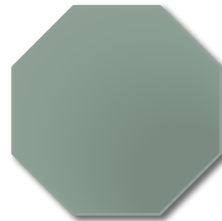
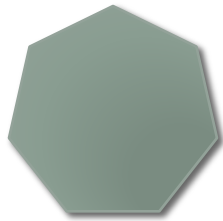
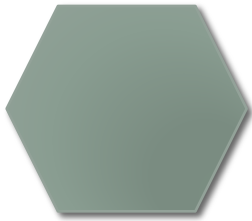
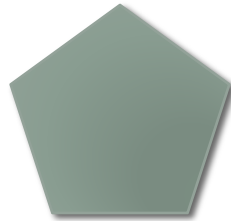
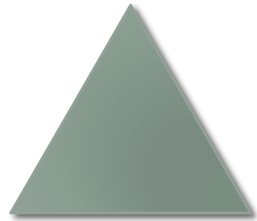


# SCRATCH MY MATH

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# Geometry!

- Review of shapes and sides



# Scratch Tip - Drawing

- You can always graph out your figure and draw from one coordinate to another
  - But that seems like a lot of work when you are drawing a triangle
- Consider going to a specific point, setting your direction and then taking a certain number of steps and turning.
  - Use
    - Go to x \_\_\_ y\_\_\_
    - Point in direction \_\_\_\_\_
    - Move \_\_\_ steps
    - Turn \_\_\_ degrees
- Don't forget about Pen Up and Pen Down!

# Drawing Geometric Shapes!

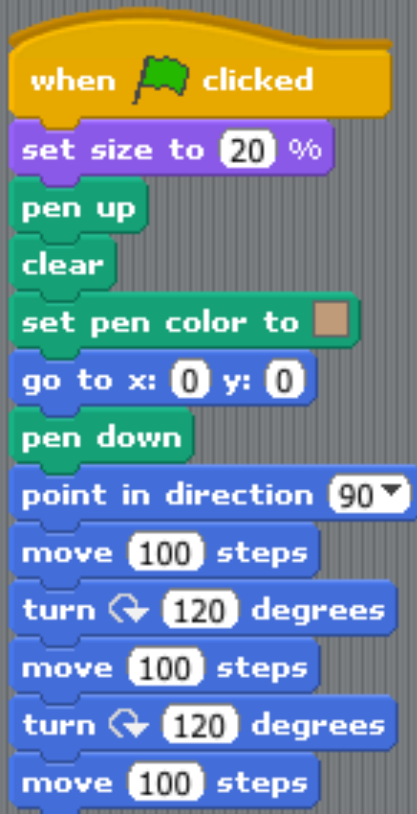
- Remember, a circle is 360 degrees around

Shape	# Sides	Turn Angle
Triangle	3	120
Square	4	90 (right angles!)
Pentagon	5	72
Hexagon	6	60
Octagon	8	45

- What's the formula for each turn angle?
  - $360/(\# \text{ sides})$

# Let's build shapes in Scratch - Triangle

## The Hard Way (1)

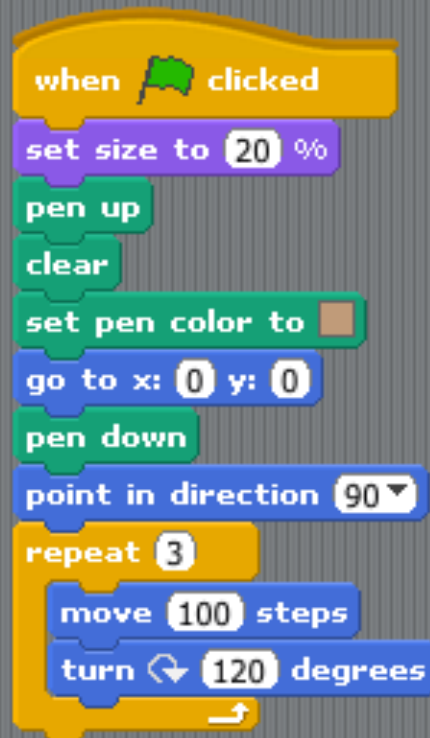


```
when clicked
set size to 20 %
pen up
clear
set pen color to brown
go to x: 0 y: 0
pen down
point in direction 90
move 100 steps
turn 120 degrees
move 100 steps
turn 120 degrees
move 100 steps
```

when clicked

- set size to 20 %
- pen up
- clear
- set pen color to brown
- go to x: 0 y: 0
- pen down
- point in direction 90
- move 100 steps
- turn 120 degrees
- move 100 steps
- turn 120 degrees
- move 100 steps

## The Easier Way (2)

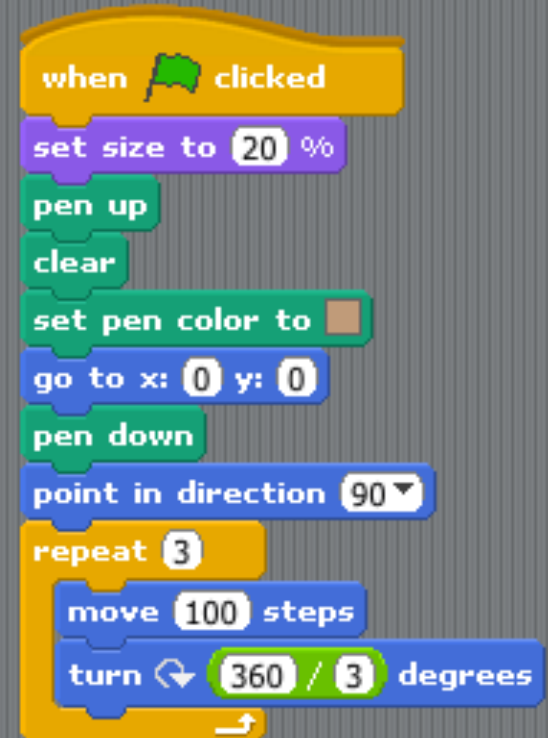


```
when clicked
set size to 20 %
pen up
clear
set pen color to brown
go to x: 0 y: 0
pen down
point in direction 90
repeat 3
  move 100 steps
  turn 120 degrees
```

when clicked

- set size to 20 %
- pen up
- clear
- set pen color to brown
- go to x: 0 y: 0
- pen down
- point in direction 90
- repeat 3
  - move 100 steps
  - turn 120 degrees

## I Don't Like Division Way (3)



```
when clicked
set size to 20 %
pen up
clear
set pen color to brown
go to x: 0 y: 0
pen down
point in direction 90
repeat 3
  move 100 steps
  turn 360 / 3 degrees
```

when clicked

- set size to 20 %
- pen up
- clear
- set pen color to brown
- go to x: 0 y: 0
- pen down
- point in direction 90
- repeat 3
  - move 100 steps
  - turn  $360 / 3$  degrees

# So let's try building a square

- Will you do it the hard way?
- How will you approach this?
- Remember
  - Pick a starting point
  - You are drawing 4 sides
  - How much do you need to turn?
- #4 and 5 in file

# Now let's build more shapes

- Triangle
- Square
- Pentagon
- Hexagon
- Octagon
- Oh my! Too much work!

**There must be a better way!**

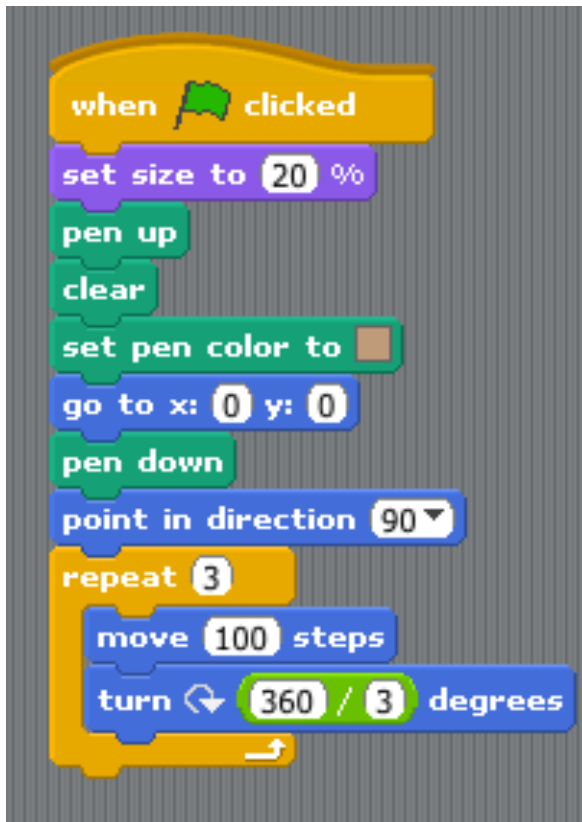
# A New Scratch Concept - Variables

- Variables have a name and that name references a value that can change over time

The image shows a screenshot of the Scratch interface. On the left, the 'Variables' category is selected in the 'Make a variable' panel. A dialog box titled 'Variable name?' is open, with 'giveMeaName' entered in the text field. Below the text field, the radio button for 'For all sprites' is selected. The 'OK' and 'Cancel' buttons are visible at the bottom of the dialog. On the right, a script area shows a sequence of four blocks for the variable 'giveMeaName': a checkmark, a 'set giveMeaName to 0' block, a 'change giveMeaName by 1' block, a 'show variable giveMeaName' block, and a 'hide variable giveMeaName' block. A 'Make a list' button is also visible at the bottom of the script area.

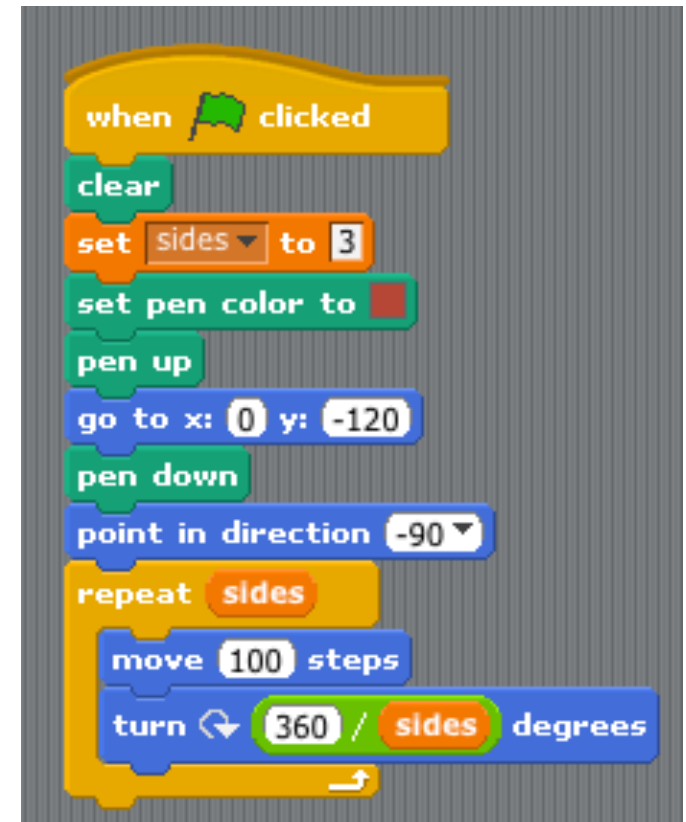


# Make a Triangle with a Variable



```
when clicked
  set size to 20 %
  pen up
  clear
  set pen color to #A52A2A
  go to x: 0 y: 0
  pen down
  point in direction 90
  repeat 3
    move 100 steps
    turn 360 / 3 degrees
```

The code block on the left is a Scratch script for drawing a triangle. It starts with a 'when clicked' event. The size is set to 20%, the pen is lifted, the canvas is cleared, and the pen color is set to a brownish-red. The turtle is moved to the origin (0,0) and the pen is lowered. It then points in the direction of 90 degrees. A 'repeat' loop with a count of 3 contains two blocks: 'move 100 steps' and 'turn 360 / 3 degrees'.

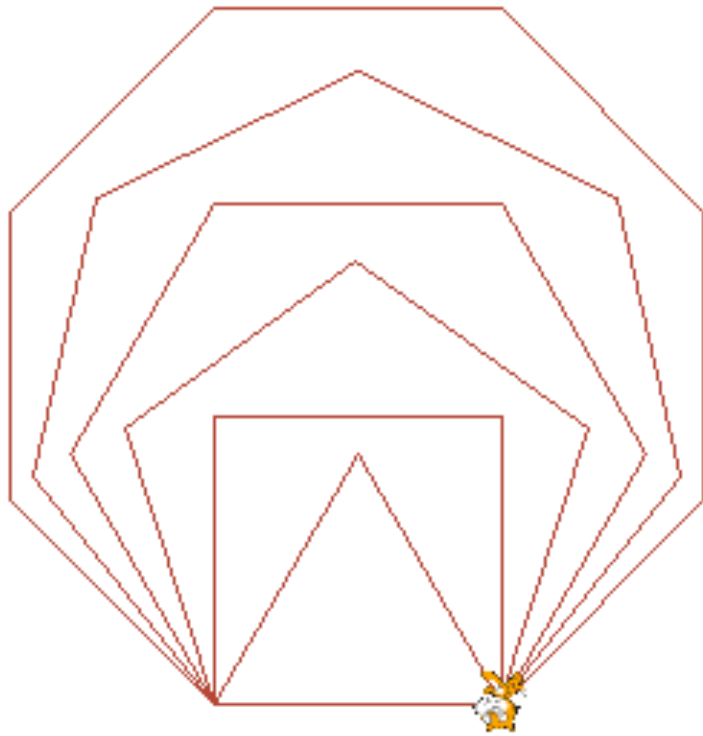


```
when clicked
  clear
  set sides to 3
  set pen color to #800000
  pen up
  go to x: 0 y: -120
  pen down
  point in direction -90
  repeat sides
    move 100 steps
    turn 360 / sides degrees
```

The code block on the right is a Scratch script for drawing a triangle using a variable. It starts with a 'when clicked' event. The canvas is cleared, and a variable named 'sides' is set to 3. The pen color is set to red, the pen is lifted, and the turtle is moved to the point (0, -120). The pen is lowered, and the turtle is pointed in the direction of -90 degrees. A 'repeat' loop with the variable 'sides' contains two blocks: 'move 100 steps' and 'turn 360 / sides degrees'.

# Modify your program to draw figures that have between 3 and 8 sides

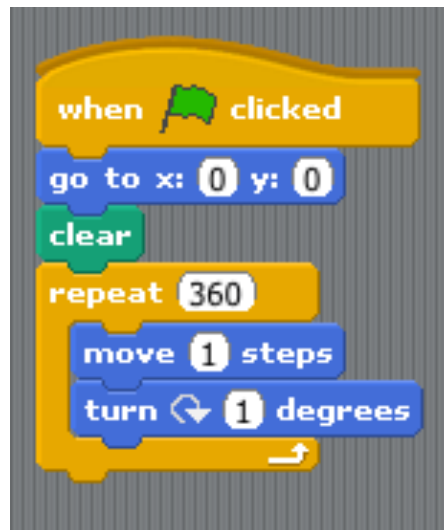
- You need to add a loop (#7)
- You need to “increment” your variable
- Don't let your drawing go off the screen



```
when clicked
clear
set sides to 3
set pen color to red
repeat 6
  pen up
  go to x: 0 y: -120
  pen down
  point in direction -90
  repeat sides
    move 100 steps
    turn 360 / sides degrees
  change sides by 1
```

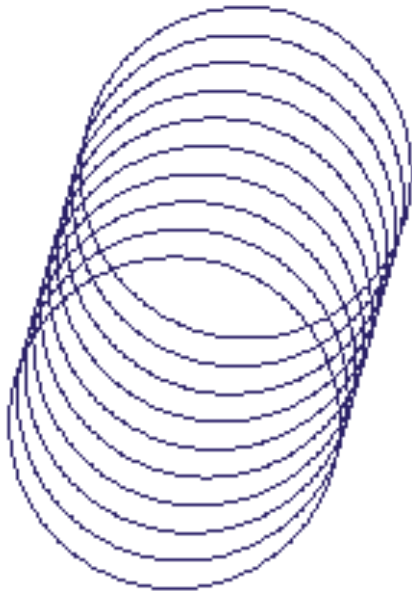
# Circle Time

- A circle has 360 degrees
- How can we draw a simple circle?
- Figured that out? How would you make it draw faster?
- #8



# Can you draw a cylinder the same way?

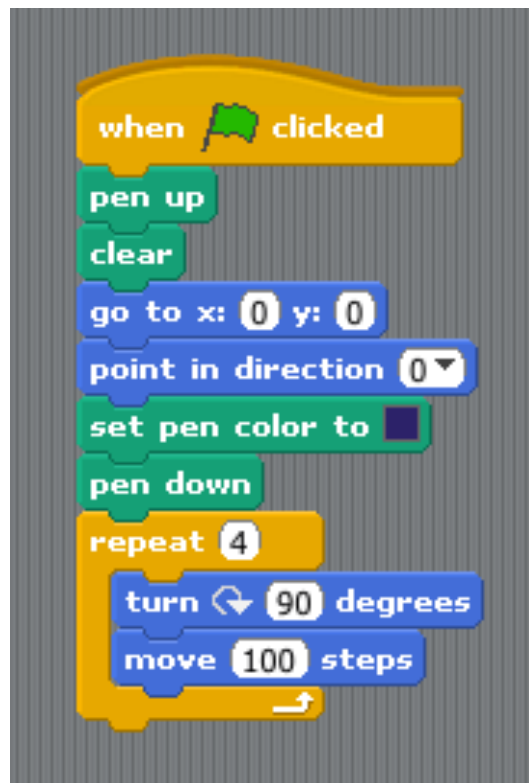
- It's 10 circles that are a few steps apart (#9)



```
when clicked
  go to x: 0 y: 0
  clear
  repeat 10
    repeat 360
      pen down
      move 1 steps
      turn 1 degrees
    pen up
    move 10 steps
```

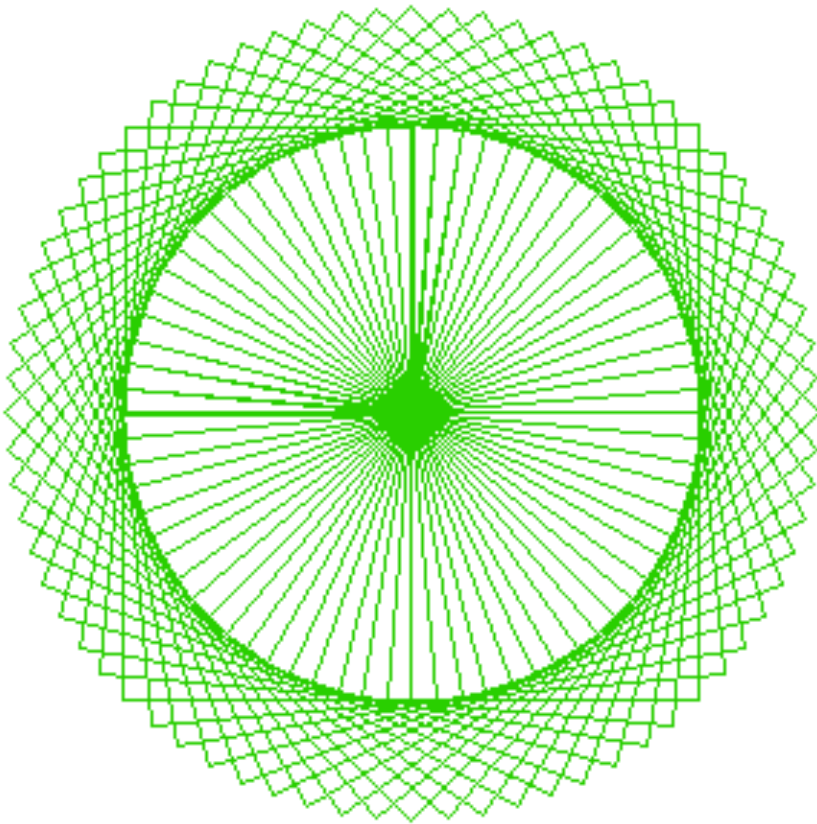
# Square Graphs

- Let's draw a very simple square again



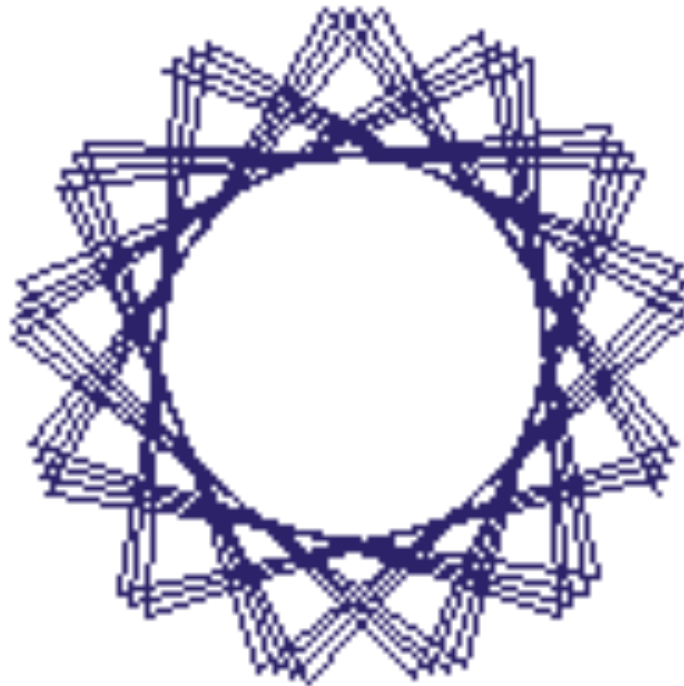
# Can you draw this?

- It's a lot of squares (how many?) each rotated 5 degrees (h)



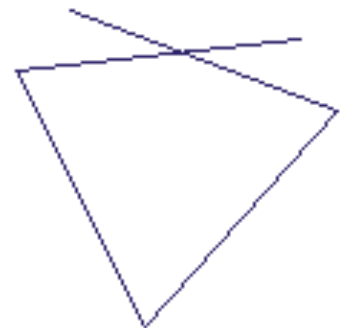
```
when h key pressed
hide
pen up
clear
set pen color to green
go to x: 0 y: 0
pen down
point in direction -90
repeat 72
  repeat 4
    move 100 steps
    turn 90 degrees
  turn 5 degrees
```

How can we draw this?



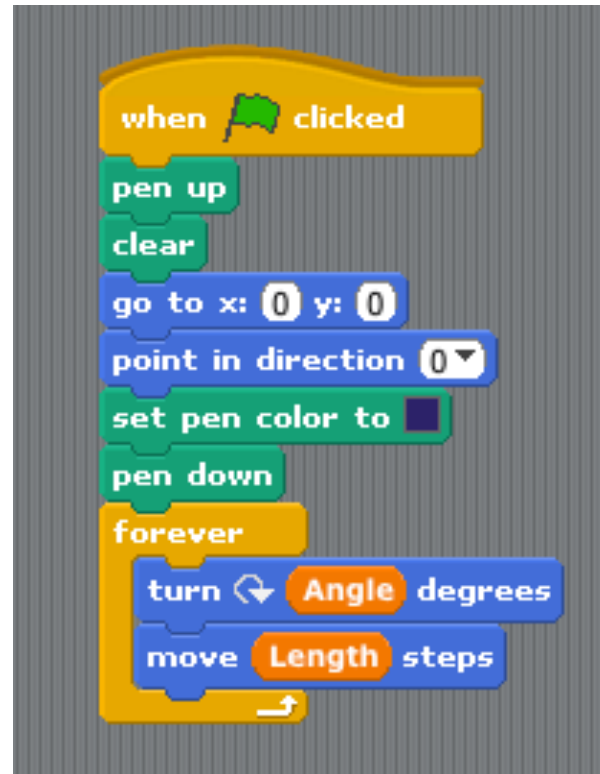
# Let's think about it

- I'm kind of drawing a square, right?
- BUT
  - I'm turning more (or less) than 90 degrees
  - So have a variable called Angle (and maybe one for length too!)
  - I'm going to draw more than 4 lines!
- Don't forget that your "orientation" (which way you are pointing) matters!
- (a)

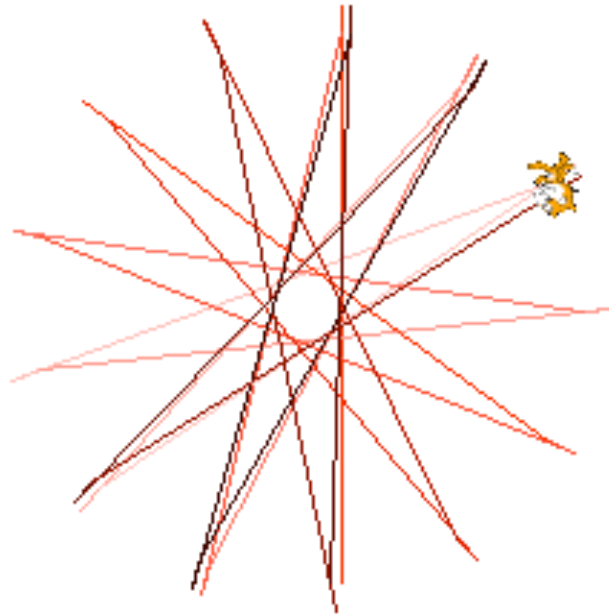




# What Does the Code Say?



# How about a Spiro graph? ( b )

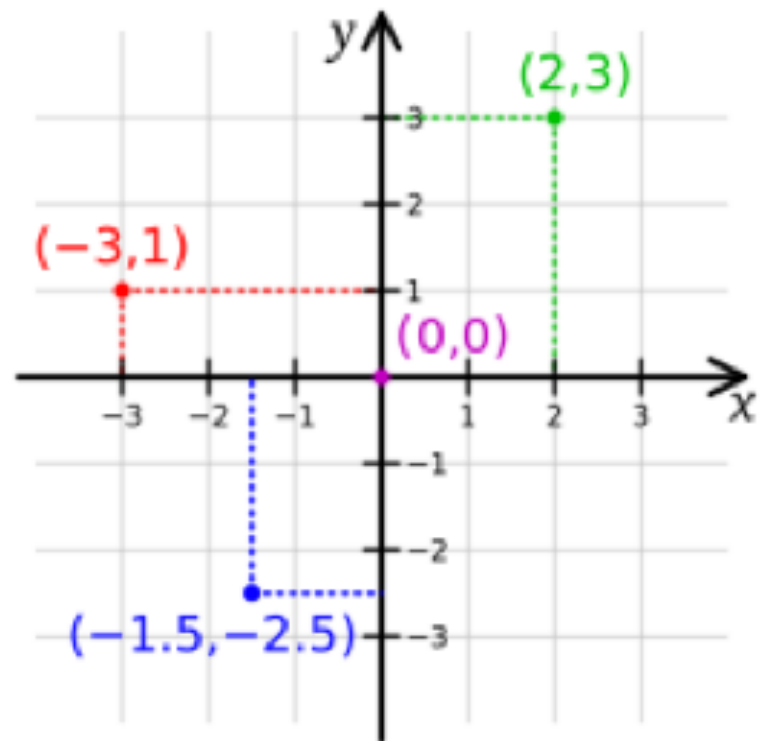


```
when clicked
  set size to 20 %
  go to x: 0 y: -120
  point in direction 0
  clear
  pen down
  forever
    move 0 steps
    turn 0 degrees
    move 0 steps
    turn 0 degrees
    change pen shade by 10

when clicked
  go to x: 50 y: -50
  point in direction 0
  clear
  pen down
  forever
    move 200 steps
    turn 179 degrees
    move 10 steps
    turn 15 degrees
```

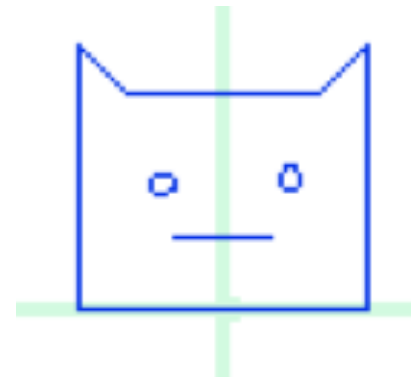
# Graphs

- What's a graph?
  - The Cartesian Coordinate System
    - X Axis
    - Y Axis



# Drawing Pictures

- Let's draw a picture:
  - Bottom line goes from -30 to 30 on the X Axis
  - Top of ears at 55 on the Y Axis
  - Top of head at 45 on the Y Axis
  - Ears end at -20 and 20 on the X Axis
  - Mouth from -10 to 10 on the X Axis( $y = 15$ )
  - Eyes at  $x:-15, y:25$  and  $x:15, y:25$ 
    - Draw small circle
      - 36 degrees with 1 step repeat 10 times
  - ( c )



when  clicked

hide

pen up

clear

go to x: 30 y: 0

pen down

go to x: 30 y: 55

go to x: 20 y: 45

go to x: -20 y: 45

go to x: -30 y: 55

go to x: -30 y: 0

go to x: 30 y: 0

pen up

go to x: 10 y: 15

pen down

go to x: -10 y: 15

pen up

go to x: -15 y: 25

pen down

repeat 10

turn  36 degrees

move 1 steps

pen up

go to x: 15 y: 25

pen down

repeat 10

turn  36 degrees

move 1 steps

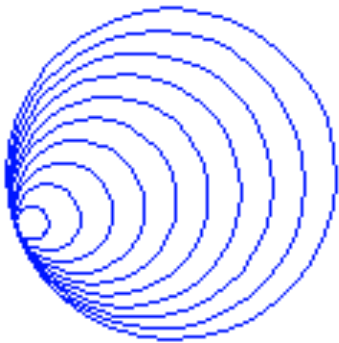
# How About Some Scale?

- Scale means making something bigger or smaller
- How can you change your picture to account for variable scale?
  - Note: Only change the X Axis
  - HINT: You need a variable called scale
  - Instead of moving to absolute locations you will multiply by your variable called scale
- (d)

```
when clicked
hide
pen up
clear
go to x: Scale * 30 y: 0
pen down
go to x: Scale * 30 y: 55
go to x: Scale * 20 y: 45
go to x: Scale * -20 y: 45
go to x: Scale * -30 y: 55
go to x: Scale * -30 y: 0
go to x: Scale * 30 y: 0
pen up
go to x: Scale * 10 y: 15
pen down
go to x: Scale * -10 y: 15
pen up
go to x: Scale * -15 y: 25
pen down
repeat 10
  turn 36 degrees
  move Scale steps
pen up
go to x: Scale * 15 y: 25
pen down
repeat 10
  turn 36 degrees
  move Scale steps
```

# OMG You're Still Doing This?

- OK, here are more challenges you can figure out on your own.
- Try this!
  - HINT: Each circle is bigger than the previous one.
- (e)

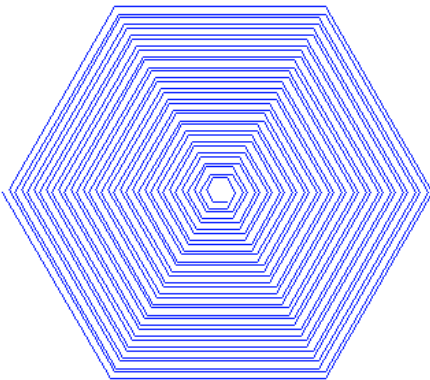


```
when e key pressed
hide
pen up
go to x: 0 y: 0
set spiral to 1
clear
repeat 10
  repeat 36
    pen down
    move spiral steps
    turn 10 degrees
  change spiral by 1
```



# Another?

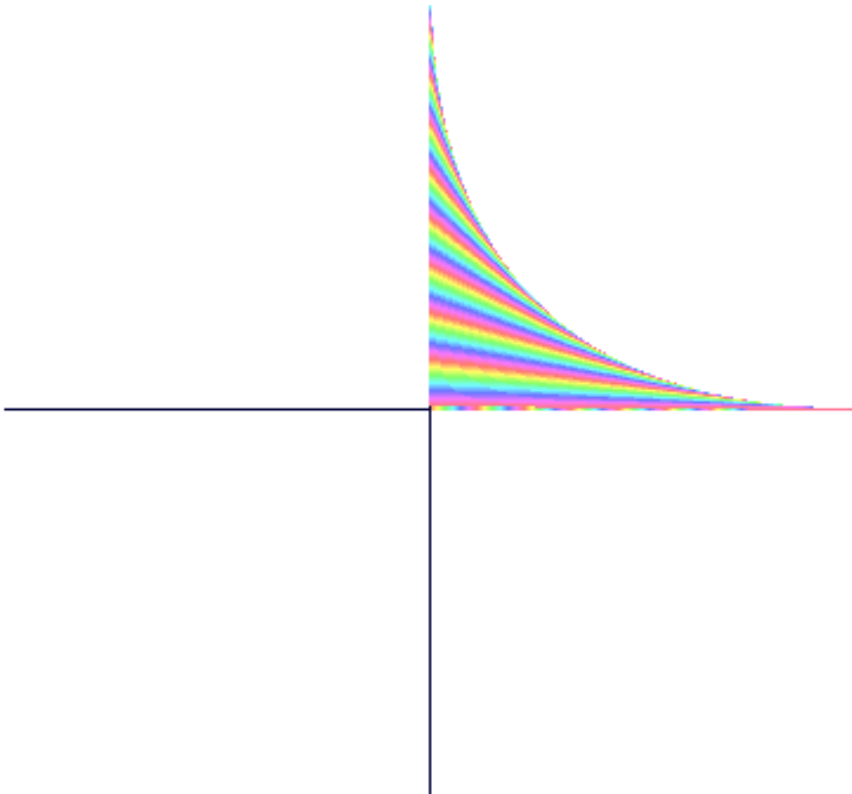
- Can you draw this?
- Look closely
- Aren't you just drawing a bunch of hexagons that get bigger and bigger over time?
- (g)



```
when g key pressed
  go to x: 0 y: 0
  clear
  pen down
  point in direction -90
  set Length to 10
  repeat 50
    repeat 4
      move Length steps
      turn 60 degrees
    change Length by 3
```

# Cool line art anyone?

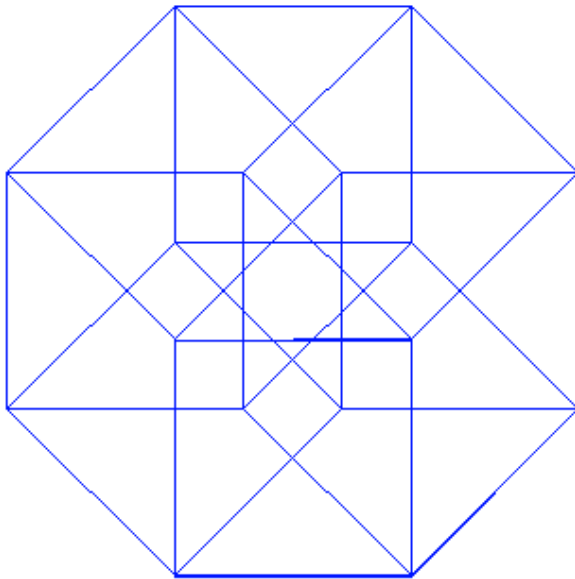
- Straight lines can make a curve!
- (i)



```
when i key pressed
clear
pen up
set pen color to black
go to x: 0 y: 180
pen down
go to x: 0 y: -180
pen up
go to x: -180 y: 0
pen down
go to x: 180 y: 0
set pen color to red
set yAxis to 180
set xAxis to 1
repeat 179
  pen up
  change pen color by 10
  go to x: 0 y: yAxis
  pen down
  go to x: xAxis y: 0
  change xAxis by 1
  change yAxis by -1
```

# Even harder!

- Create a shape with <number>
- Example (f):



```
when key pressed
ask How many sides does your shape have and wait
go to x: -46 y: -150
clear
pen down
if answer < 4
  move 1 / answer * 275 steps
  point in direction 90
  repeat 4
    turn 90 degrees
    move 1 / answer * 275 steps
  repeat answer
    turn 360 / answer degrees
    move 1 / answer * 275 steps
  repeat 4
    turn 90 degrees
    move 1 / answer * 275 steps
else
  move 1 / answer * 1000 steps
  point in direction 90
  repeat 4
    turn 90 degrees
    move 1 / answer * 1000 steps
  repeat answer
    turn 360 / answer degrees
    move 1 / answer * 1000 steps
  repeat 4
    turn 90 degrees
    move 1 / answer * 1000 steps
```

res