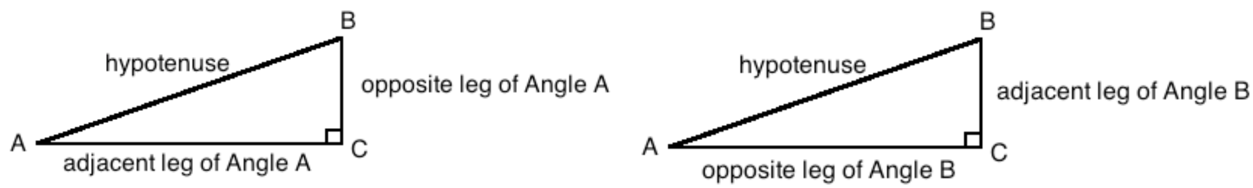
Introduction to Right Triangle Trigonometry

First, let's learn how to name each side in a right triangle:



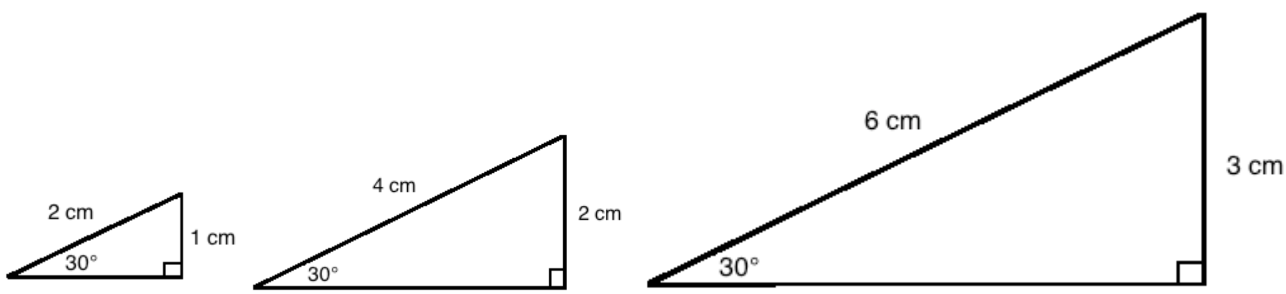
The longest side, which faces the right angle, is called the hypotenuse. The other two sides are called "legs." To differentiate them, we use "opposite leg" and "adjacent leg."

Notice that for $\angle A$ and $\angle B$, the "opposite leg" and "adjacent leg" are different!

- For $\angle A$, side BC is the opposite leg because BC is "opposite" to $\angle A$;
- For $\angle B$, side AC is the opposite leg because AC is "opposite" to $\angle B$.

The same is true for "adjacent leg." In English, the word "adjacent" means "next to."

We have covered how to name each side in a right triangle. Let's observe a pattern from the following right triangles:



We can see that, as long as the acute angle measures 30°, the ratio of its opposite leg and hypotenuse is always $\frac{1}{2}$. Mathematicians came up with a simpler way to write this relationship:

$$\sin 30° = \frac{1}{2}$$

This is read "sine of 30° is $\frac{1}{2}$." The sine function is defined as $\frac{opposite\ leg}{hypotenuse}$.

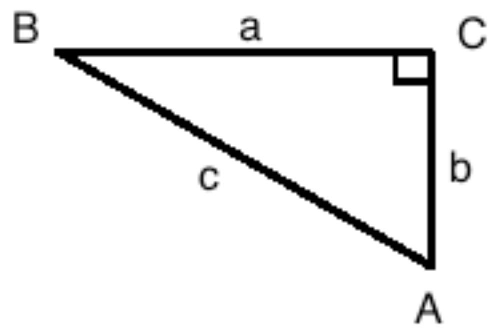
Similarly, we define the cosine function and tangent function:

$$\sin\theta = \frac{opposite\ leg}{hypotenuse}, \cos\theta = \frac{adjacent\ leg}{hypotenuse}, \tan\theta = \frac{opposite\ leg}{adjacent\ leg}$$

An acronym to help you memorize them is SOH CAH TOA (Look at the leading letters).

In later courses, we will learn how to use them to find missing lengths and angles. In this course, we only need to know their definitions. Let's look at some examples.

[**Example 1**] Find all trigonometry values of $\angle A$ and $\angle B$ in this right triangle.



In a right triangle, by math convention, the length of the side facing $\angle A$ is labeled by lower case letter a. The same is true with the other two angles.

First, we identify the longest side, or the side facing right angle $\angle C$. It's labeled "c" in the figure.

The opposite leg for $\angle A$ is a, the adjacent leg for $\angle B$ is b.

The opposite leg for $\angle B$ is b, the adjacent leg for $\angle B$ is a.

Here are definitions of trigonometry values:

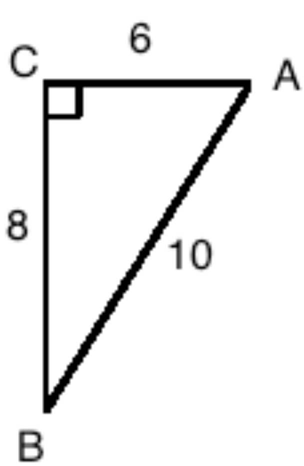
$$\sin\theta = \frac{opposite\ leg}{hypotenuse}, \cos\theta = \frac{adjacent\ leg}{hypotenuse}, \tan\theta = \frac{opposite\ leg}{adjacent\ leg}$$

By those definitions, based on the given figure, we have:

$$\sin A = \frac{a}{c}, \cos A = \frac{b}{c}, \tan A = \frac{a}{b}, \sin B = \frac{b}{c}, \cos B = \frac{a}{c}, \tan B = \frac{b}{a}$$

Notice that the values of $\sin A$ and $\cos B$ are the same, because the opposite leg of $\angle A$ and the adjacent leg of $\angle B$ are the same. The same is true for the values of $\sin B$ and $\cos A$.

[**Example 2**] Find all trigonometry values of $\angle A$ and $\angle B$ in this right triangle.



$$\sin A = \frac{8}{10} = \frac{4}{5} \qquad \sin B = \frac{6}{10} = \frac{3}{5}$$

$$\cos A = \frac{6}{10} = \frac{3}{5} \qquad \cos B = \frac{8}{10} = \frac{4}{5}$$

$$\tan A = \frac{8}{6} = \frac{4}{3} \qquad \tan B = \frac{6}{8} = \frac{3}{4}$$