

Create Python Project from Scratch

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Create a Python Project from Scratch with Visual Studio Code & UV

This document provides detailed instructions for setting up your Python environment for this course/workshop. You should have already read the information in the [00_setup_slides](#) and completed the installation of Visual Studio Code and Python using uv by following [Setup Notebook 01](#).

Table of Contents

1. setup project in Visual Studio Code (10 mins.)
2. write your first markdown document (10)
3. set up virtual environment
4. write your first script
5. write your first notebook
6. import external data

1. Setup Project in Visual Studio Code

1a. Set up sample project folder

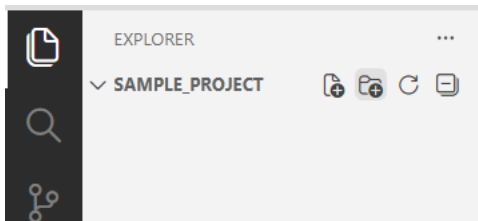
1. Create a new folder for your sample project in a place which you can easily find again. Follow recommended file naming projects (outlined in [00_setup_slides](#)) such as using underscores _ in place of whitespace, avoiding special characters, etc. i.e.:

`~/Users/your-user-name/Documents/python_code/sample_project`

1b. Open Project Folder in Visual Studio Code

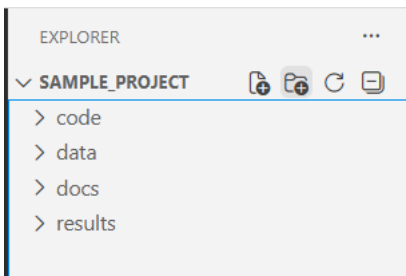
Visual Studio Code and other IDEs allow you to load an entire project at once. Thus, you can easily switch between projects and when you return to a given project all the same files that were open before are opened once again. Below, we will open our sample project folder and modify it.

1. Open Visual Studio Code, which you installed with [notebook 01](#).
2. Click on **File** -> **Open Folder**. Navigate to your new project folder and open it.
3. In the left pane of VSC, click on the **Explorer** icon (looks like pages or files) and you will see your empty folder there.



4. Add the following folders using the **+ Folder icon**:

```
|--code  
|--data  
|--docs  
|--results
```



2. Setting Up a Python Virtual Environment for your project

As noted in the opening slides presentation ([html](#) or [pdf](#)) “A virtual environment keeps each project’s packages separate and organized, preventing conflicts and making your code easy to share.”

We will now use `uv` to create a virtual environment for our sample project.

2a. Open the command line in VSC

1. Select the **Terminal** tab at the top of VSC -> **New Terminal**
2. A new terminal should appear at the bottom.
3. If you are using a PC, it is recommended you use a **Command Prompt** terminal instead of **Powershell**. To open Command, select the + symbol at the far right side of the terminal pane, and select **Command Prompt**.

2b. Confirm VSC can find your Python and uv installations

1. In the **terminal**, you can test to see if VSC can find your Python and uv installations (just as we did in notebook 01) by running the following code:

```
uv --version
```

```
uv python list
```

2c. Create Virtual Environment

Make sure you are in the project root folder, i.e. your terminal should look like something like this (with a path to your project directory shown):

```
f0040rp@7KF61T3 MINGW64 ~/Documents/Python_Scripts/sample_project  
$ █
```

If you are not in the project root directory you can navigate to it by using the `cd` (change directory) command. Some tips:

1. to navigate up one directory type `cd ..`
2. to navigate up 3 directories type `cd ../../..`
3. to navigate from the current working directory into your code folder type `cd code`.
4. to navigate down two directories, type something like this: `cd code/scripts` (assuming the code folder is in your current working directory and a scripts folder is inside of that).

Now, run the following in your project's root directory from the **terminal**:

```
# This initiates a new uv environment for your project  
uv init
```

You will see in the **Explorer pane** on the left side of VSC several new files and folders were created in your project's working directory. The above command:

- Installed Python if the correct version isn't available
- Created a `pyproject.toml` file, where uv will store information about the packages / dependencies used in this project.
- Created a `.python-version` file to store the version of Python used for this project.

2d. Install / add packages to virtual environment

Initiating **uv** *may also create* a `uv.lock` file and a `.venv` folder if you have already installed some packages. Let's test this out by installing a package to our local environment at which point this file and folder will be created:

Run in the terminal:

```
uv add requests
```

Certainly, now you should see the following in your project's root directory:

- a `uv.lock` file which may be used by others (or by yourself in a different environment)
- a `.venv` folder where the code for all projects added to the local environment are stored

You can also install / add multiple packages at once:

```
uv add numpy pandas rich
```

You can use `uv remove` to uninstall packages. We really didn't need **requests**. Let's uninstall it:

```
uv remove requests
```

You can review what packages have been installed in multiple ways. You can open either the `pyproject.toml` or the `uv.lock` file. Or you can run the following in the terminal:

```
uv pip list
```

You should see something like this:

Package	Version
-----	-----
markdown-it-py	4.0.0
mdurl	0.1.2
numpy	2.4.1
pandas	2.3.3
pygments	2.19.2
python-dateutil	2.9.0.post0
pytz	2025.2
rich	14.2.0
six	1.17.0
tzdata	2025.3

*Note: the `.toml` file and `uv pip list` return all packages installed including dependencies. For example, when we installed **rich**, UV also installed the packages rich depends on: `markdown-it-py`, `mdurl`, and `pygments`. In contrast, the `uv.lock` just lists the actual packages that you, the user, installed:

```
dependencies = [
    "numpy>=2.4.1",
    "pandas>=2.3.3",
    "rich>=14.2.0",
]
```

This is because `uv.lock` serves as instructions for the re-creation of this environment on another computer. If you were to open this project on a different computer, you would run the command `uv sync`, which would recreate your environment by installing the specific versions of `numpy`, `pandas`, and `rich` you have installed on your machine. When those are installed, their dependencies will be automatically installed as well.

Now, try running this:

```
pip list
```

Notice any difference from the results returned by `uv pip list`? In my case this second command returned many, many more packages? Why? It's because the `uv` command automatically just retrieves the names of packages installed to the local virtual environment, whereas `pip` is retrieving all packages installed. That is why, under the `pip` system, you need to activate your virtual environment with `.venv/Scripts/activate` (Windows) or `.venv/bin/activate` (Macs) every time you open a project. Fortunately, with `uv`, we are automatically using the virtual environment whenever we call `uv` within a project that has one.

2e. Set up the Python Interpreter

One final step: every time we start a new project in VSC we need to configure VSC to use the correct version of Python. We can do this by selecting our Python interpreter:

1. Open the “Show and Run Command Bars” (either select from central dropdown project menu at top of screen or by clicking CTRL + SHIFT + P on Windows or CMD + CTRL + SPACE on a Mac)
2. Search for and select **Python: Select Interpreter**

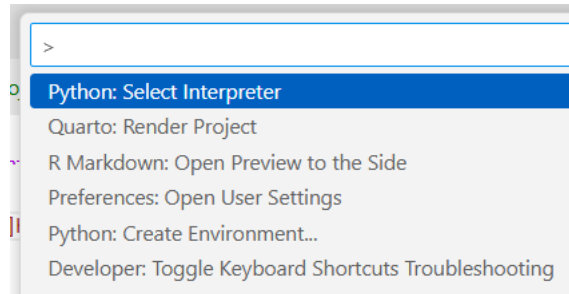


Figure 1: Select “Python: Select Interpreter” from Show and Run Command Bars

3. Choose the version of Python installed to your local environment. It should look something like this: ‘Python 3.14.2 (name-of-project) .venv/Scripts/python.exe Recommended’

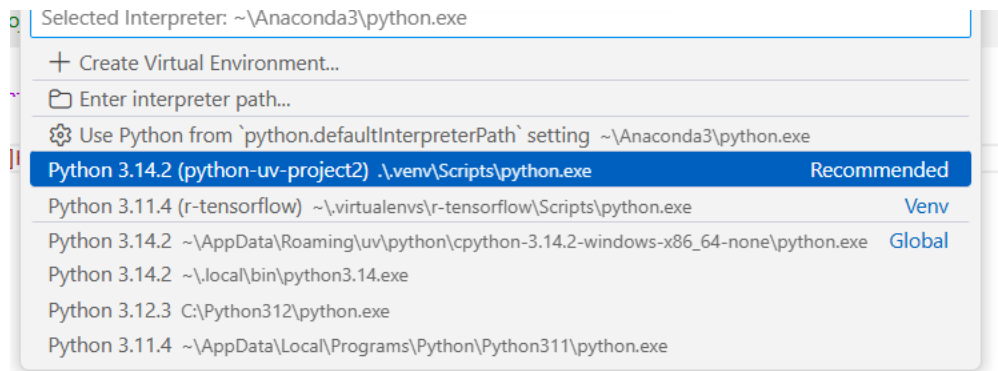


Figure 2: Select the version of Python found within your local project environment

Let's view which version of Python is being used by this project. Run the following in the **terminal**:

```
uv run python --version
```

VS Code Setup Checklist

```
Install VS Code
Install Python extension (ms-python.python)
Install Jupyter extension
Open project folder
Select interpreter: Ctrl+Shift+P → "Python: Select Interpreter" → .venv
Configure terminal to use uv
```

3. Write your first markdown document

A **markdown** file is a text file that allows you to use simple symbols to specify its formatting. This notebook and the **00_setup_slides** presentation were both created using markdown.

Some commonly used symbols:

```
# Header level 1 (note '#' should be the first symbol on the line and followed by a single w
## Header level 2
### Header level 3
**bold**
*italics*
[filename](link/to/file)  # to create hyperlinks
```
place code blocks between sets of 3 back ticks
```
```

In the Explorer pane on the left, create a new file using the + **File icon** and name it **README.md** (**.md** is the extension for a markdown file).

Create a skeletal outline of a README file using headers of different levels, bold, italics, links, and code blocks (see the symbol directory above or the Markdown Guide's [Cheat Sheet](#) for more examples of Markdown syntax). Include the following information:

1. tentative name of your project
2. name(s) of author(s) (you!)
3. Overview section
4. Data section
5. Methods section

Save the file.

4. Write your first Python script

1. Create a Python script in your **code/** folder and name it something like this: **greeting.py**.

1. Create a new script either by navigating to the **code/** folder, right-clicking it, and selecting **New File**. Be sure to give the file the **.py** extension.
2. OR **File** → **New File** and then give your file a name and place it in the **code** folder.

*Note: using the correct extension is essential so the computer knows how to read it. A **.py** file is a plain text file containing Python code that can be run with software like VSC or from the command line.*

2. Type / paste in the following code (modifying it to make it your own) in the **Python script**:

```
# Get the user's name
name = input("What's your name? ")

# print(name, "is a beautiful name.")
```

3. Save the script (important: when you run a script it will only run the most recently saved version).
4. Run your script in the **terminal** using uv:

```
uv run code/greeting.py
```

5. Other options to run this file:

- a. **Right-click** anywhere within **greeting.py** (in VSC) and select **Run Python** → **Run Python File in Terminal**
- b. You can also run the script by selecting the **Play icon button** at the top of the editor window where you have **greeting.py**. Note: with this method, you are NOT using uv to run the script. Therefore, VSC may not know which Python version on your computer to run or it may choose a version that doesn't work. If you get an error: choose the version that looks something like this: **Python 3.XX.X (sample-project) .\.venv\Scripts\python.exe** **Workspace**.

Optional additions to script:

add to your **Python** script:

```
# Get their favorite color
color = input("What's your favorite color? ")

# Respond based on their color choice
if color.lower() == "blue":
    print(f"Hello, {name}! Blue is a calm and peaceful color. Great choice!")
elif color.lower() == "red":
    print(f"Hello, {name}! Red is bold and energetic. I like it!")
elif color.lower() == "green":
    print(f"Hello, {name}! Green is the color of nature. Very refreshing!")
else:
    print(f"Hello, {name}! {color.title()} is a wonderful color!")
```

4b. Create a Script Requiring External Code from a Python Package

You can only do a few simple things with core Python code. Anything more complex - from data analysis to statistics, working with images and text, etc. - you will need to:

1. install the package to your local environment using `uv` (do this once per project)
2. import the package into any scripts or notebooks that use it (must include in each code script or notebook)

We will create a **random compliments generator** in a Python script, which requires the use of two packages:

- **random** (which is part of the core Python installation and thus DOES NOT need to be installed, but DOES need to be imported) and
- **rich** (which DOES NEED to be installed AND imported).

To install **rich** run the following in the **terminal**:

```
uv add rich
```

You can confirm the installation of this package to your local environment in multiple ways.

1. Open the `pyproject.toml` file and you should see it listed among the dependencies.
2. Open `uv.lock` and you can see information about the installed **rich** package.
3. Review code files for the rich package stored in `.venv/Lib/site-packages`.

4. Type `uv pip list` or `uv pip freeze` in the command line / terminal.

*NOTE: Never manually modify any of the above unless you know what you are doing. These files and folders are manually updated by **uv** when you run `uv` commands.*

Then paste / type the following into a new **Python** script called `compliment_generator.py`.

```
import random
from rich import print

# List of compliments
compliments = [
    "You're doing an amazing job learning Python! ", # \U0001F389
    "Your curiosity is inspiring! ", # \U00002B50
    "You have great potential as a programmer! ",
    "Keep up the excellent work! ", # \U0001F680"
    "You're braver than you think for trying something new! "
    " "
]

# Get user's name
name = input("What's your name? ")

# Pick a random compliment
chosen_compliment = random.choice(compliments)

# Print with color using rich
print(f"\n[bold cyan]Hey {name}![/bold cyan]")
print(f"[green]{chosen_compliment}[/green]\n")
```

Note: to acquire these and other emojis:

1. on a **PC** press `Windows + .` or `Windows + ;`
2. On a Mac type `Command + Control + Space`.
3. On a Linux type `Ctrl + .` or `Ctrl + ;`.

Try running this script from the command line using the same procedure introduced in the previous step.

5. Write your first Jupyter Notebook

Coding notebooks allow a user to create a more interactive, modular code script. These notebooks allow users to mix markdown texts (with human-readable instructions and explanations)

with code cells, which can be run one at a time or all at once. They also allow users to view various intermediary results (i.e. data tables or visualizations) right within their notebook.

Jupyter is the most commonly used type of coding notebook for Python.

5a. Install Jupyter

1. To use Jupyter first we need to install it using **uv**. Run the following in the **terminal**:

```
uv add jupyter
```

5b. Create a New Notebook

1. **Right-click** in the Explorer sidebar (where your files are)
 2. Click “**New File**”
 3. Name it: `my_first_notebook.ipynb`
- The `.ipynb`` extension is important!
4. Press Enter

5c. Select Your Python Environment

1. When the notebook opens, look at the **top-right corner**
2. Click “**Select Kernel**”
3. Choose “**Python Environments...**”
4. Select the one that says `.venv` or `uv`

5d. Start Coding

1. Click in the first cell
2. Type some Python code
3. Press **Shift + Enter** to run the cell
4. That’s it!

5e. Fun Practice Notebook Contents

A short cheatsheet for working with Jupyter notebooks (or click [here](#) for a more extensive cheatsheet:

JUPYTER NOTEBOOK SHORTCUTS

RUN CELL:

- Shift + Enter (run and move to next)
- Ctrl + Enter (run and stay)

ADD CELLS:

- Click "+ Code" or "+ Markdown" buttons
- Or use the + icon at top

CHANGE CELL TYPE:

- Use dropdown: "Code" or "Markdown"

DELETE CELL:

- Click trash icon on left of cell

SAVE NOTEBOOK:

- Ctrl + S (or Cmd + S on Mac)

RESTART KERNEL:

- Click "Restart" icon at top
- Use when things get stuck

Copy and paste these cells into your notebook to practice:

Cell 1: Markdown (Introduction)

Click the cell, then change it to “Markdown” using the dropdown at the top

```
# My First Jupyter Notebook
```

```
Welcome to my coding adventure! Today I'm learning about Jupyter notebooks.
```

```
## What I'll practice:
- Running Python code in cells
- Using markdown for notes
- Making calculations
- Creating simple visualizations
---

Date: January 2025
Mood: Excited!
```

Cell 2: Code (Simple Math)

```
# Let's do some calculations!
print(" Quick Math Practice")
print("-" * 30)

my_age = 25 # Change this to your age!
python_age = 2025 - 1991 # Python was created in 1991

print(f"I am {my_age} years old")
print(f"Python is {python_age} years old")
print(f"Python is {python_age - my_age} years older than me!")
```

Quick Math Practice

I am 25 years old
Python is 34 years old
Python is 9 years older than me!

Cell 3: Markdown (Observations)

```
## My Observations

The cool thing about notebooks is that I can:
1. Write code
2. See the results immediately
3. Add notes about what I learned

> Tip: Press `Shift + Enter` to run a cell!
```

5f. Create a basic visualization

Let's experiment by creating a data visualization using some popular Python packages.

1. Create a new notebook and name it `plotting_penguins.ipynb` or something like that.
2. Next, we need to install the following Python libraries / packages:
 - **pandas** - for working with data tables
 - **matplotlib** - for creating data visualizations
 - **seaborn** - some additional functionality and assistance working with matplotlib

To install these, we will use **uv** in the terminal:

```
uv add pandas matplotlib seaborn
```

Note: we can install multiple packages at once using this syntax.

3. In the first code cell in the new notebook, let's install the necessary packages:

```
import seaborn as sns
import matplotlib.pyplot as plt
```

4. Next, we can import a preloaded dataset from **seaborn** and preview its data:

```
# Load a built-in dataset (no files needed!)
penguins = sns.load_dataset('penguins')

# Take a quick look at the data
print(" Palmer Penguins Dataset")
print("=" * 50)
print(penguins.head())
print(f"\nTotal penguins: {len(penguins)}")
print(f"Species: {penguins['species'].unique()}")
```

Palmer Penguins Dataset

```
=====
   species  island  bill_length_mm  bill_depth_mm  flipper_length_mm  \
0  Adelie  Torgersen           39.1           18.7             181.0
1  Adelie  Torgersen           39.5           17.4             186.0
2  Adelie  Torgersen           40.3           18.0             195.0
3  Adelie  Torgersen            NaN            NaN              NaN
4  Adelie  Torgersen           36.7           19.3             193.0
```

	body_mass_g	sex
0	3750.0	Male
1	3800.0	Female
2	3250.0	Female
3	NaN	NaN
4	3450.0	Female

Total penguins: 344

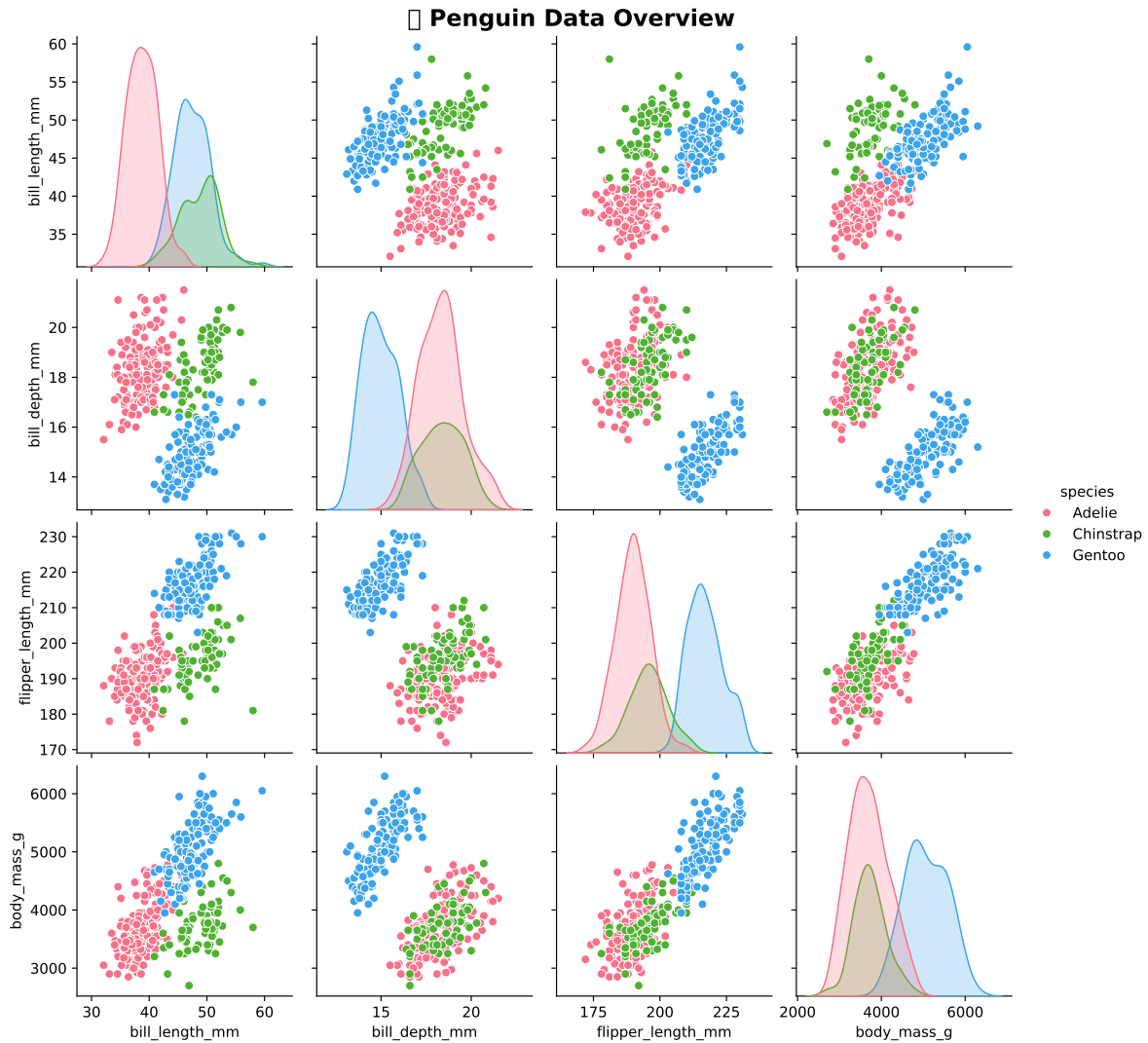
Species: ['Adelie' 'Chinstrap' 'Gentoo']

5. Now, let's create a pair plot of this data:

```
# Create visualization in ONE line!
sns.pairplot(penguins, hue='species', palette='husl')

plt.suptitle(' Penguin Data Overview', y=1.01, fontsize=16, fontweight='bold')
plt.show()
```

```
C:\Users\F0040RP\Documents\DartLib_RDS\projects\python-setup\.venv\Lib\site-
packages\IPython\core\pylabtools.py:170: UserWarning: Glyph 128039 (\N{PENGUIN}) missing from
fig.canvas.print_figure(bytes_io, **kw)
```



Or, we can create a scatterplot with additional customization:

```
# Create a colorful visualization
sns.set_style("whitegrid")
plt.figure(figsize=(10, 6))

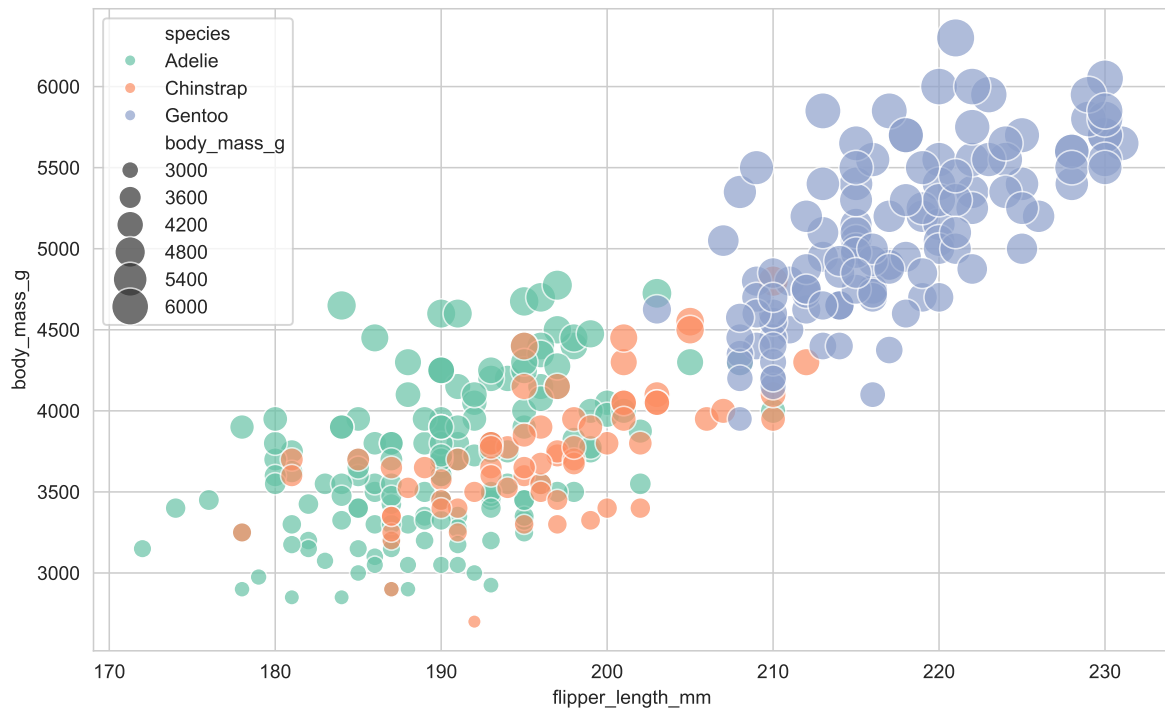
# Scatter plot: flipper length vs body mass, colored by species
sns.scatterplot(
    data=penguins,
    x='flipper_length_mm',
    y='body_mass_g',
    hue='species',
```



```

size='body_mass_g',
sizes=(50, 400),
alpha=0.7,
palette='Set2'
)

```



Brief Cheatsheet

the brief, no explanation need version:

1. Set up a sample project folder, i.e. `~/Users/your-user-name/Documents/python_code/sample_project`
2. Open VSC and set up a link to this project folder, by selecting **File** -> **Open Folder** and open the folder you created above.
3. In Explorers pane, create the following subfolders in your project folder: `code`, `data`, `docs`, `results`.
4. Create a `README.md` file with important explanatory information about your project. Use markdown syntax to format the text.
5. Set up a virtual environment for your project

1. Terminal (Mac/Linux or Windows Command): `uv --version`
2. Create virtual environment: `uv init`
6. Create a Python script in your `code` folder, giving it the extension: `.py`.
7. Select the Python Interpreter you want to use for this project by opening the “Show and Run Command Bars” (Windows: `CTRL + SHIFT + P`; Mac: `CMD + CTRL + SPACE`), select **Python: Select Interpreter**, and choose the version of Python installed to your local environment. I.e.: ‘Python 3.14.2 (name-of-project) .venv/Scripts/python.exe Recommended’
8. Confirm `uv` is using the correct environment and Python:
 - a. Windows: `uv run where.exe python` # first response should be your local Python
 - b. Mac: `uv run which python`
 - c. *Note:* compare to the results if you run these commands without `uv run`. You can also check by comparing the results of `uv run python --version` and `python --version`.
9. Write code (see Step 4 above for an example script) and save your script.
10. Run your script with `uv run code/script-name.py` or by pressing the “Play” button.
11. To run code requiring external packages:
 1. install packages with `uv add package_name`.
 2. when needed, import a package with the code `import package_name` placed at the top of the document.
12. To create a Jupyter notebook:
 1. install Jupyter via the Terminal with `uv add jupyter`.
 2. Create a new Jupyter notebook in your `code` folder (with the extension `.ipynb`).
 3. select your Python environment: top-right corner → **Select Kernel** → Choose “Python Environments” → select the one that says `.venv` or `uv`.
 4. See Steps 5e and 5f above for sample code.

Troubleshooting Section

Problem 1: “Select Kernel” Button Missing

Solution:

- Make sure you saved the file with `.ipynb` extension
- Close and reopen the file
- Install the Jupyter extension: Click Extensions (sidebar) → search “Jupyter” → Install

Problem 2: Kernel Won’t Start

Solution:

- Open Terminal and run: `uv add ipykernel`
- Reload VS Code: Press `Ctrl+Shift+P`, type “Reload Window”, press Enter
- Try selecting the kernel again

Problem 3: Code Cell Won’t Run

Symptoms: Nothing happens when you press Shift+Enter

Solution:

- Check if kernel is connected (top-right should show Python version)
- Click the kernel name and select it again
- Restart kernel: Click “Restart” icon at the top

Problem 4: Matplotlib Charts Don’t Show

Solution:

- Make sure you ran the installation cell (Cell 6)
- Add this line before your plotting code:

```
%matplotlib inline
```

Restart the kernel and run all cells again

Problem 5: Input() Not Working

Symptoms: Input prompt doesn't appear or freezes

Solution:

This is normal in Jupyter! Look for the input box at the TOP of the cell output
Make sure you're running the cell (not just clicking it)
If stuck, click "Interrupt" button at top, then try again

Problem 6: Can't Install Packages

Error: "uv: command not found" or similar

Solution:

Use pip instead:

```
... {.cell execution_count=7}  
... {.python .cell-code}  
pip install matplotlib  
...
```

```
... {.cell-output .cell-output-stdout}  
...
```

Note: you may need to restart the kernel to use updated packages.

```
...  
...
```

```
... {.cell-output .cell-output-stderr}  
...
```

```
C:\Users\F0040RP\Documents\DartLib_RDS\projects\python-setup\.venv\Scripts\python.exe: No mo  
...
```

```
...  
...
```

Problem 5: Input() Not Working

Symptoms: Input prompt doesn't appear or freezes

Solution:

- This is normal in Jupyter! Look for the input box at the TOP of the cell output

- Make sure you're running the cell (not just clicking it)
- If stuck, click "Interrupt" button at top, then try again

Problem 6: Markdown Cell Shows Code Instead of Formatted Text

Solution:

- Make sure the cell type is set to "Markdown" (check dropdown at top)
- Run the cell with Shift+Enter to render it
- If still showing code, change to Markdown and run again

Problem 7: Notebook is Slow or Unresponsive

Solution:

- Restart the kernel: Click "Restart" icon at top
- Clear all outputs: Click "..." menu → "Clear All Outputs"
- Close other programs to free up memory
- Save and reload VS Code