Customizing Styles in Matplotlib

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Here, we'll delve into the fundamentals of Matplotlib, exploring its various classes and functionalities to help you unleash the full potential of your data visualization projects. From basic plotting techniques to advanced customization options, this guide will equip you with the knowledge needed to create stunning visualizations with Matplotlib. So, let's dive in and discover how to effectively utilize Matplotlib for your data visualization needs.

Table of Content

Getting Started with Matplotlib

Matplotlib is easy to use and an amazing visualizing library in Python. It is built on NumPy arrays and designed to work with the broader SciPy stack and consists of several plots like line, bar, scatter, histogram, etc. Before we start learning about Matplotlib we first have to set up the environment and will also see how to use Matplotlib with Jupyter Notebook

- Matplotlib with Jupyter Notebook

Exploring Different Plot Styles with Matplotlib

Matplotlib's versatile styling capabilities empower you to craft visualizations that captivate and inform your audience. Join us as we embark on a journey to unlock the full potential of Matplotlib's plot styles and elevate your data visualization endeavors to new heights.

1. Matplotlib Figure Class

Figure class is the top-level container that contains one or more axes. It is the overall window or page on which everything is drawn.

Syntax:

```
class matplotlib.figure.Figure(
                      figsize=None,
                      dpi=None,
                      facecolor=None,
                      edgecolor=None,
                      linewidth=0.0,
                      frameon=None,
                      subplotpars=None,
                      tight_layout=None,
                      constrained_layout=None)
```

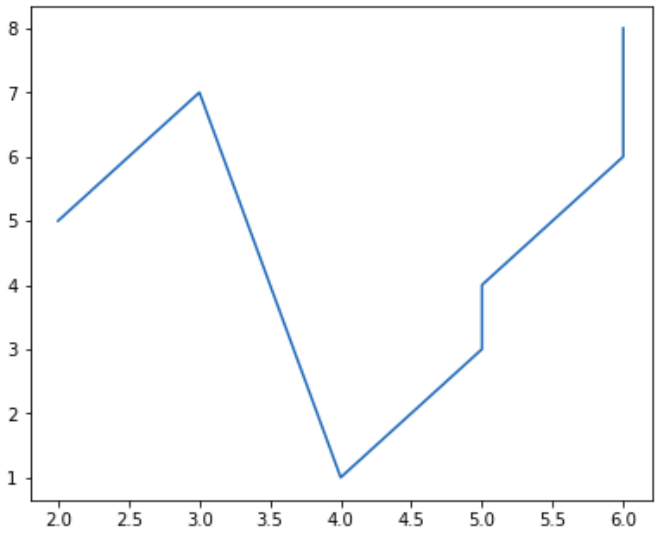
Example 1: Creating Single Plot

Python3

```
# Python program to show pyplot module
import matplotlib.pyplot as plt
from matplotlib.figure import Figure

# Creating a new figure with width = 5 inches
# and height = 4 inches
fig = plt.figure(figsize =(5, 4))

# Creating a new axes for the figure
ax = fig.add_axes([1, 1, 1, 1])

```

```
# Adding the data to be plotted
ax.plot([2, 3, 4, 5, 5, 6, 6],
        [5, 7, 1, 3, 4, 6 ,8])
plt.show()
```

Output



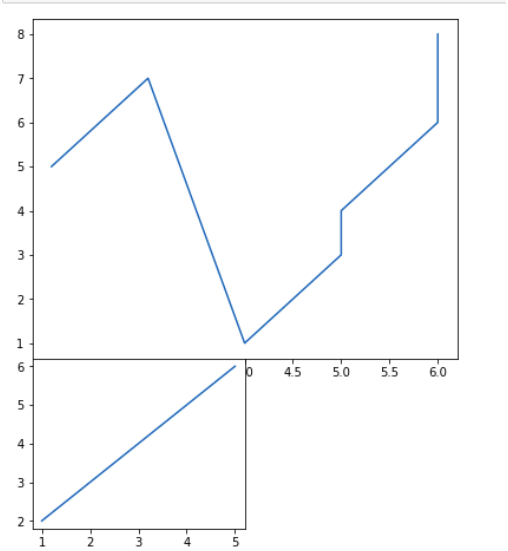
Example 2: Creating multiple plots

Python3

```
# Python program to show pyplot module
import matplotlib.pyplot as plt
from matplotlib.figure import Figure

# Creating a new figure with width = 5 inches
# and height = 4 inches
fig = plt.figure(figsize =(5, 4))

# Creating first axes for the figure
ax1 = fig.add_axes([1, 1, 1, 1])

# Creating second axes for the figure
ax2 = fig.add_axes([1, 0.5, 0.5, 0.5])

# Adding the data to be plotted
ax1.plot([2, 3, 4, 5, 5, 6, 6],
         [5, 7, 1, 3, 4, 6 ,8])
ax2.plot([1, 2, 3, 4, 5],
         [2, 3, 4, 5, 6])
```

```
20
21  plt.show()
```

Output



Refer to the below articles to get detailed information about the Figure class and functions associated with it.

- Matplotlib.figure.Figure() in Python
- Matplotlib.figure.Figure.add_axes() in Python
- Matplotlib.figure.Figure.clear() in Python
- Matplotlib.figure.Figure.colorbar() in Python
- Matplotlib.figure.Figure.get_figwidth() in Python
- Matplotlib.figure.Figure.get_figheight() in Python
- Matplotlib.figure.Figure.subplots() in Python

2. Python Pyplot Class

Pyplot is a Matplotlib module that provides a MATLAB-like interface. Pyplot provides functions that interact with the figure i.e. creates a figure, decorates the plot with labels, and creates a plotting area in a figure.

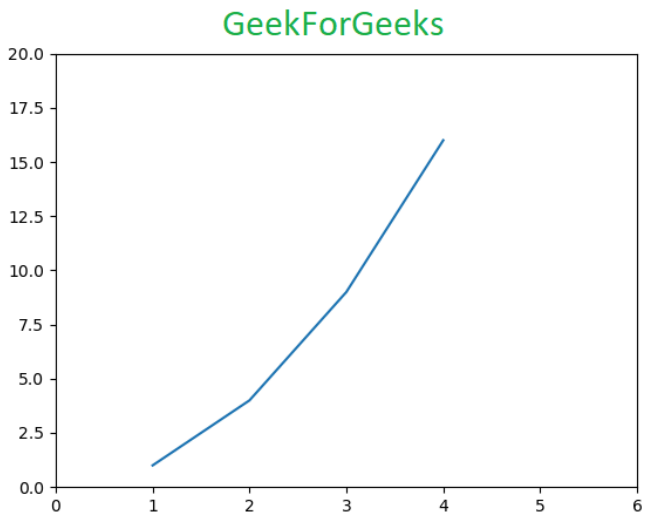
> ***Syntax:*** *matplotlib.pyplot.plot(*args, scalex=True, scaley=True, data=None, **kwargs)*

Example

Python3

```
# Python program to show pyplot module
import matplotlib.pyplot as plt
plt.plot([1, 2, 3, 4], [1, 4, 9, 16])
plt.axis([0, 6, 0, 20])
plt.show()
```

Output



Matplotlib take care of the creation of inbuilt defaults like **Figure and Axes.** Don't worry about these terms we will study them in detail in the below section but let's take a brief about these terms.

3. Matplotlib Axes Class

Axes class is the most basic and flexible unit for creating sub-plots. A given figure may contain many axes, but a given axes can only be present in one figure. The axes() function creates the axes object. Let's see the below example.

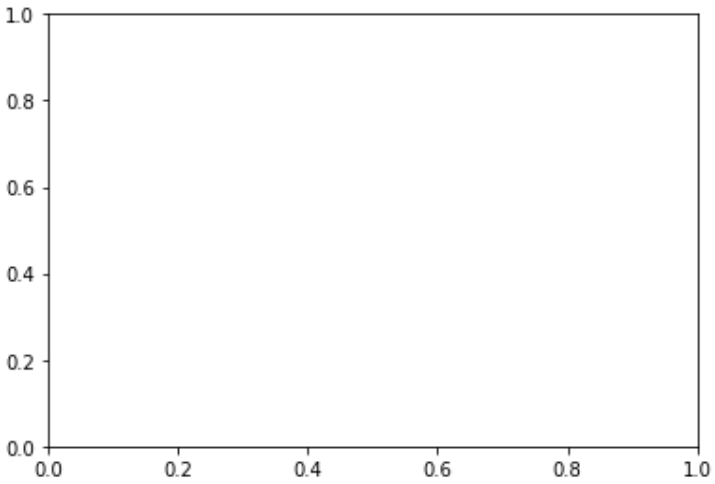
Syntax: *matplotlib.pyplot.axis(*args, emit=True, **kwargs)*

Example 1: Creating Only Axes

Python3

```python
# Python program to show pyplot module
import matplotlib.pyplot as plt
from matplotlib.figure import Figure
# Creating the axes object with argument as
# [left, bottom, width, height]
ax = plt.axes([1, 1, 1, 1])
```

Output

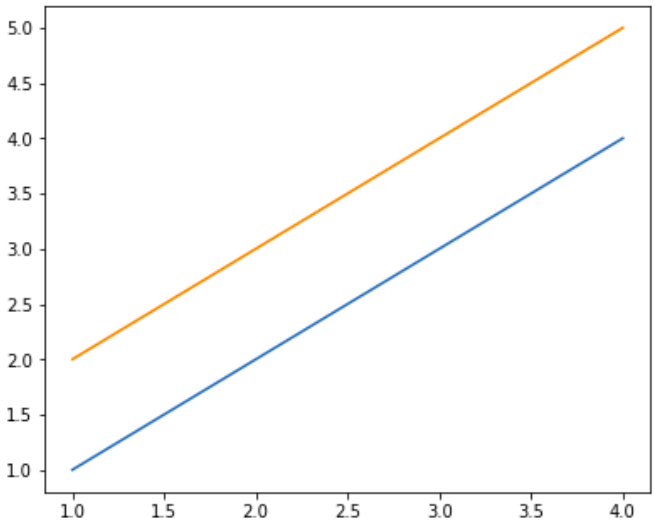


Example 2: Craeting Axes with line Chart

Python3

```python
# Python program to show pyplot module
import matplotlib.pyplot as plt
from matplotlib.figure import Figure
fig = plt.figure(figsize = (5, 4))

# Adding the axes to the figure
ax = fig.add_axes([1, 1, 1, 1])

# plotting 1st dataset to the figure
ax1 = ax.plot([1, 2, 3, 4], [1, 2, 3, 4])

# plotting 2nd dataset to the figure
ax2 = ax.plot([1, 2, 3, 4], [2, 3, 4, 5])
plt.show()
```

Output



Refer to the below articles to get detailed information about the axes class and functions associated with it.

- Matplotlib – Axes Class
- Matplotlib.axes.Axes.update() in Python
- Matplotlib.axes.Axes.draw() in Python
- Matplotlib.axes.Axes.get_figure() in Python
- Matplotlib.axes.Axes.set_figure() in Python
- Matplotlib.axes.Axes.properties() in Python

>>> More Functions on Axes Class

4. Set Colors in Matplotlib

Color plays a vital role in data visualization, conveying information, highlighting patterns, and making plots visually appealing. Matplotlib, a powerful plotting library in Python, offers extensive options for customizing colors in plots.

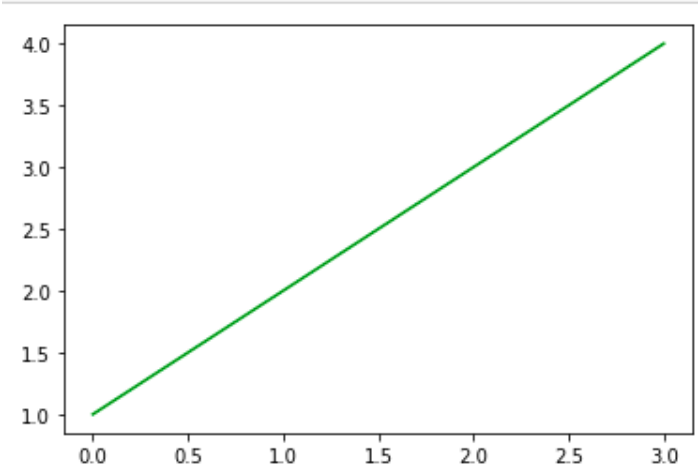
Example 1: Using Color attribute in Matplotlib

Python3

```
import matplotlib.pyplot as plt

# Define the Color
color = 'green'
plt.plot([1, 2, 3, 4], color=color)
```

```
6
7  plt.show()
```

Output

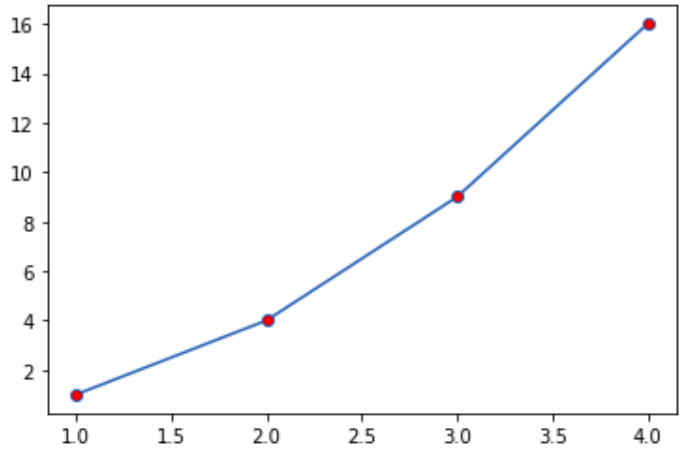


Example 2: Use of marker in Matplotlib

Python3

```
1  import matplotlib.pyplot as plt
2
3  x = [1, 2, 3, 4]
4  y = [1, 4, 9, 16]
5
6  plt.plot(x, y, marker='o', markerfacecolor='r')
7
8  plt.show()
```

Output



Refere

- Change Line Color in Matplotlib
- Matplotlib – Change Slider Color
- Adjust the Position of a Matplotlib Colorbar
- Listed Colormap class in Python
- Matplotlib colors to rgba()
- Change the Color of a Graph Plot in Matplotlib

5. Add Text, Font and Grid lines in Matplotlib

Adding text annotations and grid lines in Matplotlib enhances the readability and clarity of plots. Here's how you can incorporate text annotations and grid lines into your Matplotlib plots.

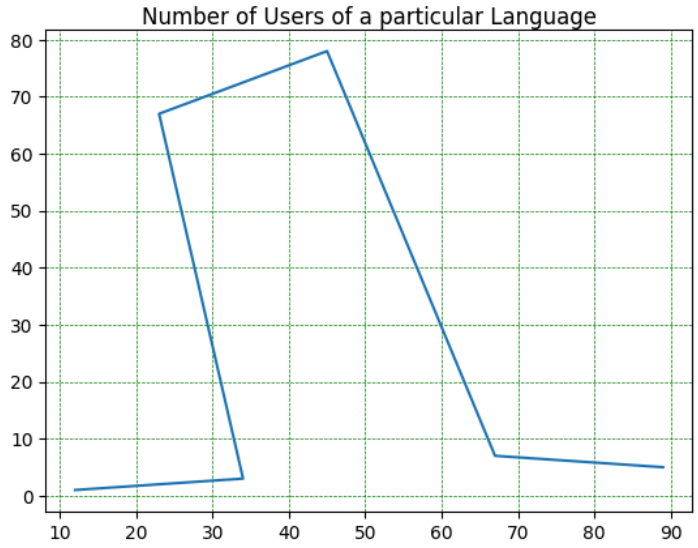
Example: Creating Grid Lines with Chart Title in Matplotlib

Python3

```
# Importing the library
import matplotlib.pyplot as plt

# Define X and Y data points
X = [12, 34, 23, 45, 67, 89]
Y = [1, 3, 67, 78, 7, 5]

# Plot the graph using matplotlib
plt.plot(X, Y)

# Add gridlines to the plot
```

```
plt.grid(color = 'green', linestyle = '--', linewidth = 0.5)
# `plt.grid()` also works

# displaying the title
plt.title(label='Number of Users of a particular Language',
          fontweight=10,
          pad='2.0')

# Function to view the plot
plt.show()
```

Output



Refere

- How to add a grid on a figure in Matplotlib?
- How to Change Legend Font Size in Matplotlib?
- How to Change Fonts in matplotlib?
- How to change the font size of the Title in a Matplotlib figure ?
- How to Set Tick Labels Font Size in Matplotlib?
- Add Text Inside the Plot in Matplotlib
- How to add text to Matplotlib?

6. Custom Legends with Matplotlib

A legend is an area describing the elements of the graph. In simple terms, it reflects the data displayed in the graph's Y-axis. It generally appears as the box

containing a small sample of each color on the graph and a small description of what this data means.

A Legend can be created using the **legend()** method. The attribute **Loc** in the legend() is used to specify the location of the legend. The default value of loc is loc="best" (upper left). The strings 'upper left', 'upper right', 'lower left', 'lower right' place the legend at the corresponding corner of the axes/figure.

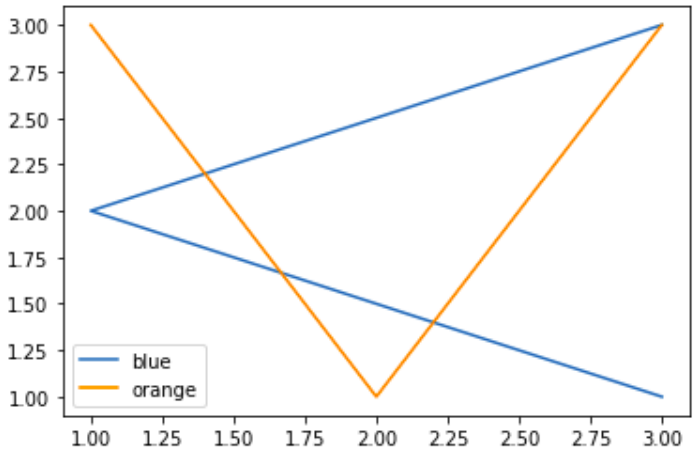
> ***Syntax:*** *matplotlib.pyplot.legend(["blue", "green"], bbox_to_anchor= (0.75, 1.15), ncol=2)*

Example: The attribute **bbox_to_anchor=(x, y)** of legend() function is used to specify the coordinates of the legend, and the attribute ncol represents the number of columns that the legend has. Its default value is 1.

Python3

```
import matplotlib.pyplot as plt

# data to display on plots
x = [3, 1, 3]
y = [3, 2, 1]
plt.plot(x, y)
plt.plot(y, x)

# Adding the legends
plt.legend(["blue", "orange"])
plt.show()
```

Output



Refer to the below articles to get detailed information about the legend –

- Matplotlib.pyplot.legend() in Python
- Matplotlib.axes.Axes.legend() in Python
- Change the legend position in Matplotlib
- How to Change Legend Font Size in Matplotlib?
- How Change the vertical spacing between legend entries in Matplotlib?
- Use multiple columns in a Matplotlib legend
- How to Create a Single Legend for All Subplots in Matplotlib?
- How to manually add a legend with a color box on a Matplotlib figure ?
- How to Place Legend Outside of the Plot in Matplotlib?
- How to Remove the Legend in Matplotlib?
- Remove the legend border in Matplotlib

7. Matplotlib Ticks and Tick Labels

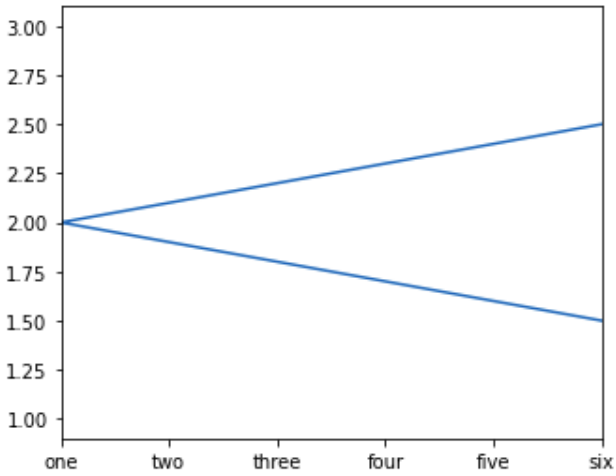
You might have seen that Matplotlib automatically sets the values and the markers(points) of the x and y axis, however, it is possible to set the limit and markers manually. **set_xlim()** and **set_ylim()** functions are used to set the limits of the x-axis and y-axis respectively. Similarly, **set_xticklabels()** and **set_yticklabels()** functions are used to set tick labels.

Python3

```
# Python program to show pyplot module
import matplotlib.pyplot as plt
from matplotlib.figure import Figure
x = [3, 1, 3]
y = [3, 2, 1]
```

```
6
7  # Creating a new figure with width = 5 inches
8  # and height = 4 inches
9  fig = plt.figure(figsize =(5, 4))
10
11 # Creating first axes for the figure
12 ax = fig.add_axes([0.1, 0.1, 0.8, 0.8])
13
14 # Adding the data to be plotted
15 ax.plot(x, y)
16 ax.set_xlim(1, 2)
17 ax.set_xticklabels((
18   "one", "two", "three", "four", "five", "six"))
19 plt.show()
```

Output



Refer to the below articles to get detailed information about the legend:

- How to Set Tick Labels Font Size in Matplotlib?
- How to Hide Axis Text Ticks or Tick Labels in Matplotlib?

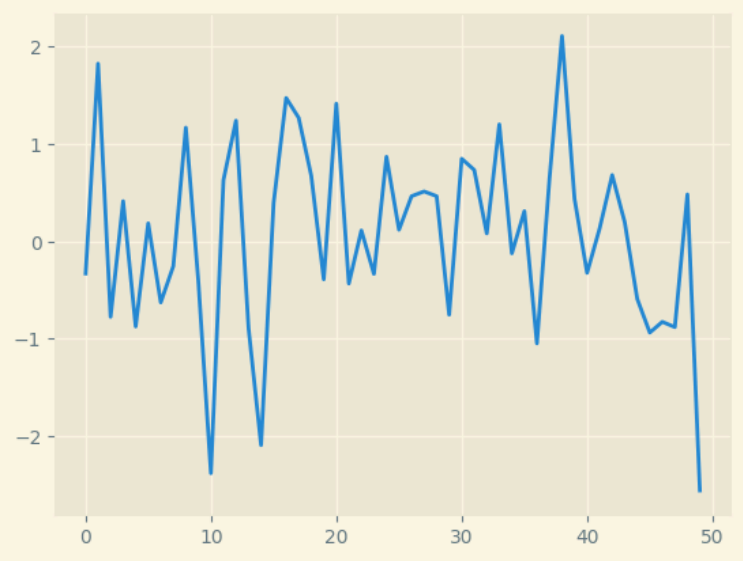
8. Style Plots using Matplotlib

Matplotlib styles allow you to change the overall appearance of your plots, including colors, fonts, gridlines, and more. By applying different styles, you can tailor your visualizations to match your preferences or the requirements of your audience. Matplotlib provides a variety of built-in styles to choose from, each offering a unique look and feel.

Python3

```python
# importing all the necessary packages
import numpy as np
import matplotlib.pyplot as plt

# importing the style package
from matplotlib import style

# creating an array of data for plot
data = np.random.randn(50)

# using the style for the plot
plt.style.use('Solarize_Light2')

# creating a plot
plt.plot(data)

# show plot
plt.show()
```

Output



9. Create Multiple Subplots in Matplotlib

Till now you must have got a basic idea about Matplotlib and plotting some simple plots, now what if you want to plot multiple plots in the same figure. This can be done using multiple ways. One way was discussed above using the add_axes() method of the figure class. Let's see various ways multiple plots can be added with the help of examples.

Method 1: Using the add_axes() method

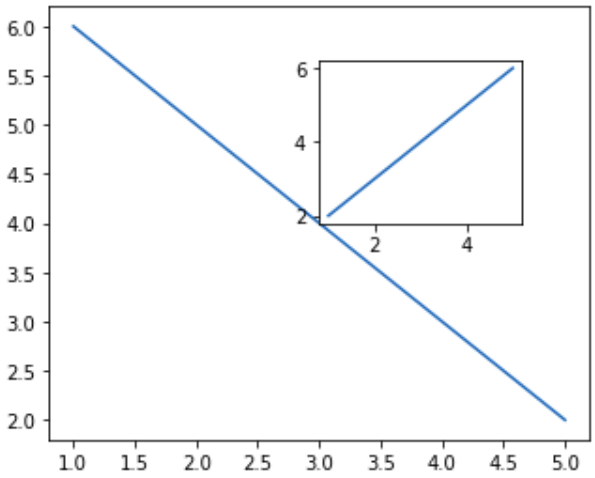
The add_axes() method figure module of matplotlib library is used to add an axes to the figure.

Syntax: *add_axes(self, *args, **kwargs)*

Python3

```
# Python program to show pyplot module
import matplotlib.pyplot as plt
from matplotlib.figure import Figure

# Creating a new figure with width = 5 inches
# and height = 4 inches
fig = plt.figure(figsize =(5, 4))

# Creating first axes for the figure
ax1 = fig.add_axes([0.1, 0.1, 0.8, 0.8])

# Creating second axes for the figure
ax2 = fig.add_axes([0.5, 0.5, 0.3, 0.3])

# Adding the data to be plotted
ax1.plot([5, 4, 3, 2, 1], [2, 3, 4, 5, 6])
ax2.plot([1, 2, 3, 4, 5], [2, 3, 4, 5, 6])
plt.show()
```

Output



The add_axes() method adds the plot in the same figure by creating another axes object.

Method 2: Using subplot() method

This method adds another plot to the current figure at the specified grid position.

Syntax: *subplot(nrows, ncols, index, **kwargs)*

*subplot(pos, **kwargs)*

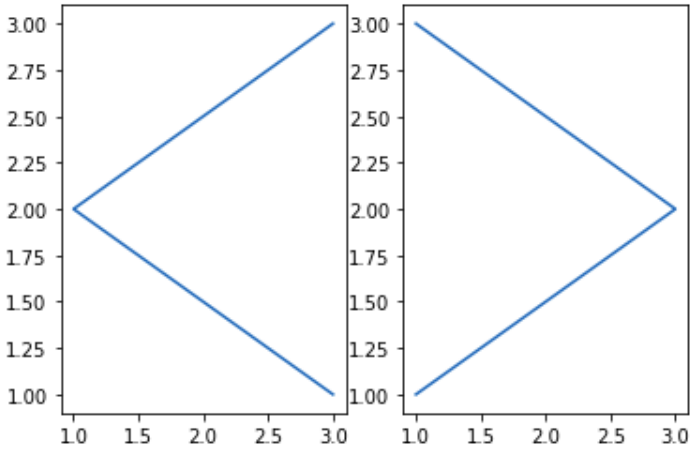
subplot(ax)

Python3

```
import matplotlib.pyplot as plt
# data to display on plots
x = [3, 1, 3]
y = [3, 2, 1]
z = [1, 3, 1]

# Creating figure object
plt.figure()

```

```
# adding first subplot
plt.subplot(121)
plt.plot(x, y)

# adding second subplot
plt.subplot(122)
plt.plot(z, y)
```

Output



Note: Subplot() function have the following disadvantages –

- It does not allow adding multiple subplots at the same time.
- It deletes the preexisting plot of the figure.

Method 3: Using subplots() method

This function is used to create figure and multiple subplots at the same time.

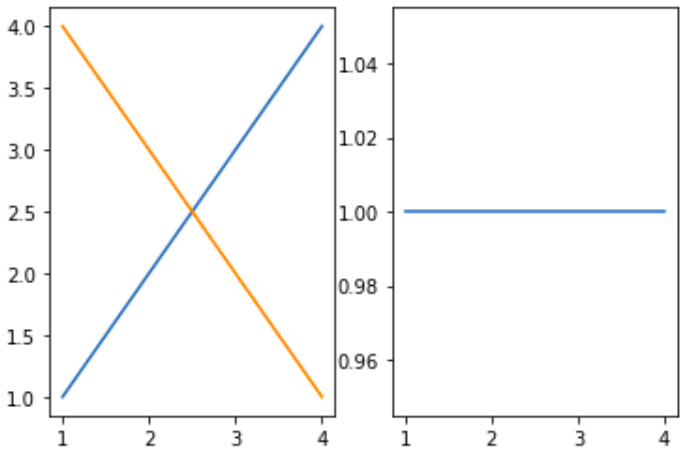
> ***Syntax*** *matplotlib.pyplot.subplots(nrows=1, ncols=1, sharex=False, sharey=False, squeeze=True, subplot_kw=None, gridspec_kw=None, **fig_kw)*

Python3

```
import matplotlib.pyplot as plt

# Creating the figure and subplots
```

```
# according the argument passed
fig, axes = plt.subplots(1, 2)

# plotting the data in the 1st subplot
axes[0].plot([1, 2, 3, 4], [1, 2, 3, 4])

# plotting the data in the 1st subplot only
axes[0].plot([1, 2, 3, 4], [4, 3, 2, 1])

# plotting the data in the 2nd subplot only
axes[1].plot([1, 2, 3, 4], [1, 1, 1, 1])
```

Output



Method 4: Using subplot2grid() Method

This function give additional flexibility in creating axes object at a specified location inside a grid. It also helps in spanning the axes object across multiple rows or columns. In simpler words, this function is used to create multiple charts within the same figure.

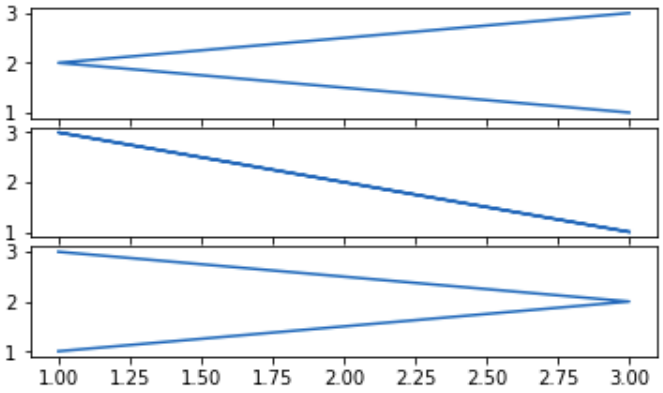
***Syntax**: plt.subplot2grid(shape, location, rowspan, colspan)*

Python3

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

```
# data to display on plots
x = [3, 1, 3]
y = [3, 2, 1]
z = [1, 3, 1]

# adding the subplots
axes1 = plt.subplot2grid (
  (7, 1), (0, 0), rowspan = 2,  colspan = 1)
axes2 = plt.subplot2grid (
  (7, 1), (2, 0), rowspan = 2, colspan = 1)
axes3 = plt.subplot2grid (
  (7, 1), (4, 0), rowspan = 2, colspan = 1)

# plotting the data
axes1.plot(x, y)
axes2.plot(x, z)
axes3.plot(z, y)
```

Output:



10. Working With Images In Matplotlib

The image module in matplotlib library is used for working with images in Python. The image module also includes two useful methods which are **imread** which is used to read images and **imshow** which is used to display the image.

Python3

```
# importing required libraries
import matplotlib.pyplot as plt
import matplotlib.image as img
# reading the image
```

```
testImage = img.imread('g4g.png')
# displaying the image
plt.imshow(testImage)
```

Output:

Refer to the below articles to get detailed information while working with Images:

- Working with Images in Python using Matplotlib
- Working with PNG Images using Matplotlib

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