... done
Executing transaction: ...working...
done
installation finished.
[METWKC-MAC-006:~] scott.powell% rm -rf ~/miniconda3/miniconda.sh
[METWKC-MAC-006:~] scott.powell%
```

Something like this will appear after Step 4.

Terminal — -tcsh — 122×52

```
rm -rf ~/miniconda3/miniconda.sh[METWKC-MAC-006:~] scott.powell% curl https://repo.anaconda.com/miniconda/Miniconda3-lates
t-MacOSX-arm64.sh -o ~/miniconda3/miniconda.sh
  % Total    % Received % Xferd  Average Speed   Time    Time     Time  Current
                                 Dload  Upload   Total   Spent    Left  Speed
100  105M  100  105M    0     0  64.4M      0  0:00:01  0:00:01 --:--:-- 64.5M
[METWKC-MAC-006:~] scott.powell% bash ~/miniconda3/miniconda.sh -b -u -p ~/miniconda3
PREFIX=/Users/scott.powell/miniconda3
Unpacking payload ...

Installing base environment...

Preparing transaction: ...working... done
Executing transaction: ...working...
done
installation finished.
[METWKC-MAC-006:~] scott.powell% rm -rf ~/miniconda3/miniconda.sh
[METWKC-MAC-006:~] scott.powell% ~/miniconda3/bin/conda init bash
~/miniconda3/bin/conda init zsh

no change     /Users/scott.powell/miniconda3/condabin/conda
no change     /Users/scott.powell/miniconda3/bin/conda
no change     /Users/scott.powell/miniconda3/bin/conda-env
no change     /Users/scott.powell/miniconda3/bin/activate
no change     /Users/scott.powell/miniconda3/bin/deactivate
no change     /Users/scott.powell/miniconda3/etc/profile.d/conda.sh
no change     /Users/scott.powell/miniconda3/etc/fish/conf.d/conda.fish
no change     /Users/scott.powell/miniconda3/shell/condabin/Conda.psm1
modified      /Users/scott.powell/miniconda3/shell/condabin/conda-hook.ps1
no change     /Users/scott.powell/miniconda3/lib/python3.12/site-packages/xontrib/conda.xsh
no change     /Users/scott.powell/miniconda3/etc/profile.d/conda.csh
modified      /Users/scott.powell/.bash_profile

==> For changes to take effect, close and re-open your current shell. <==

[METWKC-MAC-006:~] scott.powell% ~/miniconda3/bin/conda init zsh
no change     /Users/scott.powell/miniconda3/condabin/conda
no change     /Users/scott.powell/miniconda3/bin/conda
no change     /Users/scott.powell/miniconda3/bin/conda-env
no change     /Users/scott.powell/miniconda3/bin/activate
no change     /Users/scott.powell/miniconda3/bin/deactivate
no change     /Users/scott.powell/miniconda3/etc/profile.d/conda.sh
no change     /Users/scott.powell/miniconda3/etc/fish/conf.d/conda.fish
no change     /Users/scott.powell/miniconda3/shell/condabin/Conda.psm1
no change     /Users/scott.powell/miniconda3/shell/condabin/conda-hook.ps1
no change     /Users/scott.powell/miniconda3/lib/python3.12/site-packages/xontrib/conda.xsh
no change     /Users/scott.powell/miniconda3/etc/profile.d/conda.csh
modified      /Users/scott.powell/.zshrc

==> For changes to take effect, close and re-open your current shell. <==

[METWKC-MAC-006:~] scott.powell%
[METWKC-MAC-006:~] scott.powell%
```

Create a Python environment

1. Open a new terminal. Enter "zsh". You should see something like "(base)" appear at the beginning of the command line after this, meaning that miniconda is functioning in the terminal and that the base environment is active. We're not going to use the base environment though. We're going to create a new one.

2. Enter the following command to add the package repository conda-forge to your download options:

```
conda config --add channels conda-forge
```

3. Then enter the following to create a Python environment using packages in that repo:

```
conda create –c conda-forge –n mr2020 numpy scipy pandas matplotlib ipython
metpy xarray ipykernel
```

This will install the Python packages numpy, scipy, pandas, matplotlib, ipython, metpy, and xarray from the channel/package repository called conda_forge. Don't worry about installing everything you may ever need. You can always add on to your environment later. The "-n mr2020" means that this Python environment will be called mr2020. This will be useful to know soon. A bunch of stuff will pop up. Enter 'y', press enter, and wait for the transaction to execute. When done, close out the terminal (Command + q.)

Configuring git (This is the hardest part.)

3. Quit Visual Studio Code and reopen it.

4. Click on the git icon. You should now see a button called "Initialize Repository" or "Clone Repository". This means that your git installation worked!

5. In a terminal (open a new one if needed), enter the following commands (hit enter 3 times after the first line when prompted):

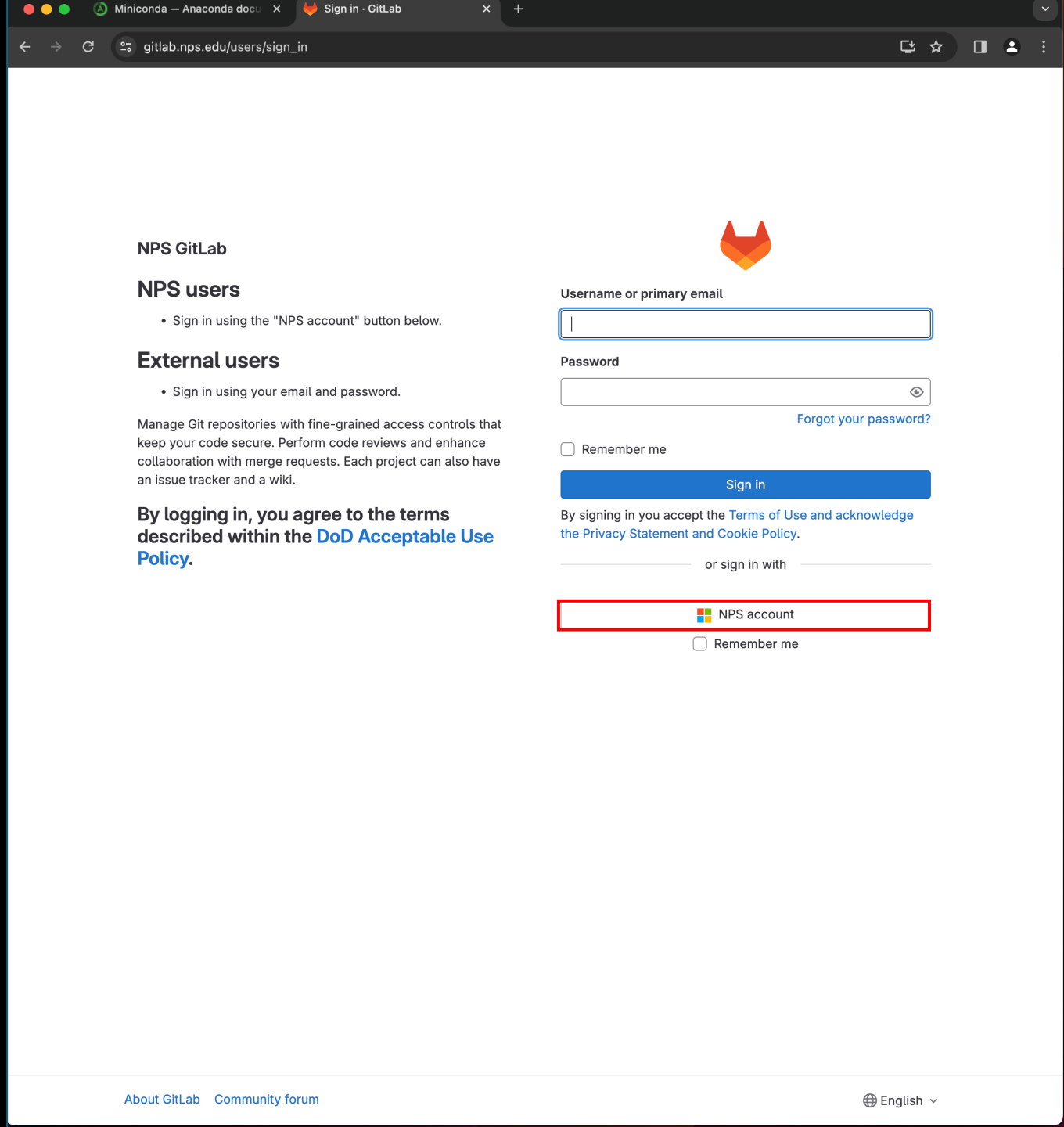
```
ssh-keygen –t ed25519 –C your_NPSname@nps.edu
cd ~/.ssh
less id_ed25519.pub
```

After the less command you should see something like the below. Expand the window to get everything on one line if necessary and leave the window open. We'll come back to it soon.

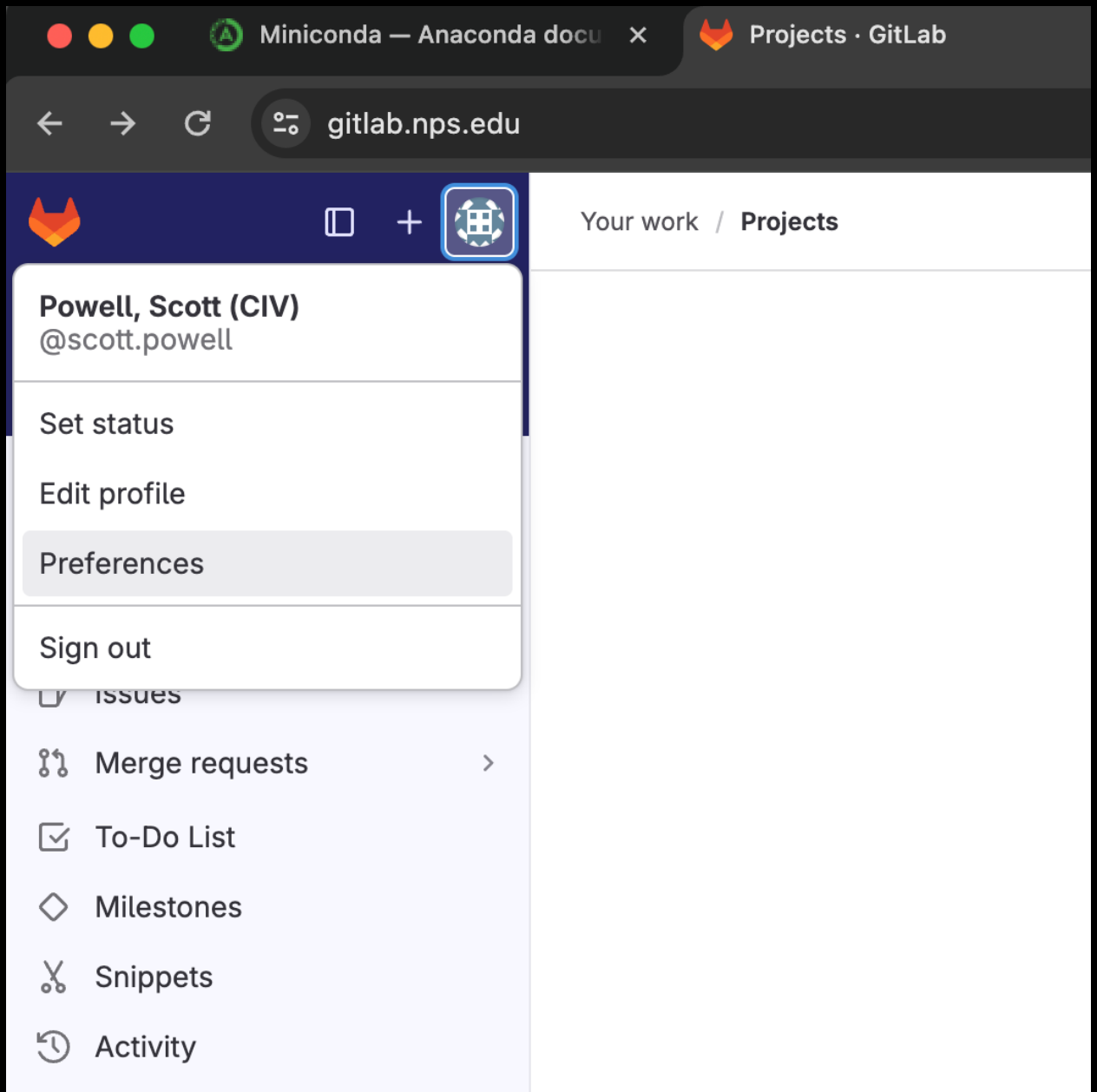
Terminal — less id_ed25519.pub — 120×24

```
ssh-ed25519 AAAAC3NzaC1lZDI1NTE5AAAAIOjP9J7dWTuZ2Ujg8s+khP4QXLHOTkNR2UMpHpmoen4f scott.powell@nps.edu
~
~
```

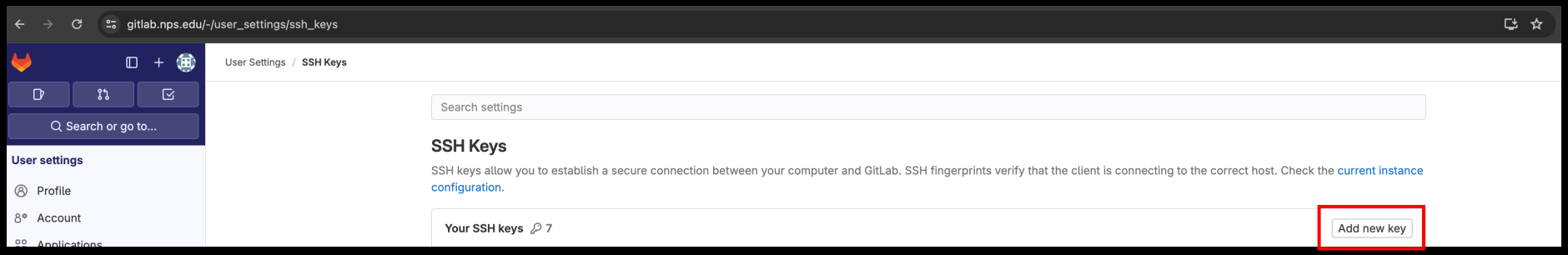
6. Open a browser window (e.g., Google Chrome, Safari). Go to gitlab.nps.edu and Click the “NPS Account” button. Enter your login credentials and go through the 2FA prompts using Microsoft Authenticator.



7. In the browser, enter the circular avatar icon in Gitlab (see screenshot), select Preferences. After a new page loads, select “SSH keys” from the new menu bar on the left.



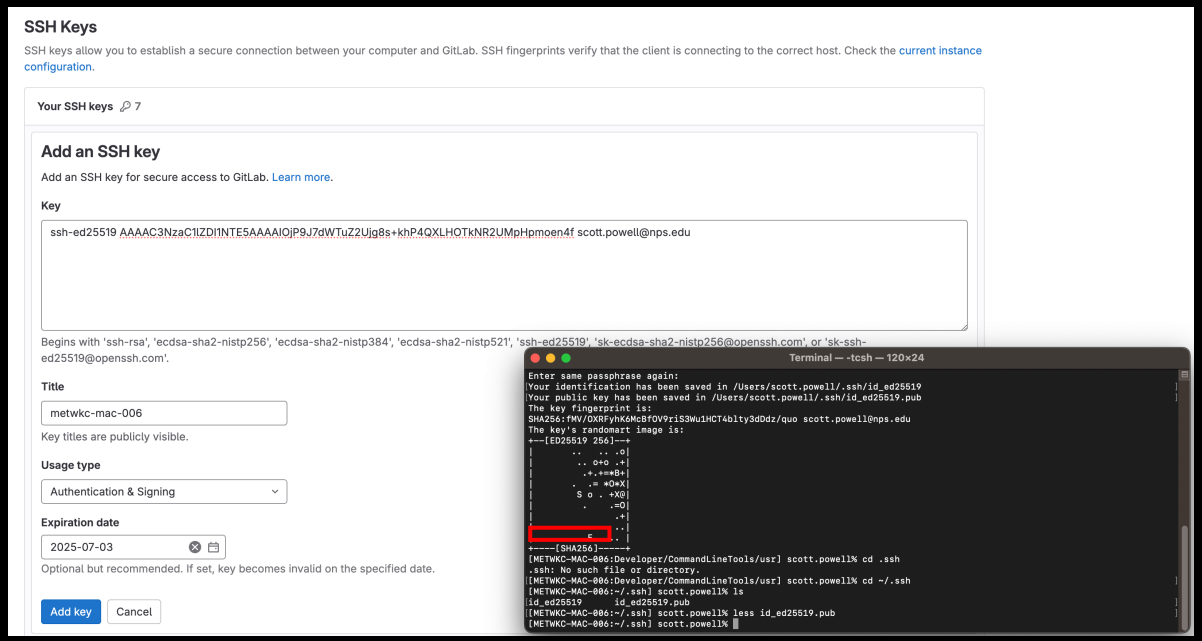
8. Click "Add a key".



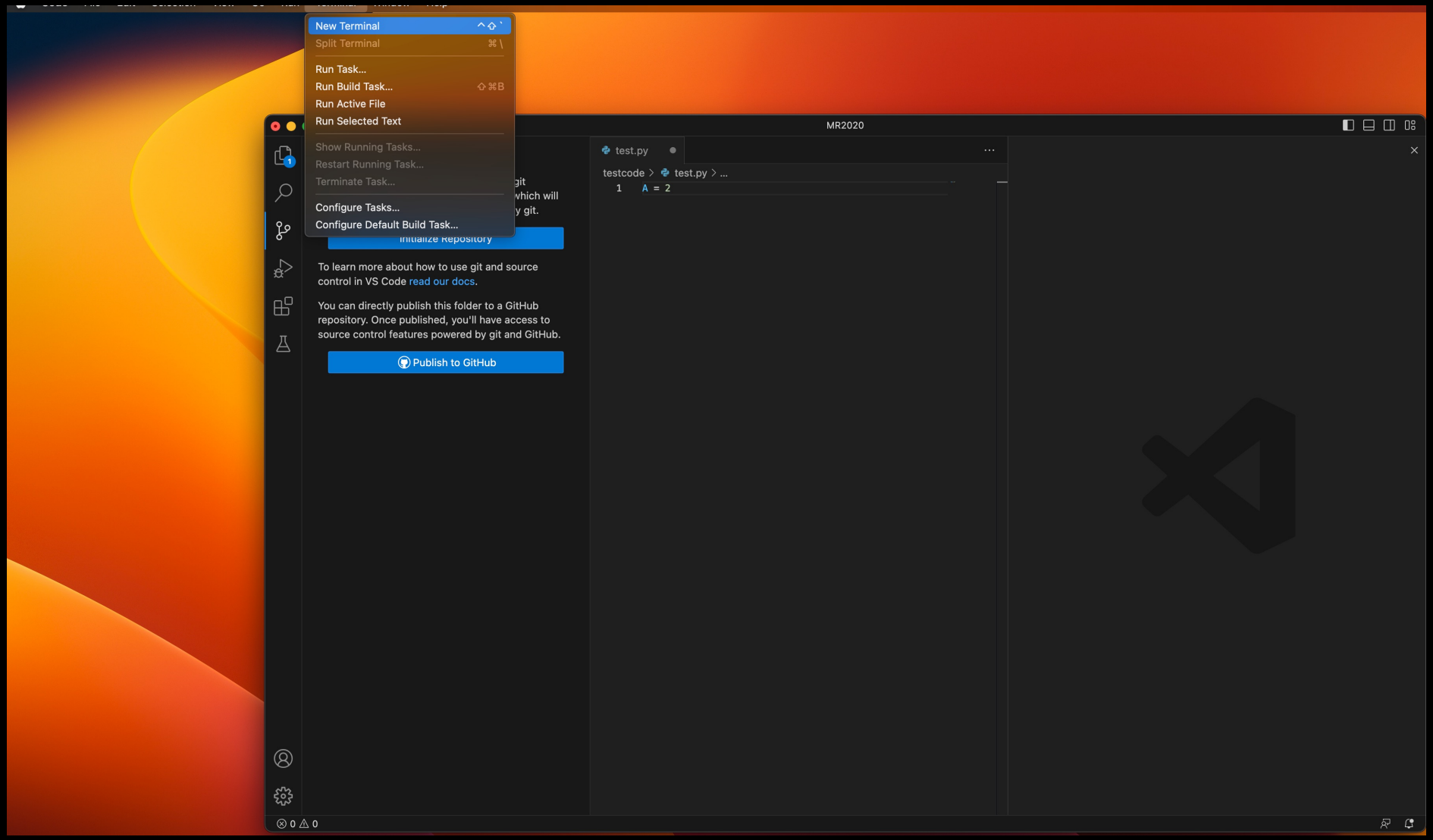
9. Copy and paste the entire SSH key from the open terminal window into the Key box as shown to the right.

For Title, enter the name of the machine you are working on. It will be the part in the red box in the terminal inset in bottom right of image.

Then, click Add Key.



10. In Visual Studio Code, look at the menu bar at the top and open a new terminal.



11. In the VSC terminal window, enter ssh –T git@gitlab.nps.edu. Type and enter "yes" when prompted. You should get a message that says, "Welcome to Gitlab, @username!"

MR2020

SOURCE CONTROL

The folder currently open doesn't have a git repository. You can initialize a repository which will enable source control features powered by git.

Initialize Repository

To learn more about how to use git and source control in VS Code read our docs.

You can directly publish this folder to a GitHub repository. Once published, you'll have access to source control features powered by git and GitHub.

Publish to GitHub

test.py

testcode > test.py > ...

```
1  A = 2
```

Make sure that TERMINAL is white with a blue line beneath it.

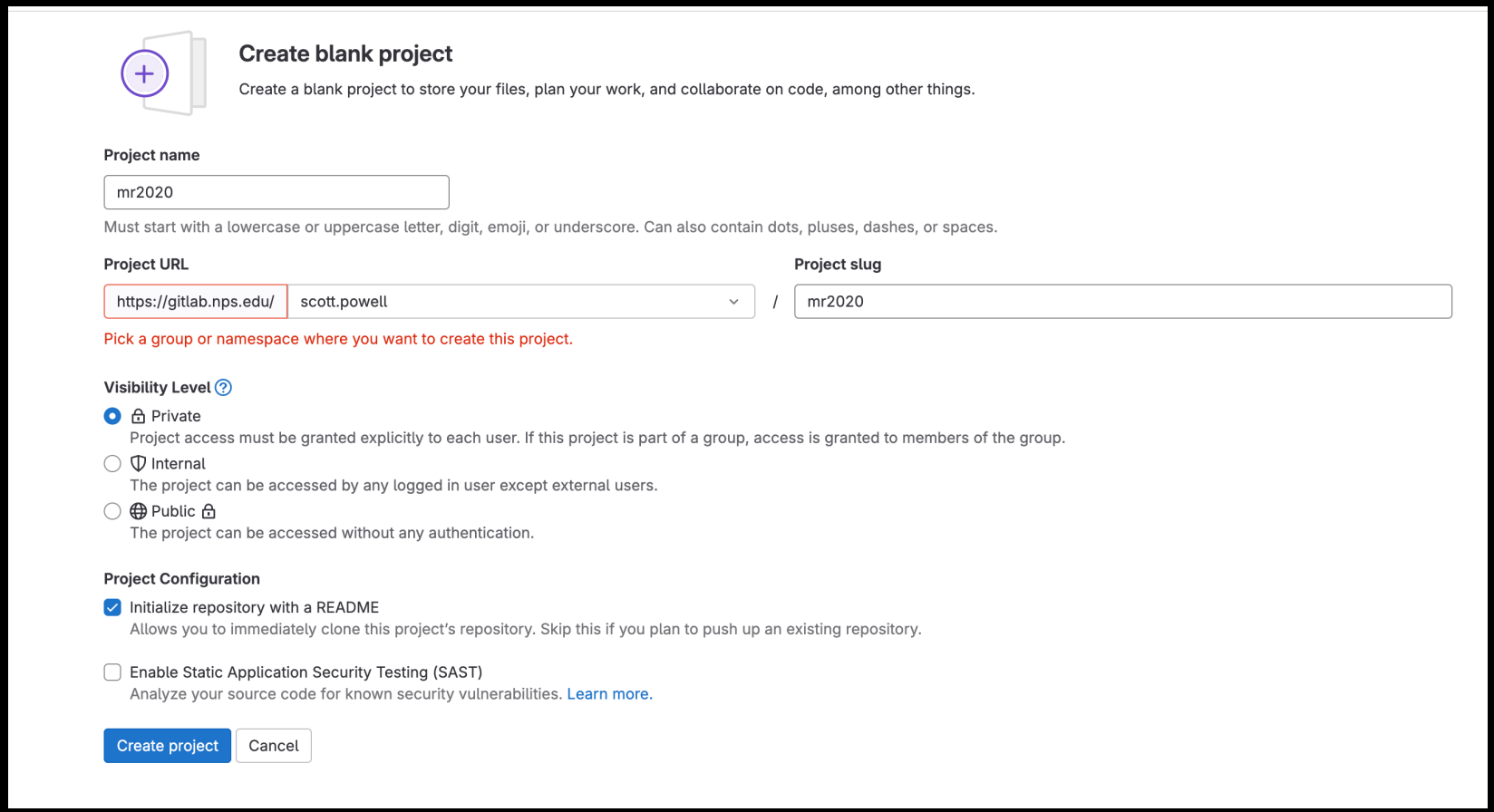
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

```
[METWKC-MAC-006:~/Desktop/MR2020] scott.powell% ssh -T git@gitlab.nps.edu
You are accessing a U.S. Government (USG) Information System (IS) that is provided for USG-authorized use only. By using this IS
(which includes any device attached to this IS), you consent to the following conditions: -The USG routinely intercepts and monit
ors communications on this IS for purposes including, but not limited to, penetration testing, COMSEC monitoring, network operati
ons and defense, personnel misconduct (PM), law enforcement (LE), and counterintelligence (CI) investigations. -At any time, the
USG may inspect and seize data stored on this IS. -Communications using, or data stored on, this IS are not private, are subject
to routine monitoring, interception, and search, and may be disclosed or used for any USG-authorized purpose. -This IS includes s
ecurity measures (e.g., authentication and access controls) to protect USG interests-not for your personal benefit or privacy. -N
otwithstanding the above, using this IS does not constitute consent to PM, LE or CI investigative searching or monitoring of the
content of privileged communications, or work product, related to personal representation or services by attorneys, psychotherapi
sts, or clergy, and their assistants. Such communications and work product are private and confidential. See User Agreement for d
etails.
Welcome to GitLab, @scott.powell!
[METWKC-MAC-006:~/Desktop/MR2020] scott.powell%
```

tcsh
tcsh

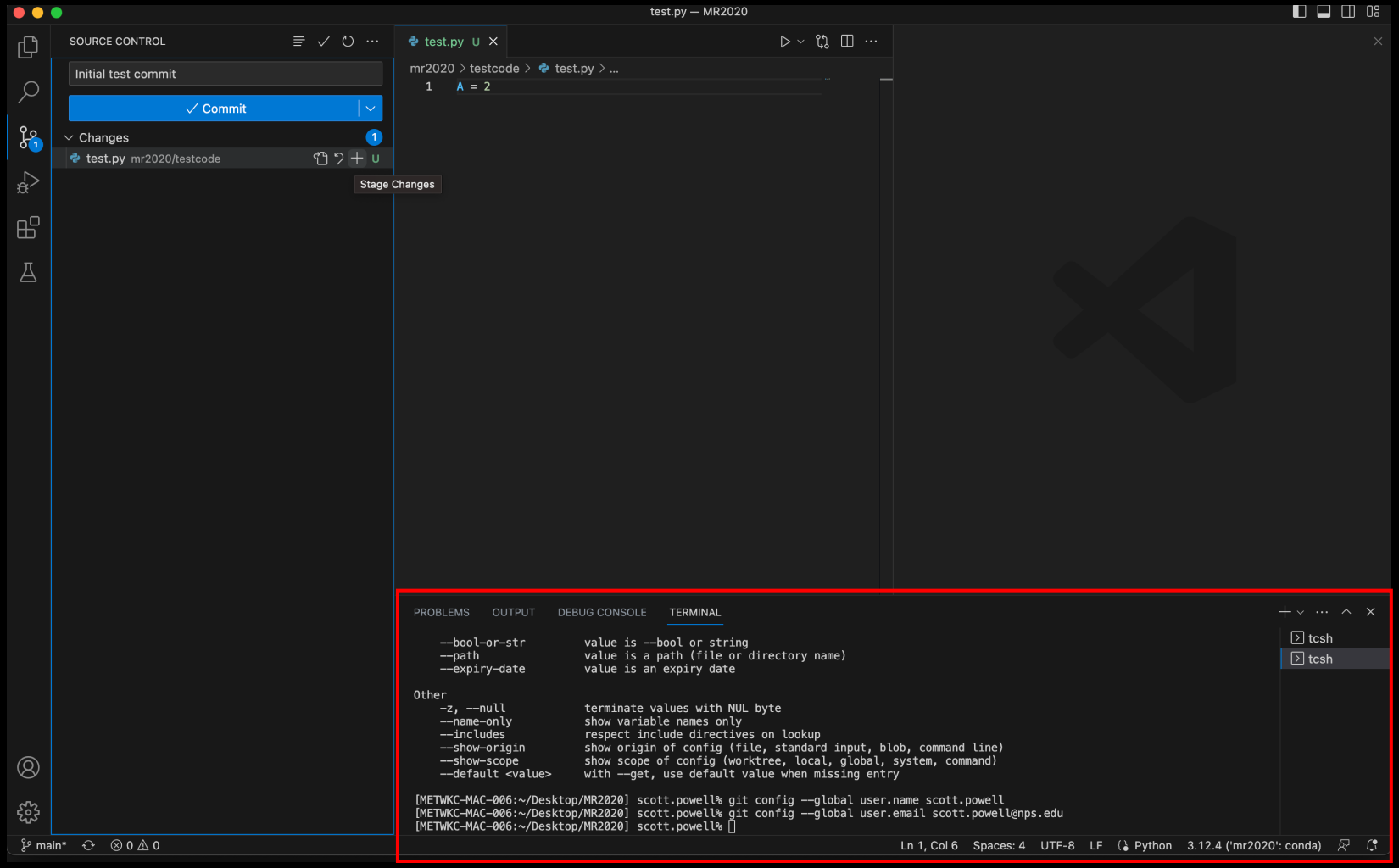
⊗ 0 ⚠ 0

12. Back in the browser window with Gitlab, hit the fox in the top left. In the top right of the screen that displays, there is a blue button that says, “New Project”. Click it. Follow the screenshots to create a repository called “mr2020”. Under Project name, enter “mr2020”. Under ”Project URL”, choose your user name from the drop-down menu. Under “Project slug”, enter ”mr2020”. Then, click the blue “Create Project” button.

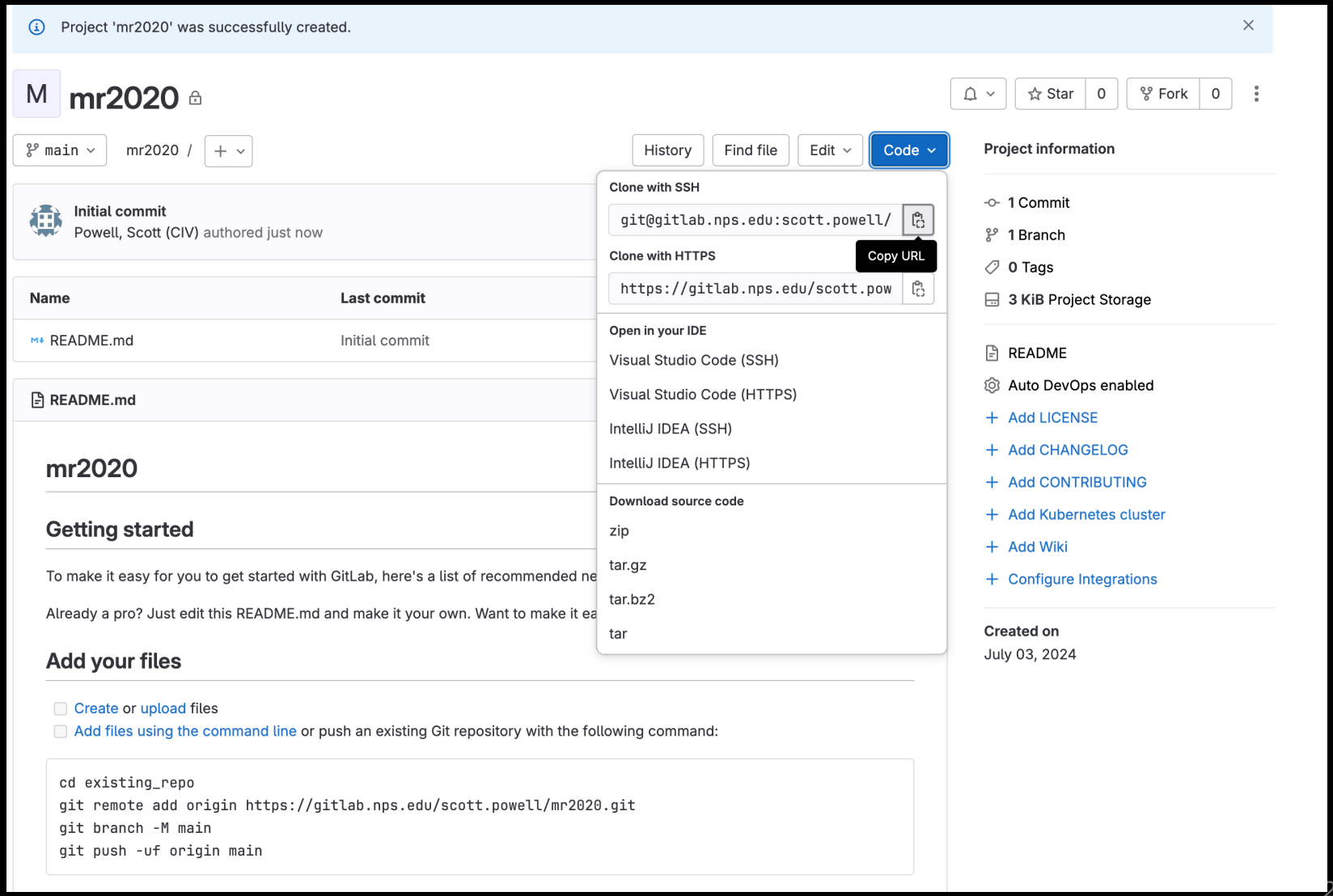


13. Back in Visual Studio Code, in the terminal enter the following (replacing scott.powell with your NPS login name):

```
git config --global user.name scott.powell
git config --global user.email scott.powell@nps.edu
```



14. We need to clone the repo. Right-click on your Desktop and create a new folder. Call it MR2020. In the browser, click the blue “Code” button in the top right, and copy the text under “Clone with SSH”.



15. Back in VSC, in the terminal, type and enter the following two lines one at a time:

cd
cd Desktop
mkdir MR2020
cd MR2020

Then, in the terminal, type in git clone and paste the command you copied from the browser into the terminal as seen below and press enter. (See below.) Your repo is now set up and linked to VSC!

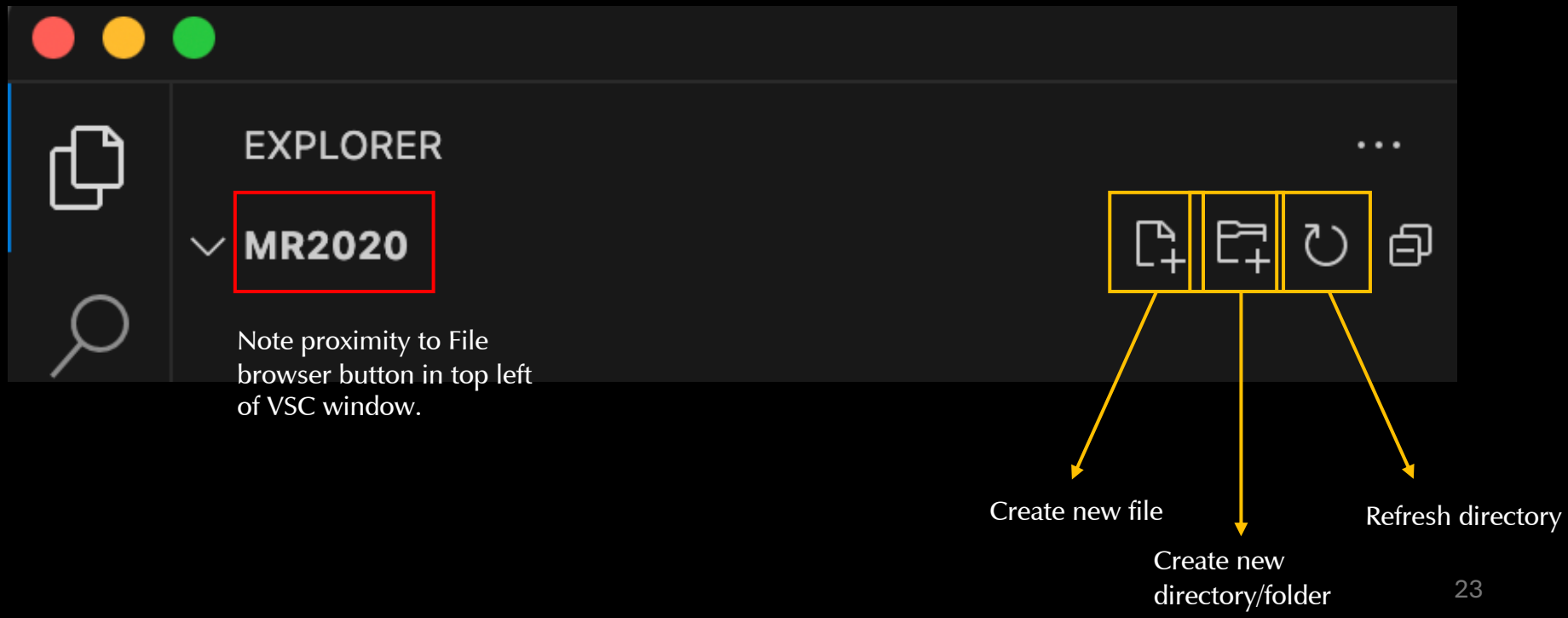
```
ata stored on this IS. -Communications using, or data stored on, this IS are not private, are subject t
or any USG-authorized purpose. -This IS includes security measures (e.g., authentication and access con
withstanding the above, using this IS does not constitute consent to PM, LE or CI investigative searchi
 related to personal representation or services by attorneys, psychotherapists, or clergy, and their as
ee User Agreement for details.
Welcome to GitLab, @scott.powell!
[METWKC-MAC-006:~/Desktop/MR2020] scott.powell% cd Desktop
Desktop: No such file or directory.
[METWKC-MAC-006:~/Desktop/MR2020] scott.powell% ls
testcode
[METWKC-MAC-006:~/Desktop/MR2020] scott.powell% cd
[METWKC-MAC-006:~] scott.powell% cd Desktop/MR2020
[METWKC-MAC-006:~/Desktop/MR2020] scott.powell% ls
testcode
[METWKC-MAC-006:~/Desktop/MR2020] scott.powell% git clone git@gitlab.nps.edu:scott.powell/mr2020.git
```

⊗ 0 ⚠ 0

Updating your repo and pushing to GitLab

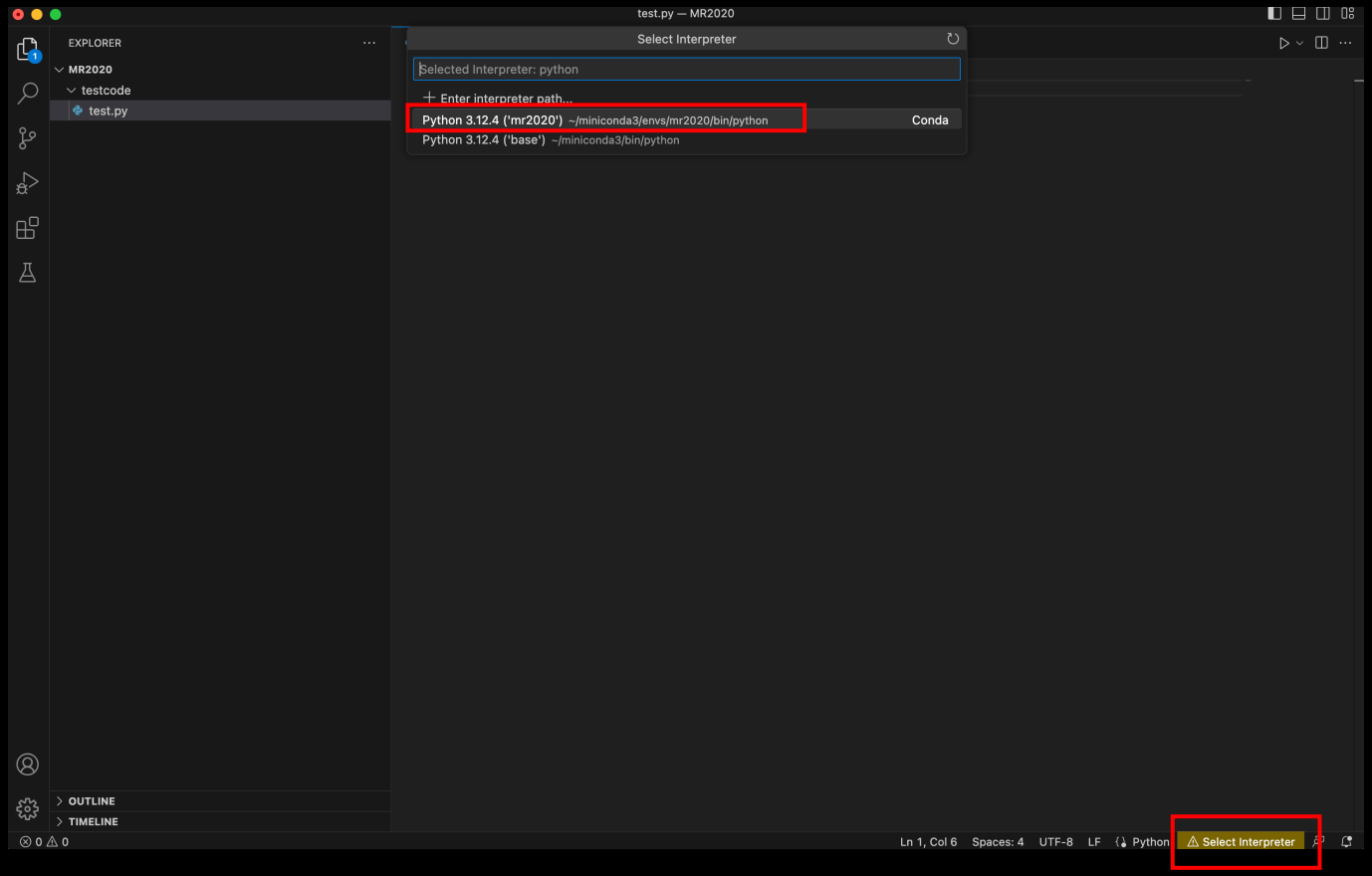
16. Next, let's put something meaningful into the repository you just created. Click the File browser button in VSC. Click the blue "Open Folder" button. Choose "Desktop -> MR2020 -> mr2020". If prompted, trust the author (yourself). After a few seconds, you should see a README file populate the file browser since your repo was initialized with one.

17. If you hover over the area near the "MR2020" text in the upper right (see red box on image below), you'll see some icons pop up nearby (in the orange box). See the image below for details about these icons.



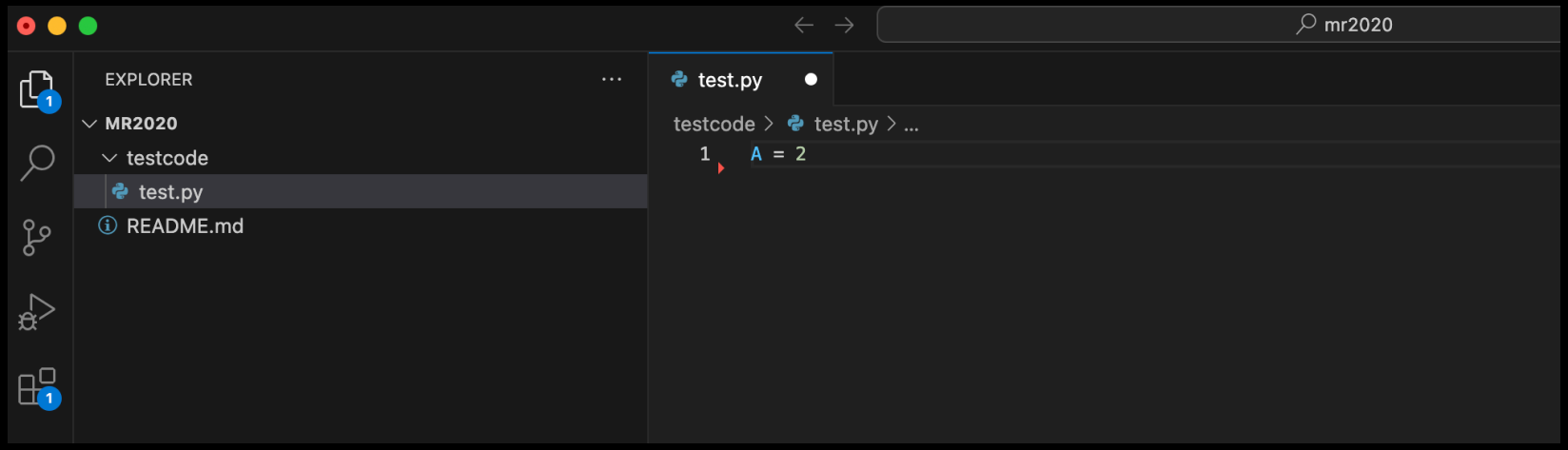
18. Click the new directory button and create a directory called “testcode”. Click on that folder, then create a new file and call it “test.py”. Click on test.py to cause a tab to open to the right.

19. In the bottom right, hit “Select Interpreter”. Select mr2020 from the dropdown menu. This is the Python environment you created earlier.



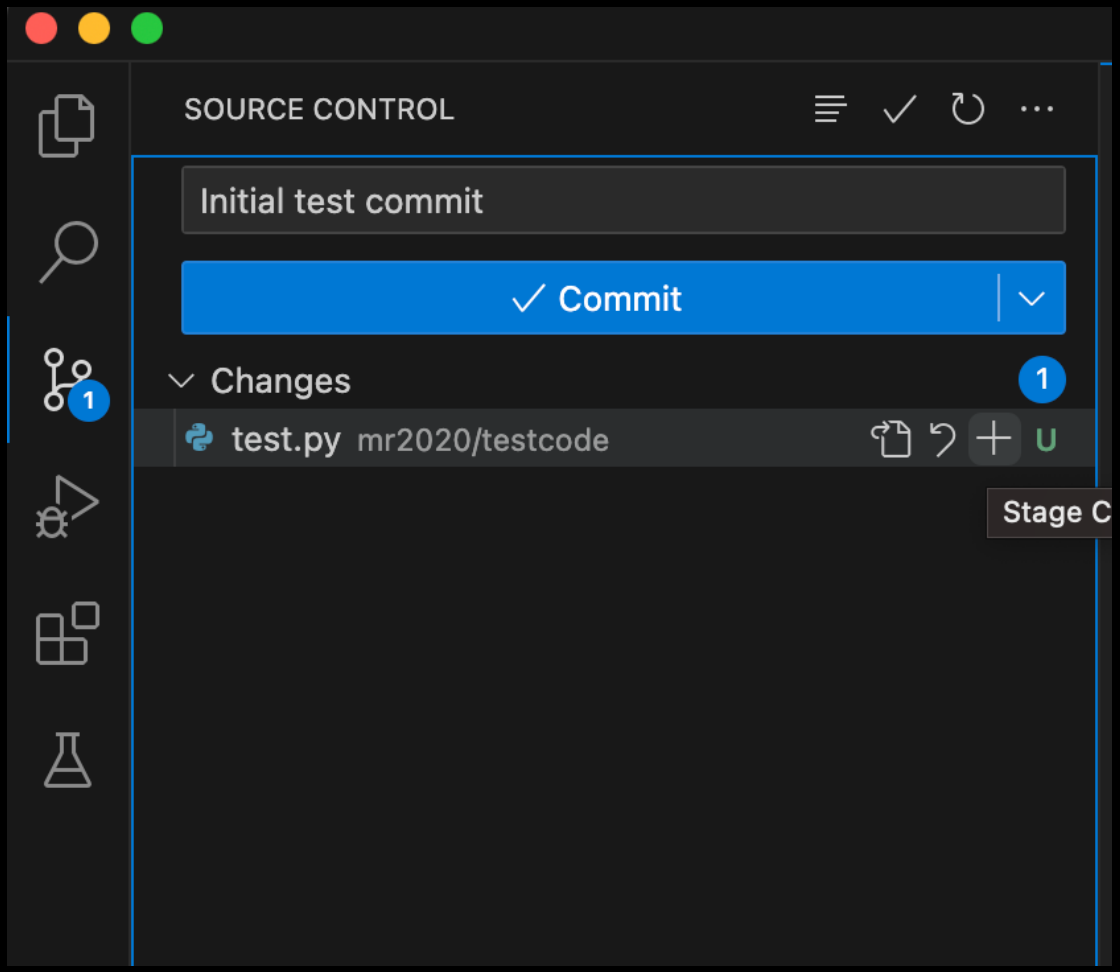
20. Enter the following code for test.py:

$A = 2$



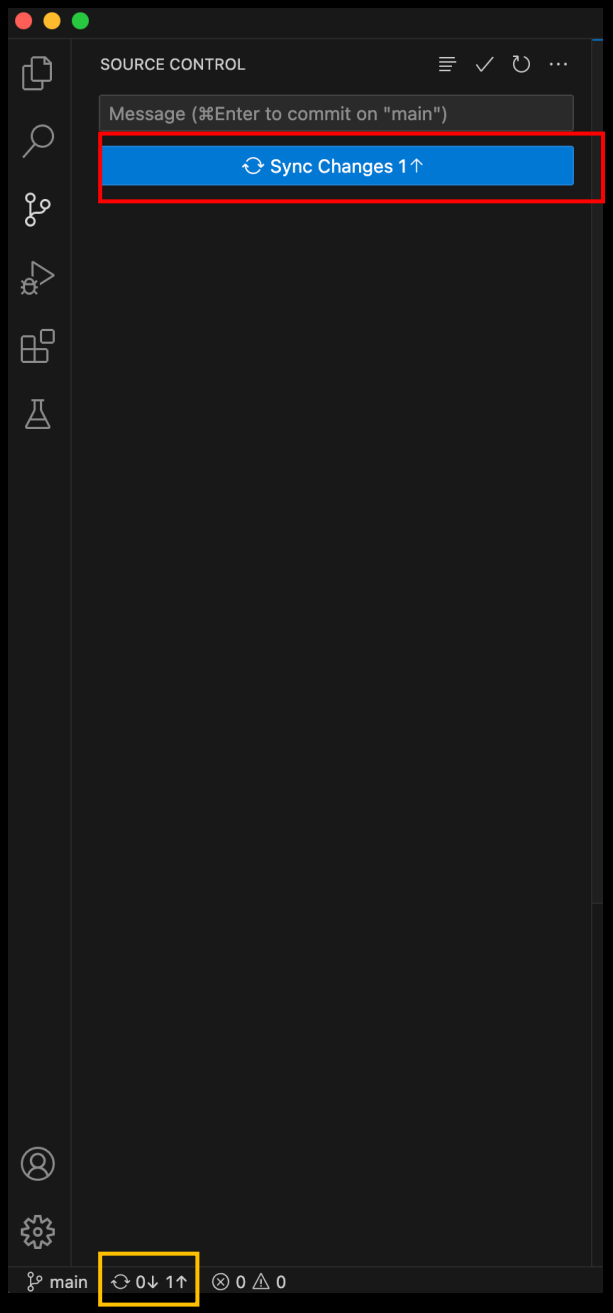
After you do so, a little blue bubble with a number in it should appear on the git icon on the left menu bar of VSC. (There are blue bubbles for other things shown in the image above but not for the git icon.) The number in the git icon bubble indicates how many files have been changed since the last push to GitLab, i.e., how many files have progress that has not been backed up.

21. Click the git button. You will see a list of files that need to be pushed to GitLab for backup. Click the plus next to the file you want to push. It will move to a tab labeled “Staged Changes”. Enter a message in the box above the blue Commit button (such as “Initial test commit”. Then click Commit.



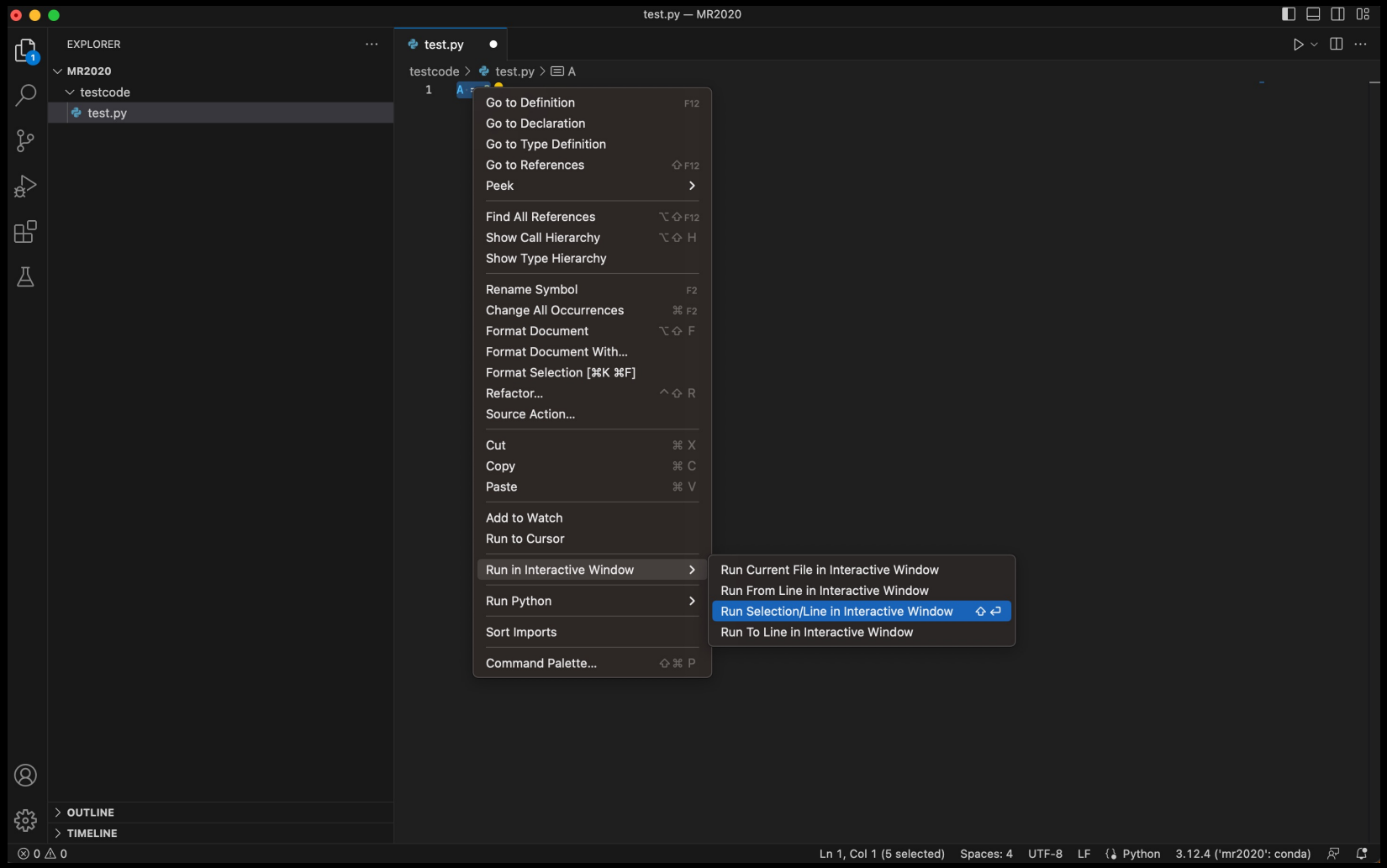
22. You haven't finished the push yet! Make sure you click the Sync button(red box in the image below) after the Commit button goes away. If no sync button appears, look in the bottom left of the VSC window and click the up arrow with a number next to it (orange box in image below).

Refresh the browser window in Gitlab, and you should see your new directory appear. Inside the directory, if you click it, you will see the test.py code. You may now close out the browser window. You should not need to login to Gitlab via the browser anymore.

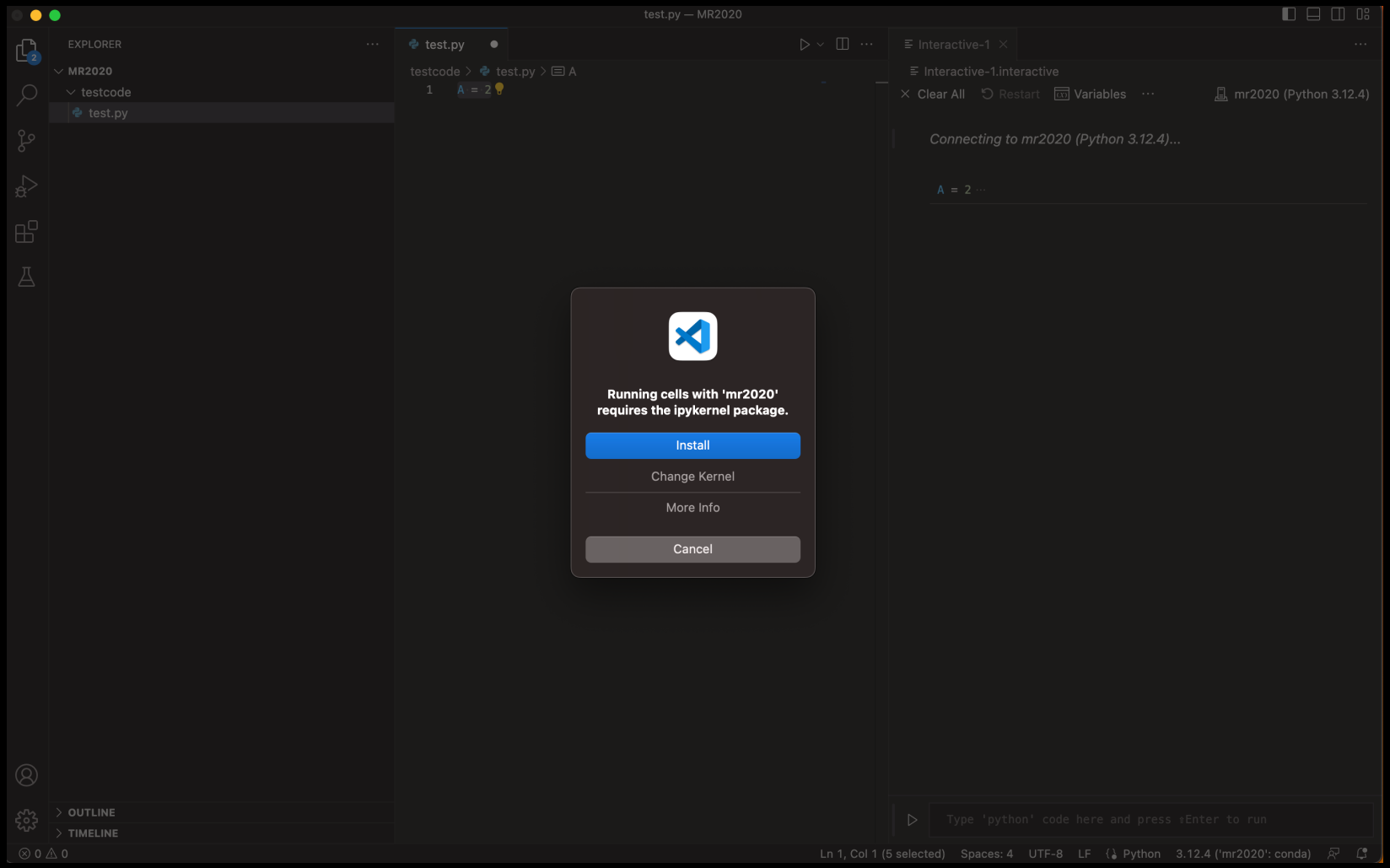


Running code in an interactive window

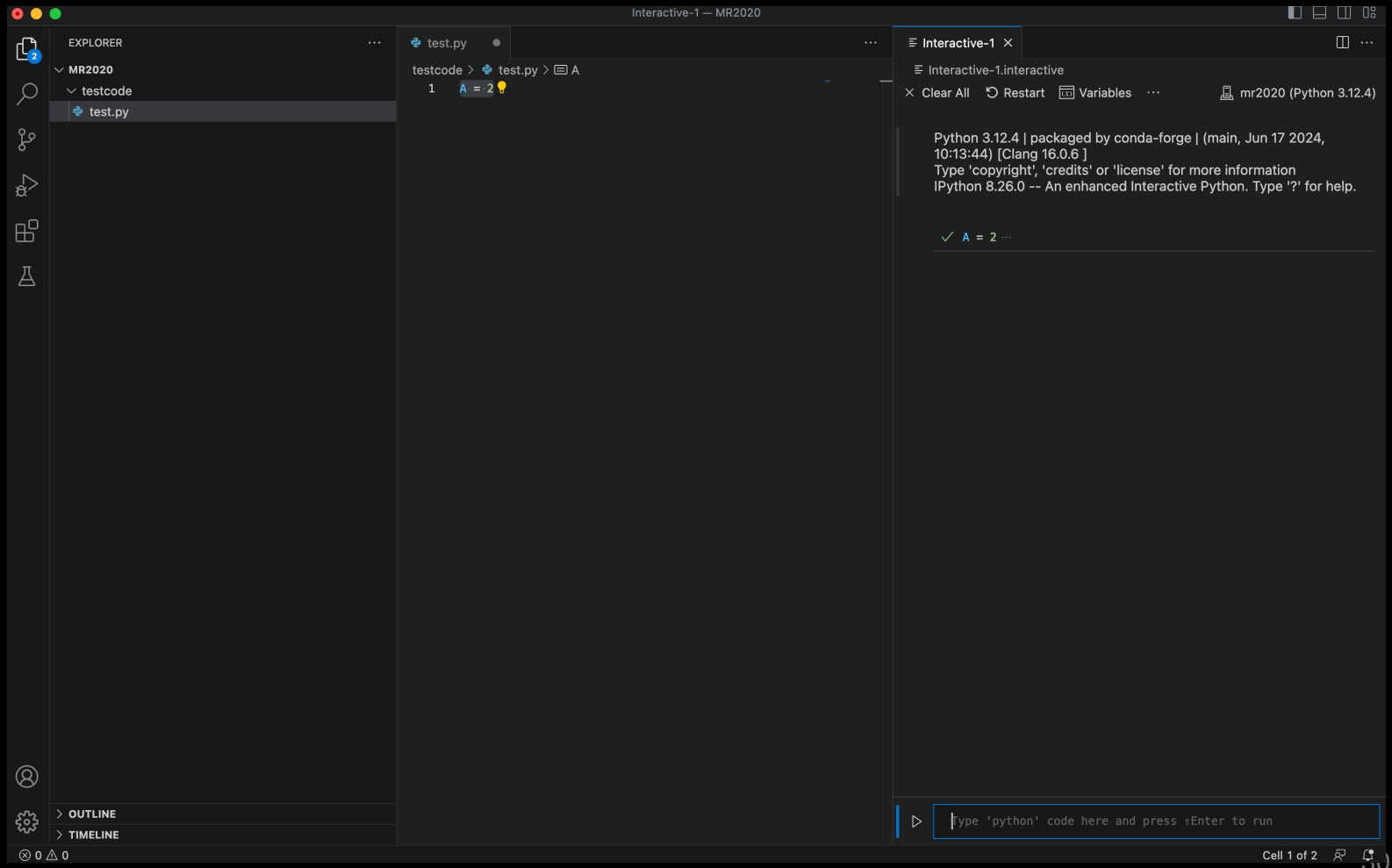
In VSC, highlight the code A = 2 in test.py. Select “Run in Interactive Window” -> “Run Selection/Line in Interactive Window” as shown below.



Click install to install ipykernel into the environment if prompted. If not, continue. If asked if you want to periodically run “git fetch”, click no.



You should get something like the screen below, with an interactive window appearing to the right of the code. You can enter or copy/paste other snippets of code into the box at the bottom of the interactive window and either pressure Command + Enter or press the play button to execute the code. You can close the interactive window by pressing the x on the tab near the top of the screen that says “Interactive-1”.



Get a ChatGPT account

Go to chatgpt.com in a browser. Use your existing login, or if you don't have one, sign up for account by clicking the green button in the bottom left of the screen.