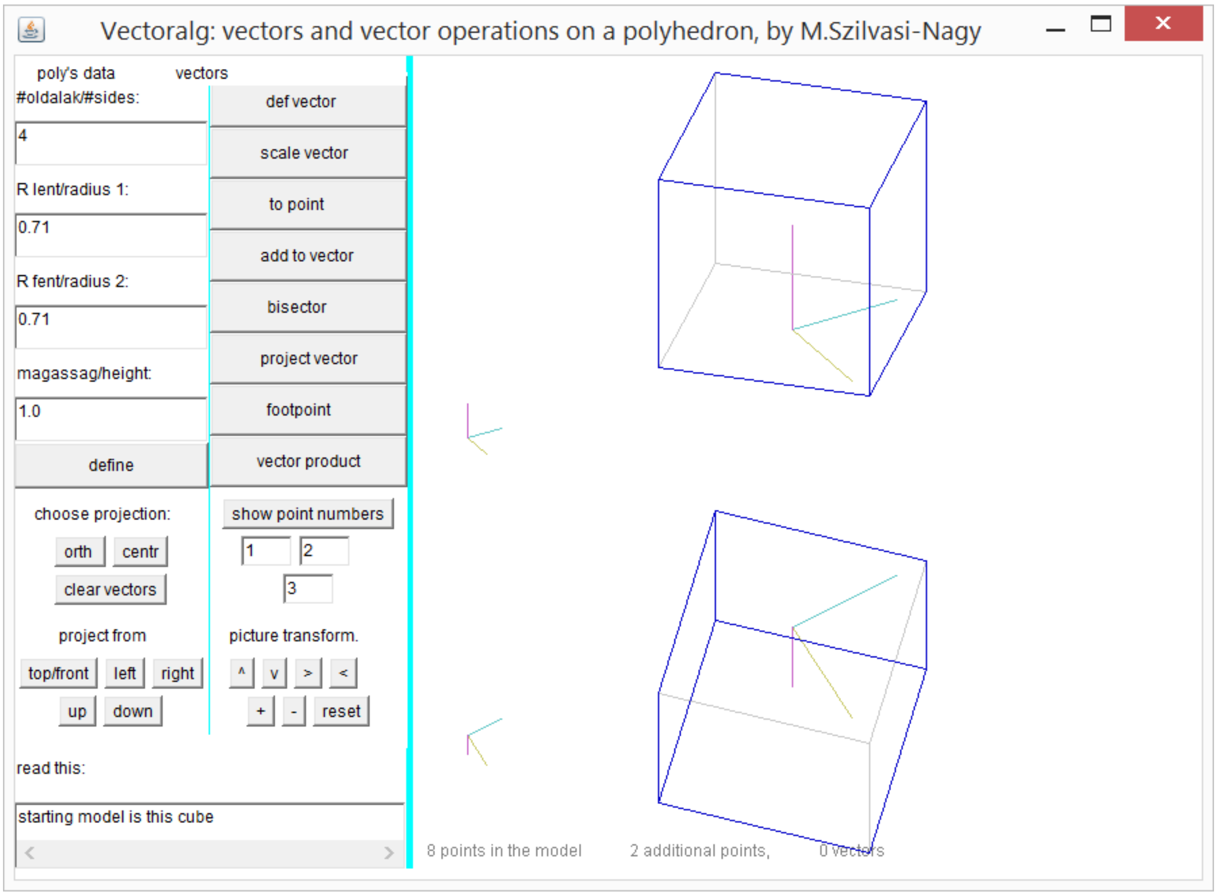
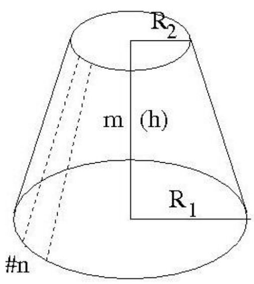
Vectoralg: a program for visualizing vectors and vector operations on the surface of a polyhedron.

The window of the program may appear in icon-size. In this case enlarge the window!

<u>Use the menu system! The mouse is not active in the drawing field!</u>



The polyhedron is a regular truncated pyramid defined by the number n of side faces, the radius R_1 of the circumscribed circle of the base polygon, the radius R_2 of the circumscribed circle of the covering face and the hight m (h). With the special data at starting the program the polyhedron is the unit cube. It is shown in the Monge projection by two orthogonal projections. You may change the polyhedron by entering appropriate data in the textfields on the left side of the menu.



The central projection (click on the button *centr*) shows an anaglyph picture, which makes a 3D effect by using red-green glasses.

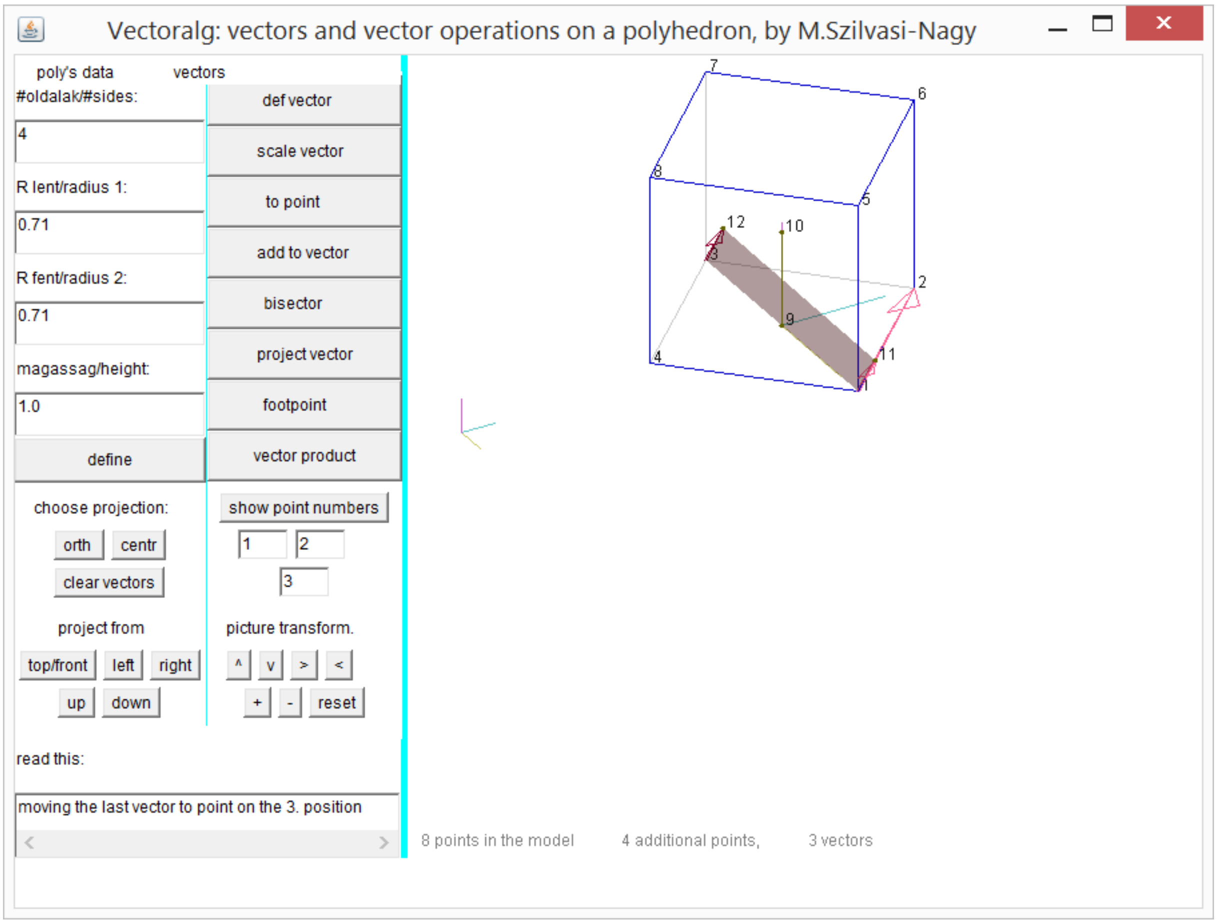
The vectors can be defined by the numbers of their tail and head points shown in the first and second textfield on the right side of the menu (these numbers are 1 and 2 at starting the program). The vertices and two points on the axis of the truncated pyramid are numerated (click on *show point numbers*). The third number is also a point number (it specifies the new starting point in the command *move* a vector) or a factor of *scaling* the actual vector.

The direction of projection can be changed by clicking on *top/front, left, right, up* and *down*. This does not change the position of the polyhedron in the coordinate system.

The position of the projection in the window can be changed by clicking on the buttons below *picture transform*. These are 2D transformations in the image plane.

Examples

1. Definition, scaling and moving a vector



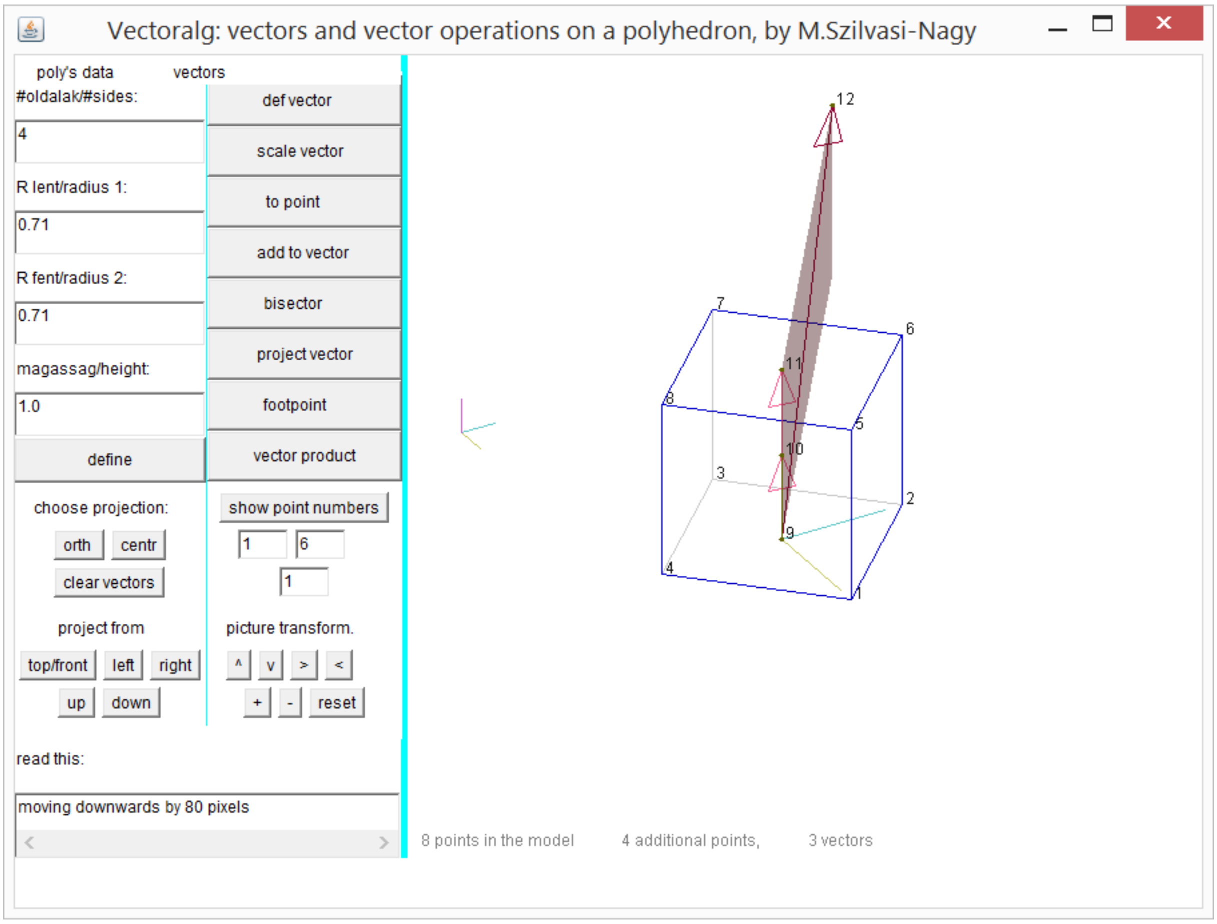
We **define** the edge vector starting from vertex 1 and ending in vertex 2 by the command *def vector.* These vertex number are in the first and second textfield on the right side in the menu (default numbers are 1 and 2)

The vector will be **multiplied by the scalar** number 3/10 by the command *scale vector*. The nominator of this factor is in the third textfield on the right side in the menu (default value = 3). The head of the vector is a new point number 11.

We **move** this vector into the point number 3 (this number is in the third textfield) by the command *to point*. This vector defines a new point number 12.

clear vectors deletes the vectors and the new points.

2. Orthogonal projection of a vector onto the last one and addition of two vectors.



Define the vector 9-10, which is on the axis of this special truncated pyramid (default cube), it is half edge long. Enter the numbers 1 and 6 into the first two text fields. The **orthogonal projection** of the diagonal vector 1-6 onto the last vector 9-10 is computed by the command *project vector*. For this operation the vector to be projected is moved into the common starting point number 9. The triangle of the projection will be shown.

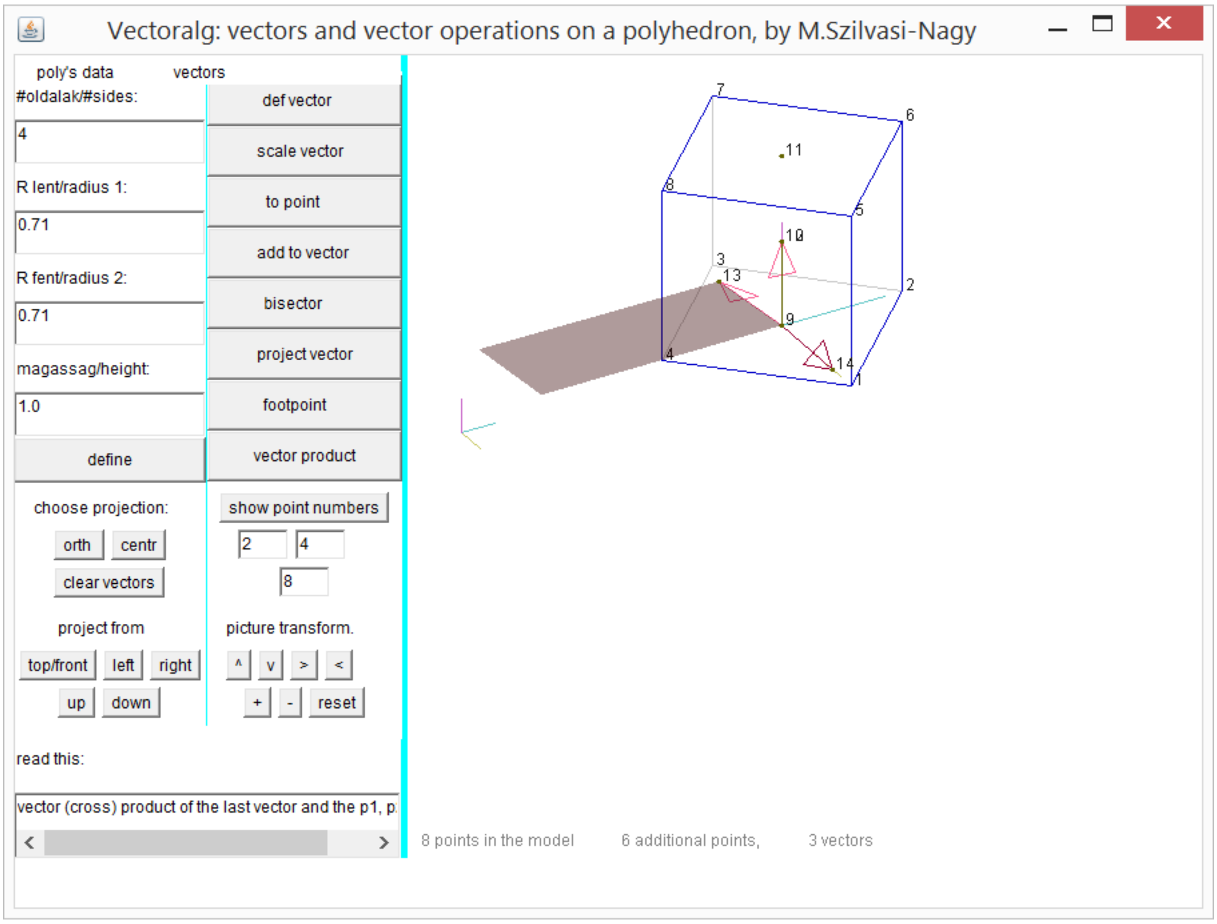
To the new actual vector 9-11 we **add the vector** 1-6 by the command *add to vector*. The parallelogram of this vector operation is shown. Move the projection downwards by clicking on “v” in order to fit the model into the screen.

Click on *clear vectors* and *reset!*

3. Orthogonal projection of a point onto the actual vector, bisector and vector (cross) product of two vectors.

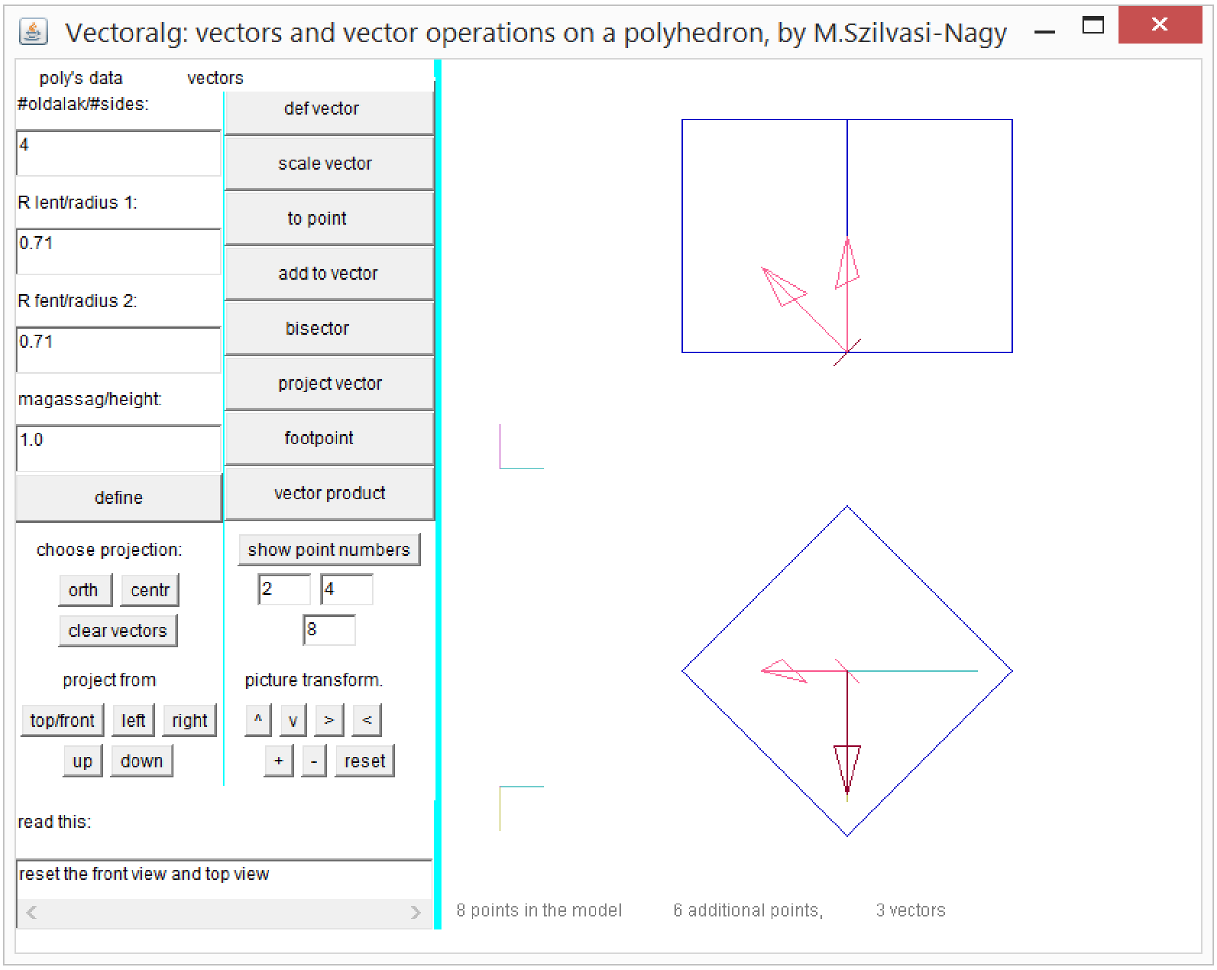
Define again the vector 9-10, enter the number 8 in the third textfield, then find the **orthogonal projection** of the vertex number 8 on the line of this vector. It is the *footpoint* of the perpendicular on the line 9-10 through the point number 8. The result is the point 11, which is the center point of the covering face.

Enter the numbers 2 and 4 into the first two textfields! Find the **bisector** of this vector 2-4 and the last one. The triangle of the construction will be shown.



The **vector product** of the actual vector with the data in the first and second textfields (2 and 4) and the last vector is perpendicular to both factors. The plane of them is shown by a parallelogram. The result is the vector 9-14.

The spatial position is clearer, if you rotate the direction of projection to the *right* four times, now the diagonal plane of the cube is in the image plane, and the vector 9-14 shows downwards in this projection. Switch into the Monge projection by clicking on the button *orth* and *top/front.* (The numbering is not shown, but the color of the last vector is dark red.) You can see that the vector product 9-14 is lying in the base of the cube.



4. Definition of a new polyhedron.

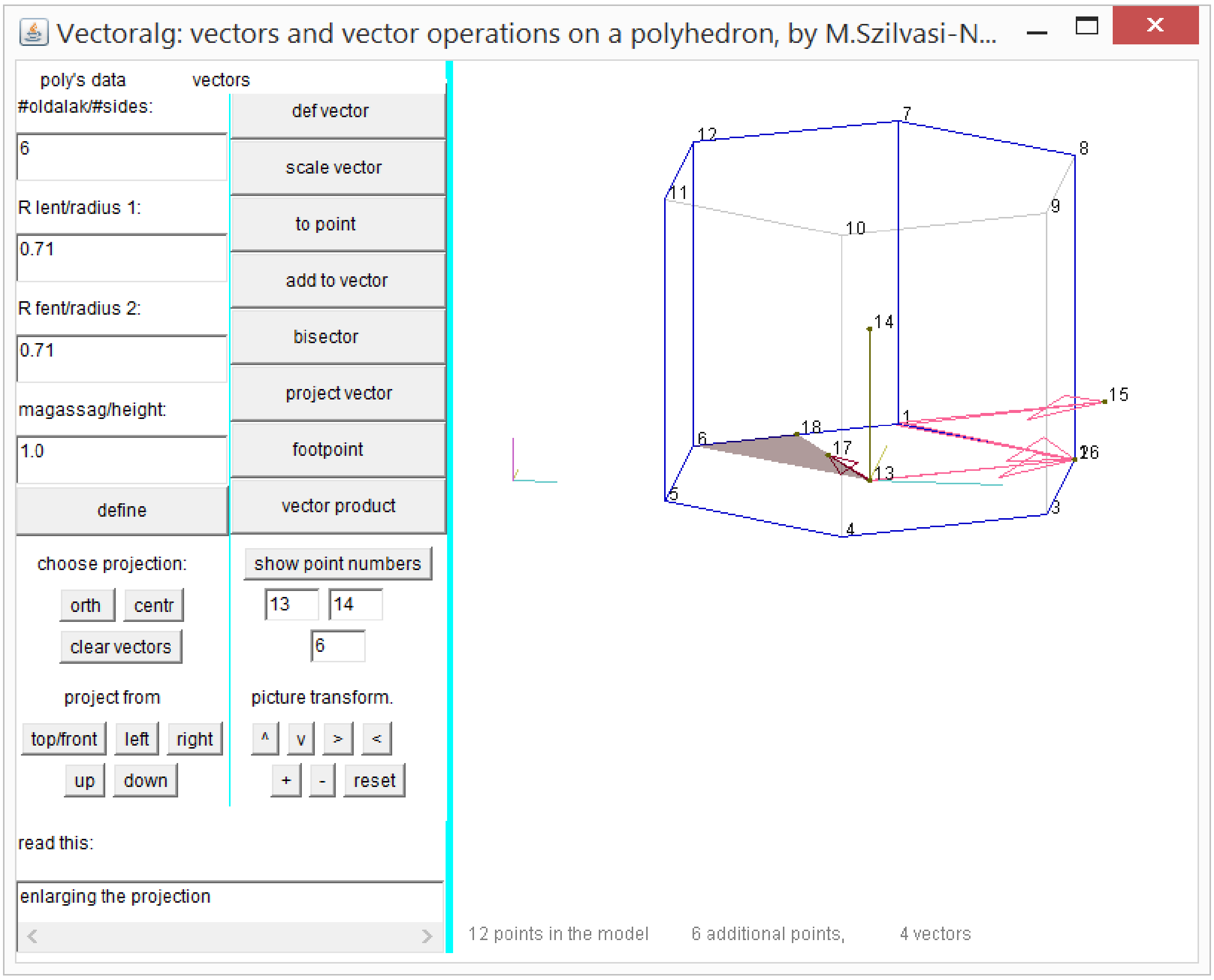
After starting the program change the number of side faces onto 6, and click on *define*! The polyhedron is a regular prism.

Give the following commands, and watch what happens:

Create the vector 1-2 by *def vector,* enter the numbers 3 and 2 into the first and second textfield, then *add to vector.* Enter 13 into the third textfield, then move the last vector into this point by the command *to point.* The result is equal to the half diagonal 13-2. Generate the vector (cross) product by the vector 13-14 (first enter 13 and 14 for tail and head numbers and click *vector product*). The projection of the resulting vector shows downwards on the axis line, but in fact it is lying in the base face. Check this situation by clicking on *top/front*! Many things are coinciding now, click twice on *down* and one times on *left* for better understanding.

Find the foot point of the vertex number 6 (or 1), you will get the center point of the edge 6-1.

In the picture the projection of the model is moved downwards and enlarged by clicking on "+" twice.



Create new examples and have a lot of fun!

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