CS-UY 1114: Lab 2

Expressions, Operators, Math, Random, Number Systems

You must get checked out by your lab CA **prior to leaving early.** If you leave without being checked out, you will receive 0 credit for the lab.

Restrictions

The Python structures that you use in this lab should be restricted to those you have learned in lecture so far. Please check with your teaching assistants in case you are unsure whether something is or is not allowed!

Create a new python file for each of the following problems.

Your files should be named *lab[num]_q[num].py* **similar to homework naming conventions.**

Problem 1: *Binary and Other Number Systems Conversions*

Convert the following numbers by hand:

Binary to Decimal: $01011010_{2 = ?}$

Decimal to Binary: $153_{10 = ?}$

Binary to Hexadecimal: $10100111_{2 = ?}$

Hexadecimal to Decimal: $0xFDA_{16 = ?}$

Decimal to Octal (base 8): $229_{10 = ?}$

Here is a nice website for visualizing binary and decimal conversions

Make sure you know how to convert between number systems by hand!

Problem 2: *Evaluating Advanced Expressions*

```
A = True
B = False
C = False
```

Evalutate the following expressions by hand assuming the above variable values.

```
(A and C or B) or (C and A)
```

```
not(C and A) and (4 * 5 >= 20)
```

```
(3 + 3 == 5) or (C or B and A) or (3 * 3 == 9)
```

```
(not("")) or (A and 0) or (A or B)
```

Do not use conditionals for Problem 3, 4 or 5

Problem 3: *Random Number Analysis*

This is a quick problem to work on making your own advanced expressions.

1. Generate a random number between 0 and 100
2. Determine whether it is even or odd and print the result
3. Determine whether the number is above or below 50 and print the result

Here are some expected outputs for this problem

```
71 is even: False
71 is greater than 50: True
```

```
18 is even: True
18 is greater than 50: False
```

Hints

Take a look through the random module documentation to find the functions you need for the problem.

- Try to think about how you can use advanced boolean expressions to determine the results.
- Consider using modulus operator to solve some of the problem

Problem 4: *When in Rome*

This problem will convert a decimal number to Roman Numerals.

1. Ask the user to input a decimal integer less than 100.
2. Convert the input to Roman numbers and print to the screen.

Roman numerals and decimals follow the table below.

Decimal	Roman

Decimal	Roman
1	I
5	V
10	X
50	L

For this problem there is no need to consider subtractions.
i.e., 4 = IIII, 9 = VIIII instead of IV and IX respectively.

Hints:

- Use div and mod
- Recall string multiplcation

Problem 5: *Reaching for the Heights*

You're a house painter who was recently hired to paint the outside of a home. However, you somehow forgot to bring a ladder to reach the roof so you can paint it! You inform your employer you need a ladder for the job and they tell you that:

- There's a 40% chance that there's an available ladder for you to use
- The ladder can be of a random size from [1, 100] meters tall inclusive

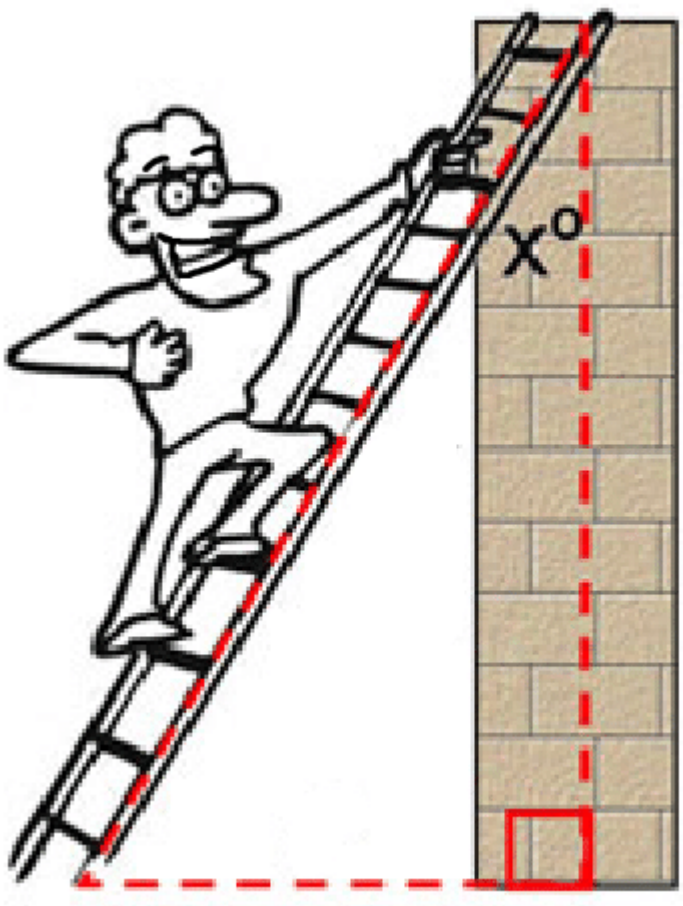

***Figure 1**: The Ladder Resting Against the Home*

Your file should:

- Ask the user for two inputs: the height of the wall and the distance from the wall the ladder will be at (in meters)
- Calculate the minimum height your ladder needs to be to reach the roof using the given values (think pythagorean theroem)
- Randomly generate 2 values. The first value will be used to determine if there's an available ladder following the 40% probability. The other value will be used to determine the random ladder's height following the [1, 100] range.

Determine if your employer has an available ladder and if this ladder is of sufficient height for you to finish your painting job.

Recall the pythagorean theorem below:

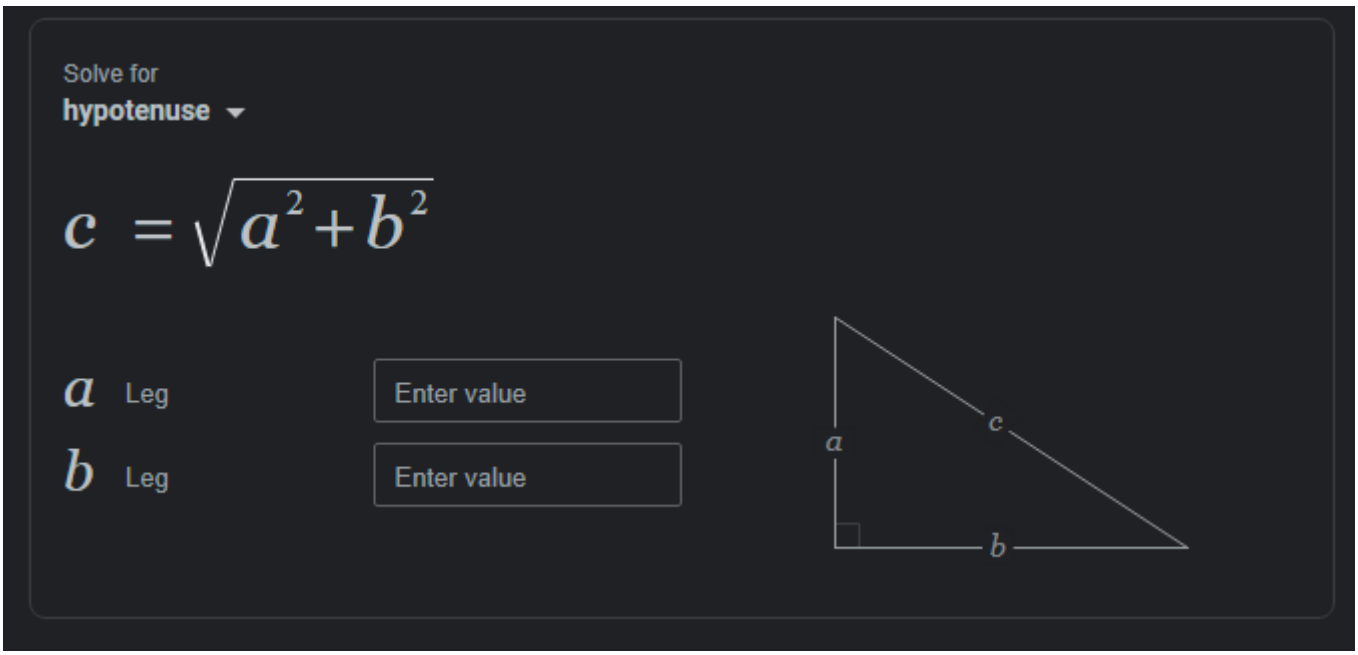

***Figure 2**: Pythagorean Theroem*

The following are examples of possible outputs:

```
How many meters from the wall will the ladder be? 3
How many meters tall is the wall? 4
From a distance of 3.0 meters and a wall height of 4.0 meters, can we reach the
roof?: False
```

```
How many meters from the wall will the ladder be? 5
How many meters tall is the wall? 6
From a distance of 5.0 meters and a wall height of 6.0 meters, can we reach the
roof?: True
```

Hints

- Think of an available ladder and a ladder of sufficient height as *two conditions* that *both must be met* in order to determine if you can reach the roof. How can **advanced boolean expressions** help?
- Refer to the random module and math module documentation.

Problem 6: *The Bell Curve*

In statistics, a normal distribution (sometimes called a "bell curve") is observed in many situations. For example, the scores of all students who take the SAT exam are expected to fall in a normal distribution where most of the students score the mean value or close to the mean value. Smaller numbers of students will score above and below the mean.

The standard normal distribution is a simple case of the normal distribution in which the mean = 0 and the standard deviation = 1.

It is described by the probability density function given below:

$$f(x) = \frac{1}{\sqrt{2\pi}} e^{\frac{-1}{2}x^2}$$

***Figure 3**: Probability Density Function*

Create a new file and write code to check the value of the probability density function at x = 0, x = 1, and x = -1. You do **not** need to read in user input for this problem. Print the value of the probability density function for each value of x. Your output should be formatted as follows:

```
The value of the pdf at x = 0.0 is 0.3989422804014327
The value of the pdf at x = 1.0 is 0.24197072451914337
The value of the pdf at x = -1.0 is 0.24197072451914337
```

Take a look through the math module documentation to find the functions you need for the problem.