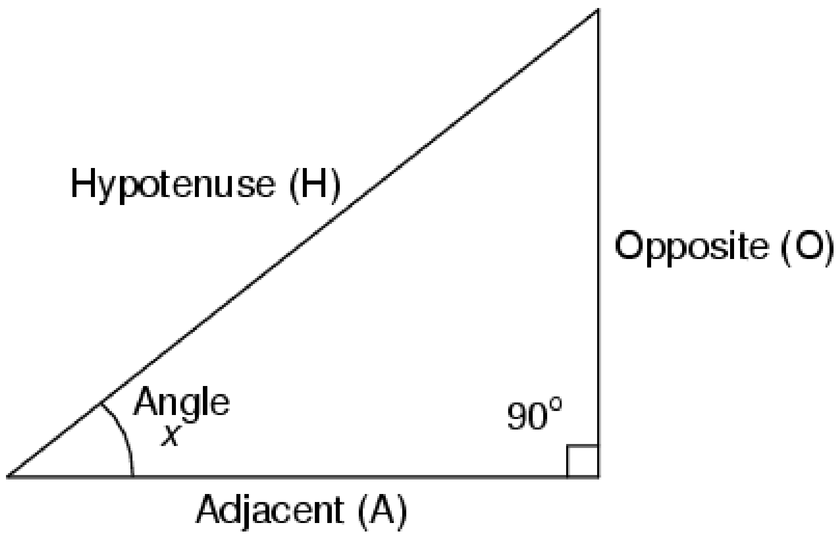
Chapter 5: Trigonometry Reference

Right triangle trigonometry



A *right triangle* is defined as having one angle precisely equal to 90° (a *right angle*).

Trigonometric identities

[]{#Trigonometric identities}

$$\sin x = \frac{O}{H} \qquad \cos x = \frac{A}{H} \qquad \tan x = \frac{O}{A} \qquad \tan x = \frac{\sin x}{\cos x}$$

$$\csc x = \frac{H}{O} \qquad \sec x = \frac{H}{A} \qquad \cot x = \frac{A}{O} \qquad \cot x = \frac{\cos x}{\sin x}$$

H is the *Hypotenuse*, always being opposite the right angle. Relative to angle x, O is the *Opposite* and A is the *Adjacent*.

"Arc" functions such as "arcsin", "arccos", and "arctan" are the complements of normal trigonometric functions. These functions return an angle for a ratio input. For example, if the tangent of 45° is equal to 1, then the "arctangent" (arctan) of

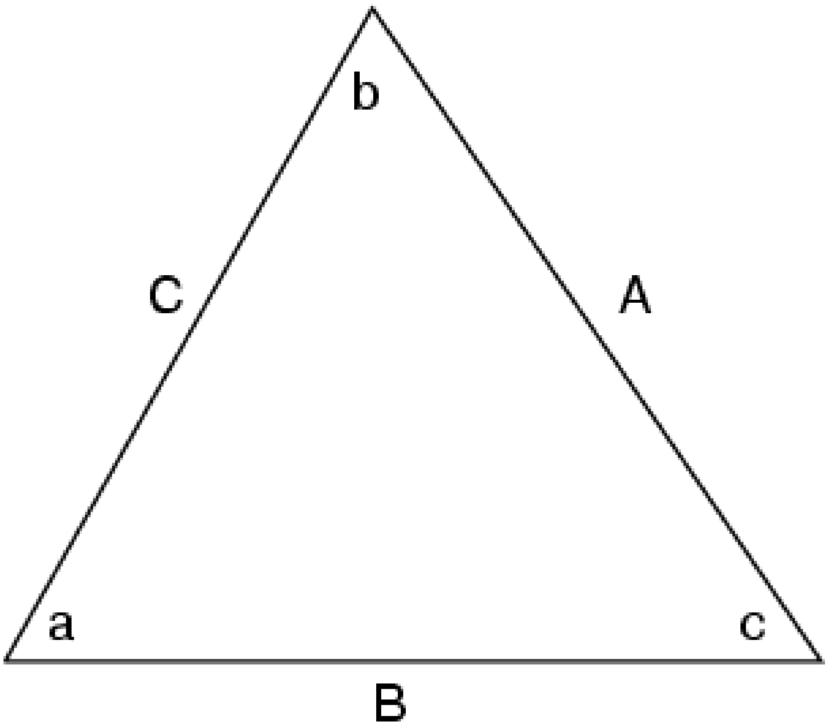
1 is 45°. "Arc" functions are useful for finding angles in a right triangle if the side lengths are known.

The Pythagorean theorem

[]{#Pythagorean Theorem}

$$H^2 = A^2 + O^2$$

Non-right triangle trigonometry



The Law of Sines (for *any* triangle)

[]{#Law of sines} []{#Sines, law of}

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

The Law of Cosines (for *any* triangle)

[]{#Law of cosines} []{#Cosines, law of}

$$A^2 = B^2 + C^2 - (2BC)(\cos a)$$

$$B^2 = A^2 + C^2 - (2AC)(\cos b)$$

$$C^2 = A^2 + B^2 - (2AB)(\cos c)$$

Trigonometric equivalencies

[]{#Trigonometric equivalencies}

$\sin -x = -\sin x$ $\cos -x = \cos x$ $\tan -t = -\tan t$

$\csc -t = -\csc t$ $\sec -t = \sec t$ $\cot -t = -\cot t$

$\sin 2x = 2(\sin x)(\cos x)$ $\cos 2x = (\cos^2 x) - (\sin^2 x)$

$$\tan 2t = \frac{2(\tan x)}{1 - \tan^2 x}$$

$\sin^2 x = \frac{1}{2} - \frac{\cos 2x}{2}$ $\cos^2 x = \frac{1}{2} + \frac{\cos 2x}{2}$

Hyperbolic functions

[]{#Hyperbolic functions} []{#Unit, radian}

$$\sinh x = \frac{e^x - e^{-x}}{2}$$

$$\cosh x = \frac{e^x + e^{-x}}{2}$$

$$\tanh x = \frac{\sinh x}{\cosh x}$$

Note: all angles (x) must be expressed in units of *radians* for these hyperbolic functions. There are 2π radians in a circle (360^o).

Contributors

Contributors to this chapter are listed in chronological order of their contributions, from most recent to first. See Appendix 2 (Contributor List) for dates and contact information.

Harvey Lew (??? 2003): Corrected typographical error: "tangent" should have been "cotangent".