

The goal here is to write a program that will help a math student solve triangles, either by specifying coordinates of vertices and then computing lengths of edges and angle measurements, or by specifying lengths of edges and then determining angles and coordinates of vertices in a canonical position for the triangle in the first quadrant with one vertex at the origin and one edge along the positive x-axis.

First, use the `cout` command from the `iostream` library to tell the user what the program is designed to do:

```
This program is designed to aid in the analysis of triangles.
```

Then (again, using `cout`), prompt the user to specify whether they want to give coordinates of vertices or lengths of edges:

```
Would you like to specify the coordinates of a triangle (C),  
or the lengths of their sides(S) ? Enter 'C' or 'S':
```

Use the `iostream` library function `cin` to store the user's response in variable of type `char`, say, with the variable name `mode`, and then branch the program with an `if` statement based on their response, prompting for and retrieving input, like so:

```
if(toupper(mode) == 'C') {  
    cout << "\nEnter the x coordinate of point A: ";  
    cin >> Ax;  
    ...etc
```

You will need to have declared variables `Ax`, `Ay`, etc of type `double` or `float`, to hold the user's input.

Then use functions from the `cmath` library to compute lengths of edges and angles. You will need to remember what you learned in trigonometry!

A typical run might look like this:

```
This program is designed to aid in the analysis of triangles.  
Would you like to specify the coordinates of a triangle (C),  
or the lengths of their sides(S) ? Enter 'C' or 'S': C
```

```
Enter the x coordinate of point A: 0
```

```
Enter the y coordinate of point A: 0
```

```
Enter the x coordinate of point B: 1
```

```
Enter the y coordinate of point B: 0
```

```
Enter the x coordinate of point C: 0
```

```
Enter the y coordinate of point C: 1
```

```
The lengths of the sides are a = 1.41421, b = 1, and c = 1
```

```
The angles are A = 1.5708, B = 0.785398, and C = 0.782217
```

Alternatively, the user could choose to give sides, in which case we can find a canonical form for the triangle by placing the first vertex at  $A(0,0)$ , the second vertex at  $B(c,0)$  (where  $c$  is the length of the third given side) and  $C$  at an appropriate point in the first quadrant so that  $C(C_x, C_y)$  makes the side opposite  $A$  equal to  $a$  and the side opposite  $B$  equal to  $b$ . Note that you should first check that the triangle is feasible (satisfies the triangle inequality.)

A typical run for this case would look like this:

This program is designed to aid in the analysis of triangles. Would you like to specify the coordinates of a triangle (C), or the lengths of their sides(S) ? Enter 'C' or 'S': S

Enter the length of side a: 3

Enter the length of side b: 4

Enter the length of side c: 5

The coordinates of the triangle are at A(0,0), B(5,0) and C(3.2,2.4).

The angles are  $A = 0.643501$ ,  $B = 0.927295$ , and  $C = 1.5708$

Note that, since  $3^2 + 4^2 = 5^2$ , this is a right triangle and the right angle is opposite  $\angle C = \frac{\pi}{2} \approx 1.5708$ .

If the triangle is not feasible, the program simply reports that:

```
This program is designed to aid in the analysis of triangles.
Would you like to specify the coordinates of a triangle (C),
or the lengths of their sides(S) ? Enter 'C' or 'S': S
```

```
Enter the length of side a: 1
```

```
Enter the length of side b: 2
```

```
Enter the length of side c: 4
```

```
Those lengths won't form a triangle.
```

Include as a comment at the end of your code the results of a trial run or two like that shown above. Send your .cpp file to my email address with the format <your initials>\_trianglesI.cpp by Tuesday, September 14 at 2:00pm.