CSE 231 **Fall 2022**

Computer Project #3

Assignment Overview

This assignment focuses on the design, implementation and testing of a Python program to display the properties of user-entered triangles (see below).

It is worth 20 points (4% of course grade) and must be completed no later than 11:59 PM on Monday, September 26. **After the due date, your score will be deducted by 1pt for every 2 hours late.**

Assignment Deliverable

The deliverable for this assignment is the following file:

`proj03.py` – the source code for your Python program

Be sure to use the specified file name and to submit it for grading via the **Coding Rooms system** before the project deadline.

Assignment Background

In Euclidian geometry, three line segments (AB, BC and CA) are the sides of a triangle under certain circumstances. The three sides form a triangle if the sum of the lengths of any two sides is greater than or equal to the length of the remaining side (it is a *degenerate triangle* if the sum equals the length of the remaining side). All combinations of two sides must be higher than the other side. If two sides are less than the remaining side, then the sides cannot make a triangle.

Given the lengths of the three sides of a triangle, it is possible to determine additional properties of that triangle.

Assignment Specifications

1. You will develop a Python program which displays the properties associated with an unknown number (zero or more) of user-supplied triangles.

2. The program will repeatedly ask if the user wishes to process another triangle. If the user's response is the letter `Y` or the letter `y`, the program will proceed with the steps to process a triangle. If the user's response is anything else, the program will display the number of valid triangles processed and then halt.

3. When the user chooses to process a triangle, the program will prompt the user to enter the lengths of the three sides of a triangle (three different prompts, one for each side length). The program will assume the user enters three non-zero numeric values in response to the prompts, so you do not need to error-check the input.

4. The program will display one of the following messages, based on the three values entered by the user. See the "Condition on the sides" subsection in the "Existence of a triangle" section in the Wikipedia page (see Notes below) which describes the "triangle inequality". The triangle inequality defines the conditions for a valid triangle and the referenced paragraph also describes a degenerate triangle.

- Valid Triangle
- Degenerate Triangle
- Not A Triangle

Note that exactly one message will be displayed for each set of three values.

5. If the three sides form a valid triangle, the program will display the following:

- length of each of the three sides
- degree measure of each of the three interior angles
- radian measure of each of the three interior angles
- perimeter
- area

All numeric values will be rounded to one decimal place when they are displayed.

The measure of the three interior angles can be determined by the "law of cosines" which is found in the "Sine, cosine, and tangent rules" subsection of the "Computing the sides and angles" section of the Wikipedia page. Note that you will need the inverse of the cosine function when solving the law of cosines to get the angle measure. The inverse is the arccosine function which in the math library is `math.acos()` which returns the angle with the result in radians. To convert to degrees, you have to multiply by 180 and divide by π (in the math library, π is `math.pi`)

Given that you know the sides, the easiest way to find the area is to use Heron's formula which is in the "Using Heron's formula" subsection of the "Computing the area of a triangle" section of the Wikipedia page.

6. If the three sides form a valid triangle, the program will display all messages from the following list which are appropriate for that particular triangle:

- Scalene Triangle
- Isosceles Triangle
- Equilateral Triangle
- Oblique Triangle
- Right Triangle
- Obtuse Triangle

Note that more than one message will be displayed for certain triangles.

The types of triangles are defined in the “Types of triangle” section and since you have the sides the “By lengths of sides” subsection will be the most useful to determine scalene, isosceles, and equilateral. However, angles determine the oblique, right and obtuse triangles so the “By internal angles” subsection will be most useful for those.

7. prompt if the user wants to process another triangle. If the user enters ‘Y’ or ‘y’ then repeat steps 3-6.

Assignment Notes

1. The coding standard for CSE 231 is posted on the course website:

    http://www.cse.msu.edu/~cse231/General/coding.standard.html

Items 1-7 of the Coding Standard will be enforced for this project.

2. One resource for information about triangles is the Wikipedia entry:

    http://en.wikipedia.org/wiki/Triangle

For example, Heron's formula can be used to compute the area of a triangle when the lengths of the three sides are known.

3. The program will produce reasonable and readable output, with appropriate labels for all values displayed. Everything should be rounded to ONE decimal place.

4. The math module might be useful for this project. A simple program which uses some of the symbolic constants and functions from the math module is given below:

```
import math

print( "pi:", math.pi )

result = math.cos( math.pi )
print( "cosine of pi:", result )
```

The output produced by that simple program is shown below:

```
pi: 3.141592653589793
cosine of pi: -1.0
```

Suggested Procedure

- *Solve the problem using pencil and paper first.* You cannot write a program until you have figured out how to solve the problem. This first step can be done collaboratively with another student. However, once the discussion turns to Python specifics and the subsequent writing of Python statements, you must work on your own.

- Cycle through the following steps to incrementally develop your program:
    - Edit your program to add new capabilities.
    - Run the program and fix any errors.
    - Use the **Coding Rooms** system to submit the current version of your program.
- Be sure to use the **Coding Rooms** system to submit the final version of your program.
- Be sure to log out when you leave the room, if you're working in a public lab.

The last version of your solution is the program which will be graded by your TA.

*You should use the **Coding Rooms** system to back up your partial solutions, especially if you are working close to the project deadline. That is the easiest way to ensure that you won't lose significant portions of your work if your machine fails or there are other last-minute problems.*

*You would also be wise to save a copy of your completed program in your local computer **before** the project deadline.*

*In case of problems with electronic submission, an archived copy in the **Coding Rooms** system is the only acceptable evidence of completion.*

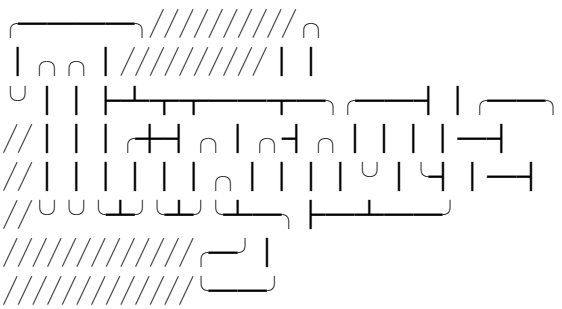
Grading Rubric

```
Computer Project #03                                Scoring Summary
General Requirements:
  ( 3 pts) Coding Standard 1-7
             (descriptive comments, mnemonic identifiers, format,
     etc...)

Implementation:
 (2 pts) Test Case 1:
 (3 pts) Test Case 2:
 (4 pts) Test Case 3:
 (3 pts) Test Case 4:
 (5 pts) Test Case 5:
```

Sample Output

Test 1



```
Do you wish to process a triangle (Y or N)?  N

Number of valid triangles: 0
```

Test 2 (note that the banner was omitted just to be concise)

```
Do you wish to process a triangle (Y or N)?  Y

Enter length of side AB: 3

Enter length of side BC: 3

Enter length of side CA: 3


  Valid Triangle

  Triangle sides:
    Length of side AB: 3.0
    Length of side BC: 3.0
    Length of side CA: 3.0

  Degree measure of interior angles:
    Angle A: 60.0
    Angle B: 60.0
    Angle C: 60.0

  Radian measure of interior angles:
    Angle A: 1.0
    Angle B: 1.0
    Angle C: 1.0

  Perimeter and Area of triangle:
    Perimeter of triangle: 9.0
    Area of triangle: 3.9

  Types of triangle:
```

```
    Isosceles Triangle
    Equilateral Triangle
    Oblique Triangle

Do you wish to process another triangle? (Y or N) n

Number of valid triangles: 1
```

Test 3 (note that the banner was omitted just to be concise)

```
Do you wish to process a triangle (Y or N)?  Y

Enter length of side AB: 3

Enter length of side BC: 4

Enter length of side CA: 6


  Valid Triangle

  Triangle sides:
    Length of side AB: 3.0
    Length of side BC: 4.0
    Length of side CA: 6.0

  Degree measure of interior angles:
    Angle A: 36.3
    Angle B: 117.3
    Angle C: 26.4

  Radian measure of interior angles:
    Angle A: 0.6
    Angle B: 2.0
    Angle C: 0.5

  Perimeter and Area of triangle:
    Perimeter of triangle: 13.0
    Area of triangle: 5.3

  Types of triangle:
    Scalene Triangle
    Oblique Triangle
    Obtuse Triangle

Do you wish to process another triangle? (Y or N) Y

Enter length of side AB: 3

Enter length of side BC: 4

Enter length of side CA: 7
```

```
  Degenerate Triangle
Do you wish to process another triangle? (Y or N) n
Number of valid triangles: 1
```

Test 4 (note that the banner was omitted just to be concise)

```
Do you wish to process a triangle (Y or N)?  y
Enter length of side AB: 4
Enter length of side BC: 5
Enter length of side CA: 9

  Degenerate Triangle
Do you wish to process another triangle? (Y or N) Y
Enter length of side AB: 3
Enter length of side BC: 4
Enter length of side CA: 8

  Not a Triangle
Do you wish to process another triangle? (Y or N) n
Number of valid triangles: 0
```

Test 5 (note that the banner was omitted just to be concise)

```
Do you wish to process a triangle (Y or N)?  Y
Enter length of side AB: 3
Enter length of side BC: 3
Enter length of side CA: 3

  Valid Triangle
```

```
  Triangle sides:
    Length of side AB: 3.0
    Length of side BC: 3.0
    Length of side CA: 3.0

  Degree measure of interior angles:
    Angle A: 60.0
    Angle B: 60.0
    Angle C: 60.0

  Radian measure of interior angles:
    Angle A: 1.0
    Angle B: 1.0
    Angle C: 1.0

  Perimeter and Area of triangle:
    Perimeter of triangle: 9.0
    Area of triangle: 3.9

  Types of triangle:
    Isosceles Triangle
    Equilateral Triangle
    Oblique Triangle

Do you wish to process another triangle? (Y or N) y

Enter length of side AB: 3

Enter length of side BC: 4

Enter length of side CA: 5


  Valid Triangle

  Triangle sides:
    Length of side AB: 3.0
    Length of side BC: 4.0
    Length of side CA: 5.0

  Degree measure of interior angles:
    Angle A: 53.1
    Angle B: 90.0
    Angle C: 36.9

  Radian measure of interior angles:
    Angle A: 0.9
    Angle B: 1.6
    Angle C: 0.6

  Perimeter and Area of triangle:
```

```
    Perimeter of triangle: 12.0
    Area of triangle: 6.0

  Types of triangle:
    Scalene Triangle
    Right Triangle

Do you wish to process another triangle? (Y or N) Y

Enter length of side AB: 3

Enter length of side BC: 3

Enter length of side CA: 2


  Valid Triangle

  Triangle sides:
    Length of side AB: 3.0
    Length of side BC: 3.0
    Length of side CA: 2.0

  Degree measure of interior angles:
    Angle A: 70.5
    Angle B: 38.9
    Angle C: 70.5

  Radian measure of interior angles:
    Angle A: 1.2
    Angle B: 0.7
    Angle C: 1.2

  Perimeter and Area of triangle:
    Perimeter of triangle: 8.0
    Area of triangle: 2.8

  Types of triangle:
    Isosceles Triangle
    Oblique Triangle

Do you wish to process another triangle? (Y or N) y

Enter length of side AB: 3

Enter length of side BC: 4

Enter length of side CA: 6


  Valid Triangle
```

```
  Triangle sides:
    Length of side AB: 3.0
    Length of side BC: 4.0
    Length of side CA: 6.0

  Degree measure of interior angles:
    Angle A: 36.3
    Angle B: 117.3
    Angle C: 26.4

  Radian measure of interior angles:
    Angle A: 0.6
    Angle B: 2.0
    Angle C: 0.5

  Perimeter and Area of triangle:
    Perimeter of triangle: 13.0
    Area of triangle: 5.3

  Types of triangle:
    Scalene Triangle
    Oblique Triangle
    Obtuse Triangle

Do you wish to process another triangle? (Y or N) Y

Enter length of side AB: 3

Enter length of side BC: 4

Enter length of side CA: 7


  Degenerate Triangle

Do you wish to process another triangle? (Y or N) y

Enter length of side AB: 3

Enter length of side BC: 4

Enter length of side CA: 8


  Not a Triangle

Do you wish to process another triangle? (Y or N) n

Number of valid triangles: 4
```