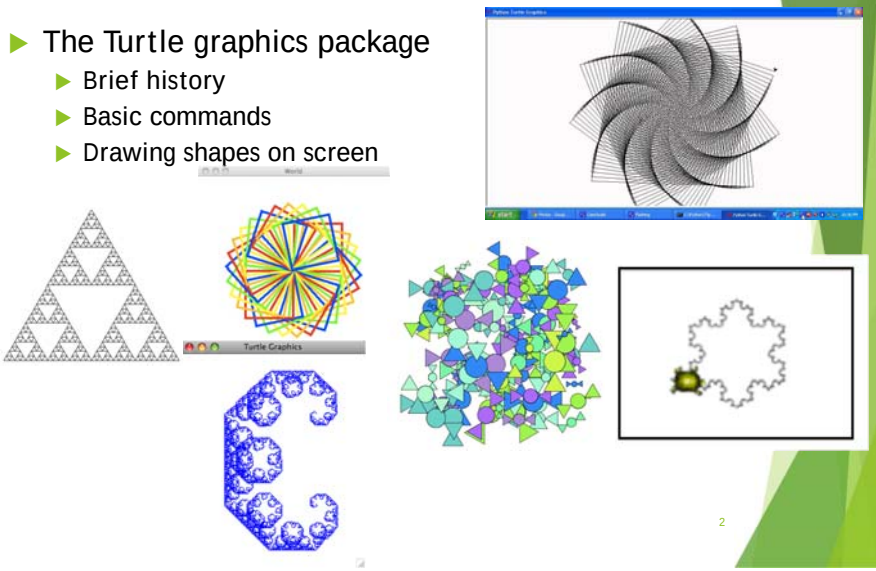
Python 3 – Turtle graphics

Lecture 18 – COMPSCI111/111G

Today's lecture

- The Turtle graphics package
  - Brief history
  - Basic commands
  - Drawing shapes on screen



Logo and Turtle graphics

- In 1967, Seymour Papert and Wally Feurzeig created an interpretive programming language called Logo.
- Papert added commands to Logo so that he could control a turtle robot, which drew shaped on paper, from his computer
- Turtle graphics is now part of Python
- Using the Turtle involves instructing the turtle to move on the screen and draw lines to create the desired shape

The Turtle package

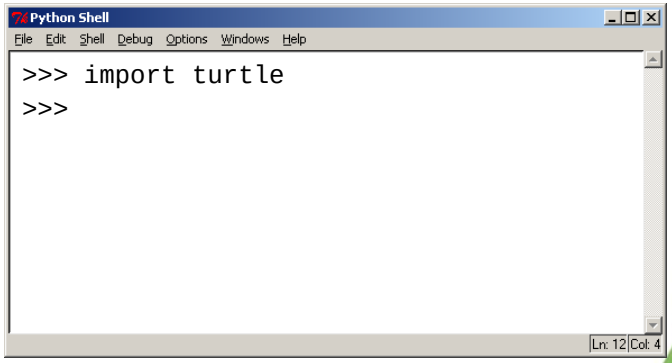
- Some functions are part of Python's core libraries, in other words they are 'built-in'
  - `print()`
  - `input()`
  - `float()`
- Other functions need to be imported into your Python program
- The `turtle` module needs to be imported at the start of any Python program that uses it:
  `import turtle`

Basic Turtle commands

- There are four basic turtle commands
- `turtle.forward(x)`
  - Moves turtle forward in direction it is facing by x steps
- `turtle.back(x)`
  - Moves turtle backward from its facing direction by x steps
- `turtle.left(x)`
  - Turns the turtle x degrees counterclockwise
- `turtle.right(x)`
  - Turns the turtle x degrees clockwise

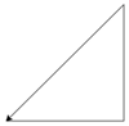
Turtle example

- Using the Python interpreter in IDLE to demonstrate how to use Turtle graphics
- First, import the `turtle` package

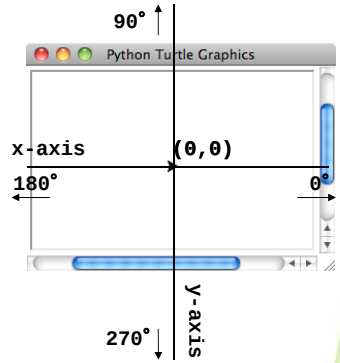


Turtle example

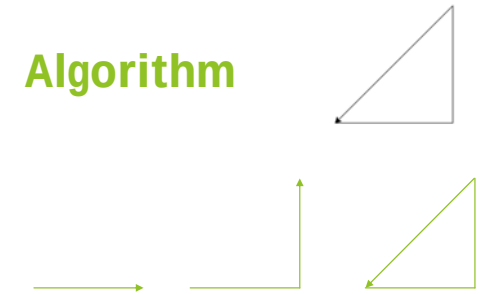
- We are going to draw a right-angled triangle



- Important information:
  - The turtle appears as an icon
  - Initial position: (0, 0)
  - Initial direction: East (0°)
  - Colour: black
  - Line width: 1 pixel
  - Pen: down (ready to draw)



Algorithm



draw a line

Turn 90 degrees left (anti-clockwise)

draw a line

Turn 135 degrees left (anti-clockwise)

draw a line

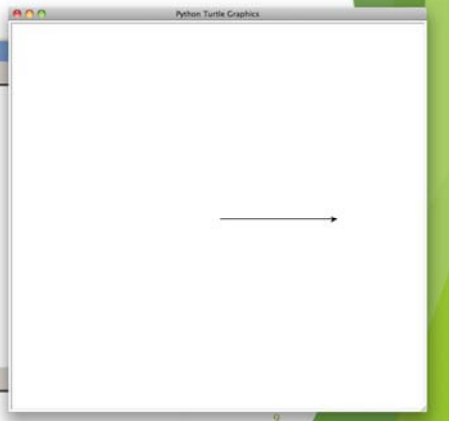
Turtle example

DEMO

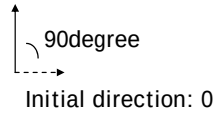
- Step 1: Draw a line

```
Python Shell
File Edit Shell Debug Options Windows Help
>>> import turtle
>>>
>>> turtle.forward(200)
>>>
```

1. Draw a line

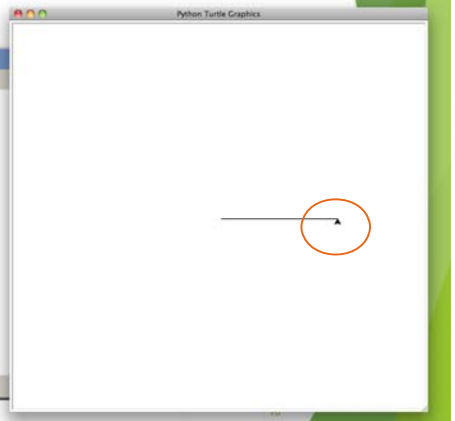


Turtle example



- Note how the turtle is now facing upward after being turned 90 degrees left

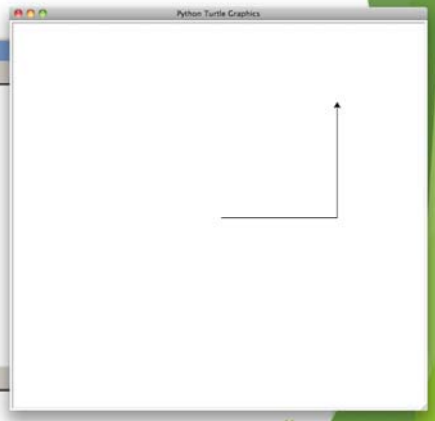
```
Python Shell
File Edit Shell Debug Options Windows Help
>>> import turtle
>>>
>>> turtle.forward(200)
>>> turtle.left(90)
>>>
```



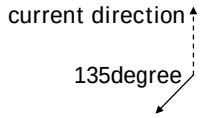
Turtle example

- Step 3: draw a line

```
Python Shell
File Edit Shell Debug Options Windows Help
>>> import turtle
>>>
>>> turtle.forward(200)
>>> turtle.left(90)
>>> turtle.forward(200)
>>>
```

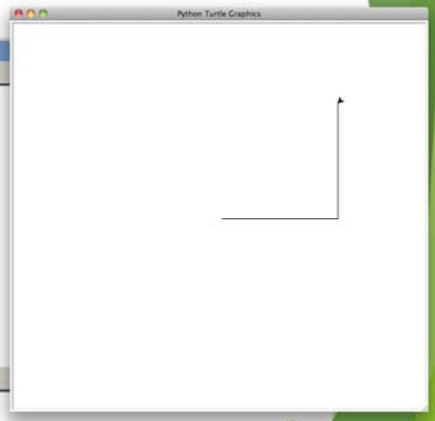


Turtle example



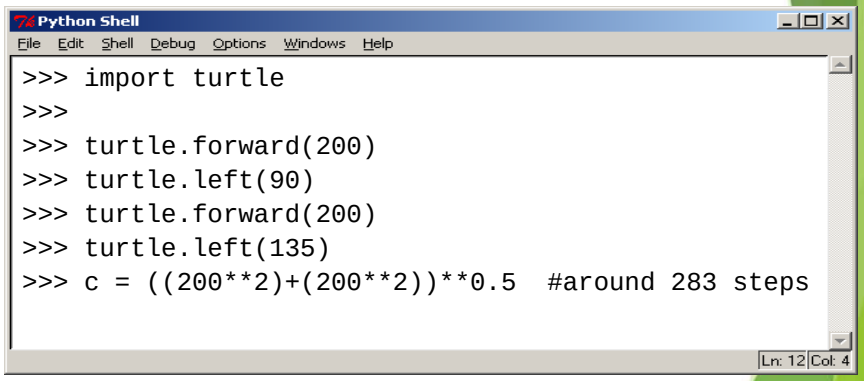
- Step 4: turn 135 degree left (anti-clockwise)

```
Python Shell
File Edit Shell Debug Options Windows Help
>>> import turtle
>>>
>>> turtle.forward(200)
>>> turtle.left(90)
>>> turtle.forward(200)
>>> turtle.left(135)
>>>
```



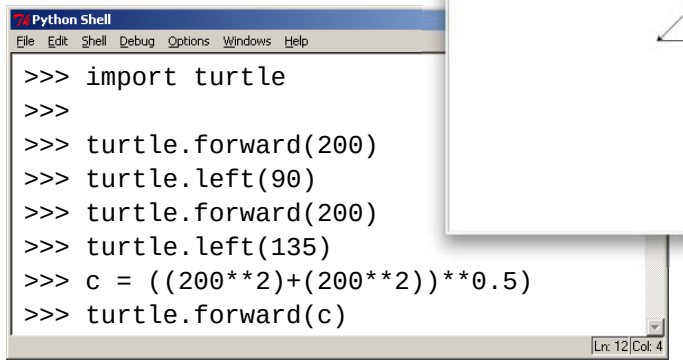
Turtle example

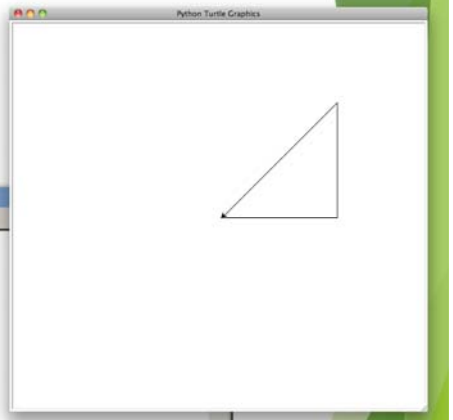
- Working out the length of the longest side using the Pythagoras' formula



Turtle example

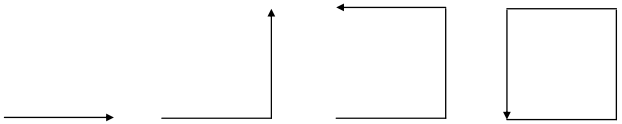
- Step 6: draw a line
- The finished image

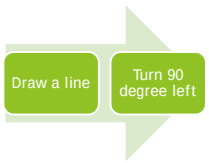




Turtle example

- We can use loops when drawing shapes using Turtle graphics
- Write a program that will draw a square using a loop



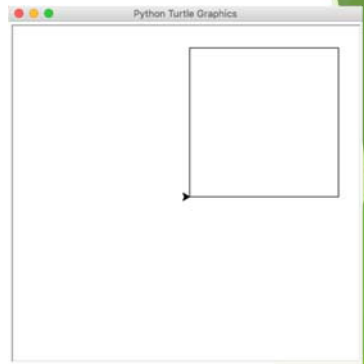


X 4 times

Turtle example

- We can use loops when drawing shapes using Turtle graphics
- Write a program that will draw a square using a loop

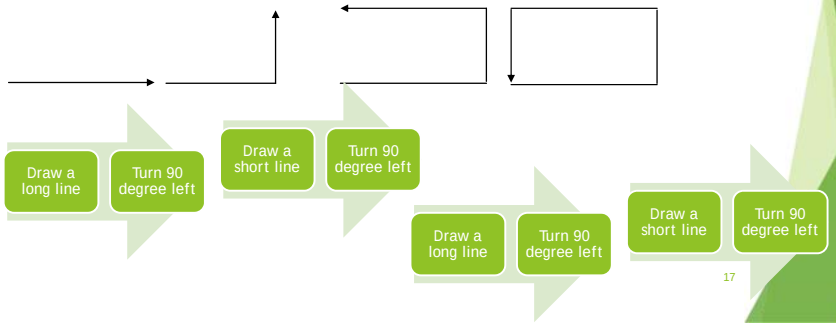
```
import turtle

count = 0
while count < 4:
    turtle.forward(200)
    turtle.left(90)
    count = count + 1
```



Exercise 1

TRY IT OUT!

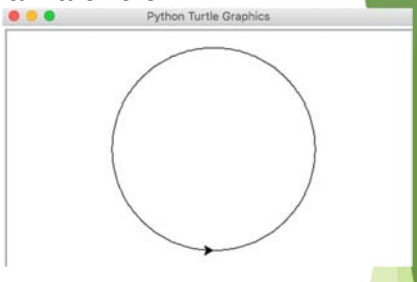
- Write a Python program that draws a rectangle. The long sides must be 300 steps long and the short sides must be 150 steps long



Turtle example

DEMO

- Write a program that will draw a circle



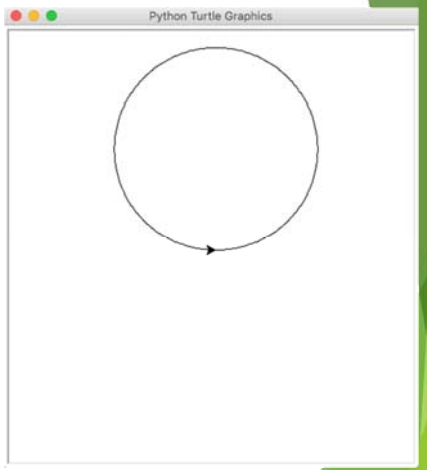
- Steps:
  - Draw a short line (2 pixels)
  - Turn 1 degree
  - Repeat the above steps 360 times

Turtle example

DEMO

- Write a program that will draw a circle

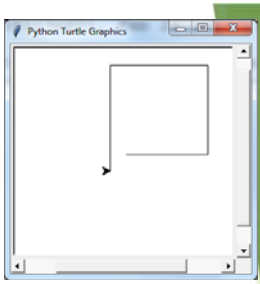
```
import turtle
count = 0
while(count < 360):
   turtle.forward(2)
   turtle.left(1)
   count = count + 1
print("Finished!")
```

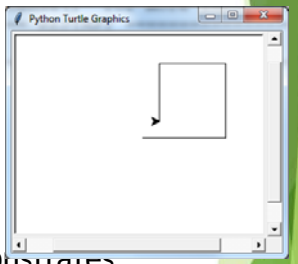


Question

- Consider the following program:

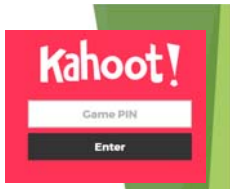
```
import turtle
count = 0
length = 100
while count < 4:
    turtle.forward(length)
    turtle.left(90)
    count = count + 1
    length = length - 10
```



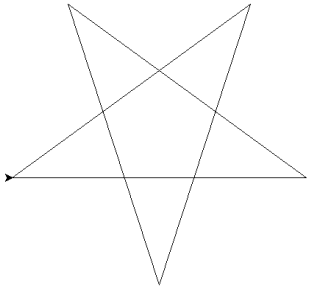


- Which of the following pictures demonstrates the output generated by the program above?

Exercise 2



- How to draw a star?
  - How many steps do you need?
  - What is the size/length for each step? E.g. 400 pixels
  - What is the turning angle for each step?



Exercise 3

TRY IT OUT!

- Draw the shape that is produced by the following Python program:

```
import turtle
count = 0
while(count < 180):
   turtle.forward(2)
   turtle.right(1)
   count = count + 1
turtle.right(45)
turtle.forward(300)
turtle.left(90)
turtle.back(150)
turtle.right(45)
turtle.back(250)
```


Exercise 4

TRY IT OUT!

- Draw the shape that is produced by the following Python program:

```
import turtle
big_line = 100
little_line = 50
angle = 90

turtle.left(angle)
turtle.forward(big_line)
count = 0
while count < 4:
    turtle.right(angle//2)
    if count != 3:
        turtle.forward(little_line)
    else:
        turtle.forward(big_line)
    count = count + 1
turtle.right(90)
turtle.forward(130)
```


Summary

- The Turtle package must be imported into every Python program that uses it
- The Turtle has four basic commands; forward, back, left and right