Name: T Abishek                                    Entry Number: 2019CS10407
Name: Gaurav Jain                                  Entry Number: 2019CS10349

# COL216: Assignment 1

This assignment aims to calculate the area under a curve formed by joining successive points by a straight line. We intend to move forward by making a loop of length n-1 where n denotes the number of points given in the input. In each iteration of the loop, we calculate the area by considering the set of values from the previous iteration and input the current set of values.

**Calculation of area between two successive points:**

Let *x,y* and *x',y'* denote the current and previous values, respectively.
Consider two cases-

1. $y * y' \geq 0$
   In this case, the straight line joining these two points doesn't intersect the *x*-axis. So, the area enclosed by this line is a trapezium, and its area can be calculated using the formula-

$$\Delta = \frac{1}{2}(x - x')(y + y')$$

   If both *y* and *y'* are negative then, we put the absolute values in the above formula.

2. $y * y' < 0$
   In this case, the straight line joining these two points intersects the *x*-axis at some point, say *(k,0)*. So, the area enclosed by this line consists of two triangles, and the area of these two triangles is calculated using trigonometry and is given by the formula-

$$\Delta = \frac{1}{2}(x - x')\frac{(y^2 + y'^2)}{(y + y')}$$

   In this case, we take y and *y'* to be absolute values of *y* and *y',* respectively.

**Approach to the code:**

First of all, we input *n* and check whether the entered value is less than 2. If it is less than two then, we print a message stating that n should be greater than or equal than two and terminate the program.
Otherwise, we move to the next line. We input the first set of values outside the loop, and then we move to the loop part, where we input the second set of values into new registers. We first check that the entered *x*-coordinate is greater than or equal to the previous *x*-coordinate. It is specified in the specifications that the input is taken in sorted order according to the *x*-coordinate.
So, now we have all the values required for the computation of the area. Using the above two formulas and the value of *y.y'*, we calculate this part's area and add it to the total area. **Suitable comments are also present inside the code** for a better understanding of the code.

Name: T Abishek                                    Entry Number: 2019CS10407
Name: Gaurav Jain                                  Entry Number: 2019CS10349

As the input is taken as a signed 32 bit integer, the range of admissible input is -2147483648 to 2147483647. If input is given out of this range, it would lead to stackoverflow error and lead to wrong results. As the area sum is also being stored in a double register, the range of the allowed area is 1.7E +/- 308, and any input which exceeds this area will cause overflow error and thus a wrong result.

Our testing strategy involved thinking and figuring out the corner cases that could cause blunders as we wrote the program and then implementing code to handle such cases. Cases like input being less than 2, 2 consecutive points being of opposite sign were all handled while writing the program. The testing strategy also involved trying out different scenarios using a variety of test cases that test all the different scenarios that can transpire while running the program. The different kinds of test cases that were used are shown below. The area of the graph was also calculated manually and matched for checking the accuracy of the program,

## **Testcases:**

1. Testcase 1-
   This testcase is given to show the error message when the user enters n less than or equal to 2.
   Input-
         n = 1
   Output-
         "Enter N greater than or equal to 2"

------------------------------------------------------------------------------------------------------------------------

2. Testcase 2-
   This is a normal testcase same to the given testcase in the problem statement.
   Input-
         n = 5
         Enter X coordinate: 1
         Enter Y coordinate: 1
         Enter X coordinate: 3
         Enter Y coordinate: 4
         Enter X coordinate: 5
         Enter Y coordinate: 3
         Enter X coordinate: 6
         Enter Y coordinate: 7
         Enter X coordinate: 9
         Enter Y coordinate: 5
   Output-
         Area of entered coordinates: 35

------------------------------------------------------------------------------------------------------------

3.  Testcase 3-
    This is a testcase where the straight line joining the two points intersect the x-axis.
    So, the area consists of two triangles with areas ½ and ½.
    Input-
            n = 2
            Enter X coordinate: -1
            Enter Y coordinate: -1
            Enter X coordinate: 1
            Enter Y coordinate: 1
    Output-
            Area of entered coordinates: 1

------------------------------------------------------------------------------------------------------------


4.  Testcase 4-
    This is a testcase given to show the error message when the entered coordinates are
    not sorted according to the X-coordinate.
    Input-
            n = 2
            Enter X coordinate: -1
            Enter Y coordinate: -1
            Enter X coordinate: -2
            Enter Y coordinate: 1
    Output-
            "Enter coordinates with X coordinate in strictly increasing order"

------------------------------------------------------------------------------------------------------------

5.  Testcase 5-
    This is a testcase where the entire curve is below the x-axis. In this testcase, the
    area is calculated using the absolute values of Y-coordinate.
    Input-
            n = 2
            Enter X coordinate: -1
            Enter Y coordinate: -1
            Enter X coordinate: 1
            Enter Y coordinate: -8
    Output-
            Area of entered coordinates: 9


------------------------------------------------------------------------------------------------------------

6. Testcase 6-
   This testcase is used to show that if two points are on a vertical line, then area is zero. (This is a design decision that we took)
   Input-
   > n = 2
   > Enter X coordinate: -1
   > Enter Y coordinate: -1
   > Enter X coordinate: -1
   > Enter Y coordinate: -8

   Output-
   > Area of entered coordinates: 0

---------------------------------------------------------------------------------------------------------------------

7. Testcase 7-
   This testcase shows that if the same point is passed two times then, area is calculated to be zero.
   Input-
   > n = 2
   > Enter X coordinate: 1
   > Enter Y coordinate: 1
   > Enter X coordinate: 1
   > Enter Y coordinate: 1

   Output-
   > Area of entered coordinates: 0

---------------------------------------------------------------------------------------------------------------------

8. Testcase 8-
   When two points are on the x-axis then the area is calculated as zero.
   Input-
   > n = 2
   > Enter X coordinate: 1
   > Enter Y coordinate: 0
   > Enter X coordinate: 7
   > Enter Y coordinate: 0

   Output-
   > Area of entered coordinates: 0

---------------------------------------------------------------------------------------------------------------------

9. Testcase 9-
   This is a simple testcase where all the three points are on same line.
   Input-
   > n = 3
   > Enter X coordinate: -1
   > Enter Y coordinate: -1
   > Enter X coordinate: 0
   > Enter Y coordinate: 0
   > Enter X coordinate: 2
   > Enter Y coordinate: 2

   Output-
   > Area of entered coordinates: 2.5

Name: T Abishek                    Entry Number: 2019CS10407
Name: Gaurav Jain                  Entry Number: 2019CS10349

---------------------------------------------------------------------------------------------------------------------

10. Testcase 10-
    This testcase has points in a periodic fashion and its area is actually the sum of 3
    identical triangles of area 1 each.
    Input-
            n = 7
            Enter X coordinate: -4
            Enter Y coordinate: 0
            Enter X coordinate: -3
            Enter Y coordinate: 1
            Enter X coordinate: -2
            Enter Y coordinate: 0
            Enter X coordinate: -1
            Enter Y coordinate: 1
            Enter X coordinate: 0
            Enter Y coordinate: 0
            Enter X coordinate: 1
            Enter Y coordinate: 1
            Enter X coordinate: 2
            Enter Y coordinate: 0
    Output-
            Area of entered coordinates: 3

---------------------------------------------------------------------------------------------------------------------