Project 1: Triangles

CSE3333

The University of Texas Rio Grande Valley

Spring 2018

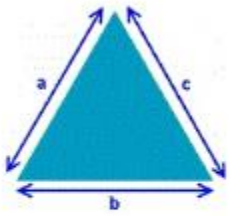
Dr. Liyu Zhang

Juan Bermudez

September 10, 2018

In order to calculate which triangle from a series of triangles, has the max area and max perimeter, we need some formulas to help calculate the sides and angles of a triangle. We can use Heron's formulas to find the semi perimeter, or half perimeter, s, of the triangle, and also the area of the triangle, A.

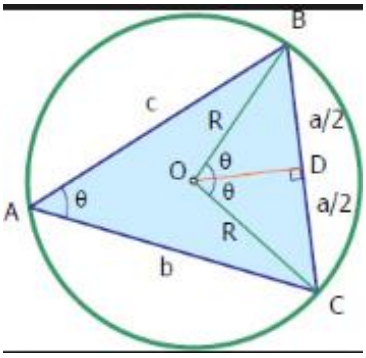
Heron's Triangle & *Formulas*



$$\textbf{semiperimeter } s = \frac{(a+b+c)}{2}$$

$$\textbf{area } A = \sqrt{s(s-a)(s-b)(s-c)}$$

Now that we can find the perimeter and area of the triangles we can use the circumradius, R, to calculate the angles using a derivation of the extended law of sines:



$$R = \frac{abc}{4\sqrt{s(s-a)(s-b)(s-c)}}.$$

The **Extended Law of Sines** i

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C} = 2R.$$

We can use the arcsine of each side to find each angle respectively: (A, B, and C denote the angles with a, b, and c, being the side lengths of the triangle.

$$A = \sin^{-1}\left(\frac{a}{2R}\right)$$

$$B = \sin^{-1}\left(\frac{b}{2R}\right)$$

$$C = \sin^{-1}\left(\frac{c}{2R}\right)$$

These formulas will also calculate the perimeter of the triangle and the area of a triangle.

Read Me:

The program was run on a single file along with the class because I was not able to program it with a header file. Most of the comments have been written in the main.cpp file. To run the program I used an online compiler and debugger:
https://www.onlinegdb.com/online_c++_compiler

I did this by copying and pasting the code and then running it, this generated the following results:

```
The total number of triangles generated randomly are: 19

 The max area is: 20.9762
The max perimeter is: 23


...Program finished with exit code 0
Press ENTER to exit console.
```

```
The total number of triangles generated randomly are: 6

 The max area is: 17.8885
The max perimeter is: 20


...Program finished with exit code 0
Press ENTER to exit console.
```

```
The total number of triangles generated randomly are: 19

 The max area is: 14.1421
The max perimeter is: 22


...Program finished with exit code 0
Press ENTER to exit console.
```

Sources for formulas :

1. Phelps, Steve. “Extended Law of Sines.” *GeoGebra*, www.geogebra.org/m/ycbWy8C9.

2. “NCERT Class 9 Solutions: Heron's Formula (Chapter 12) Exercise 12.1 Part 1.” *FlexiPrep*, www.flexiprep.com/NCERT-Exercise-Solutions/Mathematics/Class-9/Ch-12-Herons-Formula-Exercise-12-1-Solutions-Part-1.html.