Turtle Graphics

- The **turtle** moves and draws with commands that are relative to its own position, such as:
  1. "Move forward 10 spaces" and
  2. "Turn left 90 degrees".

- The Turtle moves on a 2D surface and carries a pen.

- The state of the turtle has three attributes:
  1. Position
  2. Orientation
  3. Color

  ![Forward 1](image1) ![Right 90° Forward 1](image2) ![Right 90°](image3)
import turtle

turtle.setup(300,300) #create a window 300x300 pixels.
window = turtle.Screen()
window.bgcolor("lightgreen")
window.title("Hello, Tess!")

tess = turtle.Turtle()
tess.shape("turtle")
tess.color("blue")
tess.pensize(3)
tess.forward(60) #60 pixels
tess.left(90)    #90 degrees
tess.forward(120)

window.exitonclick()
What Pattern Does This Make?

```python
# Code for setting up window and turtle goes here.
tess.forward(25)
tess.right(90)
tess.forward(50)
tess.right(90)
tess.forward(75)
tess.right(90)
tess.forward(100)
tess.right(90)
tess.forward(125)
tess.right(90)
tess.forward(150)
tess.right(90)
tess.forward(175)

window.exitonclick()
```

This code is very repetitive. What is a better way to make a bigger spiral?

Leverage Patterns with while Loop

```python
# Code for setting up window and turtle goes here.
distance = 25
while (distance <= 175):
    tess.forward(distance)
    tess.right(90)
distance = distance + 25

tess.forward(25)
tess.right(90)
tess.forward(50)
tess.right(90)
tess.forward(75)
tess.right(90)
tess.forward(100)
tess.right(90)
tess.forward(125)
tess.right(90)
tess.forward(150)
tess.right(90)
tess.forward(175)

window.exitonclick()
```
Same Loop, New Numbers

```python
import turtle
turtle.setup(300,300)  #Create a window 300x300 pixels.
window = turtle.Screen()
window.bgcolor("lightgreen")
window.title("Hello, Tess!")
tess = turtle.Turtle()
tess.shape("turtle")
tess.color("blue")
tess.pensize(3)

distance = 10  #was 25
while (distance <= 240):  #was 175
    tess.forward(distance)
tess.right(90)  #unchanged
distance = distance + 10  #was 25
window.exitonclick()
```

Tess and Todd

```python
import turtle
turtle.setup(300,300)
window = turtle.Screen()
window.bgcolor("white")
window.title("Hello, Tess!")
tess = turtle.Turtle()
tess.shape("turtle")
tess.color("darkblue")
tess.pensize(10)
todd = turtle.Turtle()
todd.shape("turtle")
todd.color("lightblue")
todd.pensize(4)

distance = 25
while (distance <= 200):
    tess.right(100)
todd.right(100)
tess.forward(distance)
todd.forward(distance)
distance = distance + 25
```
How Can This Image be Produced?

myTurtle.left(90)
myTurtle.forward(50)
myTurtle.right(60)
myTurtle.forward(50)
myTurtle.left(60)
myTurtle.forward(50)

Quiz: Which is the Turtle's Path?

myTurtle.left(90)
myTurtle.forward(50)
myTurtle.right(60)
myTurtle.forward(50)
myTurtle.left(60)
myTurtle.forward(50)

(a) (b) (c) (d)
Quiz: Which is the Turtle's Path?

myTurtle.left(90)
myTurtle.forward(50)
myTurtle.left(45)
myTurtle.forward(50)
myTurtle.left(45)
myTurtle.forward(50)

(a) (b) (c) (d)