**Tribhuvan University**

**Institute of Science and Technology**

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

**Kirtipur, Kathmandu**

**Computational Geometry**

**Assignment**

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

**Submitted by: Submitted To:**

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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>

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):

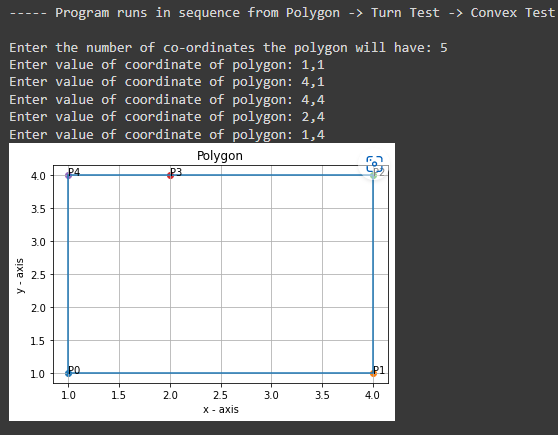
        print("Right Turn\n")

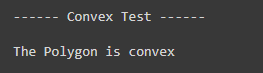
      else:

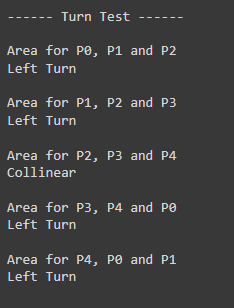
        print("Collinear\n")

main()

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

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