Lab Guide: Setting Up a Python Environment with NumPy, Pandas, and Scikit-learn

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Description

This lab guide provides step-by-step instructions to set up a Python environment equipped with essential libraries such as NumPy, Pandas, and Scikit-learn, which are vital for data manipulation, analysis, and machine learning tasks.

Problem-Statement

Setting up a Python environment with the right libraries is crucial for conducting data science and machine learning projects. This guide aims to simplify the process for beginners and provide a solid foundation for further exploration in AIML.

Prerequisites

Software Required

- **Python Installation:** Python version 3.11.9.
- **Libraries:** `numpy`, `pandas`, `scikit-learn`.
- **Visual Studio Code (VSCode)**: A lightweight code editor that provides powerful features for Python development, including extensions for linting, debugging, and version control.

Hardware Requirements

- **Minimum System Requirements**:
  - **CPU:** Intel Core i3 or equivalent
  - **RAM:** 4 GB (8 GB recommended for better performance)
  - **Disk Space:** 1 GB free for Python and libraries installation

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Setup-Instructions

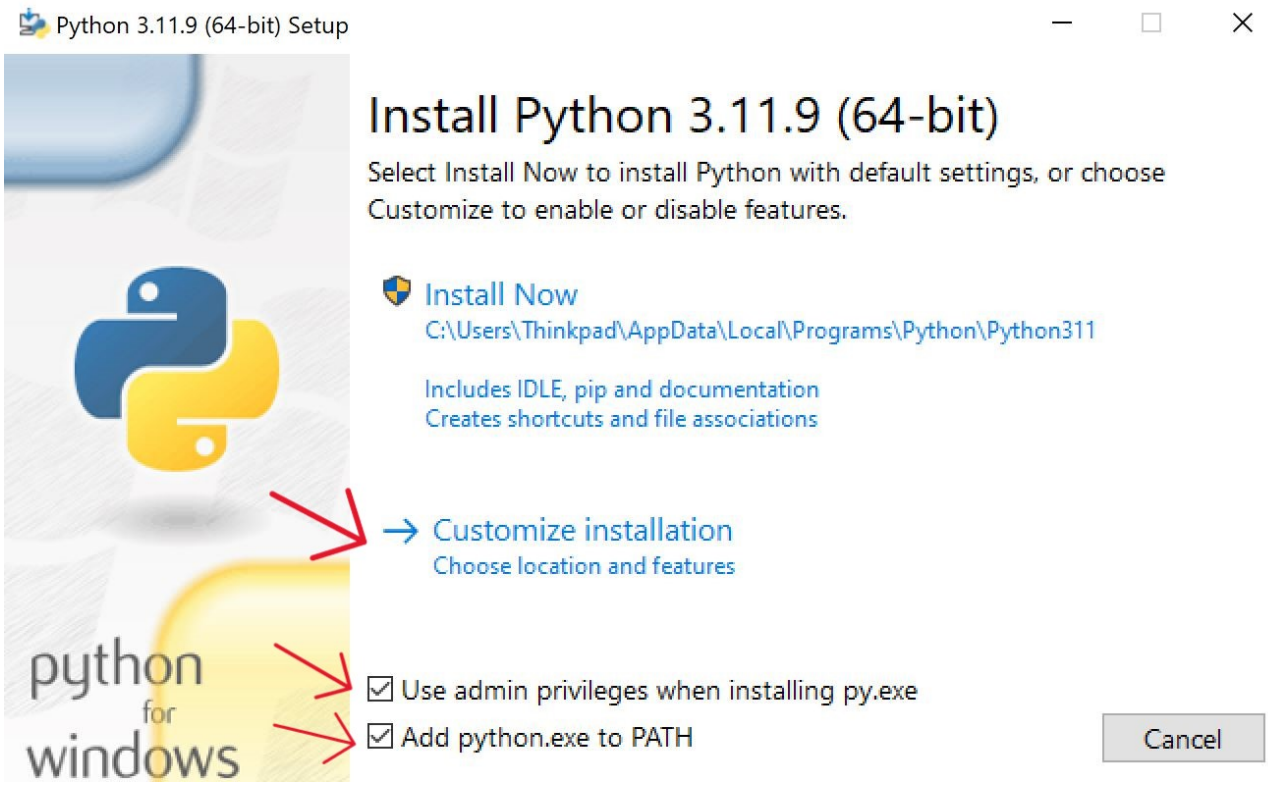
Setting-Up-a-Python-Environment-with-NumPy-Pandas-and-Scikit-learn

Step 1: Download the Python Installer:

- Visit the official Python website.
- Locate a reliable version of Python 3, **"Download Python 3.11.9"**.
- Choose the correct link for your device from the options provided: either Windows installer (64-bit) or Windows installer (32-bit) and proceed to download the executable file.

Step 2: Run the Installer:

1. Run the downloaded Python Installer.
2. The installation window shows two checkboxes:
    - **Admin privileges:** The parameter controls whether to install Python for the current or all system users. This option allows you to change the installation folder for Python.
    - **Add Python to PATH:** The second option places the executable in the PATH variable after installation. You can also add Python to the PATH environment variable manually later.



3. Select the **Install Now** option for the recommended installation (in that case, skip the next two steps).

4. To adjust the default installation options, choose **Customize installation** instead and proceed to the following step.

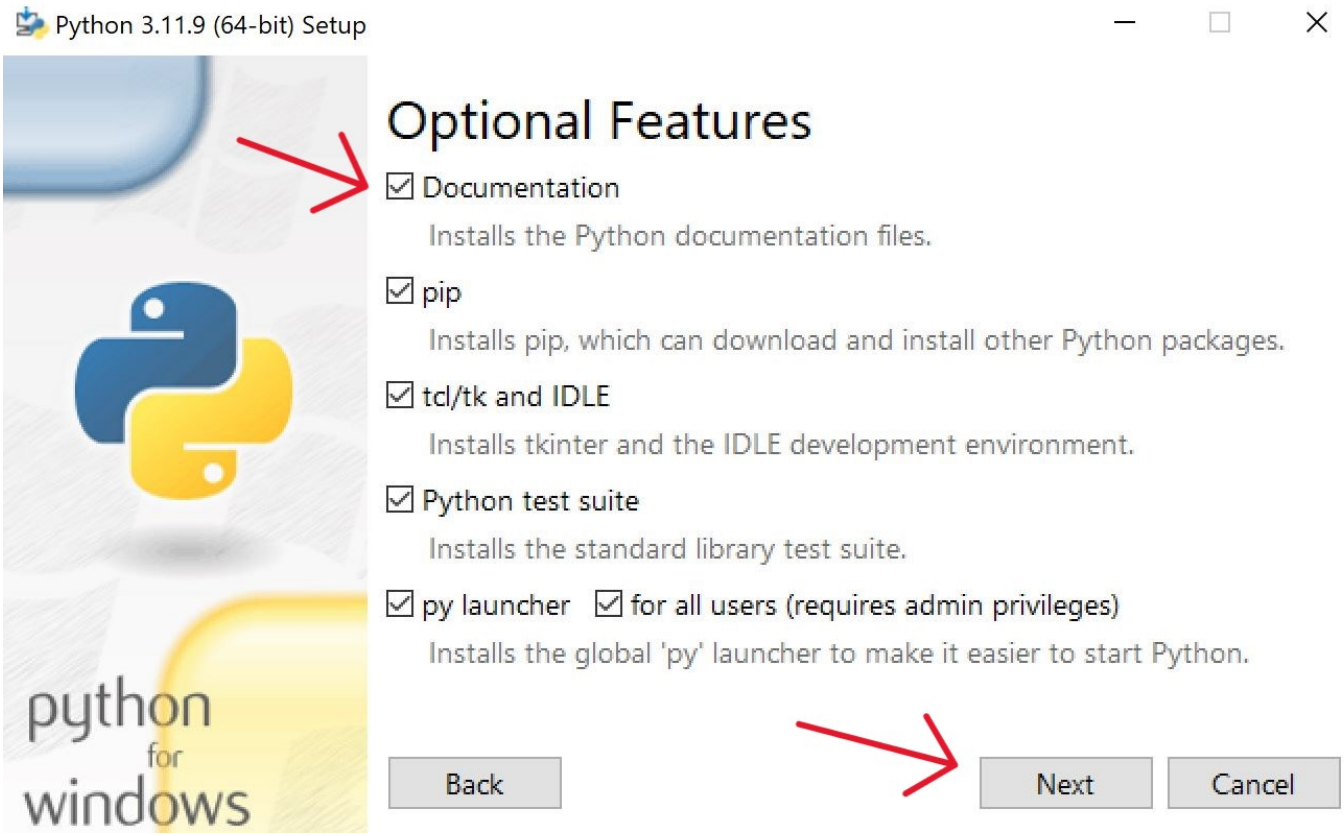
- **Installation Directory:** `C:\Users\[user]\AppData\Local\Programs\Python\Python[version]`
- **Included Components:**
    - **IDLE** (the default Python Integrated Development and Learning Environment).
    - **PIP** (Python's package installer).
    - **Additional Documentation.**
- **The installer also creates:**
    - Required shortcuts.
    - File associations for `.py` files.

If you choose the **"Customize Installation"** option during setup, you can modify the default configurations, such as the installation location, optional features, and advanced settings. This flexibility allows you to tailor

the setup to your specific project requirements or environment.

Step 3: Choose the optional installation features

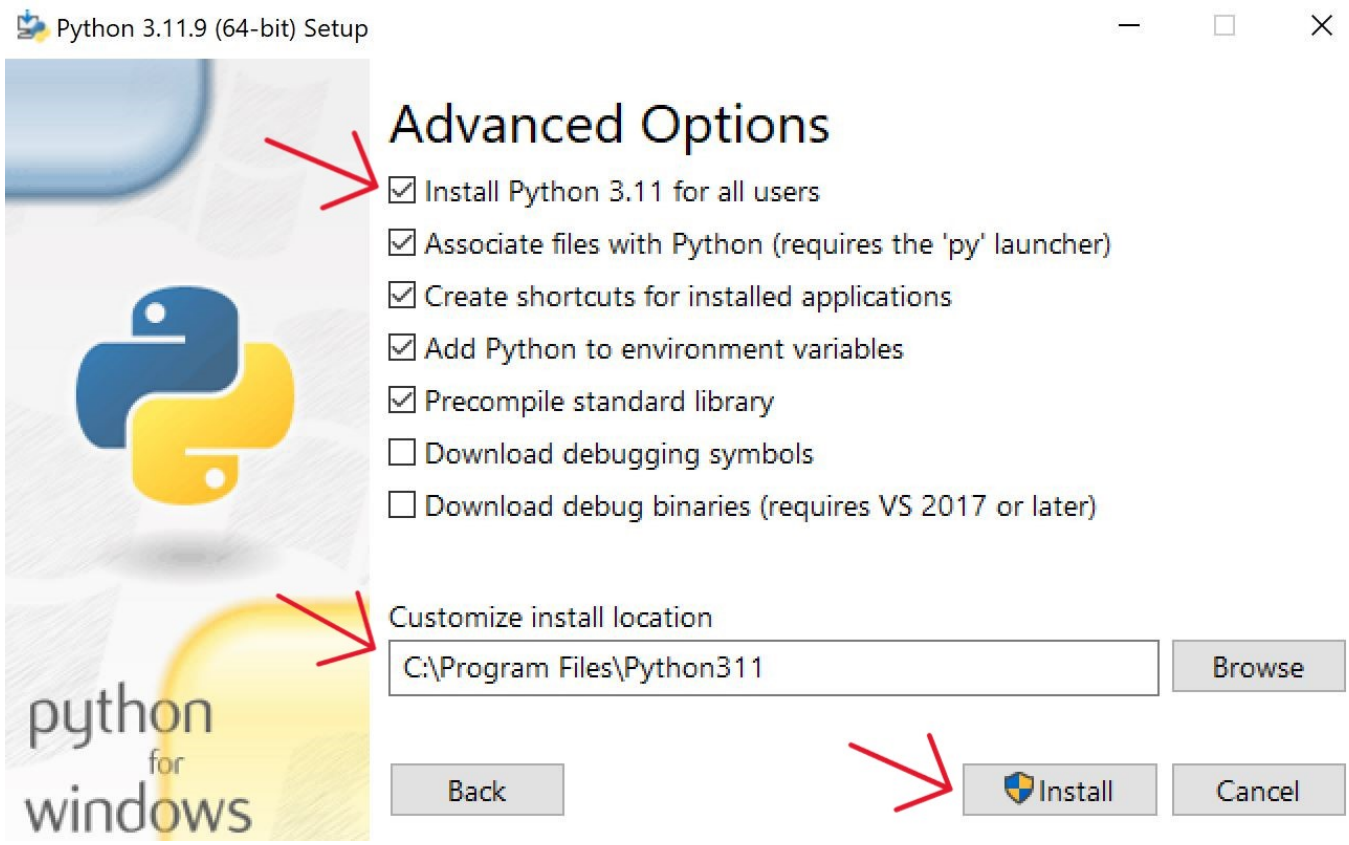
- Python works without these features, but adding them improves the program's usability.



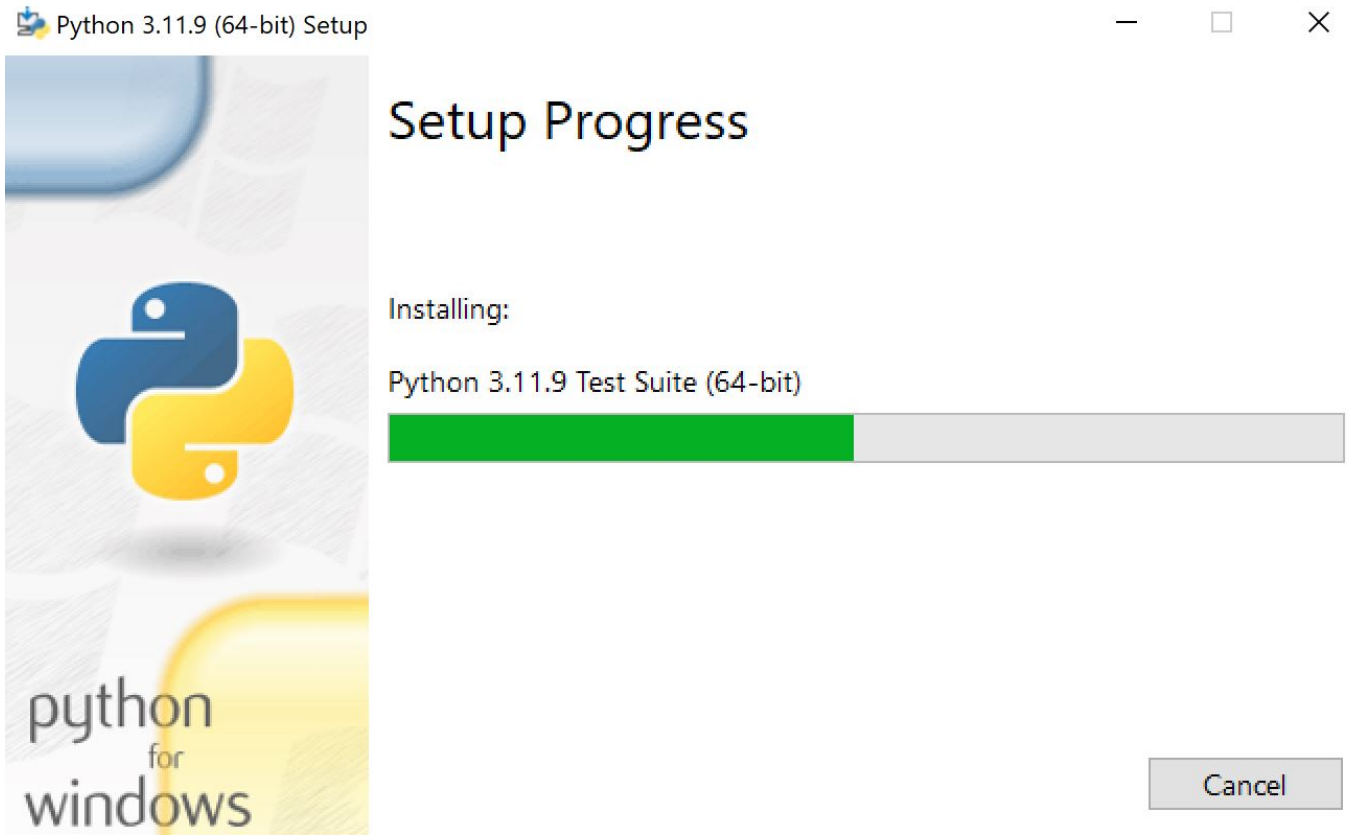
- Click `Next` to proceed to the Advanced Options screen.

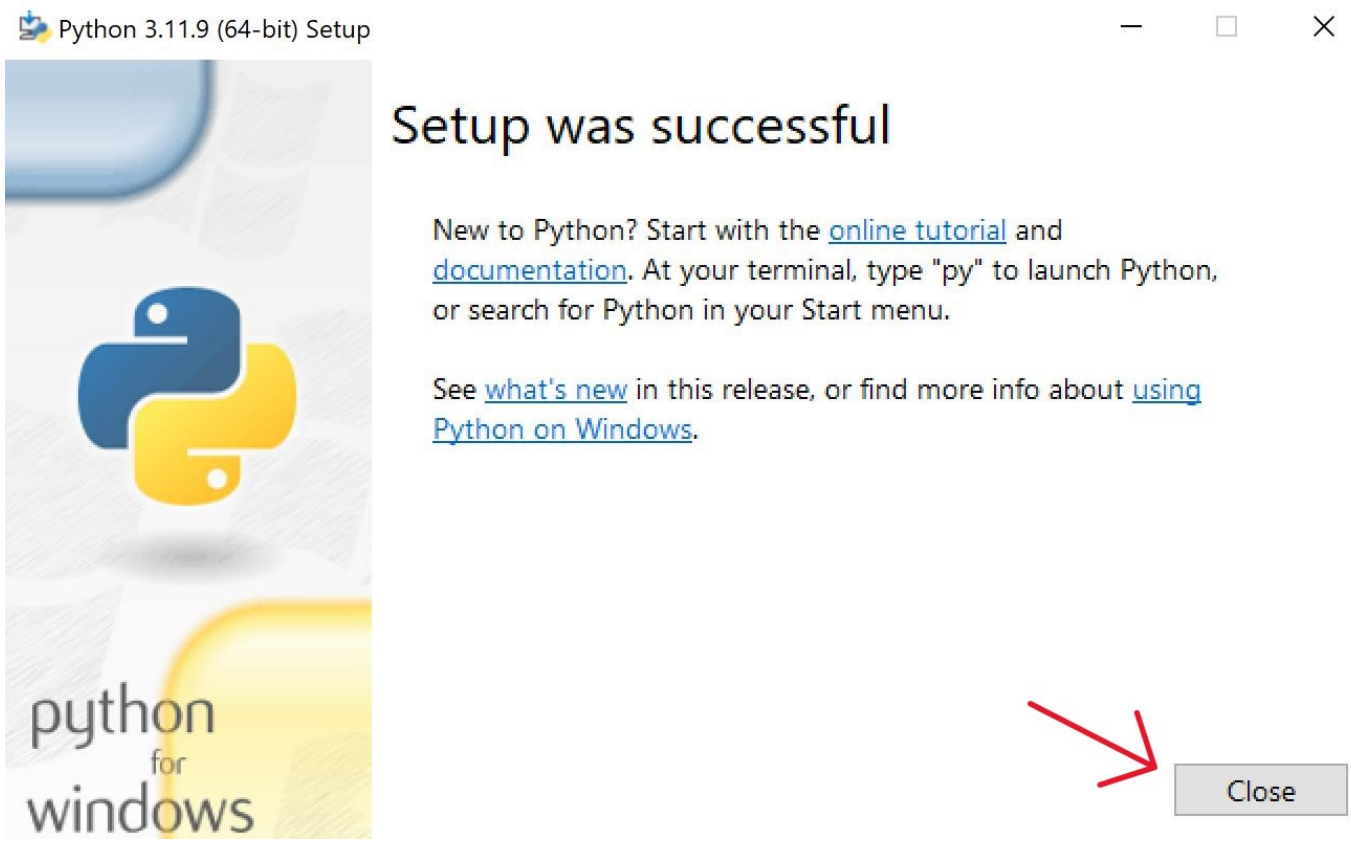
Step 4: Choosing advanced options

- Choose whether to install Python for all users. The option changes the install location to C:\Program Files\Python[version].
- If selecting the location manually, a common choice is C:\Python[version] because it avoids spaces in the path, and all users can access it.Due to administrative rights, both paths may cause issues during package installation.



After picking the appropriate options, click Install to start the installation.





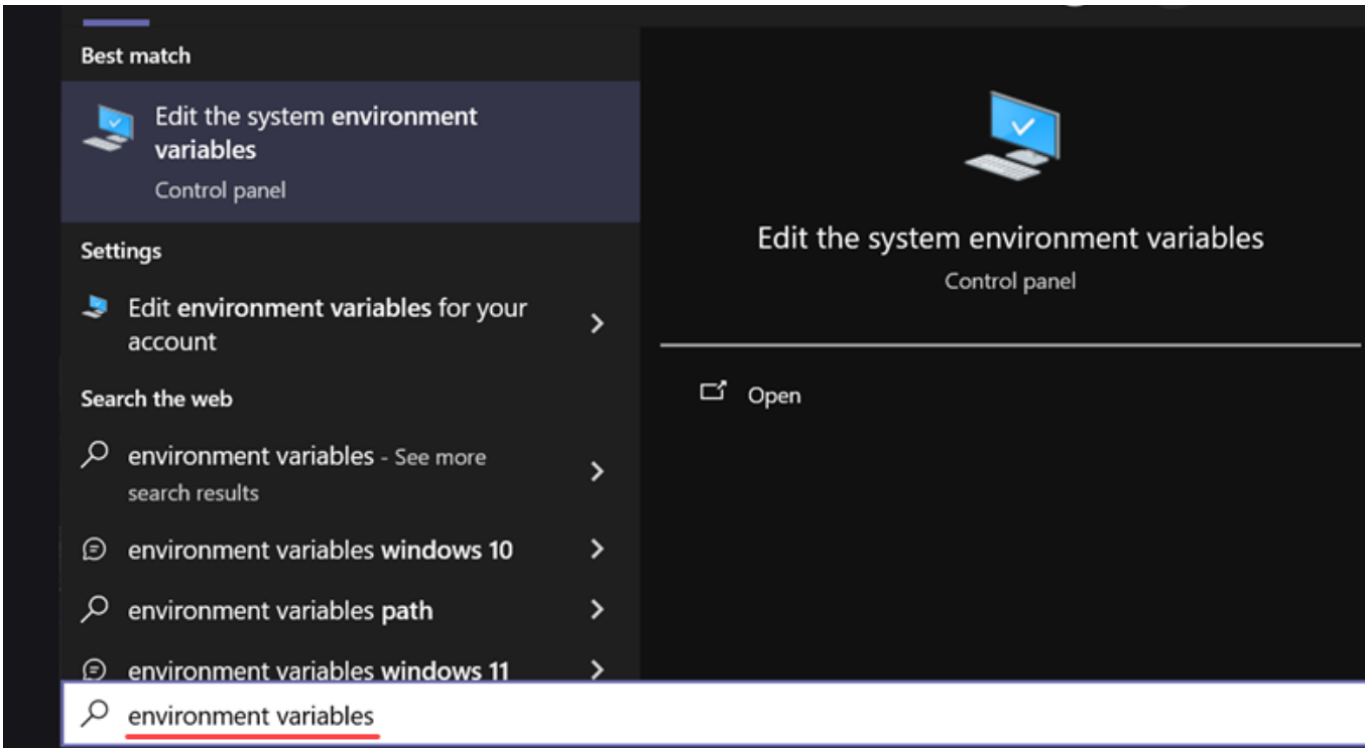
Select the option and close the setup.

Step 5: Add Python to Path (Optional)

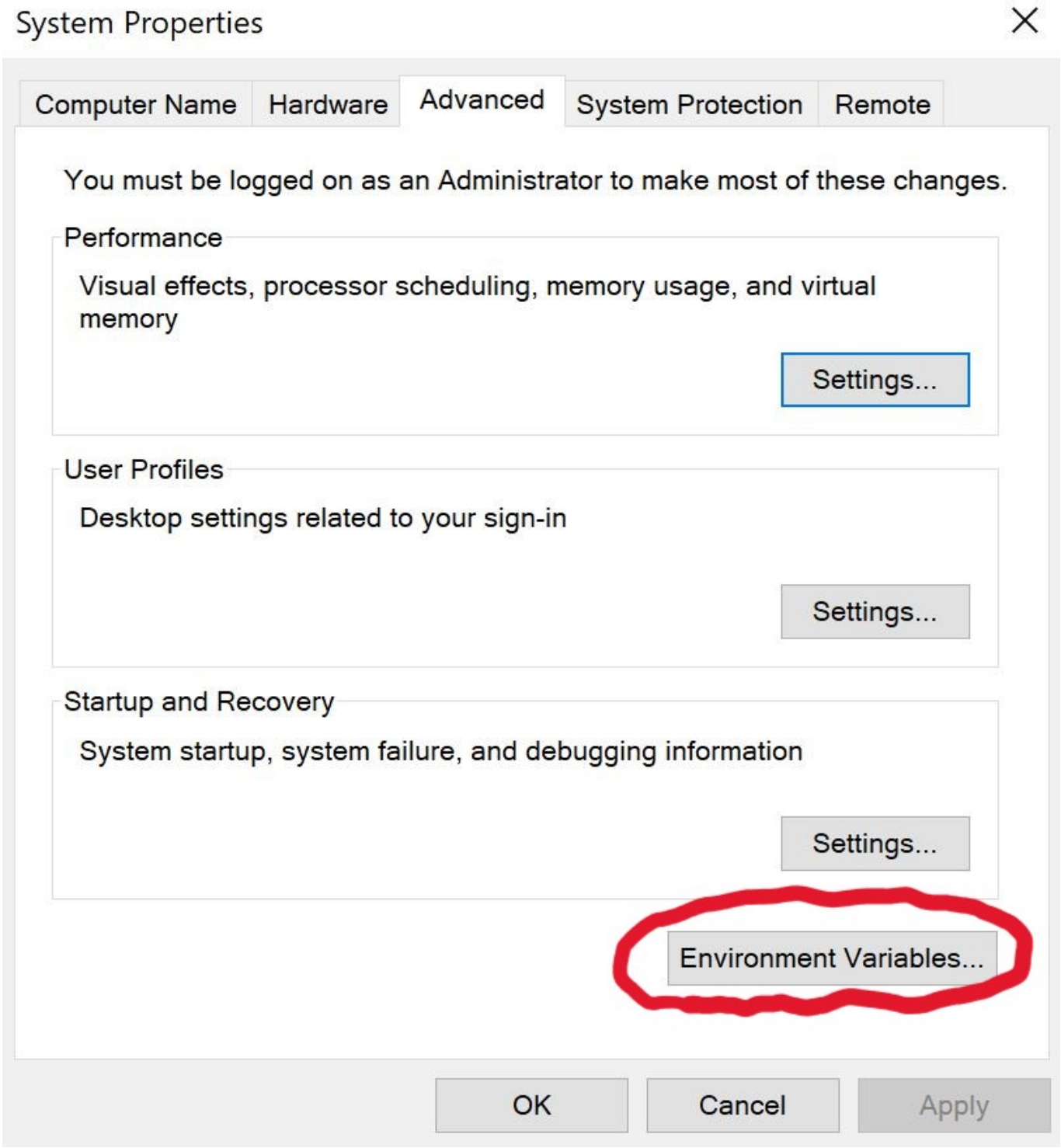
If the Python installer does not include the Add Python to PATH checkbox or you have not selected that option, continue in this step. Otherwise, skip to the next step.

To add Python to PATH, do the following:

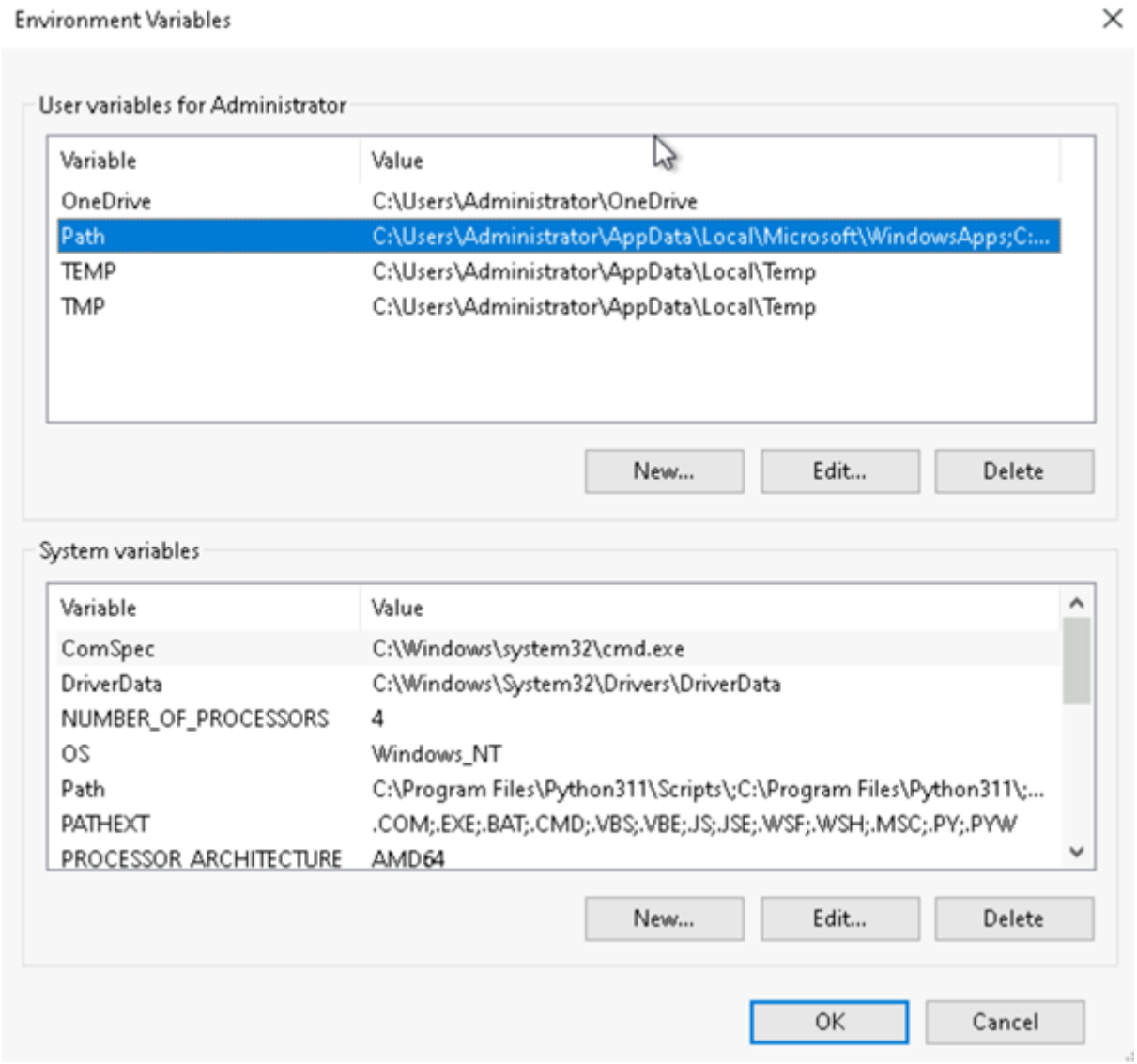
1. In the Start menu, search for Environment Variables and press Enter.



2. Click Environment Variables to open the overview screen.

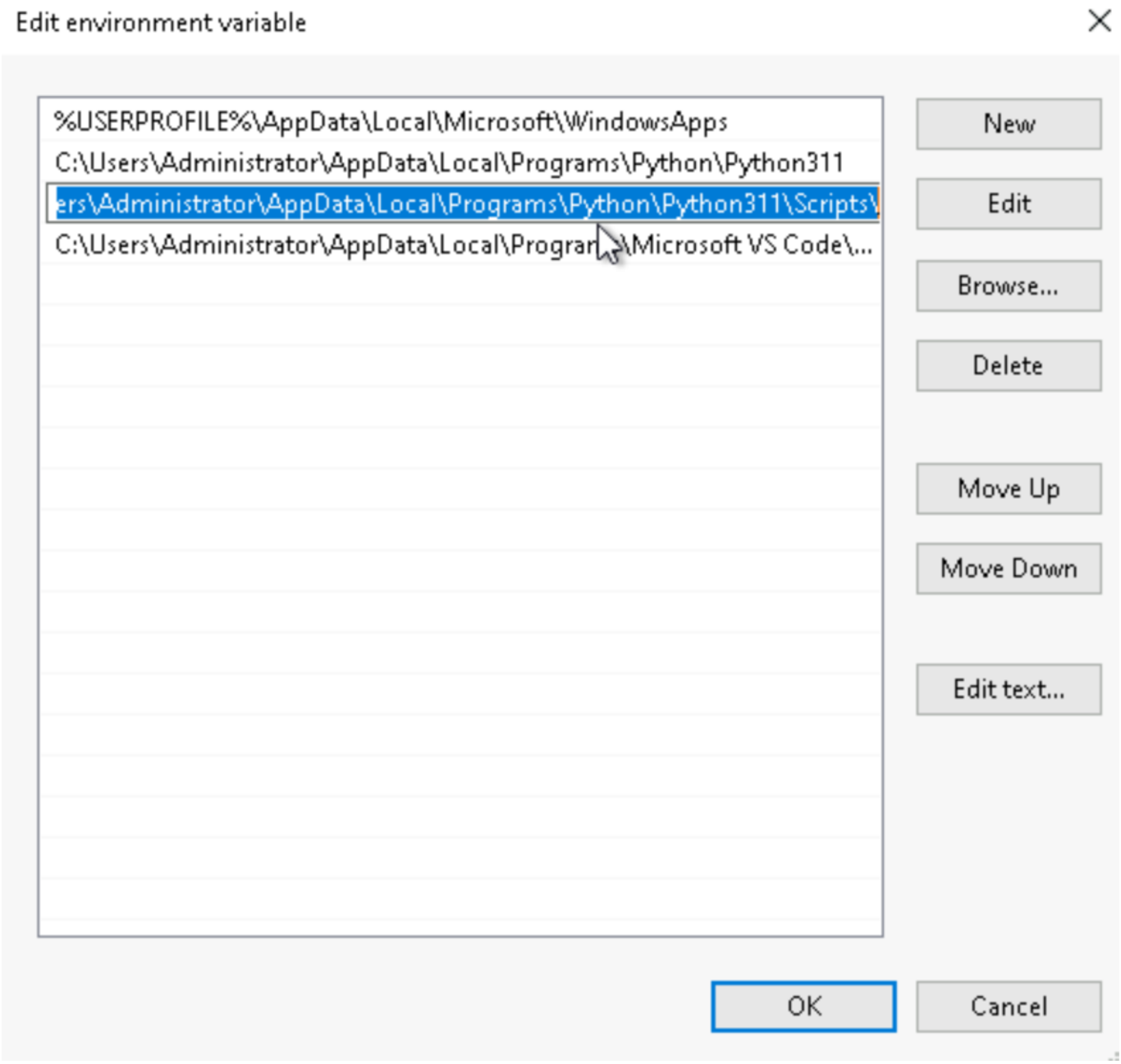


3. Double-click Path on the list to edit it.



Alternatively, select the variable and click the Edit button.

4. Double-click the first empty field and paste the Python installation folder path for both system and user environmental variables for Administration

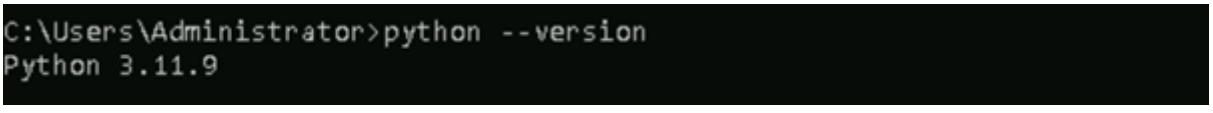


Alternatively, click the **New button** instead and paste the path. Click **OK** to save the changes.

Step 7: Verify Python Was Installed on Windows

The first way to verify that Python was installed successfully is through the command line. Open the command prompt and run the following command:

```
python --version
```



The output shows the installed Python version.

Verify PIP Was Installed

To verify whether PIP was installed, enter the following command in the command prompt:

```
pip --version
```

If it was installed successfully, you should see the PIP version number, the executable path, and the Python version:

PIP has not been installed yet if you get the following output:

```
'pip' is not recognized as an internal or external command,
Operable program or batch file.
```

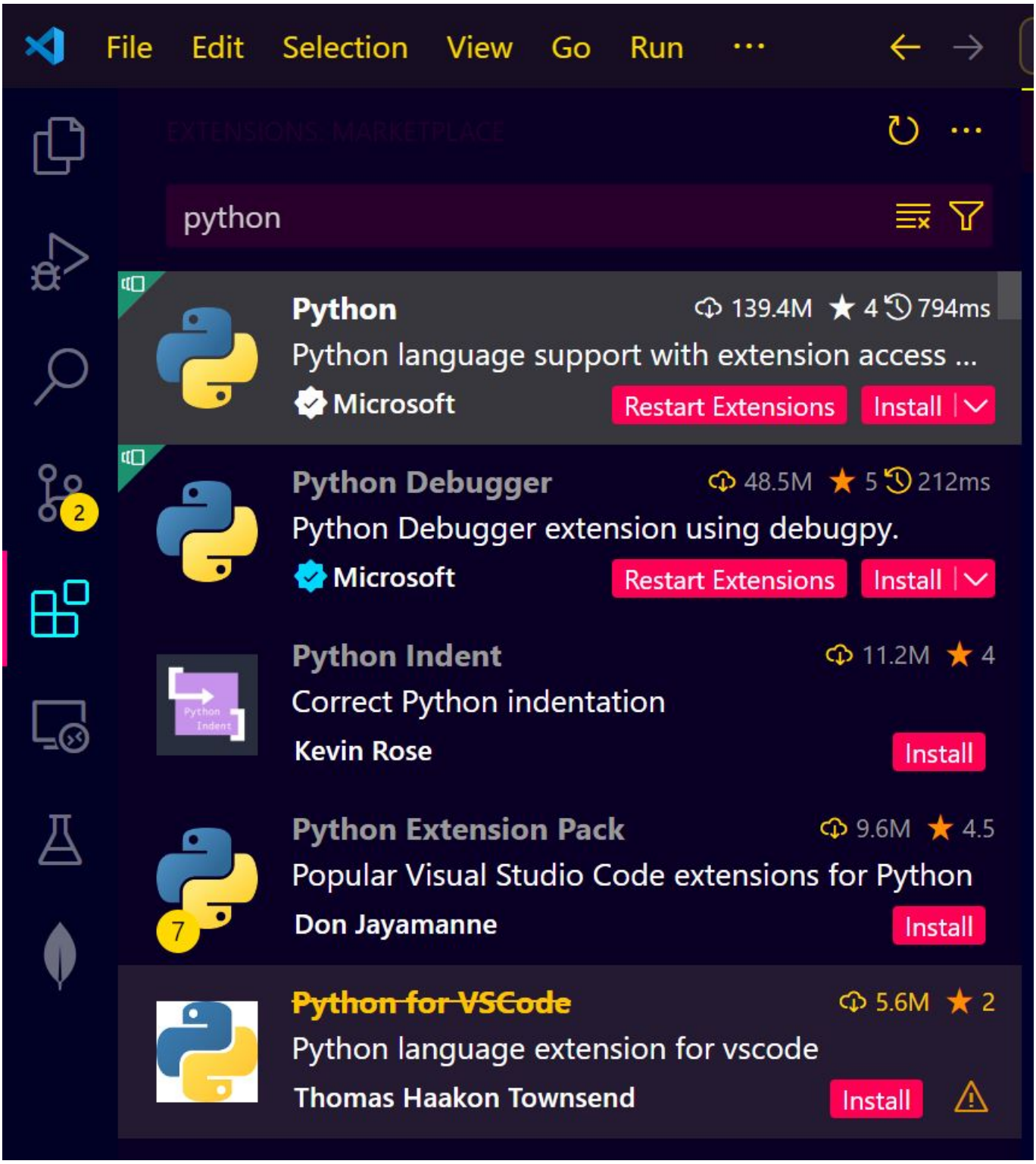
Step 8: Connect VScode with Python To set up Visual Studio Code (VS Code) with Python, follow these steps:

1. Install Visual Studio Code:

- Download and install the latest version of Visual Studio Code for your operating system.

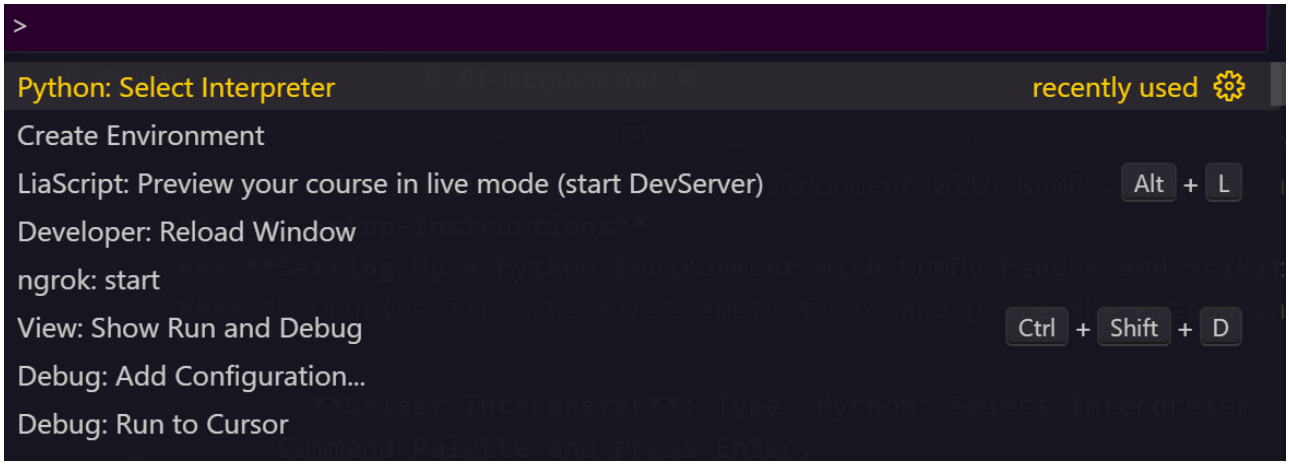
2. Install the Python Extension for VS Code:

- Open VS Code.
- Go to the **Extensions** view by clicking on the square icon in the left sidebar or pressing `Ctrl+Shift+X`.

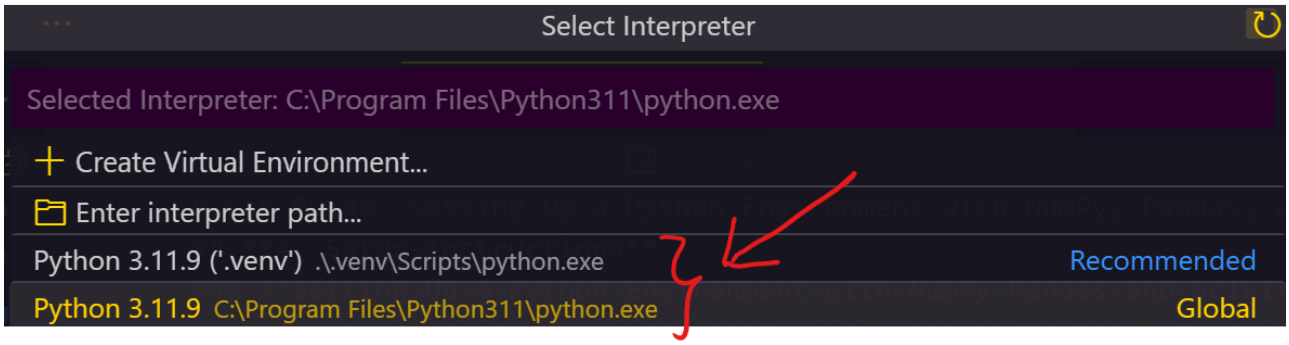


- Search for the **Python** extension by Microsoft.

- Click **Install** to add the extension to your VS Code.
- To select and set the Python interpreter in Visual Studio Code (VS Code), follow these steps:
    - **Open the Command Palette**: You can open the Command Palette by pressing `Ctrl+Shift+P`.
    - **Select Interpreter**: Type `Python: Select Interpreter` in the Command Palette and press Enter.



    - **Choose an Interpreter**: VS Code will display a list of available Python interpreters. Select the one you want to use. If you have a virtual environment or a specific Python installation, ensure it's activated or listed here.



- **Verify the Interpreter**: You can verify the selected interpreter by checking the bottom-left corner of VS Code. It should display the selected Python version and the path to the interpreter.
- **Set Interpreter Path Manually**: If the desired interpreter is not listed, you can manually set the interpreter path in the `settings.json` file by adding or modifying the following line:

```
"python.pythonPath": "path/to/your/python"
```

Replace `"path/to/your/python"` with the actual path to the Python interpreter.

3. Create a Python File:

- Open a new file in your workspace.
- Save it with the `.py` extension (e.g., `main.py`).

4. Write and Run Python Code:

- Type a simple Python script, such as:

```
print("Hello, World!")
```

- Save the file.

Run the Python file

- Use the command below in your terminal to run the Python file:

```
python main.py
```

```
PS C:\Users\Administrator\Desktop\AIML> python main.py
Hello world
```

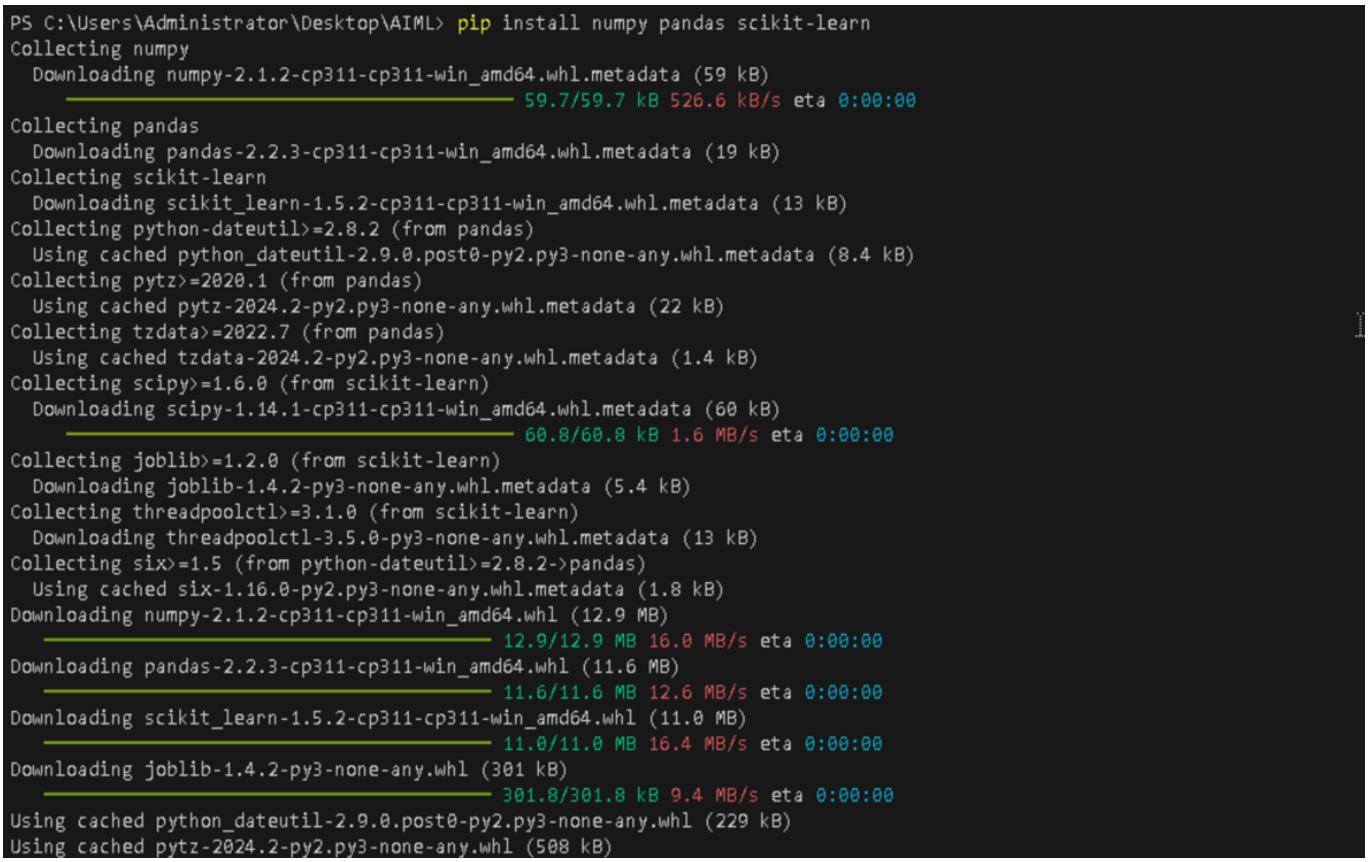
This is the terminal output (Hello World)

Step 9: Install Libraries

To install the essential libraries, open your command prompt and run the following command:

```
pip install numpy pandas scikit-learn
```

This command will install NumPy, Pandas, and Scikit-learn, which are essential for data manipulation, analysis, and machine learning tasks.



Step 9: Verify Library Installation

To verify the installation, you can run a simple script that imports the libraries and prints their versions. Follow these steps to create and run the script in Visual Studio Code (VS Code):

1. Open VS Code

- Launch Visual Studio Code from your Start menu or desktop shortcut.

2. Create a New Python File

- Click on `File > New File` or press `Ctrl+N` to create a new file.

- Save the file with a `.py` extension, e.g., `verify_libraries.py`, by clicking on `File > Save As` or pressing `Ctrl+S`.

3. Write the Verification Script

- In the new file, type the following Python script:

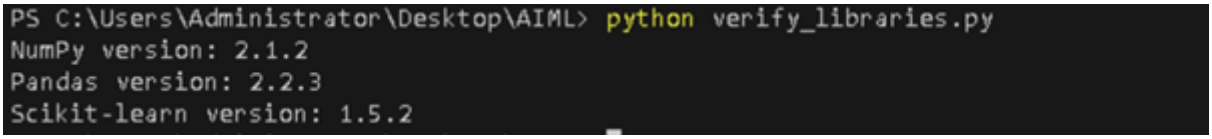
```
import numpy as np
import pandas as pd
import sklearn

print("NumPy version:", np.__version__)
print("Pandas version:", pd.__version__)
print("Scikit-learn version:", sklearn.__version__)
```

Run the Python file

- Use the command below in your terminal to run the Python file:

```
python verify_libraries.py
```

Output



5. Example-Usage

NumPy-Example

- **Create a new python file**
  - Create a Python file named `creating_array.py` and write the following code in it.

NumPy is a powerful library for numerical computations. Here are two simple examples to demonstrate its capabilities:

Example 1: Creating and Manipulating Arrays

```
import numpy as np

# Create a 1D array
array = np.array([1, 2, 3, 4, 5])
print("1D Array:", array)
```

```
# Perform element-wise multiplication
result = array * 2
print("Element-wise Multiplication Result:", result)
```

Run the Python file

- Use the command below in your terminal to run the Python file:

```
python creating_array.py
```

Output:

```
PS C:\Users\Administrator\Desktop\AIML> python creating_array.py
1D Array: [1 2 3 4 5]
Element-wise Multiplication Result: [ 2  4  6  8 10]
```

Example 2: Matrix

- **Create a new python file**
  - Create a Python file named `matrix.py` and write the following code in it.

```
import numpy as np

# Step 1: Create two small matrices
matrix_A = np.array([[1, 2],
                     [3, 4]])

matrix_B = np.array([[5, 6],
                     [7, 8]])

print("Matrix A:")
print(matrix_A)

print("\nMatrix B:")
print(matrix_B)

# Step 2: Perform basic operations

# Matrix addition
matrix_sum = matrix_A + matrix_B
print("\nSum of Matrix A and B:")
print(matrix_sum)

# Matrix subtraction
matrix_diff = matrix_A - matrix_B
print("\nDifference of Matrix A and B:")
print(matrix_diff)
```

```
# Element-wise multiplication
matrix_product = matrix_A * matrix_B
print("\nElement-wise Product of Matrix A and B:")
print(matrix_product)

# Matrix multiplication
matrix_mul = np.dot(matrix_A, matrix_B)
print("\nMatrix A multiplied by Matrix B:")
print(matrix_mul)

# Step 3: Transpose of a matrix
matrix_A_T = matrix_A.T
print("\nTranspose of Matrix A:")
print(matrix_A_T)

# Step 4: Determinant of a square matrix
determinant_A = np.linalg.det(matrix_A)
print("\nDeterminant of Matrix A:", determinant_A)

# Step 5: Inverse of a matrix
matrix_A_inv = np.linalg.inv(matrix_A)
print("\nInverse of Matrix A:")
print(matrix_A_inv)

# Verification: Matrix A multiplied by its inverse
identity_matrix = np.dot(matrix_A, matrix_A_inv)
print("\nMatrix A multiplied by its Inverse (should be Identity Matrix):")
print(identity_matrix)
```

Run the Python file

- Use the command below in your terminal to run the Python file:

```
python matrix.py
```

Output

```
PS C:\Users\Administrator\Desktop\AIML> python matrix.py
Matrix A:
[[1 2]
 [3 4]]

Matrix B:
[[5 6]
 [7 8]]

Sum of Matrix A and B:
[[ 6  8]
 [10 12]]

Difference of Matrix A and B:
[[-4 -4]
 [-4 -4]]

Element-wise Product of Matrix A and B:
[[ 5 12]
 [21 32]]

Matrix A multiplied by Matrix B:
[[19 22]
 [43 50]]

Transpose of Matrix A:
 [2 4]]

Determinant of Matrix A: -2.000000000000004
```

```
Inverse of Matrix A:
[[-2.   1. ]
 [ 1.5 -0.5]]

Matrix A multiplied by its Inverse (should be Identity Matrix):
[[1.0000000e+00 0.0000000e+00]
 [8.8817842e-16 1.0000000e+00]]
```

Pandas-Example

- **Create a new python file**
  - Create a Python file named `creating_dataframe.py` and write the following code in it.

Pandas is used for data manipulation and analysis. Here are two examples of creating and manipulating DataFrames:

Example 1: Creating a DataFrame

```
import pandas as pd

# Create a DataFrame
data = {'Name': ['Alice', 'Bob', 'Charlie'],
        'Age': [25, 30, 35],
        'City': ['New York', 'Los Angeles', 'Chicago']}
df = pd.DataFrame(data)
print("DataFrame:\n", df)
```

Run the Python file

- Use the command below in your terminal to run the Python file:

```
python creating_dataframe.py
```

Output:

```
PS C:\Users\Administrator\Desktop\AIML> python creating_dataframe.py
DataFrame:
      Name  Age         City
1      Bob   30  Los Angeles
2  Charlie   35      Chicago
```

Example 2: Filtering a DataFrame

- **Create a new python file**
  - Create a Python file named `filtering_dataframe.py` and write the following code in it.

```
import pandas as pd

# Create a DataFrame
data = {'Name': ['Alice', 'Bob', 'Charlie', 'David'],
        'Age': [25, 30, 35, 28],
        'City': ['New York', 'Los Angeles', 'Chicago', 'Boston']}
df = pd.DataFrame(data)
print("Original DataFrame:\n", df)

# Filter DataFrame for Age greater than 28
filtered_df = df[df['Age'] > 28]
print("Filtered DataFrame:\n", filtered_df)
```

Run the Python file

- Use the command below in your terminal to run the Python file:

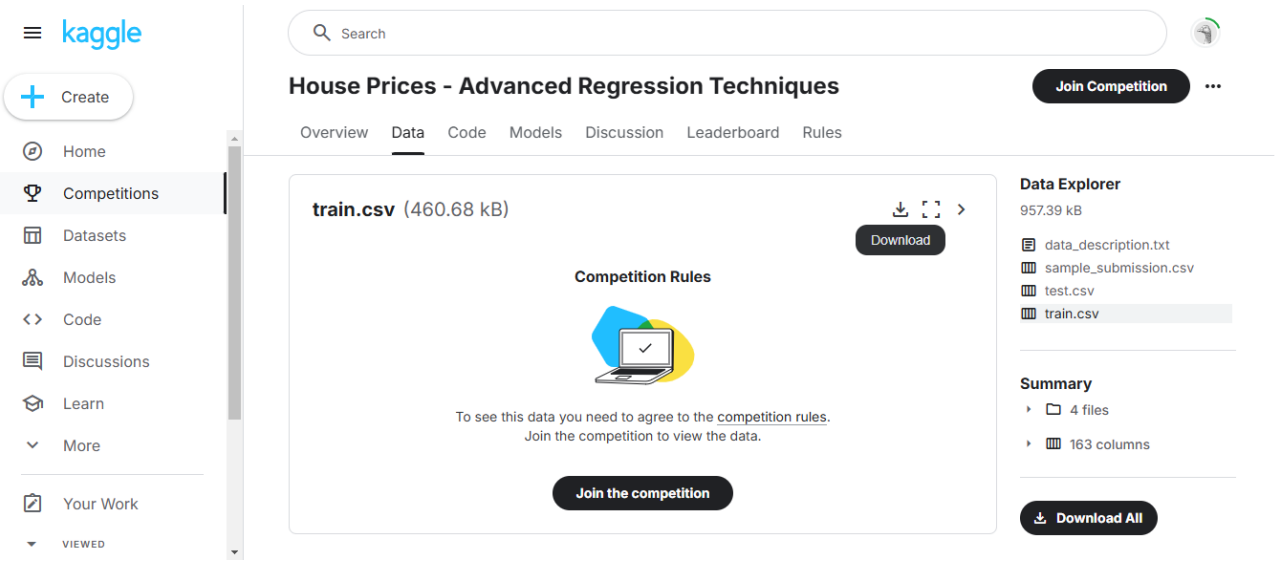
```
python filtering_dataframe.py
```

Output:

```
PS C:\Users\Administrator\Desktop\AIML> python filtering_dataframe.py
Original DataFrame:
      Name  Age         City
0    Alice   25     New York
1      Bob   30  Los Angeles
2  Charlie   35      Chicago
3    David   28       Boston
Filtered DataFrame:
      Name  Age         City
1      Bob   30  Los Angeles
2  Charlie   35      Chicago
```

Example 3: Load the CSV into a DataFrame

- **Create a new python file**
  - Create a Python file named `analysing_data.py` and write the following code in it.
- **Downloading the Dataset**
  - Go to the **Kaggle website** and sign in to your account. If you don't have an account, create one.
  - Navigate to the **House Prices: Advanced Regression Techniques** competition page.



  - Click on the "Data" tab and download the `train.csv` file (the dataset used for training).
  - Move the downloaded `train.csv` file into your project directory.

Analysing data

```
import pandas as pd
df = pd.read_csv('/train.csv')
print(df.head(10))
```

Run the Python file

- Use the command below in your terminal to run the Python file:

```
python analysing_data.py
```

Output

```
PS C:\Users\Administrator\Desktop\AIML> python analysing_data.py
   Id  MSSubClass MSZoning  LotFrontage  LotArea Street  ... MiscVal MoSold YrSold SaleType SaleCondition SalePrice
0   1          60       RL         65.0     8450   Pave  ...       0      2   2008       WD        Normal    208500
1   2          20       RL         80.0     9600   Pave  ...       0      5   2007       WD        Normal    181500
6   7          20       RL         75.0    10084   Pave  ...       0      8   2007       WD        Normal    307000
7   8          60       RL          NaN    10382   Pave  ...     350     11   2009       WD        Normal    200000
8   9          50       RM         51.0     6120   Pave  ...       0      4   2008       WD       Abnorml    129900
9  10         190       RL         50.0     7420   Pave  ...       0      1   2008       WD        Normal    118000

[10 rows x 81 columns]
```

Scikit-learn-Example

Scikit-learn is a library for machine learning. Here are two simple examples of using Scikit-learn for linear regression:

Example 1: Linear Regression

- **Create a new python file**
  - Create a Python file named `linear_regression.py` and write the following code in it.

```
import numpy as np
from sklearn.linear_model import LinearRegression

# Sample data
X = np.array([[1, 1], [1, 2], [2, 2], [2, 3]])
y = np.dot(X, np.array([1, 2])) + 3

# Create a linear regression model
model = LinearRegression().fit(X, y)

# Predict using the model
predictions = model.predict(np.array([[3, 5]]))
print("Predictions:", predictions)
```

Run the Python file

- Use the command below in your terminal to run the Python file:

```
python linear_regression.py
```

Output:

```
PS C:\Users\Administrator\Desktop\AIML> python linear_regression.py
Predictions: [16.]
```

Example 2: Model Coefficients

- **Create a new python file**
  - Create a Python file named `model_coeffient.py` and write the following code in it.

```
import numpy as np
from sklearn.linear_model import LinearRegression

# Sample data
X = np.array([[1, 2], [2, 3], [3, 4], [4, 5]])
y = np.dot(X, np.array([2, 1])) + 4

# Create a linear regression model
model = LinearRegression().fit(X, y)

# Display model coefficients
print("Coefficients:", model.coef_)
print("Intercept:", model.intercept_)
```

Run the Python file

- Use the command below in your terminal to run the Python file:

```
python model_coeffient.py
```

Output:

```
PS C:\Users\Administrator\Desktop\AIML> python model_cofficient.py
Coefficients: [1.5 1.5]
Intercept: 3.5000000000000036
```

Reference

- NumPy Documentation
- Pandas Documentation
- Scikit-learn Documentation
