The **ScienceMath**-project: **Similar Triangles used for Parallax-Measurement**
Idea: Tine Golež,
St. Stanislav Institution for Education,
Diocesan Classical Gymnasium Ljubljana, Slovenia

Education and Culture
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Teaching Material

The Context

Figure 1 (not in scale) represents the position of the Earth, the Sun, a nearby star and a distant star. The thinner arrows represent the light traveling from the two stars to the Earth.

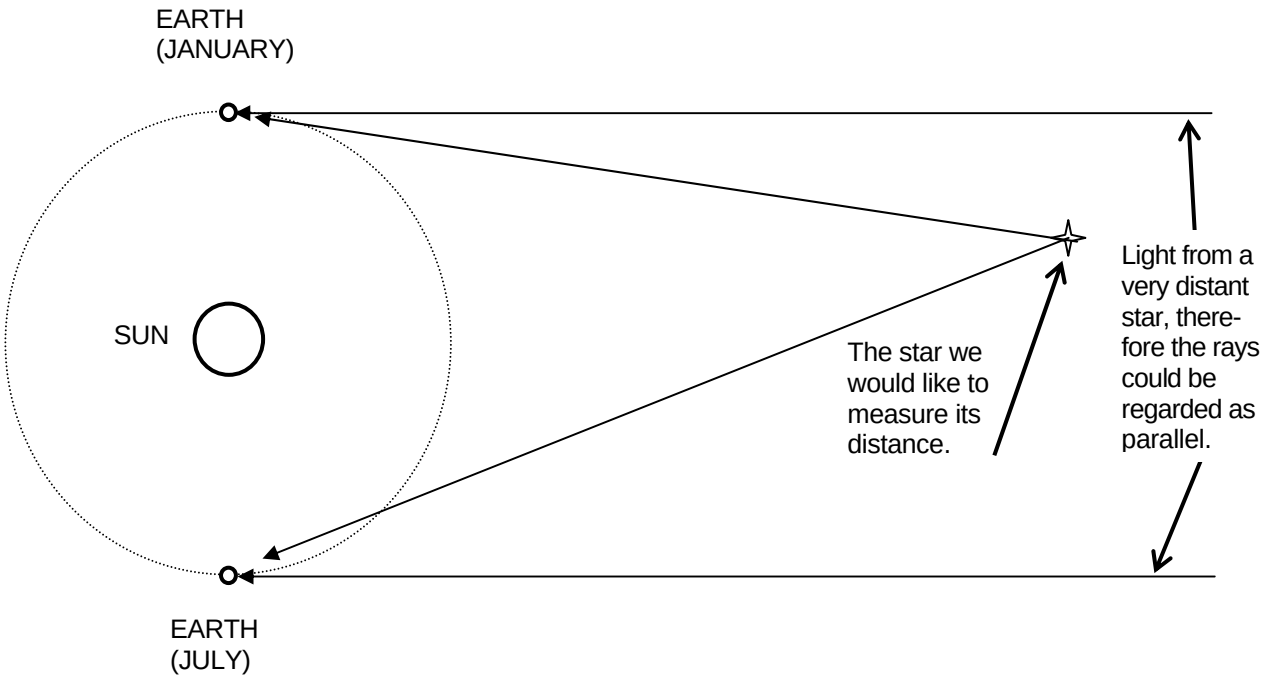

Fig. 1: Model of the Earth, the Sun and two stars. The figure is not in scale.

Idea

Use simple geometry to measure the parallax of a “star”.

Equipment needed:

- 4 base and support rods (stands, see Figure 2)
- ruler attached by rope
- Poster paper
- Measuring tape

Set up

The three stands are placed as shown in Figure 2. Two are placed on the poster paper. They represent the Earth and the third one represents a nearby star. “The distant star” (fourth stand) is far away.

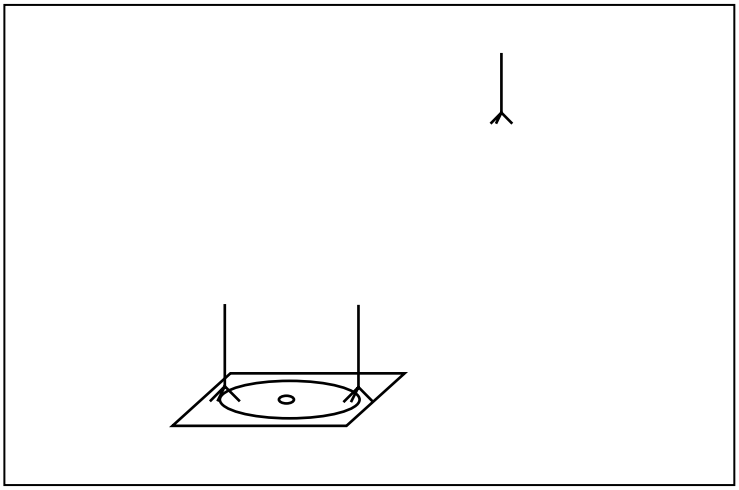

Fig. 2: The three stands representing the Earth (January and July position) and a nearby star. The smaller circle is the Sun, the big one is the earth’s orbit.

Procedure

Attach the ruler’s rope to the “January Earth” stand. The length of the rope is *b*. Measure the distance between the appearing nearby star and the distant star, *x* (Figure 3). Repeat the same procedure starting from the “July Earth” stand and measure *y*. Also measure the distance *a*.

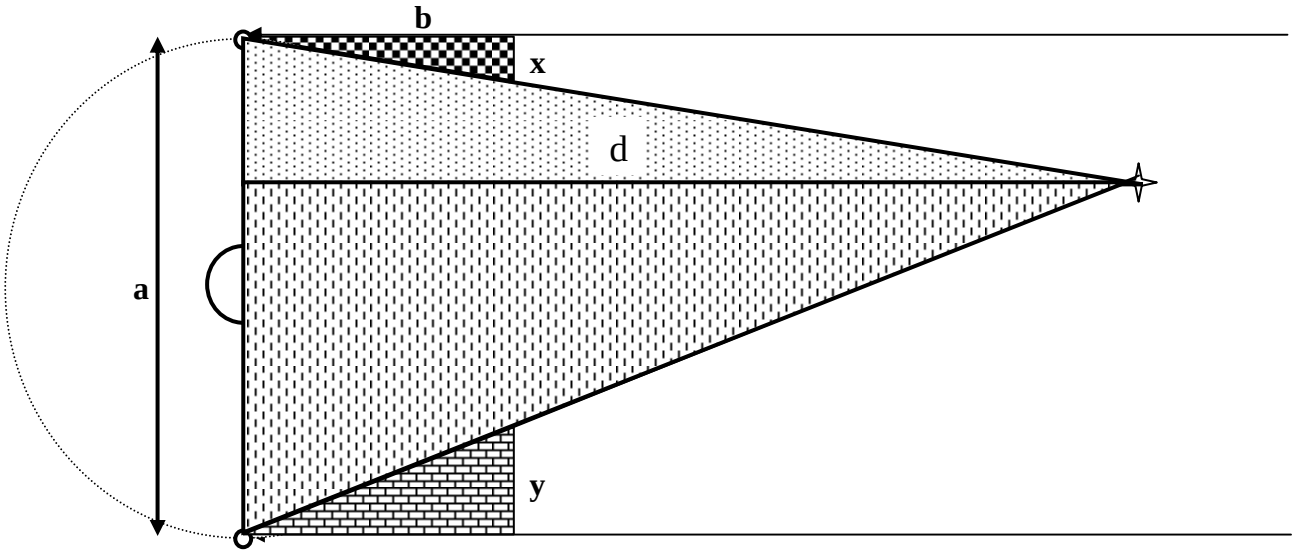

Fig. 3: Measured quantities (a, b, x, y) in our model.

Analysis

You can see two pairs of right-angled triangles in the figure. The upper two triangles are similar and the lower two are also similar. The two longer catheti define the distance to the star (d). Put together the two small triangles (Figure 4) and construct a new triangle, which is not right-angle any more, but is similar to the triangle constructed of the big right-angled triangles (Figure 3).

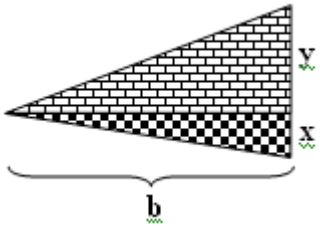

Fig. 4: A triangle constructed of the two small triangles from Figure 3.

Derive the equation for the distance of a star. Use it to calculate the distance to the star. Measure the distance to the star directly (D) using a measuring tape. Put the nearby star to three different positions for each measurement.

measurement No.	a [cm]	b [cm]	x [cm]	y [cm]	d [cm]	D [cm]
1						
2						
3						

Question

What is the reason for the differences (parallax measurement versus direct measurement)?

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