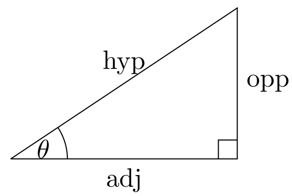
# Sines, cosines, and right triangles

Sine and cosine are two of the most important functions in all of math. They show up all over math and science.

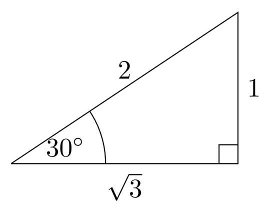
One of the most important places sines and cosines show up is in right triangles. The right triangle shown below has an angle $\theta$ indicated. The three sides of the triangle are the *hypotenuse*, the side *opposite* the angle, and the side *adjacent* to the angle. These are abbreviated as hyp, opp, and adj.




The sine and cosine of the angle $\theta$, denoted as $\sin\theta$ and $\cos\theta$ are

$$\sin\theta = \frac{\text{opp}}{\text{hyp}} \qquad \cos\theta = \frac{\text{adj}}{\text{hyp}}.$$

For example, consider the following 30-60-90 triangle.

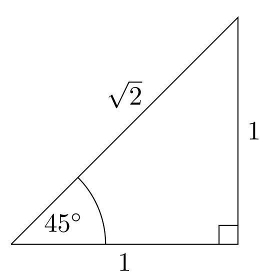



We have $\sin(30^\circ) = \frac{\text{opp}}{\text{hyp}} = \frac{1}{2}$ and $\cos(30^\circ) = \frac{\text{adj}}{\text{hyp}} = \frac{\sqrt{3}}{2}$.

We usually prefer radian measure, so since $30^\circ$ is $\pi/6$ radians, we can say $\sin(\pi/6) = \frac{1}{2}$ and $\cos(\pi/6) = \frac{\sqrt{3}}{2}$.

The unlabeled angle in this triangle is $60^\circ$ ($\pi/3$ radians). For this angle, the hypotenuse is still 2, but now the opposite side is $\sqrt{3}$ and the adjacent side is 1. From this we get that $\sin(\pi/3) = \sqrt{3}/2$ and $\cos(\pi/3) = 1/2$.

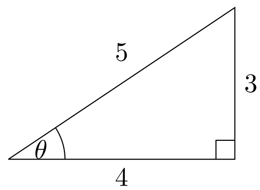
The other really well-known triangle from geometry is the 45-45-90 triangle shown below.

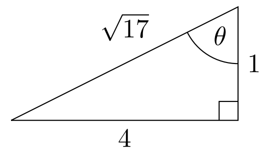



Since $45^\circ$ is $\pi/4$, from this triangle we get that $\sin(\pi/4)$ and $\cos(\pi/4)$ are both $1/\sqrt{2}$, which is usually rewritten as $\sqrt{2}/2$.

## Exercises

1. For the following triangles, find $\sin\theta$ and $\cos\theta$.



## Answers

1. $\sin\theta = \dfrac{3}{5}$, $\cos\theta = \dfrac{4}{5}$

2. $\sin\theta = \dfrac{1}{\sqrt{17}}$, $\cos\theta = \dfrac{4}{\sqrt{17}}$