

# **Tribhuvan University**

## **Institute of Science and Technology**



### **Central Department of Computer Science and Information Technology**

**Kirtipur, Kathmandu**



### **Computational Geometry Assignment**

#### **Lab 2: Implementation of polygon, turn test, and convexity**

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## Lab 1: Write a program to implement following geometric objects

1. Implementation of Polygon
2. Implementation of Turn Test (Left, Right and Collinear)
3. Checking whether polygon created in Q1. is convex or not.

### Answer

Code can be found on:

[https://colab.research.google.com/drive/1ZQUxYDUDufHA\\_a0L9IyK\\_JKhBWhmVqza](https://colab.research.google.com/drive/1ZQUxYDUDufHA_a0L9IyK_JKhBWhmVqza)

```
import matplotlib.pyplot as plt

def main():
    print("----- Program runs in sequence from Polygon -> Convex Test -> Turn Test -----\\n")
    polygon()

def convexTest(data):
    print("\\n----- Convex Test -----\\n")
    points = data
    total_points = len(data)
    x = []
    y = []

    result = []
    for i in range(total_points):
        pi = points[i]
        xi = float(pi[0])
        x.append(xi)
        yi = float(pi[1])
        y.append(yi)

    for i in range(total_points):
        if(i == total_points-1):
            crossProduct = ((x[0]-x[i])*(y[1]-y[i]))-((x[1]-x[i])*(y[0]-y[i]))
        if(i == total_points-2):
            crossProduct = ((x[i+1]-x[i])*(y[0]-y[i]))-((x[0]-x[i])*(y[i+1]-y[i]))
        if(i <= total_points-3):
            crossProduct = ((x[i+1]-x[i])*(y[i+2]-y[i]))-((x[i+2]-x[i])*(y[i+1]-y[i]))

        if(crossProduct >= 0):
            result.append("Left Turn")
        else:
            result.append("Not")

    convex = True
```

```

for item in result:
    if(item != "Left Turn"):
        convex = False
        break;

if (convex == True):
    print("The Polygon is convex")
else:
    print("The Polygon is not convex")

def polygon():
    total_points = int(input("Enter the number of co-
ordinates the polygon will have: "))
    plt.xlabel('x - axis')
    plt.ylabel('y - axis')
    plt.title("Polygon")
    plt.grid()

    point = []
    cx = []
    cy = []
    PI = []
    for i in range(total_points):

        Pi = input("Enter value of coordinate of polygon: ")
        point.append(Pi)

        pi = point[i].split(",")
        xi = float(pi[0])
        yi = float(pi[1])

        PI.append(pi)
        cx.append(xi)
        cy.append(yi)
        plt.scatter(xi, yi)
        plt.text(x=xi, y=yi, s="P" + str(i))
    cx.append(cx[0])
    cy.append(cy[0])
    plt.plot(cx, cy)
    plt.show()

    convexTest(PI)
    turnTest(PI)

def turnTest(data):
    print("\n----- Turn Test ----- \n")
    points = data
    total_points = len(data)
    x = []
    y = []

    for i in range(total_points):

```

```

    pi = points[i]
    xi = float(pi[0])
    x.append(xi)
    yi = float(pi[1])
    y.append(yi)

for i in range(total_points):
    if(i == total_points-1):
        print("Area for P"+str(i)+"", P0 and P1")
        crossProduct = ((x[0]-x[i])*(y[1]-y[i]))-((x[1]-x[i])*(y[0]-
y[i]))
    if(i == total_points-2):
        print("Area for P"+str(i)+"", P"+str(i+1) +" and P0")
        crossProduct = ((x[i+1]-x[i])*(y[0]-y[i]))-((x[0]-
x[i])*(y[i+1]-y[i]))
    if(i <= total_points-3):
        print("Area for P"+str(i)+"", P"+str(i+1)+" and P"+str(i+2))
        crossProduct = ((x[i+1]-x[i])*(y[i+2]-y[i]))-((x[i+2]-
x[i])*(y[i+1]-y[i]))

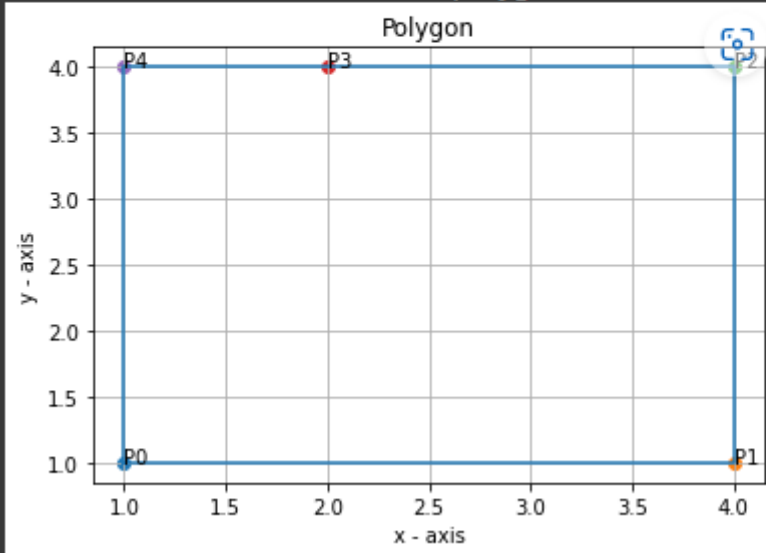
    if(crossProduct > 0):
        print("Left Turn\n")
    elif(crossProduct < 0):
        print("Right Turn\n")
    else:
        print("Collinear\n")

main()

```

**Output:** The output is considered for given same points in sequence from polygon, convex test to turn test of same given points.

```
Enter the number of co-ordinates the polygon will have: 5
Enter value of coordinate of polygon: 1,1
Enter value of coordinate of polygon: 4,1
Enter value of coordinate of polygon: 4,4
Enter value of coordinate of polygon: 2,4
Enter value of coordinate of polygon: 1,4
```



```
----- Convex Test -----
```

```
The Polygon is convex
```

```
----- Turn Test -----
```

```
Area for P0, P1 and P2
Left Turn
```

```
Area for P1, P2 and P3
Left Turn
```

```
Area for P2, P3 and P4
Collinear
```

```
Area for P3, P4 and P0
Left Turn
```

```
Area for P4, P0 and P1
Left Turn
```