Coding with Python and Mathematics

RATE OF CHANGE IN PYTHON

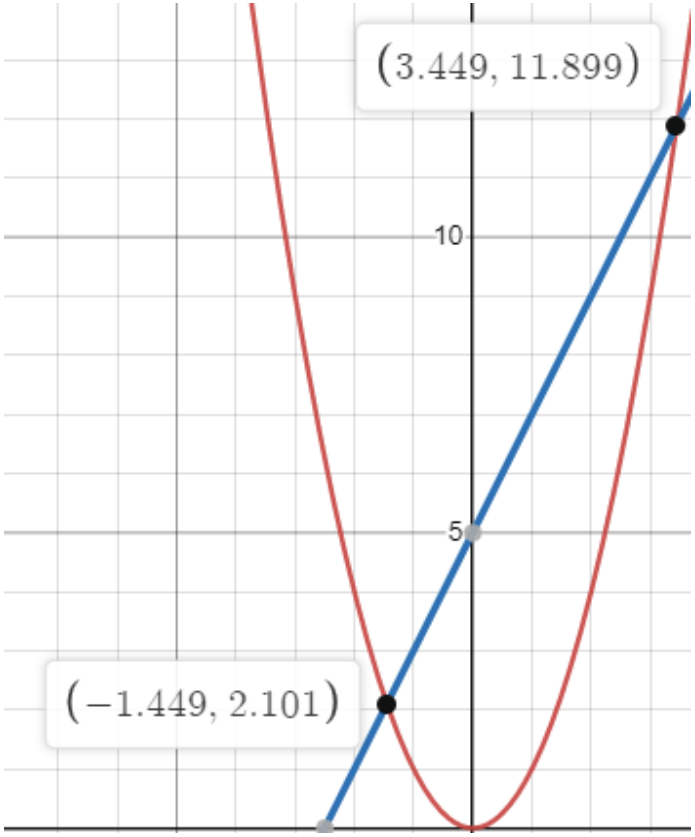
Recall…

- Rate of change can be defined as a measure of the change in one quantity with respect to a change in another quantity.
- In the field of STEM these quantities are represented as the dependent (y) and independent (x) variables.
- Think, Pair, Share. “What are some examples of rate of change in your daily life?”

Average rate of change

- An average rate of change is a change that takes place over an interval in any given function and corresponds to the slope of a secant line between that interval. (A line that passes through two points on the graph of a relation).

Secant line



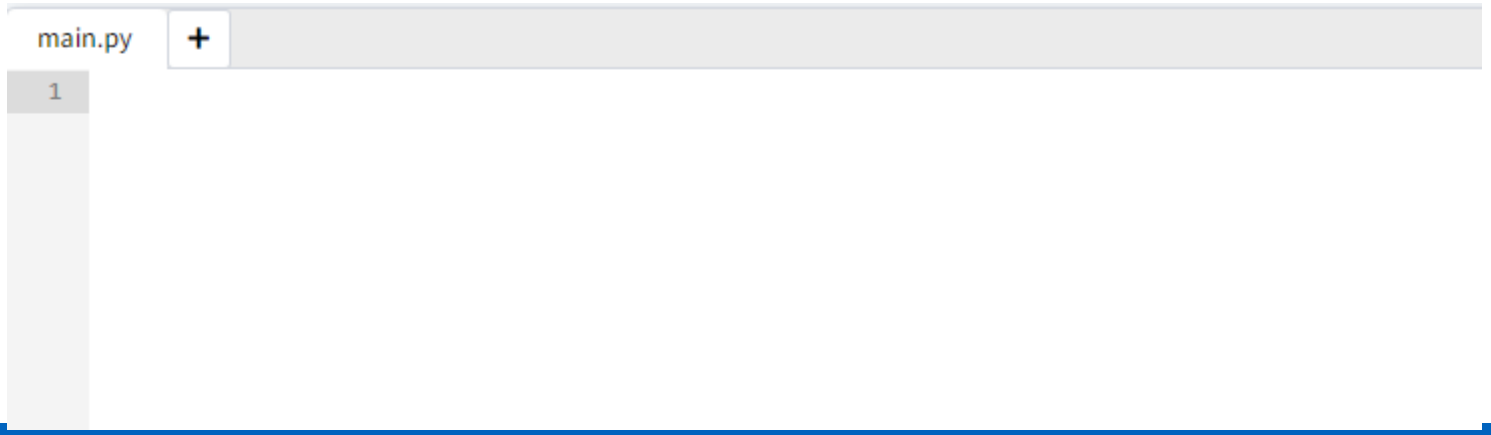
Intro to Python

- Python code is written in a console that looks like this

Coding 101

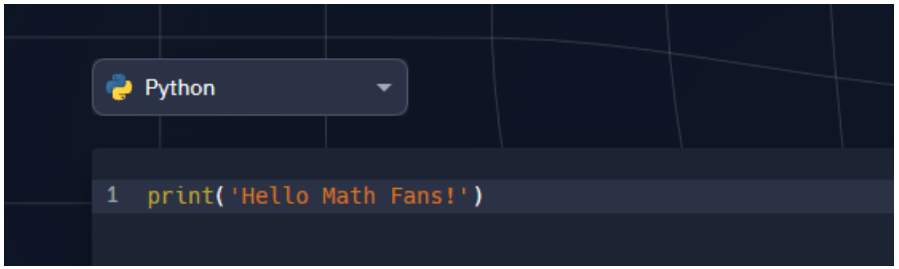
- Head to an online Python compiler

- Erase everything found in the console, so it is blank



print

- The print function is used to display messages.
- In your console type;



- Then press; 

- The result

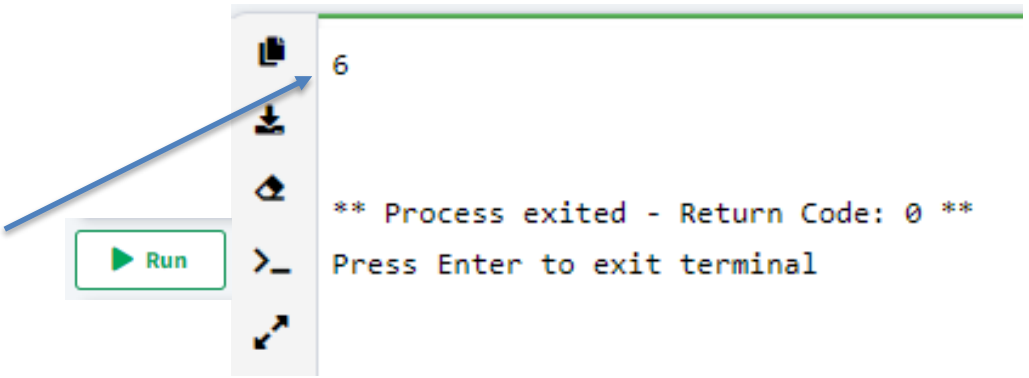
variables

- We can define variable values within python;

```
1  x = 3
```

- If we then tell the program to print

```
1  x = 3
2
3  print(x + 3)
```



input

- Assigning a value is fine, but sometimes we want to give the user the ability to set the value via the terminal.

- Try a command to print x

Input error!?

```
1  x = input("What would you like the value of x to be?")
2
3  print(x + 4)
```

Run

```
What would you like the value of x to be?3
Traceback (most recent call last):
  File "main.py", line 3, in <module>
    print(x + 4)
TypeError: can only concatenate str (not "int") to str
```

Int, float, string

- Integers are whole numbers that are + or –
- Floats are numbers that contain decimal places (can be + or –)
- Strings are arrangements of one or more characters

In your pods

- Classify each of the following as;
  - Int
  - String
  - Float

10	10.5	Ontario	Apple	
11	32.5	-4	-4.5	3

Debug

- We can fix our “bug” by adding “int” before “input”

```
1  x = input("What would you like the value of x to be?")
2
3  print(x + 4)
```

```
1  x = int(input("What would you like the value of x to be?"))
2
3  print(x + 4)
```

- Our code works now!

```
What would you like the value of x to be?3
7
```

Math Operators

```
1  x = float(input("What would you like the value of x to
   be?"))
2
3  print("the sum of x and 4 is", x + 4)
4
5  print("the difference of x and 4 is ", x - 4)
6
7  print("the product of x and 4 is", x * 4)
8
9  print("the quotient of x over 4 is", x / 4)
10
11 print("x to the exponent of 4 is ", x**4)
12
13
```

```
What would you like the value of x to be?3
the sum of x and 4 is 7.0
the difference of x and 4 is  -1.0
the product of x and 4 is 12.0
the quotient of x over 4 is 0.75
x to the exponent of 4 is  81.0
```

Square root operator????

With your elbow partner discuss how you could find some n^{th} root given these commands.

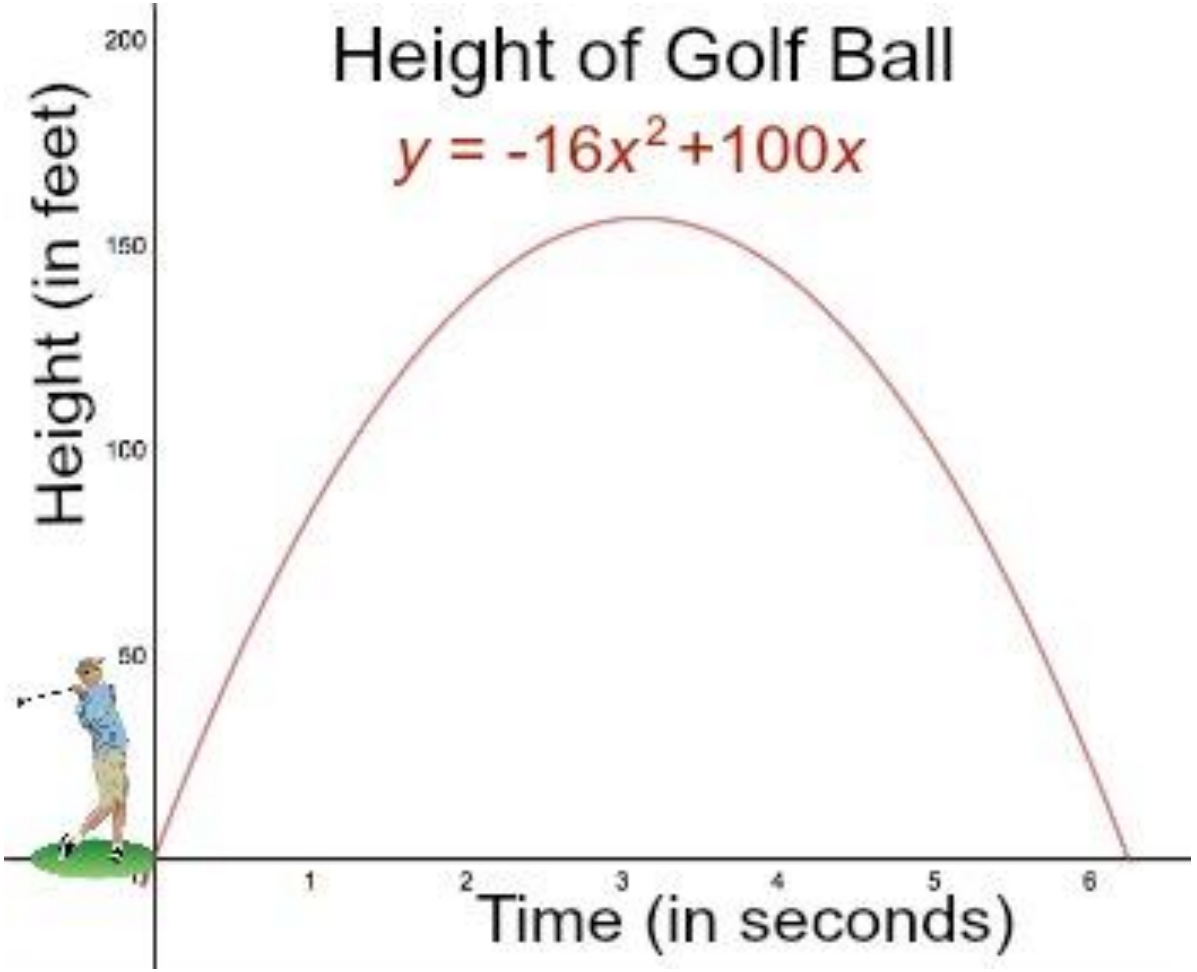
The challenge

- For this lesson, the focus will be on non-linear relationships. Non-linear relationships have different rates of change over different intervals.

- You may select a situation or search for a data set / graph which is modeled by a quadratic equation. If you are unsure of how to get started, pleas

- Your task is to create a computer program using the Python language that can evaluate the relationship at any two given points and calculates the average rate of change

Exemple


Height of Golf Ball
$y = -16x^2 + 100x$
Height (in feet)
200
150
100
50
0
1
2
3
4
5
6
Time (in seconds)

Program

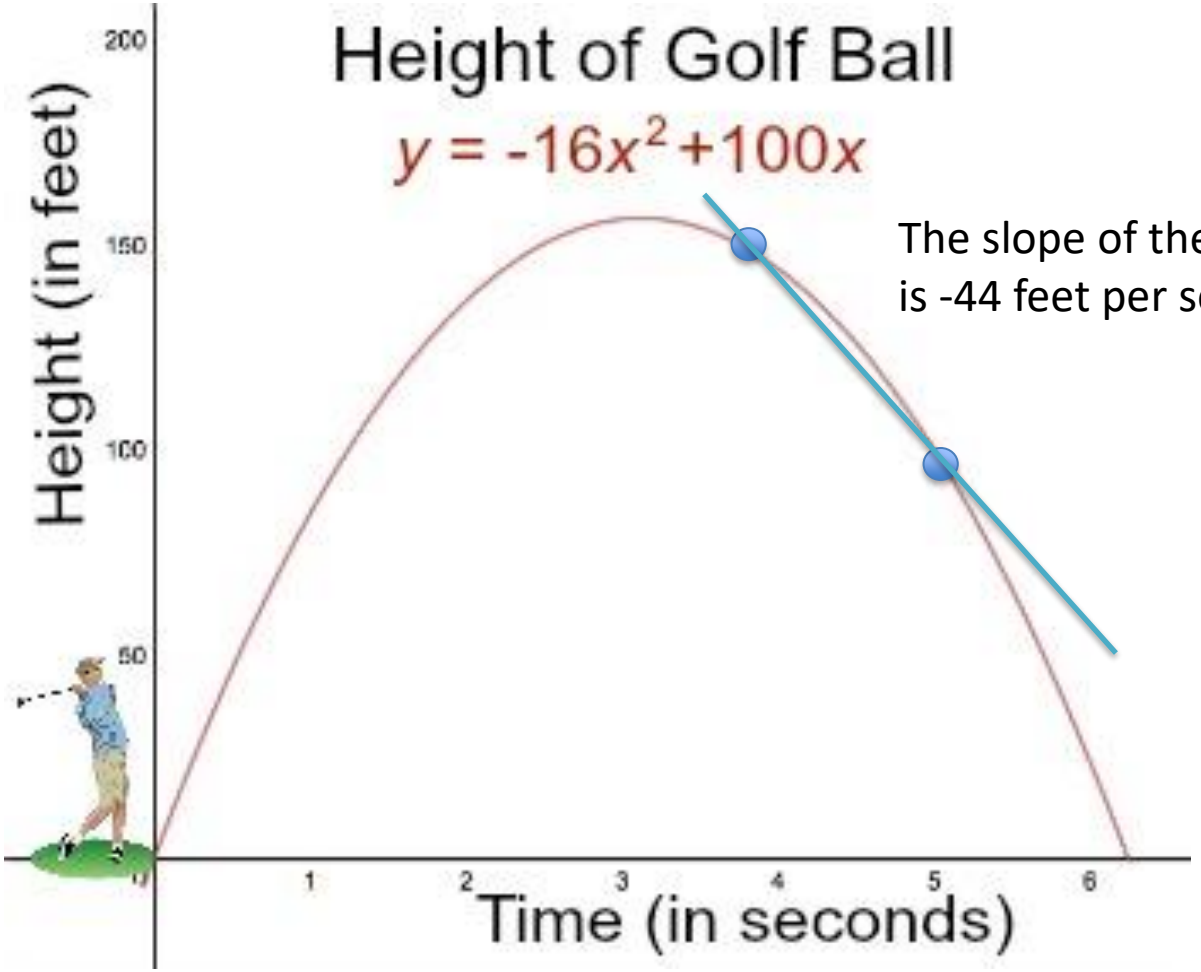
main.py +

```
1  print("Welcome to our rate of change calculator")
2  print("We will start by outlining the a ,b ,and c values of our quadratic in standard form")
3  print("Remember that standard form is ax^2 + bx + c")
4  a = float(input("What is the a value of your quadratic?"))
5  b = float(input("What is the b value of your quadratic?"))
6  c = float(input("What is the c value of your quadratic?"))
7
8  print("We will now evaluate the function at two points.")
9
10 p1 = float(input("What is the x value of your first point?"))
11 p2 = float(input("What is the x value of your second point?"))
12
13 # Calculations for rate of change
14
15 y2 = (a*p2**2 + b*p2 + c)
16 y1 = (a*p1**2 + b*p1 + c)
17
18 denominator = (p2 - p1)
19 numerator = (y2 - y1)
20
21 print("The rate of change is", numerator/denominator, "feet per second")
```

Terminal output

```
Welcome to our rate of change calculator
We will start by outlining the a ,b ,and c values of our quadratic in standard form
Remember that standard form is ax^2 + bx + c
What is the a value of your quadratic?
-16
What is the b value of your quadratic?
100
What is the c value of your quadratic?
0
We will now evaluate the function at two points.
What is the x value of your first point?
4
What is the x value of your second point?
5
The rate of change is -44.0 feet per second
```

Exemplar Solution



The slope of the secant line is -44 feet per second