Matplotlib

What is Matplotlib?

Matplotlib is a Python library used for **data visualization**.
It allows you to create static, animated, and interactive plots.

Install first (if not installed):

```
pip install matplotlib
```

Import it:

```
import matplotlib.pyplot as plt
```

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1. Basic Line Plot

```
import matplotlib.pyplot as plt


x = [1, 2, 3, 4, 5]

y = [2, 4, 6, 8, 10]


plt.plot(x, y)

plt.title("Simple Line Plot")

plt.xlabel("X Axis")

plt.ylabel("Y Axis")

plt.show()
```

Explanation:

- plot() → draws a line between given (x, y) points
- title(), xlabel(), ylabel() → add labels
- show() → displays the graph

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2. Customize Line Style and Color

```
plt.plot(x, y, color='red', linestyle='--', marker='o')

plt.title("Customized Line")
plt.show()
```

Options:

- Colors: 'red', 'green', 'blue', 'black', etc.
- Line styles: '-', '--', ':', '-.'
- Markers: 'o', 's', '^', '*'

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3. Multiple Lines on One Graph

```
x = [1, 2, 3, 4, 5]
y1 = [2, 4, 6, 8, 10]
y2 = [1, 3, 5, 7, 9]

plt.plot(x, y1, label='Line 1', color='blue')
plt.plot(x, y2, label='Line 2', color='orange')
plt.xlabel("X-axis")
plt.ylabel("Y-axis")
plt.title("Multiple Lines")
plt.legend()
plt.show()
```

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4. Bar Chart

```
x = ['A', 'B', 'C', 'D']
y = [10, 15, 7, 12]

plt.bar(x, y, color='purple')
plt.title("Bar Chart Example")
plt.xlabel("Categories")
plt.ylabel("Values")
plt.show()
```

Horizontal bar chart:

```
plt.barh(x, y, color='teal')
plt.title("Horizontal Bar Chart")
plt.show()
```

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5. Pie Chart

```
labels = ['Apples', 'Bananas', 'Cherries', 'Dates']
sizes = [20, 30, 25, 25]
colors = ['red', 'yellow', 'pink', 'brown']

plt.pie(sizes, labels=labels, colors=colors, autopct='%1.1f%%', startangle=90)
plt.title("Fruit Distribution")
plt.show()
```

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6. Scatter Plot

```
x = [5, 7, 8, 10, 12, 15]
y = [99, 86, 87, 88, 100, 104]

plt.scatter(x, y, color='green', marker='o')
plt.title("Scatter Plot Example")
plt.xlabel("X values")
plt.ylabel("Y values")
plt.show()
```

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7. Histogram

```
import numpy as np

data = np.random.randn(1000)

plt.hist(data, bins=20, color='skyblue', edgecolor='black')
plt.title("Histogram Example")
plt.xlabel("Value Range")
plt.ylabel("Frequency")
plt.show()
```

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8. Subplots (Multiple Charts Together)

```
x = [1, 2, 3, 4, 5]
y1 = [2, 3, 4, 5, 6]
y2 = [1, 4, 9, 16, 25]

plt.subplot(1, 2, 1)   # 1 row, 2 columns, first plot
plt.plot(x, y1, color='blue')
plt.title("Line 1")

plt.subplot(1, 2, 2)   # 1 row, 2 columns, second plot
plt.plot(x, y2, color='red')
plt.title("Line 2")

plt.show()
```

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9. Adding Grid, Text & Annotations

```
plt.plot(x, y2)
plt.title("Example with Grid & Text")
plt.xlabel("X-axis")
plt.ylabel("Y-axis")
plt.grid(True)
plt.text(3, 15, "Mid Point", fontsize=10, color='red')
plt.show()
```

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10. Box Plot

```
data = [20, 25, 30, 35, 40, 45, 50, 55, 60]

plt.boxplot(data)

plt.title("Box Plot Example")

plt.show()
```

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11. Area Plot (Filled Curve)

```
x = [1, 2, 3, 4, 5]

y = [2, 4, 6, 8, 10]


plt.fill_between(x, y, color='lightgreen', alpha=0.5)

plt.title("Area Plot Example")

plt.show()
```

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12. Save Plots as Image

```
plt.plot(x, y)

plt.title("Save Plot Example")

plt.savefig("plot_example.png")   # Save as PNG file

plt.show()
```

Complete Example

```
import matplotlib.pyplot as plt

import numpy as np


x = np.linspace(0, 10, 100)

y = np.sin(x)

z = np.cos(x)


plt.figure(figsize=(8,5))
plt.plot(x, y, label='sin(x)', color='blue')

plt.plot(x, z, label='cos(x)', color='red')

plt.title("Sine and Cosine Waves")

plt.xlabel("X values")

plt.ylabel("Y values")

plt.legend()

plt.grid(True)

plt.show()
```