

Coding with Python and Mathematics

# RATE OF CHANGE IN PYTHON

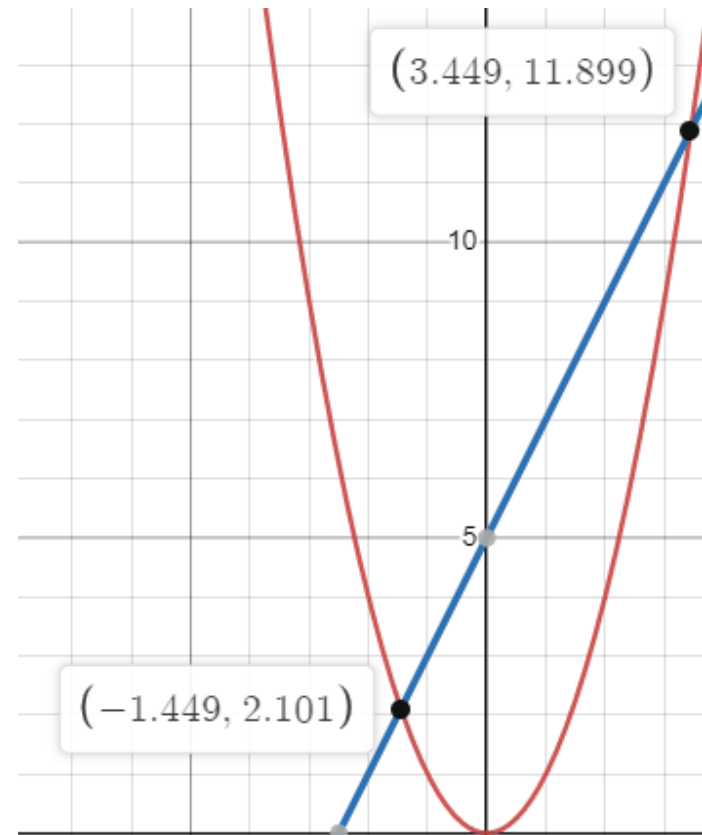
# Recall...

- 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

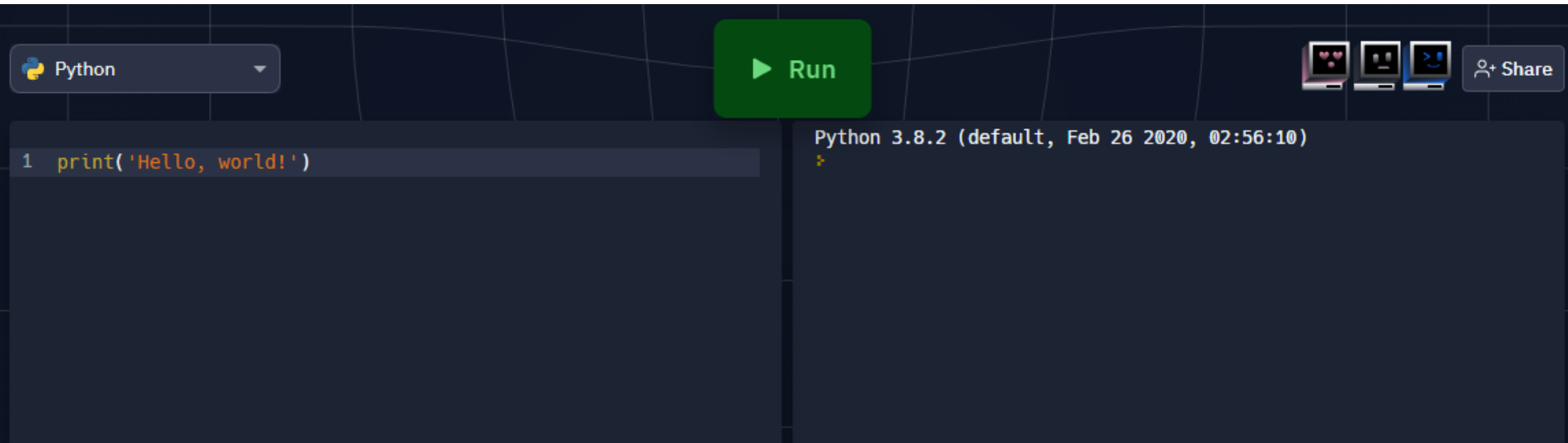
## Secant line

- 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).



# Intro to Python

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



The image shows a screenshot of a Python code editor interface. At the top left, there is a dropdown menu labeled "Python" with a Python logo icon. In the center, there is a green "Run" button with a play icon. On the right side, there are three small icons representing different environments or themes, and a "Share" button with a plus icon. The main area is split into two panels. The left panel contains a code cell with the following code: 

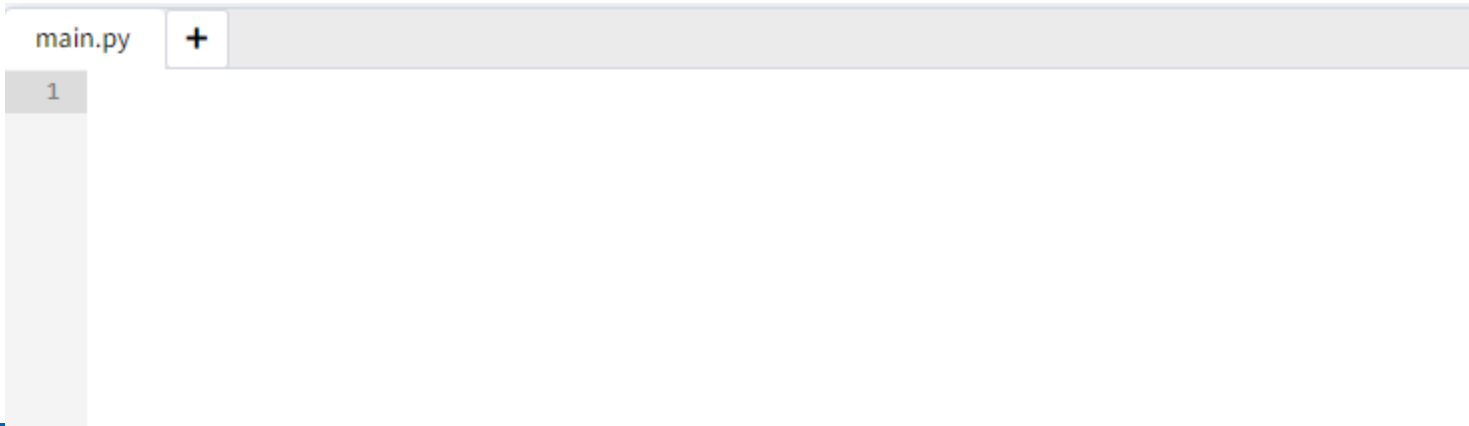
```
1 print('Hello, world!')
```

 The right panel shows the output of the code, which is the text: 

```
Python 3.8.2 (default, Feb 26 2020, 02:56:10)  
>
```

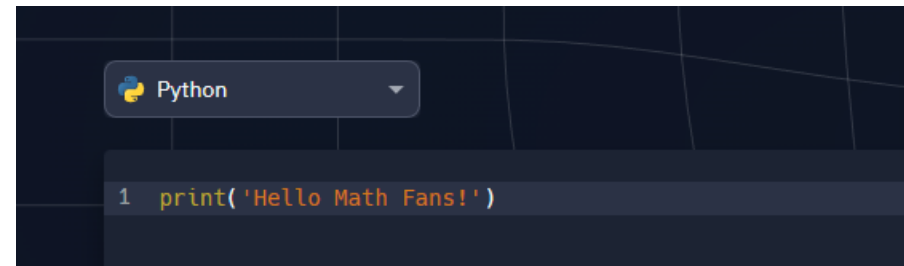
# Coding 101

- Head to an online Python compiler
- Erase everything found in the console, so it is blank

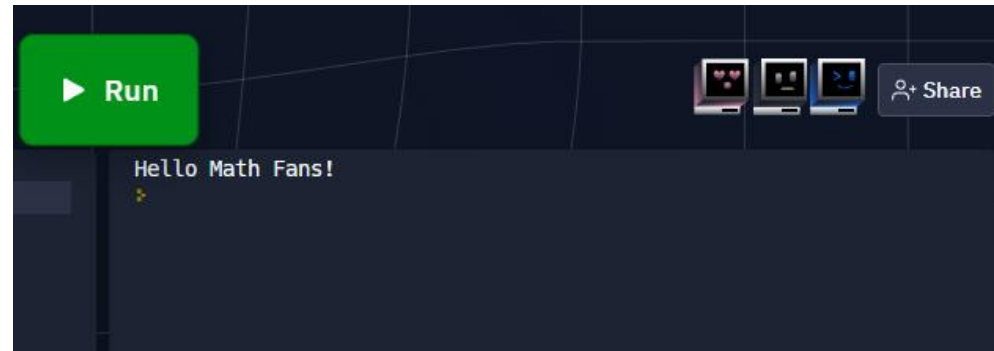


# print

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



A screenshot of a Python IDE interface. At the top, there is a dropdown menu with the Python logo and the word "Python". Below it, a code editor shows a single line of code: `1 print('Hello Math Fans!')`



A screenshot of a Python IDE interface showing the execution of the code. A large green "Run" button is visible at the top left. To the right of the "Run" button are three small icons representing different output types (text, image, audio) and a "Share" button. Below the code editor, the output "Hello Math Fans!" is displayed in a dark console window.

# 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)
```

▶ Run


6

\*\* Process exited - Return Code: 0 \*\*

Press Enter to exit terminal

# input

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




A screenshot of a Python IDE interface. The top left shows a dropdown menu with the Python logo and the word "Python". To its right is a "Stop" button. On the far right, there are three small icons representing different terminal environments and a "Share" button. The main area is split into two panes. The left pane contains a code editor with the following text: 

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

 The right pane shows the terminal output: 

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

- Try a command to print x



A screenshot of a Python IDE interface, similar to the one above. The top left shows the "Python" dropdown menu. A prominent green "Run" button is visible in the top center. On the far right, there are three small icons and a "Share" button. The left pane contains a code editor with the following text: 

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

 The right pane shows the terminal output: 

```
What would you like the value of x to be?3  
x is equal to 3  
:
```



# 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  
 $n^{\text{th}}$  root given these  
commands.

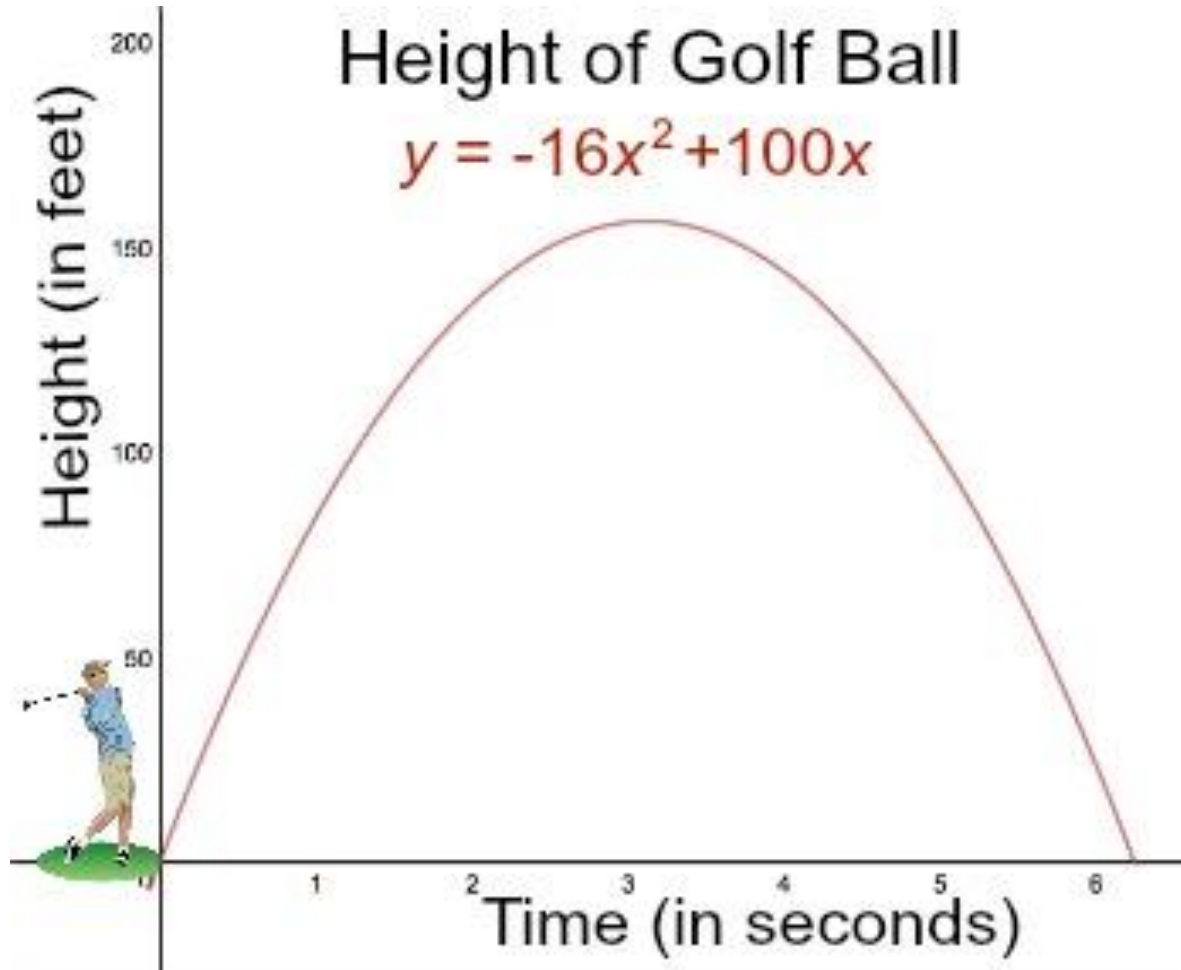
# The challenge

- 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, please
- 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

# Example

Height of Golf Ball

$$y = -16x^2 + 100x$$



# 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

