Turtle Graphics using Python

A Gentle Introduction to Programming

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Why coding?

- Authentic work
- Supports STEAM initiatives
- Work with real data in Science, Geography, Math
- Required course in first year of university in many disciplines

DSBN Coding Initiatives

- Learning Teams
- Hour of Code
- Coding Contests
- Technovation

Why Python?

- Easy to get started
- Lots of online resource
- Widely used in post-secondary and industry

Why Turtle Graphics?

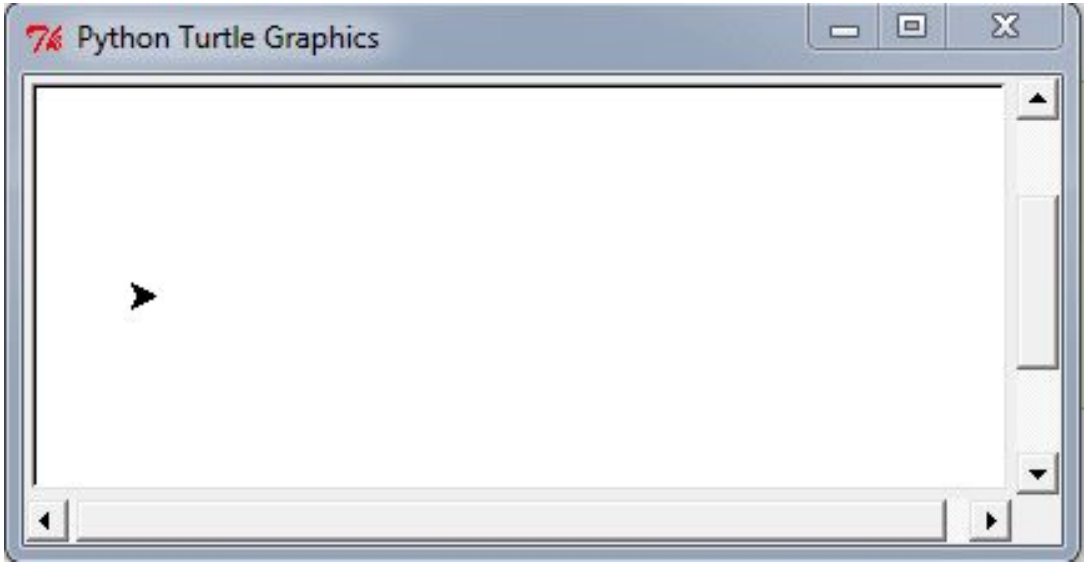
- Visual
- Immediate Visual Feedback
- Historical significance (Seymour Papert) back to the 1960's
- Easy to scaffold into more complex programming concepts

What is Turtle?

The turtle has three attributes: a location, an orientation (or direction), and a pen. The pen, too, has attributes: color, width, and on/off state.

The turtle moves with commands that are relative to its own position, such as "move forward 10 spaces" and "turn left 90 degrees".

--*Wikipedia*



Credit: http://people.duke.edu/~tkb13/courses/ncsu-csc230/homework/6/

Install Python

First Things First -- Download Python!

Download the latest 3.x version from https://www.python.org/

(or install from your USB drive)

Files

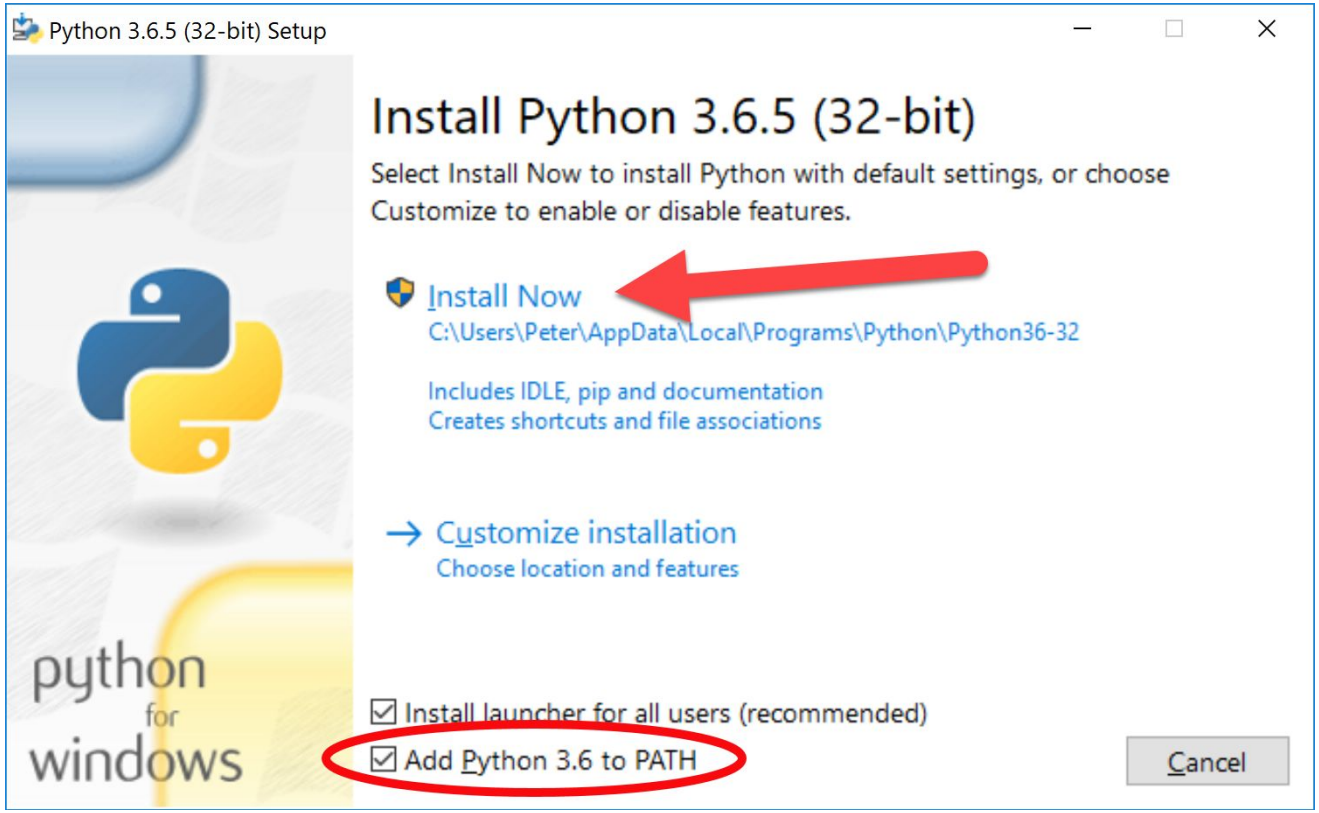
Version	Operating System
Gzipped source tarball	Source release
XZ compressed source tarball	Source release
macOS 64-bit/32-bit installer	Mac OS X
macOS 64-bit installer	Mac OS X
Windows help file	Windows
Windows x86-64 embeddable zip file	Windows
Windows x86-64 executable installer	Windows
Windows x86-64 web-based installer	Windows
Windows x86 embeddable zip file	Windows
Windows x86 executable installer	Windows
Windows x86 web-based installer	Windows

Installing Python

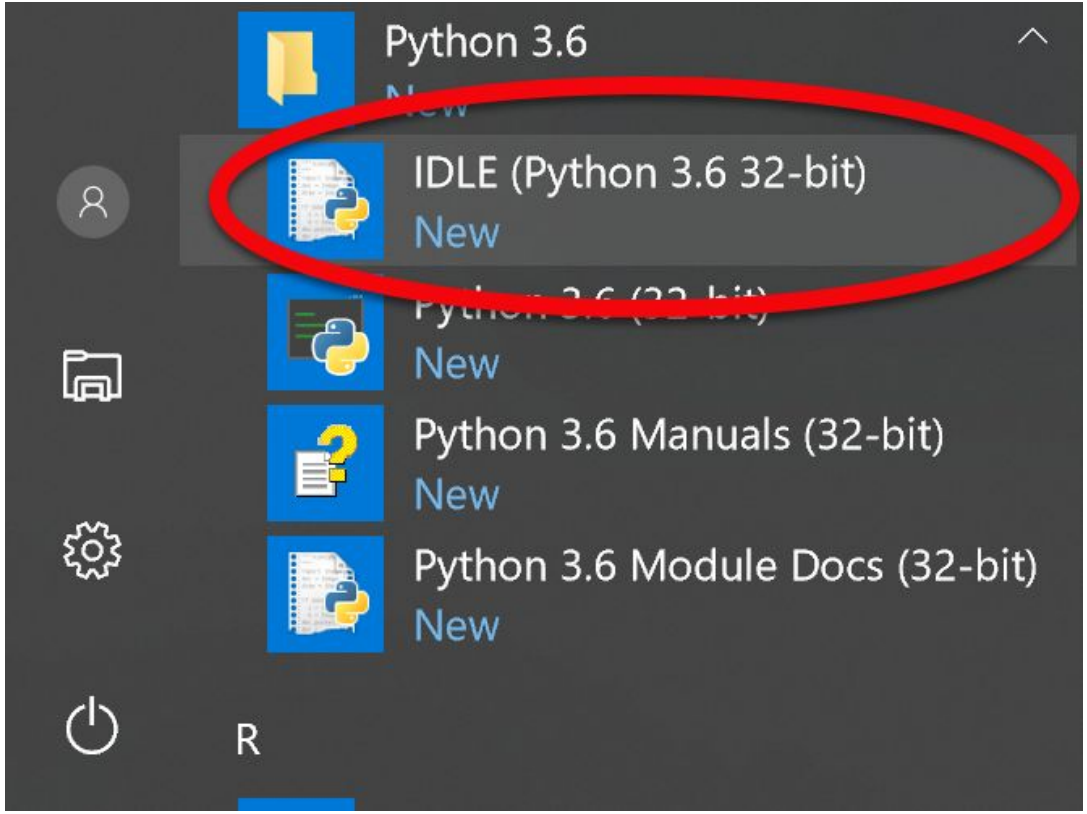
macOS 64-bit installer	Mac OS X	for OS X
Windows help file	Windows	
Windows x86-64 embeddable zip file	Windows	for AMD
Windows x86-64 executable installer	Windows	for AMD
Windows x86-64 web-based installer	Windows	for AMD
Windows x86 embeddable zip file	Windows	
Windows x86 executable installer	Windows	
Windows x86 web-based installer	Windows	

python-3.6.5.exe

Installing Python



Running Python



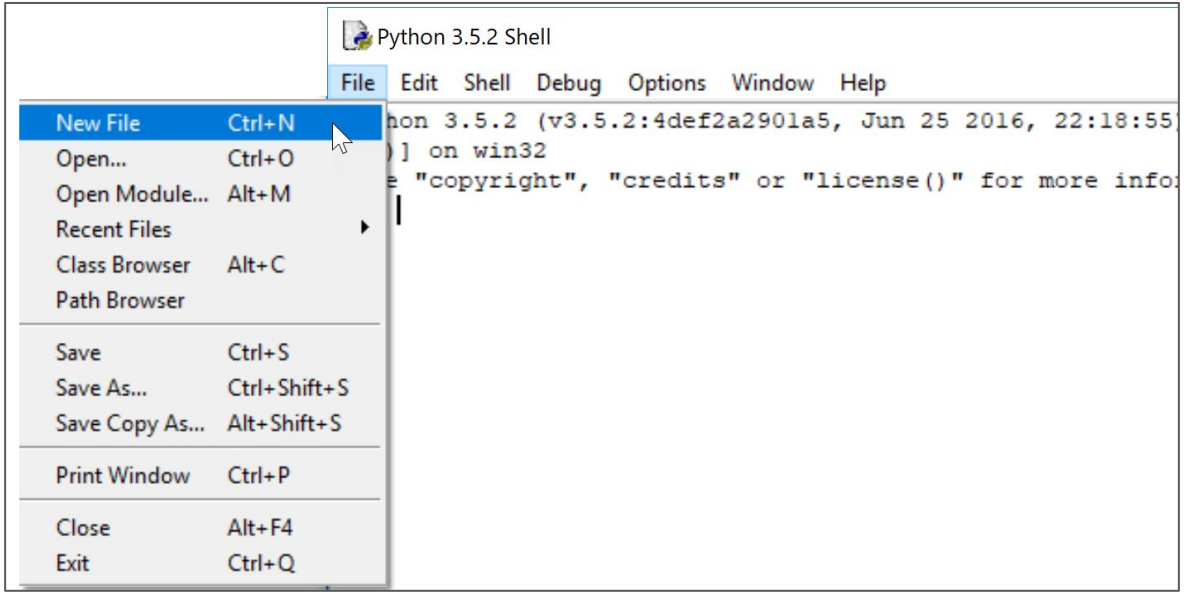
Before We Start...

- Never copy-and-paste code. You won’t learn that way.
- Case matters! “Print” is not the same as “print”.
- Whitespace (tabs, spaces) matters!

Testing Python

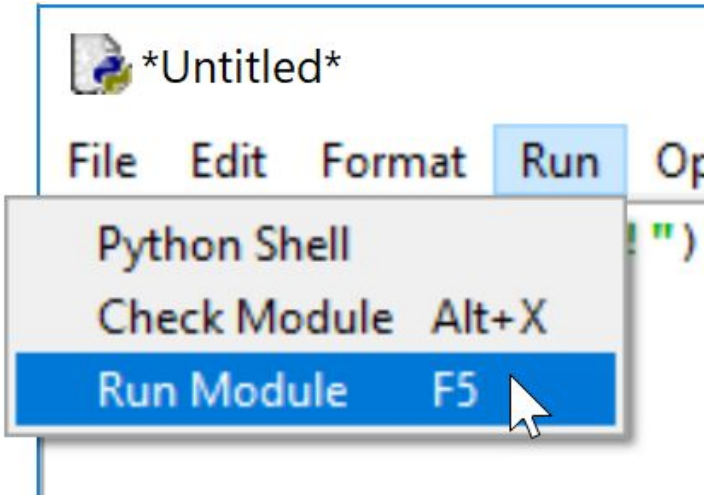
Our First Python Program

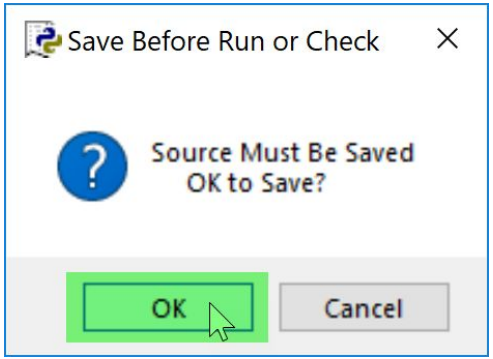
Start by creating a new program in our editor (IDLE). Menu: File > New File (or Ctrl-N)



Hello World! (to test Python)

Hello World! (cont'd)





Hello World! (cont'd)

Python 3.6.5 Shell

File Edit Shell Debug Options Window Help

```
Python 3.6.5 (v3.6.5:f59c0932b4, Mar 28 2018, 16:07:46) [MSC v.1900 32 bit (Inte
l)] on win32
Type "copyright", "credits" or "license()" for more information.
>>>
 RESTART: C:/Users/Peter/Dropbox/My Docs/Python/DSBN Python Team/Presentation/He
lloWorld.py
Hello World!
>>>
```

Ln: 6 Col: 4

Yay!!!

Introducing Turtle Graphics

Using Turtle Graphics

The first thing we need to do is import the turtle library:

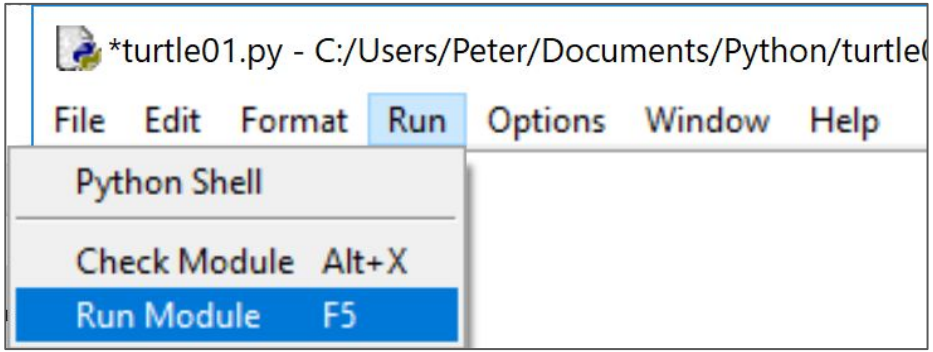
```
import turtle
```

Save and run this program. If there were no errors, it worked!

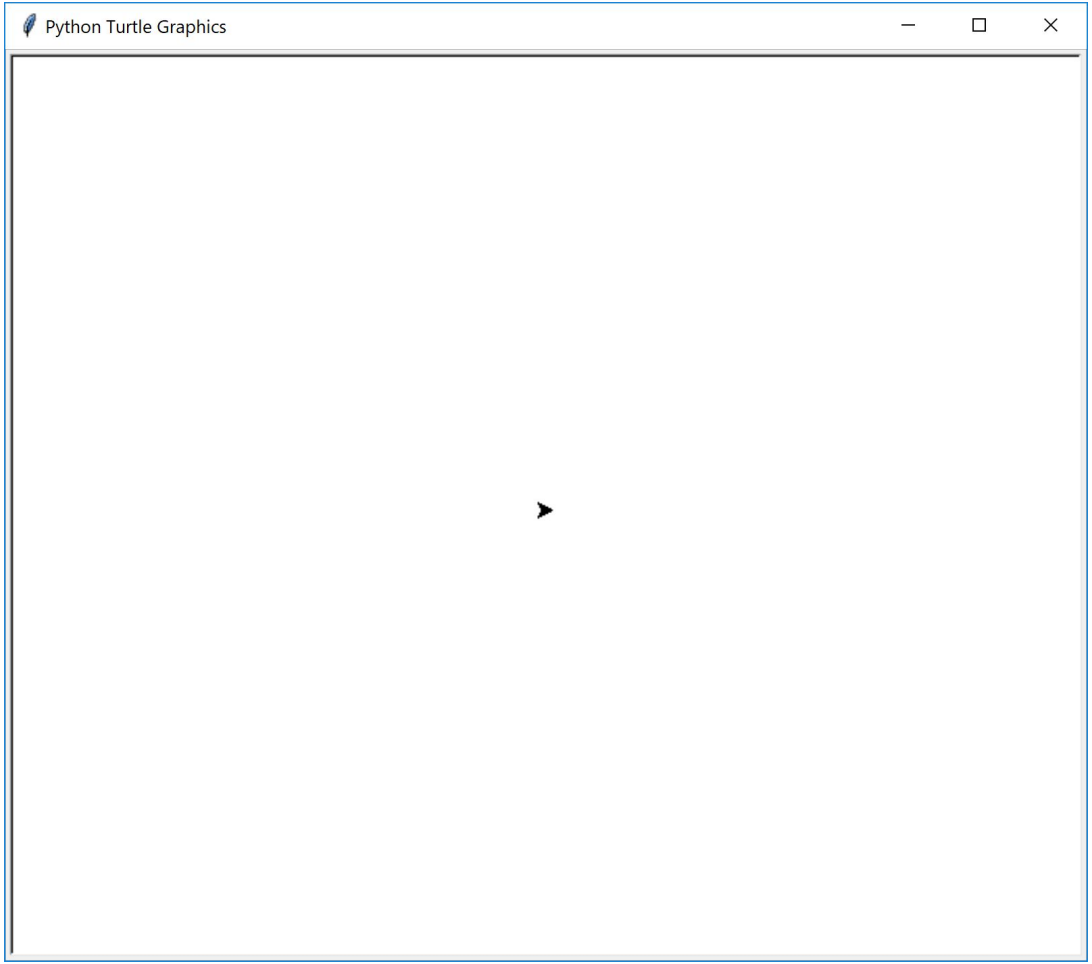
Create a Turtle “Object”

We then need to create a turtle object, which we conventionally call “t” (you can call it whatever you want):

```
import turtle
t = turtle.Pen()
```



(New content is shown in blue)


Python Turtle Graphics

If Your Screen Disappeared!

Add the following line:

```
turtle.exitonclick()
```

...to prevent the screen from closing. Make this the last line of the program.

Want to Change the Icon?

```
import turtle
t = turtle.Pen()
t.shape("circle")
```

The standard shapes are “arrow”, “turtle”, “circle”, “square”, “triangle”, or “classic”. The default shape is “classic”.

Let's Draw a Line

```
t.forward(n)
```

Where *n* is the number of pixels.

Assignment: draw a 250 pixel line.

Let's Move in a New Direction!

`t.right(n)`

...where *n* is the number of degrees.

Assignment: combine forward() and rotate() to draw a square.

Challenge!

How would you use forward() and rotate() to draw a decagon (10 sided)?

Answer: It’s not realistic using the technique we used to draw the square.

So…. Let’s learn about looping!

Intro Concepts and Assignments

Introduction to For Loops

```
for i in range (0, 10):
   print (i)
```

Assignment: Use a for loop to draw the square.

Solution for Square

```
import turtle

t = turtle.Pen()

for i in range(0, 4):
    t.forward(250)
    t.right(90)

turtle.exitonclick()
```

Introducing Variables

```
import turtle

t = turtle.Pen()

num_sides = 4

for i in range(0, num_sides):
    t.forward(250)
    t.right(90)

turtle.exitonclick()
```

Hexagon Assignment

Assignment: Modify the previous program to draw a hexagon.

```
import turtle

t = turtle.Pen()

num_sides = 4

for i in range(0, num_sides):
    t.forward(250)
    t.right(90)

turtle.exitonclick()
```

Introducing Basic Math

- Addition +
- Subtraction -
- Multiplication *
- Division /
- Exponent **

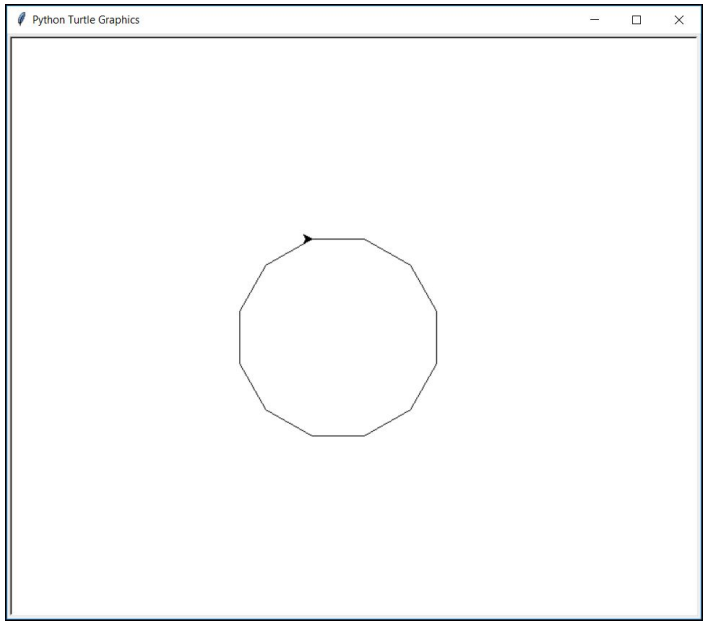
Calculating the Turn Angle

```
import turtle

t = turtle.Pen()

num_sides = 4

for i in range(0, num_sides):
    t.forward(250)
    t.right(360 / num_sides)

turtle.exitonclick()
```

Assignment: Drawing Regular Polygons

Change the program so that any value of `num_sides` will draw a shape that does not go off the screen.

(Hint: see next slide!)



Tools You Will Need

- goto (x,y) - teleports the turtle to a new position on the screen.

```
t.goto (100, -100)
```

- penup() and pendown() - stop drawing, start drawing

```
t.penup()
```

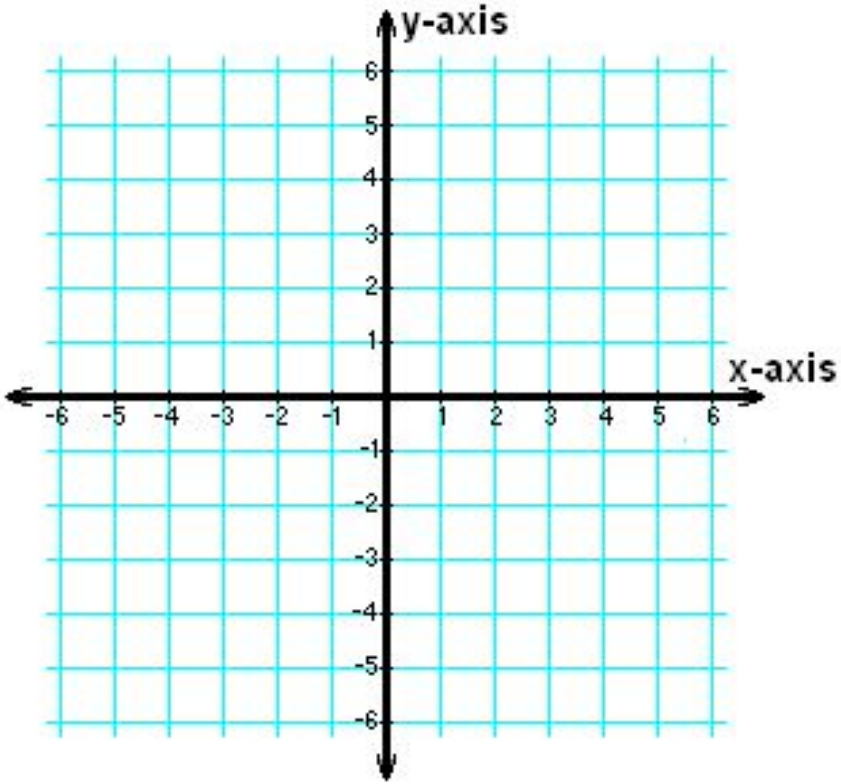
Setting the Size of the Window

What if we want to set the window size? Just use this command:

```
turtle.setup(width=800, height=600)
```

Turtle Uses a Cartesian Plane

- (0,0) is in the centre
- The screen is approximately 700 by 700



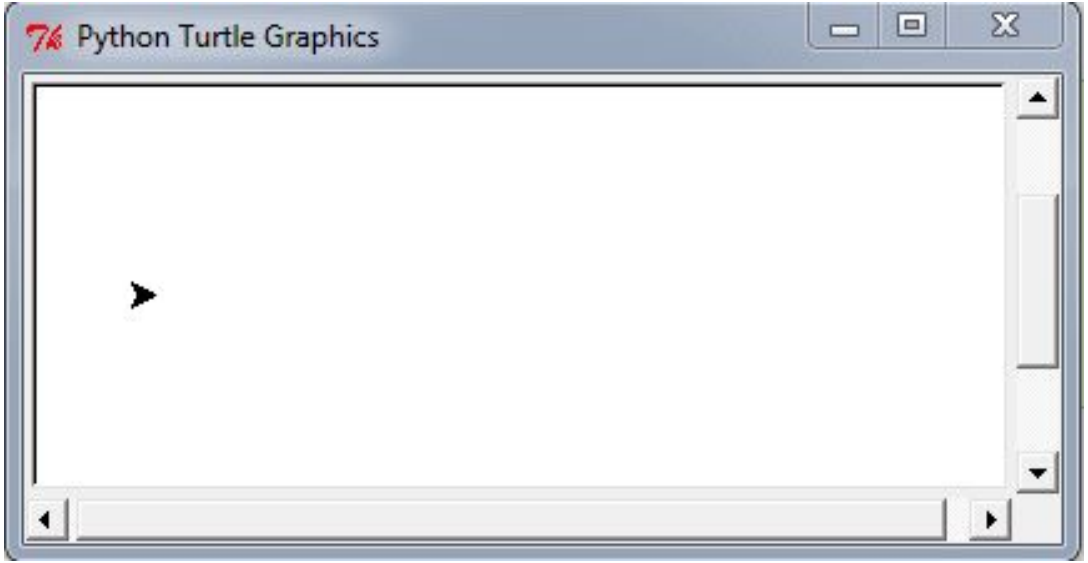
Loops Inside Loops

```
for i in range(1, 4):
    for j in range(1, 3):
        print(i, '*', j, '=', i * j)
    print('----')
```

```
1 * 1 = 1
1 * 2 = 2
----
2 * 1 = 2
2 * 2 = 4
----
3 * 1 = 3
3 * 2 = 6
----
```

Assignment: Drawing Boxes

Make a program that draws the boxes similar to the picture.



Some Tips

Change the Pen Color

- You can change the color of the pen you are drawing with using: t.color(“blue”)
- A color list can be found here: https://trinket.io/docs/colors

Fill with a Colour

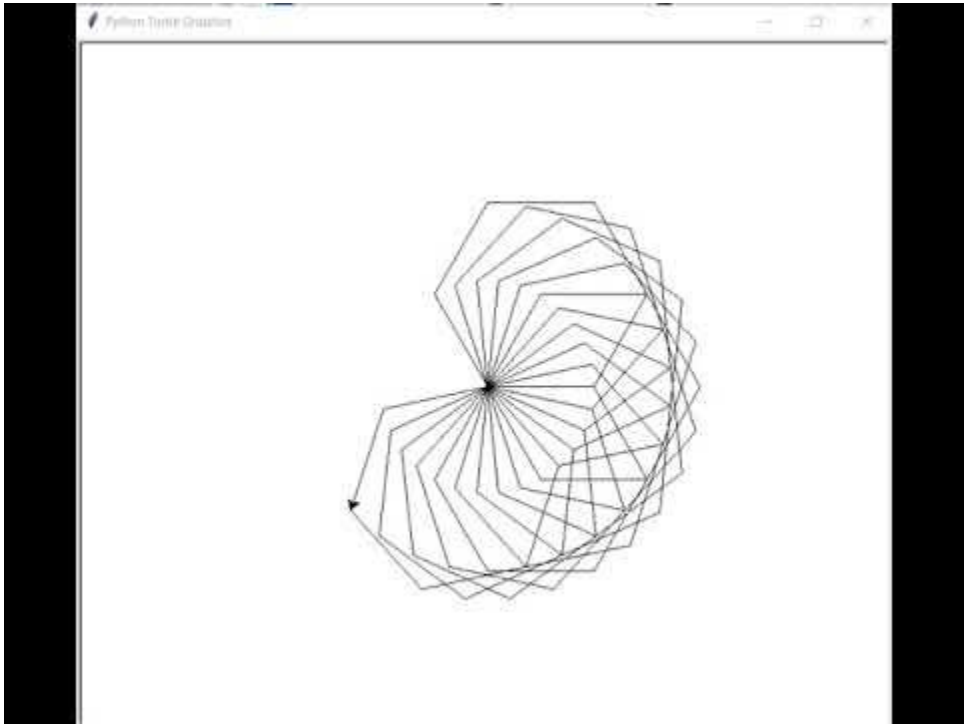
```
import turtle

t = turtle.Pen()
t.color('blue')

t.begin_fill()
for i in range(4):
    t.forward(100)
    t.right(90)
t.end_fill()

turtle.exitonclick()
```

Creating a Function

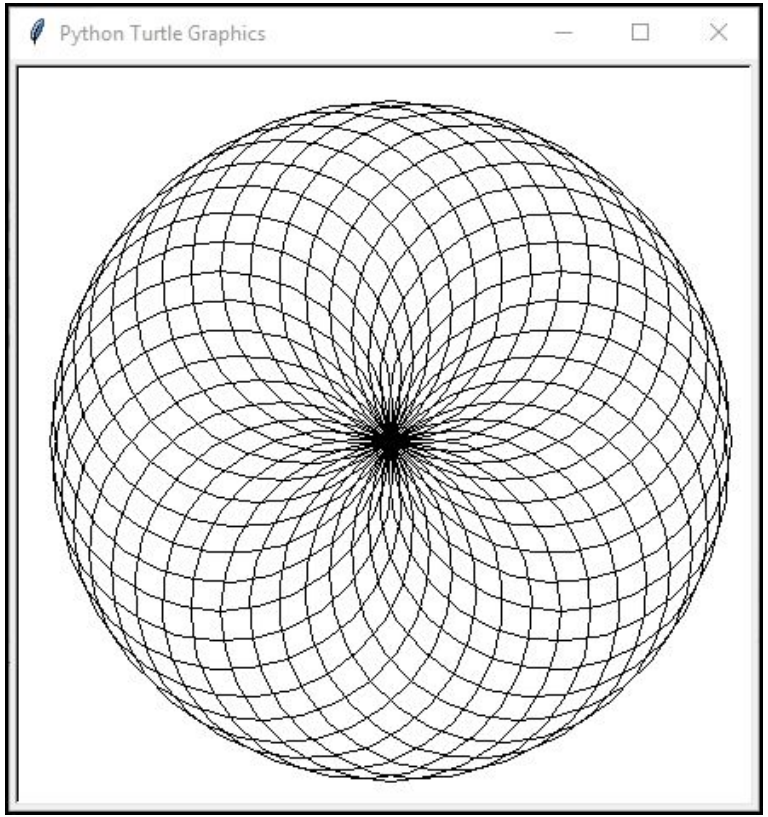
```
import turtle

def draw_square(turtle_name, num):
    for i in range(4):
        turtle_name.forward(num)
        turtle_name.right(90)

t = turtle.Pen()

draw_square(t, 100)

turtle.exitonclick()
```

Assignments

Assignment: Spirograph



Assignment: Circle of Circles



Assignment: Landscape

Try to create this using the different concepts you have learned (for loop, functions, penup/pendown, begin_fill/end_fill, forward, right)

https://youtu.be/y8KTeYKIFos