

**Homework #2**  
Due on Tuesday 10/29

**Exercise 1.**

Write a program that, for four points A, B, C and P, draws a triangle formed by ABC and a small cross showing the position of P; and displays a line of text indicating which of the following three cases applies: P lies (a) inside ABC, (b) outside ABC, or (c) on an edge of ABC.

The user will specify the four points by clicking.

**Exercise 2.** (3.1 page 88 from the textbook)

**Exercise 3.**

Show that the following sequences commute:

- A rotation and a uniform scaling
- Two rotations about the same axis
- Two translations

**Exercise 4.**

If we are interested in only two-dimensional graphics, we can use three-dimensional homogeneous coordinates by representing a point as  $p=[x \ y \ 1]^T$  and a vector as  $v=[a \ b \ 0]^T$ . Find the 3x3 rotation, translation, scaling, and shear matrices. How many degrees of freedom are there in an affine transformation for transforming two-dimensional points?

**Exercise 5.**

Three vertices determine a triangle if they do not lie in the same line. Devise a test for collinearity of three vertices.

**Optional:** Write a JAVA program that receives coordinates of three points and draws the triangle or output the following message: *“the points you gave are in the same line”*.