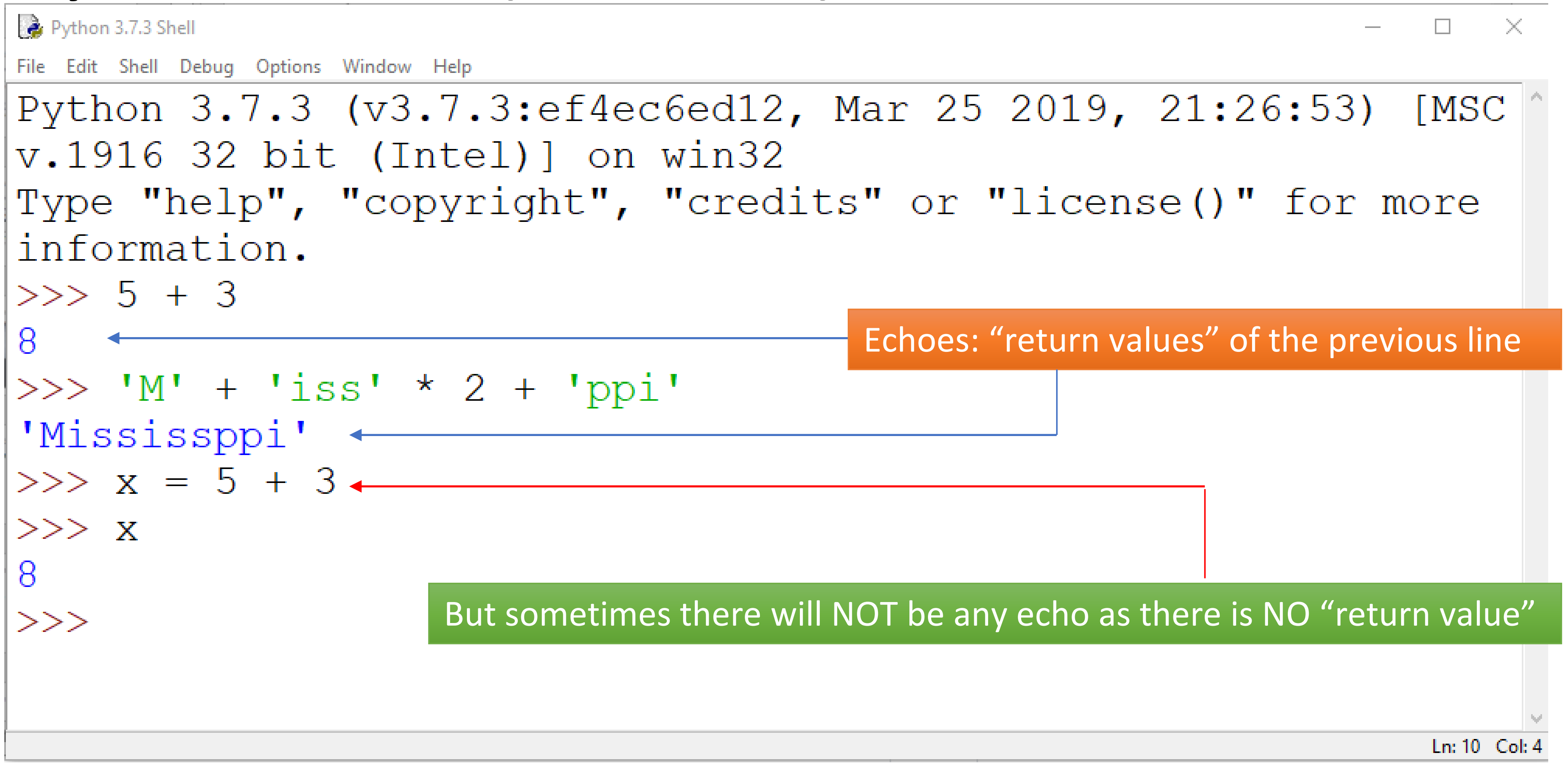
Week 3

Evaluation, Variables and Turtle

Python Shell (Console)


Python 3.7.3 Shell
File Edit Shell Debug Options Window Help
Echoes: “return values” of the previous line
But sometimes there will NOT be any echo as there is NO “return value”
Ln: 10 Col: 4

```
Python 3.7.3 (v3.7.3:ef4ec6ed12, Mar 25 2019, 21:26:53) [MSC
v.1916 32 bit (Intel)] on win32
Type "help", "copyright", "credits" or "license()" for more
information.
>>> 5 + 3
8
>>> 'M' + 'iss' * 2 + 'ppi'
'Missisppi'
>>> x = 5 + 3
>>> x
8
>>>
```

- However, this should NOT be the main area we work in (i.e. 90% of the time)

Arithmetic Evaluation

- What will be the evaluated values for the following:

```
3 * 4 + 5
3 + 4 * 5
5 ** 3 % 4
97 / 4
97 // 4
```

You should try evaluating these WITHOUT typing into Python first

Logical Evaluation

- What will be the evaluated values for the following:

```
1 == 1
3 + 2 == 1 + 4
3 + 2 != 1 + 4
4 > 3
4 > 4
6 + 3 < 9 + 3
True or False
True and (False or True)
```

String Evaluation

- What will be the evaluated values for the following:

```
'abc' + 'def'
'gala' * 3
'mu' + 'ha' * 4
('ba '*2+'bidu'*2+'bi ' + 'jam '*2)*3

'banana'[3]
'banana'[2:4]
'banana'[1::2]
```

String Slicing

	a	b	c	d	e	f
Index	0	1	2	3	4	5

- Let s = ‘abcdef’
- What is the result of `s[]` and `s[:2]` and `s[:2:]`?
  - Are they the same?

- Only `s[:2]` and `s[:2:]` are the same.
- `s[]` is a syntax error

Start – By default, start from index 0.
Stop – By default, include the last letter.
Step – By default, “jump” by 1 step.

String Slicing

	a	b	c	d	e	f
Index	0	1	2	3	4	5

- Let s = ‘abcdef’
- What about `s[5:0:-1]`?

`‘fedcb’`

- What happens if we do `s[:2:-1]`?

`‘fed’`

- Lecture example: `s[::-1]`

`‘fedcba’`

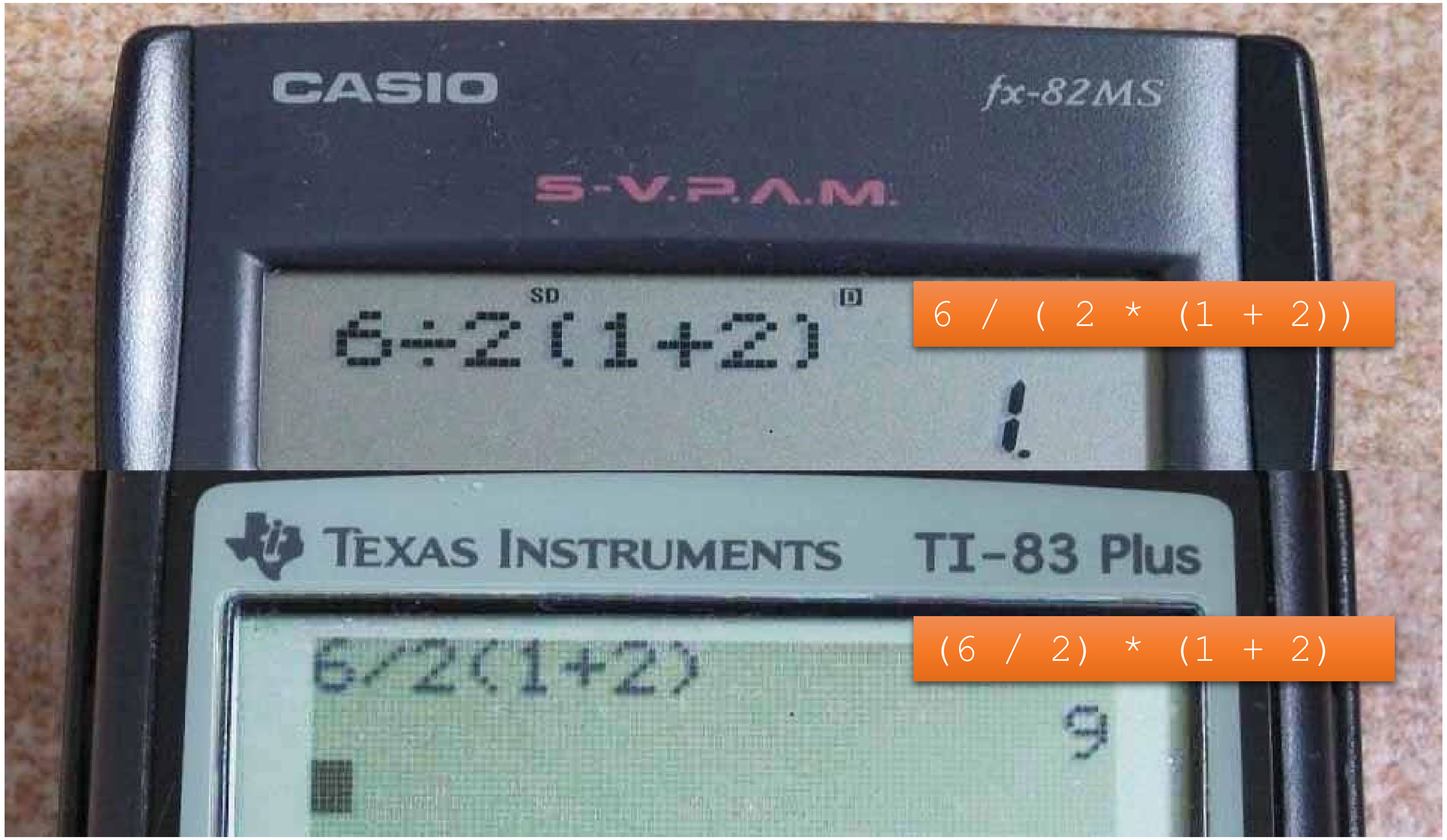
Start – By default, start from index 0.
Stop – By default, include the last letter.
Step – By default, “jump” by 1 step.

Default

- If step > 0
  - Start – By default, start from index 0.
  - Stop – By default, include the last letter.
  - Step – By default, “jump” by 1 step.
- Else (step < 0)
  - Default start = last letter
  - Default end = -n-1

- Let n = length of your string
- If step > 0
  - Start = 0
  - Stop = n
- Else if step < 0
  - Start = n-1
  - Stop = -n-1

Operator Precedence



Python Operator Precedence

- 6/2*(1+2)
- 6/2*(1+2)
- 6/2*3
- 3*3
- 9

Operators	Associativity
() Highest precedence	Left - Right
**	Right - Left
+x , -x, ~x	Left - Right
*, /, //, %	Left - Right
+, -	Left - Right
<<, >>	Left - Right
&	Left - Right
^	Left - Right
|	Left - Right
Is, is not, in, not in, <, <=, >, >=, ==, !=	Left - Right
Not x	Left - Right
And	Left - Right
Or	Left - Right
If else	Left - Right
Lambda	Left - Right
=, +=, -=, *=, /= Lowest Precedence	Right - Left

How Do I Remember It All ... ? BODMAS !

B	**B**rackets first
O	**O**rders (i.e. Powers and Square Roots, etc.)
DM	**D**ivision and **M**ultiplication (left-to-right)
AS	**A**ddition and **S**ubtraction (left-to-right)

Divide and Multiply rank equally (and go left to right).

Add and Subtract rank equally (and go left to right)

Arithmetic Evaluation

- What will be the evaluated values for the following (or what is the orders of the operators?)

```
1 + 2 * 3
1 + 2 * 3 **4
1 + 2 * 3 **4 – 5
not 0 + 1
```

What is the difference?

- What do we have when we ask if 1 is it the same as ‘1’?

```
1 == ‘1’
```

- Or what is the difference between the following two lines?

```
123+456
‘123’+‘456’
```

Type Conversions

```
>>> type(123)
<class 'int'>
>>> 123 + 456
579
>>> type('123')
<class 'str'>
>>> '123' + '456'
'123456'
>>> '123' + 456
Traceback (most recent call last):
  File "<pyshell#12>", line 1, in <module>
    '123' + 456
TypeError: can only concatenate str (not "int") to str
```

Note that the “+” operator performs differently for different types

Variables

- Now you should know the following:

```
3 * 4 + 5
3 + 4 * 5
```

- How about

```
x = 3
y = 4
z = 5
x * y + z
```

“Creation” of Variables

- What will be the evaluated values for the following:

```
a * b + c
```

- Error! Why?
- Because a, b and c are undeclared
  - In another words, “not created”, “not born yet”
  - Whenever you type a line

    a = …. (something)
  - A variable (a) is born

From scratch

```
m + 3
```

- Error!

```
m = 1
m + 3
```

Creation of the variable m

- Output:

```
4
```

Turtle Graphics

```
>>> from turtle import *
>>> forward(100)
>>>
```

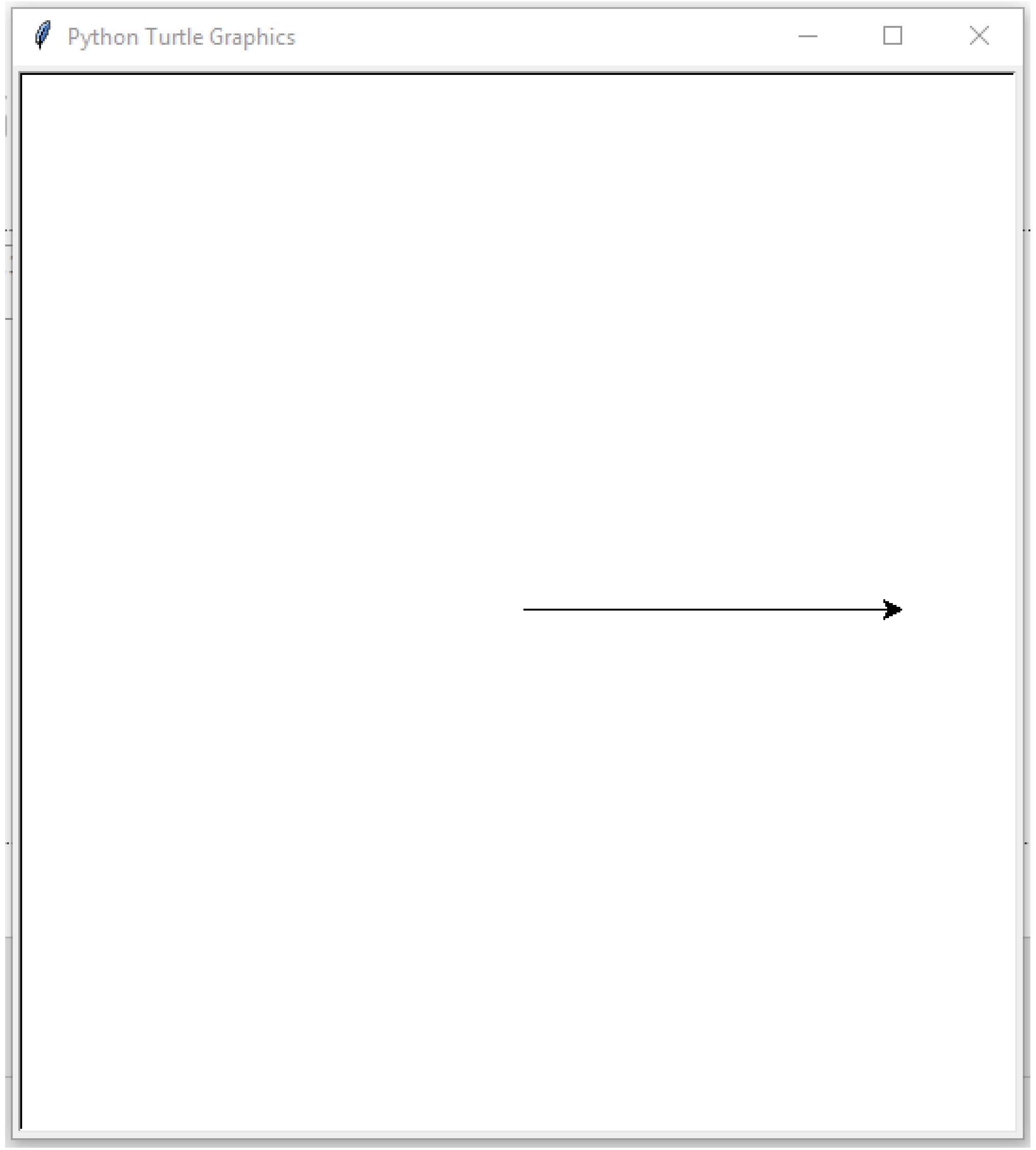
- Or you can use the short from

```
>>> from turtle import *
>>> fd(100)
```

- Or this,

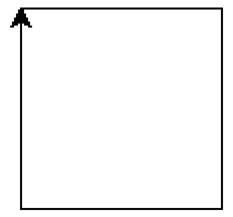
```
>>> import turtle
>>> turtle.fd(100)
```

- But for our course, please do NOT use the last form



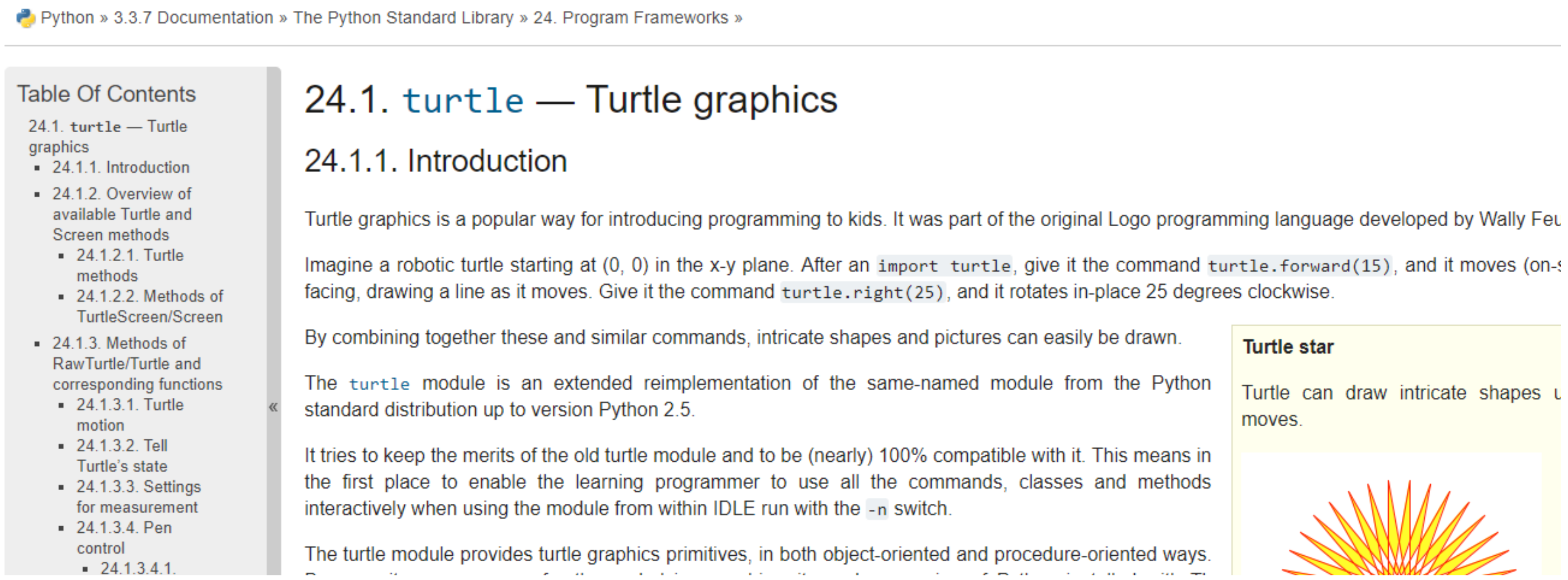
Turtle Graphics

```
>>> from turtle import *
>>> fd(100)
>>> rt(90)
>>> fd(100)
>>> rt(90)
>>> fd(100)
>>> rt(90)
>>> fd(100)
>>>
```



More Turtle Commands

- You can go to the website: https://docs.python.org/3.3/library/turtle.html?highlight=turtle
- Or just google “Python Turtle”



Python » 3.3.7 Documentation » The Python Standard Library » 24. Program Frameworks »

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24.1. `turtle` — Turtle graphics

24.1.1. Introduction

Turtle graphics is a popular way for introducing programming to kids. It was part of the original Logo programming language developed by Wally Feu

Imagine a robotic turtle starting at (0, 0) in the x-y plane. After an `import turtle`, give it the command `turtle.forward(15)`, and it moves (on-s facing, drawing a line as it moves. Give it the command `turtle.right(25)`, and it rotates in-place 25 degrees clockwise.

By combining together these and similar commands, intricate shapes and pictures can easily be drawn.

The `turtle` module is an extended reimplementation of the same-named module from the Python standard distribution up to version Python 2.5.

It tries to keep the merits of the old turtle module and to be (nearly) 100% compatible with it. This means in the first place to enable the learning programmer to use all the commands, classes and methods interactively when using the module from within IDLE run with the `-n` switch.

The turtle module provides turtle graphics primitives, in both object-oriented and procedure-oriented ways.

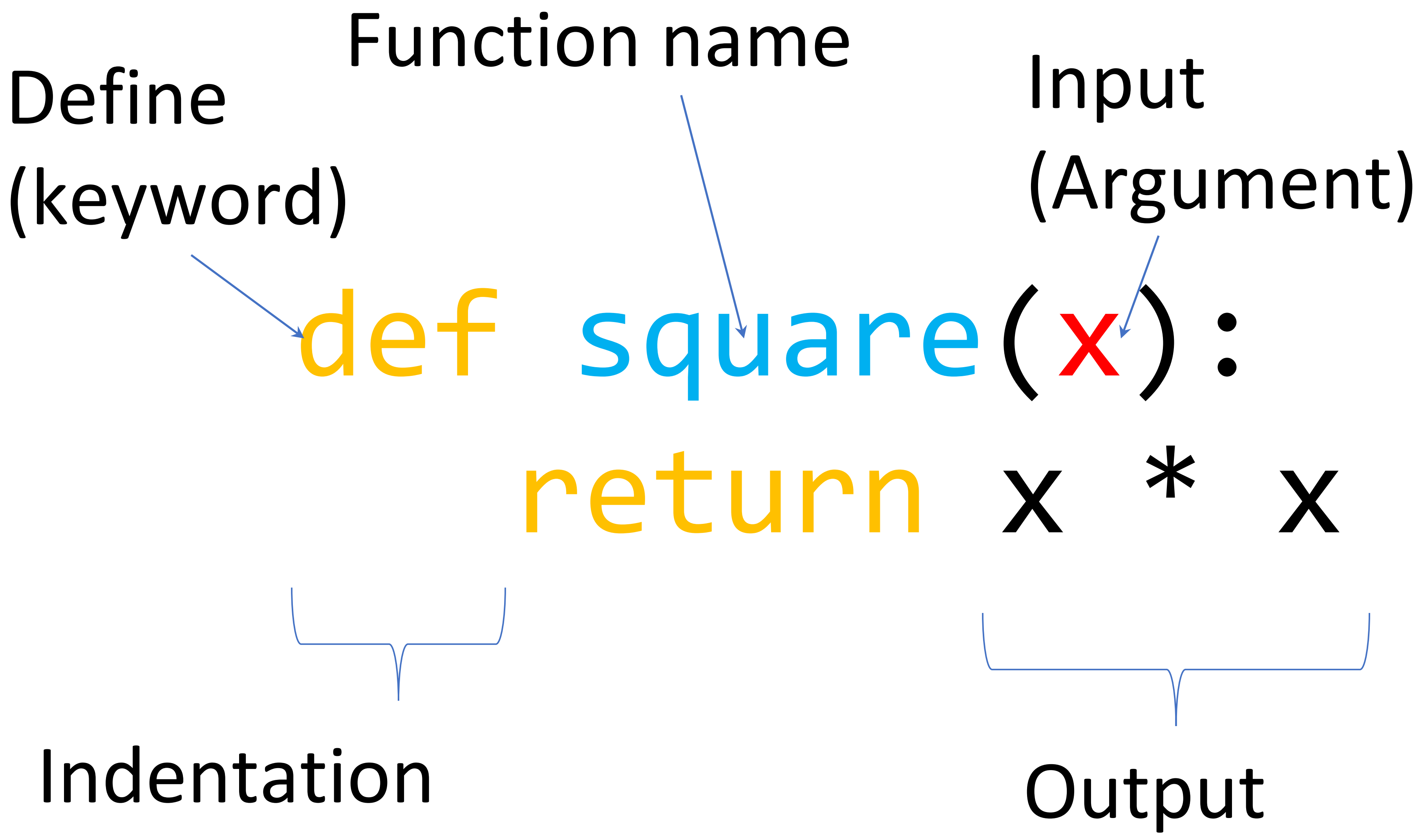
Turtle star

Turtle can draw intricate shapes u moves.

- Actually, this is what most programmers do

Functions

Let’s Write Our Own Function!



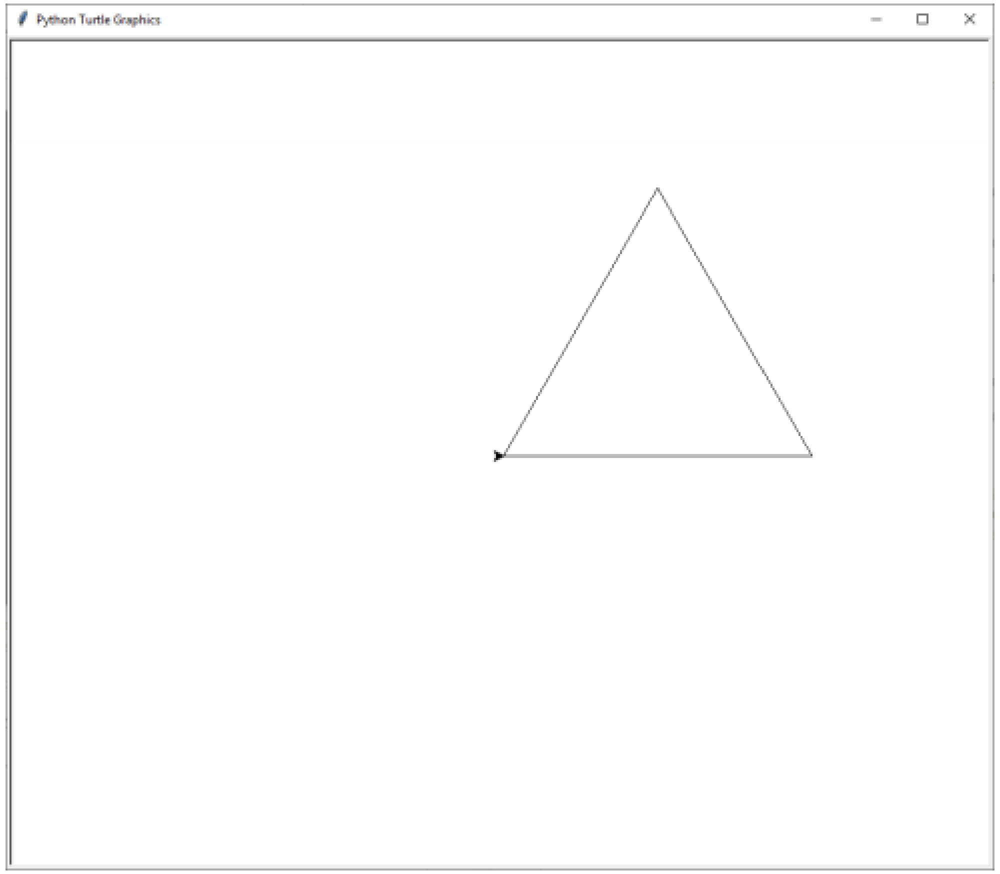
```
def square(x):
    return x * x
```

Put Statements into a Function

- For the Assignment last week
- Your answer will be something like (yours maybe a bit different)

```
fd(300)
lt(120)
fd(300)
lt(120)
fd(300)
lt(120)
```

- But if I want to draw it again?
  - It’s too troublesome to type the above lines again and again



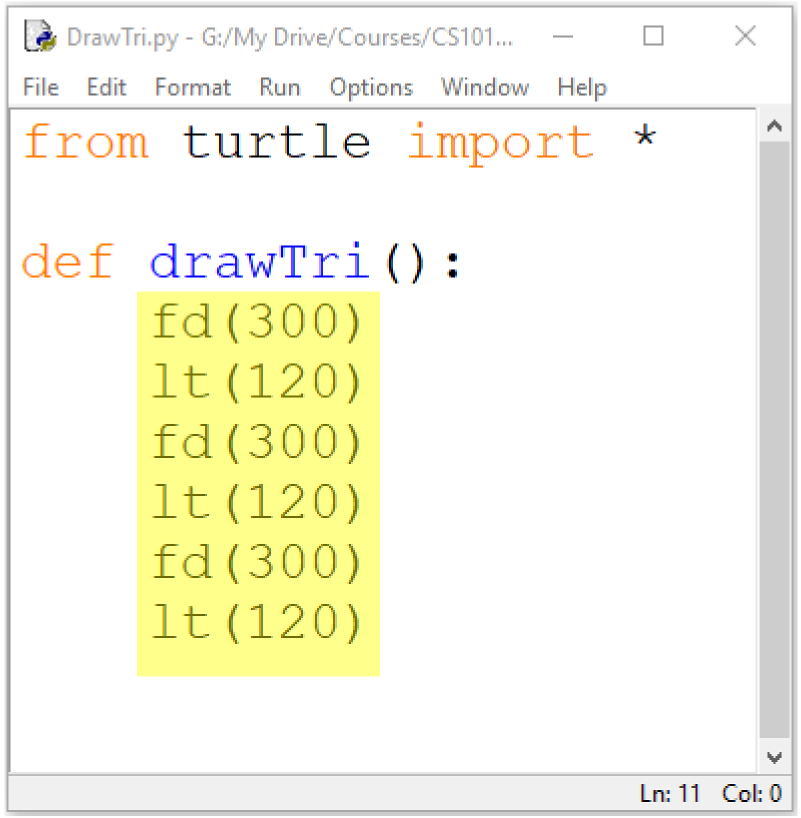
Put Statements into a Function

- Last week Assignment
- Your answer will be something like (yours maybe a bit different)

```
fd(300)
lt(120)
fd(300)
lt(120)
fd(300)
lt(120)
```

- But if I want to draw it again?
  - It's too troublesome to type the above lines again

- We save it into a file by
  - In IDLE, File > New


DrawTri.py - G:/My Drive/Courses/CS101...
File Edit Format Run Options Window Help
Ln: 11 Col: 0

```
from turtle import *

def drawTri():
    fd(300)
    lt(120)
    fd(300)
    lt(120)
    fd(300)
    lt(120)
```

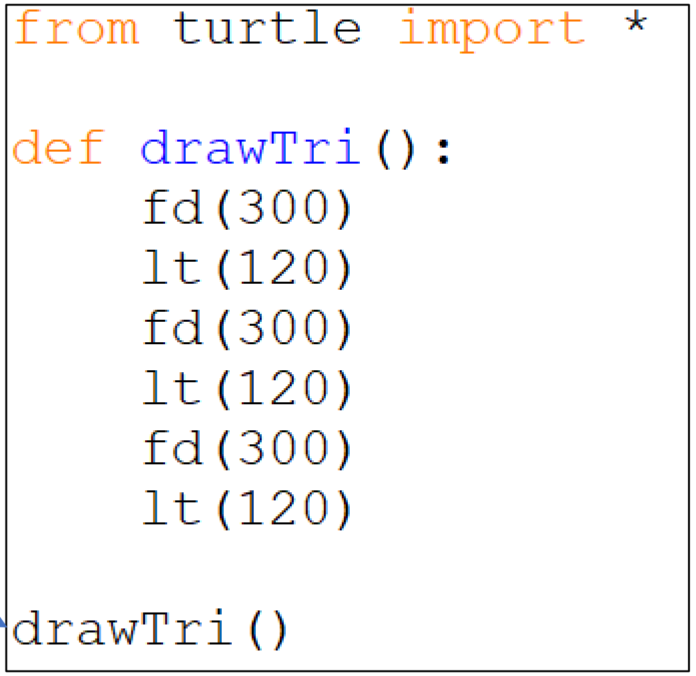
Put Statements into a Function

- After you saved the file and run it
- You can call the function drawTri() by

```
>>> drawTri()
```

- Or
  - Directly put it into the file

- We save it into a file by
  - In IDLE, File > New



```
from turtle import *

def drawTri():
    fd(300)
    lt(120)
    fd(300)
    lt(120)
    fd(300)
    lt(120)

drawTri()
```

Function Parameters

- What if we want to draw a triangle that is larger or smaller
  - Namely, the side length is different from 300?
  - Do we write…

```
def drawTri():
    fd(200)
    lt(120)
    fd(200)
    lt(120)
    fd(200)
    lt(120)
```

```
def drawTri():
    fd(100)
    lt(120)
    fd(100)
    lt(120)
    fd(100)
    lt(120)
```

  - Etc…?

```
from turtle import *

def drawTri():
    fd(300)
    lt(120)
    fd(300)
    lt(120)
    fd(300)
    lt(120)

drawTri()
```

Capture the COMMON Pattern

This is an important skill in computational thinking

- What if we want to draw a triangle that is larger or smaller
  - Namely, the side length is different from 300?
  - Do we write…

```
def drawTri():
    fd(200)
    lt(120)
    fd(200)
    lt(120)
    fd(200)
    lt(120)
```

```
def drawTri():
    fd(100)
    lt(120)
    fd(100)
    lt(120)
    fd(100)
    lt(120)
```

  - Etc…?

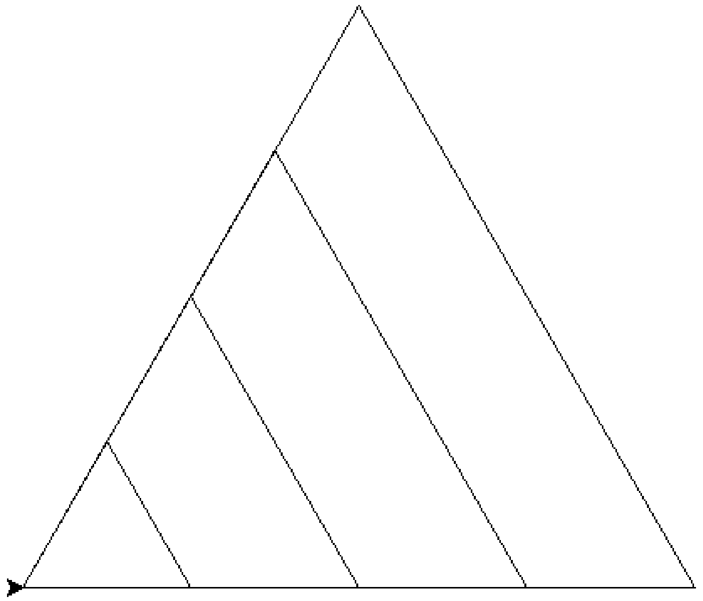
- No, we **capture the common pattern** and make it an input of the function

```
from turtle import *

def drawTri(length):
    fd(length)
    lt(120)
    fd(length)
    lt(120)
    fd(length)
    lt(120)

drawTri(100)
drawTri(200)
drawTri(300)
```

Capture the COMMON Pattern

This is an important skill in computational thinking

```
>>> drawTri(100)
>>> drawTri(200)
>>> drawTri(300)
>>> drawTri(400)
>>>
```

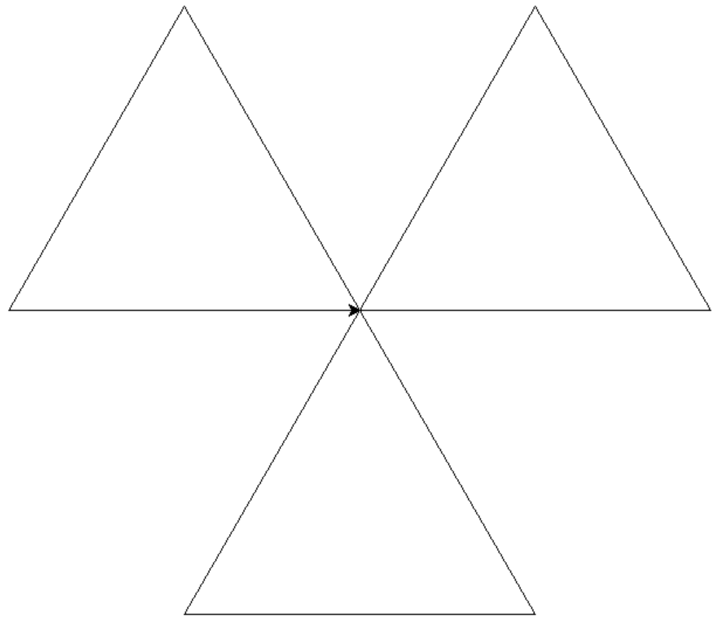


- No, we **capture the common pattern** and make it an input of the function

```
from turtle import *

def drawTri(length):
    fd(length)
    lt(120)
    fd(length)
    lt(120)
    fd(length)
    lt(120)

drawTri(100)
drawTri(200)
drawTri(300)
```

Moreover

- What does this code do?
  - Output:



```
from turtle import *

def drawTri(length):
    fd(length)
    lt(120)
    fd(length)
    lt(120)
    fd(length)
    lt(120)

def foo():
    drawTri(100)
    lt(120)
    drawTri(100)
    lt(120)
    drawTri(100)
    lt(120)

foo()
```