CS177 Fall13 - Lab for week: 3
Lab Title: Using functions
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Outcomes

In this lab you will learn:

- to define a function, and its input arguments, to accomplish a given task,
- how to launch a function from the Python Shell, passing the needed arguments for testing/debugging purposes
- how a function can be used by another function, that is how to call a function from within another function
- how the calling function can pass arguments to the called function
- continue to practice the `eval` and `input` commands to get input from the user and assign it to a variable

Why do we create functions?
The first reason is that we should subdivide our program into functions that perform one (or a limited number of) specific task(s). In so doing, we can later reuse these functions in other programs. We can also reuse the function multiple times in the same program. This eliminates the need to rewrite multiple times the same code.

The second reason is that it's a good practice to separate the calculation of one (or more) values from the visualization of these values. Using functions to accomplish this goal allows us to concentrate on the calculation and the visualization separately, and to use different visualization for the same data values.

Prerequisites

Textbook references:
Chapter 4, Sections 1-3

Lesson and recitation slides:

Week2 lesson slides: http://courses.cs.purdue.edu/_media/cs17700:fall13:lect02_2013.pdf

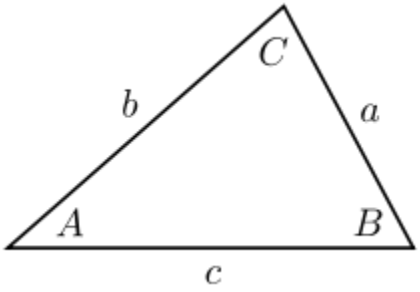
Week2 recitation slides: http://courses.cs.purdue.edu/_media/cs17700:fall13:rec02_2013.pdf

Prelab material:

prelab2 (about variables, expressions, assignment statement):
http://courses.cs.purdue.edu/cs17700:prelab2

prelab3 (about functions and printing character strings):
http://courses.cs.purdue.edu/cs17700:prelab3

Law of Sinuses: http://en.wikipedia.org/wiki/Law_of_sines



$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

Set-up

Before starting, you must create a folder **lab03** under the folder **CS177** you created in lab01. If you already created the folder lab03 skip this step.

If you did not have created the folder CS177 yet, ask your lab TA to help you to do that, and then create the folder lab03.

Download the skeleton file lab3.py under the lab03 folder you created. Your lab TA will guide you to perform the download.

Open the file lab3.py from the Python IDLE

Introduction

In this lab you are going to solve a simple geometric problem, that is determining the length of two sides of a triangle given the three angles and length of the other side. The values of the three angles and the length of one of the side must be given by the user. Hence your program will need to accommodate for user input. The outcome of your program will be the length of ONE of the other two sides.

The algorithm consists in using the law of sinuses to determine the other two sides' length. In this case mathematicians have already done the work for you.

You are also requested to separate the calculation of the sides' length from its "presentation", that is the printout of the calculation results. To do this you will be writing three different functions:

1. `calculate`: This function calculates the lengths of the missing sides of a triangle. It will then return the value of the side the user wished to see.
2. `main`: This function gets `Angle A, Angle B, Angle C` (the angles of the triangle), and `Side a` (the length of side a), and which side to calculate from the user. These inputs are used by `calculate` to determine the length of `Side b` and `Side c`.

What is the advantage of decomposing our problem in these two parts, each one implemented by a different function?

Well, what about if we want to get the input from the user using a fancy graphical user interface? We can do that without changing the `calculate` function. We might also want to represent the calculated lengths of the two sides as number printed over the triangle shape. Again, we will not have to change the `calculate` function.

NOTES:

- To facilitate your work, we provided you the file **lab3.py** that you have downloaded in the lab03 folder. This file contains some statements already provided to you and marked with the comment (remember that a line starting with the # sign is a comment!) **# DO NOT MODIFY OR DELETE THIS STATEMENT**
- Also statements following the comment: **# DO NOT MODIFY THIS STATEMENT** must not be modified.
- You have to write your Python statements in this file AFTER the # TODO comment. REMEMBER TO USE THE SAME INDENTATION!

Exercises

TODO1:
Write the function `calculate(Angle_A,Angle_B,Angle_C,Side_a, choice):`

- *Angle_A*: a floating point number (examples: 87.5 or 77.3, and so forth), representing the value of angle A (in degrees)
- *Angle_B*: a floating point number representing the value of angle B (in degrees)
- *Angle_C*: a floating point number representing the value of angle C (in degrees)
- *Side_a*: a floating point number representing the length of side a (in inches)
- *choice:* the value 'b' or 'c', i.e. the side for which you need to calculate the lenght

HINT: use the names above when defining your function.

The function should calculate the value of side `b` and side `c`. We will be using the law of sinuses to do this. The values taken in by the function are just enough to solve for the two missing sides.

To do this you will need to follow these steps:

1. Remember that trigonometric functions expect the angles to be in radians not degrees. This means that the angles used as argument of `math.sin()` cannot be the values input by the user as humans normally deal in degrees not radians. Start by converting `Angle_A, Angle_B`, and `Angle_C` into radians. Save them in a variable for later use.
    a. $radian = degree * \left(\frac{\pi}{180}\right)$
    b. In Python the constant π can be found in math library as `math.pi`

2. Next use the law of sinuses $\frac{Side\ a}{Sin(Angle\ A)} = \frac{Side\ b}{Sin(Angle\ B)}$ to calculate `Side b`.
    a. You have values for `Angle A, Angle B`, and `Side a`. Use them to solve for `Side b`.
    b. Save your result in a variable for later use
3. Next use the law of sinuses $\frac{Side\ b}{Sin(Angle\ B)} = \frac{Side\ c}{Sin(Angle\ C)}$ to calculate `Side c`.
    a. You now have `Side b` from step 2, use it to solve for `Side c`.
    b. Save your results in a variable for later use
4. Finally RETURN the side value of the user's choice. If the user chose to display side b, return side b's length. If the user chose to display side c, return side c's length. If the user's choice is neither of these, return an error message. **NOTE: points will be taken off if RETURN is not used.**

IMPORTANT: When you have finished writing your program in the file lab3.py, make sure to save it!
IMPORTANT: when you have finished writing and testing the `calculate` function, turnin your lab3.py file. You can turnin your file several times**.**

TODO3
Write the `main()` function. This function is the one that starts the whole process. Its job is to collect input from the user and give that input to the `calculate` function.

The function must do the following:

1. Prompt the user to input the value of angle A. Store that in a variable
2. Prompt the user to input the value of angle B. Store that in a variable
3. Prompt the user to input the value of angle C. Store that in a variable
4. Prompt user to input the length of side a. Store that in a variable
5. Prompt user which side's length they would like to display ('b', or 'c'). Store that in a variable.
6. Call the `calculate` function, and pass it the angles of A,B,C, length of side a, and their choice.
7. Print the length of the side chosen by the user.

Hint: Recall the use of the `eval` and `input` functions from before.

When you have finished writing your program in the file lab3.py, make sure to save it!

Test Cases

When you have finished writing the `main()` function, you must run it with the different inputs provided below. Your lab TA instructor will explain you how to do it. We call these input "test cases". A test case tells you which input values you must use and which is the corresponding output that your program must produce. This way you are able to see if your program implemented correctly the specifications. Why to run multiple test cases? Because, in general, your program may perform correctly for one test case, but may perform wrongly for other test cases.

Case 1:
INPUT VALUES: Angle A=45.3, Angle B = 29.32, Angle C = 105.38, Side a = 52.23, choice = "b"
EXPECTED OUTPUT:

```
Now entering main function!
     b:  35.98250160688825
Now leaving main function!
```

Case 2:
INPUT VALUES: Angle A=67.23, Angle B = 90, Angle C = 22.77, Side a = .2, choice = "c"
EXPECTED OUTPUT:

```
Now entering main function!
     c:  0.08394906160753209
Now leaving main function!
```

Case 3:
INPUT VALUES: Angle A=67.23, Angle B = 90, Angle C = 22.77, Side a = .2, choice = "d"
EXPECTED OUTPUT:

```
Now entering main function!
     d:  error with your choice
Now leaving main function!
```

Grading Rubric

TODO	Points
TODO1.1	10
TODO1.2	10
TODO1.3	10
TODO1.4	21
TODO2.1	7
TODO2.2	7
TODO2.3	7
TODO2.4	7
TODO2.5	7
TODO2.6	7
TODO2.7	7
TOTAL	100

Turn-in instructions

You must turn-in one files: lab3.py you created under the folder lab03.

From the UNIX terminal window, login into your UNIX CS account.

Then launch the following command:

$ cd

$ cd CS177

$ **turnin –v -c cs177=COMMON -p lab03 lab03**