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College Sangamner

DEPARTMENT OF COMPUTER SCIENCE

MATHEMATICS

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Batch No. :- D

Roll No:- 04 **Date:-** / /2023

Title of the:- Practical 1

Expt. No . 1

Class :- S.Y.BCS

Remark

Demonstrators

Signature

Date :- / /2023

Q.1) Write a Python program to plot 2D graph of the functions $f(x) = x^2$ and $g(x) = x^3$ in $[-1, 1]$

Syntax:

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

```
import numpy as np
```

```
def f(x):
```

```
    return x**2
```

```
def g(x):
```

```
    return x**3
```

```
# Generate x values in the range [-1, 1]
```

```
x = np.linspace(-1, 1, 100)
```

```
# Calculate y values for f(x) and g(x)
```

```
y_f = f(x)
```

```
y_g = g(x)
```

```
# Create a figure and axes
```

```
fig, ax = plt.subplots()
```

```
# Plot f(x) and g(x) on the same graph
```

```
ax.plot(x, y_f, label='f(x) = x^2')
```

```
ax.plot(x, y_g, label='g(x) = x^3')
```

```
# Add labels and legend
```

```
ax.set_xlabel('x')
```

```
ax.set_ylabel('y')
```

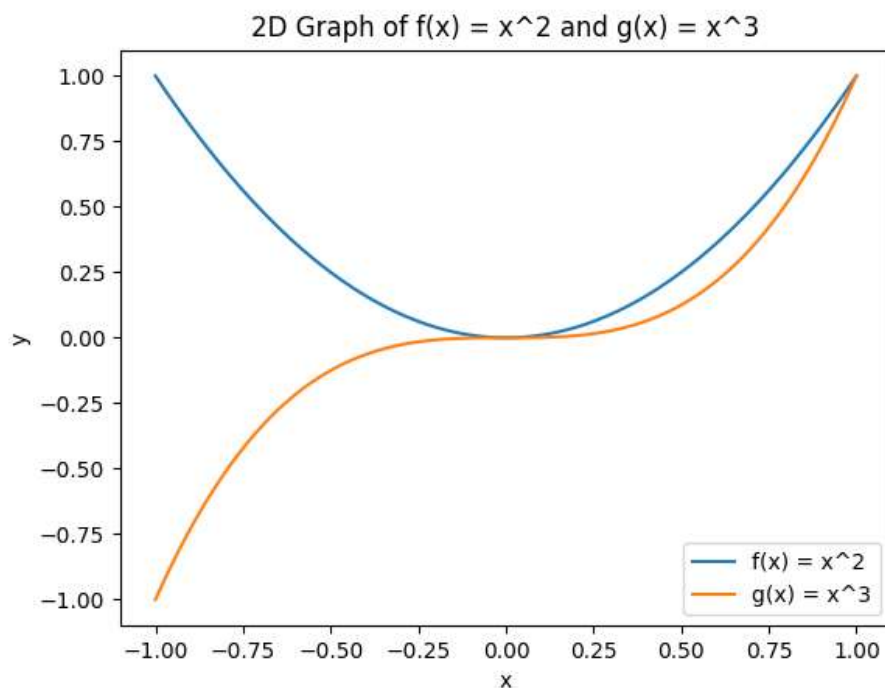
```
ax.legend()
```

```

# Set title
ax.set_title('2D Graph of f(x) = x^2 and g(x) = x^3')
# Show the plot
plt.show()

```

OUTPUT:



Q.2) Write a Python program to plot 3D graph of the function $f(x) = e^{-x^2}$ in $[-5, 5]$ with green dashed points line with upward pointing triangle.

Syntax:

```

import numpy as np
import matplotlib.pyplot as plt
# Generate x values
x = np.linspace(-5, 5, 100)
# Compute y values using the given function
y = np.exp(-x**2)

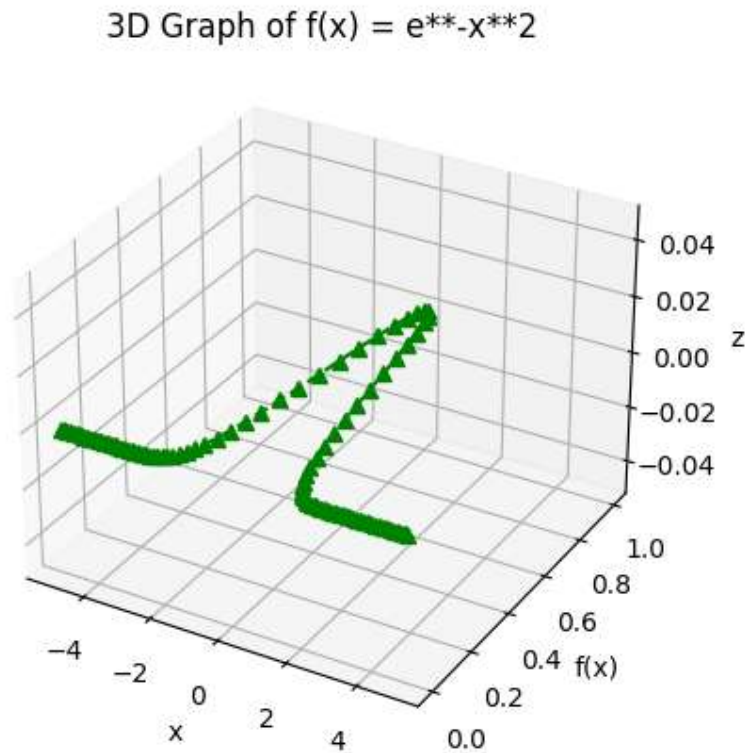
```

```

# Create 3D plot
fig = plt.figure()
ax = fig.add_subplot(111, projection='3d')
# Plot the points with green dashed line and upward-pointing triangles
ax.plot(x, y, np.zeros_like(x), linestyle='dashed', color='green', marker='^')
# Set labels for axes
ax.set_xlabel('x')
ax.set_ylabel('f(x)')
ax.set_zlabel('z')
# Set title for the plot
ax.set_title('3D Graph of f(x) = e**-x**2')
# Show the plot
plt.show()

```

OUTPUT:



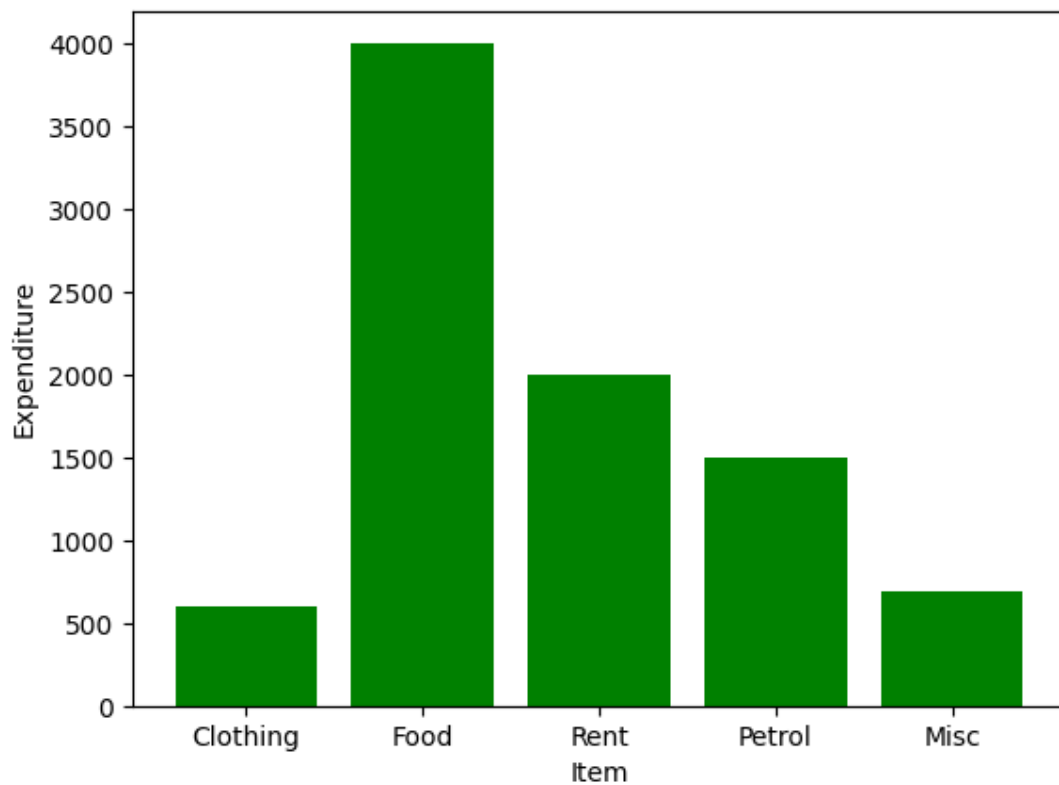
Q.3) Using python, represent the following information using a bar graph (in green color)

Item	Clothing	Food	Rent	Petrol	Misc
Expenditure in Rs	60	4000	2000	1500	700

Syntax:

```
import matplotlib.pyplot as plt
left = [1,2,3,4,5]
height = [600,4000,200,1500,]
tick_label=['clothing', 'food', 'rent', 'petrol', 'Misc']
plt.bar (left,height,tick_label = tick_label,width = 0.8 ,color = ['green','green'])
plt.xlabel('Item')
plt.ylabel('Expenditure')
plt. show()
```

OUTPUT:



Q.4) write a Python program to reflect the line segment joining the points A[5, 3] and B[1, 4] through the line $y = x + 1$.

Syntax:

```
import numpy as np
# Define the points A and B
A = np.array([5, 3])
B = np.array([1, 4])
# Define the equation of the reflecting line
def reflect(line, point):
    m = line[0]
    c = line[1]
    x, y = point
    x_reflect = (2 * m * (y - c) + x * (m ** 2 - 1)) / (m ** 2 + 1)
    y_reflect = (2 * m * x + y * (1 - m ** 2) + 2 * c) / (m ** 2 + 1)
    return np.array([x_reflect, y_reflect])
# Define the equation of the reflecting line y = x + 1
line = np.array([1, -1])
# Reflect points A and B through the reflecting line
A_reflected = reflect(line, A)
B_reflected = reflect(line, B)
# Print the reflected points
print("Reflected Point A'", A_reflected)
print("Reflected Point B'", B_reflected)
```

Output:

Reflected Point A': [4. 4.]

Reflected Point B': [5. 0.]

Q.5) Write a Python program to draw a polygon with vertices (0, 0), (2, 0), (2, 3) and (1, 6) and rotate it by 180° .

Syntax:

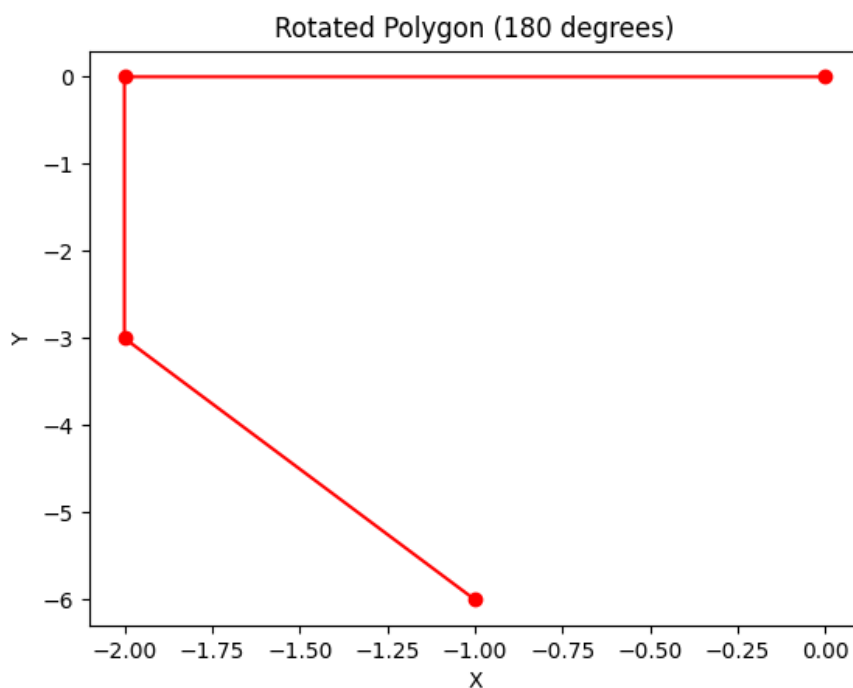
```
import matplotlib.pyplot as plt
import numpy as np
# Define the vertices of the polygon
vertices = np.array([[0, 0], [2, 0], [2, 3], [1, 6]])
```

```

# Plot the original polygon
plt.figure()
plt.plot(vertices[:, 0], vertices[:, 1], 'bo-')
plt.title('Original Polygon')
plt.xlabel('X')
plt.ylabel('Y')
# Define the rotation matrix for 180 degrees
theta = np.pi # 180 degrees
rotation_matrix = np.array([[np.cos(theta), -np.sin(theta)],
                             [np.sin(theta), np.cos(theta)]])
# Apply rotation to the vertices
vertices_rotated = np.dot(vertices, rotation_matrix)
# Plot the rotated polygon
plt.figure()
plt.plot(vertices_rotated[:, 0], vertices_rotated[:, 1], 'ro-')
plt.title('Rotated Polygon (180 degrees)')
plt.xlabel('X')
plt.ylabel('Y')
# Show the plots
plt.show()

```

OUTPUT:



Q.6) Write a Python program to find the area and perimeter of the ABC, where A[0, 0] B[5, 0], C[3,3].

Syntax:

```
import numpy as np

# Define the vertices of the triangle
A = np.array([0, 0])
B = np.array([5, 0])
C = np.array([3, 3])

# Calculate the side lengths of the triangle
AB = np.linalg.norm(B - A)
BC = np.linalg.norm(C - B)
CA = np.linalg.norm(A - C)

# Calculate the semiperimeter
s = (AB + BC + CA) / 2

# Calculate the area using Heron's formula
area = np.sqrt(s * (s - AB) * (s - BC) * (s - CA))

# Calculate the perimeter
perimeter = AB + BC + CA

# Print the results
print("Triangle ABC:")
print("Side AB:", AB)
print("Side BC:", BC)
print("Side CA:", CA)
print("Area:", area)
print("Perimeter:", perimeter)
```

OUTPUT:

Triangle ABC:

Side AB: 5.0

Side BC: 3.605551275463989

Side CA: 4.242640687119285

Area: 7.5000000000000036

Perimeter: 12.848191962583275

Transformed Point A: [38. 10.]

Transformed Point B: [35. 8.]

Q.7) write a Python program to solve the following LPP

$$\text{Max } Z = 150x + 75y$$

Subjected to

$$4x + 6y \leq 24$$

$$5x + 3y \leq 15$$

$$x > 0, y > 0$$

Syntax:

```
from pulp import *  
  
# Create the LP problem as a maximization problem  
problem = LpProblem("LPP", LpMaximize)  
  
# Define the decision variables  
x = LpVariable('x', lowBound=0, cat='Continuous')  
y = LpVariable('y', lowBound=0, cat='Continuous')  
  
# Define the objective function  
problem += 150 * x + 75 * y, "Z"  
  
# Define the constraints  
problem += 4 * x + 6 * y <= 24, "Constraint1"  
problem += 5 * x + 3 * y <= 15, "Constraint2"  
  
# Solve the LP problem  
problem.solve()
```

```

# Print the status of the solution
print("Status:", LpStatus[problem.status])

# Print the optimal values of x and y
print("Optimal x =", value(x))
print("Optimal y =", value(y))

# Print the optimal value of the objective function
print("Optimal Z =", value(problem.objective

```

OUTPUT:

```

Status: Optimal
Optimal x = 3.0
Optimal y = 0.0
Optimal Z = 450.0

```

Q.8) Write a python program to display the following LPP by using pulp module and simplex method. Find its optimal solution if exist.

```

Min Z = x+y
subject to
x => 6
y => 6
x + y <= 11
x=>0, y=>0

```

Syntax:

```

from pulp import *
# Create the LP problem as a minimization problem
problem = LpProblem("LPP", LpMinimize)
# Define the decision variables
x = LpVariable('x', lowBound=0, cat='Continuous')
y = LpVariable('y', lowBound=0, cat='Continuous')
# Define the objective function
problem += x + y, "Z"
# Define the constraints
problem += x >= 6, "Constraint1"
problem += y >= 6, "Constraint2"
problem += x + y <= 11, "Constraint3"
# Solve the LP problem using the simplex method

```

```

problem.solve(PULP_CBC_CMD(msg=False))
# Print the status of the solution
print("Status:", LpStatus[problem.status])
# If the problem has an optimal solution
if problem.status == LpStatusOptimal:
    # Print the optimal values of x and y
    print("Optimal x =", value(x))
    print("Optimal y =", value(y))
    # Print the optimal value of the objective function
    print("Optimal Z =", value(problem.objective))
OUTPUT:
Status: Optimal
Status: Infeasible

```

Q.9) Apply Python. Program in each of the following transformation on the point P[3,-1]

(I) Reflection through X-axis.

(II) Scaling in X-co-ordinate by factor 2.

(III) Scaling in Y-co-ordinate by factor 1.5.

(IV) Reflection through the line $y = x$

Syntax:

Original point

$x = 3$

$y = -1$

```
print("Original point: ({} , {})".format(x, y))
```

Transformation 1: Reflection through X-axis

```
x_reflected = x
```

```
y_reflected = -y
```

```
print("After reflection through X-axis: ({} , {})".format(x_reflected, y_reflected))
```

Transformation 2: Scaling in X-coordinate by factor 2

```
x_scaled = x * 2
```

```
y_scaled = y
```

```
print("After scaling in X-coordinate by factor 2: ({} , {})".format(x_scaled, y_scaled))
```

Transformation 3: Scaling in Y-coordinate by factor 1.5

```
x_scaled = x
```

```
y_scaled = y * 1.5
```

```
print("After scaling in Y-coordinate by factor 1.5: ({} , {})".format(x_scaled, y_scaled))
```

Transformation 4: Reflection through the line $y = x$

```
x_reflected = y
```

```

y_reflected = x
print("After reflection through the line y = x: ({} , {})".format(x_reflected,
y_reflected))

```

OUTPUT:

```

Original point: (3, -1)
After reflection through X-axis: (3, 1)
After scaling in X-coordinate by factor 2: (6, -1)
After scaling in Y-coordinate by factor 1.5: (3, -1.5)
After reflection through the line y = x: (-1, 3)

```

Q.10) Find the combined transformation of the line segment between the point A[5, -2] & B[4, 3] by using Python program for the following sequence of transformation:-

- (I) Rotation about origin through an angle π .
- (II) Scaling in X-Coordinate by 2 units.
- (III) Reflection through the line $y = x$
- (IV) Shearing in X – Direction by 4 unit

Syntax:

```

import numpy as np
# Input points A and B
A = np.array([5, -2])
B = np.array([4, 3])
# Transformation 1: Rotation about origin through an angle pi
def rotation(pi, point):
    rotation_matrix = np.array([[np.cos(pi), -np.sin(pi)],
                                [np.sin(pi), np.cos(pi)]])
    return np.dot(rotation_matrix, point)
A = rotation(np.pi, A)
B = rotation(np.pi, B)
# Transformation 2: Scaling in X-coordinate by 2 units
def scaling_x(sx, point):
    scaling_matrix = np.array([[sx, 0],
                                [0, 1]])
    return np.dot(scaling_matrix, point)
A = scaling_x(2, A)
B = scaling_x(2, B)
# Transformation 3: Reflection through the line y = -x
def reflection(line, point):

```

```

reflection_matrix = np.array([[ -line[0]**2 + line[1]**2, 2*line[0]*line[1]],
                             [2*line[0]*line[1], -line[0]**2 + line[1]**2]]) / (line[0]**2 +
line[1]**2)
    return np.dot(reflection_matrix, point)
A = reflection(np.array([1, -1]), A)
B = reflection(np.array([1, -1]), B)
# Transformation 4: Shearing in X direction by 4 units
def shearing_x(shx, point):
    shearing_matrix = np.array([[1, shx],
                                [0, 1]])
    return np.dot(shearing_matrix, point)
A = shearing_x(4, A)
B = shearing_x(4, B)
# Print the transformed points A and B
print("Transformed Point A:", A)
print("Transformed Point B:", B)

```

OUTPUT:

Status: Infeasible

Transformed Point A: [38. 10.]

Transformed Point B: [35. 8.]

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College Sangamner

DEPARTMENT OF COMPUTER SCIENCE

MATHEMATICS

Name :- Prem Vijay Vajare

Batch No. :- D

Roll No:- 04 **Date:-** / /2023

Title of the:- Practical 2

Expt. No . 2

Class :- S.Y.BCS

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Demonstrators

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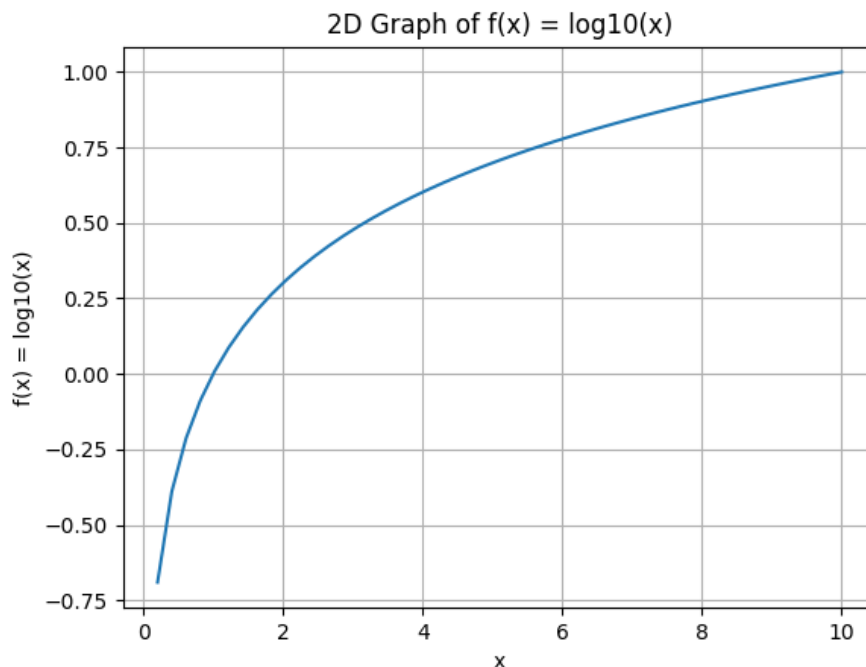
Date :- / /2023

Q.1) Write a Python program to plot 2D graph of the functions $f(x) = x^2$ and in $[0, 10]$

Syntax:

```
import numpy as np
import matplotlib.pyplot as plt
x = np.linspace(0,10)
# Compute y values using the function  $f(x) = \log_{10}(x)$ 
y = np.log10(x)
# Plot the graph
plt.plot(x, y)
plt.xlabel('x')
plt.ylabel('f(x) = log10(x)')
plt.title('2D Graph of  $f(x) = \log_{10}(x)$ ')
plt.grid(True)
plt.show()
```

OUTPUT:

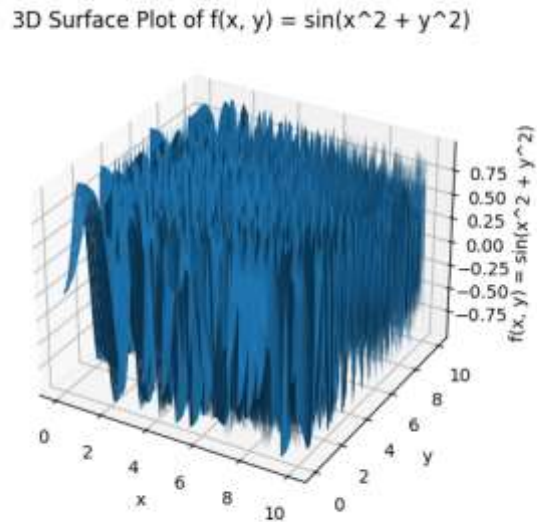


Q.2) Using python, generate 3D surface Plot for the function $f(x) = \sin(x^2 + y^2)$ in the interval $[0,10]$

Syntax:

```
import numpy as np
import matplotlib.pyplot as plt
from mpl_toolkits.mplot3d import Axes3D
# Generate x and y values in the interval [0,10]
x = np.linspace(0, 10, 100)
y = np.linspace(0, 10, 100)
# Create a grid of x and y values
X, Y = np.meshgrid(x, y)
# Compute z values using the function  $f(x, y) = \sin(x^2 + y^2)$ 
Z = np.sin(X**2 + Y**2)
# Create a 3D plot
fig = plt.figure()
ax = fig.add_subplot(111, projection='3d')
ax.plot_surface(X, Y, Z)
# Set labels and title
ax.set_xlabel('x')
ax.set_ylabel('y')
ax.set_zlabel('f(x, y) = sin(x^2 + y^2)')
ax.set_title('3D Surface Plot of f(x, y) = sin(x^2 + y^2)')
# Show the plot
plt.show()
```

OUTPUT:



Q.3) Using python, represent the following information using a bar graph (in green color)

Subject	Maths	Science	English	Marathi	Hindi
Percentage of passing	68	90	70	85	91

Syntax:

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

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

```
height = [68,90,70,85,91]
```

```
tick_label=['Maths','Science','English','Marathi','Hindi']
```

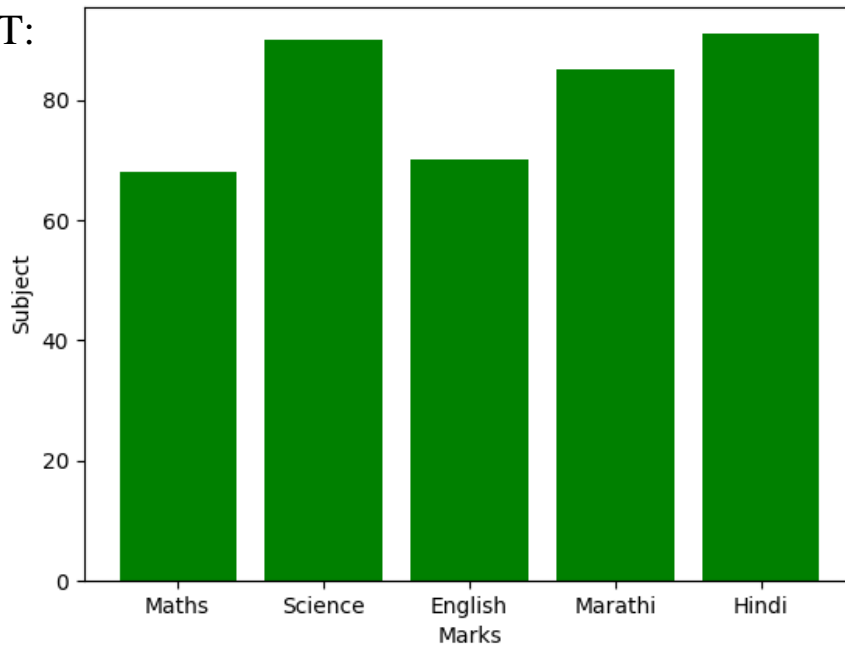
```
plt.bar(left,height,tick_label = tick_label,width = 0.8 ,color = ['green','green'])
```

```
plt.xlabel('Item')
```

```
plt.ylabel('Expenditure')
```

```
plt.show()
```

OUTPUT:



Q.4) Using sympy declare the points $A(0, 2)$, $B(5, 2)$, $C(3, 0)$ check whether these points are collinear. Declare the line passing through the points A and B, find the distance of this line from point C.

Syntax:

```
from sympy import Point, Line
# Declare the points A, B, and C
A = Point(0, 2)
B = Point(5, 2)
C = Point(3, 0)
# Check if points A, B, and C are collinear
collinear = Point.is_collinear(A, B, C)
if collinear:
    print("Points A, B, and C are collinear.")
else:
    print("Points A, B, and C are not collinear.")
# Declare the line passing through points A and B
AB_line = Line(A, B)
# Find the distance of the line AB from point C
distance = AB_line.distance(C)
print("Distance of the line passing through A and B from point C: ", distance)
```

Output:

Points A, B, and C are not collinear.

Distance of the line passing through A and B from point C: 2

Q.5) Using python, draw a regular polygon with 6 sides and radius 1 centered at (1, 2) and find its area and perimeter.

Syntax:

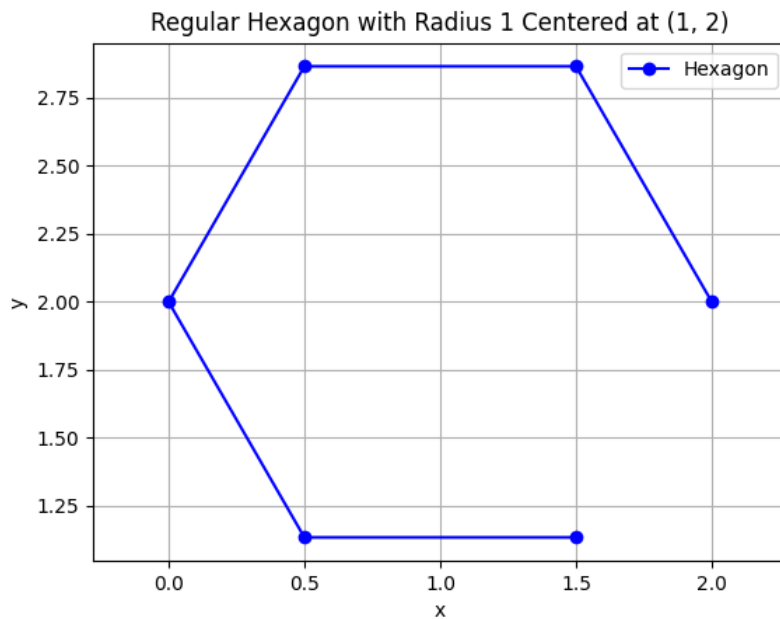
```
import numpy as np
import matplotlib.pyplot as plt
# Define the center of the hexagon
center = np.array([1, 2])
# Define the radius of the hexagon
radius = 1
# Calculate the coordinates of the vertices of the hexagon
angles = np.linspace(0, 2*np.pi, 7)[::-1]
x = center[0] + radius * np.cos(angles)
y = center[1] + radius * np.sin(angles)
# Plot the hexagon
plt.plot(x, y, '-o', color='b', label='Hexagon')
plt.xlabel('x')
plt.ylabel('y')
plt.title('Regular Hexagon with Radius 1 Centered at (1, 2)')
plt.grid(True)
plt.axis('equal')
plt.legend()
plt.show()
# Calculate the area of the hexagon
side_length = np.sqrt(3) * radius # Length of each side of the hexagon
area = 3 * np.sqrt(3) / 2 * side_length**2 # Area of the hexagon
```

```

# Calculate the perimeter of the hexagon
perimeter = 6 * side_length # Perimeter of the hexagon
print("Area of the hexagon: ", area)
print("Perimeter of the hexagon: ", perimeter)

```

OUTPUT:



Q.6) Write a Python program to find the area and perimeter of the ABC, where A[0, 0] B[6, 0], C[4,4].

Syntax:

```

import numpy as np
# Define the vertices of the triangle
A = np.array([0, 0])
B = np.array([6, 0])
C = np.array([4, 4])
# Calculate the side lengths of the triangle
AB = np.linalg.norm(B - A)
BC = np.linalg.norm(C - B)
CA = np.linalg.norm(A - C)
# Calculate the semiperimeter

```

```

s = (AB + BC + CA) / 2
# Calculate the area using Heron's formula
area = np.sqrt(s * (s - AB) * (s - BC) * (s - CA))
# Calculate the perimeter
perimeter = AB + BC + CA
# Print the results
print("Triangle ABC:")
print("Side AB:", AB)
print("Side BC:", BC)
print("Side CA:", CA)
print("Area:", area)
print("Perimeter:", perimeter)

```

OUTPUT:

Side AB: 6.0

Side BC: 4.47213595499958

Side CA: 5.656854249492381

Area: 11.999999999999998

Perimeter: 16.12899020449196

Q.7) write a Python program to solve the following LPP

$$\text{Max } Z = 5x + 3y$$

Subjected to

$$x + 6 \leq 7$$

$$2x + 5y \leq 7$$

$$x > 0$$

$$y > 0$$

Syntax:

```

from pulp import *
# Create the LP problem as a maximization problem
problem = LpProblem("LPP", LpMaximize)
# Define the decision variables
x = LpVariable('x', lowBound=0, cat='Continuous')
y = LpVariable('y', lowBound=0, cat='Continuous')
# Define the objective function
problem += 5 * x + 3 * y, "Z"
# Define the constraints
problem += x + y <= 7, "Constraint1"
problem += 2*x +5* y <= 15, "Constraint2"
# Solve the LP problem
problem.solve()
# Print the status of the solution
print("Status:", LpStatus[problem.status])
# Print the optimal values of x and y
print("Optimal x =", value(x))
print("Optimal y =", value(y))
# Print the optimal value of the objective function
print("Optimal Z =", value(problem.objective))

```

OUTPUT:

Status: Optimal

Optimal x = 7.0

Optimal y = 0.0

Optimal Z = 35.0

Q.8) Write a python program to display the following LPP by using pulp module and simplex method. Find its optimal solution if exist.

$$\begin{aligned} \text{Min } Z &= 3x + 2y + 5z \\ \text{subject to} \\ x + 2y + z &\leq 430 \\ 3x + 2z &\leq 460 \\ x + 4y &\leq 120 \\ x \geq 0, y \geq 0, z &\geq 0 \end{aligned}$$

Syntax:

```
from pulp import *
# Create a minimization problem
prob = LpProblem("Linear Programming Problem", LpMinimize)
# Define decision variables
x = LpVariable('x', lowBound=0)
y = LpVariable('y', lowBound=0)
z = LpVariable('z', lowBound=0)
# Define the objective function
prob += 3 * x + 2 * y + 5 * z
# Define the constraints
prob += x + 2 * y + z <= 430
prob += 3 * x + 2 * z <= 460
prob += x + 4 * y <= 120
# Solve the problem
prob.solve()
# Print the status of the problem
print("Status:", LpStatus[prob.status])
# If the problem is solved, print the optimal solution and its value
if prob.status == LpStatusOptimal:
    print("Optimal Solution:")
    print("x =", value(x))
    print("y =", value(y))
    print("z =", value(z))
    print("Objective Value =", value(prob.objective))
else:
    print("No optimal solution found.")
```

OUTPUT:

Status: Optimal

Optimal Solution:

x = 0.0

$y = 0.0$

$z = 0.0$

Objective Value = 0.0

Q.9) Apply Python. Program in each of the following transformation on the point $P[4,-2]$

(I) Reflection through y-axis.

(II) Scaling in X-co-ordinate by factor 3.

(III) Scaling in Y-co-ordinate by factor 2.5.

(IV) Reflection through the line $y = -x$

Syntax:

```
import numpy as np
```

```
# Original point P
```

```
P = np.array([4, -2])
```

```
# Reflection through y-axis
```

```
P_reflection_y_axis = np.array([-P[0], P[1]])
```

```
# Scaling in X-coordinate by factor 3
```

```
P_scaling_x = np.array([3 * P[0], P[1]])
```

```
# Scaling in Y-coordinate by factor 2.5
```

```
P_scaling_y = np.array([P[0], 2.5 * P[1]])
```

```
# Reflection through the line  $y = -x$ 
```

```
P_reflection_line = np.array([-P[1], -P[0]])
```

```
# Print the transformed points
```

```
print("Original Point P: ", P)
```

```
print("Reflection through y-axis: ", P_reflection_y_axis)
```

```
print("Scaling in X-coordinate by factor 3: ", P_scaling_x)
```

```
print("Scaling in Y-coordinate by factor 2.5: ", P_scaling_y)
```

```
print("Reflection through the line  $y = -x$ : ", P_reflection_line)
```

OUTPUT:

Original Point P: [4 -2]

Reflection through y-axis: [-4 -2]

Scaling in X-coordinate by factor 3: [12 -2]

Scaling in Y-coordinate by factor 2.5: [4. -5.]

Reflection through the line $y = -x$: [2 -4]

Q.10) Find the combined transformation of the line segment between the point A[4, -1] & B[3, 0] by using Python program for the following sequence of transformation:-

- (I) Rotation about origin through an angle π .
- (II) Shearing in y direction by 4.5 units.
- (III) Scaling in X – coordinate by 3 unit.
- (IV) Reflection through the line $y = x$

Syntax:

```
import numpy as np
# Define the original points A and B
A = np.array([4, -1])
B = np.array([3, 0])
# Define the transformation matrices for each transformation
# (I) Rotation about origin through an angle pi
rotation_matrix = np.array([[np.cos(np.pi), -np.sin(np.pi)],
                             [np.sin(np.pi), np.cos(np.pi)]])
# (II) Shearing in y direction by 4.5 units
shearing_matrix = np.array([[1, 0],
                             [0, 1]])
shearing_matrix[1, 0] = 4.5
# (III) Scaling in X-coordinate by 3 units
scaling_matrix = np.array([[3, 0],
                             [0, 1]])
# (IV) Reflection through the line y = x
reflection_matrix = np.array([[0, 1],
                              [1, 0]])
# Perform the combined transformation
AB_transformed =
A.dot(rotation_matrix).dot(shearing_matrix).dot(scaling_matrix).dot(reflection_
matrix)
BA_transformed =
B.dot(rotation_matrix).dot(shearing_matrix).dot(scaling_matrix).dot(reflection_
matrix)
# Print the transformed points
print("Original Point A: ", A)
print("Original Point B: ", B)
print("Transformed Point A': ", AB_transformed)
print("Transformed Point B': ", BA_transformed)
```

OUTPUT:

Original Point A: [4 -1]

Original Point B: [3 0]

Transformed Point A': [1.00000000e+00 -5.32907052e-15]

Transformed Point B': [-3.6739404e-16 -9.0000000e+00]

Sahakar Maharshi Bhausaheb Santuji Thorat

College Sangamner

DEPARTMENT OF COMPUTER SCIENCE

MATHEMATICS

Name :- Prem Vijay Vajare

Batch No. :- D

Roll No:- 04 **Date:-** / /2023

Title of the:- Practical 3

Expt. No . 3

Class :- S.Y.BCS

Remark

Demonstrators

Signature

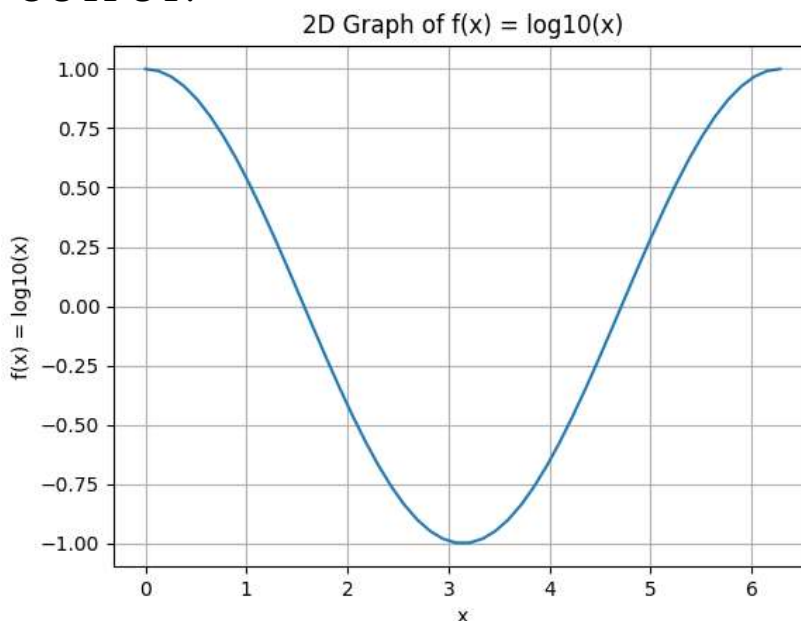
Date :- / /2023

Q.1) Write a Python program to plot graph of the functions $f(x) = \cos(x)$ in $[0, 2\pi]$

Syntax:

```
import numpy as np
import matplotlib.pyplot as plt
x = np.linspace(0, 2*np.pi)
# Compute y values using the function  $f(x) = \log_{10}(x)$ 
y = np.cos(x)
# Plot the graph
plt.plot(x, y)
plt.xlabel('x')
plt.ylabel('f(x) = log10(x)')
plt.title('2D Graph of f(x) = log10(x)')
plt.grid(True)
plt.show()
```

OUTPUT:

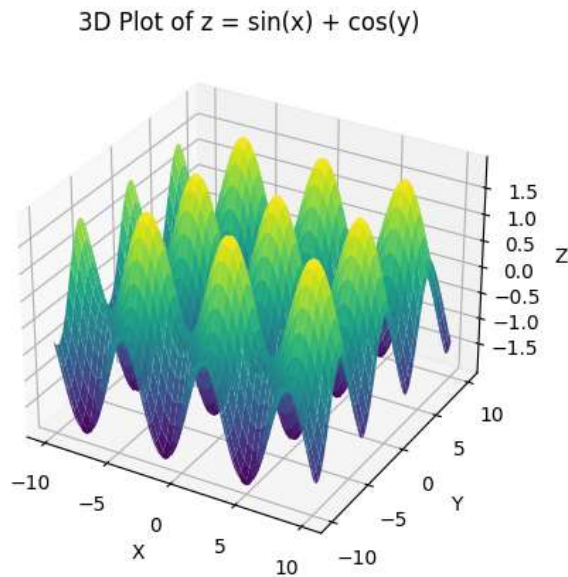


Q.2) Write a Python program to generate 3D plot of the functions $z = \sin x + \cos y$ in $-10 < x, y < 10$.

Syntax:

```
import numpy as np
import matplotlib.pyplot as plt
from mpl_toolkits.mplot3d import Axes3D
# Generate x, y coordinates
x = np.linspace(-10, 10, 100)
y = np.linspace(-10, 10, 100)
X, Y = np.meshgrid(x, y)
# Compute z values
Z = np.sin(X) + np.cos(Y)
# Create 3D plot
fig = plt.figure()
ax = fig.add_subplot(111, projection='3d')
# Plot the surface
surf = ax.plot_surface(X, Y, Z, cmap='viridis')
# Add labels and title
ax.set_xlabel('X')
ax.set_ylabel('Y')
ax.set_zlabel('Z')
ax.set_title('3D Plot of  $z = \sin(x) + \cos(y)$ ')
# Show the plot
plt.show()
```

OUTPUT:



Q.3) Following is the information of student participating in various games in school. Represent it by a Bar graph with bar width 0.7 inches.

Game	Cricket	Football	Hockey	Chess	Tennis
Number of student	65	30	54	10	20

Syntax:

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

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

```
height = [65,30,54,10,20]
```

```
tick_label=['Cricket','Football','Hockey','Chess','Tennis']
```

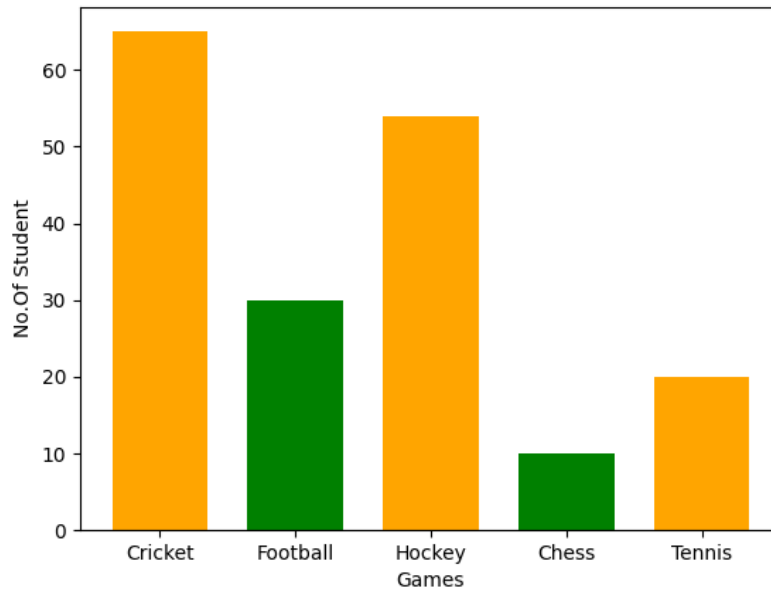
```
plt.bar(left,height,tick_label = tick_label,width = 0.7 ,color = ['orange','green'])
```

```
plt.xlabel('Games')
```

```
plt.ylabel('No.Of Student')
```

```
plt. show()
```

OUTPUT:



Q.4) write a Python program to reflect the line segment joining the points A[5, 3] and B[1, 4] through the line $y = x + 1$.

Syntax:

```
import numpy as np
# Define the points A and B
A = np.array([5, 3])
B = np.array([1, 4])
# Define the equation of the reflecting line
def reflect(line, point):
    m = line[0]
    c = line[1]
    x, y = point
    x_reflect = (2 * m * (y - c) + x * (m ** 2 - 1)) / (m ** 2 + 1)
    y_reflect = (2 * m * x + y * (1 - m ** 2) + 2 * c) / (m ** 2 + 1)
    return np.array([x_reflect, y_reflect])
# Define the equation of the reflecting line  $y = x + 1$ 
line = np.array([1, -1])
# Reflect points A and B through the reflecting line
A_reflected = reflect(line, A)
B_reflected = reflect(line, B)
# Print the reflected points
print("Reflected Point A'", A_reflected)
print("Reflected Point B'", B_reflected)
```

Output:

Reflected Point A': [4. 4.]

Reflected Point B': [5. 0.]

Q.5) If the line with points A[2, 1], B[4, -1] is transformed by the transformation

matrix $[T] = \begin{bmatrix} 1 & 2 \\ 2 & 1 \end{bmatrix}$ then using python, find the equation of transformed line.

Syntax:

```
import numpy as np
# Define original line points
A = np.array([2, 1])
B = np.array([4, -1])
# Define transformation matrix [T]
T = np.array([[1, 2], [2, 1]])
# Find transformed points A' and B'
A_transformed = np.dot(T, A)
B_transformed = np.dot(T, B)
# Extract coordinates of transformed points
x1_transformed, y1_transformed = A_transformed
x2_transformed, y2_transformed = B_transformed
# Find equation of transformed line
m_transformed = (y2_transformed - y1_transformed) / (x2_transformed -
x1_transformed)
b_transformed = y1_transformed - m_transformed * x1_transformed
# Format the equation of the transformed line
equation_transformed = f'y = {m_transformed} * x + {b_transformed}'
print("Equation of transformed line: ", equation_transformed)
```

OUTPUT:

Equation of transformed line: $y = -1.0 * x + 9.0$

Q.6) Generate line segment having endpoints (0, 0) and (10, 10) find midpoint of line segment.

Syntax:

```
# Define endpoints
```

```
x1, y1 = 0, 0
```

```
x2, y2 = 10, 10
```

```
# Calculate midpoint
```

```
midpoint_x = (x1 + x2) / 2
```

```
midpoint_y = (y1 + y2) / 2
```

```
# Print midpoint
```

```
print("Midpoint: ({} , {})".format(midpoint_x, midpoint_y))
```

OUTPUT:

Midpoint: (5.0, 5.0)

Q.7) write a Python program to solve the following LPP

Max $Z = 3.5x + 2y$

Subjected to

$x + y \Rightarrow 5$

$x \Rightarrow 15$

$y \leq 2$

$x > 0, y > 0$

Syntax:

```
from pulp import *
```

```
# Create a maximization problem
```

```
problem = LpProblem("Maximize Z", LpMaximize)
```

```
# Define decision variables
```

```
x = LpVariable("x", lowBound=0, cat='Continuous')
```

```
y = LpVariable("y", lowBound=0, cat='Continuous')
```

```

# Define the objective function
Z = 3.5 * x + 2 * y
problem += Z
# Add constraints
problem += x + y >= 5
problem += x >= 15
problem += y <= 2
# Solve the problem
problem.solve()
# Print the optimal solution and the optimal value of Z
print("Optimal solution:")
print("x =", value(x))
print("y =", value(y))
print("Optimal value of Z =", value(problem.objective))

```

OUTPUT:

Optimal solution:

x = 15.0

y = 2.0

Optimal value of Z = 56.5

Q.8) Write a python program to display the following LPP by using pulp module and simplex method. Find its optimal solution if exist.

$$\text{Min } Z = 3x_1 + 5x_2 + 4x_3$$
subject to
$$2x_1 + 3x_2 \leq 8$$

$$2x_2 + 5x_3 \leq 10$$

$$3x_1 + 2x_2 + 4x_3 \leq 15$$

$$x_1 \geq 0, x_2 \geq 0, x_3 \geq 0$$

Syntax:

#By using Pulp Method

```
from pulp import *
# Create a minimization problem
problem = LpProblem("Minimize Z", LpMinimize)
# Define decision variables
x = LpVariable("x", lowBound=0, cat='Continuous')
y = LpVariable("y", lowBound=0, cat='Continuous')
z = LpVariable("z", lowBound=0, cat='Continuous')
# Define the objective function
Z = 3 * x + 5 * y + 4 * z
problem += Z
# Add constraints
problem += 2 * x + 3 * y <= 8
problem += 2 * y + 5 * z <= 10
problem += 3 * x + 2 * y + 4 * z <= 15
# Solve the problem
problem.solve()
# Check the status of the solution
if problem.status == LpStatusOptimal:
    # Print the optimal solution and the optimal value of Z
    print("Optimal solution:")
    print("x =", value(x))
    print("y =", value(y))
    print("z =", value(z))
    print("Optimal value of Z =", value(problem.objective))
else:
    print("No optimal solution found.")
```

OUTPUT:

Optimal solution:

x = 0.0

y = 0.0

z = 0.0

Optimal value of Z = 0.0

```

#by using Simplex Method
import numpy as np
from scipy.optimize import linprog
# Define the coefficients of the objective function
c = np.array([3, 5, 4])
# Define the coefficients of the inequality constraints (Ax <= b)
A = np.array([[2, 3, 0],
              [0, 2, 5],
              [3, 2, 4]])
b = np.array([8, 10, 15])
# Define the bounds for the decision variables (x >= 0)
bounds = [(0, None), (0, None), (0, None)]
# Solve the linear programming problem using the simplex method
result = linprog(c, A_ub=A, b_ub=b, bounds=bounds, method='simplex')
# Check if an optimal solution was found
if result.success:
    # Print the optimal solution and the optimal value of Z
    print("Optimal solution:")
    print("x =", result.x[0])
    print("y =", result.x[1])
    print("z =", result.x[2])
    print("Optimal value of Z =", result.fun)
else:
    print("No optimal solution found.")

```

OUTPUT:

Optimal solution:

x = 0.0

y = 0.0

z = 0.0

Optimal value of Z = 0.0

Q.9) Apply Python. Program in each of the following transformation on the point P[4,-2]

(I) Reflection through y-axis.

(II) Scaling in X-co-ordinate by factor 3.

(III) Scaling in Y-co-ordinate by factor 2.5.

(IV) Reflection through the line $y = -x$

Syntax:

```
import numpy as np
# Point P
P = np.array([4, -2])
# Reflection through y-axis
reflection_y_axis = np.array([-1, 1]) * P
# Scaling in X-coordinates by factor 3
scaling_x = np.array([3, 1]) * P
# Scaling in Y-coordinates by factor 2.5
scaling_y = np.array([1, 2.5]) * P
# Reflection through the line y = -x
reflection_line = np.array([1, -1]) * P
print("Original point P:", P)
print("Reflection through y-axis:", reflection_y_axis)
print("Scaling in X-coordinates by factor 3:", scaling_x)
print("Scaling in Y-coordinates by factor 2.5:", scaling_y)
print("Reflection through the line y = -x:", reflection_line)
```

OUTPUT:

```
Original point P: [ 4 -2]
Reflection through y-axis: [-4 -2]
Scaling in X-coordinates by factor 3: [12 -2]
Scaling in Y-coordinates by factor 2.5: [ 4. -5.]
Reflection through the line y = -x: [4 2]
```

Q.10) Find the combined transformation of the line segment between the point A[2, -1] & B[5, 4] by using Python program for the following sequence of transformation:-

- (I) Rotation about origin through an angle π .
- (II) Scaling in X-Coordinate by 3 units.
- (III) Shearing in X – Direction by 6 unit
- (IV) Reflection through the line $y = x$

Syntax:

```
import numpy as np
# Define the points A and B
A = np.array([2, -1])
B = np.array([5, 4])
# Transformation 1: Rotation about origin through an angle of  $\pi$  (180 degrees)
rotation_angle = np.pi
rotation_matrix = np.array([[np.cos(rotation_angle), -np.sin(rotation_angle)],
```

```

        [np.sin(rotation_angle), np.cos(rotation_angle)])
A_rotation = np.dot(rotation_matrix, A)
B_rotation = np.dot(rotation_matrix, B)
# Transformation 2: Scaling in X-coordinate by 3 units
scaling_x = np.array([3, 1])
A_scaling_x = scaling_x * A
B_scaling_x = scaling_x * B
# Transformation 3: Shearing in X-direction by 6 units
shearing_x = np.array([1, 0]) + np.array([6, 0])
A_shearing_x = A + shearing_x * A
B_shearing_x = B + shearing_x * B
# Transformation 4: Reflection through the line y = x
reflection_line = np.array([1, -1])
A_reflection_line = reflection_line * A
B_reflection_line = reflection_line * B
print("Original line segment between A and B:")
print("A =", A)
print("B =", B)
print("Transformation 1: Rotation about origin through an angle of pi:")
print("A after rotation =", A_rotation)
print("B after rotation =", B_rotation)
print("Transformation 2: Scaling in X-coordinate by 3 units:")
print("A after scaling in X-coordinate =", A_scaling_x)
print("B after scaling in X-coordinate =", B_scaling_x)
print("Transformation 3: Shearing in X-direction by 6 units:")
print("A after shearing in X-direction =", A_shearing_x)
print("B after shearing in X-direction =", B_shearing_x)
print("Transformation 4: Reflection through the line y = x:")
print("A after reflection through y = x =", A_reflection_line)
print("B after reflection through y = x =", B_reflection_line)

```

OUTPUT:

Status: Infeasible

Original line segment between A and B:

A = [2 -1]

B = [5 4]

Transformation 1: Rotation about origin through an angle of pi:

A after rotation = [-2. 1.]

B after rotation = [-5. -4.]

Transformation 2: Scaling in X-coordinate by 3 units:

A after scaling in X-coordinate = [6 -1]

B after scaling in X-coordinate = [15 4]

Transformation 3: Shearing in X-direction by 6 units:

A after shearing in X-direction = [16 -1]

B after shearing in X-direction = [40 4]

Transformation 4: Reflection through the line $y = x$:

A after reflection through $y = x$ = [2 1]

B after reflection through $y = x$ = [5 -4]

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DEPARTMENT OF COMPUTER SCIENCE

MATHEMATICS

Name :- Prem Vijay Vajare

Batch No. :- D

Roll No:- 04 **Date:-** / /2023

Title of the:- Practical 4

Expt. No . 4

Class :- S.Y.BCS

Remark

Demonstrators

Signature

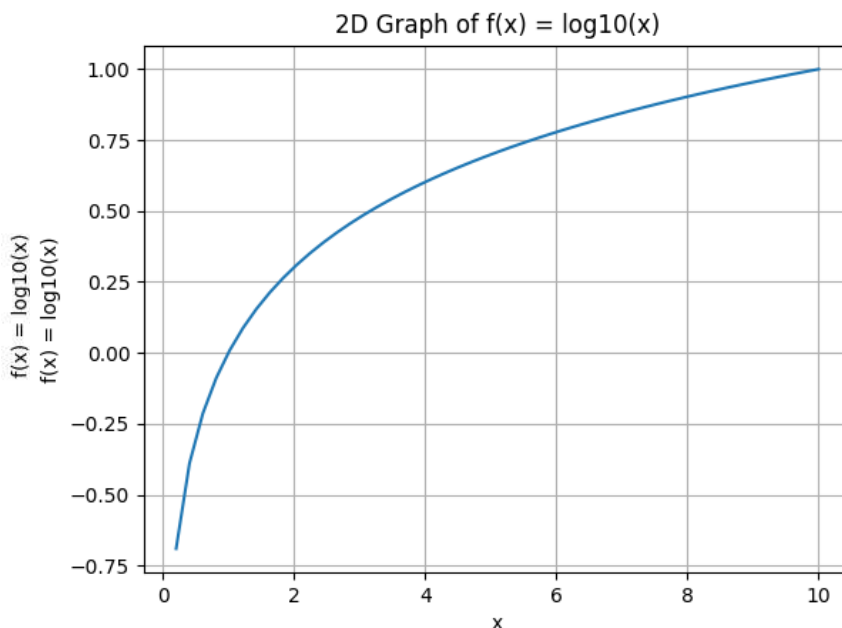
Date :- / /2023

Q.1) Write a Python program to plot graph of the functions $f(x) = \log_{10}(x)$ in $[0,10]$

Syntax:

```
import numpy as np
import matplotlib.pyplot as plt
x = np.linspace(0,10)
y = np.log10(x)
# Plot the graph
plt.plot(x, y)
plt.xlabel('x')
plt.ylabel('f(x) = log10(x)')
plt.title('2D Graph of f(x) = log10(x)')
plt.grid(True)
plt.show()
```

OUTPUT:

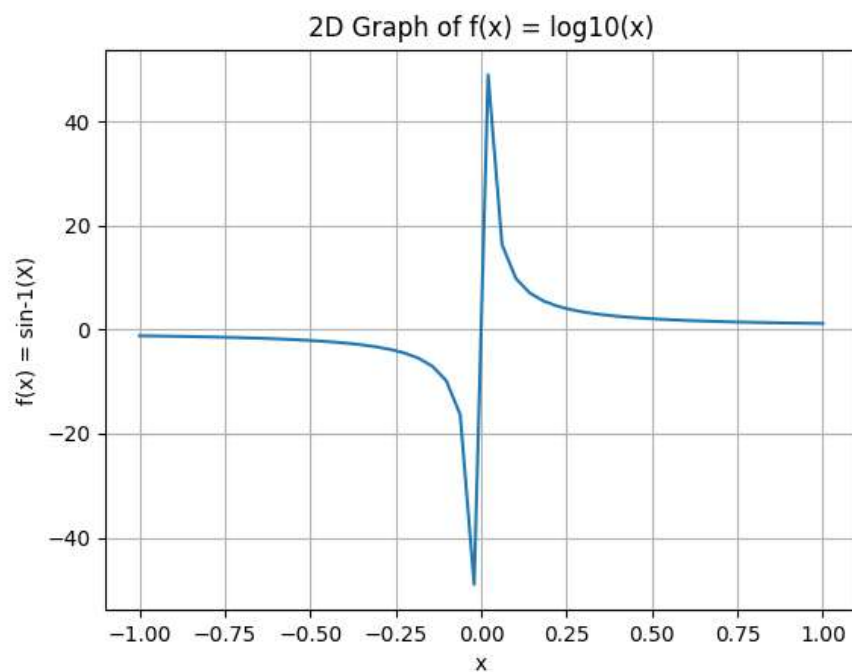


Q.2) Write a Python program to plot graph of the functions $f(x) = \sin^{-1}(x)$ in $[-1,1]$

Syntax:

```
import numpy as np
import matplotlib.pyplot as plt
x = np.linspace(-1,1)
y = 1/np.sin(x)
# Plot the graph
plt.plot(x, y)
plt.xlabel('x')
plt.ylabel('f(x) = sin-1(X)')
plt.title('2D Graph of f(x) = log10(x)')
plt.grid(True)
plt.show()
```

OUTPUT:

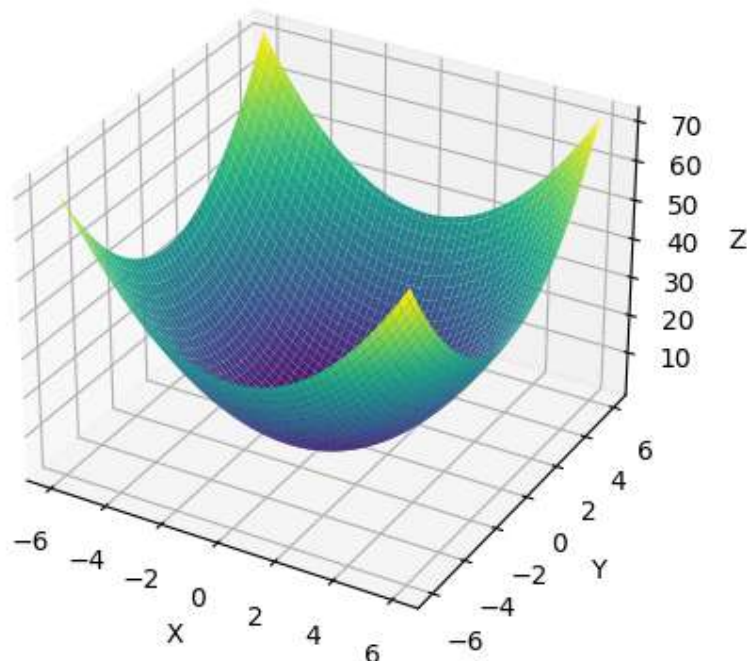


Q.3) Using Python plot the surface plot of parabola $z = x^2 + y^2$ in $-6 < x, y < 6$

Syntax:

```
import numpy as np
import matplotlib.pyplot as plt
from mpl_toolkits.mplot3d import Axes3D
# Generate data for x, y, and z
x = np.linspace(-6, 6, 100) # x values from -6 to 6
y = np.linspace(-6, 6, 100) # y values from -6 to 6
X, Y = np.meshgrid(x, y) # Create a meshgrid of x and y values
Z = X**2 + Y**2 # Calculate z values using the parabola equation
# Create a 3D plot
fig = plt.figure()
ax = fig.add_subplot(111, projection='3d')
ax.plot_surface(X, Y, Z, cmap='viridis')
# Set labels and title
ax.set_xlabel('X')
ax.set_ylabel('Y')
ax.set_zlabel('Z')
ax.set_title('Parabola Surface Plot')
# Show the plot
plt.show()
```

OUTPUT:



Q.4) If the line with points A[3, 1], B[5, -1] is transformed by the transformation

matrix $[T] = \begin{bmatrix} 3 & -2 \\ 2 & 1 \end{bmatrix}$ then using python, find the equation of transformed line.

Syntax:

```
import numpy as np
import matplotlib.pyplot as plt
# Define original points A and B
A = np.array([3, 1])
B = np.array([5, -1])
# Define transformation matrix [T]
T = np.array([[3, -2],
              [2, 1]])
# Apply transformation matrix to points A and B
A_transformed = np.dot(T, A)
B_transformed = np.dot(T, B)
# Extract transformed coordinates for points A and B
A_transformed_x = A_transformed[0]
A_transformed_y = A_transformed[1]
B_transformed_x = B_transformed[0]
B_transformed_y = B_transformed[1]
# Calculate slope and y-intercept of the transformed line
m = (B_transformed_y - A_transformed_y) / (B_transformed_x - A_transformed_x)
b = A_transformed_y - m * A_transformed_x
# Print equation of the transformed line
print(f"The equation of the transformed line is: y = {m:.2f}x + {b:.2f}")
```

Output:

The equation of the transformed line is: $y = 0.20x + 5.60$

Q.5) Write a Python program to draw a polygon with vertices (0,0), (2,0), (2,3) and (1,6) and rotate by 180°

Syntax:

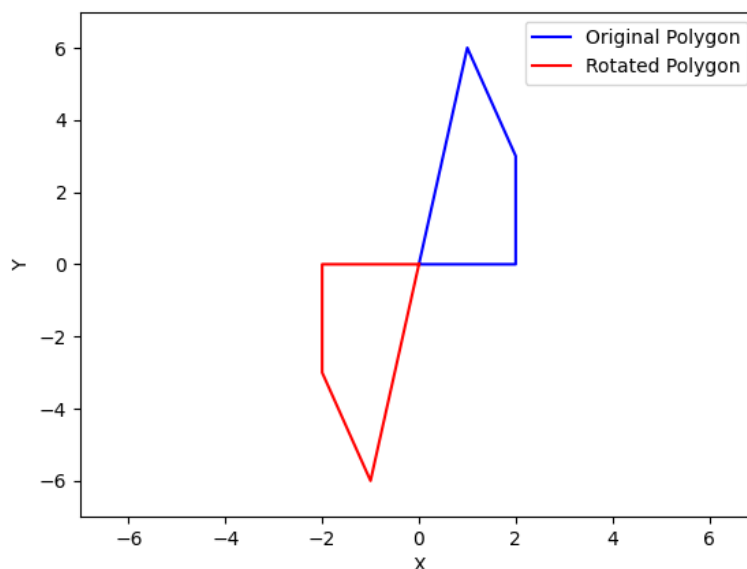
```
import matplotlib.pyplot as plt
import numpy as np
# Define vertices of the polygon
```

```

vertices = np.array([[0, 0],
                    [2, 0],
                    [2, 3],
                    [1, 6],
                    [0, 0]]) # Closing the polygon by repeating the first vertex
# Plot the original polygon
plt.plot(vertices[:, 0], vertices[:, 1], 'b-', label='Original Polygon')
# Define rotation matrix for 180 degrees (in radians)
angle_rad = np.deg2rad(180)
rotation_matrix = np.array([[np.cos(angle_rad), -np.sin(angle_rad)],
                            [np.sin(angle_rad), np.cos(angle_rad)]])
# Apply rotation matrix to vertices
vertices_rotated = np.dot(rotation_matrix, vertices.T).T
# Plot the rotated polygon
plt.plot(vertices_rotated[:, 0], vertices_rotated[:, 1], 'r-', label='Rotated Polygon')
# Set axis limits and labels
plt.xlim(-7, 7)
plt.ylim(-7, 7)
plt.xlabel('X')
plt.ylabel('Y')
# Add a legend
plt.legend()
# Show the plot
plt.show()

```

OUTPUT:

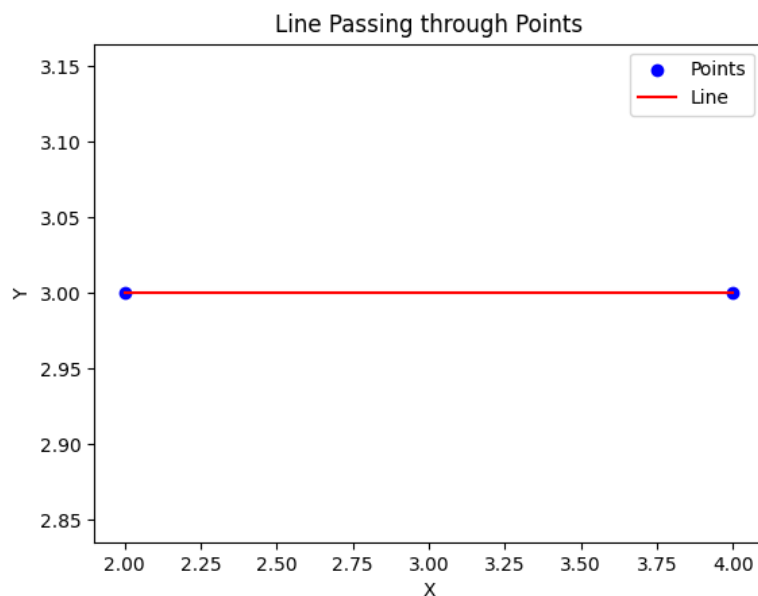


Q.6) Using python, generate line passing through points (2,3) and (4,3) and equation of the line

Syntax:

```
import matplotlib.pyplot as plt
import numpy as np
# Define the points
x = np.array([2, 4])
y = np.array([3, 3])
# Calculate the slope (m) and y-intercept (b) of the line
m = (y[1] - y[0]) / (x[1] - x[0])
b = y[0] - m * x[0]
# Print the equation of the line
print(f"The equation of the line is: y = {m:.2f}x + {b:.2f}")
# Plot the points and the line
plt.scatter(x, y, c='blue', label='Points')
plt.plot(x, m * x + b, c='red', label='Line')
plt.xlabel('X')
plt.ylabel('Y')
plt.title('Line Passing through Points')
plt.legend()
plt.show()
```

OUTPUT:



Q.7) write a Python program to solve the following LPP

$$\text{Max } Z = 150x + 75y$$

Subjected to

$$4x + 6y \leq 24$$

$$5x + 3y \leq 15$$

$$x > 0, y > 0$$

Syntax:

```
from pulp import *
# Create the LP problem as a maximization problem
problem = LpProblem("LPP", LpMaximize)
# Define the decision variables
x = LpVariable('x', lowBound=0, cat='Continuous')
y = LpVariable('y', lowBound=0, cat='Continuous')
# Define the objective function
problem += 150 * x + 75 * y, "Z"
# Define the constraints
problem += 4 * x + 6 * y <= 24, "Constraint1"
problem += 5 * x + 3 * y <= 15, "Constraint2"
# Solve the LP problem
problem.solve()
# Print the status of the solution
print("Status:", LpStatus[problem.status])
# Print the optimal values of x and y
print("Optimal x =", value(x))
print("Optimal y =", value(y))
# Print the optimal value of the objective function
print("Optimal Z =", value(problem.objective
```

OUTPUT:

Status: Optimal

Optimal x = 3.0

Optimal y = 0.0

Optimal Z = 450.0

Q.8) Write a python program to display the following LPP by using pulp module and simplex method. Find its optimal solution if exist.

Min $Z = 4x + y + 3z + 5w$
subject to
 $4x - 6y - 4w \geq -20$
 $-8x - 3y + 3z + 2w \leq 20$
 $x + y \leq 11$
 $x \geq 0, y \geq 0, z \geq 0, w \geq 0$

Syntax:

#By using Pulp Method

```
from pulp import LpMinimize, LpProblem, LpStatus, lpSum, LpVariable, PULP_CBC_CMD
```

Create LP problem

```
problem = LpProblem("LPP", LpMinimize)
```

Define decision variables

```
x = LpVariable('x', lowBound=0)
```

```
y = LpVariable('y', lowBound=0)
```

```
z = LpVariable('z', lowBound=0)
```

```
w = LpVariable('w', lowBound=0)
```

Objective function

```
problem += 4 * x + y + 3 * z + 5 * w, "Z"
```

Constraints

```
problem += 4 * x - 6 * y - 4 * w >= -20, "constraint1"
```

```
problem += -8 * x - 3 * y + 3 * z + 2 * w <= 20, "constraint2"
```

```
problem += x + y <= 11, "constraint3"
```

Solve LP problem using simplex method

```
problem.solve(PULP_CBC_CMD())
```

Print status of the solution

```
print("Status: ", LpStatus[problem.status])
```

Print optimal solution if exists

```
if problem.status == 1: # LpStatusOptimal
```

```
    print("Optimal Solution:")
```

```

    print("x = ", x.value())
    print("y = ", y.value())
    print("z = ", z.value())
    print("w = ", w.value())
    print("Z = ", problem.objective.value())
else:
    print("No optimal solution exists.")

```

OUTPUT:

Status: Optimal

Optimal Solution:

x = 0.0

y = 0.0

z = 0.0

w = 0.0

Z = 0.0

#by using Simplex Method

```
import numpy as np
```

```
from scipy.optimize import linprog
```

```
# Define the coefficients of the objective function
```

```
c = np.array([4, 1, 3, 5])
```

```
# Define the coefficients of the inequality constraints
```

```
A = np.array([[4, -6, 0, -4],
```

```
              [-8, -3, 3, 2],
```

```
              [1, 1, 0, 0]])
```

```
# Define the right-hand side of the inequality constraints
```

```
b = np.array([-20, 20, 11])
```

```
# Define the bounds on the decision variables
```

```
bounds = [(0, None), (0, None), (0, None), (0, None)]
```

```
# Solve the LP problem using the simplex method
```

```
result = linprog(c, A_ub=A, b_ub=b, bounds=bounds, method='simplex')
```

```
# Print the optimal solution if exists
```

```
if result.success:
```

```
    print("Optimal Solution:")
```

```
    print("x = ", result.x[0])
```

```
    print("y = ", result.x[1])
```

```
    print("z = ", result.x[2])
```

```
    print("w = ", result.x[3])
```

```
    print("Z = ", result.fun)
```

else:

```
print("No optimal solution exists.")
```

OUTPUT:

```
x = 0.0
```

```
y = 3.3333333333333334
```

```
z = 0.0
```

```
w = 0.0
```

```
Z = 3.3333333333333334
```

Q.9) Plot 3D axes with labels X - axis and z –axis and also plot following points with given coordinate in one graph

(I) (70, -25, 15) as a diamond in black color,

(II) (50, 72, -45) as a* in green color,

(III) (58, -82, 65) as a dot in green color,

(IV) (20, 72, -45) as a * in Red color.

Syntax:

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

```
import numpy as np
```

```
# Create a 3D figure
```

```
fig = plt.figure()
```

```
ax = fig.add_subplot(111, projection='3d')
```

```
# Plot the 3D axes with labels
```

```
ax.set_xlabel('X-axis')
```

```
ax.set_zlabel('Z-axis')
```

```
# Define the points and their coordinates
```

```
points = {'(70, -25, 15)': (70, -25, 15),
```

```
         '(50, 72, -45)': (50, 72, -45),
```

```
         '(58, -82, 65)': (58, -82, 65),
```

```
         '(20, 72, -45)': (20, 72, -45)}
```

```
# Plot each point with the specified marker and color
```

```
for label, (x, y, z) in points.items():
```

```
    if label == '(70, -25, 15)':
```

```
        ax.scatter(x, y, z, marker='D', color='black', label=label)
```

```
    elif label == '(50, 72, -45)':
```

```
        ax.scatter(x, y, z, marker='*', color='green', label=label)
```

```
    elif label == '(58, -82, 65)':
```

```
        ax.scatter(x, y, z, marker='.', color='green', label=label)
```

```
    elif label == '(20, 72, -45)':
```

```
        ax.scatter(x, y, z, marker='*', color='red', label=label)
```

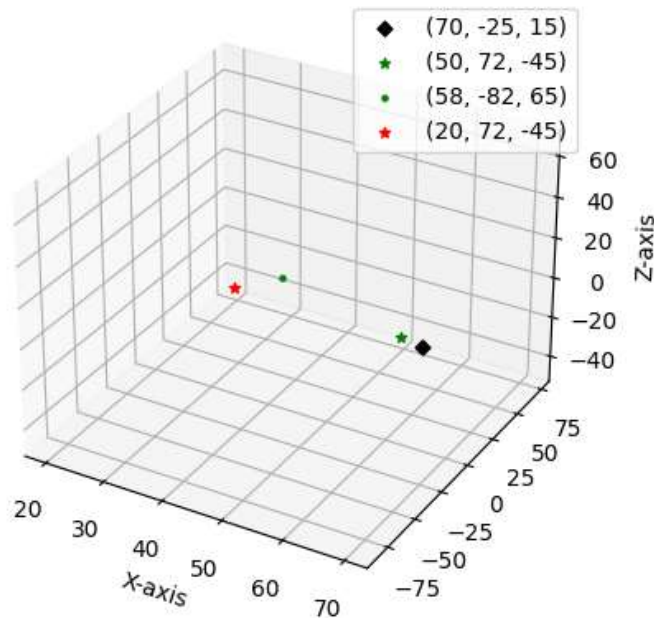
```
# Add a legend to the graph
```

```
ax.legend()
```

```
# Show the 3D graph
```

```
plt.show()
```

OUTPUT:



Q.10) Find the combined transformation of the line segment between the point A[4, -1] & B[3, 0] by using Python program for the following sequence of transformation:-

(I) Shearing in X – Direction by 9 unit

(II) Rotation about origin through an angle π .

(III) Scaling in X-Coordinate by 2 units.

(IV) Reflection trough he line $y = x$

Syntax:

```
import numpy as np
```

```
# Input points A and B
```

```
A = np.array([4, -1])
```

```
B = np.array([3, 0])
```

```
# Transformation 1: Shearing in X-Direction by 9 units
```

```
shear_matrix = np.array([[1, 9],  
                        [0, 1]])
```

```
A_sheared = np.dot(shear_matrix, A)
```

```
B_sheared = np.dot(shear_matrix, B)
```

```
print("Transformed Point A after Shearing:", A_sheared)
```

```

print("Transformed Point B after Shearing:", B_sheared)
# Transformation 2: Rotation about origin through an angle of pi (180 degrees)
rotation_matrix = np.array([[np.cos(np.pi), -np.sin(np.pi)],
                             [np.sin(np.pi), np.cos(np.pi)]])
A_rotated = np.dot(rotation_matrix, A_sheared)
B_rotated = np.dot(rotation_matrix, B_sheared)
print("Transformed Point A after Rotation:", A_rotated)
print("Transformed Point B after Rotation:", B_rotated)
# Transformation 3: Scaling in X-Coordinate by 2 units
scaling_matrix = np.array([[2, 0],
                            [0, 1]])
A_scaled = np.dot(scaling_matrix, A_rotated)
B_scaled = np.dot(scaling_matrix, B_rotated)
print("Transformed Point A after Scaling:", A_scaled)
print("Transformed Point B after Scaling:", B_scaled)
# Transformation 4: Reflection through the line y = x
reflection_matrix = np.array([[0, 1],
                              [1, 0]])
A_reflected = np.dot(reflection_matrix, A_scaled)
B_reflected = np.dot(reflection_matrix, B_scaled)
print("Transformed Point A after Reflection:", A_reflected)
print("Transformed Point B after Reflection:", B_reflected)

```

OUTPUT:

```

Transformed Point A after Shearing: [-5 -1]
Transformed Point B after Shearing: [3 0]
Transformed Point A after Rotation: [5. 1.]
Transformed Point B after Rotation: [-3.0000000e+00  3.6739404e-16]
Transformed Point A after Scaling: [10.  1.]
Transformed Point B after Scaling: [-6.0000000e+00  3.6739404e-16]
Transformed Point A after Reflection: [ 1. 10.]
Transformed Point B after Reflection: [ 3.6739404e-16 -6.0000000e+00]

```

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College Sangamner

DEPARTMENT OF COMPUTER SCIENCE

MATHEMATICS

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Batch No. :- D

Roll No:- 04 **Date:-** / /2023

Title of the:- Practical 5

Expt. No . 5

Class :- S.Y.BCS

Remark

Demonstrators

Signature

Date :- / /2023

Q.1) Using Python plot the surface plot of function $z = \cos(x^2 + y^2 - 0.5)$ in the interval from $-1 < x, y < 1$.

Syntax:

```
import numpy as np
```

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

```
from mpl_toolkits.mplot3d import Axes3D
```

```
# Define the function
```

```
def func(x, y):
```

```
    return np.cos(x**2 + y**2 - 0.5)
```

```
# Generate x, y values in the interval from -1 to 1
```

```
x = np.linspace(-1, 1, 100)
```

```
y = np.linspace(-1, 1, 100)
```

```
X, Y = np.meshgrid(x, y) # Create a grid of x, y values
```

```
Z = func(X, Y) # Compute z values using the function
```

```
# Create a 3D plot
```

```
fig = plt.figure()
```

```
ax = fig.add_subplot(111, projection='3d')
```

```
ax.plot_surface(X, Y, Z, cmap='viridis') # Plot the surface
```

```
ax.set_xlabel('X')
```

```
ax.set_ylabel('Y')
```

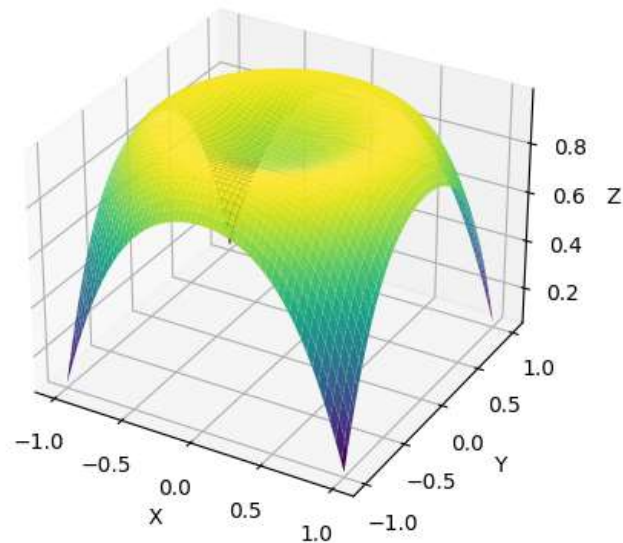
```
ax.set_zlabel('Z')
```

```
ax.set_title('Surface Plot of  $z = \cos(x^2 + y^2 - 0.5)$ ')
```

```
plt.show() # Show the plot
```

OUTPUT:

Surface Plot of $z = \cos(x^2 + y^2 - 0.5)$



Q.2) Generate 3D surface Plot for the function $f(x) = \sin(x^2 + y^2)$ in the interval $[0, 10]$.

Syntax:

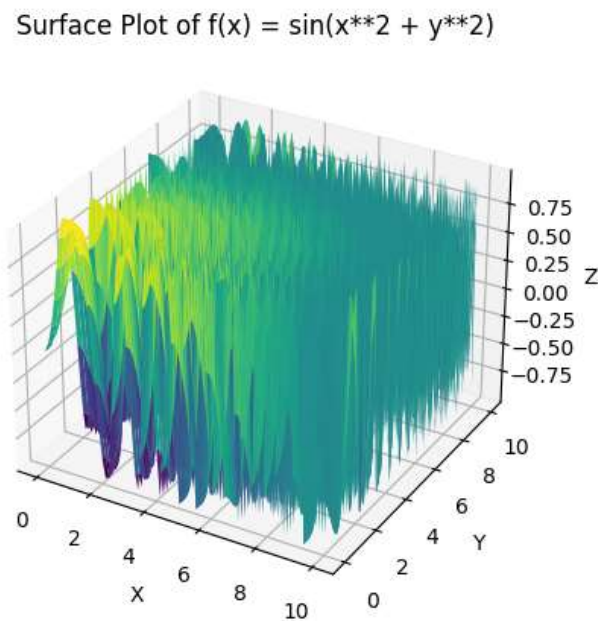
```
import numpy as np
import matplotlib.pyplot as plt
from mpl_toolkits.mplot3d import Axes3D
# Define the function
def func(x, y):
    return np.sin(x**2 + y**2)
# Generate x, y values in the interval from 0 to 10
x = np.linspace(0, 10, 100)
y = np.linspace(0, 10, 100)
X, Y = np.meshgrid(x, y) # Create a grid of x, y values
Z = func(X, Y) # Compute z values using the function
# Create a 3D plot
fig = plt.figure()
ax = fig.add_subplot(111, projection='3d')
ax.plot_surface(X, Y, Z, cmap='viridis') # Plot the surface
```

```

ax.set_xlabel('X')
ax.set_ylabel('Y')
ax.set_zlabel('Z')
ax.set_title('Surface Plot of f(x) = sin(x**2 + y**2)')
plt.show() # Show the plot

```

OUTPUT:



Q.3) Write a Python program to generate 3D plot of the functions $z = \sin x + \cos y$ in the interval $-10 < x, y < 10$.

Syntax:

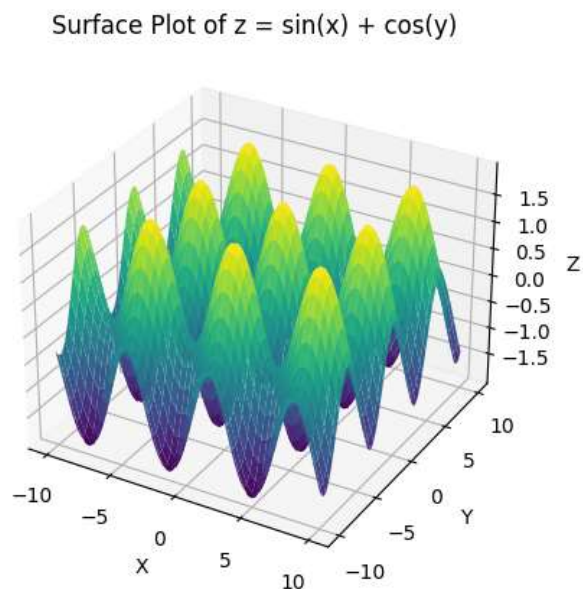
```

import numpy as np
import matplotlib.pyplot as plt
from mpl_toolkits.mplot3d import Axes3D
# Define the function
def func(x, y):
    return np.sin(x) + np.cos(y)
# Generate x, y values in the interval from -10 to 10
x = np.linspace(-10, 10, 100)

```

```
y = np.linspace(-10, 10, 100)
X, Y = np.meshgrid(x, y) # Create a grid of x, y values
Z = func(X, Y) # Compute z values using the function
# Create a 3D plot
fig = plt.figure()
ax = fig.add_subplot(111, projection='3d')
ax.plot_surface(X, Y, Z, cmap='viridis') # Plot the surface
ax.set_xlabel('X')
ax.set_ylabel('Y')
ax.set_zlabel('Z')
ax.set_title('Surface Plot of z = sin(x) + cos(y)')
plt.show() # Show the plot
```

OUTPUT:

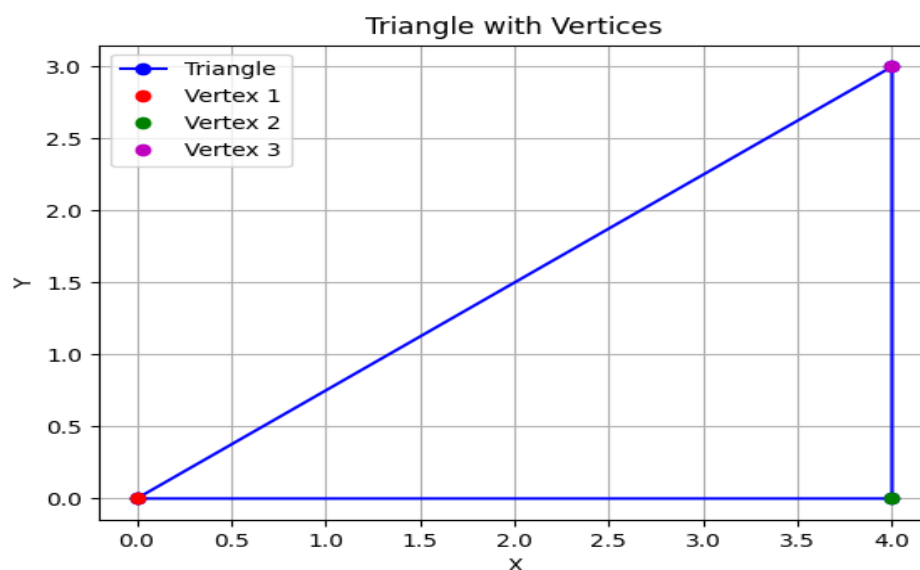


Q.4) Using python, generate triangle with vertices (0, 0), (4, 0), (4, 3) check whether the triangle is Right angle triangle.

Syntax:

```
import matplotlib.pyplot as plt
# Define the vertices of the triangle
vertex1 = (0, 0)
vertex2 = (4, 0)
vertex3 = (4, 3)
# Extract x and y coordinates of the vertices
x = [vertex1[0], vertex2[0], vertex3[0], vertex1[0]]
y = [vertex1[1], vertex2[1], vertex3[1], vertex1[1]]
# Plot the triangle
plt.plot(x, y, 'b-o', label='Triangle')
plt.plot(vertex1[0], vertex1[1], 'ro', label='Vertex 1')
plt.plot(vertex2[0], vertex2[1], 'go', label='Vertex 2')
plt.plot(vertex3[0], vertex3[1], 'mo', label='Vertex 3')
plt.xlabel('X')
plt.ylabel('Y')
plt.title("Triangle with Vertices")
plt.legend()
plt.grid(True)
plt.show()
```

Output:



Q.5) Generate vector x in the interval [-7, 7] using numpy package with 50 subintervals.

Syntax:

```
import numpy as np
# Define the interval and number of subintervals
start = -7
end = 7
num_subintervals = 50
# Generate the vector x
x = np.linspace(start, end, num=num_subintervals+1)
# Print the vector x
print("Vector x:")
print(x)
```

OUTPUT:

Vector x:

```
[-7.0000000e+00 -6.7200000e+00 -6.4400000e+00 -6.1600000e+00
-5.8800000e+00 -5.6000000e+00 -5.3200000e+00 -5.0400000e+00
-4.7600000e+00 -4.4800000e+00 -4.2000000e+00 -3.9200000e+00
-3.6400000e+00 -3.3600000e+00 -3.0800000e+00 -2.8000000e+00
-2.5200000e+00 -2.2400000e+00 -1.9600000e+00 -1.6800000e+00
-1.4000000e+00 -1.1200000e+00 -8.4000000e-01 -5.6000000e-01
-2.8000000e-01 8.8817842e-16 2.8000000e-01 5.6000000e-01
8.4000000e-01 1.1200000e+00 1.4000000e+00 1.6800000e+00
1.9600000e+00 2.2400000e+00 2.5200000e+00 2.8000000e+00
3.0800000e+00 3.3600000e+00 3.6400000e+00 3.9200000e+00
4.2000000e+00 4.4800000e+00 4.7600000e+00 5.0400000e+00
5.3200000e+00 5.6000000e+00 5.8800000e+00 6.1600000e+00
6.4400000e+00 6.7200000e+00 7.0000000e+00]
```

Q.6) Write a Python program to find the area and perimeter of the ABC, where A[0, 0] B[6, 0], C[4,4].

Syntax:

```
import numpy as np

# Define the vertices of the triangle
A = np.array([0, 0])
B = np.array([6, 0])
C = np.array([4, 4])

# Calculate the side lengths of the triangle
AB = np.linalg.norm(B - A)
BC = np.linalg.norm(C - B)
CA = np.linalg.norm(A - C)

# Calculate the semiperimeter
s = (AB + BC + CA) / 2

# Calculate the area using Heron's formula
area = np.sqrt(s * (s - AB) * (s - BC) * (s - CA))

# Calculate the perimeter
perimeter = AB + BC + CA

# Print the results
print("Triangle ABC:")
print("Side AB:", AB)
print("Side BC:", BC)
print("Side CA:", CA)
print("Area:", area)
print("Perimeter:", perimeter)
```

OUTPUT:

Side AB: 6.0

Side BC: 4.47213595499958

Side CA: 5.656854249492381

Area: 11.999999999999998

Perimeter: 16.12899020449196

Q.7) write a Python program to solve the following LPP

$$\text{Max } Z = 5x + 3y$$

Subjected to

$$x + y \leq 7$$

$$2x + 5y \leq 1$$

$$x > 0$$

$$y > 0$$

Syntax:

```
from scipy.optimize import linprog
```

```
# Objective function coefficients
```

```
c = [-5, -3]
```

```
# Coefficient matrix of inequality constraints
```

```
A = [[1, 1],
```

```
      [2, 5]]
```

```
# Right-hand side of inequality constraints
```

```
b = [7, 1]
```

```
# Bounds on variables
```

```
x_bounds = (0, None)
```

```
y_bounds = (0, None)
```

```
# Solve the linear programming problem
```

```
res = linprog(c, A_ub=A, b_ub=b, bounds=[x_bounds, y_bounds])
```

```
# Check if the optimization was successful
```

```
if res.success:
```

```

print("Optimal solution found:")
print("x =", res.x[0])
print("y =", res.x[1])
print("Maximum value of Z =", -res.fun)
else:
    print("Optimization failed. Message:", res.message)

```

OUTPUT:

Optimal solution found:

x = 0.5

y = 0.0

Maximum value of Z = 2.5

Q.8) Write a python program to display the following LPP by using pulp module and simplex method. Find its optimal solution if exist.

$$\text{Min } Z = 4x + y + 3z + 5w$$

subject to

$$4x + 6y - 5z - 4w \geq 10$$

$$-8x - 3y + 3z + 2w \leq 20$$

$$x + y \leq 11$$

$$x \geq 0, y \geq 0, z \geq 0, w \geq 0$$

Syntax:

#BY using Pulp Module

```

from pulp import LpProblem, LpMinimize, LpVariable, lpSum, LpStatus, value
# Create the LPP problem
problem = LpProblem("LPP", LpMinimize)
# Define the variables
x = LpVariable("x", lowBound=0)
y = LpVariable("y", lowBound=0)
z = LpVariable("z", lowBound=0)
w = LpVariable("w", lowBound=0)
# Define the objective function

```

```

objective = 4 * x + y + 3 * z + 5 * w
problem += objective
# Define the constraints
constraint1 = 4 * x + 6 * y - 5 * z - 4 * w >= 10
constraint2 = -8 * x - 3 * y + 3 * z + 2 * w <= 20
constraint3 = x + y <= 11
problem += constraint1
problem += constraint2
problem += constraint3
# Solve the LPP problem using the simplex method
problem.solve()
# Check if the optimization was successful
if LpStatus[problem.status] == "Optimal":
    print("Optimal solution found:")
    print("x =", value(x))
    print("y =", value(y))
    print("z =", value(z))
    print("w =", value(w))
    print("Minimum value of Z =", value(objective))
else:
    print("Optimization failed.")

```

OUTPUT :

Optimal solution found:

x = 0.0

y = 1.6666667

z = 0.0

w = 0.0

Minimum value of Z = 1.6666667

Q.9) Apply Python. Program in each of the following transformation on the point P[3,8]

(I) Reflection through y-axis.

(II) Scaling in X-co-ordinate by factor 6.

(III) Rotation about origin through an angle 30°

(IV) Reflection through the line $y = -x$

Syntax:

```
import numpy as np
```

```
# Point P
```

```
P = np.array([3, 8])
```

```

# Transformation I: Reflection through y-axis
P_reflection_y_axis = np.array([-P[0], P[1]])
# Transformation II: Scaling in X-coordinate by factor 6
P_scaling_x = np.array([6 * P[0], P[1]])
# Transformation III: Rotation about origin through an angle of 30 degrees
theta = np.deg2rad(30) # Convert angle from degrees to radians
rotation_matrix = np.array([[np.cos(theta), -np.sin(theta)],
                             [np.sin(theta), np.cos(theta)]])
P_rotation = np.dot(rotation_matrix, P)
# Transformation IV: Reflection through the line y = -x
reflection_line = np.array([[0, -1],
                             [-1, 0]])
P_reflection_line = np.dot(reflection_line, P)
# Print the results
print("Original Point P:", P)
print("Transformation I - Reflection through y-axis:", P_reflection_y_axis)
print("Transformation II - Scaling in X-coordinate by factor 6:", P_scaling_x)
print("Transformation III - Rotation about origin through an angle of 30
degrees:", P_rotation)
print("Transformation IV - Reflection through the line y = -x:", P_reflection_line)

```

OUTPUT:

Original Point P: [3 8]

Transformation I - Reflection through y-axis: [-3 8]

Transformation II - Scaling in X-coordinate by factor 6: [18 8]

Transformation III - Rotation about origin through an angle of 30 degrees: [-1.40192379 8.42820323]

Transformation IV - Reflection through the line y = -x: [-8 -3]

Q.10) Write a python program to Plot 2D X-axis and Y-axis in black color. In the same diagram plot:-

(I) Green Triangle with vertices [5,4],[7,4],[6,6]

(II) Blue rectangle with vertices [2, 2], [10, 2], [10, 8], [2, 8].

(III) Red polygon with vertices [6, 2], [10, 4], [8, 7], [4, 8], [2, 4].

(IV) Isosceles triangle with vertices [0, 0], [4, 0], [2, 4].

Syntax:

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

```
# Create figure and axis
```

```
fig, ax = plt.subplots()
```

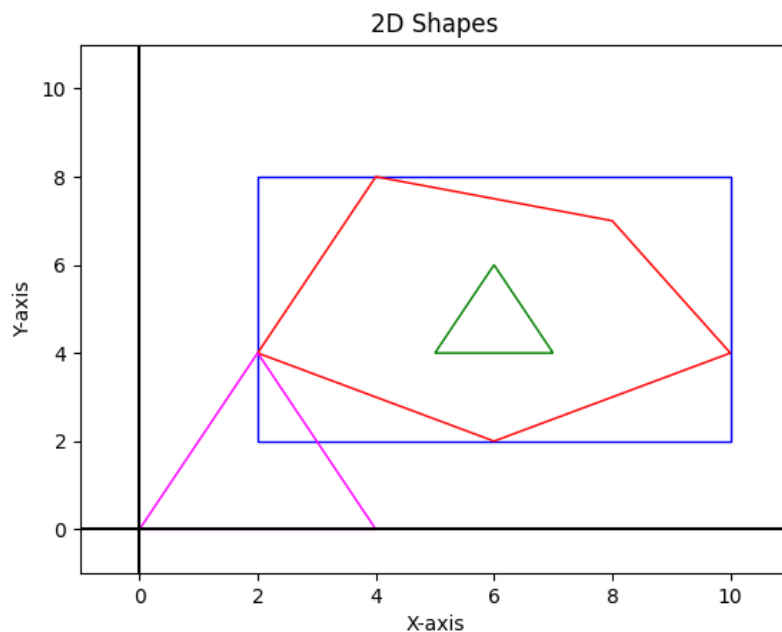
```
# Plot X-axis and Y-axis in black color
```

```

ax.axhline(0, color='black')
ax.axvline(0, color='black')
# Green Triangle with vertices [5,4],[7,4],[6,6]
green_triangle = plt.Polygon([[5, 4], [7, 4], [6, 6]], edgecolor='green',
facecolor='none')
ax.add_patch(green_triangle)
# Blue Rectangle with vertices [2, 2], [10, 2], [10, 8], [2, 8]
blue_rectangle = plt.Polygon([[2, 2], [10, 2], [10, 8], [2, 8]], edgecolor='blue',
facecolor='none')
ax.add_patch(blue_rectangle)
# Red Polygon with vertices [6, 2], [10, 4], [8, 7], [4, 8], [2, 4]
red_polygon = plt.Polygon([[6, 2], [10, 4], [8, 7], [4, 8], [2, 4]], edgecolor='red',
facecolor='none')
ax.add_patch(red_polygon)
# Isosceles Triangle with vertices [0, 0], [4, 0], [2, 4]
isosceles_triangle = plt.Polygon([[0, 0], [4, 0], [2, 4]], edgecolor='magenta',
facecolor='none')
ax.add_patch(isosceles_triangle)
# Set axis limits
ax.set_xlim([-1, 11])
ax.set_ylim([-1, 11])
# Set labels and title
ax.set_xlabel('X-axis')
ax.set_ylabel('Y-axis')
ax.set_title('2D Shapes')
# Show the plot
plt.show()

```

OUTPUT:



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DEPARTMENT OF COMPUTER SCIENCE

MATHEMATICS

Name :- Prem Vijay Vajare

Batch No. :- D

Roll No:- 75 **Date:-** / /2023

Title of the:- Practical 6

Expt. No . 6

Class :- S.Y.BCS

Remark

Demonstrators

Signature

Date :- / /2023

Q.1) Using python, generate 3D surface Plot for the function $f(x) = \sin(x^2 + y^2)$ in the interval $[0, 10]$.

Syntax:

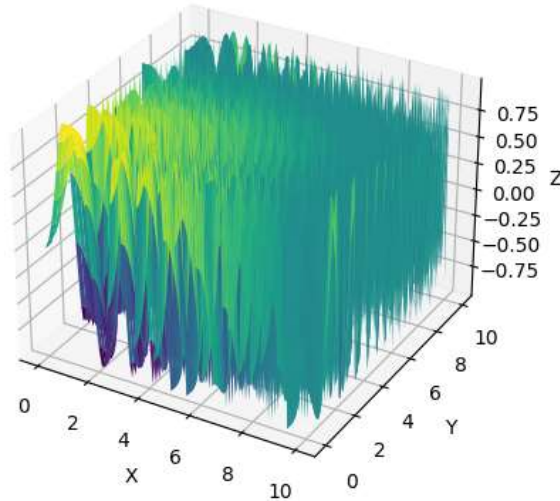
```
import numpy as np
import matplotlib.pyplot as plt
from mpl_toolkits.mplot3d import Axes3D
# Define the function
def f(x, y):
    return np.sin(x**2 + y**2)
# Generate x, y values
x = np.linspace(0, 10, 100)
y = np.linspace(0, 10, 100)
X, Y = np.meshgrid(x, y)
Z = f(X, Y)
# Create a 3D figure
fig = plt.figure()
ax = fig.add_subplot(111, projection='3d')
# Plot the surface
ax.plot_surface(X, Y, Z, cmap='viridis')
# Add labels and title
ax.set_xlabel('X')
ax.set_ylabel('Y')
ax.set_zlabel('Z')
ax.set_title('3D Surface Plot of f(x) = sin(x**2 + y**2)')
```

```
# Show the plot
```

```
plt.show()
```

OUTPUT:

3D Surface Plot of $f(x) = \sin(x^2 + y^2)$



Q.2) Using Python, plot the graph of function $f(x) = \sin(x) - e^{**x} + 3*x^{**2} - \log_{10}(x)$ on the Interval $[0, 2*\pi]$

Syntax:

```
import numpy as np
```

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

```
# Define the function
```

```
def f(x):
```

```
    return np.sin(x) - np.exp(x) + 3 * x**2 - np.log10(x)
```

```
# Generate x values
```

```
x = np.linspace(0, 2*np.pi, 500) # 500 points between 0 and 2*pi
```

```
y = f(x) # Evaluate f(x) for each x value
```

```
# Create a plot
```

```
plt.plot(x, y)
```

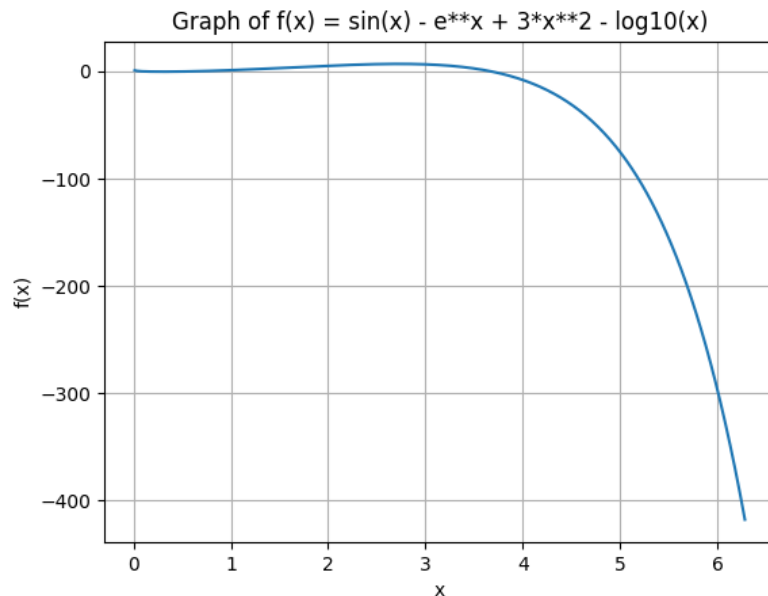
```
plt.xlabel('x')
```

```
plt.ylabel('f(x)')
```

```
plt.title('Graph of  $f(x) = \sin(x) - e^{**x} + 3*x^{**2} - \log_{10}(x)$ ')
```

```
plt.grid(True)
# Show the plot
plt.show()
```

OUTPUT:



Q.3) Draw the horizontal bar graph for the following data in Maroon.

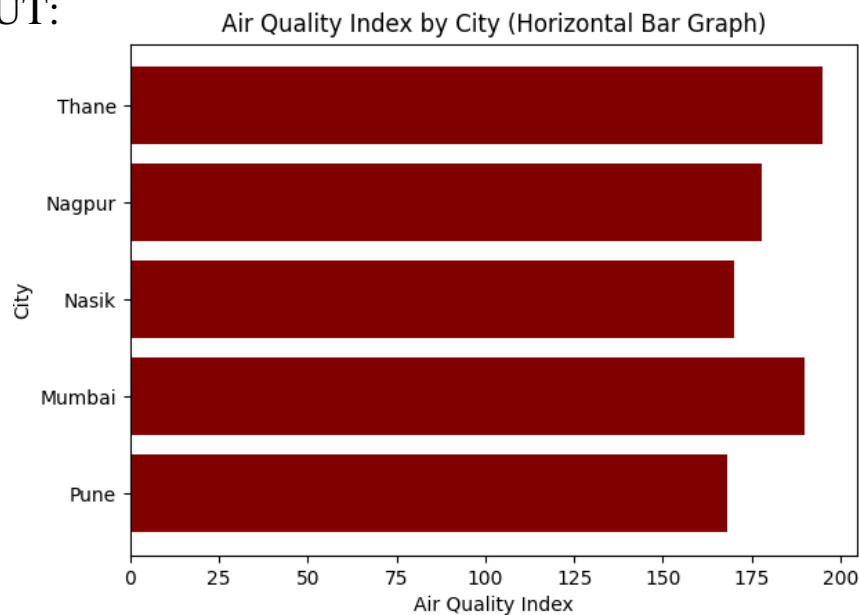
City	Pune	Mumbai	Nasik	Nagpur	Thane
Air Quality Index	168	190	170	178	195

Syntax:

```
import matplotlib.pyplot as plt
# Data
left = [1, 2, 3, 4, 5]
height = [168, 190, 170, 178, 195]
tick_label = ['Pune', 'Mumbai', 'Nasik', 'Nagpur', 'Thane']
# Create a horizontal bar graph
plt.barh(left, height, tick_label=tick_label, color='maroon')
# Set labels and title
plt.xlabel('Air Quality Index')
```

```
plt.ylabel('City')
plt.title('Air Quality Index by City (Horizontal Bar Graph)')
# Show the plot
plt.show()
```

OUTPUT:



Q.4) Using python, rotate the line segment by 180° having end points (1, 0) and (2, -1)

Syntax:

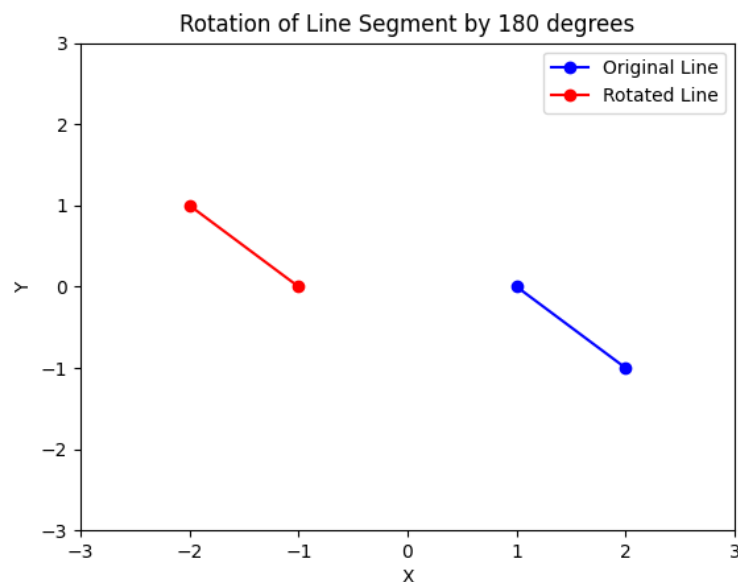
```
import numpy as np
import matplotlib.pyplot as plt
# Define the original line segment
x1, y1 = 1, 0
x2, y2 = 2, -1
# Plot the original line segment
plt.plot([x1, x2], [y1, y2], 'bo-', label='Original Line')
# Compute the rotated coordinates
x1_rot, y1_rot = -x1, -y1
x2_rot, y2_rot = -x2, -y2
# Plot the rotated line segment
plt.plot([x1_rot, x2_rot], [y1_rot, y2_rot], 'ro-', label='Rotated Line')
```

```

# Set axis limits
plt.xlim(-3, 3)
plt.ylim(-3, 3)
# Add labels and title
plt.xlabel('X')
plt.ylabel('Y')
plt.title('Rotation of Line Segment by 180 degrees')
# Add legend
plt.legend()
# Show the plot
plt.show()

```

Output:



Q.5) Write a Python program to draw a polygon with vertices (0, 0), (2, 0), (2, 3) and (1, 6) and rotate it by 180°.

Syntax:

```

import numpy as np
import matplotlib.pyplot as plt
# Define the original polygon vertices
vertices = np.array([[0, 0], [2, 0], [2, 3], [1, 6]])
# Plot the original polygon
plt.plot(vertices[:, 0], vertices[:, 1], 'bo-', label='Original Polygon')
# Compute the rotated coordinates

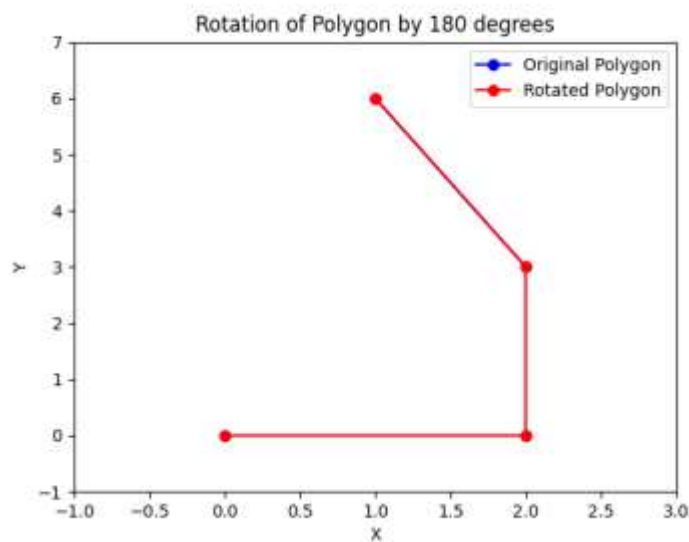
```

```

vertices_rot = np.flip(vertices, axis=0)
# Plot the rotated polygon
plt.plot(vertices_rot[:, 0], vertices_rot[:, 1], 'ro-', label='Rotated Polygon')
# Set axis limits
plt.xlim(-1, 3)
plt.ylim(-1, 7)
# Add labels and title
plt.xlabel('X')
plt.ylabel('Y')
plt.title('Rotation of Polygon by 180 degrees')
# Add legend
plt.legend()
# Show the plot
plt.show()

```

OUTPUT:



Q.6) Using python, generate triangle with vertices (0,0),(4,0),(2,4), check whether the triangle is isosceles triangle..

Syntax:

```

import numpy as np
import matplotlib.pyplot as plt
from mpl_toolkits.mplot3d import Axes3D
# Define the triangle vertices
vertices = np.array([[0, 0, 0], [4, 0, 0], [2, 4, 0]])

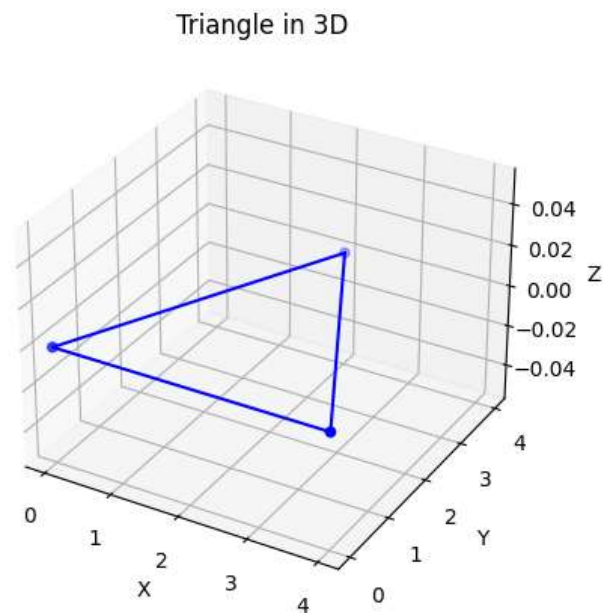
```

```

# Create a 3D plot
fig = plt.figure()
ax = fig.add_subplot(111, projection='3d')
# Plot the triangle vertices
ax.scatter(vertices[:, 0], vertices[:, 1], vertices[:, 2], c='blue', marker='o')
# Plot the triangle edges
for i in range(3):
    ax.plot([vertices[i, 0], vertices[(i+1)%3, 0]],
            [vertices[i, 1], vertices[(i+1)%3, 1]],
            [vertices[i, 2], vertices[(i+1)%3, 2]], c='blue')
# Check if any two sides are equal
d1 = np.linalg.norm(vertices[0, :2] - vertices[1, :2])
d2 = np.linalg.norm(vertices[0, :2] - vertices[2, :2])
d3 = np.linalg.norm(vertices[1, :2] - vertices[2, :2])
if d1 == d2 or d1 == d3 or d2 == d3:
    print("The triangle is an isosceles triangle.")
else:
    print("The triangle is not an isosceles triangle.")
# Set plot labels and title
ax.set_xlabel('X')
ax.set_ylabel('Y')
ax.set_zlabel('Z')
ax.set_title('Triangle in 3D')
# Show the plot
plt.show()

```

OUTPUT:



Q.7) write a Python program to solve the following LPP

$$\text{Max } Z = x + y$$

Subjected to

$$2x - 2y \Rightarrow 1$$

$$x + y \geq 2$$

$$x > 0, y > 0$$

Syntax:

```
from pulp import LpProblem, LpMaximize, LpVariable, LpStatus,  
lpSum, value
```

```
# Create a maximization problem
```

```
prob = LpProblem("MaximizationProblem", LpMaximize)
```

```
# Define variables
```

```
x = LpVariable('x', lowBound=0)
```

```
y = LpVariable('y', lowBound=0)
```

```
# Define objective function
```

```
prob += x + y
```

```
# Define constraints
```

```

prob += 2*x - 2*y >= 1
prob += x + y >= 2
# Solve the problem
prob.solve()
# Get the status of the solution
status = LpStatus[prob.status]
# Print the status of the solution
print("Status: {}".format(status))
# If the problem is solved successfully, print the optimal values of x and y
if status == 'Optimal':
    print("Optimal Solution:")
    print("x = {}".format(value(x)))
    print("y = {}".format(value(y)))
    print("Objective Function (Z) = {}".format(value(prob.objective)))

```

OUTPUT:

Status: Unbounded

Q.8) Write a python program to display the following LPP by using pulp module and simplex method. Find its optimal solution if exist.

```

Min Z = x + y
subject to
x >= 6
y >= 6
x + y <= 11
x >= 0, y >= 0

```

Syntax:

```

#By using Pulp Method
from pulp import LpProblem, LpMinimize, LpVariable, LpStatus, lpSum, value
# Create a minimization problem
prob = LpProblem("MinimizationProblem", LpMinimize)

```

```

# Define variables
x = LpVariable('x', lowBound=0)
y = LpVariable('y', lowBound=0)
# Define objective function
prob += x + y
# Define constraints
prob += x >= 6
prob += y >= 6
prob += x + y <= 11
# Solve the problem
prob.solve()
# Get the status of the solution
status = LpStatus[prob.status]
# Print the status of the solution
print("Status: {}".format(status))
# If the problem is solved successfully, print the optimal values of x and y
if status == 'Optimal':
    print("Optimal Solution:")
    print("x = {}".format(value(x)))
    print("y = {}".format(value(y)))
    print("Objective Function (Z) = {}".format(value(prob.objective)))

```

OUTPUT:

Status: Infeasible

```

from scipy.optimize import linprog
# Define the coefficients of the objective function
c = [1, 1]
# Define the coefficient matrix of the inequality constraints
A_ub = [[-1, 0], [0, -1], [-1, -1]]
# Define the right-hand side of the inequality constraints
b_ub = [-6, -6, -11]
# Define the bounds on the variables
bounds = [(6, None), (6, None)]
# Solve the linear programming problem using the simplex method
result = linprog(c, A_ub=A_ub, b_ub=b_ub, bounds=bounds, method='simplex')
# Print the result
print("Status: {}".format(result.message))
if result.success:
    print("Optimal Solution:")

```

```

print("x = {}".format(result.x[0]))
print("y = {}".format(result.x[1]))
print("Objective Function (Z) = {}".format(result.fun))

```

OUTPUT:

Status: Optimization terminated successfully.

Optimal Solution:

x = 6.0

y = 6.0

Objective Function (Z) = 12.0

Q.9) Apply Python. Program in each of the following transformation on the point P[4,-2]

(I) Reflection through y-axis.

(II) Scaling in X-co-ordinate by factor 7.

(III) Shearing in Y Direction by 3 unit.

(IV) Reflection through the line $y = -x$

Syntax:

```
# Point P
```

```
P = [4, -2]
```

```
print("Original Point P: {}".format(P))
```

```
# Reflection through y-axis
```

```
P_reflect_y_axis = [-P[0], P[1]]
```

```
print("Reflection through y-axis: {}".format(P_reflect_y_axis))
```

```
# Scaling in X-coordinates by factor 7
```

```
scaling_factor_x = 7
```

```
P_scaling_x = [scaling_factor_x * P[0], P[1]]
```

```
print("Scaling in X-coordinates by factor 7: {}".format(P_scaling_x))
```

```
# Shearing in Y-direction by 3 units
```

```
shearing_factor_y = 3
```

```
P_shearing_y = [P[0], P[0] + shearing_factor_y * P[1]]
```

```
print("Shearing in Y-direction by 3 units: {}".format(P_shearing_y))
```

```
# Reflection through the line  $y = -x$ 
```

```
P_reflect_line = [-P[1], -P[0]]
```

```
print("Reflection through the line  $y = -x$ : {}".format(P_reflect_line))
```

OUTPUT:

Original Point P: [4, -2]

Reflection through y-axis: [-4, -2]

Scaling in X-coordinates by factor 7: [28, -2]

Shearing in Y-direction by 3 units: [4, -10]

Reflection through the line $y = -x$: [2, -4]

Q.10) Find the combined transformation by using Python program for the following sequence of transformation:-

- (I) Rotation about origin through an angle 60° .
- (II) Scaling in X-Coordinate by 7 units.
- (III) Uniform Scaling by 4 unit
- (IV) Reflection through the line $y = x$

Syntax:

```
# Point P
```

```
P = [2, 3]
```

```
print("Original Point P: {}".format(P))
```

```
# Transformation 1: Rotation about origin through an angle of 60 degrees
```

```
import math
```

```
angle = 60
```

```
angle_rad = math.radians(angle)
```

```
P_rotation = [round(P[0] * math.cos(angle_rad) - P[1] * math.sin(angle_rad)),  
round(P[0] * math.sin(angle_rad) + P[1] * math.cos(angle_rad))]
```

```
print("Transformation 1: Rotation about origin through an angle of 60 degrees:  
{ }".format(P_rotation))
```

```
# Transformation 2: Scaling in X-Coordinate by 7 units
```

```
scaling_factor_x = 7
```

```
P_scaling_x = [scaling_factor_x * P_rotation[0], P_rotation[1]]
```

```
print("Transformation 2: Scaling in X-Coordinate by 7 units:  
{ }".format(P_scaling_x))
```

```
# Transformation 3: Uniform Scaling by 4 units
```

```
scaling_factor_uniform = 4
```

```
P_scaling_uniform = [scaling_factor_uniform * P_scaling_x[0],  
scaling_factor_uniform * P_scaling_x[1]]
```

```
print("Transformation 3: Uniform Scaling by 4 units:  
{ }".format(P_scaling_uniform))
```

```
# Transformation 4: Reflection through the line  $y = x$ 
```

```
P_reflect_line = [P_scaling_uniform[1], P_scaling_uniform[0]]
```

```
print("Transformation 4: Reflection through the line  $y = x$ :  
{ }".format(P_reflect_line))
```

OUTPUT:

Original Point P: [2, 3]

Transformation 1: Rotation about origin through an angle of 60 degrees: [1, 3]

Transformation 2: Scaling in X-Coordinate by 7 units: [7, 3]

Transformation 3: Uniform Scaling by 4 units: [28, 12]

Transformation 4: Reflection through the line $y = x$: [12, 28]

Sahakar Maharshi Bhausaheb Santuji Thorat

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DEPARTMENT OF COMPUTER SCIENCE

MATHEMATICS

Name :- Prem Vijay Vajare

Batch No. :- D

Roll No:- 75 **Date:-** / /2023

Title of the:- Practical 7

Expt. No . 7

Class :- S.Y.BCS

Remark

Demonstrators

Signature

Date :- / /2023

Q.1) Plot the graph of $f(x) = x^{**4}$ in $[0, 5]$ with red dashed line with circle markers.

Syntax:

```
import numpy as np
```

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

```
# Define the function  $f(x) = x^{**4}$ 
```

```
def f(x):
```

```
    return x**4
```

```
# Generate x values in the interval  $[0, 5]$ 
```

```
x = np.linspace(0, 5, 100)
```

```
# Generate y values using the function  $f(x)$ 
```

```
y = f(x)
```

```
# Plot the graph with red dashed line and circle markers
```

```
plt.plot(x, y, 'r--o', markersize=6)
```

```
# Set x-axis label
```

```
plt.xlabel('x')
```

```
# Set y-axis label
```

```
plt.ylabel('f(x)')
```

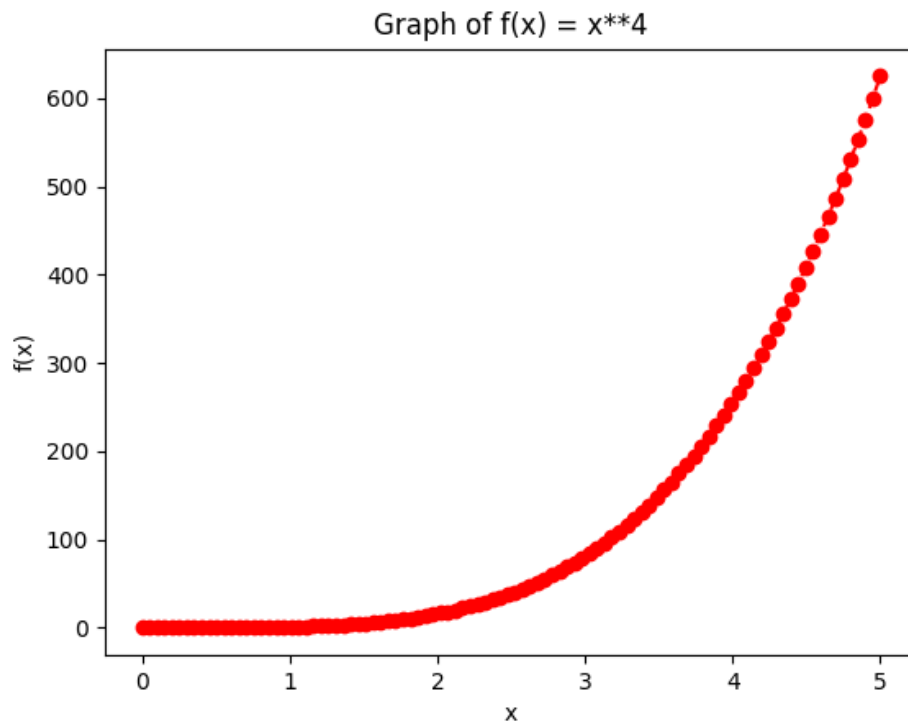
```
# Set title
```

```
plt.title('Graph of  $f(x) = x^{**4}$ ')
```

```
# Show the plot
```

```
plt.show()
```

OUTPUT:



Q.2) Using python, generate 3D surface Plot for the function $f(x, y) = \sin(x^2 + y^2)$ in the interval $[0,10]$

Syntax:

```
import numpy as np
```

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

```
from mpl_toolkits.mplot3d import Axes3D
```

```
# Generate x and y values in the interval [0,10]
```

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

```
y = np.linspace(0, 10, 100)
```

```
# Create a grid of x and y values
```

```
X, Y = np.meshgrid(x, y)
```

```
# Compute z values using the function  $f(x, y) = \sin(x^2 + y^2)$ 
```

```
Z = np.sin(X**2 + Y**2)
```

```
# Create a 3D plot
```

```
fig = plt.figure()
```

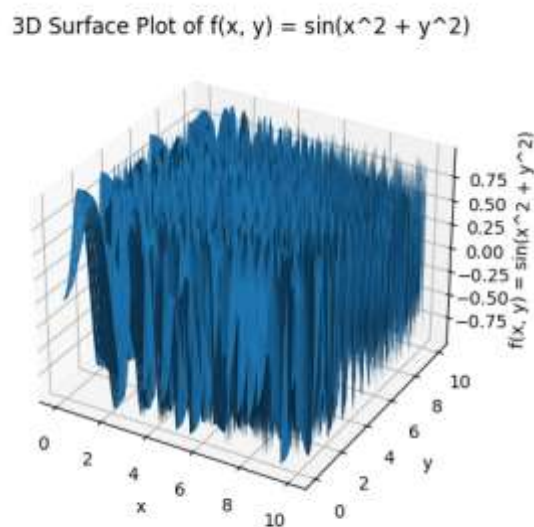
```
ax = fig.add_subplot(111, projection='3d')
```

```

ax.plot_surface(X, Y, Z)
# Set labels and title
ax.set_xlabel('x')
ax.set_ylabel('y')
ax.set_zlabel('f(x, y) = sin(x^2 + y^2)')
ax.set_title('3D Surface Plot of f(x, y) = sin(x^2 + y^2)')
# Show the plot
plt.show()

```

OUTPUT:



Q.3) Write python program to draw rectangle with vertices [1, 0], [2, 1], [1, 2] and [0, 1], its rotation.

Syntax:

```

import matplotlib.pyplot as plt
import numpy as np
# Define the rectangle vertices
vertices = np.array([[1, 0], [2, 1], [1, 2], [0, 1], [1, 0]])
# Extract x and y coordinates of the vertices
x = vertices[:, 0]
y = vertices[:, 1]

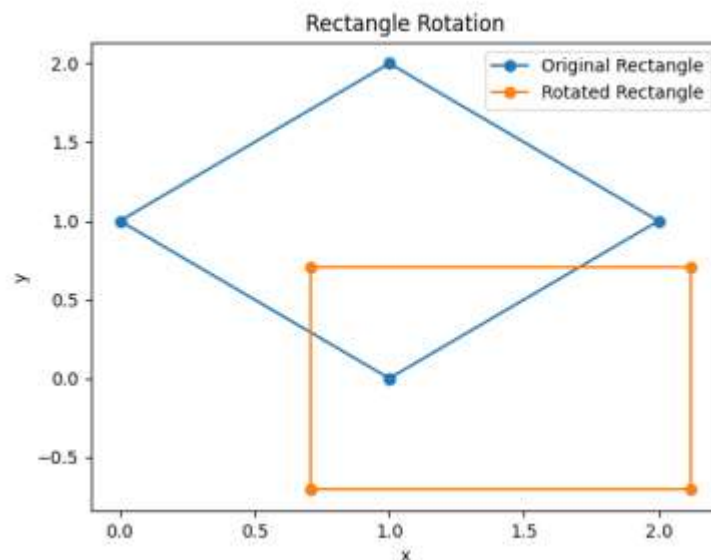
```

```

# Plot the rectangle
plt.plot(x, y, '-o', label='Original Rectangle')
# Calculate the rotation angle in radians
theta = np.radians(45)
# Rotate the rectangle vertices
rotation_matrix = np.array([[np.cos(theta), -np.sin(theta)],
                             [np.sin(theta), np.cos(theta)]])
rotated_vertices = np.dot(vertices, rotation_matrix)
# Extract x and y coordinates of the rotated vertices
rotated_x = rotated_vertices[:, 0]
rotated_y = rotated_vertices[:, 1]
# Plot the rotated rectangle
plt.plot(rotated_x, rotated_y, '-o', label='Rotated Rectangle')
# Set x-axis label
plt.xlabel('x')
# Set y-axis label
plt.ylabel('y')
# Set title
plt.title('Rectangle Rotation')
# Add legend
plt.legend()
# Show the plot
plt.show()

```

OUTPUT:

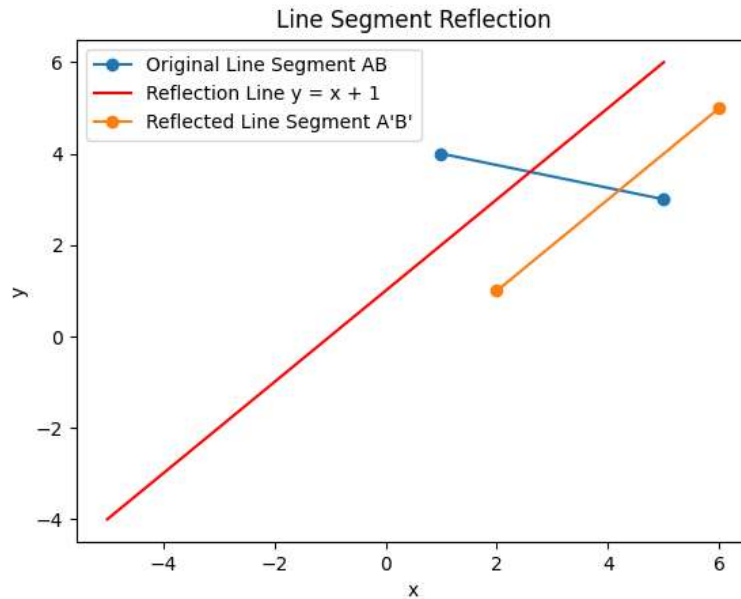


Q.4) Write a Python program to reflect the line segment joining the points A[5, 3] & B[1, 4] through the line $y = x + 1$.

Syntax:

```
import matplotlib.pyplot as plt
import numpy as np
# Define the points A and B
A = np.array([5, 3])
B = np.array([1, 4])
# Define the equation of the reflection line
reflection_line = lambda x: x + 1
# Plot the original line segment AB
plt.plot([A[0], B[0]], [A[1], B[1]], '-o', label='Original Line Segment AB')
# Plot the reflection line
x_vals = np.linspace(-5, 5, 100) # Generate x values for the plot
plt.plot(x_vals, reflection_line(x_vals), '-r', label='Reflection Line y = x + 1')
# Calculate the reflected points
reflected_A = np.array([reflection_line(A[0]), A[0]])
reflected_B = np.array([reflection_line(B[0]), B[0]])
# Plot the reflected line segment A'B'
plt.plot([reflected_A[0], reflected_B[0]], [reflected_A[1], reflected_B[1]], '-o',
label='Reflected Line Segment A\'B\'')
# Set x-axis label
plt.xlabel('x')
# Set y-axis label
plt.ylabel('y')
# Set title
plt.title('Line Segment Reflection')
# Add legend
plt.legend()
# Show the plot
plt.show()
```

Output:



Q.5) Using sympy declare the points P(5, 2), Q(5, -2), R(5, 0), check whether these points are collinear. Declare the ray passing through the points P and Q, find the length of this ray between P and Q. Also find slope of this ray.

Syntax:

```
from sympy import Point, Line
# Define the points P, Q, and R
P = Point(5, 2)
Q = Point(5, -2)
R = Point(5, 0)
# Check if points P, Q, and R are collinear
line_PQ = Line(P, Q)
line_PR = Line(P, R)
collinear = line_PQ.is_parallel(line_PR)
# Print the result
if collinear:
    print("Points P, Q, and R are collinear")
else:
    print("Points P, Q, and R are not collinear")
```

```

# Calculate the length of the ray PQ
length_PQ = P.distance(Q)
# Calculate the slope of the ray PQ
slope_PQ = (Q.y - P.y) / (Q.x - P.x)
# Print the length and slope of the ray PQ
print("Length of the ray PQ:", length_PQ)
print("Slope of the ray PQ:", slope_PQ)

```

OUTPUT:

```

Points P, Q, and R are collinear
Length of the ray PQ: 4
Slope of the ray PQ: zoo

```

Q.6) Write a Python program in 3D to rotate the point (1, 0, 0) through X Plane in anticlockwise direction (Rotation through Z axis) by an angle of 90°.

```

import numpy as np
import matplotlib.pyplot as plt
from mpl_toolkits.mplot3d import Axes3D
# Define the point to be rotated
point = np.array([1, 0, 0])
# Define the rotation angle in degrees
angle = np.radians(90)
# Define the rotation matrix for rotating around the Z axis
rotation_matrix = np.array([[np.cos(angle), -np.sin(angle), 0],
                             [np.sin(angle), np.cos(angle), 0],
                             [0, 0, 1]])
# Perform the rotation
rotated_point = np.dot(rotation_matrix, point)
# Create a 3D plot
fig = plt.figure()

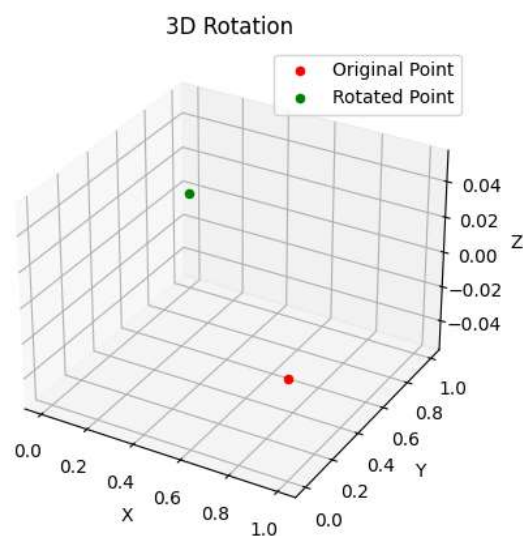
```

```

ax = fig.add_subplot(111, projection='3d')
# Plot the original point
ax.scatter(point[0], point[1], point[2], c='r', marker='o', label='Original Point')
# Plot the rotated point
ax.scatter(rotated_point[0], rotated_point[1], rotated_point[2], c='g', marker='o',
label='Rotated Point')
# Set the axes labels
ax.set_xlabel('X')
ax.set_ylabel('Y')
ax.set_zlabel('Z')
# Set the plot title
ax.set_title('3D Rotation')
# Set the plot legend
ax.legend()
# Show the plot
plt.show()

```

OUTPUT:



Q.7) write a Python program to solve the following LPP

$$\text{Max } Z = 3.5x + 2y$$

Subjected to

$$x + y \geq 5$$

$$x \geq 4$$

$$y \leq 2$$

$$x > 0, y > 0$$

Syntax:

```
import numpy as np
```

```
from scipy.optimize import linprog
```

```
# Coefficients of the objective function
```

```
c = [-3.5, -2]
```

```
# Coefficients of the inequality constraints
```

```
A = [[-1, -1], [-1, 0], [0, 1]]
```

```
b = [-5, -4, 2]
```

```
# Bounds on the variables
```

```
x_bounds = (0, None)
```

```
y_bounds = (0, None)
```

```
# Solve the linear programming problem
```

```
result = linprog(c, A_ub=A, b_ub=b, bounds=[x_bounds, y_bounds])
```

```
if result.success:
```

```
    print("Optimal solution found:")
```

```
    print("x =", result.x[0])
```

```
    print("y =", result.x[1])
```

```
    print("Maximum value of Z =", -result.fun)
```

```
else:
```

```
    print("Optimal solution not found.")
```

OUTPUT:

Optimal solution not found.

Q.8) Write a python program to display the following LPP by using pulp module and simplex method. Find its optimal solution if exist.

$$\begin{aligned} \text{Min } Z &= x + 2y + z \\ \text{subject to} \\ x + 2y + 2x &\leq 1 \\ 3x + 2y + z &\geq 8 \\ x + y &\leq 11 \\ x \geq 0, y \geq 0, z &\geq 0 \end{aligned}$$

Syntax:

```
from pulp import *
# Create a minimization problem
prob = LpProblem("LP Problem", LpMinimize)
# Define decision variables
x = LpVariable("x", lowBound=0)
y = LpVariable("y", lowBound=0)
z = LpVariable("z", lowBound=0)
# Objective function
prob += x + 2 * y + z, "Z"
# Constraints
prob += x + 2 * y + 2 * x <= 1, "constraint1"
prob += 3 * x + 2 * y + z >= 8, "constraint2"
prob += x + y <= 11, "constraint3"
# Solve the problem using the simplex method
prob.solve(PULP_CBC_CMD())
# Print the results
print("Status:", LpStatus[prob.status])
if prob.status == LpStatusOptimal:
    print("Optimal Solution:")
    print("x =", value(x))
    print("y =", value(y))
    print("z =", value(z))
    print("Optimal Objective Value (Z) =", value(prob.objective))
```

OUTPUT:

Status: Optimal

Optimal Solution:

x = 0.33333333

y = 0.0

z = 7.0

Optimal Objective Value (Z) = 7.33333333

Q.9) Apply Python. Program in each of the following transformation on the point P[4,-2]

(I) Reflection through y-axis.

(II) Scaling in X-coordinate by factor 3.

(III) Rotation about origin through an angle π

(IV) Shearing in both X and Y Direction by -2 and 4 unit Respectively.

Syntax:

```
import numpy as np
# Point P
P = np.array([4, -2])
# (I) Reflection through y-axis
reflection_y_axis = np.array([-1, 1]) # Reflection matrix through y-axis
P_reflected_y_axis = np.dot(reflection_y_axis, P)
print("Reflection through y-axis:", P_reflected_y_axis)
# (II) Scaling in X-coordinate by factor 3
scaling_x = np.array([3, 1]) # Scaling matrix in X-coordinate by factor 3
P_scaled_x = np.dot(scaling_x, P)
print("Scaling in X-coordinate by factor 3:", P_scaled_x)
# (III) Rotation about origin through an angle pi
angle_pi = np.pi # Angle in radians
rotation_pi = np.array([[np.cos(angle_pi), -np.sin(angle_pi)],
                        [np.sin(angle_pi), np.cos(angle_pi)]]) # Rotation matrix about
origin by angle pi
P_rotated_pi = np.dot(rotation_pi, P)
print("Rotation about origin through angle pi:", P_rotated_pi)
# (IV) Shearing in both X and Y Direction by -2 and 4 units respectively
shear_x = np.array([1, -2]) # Shearing matrix in X-direction by -2 units
shear_y = np.array([4, 1]) # Shearing matrix in Y-direction by 4 units
P_sheared = np.dot(shear_x, P) + np.dot(shear_y, P)
print("Shearing in both X and Y Direction by -2 and 4 units respectively:",
P_sheared)
```

OUTPUT:

Reflection through y-axis: -6

Scaling in X-coordinate by factor 3: 10

Rotation about origin through angle pi: [-4. 2.]

Shearing in both X and Y Direction by -2 and 4 units respectively: 22

Q.10) Find the combined transformation of line segment between the points A[4,-1] & B[3,2] by using Python program for the following sequence of transformation:-

- (I) Rotation about origin through an angle $\pi/4$.
- (II) Shearing in Y direction by 7 units.
- (III) Scaling in X – direction by 5 units
- (IV) Reflection through y – axis

Syntax:

```
import numpy as np
# Points A and B
A = np.array([4, -1])
B = np.array([3, 2])
# (I) Rotation about origin through an angle pi/4
angle_pi_4 = np.pi / 4 # Angle in radians
rotation_pi_4 = np.array([[np.cos(angle_pi_4), -np.sin(angle_pi_4)],
                          [np.sin(angle_pi_4), np.cos(angle_pi_4)]]) # Rotation matrix about origin by
angle pi/4
A_rotated = np.dot(rotation_pi_4, A)
B_rotated = np.dot(rotation_pi_4, B)
# (II) Shearing in Y direction by 7 units
shear_y_7 = np.array([0, 7]) # Shearing matrix in Y-direction by 7 units
A_sheared = A_rotated + np.dot(shear_y_7, A_rotated)
B_sheared = B_rotated + np.dot(shear_y_7, B_rotated)
# (III) Scaling in X direction by 5 units
scaling_x_5 = np.array([5, 1]) # Scaling matrix in X-direction by 5 units
A_scaled_x = np.dot(scaling_x_5, A_sheared)
B_scaled_x = np.dot(scaling_x_5, B_sheared)
# (IV) Reflection through y-axis
reflection_y_axis = np.array([-1, 1]) # Reflection matrix through y-axis
A_reflected_y_axis = np.dot(reflection_y_axis, A_scaled_x)
B_reflected_y_axis = np.dot(reflection_y_axis, B_scaled_x)
print("Line segment after applying the sequence of transformations:")
print("A:", A_reflected_y_axis)
print("B:", B_reflected_y_axis)
```

OUTPUT:

Line segment after applying the sequence of transformations:

A: [-108.8944443 108.8944443]

B: [-155.56349186 155.56349186]

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College Sangamner

DEPARTMENT OF COMPUTER SCIENCE

MATHEMATICS

Name :- Prem Vijay Vajare

Batch No. :- D

Roll No:- 75 **Date:-** / /2023

Title of the:- Practical 8

Expt. No . 8

Class :- S.Y.BCS

Remark

Demonstrators

Signature

Date :- / /2023

Q.1) Plot the graphs of $\sin x$, $\cos x$, e^{**x} and x^{**2} in $[0, 5]$ in one figure with (2 x 2) subplot

Syntax:

```
import numpy as np
```

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

```
# Generate x values
```

```
x = np.linspace(0, 5, 500)
```

```
# Compute y values for sin(x), cos(x), e**x, x**2
```

```
y1 = np.sin(x)
```

```
y2 = np.cos(x)
```

```
y3 = np.exp(x)
```

```
y4 = x**2
```

```
# Create subplots
```

```
fig, axs = plt.subplots(2, 2, figsize=(10, 8))
```

```
fig.suptitle('Graphs of sin(x), cos(x), e**x, and x**2')
```

```
# Plot sin(x)
```

```
axs[0, 0].plot(x, y1, label='sin(x)')
```

```
axs[0, 0].legend()
```

```
# Plot cos(x)
```

```
axs[0, 1].plot(x, y2, label='cos(x)')
```

```
axs[0, 1].legend()
```

```
# Plot e**x
```

```
axs[1, 0].plot(x, y3, label='e**x')
```

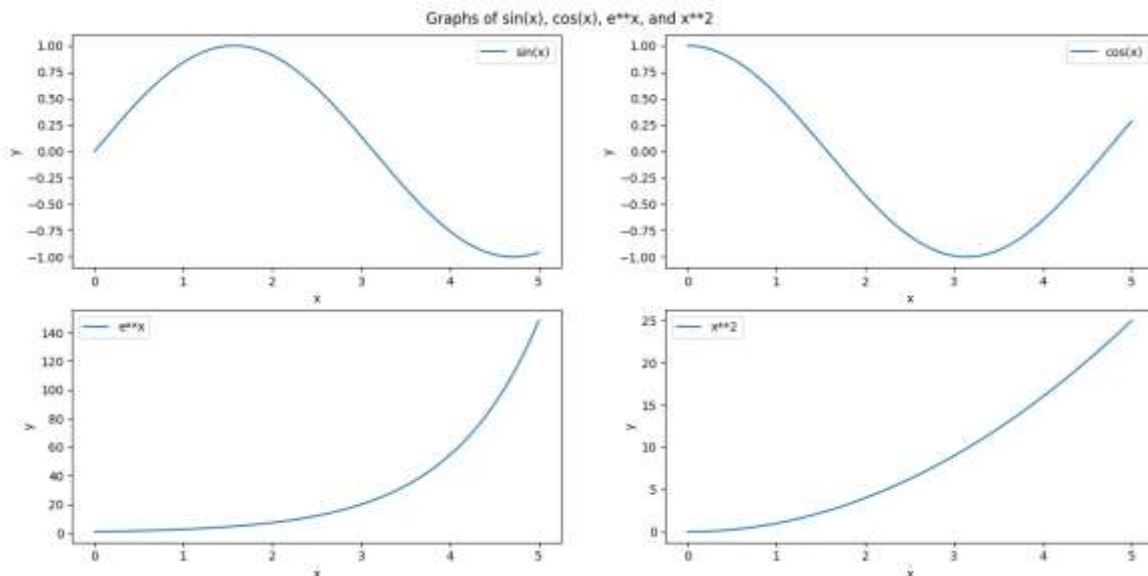
```
axs[1, 0].legend()
```

```

# Plot x**2
axs[1, 1].plot(x, y4, label='x**2')
axs[1, 1].legend()
# Set x and y axis labels for all subplots
for ax in axs.flat:
    ax.set_xlabel('x')
    ax.set_ylabel('y')
# Adjust spacing between subplots
fig.tight_layout()
# Show the plot
plt.show()

```

OUTPUT:



Q.2) Using Python plot the graph of function $f(x) = \cos(x)$ in the interval $[0, 2*\pi]$.

Syntax:

```

import numpy as np
import matplotlib.pyplot as plt
# Generate x values
x = np.linspace(0, 2*np.pi, 500)
# Compute y values for cos(x)

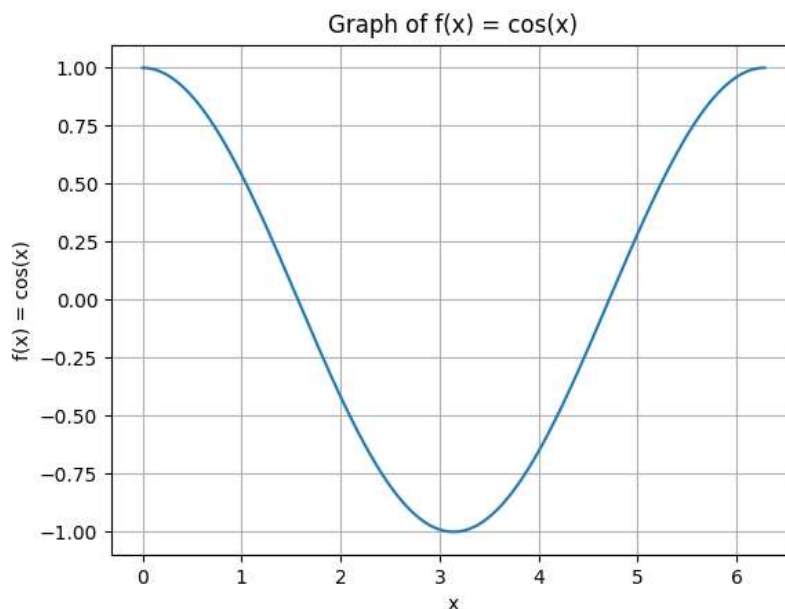
```

```

y = np.cos(x)
# Plot f(x) = cos(x)
plt.plot(x, y)
plt.xlabel('x')
plt.ylabel('f(x) = cos(x)')
plt.title('Graph of f(x) = cos(x)')
plt.grid(True)
plt.show()

```

OUTPUT:



Q.3) Write a Python program to generate 3D plot of the functions $z = \sin x + \cos y$ in $-10 < x, y < 10$.

Syntax:

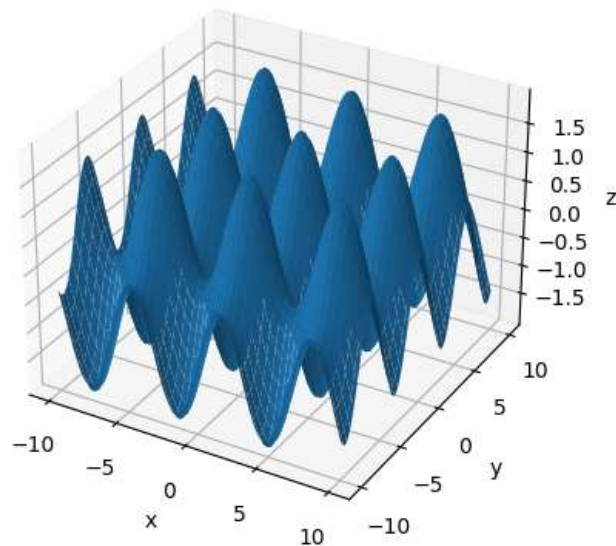
```

import numpy as np
import matplotlib.pyplot as plt
from mpl_toolkits.mplot3d import Axes3D
# Generate x and y values
x = np.linspace(-10, 10, 100)
y = np.linspace(-10, 10, 100)

```

```
# Create a meshgrid of x and y values
X, Y = np.meshgrid(x, y)
# Compute z values for the function z = sin(x) + cos(y)
Z = np.sin(X) + np.cos(Y)
# Create a 3D plot
fig = plt.figure()
ax = fig.add_subplot(111, projection='3d')
ax.plot_surface(X, Y, Z)
ax.set_xlabel('x')
ax.set_ylabel('y')
ax.set_zlabel('z')
ax.set_title('3D Plot of z = sin(x) + cos(y)')
plt.show()
OUTPUT:
```

3D Plot of $z = \sin(x) + \cos(y)$



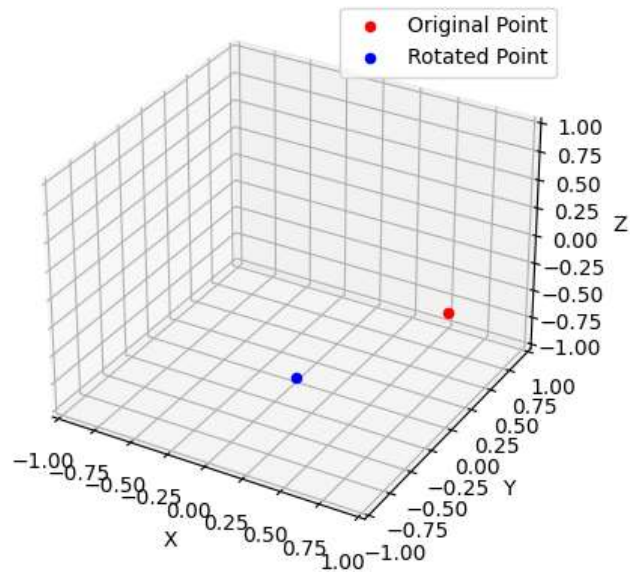
Q.4) Write a Python program in 3D to rotate the point (1, 0, 0) through XZ Plane in anticlockwise direction (Rotation through Y axis) by an angle of 90°.

Syntax:

```
import numpy as np
import matplotlib.pyplot as plt
from mpl_toolkits.mplot3d import Axes3D
# Point to rotate
point = np.array([1, 0, 0])
# Rotation angle in radians
angle = np.deg2rad(90)
# Rotation matrix for Y axis (anticlockwise)
rotation_matrix = np.array([
    [np.cos(angle), 0, np.sin(angle)],
    [0, 1, 0],
    [-np.sin(angle), 0, np.cos(angle)]
])
# Apply rotation
rotated_point = np.dot(rotation_matrix, point)
# Create 3D plot
fig = plt.figure()
ax = fig.add_subplot(111, projection='3d')
# Plot original point
ax.scatter(point[0], point[1], point[2], c='r', marker='o', label='Original Point')
# Plot rotated point
ax.scatter(rotated_point[0], rotated_point[1], rotated_point[2], c='b', marker='o',
label='Rotated Point')
# Set plot limits
ax.set_xlim([-1, 1])
ax.set_ylim([-1, 1])
ax.set_zlim([-1, 1])
# Set plot labels
ax.set_xlabel('X')
ax.set_ylabel('Y')
ax.set_zlabel('Z')
# Add legend
ax.legend()
```

```
# Show the plot  
plt.show()
```

Output:

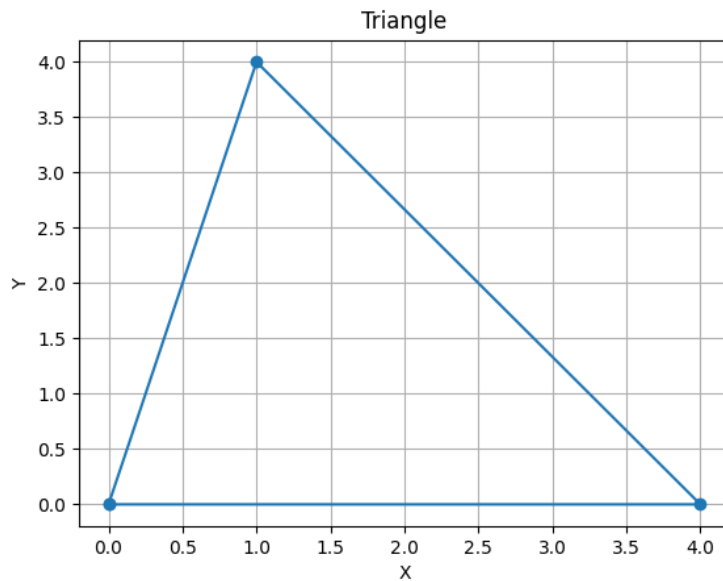


Q.5) Using python, generate triangle with vertices (0, 0), (4, 0), (1, 4), check whether the triangle is Scalene triangle.

Syntax:

```
import matplotlib.pyplot as plt  
# Vertices of the triangle  
vertex1 = (0, 0)  
vertex2 = (4, 0)  
vertex3 = (1, 4)  
# Plot the triangle  
plt.plot(*zip(vertex1, vertex2, vertex3, vertex1), marker='o')  
plt.xlabel('X')  
plt.ylabel('Y')  
plt.title("Triangle")  
plt.grid(True)  
plt.show()
```

OUTPUT:



Q.6) Write a Python program to find the area and perimeter of the ABC, where A[0, 0] B[6, 0], C[4,4].

Syntax:

```
import numpy as np
# Define the vertices of the triangle
A = np.array([0, 0])
B = np.array([6, 0])
C = np.array([4, 4])
# Calculate the side lengths of the triangle
AB = np.linalg.norm(B - A)
BC = np.linalg.norm(C - B)
CA = np.linalg.norm(A - C)
# Calculate the semiperimeter
s = (AB + BC + CA) / 2
# Calculate the area using Heron's formula
area = np.sqrt(s * (s - AB) * (s - BC) * (s - CA))
# Calculate the perimeter
perimeter = AB + BC + CA
```

```
# Print the results
print("Triangle ABC:")
print("Side AB:", AB)
print("Side BC:", BC)
print("Side CA:", CA)
print("Area:", area)
print("Perimeter:", perimeter)
```

OUTPUT:

```
Triangle ABC:
Side AB: 6.0
Side BC: 4.47213595499958
Side CA: 5.656854249492381
Area: 11.999999999999998
Perimeter: 16.12899020449196
```

Q.7) write a Python program to solve the following LPP

$$\text{Max } Z = 150x + 75y$$

Subjected to

$$4x + 6y \leq 24$$

$$5x + 3y \leq 15$$

$$x > 0, y > 0$$

Syntax:

```
from pulp import *
```

```
# Create the LP problem as a maximization problem
```

```
problem = LpProblem("LPP", LpMaximize)
```

```
# Define the decision variables
```

```
x = LpVariable('x', lowBound=0, cat='Continuous')
```

```

y = LpVariable('y', lowBound=0, cat='Continuous')
# Define the objective function
problem += 150 * x + 75 * y, "Z"
# Define the constraints
problem += 4 * x + 6 * y <= 24, "Constraint1"
problem += 5 * x + 3 * y <= 15, "Constraint2"
# Solve the LP problem
problem.solve()
# Print the status of the solution
print("Status:", LpStatus[problem.status])
# Print the optimal values of x and y
print("Optimal x =", value(x))
print("Optimal y =", value(y))
# Print the optimal value of the objective function
print("Optimal Z =", value(problem.objective

```

OUTPUT:

Status: Optimal

Optimal x = 3.0

Optimal y = 0.0

Optimal Z = 450.0

Q.8) Write a python program to display the following LPP by using pulp module and simplex method. Find its optimal solution if exist.

$$\text{Min } Z = 3x + 5y + 4z$$

subject to

$$2x + 3y \leq 8$$

$$2y + 5z \leq 10$$

$$3x + 2y + 5z \leq 15$$

$$x \geq 0, y \geq 0$$

Syntax:

from pulp import *

```

# Create a PuLP minimization problem
prob = LpProblem("LPP", LpMinimize)
# Define decision variables
x = LpVariable("x", lowBound=0)
y = LpVariable("y", lowBound=0)
z = LpVariable("z", lowBound=0)
# Define objective function
prob += 3*x + 5*y + 4*z, "Z"
# Define constraints
prob += 2*x + 3*y <= 8, "Constraint1"
prob += 2*y + 5*z <= 10, "Constraint2"
prob += 3*x + 2*y + 5*z <= 15, "Constraint3"
# Solve the problem
prob.solve()
# Print the status of the solution
print("Status:", LpStatus[prob.status])
# If the problem is solved, print the optimal solution and the optimal value of Z
if prob.status == LpStatusOptimal:
    print("Optimal Solution:")
    print("x =", value(x))
    print("y =", value(y))
    print("z =", value(z))
    print("Z =", value(prob.objective))

```

OUTPUT:

Status: Optimal

Optimal Solution:

x = 0.0

y = 0.0

z = 0.0

Z = 0.0

Q.9) Apply Python. Program in each of the following transformation on the point P[4,-2]

(I) Reflection through Y-axis.

(II) Scaling in X-co-ordinate by factor 5.

(III) Rotation about origin through an angle $\pi/2$.

(IV) Shearing in X direction by $7/2$ units

Syntax:

```
import numpy as np
```

```
# Initial point P
```

```

P = np.array([4, -2])
# (I) Reflection through Y-axis
P_reflect_y = np.array([-P[0], P[1]])
# (II) Scaling in X-coordinate by factor 5
P_scale_x = np.array([5 * P[0], P[1]])
# (III) Rotation about origin through an angle pi/2
angle = np.pi / 2
P_rotate = np.array([P[0] * np.cos(angle) - P[1] * np.sin(angle), P[0] *
np.sin(angle) + P[1] * np.cos(angle)])
# (IV) Shearing in X-direction by 7/2 units
shearing_factor = 7 / 2
P_shear_x = np.array([P[0] + shearing_factor * P[1], P[1]])
# Print the transformed points
print("Initial point P:", P)
print("Reflection through Y-axis:", P_reflect_y)
print("Scaling in X-coordinate by factor 5:", P_scale_x)
print("Rotation about origin through an angle pi/2:", P_rotate)
print("Shearing in X-direction by 7/2 units:", P_shear_x)

```

OUTPUT:

Initial point P: [4 -2]

Reflection through Y-axis: [-4 -2]

Scaling in X-coordinate by factor 5: [20 -2]

Rotation about origin through an angle pi/2: [2. 4.]

Shearing in X-direction by 7/2 units: [-3. -2.]

Q.10) Find the combined transformation of the line segment between the point A[7, -2] & B[6, 2] by using Python program for the following sequence of transformation:-

(I) Rotation about origin through an angle $\pi/3$.

(II) Scaling in X-Coordinate by 7 units.

(III) Uniform scaling by -4 units

(IV) Reflection through the line X - axis

Syntax:

```

import numpy as np
# Define the point P
P = np.array([4, -2])
# Define the transformation functions
def rotate_about_origin(point, angle):
    # Rotation about origin through an angle
    cos_theta = np.cos(angle)
    sin_theta = np.sin(angle)

```

```

x = point[0]
y = point[1]
x_rotated = x * cos_theta - y * sin_theta
y_rotated = x * sin_theta + y * cos_theta
return np.array([x_rotated, y_rotated])
def scale_x(point, factor):
    # Scaling in X-coordinate
    x_scaled = point[0] * factor
    y_scaled = point[1]
    return np.array([x_scaled, y_scaled])
def uniform_scale(point, factor):
    # Uniform scaling
    x_scaled = point[0] * factor
    y_scaled = point[1] * factor
    return np.array([x_scaled, y_scaled])
def reflect_x_axis(point):
    # Reflection through X-axis
    x_reflected = point[0]
    y_reflected = -point[1]
    return np.array([x_reflected, y_reflected])
# Apply the transformations to the point P
angle = np.pi / 3
P_rotated = rotate_about_origin(P, angle)
P_scaled_x = scale_x(P_rotated, 7)
P_uniform_scaled = uniform_scale(P_scaled_x, -4)
P_reflected_x_axis = reflect_x_axis(P_uniform_scaled)
# Print the transformed points
print("Point P: ", P)
print("After Rotation: ", P_rotated)
print("After Scaling in X-Coordinate: ", P_scaled_x)
print("After Uniform Scaling: ", P_uniform_scaled)
print("After Reflection through X-axis: ", P_reflected_x_axis)
OUTPUT:
Point P: [ 4 -2]
After Rotation: [3.73205081 2.46410162]
After Scaling in X-Coordinate: [26.12435565 2.46410162]
After Uniform Scaling: [-104.49742261 -9.85640646]
After Reflection through X-axis: [-104.49742261 9.85640646]

```

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DEPARTMENT OF COMPUTER SCIENCE

MATHEMATICS

Name :- Prem Vijay Vajare

Batch No. :- D

Roll No:- 75 **Date:-** / /2023

Title of the:- Practical 9

Expt. No . 9

Class :- S.Y.BCS

Remark

Demonstrators

Signature

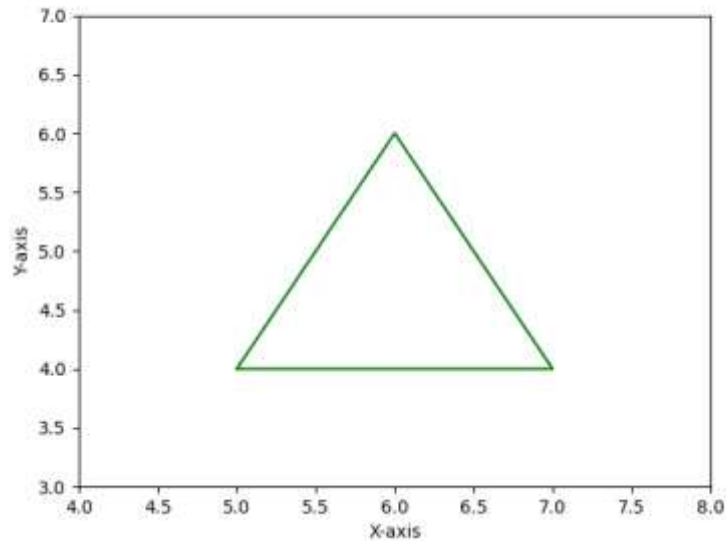
Date :- / /2023

Q.1) Write a python program to Plot 2D X-axis and Y-axis black color and in the same diagram plot green triangle with vertices [5,4],[7,4],[6,6]

Syntax:

```
import matplotlib.pyplot as plt
# Define the vertices of the triangle
triangle_vertices = [[5, 4], [7, 4], [6, 6]]
# Extract the x and y coordinates of the triangle vertices
x = [vertex[0] for vertex in triangle_vertices]
y = [vertex[1] for vertex in triangle_vertices]
# Plot the X-axis and Y-axis in black color
plt.axhline(0, color='black')
plt.axvline(0, color='black')
# Plot the triangle with green color
plt.plot(x + [x[0]], y + [y[0]], 'g')
# Set the plot limits and labels
plt.xlim(4, 8)
plt.ylim(3, 7)
plt.xlabel('X-axis')
plt.ylabel('Y-axis')
# Show the plot
plt.show()
```

OUTPUT:



Q.2) Write a program in python to rotate the point. through YZ-plane in anticlockwise direction. (Rotation through Y-axis by an angle of 90° .)

Syntax:

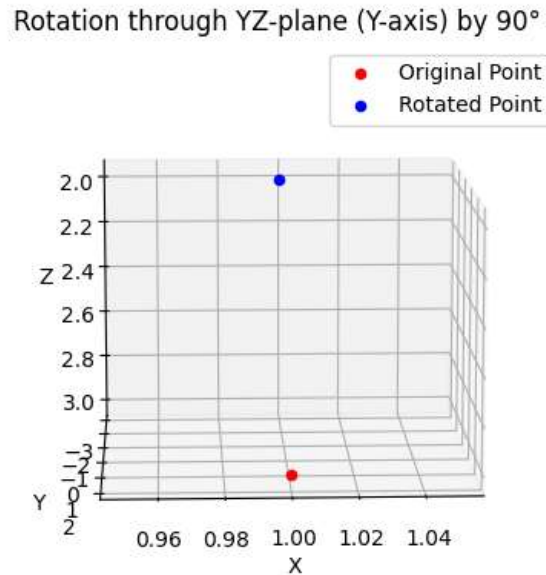
```
import math
import numpy as np
import matplotlib.pyplot as plt
from mpl_toolkits.mplot3d import Axes3D
# Function to rotate a point (x, y, z) through YZ-plane by an angle of  $90^\circ$ 
def rotate_yz_plane(point):
    x, y, z = point
    new_y = y * math.cos(math.radians(90)) - z * math.sin(math.radians(90))
    new_z = y * math.sin(math.radians(90)) + z * math.cos(math.radians(90))
    return [x, new_y, new_z]
# Point to rotate
point = [1, 2, 3]
# Call the rotation function
rotated_point = rotate_yz_plane(point)
# Original point coordinates
x_original, y_original, z_original = point
```

```

# Rotated point coordinates
x_rotated, y_rotated, z_rotated = rotated_point
# Create a 3D plot
fig = plt.figure()
ax = fig.add_subplot(111, projection='3d')
# Plot original point as a red dot
ax.scatter(x_original, y_original, z_original, color='red', label='Original Point')
# Plot rotated point as a blue dot
ax.scatter(x_rotated, y_rotated, z_rotated, color='blue', label='Rotated Point')
ax.set_xlabel('X')
ax.set_ylabel('Y')
ax.set_zlabel('Z')
ax.set_title('Rotation through YZ-plane (Y-axis) by 90°')
ax.legend()
plt.show()

```

OUTPUT:



Q.3) Using Python plot the graph of function $f(x) = \cos(x)$ on the interval $(0, 2*\pi)$.

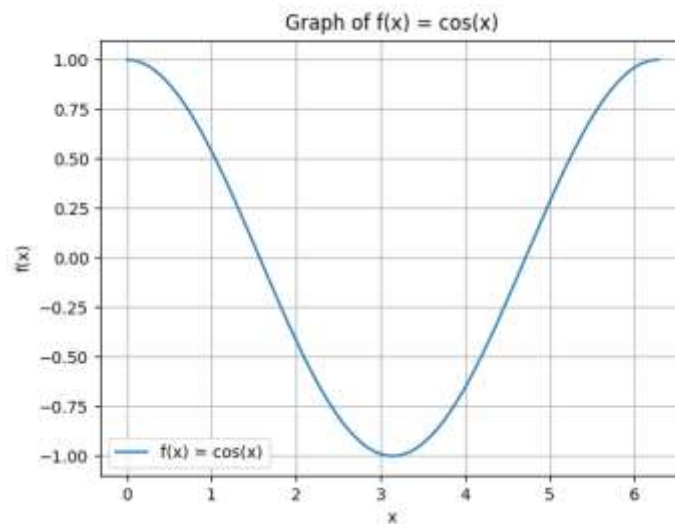
Syntax:

```

import numpy as np
import matplotlib.pyplot as plt
# Generate x values from 0 to 2*pi with a step of 0.01
x = np.arange(0, 2*np.pi, 0.01)
# Compute the corresponding y values for f(x) = cos(x)
y = np.cos(x)
# Create a plot
plt.plot(x, y, label='f(x) = cos(x)')
plt.xlabel('x')
plt.ylabel('f(x)')
plt.title('Graph of f(x) = cos(x)')
plt.legend()
plt.grid(True)
plt.show()

```

OUTPUT:



Q.4) Write a python program to rotate the ray by 90° having starting point (1,0) and (2,-1)

Syntax:

```

import numpy as np
import matplotlib.pyplot as plt
# Define the starting points of the ray
start_point_1 = np.array([1, 0])

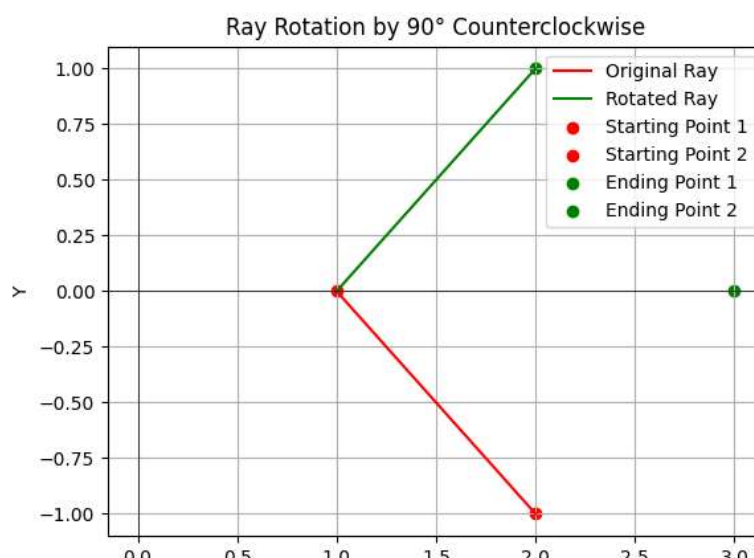
```

```

start_point_2 = np.array([2, -1])
# Compute the direction vector of the ray
direction_vector = start_point_2 - start_point_1
# Perform the rotation by 90° counterclockwise
rotation_matrix = np.array([[0, -1], [1, 0]])
rotated_direction_vector = np.dot(rotation_matrix, direction_vector)
# Compute the ending point of the rotated ray
end_point_1 = start_point_1 + rotated_direction_vector
end_point_2 = start_point_2 + rotated_direction_vector
# Plot the original and rotated rays
plt.plot([start_point_1[0], start_point_2[0]], [start_point_1[1], start_point_2[1]],
'r', label='Original Ray')
plt.plot([start_point_1[0], end_point_1[0]], [start_point_1[1], end_point_1[1]],
'g', label='Rotated Ray')
plt.scatter(start_point_1[0], start_point_1[1], c='r', marker='o', label='Starting Point 1')
plt.scatter(start_point_2[0], start_point_2[1], c='r', marker='o', label='Starting Point 2')
plt.scatter(end_point_1[0], end_point_1[1], c='g', marker='o', label='Ending Point 1')
plt.scatter(end_point_2[0], end_point_2[1], c='g', marker='o', label='Ending Point 2')
plt.axhline(0, color='k', linewidth=0.5)
plt.axvline(0, color='k', linewidth=0.5)
plt.xlabel('X')
plt.ylabel('Y')
plt.legend()
plt.title('Ray Rotation by 90° Counterclockwise')
plt.grid(True)
plt.show()

```

Output:



Q.5) Using sympy declare the points A(0, 7), B(5, 2). Declare the line segment passing through them. Find the length and midpoint of the line segment passing through points A and B.

Syntax:

```
from sympy import Point, Line
# Declare the points A and B
A = Point(0, 7)
B = Point(5, 2)
# Declare the line passing through points A and B
line_AB = Line(A, B)
# Calculate the length of the line segment AB
length_AB = A.distance(B)
# Calculate the midpoint of the line segment AB
midpoint_AB = ((A[0] + B[0]) / 2, (A[1] + B[1]) / 2)
# Print the results
print("Point A: {}".format(A))
print("Point B: {}".format(B))
print("Line segment AB: {}".format(line_AB))
print("Length of line segment AB: {}".format(length_AB))
print("Midpoint of line segment AB: {}".format(midpoint_AB))
```

OUTPUT:

```
Point A: Point2D(0, 7)
Point B: Point2D(5, 2)
Line segment AB: Line2D(Point2D(0, 7), Point2D(5, 2))
Length of line segment AB: 5*sqrt(2)
Midpoint of line segment AB: (5/2, 9/2)
```

Q.6) Write a Python program to find the area and perimeter of the ABC, where A[0, 0] B[5, 0], C[3,3].

Syntax:

```
import numpy as np
# Define the vertices of the triangle
A = np.array([0, 0])
```

```
B = np.array([5, 0])
C = np.array([3, 3])
# Calculate the side lengths of the triangle
AB = np.linalg.norm(B - A)
BC = np.linalg.norm(C - B)
CA = np.linalg.norm(A - C)
# Calculate the semiperimeter
s = (AB + BC + CA) / 2
# Calculate the area using Heron's formula
area = np.sqrt(s * (s - AB) * (s - BC) * (s - CA))
# Calculate the perimeter
perimeter = AB + BC + CA
# Print the results
print("Triangle ABC:")
print("Side AB:", AB)
print("Side BC:", BC)
print("Side CA:", CA)
print("Area:", area)
print("Perimeter:", perimeter)
```

OUTPUT:

Triangle ABC:

Side AB: 5.0

Side BC: 3.605551275463989

Side CA: 4.242640687119285

Area: 7.5000000000000036

Perimeter: 12.848191962583275

Q.7) write a Python program to solve the following LPP

$$\text{Max } Z = 150x + 75y$$

Subjected to

$$4x + 6y \leq 24$$

$$5x + 3y \leq 15$$

$$x > 0, y > 0$$

Syntax:

```
from pulp import *
# Create the LP problem as a maximization problem
problem = LpProblem("LPP", LpMaximize)
# Define the decision variables
x = LpVariable('x', lowBound=0, cat='Continuous')
y = LpVariable('y', lowBound=0, cat='Continuous')
# Define the objective function
problem += 150 * x + 75 * y, "Z"
# Define the constraints
problem += 4 * x + 6 * y <= 24, "Constraint1"
problem += 5 * x + 3 * y <= 15, "Constraint2"
# Solve the LP problem
problem.solve()
# Print the status of the solution
print("Status:", LpStatus[problem.status])
# Print the optimal values of x and y
print("Optimal x =", value(x))
print("Optimal y =", value(y))
# Print the optimal value of the objective function
print("Optimal Z =", value(problem.objective))
```

OUTPUT:

Status: Optimal

Optimal x = 3.0

Optimal y = 0.0

Optimal Z = 450.0

Q.8) Write a python program to display the following LPP by using pulp module and simplex method. Find its optimal solution if exist.

Min $Z = 4x + y + 3z + 5w$

subject to

$4x + 6y - 5z - 4w \geq 20$

$-3x - 2y + 2z + w \leq 10$

$-8x - 3y + 3z + 2w \leq 20$

$x \geq 0, y \geq 0, z \geq 0, w \geq 0$

Syntax:

```
from pulp import *
# Define the decision variables
x = LpVariable("x", lowBound=0)
y = LpVariable("y", lowBound=0)
z = LpVariable("z", lowBound=0)
w = LpVariable("w", lowBound=0)
# Define the objective function
objective = 4 * x + y + 3 * z + 5 * w
# Define the constraints
constraint1 = 4 * x + 6 * y - 5 * z - 4 * w >= 20
constraint2 = -3 * x - 2 * y + 2 * z + w <= 10
constraint3 = -8 * x - 3 * y + 3 * z + 2 * w <= 20
# Create the LP problem
problem = LpProblem("Linear_Programming_Problem", LpMinimize)
# Add the objective function and constraints to the problem
problem += objective
problem += constraint1
problem += constraint2
problem += constraint3
# Solve the LP problem
status = problem.solve()
# Check the status of the solution
if status == LpStatusOptimal:
```

```

# Get the optimal values of the decision variables
opt_x = value(x)
opt_y = value(y)
opt_z = value(z)
opt_w = value(w)
# Get the optimal value of the objective function
opt_z = value(objective)
# Print the optimal solution
print("Optimal Solution:")
print("x = {}".format(opt_x))
print("y = {}".format(opt_y))
print("z = {}".format(opt_z))
print("w = {}".format(opt_w))
print("Optimal value of the objective function: {}".format(opt_z))
else:
    print("No optimal solution found.")

```

OUTPUT:

Optimal Solution:

x = 0.0

y = 3.3333333

z = 3.3333333

w = 0.0

Optimal value of the objective function: 3.3333333

Q.9) Apply Python. Program in each of the following transformation on the point P[-2,4]

(I) Shearing in Y direction by 7 units.

(II) Scaling in X and Y direction by 7/2 and 7 unit respectively.

(III) Shearing in X and Y direction by 4 and 7 unit respectively.

(IV) Rotation about origin by an angle 60°

Syntax:

```
import numpy as np
```

```
# Define the original point P
```

```
P = np.array([-2, 4])
```

```
# Transformation 1: Shearing in Y direction by 7 units
```

```
shearing_Y = np.array([[1, 0], [7, 1]])
```

```
P_transformed1 = np.dot(shearing_Y, P)
```

```
# Transformation 2: Scaling in X and Y direction by 7/2 and 7 units respectively
```

```
scaling_XY = np.array([[7/2, 0], [0, 7]])
```

```
P_transformed2 = np.dot(scaling_XY, P)
```

```

# Transformation 3: Shearing in X and Y direction by 4 and 7 units respectively
shearing_XY = np.array([[1, 4], [7, 1]])
P_transformed3 = np.dot(shearing_XY, P)
# Transformation 4: Rotation about origin by an angle of 60 degrees
angle = np.radians(60)
rotation = np.array([[np.cos(angle), -np.sin(angle)], [np.sin(angle),
np.cos(angle)]])
P_transformed4 = np.dot(rotation, P)
# Print the transformed points
print("Original Point P: {}".format(P))
print("Transformation 1: Shearing in Y direction by 7 units:
{}".format(P_transformed1))
print("Transformation 2: Scaling in X and Y direction by 7/2 and 7 units
respectively: {}".format(P_transformed2))
print("Transformation 3: Shearing in X and Y direction by 4 and 7 units
respectively: {}".format(P_transformed3))
print("Transformation 4: Rotation about origin by an angle of 60 degrees:
{}".format(P_transformed4))

```

OUTPUT:

Original Point P: [-2 4]

Transformation 1: Shearing in Y direction by 7 units: [-2 -10]

Transformation 2: Scaling in X and Y direction by 7/2 and 7 units respectively:
[-7. 28.]

Transformation 3: Shearing in X and Y direction by 4 and 7 units respectively: [14 -10]

Transformation 4: Rotation about origin by an angle of 60 degrees: [-4.46410162 0.26794919]

Q.10) Find the combined transformation of the line segment between the point A[5,3] & B[1, 4] by using Python program for the following sequence of transformation:-

- (I) Rotate about origin through an angle $\pi/3$.
- (II) Uniform scaling by .5 units
- (III) scaling in Y – axis by 5 units
- (IV) Shearing in X and Y direction by 3 and 4 nits respectively.

Syntax:

```

import numpy as np
# Define the original points A and B

```

```

A = np.array([5, 3])
B = np.array([1, 4])
# Transformation 1: Rotate about origin through an angle of pi/3
angle = np.pi / 3
rotation = np.array([[np.cos(angle), -np.sin(angle)], [np.sin(angle),
np.cos(angle)]])
A_transformed1 = np.dot(rotation, A)
B_transformed1 = np.dot(rotation, B)
# Transformation 2: Uniform scaling by -0.5 units
scaling_uniform = np.array([[ -0.5, 0], [0, -0.5]])
A_transformed2 = np.dot(scaling_uniform, A_transformed1)
B_transformed2 = np.dot(scaling_uniform, B_transformed1)
# Transformation 3: Scaling in Y-axis by 5 units
scaling_Y = np.array([[1, 0], [0, 5]])
A_transformed3 = np.dot(scaling_Y, A_transformed2)
B_transformed3 = np.dot(scaling_Y, B_transformed2)
# Transformation 4: Shearing in X and Y direction by 3 and 4 units respectively
shearing_XY = np.array([[1, 3], [4, 1]])
A_transformed4 = np.dot(shearing_XY, A_transformed3)
B_transformed4 = np.dot(shearing_XY, B_transformed3)
# Print the transformed points
print("Original Point A: {}".format(A))
print("Original Point B: {}".format(B))
print("Transformation 1: Rotate about origin through an angle of pi/3")
print("A_transformed1: {}".format(A_transformed1))
print("B_transformed1: {}".format(B_transformed1))
print("Transformation 2: Uniform scaling by -0.5 units")
print("A_transformed2: {}".format(A_transformed2))
print("B_transformed2: {}".format(B_transformed2))
print("Transformation 3: Scaling in Y-axis by 5 units")
print("A_transformed3: {}".format(A_transformed3))
print("B_transformed3: {}".format(B_transformed3))
print("Transformation 4: Shearing in X and Y direction by 3 and 4 units
respectively")
print("A_transformed4: {}".format(A_transformed4))
print("B_transformed4: {}".format(B_transformed4))

```

OUTPUT:

Original Point P: [-2 4]

Transformation 1: Shearing in Y direction by 7 units: [-2 -10]

Transformation 2: Scaling in X and Y direction by $7/2$ and 7 units respectively:
[-7. 28.]

Transformation 3: Shearing in X and Y direction by 4 and 7 units respectively: [14 -10]

Transformation 4: Rotation about origin by an angle of 60 degrees: [-4.46410162 0.26794919]

```
PS E:\Python 2nd Sem Practical> python -u "e:\Python 2nd Sem Practical\tempCodeRunnerFile.py"
```

Original Point A: [5 3]

Original Point B: [1 4]

Transformation 1: Rotate about origin through an angle of $\pi/3$

A_transformed1: [-0.09807621 5.83012702]

B_transformed1: [-2.96410162 2.8660254]

Transformation 2: Uniform scaling by -0.5 units

A_transformed2: [0.04903811 -2.91506351]

B_transformed2: [1.48205081 -1.4330127]

Transformation 3: Scaling in Y-axis by 5 units

A_transformed3: [0.04903811 -14.57531755]

B_transformed3: [1.48205081 -7.16506351]

Transformation 4: Shearing in X and Y direction by 3 and 4 units respectively

A_transformed4: [-43.67691454 -14.37916512]

B_transformed4: [-20.01313972 -1.23686028]

Sahakar Maharshi Bhausaheb Santuji Thorat

College Sangamner

DEPARTMENT OF COMPUTER SCIENCE

MATHEMATICS

Name :- Prem Vijay Vajare

Batch No. :- D

Roll No:- 75 **Date:-** / /2023

Title of the:- Practical 10

Expt. No . 10

Class :- S.Y.BCS

Remark

Demonstrators

Signature

Date :- / /2023

Q.1) Write a python in 3D to rotate the point (1,0,0) through XY plane in Clockwise direction (Rotation Through Z – Axis by an angle of 90^0)

Syntax:

```
import numpy as np
```

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

```
from mpl_toolkits.mplot3d import Axes3D
```

```
# Define the original point
```

```
point = np.array([1, 0, 0])
```

```
# Define the rotation matrix for rotation through Z-axis by 90 degrees (clockwise)
```

```
angle = np.radians(90)
```

```
rotation_matrix = np.array([[np.cos(angle), -np.sin(angle), 0],
```

```
                          [np.sin(angle), np.cos(angle), 0],
```

```
                          [0, 0, 1]])
```

```
# Apply the rotation to the point
```

```
point_rotated = np.dot(rotation_matrix, point)
```

```
# Create a 3D plot
```

```
fig = plt.figure()
```

```
ax = fig.add_subplot(111, projection='3d')
```

```
# Plot the original point
```

```
ax.scatter(point[0], point[1], point[2], color='red', label='Original Point')
```

```
# Plot the rotated point
```

```
ax.scatter(point_rotated[0], point_rotated[1], point_rotated[2], color='blue',
```

```
label='Rotated Point')
```

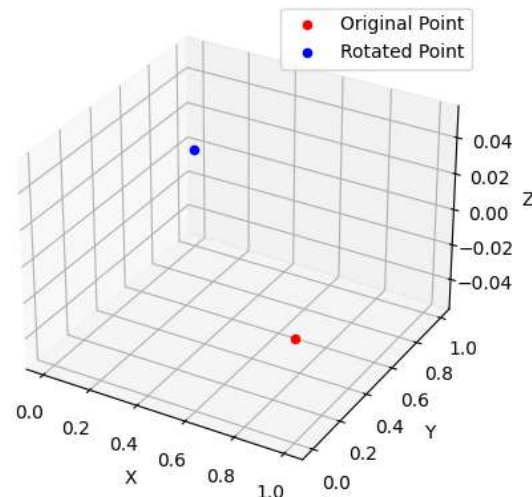
```
# Set plot labels and legend
```

```

ax.set_xlabel('X')
ax.set_ylabel('Y')
ax.set_zlabel('Z')
ax.legend()
# Show the plot
plt.show()

```

OUTPUT:



Q.2) Write a Python program to plot 3D line graph Whose parametric equation is $(\cos(2x), \sin(2x), x)$ for $10 \leq x \leq 20$ (in red color), with title of the graph

Syntax:

```

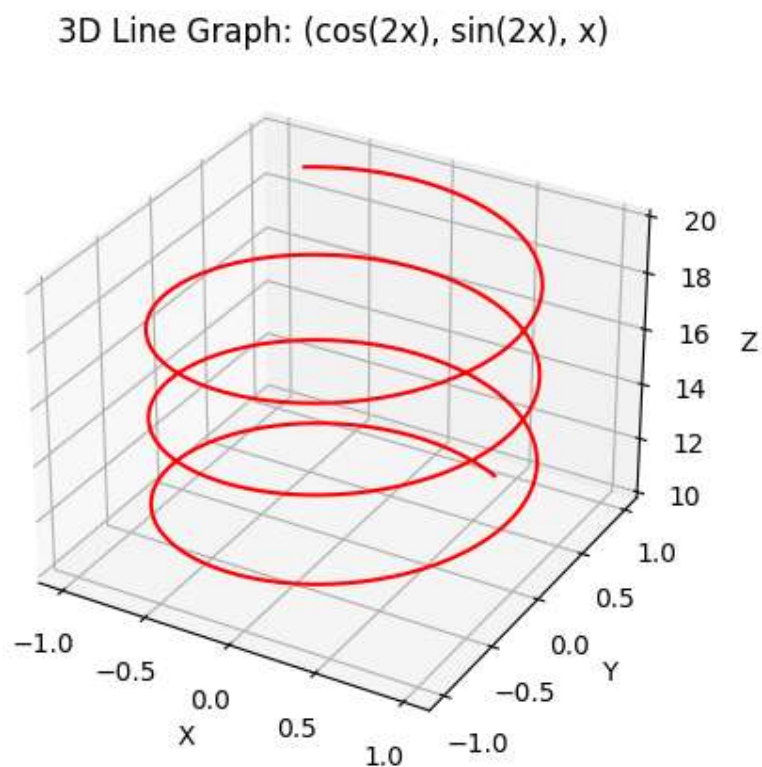
import numpy as np
import matplotlib.pyplot as plt
from mpl_toolkits.mplot3d import Axes3D
# Generate values for x
x = np.linspace(10, 20, 500)
# Calculate parametric equations for x, y, z
y = np.sin(2 * x)
z = x
x = np.cos(2 * x)
# Create a 3D figure
fig = plt.figure()
ax = fig.add_subplot(111, projection='3d')
# Plot the 3D line graph

```

```

ax.plot(x, y, z, color='red')
# Set title for the graph
ax.set_title("3D Line Graph: (cos(2x), sin(2x), x)")
# Set labels for x, y, z axes
ax.set_xlabel('X')
ax.set_ylabel('Y')
ax.set_zlabel('Z')
# Show the plot
plt.show()
OUTPUT:

```



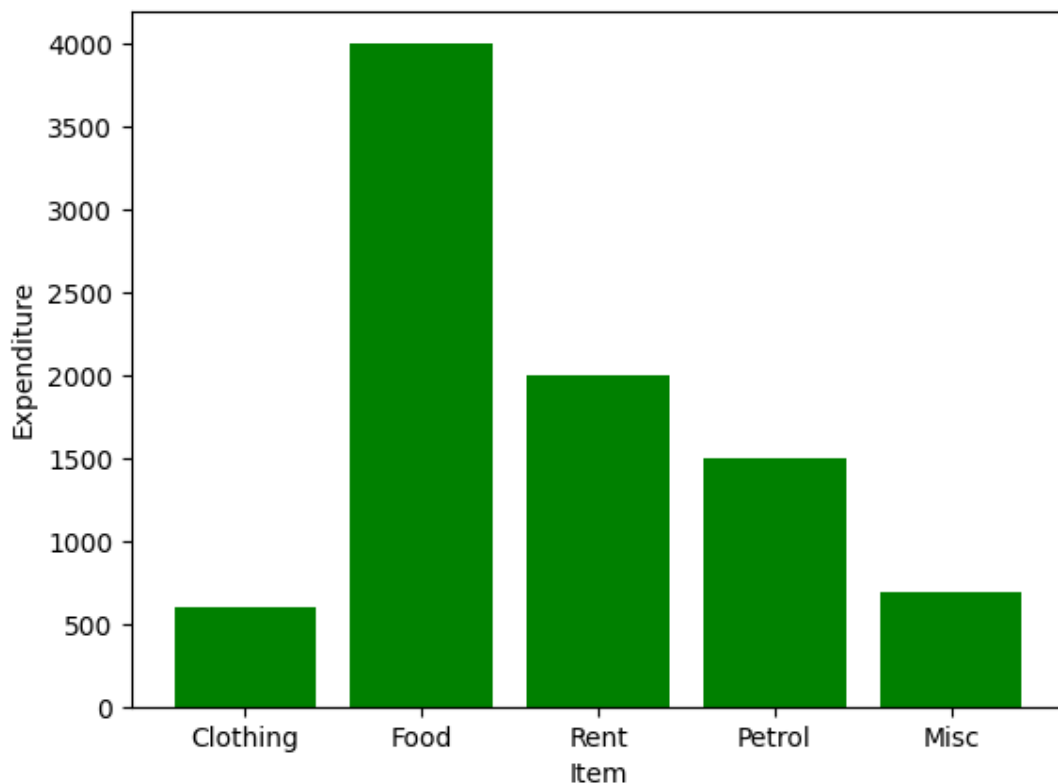
Q.3) Using python, represent the following information using a bar graph (in green color)

Item	Clothing	Food	Rent	Petrol	Misc
Expenditure in Rs	60	4000	2000	1500	700

Syntax:

```
import matplotlib.pyplot as plt
left = [1,2,3,4,5]
height = [600,4000,200,1500,]
tick_label=['clothing', 'food', 'rent', 'petrol', 'Misc']
plt.bar (left,height,tick_label = tick_label,width = 0.8 ,color = ['green','green'])
plt.xlabel('Item')
plt.ylabel('Expenditure')
plt. show()
```

OUTPUT:



Q.4) Write a python program to rotate the ABC by 90° where A(1, 1), B(2, -2), C(1, 2).

Syntax:

```
import numpy as np
# Define the original points
A = np.array([1, 1])
B = np.array([2, -2])
C = np.array([1, 2])

# Define the rotation matrix for rotation by 90 degrees counterclockwise
angle = np.radians(90)
rotation_matrix = np.array([[np.cos(angle), -np.sin(angle)],
                             [np.sin(angle), np.cos(angle)]])
# Apply the rotation to the points
A_rotated = np.dot(rotation_matrix, A)
B_rotated = np.dot(rotation_matrix, B)
C_rotated = np.dot(rotation_matrix, C)
# Print the rotated points
print("Rotated Point A: ", A_rotated)
print("Rotated Point B: ", B_rotated)
print("Rotated Point C: ", C_rotated)
```

Output:

Rotated Point A: [-1. 1.]

Rotated Point B: [2. 2.]

Rotated Point C: [-2. 1.]

Q.5) Write a Python program to draw a polygon with vertices (0, 0), (2, 0), (2, 3) and (1, 6) and rotate it by 180° .

Syntax:

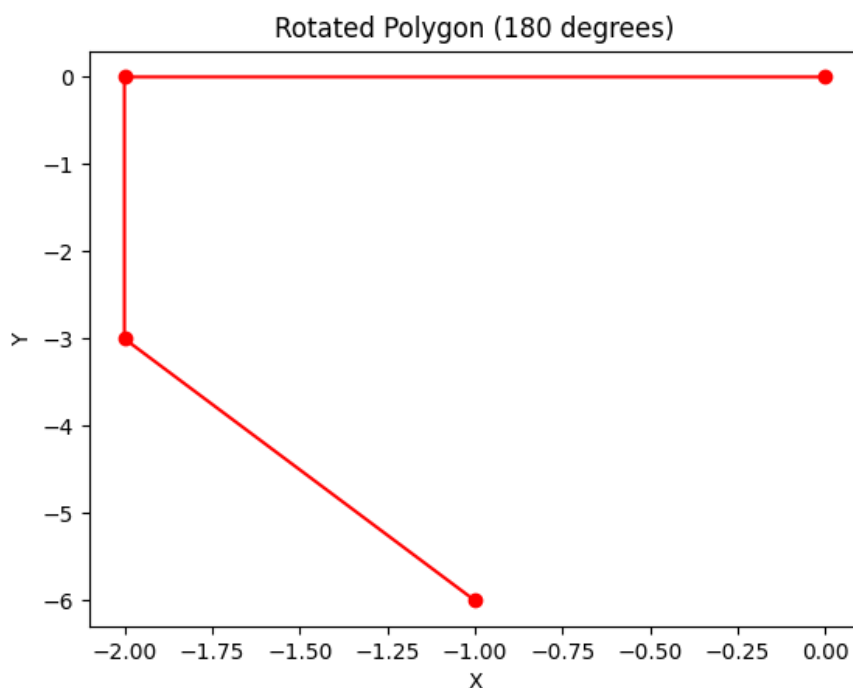
```
import matplotlib.pyplot as plt
import numpy as np
# Define the vertices of the polygon
vertices = np.array([[0, 0], [2, 0], [2, 3], [1, 6]])
# Plot the original polygon
plt.figure()
plt.plot(vertices[:, 0], vertices[:, 1], 'bo-')
plt.title('Original Polygon')
```

```

plt.xlabel('X')
plt.ylabel('Y')
# Define the rotation matrix for 180 degrees
theta = np.pi # 180 degrees
rotation_matrix = np.array([[np.cos(theta), -np.sin(theta)],
                             [np.sin(theta), np.cos(theta)]])
# Apply rotation to the vertices
vertices_rotated = np.dot(vertices, rotation_matrix)
# Plot the rotated polygon
plt.figure()
plt.plot(vertices_rotated[:, 0], vertices_rotated[:, 1], 'ro-')
plt.title('Rotated Polygon (180 degrees)')
plt.xlabel('X')
plt.ylabel('Y')
# Show the plots
plt.show()

```

OUTPUT:



Q.6) Write a Python program to find the area and perimeter of the ABC, where A[0, 0] B[5, 0], C[3,3].

Syntax:

```
import numpy as np
# Define the vertices of the triangle
A = np.array([0, 0])
B = np.array([5, 0])
C = np.array([3, 3])
# Calculate the side lengths of the triangle
AB = np.linalg.norm(B - A)
BC = np.linalg.norm(C - B)
CA = np.linalg.norm(A - C)
# Calculate the semiperimeter
s = (AB + BC + CA) / 2
# Calculate the area using Heron's formula
area = np.sqrt(s * (s - AB) * (s - BC) * (s - CA))
# Calculate the perimeter
perimeter = AB + BC + CA
# Print the results
print("Triangle ABC:")
print("Side AB:", AB)
print("Side BC:", BC)
print("Side CA:", CA)
print("Area:", area)
print("Perimeter:", perimeter)
```

OUTPUT:

Triangle ABC:

Side AB: 5.0

Side BC: 3.605551275463989

Side CA: 4.242640687119285

Area: 7.50000000000000036

Perimeter: 12.848191962583275

Transformed Point A: [38. 10.]

Transformed Point B: [35. 8.]

Q.7) write a Python program to solve the following LPP

Max $Z = x + y$

Subjected to

$x - y \geq 1$

$x + y \geq 2$

$x > 0, y > 0$

Syntax:

```
from pulp import *
# Create a maximization problem
prob = LpProblem("Maximization Problem", LpMaximize)
# Define the decision variables
x = LpVariable('x', lowBound=0, cat='Continuous')
y = LpVariable('y', lowBound=0, cat='Continuous')
# Define the objective function
prob += x + y, "Z"
# Define the constraints
prob += x - y >= 1
prob += x + y >= 2
# Solve the problem
prob.solve()
# Print the status of the solution
print("Status: ", LpStatus[prob.status])
```

If the problem is solved successfully, print the optimal solution

if prob.status == LpStatusOptimal:

print("Optimal Solution:")

print("x = ", value(x))

print("y = ", value(y))

print("Z = ", value(prob.objective))

Status: Optimal

Status: Unbounded

Q.8) Write a python program to display the following LPP by using pulp module and simplex method. Find its optimal solution if exist.

$$\text{Min } Z = 3x + 2y + 5z$$

subject to

$$x + 2y + z \leq 430$$

$$3x + 4z \leq 460$$

$$x + 4y \leq 120$$

$$x \geq 0, y \geq 0, z \geq 0$$

Syntax:

```
from pulp import *
# Create a minimization problem
prob = LpProblem("Minimization Problem", LpMinimize)
# Define the decision variables
x = LpVariable('x', lowBound=0, cat='Continuous')
y = LpVariable('y', lowBound=0, cat='Continuous')
z = LpVariable('z', lowBound=0, cat='Continuous')
# Define the objective function
prob += 3*x + 2*y + 5*z, "Z"
# Define the constraints
prob += x + 2*y + z <= 430
prob += 3*x + 4*z <= 460
prob += x + 4*y <= 120
# Solve the problem
prob.solve()
# Print the status of the solution
print("Status: ", LpStatus[prob.status])
# If the problem is solved successfully, print the optimal solution
```

```

if prob.status == LpStatusOptimal:
    print("Optimal Solution:")
    print("x = ", value(x))
    print("y = ", value(y))
    print("z = ", value(z))
    print("Z = ", value(prob.objective))

```

Status: Optimal

Optimal Solution:

x = 0.0

y = 0.0

z = 0.0

Z = 0.0

Q.9) Write a python program to apply the following transformation on the point (-2, 4)

(I) Shearing in Y direction by 7 unit

(II) Scaling in X and Y direction by $\frac{3}{2}$ and 4 unit respectively.

(III) Shearing in X and Y direction by 2 and 4 unit respectively.

(IV) Rotation About origin by an angle 45°

Syntax:

```
import numpy as np
```

```
# Initial point
```

```
P = np.array([-2, 4])
```

```
# Transformation 1: Shearing in Y direction by 7 units
```

```
shearing_matrix_1 = np.array([[1, 0],
                               [0, 1]])
```

```
shearing_matrix_1[0, 1] = 7
```

```
P_sheared_1 = np.dot(shearing_matrix_1, P)
```

```
# Transformation 2: Scaling in X and Y direction by 3/2 and 4 units respectively
```

```
scaling_matrix = np.array([[3/2, 0],
                            [0, 4]])
```

```
P_scaled = np.dot(scaling_matrix, P)
```

```
# Transformation 3: Shearing in X and Y direction by 2 and 4 units respectively
```

```
shearing_matrix_2 = np.array([[1, 0],
                               [0, 1]])
```

```
shearing_matrix_2[0, 1] = 4
```

```
shearing_matrix_2[1, 0] = 2
```

```
P_sheared_2 = np.dot(shearing_matrix_2, P)
```

```
# Transformation 4: Rotation about origin by an angle of 45 degrees
```

```

angle = np.radians(45)
rotation_matrix = np.array([[np.cos(angle), -np.sin(angle)],
                             [np.sin(angle), np.cos(angle)]])
P_rotated = np.dot(rotation_matrix, P)
# Print the transformed points
print("Original Point: ", P)
print("Sheared in Y direction by 7 units: ", P_sheared_1)
print("Scaled in X and Y direction by 3/2 and 4 units respectively: ", P_scaled)
print("Sheared in X and Y direction by 2 and 4 units respectively: ", P_sheared_2)
print("Rotated about origin by an angle of 45 degrees: ", P_rotated)

```

OUTPUT:

```

Original Point: [-2  4]
Sheared in Y direction by 7 units: [26  4]
Scaled in X and Y direction by 3/2 and 4 units respectively: [-3. 16.]
Sheared in X and Y direction by 2 and 4 units respectively: [14  0]
Rotated about origin by an angle of 45 degrees: [-4.24264069  1.41421356]

```

Q.10) Find the combined transformation of the line segment between the point A[3, 2] & B[2,-3] by using Python program for the following sequence of transformation:-

- (I) Rotation about origin through an angle $\pi/6$.
- (II) Scaling in y-Coordinate by -4 units.
- (III) Uniform scaling by -6.4units
- (IV) Shearing in y – Direction by 5 unit

Syntax:

```

import numpy as np
# Define the initial points A and B
A = np.array([3, 2])
B = np.array([2, -3])
# Transformation 1: Rotation about origin through an angle of pi/6
angle_1 = np.pi/6
rotation_matrix_1 = np.array([[np.cos(angle_1), -np.sin(angle_1)],
                               [np.sin(angle_1), np.cos(angle_1)]])
A_rotated_1 = np.dot(rotation_matrix_1, A)
B_rotated_1 = np.dot(rotation_matrix_1, B)
# Transformation 2: Scaling in y-Coordinate by -4 units
scaling_matrix_2 = np.array([[1, 0],
                              [0, -4]])
A_scaled_2 = np.dot(scaling_matrix_2, A_rotated_1)
B_scaled_2 = np.dot(scaling_matrix_2, B_rotated_1)

```

```

# Transformation 3: Uniform scaling by -6.4 units
scaling_matrix_3 = np.array([[ -6.4, 0],
                             [0, -6.4]])
A_scaled_3 = np.dot(scaling_matrix_3, A_scaled_2)
B_scaled_3 = np.dot(scaling_matrix_3, B_scaled_2)
# Transformation 4: Shearing in y-Direction by 5 units
shearing_matrix_4 = np.array([[1, 0],
                              [0, 1]])
shearing_matrix_4[0, 1] = 5
A_sheared_4 = np.dot(shearing_matrix_4, A_scaled_3)
B_sheared_4 = np.dot(shearing_matrix_4, B_scaled_3)
# Print the input and output points for each transformation
print("Input Point A: ", A)
print("Input Point B: ", B)
print("Transformation 1 - Rotation: ")
print(" - Rotated Point A: ", A_rotated_1)
print(" - Rotated Point B: ", B_rotated_1)
print("Transformation 2 - Scaling in y-Coordinate: ")
print(" - Scaled Point A: ", A_scaled_2)
print(" - Scaled Point B: ", B_scaled_2)
print("Transformation 3 - Uniform Scaling: ")
print(" - Scaled Point A: ", A_scaled_3)
print(" - Scaled Point B: ", B_scaled_3)
print("Transformation 4 - Shearing in y-Direction: ")
print(" - Sheared Point A: ", A_sheared_4)
print(" - Sheared Point B: ", B_sheared_4)

```

OUTPUT:

Input Point A: [3 2]

Input Point B: [2 -3]

Transformation 1 - Rotation:

- Rotated Point A: [1.59807621 3.23205081]

- Rotated Point B: [3.23205081 -1.59807621]

Transformation 2 - Scaling in y-Coordinate:

- Scaled Point A: [1.59807621 -12.92820323]

- Scaled Point B: [3.23205081 6.39230485]

Transformation 3 - Uniform Scaling:

- Scaled Point A: [-10.22768775 82.74050067]

- Scaled Point B: [-20.68512517 -40.91075101]

Transformation 4 - Shearing in y-Direction:

- Sheared Point A: [403.47481562 82.74050067]

- Sheared Point B: [-225.23888022 -40.91075101]

Combined Transformation of A: [403.47481562 82.74050067]

Sahakar Maharshi Bhausaheb Santuji Thorat

College Sangamner

DEPARTMENT OF COMPUTER SCIENCE

MATHEMATICS

Name :- Prem Vijay Vajare

Batch No. :- D

Title of the:- Practical 11

Expt. No . 11

Remark
Demonstrators
Signature
Date :- / /2023

Roll No:- 75 **Date:-** / /2023

Class :- S.Y.BCS

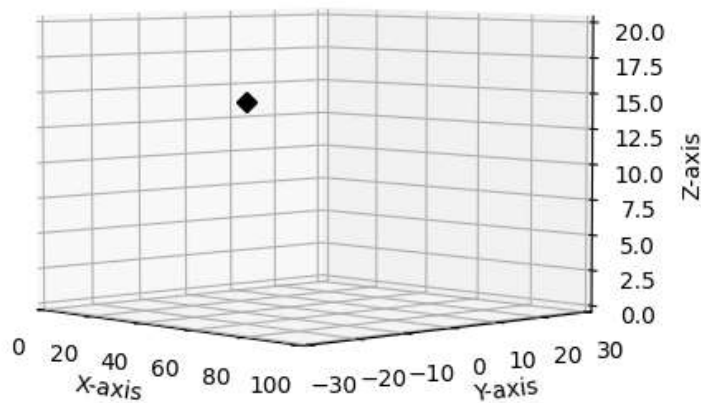
Q.1) Write a python program to plot 3D axes with labels as X – axis and Y – axis And z axis and also plot following point. With given coordinate in the same graph (70,-25,15) as a diamond in black color

Syntax:

```
import matplotlib.pyplot as plt
import numpy as np
# Create a 3D plot figure
fig = plt.figure()
ax = fig.add_subplot(111, projection='3d')
# Define the point coordinates
x = 70
y = -25
z = 15
# Plot the point as a diamond shape in black color
ax.plot([x], [y], [z], marker='D', color='black')
# Set labels for the axes
ax.set_xlabel('X-axis')
ax.set_ylabel('Y-axis')
ax.set_zlabel('Z-axis')
# Set limits for the axes
ax.set_xlim([0, 100])
ax.set_ylim([-30, 30])
ax.set_zlim([0, 20])
# Display the plot
plt.show()
```

plt.show()

OUTPUT:



Q.2) Plot the graph of $y = e^{-x}$ in $[-5,5]$ with red dashed line with Upward pointing Triangle

Syntax:

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

```
import numpy as np
```

```
# Generate x values in the range [-5,5]
```

```
x = np.linspace(-5, 5, 100)
```

```
# Compute y values using  $y = e^{-x}$ 
```

```
y = np.exp(-x)
```

```
# Create a figure and axis
```

```
fig, ax = plt.subplots()
```

```
# Plot the graph with red dashed line and upward pointing triangles as markers
```

```
ax.plot(x, y, 'r--', marker='^')
```

```
# Set labels for the x-axis and y-axis
```

```
ax.set_xlabel('x')
```

```
ax.set_ylabel('y')
```

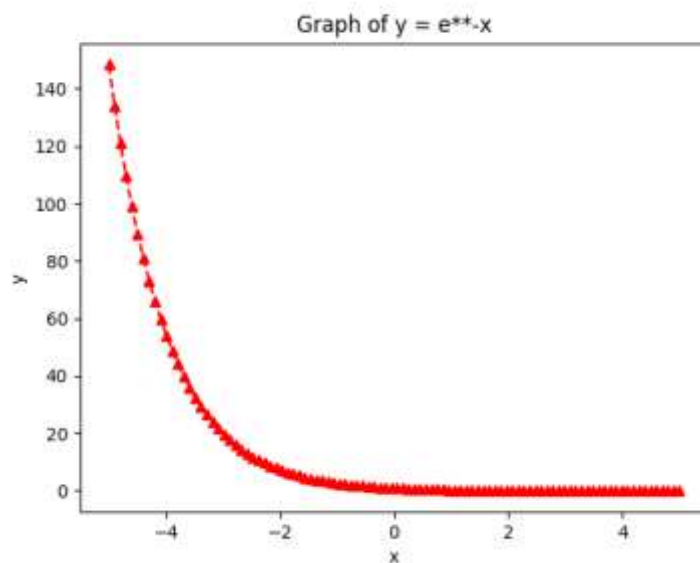
```
# Set title for the plot
```

```
ax.set_title('Graph of  $y = e^{-x}$ ')
```

```
# Display the plot
```

```
plt.show() plt.show()
```

OUTPUT:



Q.3) Using python, represent the following information using a bar graph (in green color)

Subject	Maths	Science	English	Marathi	Hindi
Percentage of passing	68	90	70	85	91

Syntax:

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

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

```
height = [68,90,70,85,91]
```

```
tick_label=['Maths','Science','English','Marathi','Hindi']
```

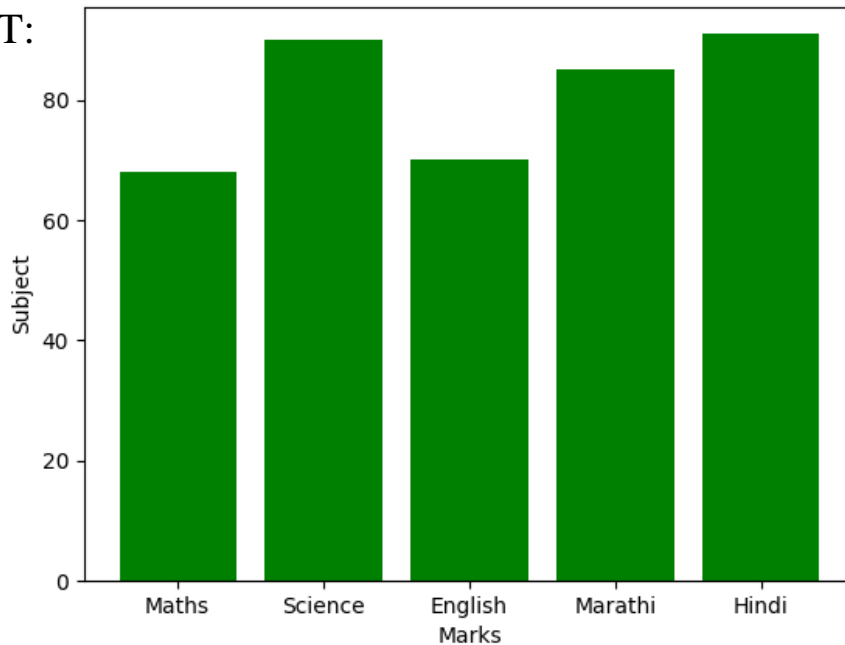
```
plt.bar (left,height,tick_label = tick_label,width = 0.8 ,color = ['green','green'])
```

```
plt.xlabel('Item')
```

```
plt.ylabel('Expenditure')
```

```
plt. show()
```

OUTPUT:



Q.4) Write a python program to rotate the ABC by 90° where A(1, 1), B(2, -2), C(1, 2).

Syntax:

```
import numpy as np
```

```
# Define the original points
```

```
A = np.array([1, 1])
```

```
B = np.array([2, -2])
```

```
C = np.array([1, 2])
```

```
# Define the rotation matrix for rotation by 90 degrees counterclockwise
```

```
angle = np.radians(90)
```

```
rotation_matrix = np.array([[np.cos(angle), -np.sin(angle)],  
                             [np.sin(angle), np.cos(angle)]])
```

```
# Apply the rotation to the points
```

```
A_rotated = np.dot(rotation_matrix, A)
```

```
B_rotated = np.dot(rotation_matrix, B)
```

```
C_rotated = np.dot(rotation_matrix, C)
```

```
# Print the rotated points
```

```
print("Rotated Point A: ", A_rotated)
```

```
print("Rotated Point B: ", B_rotated)
```

```
print("Rotated Point C: ", C_rotated)
```

Output:

Rotated Point A: [-1. 1.]

Rotated Point B: [2. 2.]

Rotated Point C: [-2. 1.]

Q.5) Write a python program to reflect the ABC through the line $y = 3$ where A(1, 0), B(2, -2), C(-1, 2).

Syntax:

```
import numpy as np
# Define the reflection line y = 3
reflection_line = 3
# Define the points A, B, and C
A = np.array([1, 0])
B = np.array([2, -2])
C = np.array([-1, 2])
# Compute the reflected points A', B', and C'
Ap = np.array([A[0], 2 * reflection_line - A[1]])
Bp = np.array([B[0], 2 * reflection_line - B[1]])
Cp = np.array([C[0], 2 * reflection_line - C[1]])
# Print the original points and reflected points
print("Original Points:")
print("A: ", A)
print("B: ", B)
print("C: ", C)
print("Reflected Points:")
print("A':", Ap)
print("B':", Bp)
print("C':", Cp)
```

Output:

Original Points:

A: [1 0]

B: [2 -2]

C: [-1 2]

Reflected Points:

A': [1 6]

B': [2 8]

C': [-1 4]

Q.6) Write a python program to draw a polygon with 6 sides and radius 1 centered at (1,2) and find its area and perimeter

Syntax:

```
import math
```

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

```
import numpy as np
```

```
# Define the center of the hexagon
```

```
center = np.array([1, 2])
```

```
# Define the radius of the hexagon
```

```
radius = 1
```

```
# Calculate the coordinates of the vertices of the hexagon
```

```
angle_deg = np.linspace(0, 360, 7)[: -1]
```

```
angle_rad = np.deg2rad(angle_deg)
```

```
x_coors = center[0] + radius * np.cos(angle_rad)
```

```
y_coors = center[1] + radius * np.sin(angle_rad)
```

```
# Plot the hexagon
```

```
plt.plot(x_coors, y_coors, 'b-')
```

```
plt.xlabel('X-axis')
```

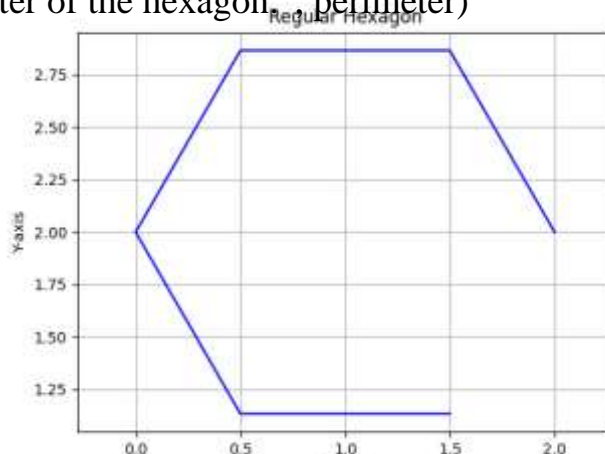
```
plt.ylabel('Y-axis')
```

```

plt.title('Regular Hexagon')
plt.axis('equal')
plt.grid(True)
plt.show()
# Calculate the area of the hexagon
side_length = 2 * radius * np.sin(np.pi / 3)
area = (3 * np.sqrt(3) * side_length ** 2) / 2
# Calculate the perimeter of the hexagon
perimeter = 6 * side_length
# Print the area and perimeter
print("Area of the hexagon:", area)
print("Perimeter of the hexagon:" perimeter)

```

OUTPUT:



Area of the hexagon: 7.794228634059947

Perimeter of the hexagon: 10.392304845413264

Q.7) write a Python program to solve the following LPP

```

Max Z = x + y
Subjected to
x >= 6
y >= 6
x+y >= 11
x > 0 , y > 0

```

Syntax:

```
from pulp import *  
  
# Create a maximization problem  
prob = LpProblem("Maximization Problem", LpMaximize)  
  
# Define decision variables  
x = LpVariable("x", lowBound=0, cat='Continuous')  
y = LpVariable("y", lowBound=0, cat='Continuous')  
  
# Define the objective function  
prob += x + y, "Z"  
  
# Define the constraints  
prob += x >= 6, "Constraint 1"  
prob += y >= 6, "Constraint 2"  
prob += x + y >= 11, "Constraint 3"  
  
# Solve the problem  
prob.solve()  
  
# Print the status of the problem  
print("Status:", LpStatus[prob.status])  
  
# Print the optimal solution  
print("Optimal Solution:")  
print("x =", value(x))  
print("y =", value(y))  
  
# Print the optimal objective value  
print("Z =", value(prob.objective))
```

OUTPUT:

Status: Unbounded

Optimal Solution:

x = 0.0

y = 0.0

Z = 0.0

Q.8) Write a python program to display the following LPP by using pulp module and simplex method. Find its optimal solution if exist.

$$\begin{aligned} \text{Min } Z &= 3x + 5y + 4z \\ \text{subject to} \\ 2x + 3y &\leq 8 \\ 2y + 5z &\leq 10 \\ 3x + 2y + 4z &\leq 15 \\ x \geq 0, y \geq 0, z &\geq 0 \end{aligned}$$

Syntax:

```
from pulp import *
# Create a minimization problem
prob = LpProblem("Minimization Problem", LpMinimize)
# Define decision variables
x = LpVariable("x", lowBound=0, cat='Continuous')
y = LpVariable("y", lowBound=0, cat='Continuous')
z = LpVariable("z", lowBound=0, cat='Continuous')
# Define the objective function
prob += 3*x + 5*y + 4*z, "Z"
# Define the constraints
prob += 2*x + 3*y <= 8, "Constraint 1"
prob += 2*y + 5*z <= 10, "Constraint 2"
prob += 3*x + 2*y + 4*z <= 15, "Constraint 3"
# Solve the problem
prob.solve()
# Print the status of the problem
print("Status:", LpStatus[prob.status])
# Print the optimal solution
print("Optimal Solution:")
print("x =", value(x))
print("y =", value(y))
print("z =", value(z))
# Print the optimal objective value
print("Z =", value(prob.objective))
Status: Optimal
Optimal Solution:
x = 0.0
y = 0.0
z = 0.0
Z = 0.0
```

Q.9) Write a python program to apply the following transformation on the point (-2, 4)

(I) Reflection through x – axis

(II) Scaling in X – coordinate by 6 factor

(III) Shearing in x direction by 4 unit

(IV) Rotation About origin through an angle 30

Syntax:

```
import math
# Initial point
point = (-2, 4)
x, y = point
# Transformation 1: Reflection through x-axis
point_reflection_x_axis = (x, -y)
# Transformation 2: Scaling in X-coordinate by 6 factor
scale_factor = 6
point_scaling_x = (x * scale_factor, y)
# Transformation 3: Shearing in x-direction by 4 units
shear_factor = 4
point_shearing_x = (x + shear_factor * y, y)
# Transformation 4: Rotation about origin through an angle of 30 degrees
angle = 30
angle_rad = math.radians(angle)
point_rotation = (x * math.cos(angle_rad) - y * math.sin(angle_rad), x *
math.sin(angle_rad) + y * math.cos(angle_rad))
# Print the transformed points
print("Transformation 1: Reflection through x-axis")
print("x =", point_reflection_x_axis[0])
print("y =", point_reflection_x_axis[1])
print("\nTransformation 2: Scaling in X-coordinate by 6 factor")
print("x =", point_scaling_x[0])
print("y =", point_scaling_x[1])
print("\nTransformation 3: Shearing in x-direction by 4 units")
print("x =", point_shearing_x[0])
print("y =", point_shearing_x[1])
print("\nTransformation 4: Rotation about origin through an angle of 30 degrees")
print("x =", point_rotation[0])
print("y =", point_rotation[1])
```

OUTPUT:

Transformation 1: Reflection through x-axis

x = -2

$$y = -4$$

Transformation 2: Scaling in X-coordinate by 6 factor

$$x = -12$$

$$y = 4$$

Transformation 3: Shearing in x-direction by 4 units

$$x = 14$$

$$y = 4$$

Transformation 4: Rotation about origin through an angle of 30 degrees

$$x = -3.732050807568877$$

$$y = 2.464101615137755$$

Q.10) Find the combined transformation between the point by using Python program for the following sequence of transformation:-

- (I) Rotation about origin through an angle $\pi/2$.
- (II) Uniform scaling by -6.4units
- (III) Scaling in x & y-Coordinate by 3 &5 units respectively.
- (IV) Shearing in X – Direction by 6 unit.

Syntax:

```
import math
```

```
# Initial point
```

```
point = (3, 5)
```

```
x, y = point
```

```
# Transformation 1: Rotation about origin through an angle of  $\pi/2$ 
```

```
angle_rad = math.pi/2
```

```
point_rotation = (x * math.cos(angle_rad) - y * math.sin(angle_rad), x *  
math.sin(angle_rad) + y * math.cos(angle_rad))
```

```
# Transformation 2: Uniform scaling by -6.4 units
```

```
scale_factor_uniform = -6.4
```

```
point_uniform_scaling = (x * scale_factor_uniform, y * scale_factor_uniform)
```

```
# Transformation 3: Scaling in x & y-coordinate by 3 & 5 units respectively
```

```
scale_factor_x = 3
```

```
scale_factor_y = 5
```

```
point_scaling = (x * scale_factor_x, y * scale_factor_y)
```

```
# Transformation 4: Shearing in X-Direction by 6 units
```

```
shear_factor_x = 6
```

```
point_shearing_x = (x + shear_factor_x * y, y)
```

```
# Combined Transformation
```

```
point_combined_transformation = point_rotation
```

```
point_combined_transformation = (point_combined_transformation[0] *
```

```
scale_factor_uniform, point_combined_transformation[1] *
```

```
scale_factor_uniform)
```

```

point_combined_transformation = (point_combined_transformation[0] *
scale_factor_x, point_combined_transformation[1] * scale_factor_y)
point_combined_transformation = (point_combined_transformation[0] +
shear_factor_x * point_combined_transformation[1],
point_combined_transformation[1])
# Print the transformed points
print("Transformation 1: Rotation about origin through an angle of pi/2")
print("x =", point_rotation[0])
print("y =", point_rotation[1])
print("\nTransformation 2: Uniform scaling by -6.4 units")
print("x =", point_uniform_scaling[0])
print("y =", point_uniform_scaling[1])
print("\nTransformation 3: Scaling in x & y-coordinate by 3 & 5 units
respectively")
print("x =", point_scaling[0])
print("y =", point_scaling[1])
print("\nTransformation 4: Shearing in X-Direction by 6 units")
print("x =", point_shearing_x[0])
print("y =", point_shearing_x[1])
print("\nCombined Transformation:")
print("x =", point_combined_transformation[0])
print("y =", point_combined_transformation[1])
OUTPUT:

```

Transformation 1: Rotation about origin through an angle of pi/2

x = -5.0

y = 3.0000000000000004

Transformation 2: Uniform scaling by -6.4 units

x = -19.200000000000003

y = -32.0

Transformation 3: Scaling in x & y-coordinate by 3 & 5 units respectively

x = 9

y = 25

Transformation 4: Shearing in X-Direction by 6 units

x = 33

y = 5

Combined Transformation:

x = -480.0000000000001

y = -96.0000000000001

Sahakar Maharshi Bhausaheb Santuji Thorat

College Sangamner

DEPARTMENT OF COMPUTER SCIENCE

MATHEMATICS

Name :- Prem Vijay Vajare

Batch No. :- D

Title of the:- Practical 12

Expt. No . 12

Remark
Demonstrators
Signature
Date :- / /2023

Roll No:- 75 **Date:-** / /2023

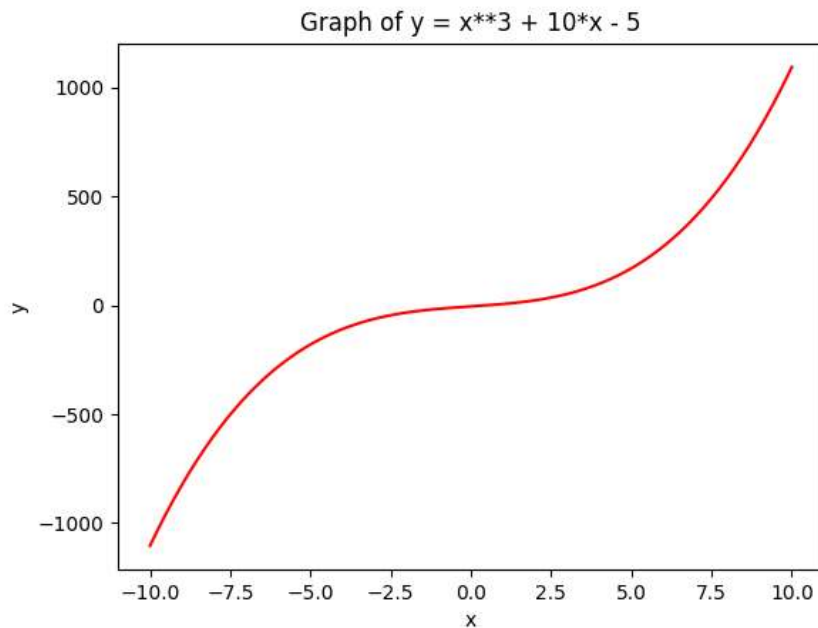
Class :- S.Y.BCS

Q.1) write a python program to plot the graph of $y = x^{**3} + 10*x - 5$, for x belongs [-10, 10] in red color.

Syntax:

```
import numpy as np
import matplotlib.pyplot as plt
# Define the equation  $y = x^{**3} + 10*x - 5$ 
def equation(x):
    return  $x^{**3} + 10*x - 5$ 
# Generate x values in the range [-10, 10]
x = np.linspace(-10, 10, 500)
# Evaluate the y values using the equation
y = equation(x)
# Create the plot
plt.plot(x, y, color='red')
# Set the plot title and axis labels
plt.title("Graph of  $y = x^{**3} + 10*x - 5$ ")
plt.xlabel("x")
plt.ylabel("y")
# Show the plot
plt.show()
```

OUTPUT:



Q.2) write a python program in 3D to rotate the point (1, 0, 0) through XZ- plane in clockwise direction (rotation through Y- axis by an angle of 90°).

Syntax:

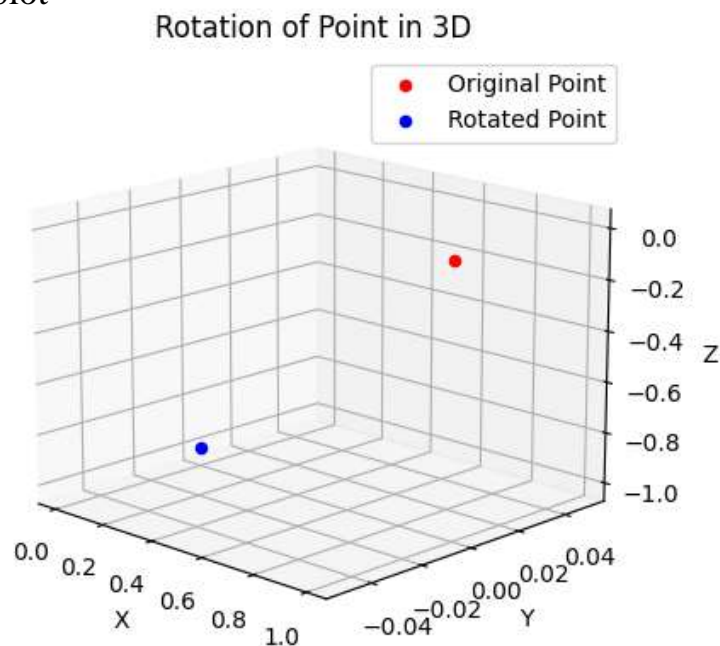
```
import numpy as np
import matplotlib.pyplot as plt
from mpl_toolkits.mplot3d import Axes3D
# Define the point to rotate
point = np.array([1, 0, 0])
# Define the rotation angle in radians
theta = np.radians(90)
# Create the 3D plot
fig = plt.figure()
ax = fig.add_subplot(111, projection='3d')
# Plot the original point
ax.scatter(point[0], point[1], point[2], color='red', label='Original Point')
# Perform the rotation
rotated_point = np.dot(np.array([[np.cos(theta), 0, np.sin(theta)],
```

```

[0, 1, 0],
[-np.sin(theta), 0, np.cos(theta)]]), point)
# Plot the rotated point
ax.scatter(rotated_point[0], rotated_point[1], rotated_point[2], color='blue',
label='Rotated Point')
# Set the plot title and axis labels
ax.set_title('Rotation of Point in 3D')
ax.set_xlabel('X')
ax.set_ylabel('Y')
ax.set_zlabel('Z')
# Add a legend
ax.legend()
# Show the plot
plt.show()

```

OUTPUT:



Q.3) Using Python plot the graph of function $f(x) = x^2$ on the interval $(-2,2)$.

Syntax:

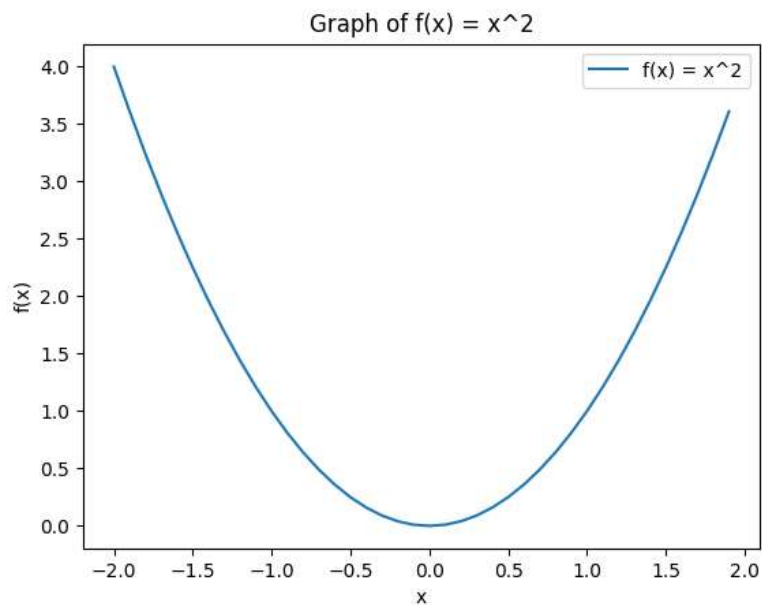
```

import numpy as np
import matplotlib.pyplot as plt
# Define the function f(x) = x^2

```

```
def f(x):  
    return x**2  
# Generate x values in the range (-2,2) with a step of 0.1  
x = np.arange(-2, 2, 0.1)  
# Calculate y values using the function f(x)  
y = f(x)  
# Create the plot  
plt.plot(x, y, label='f(x) = x^2')  
# Set the plot title and axis labels  
plt.title('Graph of f(x) = x^2')  
plt.xlabel('x')  
plt.ylabel('f(x)')  
# Add a legend  
plt.legend()  
# Show the plot  
plt.show()
```

OUTPUT:



Q.4) Write a python program to rotate the segment by 180° having endpoints (1,0) and (2,-1)

Syntax:

```
import math
# Define the endpoints of the line segment
x1, y1 = 1, 0
x2, y2 = 2, -1
# Perform the rotation
x1_rotated = -x1
y1_rotated = -y1
x2_rotated = -x2
y2_rotated = -y2
# Print the original and rotated endpoints
print("Original Endpoint 1: ({} , {})".format(x1, y1))
print("Original Endpoint 2: ({} , {})".format(x2, y2))
print("Rotated Endpoint 1: ({} , {})".format(x1_rotated, y1_rotated))
print("Rotated Endpoint 2: ({} , {})".format(x2_rotated, y2_rotated))
```

Output:

```
Original Endpoint 1: (1, 0)
Original Endpoint 2: (2, -1)
Rotated Endpoint 1: (-1, 0)
Rotated Endpoint 2: (-2, 1)
```

Q.5) Write a python program to draw a polygon with 8 sides and radius 5 centered at origin and find its area and perimeter

Syntax:

```
import matplotlib.pyplot as plt
import numpy as np
# Number of sides in the polygon
num_sides = 8
# Radius of the polygon
radius = 5
# Calculate the angle between each pair of vertices
```

```

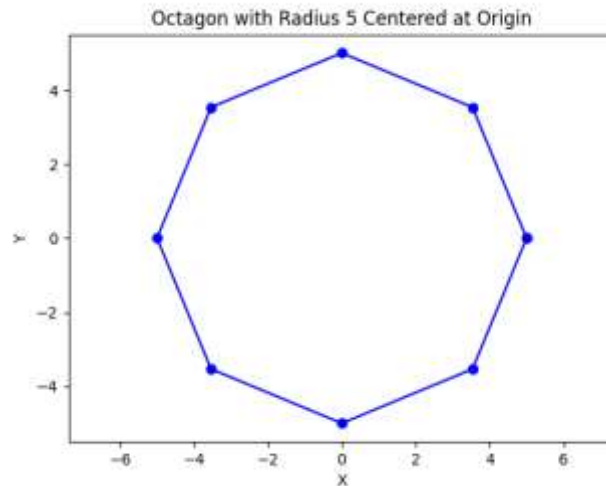
angle = 2 * np.pi / num_sides
# Generate the x and y coordinates of the vertices
x = [radius * np.cos(i * angle) for i in range(num_sides)]
y = [radius * np.sin(i * angle) for i in range(num_sides)]
# Add the first vertex again to close the polygon
x.append(x[0])
y.append(y[0])
# Plot the polygon
plt.plot(x, y, 'bo-') # 'bo-' specifies blue color, circle marker, and solid line
# Set the aspect ratio to 'equal' to ensure the polygon is displayed as a regular
shape
plt.axis('equal')
# Set the labels for the axes
plt.xlabel('X')
plt.ylabel('Y')
# Set the title of the plot
plt.title('Octagon with Radius 5 Centered at Origin')
# Show the plot
plt.show()
# Calculate the area of the polygon
area = 0.5 * num_sides * radius ** 2 * np.sin(angle)
# Calculate the perimeter of the polygon
perimeter = num_sides * radius
# Print the calculated area and perimeter
print('Area of the octagon:', area)
print('Perimeter of the octagon:', perimeter)

```

Output:

Area of the octagon: 70.71067811865476

Perimeter of the octagon: 40



Q.6) Write a python program to find the area and perimeter of the XYZ, where X(1, 2), Y(2, -2), Z(-1,2).

Syntax:

```
import math
```

```
# Input coordinates
```

```
X = [1, 2]
```

```
Y = [2, -2]
```

```
Z = [-1, 2]
```

```
# Calculate distances between points
```

```
def distance(p1, p2):
```

```
    return math.sqrt((p2[0] - p1[0]) ** 2 + (p2[1] - p1[1]) ** 2)
```

```
# Calculate lengths of sides
```

```
XY = distance(X, Y)
```

```
YZ = distance(Y, Z)
```

```
XZ = distance(X, Z)
```

```
# Calculate perimeter
```

```
perimeter = XY + YZ + XZ
```

```
# Calculate area using Heron's formula
```

```
s = perimeter / 2
```

```
area = math.sqrt(s * (s - XY) * (s - YZ) * (s - XZ))
```

```
# Print results
```

```
print("Length of XY: ", XY)
```

```
print("Length of YZ: ", YZ)
print("Length of XZ: ", XZ)
print("Perimeter: ", perimeter)
print("Area: ", area))
```

OUTPUT:

Length of XY: 4.123105625617661

Length of YZ: 5.0

Length of XZ: 2.0

Perimeter: 11.123105625617661

Area: 4.0000000000000003

Q.7) write a Python program to solve the following LPP

Max $Z = 3.5x + 2y$

Subjected to

$x + y \geq 5$

$x \geq 4$

$y \leq 2$

$x > 0, y > 0$

Syntax:

```
from pulp import *
# Create the problem
prob = LpProblem("Linear Programming Problem", LpMaximize)
# Define the decision variables
x = LpVariable("x", lowBound=0)
y = LpVariable("y", lowBound=0)
# Define the objective function
objective = 3.5 * x + 2 * y
prob += objective
# Define the constraints
prob += x + y >= 5
prob += x >= 4
prob += y <= 2
# Solve the problem
prob.solve()
```

```

# Print the results
print("Status:", LpStatus[prob.status])
print("Optimal Solution:")
print("x =", value(x))
print("y =", value(y))
print("Optimal Objective Value: Z =", value(objective))
OUTPUT:
Status: Unbounded
Optimal Solution:
x = 5.0
y = 0.0
Optimal Objective Value: Z = 17.5

```

Q.8) Write a python program to display the following LPP by using pulp module and simplex method. Find its optimal solution if exist.

$$\text{Min } Z = 3x + 5y + 4z$$

subject to

$$2x + 3y \leq 8$$

$$2y + 5z \leq 10$$

$$3x + 2y + 4z \leq 15$$

$$x \geq 0, y \geq 0, z \geq 0$$

Syntax:

```

from pulp import *
# Create a minimization problem
prob = LpProblem("Minimization Problem", LpMinimize)
# Define decision variables
x = LpVariable("x", lowBound=0, cat='Continuous')
y = LpVariable("y", lowBound=0, cat='Continuous')
z = LpVariable("z", lowBound=0, cat='Continuous')
# Define the objective function
prob += 3*x + 5*y + 4*z, "Z"
# Define the constraints
prob += 2*x + 3*y <= 8, "Constraint 1"
prob += 2*y + 5*z <= 10, "Constraint 2"
prob += 3*x + 2*y + 4*z <= 15, "Constraint 3"
# Solve the problem
prob.solve()
# Print the status of the problem
print("Status:", LpStatus[prob.status])
# Print the optimal solution

```

```

print("Optimal Solution:")
print("x =", value(x))
print("y =", value(y))
print("z =", value(z))
# Print the optimal objective value
print("Z =", value(prob.objective))
Status: Optimal
Optimal Solution:
x = 0.0
y = 0.0
z = 0.0
Z = 0.0

```

Q.9) Write a python program to apply the following transformation on the point (-2, 4)

- (I) Reflection through y – axis
- (II) Scaling in X – coordinate by 6 factor
- (III) Scaling in Y – coordinate by factor 4.1
- (IV) Shearing in X Direction by $\frac{7}{2}$ units

Syntax:

```

# Initial point
x = -2
y = 4
# (I) Reflection through y-axis
print("Point after reflection through y-axis:")
x = -x
y = y
print("x =", x)
print("y =", y)
# (II) Scaling in X-coordinate by 6 factor
print("\nPoint after scaling in X-coordinate by 6 factor:")
x = x * 6
y = y
print("x =", x)
print("y =", y)
# (III) Scaling in Y-coordinate by factor 4.1
print("\nPoint after scaling in Y-coordinate by factor 4.1:")
x = x
y = y * 4.1
print("x =", x)
print("y =", y)

```

```
# (IV) Shearing in X Direction by 7/2 units
print("\nPoint after shearing in X Direction by 7/2 units:")
x = x + (7/2) * y
y = y
print("x =", x)
print("y =", y)
```

OUTPUT:

Point after reflection through y-axis:

x = 2

y = 4

Point after scaling in X-coordinate by 6 factor:

x = 12

y = 4

Point after scaling in Y-coordinate by factor 4.1:

x = 12

y = 16.4

Point after shearing in X Direction by 7/2 units:

x = -55.7

y = 16.4

Q.10) Find the combined transformation on line segment between the point A[4,1] & B[-3,0] by using Python program for the following sequence of transformation:-

(I) Rotation about origin through an angle $\pi/4$.

(II) Uniform scaling by 7.3units

(III) Scaling in X Coordinate by 3 units.

(IV) Shearing in X – Direction by 1/2 unit.

Syntax:

```
import numpy as np
# Initial points
A = np.array([4, 1])
B = np.array([-3, 0])
# (I) Rotation about origin through an angle pi/4
theta = np.pi/4
rot_matrix = np.array([[np.cos(theta), -np.sin(theta)],
                       [np.sin(theta), np.cos(theta)]])
A = np.dot(rot_matrix, A)
B = np.dot(rot_matrix, B)
print("Points after rotation about origin through angle pi/4:")
print("A =", A)
print("B =", B)
```

```

# (II) Uniform scaling by 7.3 units
scale_factor = 7.3
A = A * scale_factor
B = B * scale_factor
print("\nPoints after uniform scaling by 7.3 units:")
print("A =", A)
print("B =", B)
# (III) Scaling in X Coordinate by 3 units
scale_x = 3
A[0] = A[0] * scale_x
B[0] = B[0] * scale_x
print("\nPoints after scaling in X Coordinate by 3 units:")
print("A =", A)
print("B =", B)
# (IV) Shearing in X Direction by 1/2 unit
shear_x = 1/2
A[0] = A[0] + shear_x * A[1]
B[0] = B[0] + shear_x * B[1]
print("\nPoints after shearing in X Direction by 1/2 unit:")
print("A =", A)
print("B =", B)

```

OUTPUT:

Points after rotation about origin through angle $\pi/4$:

A = [2.12132034 3.53553391]

B = [-2.12132034 -2.12132034]

Points after uniform scaling by 7.3 units:

A = [15.48563851 25.80939751]

B = [-15.48563851 -15.48563851]

Points after scaling in X Coordinate by 3 units:

A = [46.45691552 25.80939751]

B = [-46.45691552 -15.48563851]

Points after shearing in X Direction by 1/2 unit:

A = [59.36161428 25.80939751]

B = [-54.19973478 -15.48563851]

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College Sangamner

DEPARTMENT OF COMPUTER SCIENCE

MATHEMATICS

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Batch No. :- D

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Q.1) Write a Python program to plot 2D graph of the functions $f(x) = x^2$ and $g(x) = x^3$ in $[-1, 1]$

Syntax:

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

```
import numpy as np
```

```
def f(x):
```

```
    return x**2
```

```
def g(x):
```

```
    return x**3
```

```
# Generate x values in the range [-1, 1]
```

```
x = np.linspace(-1, 1, 100)
```

```
# Calculate y values for f(x) and g(x)
```

```
y_f = f(x)
```

```
y_g = g(x)
```

```
# Create a figure and axes
```

```
fig, ax = plt.subplots()
```

```
# Plot f(x) and g(x) on the same graph
```

```
ax.plot(x, y_f, label='f(x) = x^2')
```

```
ax.plot(x, y_g, label='g(x) = x^3')
```

```
# Add labels and legend
```

```
ax.set_xlabel('x')
```

```
ax.set_ylabel('y')
```

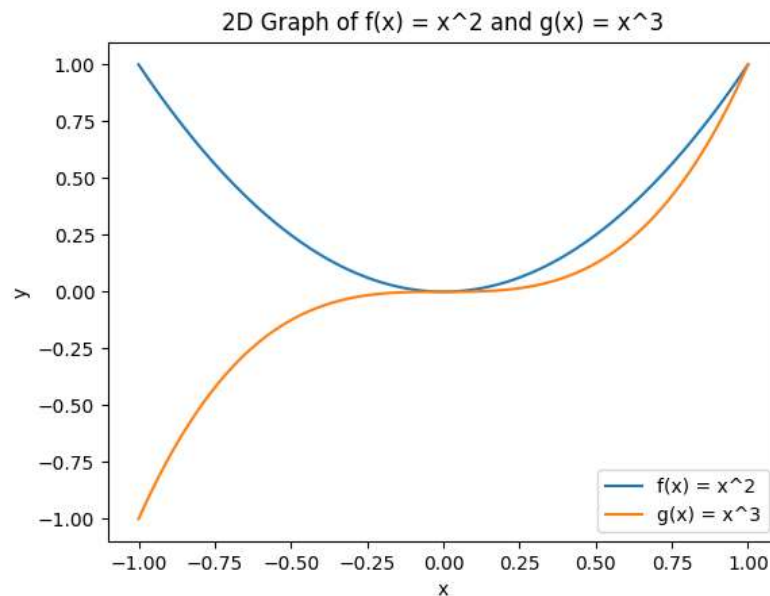
```
ax.legend()
```

```

# Set title
ax.set_title('2D Graph of f(x) = x^2 and g(x) = x^3')
# Show the plot
plt.show()

```

OUTPUT:



Q.2) Using Python, plot the surface plot of parabola $z = x^2 + y^2$ in $-6 < x, y < 6$

Syntax:

```

import numpy as np
import matplotlib.pyplot as plt
from mpl_toolkits.mplot3d import Axes3D
# Generate values for x and y
x = np.linspace(-6, 6, 100)
y = np.linspace(-6, 6, 100)
X, Y = np.meshgrid(x, y)
# Calculate values for z based on the parabola equation
Z = X**2 + Y**2
# Create a 3D figure

```

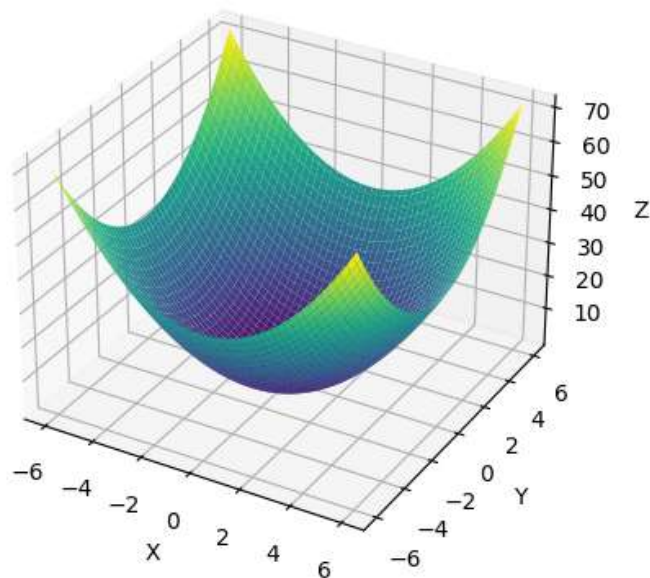
```

fig = plt.figure()
ax = fig.add_subplot(111, projection='3d')
# Plot the surface plot
surf = ax.plot_surface(X, Y, Z, cmap='viridis')
# Set labels for x, y, z axes
ax.set_xlabel('X')
ax.set_ylabel('Y')
ax.set_zlabel('Z')
# Set title for the graph
ax.set_title('Surface Plot of z = x**2 + y**2')
# Show the plot
plt.show()

```

OUTPUT:

Surface Plot of $z = x^2 + y^2$



Q.3) Write a Python program to plot 3D line graph Whose parametric equation is $(\cos(2x), \sin(2x), x)$ for $10 \leq x \leq 20$ (in red color), with title of the graph

Syntax:

```

import numpy as np
import matplotlib.pyplot as plt
from mpl_toolkits.mplot3d import Axes3D

```

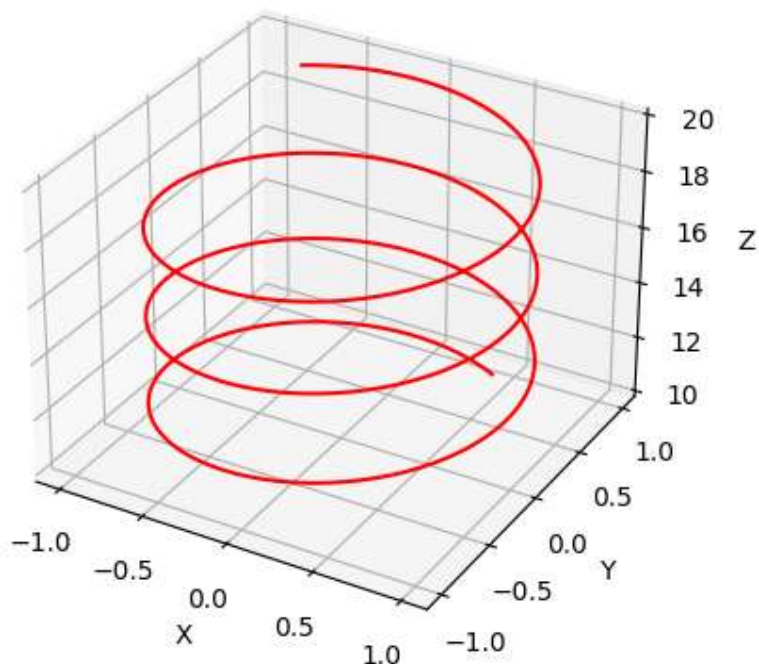
```

# Generate values for x
x = np.linspace(10, 20, 500)
# Calculate parametric equations for x, y, z
y = np.sin(2 * x)
z = x
x = np.cos(2 * x)
# Create a 3D figure
fig = plt.figure()
ax = fig.add_subplot(111, projection='3d')
# Plot the 3D line graph
ax.plot(x, y, z, color='red')
# Set title for the graph
ax.set_title("3D Line Graph: (cos(2x), sin(2x), x)")
# Set labels for x, y, z axes
ax.set_xlabel('X')
ax.set_ylabel('Y')
ax.set_zlabel('Z')
# Show the plot
plt.show()

```

3D Line Graph: (cos(2x), sin(2x), x)

OUTPUT:



Q.4) Write a python program to reflect the ABC through the line $y = 3$ where $A(1,0), D(2, -1), C(-1,3)$.

Syntax:

```
def reflect_point(point, line_y):
    x, y = point
    y_reflected = 2 * line_y - y
    return x, y_reflected
# Define the points A, D, and C
A = (1, 0)
D = (2, -1)
C = (-1, 3)
# Define the line of reflection
line_y = 3
# Reflect the points A, D, and C through the line of reflection
A_reflected = reflect_point(A, line_y)
D_reflected = reflect_point(D, line_y)
C_reflected = reflect_point(C, line_y)
# Print the reflected points
print("Original Points:")
print("A:", A)
print("D:", D)
print("C:", C)
print("Reflected Points:")
print("A_reflected:", A_reflected)
print("D_reflected:", D_reflected)
print("C_reflected:", C_reflected)
```

Output:

Original Points:

A: (1, 0)

D: (2, -1)

C: (-1, 3)

Reflected Points:

A_reflected: (1, 6)

D_reflected: (2, 7)

C_reflected: (-1, 3)

Q.5) Using sympy declare the points P(5, 2), Q(5, -2), R(5, 0), check whether these points are collinear. Declare the ray passing through the points P and Q, find the length of this ray between P and Q. Also find slope of this ray.

Syntax:

```
from sympy import *
# Declare the points P, Q, and R
P = Point(5, 2)
Q = Point(5, -2)
R = Point(5, Symbol('O'))
# Check if points P, Q, and R are collinear
collinear = Point.is_collinear(P, Q, R)
if collinear:
    print("Points P, Q, and R are collinear.")
else:
    print("Points P, Q, and R are not collinear.")
# Declare the ray passing through points P and Q
ray_PQ = Ray(P, Q)
# Find the length of the ray between points P and Q
length_PQ = ray_PQ.length
print("Length of ray PQ between points P and Q:", length_PQ)
# Find the slope of the ray PQ
slope_PQ = ray_PQ.slope
print("Slope of ray PQ:", slope_PQ)
```

OUTPUT:

```
Points P, Q, and R are collinear.
Length of ray PQ between points P and Q: 00
Slope of ray PQ: 00
```

Q.6) Write a Python program to find the area and perimeter of the $\triangle ABC$, where $A[0, 0]$, $B[5, 0]$, $C[3, 3]$.

Syntax:

```
import numpy as np
# Define the vertices of the triangle
A = np.array([0, 0])
```

```
B = np.array([4, 0])
C = np.array([3, 3])
# Calculate the side lengths of the triangle
AB = np.linalg.norm(B - A)
BC = np.linalg.norm(C - B)
CA = np.linalg.norm(A - C)
# Calculate the semiperimeter
s = (AB + BC + CA) / 2
# Calculate the area using Heron's formula
area = np.sqrt(s * (s - AB) * (s - BC) * (s - CA))
# Calculate the perimeter
perimeter = AB + BC + CA
# Print the results
print("Triangle ABC:")
print("Side AB:", AB)
print("Side BC:", BC)
print("Side CA:", CA)
print("Area:", area)
print("Perimeter:", perimeter)
```

OUTPUT:

Triangle ABC:

Side AB: 4.0

Side BC: 3.1622776601683795

Side CA: 4.242640687119285

Area: 6.00000000000000036

Perimeter: 11.404918347287666

Q.7) write a Python program to solve the following LPP

$$\text{Max } Z = 5x + 3y$$

Subjected to

$$x + y \leq 7$$

$$2x + 5y \leq 1$$

$$x > 0$$

$$y > 0$$

Syntax:

```
from scipy.optimize import linprog
# Objective function coefficients
c = [-5, -3]
# Coefficient matrix of inequality constraints
A = [[1, 1],
      [2, 5]]
# Right-hand side of inequality constraints
b = [7, 1]
# Bounds on variables
x_bounds = (0, None)
y_bounds = (0, None)
# Solve the linear programming problem
res = linprog(c, A_ub=A, b_ub=b, bounds=[x_bounds, y_bounds])
# Check if the optimization was successful
if res.success:
    print("Optimal solution found:")
    print("x =", res.x[0])
    print("y =", res.x[1])
    print("Maximum value of Z =", -res.fun)
```

else:

```
print("Optimization failed. Message:", res.message)
```

OUTPUT:

Optimal solution found:

$x = 0.5$

$y = 0.0$

Maximum value of $Z = 2.5$

Q.8) Write a python program to display the following LPP by using pulp module and simplex method. Find its optimal solution if exist.

Min $Z = 3x + 2y + 5z$

subject to

$x + 2y + z \leq 430$

$3x + 2z \leq 460$

$x + 4y \leq 120$

$x \geq 0, y \geq 0, z \geq 0$

Syntax:

```
from pulp import *
```

```
# Create a minimization problem
```

```
prob = LpProblem("Linear Programming Problem", LpMinimize)
```

```
# Define decision variables
```

```
x = LpVariable('x', lowBound=0)
```

```
y = LpVariable('y', lowBound=0)
```

```
z = LpVariable('z', lowBound=0)
```

```
# Define the objective function
```

```
prob += 3 * x + 2 * y + 5 * z
```

```
# Define the constraints
```

```

prob += x + 2 * y + z <= 430
prob += 3 * x + 2 * z <= 460
prob += x + 4 * y <= 120
# Solve the problem
prob.solve()
# Print the status of the problem
print("Status:", LpStatus[prob.status])
# If the problem is solved, print the optimal solution and its value
if prob.status == LpStatusOptimal:
    print("Optimal Solution:")
    print("x =", value(x))
    print("y =", value(y))
    print("z =", value(z))
    print("Objective Value =", value(prob.objective))
else:
    print("No optimal solution found.")

```

OUTPUT:

Status: Optimal

Optimal Solution:

x = 0.0

y = 0.0

z = 0.0

Objective Value = 0.0

Q.9) Apply Python. Program in each of the following transformation on the point P[-2,4]

(I) Shearing in Y direction by 7 units

(II) Scaling in X- and Y co-ordinate by $\frac{7}{2}$ and 7 units respectively.

(III) Scaling in X- and Y co-ordinate by 4 and 7 units respectively.

(IV) Rotation about origin by an angle 60°

Syntax:

```
import math
# Original point P
P = [-2, 4]
# Transformation 1: Shearing in Y direction by 7 units
shear_y = 7
P_sheared_y = [P[0], P[1] + shear_y]
print("Point after Shearing in Y direction by 7 units:", P_sheared_y)
# Transformation 2: Scaling in X- and Y-coordinate by 7/2 and 7 units
respectively
scale_x_1 = 7/2
scale_y_1 = 7
P_scaled_1 = [P_sheared_y[0] * scale_x_1, P_sheared_y[1] * scale_y_1]
print("Point after Scaling in X- and Y-coordinate by 7/2 and 7 units
respectively:", P_scaled_1)
# Transformation 3: Scaling in X- and Y-coordinate by 4 and 7 units respectively
scale_x_2 = 4
scale_y_2 = 7
P_scaled_2 = [P_scaled_1[0] * scale_x_2, P_scaled_1[1] * scale_y_2]
print("Point after Scaling in X- and Y-coordinate by 4 and 7 units respectively:",
P_scaled_2)
# Transformation 4: Rotation about origin by an angle of 60 degrees
angle = 60
angle_rad = math.radians(angle)
P_rotated = [P_scaled_2[0] * math.cos(angle_rad) - P_scaled_2[1] *
math.sin(angle_rad), P_scaled_2[0] * math.sin(angle_rad) + P_scaled_2[1] *
math.cos(angle_rad)]
print("Point after Rotation about origin by an angle of 60 degrees:", P_rotated)
```

OUTPUT:

Point after Shearing in Y direction by 7 units: [-2, 11]

Point after Scaling in X- and Y-coordinate by 7/2 and 7 units respectively: [-7.0, 77]

Point after Scaling in X- and Y-coordinate by 4 and 7 units respectively: [-28.0, 539]

Point after Rotation about origin by an angle of 60 degrees: [-480.7876926398124, 245.25128869403576]

Q.10) Write a python program to Plot 2D X-axis and Y-axis in black color. In the same diagram plot:-

(I) Green Triangle with vertices [5,4],[7,4],[6,6]

(II) Blue rectangle with vertices [2, 2], [10, 2], [10, 8], [2, 8].

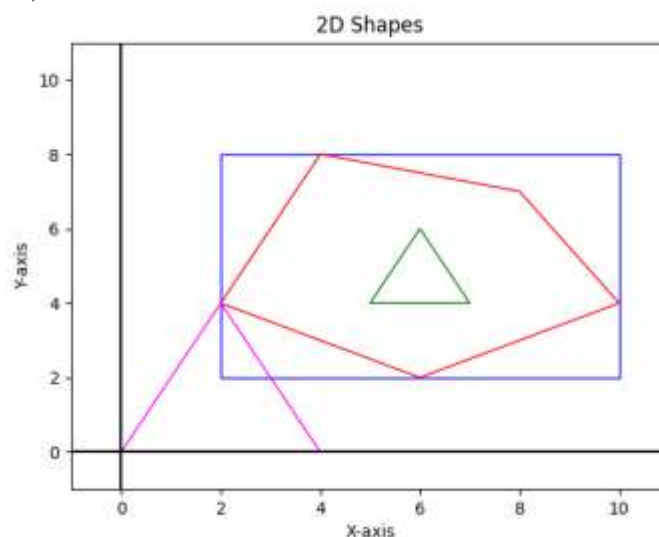
(III) Red polygon with vertices [6, 2], [10, 4], [8, 7], [4, 8], [2, 4].

(IV) Isosceles triangle with vertices [0, 0], [4, 0], [2, 4].

Syntax:

```
import matplotlib.pyplot as plt
# Create figure and axis
fig, ax = plt.subplots()
# Plot X-axis and Y-axis in black color
ax.axhline(0, color='black')
ax.axvline(0, color='black')
# Green Triangle with vertices [5,4],[7,4],[6,6]
green_triangle = plt.Polygon([[5, 4], [7, 4], [6, 6]], edgecolor='green',
facecolor='none')
ax.add_patch(green_triangle)
# Blue Rectangle with vertices [2, 2], [10, 2], [10, 8], [2, 8]
blue_rectangle = plt.Polygon([[2, 2], [10, 2], [10, 8], [2, 8]], edgecolor='blue',
facecolor='none')
ax.add_patch(blue_rectangle)
# Red Polygon with vertices [6, 2], [10, 4], [8, 7], [4, 8], [2, 4]
red_polygon = plt.Polygon([[6, 2], [10, 4], [8, 7], [4, 8], [2, 4]], edgecolor='red',
facecolor='none')
ax.add_patch(red_polygon)
# Isosceles Triangle with vertices [0, 0], [4, 0], [2, 4]
isosceles_triangle = plt.Polygon([[0, 0], [4, 0], [2, 4]], edgecolor='magenta',
facecolor='none')
ax.add_patch(isosceles_triangle)
# Set axis limits
ax.set_xlim([-1, 11])
ax.set_ylim([-1, 11])
# Set labels and title
ax.set_xlabel('X-axis')
ax.set_ylabel('Y-axis')
ax.set_title('2D Shapes')
# Show the plot
plt.show()
```

OUTPUT:



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DEPARTMENT OF COMPUTER SCIENCE

MATHEMATICS

Name :- Prem Vijay Vajare

Batch No. :- D

Title of the:- Practical 14

Expt. No . 14

Remark
Demonstrators
Signature
Date :- / /2023

Roll No:- 75 **Date:-** / /2023

Class :- S.Y.BCS

Q.1) Write a Python program to plot 2D graph of the functions $f(x) = x^2$ and $g(x) = x^3$ in $[-1, 1]$

Syntax:

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

```
import numpy as np
```

```
def f(x):
```

```
    return x**2
```

```
def g(x):
```

```
    return x**3
```

```
# Generate x values in the range [-1, 1]
```

```
x = np.linspace(-1, 1, 100)
```

```
# Calculate y values for f(x) and g(x)
```

```
y_f = f(x)
```

```
y_g = g(x)
```

```
# Create a figure and axes
```

```
fig, ax = plt.subplots()
```

```
# Plot f(x) and g(x) on the same graph
```

```
ax.plot(x, y_f, label='f(x) = x^2')
```

```
ax.plot(x, y_g, label='g(x) = x^3')
```

```
# Add labels and legend
```

```
ax.set_xlabel('x')
```

```
ax.set_ylabel('y')
```

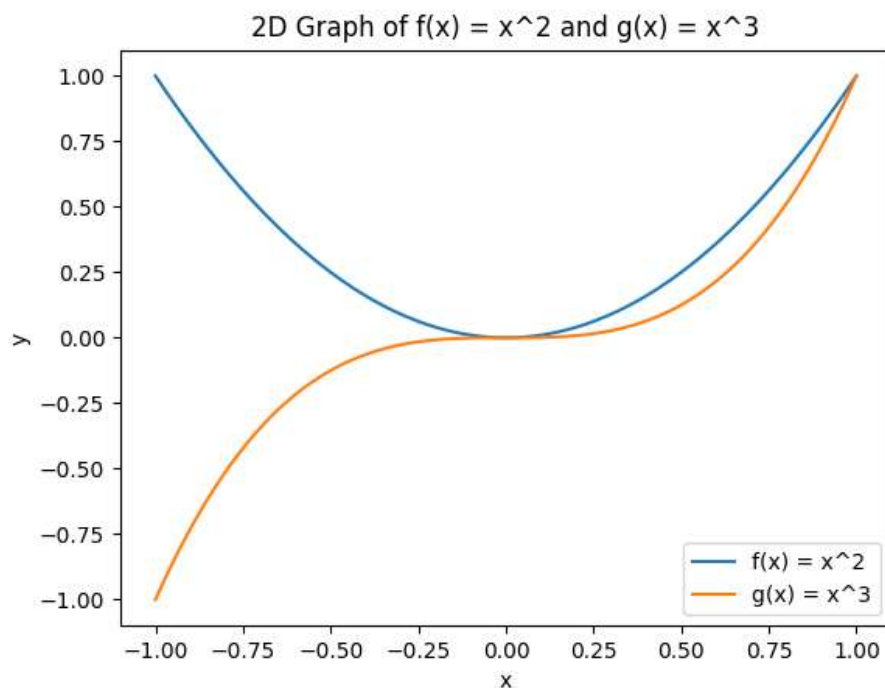
```
ax.legend()
```

```

# Set title
ax.set_title('2D Graph of f(x) = x^2 and g(x) = x^3')
# Show the plot
plt.show()

```

OUTPUT:



Q.2) Write a Python program to plot 3D graph of the function $f(x) = e^{-x^2}$ in $[-5, 5]$ with green dashed points line with upward pointing triangle.

Syntax:

```

import numpy as np
import matplotlib.pyplot as plt
# Generate x values
x = np.linspace(-5, 5, 100)
# Compute y values using the given function
y = np.exp(-x**2)

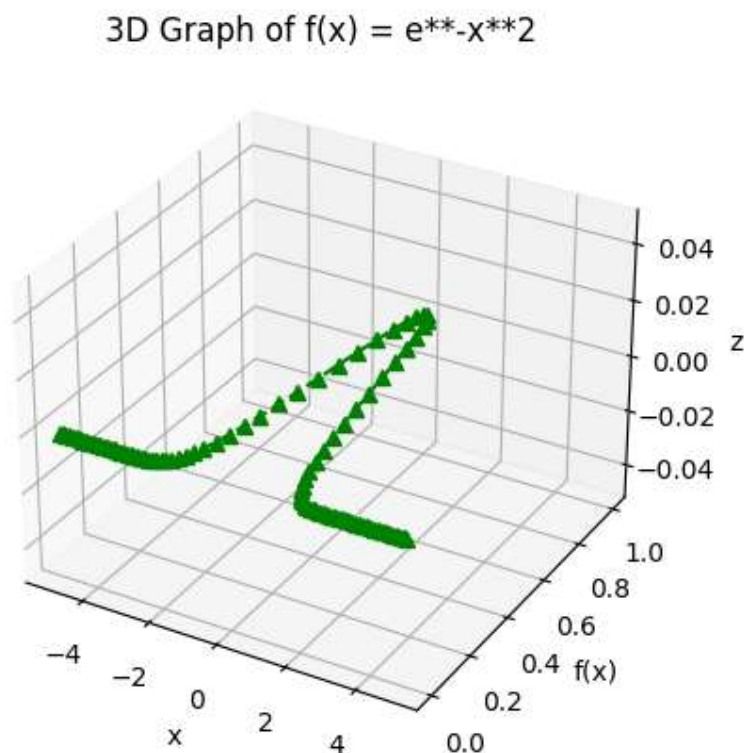
```

```

# Create 3D plot
fig = plt.figure()
ax = fig.add_subplot(111, projection='3d')
# Plot the points with green dashed line and upward-pointing triangles
ax.plot(x, y, np.zeros_like(x), linestyle='dashed', color='green', marker='^')
# Set labels for axes
ax.set_xlabel('x')
ax.set_ylabel('f(x)')
ax.set_zlabel('z')
# Set title for the plot
ax.set_title('3D Graph of f(x) = e**(-x**2)')
# Show the plot
plt.show()

```

OUTPUT:

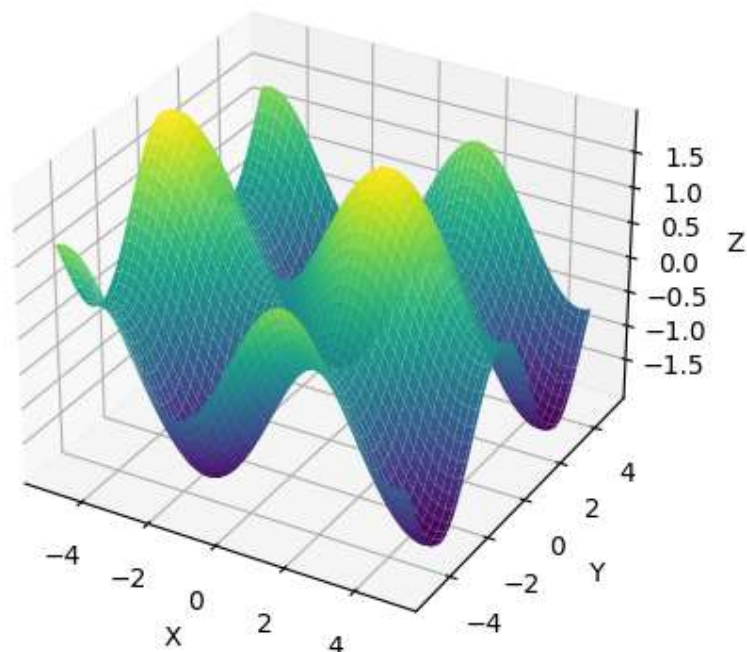


Q.3) Write a Python program to generate 3D plot of the functions $z = \sin x + \cos y$ in $-5 < x, y < 5$.

Syntax:

```
import numpy as np
import matplotlib.pyplot as plt
from mpl_toolkits.mplot3d import Axes3D
# Generate data
x = np.linspace(-5, 5, 100)
y = np.linspace(-5, 5, 100)
X, Y = np.meshgrid(x, y)
Z = np.sin(X) + np.cos(Y)
# Create 3D plot
fig = plt.figure()
ax = fig.add_subplot(111, projection='3d')
ax.plot_surface(X, Y, Z, cmap='viridis')
ax.set_xlabel('X')
ax.set_ylabel('Y')
ax.set_zlabel('Z')
ax.set_title('3D Plot of z = sin(x) + cos(y)')
plt.show()
```

OUTPUT: 3D Plot of $z = \sin(x) + \cos(y)$



Q.4) write a Python program to reflect the line segment joining the points A[5, 3] and B[1, 4] through the line $y = x + 1$.

Syntax:

```
import numpy as np
# Define the points A and B
A = np.array([5, 3])
B = np.array([1, 4])
# Define the equation of the reflecting line
def reflect(line, point):
    m = line[0]
    c = line[1]
    x, y = point
    x_reflect = (2 * m * (y - c) + x * (m ** 2 - 1)) / (m ** 2 + 1)
    y_reflect = (2 * m * x + y * (1 - m ** 2) + 2 * c) / (m ** 2 + 1)
    return np.array([x_reflect, y_reflect])
# Define the equation of the reflecting line  $y = x + 1$ 
line = np.array([1, -1])
# Reflect points A and B through the reflecting line
A_reflected = reflect(line, A)
B_reflected = reflect(line, B)
# Print the reflected points
print("Reflected Point A'", A_reflected)
print("Reflected Point B'", B_reflected)
```

Output:

Reflected Point A': [4. 4.]

Reflected Point B': [5. 0.]

Q.5) Write a Python program to draw a polygon with vertices (0, 0), (2, 0), (2, 3) and (1, 6) and rotate it by 180° .

Syntax:

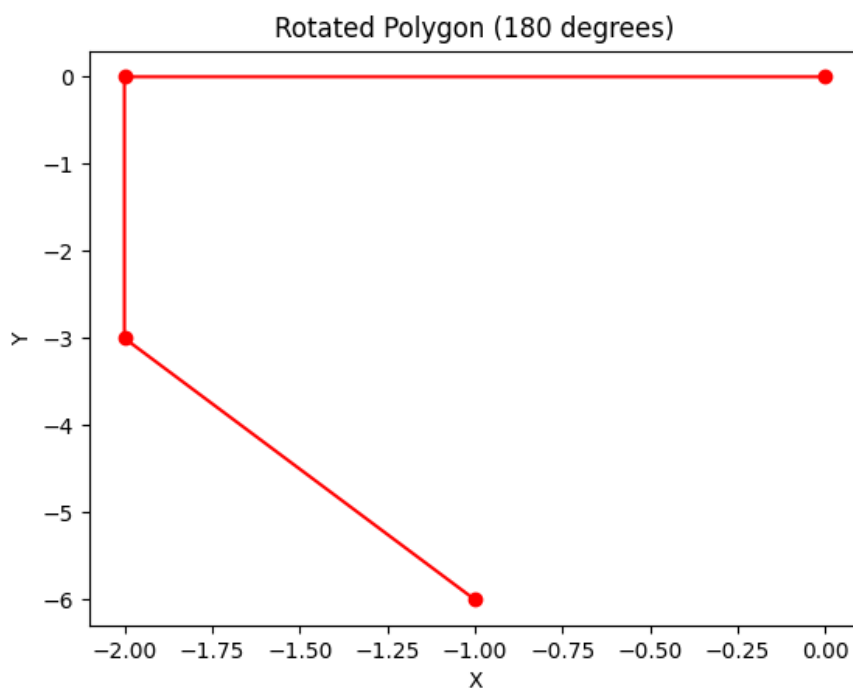
```
import matplotlib.pyplot as plt
import numpy as np
# Define the vertices of the polygon
vertices = np.array([[0, 0], [2, 0], [2, 3], [1, 6]])
```

```

# Plot the original polygon
plt.figure()
plt.plot(vertices[:, 0], vertices[:, 1], 'bo-')
plt.title('Original Polygon')
plt.xlabel('X')
plt.ylabel('Y')
# Define the rotation matrix for 180 degrees
theta = np.pi # 180 degrees
rotation_matrix = np.array([[np.cos(theta), -np.sin(theta)],
                             [np.sin(theta), np.cos(theta)]])
# Apply rotation to the vertices
vertices_rotated = np.dot(vertices, rotation_matrix)
# Plot the rotated polygon
plt.figure()
plt.plot(vertices_rotated[:, 0], vertices_rotated[:, 1], 'ro-')
plt.title('Rotated Polygon (180 degrees)')
plt.xlabel('X')
plt.ylabel('Y')
# Show the plots
plt.show()

```

OUTPUT:



Q.6) Write a Python program to find the area and perimeter of the ABC, where A[0, 0] B[5, 0], C[3,3].

Syntax:

```
import numpy as np

# Define the vertices of the triangle
A = np.array([0, 0])
B = np.array([5, 0])
C = np.array([3, 3])

# Calculate the side lengths of the triangle
AB = np.linalg.norm(B - A)
BC = np.linalg.norm(C - B)
CA = np.linalg.norm(A - C)

# Calculate the semiperimeter
s = (AB + BC + CA) / 2

# Calculate the area using Heron's formula
area = np.sqrt(s * (s - AB) * (s - BC) * (s - CA))

# Calculate the perimeter
perimeter = AB + BC + CA

# Print the results
print("Triangle ABC:")
print("Side AB:", AB)
print("Side BC:", BC)
print("Side CA:", CA)
print("Area:", area)
print("Perimeter:", perimeter)
```

OUTPUT:

Triangle ABC:

Side AB: 5.0

Side BC: 3.605551275463989

Side CA: 4.242640687119285

Area: 7.5000000000000036

Perimeter: 12.848191962583275

Transformed Point A: [38. 10.]

Transformed Point B: [35. 8.]

Q.7) write a Python program to solve the following LPP

$$\text{Max } Z = 150x + 75y$$

Subjected to

$$4x + 6y \leq 24$$

$$5x + 3y \leq 15$$

$$x > 0, y > 0$$

Syntax:

```
from pulp import *  
  
# Create the LP problem as a maximization problem  
problem = LpProblem("LPP", LpMaximize)  
  
# Define the decision variables  
x = LpVariable('x', lowBound=0, cat='Continuous')  
y = LpVariable('y', lowBound=0, cat='Continuous')  
  
# Define the objective function  
problem += 150 * x + 75 * y, "Z"  
  
# Define the constraints  
problem += 4 * x + 6 * y <= 24, "Constraint1"  
problem += 5 * x + 3 * y <= 15, "Constraint2"  
  
# Solve the LP problem  
problem.solve()
```

```

# Print the status of the solution
print("Status:", LpStatus[problem.status])

# Print the optimal values of x and y
print("Optimal x =", value(x))
print("Optimal y =", value(y))

# Print the optimal value of the objective function
print("Optimal Z =", value(problem.objective

```

OUTPUT:

```

Status: Optimal
Optimal x = 3.0
Optimal y = 0.0
Optimal Z = 450.0

```

Q.8) Write a python program to display the following LPP by using pulp module and simplex method. Find its optimal solution if exist.

```

Min Z = x+y
subject to
x => 6
y => 6
x + y <= 11
x=>0, y=>0

```

Syntax:

```

from pulp import *
# Create the LP problem as a minimization problem
problem = LpProblem("LPP", LpMinimize)
# Define the decision variables
x = LpVariable('x', lowBound=0, cat='Continuous')
y = LpVariable('y', lowBound=0, cat='Continuous')
# Define the objective function
problem += x + y, "Z"
# Define the constraints
problem += x >= 6, "Constraint1"
problem += y >= 6, "Constraint2"
problem += x + y <= 11, "Constraint3"
# Solve the LP problem using the simplex method

```

```

problem.solve(PULP_CBC_CMD(msg=False))
# Print the status of the solution
print("Status:", LpStatus[problem.status])
# If the problem has an optimal solution
if problem.status == LpStatusOptimal:
    # Print the optimal values of x and y
    print("Optimal x =", value(x))
    print("Optimal y =", value(y))
    # Print the optimal value of the objective function
    print("Optimal Z =", value(problem.objective))

```

OUTPUT:

Status: Optimal

Status: Infeasible

Q.9) Apply each of the following Transformation on the point P[2, -3].

(I) Reflection through X-axis.

(II) Scaling in X-co-ordinate by factor 2.

(III) Scaling in Y-co-ordinate by factor 1.5.

(IV) Reflection through the line $y = x$

Syntax:

```

import numpy as np
# Point P
P = np.array([2, -3])
# Transformation 1: Reflection through X-axis
T1 = np.array([[1, 0], [0, -1]])
P_T1 = np.dot(T1, P)
# Transformation 2: Scaling in X-coordinate by factor 2
T2 = np.array([[2, 0], [0, 1]])
P_T2 = np.dot(T2, P)
# Transformation 3: Scaling in Y-coordinate by factor 1.5
T3 = np.array([[1, 0], [0, 1.5]])
P_T3 = np.dot(T3, P)
# Transformation 4: Reflection through the line y = x
T4 = np.array([[0, 1], [1, 0]])
P_T4 = np.dot(T4, P)
# Displaying the results
print("Original Point P: ", P)
print("Transformation 1: Reflection through X-axis: ", P_T1)
print("Transformation 2: Scaling in X-coordinate by factor 2: ", P_T2)
print("Transformation 3: Scaling in Y-coordinate by factor 1.5: ", P_T3)

```

```
print("Transformation 4: Reflection through the line  $y = x$ : ", P_T4)
```

OUTPUT:

Original Point P: [2 -3]

Transformation 1: Reflection through X-axis: [2 3]

Transformation 2: Scaling in X-coordinate by factor 2: [4 -3]

Transformation 3: Scaling in Y-coordinate by factor 1.5: [2. -4.5]

Transformation 4: Reflection through the line $y = x$: [-3 2]

Q.10) Apply each of the following Transformation on the point P[3, -1].

(I) Shearing in Y direction by 2 units.

(II) Scaling in X and Y direction by 1/2 and 3 units respectively.

(III) Shearing in both X and Y direction by -2 and 4 units respectively.

(IV) Rotation about origin by an angle 30 degrees.

Syntax:

```
import numpy as np
```

```
import math
```

```
# Point P
```

```
P = np.array([3, -1])
```

```
# Transformation 1: Shearing in Y direction by 2 units
```

```
T1 = np.array([[1, 0], [2, 1]])
```

```
P_T1 = np.dot(T1, P)
```

```
# Transformation 2: Scaling in X and Y direction by 1/2 and 3 units respectively
```

```
T2 = np.array([[1/2, 0], [0, 3]])
```

```
P_T2 = np.dot(T2, P)
```

```
# Transformation 3: Shearing in both X and Y direction by -2 and 4 units  
respectively
```

```
T3 = np.array([[1, -2], [4, 1]])
```

```
P_T3 = np.dot(T3, P)
```

```
# Transformation 4: Rotation about origin by an angle 30 degrees
```

```
theta = np.deg2rad(30) # Convert angle to radians
```

```
T4 = np.array([[np.cos(theta), -np.sin(theta)], [np.sin(theta), np.cos(theta)]])
```

```
P_T4 = np.dot(T4, P)
```

```
# Displaying the results
```

```
print("Original Point P: ", P)
```

```
print("Transformation 1: Shearing in Y direction by 2 units: ", P_T1)
```

```
print("Transformation 2: Scaling in X and Y direction by 1/2 and 3 units  
respectively: ", P_T2)
```

```
print("Transformation 3: Shearing in both X and Y direction by -2 and 4 units  
respectively: ", P_T3)
```

```
print("Transformation 4: Rotation about origin by an angle 30 degrees: ", P_T4)
```

OUTPUT:

Original Point P: [3 -1]

Transformation 1: Shearing in Y direction by 2 units: [3 5]

Transformation 2: Scaling in X and Y direction by 1/2 and 3 units respectively:
[1.5 -3.]

Transformation 3: Shearing in both X and Y direction by -2 and 4 units
respectively: [5 11]

Transformation 4: Rotation about origin by an angle 30 degrees: [3.09807621
0.6339746]

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DEPARTMENT OF COMPUTER SCIENCE

MATHEMATICS

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Roll No:- 75 **Date:-** / /2023

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Q.1) Write the python program to find area of the triangle ABC where A[0,0],B[5,0],C[3,3]

Syntax:

```
import math
```

```
def calculate_area(x1, y1, x2, y2, x3, y3):
```

```
    """Function to calculate area of a triangle given its three vertices."""
```

```
    area = abs((x1 * (y2 - y3) + x2 * (y3 - y1) + x3 * (y1 - y2)) / 2)
```

```
    return area
```

```
# Coordinates of vertices A, B, and C
```

```
Ax, Ay = 0, 0
```

```
Bx, By = 5, 0
```

```
Cx, Cy = 3, 3
```

```
# Call the function to calculate the area
```

```
area = calculate_area(Ax, Ay, Bx, By, Cx, Cy)
```

```
# Print the result
```

```
print("Area of triangle ABC is:", area)
```

OUTPUT:

Area of triangle ABC is: 7.5

Q.2) Write the python program to plot the graphs of sin x, cos x, e**x and x **2 in [0,5] in one figure with 2X2 subplots

Syntax:

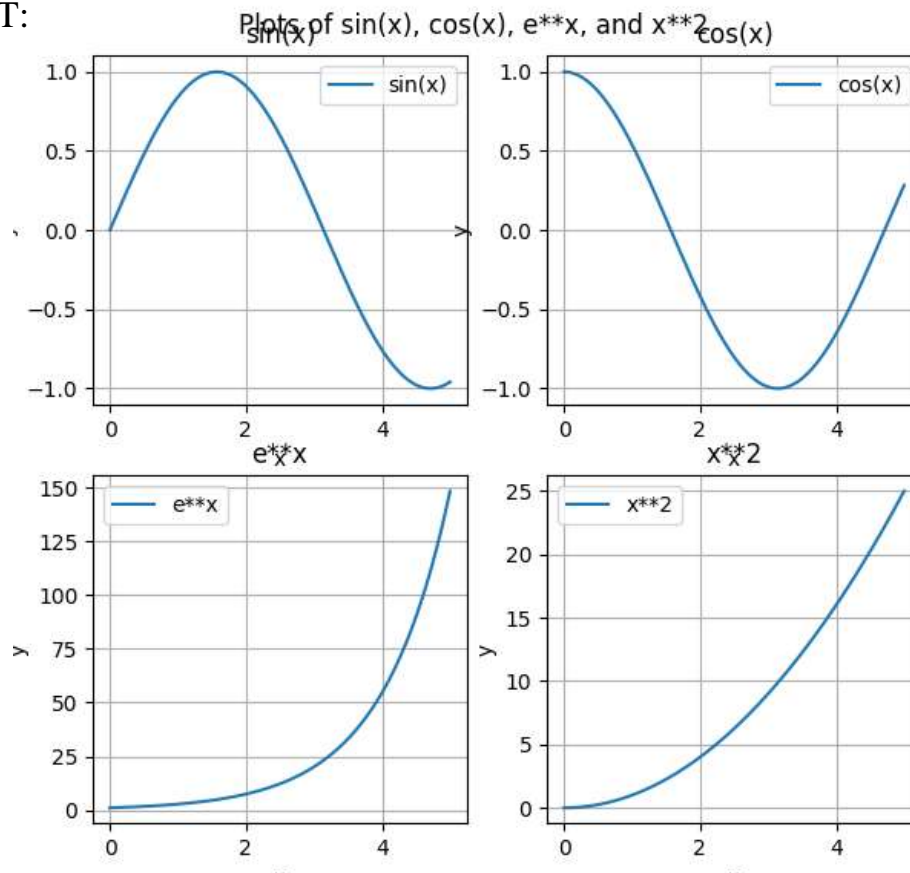
```
import numpy as np
```

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

```
# Generate x values in the interval [0, 5]
x = np.linspace(0, 5, 500)
# Evaluate sin(x), cos(x), e**x, and x**2 for the x values
y1 = np.sin(x)
y2 = np.cos(x)
y3 = np.exp(x)
y4 = x**2
# Create a 2x2 subplot figure
fig, axs = plt.subplots(2, 2, figsize=(10, 10))
fig.suptitle('Plots of sin(x), cos(x), e**x, and x**2')
# Plot sin(x) in the top left subplot
axs[0, 0].plot(x, y1, label='sin(x)')
axs[0, 0].set_title('sin(x)')
# Plot cos(x) in the top right subplot
axs[0, 1].plot(x, y2, label='cos(x)')
axs[0, 1].set_title('cos(x)')
# Plot e**x in the bottom left subplot
axs[1, 0].plot(x, y3, label='e**x')
axs[1, 0].set_title('e**x')
# Plot x**2 in the bottom right subplot
axs[1, 1].plot(x, y4, label='x**2')
axs[1, 1].set_title('x**2')
# Add labels, legends, and grids to all subplots
for ax in axs.flat:
    ax.set_xlabel('x')
    ax.set_ylabel('y')
    ax.legend()
    ax.grid(True)
# Adjust spacing between subplots
```

```
fig.tight_layout()
# Show the plot
plt.show()
```

OUTPUT:



Q.3) Write the python program to plot the graph of the function using def ()

$$f(x) = \begin{cases} x^2 + 4, & \text{if } -10 < x < 5 \\ 3x + 9, & \text{if } 5 < x \leq 0 \end{cases}$$

Syntax:

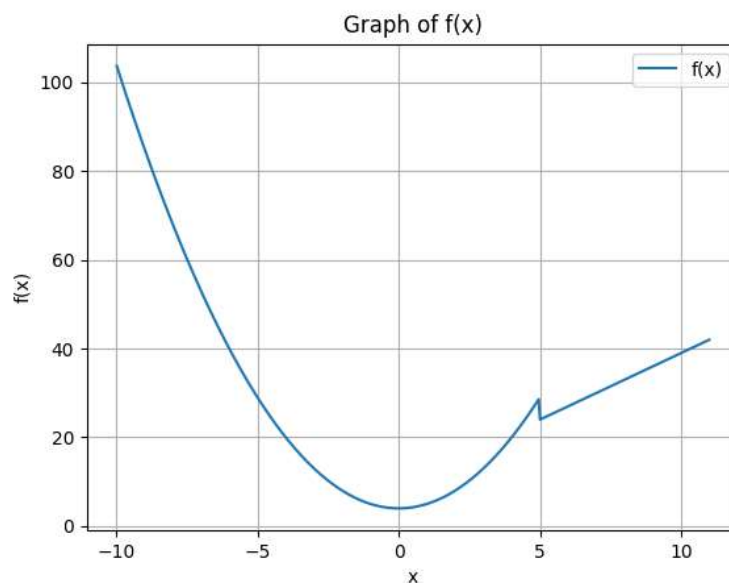
```
import numpy as np
import matplotlib.pyplot as plt
def f(x):
    """Function to define f(x)."""
    if -10 < x < 5:
        return x**2 + 4
    elif 5 <= x:
```

```

    return 3*x + 9
else:
    return None
# Generate x values
x = np.linspace(-11, 11, 500) # Generate 500 points between -11 and 11
# Calculate y values using f(x)
y = np.array([f(xi) for xi in x])
# Create the plot
plt.plot(x, y, label='f(x)')
plt.xlabel('x')
plt.ylabel('f(x)')
plt.title('Graph of f(x)')
plt.legend()
plt.grid(True)
plt.show()

```

OUTPUT:



Q.4) write the Python program to rotate the triangle ABC by 180 degree, where A [2,1] B[2, -2] & C[-1, 2].

Syntax:

```
import numpy as np
# Define the original triangle vertices
A = np.array([2, 1])
B = np.array([2, -2])
C = np.array([-1, 2])
# Define the rotation matrix for 180 degrees
rotation_matrix = np.array([[ -1, 0],[0, -1]])
# Rotate the triangle vertices using the rotation matrix
A_rotated = np.dot(rotation_matrix, A)
B_rotated = np.dot(rotation_matrix, B)
C_rotated = np.dot(rotation_matrix, C)
# Print the rotated triangle vertices
print("Original Triangle Vertices:")
print("A:", A)
print("B:", B)
print("C:", C)
print("Rotated Triangle Vertices:")
print("A Rotated:", A_rotated)
print("B Rotated:", B_rotated)
print("C Rotated:", C_rotated)
```

Output:

Original Triangle Vertices:

A: [2 1]

B: [2 -2]

C: [-1 2]

Rotated Triangle Vertices:

A Rotated: [-2 -1]

B Rotated: [-2 2]

C Rotated: [1 -2]

Q.5) Write the Python program to plot the graph of function $f(x) = e^{**x}$ in the interval [-10, 10].

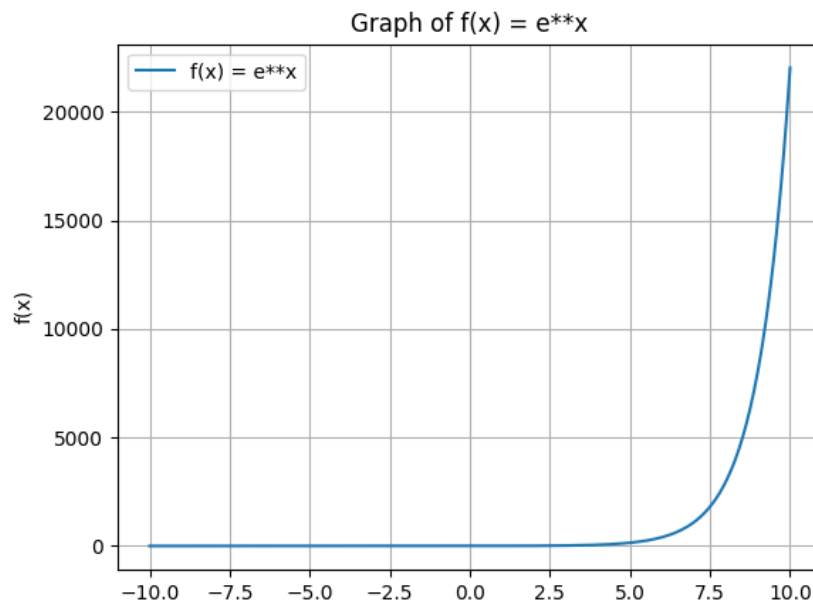
Syntax:

```

import numpy as np
import matplotlib.pyplot as plt
# Define the function f(x) = e**x
def f(x):
    return np.exp(x)
# Generate x values in the interval [-10, 10]
x = np.linspace(-10, 10, 500)
# Evaluate f(x) for the x values
y = f(x)
# Create a plot
plt.plot(x, y, label='f(x) = e**x')
plt.xlabel('x')
plt.ylabel('f(x)')
plt.title('Graph of f(x) = e**x')
plt.legend()
plt.grid(True)
plt.show()

```

OUTPUT:



Q.6) Write a Python program to plot 3D line graph Whose parametric equation is $(\cos(2x), \sin(2x), x)$ for $10 \leq x \leq 20$ (in red color), with title of the graph

Syntax:

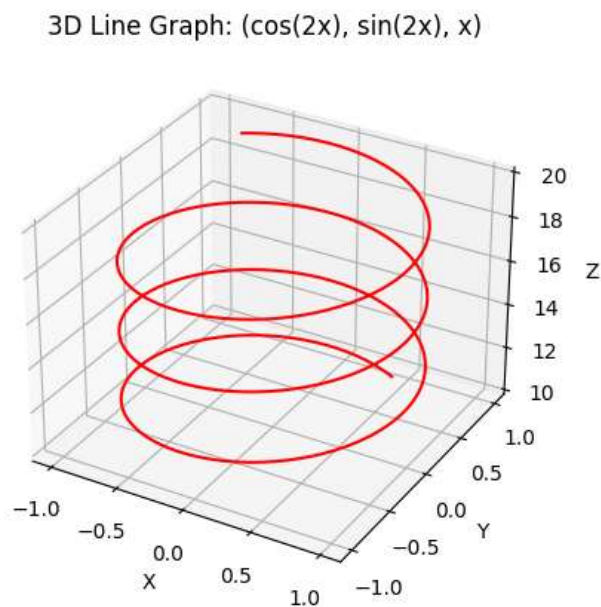
```
import numpy as np
```

```

import matplotlib.pyplot as plt
from mpl_toolkits.mplot3d import Axes3D
# Generate values for x
x = np.linspace(10, 20, 500)
# Calculate parametric equations for x, y, z
y = np.sin(2 * x)
z = x
x = np.cos(2 * x)
# Create a 3D figure
fig = plt.figure()
ax = fig.add_subplot(111, projection='3d')
# Plot the 3D line graph
ax.plot(x, y, z, color='red')
# Set title for the graph
ax.set_title("3D Line Graph: (cos(2x), sin(2x), x)")
# Set labels for x, y, z axes
ax.set_xlabel('X')
ax.set_ylabel('Y')
ax.set_zlabel('Z')
# Show the plot
plt.show()

```

OUTPUT:



Q.7) write a Python program to solve the following LPP

$$\text{Max } Z = 3.5x + 2y$$

Subjected to

$$x + y \geq 5$$

$$x \geq 4$$

$$y \leq 5$$

$$x \geq 0, y \geq 0.$$

Syntax:

```
from pulp import *
# Create the LP problem
problem = LpProblem("Maximize Z", LpMaximize)
# Define the decision variables
x = LpVariable('x', lowBound=0) # x >= 0
y = LpVariable('y', lowBound=0) # y >= 0
# Define the objective function
problem += 3.5 * x + 2 * y
# Define the constraints
problem += x + y >= 5
problem += x >= 4
problem += y <= 5
# Solve the LP problem
status = problem.solve()
# Check the solution status
if status == 1:
    # Print the optimal solution
    print("Optimal solution:")
    print(f"x = {value(x)}")
```

```

    print(f"y = {value(y)}")
    print(f"Z = {value(problem.objective)}")
else:
    print("No feasible solution found.")

```

OUTPUT:

No feasible solution found.

Q.8) Write a python program to display the following LPP by using pulp module and simplex method. Find its optimal solution if exist.

Min $Z = x+y$

subject to

$x \geq 6$

$y \geq 6$

$x + y \leq 11$

$x \geq 0, y \geq 0$

Syntax:

```

from pulp import *

# Create the LP problem as a minimization problem
problem = LpProblem("LPP", LpMinimize)

# Define the decision variables
x = LpVariable('x', lowBound=0, cat='Continuous')
y = LpVariable('y', lowBound=0, cat='Continuous')

# Define the objective function
problem += x + y, "Z"

# Define the constraints
problem += x >= 6, "Constraint1"
problem += y >= 6, "Constraint2"
problem += x + y <= 11, "Constraint3"

# Solve the LP problem using the simplex method
problem.solve(PULP_CBC_CMD(msg=False))

# Print the status of the solution

```



```

A_rotation = np.dot(rotation_matrix, A)
B_rotation = np.dot(rotation_matrix, B)

# Print points A and B after rotation
print("\nPoints after Rotation:")
print("Point A: ({} , {})".format(A_rotation[0], A_rotation[1]))
print("Point B: ({} , {})".format(B_rotation[0], B_rotation[1]))
# Transformation II: Scaling in x-coordinate by 5 units
scaling_matrix = np.array([[5, 0],
                           [0, 1]])
A_scaling = np.dot(scaling_matrix, A_rotation)
B_scaling = np.dot(scaling_matrix, B_rotation)
# Print points A and B after scaling
print("\nPoints after Scaling:")
print("Point A: ({} , {})".format(A_scaling[0], A_scaling[1]))
print("Point B: ({} , {})".format(B_scaling[0], B_scaling[1]))
# Transformation III: Reflection through the line y = -x
reflection_matrix = np.array([[0, -1], [-1, 0]])
A_reflection = np.dot(reflection_matrix, A_scaling)
B_reflection = np.dot(reflection_matrix, B_scaling)
# Print points A and B after reflection
print("\nPoints after Reflection:")
print("Point A: ({} , {})".format(A_reflection[0], A_reflection[1]))
print("Point B: ({} , {})".format(B_reflection[0], B_reflection[1]))

```

OUTPUT:

Original Points:

Point A: (5, 3)

Point B: (1, 4)

Points after Rotation:

Point A: (-2.9999999999999996, 5.0)

Point B: (-4.0, 1.0000000000000002)

Points after Scaling:

Point A: (-14.999999999999998, 5.0)

Point B: (-20.0, 1.0000000000000002)

Points after Reflection:

Point A: (-5.0, 14.999999999999998)

Point B: (-1.0000000000000002, 20.0)

Q.10) Write the python program to apply each of the following transformation on the point P(-2,4)

- (I) Reflection Through the line $y = x + 1$
- (II) Scaling in y-Coordinate by factor 1.5
- (III) Shearing in x – Direction by 2 unit
- (IV) Rotation about origin by an angle 45 degree.

Syntax:

```
import numpy as np
# Define the original point P
P = np.array([-2, 4])
# Print the original point P
print("Original Point:")
print("Point P: ({} , {})".format(P[0], P[1]))
# Transformation I: Reflection through the line y = x + 1
reflection_matrix = np.array([[0, 1], [1, 0]])
P_reflection = np.dot(reflection_matrix, P)
# Print the point P after reflection
print("\nPoint after Reflection:")
print("Point P: ({} , {})".format(P_reflection[0], P_reflection[1]))
# Transformation II: Scaling in y-coordinate by factor 1.5
scaling_matrix = np.array([[1, 0], [0, 1.5]])
P_scaling = np.dot(scaling_matrix, P_reflection)
# Print the point P after scaling
print("\nPoint after Scaling:")
print("Point P: ({} , {})".format(P_scaling[0], P_scaling[1]))
# Transformation III: Shearing in x-direction by 2 units
shearing_matrix = np.array([[1, 2], [0, 1]])
P_shearing = np.dot(shearing_matrix, P_scaling)
# Print the point P after shearing
print("\nPoint after Shearing:")
print("Point P: ({} , {})".format(P_shearing[0], P_shearing[1]))
# Transformation IV: Rotation about origin by an angle of 45 degrees
theta = np.deg2rad(45)
rotation_matrix = np.array([[np.cos(theta), -np.sin(theta)], [np.sin(theta), np.cos(theta)]])
P_rotation = np.dot(rotation_matrix, P_shearing)
# Print the point P after rotation
print("\nPoint after Rotation:")
print("Point P: ({} , {})".format(P_rotation[0], P_rotation[1]))
```

OUTPUT:

Original Point:

Point P: (-2, 4)

Point after Reflection:

Point P: (4, -2)

Point after Scaling:

Point P: (4.0, -3.0)

Point after Shearing:

Point P: (-2.0, -3.0)

Point after Rotation:

Point P: (0.7071067811865477, -3.5355339059327378)

Sahakar Maharshi Bhausaheb Santuji Thorat

College Sangamner

DEPARTMENT OF COMPUTER SCIENCE

MATHEMATICS

Name :- Prem Vijay Vajare

Batch No. :- D

Title of the:- Practical 16

Expt. No .16

Remark
Demonstrators
Signature
Date :- / /2023

Roll No:- 75 **Date:-** / /2023

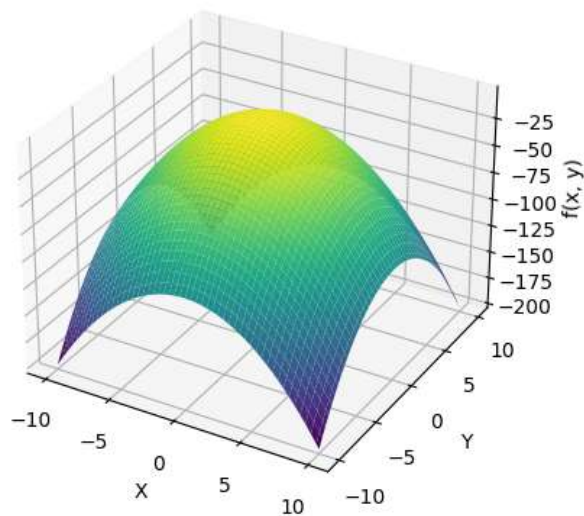
Class :- S.Y.BCS

Q.1) Write a Python program to plot graph of the function $f(x, y) = -x^2 - y^2$ when $-10 \leq x, y \leq 10$.

Syntax:

```
import matplotlib.pyplot as plt
import numpy as np
# Define the function
def f(x, y):
    return -x**2 - y**2
# Generate x and y values within the range of -10 to 10
x = np.linspace(-10, 10, 100)
y = np.linspace(-10, 10, 100)
# Create a grid of x and y values
X, Y = np.meshgrid(x, y)
# Compute the values of f(x, y) for each (x, y) in the grid
Z = f(X, Y)
# Plot the surface using matplotlib
fig = plt.figure()
ax = fig.add_subplot(111, projection='3d')
ax.plot_surface(X, Y, Z, cmap='viridis')
ax.set_xlabel('X')
ax.set_ylabel('Y')
ax.set_zlabel('f(x, y)')
ax.set_title('Graph of f(x, y) = -x**2 - y**2')
plt.show()
```

OUTPUT: Graph of $f(x, y) = -x^{**2} - y^{**2}$

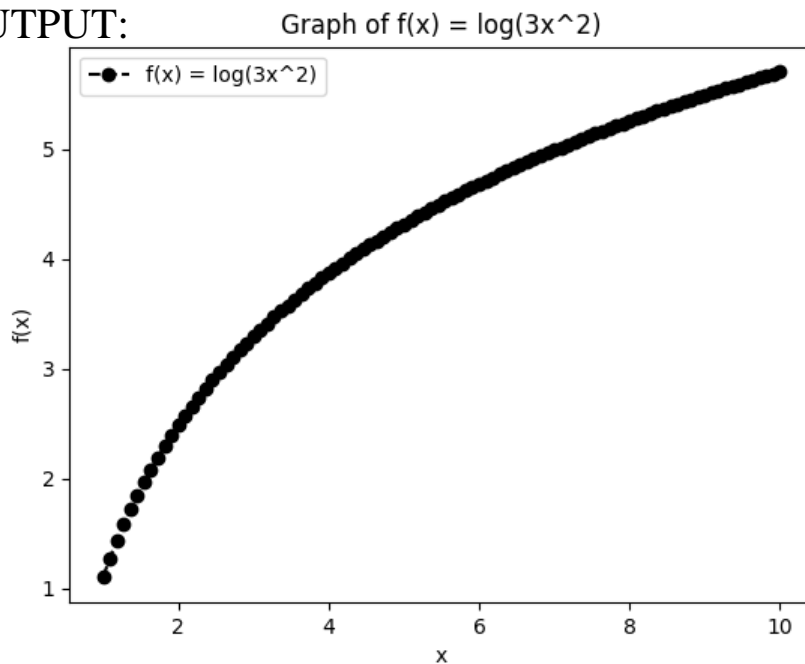


Q.2) Write a Python program to plot graph of the function $f(x) = \log(3x^2)$ in $[1, 10]$ with black dashed points

Syntax:

```
import matplotlib.pyplot as plt
import numpy as np
# Define the function
def f(x):
    return np.log(3 * x**2)
# Generate x values within the range of [1, 10]
x = np.linspace(1, 10, 100)
# Compute the values of f(x) for each x in the range
y = f(x)
# Plot the graph with black dashed points
plt.plot(x, y, 'o--', color='black', label='f(x) = log(3x^2)')
plt.xlabel('x')
plt.ylabel('f(x)')
plt.title('Graph of f(x) = log(3x^2)')
plt.legend()
plt.show()
```

OUTPUT:



Q.3) Write python program to generate plot of the function $f(x) = x^2$, in the interval $[-5,5]$ in figure of size 6X6 inches

Syntax:

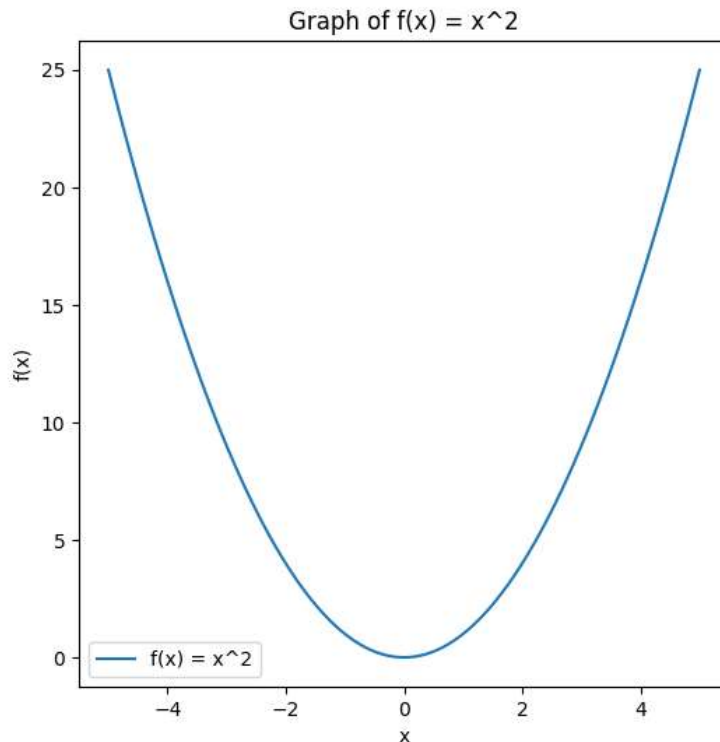
```
import matplotlib.pyplot as plt
import numpy as np
# Define the function
def f(x):
    return x**2
# Generate x values within the range of [-5, 5]
x = np.linspace(-5, 5, 100)
# Compute the values of f(x) for each x in the range
y = f(x)
# Create a figure with size 6x6 inches
fig = plt.figure(figsize=(6, 6))
# Plot the graph of the function
plt.plot(x, y, label='f(x) = x^2')
plt.xlabel('x')
plt.ylabel('f(x)')
```

```
plt.title('Graph of f(x) = x^2')
```

```
plt.legend()
```

```
plt.show()
```

OUTPUT:



Q.4) Write a Python program to declare the line segment passing through the points A(0, 7), B(5, 2). Also find the length and midpoint of the line segment passing through points A and B.

Syntax:

```
import math
```

```
# Define the coordinates of points A and B
```

```
xA, yA = 0, 7
```

```
xB, yB = 5, 2
```

```
# Calculate the length of the line segment using the distance formula
```

```
length = math.sqrt((xB - xA)**2 + (yB - yA)**2)
```

```
# Calculate the midpoint of the line segment
```

```
midpoint_x = (xA + xB) / 2
```

```
midpoint_y = (yA + yB) / 2
```

```
# Print the equation of the line passing through A and B
```

```
print("The equation of the line passing through A and B is: ")
```

```

print(f"y - {yA} = {(yB - yA) / (xB - xA)}(x - {xA})")
# Print the length and midpoint of the line segment
print(f"Length of the line segment: {length}")
print(f"Midpoint of the line segment: ({midpoint_x}, {midpoint_y})")

```

Output:

The equation of the line passing through A and B is:

$y - 7 = -1.0(x - 0)$

Length of the line segment: 7.0710678118654755

Midpoint of the line segment: (2.5, 4.5)

Q.5) Write a Python program to draw a polygon with vertices (0, 0), (2, 0), (2, 3) and (1, 6) and rotate it by 90°.

Syntax:

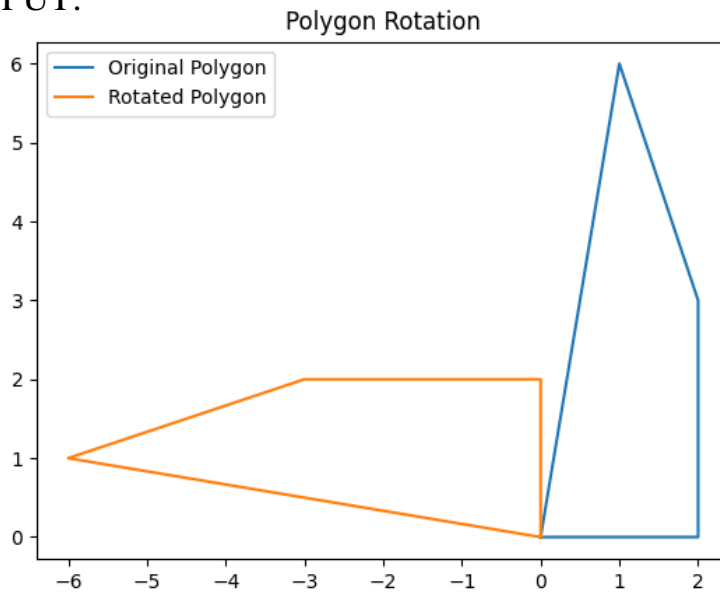
```

import matplotlib.pyplot as plt
import numpy as np
# Define the vertices of the polygon
vertices = np.array([[0, 0], [2, 0], [2, 3], [1, 6], [0, 0]])
# Plot the original polygon
plt.plot(vertices[:, 0], vertices[:, 1], label='Original Polygon')
# Define the rotation angle in degrees
rotation_angle = 90
# Convert the rotation angle to radians
theta = np.radians(rotation_angle)
# Create the rotation matrix
rotation_matrix = np.array([[np.cos(theta), -np.sin(theta)], [np.sin(theta), np.cos(theta)]])
# Apply the rotation matrix to the vertices of the polygon
rotated_vertices = np.dot(vertices, rotation_matrix.T)
# Plot the rotated polygon
plt.plot(rotated_vertices[:, 0], rotated_vertices[:, 1], label='Rotated Polygon')
# Set the aspect ratio to 'equal' for a square plot
plt.axis('equal')
# Add legend and title
plt.legend()
plt.title('Polygon Rotation')

```

```
# Show the plot  
plt.show()
```

OUTPUT:



Q.6) Write a Python program to Generate vector x in the interval [0, 15] using numpy package with 100 subintervals. import numpy as np

```
import numpy as np
```

```
# Define the start and end values of the interval
```

```
start = 0
```

```
end = 15
```

```
# Define the number of subintervals
```

```
num_subintervals = 100
```

```
# Generate the vector x with equally spaced values in the interval [0, 15]
```

```
x = np.linspace(start, end, num=num_subintervals+1)
```

```
# Print the generated vector x
```

```
print("Generated vector x:")
```

```
print(x)
```

OUTPUT:

Generated vector x:

```
[0.  0.15 0.3  0.45 0.6  0.75 0.9  1.05 1.2  1.35 1.5  1.65
 1.8  1.95 2.1  2.25 2.4  2.55 2.7  2.85 3.  3.15 3.3  3.45
 3.6  3.75 3.9  4.05 4.2  4.35 4.5  4.65 4.8  4.95 5.1  5.25
 5.4  5.55 5.7  5.85 6.  6.15 6.3  6.45 6.6  6.75 6.9  7.05
 7.2  7.35 7.5  7.65 7.8  7.95 8.1  8.25 8.4  8.55 8.7  8.85
 9.  9.15 9.3  9.45 9.6  9.75 9.9  10.05 10.2  10.35 10.5  10.65
10.8 10.95 11.1  11.25 11.4  11.55 11.7  11.85 12.  12.15 12.3  12.45
12.6 12.75 12.9  13.05 13.2  13.35 13.5  13.65 13.8  13.95 14.1  14.25
14.4 14.55 14.7  14.85 15. ]
```

Q.7) write a Python program to solve the following LPP

Max $Z = 3.5x + 2y$

Subjected to

$x + y \geq 5$

$x \geq 4$

$y \leq 2$

$x > 0, y > 0$

Syntax:

```
import numpy as np
from scipy.optimize import linprog
# Coefficients of the objective function
c = [-3.5, -2]
# Coefficients of the inequality constraints
A = [[-1, -1], [-1, 0], [0, 1]]
b = [-5, -4, 2]
# Bounds on the variables
x_bounds = (0, None)
y_bounds = (0, None)
# Solve the linear programming problem
```

```
result = linprog(c, A_ub=A, b_ub=b, bounds=[x_bounds, y_bounds])
```

```
if result.success:
```

```
    print("Optimal solution found:")
```

```
    print("x =", result.x[0])
```

```
    print("y =", result.x[1])
```

```
    print("Maximum value of Z =", -result.fun)
```

```
else:
```

```
    print("Optimal solution not found.")
```

OUTPUT:

Optimal solution not found.

Q.8) Write a python program to display the following LPP by using pulp module and simplex method. Find its optimal solution if exist.

Min $Z = 5x + 3y$

subject to

$x + y \geq 5$

$x \geq 4$

$y \leq 2$

$x \geq 0, y \geq 0$

Syntax:

```
from pulp import *
```

```
# Create the LP problem
```

```
problem = LpProblem("LPP", LpMinimize)
```

```
# Define the variables
```

```
x = LpVariable("x", lowBound=0)
```

```
y = LpVariable("y", lowBound=0)
```

```
# Define the objective function
```

```
problem += 5*x + 3*y
```

```
# Define the constraints
```

```
problem += x + y >= 5
```

```
problem += x >= 4
```

```
problem += y <= 2
```

```
# Solve the LP problem
```

```
problem.solve()
```

```
# Print the status of the solution
```

```

print("Status:", LpStatus[problem.status])
# If the solution is optimal, print the optimal values of x, y, and Z
if problem.status == 1:
    print("Optimal Solution:")
    print("x =", value(x))
    print("y =", value(y))
    print("Z =", 5*value(x) + 3*value(y))
else:
    print("No Optimal Solution Found.")

```

OUTPUT:

Status: Optimal

Optimal Solution:

x = 4.0

y = 1.0

Z = 23.0

Q.9) Write a python program to plot the Triangle with vertices at [4, 3], [6, 3], [6, 5]. and its reflections through, 1) x-axis, 2) y-axis. All the figures must be in different colors, also plot the two axes.

Syntax:

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

```
import numpy as np
```

```
# Define the vertices of the original triangle
```

```
triangle_vertices = np.array([[4, 3], [6, 3], [6, 5], [4, 3]])
```

```
# Reflect the triangle through the x-axis
```

```
x_reflected_vertices = np.array([triangle_vertices[:, 0], -triangle_vertices[:, 1]]).T
```

```
# Reflect the triangle through the y-axis
```

```
y_reflected_vertices = np.array([-triangle_vertices[:, 0], triangle_vertices[:, 1]]).T
```

```
# Plot the original triangle in red color
```

```
plt.plot(triangle_vertices[:, 0], triangle_vertices[:, 1], 'r', label='Original Triangle')
```

```
# Plot the x-reflected triangle in blue color
```

```
plt.plot(x_reflected_vertices[:, 0], x_reflected_vertices[:, 1], 'b', label='X-Reflected Triangle')
```

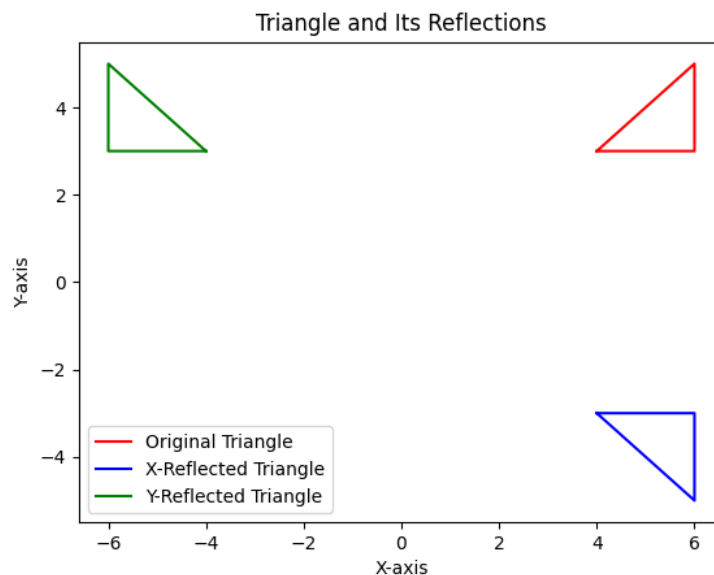
```
# Plot the y-reflected triangle in green color
```

```
plt.plot(y_reflected_vertices[:, 0], y_reflected_vertices[:, 1], 'g', label='Y-Reflected Triangle')
```

```

# Set the axis labels and title
plt.xlabel('X-axis')
plt.ylabel('Y-axis')
plt.title('Triangle and Its Reflections')
plt.legend()
# Show the plot
plt.show()
OUTPUT:

```



Q.10) Write a python program to plot the Triangle with vertices at [3, 3], [3, 6], [0, 6] and its reflections through, line $y = x$ and y -axis. Also plot the mirror lines.

Syntax:

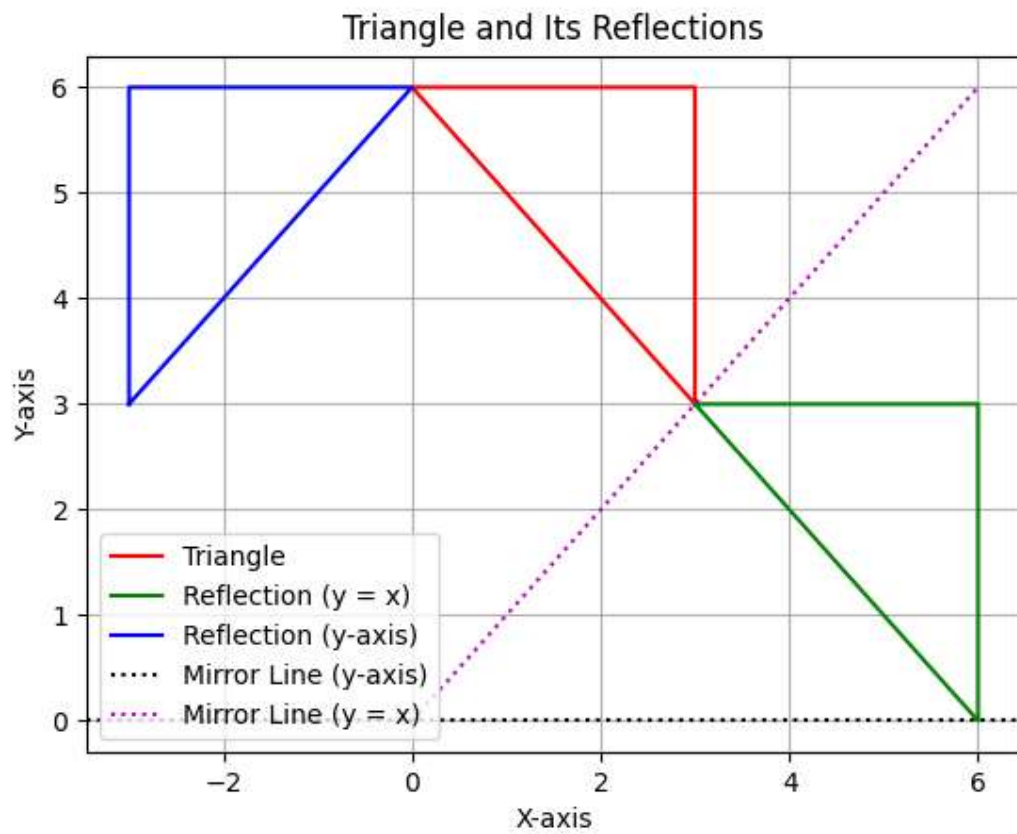
```

import matplotlib.pyplot as plt
import numpy as np
# Triangle vertices
triangle_vertices = np.array([[3, 3], [3, 6], [0, 6], [3, 3]])
# Reflection through y = x
reflection_y_equals_x = np.dot(triangle_vertices, np.array([[0, 1], [1, 0]]))
# Reflection through y-axis
reflection_y_axis = np.dot(triangle_vertices, np.array([[ -1, 0], [0, 1]]))
# Plotting the triangle and its reflections
plt.plot(triangle_vertices[:, 0], triangle_vertices[:, 1], 'r-', label='Triangle')
plt.plot(reflection_y_equals_x[:, 0], reflection_y_equals_x[:, 1], 'g-', label='Reflection (y = x)')
plt.plot(reflection_y_axis[:, 0], reflection_y_axis[:, 1], 'b-', label='Reflection (y-axis)')
# Plotting the mirror lines
plt.axhline(0, color='k', linestyle=':', label='Mirror Line (y-axis)')
plt.plot(np.array([0, 6]), np.array([0, 6]), 'm-', label='Mirror Line (y = x)')

```

```
plt.xlabel('X-axis')
plt.ylabel('Y-axis')
plt.title('Triangle and Its Reflections')
plt.legend()
plt.grid(True)
plt.show()
```

OUTPUT:



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DEPARTMENT OF COMPUTER SCIENCE

MATHEMATICS

Name :- Prem Vijay Vajare

Batch No. :- D

Title of the:- Practical 17

Expt. No . 17

Remark
Demonstrators
Signature
Date :- / /2023

Roll No:- 75 **Date:-** / /2023

Class :- S.Y.BCS

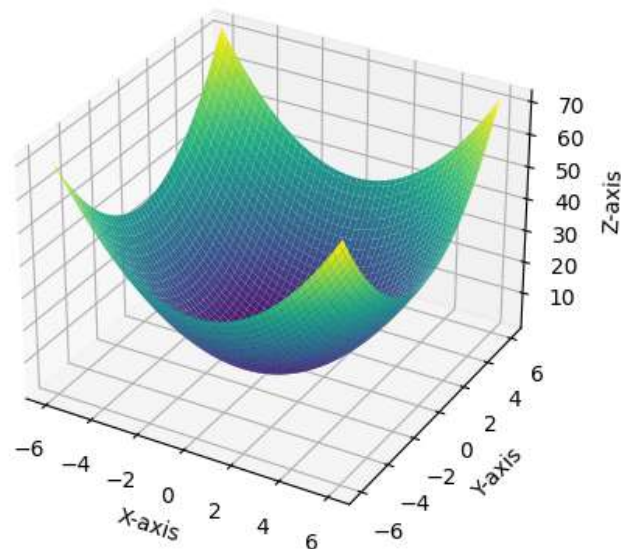
Q.1) Write a python program to plot the 3D graph of the function $z = x^2 + y^2$ in $-6 < x, y < 6$ using surface plot.

Syntax:

```
import matplotlib.pyplot as plt
import numpy as np
# Create a meshgrid for x and y values
x = np.linspace(-6, 6, 100)
y = np.linspace(-6, 6, 100)
X, Y = np.meshgrid(x, y)
# Compute the values of z
Z = X**2 + Y**2
# Create a 3D surface plot
fig = plt.figure()
ax = fig.add_subplot(111, projection='3d')
ax.plot_surface(X, Y, Z, cmap='viridis')
# Set labels and title
ax.set_xlabel('X-axis')
ax.set_ylabel('Y-axis')
ax.set_zlabel('Z-axis')
ax.set_title('3D Surface Plot of  $z = x^2 + y^2$ ')
# Show the plot
plt.show()
```

OUTPUT:

3D Surface Plot of $z = x^2 + y^2$



Q.2) Write a python program to plot 3D contours for the function $f(x,y) = \log(x^2y^2)$ when $-5 \leq x, y \leq 5$ with green color map

Syntax:

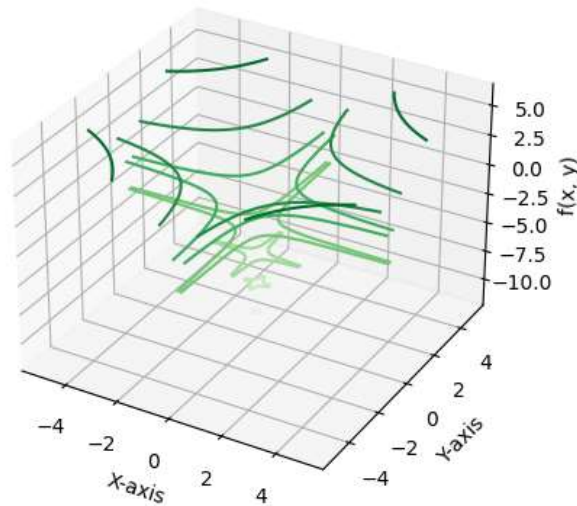
```
import matplotlib.pyplot as plt
import numpy as np
# Create a meshgrid for x and y values
x = np.linspace(-5, 5, 100)
y = np.linspace(-5, 5, 100)
X, Y = np.meshgrid(x, y)
# Compute the values of f(x, y)
Z = np.log(X**2 * Y**2)
# Create a 3D contour plot
fig = plt.figure()
ax = fig.add_subplot(111, projection='3d')
ax.contour(X, Y, Z, cmap='Greens')
# Set labels and title
ax.set_xlabel('X-axis')
ax.set_ylabel('Y-axis')
ax.set_zlabel('f(x, y)')
```

```
ax.set_title('3D Contour Plot of  $f(x, y) = \log(x^2 * y^2)$ ')
```

```
# Show the plot
```

```
plt.show()
```

OUTPUT: 3D Contour Plot of $f(x, y) = \log(x^2 * y^2)$



Q.3) Write a Python program to reflect the line segment joining the points A[-5, 2] and D[1, 3] through the line $y = x$.

Syntax:

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

```
import numpy as np
```

```
# Define the points A and D
```

```
A = np.array([-5, 2])
```

```
D = np.array([1, 3])
```

```
# Define the line  $y = x$ 
```

```
def reflect_y_equals_x(point):
```

```
    return np.array([point[1], point[0]])
```

```
# Reflect points A and D through the line  $y = x$ 
```

```
A_reflected = reflect_y_equals_x(A)
```

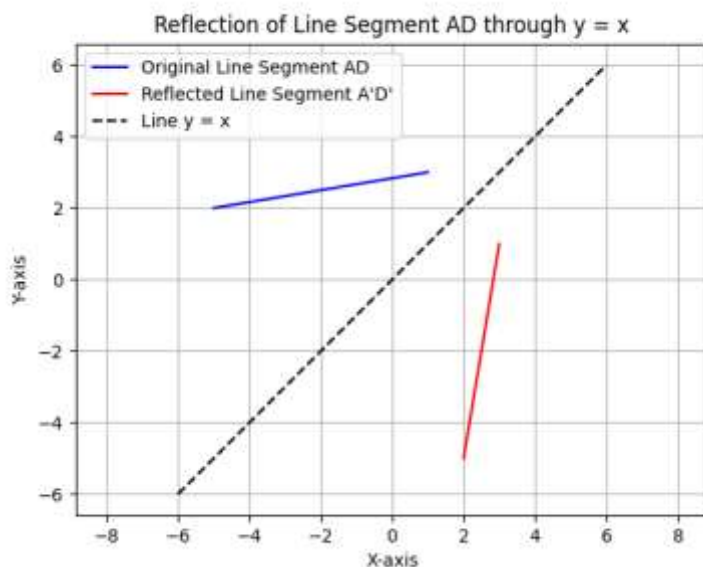
```
D_reflected = reflect_y_equals_x(D)
```

```
# Plot the original line segment and its reflection
```

```

fig, ax = plt.subplots()
ax.plot([A[0], D[0]], [A[1], D[1]], 'b', label='Original Line Segment AD')
ax.plot([A_reflected[0], D_reflected[0]], [A_reflected[1], D_reflected[1]], 'r',
label='Reflected Line Segment A\'D\'')
ax.plot([-6, 6], [-6, 6], 'k--', label='Line y = x') # Plot the line y = x
ax.legend()
ax.set_xlabel('X-axis')
ax.set_ylabel('Y-axis')
ax.set_title('Reflection of Line Segment AD through y = x')
plt.axis('equal')
plt.grid(True)
plt.show()
OUTPUT:

```



Q.4) write a python program to rotate line line segment by 180 degrees having end points (1, 0) and (2,-1).

Syntax:

```

import matplotlib.pyplot as plt
import numpy as np
# Define the end points of the line segment
A = np.array([1, 0])

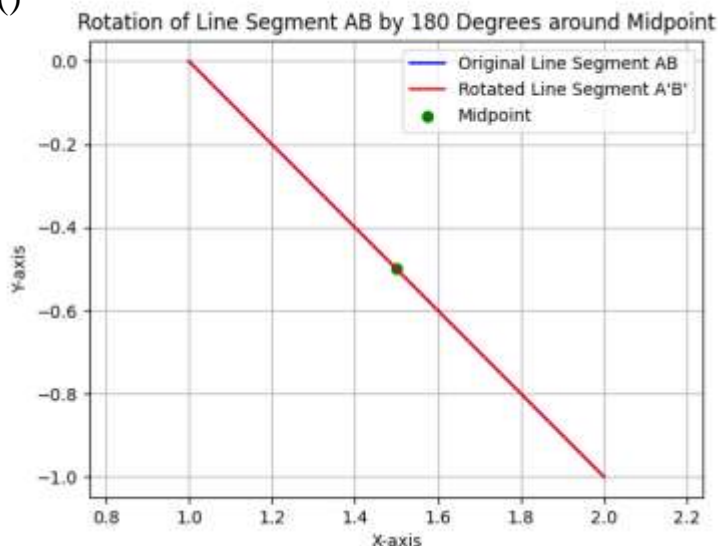
```

```

B = np.array([2, -1])
# Find the midpoint of the line segment
midpoint = (A + B) / 2
# Define the rotation matrix for 180 degrees
rotation_matrix = np.array([[ -1,  0],
                             [ 0, -1]])
# Rotate the end points of the line segment around the midpoint
A_rotated = np.dot(rotation_matrix, A - midpoint) + midpoint
B_rotated = np.dot(rotation_matrix, B - midpoint) + midpoint
# Plot the original line segment and its rotated version
fig, ax = plt.subplots()
ax.plot([A[0], B[0]], [A[1], B[1]], 'b', label='Original Line Segment AB')
ax.plot([A_rotated[0], B_rotated[0]], [A_rotated[1], B_rotated[1]], 'r',
label='Rotated Line Segment A\B\'')
ax.scatter(midpoint[0], midpoint[1], color='g', marker='o', label='Midpoint') #
Plot the midpoint
ax.legend()
ax.set_xlabel('X-axis')
ax.set_ylabel('Y-axis')
ax.set_title('Rotation of Line Segment AB by 180 Degrees around Midpoint')
plt.axis('equal')
plt.grid(True)
plt.show()

```

Output:

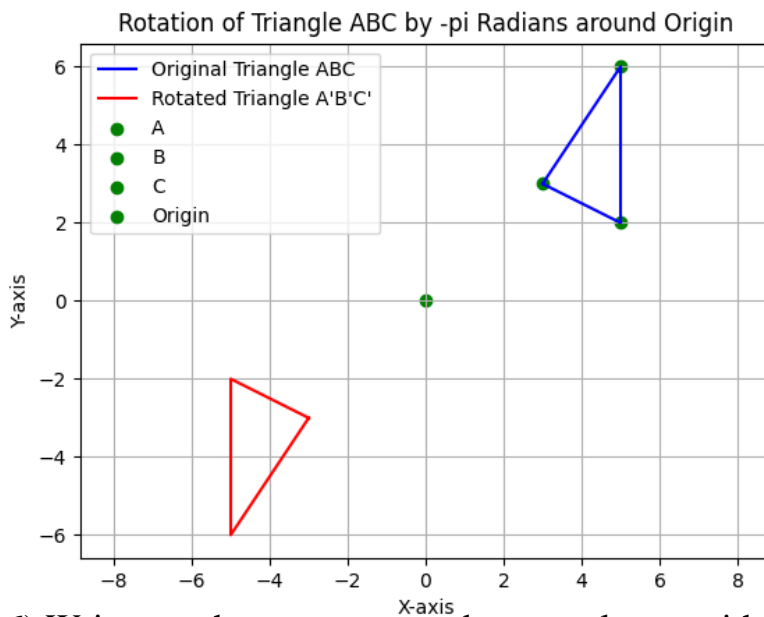


Q.5) Write a python program to plot triangle with vertices [3, 3], [5, 6], [5, 2], and its rotation about the origin by angle $-\pi$ radians.

Syntax:

```
import matplotlib.pyplot as plt
import numpy as np
# Define the vertices of the triangle
A = np.array([3, 3])
B = np.array([5, 6])
C = np.array([5, 2])
# Define the rotation angle in radians
theta = -np.pi
# Define the rotation matrix for the given angle
rotation_matrix = np.array([[np.cos(theta), -np.sin(theta)],
                             [np.sin(theta), np.cos(theta)]])
# Rotate the vertices of the triangle around the origin
A_rotated = np.dot(rotation_matrix, A)
B_rotated = np.dot(rotation_matrix, B)
C_rotated = np.dot(rotation_matrix, C)
# Plot the original triangle and its rotated version
fig, ax = plt.subplots()
ax.plot([A[0], B[0], C[0], A[0]], [A[1], B[1], C[1], A[1]], 'b', label='Original
Triangle ABC')
ax.plot([A_rotated[0], B_rotated[0], C_rotated[0], A_rotated[0]], [A_rotated[1],
B_rotated[1], C_rotated[1], A_rotated[1]], 'r', label='Rotated Triangle A\'B\'C\'')
ax.scatter(A[0], A[1], color='g', marker='o', label='A') # Plot vertex A
ax.scatter(B[0], B[1], color='g', marker='o', label='B') # Plot vertex B
ax.scatter(C[0], C[1], color='g', marker='o', label='C') # Plot vertex C
ax.scatter(0, 0, color='g', marker='o', label='Origin') # Plot origin
ax.legend()
ax.set_xlabel('X-axis')
ax.set_ylabel('Y-axis')
ax.set_title('Rotation of Triangle ABC by -pi Radians around Origin')
plt.axis('equal')
plt.grid(True)
plt.show()
```

OUTPUT:



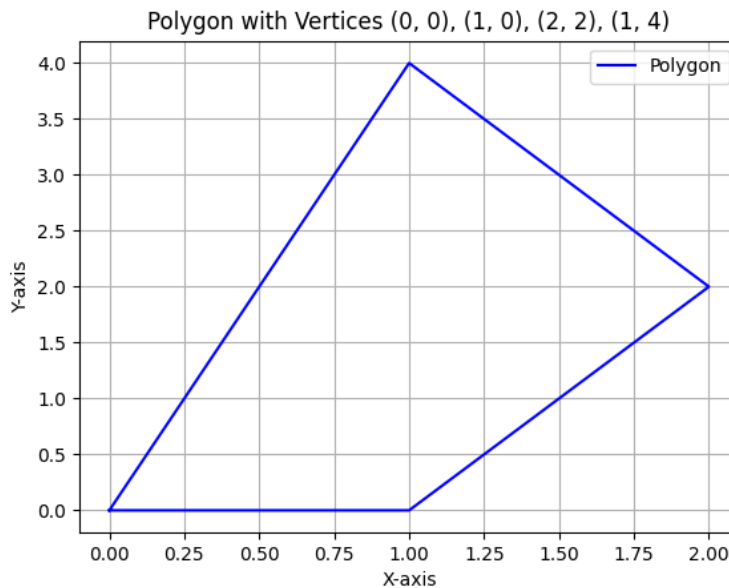
Q.6) Write a python program to draw a polygon with vertices (0, 0), (1, 0), (2, 2), (1, 4) and find its area and perimeter.

Syntax:

```
import matplotlib.pyplot as plt
import numpy as np
# Define the vertices of the polygon
vertices = np.array([[0, 0], [1, 0], [2, 2], [1, 4], [0, 0]])
# Extract x and y coordinates of the vertices
x = vertices[:, 0]
y = vertices[:, 1]
# Plot the polygon
fig, ax = plt.subplots()
ax.plot(x, y, 'b', label='Polygon')
# Calculate the area of the polygon
area = 0.5 * np.abs(np.dot(x, np.roll(y, 1)) - np.dot(y, np.roll(x, 1)))
# Calculate the perimeter of the polygon
perimeter = np.sum(np.sqrt(np.diff(x) ** 2 + np.diff(y) ** 2))
# Print the calculated area and perimeter
print("Area of the polygon: ", area)
print("Perimeter of the polygon: ", perimeter)
ax.set_xlabel('X-axis')
ax.set_ylabel('Y-axis')
ax.set_title('Polygon with Vertices (0, 0), (1, 0), (2, 2), (1, 4)')
ax.legend()
```

```
plt.grid(True)
plt.show()
```

OUTPUT:



Q.7) write a Python program to solve the following LPP

$$\text{Max } Z = 4x + y + 3z + 5w$$

Subjected to

$$4x + 6y - 5z - 4w \geq -20$$

$$-8x - 3y + 3z + 2w \leq 5$$

$$x > 0, y > 0$$

Syntax:

```
from pulp import *
# Create the LP problem
lp_problem = LpProblem("Linear_Programming_Problem",
LpMaximize)
# Define the decision variables
x = LpVariable('x', lowBound=0, cat='Continuous')
y = LpVariable('y', lowBound=0, cat='Continuous')
z = LpVariable('z', lowBound=0, cat='Continuous')
w = LpVariable('w', lowBound=0, cat='Continuous')
# Set the objective function
lp_problem += 4*x + y + 3*z + 5*w
# Add the constraints
lp_problem += 4*x + 6*y - 5*z - 4*w >= -20
lp_problem += -8*x - 3*y + 3*z + 2*w <= 5
lp_problem += x >= 0
```

```

lp_problem += y >= 0
# Solve the LP problem
lp_problem.solve()
# Print the status of the LP problem
print("Status: ", LpStatus[lp_problem.status])
# Print the optimal values of the decision variables
print("Optimal Values:")
print("x = ", x.varValue)
print("y = ", y.varValue)
print("z = ", z.varValue)
print("w = ", w.varValue)
# Print the optimal value of the objective function
print("Optimal Objective Function Value = ", lpSum([4*x, y, 3*z,
5*w]).getValue())

```

OUTPUT:

Status: Unbounded

Optimal Values:

x = 0.83333333

y = 0.0

z = 0.0

w = 5.83333333

Q.8) Write a python program to display the following LPP by using pulp module and simplex method. Find its optimal solution if exist.

```

Min Z = x+y
subject to
x >= 6
y >= 6
x + y <= 11
x>=0, y>=0

```

Syntax:

```

from pulp import *
# Create the LP problem as a minimization problem
problem = LpProblem("LPP", LpMinimize)
# Define the decision variables
x = LpVariable('x', lowBound=0, cat='Continuous')
y = LpVariable('y', lowBound=0, cat='Continuous')
# Define the objective function
problem += x + y, "Z"

```

```

# Define the constraints
problem += x >= 6, "Constraint1"
problem += y >= 6, "Constraint2"
problem += x + y <= 11, "Constraint3"
# Solve the LP problem using the simplex method
problem.solve(PULP_CBC_CMD(msg=False))
# Print the status of the solution
print("Status:", LpStatus[problem.status])
# If the problem has an optimal solution
if problem.status == LpStatusOptimal:
    # Print the optimal values of x and y
    print("Optimal x =", value(x))
    print("Optimal y =", value(y))
    # Print the optimal value of the objective function
    print("Optimal Z =", value(problem.objective))

```

OUTPUT:

Status: Infeasible

Q.9) Apply each of the following Transformation on the point P[2, -3].

(I) Reflection through X-axis.

(II) Scaling in Y-coordinate by factor 1.5.

(III) Shearing in both X and Y direction by -2 and 4 units respectively.

(IV) Rotation about origin by an angle 30 degrees.

Syntax:

```

import numpy as np
# Define the original point P
P = np.array([2, -3])
# (I) Reflection through X-axis
reflection_X = np.array([[1, 0],[0, -1]])
P_reflection_X = np.dot(reflection_X, P)
# (II) Scaling in Y-coordinate by factor 1.5
scaling_Y = np.array([[1, 0],[0, 1.5]])
P_scaling_Y = np.dot(scaling_Y, P)
# (III) Shearing in both X and Y direction by -2 and 4 units respectively
shearing_XY = np.array([[1, -2],[4, 1]])
P_shearing_XY = np.dot(shearing_XY, P)
# (IV) Rotation about origin by an angle of 30 degrees
angle = np.deg2rad(30)
rotation = np.array([[np.cos(angle), -np.sin(angle)],
                    [np.sin(angle), np.cos(angle)]])

```

```

P_rotation = np.dot(rotation, P)
# Print the results
print("Original Point P:", P)
print("Result after reflection through X-axis:", P_reflection_X)
print("Result after scaling in Y-coordinate by factor 1.5:", P_scaling_Y)
print("Result after shearing in both X and Y direction by -2 and 4 units
respectively:", P_shearing_XY)
print("Result after rotation about origin by an angle of 30 degrees:", P_rotation)

```

OUTPUT:

Original Point P: [2 -3]

Result after reflection through X-axis: [2 3]

Result after scaling in Y-coordinate by factor 1.5: [2. -4.5]

Result after shearing in both X and Y direction by -2 and 4 units respectively: [8
5]

Result after rotation about origin by an angle of 30 degrees: [3.23205081 -
1.59807621]

Q.10) Write a python program to draw polygon with vertices [3,3],[4,6],[5,4],[4,2] and [2,2] and its translation in x and y direction by factor -2 and 1 respectively

Syntax:

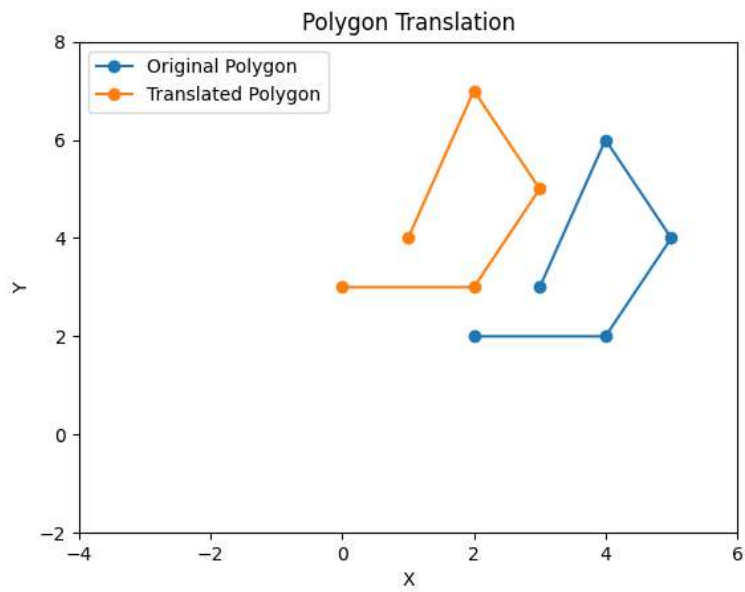
```

import matplotlib.pyplot as plt
import numpy as np
# Define the original vertices of the polygon
vertices = np.array([[3, 3],[4, 6],[5, 4],[4, 2],[2, 2]])
# Plot the original polygon
plt.plot(vertices[:, 0], vertices[:, 1], '-o', label='Original Polygon')
# Define the translation matrix
translation_matrix = np.array([[ -2, 1]])
# Perform the translation on the vertices
vertices_translated = vertices + translation_matrix
# Plot the translated polygon
plt.plot(vertices_translated[:, 0], vertices_translated[:, 1], '-o', label='Translated
Polygon')
# Set plot title and labels
plt.title('Polygon Translation')
plt.xlabel('X')
plt.ylabel('Y')
# Add legend

```

```
plt.legend()
# Set plot limits
plt.xlim(-4, 6)
plt.ylim(-2, 8)
# Show the plot
plt.show()
```

OUTPUT:



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College Sangamner

DEPARTMENT OF COMPUTER SCIENCE

MATHEMATICS

Name :- Prem Vijay Vajare

Batch No. :- D

Roll No:- 75 **Date:-** / /2023

Title of the:- Practical 18

Expt. No . 18

Class :- S.Y.BCS

Remark

Demonstrators

Signature

Date :- / /2023

Q.1) Write a python program to draw polygon with vertices [3,3],[4,6],[4,2] and [2,2] and its translation in x and y direction by factor 3 and 5 respectively.

Syntax:

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

```
import numpy as np
```

```
# Given vertices of the polygon
```

```
vertices = np.array([[3, 3], [4, 6], [4, 2], [2, 2]])
```

```
# Plot the original polygon
```

```
plt.plot(vertices[:, 0], vertices[:, 1], 'bo-', label='Original Polygon')
```

```
# Translation factors
```

```
tx = 3 # Translation in x-direction
```

```
ty = 5 # Translation in y-direction
```

```
# Translated vertices
```

```
translated_vertices = vertices + np.array([tx, ty])
```

```
# Plot the translated polygon
```

```
plt.plot(translated_vertices[:, 0], translated_vertices[:, 1], 'ro-', label='Translated Polygon')
```

```
# Set x and y axis limits
```

```
plt.xlim(vertices[:, 0].min() - 1, vertices[:, 0].max() + 1)
```

```
plt.ylim(vertices[:, 1].min() - 1, vertices[:, 1].max() + 1)
```

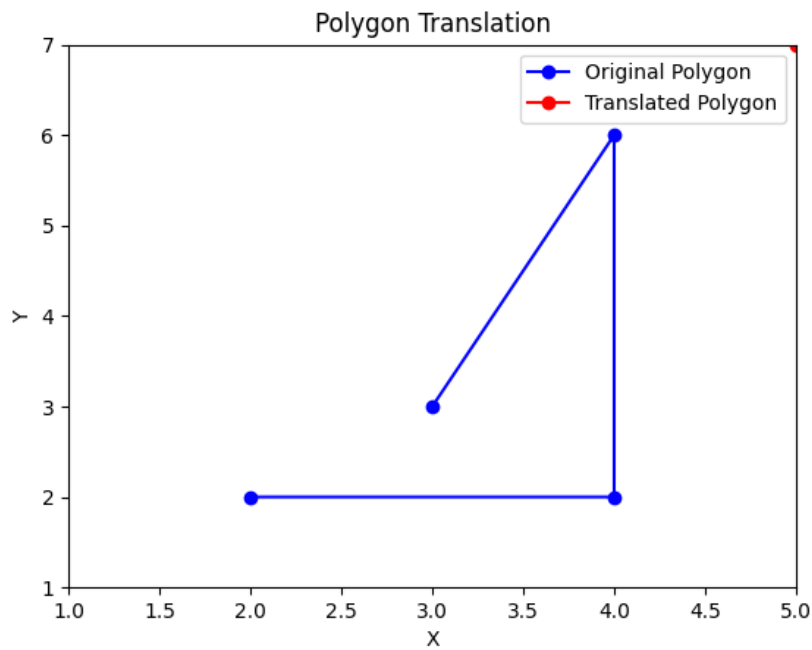
```
# Add legend, title and axis labels
```

```
plt.legend()
```

```
plt.title('Polygon Translation')
```

```
plt.xlabel('X')
```

```
plt.ylabel('Y')
# Show the plot
plt.show()
OUTPUT:
```



Q.2) Write a python program to plot the graph $2x^2 - 4x + 5$ in $[-10,10]$ in magenta colored dashed pattern.

Syntax:

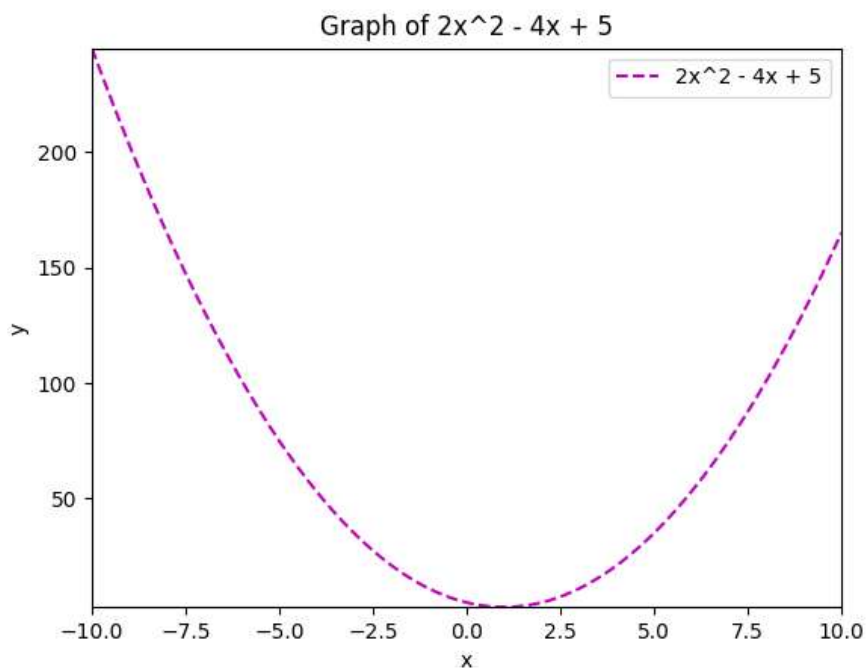
```
import matplotlib.pyplot as plt
import numpy as np
# Define the function
def func(x):
    return 2 * x**2 - 4 * x + 5
# Generate x values in the range [-10,10]
x = np.linspace(-10, 10, 500)
# Generate y values using the function
y = func(x)
# Plot the graph with magenta colored dashed pattern
```

```

plt.plot(x, y, 'm--', label='2x^2 - 4x + 5')
# Set x and y axis limits
plt.xlim(-10, 10)
plt.ylim(y.min(), y.max())
# Add legend, title and axis labels
plt.legend()
plt.title('Graph of 2x^2 - 4x + 5')
plt.xlabel('x')
plt.ylabel('y')
# Show the plot
plt.show()

```

OUTPUT:



Q.3) Write a Python program to generate 3D plot of the function $z = x^2 + y^2$ in $-5 < x, y < 5$.

Syntax:

```

import numpy as np
import matplotlib.pyplot as plt
from mpl_toolkits.mplot3d import Axes3D
# Generate x, y values in the range [-5, 5]

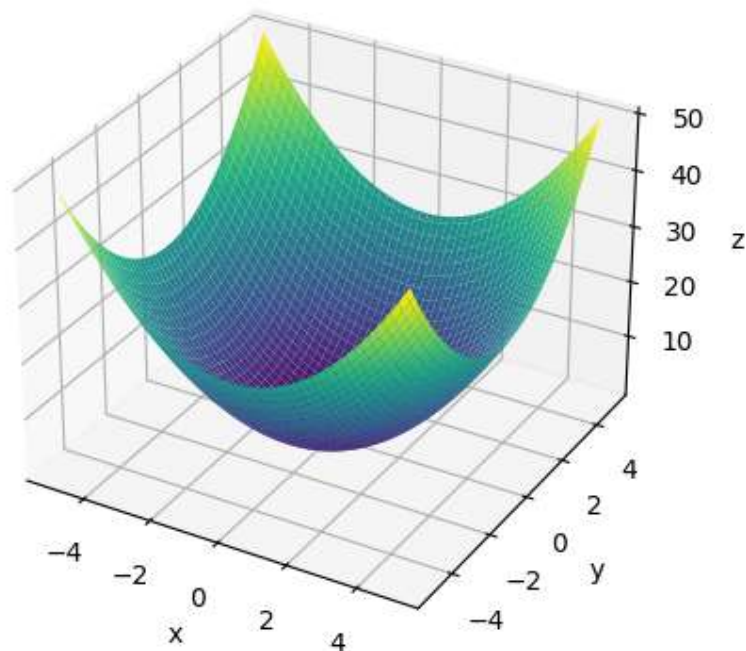
```

```

x = np.linspace(-5, 5, 100)
y = np.linspace(-5, 5, 100)
# Create a grid of x, y values
X, Y = np.meshgrid(x, y)
# Compute the corresponding z values using the function z = x^2 + y^2
Z = X**2 + Y**2
# Create a 3D figure
fig = plt.figure()
ax = fig.add_subplot(111, projection='3d')
# Plot the surface
ax.plot_surface(X, Y, Z, cmap='viridis')
# Set labels for x, y, and z axes
ax.set_xlabel('x')
ax.set_ylabel('y')
ax.set_zlabel('z')
# Set title
ax.set_title('3D Plot of z = x^2 + y^2')
# Show the plot
plt.show()

```

OUTPUT: 3D Plot of z = x² + y²



Q.4) Write a Python program to generate vector x in the interval [-22, 22] using numpy package 80 subintervals

Syntax:

```
import numpy as np
# Define the interval and the number of subintervals
start = -22
end = 22
num_subintervals = 80
# Calculate the step size
step = (end - start) / num_subintervals
# Generate the vector x using numpy's arange() function
x = np.arange(start, end + step, step)
# Print the generated vector x
print(x)
```

Output:

```
[-2.20000000e+01 -2.14500000e+01 -2.09000000e+01 -2.03500000e+01
 -1.98000000e+01 -1.92500000e+01 -1.87000000e+01 -1.81500000e+01
 -1.76000000e+01 -1.70500000e+01 -1.65000000e+01 -1.59500000e+01
 -1.54000000e+01 -1.48500000e+01 -1.43000000e+01 -1.37500000e+01
 -1.32000000e+01 -1.26500000e+01 -1.21000000e+01 -1.15500000e+01
 -1.10000000e+01 -1.04500000e+01 -9.90000000e+00 -9.35000000e+00
 -8.80000000e+00 -8.25000000e+00 -7.70000000e+00 -7.15000000e+00
 -6.60000000e+00 -6.05000000e+00 -5.50000000e+00 -4.95000000e+00
 -4.40000000e+00 -3.85000000e+00 -3.30000000e+00 -2.75000000e+00
 -2.20000000e+00 -1.65000000e+00 -1.10000000e+00 -5.50000000e-01
 2.84217094e-14 5.50000000e-01 1.10000000e+00 1.65000000e+00
 2.20000000e+00 2.75000000e+00 3.30000000e+00 3.85000000e+00
 4.40000000e+00 4.95000000e+00 5.50000000e+00 6.05000000e+00
 6.60000000e+00 7.15000000e+00 7.70000000e+00 8.25000000e+00
 8.80000000e+00 9.35000000e+00 9.90000000e+00 1.04500000e+01
 1.10000000e+01 1.15500000e+01 1.21000000e+01 1.26500000e+01
 1.32000000e+01 1.37500000e+01 1.43000000e+01 1.48500000e+01
 1.54000000e+01 1.59500000e+01 1.65000000e+01 1.70500000e+01
 1.76000000e+01 1.81500000e+01 1.87000000e+01 1.92500000e+01
 1.98000000e+01 2.03500000e+01 2.09000000e+01 2.14500000e+01
 2.20000000e+01]
```

Q.5) Write a Python program to rotate the triangle ABC by 90 degree, where A[1,2], B[2, -2]and C[-1, 2].

Syntax:

```
import numpy as np
# Define the coordinates of the triangle ABC
A = np.array([1, 2])
B = np.array([2, -2])
C = np.array([-1, 2])
# Define the rotation matrix for 90 degrees counterclockwise
theta = np.deg2rad(90)
rotation_matrix=np.array([[np.cos(theta),-np.sin(theta)],[np.sin(theta),
np.cos(theta)]])
# Rotate the triangle ABC using the rotation matrix
A_rotated = np.dot(rotation_matrix, A)
B_rotated = np.dot(rotation_matrix, B)
C_rotated = np.dot(rotation_matrix, C)
# Print the coordinates of the rotated triangle
print("Original Triangle ABC:")
print("A:", A)
print("B:", B)
print("C:", C)
print("\nRotated Triangle ABC (90 degrees counterclockwise):")
print("A_rotated:", A_rotated)
print("B_rotated:", B_rotated)
print("C_rotated:", C_rotated)
```

OUTPUT:

Original Triangle ABC:

A: [1 2]

B: [2 -2]

C: [-1 2]

Rotated Triangle ABC (90 degrees counterclockwise):

A_rotated: [-2. 1.]

B_rotated: [2. 2.]

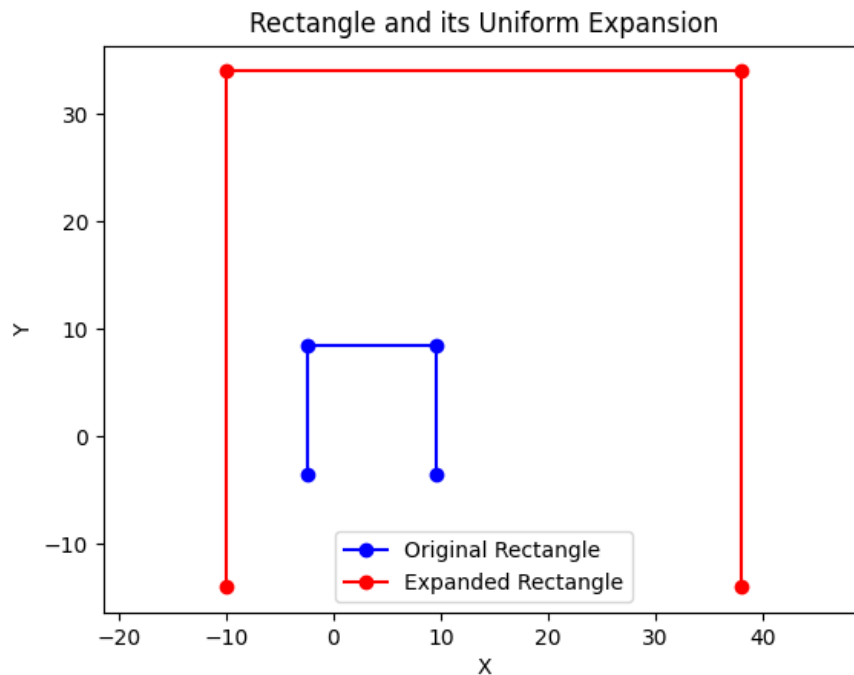
C_rotated: [-2. -1.]

Q.6) Write a Python program to plot the rectangle with vertices at [2, 1], [2, 4], [5, 4], [5, 1] and its uniform expansion by factor 4.

Syntax:

```
import matplotlib.pyplot as plt
import numpy as np
# Define the vertices of the rectangle
vertices = np.array([[2, 1], [2, 4], [5, 4], [5, 1]], dtype=float)
# Define the uniform expansion factor
expansion_factor = 4
# Calculate the center of the rectangle
center = np.mean(vertices, axis=0)
# Translate the rectangle to the origin
vertices -= center
# Perform uniform expansion
vertices *= expansion_factor
# Translate the rectangle back to its original position
vertices += center
# Extract the x and y coordinates of the vertices
x = vertices[:, 0]
y = vertices[:, 1]
# Plot the original rectangle
plt.plot(x, y, 'bo-', label='Original Rectangle')
# Plot the expanded rectangle
plt.plot(x * expansion_factor, y * expansion_factor, 'ro-', label='Expanded
Rectangle')
# Set the aspect ratio to 'equal'
plt.axis('equal')
# Set the title and labels
plt.title('Rectangle and its Uniform Expansion')
plt.xlabel('X')
plt.ylabel('Y')
# Add a legend
plt.legend()
# Show the plot
plt.show()
```

OUTPUT:



Q.7) write a Python program to solve the following LPP

$$\text{Max } Z = 2x + 3y$$

Subjected to

$$5x - y \geq 0$$

$$x + y \geq 6$$

$$x > 0, y > 0$$

Syntax:

```
from pulp import LpMaximize, LpProblem, LpVariable, lpSum, value
```

```
# Create a linear programming problem
```

```
prob = LpProblem("Linear Programming Problem", LpMaximize)
```

```
# Define decision variables
```

```
x = LpVariable('x', lowBound=0, cat='Continuous')
```

```
y = LpVariable('y', lowBound=0, cat='Continuous')
```

```
# Define the objective function
```

```
prob += 2*x + 3*y, "Z"
```

```
# Add inequality constraints
```

```
prob += 5*x - y >= 0, "Constraint1"
```

```
prob += x + y >= 6, "Constraint2"
```

```
# Solve the linear programming problem
```

```
prob.solve()
```

```
# Check if the optimization was successful
```

```

if prob.status == 1:
    # Extract the optimal values of x and y
    x_opt = value(x)
    y_opt = value(y)
    # Extract the optimal value of Z (objective function)
    z_opt = value(prob.objective)
    # Print the results
    print("Optimal value of x: {:.2f}".format(x_opt))
    print("Optimal value of y: {:.2f}".format(y_opt))
    print("Optimal value of Z: {:.2f}".format(z_opt))
else:
    print("Linear programming problem failed to converge.")

```

OUTPUT:

Linear programming problem failed to converge.

Q.8) Write a python program to display the following LPP by using pulp module and simplex method. Find its optimal solution if exist.

$$\begin{aligned} &\text{Min } Z = x+y \\ &\text{subject to} \\ &x \geq 6 \\ &y \geq 6 \\ &x + y \leq 11 \\ &x \geq 0, y \geq 0 \end{aligned}$$

Syntax:

```

from pulp import *
# Create the LP problem as a minimization problem
problem = LpProblem("LPP", LpMinimize)
# Define the decision variables
x = LpVariable('x', lowBound=0, cat='Continuous')
y = LpVariable('y', lowBound=0, cat='Continuous')
# Define the objective function
problem += x + y, "Z"
# Define the constraints
problem += x >= 6, "Constraint1"
problem += y >= 6, "Constraint2"
problem += x + y <= 11, "Constraint3"
# Solve the LP problem using the simplex method
problem.solve(PULP_CBC_CMD(msg=False))
# Print the status of the solution
print("Status:", LpStatus[problem.status])
# If the problem has an optimal solution

```

```

if problem.status == LpStatusOptimal:
    # Print the optimal values of x and y
    print("Optimal x =", value(x))
    print("Optimal y =", value(y))
    # Print the optimal value of the objective function
    print("Optimal Z =", value(problem.objective))

```

OUTPUT:

Status: Infeasible

Q.9) Write a python program to find the combined transformation of the line segment between the points. A[3,2] and B[2,-3] for the following sequence of transformation.

(I) First rotation about origin through an angle $\pi/2$

(II) Followed by scaling in Y – coordinate by 5 units respectively

(III) Followed by reflection through the origin

Syntax:

```

import numpy as np
# Define the line segment as a numpy array
A = np.array([3, 2])
B = np.array([2, -3])
# Define the transformations as matrices
# (I) Rotation about origin through an angle  $\pi/2$ 
R = np.array([[0, -1], [1, 0]])
# (II) Scaling in Y-coordinate by 5 units
S = np.array([[1, 0], [0, 5]])
# (III) Reflection through the origin
F = np.array([[-1, 0], [0, -1]])
# Compute the combined transformation
T = F @ S @ R
# Apply the combined transformation to the line segment
A_new = T @ A
B_new = T @ B
# Print the results
print("Line segment before transformation:")
print("A:", A)
print("B:", B)
print("\nCombined transformation matrix:")
print(T)
print("\nLine segment after transformation:")
print("A'", A_new)

```

```
print("B'", B_new)
```

OUTPUT:

Line segment before transformation:

A: [3 2]

B: [2 -3]

Combined transformation matrix:

[[0 1]

[-5 0]]

Line segment after transformation:

A': [2 -15]

B': [-3 -10]

Q.10) Apply each of the following transformation of the line segment on the point P[3, -1]

I. Reflection through Y-axis.

11. Scaling in X and Y direction by $1/2$ and 3 units respectively

111. Shearing in both X and Y direction by -2 and 4 units respectively.

IV. Rotation about origin by an angle 60 degrees.

Syntax:

```
import numpy as np
```

```
# Define the point P
```

```
P = np.array([3, -1])
```

```
# I. Reflection through Y-axis
```

```
T1 = np.array([[ -1,  0], [ 0,  1]])
```

```
P1 = T1 @ P
```

```
# II. Scaling in X and Y direction by  $1/2$  and 3 units respectively
```

```
T2 = np.array([[1/2,  0], [ 0,  3]])
```

```
P2 = T2 @ P
```

```
# III. Shearing in both X and Y direction by -2 and 4 units respectively
```

```
T3 = np.array([[ 1, -2], [ 4,  1]])
```

```
P3 = T3 @ P
```

```
# IV. Rotation about origin by an angle 60 degrees
```

```
angle = np.deg2rad(60)
```

```
T4 = np.array([[np.cos(angle), -np.sin(angle)], [np.sin(angle), np.cos(angle)]])
```

```
P4 = T4 @ P
```

```
# Print the results
```

```
print("Original point P:", P)
```

```
print("\nTransformation I - Reflection through Y-axis:")
```

```
print("P1:", P1)
```

```
print("\nTransformation II - Scaling in X and Y direction:")
print("P2:", P2)
print("\nTransformation III - Shearing in X and Y direction:")
print("P3:", P3)
print("\nTransformation IV - Rotation about origin by 60 degrees:")
print("P4:", P4)
```

OUTPUT:

Original point P: [3 -1]

Transformation I - Reflection through Y-axis:

P1: [-3 -1]

Transformation II - Scaling in X and Y direction:

P2: [1.5 -3.]

Transformation III - Shearing in X and Y direction:

P3: [5 11]

Transformation IV - Rotation about origin by 60 degrees:

P4: [2.3660254 2.09807621]

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College Sangamner

DEPARTMENT OF COMPUTER SCIENCE

MATHEMATICS

Name :- Prem Vijay Vajare

Batch No. :- D

Roll No:- 75 **Date:-** / /2023

Title of the:- Practical 19

Expt. No . 19

Class :- S.Y.BCS

Remark

Demonstrators

Signature

Date :- / /2023

Q.1) Plot the graphs of $\sin x$, $\cos x$, e^{**x} and x^{**3} in $[0, 5]$ in one figure with (2 x 2) subplot

Syntax:

```
import numpy as np
```

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

```
# Generate x values
```

```
x = np.linspace(0, 5, 500)
```

```
# Compute y values for sin(x), cos(x), e**x, x**2
```

```
y1 = np.sin(x)
```

```
y2 = np.cos(x)
```

```
y3 = np.exp(x)
```

```
y4 = x**3
```

```
# Create subplots
```

```
fig, axs = plt.subplots(2, 2, figsize=(10, 8))
```

```
fig.suptitle('Graphs of sin(x), cos(x), e**x, and x**2')
```

```
# Plot sin(x)
```

```
axs[0, 0].plot(x, y1, label='sin(x)')
```

```
axs[0, 0].legend()
```

```
# Plot cos(x)
```

```
axs[0, 1].plot(x, y2, label='cos(x)')
```

```
axs[0, 1].legend()
```

```
# Plot e**x
```

```
axs[1, 0].plot(x, y3, label='e**x')
```

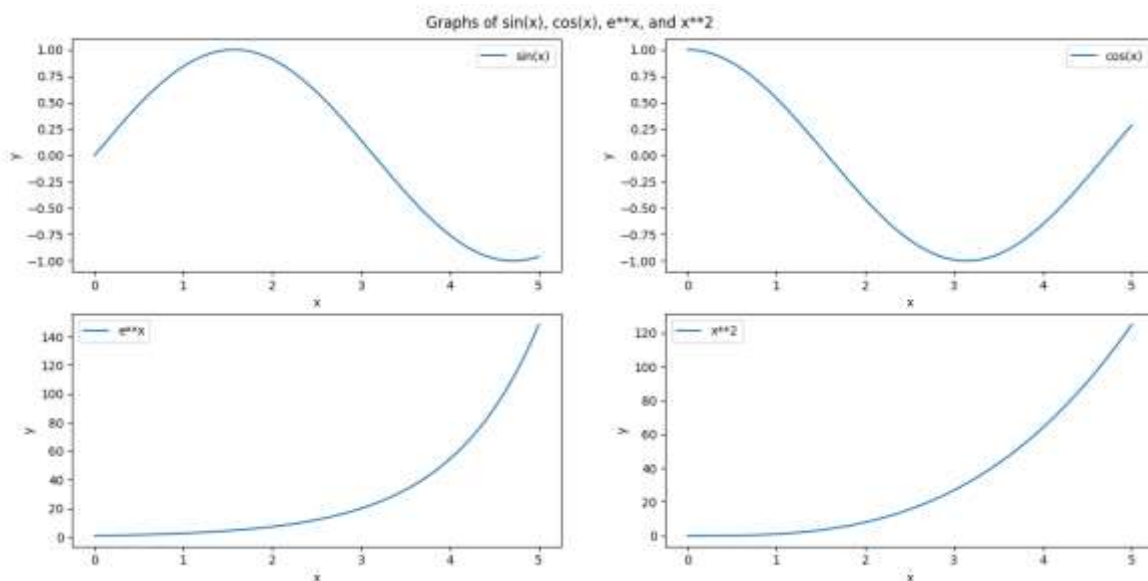
```
axs[1, 0].legend()
```

```

# Plot x**2
axs[1, 1].plot(x, y4, label='x**2')
axs[1, 1].legend()
# Set x and y axis labels for all subplots
for ax in axs.flat:
    ax.set_xlabel('x')
    ax.set_ylabel('y')
# Adjust spacing between subplots
fig.tight_layout()
# Show the plot
plt.show()

```

OUTPUT:



Q.2) Write a python program to plot 3D Surface Plot of the function $z = \cos(|x| + |y|)$ in $-1 < x, y < 1$.

Syntax:

```
import numpy as np
```

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

```
# Generate 30 random x, y pairs within the range -1 < x, y < 1
```

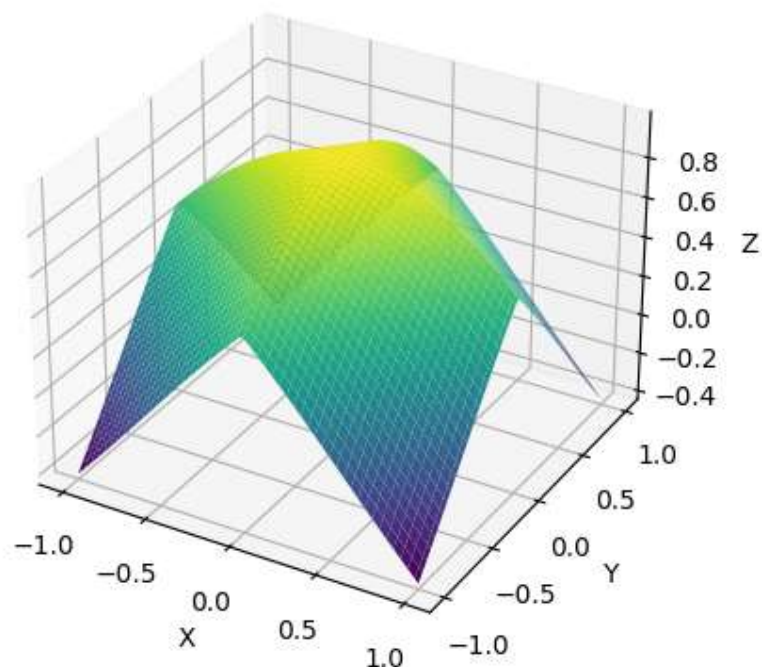
```

np.random.seed(0)
x_vals = np.random.uniform(-1, 1, size=30)
y_vals = np.random.uniform(-1, 1, size=30)
# Create a 2D grid of x, y values
x, y = np.meshgrid(np.linspace(-1, 1, 100), np.linspace(-1, 1, 100))
# Compute the z values for each x, y pair
z = np.cos(np.abs(x) + np.abs(y))
# Plot the surface plots
for i in range(30):
    fig = plt.figure()
    ax = fig.add_subplot(111, projection='3d')
    ax.plot_surface(x, y, z, cmap='viridis')
    ax.set_xlabel('X')
    ax.set_ylabel('Y')
    ax.set_zlabel('Z')
    ax.set_title(f'Surface Plot {i+1}: z = cos(|x| + |y|) for x = {x_vals[i]:.2f}, y =
    {y_vals[i]:.2f}')
    plt.show()

```

OUTPUT:

Surface Plot 1: $z = \cos(|x| + |y|)$ for $x = 0.10$, $y = -0.47$

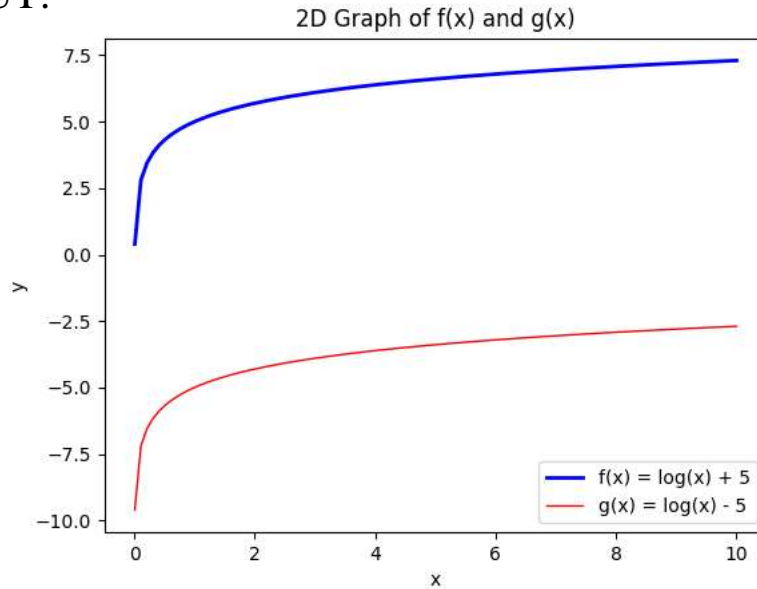


Q.3) Write a python program to plot 2D graph of the functions $f(x) = \log(x) + 5$ and $g(x) = \log(x) - 5$ in $[0, 10]$ by setting different line width and different colors to the curve.

Syntax:

```
import numpy as np
import matplotlib.pyplot as plt
# Define the functions
def f(x):
    return np.log(x) + 5
def g(x):
    return np.log(x) - 5
# Generate x values in the range [0, 10]
x = np.linspace(0.01, 10, 100)
# Compute y values for f(x) and g(x)
y_f = f(x)
y_g = g(x)
# Create the plot
plt.plot(x, y_f, label='f(x) = log(x) + 5', linewidth=2, color='blue')
plt.plot(x, y_g, label='g(x) = log(x) - 5', linewidth=1, color='red')
# Add labels and legend
plt.xlabel('x')
plt.ylabel('y')
plt.legend()
# Set the title and show the plot
plt.title('2D Graph of f(x) and g(x)')
plt.show()
```

OUTPUT:



Q.4) Write a python program to rotate the segment by 90° having endpoints (0,0) and (4,4)

Syntax:

```
import math
# Define the endpoints of the line segment
x1, y1 = 0, 0
x2, y2 = 4, 4
# Perform the rotation
x1_rotated = -x1
y1_rotated = -y1
x2_rotated = -x2
y2_rotated = -y2
# Print the original and rotated endpoints
print("Original Endpoint 1: ({} , {})".format(x1, y1))
print("Original Endpoint 2: ({} , {})".format(x2, y2))
print("Rotated Endpoint 1: ({} , {})".format(x1_rotated, y1_rotated))
print("Rotated Endpoint 2: ({} , {})".format(x2_rotated, y2_rotated))
```

Output:

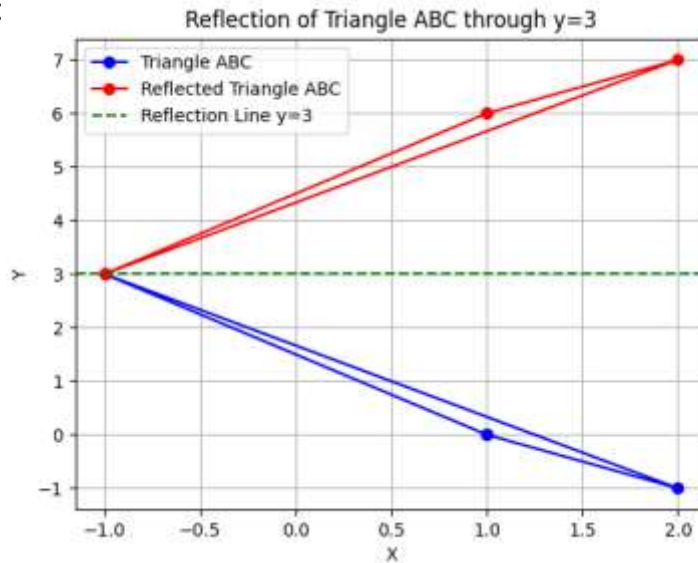
```
Original Endpoint 1: (0, 0)
Original Endpoint 2: (4, 4)
Rotated Endpoint 1: (0, 0)
Rotated Endpoint 2: (-4, -4)
```

Q.5) Write a Python program to Reflect the triangle ABC through the line $y=3$, where $A[1, 0]$, $B[2, -1]$ and $C[-1, 3]$

Syntax:

```
import numpy as np
import matplotlib.pyplot as plt
# Define the coordinates of the triangle ABC
A = np.array([1, 0])
B = np.array([2, -1])
C = np.array([-1, 3])
# Define the equation of the reflection line  $y = 3$ 
reflection_line = 3
# Reflect the triangle ABC through the reflection line
A_reflected = np.array([A[0], 2*reflection_line - A[1]])
B_reflected = np.array([B[0], 2*reflection_line - B[1]])
C_reflected = np.array([C[0], 2*reflection_line - C[1]])
# Plot the original and reflected triangles
plt.plot([A[0], B[0], C[0], A[0]], [A[1], B[1], C[1], A[1]], 'bo-', label='Triangle
ABC')
plt.plot([A_reflected[0], B_reflected[0], C_reflected[0], A_reflected[0]],
         [A_reflected[1], B_reflected[1], C_reflected[1], A_reflected[1]], 'ro-',
         label='Reflected Triangle ABC')
plt.axhline(y=reflection_line, color='g', linestyle='--', label='Reflection Line
y=3')
plt.xlabel('X')
plt.ylabel('Y')
plt.legend()
plt.title('Reflection of Triangle ABC through  $y=3$ ')
plt.grid(True)
plt.show()
```

Output:



Q.6) Write a Python program to draw a polygon with vertices (0,0),(1,0),(2,2),(1,4). Also find area and perimeter of the polygon.

Syntax:

```
import matplotlib.pyplot as plt

# Define the coordinates of the vertices of the polygon
vertices = [(0, 0), (1, 0), (2, 2), (1, 4)]

# Extract the x and y coordinates of the vertices
x = [vertex[0] for vertex in vertices]
y = [vertex[1] for vertex in vertices]

# Plot the polygon
plt.plot(x + [x[0]], y + [y[0]], 'bo-', label='Polygon')
plt.xlabel('X')
plt.ylabel('Y')
plt.legend()
plt.title('Polygon with Vertices')
plt.grid(True)
plt.show()

# Calculate the area of the polygon using shoelace formula
```

```

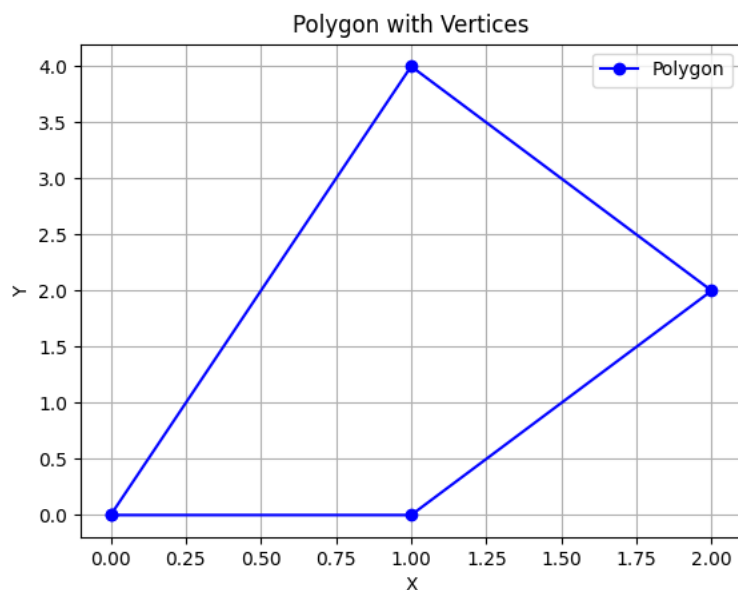
area = 0
for i in range(len(vertices)):
    area += (x[i] * y[(i + 1) % len(vertices)]) - (x[(i + 1) % len(vertices)] * y[i])
area /= 2
area = abs(area)
# Calculate the perimeter of the polygon
perimeter = 0
for i in range(len(vertices)):
    dx = x[(i + 1) % len(vertices)] - x[i]
    dy = y[(i + 1) % len(vertices)] - y[i]
    perimeter += ((dx ** 2) + (dy ** 2)) ** 0.5
# Print the area and perimeter of the polygon
print("Area of the Polygon:", area)
print("Perimeter of the Polygon:", perimeter)

```

OUTPUT:

Area of the Polygon: 4.0

Perimeter of the Polygon: 9.595241580617241



Q.7) write a Python program to solve the following LPP

Max $Z = x + 2y + z$
Subjected to
 $X + 0.5y + 0.5z \leq 1$
 $1.5x + 2y + z \geq 8$
 $x > 0, y > 0$
Syntax:

```
from scipy.optimize import linprog
# Coefficients of the objective function
c = [1, 2, 1]
# Coefficients of the inequality constraints (LHS matrix)
A = [[1, 0.5, 0.5],
     [-1.5, -2, -1]]
# RHS values of the inequality constraints
b = [1, -8]
# Bounds on the variables (x, y, z)
bounds = [(0, None), (0, None), (0, None)]
# Specify the inequality constraint directions (<=, >=)
# and the corresponding bound values (1, -1)
ineq_ops = ['<=', '>=']
# Solve the linear programming problem
res = linprog(c, A_ub=A, b_ub=b, bounds=bounds, method='simplex')
# Print the results
print("Optimization Result:")
print("Objective Value (Z):", res.fun)
print("Optimal Solution (x, y, z):", res.x)
OUTPUT:
Optimization Result:
Objective Value (Z): 4.0
Optimal Solution (x, y, z): [0. 2. 0.]
```

Q.8) Write a python program to display the following LPP by using pulp module and simplex method. Find its optimal solution if exist.

Min $Z = 3x + 5y + 4z$
subject to
 $2x + 3y \leq 8$
 $2y + 5z \leq 10$
 $3x + 2y + 4z \leq 15$
 $x \geq 0, y \geq 0, z \geq 0$

Syntax:

```
from pulp import *
# Create a minimization problem
prob = LpProblem("Minimization Problem", LpMinimize)
# Define decision variables
x = LpVariable("x", lowBound=0, cat='Continuous')
y = LpVariable("y", lowBound=0, cat='Continuous')
z = LpVariable("z", lowBound=0, cat='Continuous')
# Define the objective function
prob += 3*x + 5*y + 4*z, "Z"
# Define the constraints
prob += 2*x + 3*y <= 8, "Constraint 1"
prob += 2*y + 5*z <= 10, "Constraint 2"
prob += 3*x + 2*y + 4*z <= 15, "Constraint 3"
# Solve the problem
prob.solve()
# Print the status of the problem
print("Status:", LpStatus[prob.status])
# Print the optimal solution
print("Optimal Solution:")
print("x =", value(x))
print("y =", value(y))
print("z =", value(z))
# Print the optimal objective value
print("Z =", value(prob.objective))
Status: Optimal
Optimal Solution:
x = 0.0
y = 0.0
z = 0.0
Z = 0.0
```

Q.9) Write a python program to apply the following transformation on the point (-2, 4)

- (I) Rotation about origin through an angle 48 degree
- (II) Scaling in X – coordinate by 2 factor
- (III) Reflection through the line $y = 2x - 3$
- (IV) Shearing in X Direction by 7 units

Syntax:

```
import numpy as np
# Define the initial point
point = np.array([-2, 4])
# Transformation 1: Rotation about origin through an angle of 48 degrees
angle = np.deg2rad(48)
rotation_matrix = np.array([[np.cos(angle), -np.sin(angle)],
                             [np.sin(angle), np.cos(angle)]])
rotated_point = np.dot(rotation_matrix, point)
# Transformation 2: Scaling in X-coordinate by a factor of 2
scaling_factor = np.array([[2, 0],
                             [0, 1]])
scaled_point = np.dot(scaling_factor, rotated_point)
# Transformation 3: Reflection through the line y = 2x - 3
reflection_matrix = np.array([[1, -4],
                              [-4, 1]])
reflected_point = np.dot(reflection_matrix, scaled_point)
# Transformation 4: Shearing in X-direction by 7 units
shearing_factor = np.array([[1, 7],
                              [0, 1]])
sheared_point = np.dot(shearing_factor, reflected_point)
# Print the results
print("Initial Point:", point)
print("Rotated Point:", rotated_point)
print("Scaled Point:", scaled_point)
print("Reflected Point:", reflected_point)
print("Sheared Point:", sheared_point)
```

OUTPUT:

```
Initial Point: [-2  4]
Rotated Point: [-4.31084051  1.19023277]
Scaled Point: [-8.62168103  1.19023277]
Reflected Point: [-13.38261213  35.67695689]
Sheared Point: [236.35608611  35.67695689]
```

Q.10) Find Combined transformation of the line segment between the points A[4,-1] and B[3,0] for the following sequence :

First rotation about origin through an angle π ; followed by scaling in x coordinate by 3 units. Followed by reflection through the line $y = x$;

Syntax:

```
import numpy as np
```

```

# Define the initial points A and B
A = np.array([4, -1])
B = np.array([3, 0])
# Transformation 1: Rotation about origin through an angle pi (180 degrees)
angle = np.pi
rotation_matrix = np.array([[np.cos(angle), -np.sin(angle)],
                             [np.sin(angle), np.cos(angle)]])
rotated_A = np.dot(rotation_matrix, A)
rotated_B = np.dot(rotation_matrix, B)
# Transformation 2: Scaling in x-coordinate by 3 units
scaling_factor = np.array([[3, 0],
                             [0, 1]])
scaled_A = np.dot(scaling_factor, rotated_A)
scaled_B = np.dot(scaling_factor, rotated_B)
# Transformation 3: Reflection through the line y = x
reflection_matrix = np.array([[0, 1],
                              [1, 0]])
reflected_A = np.dot(reflection_matrix, scaled_A)
reflected_B = np.dot(reflection_matrix, scaled_B)
# Print the results
print("Initial Points A and B:")
print("A =", A)
print("B =", B)
print("Combined Transformed Points A and B:")
print("A' =", reflected_A)
print("B' =", reflected_B)
OUTPUT:
Initial Point: [-2  4]
Rotated Point: [-4.31084051  1.19023277]
Scaled Point: [-8.62168103  1.19023277]
Reflected Point: [-13.38261213  35.67695689]
Sheared Point: [236.35608611  35.67695689]

```

Sahakar Maharshi Bhausaheb Santuji Thorat

College Sangamner

DEPARTMENT OF COMPUTER SCIENCE

MATHEMATICS

Name :- Prem Vijay Vajare

Batch No. :- D

Title of the:- Practical 20

Expt. No . 20

Remark
Demonstrators
Signature
Date :- / /2023

Roll No:- 75 **Date:-** / /2023

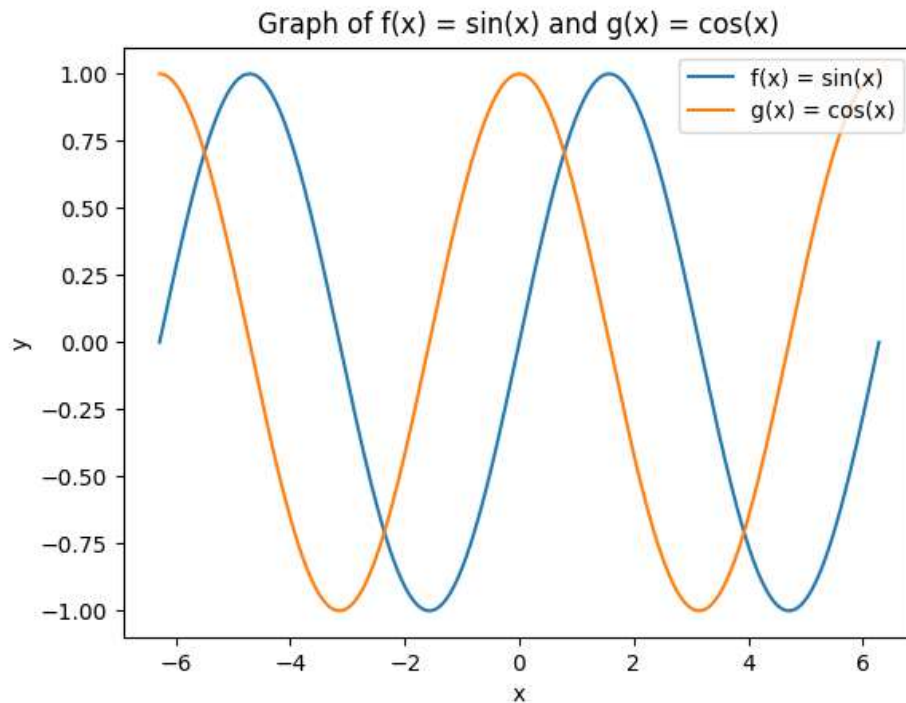
Class :- S.Y.BCS

Q.1) Write a Python program to plot 2D graph of the function $f(x) = \sin(x)$ and $g(x) = \cos(x)$ in $[-2\pi, 2\pi]$

Syntax:

```
import numpy as np
import matplotlib.pyplot as plt
# Define the range of x values
x = np.linspace(-2 * np.pi, 2 * np.pi, 1000)
# Compute the y values for f(x) = sin(x) and g(x) = cos(x)
f_x = np.sin(x)
g_x = np.cos(x)
# Create a figure and axis
fig, ax = plt.subplots()
# Plot f(x) = sin(x)
ax.plot(x, f_x, label='f(x) = sin(x)')
# Plot g(x) = cos(x)
ax.plot(x, g_x, label='g(x) = cos(x)')
# Set the title and labels for x and y axes
ax.set_title('Graph of f(x) = sin(x) and g(x) = cos(x)')
ax.set_xlabel('x')
ax.set_ylabel('y')
# Add a legend
ax.legend()
# Show the plot
plt.show()
```

OUTPUT:



Q.2) Write a Python program to plot the 2D graph of the function $f(x)=e(x)\sin(x)$ in $[-5*\pi,5*\pi]$ with blue points line with upward pointing triangle.

Syntax:

```
import numpy as np
```

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

```
# Define the function f(x)
```

```
def f(x):
```

```
    return np.exp(x) * np.sin(x)
```

```
# Generate x values in the range  $[-5*\pi, 5*\pi]$ 
```

```
x = np.linspace(-5*np.pi, 5*np.pi, 500)
```

```
# Calculate y values using the function f(x)
```

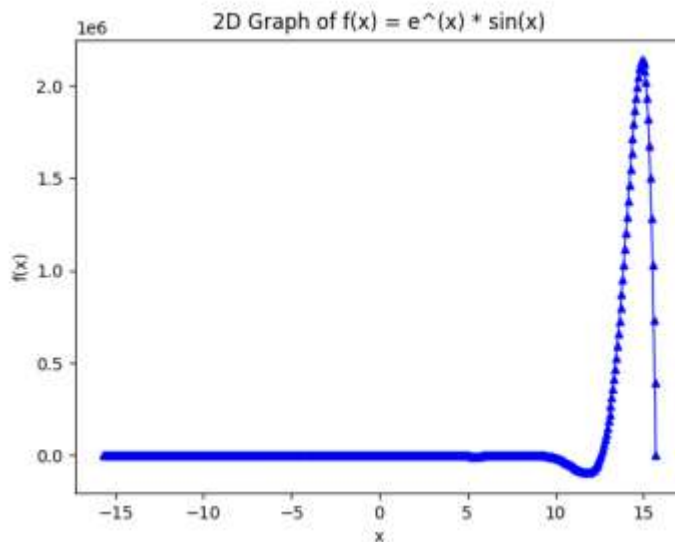
```
y = f(x)
```

```
# Plot the graph with blue points and a line with upward pointing triangles
```

```

plt.plot(x, y, 'b^-', linewidth=1, markersize=4)
# Set x and y axis labels
plt.xlabel('x')
plt.ylabel('f(x)')
# Set the title of the graph
plt.title('2D Graph of f(x) = e^(x) * sin(x)')
# Show the graph
plt.show()
OUTPUT:

```



Q.3) Write a Python program to plot the 3D graph of the function $f(x) = \sin(x^2 + y^2)$, $-6 < x, y < 6$.

Syntax:

```

import numpy as np
import matplotlib.pyplot as plt
from mpl_toolkits.mplot3d import Axes3D
# Define the function f(x, y)
def f(x, y):
    return np.sin(x**2 + y**2)
# Generate x, y values in the range -6 to 6 with a step of 0.1
x = np.arange(-6, 6, 0.1)

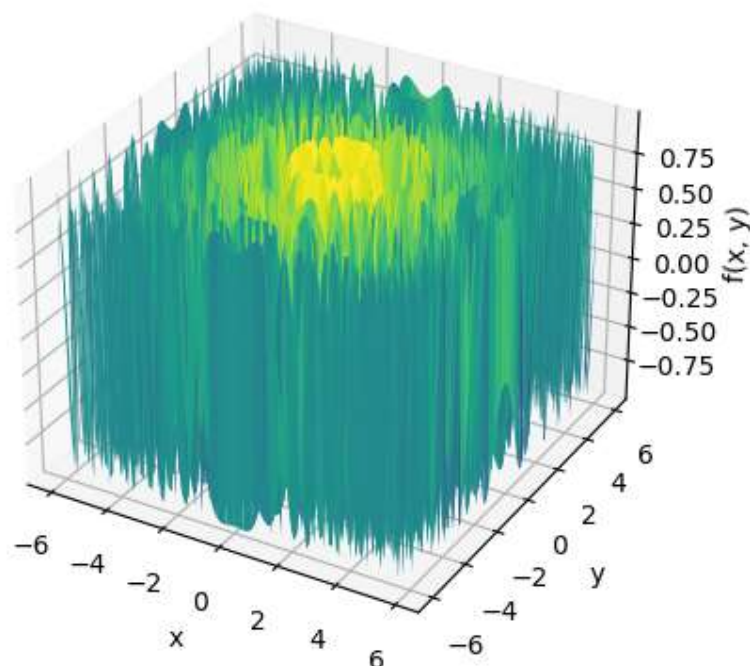
```

```

y = np.arange(-6, 6, 0.1)
# Create a meshgrid from x, y values
X, Y = np.meshgrid(x, y)
# Calculate z values using the function f(x, y)
Z = f(X, Y)
# Create a 3D figure
fig = plt.figure()
ax = fig.add_subplot(111, projection='3d')
# Plot the 3D surface
ax.plot_surface(X, Y, Z, cmap='viridis')
# Set x, y, z axis labels
ax.set_xlabel('x')
ax.set_ylabel('y')
ax.set_zlabel('f(x, y)')
# Set the title of the graph
ax.set_title('3D Graph of f(x, y) = sin(x^2 + y^2)')
# Show the graph
plt.show()

```

OUTPUT: 3D Graph of $f(x, y) = \sin(x^2 + y^2)$

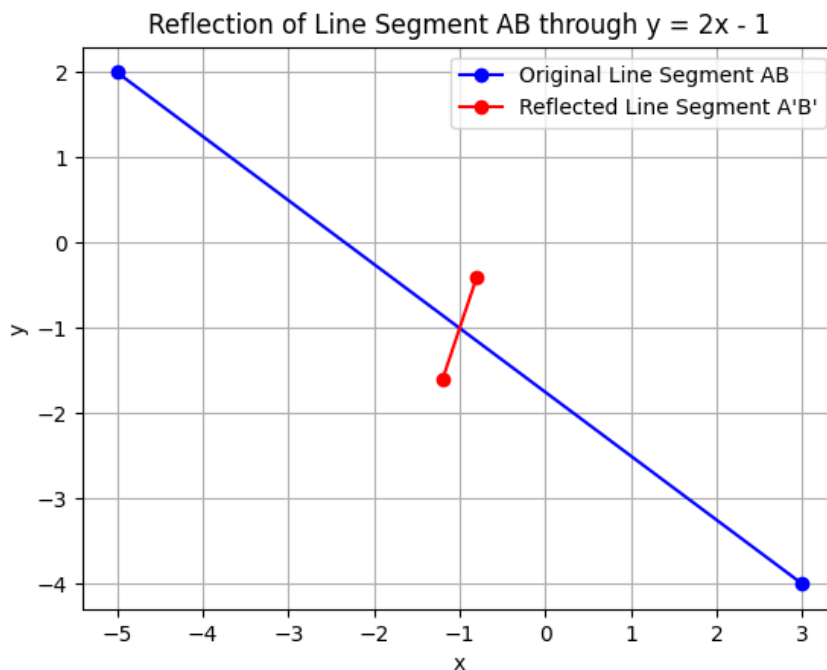


Q.4) Write a python program to reflect the line segment joining the points A[-5, 2], B[3, -4] through the line $y = 2x - 1$.

Syntax:

```
import numpy as np
import matplotlib.pyplot as plt
# Define the line segment endpoints A and B
A = np.array([-5, 2])
B = np.array([3, -4])
# Define the reflection line  $y = 2x - 1$ 
m = 2 # slope of the reflection line
c = -1 # y-intercept of the reflection line
# Calculate the midpoint of the line segment AB
midpoint = (A + B) / 2
# Calculate the direction vector of the reflection line
direction = np.array([1, m])
# Calculate the projection of the midpoint onto the reflection line
projection = (2 * midpoint.dot(direction) - 2 * c * direction) / (1 + m**2)
# Calculate the reflected point of A with respect to the reflection line
reflected_A = midpoint + (projection - midpoint)
# Calculate the reflected point of B with respect to the reflection line
reflected_B = midpoint - (projection - midpoint)
# Plot the original line segment AB and the reflected line segment A'B'
plt.plot([A[0], B[0]], [A[1], B[1]], 'bo-', label='Original Line Segment AB')
plt.plot([reflected_A[0], reflected_B[0]], [reflected_A[1], reflected_B[1]], 'ro-',
label='Reflected Line Segment A\B\'')
plt.xlabel('x')
plt.ylabel('y')
plt.legend()
plt.title('Reflection of Line Segment AB through  $y = 2x - 1$ ')
plt.grid()
plt.show()
```

Output:



Q.5) Write a Python program to find the area and perimeter of a polygon with vertices (0, 0), (-2, 0), (5,5), (1, -1)

Syntax:

```
import math
# Define the vertices of the polygon
vertices = [(0, 0), (-2, 0), (5, 5), (1, -1)]
# Calculate the area of the polygon using Shoelace formula
def calculate_area(vertices):
    area = 0
    for i in range(len(vertices)):
        x1, y1 = vertices[i]
        x2, y2 = vertices[(i + 1) % len(vertices)]
        area += (x1 * y2 - x2 * y1)
    return abs(area) / 2
# Calculate the perimeter of the polygon
def calculate_perimeter(vertices):
    perimeter = 0
    for i in range(len(vertices)):
        x1, y1 = vertices[i]
        x2, y2 = vertices[(i + 1) % len(vertices)]
        perimeter += math.sqrt((x2 - x1) ** 2 + (y2 - y1) ** 2)
```

```

    return perimeter
# Call the functions to calculate area and perimeter
area = calculate_area(vertices)
perimeter = calculate_perimeter(vertices)
# Print the results
print("Area of the polygon: ", area)
print("Perimeter of the polygon: ", perimeter)
OUTPUT:
Area of the polygon: 10.0
Perimeter of the polygon: 19.2276413803437

```

Q.6) Write a Python program to plot the 3D graph of the function $f(x, y) = \sin x + \cos y$, x, y belongs $[-2\pi, 2\pi]$ using wireframe plot.

```

import numpy as np
import matplotlib.pyplot as plt
from mpl_toolkits.mplot3d import Axes3D
# Define the range of x and y values
x = np.linspace(-2 * np.pi, 2 * np.pi, 100)
y = np.linspace(-2 * np.pi, 2 * np.pi, 100)
# Create a meshgrid from x and y
X, Y = np.meshgrid(x, y)
# Calculate the Z values using the function  $f(x, y) = \sin(x) + \cos(y)$ 
Z = np.sin(X) + np.cos(Y)
# Create a 3D plot
fig = plt.figure()
ax = fig.add_subplot(111, projection='3d')
# Create a wireframe plot
ax.plot_wireframe(X, Y, Z)
# Set labels and title
ax.set_xlabel('X')
ax.set_ylabel('Y')

```

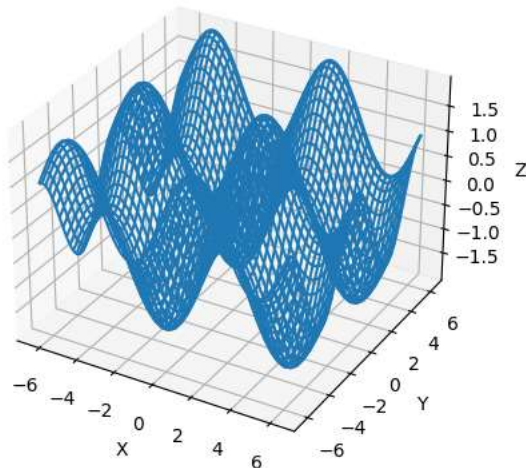
```

ax.set_zlabel('Z')
ax.set_title('3D Wireframe Plot of f(x, y) = sin(x) + cos(y)')
# Show the plot
plt.show()

```

OUTPUT:

3D Wireframe Plot of $f(x, y) = \sin(x) + \cos(y)$



Q.7) write a Python program to solve the following LPP

$$\text{Max } Z = 3.5x + 2y$$

Subjected to

$$x + y \geq 5$$

$$x \geq 4$$

$$y \leq 2$$

$$x > 0, y > 0$$

Syntax:

```
import numpy as np
```

```
from scipy.optimize import linprog
```

```
# Coefficients of the objective function
```

```
c = [-3.5, -2]
```

```
# Coefficients of the inequality constraints
```

```
A = [[-1, -1], [-1, 0], [0, 1]]
```

```

b = [-5, -4, 2]
# Bounds on the variables
x_bounds = (0, None)
y_bounds = (0, None)
# Solve the linear programming problem
result = linprog(c, A_ub=A, b_ub=b, bounds=[x_bounds, y_bounds])
if result.success:
    print("Optimal solution found:")
    print("x =", result.x[0])
    print("y =", result.x[1])
    print("Maximum value of Z =", -result.fun)
else:
    print("Optimal solution not found.")

```

OUTPUT:

Optimal solution not found.

Q.8) Write a python program to display the following LPP by using pulp module and simplex method. Find its optimal solution if exist.

```

Min Z = x+ y
subject to
x - y >= 1
x + y >= 2
x >= 0, y >= 0

```

Syntax:

```

from pulp import *
# Create a LP Minimization problem
problem = LpProblem("LPP", LpMinimize)
# Define the decision variables
x = LpVariable("x", lowBound=0) # x >= 0
y = LpVariable("y", lowBound=0) # y >= 0
# Define the objective function

```

```

problem += x + y
# Define the constraints
problem += x - y >= 1
problem += x + y >= 2
# Solve the problem using the simplex method
status = problem.solve()
# Check if the problem has an optimal solution
if status == LpStatusOptimal:
    # Print the optimal solution
    print("Optimal Solution:")
    print("x =", value(x))
    print("y =", value(y))
    print("Z =", value(problem.objective))
else:
    print("No Optimal Solution")

```

OUTPUT:

Optimal Solution:

x = 2.0

y = 0.0

Z = 2.0

Q.9) Apply Python. Program in each of the following transformation on the point P[3,-2]

(I) Scaling in y direction by 4 unit.

(II) Reflection through y axis.

(III) Rotation about origin by angle 45° .

(IV) Reflection through the line $y = x$.

Syntax:

```

import numpy as np
# Given point P
P = np.array([3, -2])
# Transformation I: Scaling in y direction by 4 units
scaling_matrix = np.array([[1, 0], [0, 4]])
P_scaled_y = np.dot(scaling_matrix, P)
print("After Scaling in y direction by 4 units:")
print("Point P_scaled_y:", P_scaled_y)
# Transformation II: Reflection through y axis
reflection_y_axis_matrix = np.array([[ -1, 0], [0, 1]])
P_reflected_y_axis = np.dot(reflection_y_axis_matrix, P)
print("After Reflection through y axis:")

```

```

print("Point P_reflected_y_axis:", P_reflected_y_axis)
# Transformation III: Rotation about origin by angle 45 degrees
angle_rad = np.deg2rad(45) # Convert angle to radians
rotation_matrix = np.array([[np.cos(angle_rad), -np.sin(angle_rad)],
[ np.sin(angle_rad), np.cos(angle_rad) ]])
P_rotated = np.dot(rotation_matrix, P)
print("After Rotation about origin by angle 45 degrees:")
print("Point P_rotated:", P_rotated)
# Transformation IV: Reflection through the line y = x
reflection_line_matrix = np.array([[0, 1], [1, 0]])
P_reflected_line = np.dot(reflection_line_matrix, P)
print("After Reflection through the line y = x:")
print("Point P_reflected_line:", P_reflected_line)

```

OUTPUT:

```

Point P_scaled_y: [ 3 -8]
After Reflection through y axis:
Point P_reflected_y_axis: [-3 -2]
After Rotation about origin by angle 45 degrees:
Point P_rotated: [3.53553391 0.70710678]
After Reflection through the line y = x:
Point P_reflected_line: [-2  3]

```

Q.10) Apply the following transformation on the point $P[3, -2]$

- (I) Shearing in x direction by -2 units.
- (II) Scaling in X and y direction by -2 and 2 units respectively
- (III) Reflection through x axis.
- (IV) Reflection through the line $y = -x$

Syntax:

```

import numpy as np
# Given point P
P = np.array([3, -2])
# Transformation I: Shearing in x direction by -2 units
shearing_x_matrix = np.array([[1, -2], [0, 1]])
P_sheared_x = np.dot(shearing_x_matrix, P)
print("After Shearing in x direction by -2 units:")
print("Point P_sheared_x:", P_sheared_x)
# Transformation II: Scaling in x and y direction by -2 and 2 units respectively
scaling_matrix = np.array([[-2, 0], [0, 2]])
P_scaled_xy = np.dot(scaling_matrix, P)
print("After Scaling in x and y direction by -2 and 2 units respectively:")

```

```

print("Point P_scaled_xy:", P_scaled_xy)
# Transformation III: Reflection through x axis
reflection_x_axis_matrix = np.array([[1, 0], [0, -1]])
P_reflected_x_axis = np.dot(reflection_x_axis_matrix, P)
print("After Reflection through x axis:")
print("Point P_reflected_x_axis:", P_reflected_x_axis)
# Transformation IV: Reflection through the line y = -x
reflection_line_matrix = np.array([[0, -1], [-1, 0]])
P_reflected_line = np.dot(reflection_line_matrix, P)
print("After Reflection through the line y = -x:")
print("Point P_reflected_line:", P_reflected_line)

```

OUTPUT:

Line segment after applying the sequence of transformations:

After Scaling in y direction by 4 units:

Point P_scaled_y: [3 -8]

After Reflection through y axis:

Point P_reflected_y_axis: [-3 -2]

After Rotation about origin by angle 45 degrees:

Point P_rotated: [3.53553391 0.70710678]

After Reflection through the line y = x:

Point P_reflected_line: [-2 3]

PS E:\Python 2nd Sem Practical> python -u "e:\Python 2nd Sem Practical\tempCodeRunnerFile.py"

After Shearing in x direction by -2 units:

Point P_sheared_x: [7 -2]

After Scaling in x and y direction by -2 and 2 units respectively:

Point P_scaled_xy: [-6 -4]

After Reflection through x axis:

Point P_reflected_x_axis: [3 2]

After Reflection through the line y = -x:

Point P_reflected_line: [2 -3]

Sahakar Maharshi Bhausaheb Santuji Thorat

College Sangamner

DEPARTMENT OF COMPUTER SCIENCE

MATHEMATICS

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Class :- S.Y.BCS

Q.1) Plot the graph of $f(x) = x^{**4}$ in $[0, 5]$ with red dashed line with circle markers.

Syntax:

```
import numpy as np
```

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

```
# Define the function  $f(x) = x^{**4}$ 
```

```
def f(x):
```

```
    return x**4
```

```
# Generate x values in the interval  $[0, 5]$ 
```

```
x = np.linspace(0, 5, 100)
```

```
# Generate y values using the function  $f(x)$ 
```

```
y = f(x)
```

```
# Plot the graph with red dashed line and circle markers
```

```
plt.plot(x, y, 'r--o', markersize=6)
```

```
# Set x-axis label
```

```
plt.xlabel('x')
```

```
# Set y-axis label
```

```
plt.ylabel('f(x)')
```

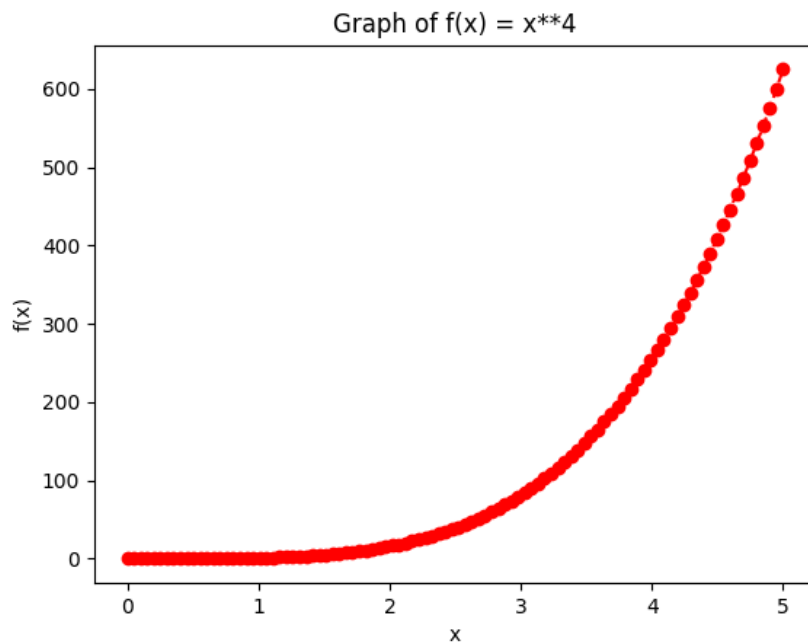
```
# Set title
```

```
plt.title('Graph of  $f(x) = x^{**4}$ ')
```

```
# Show the plot
```

```
plt.show()
```

OUTPUT:



Q.2) Write a Python program to plot the 3D graph of the function $f(x) = \sin(x^2 + y^2)$, $-6 < x, y < 6$.

Syntax:

```
import numpy as np
import matplotlib.pyplot as plt
from mpl_toolkits.mplot3d import Axes3D
# Define the function f(x, y)
def f(x, y):
    return np.sin(x**2 + y**2)
# Generate x, y values in the range -6 to 6 with a step of 0.1
x = np.arange(-6, 6, 0.1)
y = np.arange(-6, 6, 0.1)
# Create a meshgrid from x, y values
X, Y = np.meshgrid(x, y)
# Calculate z values using the function f(x, y)
Z = f(X, Y)
# Create a 3D figure
```

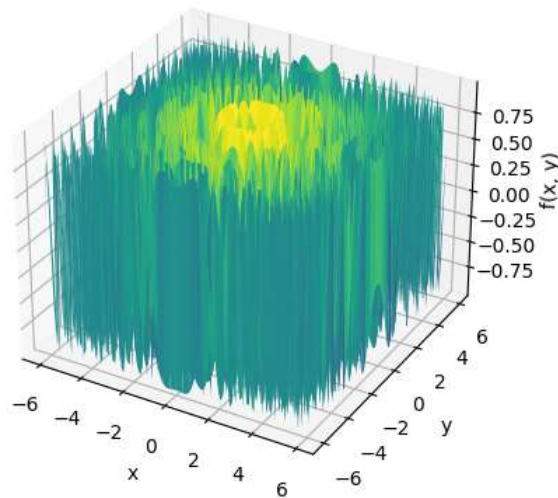
```

fig = plt.figure()
ax = fig.add_subplot(111, projection='3d')
# Plot the 3D surface
ax.plot_surface(X, Y, Z, cmap='viridis')
# Set x, y, z axis labels
ax.set_xlabel('x')
ax.set_ylabel('y')
ax.set_zlabel('f(x, y)')
# Set the title of the graph
ax.set_title('3D Graph of f(x, y) = sin(x^2 + y^2)')
# Show the graph
plt.show()

```

OUTPUT:

3D Graph of $f(x, y) = \sin(x^2 + y^2)$



Q.3) Write a Python program to plot the 3D graph of the function $f(x, y) = e^{-(x^2+y^2)}$ for x, y belongs $[0, 2*\pi]$ using wireframe.

Syntax:

```

import numpy as np
import matplotlib.pyplot as plt
from mpl_toolkits.mplot3d import Axes3D
# Define the function f(x, y)

```

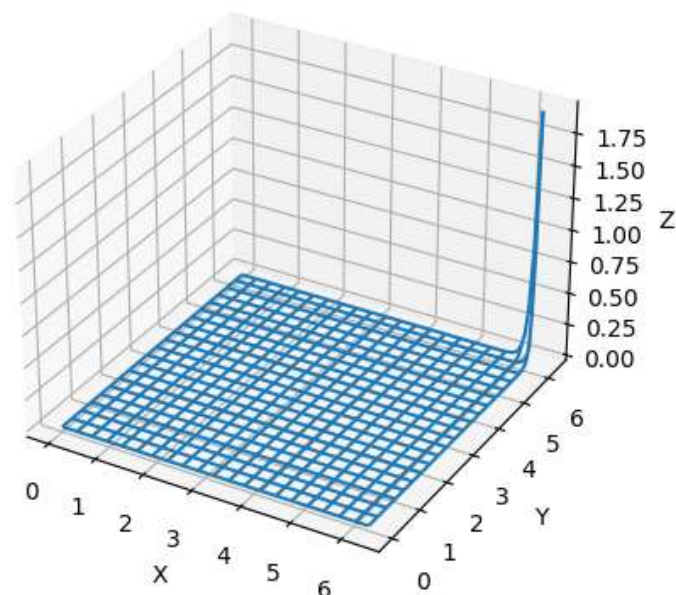
```

def f(x, y):
    return np.exp(x**2 + y**2)
# Generate x, y values
x = np.linspace(0, 2*np.pi, 100)
y = np.linspace(0, 2*np.pi, 100)
X, Y = np.meshgrid(x, y)
Z = f(X, Y)
# Create a 3D figure
fig = plt.figure()
ax = fig.add_subplot(111, projection='3d')
# Create a wireframe plot
ax.plot_wireframe(X, Y, Z, rstride=5, cstride=5)
# Set axis labels
ax.set_xlabel('X')
ax.set_ylabel('Y')
ax.set_zlabel('Z')
ax.set_title('3D Wireframe Plot of f(x) = exp(x^2 + y^2)')
# Show the plot
plt.show()

```

OUTPUT:

3D Wireframe Plot of $f(x) = \exp(x^2 + y^2)$



Q.4) if the line segment joining the points A[2,5] and [4,-13] is transformed to the line segment A'B' by the transformation matrix $[T] = \begin{bmatrix} 2 & 3 \\ 4 & 1 \end{bmatrix}$ the using python find the slope and midpoint of the transformed line.

Syntax:

```
import numpy as np
# Define the original line segment points A and B
A = np.array([2, 5])
B = np.array([4, -13])
# Define the transformation matrix [T]
T = np.array([[2, 3], [4, 1]])
# Apply the transformation matrix [T] to points A and B
A_transformed = np.dot(T, A)
B_transformed = np.dot(T, B)
# Calculate the slope of the transformed line
slope_transformed = (B_transformed[1] - A_transformed[1]) /
(B_transformed[0] - A_transformed[0])
# Calculate the midpoint of the transformed line
midpoint_transformed = (A_transformed + B_transformed) / 2
# Print the slope and midpoint of the transformed line
print("Slope of the transformed line: ", slope_transformed)
print("Midpoint of the transformed line: ", midpoint_transformed)
```

Output:

Slope of the transformed line: 0.2

Midpoint of the transformed line: [-6. 8.]

Q.5) Write a python program to plot square with vertices at [4, 4] [2, 4], [2, 2], [4, 2] and find its uniform expansion by factor 3, uniform reduction by factor 0.4.

Syntax:

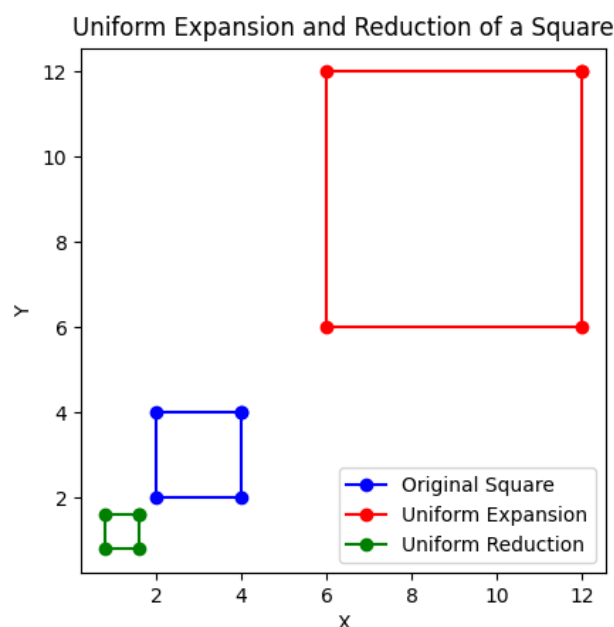
```
import numpy as np
import matplotlib.pyplot as plt
# Define the vertices of the original square
vertices = np.array([[4, 4], [2, 4], [2, 2], [4, 2], [4, 4]])
```

```

# Create a figure and axis
fig, ax = plt.subplots()
# Plot the original square
ax.plot(vertices[:, 0], vertices[:, 1], 'b-o', label='Original Square')
# Define the uniform expansion and reduction factors
expansion_factor = 3
reduction_factor = 0.4
# Perform uniform expansion
expanded_vertices = vertices * expansion_factor
# Perform uniform reduction
reduced_vertices = vertices * reduction_factor
# Plot the expanded and reduced squares
ax.plot(expanded_vertices[:, 0], expanded_vertices[:, 1], 'r-o', label='Uniform
Expansion')
ax.plot(reduced_vertices[:, 0], reduced_vertices[:, 1], 'g-o', label='Uniform
Reduction')
# Set axis labels and title
ax.set_xlabel('X')
ax.set_ylabel('Y')
ax.set_title('Uniform Expansion and Reduction of a Square')
# Set legend
ax.legend()
# Set aspect ratio to 'equal' for a square plot
ax.set_aspect('equal')
# Show the plot
plt.show()

```

OUTPUT:



Q.6) write a Python program to find the equation of the transformed line if shearing is applied on the line $2x + y = 3$ in x and y direction by 2 and -3 units respectively.

```
import numpy as np

# Define the original line equation
original_line = np.array([2, 1, -3]) # Coefficients of x, y, and constant term

# Define the shear transformation matrices in x and y directions
shear_matrix_x = np.array([[1, 2, 0],
                            [0, 1, 0],
                            [0, 0, 1]])
shear_matrix_y = np.array([[1, 0, 0],
                            [-3, 1, 0],
                            [0, 0, 1]])

# Apply shear transformations to the original line
transformed_line_x = np.dot(shear_matrix_x, original_line)
transformed_line_y = np.dot(shear_matrix_y, original_line)

# Extract the coefficients of x, y, and constant term from the transformed lines
a_x, b_x, c_x = transformed_line_x
a_y, b_y, c_y = transformed_line_y

# Print the equations of the transformed lines
print("Equation of the transformed line after x-direction shear: {}x + {}y = {}".format(a_x, b_x, c_x))
print("Equation of the transformed line after y-direction shear: {}x + {}y = {}".format(a_y, b_y, c_y))
```

OUTPUT:

Equation of the transformed line after x-direction shear: $4x + 1y = -3$

Equation of the transformed line after y-direction shear: $2x + -5y = -3$

Q.7) write a Python program to solve the following LPP

$$\text{Max } Z = 4x + 2y$$

Subjected to

$$x + y \leq 5$$

$$x - y \geq 2$$

$$y \leq 2$$

$$x > 0, y > 0$$

Syntax:

```
from pulp import *

# Create a maximization problem
prob = LpProblem("Maximize Z", LpMaximize)

# Define the decision variables
x = LpVariable("x", lowBound=0, cat='Continuous') # x >= 0
y = LpVariable("y", lowBound=0, cat='Continuous') # y >= 0

# Define the objective function
prob += 4 * x + 2 * y, "Z"

# Define the constraints
prob += x + y <= 5, "Constraint 1"
prob += x - y >= 2, "Constraint 2"
prob += y <= 2, "Constraint 3"

# Solve the problem
prob.solve()

# Print the solution status
print("Solution Status: {}".format(LpStatus[prob.status]))

# Print the optimal values of the decision variables
print("Optimal Solution:")
print("x = {}".format(value(x)))
print("y = {}".format(value(y)))

# Print the optimal value of the objective function
```

```
print("Z = {}".format(value(prob.objective)))
```

OUTPUT:

Solution Status: Optimal

Optimal Solution:

x = 5.0

y = 0.0

Z = 20.0

Q.8) Write a python program to display the following LPP by using pulp module and simplex method. Find its optimal solution if exist.

Min $Z = 2x + 4y$

subject to

$2x + 2y \geq 30$

$x + 2y = 26$

$x \geq 0, y \geq 0$

Syntax:

```
from pulp import *
```

```
# Create a maximization problem
```

```
prob = LpProblem("Minimize Z", LpMinimize)
```

```
# Define the decision variables
```

```
x = LpVariable("x", lowBound=0, cat='Continuous') # x >= 0
```

```
y = LpVariable("y", lowBound=0, cat='Continuous') # y >= 0
```

```
# Define the objective function
```

```
obj_func = 2 * x + 4 * y
```

```
prob += obj_func
```

```
# Define the constraints
```

```
constr1 = 2 * x + 2 * y >= 30
```

```
constr2 = x + 2 * y == 26
```

```
prob += constr1
```

```
prob += constr2
```

```
# Solve the problem using the simplex method
```

```
solver = getSolver('PULP_CBC_CMD')
```

```
solver.actualSolve(prob)
```

```
# Print the solution status
```

```
print("Solution Status: {}".format(LpStatus[prob.status]))
```

```
# If the problem has an optimal solution, print the optimal values of the decision variables and the objective function
```

```
if prob.status == LpStatusOptimal:
```

```

print("Optimal Solution:")
print("x = {}".format(value(x)))
print("y = {}".format(value(y)))
print("Z = {}".format(value(obj_func)))

```

OUTPUT:

Solution Status: Optimal

Optimal Solution:

x = 4.0

y = 11.0

Z = 52.0

Q.9) Apply Python. Program in each of the following transformation on the point P[-2,4]

(I) Reflection through line $3x + 4y = 5$

(II) Scaling in X coordinate by factor 6.

(III) Scaling in Y coordinate by factor 4.1

(IV) Reflection through the line $y = 2x + 3$

Syntax:

```
P = [-2, 4]
```

```
print("Original Point P: {}".format(P))
```

```
A = 3
```

```
B = 4
```

```
C = -5
```

```
# Compute the reflected point
```

```
Px_reflect = P[0] - 2 * (A * P[0] + B * P[1] + C) / (A**2 + B**2)
```

```
Py_reflect = P[1] - 2 * (A * P[1] - B * P[0] + C) / (A**2 + B**2)
```

```
P_reflect = [Px_reflect, Py_reflect]
```

```
print("Reflection through line  $3x + 4y = 5$ : {}".format(P_reflect))
```

```
# Transformation (II): Scaling in X coordinate by factor 6
```

```
scale_factor_x = 6
```

```
Px_scaled_x = P[0] * scale_factor_x
```

```
Py_scaled_x = P[1]
```

```
P_scaled_x = [Px_scaled_x, Py_scaled_x]
```

```
print("Scaling in X coordinate by factor 6: {}".format(P_scaled_x))
```

```
# Transformation (III): Scaling in Y coordinate by factor 4.1
```

```
scale_factor_y = 4.1
```

```
Px_scaled_y = P[0]
```

```
Py_scaled_y = P[1] * scale_factor_y
```

```
P_scaled_y = [Px_scaled_y, Py_scaled_y]
```

```

print("Scaling in Y coordinate by factor 4.1: {}".format(P_scaled_y))
A = 2
B = -1
C = -3
# Compute the reflected point
Px_reflect_y = P[0]
Py_reflect_y = P[1] - 2 * (A * P[0] + B * P[1] + C) / (A**2 + B**2)
P_reflect_y = [Px_reflect_y, Py_reflect_y]
print("Reflection through line y = 2x + 3: {}".format(P_reflect_y))

```

OUTPUT:

```

Original Point P: [-2, 4]
Reflection through line 3x + 4y = 5: [-2.4, 2.8]
Scaling in X coordinate by factor 6: [-12, 4]
Scaling in Y coordinate by factor 4.1: [-2, 16.4]
Reflection through line y = 2x + 3: [-2, 8.4]

```

Q.10) Apply the following transformation on the point $P[-2,4]$

- (I) Shearing in Y direction by 7 units.
- (II) Scaling in X and Y direction by 4 and 7 units respectively
- (III) Rotation about origin by an angle 48 degree.
- (IV) Reflection through the line $y = x$

Syntax:

```

import math
# Point P
P = [-2, 4]
print("Original Point P: {}".format(P))
# Transformation (I): Shearing in Y direction by 7 units
shear_factor_y = 7
Px_shear_y = P[0]
Py_shear_y = P[1] + shear_factor_y * P[0]
P_shear_y = [Px_shear_y, Py_shear_y]
print("Shearing in Y direction by 7 units: {}".format(P_shear_y))
# Transformation (II): Scaling in X and Y direction by 4 and 7 units respectively
scale_factor_x = 4
scale_factor_y = 7
Px_scaled_xy = P[0] * scale_factor_x
Py_scaled_xy = P[1] * scale_factor_y
P_scaled_xy = [Px_scaled_xy, Py_scaled_xy]
print("Scaling in X and Y direction by 4 and 7 units respectively:
{}".format(P_scaled_xy))
# Transformation (III): Rotation about origin by an angle of 48 degrees

```

```
angle_degrees = 48
angle_radians = math.radians(angle_degrees)
Px_rotate = P[0] * math.cos(angle_radians) - P[1] * math.sin(angle_radians)
Py_rotate = P[0] * math.sin(angle_radians) + P[1] * math.cos(angle_radians)
P_rotate = [Px_rotate, Py_rotate]
print("Rotation about origin by an angle of 48 degrees: {}".format(P_rotate))
# Transformation (IV): Reflection through the line y = x
Px_reflect = P[1]
Py_reflect = P[0]
P_reflect = [Px_reflect, Py_reflect]
print("Reflection through the line y = x: {}".format(P_reflect))
```

OUTPUT:

Original Point P: [-2, 4]

Shearing in Y direction by 7 units: [-2, -10]

Scaling in X and Y direction by 4 and 7 units respectively: [-8, 28]

Rotation about origin by an angle of 48 degrees: [-4.3108405146272935,
1.1902327744806445]

Reflection through the line y = x: [4, -2]

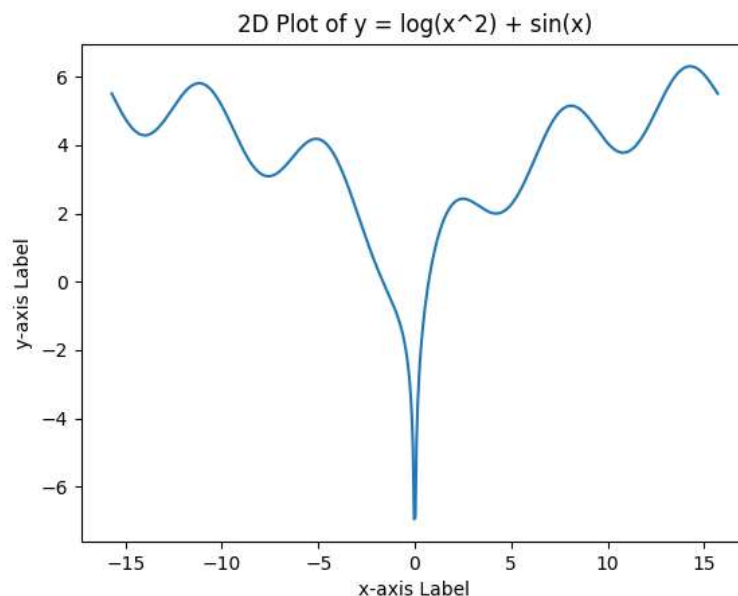
Remark
Demonstrators
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Date :- / /2023

Q.1) Write a python program to draw 2D plot $y = \log(x^2) + \sin(x)$ with suitable label in the x axis , y axis and a tittle in $[-5*\pi,5*\pi]$

Syntax:

```
import numpy as np
import matplotlib.pyplot as plt
# Generate x values from -5*pi to 5*pi
x = np.linspace(-5 * np.pi, 5 * np.pi, 500)
# Compute y values using the given function
y = np.log(x**2) + np.sin(x)
# Create the plot
plt.plot(x, y)
plt.xlabel('x-axis Label') # Label for x-axis
plt.ylabel('y-axis Label') # Label for y-axis
plt.title('2D Plot of y = log(x^2) + sin(x)') # Title of the plot
# Show the plot
plt.show()
```

OUTPUT:



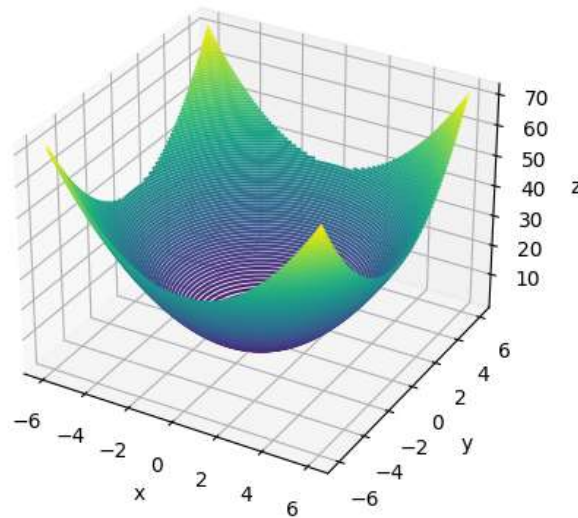
Q.2) Write a python program to plot 3D dimensional Contour plot of parabola $z = x^2 + y^2$, $-6 < x, y < 6$

Syntax:

```
import numpy as np
import matplotlib.pyplot as plt
from mpl_toolkits import mplot3d
# Generate x and y values
x = np.linspace(-6, 6, 100)
y = np.linspace(-6, 6, 100)
# Create a grid of x and y values
X, Y = np.meshgrid(x, y)
# Compute z values using the given function
Z = X**2 + Y**2
# Create a 3D contour plot
fig = plt.figure()
ax = fig.add_subplot(111, projection='3d')
ax.contour3D(X, Y, Z, 100, cmap='viridis')
# Set labels and title
ax.set_xlabel('x')
ax.set_ylabel('y')
ax.set_zlabel('z')
ax.set_title('3D Contour Plot of  $z = x^2 + y^2$ ')
# Show the plot
plt.show()
```

OUTPUT:

3D Contour Plot of $z = x^2 + y^2$

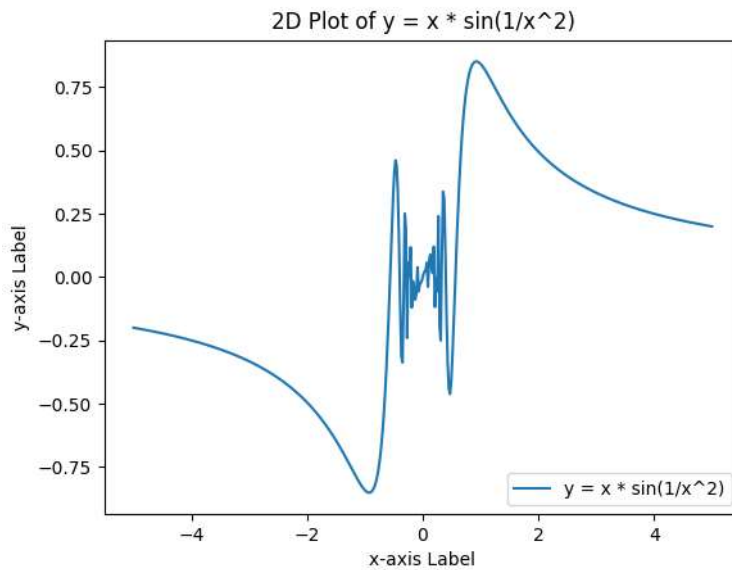


Q.3) Write a python program to draw 2D plot $y = x \sin(1/x^2)$ in $[-5,5]$ with suitable label in the x axis, y axis a title and location of legend to lower right corner.

Syntax:

```
import numpy as np
import matplotlib.pyplot as plt
# Generate x values from -5 to 5
x = np.linspace(-5, 5, 500)
# Compute y values using the given function
y = x * np.sin(1 / x**2)
# Create the plot
plt.plot(x, y, label='y = x * sin(1/x^2)')
plt.xlabel('x-axis Label') # Label for x-axis
plt.ylabel('y-axis Label') # Label for y-axis
plt.title('2D Plot of y = x * sin(1/x^2)') # Title of the plot
plt.legend(loc='lower right') # Legend in lower-right corner
# Show the plot
plt.show()
```

OUTPUT:



Q.4) Write a python program to find the angle at each vertex of the triangle ABC where A[0,0] B[2,2] and C[0,2].

Syntax:

```
import numpy as np
# Given coordinates of points A, B, and C
A = np.array([0, 0])
B = np.array([2, 2])
C = np.array([0, 2])
# Compute the sides of the triangle
AB = np.linalg.norm(B - A) # Length of side AB
BC = np.linalg.norm(C - B) # Length of side BC
AC = np.linalg.norm(C - A) # Length of side AC
# Compute the angles using the Law of Cosines
angle_A = np.arccos((AB**2 + AC**2 - BC**2) / (2 * AB * AC))
angle_B = np.arccos((-AB**2 + AC**2 + BC**2) / (2 * AC * BC))
angle_C = np.pi - angle_A - angle_B
# Convert angles from radians to degrees
angle_A_deg = np.degrees(angle_A)
angle_B_deg = np.degrees(angle_B)
angle_C_deg = np.degrees(angle_C)
# Print the angles in degrees
print("Angle at vertex A: {:.2f} degrees".format(angle_A_deg))
print("Angle at vertex B: {:.2f} degrees".format(angle_B_deg))
```

```
print("Angle at vertex C: {:.2f} degrees".format(angle_C_deg))
```

Output:

Angle at vertex A: 45.00 degrees

Angle at vertex B: 90.00 degrees

Angle at vertex C: 45.00 degrees

Q.5) Write a Python program to Reflect the Point P[3,6] through the line $x - 2y + 4 = 0$.

Syntax:

```
import numpy as np
# Given point P
P = np.array([3, 6])
# Given line parameters
a = 1 # Coefficient of x in the line equation
b = -2 # Coefficient of y in the line equation
c = 4 # Constant term in the line equation
# Compute the perpendicular distance from point P to the line
dist = abs(a * P[0] + b * P[1] + c) / np.sqrt(a**2 + b**2)
# Compute the reflected point using the formula
reflected_x = P[0] - 2 * a * dist / (a**2 + b**2)
reflected_y = P[1] - 2 * b * dist / (a**2 + b**2)
# Create the reflected point as a NumPy array
reflected_P = np.array([reflected_x, reflected_y])
# Print the coordinates of the reflected point
print("Reflected Point: ({:.2f}, {:.2f})".format(reflected_P[0], reflected_P[1]))
```

OUTPUT:

Reflected Point: (2.11, 7.79)

Q.6) Write a Python program to find the area and perimeter of the ABC, where A[0, 0] B[5, 0], C[3,3].

Syntax:

```
import numpy as np
# Define the vertices of the triangle
A = np.array([0, 0])
```

```
B = np.array([5, 0])
C = np.array([3, 3])
# Calculate the side lengths of the triangle
AB = np.linalg.norm(B - A)
BC = np.linalg.norm(C - B)
CA = np.linalg.norm(A - C)
# Calculate the semiperimeter
s = (AB + BC + CA) / 2
# Calculate the area using Heron's formula
area = np.sqrt(s * (s - AB) * (s - BC) * (s - CA))
# Calculate the perimeter
perimeter = AB + BC + CA
# Print the results
print("Triangle ABC:")
print("Side AB:", AB)
print("Side BC:", BC)
print("Side CA:", CA)
print("Area:", area)
print("Perimeter:", perimeter)
```

OUTPUT:

Triangle ABC:

Side AB: 5.0

Side BC: 3.605551275463989

Side CA: 4.242640687119285

Area: 7.5000000000000036

Perimeter: 12.848191962583275

Q.7) write a Python program to solve the following LPP

Max $Z = x + y$

Subjected to

$x + y \leq 11$

$x \geq 6$

$y \geq 6$

$x > 0, y > 0$

Syntax:

```
from pulp import *

# Create the problem

prob = LpProblem("Maximization Problem", LpMaximize)

# Define the variables

x = LpVariable("x", lowBound=0)
y = LpVariable("y", lowBound=0)

# Define the objective function

prob += x + y, "Objective Function"

# Define the constraints

prob += x + y <= 11, "Constraint 1"
prob += x >= 6, "Constraint 2"
prob += y >= 6, "Constraint 3"

# Solve the problem

prob.solve()

# Print the results

print("Status: ", LpStatus[prob.status])
print("Optimal Solution:")
print("x = ", value(x))
print("y = ", value(y))
print("Max Z = ", value(prob.objective))
```

OUTPUT:

Status: Infeasible

Optimal Solution:

x = 5.0

y = 6.0

Max Z = 11.0

Q.8) Write a python program to display the following LPP by using pulp module and simplex method. Find its optimal solution if exist.

Min $Z = 4x + y + 3z + 5w$
subject to
 $4x + 6y - 5z - 4w \geq -20$
 $-8x - 3y + 3z + 2w \leq 20$
 $-3x - 2y + 4z + w \leq 10$
 $x \geq 0, y \geq 0, z \geq 0, w \geq 0$

Syntax:

#BY using Pulp Module

```
from pulp import LpProblem, LpMinimize, LpVariable, lpSum, LpStatus, value
# Create the LPP problem
problem = LpProblem("LPP", LpMinimize)
# Define the variables
x = LpVariable("x", lowBound=0)
y = LpVariable("y", lowBound=0)
z = LpVariable("z", lowBound=0)
w = LpVariable("w", lowBound=0)
# Define the objective function
objective = 4 * x + y + 3 * z + 5 * w
problem += objective
# Define the constraints
constraint1 = 4 * x + 6 * y - 5 * z - 4 * w >= -20
constraint2 = -8 * x - 3 * y + 3 * z + 2 * w <= 20
constraint3 = -3 * x - 2 * y + 4 * z + w <= 10
problem += constraint1
problem += constraint2
problem += constraint3
# Solve the LPP problem using the simplex method
```

```

problem.solve()
# Check if the optimization was successful
if LpStatus[problem.status] == "Optimal":
    print("Optimal solution found:")
    print("x =", value(x))
    print("y =", value(y))
    print("z =", value(z))
    print("w =", value(w))
    print("Minimum value of Z =", value(objective))
else:
    print("Optimization failed.")

```

OUTPUT :

Optimal solution found:

x = 0.0

y = 0.0

z = 0.0

w = 0.0

Minimum value of Z = 0.0

Q.9) Write the python program for each of the following

(I) Rotate the point (1,1) about (1,4) through angle $\pi / 2$

(II) Find Distance between two points (0,0) and (1,0)

(III) Find the shearing of the point (3,4) in X direction by 3 units.

(IV) Represent two dimensional points using point function (-2,5)

Syntax:

```
import math
```

```
# Rotate point (x, y) about (cx, cy) through angle theta (in radians)
```

```
def rotate_point(x, y, cx, cy, theta):
```

```
    dx = x - cx
```

```
    dy = y - cy
```

```
    cos_theta = math.cos(theta)
```

```
    sin_theta = math.sin(theta)
```

```
    new_x = cx + dx * cos_theta - dy * sin_theta
```

```
    new_y = cy + dx * sin_theta + dy * cos_theta
```

```
    return new_x, new_y
```

```
# Find distance between two points (x1, y1) and (x2, y2)
```

```
def distance_between_points(x1, y1, x2, y2):
```

```
    return math.sqrt((x2 - x1) ** 2 + (y2 - y1) ** 2)
```

```
# Shear point (x, y) in X direction by shx units
```

```

def shear_point_x(x, y, shx):
    new_x = x + shx * y
    return new_x, y
# Define a class for representing two-dimensional points
class Point:
    def __init__(self, x, y):
        self.x = x
        self.y = y
# Rotate point (1,1) about (1,4) through angle pi/2
x1, y1 = rotate_point(1, 1, 1, 4, math.pi / 2)
print("Rotated point: ({} , {})".format(x1, y1))
# Find distance between two points (0,0) and (1,0)
x2, y2 = 0, 0
x3, y3 = 1, 0
distance = distance_between_points(x2, y2, x3, y3)
print("Distance between points: {}".format(distance))
# Find the shearing of the point (3,4) in X direction by 3 units
x4, y4 = shear_point_x(3, 4, 3)
print("Sheared point: ({} , {})".format(x4, y4))
# Represent two-dimensional points using Point class
p = Point(-2, 5)
print("Point: ({} , {})".format(p.x, p.y))

```

OUTPUT:

```

Rotated point: (4.0, 4.0)
Distance between points: 1.0
Sheared point: (15, 4)
Point: (-2, 5)

```

Q.10) A company has 3 production facilities S1, S2, and S3 with production capacity of 7,9 and 18 units (in 100's) per week of a product, respectively. These units are to be shipped to 4 warehouse D1,D2,D3,D4 with requirement of 5,6,7 and 14 units (in 100's) per week, respectively. The transportation costs (in rupee) per units between factories to warehouse are given in the table below.

	D1	D2	D3	D4	Supply
S1	19	30	50	10	7
S2	70	30	40	60	9
S3	40	8	70	20	18
Demand	5	8	7	14	34

Write a python program to solve transportation problem for minimizing the costs of whole operation.

Syntax:

```
from pulp import *
# Define the factories, warehouses, and their respective capacities
factories = ['S1', 'S2', 'S3']
warehouses = ['D1', 'D2', 'D3', 'D4']
capacities = {'S1': 7, 'S2': 9, 'S3': 18}
requirements = {'D1': 5, 'D2': 6, 'D3': 7, 'D4': 14}
# Define the transportation costs between factories and warehouses
transportation_costs = {
    ('S1', 'D1'): 19, ('S1', 'D2'): 30, ('S1', 'D3'): 50, ('S1', 'D4'): 10,
    ('S2', 'D1'): 70, ('S2', 'D2'): 30, ('S2', 'D3'): 40, ('S2', 'D4'): 60,
    ('S3', 'D1'): 40, ('S3', 'D2'): 8, ('S3', 'D3'): 70, ('S3', 'D4'): 20
}
# Create a binary variable to represent the shipment decision
shipment = LpVariable.dicts('Shipment', (factories, warehouses), lowBound=0,
cat='Integer')
# Create the LP problem
prob = LpProblem('Transportation Problem', LpMinimize)
# Define the objective function
prob += lpSum(shipment[f][w] * transportation_costs[f, w] for f in factories for
w in warehouses)
# Add the capacity constraints for factories
for f in factories:
    prob += lpSum(shipment[f][w] for w in warehouses) <= capacities[f]
# Add the demand constraints for warehouses
for w in warehouses:
    prob += lpSum(shipment[f][w] for f in factories) >= requirements[w]
# Solve the LP problem
prob.solve()
# Print the optimal solution
print('Optimal Solution:')
for f in factories:
    for w in warehouses:
        if shipment[f][w].varValue > 0:
            print('Ship {} units from {} to {}'.format(shipment[f][w].varValue, f, w))
# Print the total cost of the optimal solution
print('Total Cost: Rs. {}'.format(value(prob.objective)))
```

OUTPUT:

Optimal Solution:

Ship 5.0 units from S1 to D1

Ship 2.0 units from S1 to D4

Ship 7.0 units from S2 to D3

Ship 6.0 units from S3 to D2

Ship 12.0 units from S3 to D4

Total Cost: Rs. 683.0

Sahakar Maharshi Bhausaheb Santuji Thorat

College Sangamner

DEPARTMENT OF COMPUTER SCIENCE

MATHEMATICS

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Date :- / /2023

Roll No:- 75 **Date:-** / /2023

Class :- S.Y.BCS

Q.1) Write a python program to plot the graph of $\sin x$, and $\cos x$ in $[0, \pi]$ in one figure with $2 * 1$ subplots.

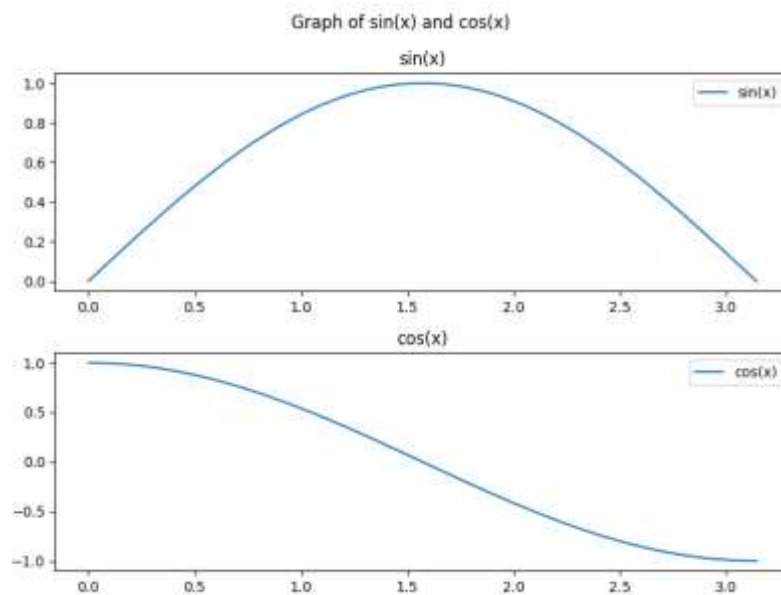
Syntax:

```
import numpy as np
import matplotlib.pyplot as plt
# Generate x values from 0 to pi with 100 data points
x = np.linspace(0, np.pi, 100)
# Calculate sin(x) and cos(x) values
sin_x = np.sin(x)
cos_x = np.cos(x)
# Create a figure with 2x1 subplots
fig, axs = plt.subplots(2, 1, figsize=(8, 6))
# Plot sin(x) in the first subplot
axs[0].plot(x, sin_x, label='sin(x)')
axs[0].set_title('sin(x)')
axs[0].legend()
# Plot cos(x) in the second subplot
axs[1].plot(x, cos_x, label='cos(x)')
axs[1].set_title('cos(x)')
axs[1].legend()
# Add overall title to the figure
fig.suptitle('Graph of sin(x) and cos(x)')
# Adjust spacing between subplots
plt.tight_layout()
```

Show the plot

plt.show()

OUTPUT:



Q.2) Write a python program to plot 3D Surface Plot of the function $z = \cos(|x| + |y|)$ in $-1 < x, y < 1$.

Syntax:

```
import numpy as np
```

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

```
# Generate 30 random x, y pairs within the range -1 < x, y < 1
```

```
np.random.seed(0)
```

```
x_vals = np.random.uniform(-1, 1, size=30)
```

```
y_vals = np.random.uniform(-1, 1, size=30)
```

```
# Create a 2D grid of x, y values
```

```
x, y = np.meshgrid(np.linspace(-1, 1, 100), np.linspace(-1, 1, 100))
```

```
# Compute the z values for each x, y pair
```

```
z = np.cos(np.abs(x) + np.abs(y))
```

```
# Plot the surface plots
```

```
for i in range(30):
```

```
    fig = plt.figure()
```

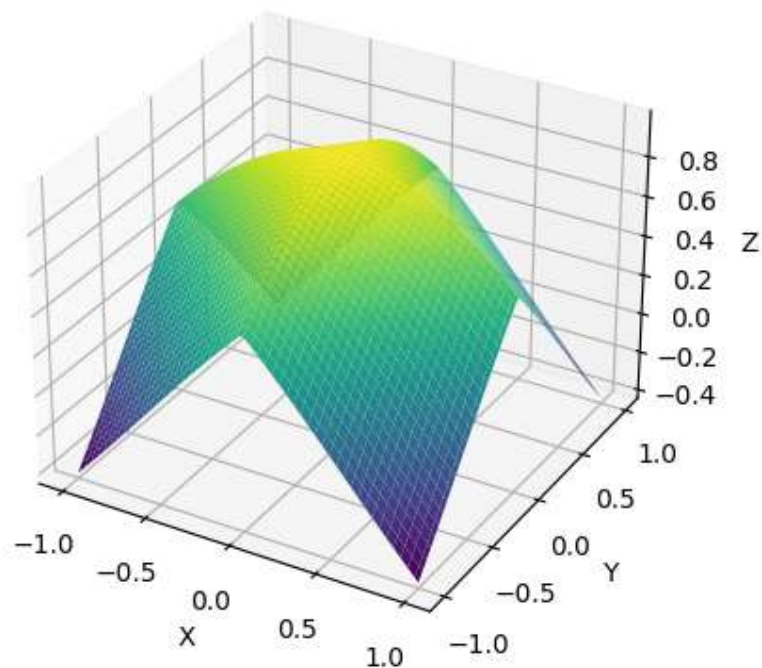
```
    ax = fig.add_subplot(111, projection='3d')
```

```

ax.plot_surface(x, y, z, cmap='viridis')
ax.set_xlabel('X')
ax.set_ylabel('Y')
ax.set_zlabel('Z')
ax.set_title(f'Surface Plot {i+1}: z = cos(|x| + |y|) for x = {x_vals[i]:.2f}, y =
{y_vals[i]:.2f}')
plt.show()

```

OUTPUT: Surface Plot 1: z = cos(|x| + |y|) for x = 0.10, y = -0.47



Q.3) Write a python program to Plot the graph of the following function in the given interval

i) $f(x) = x^3$ in $[0,5]$

ii) $f(x) = x^2$ in $[-2,2]$

Syntax:

```
import numpy as np
```

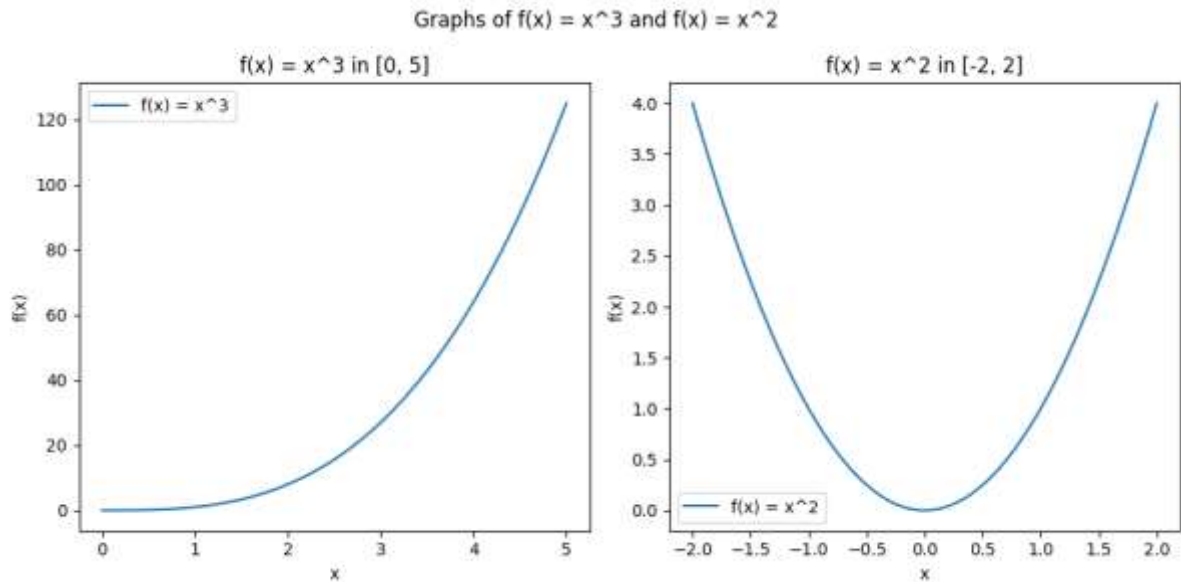
```
import matplotlib.pyplot as plt
```

```
# Define the functions
```

```
def f1(x):
    return x**3
def f2(x):
    return x**2
# Generate x values for the intervals
x1 = np.linspace(0, 5, 100)
x2 = np.linspace(-2, 2, 100)
# Calculate y values for the functions
y1 = f1(x1)
y2 = f2(x2)
# Create a figure with two subplots side by side
fig, axs = plt.subplots(1, 2, figsize=(10, 5))
# Plot  $f(x) = x^3$  in the first subplot
axs[0].plot(x1, y1, label='f(x) = x^3')
axs[0].set_xlabel('x')
axs[0].set_ylabel('f(x)')
axs[0].set_title('f(x) = x^3 in [0, 5]')
axs[0].legend()
# Plot  $f(x) = x^2$  in the second subplot
axs[1].plot(x2, y2, label='f(x) = x^2')
axs[1].set_xlabel('x')
axs[1].set_ylabel('f(x)')
axs[1].set_title('f(x) = x^2 in [-2, 2]')
axs[1].legend()
# Add overall title to the figure
fig.suptitle('Graphs of f(x) = x^3 and f(x) = x^2')
# Adjust spacing between subplots
plt.tight_layout()
# Show the plot
```

plt.show()

OUTPUT:



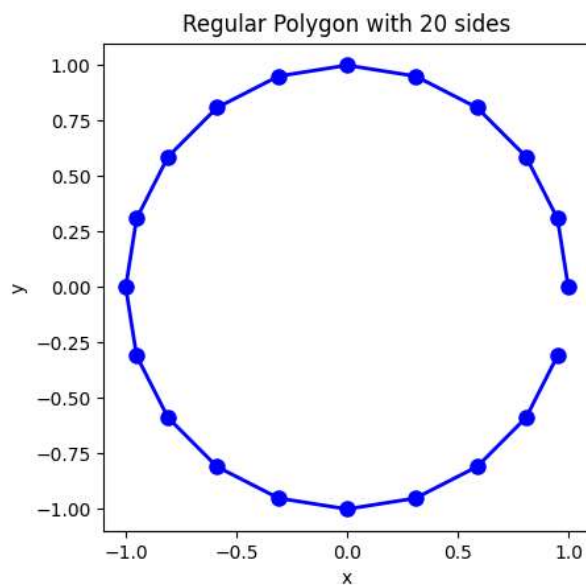
Q.4) Write a python program to draw regular polygon with 20 sides and radius 1 centered at (0,0)

Syntax:

```
import numpy as np
import matplotlib.pyplot as plt
# Number of sides of the polygon
n = 20
# Radius of the polygon
radius = 1
# Generate angles for the vertices of the polygon
angles = np.linspace(0, 2 * np.pi, n + 1)[:n]
# Calculate x and y coordinates for the vertices of the polygon
x = radius * np.cos(angles)
y = radius * np.sin(angles)
# Create a figure
fig, ax = plt.subplots()
# Plot the regular polygon
ax.plot(x, y, 'b-o', linewidth=2, markersize=8)
ax.set_aspect('equal', 'box')
ax.set_title(f'Regular Polygon with {n} sides')
```

```
ax.set_xlabel('x')
ax.set_ylabel('y')
# Show the plot
plt.show()
```

Output:



Q.5) Write a Python program to draw a polygon with vertices (0,0),(1,0),(2,2),(1,4). Also find area of polygon.

Syntax:

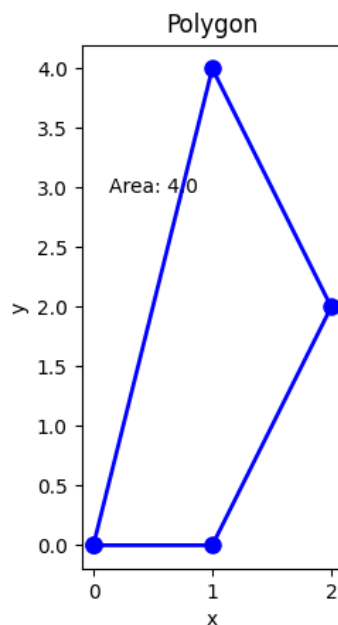
```
import matplotlib.pyplot as plt
# Define the vertices of the polygon
vertices = [(0, 0), (1, 0), (2, 2), (1, 4)]
# Extract x and y coordinates of the vertices
x = [vertex[0] for vertex in vertices]
y = [vertex[1] for vertex in vertices]
# Create a figure
fig, ax = plt.subplots()
# Plot the polygon
ax.plot(x + [x[0]], y + [y[0]], 'b-o', linewidth=2, markersize=8) # Connect last
vertex to first vertex
ax.set_aspect('equal', 'box')
ax.set_title('Polygon')
ax.set_xlabel('x')
```

```

ax.set_ylabel('y')
# Calculate the area of the polygon using Shoelace formula
area = 0
for i in range(len(vertices)):
    area += x[i] * y[(i + 1) % len(vertices)] - y[i] * x[(i + 1) % len(vertices)]
area *= 0.5
# Display the area of the polygon
ax.text(0.5, 3, f'Area: {area}', ha='center', va='center')
# Show the plot
plt.show()

```

Output:



Q.6) Write a Python program to find area and perimeter of triangle ABC where A[0, 1], B[-5,0] and C[-3,3].

Syntax:

```

import math
# Define the coordinates of the vertices A, B, and C
A = [0, 1]
B = [-5, 0]
C = [-3, 3]

```

```
# Calculate the lengths of the sides AB, BC, and AC using Euclidean distance formula
```

```
AB = math.sqrt((B[0] - A[0])**2 + (B[1] - A[1])**2)
```

```
BC = math.sqrt((C[0] - B[0])**2 + (C[1] - B[1])**2)
```

```
AC = math.sqrt((C[0] - A[0])**2 + (C[1] - A[1])**2)
```

```
# Calculate the perimeter of the triangle
```

```
perimeter = AB + BC + AC
```

```
# Calculate the area of the triangle using Heron's formula
```

```
s = perimeter / 2 # Semi-perimeter of the triangle
```

```
area = math.sqrt(s * (s - AB) * (s - BC) * (s - AC))
```

```
# Print the calculated area and perimeter
```

```
print("Area of triangle ABC:", area)
```

```
print("Perimeter of triangle ABC:", perimeter)
```

OUTPUT:

Area of triangle ABC: 6.5000000000000002

Perimeter of triangle ABC: 12.310122064520764

Q.7) write a Python program to solve the following LPP

Max $Z = 3x + 5y + 4z$

Subjected to

$2x + 3y \leq 8$

$2x + 5y \leq 10$

$3x + 2y + 4z \leq 15$

$x, y, z > 0$

Syntax:

```
import numpy as np
```

```
from scipy.optimize import linprog
```

```
# Define the coefficients of the objective function
```

```
c = [-3, -5, -4] # Coefficients of x, y, z in the objective function
```

```
# Define the coefficients of the inequality constraints
```

```

A = [
    [2, 3, 0], # Coefficients of x, y, z in the first inequality constraint
    [2, 5, 0], # Coefficients of x, y, z in the second inequality constraint
    [3, 2, 4] # Coefficients of x, y, z in the third inequality constraint
]
b = [8, 10, 15] # Right-hand side values of the inequality constraints
# Define the bounds for the variables
x_bounds = (0, None) # x >= 0
y_bounds = (0, None) # y >= 0
z_bounds = (0, None) # z >= 0
# Solve the linear programming problem
res = linprog(c, A_ub=A, b_ub=b, bounds=[x_bounds, y_bounds,
z_bounds], method='simplex')
# Extract the results
x = res.x[0] # Value of x that maximizes the objective function
y = res.x[1] # Value of y that maximizes the objective function
z = res.x[2] # Value of z that maximizes the objective function
max_z = -res.fun # Maximum value of the objective function (negation
due to maximization)
# Print the results
print("Optimal solution:")
print("x =", x)
print("y =", y)
print("z =", z)
print("Max Z =", max_z)

```

OUTPUT:

Optimal solution:

x = 0.0

y = 2.0

z = 2.75

Max Z = 21.0

Q.8) Write a python program to display the following LPP by using pulp module and simplex method. Find its optimal solution if exist.

Min $Z = 3x + 5y + 4z$

subject to

$2x + 2y \leq 12$

$2x + 2y \leq 10$

$$5x + 2y \leq 10$$

$$x \geq 0, y \geq 0, z \geq 0$$

Syntax:

```

from pulp import *
# Create a minimization problem
prob = LpProblem("LPP", LpMinimize)
# Define the decision variables
x = LpVariable('x', lowBound=0, cat='Continuous') # x >= 0
y = LpVariable('y', lowBound=0, cat='Continuous') # y >= 0
z = LpVariable('z', lowBound=0, cat='Continuous') # z >= 0
# Define the objective function
prob += 3*x + 5*y + 4*z
# Define the inequality constraints
prob += 2*x + 2*y <= 12
prob += 2*x + 2*y <= 10
prob += 5*x + 2*y <= 10
# Solve the linear programming problem
prob.solve(PULP_CBC_CMD(msg=False))
# Extract the results
optimal_solution = []
if LpStatus[prob.status] == 'Optimal':
    optimal_solution.append(('x', value(x)))
    optimal_solution.append(('y', value(y)))
    optimal_solution.append(('z', value(z)))
    optimal_solution.append(('Min Z', value(prob.objective)))
else:
    print("No optimal solution found.")
# Print the results
print("Optimal solution:")
for variable, value in optimal_solution:
    print(variable, "=", value)

```

OUTPUT:

Status: Optimal

Optimal Solution:

x = 0.0

y = 0.0

z = 0.0

Z = 0.0

Q.9) Write a python program to apply the following transformation on the point = (3, -1)

- (I) Reflection through X axis
- (II) Rotation about origin through an angle 30 degree
- (III) Scaling in Y Coordinate by factor 8
- (IV) Shearing in X Direction by 2 units

Syntax:

```
import math
# Initial point
point = (3, -1)
print("Initial point:", point)
# Reflection through X axis
reflection_x = (point[0], -point[1])
print("Reflection through X axis:", reflection_x)
# Rotation about origin by 30 degrees
angle = math.radians(30)
rotation = (point[0] * math.cos(angle) - point[1] * math.sin(angle), point[0] *
math.sin(angle) + point[1] * math.cos(angle))
print("Rotation about origin by 30 degrees:", rotation)
# Scaling in Y coordinate by factor 8
scaling_y = (point[0], point[1] * 8)
print("Scaling in Y coordinate by factor 8:", scaling_y)
# Shearing in X direction by 2 units
shearing_x = (point[0] + 2 * point[1], point[1])
print("Shearing in X direction by 2 units:", shearing_x)
```

OUTPUT:

```
Initial point: (3, -1)
Reflection through X axis: (3, 1)
Rotation about origin by 30 degrees: (2.0497560061708553,
1.6960434741550814)
Scaling in Y coordinate by factor 8: (3, -8)
Shearing in X direction by 2 units: (1, -1)
```

Q.10) Write a python program to apply the following transformation on the point = (-2, 4)

- (I) Reflection through $y = x + 2$
- (II) Scaling in Y Coordinate by factor 2
- (III) Shearing in X direction by 4 units
- (IV) Rotation about origin through an angle 60 degree

Syntax:

```
import math
# Initial point
point = (-2, 4)
print("Initial point:", point)
# Reflection through  $y = x + 2$ 
reflection = (point[1] - 2, point[0] - 2)
print("Reflection through  $y = x + 2$ :", reflection)
# Scaling in Y coordinate by factor 2
scaling_y = (point[0], point[1] * 2)
print("Scaling in Y coordinate by factor 2:", scaling_y)
# Shearing in X direction by 4 units
shearing_x = (point[0] + 4 * point[1], point[1])
print("Shearing in X direction by 4 units:", shearing_x)
# Rotation about origin by 60 degrees
angle = math.radians(60)
rotation = (point[0] * math.cos(angle) - point[1] * math.sin(angle), point[0] *
math.sin(angle) + point[1] * math.cos(angle))
print("Rotation about origin by 60 degrees:", rotation)
```

OUTPUT:

```
Initial point: (-2, 4)
Reflection through  $y = x + 2$ : (2, -4)
Scaling in Y coordinate by factor 2: (-2, 8)
Shearing in X direction by 4 units: (14, 4)
Rotation about origin by 60 degrees: (-1.9641016151377544,
2.098076211353316)
```

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College Sangamner

DEPARTMENT OF COMPUTER SCIENCE

MATHEMATICS

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Batch No. :- D

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Roll No:- 75 **Date:-** / /2023

Class :- S.Y.BCS

Q.1) Write the python program to plot 3D graph of the function $f(x) = e(-x^2)$ in $[-5,5]$ with green dashed points line with upward pointing triangle.

Syntax:

```
import numpy as np
```

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

```
# Define the function
```

```
def f(x):
```

```
    return np.exp(-x**2)
```

```
# Generate x values in the range [-5, 5]
```

```
x = np.linspace(-5, 5, 100)
```

```
# Calculate y values using the function
```

```
y = f(x)
```

```
# Create a 3D plot
```

```
fig = plt.figure()
```

```
ax = fig.add_subplot(111, projection='3d')
```

```
# Plot the points with green dashed lines and upward pointing triangles as markers
```

```
ax.plot(x, y, 'g--', marker='^', markersize=6)
```

```
# Set labels and title
```

```
ax.set_xlabel('X')
```

```
ax.set_ylabel('Y')
```

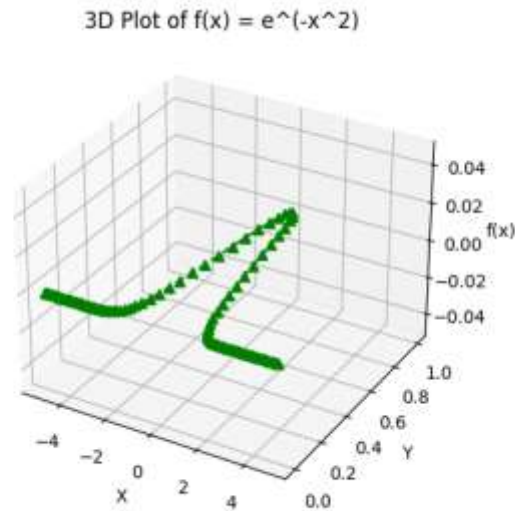
```
ax.set_zlabel('f(x)')
```

```
ax.set_title('3D Plot of  $f(x) = e^(-x^2)$ ')
```

```
# Show the plot
```

```
plt.show()
```

OUTPUT:

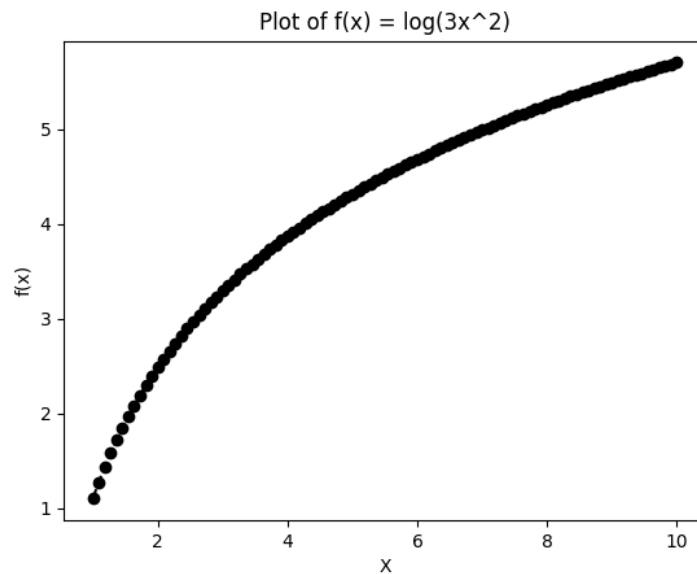


Q.2) Write the python program to plot graph of the function $f(x) = \log(3x^2)$ in $[1,10]$ with black dashed points

Syntax:

```
import numpy as np
import matplotlib.pyplot as plt
# Define the function
def f(x):
    return np.log(3 * x**2)
# Generate x values in the range [1, 10]
x = np.linspace(1, 10, 100)
# Calculate y values using the function
y = f(x)
# Create a plot
plt.plot(x, y, 'k--', marker='o', markersize=6)
# Set labels and title
plt.xlabel('X')
plt.ylabel('f(x)')
plt.title('Plot of  $f(x) = \log(3x^2)$ ')
# Show the plot
plt.show()
```

OUTPUT:



Q.3) Write the python program to plot the graph of the function using def ()

$$f(x) = \begin{cases} x^2 + 4, & \text{if } -10 < x < 5 \\ 3x + 9, & \text{if } 5 < x \leq 0 \end{cases}$$

Syntax:

```
import numpy as np
```

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

```
def f(x):
```

```
    """Function to define f(x)."""
```

```
    if -10 < x < 5:
```

```
        return x**2 + 4
```

```
    elif 5 <= x:
```

```
        return 3*x + 9
```

```
    else:
```

```
        return None
```

```
# Generate x values
```

```
x = np.linspace(-11, 11, 500) # Generate 500 points between -11 and 11
```

```
# Calculate y values using f(x)
```

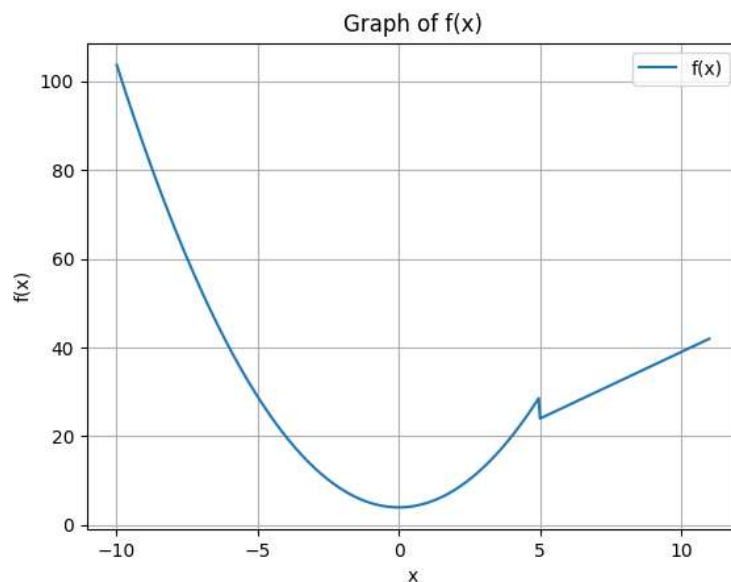
```
y = np.array([f(xi) for xi in x])
```

```

# Create the plot
plt.plot(x, y, label='f(x)')
plt.xlabel('x')
plt.ylabel('f(x)')
plt.title('Graph of f(x)')
plt.legend()
plt.grid(True)
plt.show()

```

OUTPUT:



Q.4) Write the python program to plot triangle with vertices [3,3],[5,6],[5,2] and its rotation about the origin by angle $-\pi$ radians

Syntax:

```

import numpy as np
import matplotlib.pyplot as plt
# Define the vertices of the original triangle
v1 = np.array([3, 3])
v2 = np.array([5, 6])
v3 = np.array([5, 2])
# Calculate the rotation matrix
theta = -np.pi # Angle of rotation in radians
R = np.array([[np.cos(theta), -np.sin(theta)],

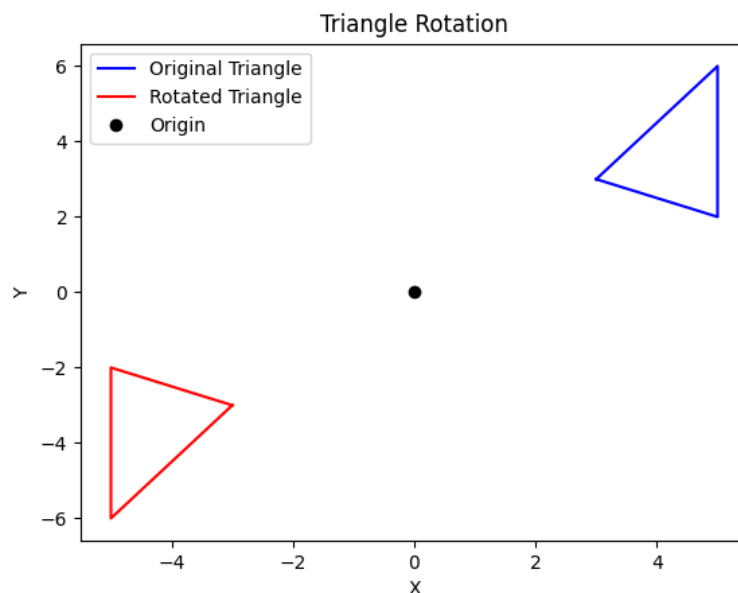
```

```

    [np.sin(theta), np.cos(theta)]]
# Apply the rotation matrix to each vertex
v1_rotated = np.dot(R, v1)
v2_rotated = np.dot(R, v2)
v3_rotated = np.dot(R, v3)
# Create a plot
plt.figure()
plt.plot([v1[0], v2[0], v3[0], v1[0]], [v1[1], v2[1], v3[1], v1[1]], 'b-',
label='Original Triangle')
plt.plot([v1_rotated[0], v2_rotated[0], v3_rotated[0], v1_rotated[0]],
[v1_rotated[1], v2_rotated[1], v3_rotated[1], v1_rotated[1]], 'r-', label='Rotated
Triangle')
plt.plot(0, 0, 'ko', label='Origin')
plt.xlabel('X')
plt.ylabel('Y')
plt.title("Triangle Rotation")
plt.legend()
# Show the plot
plt.show()

```

Output:



Q.5) Write a python to generate vector x in the interval [-22,22] using numpy package with 80 subinterval

Syntax:

```
import numpy as np
# Generate vector x with 80 subintervals
n_subintervals = 80
lower_bound = -22
upper_bound = 22
x = np.linspace(lower_bound, upper_bound, n_subintervals+1)
# Print the generated vector x
print("Vector x:", x)
```

OUTPUT:

```
Vector x: [-22.  -21.45 -20.9  -20.35 -19.8  -19.25 -18.7  -18.15 -17.6  -17.05
 -16.5  -15.95 -15.4  -14.85 -14.3  -13.75 -13.2  -12.65 -12.1  -11.55
 -11.   -10.45 -9.9   -9.35 -8.8   -8.25 -7.7   -7.15 -6.6   -6.05
 -5.5  -4.95 -4.4   -3.85 -3.3   -2.75 -2.2   -1.65 -1.1   -0.55
  0.    0.55  1.1   1.65  2.2   2.75  3.3   3.85  4.4   4.95
  5.5   6.05  6.6   7.15  7.7   8.25  8.8   9.35  9.9  10.45
 11.   11.55 12.1  12.65 13.2  13.75 14.3  14.85 15.4  15.95
 16.5  17.05 17.6  18.15 18.7  19.25 19.8  20.35 20.9  21.45
 22. ]
```

Q.6) Write a Python program to draw a polygon with vertices (0,0) ,(1,0) , (2,2) ,(1,4) also find area and perimeter of the polygon.

Syntax:

```
import numpy as np
import matplotlib.pyplot as plt
# Define the vertices of the polygon
vertices = np.array([[0, 0], [1, 0], [2, 2], [1, 4]])
# Extract x and y coordinates of the vertices
x = vertices[:, 0]
y = vertices[:, 1]
# Plot the polygon
plt.plot(x, y, 'b-', label='Polygon')
plt.plot(x, y, 'bo')
```

```

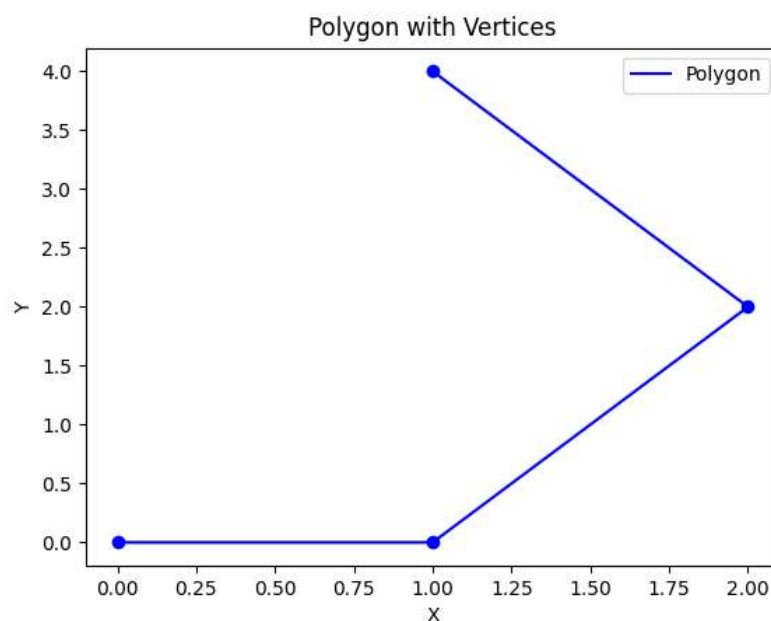
plt.xlabel('X')
plt.ylabel('Y')
plt.title('Polygon with Vertices')
plt.legend()
# Calculate the area of the polygon using shoelace formula
def calculate_area(vertices):
    x = vertices[:, 0]
    y = vertices[:, 1]
    return 0.5 * np.abs(np.dot(x, np.roll(y, 1)) - np.dot(y, np.roll(x, 1)))
area = calculate_area(vertices)
# Calculate the perimeter of the polygon
perimeter = np.sum(np.sqrt(np.sum(np.diff(vertices, axis=0)**2, axis=1)))
# Print the calculated area and perimeter
print("Area of the polygon:", area)
print("Perimeter of the polygon:", perimeter)
# Show the plot
plt.show()

```

OUTPUT:

Area of the polygon: 4.0

Perimeter of the polygon: 5.47213595499958



Q.7) write a Python program to solve the following LPP

$$\text{Max } Z = 3.5x + 2y$$

Subjected to

$$x + y \geq 5$$

$$x \geq 4$$

$$y \leq 5$$

$$x \geq 0, y \geq 0.$$

Syntax:

```
from pulp import *
# Create the LP problem
problem = LpProblem("Maximize Z", LpMaximize)
# Define the decision variables
x = LpVariable('x', lowBound=0) # x >= 0
y = LpVariable('y', lowBound=0) # y >= 0
# Define the objective function
problem += 3.5 * x + 2 * y
# Define the constraints
problem += x + y >= 5
problem += x >= 4
problem += y <= 5
# Solve the LP problem
status = problem.solve()
# Check the solution status
if status == 1:
    # Print the optimal solution
    print("Optimal solution:")
    print(f"x = {value(x)}")
```

```

    print(f"y = {value(y)}")
    print(f"Z = {value(problem.objective)}")
else:
    print("No feasible solution found.")

```

OUTPUT:

No feasible solution found.

Q.8) Write a python program to display the following LPP by using pulp module and simplex method. Find its optimal solution if exist.

Min $Z = x+y$

subject to

$x \geq 6$

$y \geq 6$

$x + y \leq 11$

$x \geq 0, y \geq 0$

Syntax:

```

from pulp import *

# Create the LP problem as a minimization problem
problem = LpProblem("LPP", LpMinimize)

# Define the decision variables
x = LpVariable('x', lowBound=0, cat='Continuous')
y = LpVariable('y', lowBound=0, cat='Continuous')

# Define the objective function
problem += x + y, "Z"

# Define the constraints
problem += x >= 6, "Constraint1"
problem += y >= 6, "Constraint2"
problem += x + y <= 11, "Constraint3"

# Solve the LP problem using the simplex method
problem.solve(PULP_CBC_CMD(msg=False))

# Print the status of the solution

```

```

print("Status:", LpStatus[problem.status])
# If the problem has an optimal solution
if problem.status == LpStatusOptimal:
    # Print the optimal values of x and y
    print("Optimal x =", value(x))
    print("Optimal y =", value(y))
    # Print the optimal value of the objective function
    print("Optimal Z =", value(problem.objective))

```

OUTPUT:

Status: Optimal

Status: Infeasible

Q.9) Write a python program to apply the following transformation on the point = (3, -1)

- (I) Reflection through X axis
- (II) Reflection through the line $y = x$.
- (III) Scaling in X Coordinate by factor 2
- (IV) Scaling in Y Coordinate by factor 1.5

Sy import numpy as np

Define the point

```
point = np.array([3, -1])
```

Transformation 1: Reflection through X axis

```
reflection_x = np.array([[1, 0], [0, -1]])
```

```
point_reflection_x = np.dot(reflection_x, point)
```

```
print("After reflection through X axis:", point_reflection_x)
```

Transformation 2: Reflection through the line $y = x$

```
reflection_yx = np.array([[0, 1], [1, 0]])
```

```
point_reflection_yx = np.dot(reflection_yx, point)
```

```
print("After reflection through the line y = x:", point_reflection_yx)
```

```

# Transformation 3: Scaling in X Coordinate by factor 2
scaling_x = np.array([[2, 0], [0, 1]])
point_scaling_x = np.dot(scaling_x, point)
print("After scaling in X Coordinate by factor 2:", point_scaling_x)
# Transformation 4: Scaling in Y Coordinate by factor 1.5
scaling_y = np.array([[1, 0], [0, 1.5]])
point_scaling_y = np.dot(scaling_y, point)
print("After scaling in Y Coordinate by factor 1.5:", point_scaling_y)

```

OUTPUT:

```

After reflection through X axis: [3 1]
After reflection through the line y = x: [-1 3]
After scaling in X Coordinate by factor 2: [ 6 -1]
After scaling in Y Coordinate by factor 1.5: [ 3. -1.5]

```

Q.10) Find the combined transformation of the line segment between the points A[4,-1] & B [3,0] by using Python program for the following sequence of transformation.

- (I) Reflection Through the line $y = x$
- (II) Scaling in X-Coordinate by factor 3
- (III) Shearing in Y – Direction by 4.5 unit
- (IV) Rotation about origin by an angle π .

Syntax:

```

import numpy as np
# Define the points A and B
A = np.array([4, -1])
B = np.array([3, 0])
# Transformation 1: Reflection through the line y = x
reflection_yx = np.array([[0, 1], [1, 0]])
A_reflection_yx = np.dot(reflection_yx, A)
B_reflection_yx = np.dot(reflection_yx, B)
# Transformation 2: Scaling in X-Coordinate by factor 3
scaling_x = np.array([[3, 0], [0, 1]])
A_scaling_x = np.dot(scaling_x, A_reflection_yx)
B_scaling_x = np.dot(scaling_x, B_reflection_yx)
# Transformation 3: Shearing in Y-Direction by 4.5 units

```

```

shearing_y = np.array([[1, 0], [0, 1]])
shearing_y[0, 1] = 4.5
A_shearing_y = np.dot(shearing_y, A_scaling_x)
B_shearing_y = np.dot(shearing_y, B_scaling_x)
# Transformation 4: Rotation about origin by an angle pi
rotation_pi = np.array([[ -1, 0], [0, -1]])
A_rotation_pi = np.dot(rotation_pi, A_shearing_y)
B_rotation_pi = np.dot(rotation_pi, B_shearing_y)
# Print the transformed points
print("After Reflection through the line y = x:")
print("A:", A_reflection_yx)
print("B:", B_reflection_yx)
print("\nAfter Scaling in X-Coordinate by factor 3:")
print("A:", A_scaling_x)
print("B:", B_scaling_x)
print("\nAfter Shearing in Y-Direction by 4.5 units:")
print("A:", A_shearing_y)
print("B:", B_shearing_y)
print("\nAfter Rotation about origin by an angle pi:")
print("A:", A_rotation_pi)
print("B:", B_rotation_pi)

```

OUTPUT:

After Reflection through the line $y = x$:

A: [-1 4]

B: [0 3]

After Scaling in X-Coordinate by factor 3:

A: [-3 4]

B: [0 3]

After Shearing in Y-Direction by 4.5 units:

A: [13 4]

B: [12 3]

After Rotation about origin by an angle π :

A: [-13 -4]

B: [-12 -3]

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DEPARTMENT OF COMPUTER SCIENCE

MATHEMATICS

Name :- Prem Vijay Vajare

Batch No. :- D

Roll No:- 75 **Date:-** / /2023

Title of the:- Practical 25

Expt. No . 25

Class :- S.Y.BCS

Remark

Demonstrators

Signature

Date :- / /2023

Q.1) Using Python plot the surface plot of function $z = \cos(x^2 + y^2 - 0.5)$ in the interval from $-1 < x, y < 1$.

Syntax:

```
import numpy as np
```

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

```
from mpl_toolkits.mplot3d import Axes3D
```

```
# Define the function
```

```
def func(x, y):
```

```
    return np.cos(x**2 + y**2 - 0.5)
```

```
# Generate x, y values in the interval from -1 to 1
```

```
x = np.linspace(-1, 1, 100)
```

```
y = np.linspace(-1, 1, 100)
```

```
X, Y = np.meshgrid(x, y) # Create a grid of x, y values
```

```
Z = func(X, Y) # Compute z values using the function
```

```
# Create a 3D plot
```

```
fig = plt.figure()
```

```
ax = fig.add_subplot(111, projection='3d')
```

```
ax.plot_surface(X, Y, Z, cmap='viridis') # Plot the surface
```

```
ax.set_xlabel('X')
```

```
ax.set_ylabel('Y')
```

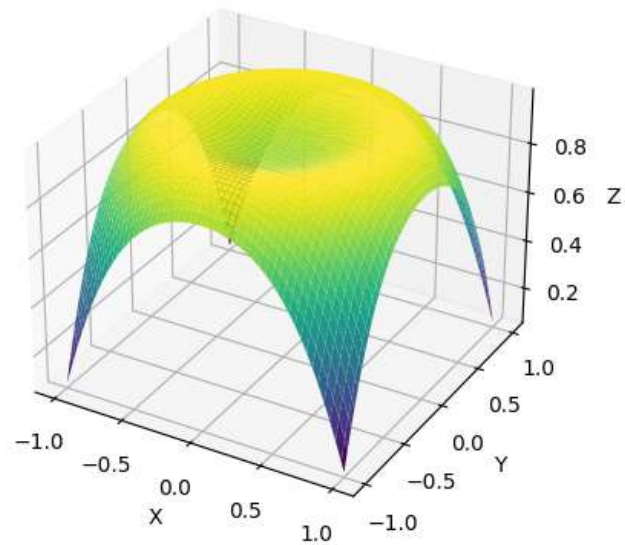
```
ax.set_zlabel('Z')
```

```
ax.set_title('Surface Plot of  $z = \cos(x^2 + y^2 - 0.5)$ ')
```

```
plt.show() # Show the plot
```

OUTPUT:

Surface Plot of $z = \cos(x^2 + y^2 - 0.5)$



Q.2) Write a Python program to generate 3D plot of the function $z = \sin(x) + \cos(y)$ in $-10 < x, y < 10$.

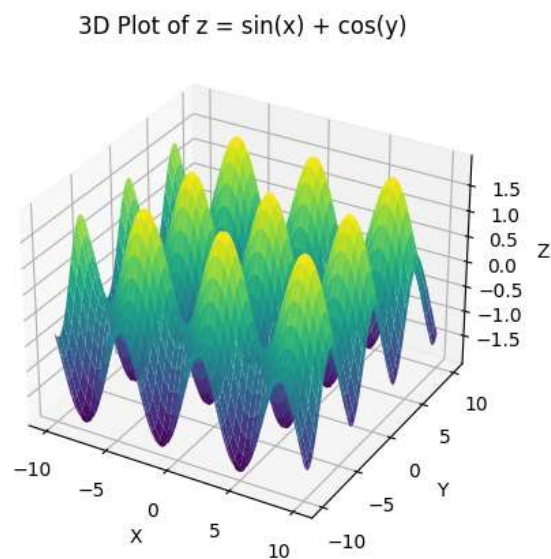
Syntax:

```
import numpy as np
import matplotlib.pyplot as plt
from mpl_toolkits.mplot3d import Axes3D
# Generate x, y values
x = np.linspace(-10, 10, 100)
y = np.linspace(-10, 10, 100)
X, Y = np.meshgrid(x, y)
# Calculate z values
Z = np.sin(X) + np.cos(Y)
# Create 3D plot
fig = plt.figure()
ax = fig.add_subplot(111, projection='3d')
# Plot the surface
ax.plot_surface(X, Y, Z, cmap='viridis')
# Set labels and title
```

```

ax.set_xlabel('X')
ax.set_ylabel('Y')
ax.set_zlabel('Z')
ax.set_title('3D Plot of z = sin(x) + cos(y)')
# Show the plot
plt.show()
OUTPUT:

```



Q.3) Using Python plot the graph of function $f(x) = \sin^{-1}(x)$ on the interval $[-1, 1]$.

Syntax:

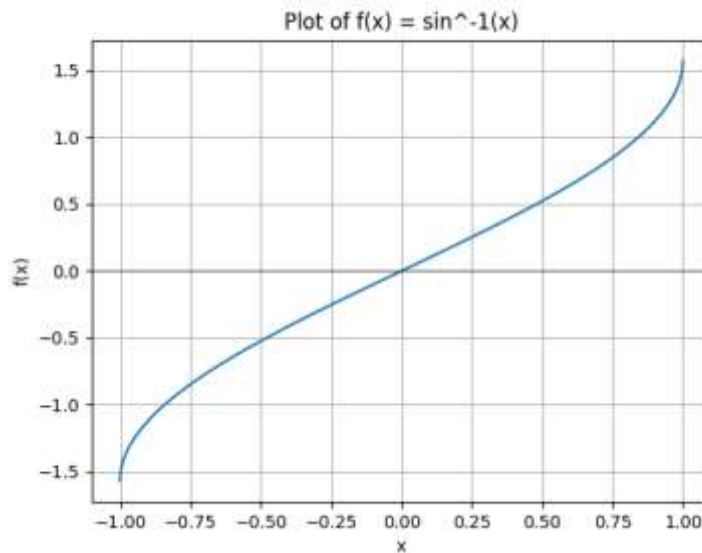
```

import numpy as np
import matplotlib.pyplot as plt
# Generate x values
x = np.linspace(-1, 1, 1000)
# Calculate f(x) values
f_x = np.arcsin(x)
# Create the plot
plt.plot(x, f_x)
plt.xlabel('x')
plt.ylabel('f(x)')

```

```
plt.title('Plot of f(x) = sin-1(x)')
plt.grid(True)
plt.axhline(0, color='black', lw=0.5) # Add horizontal grid line at y=0
# Show the plot
plt.show()
```

OUTPUT:



Q.4) Rotate the line segment by 180° having endpoints (1,0) and (2,-1).

Syntax:

```
import numpy as np
# Define the endpoints of the line segment
point1 = np.array([1, 0])
point2 = np.array([2, -1])
# Define the rotation matrix for 180 degrees
R = np.array([[ -1, 0], [0, -1]])
# Rotate the endpoints of the line segment
rotated_point1 = np.dot(R, point1)
rotated_point2 = np.dot(R, point2)
# Print the rotated coordinates
print("Rotated endpoint 1: ", rotated_point1)
print("Rotated endpoint 2: ", rotated_point2)
```

Output:

```
Rotated endpoint 1: [-1  0]
Rotated endpoint 2: [-2  1]
```

Q.5) Using sympy, declare the points P(5, 2), Q(5, -2), R(5, 0), check whether these points are collinear. Declare the ray passing through the points P and Q, find the length of this ray between P and Q. Also find slope of this ray.

Syntax:

```
from sympy import Point, Line
# Declare the points
P = Point(5, 2)
Q = Point(5, -2)
R = Point(5, 0)
# Check if points are collinear
collinear = Point.is_collinear(P, Q, R)
if collinear:
    print("Points P, Q, and R are collinear.")
else:
    print("Points P, Q, and R are not collinear.")
# Declare the ray passing through points P and Q
ray_PQ = Line(P, Q)
# Calculate the length of the ray PQ
length_PQ = P.distance(Q)
print("Length of ray PQ:", length_PQ)
# Calculate the slope of the ray PQ
if ray_PQ.slope == None:
    print("Slope of ray PQ: Undefined (division by zero)")
else:
    print("Slope of ray PQ:", ray_PQ.slope)
```

OUTPUT:

Points P, Q, and R are collinear.

Length of ray PQ: 4

Slope of ray PQ: 00

Q.6) Generate triangle with vertices (0, 0), (4, 0), (1, 4), check whether the triangle is Scalene triangle.

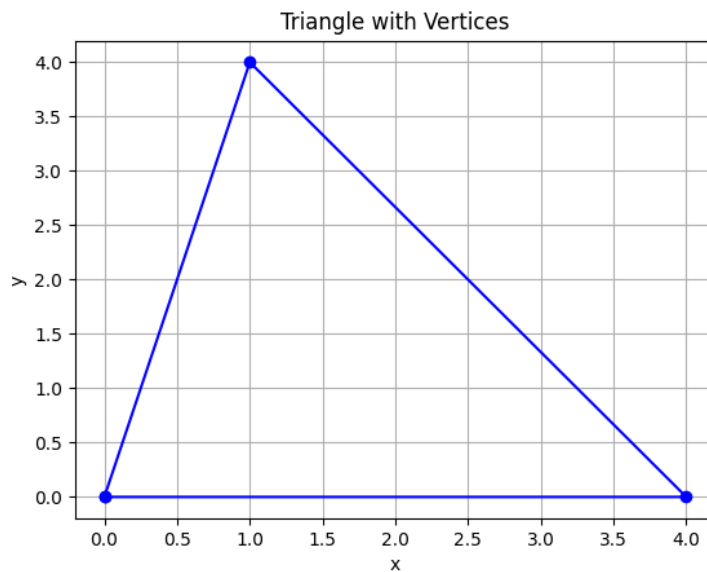
Syntax:

```
import matplotlib.pyplot as plt
# Define the vertices of the triangle
vertices = [(0, 0), (4, 0), (1, 4)]
# Check if the triangle is a scalene triangle
def is_scalene(vertices):
    x1, y1 = vertices[0]
    x2, y2 = vertices[1]
    x3, y3 = vertices[2]
    return (x1 != x2 and x1 != x3 and x2 != x3) and (y1 != y2 and y1 != y3 and
y2 != y3)
if is_scalene(vertices):
    print("The triangle is a scalene triangle.")
else:
    print("The triangle is not a scalene triangle.")
# Plot the triangle
x = [point[0] for point in vertices] + [vertices[0][0]]
y = [point[1] for point in vertices] + [vertices[0][1]]
plt.plot(x, y, marker='o', linestyle='-', color='blue')
plt.xlabel('x')
plt.ylabel('y')
plt.title("Triangle with Vertices")
plt.grid(True)
plt.show()
```

OUTPUT:

The triangle is not a scalene triangle.

Plot



Q.7) Write a python program to display the following LPP:

$$\text{Min } Z = 4x + y + 3z + 5w$$

subject to

$$4x + 6y - 5z - 4w \geq 20$$

$$-8x - 3y + 3z + 2w \leq 20$$

$$-3x - 2y + 4z + w \leq 10$$

$$x \geq 0, y \geq 0, z \geq 0, w \geq 0$$

Syntax:

```
from pulp import *
# Create a minimization problem
prob = LpProblem("LPP", LpMinimize)
# Define the decision variables
x = LpVariable("x", lowBound=0)
y = LpVariable("y", lowBound=0)
z = LpVariable("z", lowBound=0)
w = LpVariable("w", lowBound=0)
# Define the objective function
prob += 4*x + y + 3*z + 5*w, "Z"
```

```
# Define the constraints
prob += 4*x + 6*y - 5*z - 4*w >= 20
prob += -8*x - 3*y + 3*z + 2*w <= 20
prob += -3*x - 2*y + 4*z + w <= 10
# Solve the problem
prob.solve()
# Print the status of the problem
print("Status:", LpStatus[prob.status])
# Print the optimal values of the decision variables
print("Optimal values:")
print("x =", value(x))
print("y =", value(y))
print("z =", value(z))
print("w =", value(w))
# Print the optimal value of the objective function
print("Optimal Z =", value(prob.objective))
```

OUTPUT:

Status: Optimal

Optimal values:

x = 0.0

y = 3.3333333

z = 0.0

w = 0.0

Optimal Z = 3.3333333

Q.8) Write a python program to display the following LPP by using pulp module and simplex method. Find its optimal solution if exist.

$$\begin{aligned} \text{Min } Z &= 150x + 75y \\ \text{subject to} \\ 4x + 6y &\leq 24 \\ 5x + 3y &\leq 15 \\ x \geq 0, y &\geq 0 \end{aligned}$$

Syntax:

```
from pulp import *
# Create a minimization problem
prob = LpProblem("LPP", LpMinimize)
# Define the decision variables
x = LpVariable("x", lowBound=0)
y = LpVariable("y", lowBound=0)
# Define the objective function
prob += 150*x + 75*y, "Z"
# Define the constraints
prob += 4*x + 6*y <= 24
prob += 5*x + 3*y <= 15
# Solve the problem using the simplex method
prob.solve(PULP_CBC_CMD(msg=False, mip=0))
# Print the status of the problem
print("Status:", LpStatus[prob.status])
# Print the optimal values of the decision variables
print("Optimal values:")
print("x =", value(x))
print("y =", value(y))
# Print the optimal value of the objective function
print("Optimal Z =", value(prob.objective))
```

OUTPUT :

```
Status: Optimal
Optimal values:
x = 0.0
y = 0.0
Optimal Z = 0.0
```

Q.9) Write a python program to apply the following transformation on the point (-2,4) :

- (I) Reflection through X-axis.
- (II) Scaling in X-coordinate by factor 6.
- (III) Shearing in X direction by 4 units.
- (IV) Rotate about origin through an angle 30

Syntax:

```
import numpy as np
# Initial point
point = np.array([-2, 4])
# Transformation I: Reflection through X-axis
reflection_x = np.array([[1, 0],[0, -1]])
reflected_point = np.dot(reflection_x, point)
print("Reflection through X-axis:")
print("Initial point:", point)
print("Reflected point:", reflected_point)
# Transformation II: Scaling in X-coordinate by factor 6
scaling_x = np.array([[6, 0],[0, 1]])
scaled_point = np.dot(scaling_x, point)
print("\nScaling in X-coordinate by factor 6:")
print("Initial point:", point)
print("Scaled point:", scaled_point)
# Transformation III: Shearing in X direction by 4 units
shearing_x = np.array([[1, 4],[0, 1]])
sheared_point = np.dot(shearing_x, point)
print("\nShearing in X direction by 4 units:")
print("Initial point:", point)
print("Sheared point:", sheared_point)
# Transformation IV: Rotate about origin through an angle of 30 degrees
angle = np.deg2rad(30)
rotation = np.array([[np.cos(angle), -np.sin(angle)],[np.sin(angle), np.cos(angle)]])
rotated_point = np.dot(rotation, point)
print("\nRotate about origin through an angle of 30 degrees:")
print("Initial point:", point)
print("Rotated point:", rotated_point)
```

OUTPUT:

Reflection through X-axis:

Initial point: [-2 4]

Reflected point: [-2 -4]

Scaling in X-coordinate by factor 6:

Initial point: [-2 4]

Scaled point: [-12 4]

Shearing in X direction by 4 units:

Initial point: [-2 4]

Sheared point: [14 4]

Rotate about origin through an angle of 30 degrees:

Initial point: [-2 4]

Rotated point: [-3.73205081 2.46410162]

Q.10) Write a python program to find the combined transformation of the line segment between the points A[3,2] & B [2,-3] for the following sequence of transformation:

(I) Rotation about origin through an angle $\pi/6$

(II) Scaling in Y – Coordinate by -4 unit.

(III) Uniform scaling by -6.4 units

(IV) Shearing in Y direction by 5 units.

Syntax:

```
import numpy as np
```

```
# Initial points
```

```
A = np.array([3, 2])
```

```
B = np.array([2, -3])
```

```
# Transformation I: Rotation about origin through an angle  $\pi/6$ 
```

```
angle = np.pi / 6
```

```
rotation = np.array([[np.cos(angle), -np.sin(angle)],  
                    [np.sin(angle),  
                    np.cos(angle)]])
```

```
rotated_A = np.dot(rotation, A)
```

```
rotated_B = np.dot(rotation, B)
```

```
print("Transformation I: Rotation about origin through an angle  $\pi/6$ ")
```

```
print("Rotated point A:", rotated_A)
```

```
print("Rotated point B:", rotated_B)
```

```
# Transformation II: Scaling in Y-coordinate by -4 units
```

```
scaling_y = np.array([[1, 0],[0, -4]])
```

```
scaled_A = np.dot(scaling_y, rotated_A)
```

```
scaled_B = np.dot(scaling_y, rotated_B)
```

```
print("\nTransformation II: Scaling in Y-coordinate by -4 units")
```

```

print("Scaled point A:", scaled_A)
print("Scaled point B:", scaled_B)
# Transformation III: Uniform scaling by -6.4 units
uniform_scaling = np.array([[ -6.4, 0],[0, -6.4]])
uniform_scaled_A = np.dot(uniform_scaling, scaled_A)
uniform_scaled_B = np.dot(uniform_scaling, scaled_B)
print("\nTransformation III: Uniform scaling by -6.4 units")
print("Uniform scaled point A:", uniform_scaled_A)
print("Uniform scaled point B:", uniform_scaled_B)
# Transformation IV: Shearing in Y direction by 5 units
shearing_y = np.array([[1, 5],[0, 1]])
sheared_A = np.dot(shearing_y, uniform_scaled_A)
sheared_B = np.dot(shearing_y, uniform_scaled_B)
print("\nTransformation IV: Shearing in Y direction by 5 units")
print("Sheared point A:", sheared_A)
print("Sheared point B:", sheared_B)

```

OUTPUT:

```

Transformation I: Rotation about origin through an angle pi/6
Rotated point A: [1.59807621 3.23205081]
Rotated point B: [ 3.23205081 -1.59807621]
Transformation II: Scaling in Y-coordinate by -4 units
Scaled point A: [ 1.59807621 -12.92820323]
Scaled point B: [3.23205081 6.39230485]
Transformation III: Uniform scaling by -6.4 units
Uniform scaled point A: [-10.22768775 82.74050067]
Uniform scaled point B: [-20.68512517 -40.91075101]
Transformation IV: Shearing in Y direction by 5 units
Sheared point A: [403.47481562 82.74050067]
Sheared point B: [-225.23888022 -40.91075101]

```