
COMP 115 Robots, Games, and Problem Solving

Lab #2

In this lab, you will write short programs that calculate mathematical expressions and start experimenting with the Math Library in Python.

First, let me say a few words about the Math Library.

In addition to the standard operators and a few basic functions, Python provides many other mathematical functions in a package called the Math Library. These functions are not included in the basic Python description, so to tell Python you want to use them, you have to include the following line at the beginning of your program:

```
import math
```

The Math Library contains many mathematical functions and constants – we will discuss all of them in details in class – but for the purpose of this lab, you will need two of them. The constant π and the square root function. To get the constant π , you have to write `math.pi`, and the constant can be used like any other variable. For example, to calculate the expression $2\pi r$, the formula to calculate the circumference of a circle, and put the result in the variable `area`, you would write:

```
area = 2 * math.pi * r
```

To calculate the square root of the number 10, you have to write `math.sqrt(10)`. The general syntax of the square root function is `math.sqrt(<expr>)`, for some expression that evaluates to a number. For example, if you want to calculate the expression $\sqrt{b^2 - 4ac}$ and put the result in the variable `disc`, you would write:

```
disc = math.sqrt((b * b) - (4 * a * c))
```

Note that the function `math.sqrt` will cause an error if it is given a negative number.

Now for the exercises of the lab.

1. Write a short program that calculates the surface area and the volume of a sphere. The program should first ask the user for the length of the radius of the sphere (you can assume that it is a floating-point number), calculate the surface area and volume in two assignments, then display both on screen using a single `print` statement. The print statement should also display a short message indicating which number is the surface area and which number is the volume.

The formulas to calculate the surface area and volume of a sphere are as follows:

$$area = 4\pi r^2 \qquad volume = \frac{4}{3}\pi r^3$$

_____ Show me the result when you are done.

2. Write a short program that calculates the distance between two points. The program should first ask the user for the coordinates (x, y) of both points, then calculate the distance between the points using the following formula:

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

where (x_1, y_1) and (x_2, y_2) are the two points given by the user.

When asking the user to enter the points, it is possible to get both values at once using a simultaneous assignment as follows:

```
x,y = eval(input("Please enter a point in the format (x,y) "))
```

_____ Show me the result when you are done.

3. It is possible to calculate the area of a triangle given the length of its three sides a , b and c using the following formulas:

$$s = \frac{a + b + c}{2} \quad area = \sqrt{s(s - a)(s - b)(s - c)}$$

Write a program that asks the user for the length of the 3 sides of a triangle, calculates its area and displays it on screen.

_____ Show me the result when you are done.

4. Write a program that asks the user for three time durations in a format (h, m, s) where h is the number of hours, m is the number of minutes and s is the number of seconds (to do the input, you should use a trick similar to what you did to ask the user for point coordinates). The program should then find the sum of those three time durations and print it on screen. Your sum should respect the format we expect of time durations, meaning that there should be no more than 60 seconds and no more than 60 minutes. For example, a typical interaction with your program should look as follows:

```
Enter the first duration (h,m,s): (1,45,15)
Enter the second duration (h,m,s): (0,15,30)
Enter the third duration (h,m,s): (0,0,15)
The total duration is 2 hour(s), 1 minute(s) and 0 second(s)
```

Try to mimic the format above as closely as possible.

_____ Show me the result when you are done.

When you are done, write your name on the sheet and hand it to the lab instructor.

Name: _____