Drawing a triangle with three given sides

In this article, we will explain how we can draw a triangle by using a ruler and compass, if we know its three sides.

As an example, we will draw a triangle with sides 2, 3, 4. Once you learn how to draw this triangle, you will easily draw any other triangles with three given sides, because the steps are exactly the same.

The first step is choosing one of the sides, and draw that side of the triangle by using a ruler. It doesn't matter which one you choose, but it turns out that it is most convenient if you choose to draw the longest side first. So, we will choose the side with length 4. See Fig. 1. You see a line segment with length 4.

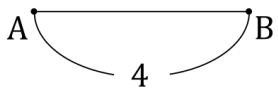

Figure 1: Line segment of length 4.

Having drawn one of the three sides of the triangle, now we have to draw the other two sides. To this end, draw a circle of radius 2 with one end of the line segment A as its center, and draw a circle of radius 3 with the other end of the line segment B as its center. See Fig. 2.

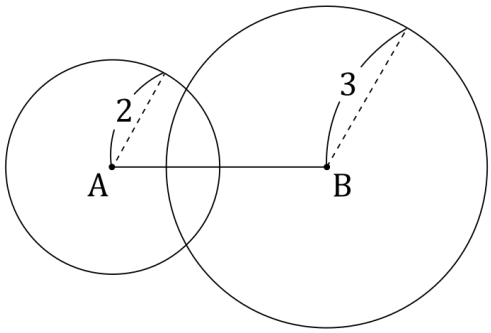

Figure 2: Circles with radius 2 and 3 centered in points A and B, respectively.

Now, from Fig. 3, you see that the two circles meet at two points C and D. Let's choose one of them, say, C. Then, you see that $\overline{AC}$ has length 2, because C is on the circle of radius

2 with A as its center. Recall that a circle is a collection of points with the same distance from its center. Similarly, $\overline{BC}$ has length 3. Now you see that the triangle ABC has three sides with length 2, 3, and 4. This is exactly the triangle we wanted.

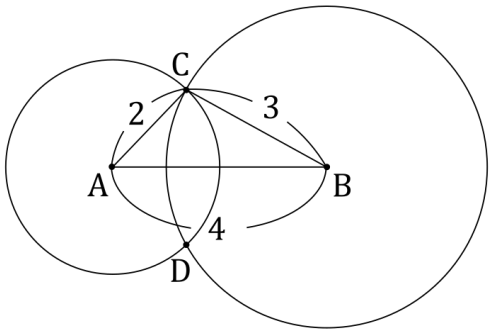

Figure 3: Circles from Fig. 2 with their radius as two of the sides of the triangle ABC.

If you chose D instead of C, you will find that the triangle ABD has also three sides with length 2, 3, and 4. So the triangle ABD is also equally valid answer. In other words, it doesn't matter, which one of the two you choose.

It is worth to remark at this point that there is actually no need to draw the two full circles. We drew these two circles to find their intersection point. Drawing small part of the circles is often enough to find the intersection point. See Fig. 4.

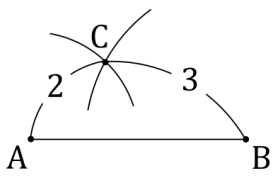

Figure 4: Same as Fig. 3 but only drawing the part of the circles where they intersect

Problem 1. Draw the triangle with sides 2, 3, and 4 again, but this time by drawing the side 2 first, and then drawing circles with radius 3 and radius 4. Do you realize why it is easiest to draw a triangle if you draw the longest side first?

Problem 2. Draw a triangle with sides 5, 6, and 7.

Problem 3. Try to draw a triangle with 2, 3, and 6, and another triangle with 3, 4, and 7. Why can't you draw them? Can you explain? If I ask you to draw a triangle with three given sides, can you immediately tell me whether you will be able to draw such a triangle, without actually trying to draw them? We will talk more about this in our later article "The triangle inequality."

Summary

- To draw a triangle with sides a, b, and c, (with $a \geq b, a \geq c$) draw the longest side a first, then draw circle of radius b at its one end and circle of radius c at the other end, find the intersection points. If you connect one of the two intersection points with the two ends of the side a, it is indeed a triangle with sides a, b, and c.