INTRODUCTION

In this assignment , we have written a MIPS Assembly Program for obtaining the area under a curve formed by joining successive points by a straight line.The points are provided by the user from keyboard as (x,y) co-ordinates of n points , sorted according to the x co-ordinate.

APPROACH

To calculate the total area under the curve , I have indivisually calculated the area between the x-axis and the straight line formed by joining 2 successive points and then summed up all the areas.

If the successive points (x1,y1) and (x2,y2) are on the same side of the x-axis , then the enclosed area is in the shape of a trapezium whose area can be calculated using the standard formula -

$$\left| \frac{(y1 + y2)(x2 - x1)}{2} \right|$$

If successive points are on opposite sides of the x-axis, then we need to add the area of the triangle below the x-axis to the the area of the triangle above the x-axis .On solving , we get the following expression -

$$\frac{(y1^2 + y2^2)(x2 - x1)}{2(|y1| + |y2|)}$$

DESIGN

When the Program is loaded into the QtSpim Simulator and run ,an instruction gets printed on the console for the user to enter the number of points "n". Then the Program asks the user to enter the x and y co-ordinates of each point one by one . After all the co-ordinates have been provided , the Program prints the required area .

TESTING

If the value of n supplied is 0 , suitable error message is consoled out .It is assumed as per the specifications that the co-ordinates are integers and sorted in ascending order according to x co-ordinate. It is assumed that n will never be negative.Some test cases covering most of the situations are given below . These test cases test the program in each of the 4 quadrants and for large values as well. I tested the program for various shapes and verified the results using known mathematical formulas. I also wrote the same program in C++ to verify the results.

```
Console

Please enter the number of points : 0
Please enter atleast 1 point

Please enter the number of points : 1
Please enter x co-ordinate of point 1:    2
Please enter y co-ordinate of point 1:    3
Area under the curve = 0

Please enter the number of points : 2
Please enter x co-ordinate of point 1:    1
Please enter y co-ordinate of point 1:    1
Please enter x co-ordinate of point 2:    2
Please enter y co-ordinate of point 2:    2
Area under the curve = 1.5

Please enter the number of points : 2
Please enter x co-ordinate of point 1:    1
Please enter y co-ordinate of point 1:    -1
Please enter x co-ordinate of point 2:    2
Please enter y co-ordinate of point 2:    -2
Area under the curve = 1.5

Please enter the number of points : 2
Please enter x co-ordinate of point 1:    -2
Please enter y co-ordinate of point 1:    -2
Please enter x co-ordinate of point 2:    -1
Please enter y co-ordinate of point 2:    -1
Area under the curve = 1.5

Please enter the number of points : 2
Please enter x co-ordinate of point 1:    -2
Please enter y co-ordinate of point 1:    2
Please enter x co-ordinate of point 2:    -1
Please enter y co-ordinate of point 2:    1
Area under the curve = 1.5

Please enter the number of points : 3
Please enter x co-ordinate of point 1:    1
Please enter y co-ordinate of point 1:    1
Please enter x co-ordinate of point 2:    3
Please enter y co-ordinate of point 2:    -1
Please enter x co-ordinate of point 3:    5
Please enter y co-ordinate of point 3:    1
Area under the curve = 2

Please enter the number of points : 5
Please enter x co-ordinate of point 1:    1000
Please enter y co-ordinate of point 1:    1000
Please enter x co-ordinate of point 2:    3000
Please enter y co-ordinate of point 2:    4000
Please enter x co-ordinate of point 3:    5000
Please enter y co-ordinate of point 3:    3000
Please enter x co-ordinate of point 4:    6000
Please enter y co-ordinate of point 4:    7000
Please enter x co-ordinate of point 5:    9000
Please enter y co-ordinate of point 5:    5000
Area under the curve = 35000000
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```
●●●                    Console
Please enter the number of points : 25
Please enter x co-ordinate of point 1:    1
Please enter y co-ordinate of point 1:    23
Please enter x co-ordinate of point 2:    2
Please enter y co-ordinate of point 2:    54
Please enter x co-ordinate of point 3:    3
Please enter y co-ordinate of point 3:    -91
Please enter x co-ordinate of point 4:    4
Please enter y co-ordinate of point 4:    -53
Please enter x co-ordinate of point 5:    6
Please enter y co-ordinate of point 5:    67
Please enter x co-ordinate of point 6:    8
Please enter y co-ordinate of point 6:    65
Please enter x co-ordinate of point 7:    9
Please enter y co-ordinate of point 7:    -89
Please enter x co-ordinate of point 8:    11
Please enter y co-ordinate of point 8:    56
Please enter x co-ordinate of point 9:    13
Please enter y co-ordinate of point 9:    98
Please enter x co-ordinate of point 10:   15
Please enter y co-ordinate of point 10:   -23
Please enter x co-ordinate of point 11:   17
Please enter y co-ordinate of point 11:   45
Please enter x co-ordinate of point 12:   19
Please enter y co-ordinate of point 12:   56
Please enter x co-ordinate of point 13:   21
Please enter y co-ordinate of point 13:   -99
Please enter x co-ordinate of point 14:   23
Please enter y co-ordinate of point 14:   78
Please enter x co-ordinate of point 15:   26
Please enter y co-ordinate of point 15:   -76
Please enter x co-ordinate of point 16:   30
Please enter y co-ordinate of point 16:   -33
Please enter x co-ordinate of point 17:   32
Please enter y co-ordinate of point 17:   -13
Please enter x co-ordinate of point 18:   34
Please enter y co-ordinate of point 18:   -47
Please enter x co-ordinate of point 19:   37
Please enter y co-ordinate of point 19:   -79
Please enter x co-ordinate of point 20:   40
Please enter y co-ordinate of point 20:   -99
Please enter x co-ordinate of point 21:   42
Please enter y co-ordinate of point 21:   -79
Please enter x co-ordinate of point 22:   44
Please enter y co-ordinate of point 22:   56
Please enter x co-ordinate of point 23:   46
Please enter y co-ordinate of point 23:   96
Please enter x co-ordinate of point 24:   48
Please enter y co-ordinate of point 24:   -37
Please enter x co-ordinate of point 25:   50
Please enter y co-ordinate of point 25:   -91
Area under the curve = 2509.69535881046522
```

Status Successfully execu

Input
```
40 -99
42 -79
44 56
46 96
48 -37
50 -91
```

Output
```
2509.7
```