

Problem**[24 Marks]**

A point can be described by its coordinates x and y . The distance between two points, $P1 = (x1, y1)$ and $P2 = (x2, y2)$, is calculated by

$$d = \sqrt{(x2 - x1)^2 + (y2 - y1)^2}$$

If the vertices (or points) of a polygon are $P1, P2, P3, \dots, Pn$ (as shown in Figure1), the center of the polygon, C , can be determined by the following equation:

$$C = \frac{P1 + P2 + P3 + \dots + Pn}{n}$$

where n is the number of points.

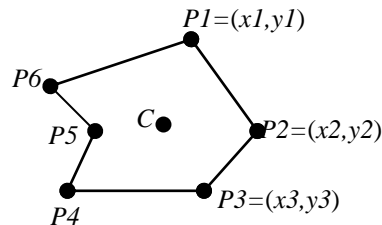


Figure 1: The representation of a polygon with six vertices (*i.e.*, $n=6$).

Given the declaration of class `Point` in the file **sbtS5.cpp**. Without changing any code of the class declaration, edit the file to accomplish the following task requirements:

1. Complete the definition of the overloaded operator `+` (addition) which adds up each coordinate of two points. For example, if the two points are $p1 = (1,2)$ and $p2 = (5,7)$, then $p1 + p2 = (6, 9)$. **(4 marks)**
2. Complete the definition of the overloaded operator `-` (subtraction) which calculates the distance between two points. For example, if the two points are $p1 = (1,2)$ and $p2 = (5,7)$, then $p1 - p2 = 6.403$. **(4 marks)**
3. Complete the definition of the overloaded operator `/` (division) which divides each coordinate with the right operand. For example, if the point is $p = (1,2)$, then $p / 2.0 = (0.5, 1.0)$. **(4 marks)**
4. Using the overloaded input operator and a proper loop, read a list of vertices from the keyboard. **(3 marks)**

5. Using another loop, calculate the center point by taking the average of the vertices of the polygon. **(3 marks)**
6. Using the overloaded output operator, print the center point onto the screen. **(1 mark)**
7. Using another loop, print the distance of each vertex to the center point of the polygon onto the screen. **(5 marks)**

Figure 2 shows example runs of the program.

```

Enter the number of vertices of a polygon => 3
Enter vertex 1 => 0 0
Enter vertex 2 => 2.5 0
Enter vertex 3 => 3.5 9

The center is (2.0,3.0)

Vertex    Coordinates    Distance to center
1         (0.0,0.0)       3.6
2         (2.5,0.0)       3.0
3         (3.5,9.0)       6.2

```

(a) A polygon with three vertices

```

Enter the number of vertices of a polygon => 5
Enter vertex 1 => 1 1
Enter vertex 2 => 2 2
Enter vertex 3 => 0 4
Enter vertex 4 => 1.5 3
Enter vertex 5 => 0 0

The center is (0.9,2.0)

Vertex    Coordinates    Distance to center
1         (1.0,1.0)       1.0
2         (2.0,2.0)       1.1
3         (0.0,4.0)       2.2
4         (1.5,3.0)       1.2
5         (0.0,0.0)       2.2

```

(b) A polygon with five vertices

Figure 2: Example runs of the program. User inputs are shown as bold texts