

## Lecture: Introduction to Python Notebooks (Google Colab)

Notebooks provide an interactive environment where you can write code, visualize data, and document your work all in one place. This is a powerful tool that combines coding with documentation, making it ideal for sharing your work and collaborating with others.

### 1. What is a Python Notebook?

A **Python notebook** is an interactive environment that allows you to write and execute Python code in cells. You can also document your work with explanations, visualizations, and results in a **single file**. Notebooks are particularly useful in data science, machine learning, and research, where you need to experiment with code, visualize data, and explain your findings in a structured way.

You will use these notebooks to complete assignments, projects, and explore Python code interactively. Notebooks are useful for:

- Writing and testing code.
- Visualizing results immediately.
- Documenting and sharing your process.

### 2. Setting Up Google Colab

To get started with notebooks, we will use **Google Colab** (Collaboratory), which is a free, cloud-based platform for Python coding. You don't need to install anything locally because everything runs in the cloud.

Here's how you can get started:

- **Step 1:** Go to Google [Colab](#).
- **Step 2:** If you don't already have a Google account, sign up for one.
- **Step 3:** Once you're signed in, you can create a new notebook by clicking on **File > New notebook**. This will open a new Python notebook where you can start coding.

Your notebook is automatically saved to **Google Drive**, which means you can access it from anywhere and never lose your work.

### 3. Basic Features of Google Colab

Once you've created a notebook, you'll see that it's divided into two types of cells:

- **Code Cells:** These are the cells where you write Python code.
- **Markdown Cells:** These are the cells where you write plain text or formatted text to document your work (like a report).

### Running Code Cells:

- To write Python code, simply type your code into a code cell.
- To run the code, click the play button on the left side of the cell or press **Shift + Enter**.

When you run a code cell, the output will appear directly below the cell, which is ideal for debugging or inspecting results.

### Using Markdown Cells:

- You can switch any cell to a Markdown cell by selecting the cell and clicking **Cell > Cell Type > Markdown** or simply typing in the cell.
- In Markdown cells, you can use basic formatting like **bold**, *italics*, lists, headers, and even LaTeX for mathematical equations.

For example, you can write:

```
# This is a Header
This is a bold statement.
Here is a list:
- Item 1
- Item 2
```

This will render nicely in the notebook when you run the Markdown cell.

## 4. Working with Libraries and Datasets

Google Colab comes with several libraries pre-installed, but you can also install additional libraries as needed using the `!pip install` command.

### Importing Libraries:

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
```

You can use these libraries to work with data, perform mathematical operations, and create visualizations.

### Loading and Exploring Data:

You can load data into Colab from your computer, Google Drive, or even external sources like Kaggle or GitHub.

To load a CSV file:

```
import pandas as pd
```

```
data = pd.read_csv('https://raw.githubusercontent.com/msfasha/307304-Data-Mining/refs/heads/main/datasets/apartment_prices.csv')
data.head()
```

You can explore your data by running simple commands like `data.head()` to view the first few rows of the dataset.

### Visualizations:

Google Colab allows you to generate plots directly within the notebook using libraries like `matplotlib` or `seaborn`. For example:

```
import matplotlib.pyplot as plt
plt.plot([1, 2, 3, 4, 5], [1, 4, 9, 16, 25])
plt.show()
```

This will display a plot right in the notebook, which is extremely useful for data visualization and exploration.

## 5. Collaborating and Sharing Notebooks

One of the greatest benefits of Google Colab is its ability to share notebooks easily with others. You can collaborate with your classmates or instructors, make comments, and even edit the same notebook simultaneously.

- **Sharing:** Click the **Share** button in the top-right corner of the notebook to share the notebook with others. You can choose to allow others to view, comment, or edit.
- **Commenting:** You can also add comments to cells, which is useful for leaving notes or feedback.

## 6. Advanced Features

As you progress, you might want to explore some of the more advanced features that Colab offers:

- **Using GPUs:** Google Colab provides free access to Graphics Processing Units (GPUs), which can speed up computations, especially in machine learning tasks. You can enable GPU support by going to **Runtime > Change runtime type** and selecting **GPU** as the hardware accelerator.
- **Google Drive Integration:** You can mount your Google Drive to access large datasets stored there by running the following code:

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

This allows you to work with data stored in Google Drive without uploading files every time.

## 7. Best Practices for Using Notebooks

When working with notebooks, there are a few best practices to keep in mind:

- **Documenting Your Work:** Always use Markdown cells to explain what you're doing. This will help you (and others) understand your process later. Use comments within code cells to clarify your logic.
- **Organizing Code:** Break down your code into logical sections using Markdown cells. For example, use one section for loading data, another for preprocessing, and another for analysis or modeling.
- **Saving Work:** Colab automatically saves your notebooks, but it's a good habit to also download copies of your work regularly. You can download your notebook by going to **File > Download .ipynb**.

## 8. Summary

This summary covered the basics of Google Colab, including how to create and run notebooks, use Python libraries, import datasets, and create visualizations. You've learned how to document your code with Markdown, share notebooks for collaboration, and utilize advanced features like GPUs and Google Drive integration. By using notebooks like Google Colab, you can easily organize, document, and share your Python projects.