

# Trilateration for SketchUp v5 and higher (Free and Pro)

D. Bur, May 2008, updated June 2008

This script is intended to draw triangles when their three side lengths are known.

## 1. Installation:

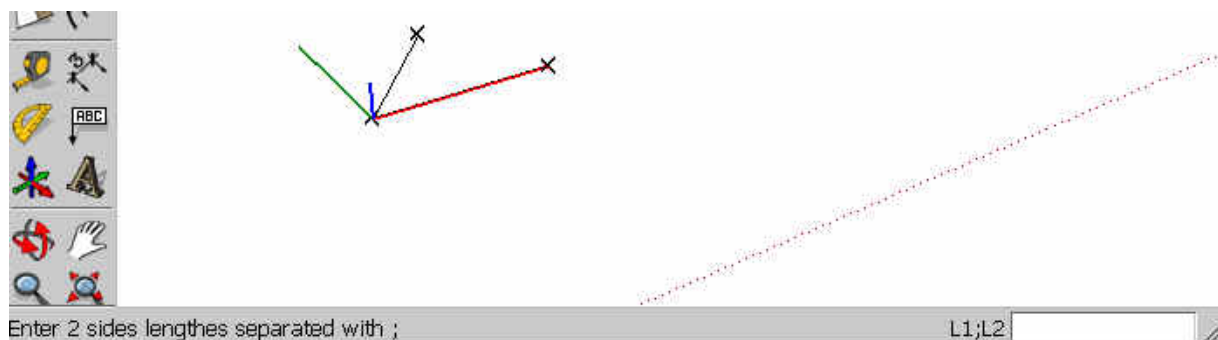
Put the file "trilateration.rb" in your Plugins folder. Restart SketchUp. You should find a "Trilateration" sub-menu in your "Draw" menu.

## 2. Usage:

- Select "Draw triangle" in the "Trilateration" sub-menu.
- Click a first point to define the starting point of the first side of the triangle.
- Click a second point or enter a length in the VCB to define the ending point of the first side of the triangle (Inference can be used, length uses current unit if entered):

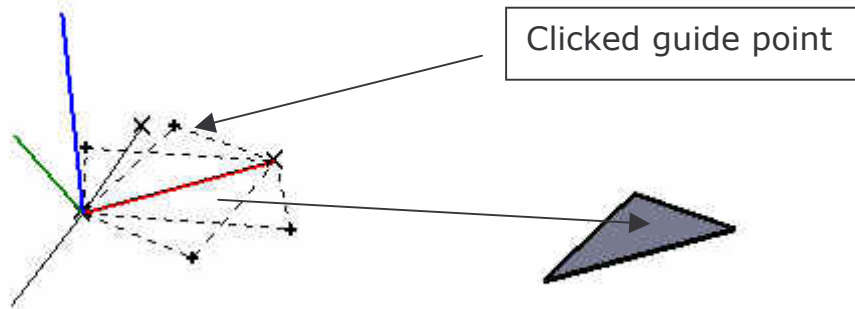


- Click a third point to define the plane of the triangle. An axis system is displayed. The red-green plane is the plane of the triangle:



- Watch the status bar and the VCB: enter the two lengths of the two other sides of the triangle, separated with ";" (no matter the order of the two lengths). If something is wrong with the lengths, nothing happens (in particular when there is no solution for the triangle, when you entered two lengths whose sum is less than the length of the first side). In this case, just hit "Enter" again and re-enter two lengths.

Once two valid lengths are entered, the four candidate triangles will be displayed as guide lines and guide points:



- Click on one of the four guide points to define the triangle. If you click elsewhere than on one of the guide points, nothing happens. Once a guide point is clicked, the triangle is drawn and all the temporary geometry erased. The tool is ready to draw another triangle.
- Select another tool to escape, or hit "Escape" key to cancel.

#### 4. Settings:

Select "Settings" in the "Trilateration" sub-menu.

Options are related to the created geometry and the guide points and lines.



**Keep geometry:** you can choose among 3 options:

- Face and edges(\*): will keep the triangular face and its boundary lines,
- edges only: will delete the triangular face but leave edges intact,
- none: will erase both the triangular face and its edges.

**Keep guides:** you can choose among 7 options:

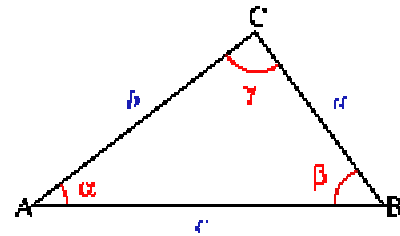
- points: will erase all temp geometry except the 4 candidates points,
- lines: will erase all candidates points and leave all guide lines intact,
- selected point: will erase all guides except the guide point you clicked,
- selected lines: will erase all guide lines except those which define the triangle,
- selected point and lines: will erase all guide lines and points except those which define the triangle,
- all: will leave all guides intact,
- none(\*) : will erase all guides.

(\*) default values

Now, for those interested, some geometry basics:

### What the script does for you: the Law of cosines

From Wikipedia, the free encyclopedia



In [trigonometry](#), the **law of cosines** (also known as **Al-Kashi law** or the **cosine formula** or **cosine rule**) is a statement about a general [triangle](#) which relates the lengths of its sides to the [cosine](#) of one of its [angles](#). Using notation as in Fig. 1, the law of cosines states that

$$c^2 = a^2 + b^2 - 2ab \cos(\gamma),$$

or, equivalently:

$$\begin{aligned} b^2 &= c^2 + a^2 - 2ca \cos(\beta), \\ a^2 &= b^2 + c^2 - 2bc \cos(\alpha), \\ \cos(\gamma) &= \frac{a^2 + b^2 - c^2}{2ab}. \end{aligned}$$

Note that  $c$  is the side opposite of angle  $\gamma$ , and that  $a$  and  $b$  are the two sides enclosing  $\gamma$ . All three of the identities above say the same thing; they are listed separately only because in solving triangles with three given sides one may apply the identity three times with the roles of the three sides permuted.

The law of cosines generalizes the [Pythagorean theorem](#), which holds only in [right triangles](#): if the angle  $\gamma$  is a right angle (of measure  $90^\circ$  or  $\pi/2$  radians), then  $\cos(\gamma) = 0$ , and thus the law of cosines reduces to

$$c^2 = a^2 + b^2$$

which is the Pythagorean theorem.

The law of cosines is useful for computing the third side of a triangle when two sides and their enclosed angle are known, and in computing the angles of a triangle if all three sides are known.