



Assignment#4 More Cool Math in Python

Again, solving problems and creating cool stuff with python sometimes includes some math. Let's take a bit of time to look at more of the handy math functions you will use need to be familiar later on.

Modulus operator % (REMAINDER)

In computer programming the **modulus** operation "%" finds the **remainder** of a division operation. It's very common and super important for solving a variety of problems.

Examples:

$$5 \% 2 = 1 \quad (5 \div 2 = 2 \text{ with a remainder of } 1)$$

$$7 \% 5 = 2 \quad (7 \div 5 = 1 \text{ with a remainder of } 2)$$

$$9 \% 3 = 0$$

$$15 \% 3 = 0$$

$$17 \% 3 = 2$$



Again, the Modulus operator **outputs the remainder** of a division problem. The Modulus operator comes in very handy in computer programming. The Modulus operator can help us:

- Distinguish between odd and even numbers.
- Determine if numbers can be divided evenly into other numbers,
- Find the remainder of division problems.
- Do a ton of other cool things!

Exercise #1

The following Python program that will tell the user the remainder of any division problem they wish.

Type in the following into trinket. See what it does and **save** your work.

```
num1 = int(input('Yo Bro! Enter a number that you want to divide:'))
num2 = int(input('Awesome. What would you like to divide your number by?'))
remainder = num1%num2
remainder = str(remainder) # this turns the integer into a string
print ('Sweet Bro! Your remainder of this division will be:' + remainder)
```

Exercise #2

Using the **Modulus Operator** write a Python program that can find out whether a given number is **even** or **odd**, then print out an appropriate message to the user.



Hints:

- **If you do modulus division of any number by 2** and your answer is zero, then the number is even! (example: $8 \% 2 = 0$; Therefore 8 is an even number!)
- You will have to use an **if statement** for this exercise.
- You will have to compare the answer to zero (for example: `if answer==0:`)
Notice the double == sign this means: "compare to see if it is equal to"

Sample Input:

Yo Bro...Give me a number and I will tell you if it is even or odd! **45**

Sample output:

45 is an ODD number my friend.

Possible solution below...**don't peek yet see if you can figure it out first.**

Possible solution (no peeking try on your own first please):

```
num = int(input("Give me a number! I will tell you if it is even or odd!: "))
mod = num % 2
if mod == 0:
    print("This is an even number Bro.")
else:
    print("This is an odd number Bro.")
```

Floor division

// - double slash is a special kind of division in computer programming that will give you **only the whole number portion** of the answer to a division problem. Example: $9/2=4.5$, $9//2=4$.
Predict what the following code will do, type into trinket and include at the end of exercise#2.

```
print(7//2)
print(13//2)
print(8//3)
print(1//4)
print(1//2)
```

Exercise#3

Use the `//` and `%` operators to do the following:

- a) Find out how many times 9 goes into 120 **evenly**.
- b) Find out what the **remainder** is when dividing 875 by 23.

Exercise#4

Imagine you selling tickets to ferry boats across Alta Lake during the summer. Each boat can hold 6 people. Your boss says you can only send **full** boats. Use the `//` and `%` math operators to create a program that will do the following:

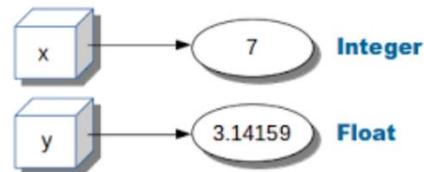


- a) Ask the user how many customers have purchased tickets that day.
- b) Output the number **full** boat trips you will *need* to get everyone across the lake.
- c) Output the number of *remaining* of people who won't fill up the last boat and might have to wait on shore until tomorrow.

Integers vs. Floats (variable types)

Remember, **whole numbers** in computer programming are called: **integers** (int).

Decimal numbers are called: **floats** or floating decimals.



Exercise#5

When you use **floats** it is **important to know few things**:

1. You can use **integers** and **floats** together, but **the result will be a float**
PLEASE TYPE-IN ALL THE EXAMPLES BELOW into Replit to see what they do.
(save as Exercise#5):

Examples:

```
print(3*3.8134)
print(4.7567 + 56)
print(79/4.23)
```

2. **floats** can be displayed so that only a precise number decimal points show:

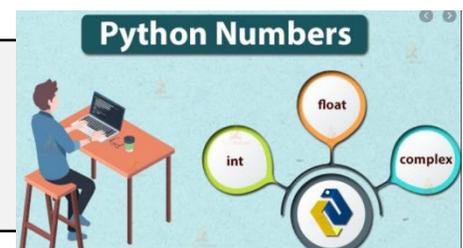
Example:

```
a=2.12544566
print(f"{a:.2f}") #this will cut-off the decimal after 2 places
b=4.5678972
print(f"{b:.4f}") #cut-off after 4 decimal placed NO rounding
```

3. The **round()** function

Unlike the previous formatting example, the **round()** function returns a **float** that is **rounded** to a specified number of decimals.

```
x = round(5.76543, 2)
print(x)
x = round(2.18149, 4)
print(x)
```





The type() function

ints , **floats**, **strings**, **characters**, **complex numbers** are all different **data types** in python.

We can use the **type()** **function** to identify which data type a **variable** or a value belongs to.

Exercise#6

Use the **type()** function with the examples below and see the output to see what it does.

```
print(type(4.54456))
print(type(4))
print(type("Python is the Best"))
print(type("a"))
```

Random Functions:

This is a **super important** function in programming. Frequently, you will need to input a random values into a program to create a realistic simulation. In programming anytime we model situations that involve chance like:

- rolling of dice,
- coin flipping,
- the shuffling of playing cards,
- motion of an opponent in a video game,



There are a number random functions in python. Here are just a few:

The **randint()** method returns an integer selected from the specified range.

```
import random
x=random.randint(1, 14)
print(x)
```



Run this code a few times to see it generate random integers and save it with **exercise#4**

The `choice()` method returns a randomly selected element from the specified list of items.

```
import random
mylist = ["apple", "banana", "cherry"]
print(random.choice(mylist))
```

Run this code a few times to see it generate random integers and save it with **exercise#4**



Exercise#7

Create a game in python where two players compete in a game of dice. In the game there should be two separate dice values that are added together to get the player total
It might look like the following:



```
Welcome to the dice game! player 1 press the letter r to roll the dice:
Player 1 rolls an 11!
Player 2 press r to roll the dice:
Player 2 roles a 3!
Player 1 is the winner!
```

Exercise#8

Create a **number guessing game** in python where:

1. A random number is created by your program (between 1 and 15).
2. A player is asked by the computer to guess a number between 1 and 15.
3. The computer will let the player know whether the guess is correct, higher, or lower, and allow the player to guess again if necessary.
4. The program will keep track of the number of guesses and will report the number of guesses at the end of the game.
5. The game might look like the following:

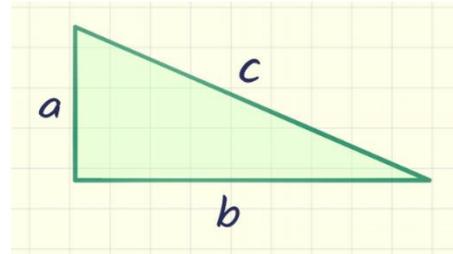
```
Welcome to the the number guessing game! Guess a
number between 1 and 15: 4 Sorry your guess was too
low. Guess again: 10
Sorry your guess was too high. Guess again: 7
Excellent! 7 was correct it only took you 3 guesses!
```

Number
Guessing Game



Exercise#9

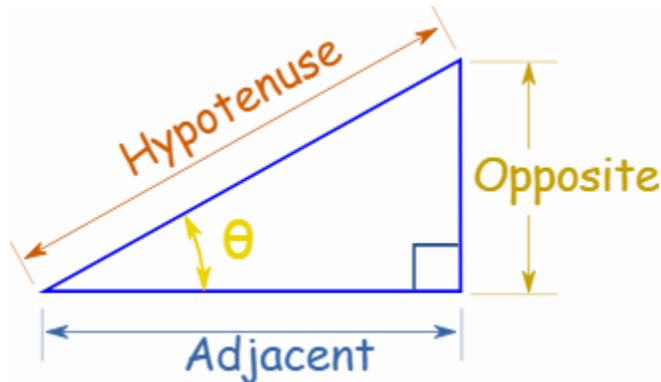
Create a python program that when given the two right angled sides of a triangle, it will be able to determine the size of the hypotenuse.
(Pythagorean Theorem!)



$$c = \sqrt{a^2 + b^2}$$

Exercise#10

Explore the math module in python. Create a program that when give an angle and the hypotenuse of a triangle it can find the length of the side opposite to the triangle.



$$\sin \theta = \frac{\text{Opposite}}{\text{Hypotenuse}}$$

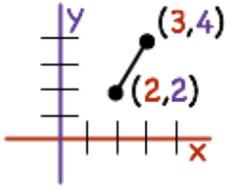
Exercise#11

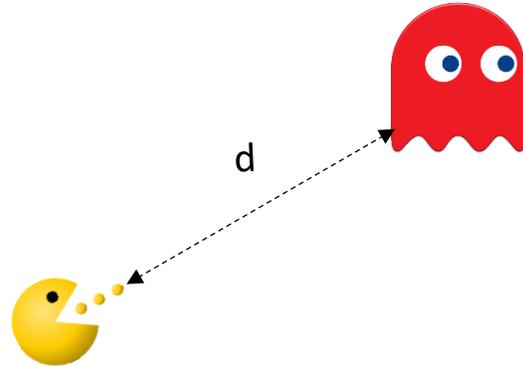
A computer screen is commonly mapped out in software using an **(x,y) coordinate system**. Keeping track of how close to objects on a screen is an essential task in programming.

In mathematics you can find the distance between two points in the following way:

Find the Distance

$(3,4)$ $(2,2)$
↑ ↑ ↑ ↑
 x_1 y_1 x_2 y_2


$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$
$$= \sqrt{(2 - 3)^2 + (2 - 4)^2}$$
$$= \sqrt{(-1)^2 + (-2)^2} = \sqrt{1 + 4} = \sqrt{5} \approx 2.24$$



The Formula you need to know is:

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

- Write a Python program that will plot two dots in random locations the screen using turtle.
- then use the formula to compute the distance between the points (x_1, y_1) and (x_2, y_2) .
- Then draw a line between the two points and display the distance value you have calculated
- You can check your answer using the `turtle.distance()` function. Look it up.
- Partial sample solution on the next page **if** you are stuck.
- You must use: `math.sqrt`

Sample solution on next page. Try first then peek...

Sample solution:

```
import math

x1=0
y1=0

x2=25
y2=56

distance = math.sqrt( ((x2-x1)**2)+((y2-y1)**2) )

print(distance)
```

Bonus (only for extra marks if you have time)

Create a python program that can help you solve a **math problem based on what you are doing in math class right now**. Maybe something in your math class that would impress your teacher! Use a turtle drawing/animation to drawing to spice up your program and the user experience.

Super Bonus:

Create a calculator user interface in turtle or pygame that operates by the user clicking on your calculator buttons.

