TRIBHUVAN UNIVERSITY
INSTITUTE OF SCIENCE AND TECHNOLOGY

Central Department of Computer Science and Information Technology
Kirtipur, Kathmandu
2022

Lab Report: IV

"Implementation of Point Inclusion Problem"

Submitted By:
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Semester: 2nd
Roll no: 2

Submitted To:
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1. Write programs for finding point inclusion test Using turn test approach.

```
import matplotlib.pyplot as plt
class Node:
    def __init__(self,data):
        self.data = data;
        self.previous = None;
        self.next = None;

class DoublyLinkedList:
    def __init__(self):
        self.head = None;
        self.tail = None;
    def addNode(self, data):
        newNode = Node(data);
        if(self.head == None):
            self.head = self.tail = newNode;
            self.head.previous = None;
            self.tail.next = None;
        else:
            self.tail.next = newNode;
            newNode.previous = self.tail;
            self.tail = newNode;
            self.tail.next = None;
class InclusionTurn(DoublyLinkedList):
    test_point=[]
    def __init__(self):
        super(InclusionTurn, self).__init__()
```

```
        number_of_vertices=int(input("Please Enter the number of vertices"))
        for i in range(number_of_vertices):
            x,y=input("Please Enter X and Y cordinate").split(',')
            x=float(x)
            y=float(y)
            self.addNode([x,y])
        a,b=input("Please Enter A and Y cordinate of Testing point").split(',')
        a=float(a)
        b=float(b)
        self.test_point.append([a,b])
    def turntest(self,points):
        area=(points[1][0]-points[0][0])*(points[2][1]-points[0][1])-(points[2][0]-
points[0][0])*(points[1][1]-points[0][1])
        if area>0:
            return "Left"
        elif area<0:
            return "Right"
        else:
            return "Colinear"
    def check_result(self):
        turn=[]
        cur=self.head
        while cur:
                a=cur.data
                cur=cur.next
                if cur==None:
                    cur1=self.head
```

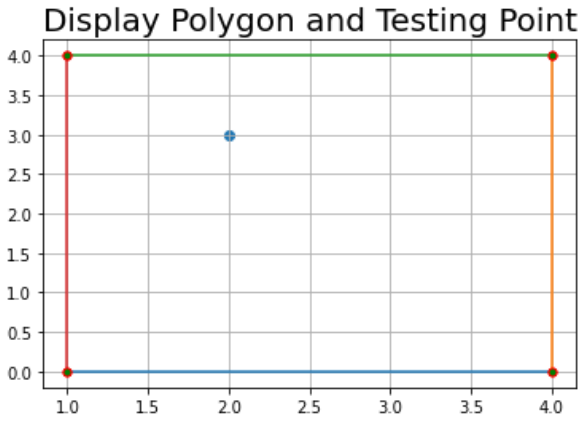
```
                while cur1:
                    b=cur1.data
                    break
            else:
                b=cur.data
            points=[a,b,self.test_point[0]]
            turn.append(self.turntest(points))
    print(turn)
    return turn

def dislpay(self):
    print("\n.....")
    print("Name: Sudhan Kandel","\nRoll No: 2","\nSection: A")
    print("\n.....")
    current=self.head
    if(self.head==None):
        print("List is empty")
        return
    while(current!=None):
        print("Vetrices of the polygons is: ")
        print(current.data)
        current=current.next
    print(".....Checking Result.....")
    List=self.check_result()
    result = all(element == List[0] for element in List)
    if (result):
        print("Points is lies inside the ploygon")
```

```
        else:
            print("Points is lies outside the ploygon")
    def visualization(self):
        self.dislpay()
        cur = self.head;
        while cur:
            a=cur.data
            cur=cur.next
            if cur==None:
                cur1=self.head
                while cur1:
                    b=cur1.data
                    break
            else:
                b=cur.data
            plt.plot([a[0],b[0]],[a[1],b[1]], linestyle="-", marker="o", markersize=5,
markeredgecolor="red", markerfacecolor="green")
        plt.grid()
        plt.scatter(self.test_point[0][0],self.test_point[0][1])
        plt.title("Display Polygon and Testing Point",fontdict={'fontsize':20})
inclusionturn=InclusionTurn()
inclusionturn.visualization()
```

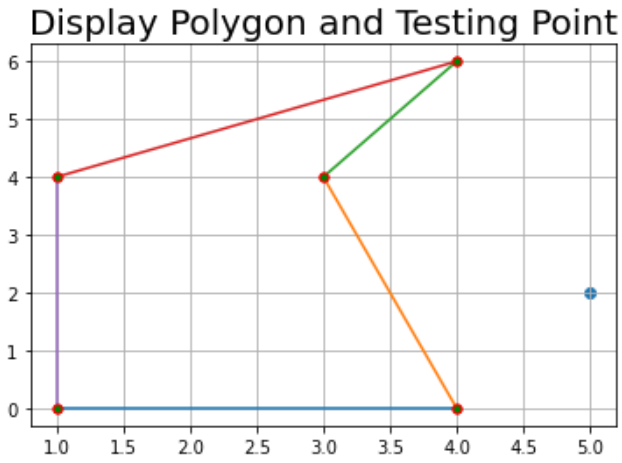
OUTPUT:

```
Please Enter the number of vertices4
Please Enter X and Y cordinate1,0
Please Enter X and Y cordinate4,0
Please Enter X and Y cordinate4,4
Please Enter X and Y cordinate1,4
Please Enter A and Y cordinate of Testing point2,3

..............................
```

```
Name: Sudhan Kandel
Roll No: 2
Section: A

................................
Vetrices of the polygons is:  [1.0, 0.0]
Vetrices of the polygons is:  [4.0, 0.0]
Vetrices of the polygons is:  [4.0, 4.0]
Vetrices of the polygons is:  [1.0, 4.0]
.............Checking Result.....................
turntest result:  ['Left', 'Left', 'Left', 'Left']
Points is lies inside the ploygon
```




```
Please Enter the number of vertices5
Please Enter X and Y cordinate1,0
Please Enter X and Y cordinate4,0
Please Enter X and Y cordinate3,4
Please Enter X and Y cordinate4,6
Please Enter X and Y cordinate1,4
Please Enter A and Y cordinate of Testing point5,2

................................
Name: Sudhan Kandel
Roll No: 2
Section: A

................................
Vetrices of the polygons is:  [1.0, 0.0]
Vetrices of the polygons is:  [4.0, 0.0]
Vetrices of the polygons is:  [3.0, 4.0]
Vetrices of the polygons is:  [4.0, 6.0]
Vetrices of the polygons is:  [1.0, 4.0]
.............Checking Result.....................
turntest result:  ['Left', 'Right', 'Right', 'Left', 'Left']
Points is lies outside the ploygon
```


Display Polygon and Testing Point
6
5
4
3
2
1
0
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0

2. Write programs for finding point inclusion test Using ray casting approach.

```
import matplotlib.pyplot as plt
class RayCrossing:
    INT_MAX = 10000
    def __init__(self):
        self.polygon=[ ]
        self.test_point=[]
        number_of_vertices=int(input("Please Enter the number of vertices"))
        for i in range(number_of_vertices):
            x,y=input("Please Enter X and Y cordinate").split(',')
            x=float(x)
            y=float(y)
            self.polygon.append([x,y])
        a,b=input("Please Enter A and Y cordinate of Testing point").split(',')
        a=float(a)
        b=float(b)
        self.test_point.append([a,b])
    def onSegment(self,p, q, r):
        if ((q[0] <= max(p[0], r[0])) &
            (q[0] >= min(p[0], r[0])) &
            (q[1] <= max(p[1], r[1])) &
            (q[1] >= min(p[1], r[1]))):
            return True
        else:
            return False
    def turntest(self,p, q, r):
        points=[p, q, r]
        area=(points[1][0]-points[0][0])*(points[2][1]-points[0][1])-(points[2][0]-points[0][0])*(points[1][1]-points[0][1])
        if area>0:
            return 1
        elif area<0:
            return 2
        else:
            return 1
    def checkIntersect(self,p1, q1, p2, q2):
        o1 = self.turntest(p1, q1, p2)
        o2 = self.turntest(p1, q1, q2)
```

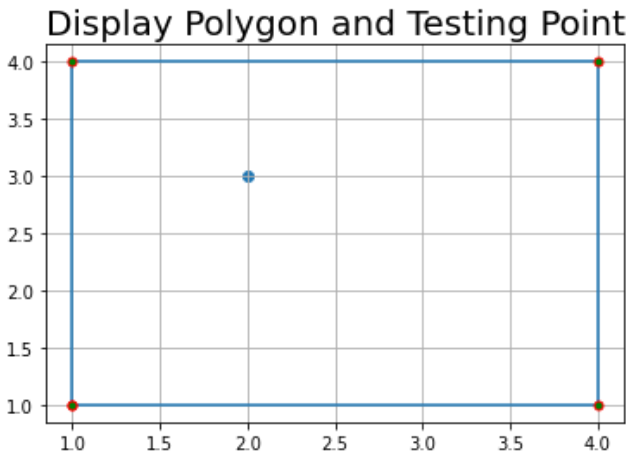
```
    o3 = self.turntest(p2, q2, p1)
    o4 = self.turntest(p2, q2, q1)
    if (o1 != o2) and (o3 != o4):
        return True
    if (o1 == 0) and (onSegment(p1, p2, q1)):
        return True
    if (o2 == 0) and (onSegment(p1, q2, q1)):
        return True
    if (o3 == 0) and (onSegment(p2, p1, q2)):
        return True
    if (o4 == 0) and (onSegment(p2, q1, q2)):
        return True
    return False
def checkinside(self):
    points=self.polygon
    p=self.test_point[0]
    n = len(points)
    if n < 3:
        return False
    extreme = (self.INT_MAX, p[1])
    decrease = 0
    count = i = 0
    while True:
        next = (i + 1) % n
        if(points[i][1] == p[1]):
            decrease += 1
        if (self.checkIntersect(points[i],
                    points[next],
                    p, extreme)):
            if self.turntest(points[i], p,
                    points[next]) == 0:
                return onSegment(points[i], p,
                            points[next])
            count += 1
        i = next
        if (i == 0):
            break
```

```
        count -= decrease
        return (count % 2 == 1)
    def result(self):
        if (self.checkinside()):
            return ("Point is lies inside the polygon")
        else:
            return "Points is lies outside the polygon"
    def dislpay(self):
        print("\n.....")
        print("Name: Sudhan Kandel","\nRoll No: 2","\nSection: A")
        print("\n.....")
        print('Vertex of the polygon is: ', self.polygon)
        print("\n.....")
        print('Testing point is : ', self.test_point)
        print("\n.....Checking Result.....")
        print(self.result())
    def visualization(self):
        x=[]
        y=[]
        for i in self.polygon:
            x.append(i[0])
            y.append(i[1])
        x.append(x[0])
        y.append(y[0])
        plt.plot(x,y ,linestyle="-", marker="o", markersize=5, markeredgecolor="red", markerfacecolor="green")
        plt.grid()
        plt.scatter(self.test_point[0][0],self.test_point[0][1])
        plt.title("Display Polygon and Testing Point",fontdict={'fontsize':20})
raycasting=RayCrossing()
raycasting.dislpay()
raycasting.visualization()
```

OUTPUT:

```
Please Enter the number of vertices4
Please Enter X and Y cordinate1,1
Please Enter X and Y cordinate4,1
Please Enter X and Y cordinate4,4
Please Enter X and Y cordinate1,4
Please Enter A and Y cordinate of Testing point2,3
```

```
.................................
Name: Sudhan Kandel
Roll No: 2
Section: A

.................................
Vertex of the polygon is:  [[1.0, 1.0], [4.0, 1.0], [4.0, 4.0], [1.0, 4.0]
]

.................................
Testing point is :  [[2.0, 3.0]]

.............Checking Result.....................
Point is lies inside the polygon
```




```
Please Enter the number of vertices5
Please Enter X and Y cordinate1,1
Please Enter X and Y cordinate4,1
Please Enter X and Y cordinate3,4
Please Enter X and Y cordinate4,6
Please Enter X and Y cordinate1,6
Please Enter A and Y cordinate of Testing point5,3

.................................
Name: Sudhan Kandel
Roll No: 2
Section: A

.................................
Vertex of the polygon is:  [[1.0, 1.0], [4.0, 1.0], [3.0, 4.0], [4.0, 6.0], [
1.0, 6.0]]

.................................
Testing point is :  [[5.0, 3.0]]
```

```
.............Checking Result.....................
Points is lies outside the polygon
```