College of Computer Training (CCT)

Assignment Cover Page

Module Title: **MATHEMATICS FOR COMPUTING AND IT**

Module Code:

Assignment Title: **CHRISTMAS PROJECT**

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Academic Year: **Year 1** ■ **/** **Year 2** □ **/** **Year 3** □

DECLARATION

I, the above named student, confirm that by submitting, or causing the attached assignment to be submitted, to CCT, I have not plagiarised any other person's work in this assignment and except where appropriately acknowledged, this assignment is my own work, has been expressed in my own words, and has not previously been submitted for assessment.

CHRISTMAS PROJECT

Mathematics for Computing and IT

1. Alice patrols the boundaries of the environment. Give your algorithm for this patrol (psuedocode is fine).

```
Set Alice to alive
    While alive is true
        Move +1
            If screenWidth is true
            turnDown
            goDown
            End IF
            If screenHeight is true
            turnLeft
            goLeft
            End IF
            If position 1 is less or equal to zero
            turnUp
            goUp
            End IF
            If screenX is true and screenWidth is not true
            turnRight
            goRight
            End IF
        End While
    End
```

2. Explain the maths involved for this movement (it should include at least two transformations).

Alice uses Translation to move forwards, backwards, up and down and Rotation to turn down, left, up and right. She moves in a linear direction until the end of screen and then when she hits the width of the screen she performs a translation of 90 degrees, she does a circle when hits the corners.

Alice position at the screen:

A (250,250)

B (240,260)

C (260,260)

Walking from origin point to the end of screen.

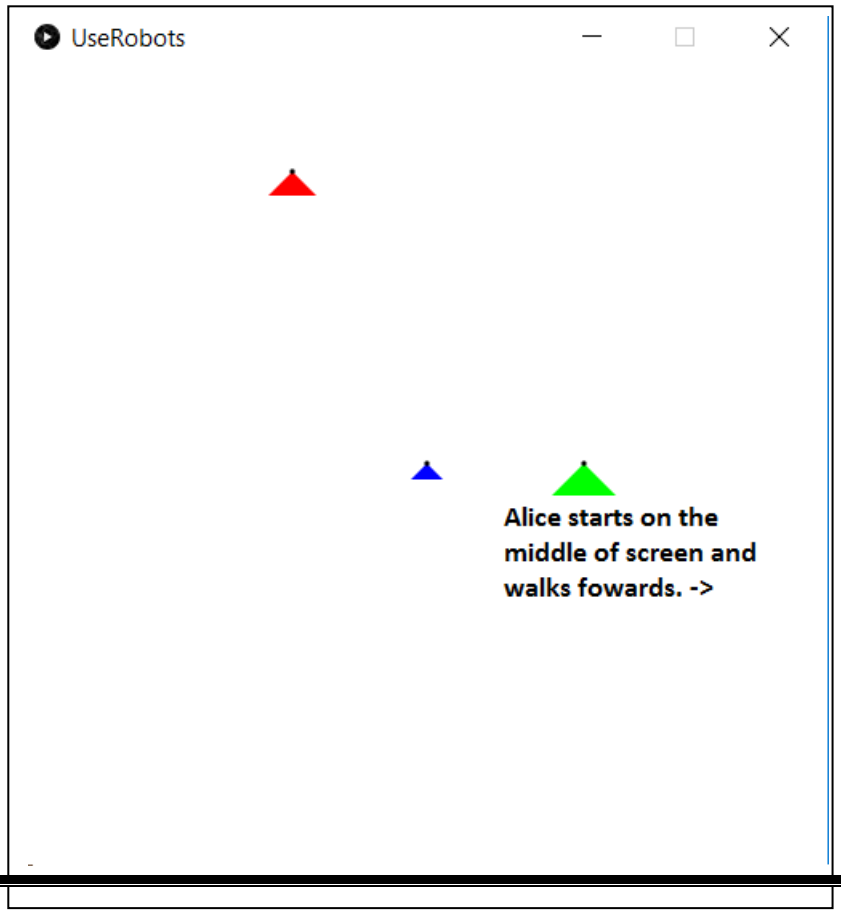
Translation to the end of Screen, New Coordinates:

Ta,b

A (250,250) ⇒ (480,250)

B (240,260) ⇒ (460, 260)

C (260,260) ⇒ (500, 260)



Rotation 90º clockwise (x,y) = (y,-x) about the origin in a Cartesian Plan:

(x,y) = (y,-x)

A (250,250) (250, -250)

B (240,260) (260,-240)

C (260,260) (260,-260)

3. Bob moves by use of a random walk. Give your algorithm (psuedo code is fine) for selection statements used in your code to replicate the random walk.

Your algorithm must contain at least two different boolean operators: (and, or and not) and two if loops.

```
Set Bob to alive
    While alive is true
        Move +1
            If random position is equal to 1
            turnRight
            goRight
            End if
            If random position is equal to 2
            turnDown
            goDown
            End if
            If random position is equal to 3
            turnLeft
            goLeft
            End if
            If random position is equal to 4
```

turnUp

goUp

End if

If random position is equal to 5

turnDown

go Right and Down

End IF

If random position is equal to 6

turnUp

go Left and Up

End IF

If random position is equal to 7

turnDown

go Left and Down

End IF

If random position is equal to 8

turnUp

go Right and Up

End IF

End While

End

4. Translate this algorithm into a worded mathematical logic statement.

Bob will start moving if he is “alive”: p is True

Bob will move forward If speed > 0 : p → q

Bob will move backwards If only if he hits the wall: p <-> q

When Bob hits the wall and move backwards is true Bob will turn : p ^ q

5. Clearly define the primitive propositions and build a compound proposition.

Bob will move forward when his speed is > 0 (true) , if speed = 0 (false) ,Bob keeps immobile ;

Bob will move forward(p), if (→) Speed(q) > 0 => p → q;

in the second conditional Bob will just move Backward if only if he hits the wall: move Backward(p), if only if<->, he hits the wall(q) => (p<->q);

The third part he will turn when he hits the wall and move backwards: he turns (p), when hits the wall and (^) move backwards(q) => (p^q).

6. Produce a truth table given the compound proposition.

If – Then(Conditional):

p	q	p→q
T	T	T
T	F	F
F	T	T
F	F	T

If only if(bi-Conditional):

p	q	p <-> q
T	T	T
T	F	F
F	T	F
F	F	T

And (Conjunction):

p	q	p ^ q
T	T	T
T	F	F
F	T	F
F	F	F

7. Reduce the compound proposition to a Conjunctive Normal Form, explaining your work.

a - speed greater than zero; (s)

r - Bobs move forward; (r)

w - Bob hits the wall; (m)

l -Bob move backwards; (b)

t - Bob turns; (t)

Bob is not able to move all the directions at the same time,

and won't be started up if it doesn't get a speed different than "0".

((r ^ a) ^ (~r ^ ~a) v (w ^ l) ^ (~l ^ ~w) v (t ^ l ^ w) ^ (~t ^ ~l ^ ~w))

For (r ^ a) ^ For (~r ^ ~a):

Bob moving forward is true when gets a speed different than zero is true;

When speed different than zero is false, then Bob doesn't move;

For (w ^ l) ^ For (~l ^ ~w):

Bob hits the wall is true and Bob move Backward is true;

Bob move backwards is false and bob hits the wall is false;

For (t ^ l ^ w) ^ For (~t ^ l ^~w):

Bob turns is true and Bob move backwards is true and Bob hits the wall is true;

Bob turns is false and bob move backwards is false and Bob hits the wall is false.

8. Your program should randomly generate a robot, Charlie. What are the coordinates of the three vertices. Label them as A, B and C.

```
C:\Users\Cah Lins\Java Files\Xmasproject>pause
Press any key to continue . . .

C:\Users\Cah Lins\Java Files\Xmasproject>java -cp ".;core.jar" UseRobots
X1 = 250.0 Y1 = 250.0
X2 = 240.0 Y2 = 260.0
X3 = 260.0 Y3 = 260.0
X1 = 250.0 Y1 = 250.0
X2 = 240.0 Y2 = 260.0
X3 = 260.0 Y3 = 260.0
X1 = 250.0 Y1 = 250.0
X2 = 240.0 Y2 = 260.0
X3 = 260.0 Y3 = 260.0
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X2 = 240.0 Y2 = 260.0
X3 = 260.0 Y3 = 260.0
X1 = 250.0 Y1 = 250.0
```
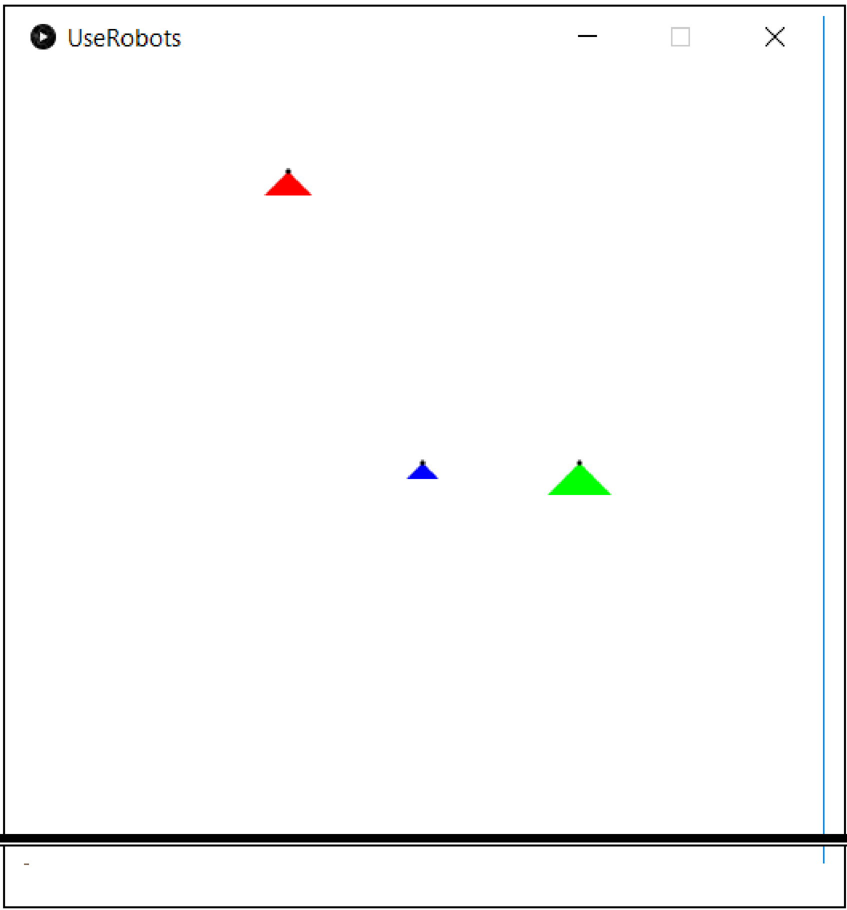



A (250,250)

B (240,260)

C (260,260)

Charlie is Blue.

9. What are the equations of each of the three lines that make up the robot Charlie, that is: AB, BC, and AC?

Line 1 = AB

A (250,250)

B(240,260)

Step 1. Finding the Slope

m = y2 – y1/ x2-x1

m = 260-250 / 240-250

m = 10/-10

m = -10/10

m = -1

Step 2. Finding the equation of the line through the point A (250,250).

y – y1 = m (x-x1)

y – 250 = -1 (x-250)

y – 250 = -1x + 250

y = -1x +250 -250

1x + y = 0

Line 2 = BC

B (240,260)

C (260,260)

Step 1. Finding the Slope

m = y2 – y1/ x2-x1

m = 260 – 260 / 260 – 240

m = 0/20 = 0

Step 2. Finding the equation of the line through the point B (260,240).

$y – y1 = m (x-x1)$

$y – 260 = 0(x -240)$

$y – 260 = x – 0$

$-x +y = 260$

Line 3 = AC

A (250,250)

C (260,260)

Step 1. Finding the Slope

$m = y2 – y1/ x2-x1$

$m = 260 – 250/260 – 250$

$m = 10/10 = 1$

Step 2. Finding the equation of the line through the point A (250,250).

$y – y1 = m (x-x1)$

$y – 250 = 1(x – 250)$

$y – 250 = x – 250$

$y = x -250 +250$

$-x +y = 0$

10. What is the length of each of the three lines that make up the robot Charlie?

Line 1 = AB

Finding the distance between points A (250, 250) and B (240, 260)

$d = \sqrt{(xb - xa)_2 + (yb - ya)_2}$

$d = \sqrt{(240 - 250)_2 + (260 - 250)_2}$

$d = \sqrt{(-10)_2 + 10_2} = \sqrt{100 + 100}$

$d = \sqrt{200} = 14.14$

Line 2 = BC

Finding the distance between points A (240, 260) and B (260, 260)

$d = \sqrt{(xb - xa)_2 + (yb - ya)_2}$

$d = \sqrt{(260 - 240)_2 + (260 - 260)_2}$

$d = \sqrt{20_2 + 0_2} = \sqrt{400 + 0}$

$d = \sqrt{400} = 20$

Line 3 = AC

Finding the distance between points A (250, 250) B (260, 260)

$d = \sqrt{(xb - xa)_2 + (yb - ya)_2}$

$d = \sqrt{(260 - 250)_2 + (260 - 250)_2}$

$d = \sqrt{10_2 + 10_2} = \sqrt{100 + 100}$

$d = \sqrt{200} = 14.14$

11. What is the area of the robot Charlie?

Finding Area of Triangle by Heron's formula.

$$p = \frac{a + b + c}{2} = \frac{1}{2}(14.14 + 20 + 14.14) = 24.14$$

$A = \sqrt{p(p-a)(p-b)(p-c)}$

$A = \sqrt{(24.14)(24.14 - 14.14)(24.14 - 20)(24.14 - 14.14)}$

$A = \sqrt{(24.14) * 10 * (4.14) * 10}$

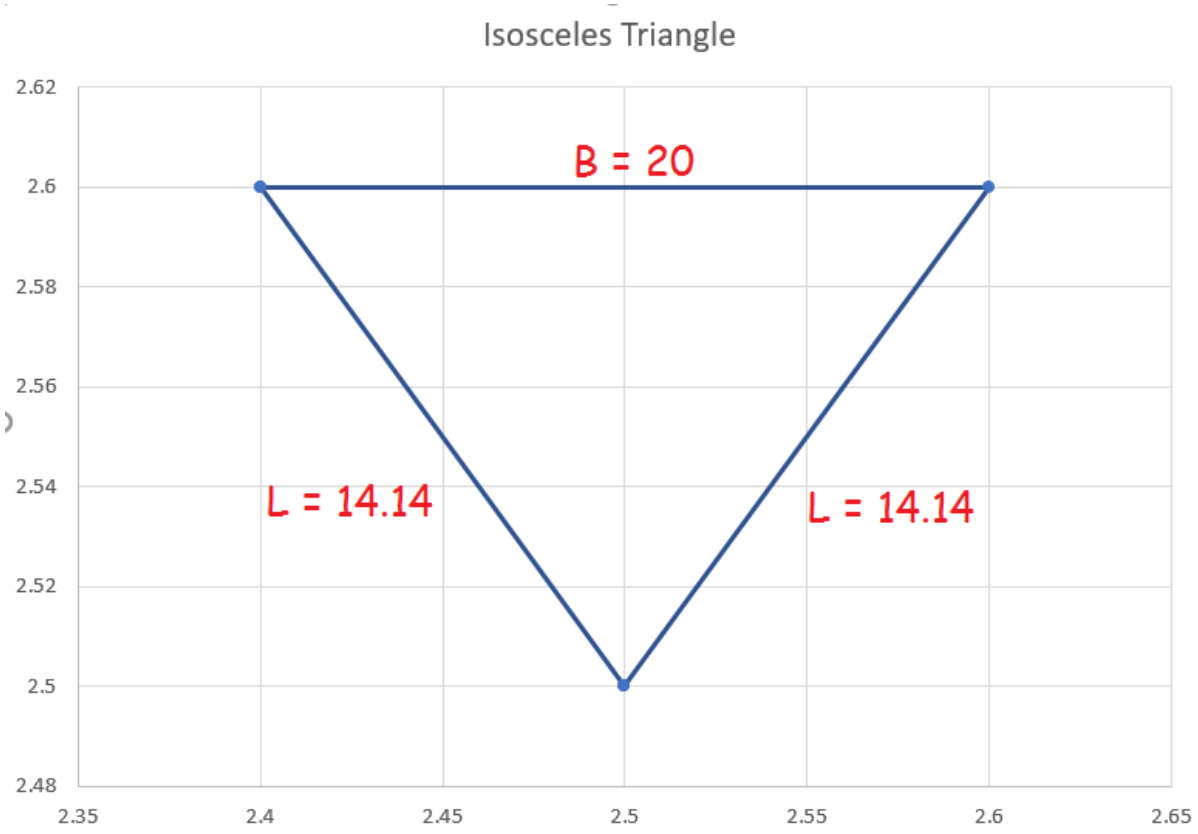
$A = \sqrt{9993.96} = 99.97$

12. Is the robot an equilateral, isoceles, right-angled or scalene triangle?

Prove using coordinate geometry.

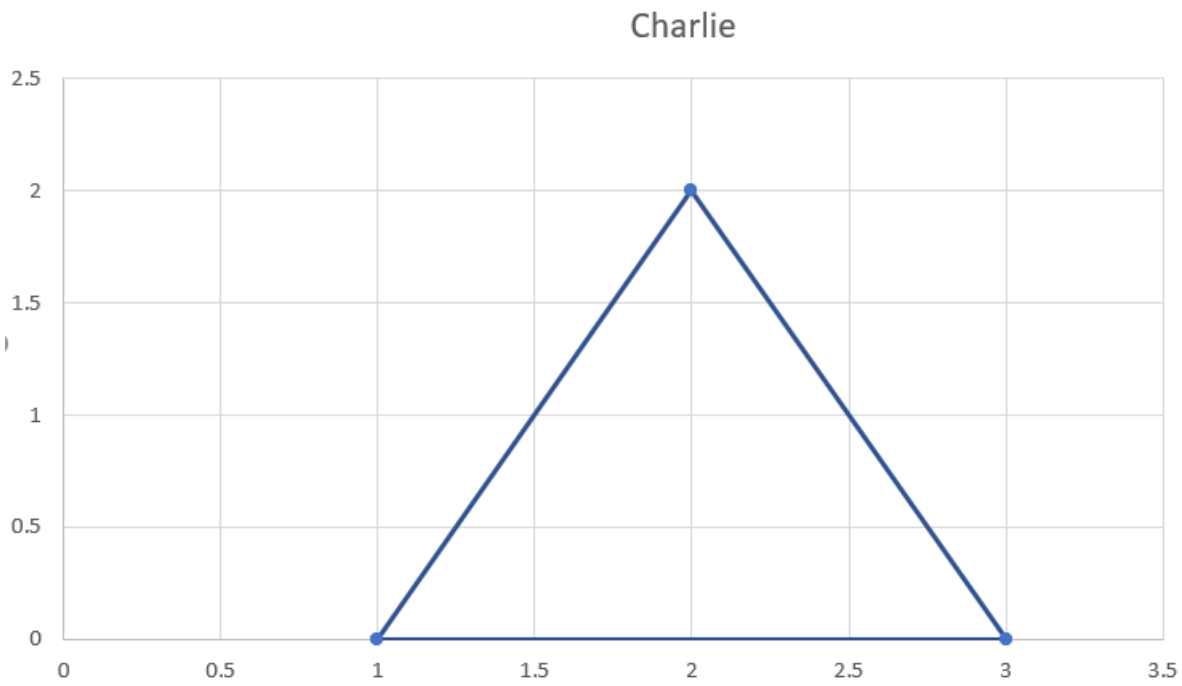
It is an Isosceles Triangle because it has two sizes of equal length.

Please , consider round numbers on the Cartesian plane. Example 2.5 = 250.



13. Use the following coordinates as the vertices of your robot, Charlie: (2,2) (1,0) and (3,0).

Given that a step is equivalent to moving one unit in any direction. If your robot is to take 7 steps in a positive horizontal direction and then performs a rotational symmetry of 90 clockwise about the origin, what are its new coordinates for the three vertices?



Traslating point 1 = (2,2)

Ta,b : (x, y) ⇒ (x + a, y + b)

T2,2 ⇒ (2 + 7, 2 + 0)

T2,2 ⇒ (9, 2)

Traslating point 2 = (1,0)

Ta,b : (x, y) ⇒ (x + a, y + b)

T1,0 ⇒ (1 + 7, 0 + 0)

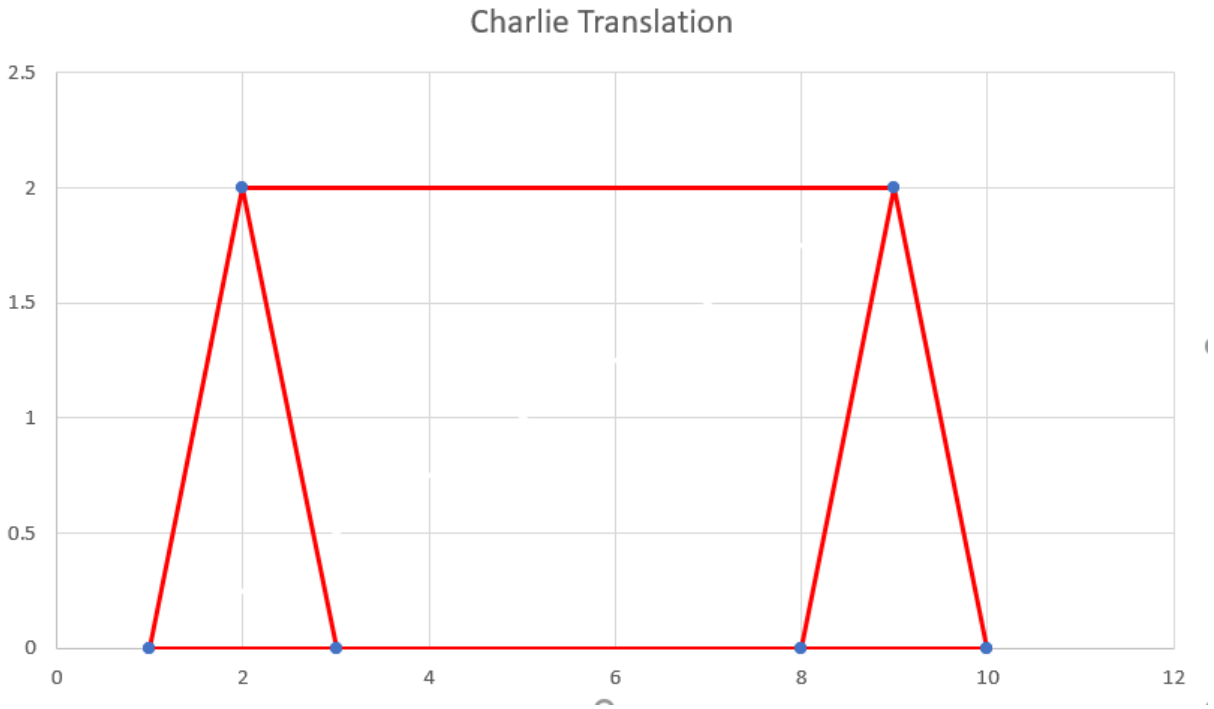
T1,0 ⇒ (8, 0)

Traslating point 3 = (3,0)

Ta,b : (x, y) ⇒ (x + a, y + b)

T3,0 ⇒ (3 + 7, 0 + 0)

T3,0 ⇒ (10, 0)



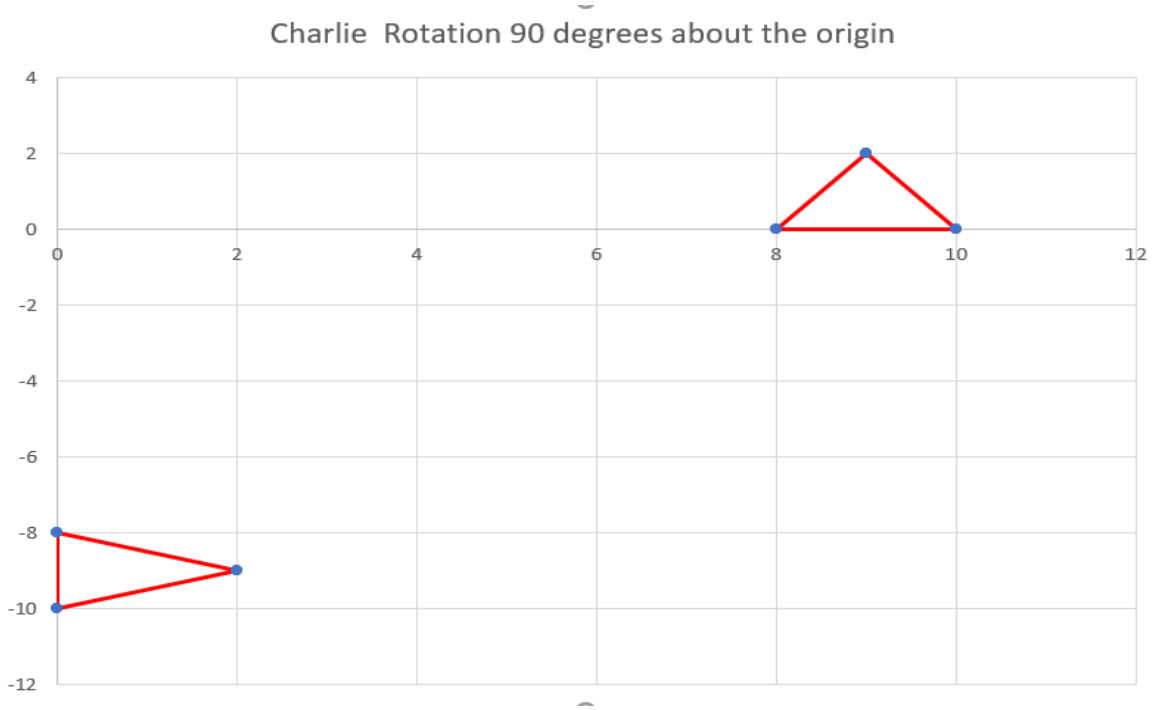
Rotational symmetry of 90 clockwise about the origin.

Clockwise 90°: (x, y) ⇒ (y, −x)

A (9,2) ⇒ (2,-9)

B (8,0) ⇒ (0,-8)

C (10,0) ⇒ (0,-10)



14. Using your current coordinate of vertex A, what are the coordinates of a point one third the distance from A to (8, 0)?

What is this distance?

Vertex A = (2,-9)

1/3 distance for A to (8,0)

Fiding X:

X = 2/3 x1 + 1/3 x2

X = 2/3 * 2 + 1/3 * 8

X = 1 1/3 + 2 2/3

X = 4

Finding Y:

Y = 2/3 y1 + 1/3 y2

Y = 2/3 * (-9) + 1/3 * 0

Y = -6

X, Y { 4, -6 } = one third distance.

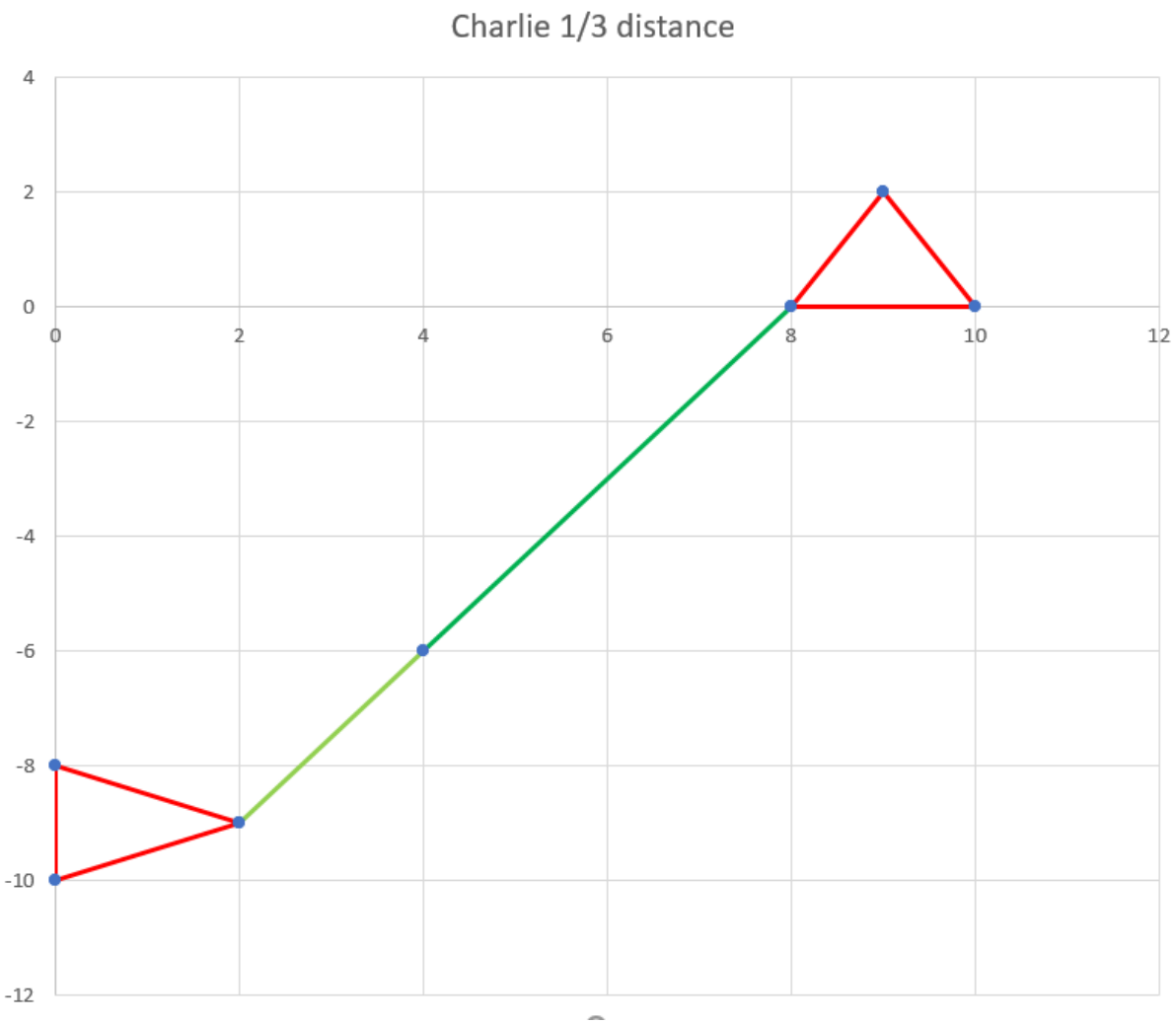
Finding distance from Vertex A (2,-9) to new coordinate (4,-6).

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

$\sqrt{(-6-(-9))^2 + (4-2)^2}$

$\sqrt{(-6+9)^2 + (2)^2}$

$\sqrt{9+4} = \sqrt{13} =$ **3.60**



15. Move A to this new coordinate and translate the other vertices accordingly. What are the new coordinates of Charlie?

Vertex A (2,-9) to new coordinate (4,-6).

Ta,b : (x, y) ⇒ (2,9) ⇒ (4, -6) = (2,3)

Traslating point 1 = (2,-9)

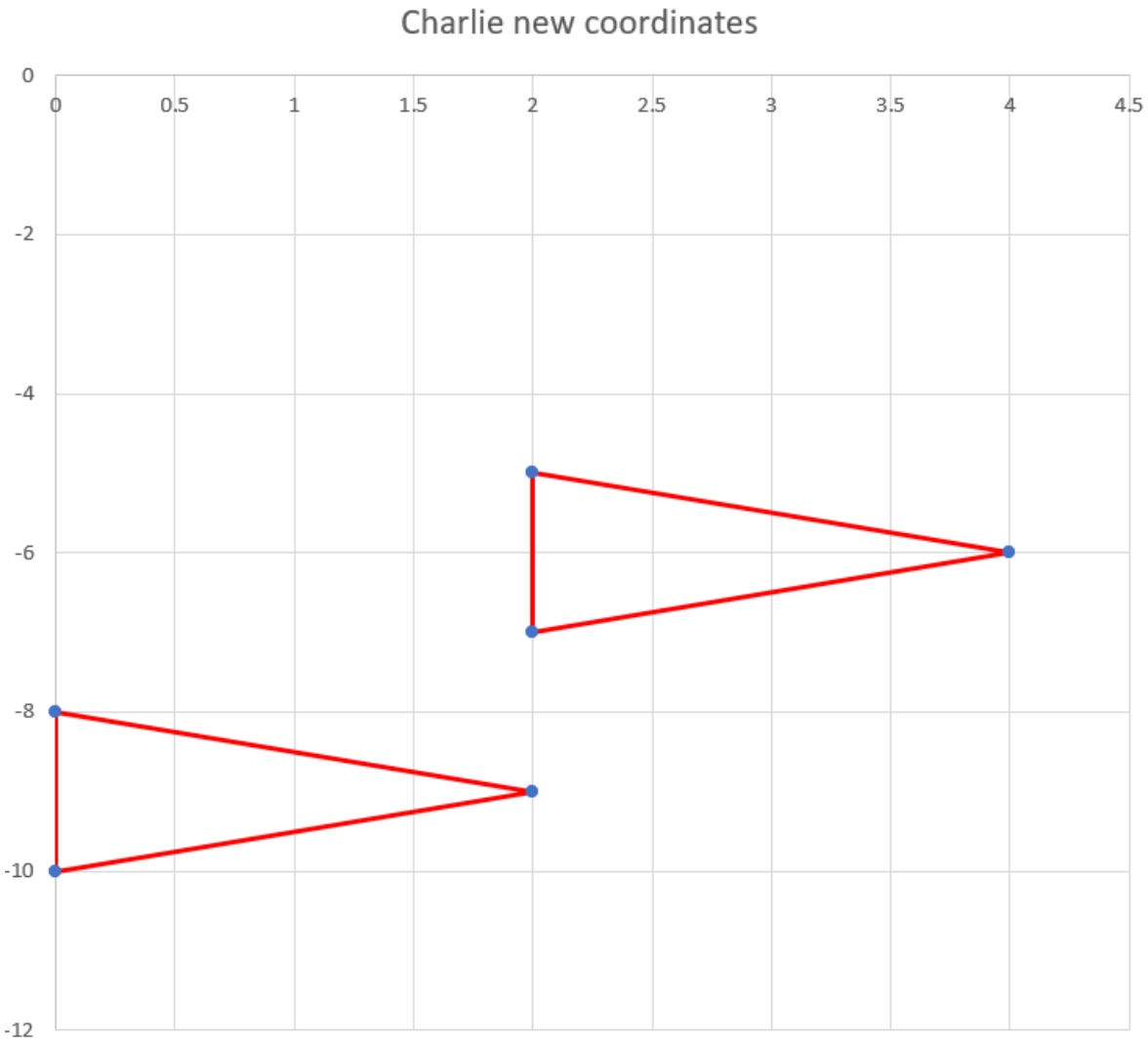
Ta,b : (x, y) ⇒ (2,-9) ⇒ (2,3) = (4,-6)

Traslating point 2 = (0,-8)

Ta,b : (x, y) ⇒ (0,-8) ⇒ (2,3) = (2,-5)

Traslating point 3 = (0,-10)

Ta,b : (x, y) ⇒ (0,-10) ⇒ (2,3) = (2,-7)



16. Find the point of intersection (POI) of the current line AB and the original line AB.

Finding the point of intersection between Original Line (2,2) (1,0) and New Line (4,-6) (2,-5)

Step 1. Finding the Slopes of two lines.

Line 1.

M = y2-y1/x2-x1

M = -5 – (-6) / 2-4

M = -5 + 6 / 2

M = -1/2 M = **-0.5**

Line 2.

M = y2-y1/x2-x1

M = 0-2/1-2 = **2**

Step 2. Finding the equation of 2 lines.

Finding Equation of Line 1.

(4,-6) (2,-5)

Y – y1 = m (x-x1)

Y – (-6) = -0.5 (x-4)

Y+6 = 0.5x -2

0.5x = -y-4

Finding Equation of Line 2.

(2,2) (1,0)

Y – y1 = m (x-x1)

y-2 = 2(x-2)

y-2 = 2x + 2

y = 2x -2

Step 3. Finding the Point of Intersection

Solving X.

0.5x = -y-4

0.5x = -(2x-2)-4

0.5x = -2x +2-4

0.5x = -2x -2

0.5x + 2x = -2

2.5x = -2

X = -2/2.5

X = -0.8

Solving Y.

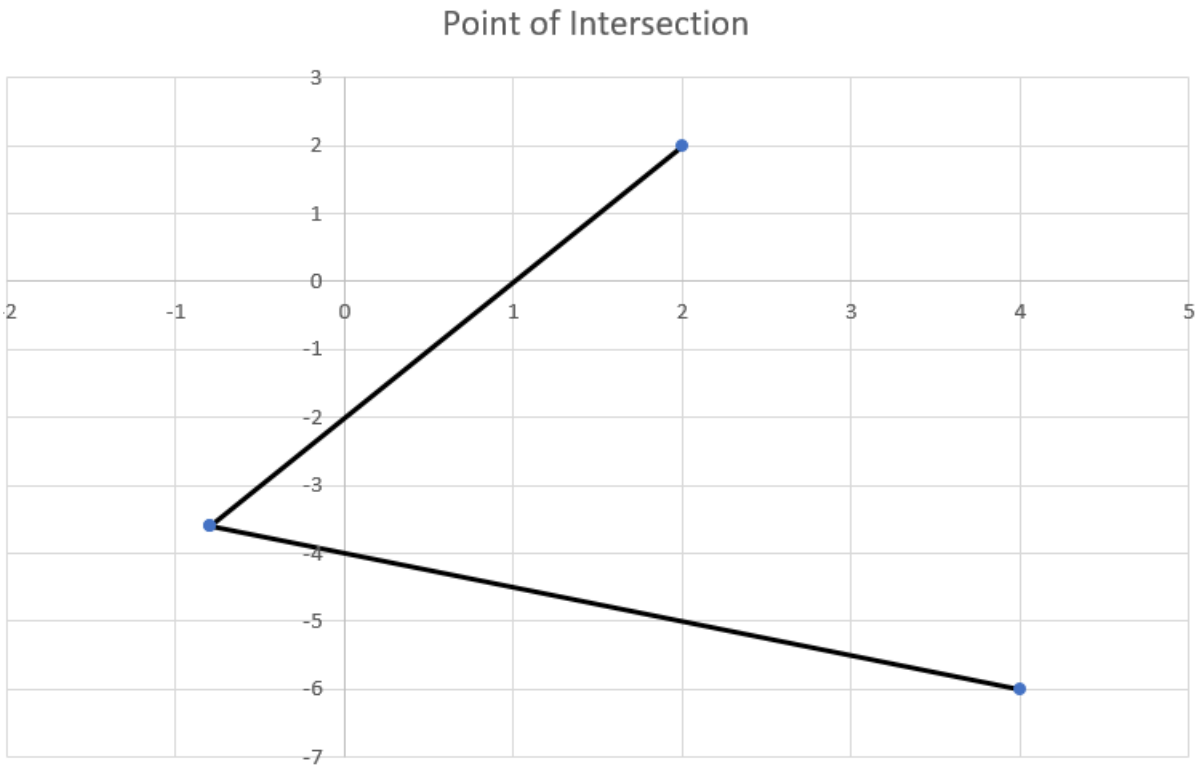
Y = 2x – 2

Y = 2 (-0.8)-2

Y = -1.6 + (-2)

Y = -3.6

POI = {-0.8,-3.6}



17. Using this point (POI) as a central point, perform a central symmetry on your robot. What are the new coordinates?

POI { -0.8, -3.6}

Origin: (x, y) ⇒ (−x, −y)

Point Ca,b : (x, y) ⇒ (−x + 2a, −y + 2b)

Line 1 (4,-6)

Ca,b: (4,-6) ⇒ (-4 + 2 * (-0.8), -(-6) +2*(-3.6))

(4,-6) ⇒ (-4+(1.6), 6+(-7.2))

(4,-6) ⇒ (-4-1.6, 6-7.2)

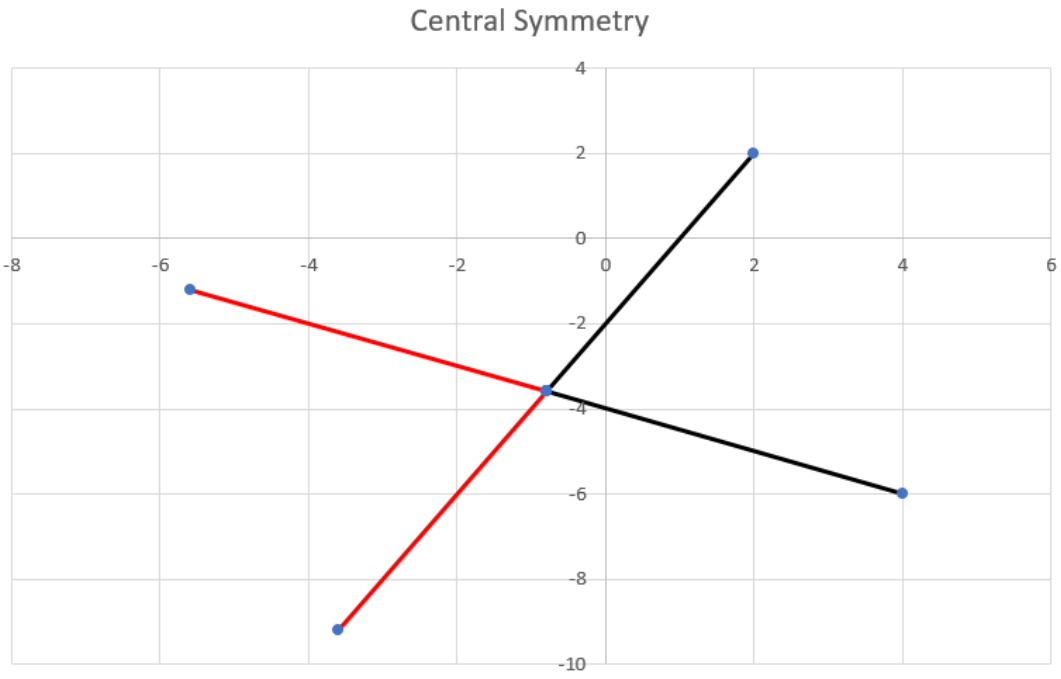
(4,-6) ⇒ (-5.6, -1.2)

Line 2 (2,2)

Ca,b: (2,2) ⇒ (-2+2*(-0.8), -2+2*(-3.6))

(2,2) ⇒ (-2+(-1.6), -2+(-7.2))

(2,2) ⇒ (-3.6, -9.2)



18. Randomly generate Charlie: What are the new coordinates? Find the centroid of the Charlie (ie the centroid of a triangle). Explain your method.

New Coordinates Charlie

A = (5,5)

B = (4,2)

C = (6,2)

Finding the Centroid of X:

X1 + x2 + x3/3

5+4+6/3 = 15/3

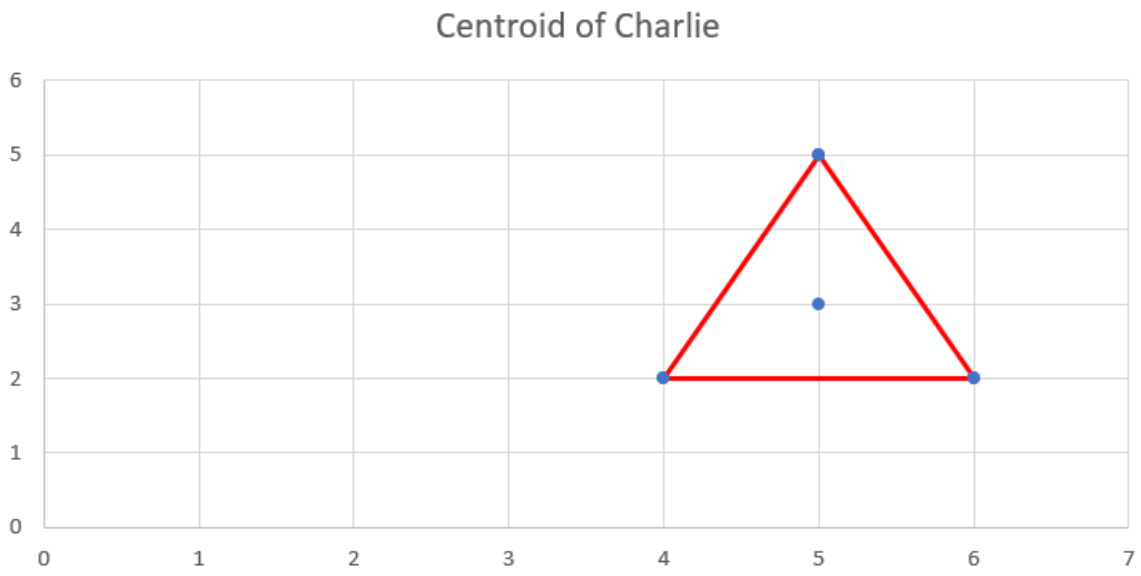
X = 5

Finding the Centroid of Y:

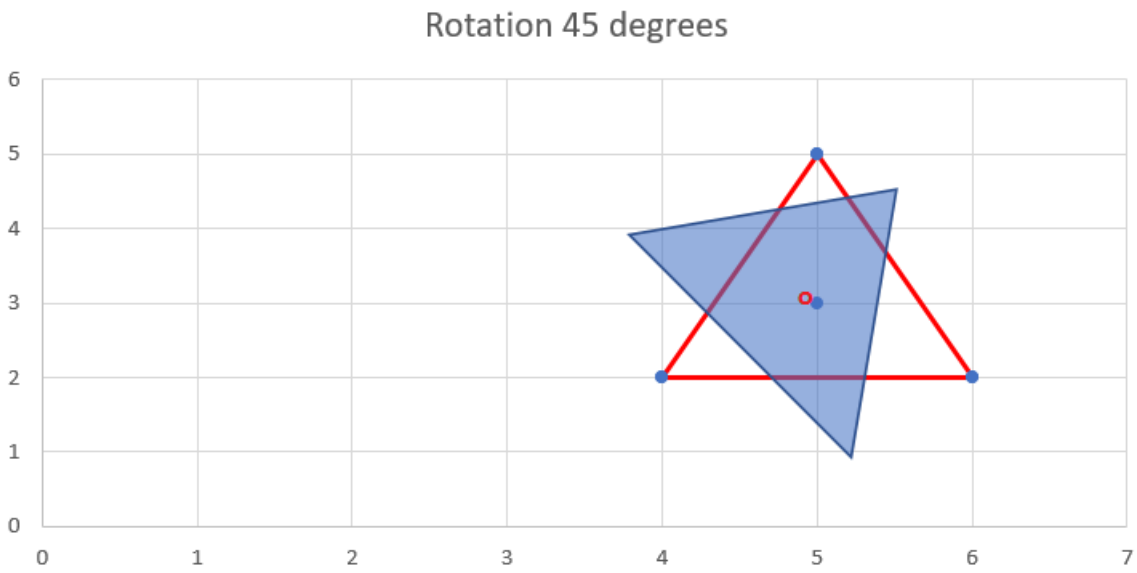
Y1 + y2 + y3 / 3

5+2+2/3 = 9/3

Y = 3



19. Use this centroid as the centre of rotation and rotate the robot (Charlie) by 45 degree clockwise.



20. Perform dilation on your robot (Charlie) – that is, shrink your robot by 30%. What are its new coordinates? What is robot Charlie's new area?

Dilatation 30%

A (250,250) x 0.7 = (175,175)

B (240,260) x 0.7 = (168,182)

C (260,260) x 0.7 = (182,182)

Finding the Length of 3 lines

Line 1 AB = = $\sqrt{(168 - 175)^2 + (182 - 175)^2}$

= $\sqrt{(-7)^2 + 7^2}$ = $\sqrt{49 + 49}$

= $\sqrt{98}$ = **9.90**

Line 2 BC = = $\sqrt{(182 - 168)^2 + (182 - 182)^2}$

= $\sqrt{14^2 + 0^2} = \sqrt{196 + 0}$

= $\sqrt{196}$ = **14**

Line 3 AC = = $\sqrt{(182 - 175)^2 + (182 - 175)^2}$

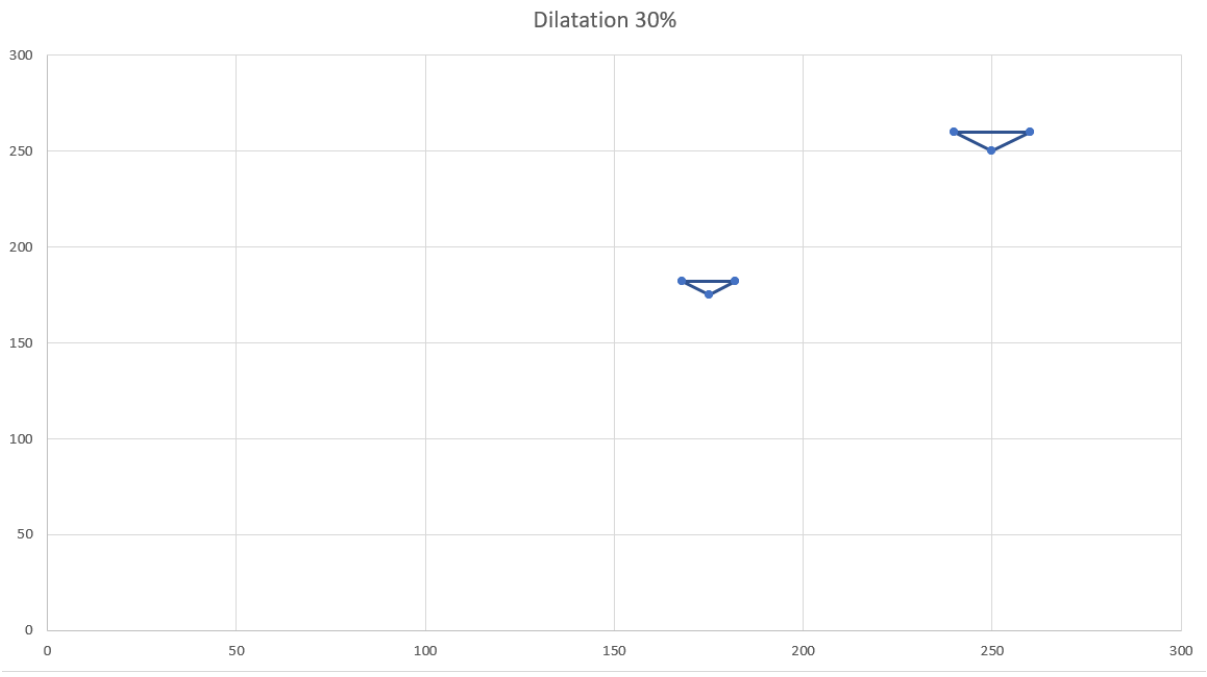
= $\sqrt{7^2 + 7^2} = \sqrt{49 + 49}$

= $\sqrt{98}$ **= 9.90**

Finding the new Area.

$$p = \frac{a + b + c}{2} = \frac{1}{2}(9.9 + 14 + 9.9) = 16.9$$

√ (16.9)(16.9-9.9)(16.9-14)(16.9-9.9)
√ (16.9)*7*(2.9)*7
√ 2401.49
A = 49



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