Functions & Modules

UNIT - IV

Unit-4: Functions & Modules

CO4 - Use built-in functions, user-defined functions and modules in a program.

4.1 Introduction to Python User defined Function

4.2 Passing parameters to a function and returning values from a function

4.3 Recursion

4.4 Standard Library: Built-in Functions

4.5 Modules and Packages

- rand module - Random numbers generators
- math module – Mathematical functions
- datetime module - Date and time functions
- matplotlib module – Plotting functions

4.6 Create and import custom user defined module

Python User Defined Functions

- A function is a reusable block of programming statements designed to perform a specific task.
- To define a function, Python provides the **def** keyword.
- The following is the syntax of defining a function.

```
def function_name (<parameters>):
        statement1
        statement2
        ...
        ...
        return <expr>
```

```
Example:
def my_function():
  print("Hello from a function")

my_function()

Output: Hello from a function
```

Passing Parameters to a Function

- It is possible to define a function to receive one or more parameters (also called arguments) and use them for processing inside the function block.
- Parameters/Arguments may be given suitable formal names.

```
def greet(name):
    print ('Hello ', name)
greet(‘Apple’) #Calling function with argument
greet(123) #Calling function with argument
```

- The **greet()** function is now defined to receive a string parameter called name. Inside the function, the **print()** statement is modified to display the greeting message addressed to the received parameter.

Output:

```
Hello Apple
Hello 123
```

Passing Multiple Parameters to a Function

- A function can have multiple parameters.
- The following function takes three arguments.

```
def greet(name1, name2, name3):
    print ('Hello ', name1,',' ,name2,',',name3)
greet('Ramesh','Suresh','Mahesh') # calling function with string argument
```

```
Output:
Hello  Ramesh , Suresh , Mahesh
```

- We can also have Variable Length Arguments:

```
def greet(*name):
    print ('Hello ', name[0], ' , ', name[1])
greet(‘AVPT',’COMPUTER')
```

```
Output:
Hello  AVPT , COMPUTER
```

Returning Values from a Function

- A user-defined function can also be made to return a value to the calling environment by putting an expression in front of the return statement.
- Unlike C/C++ it is not mandatory to declare the return method in function declaration.

Syntax:

```
def sum(a, b):
    return a + b
```

Example:

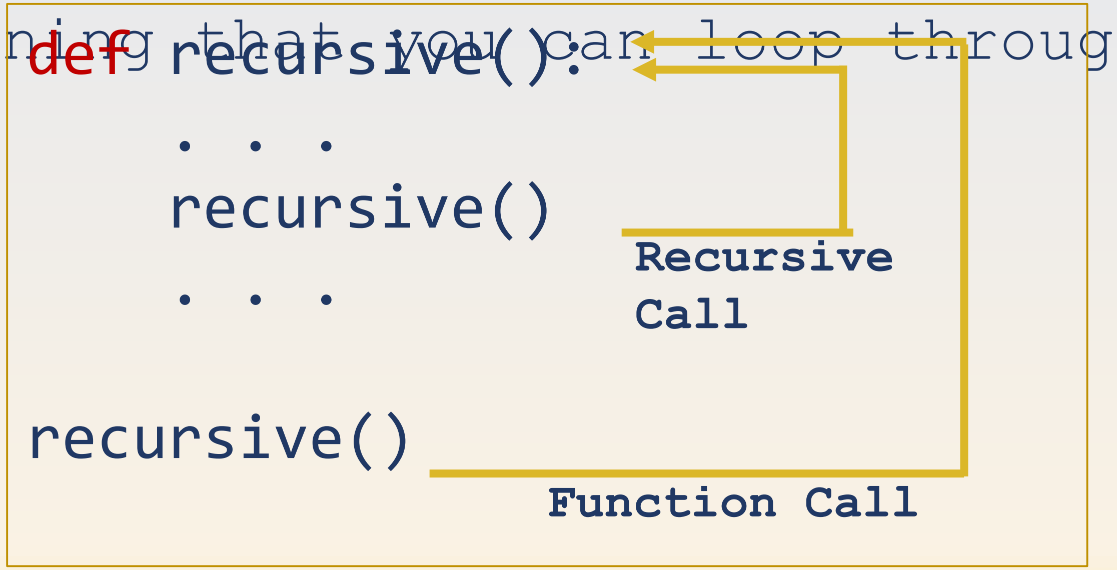
```
def sum(a,b):
  return a + b

print(sum(3,5))
```

```
Output:8
```

Note: By default, all the functions return None if the return statement does not exist.

Recursion

- Recursion is the process of calling the same function from inside a function.
- Recursion is a common mathematical and programming concept. It means that a function calls itself. This has the benefit of meaning that you can loop through data to reach a result.



```
def recursive():
     . . .
     recursive()
     . . .

recursive()
```

- ***Advantages of Recursion:***
  - A complicated function can be split down into smaller sub-problems utilizing recursion.
  - Sequence creation is simpler through recursion than utilizing any nested iteration.
  - Recursive functions render the code look simple and effective.
- ***Disadvantages of Recursion:***
  - A lot of memory and time is taken through recursive calls which makes it expensive for use.
  - Recursive functions are challenging to debug.
  - The reasoning behind recursion can sometimes be tough to think through.

Example: Factorial

```python
def factorial(x):
    if x == 1:
        return 1
    else:
        # recursive call to the function
        return (x * factorial(x-1))
num = int(input("Enter a number: "))
result = factorial(num)
print("The factorial of", num, "is", result)
```

Output:

```
Enter a number: 5
The factorial of 5 is 120
```

Standard Library : Built-In Functions

- Python supports large set of standard libraries which provides lots of modules and built in functions.
- Built-in Functions:
  - This functions is already defined in standard library.
  - Following are some common used built-in functions
    - Input/Output Functions

      Input( ), print( )
    - Data Type Conversion Functions

      int( ), float( ), str( ),list( ), tuple( ),set( ),dict( )
    - Mathematical Functions

      abs( ), min( ), max( ),sum( ), pow( ),round( ),divmod( )

Example:

```
print(max([12,4,5]))       #12
print(min([12,4,5]))       #4
print(sum([12,4,5]))       #21
print(abs(-5))             #5
print(divmod(5,2))         #(2,1)
print(pow(2,3))            #8
print(round(5.6))          #6
print(len(1,2,3))          #3
```

Modules

- Module is a python file which contains a python code including functions, class or variables.
- Python Module has a .py extension.
- Python Module Provides Flexibility to organize the code in logical way.
- **import** keyword is used to do this.
- Listing of Modules:

```
help("modules")
```

- Modules in Python can be of two types:
  - Built-in Module (Standard Library Module)
  - User-Defined Modules

Example of a Module Working:

File: example.py

```
# Python Module example
def add(a, b):
    result = a + b
    return result
```

```
# Python Module import
import example
print(example.add(4,5.5))
```

Output: 9.5

```
9.5
```

Build-in Modules

- A Module which is already created in standard library of python is known as Built-in Modules.
- Syntax to Use it:

```
    Import Module_Name
```

Example:

```
        import math
```

- random Module (Random Number Generators)
- math Module (Mathematical Functions)
- datetime Module (Date and Time Functions)
- matplotlib Module (Plotting Functions)

random module

- It contains functions to generate random numbers.

Method	Description
seed()	Initialize the random number generator
getstate()	Returns the current internal state of the random number generator
setstate()	Restores the internal state of the random number generator
getrandbits()	Returns a number representing the random bits
randrange()	Returns a random number between the given range
randint()	Returns a random number between the given range
choice()	Returns a random element from the given sequence
choices()	Returns a list with a random selection from the given sequence
shuffle()	Takes a sequence and returns the sequence in a random order
sample()	Returns a given sample of a sequence
random()	Returns a random float number between 0 and 1
uniform()	Returns a random float number between two given parameters

Example:

```
import random
print(random.random())
0.9560342718892494

print(random.randint(1,100))
45

print(random.randrange(35))
23
```

math module

- It contains functions and constant to perform mathematics related operations

Method	Description
math.degrees()	Converts an angle from radians to degrees
math.dist()	Returns the Euclidean distance between two points (p and q), where p and q are the coordinates of that point
math.exp()	Returns E raised to the power of x
math.factorial()	Returns the factorial of a number
math.floor()	Rounds a number down to the nearest integer
math.fmod()	Returns the remainder of x/y
math.log()	Returns the natural logarithm of a number, or the logarithm of number to base
math.ceil()	Rounds a number up to the nearest integer
math.pow()	Returns the value of x to the power of y
math.sqrt()	Returns the square root of a number

Method	Description
math.acos()	Returns the arc cosine of a number
math.acosh()	Returns the inverse hyperbolic cosine of a number
math.asin()	Returns the arc sine of a number
math.asinh()	Returns the inverse hyperbolic sine of a number
math.atan()	Returns the arc tangent of a number in radians
math.atan2()	Returns the arc tangent of y/x in radians
math.atanh()	Returns the inverse hyperbolic tangent of a number
math.cos()	Returns the cosine of a number
math.cosh()	Returns the hyperbolic cosine of a number
math.tan()	Returns the tangent of a number
math.tanh()	Returns the hyperbolic tangent of a number
math.sin()	Returns the sine of a number
math.sinh()	Returns the hyperbolic sine of a number

constants	Description
math.e	Returns Euler's number (2.7182...)
math.pi	Returns PI (3.1415...)

Example:

```
import math


print(math.ceil(2.3))            #3
print(math.floor(2.3))           #2
print(math.exp(2))               #7.3890560989
print(math.fabs(-4))             #4
print(math.factorial(4))         #24
print(math.gcd(12,8))            #4
print(math.pow(2,3))             #8
```

datetime module

- Python datetime module having class named datetime, that provides various functions to deal with date and time.
- In Python, the date is not a data type, but we can work with the date objects by importing the module named with datetime, so using that we can fetch current date and time as well as performs various calculations on date and time.

```
var1 = datetime.date(YYYY, MM, DD)
# This will convert the numeral date to the date object


Example:
import datetime
userdate = datetime.date(2021, 10, 20)
print('userdate: ', userdate)
print('type of userdate: ', type(userdate))


     Output:
           userdate:  2021-10-20
           type of userdate:  <class 'datetime.date'>
```

```
# returns the time with all it's value as 0 like 00:00:00
var1 = datetime.time()


Example:
time1 = datetime.time()
     00:00:00


# returns the time with the value which are specified by the user in the attributes
var2 = datetime.time(hour=?, minute=?, second=?, microsecond=?)


Example:
time2 = datetime.time(hour=12, minute=55, second=50)
     12:55:50
```

```
var1 = datetime.datetime(YYYY, MM, DD, hr, min, s, ms)
# This will convert the numeral date to the datetime object in the
form of YYYY-MM-DD hr:min:s:ms.
```

Example:

```
import datetime
userdatetime = datetime.datetime(2021, 9, 15, 20, 55, 20, 562789)
     userdatetime:  2021-09-15 20:55:20.562789
```

- We can create date objects from timestamps y=using the fromtimestamp() method.
- The timestamp is the number of seconds from 1st January 1970 at UTC to a particular date.

```
# Getting Datetime from timestamp
date_time = datetime.fromtimestamp(1887639468)
print("Datetime from timestamp:", date_time)
```

Output:

```
    Datetime from timestamp: 2029-10-25 16:17:48
```

```
# Importing datetime and time module
import datetime
import time

# Calling the time() function
# to return current time
Todays_time = time.time()

# Printing today's time
print(Todays_time)

# Calling the fromtimestamp() function
# to get date from the current time
date_From_CurrentTime =
datetime.date.fromtimestamp(Todays_time);

# Printing the current date
print("Date for the Timestamp is: “,date_From_CurrentTime);
```

- We can convert date object to a string representation using two functions isoformat() and strftime().

```
# function of date class
today = date.today()
# Converting the date to the string
Str = date.isoformat(today)
print("String Representation", Str)
print(type(Str))
```

Output:

```
String Representation 2021-08-19
<class 'str'>
```

The strftime() Method

The datetime object has a method for formatting date objects into readable strings.

The method is called strftime(), and takes one parameter, format, to specify the format of the returned string:

Example

Display the name of the month:

```
import datetime
x = datetime.datetime(2018, 6, 1)
print(x.strftime("%B"))
```

Output

```
june
```

Function Name	Description
ctime()	Return a string representing the date
fromisocalendar()	Returns a date corresponding to the ISO calendar
fromisoformat()	Returns a date object from the string representation of the date
fromordinal()	Returns a date object from the proleptic Gregorian ordinal, where January 1 of year 1 has ordinal 1
fromtimestamp()	Returns a date object from the POSIX timestamp
isocalendar()	Returns a tuple year, week, and weekday
isoformat()	Returns the string representation of the date
isoweekday()	Returns the day of the week as integer where Monday is 1 and Sunday is 7
replace()	Changes the value of the date object with the given parameter
strftime()	Returns a string representation of the date with the given format
timetuple()	Returns an object of type time.struct_time
today()	Returns the current local date
toordinal()	Return the proleptic Gregorian ordinal of the date, where January 1 of year 1 has ordinal 1
weekday()	Returns the day of the week as integer where Monday is 0 and Sunday is 6

matplotlib module

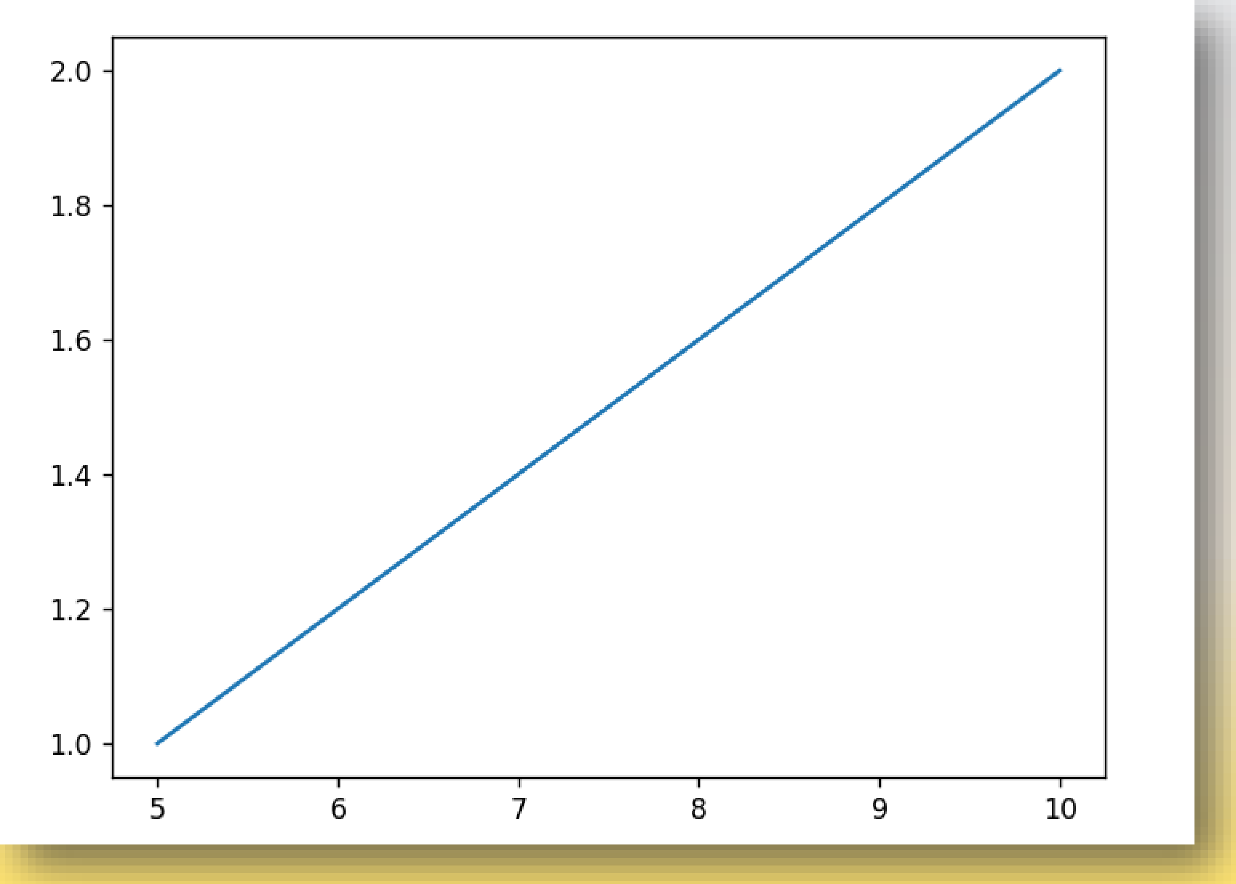
- matplotlib is a plotting library for Python, having a sub module pyplot, that contains various built in graph plotting functions.
- Along with matplotlib numpy module is also used to represent array of points for graph.
- Conventionally, the package is imported into the Python script by adding the following statement:

```
from matplotlib import pyplot as plt
```

- Here keyword as is used to give an alias to matplotlib, now you can call it as just plt.

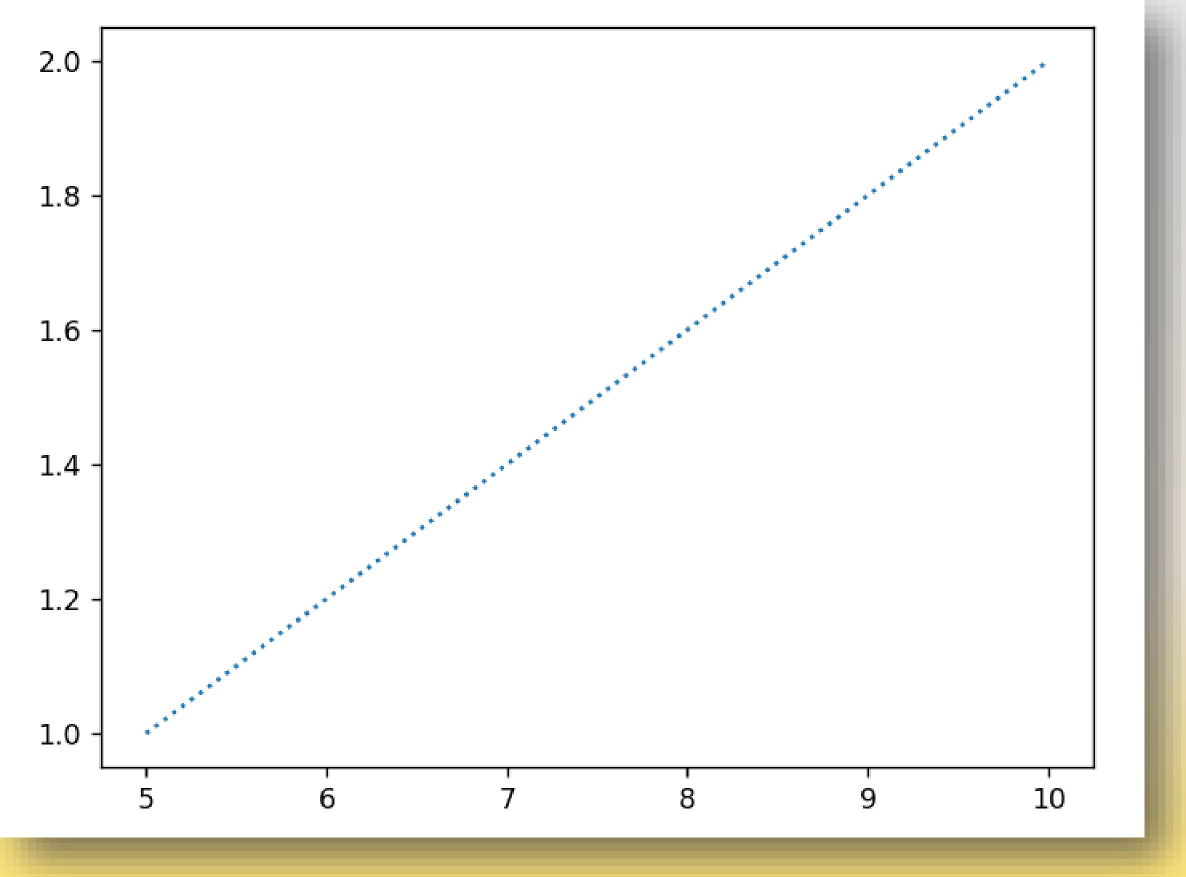
Plotting Line:

```
import numpy as np
from matplotlib import
pyplot as plt

xpoint = np.array([5,10])
ypoint = np.array([1,2])
plt.plot(xpoint,ypoint)
plt.show()
```



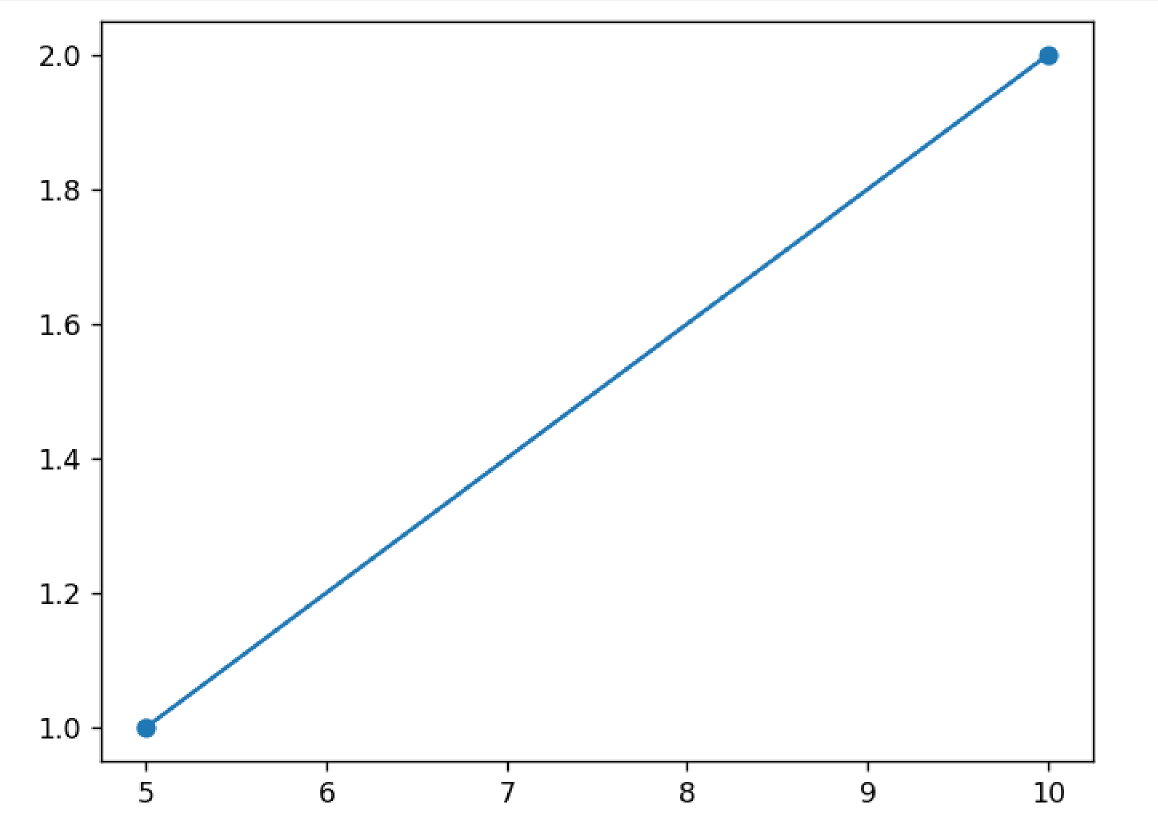
Plotting Line with Specific Style:

```
import numpy as np
from matplotlib import pyplot as plt

xpoint = np.array([5,10])
ypoint = np.array([1,2])
plt.plot(xpoint,ypoint,linestyle='dotted')plt.show()
```



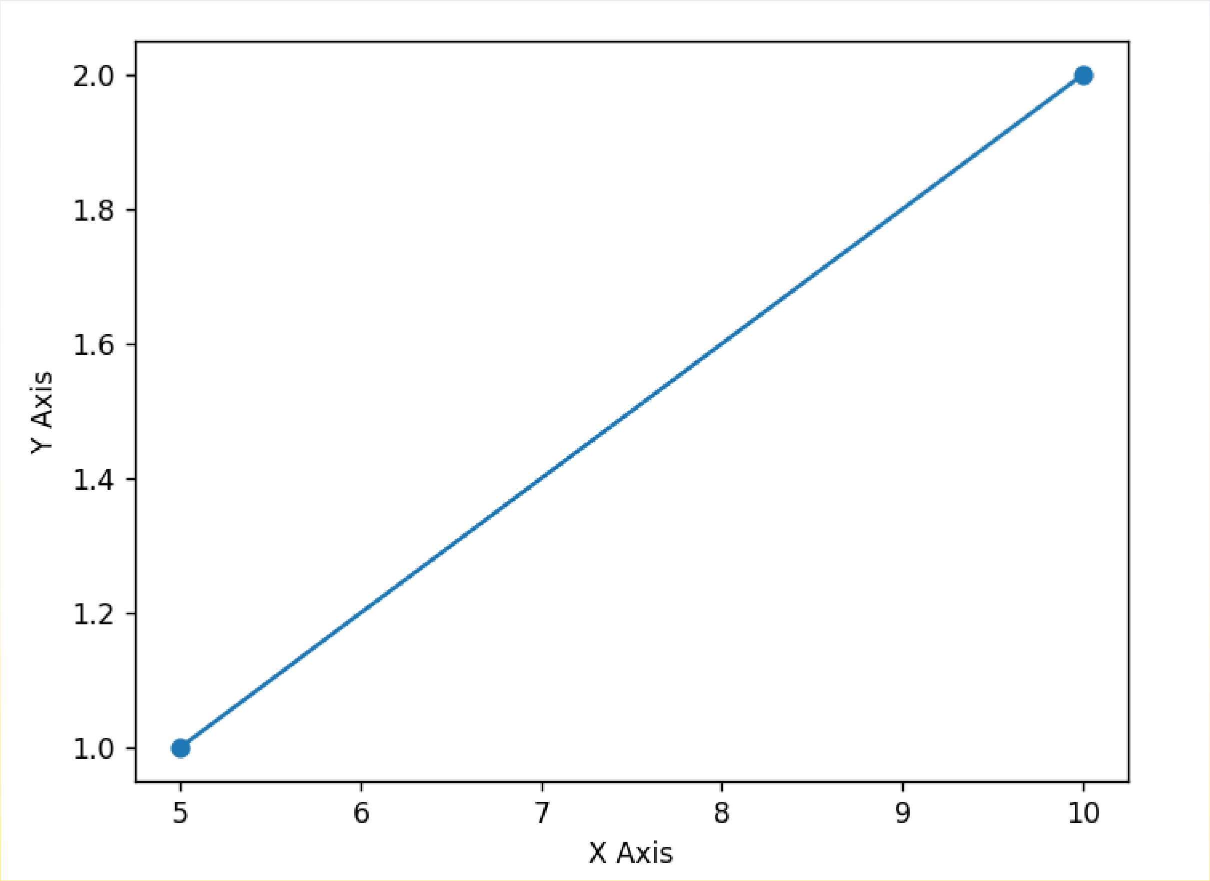
Plotting Line with end marker:

```
import numpy as np
from matplotlib import
pyplot as plt

xpoint = np.array([5,10])
ypoint = np.array([1,2])
plt.plot(xpoint,ypoint,mark
er='o’)
plt.show()
```



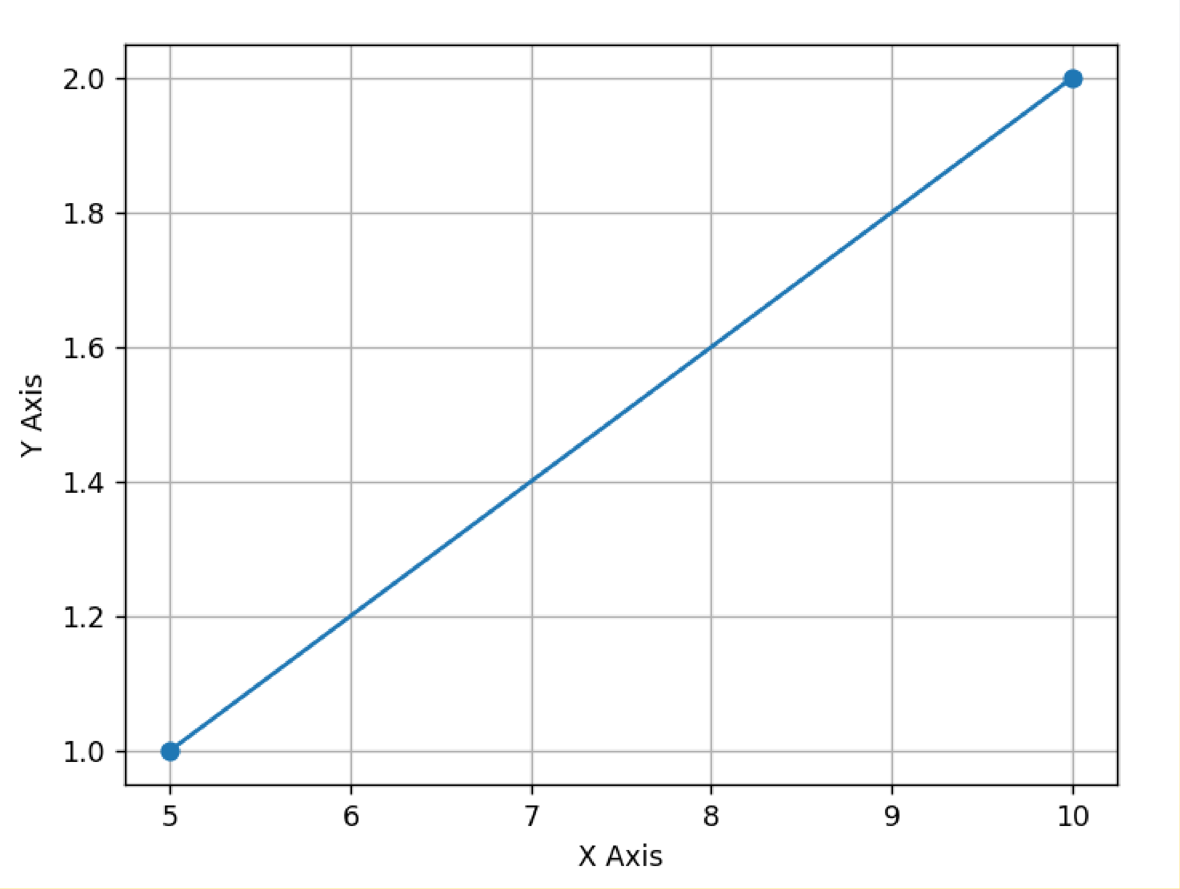
Plotting Line with Label for X axis and Y axis:

```
import numpy as np
from matplotlib import pyplot as plt

xpoint = np.array([5,10])
ypoint = np.array([1,2])
plt.plot(xpoint,ypoint,marker='o')
plt.xlabel('X Axis')
plt.ylabel('Y Axis')
plt.show()
```



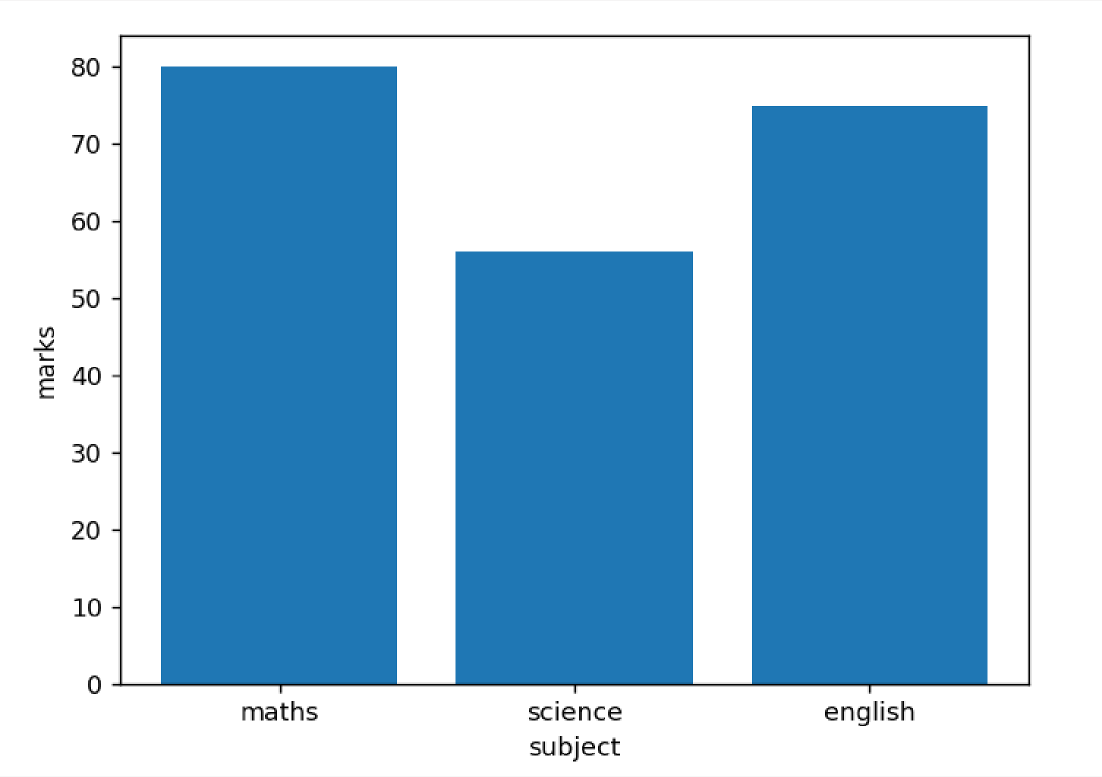
Plotting Line with Grid:

```
import numpy as np
from matplotlib import pyplot as plt

xpoint = np.array([5,10])
ypoint = np.array([1,2])
plt.plot(xpoint,ypoint,marker='o')
plt.xlabel('X Axis')
plt.ylabel('Y Axis’)
plt.grid()
plt.show()
```



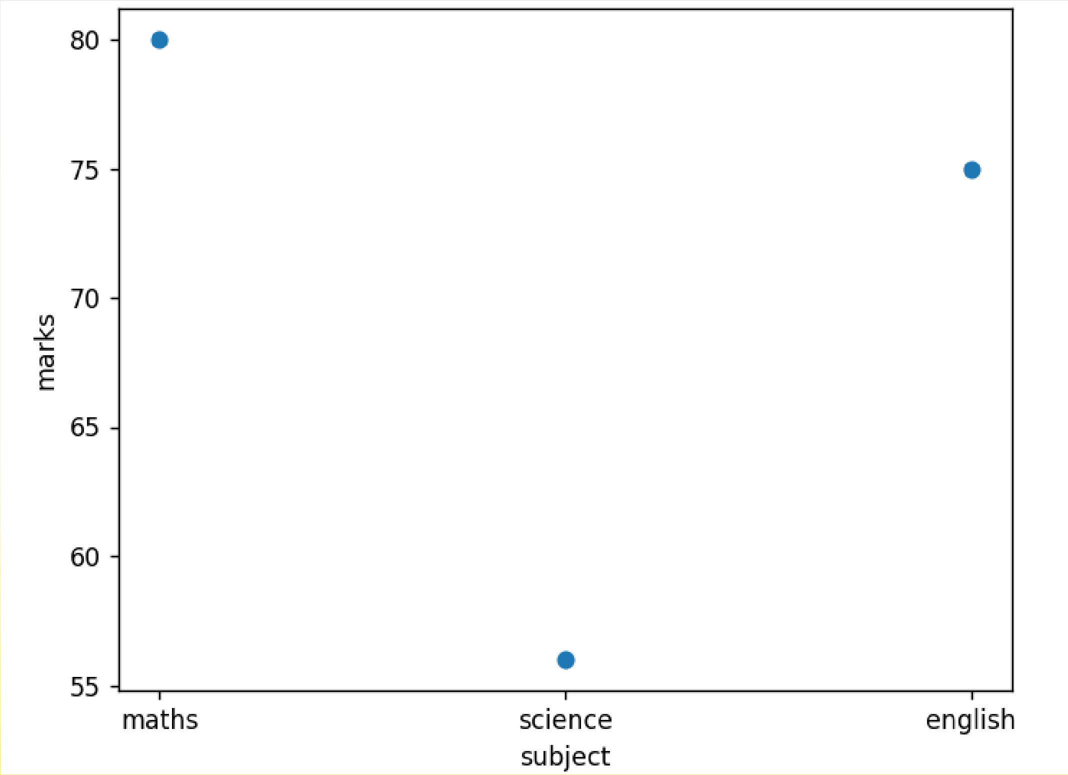
Plotting Bar Chart:

```
import numpy as np
from matplotlib import pyplot as plt

subject = np.array(["maths","science","english"])
marks = np.array([80,56,75])
plt.bar(subject,marks)
plt.xlabel("subject")
plt.ylabel("marks")
plt.show()
```



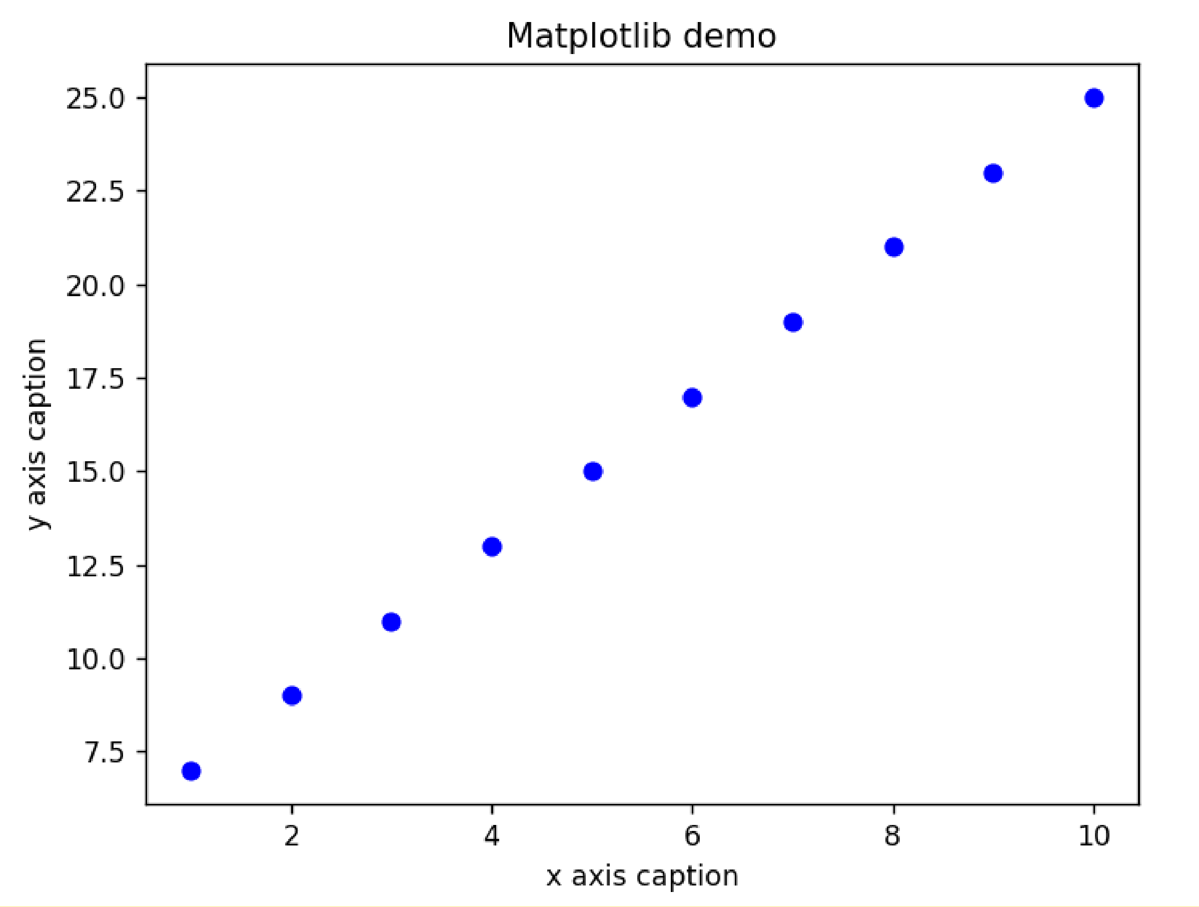
Plotting Scatter Chart:

```
import numpy as np
from matplotlib import pyplot as plt

subject = np.array(["maths","science","english"])
marks = np.array([80,56,75])
plt.scatter(subject,marks)
plt.xlabel("subject")
plt.ylabel("marks")
plt.show()
```



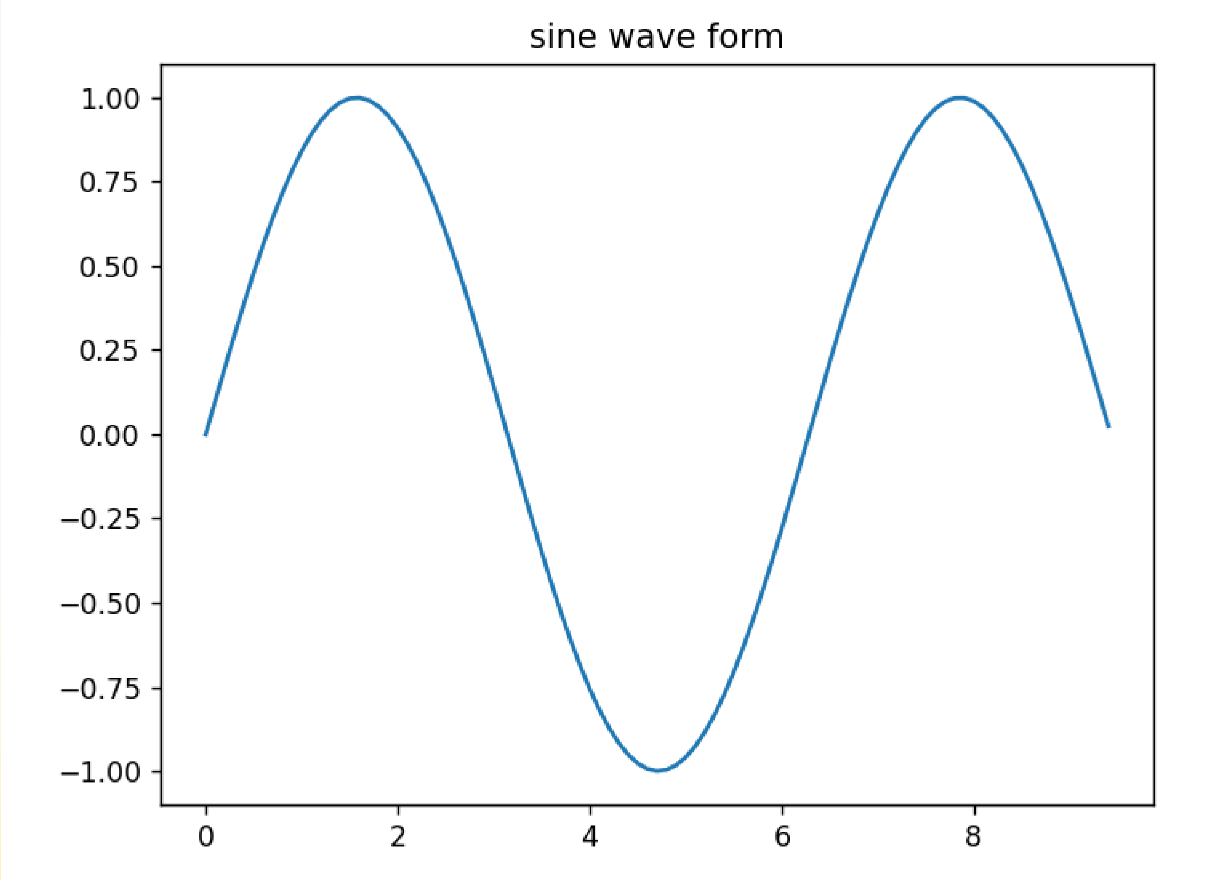
Plotting Line with Given Equation:

```
import numpy as np
from matplotlib import
pyplot as plt

x = np.arange(1,11)
y = 2 * x + 5
plt.title("Matplotlib demo")
plt.xlabel("x axis caption")
plt.ylabel("y axis caption")
plt.plot(x, y, "ob")
plt.show()
```



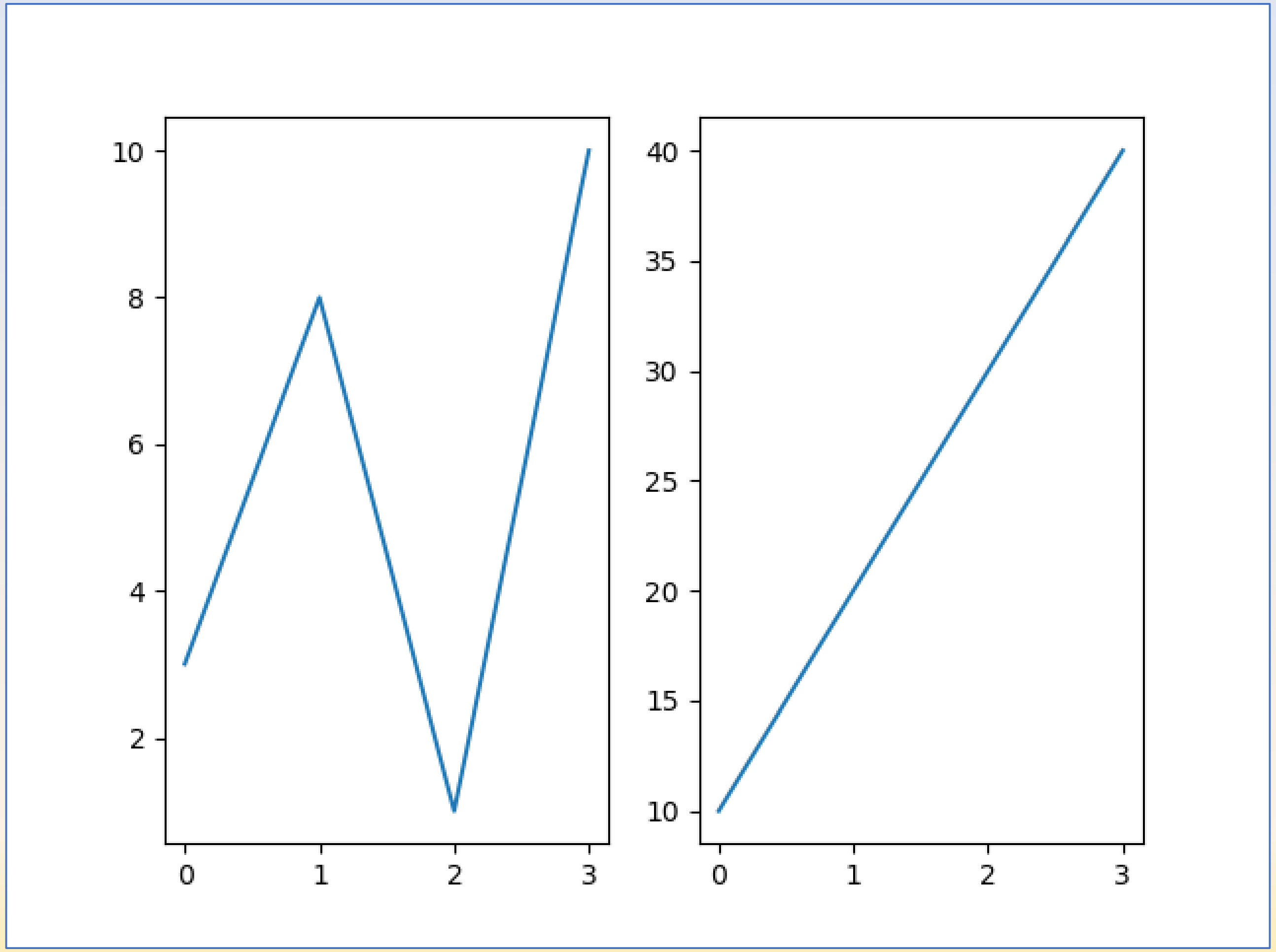
Plotting Sinusoidal waves:

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

# Compute the x and y coordinates for points on a sine curve
x = np.arange(0, 3 * np.pi, 0.1)
y = np.sin(x)
plt.title("sine wave form")
plt.plot(x, y)
plt.show()
```



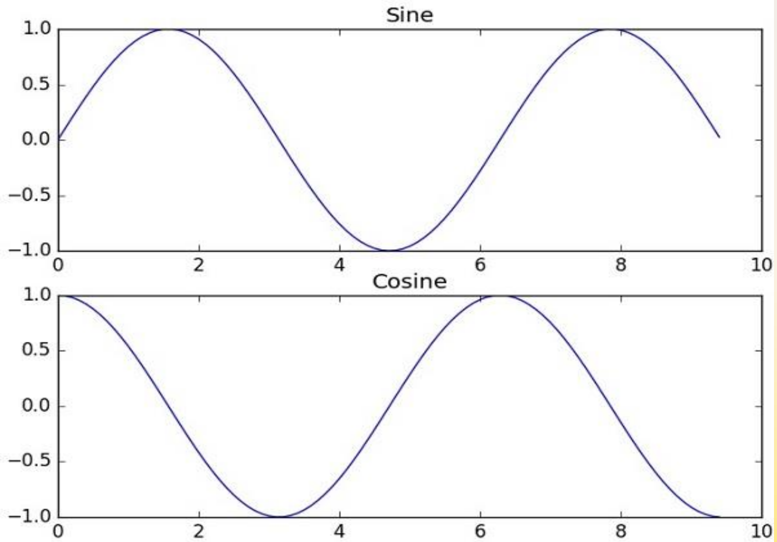
subplot() Function

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

#plot 1:
x = np.array([0, 1, 2, 3])
y = np.array([3, 8, 1, 10])

plt.subplot(1, 2, 1)
plt.plot(x,y)

#plot 2:
x = np.array([0, 1, 2, 3])
y =
np.array([10, 20, 30, 40])

plt.subplot(1, 2, 2)
plt.plot(x,y)

plt.show()
```



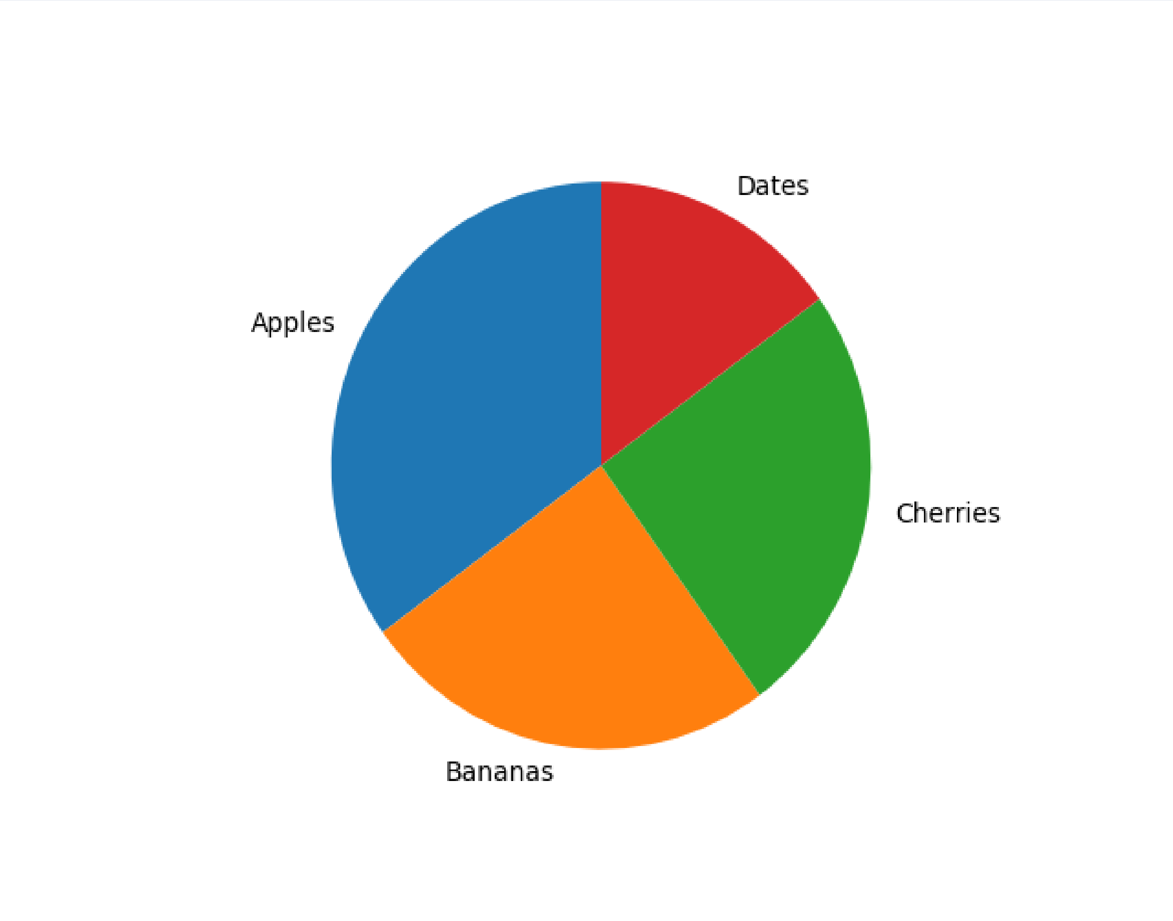
subplot() Function

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

# Compute the x and y coordinates for points on sine and cosine
curves
x = np.arange(0, 3 * np.pi, 0.1)
y_sin = np.sin(x)
y_cos = np.cos(x)
# Set up a subplot grid that has height 2 and wi
first such subplot as active.
plt.subplot(2, 1, 1)
# Make the first plot
plt.plot(x, y_sin)
plt.title('Sine')
# Set the second subplot as active, and make the
plt.subplot(2, 1, 2)
plt.plot(x, y_cos)
```



Plotting Pie Charts

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

y = np.array([35, 25, 25, 15])
mylabels =
["Apples", "Bananas", "Cherries",
 "Dates"]

plt.pie(y, labels = mylabels,
startangle = 90)
plt.show()
```



Create user defined module

- Module which is created by user is known as User Defined Module.
- Module can be created by .py file.
- You can define various functions, classes and variables in this file.

Example:

Step1: Create file Named myModule.py

Step2: Define Variable in file

```
     student = {"Name":"Yagnik"}
```

Step3: Define Functions to display value of variable

```
     def DisplayStudent():
     print("Name:"+student["Name"])
```

Step4: Save file

Import user defined module

- Once Module is Created you can use that module in another python file by Importing it by using import statement.

```
import myModule
myModule.DisplayStudent()

Output:
Name:Yagnik
```

Renaming user defined module

- You can rename module at the time of importing it using as keyword.

```
import myModule as mm
mm.DisplayStudent()

Output:
Name:Yagnik
```

Packages

- A Python Package usually consists of several modules.
- Physically, a Package is a folder containing modules and maybe other folders that themselves may contain more folders and modules (nested in the form of a hierarchy).
- Using the concept of package we can organize a large python application in a structured way where each package contains modules of relevant type.
- This simply means that a package’s modules are bound together by a package name, by which they may be referenced.
- Syntax for import packages:

```
import <package_name>
```

Example:

```
import math
print(math.factorial(3))          #6
print(math.log(1))                #0.0
```