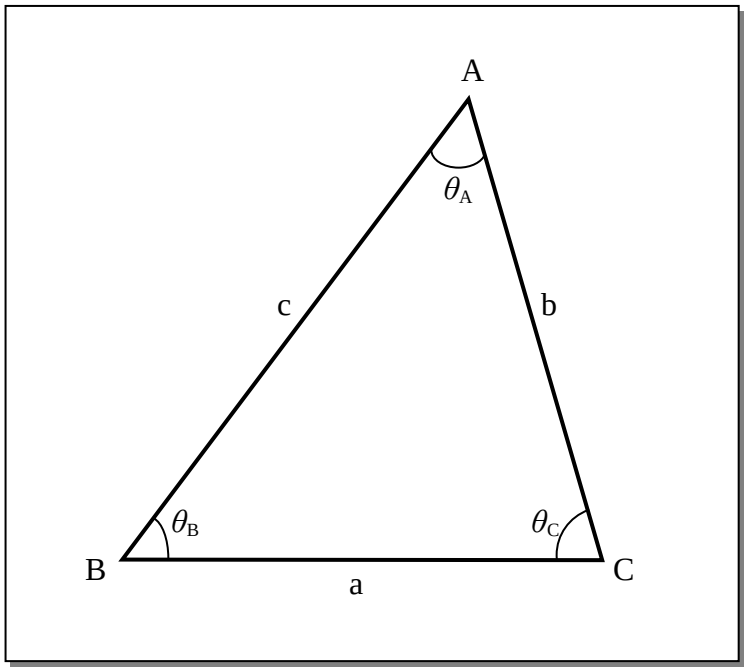
COMP110 Introduction to Computer Programming Using MATLAB

Homework #8

Due: April 18, 2018, Wednesday, 23:59.

Functions: Dealing with a triangle



The side lengths of a triangle always satisfy the following conditions:

$$a < b+c$$
$$b < a+c$$
$$c < a+b$$

Function get_abc

Write a function named **get_abc** that gets three positive integers inputs (a, b, c) from the user. If either value is negative or zero, the function should immediately ask for that input again. After all three inputs are given, using the above equations the function should check whether the given values could constitute a triangle. If not, an error message should be displayed, and all three inputs should be given again. The function gets nothing from the caller, and returns the three sides of the triangle.

Function my_fact

Write a function named **my_fact** that gets a positive integer from the calling program, and evaluates and returns the factorial of that number using loops.

Function my_sin

Write another function named **my_sin** that finds the sine of an angle using Taylor series expansion. The function should receive one angle in ***degrees***, and return the sine of that angle. The function should use **my_fact** function to evaluate factorials. It should stop evaluating new terms of the series when the absolute value of the newly evaluated term is less than value **s** (sensitivity). Variable **s** should be a global variable set by the main program. The Taylor series expansion of sin(x) is:

$$\text{my\_sin}(x) = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \frac{x^7}{7!} \ldots\ldots$$

Function my_arcsin

Write a function that will get a single value between -1 and 1 from the calling program, and find the arcsine of the given number using an interval halving algorithm. This function should use **my_sin** function, and search for the angle between limits of 90° and 270°. It should stop halving the interval and return the angle when either an exact match is found, or the left and right limits of the interval are less than 100**s** away (**s** is the global sensitivity variable defined in the main program). The function should return the result (in degrees) to the calling program.

Function find_angle

Write another function that finds an angle of the triangle by using the cosine rule.

$$a^2 = b^2 + c^2 - 2bc\cos(\theta_A) \quad \Rightarrow \quad \cos(\theta_A) = \frac{b^2 + c^2 - a^2}{2bc}$$

$$b^2 = a^2 + c^2 - 2ac\cos(\theta_B) \quad \Rightarrow \quad \cos(\theta_B) = \frac{a^2 + c^2 - b^2}{2ac}$$

$$c^2 = a^2 + b^2 - 2ab\cos(\theta_C) \quad \Rightarrow \quad \cos(\theta_C) = \frac{a^2 + b^2 - c^2}{2ab}$$

Note how the three formulas are similar! Thus it is possible to write a single generic function and call it three times, each time changing the places of a, b, and c in the argument list.

Using the formula derived on the right, the function can easily find $\cos(\theta_X)$, which will yield a number between -1 and 1. In order to find the angle θ_X, you will use the **my_arcsin** function with a little trick.

We know that

$\cos(x) = \sin(x+90°)$

Taking arcsine of both sides, and then simplifying,

$\arcsin(\cos(x)) = \arcsin(\sin(x+90°))$

$\arcsin(\cos(x)) = x+90°$

$x = \arcsin(\cos(x)) - 90°$

So if you take the arcsine of this value and subtract 90, you can easily find the angle θ_X. Return the result to the calling program.

Function find_area

Write a function that calculates the area of a triangle. The function should take three arguments as inputs; two sides and the angle between them; it should return the evaluated area as a result. Use **my_sin** function.

$$Area = \frac{1}{2} bc \sin(\theta_A)$$

Main program

In the main program, start by calling **get_abc**. After that, ask the user to provide the sensitivity value **s**, and put it into a global variable. Then call **find_angle** three times to find θ_A, θ_B, θ_C, and in the main program print those angles on the screen with two decimal places. Finally, call **find_area**, and print the value returned from this function with two decimal places.

The output of the program should look as below:

```
Give the value of a:  -5
You need to give a positive value.
Give the value of a:  0
You need to give a positive value.
Give the value of a:  5
Give the value of b:  1
Give the value of c:  7
The triangular is not valid!!!

Give the value of a:  5
Give the value of b:  8
Give the value of c:  7

Enter sensitivity:  0.00001

Angle thetaA is 38.21
Angle thetaB is 81.79
Angle thetaC is 60.00

The area of the triangle is 17.31
```

Make your program as structured as possible. Apply proper indentations. Never use BREAK, CONTINUE or RETURN.

Place all your m-files (main program and functions) into a ZIP file named **YourSurname**. Then upload this ZIP file to Blackboard Learn at http://ku.blackboard.com.

While doing all your homework assignments, remember that:

- ***You should not work together,***
- ***You should not give or take any files,***
- ***You should not give or take help other than simple verbal hints.***