	Marwadi University **Faculty of Engineering & Technology** **Department of Information and Communication Technology**
Subject: Programming With Python (01CT1309)	**Aim:** Practical based on matplotlib
Experiment No: 10	**Date:**	**Enrollment No:92400133037**

Aim: Practical based on matplotlib

IDE:

What is Matplotlib?

Matplotlib is a popular plotting library in Python used for creating high-quality visualizations and graphs. It offers various tools to generate diverse plots, facilitating data analysis, exploration, and presentation. Matplotlib is flexible, supporting multiple plot types and customization options, making it valuable for scientific research, data analysis, and visual communication. It can create different types of visualization reports like line plots, scatter plots, histograms, bar charts, pie charts, box plots, and many more different plots. This library also supports 3-dimensional plotting.

Installation of Matplotlib

pip install matplotlib

To verify the installation, you would have to write the following code chunk:

```
import matplotlib as plt
print(plt.__version__)
```
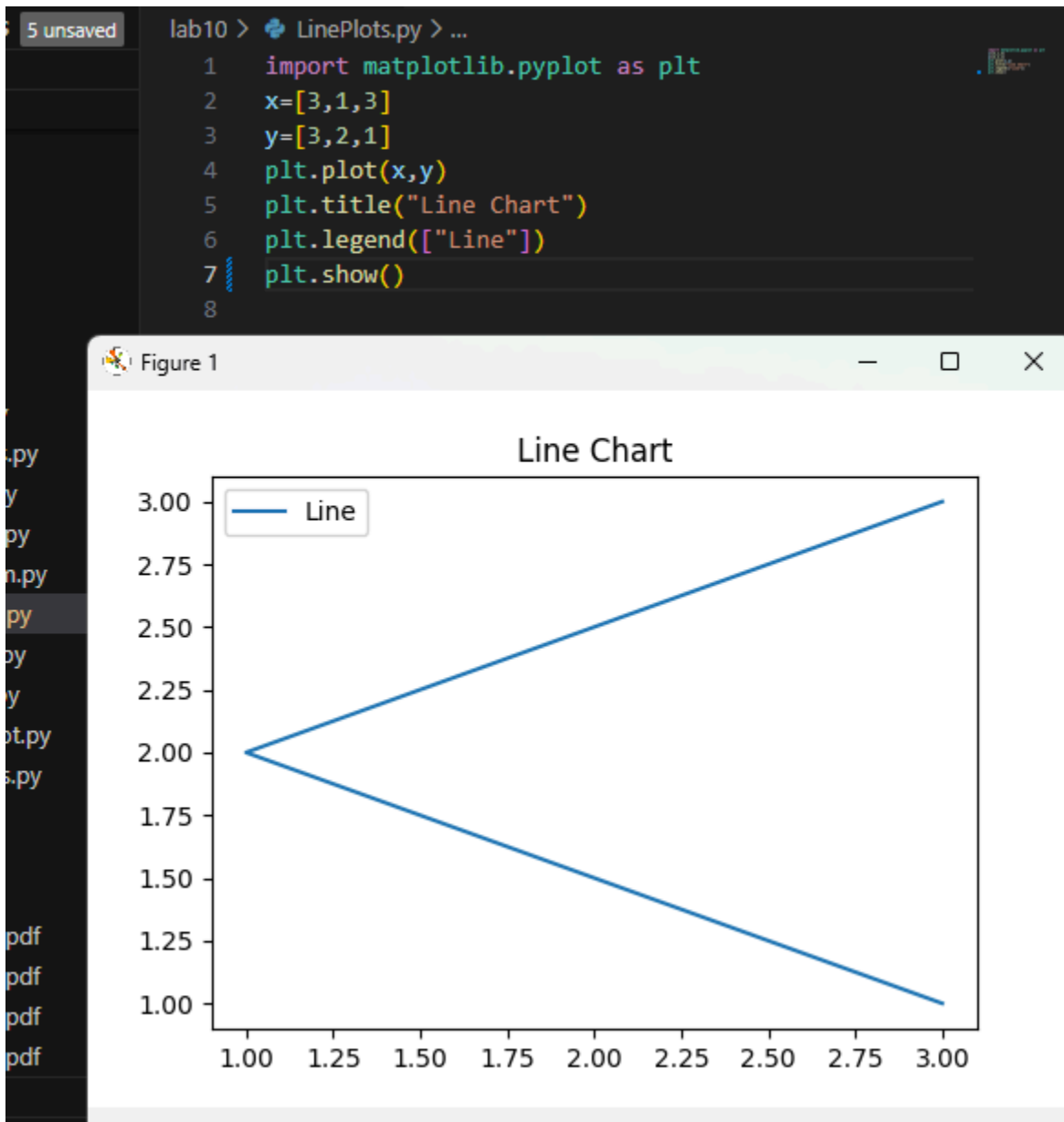
Line Plots
Line graphs are commonly used to visualize trends over time or relationships between variables.

```
Example
import matplotlib.pyplot as plt
# data to display on plots
x = [3, 1, 3]
y = [3, 2, 1]
plt.plot(x, y)
plt.title("Line Chart")
# Adding the legends
plt.legend(["Line"])
plt.show()
Output
```

Marwadi **University** Marwadi Chandarana Group	**NAAC** **A+**	**Marwadi University** **Faculty of Engineering & Technology** **Department of Information and Communication Technology**
Subject: Programming With Python (01CT1309)		**Aim:** Practical based on matplotlib
Experiment No: 10	**Date:**	**Enrollment No:92400133037**

Note: xlabel, ylabel, title, plt.xlabel("X-axis") # add X-axis label, plt.ylabel("Y-axis") # add Y-axis label plt.title("Any suitable title") # add title, plt.show(), plt.grid(), plt.axhline(y=0, color='k'), plt.axvline(x=0, color='k')

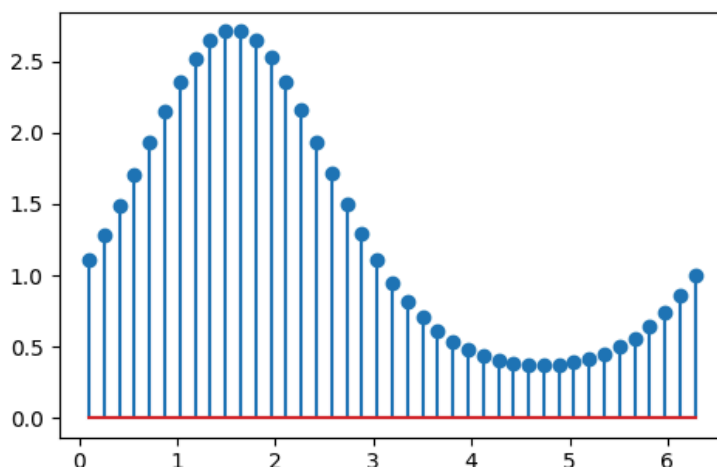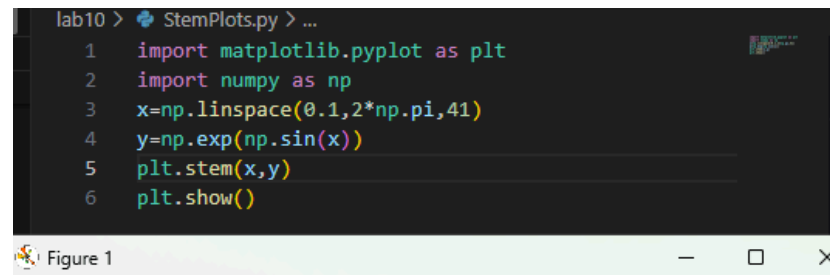|	Marwadi University
![Marwadi University Logo] NAAC A+	**Marwadi University** **Faculty of Engineering & Technology** **Department of Information and Communication Technology**
Subject: Programming With Python (01CT1309)	**Aim:** Practical based on matplotlib
Experiment No: 10	**Date:**		**Enrollment No:92400133037**

Stem Plots

A stem plot, also known as a stem-and-leaf plot, is a type of plot used to display data along a number line. Stem plots are particularly useful for visualizing discrete data sets, where the values are represented as "stems" extending from a baseline, with data points indicated as "leaves" along the stems.

Example
import matplotlib.pyplot as plt
import numpy as np
x = np.linspace(0.1, 2 * np.pi, 41)
y = np.exp(np.sin(x))
plt.stem(x, y, use_line_collection = **True**)
plt.show()
Output

```
lab10 >  StemPlots.py > ...
  1    import matplotlib.pyplot as plt
  2    import numpy as np
  3    x=np.linspace(0.1,2*np.pi,41)
  4    y=np.exp(np.sin(x))
  5    plt.stem(x,y)
  6    plt.show()
```

	Marwadi University
 Marwadi University Marwadi Chandarana Group	**Marwadi University** **Faculty of Engineering & Technology** **Department of Information and Communication Technology**
Subject: Programming With Python (01CT1309)	**Aim:** Practical based on matplotlib
Experiment No: 10	**Date:**	**Enrollment No:92400133037**

Bar Charts

A **bar plot** or bar chart is a graph that represents the category of data with rectangular bars with lengths and heights that is proportional to the values which they represent. The bar plots can be plotted horizontally or vertically. A bar chart describes the comparisons between the discrete categories. It can be created using the **bar()** method.

Example
 # This will plot a simple bar chart
plt.bar(x, y)
 # Title to the plot
plt.title("Bar Chart")
 # Adding the legends
plt.legend(["bar"])
plt.show()
Output

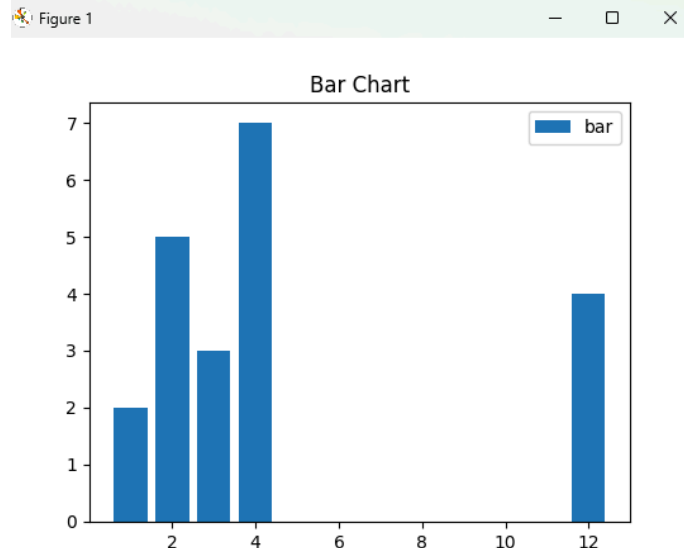|	**Marwadi University**
![Marwadi University logo with NAAC A+]	**Faculty of Engineering & Technology**
	Department of Information and Communication Technology

Subject: Programming With Python (01CT1309)	**Aim:** Practical based on matplotlib	
Experiment No: 10	**Date:**	**Enrollment No:92400133037**

Histogram Plot

A histogram is basically used to represent data in the form of some groups. It is a type of bar plot where the X-axis represents the bin ranges while the Y-axis gives information about frequency. To create a histogram the first step is to create a bin of the ranges, then distribute the whole range of the values into a series of intervals, and count the values which fall into each of the intervals. Bins are clearly identified as consecutive, non-overlapping intervals of variables.

import matplotlib.pyplot as plt
 # data to display on plots
x = [1, 2, 3, 4, 5, 6, 7, 4]
 # This will plot a simple histogram
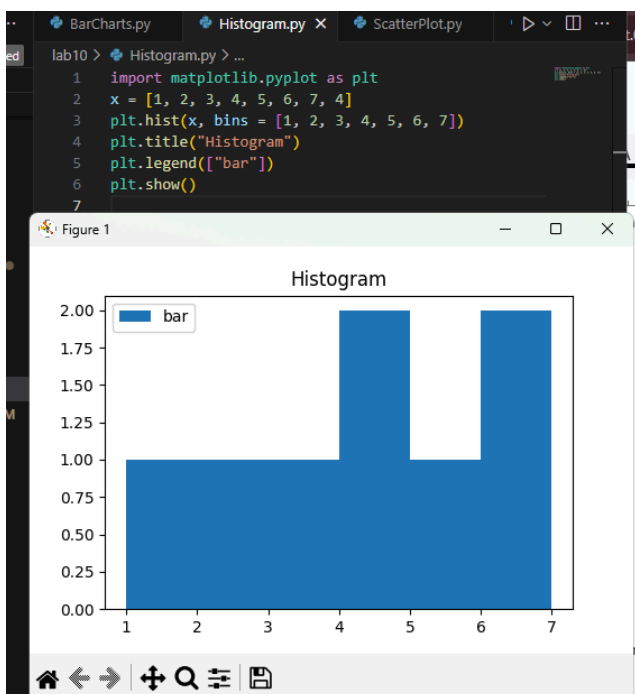plt.hist(x, bins = [1, 2, 3, 4, 5, 6, 7])
 # Title to the plot
plt.title("Histogram")
 # Adding the legends
plt.legend(["bar"])
plt.show()
Output

Subject: Programming With Python (01CT1309)	**Aim:** Practical based on matplotlib	
Experiment No: 10	**Date:**	**Enrollment No:92400133037**

Scatter Plot

Scatter plots are ideal for visualizing the relationship between two continuous variables.

Example

import matplotlib.pyplot as plt

 # data to display on plots

x = [3, 1, 3, 12, 2, 4, 4]

y = [3, 2, 1, 4, 5, 6, 7]

 # This will plot a simple scatter chart

plt.scatter(x, y)

 # Adding legend to the plot

plt.legend("A")

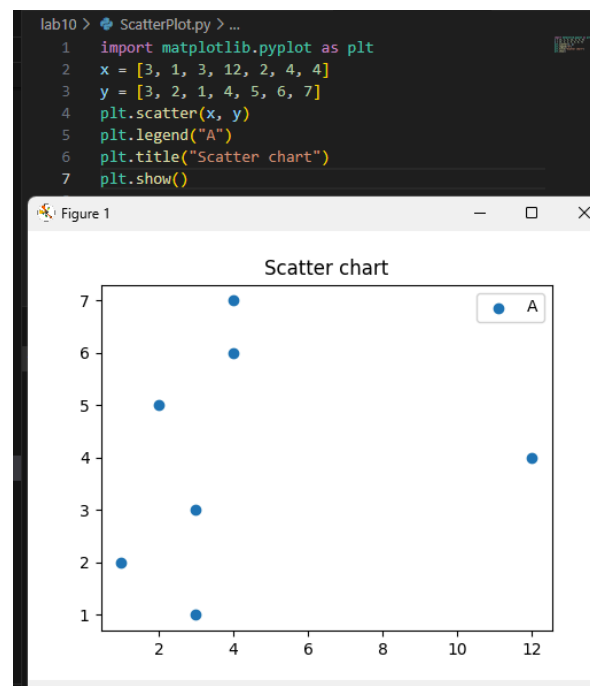*# Title to the plot*

plt.title("Scatter chart")

plt.show()

Output

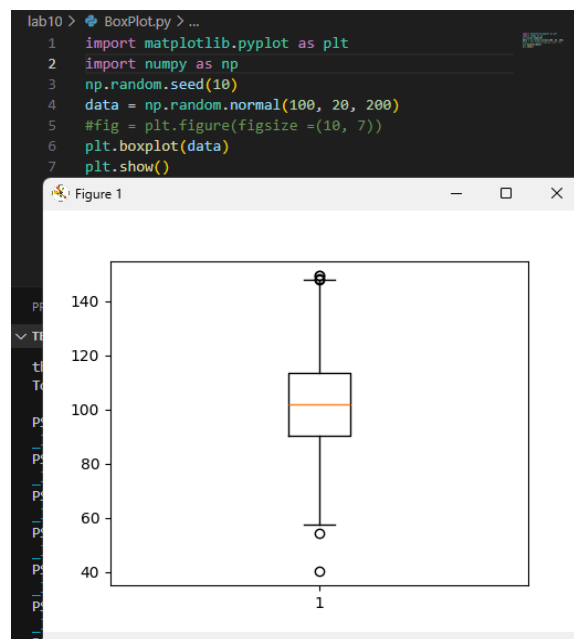|	**Marwadi University** **Faculty of Engineering & Technology** **Department of Information and Communication Technology**
Subject: Programming With Python (01CT1309)	**Aim:** Practical based on matplotlib
Experiment No: 10	**Date:**	**Enrollment No:92400133037**

Box Plot

A box plot, also known as a box-and-whisker plot, provides a visual summary of the distribution of a dataset. It represents key statistical measures such as the median, quartiles, and potential outliers in a concise and intuitive manner. Box plots are particularly useful for comparing distributions across different groups or identifying anomalies in the data.

Example

import matplotlib.pyplot as plt

import numpy as np

 # Creating dataset

np.random.seed(10)

data = np.random.normal(100, 20, 200)

fig = plt.figure(figsize =(10, 7))

 # Creating plot

plt.boxplot(data)

 # show plot

plt.show()

Output

	Marwadi University **Faculty of Engineering & Technology** **Department of Information and Communication Technology**
Subject: Programming With Python (01CT1309)	**Aim:** Practical based on matplotlib
Experiment No: 10	**Date:**	**Enrollment No:92400133037**

Pie chart

A Pie Chart is a circular statistical plot that can display only one series of data. The area of the chart is the total percentage of the given data. The area of slices of the pie represents the percentage of the parts of the data. The slices of pie are called wedges. The area of the wedge is determined by the length of the arc of the wedge.

Example

import matplotlib.pyplot as plt

 # data to display on plots

x = [1, 2, 3, 4]

 # this will explode the 1st wedge

 # i.e. will separate the 1st wedge

 # from the chart

e =(0.1, 0, 0, 0)

 # This will plot a simple pie chart
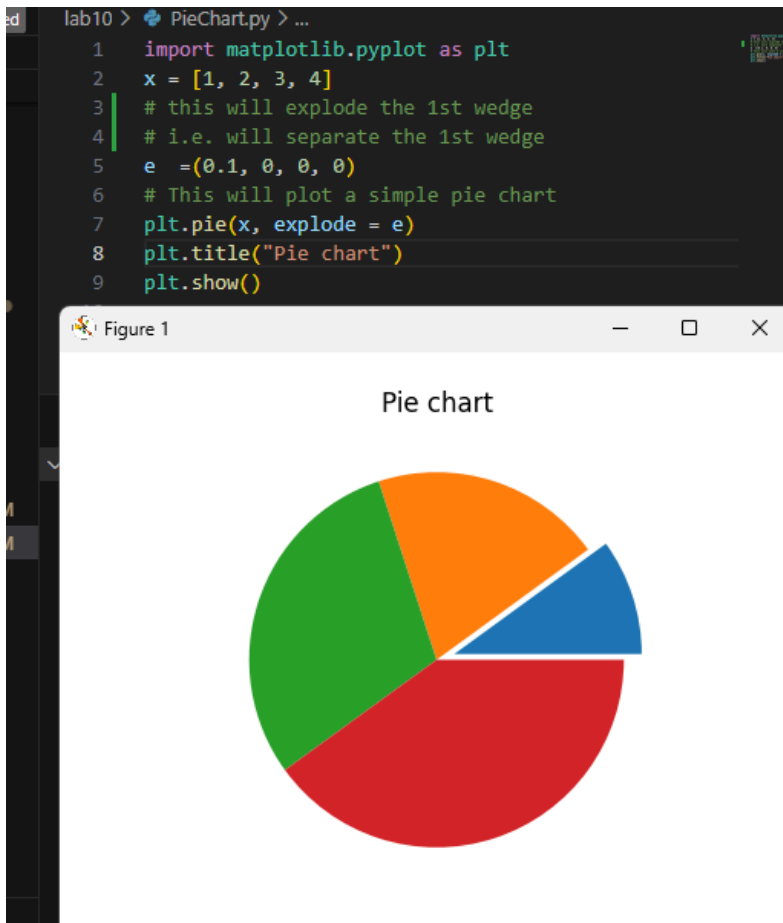
plt.pie(x, explode = e)

 # Title to the plot

plt.title("Pie chart")

plt.show()

Output

NAAC A+ Marwadi Chandarana Group	**Marwadi University** **Faculty of Engineering & Technology** **Department of Information and Communication Technology**	
Subject: Programming With Python (01CT1309)	**Aim:** Practical based on matplotlib	
Experiment No: 10	**Date:**	**Enrollment No:92400133037**

Error Plot

Error plots display the variability or uncertainty associated with each data point in a dataset. They are commonly used in scientific research, engineering, and statistical analysis to visualize measurement errors, confidence intervals, standard deviations, or other statistical properties of the data. By incorporating error bars into plots, we can convey not only the central tendency of the data but also the range of possible values around each point.

Example
 # importing matplotlib
import matplotlib.pyplot as plt

	Marwadi University
	Marwadi University
	Faculty of Engineering & Technology
	Department of Information and Communication Technology
Subject: Programming With Python (01CT1309)	**Aim:** Practical based on matplotlib
Experiment No: 10	**Date:**	**Enrollment No:92400133037**

 # making a simple plot
x =[1, 2, 3, 4, 5, 6, 7]
y =[1, 2, 1, 2, 1, 2, 1]
 # creating error
y_error = 0.2
 # plotting graph
plt.plot(x, y)
plt.errorbar(x, y,yerr = y_error,fmt ='o')
Output

![Marwadi University Logo]	**Marwadi University**
	Faculty of Engineering & Technology
	Department of Information and Communication Technology

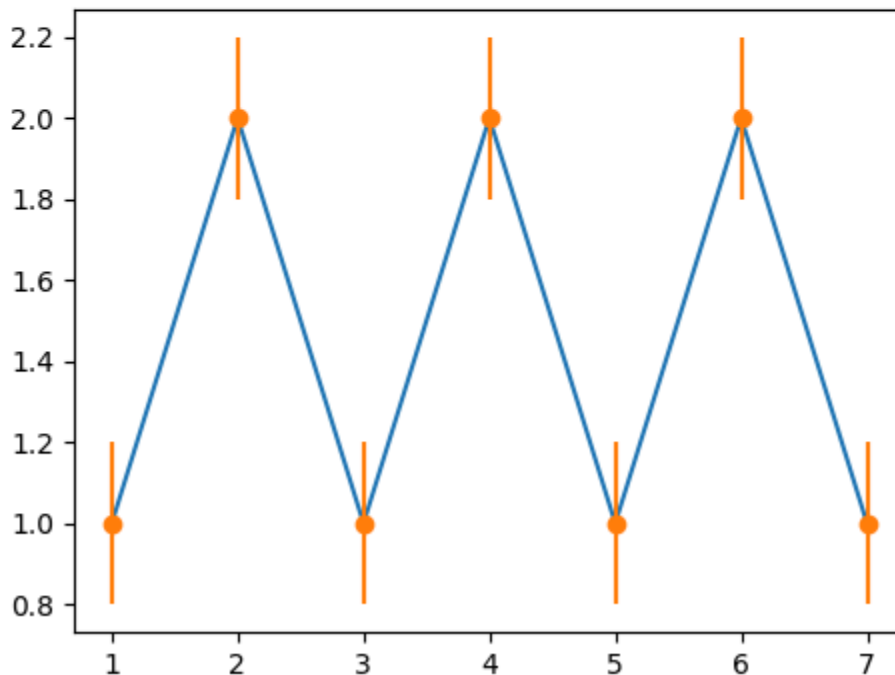| **Subject: Programming With Python (01CT1309)** | **Aim:** Practical based on matplotlib | |
| **Experiment No: 10** | **Date:** | **Enrollment No:92400133037** |

```
lab10 >  ErrorPlot.py > ...
    1    import matplotlib.pyplot as plt
    2    x =[1, 2, 3, 4, 5, 6, 7]
    3    y =[1, 2, 1, 2, 1, 2, 1]
    4    y_error = 0.2
    5    plt.plot(x, y)
    6    plt.errorbar(x, y,yerr = y_error,fmt ='o')
    7    plt.show()
```


Note:

lets the creation of a 3D plot in Matplotlib. We can create different types of 3D plots like scatter plots, contour plots, surface plots, etc. Let's create a simple 3D line plot.

Example

import matplotlib.pyplot as plt

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

![Marwadi University logo]	**Marwadi University** **Faculty of Engineering & Technology** **Department of Information and Communication Technology**
Subject: Programming With Python (01CT1309)	**Aim:** Practical based on matplotlib
Experiment No: 10	**Date:**	**Enrollment No:92400133037**

y = [1, 4, 9, 16, 25]

z = [1, 8, 27, 64, 125]

 # Creating the figure object

fig = plt.figure()

 # keeping the projection = 3d

 # creates the 3d plot

ax = plt.axes(projection = '3d')

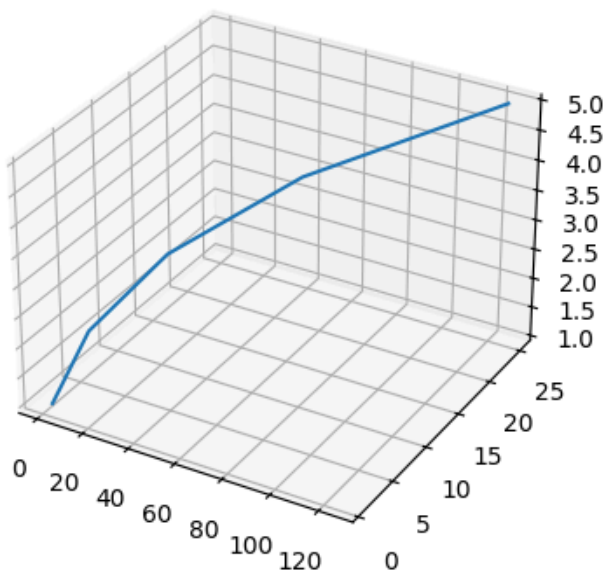ax.plot3D(z, y, x)

Output

```
1    import matplotlib.pyplot as plt
2    x = [1, 2, 3, 4, 5]
3    y = [1, 4, 9, 16, 25]
4    z = [1, 8, 27, 64, 125]
5    ax = plt.axes(projection = '3d')
6    ax.plot3D(z, y, x)
7    plt.show()
```

![Marwadi University Logo] NAAC A+ Marwadi University Marwadi Chandarana Group	**Marwadi University** **Faculty of Engineering & Technology** **Department of Information and Communication Technology**
Subject: Programming With Python (01CT1309)	**Aim:** Practical based on matplotlib
Experiment No: 10	**Date:** **Enrollment No:92400133037**

Post Lab Exercise:

a. Write a Python program to draw a line with suitable label in the x axis, y axis and a title.
b. Write a Python program to plot two or more lines on same plot with suitable legends of each line.
c. Write a Python programming to display a bar chart of the popularity of programming Languages.
   Sample data:
   Programming languages: Java, Python, PHP, JavaScript, C#, C++
   Popularity: 22.2, 17.6, 8.8, 8, 7.7, 6.7

More Practice
Reference : https://medium.com/@DebaprasannBhoi/python-matplotlib-exercises-cc46c994563c

```
lab10 > 🐍 PostLab.py > ...
  1   import matplotlib.pyplot as plt
  2
  3   x = [1, 2, 3, 4, 5]
  4   y = [2, 4, 6, 8, 10]
  5   plt.plot(x, y)
  6   plt.xlabel("X Axis")
  7   plt.ylabel("Y Axis")
  8   plt.title("Simple Line Plot")
  9   plt.show()
 10
 11
 12   x = [1, 2, 3, 4, 5]
 13   y1 = [2, 4, 6, 8, 10]
 14   y2 = [1, 3, 5, 7, 9]
 15   plt.plot(x, y1, label="Line 1", color="blue")
 16   plt.plot(x, y2, label="Line 2", color="red")
 17   plt.xlabel("X Axis")
 18   plt.ylabel("Y Axis")
 19   plt.title("Two Lines on Same Plot")
 20   plt.legend()
 21   plt.show()
 22
 23
```
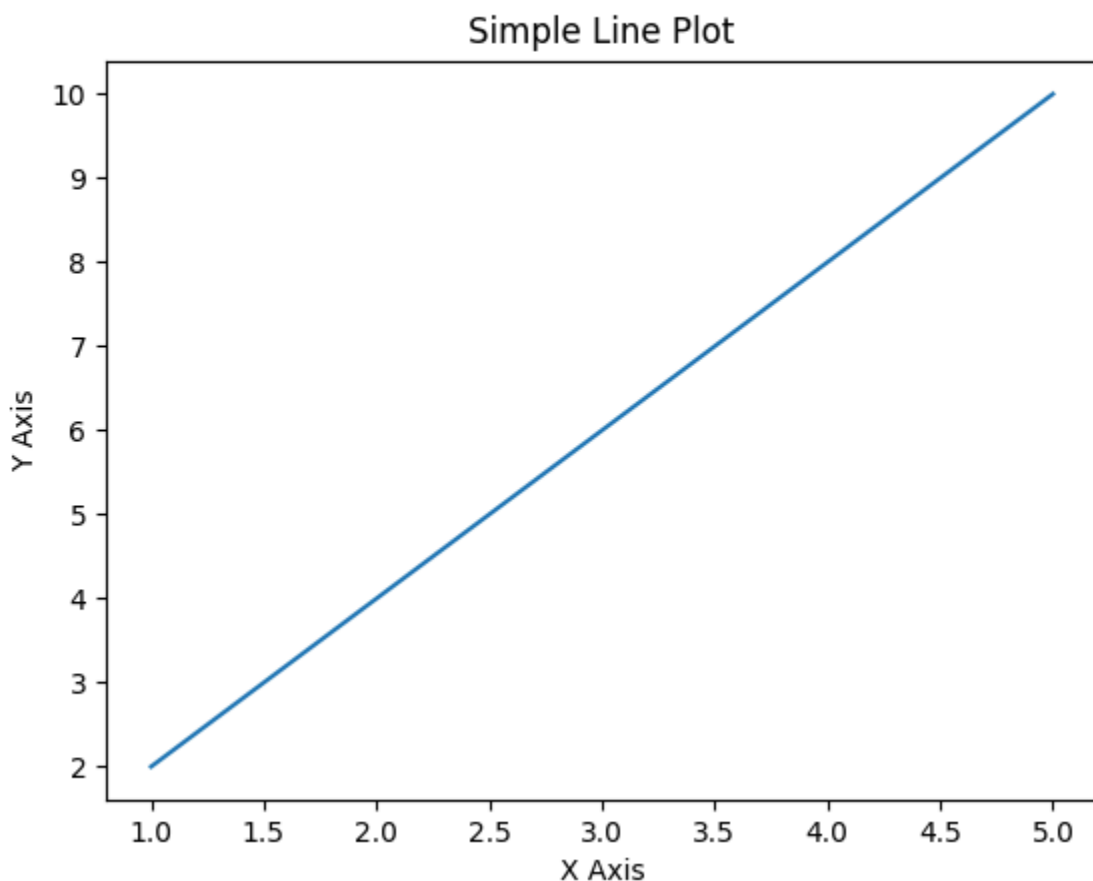
	Marwadi University
![Marwadi University logo with NAAC A+]	**Marwadi University** **Faculty of Engineering & Technology** **Department of Information and Communication Technology**
Subject: Programming With Python (01CT1309)	**Aim:** Practical based on matplotlib
Experiment No: 10	**Date:** **Enrollment No:92400133037**

```python
languages = ['Java', 'Python', 'PHP', 'JavaScript', 'C#', 'C++']
popularity = [22.2, 17.6, 8.8, 8, 7.7, 6.7]
plt.bar(languages, popularity, color=['blue','green','red',
                                       'purple','orange','cyan'])
plt.xlabel("Programming Languages")
plt.ylabel("Popularity (%)")
plt.title("Popularity of Programming Languages")
plt.show()
```

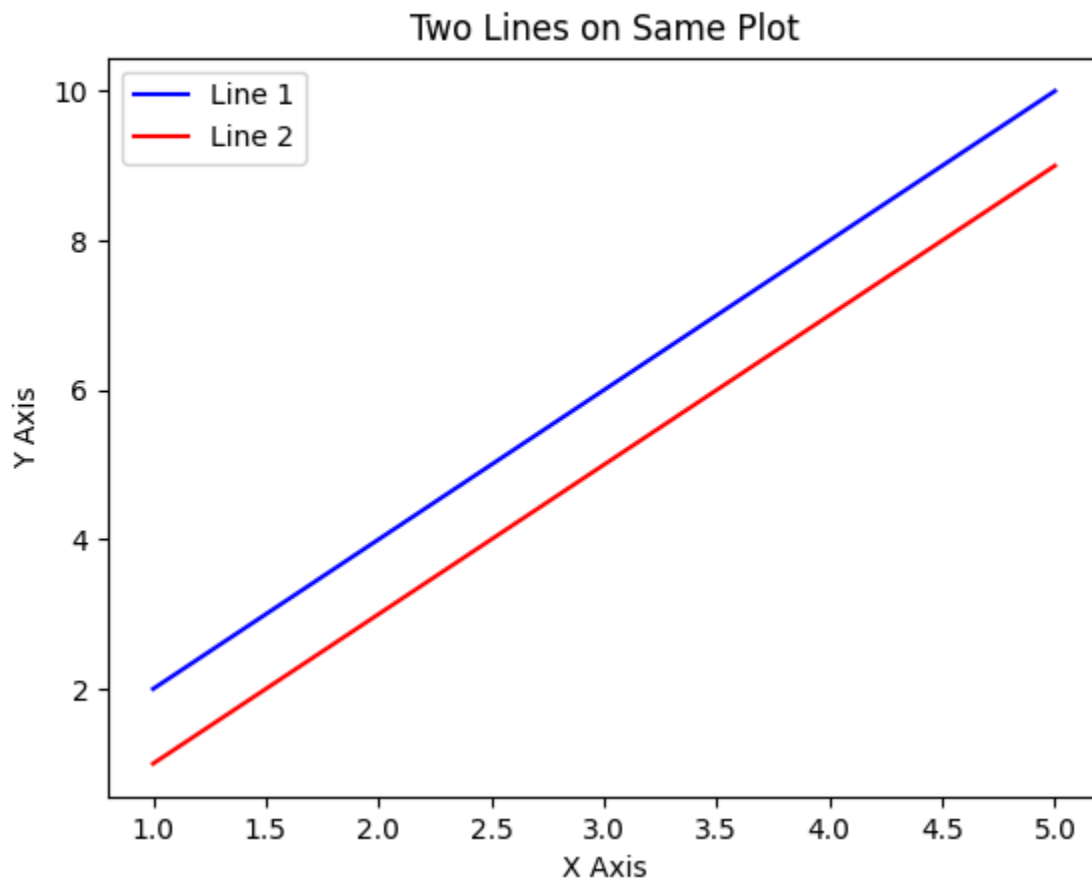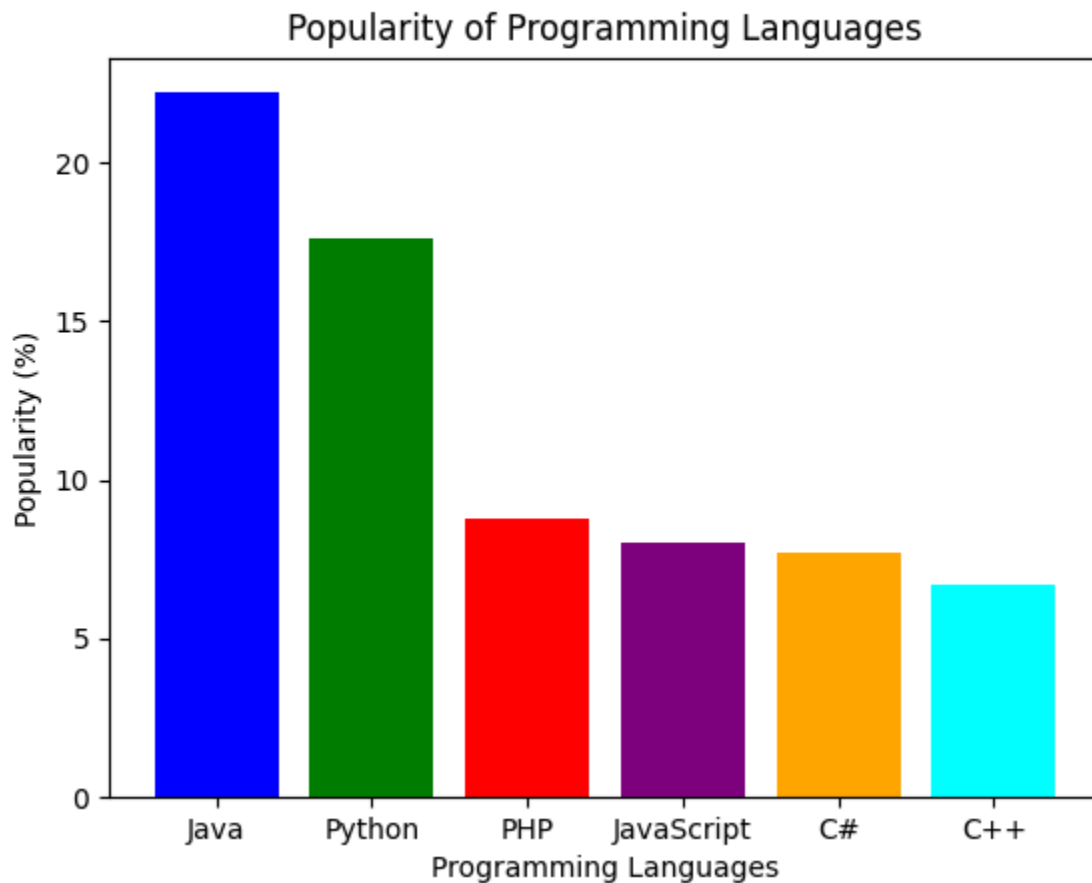|	Marwadi University
![Marwadi University logo]	**Marwadi University** **Faculty of Engineering & Technology** **Department of Information and Communication Technology**
Subject: Programming With Python (01CT1309)	**Aim:** Practical based on matplotlib
Experiment No: 10	**Date:** **Enrollment No:92400133037**

	Marwadi University
![Marwadi University Logo]	**Marwadi University** **Faculty of Engineering & Technology** **Department of Information and Communication Technology**
Subject: Programming With Python (01CT1309)	**Aim:** Practical based on matplotlib
Experiment No: 10	**Date:**	**Enrollment No:92400133037**