

JAN KAUTZ

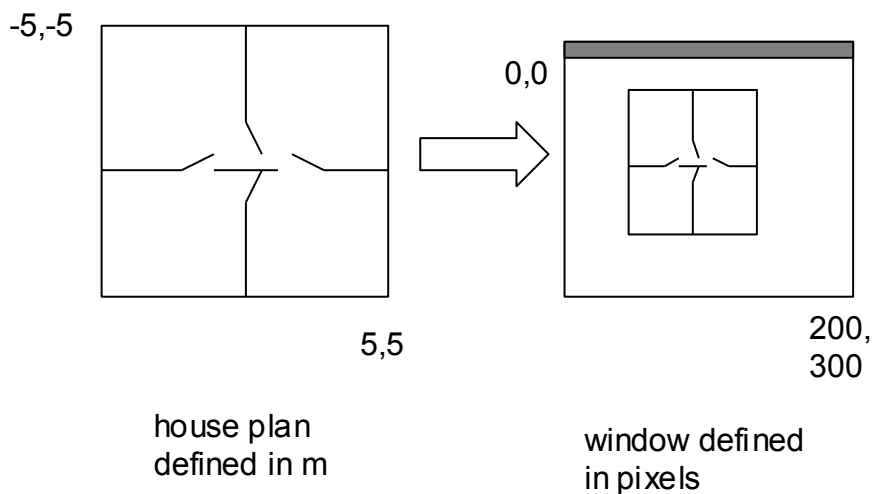
DEPARTMENT OF COMPUTER SCIENCE, UNIVERSITY COLLEGE LONDON

LECTURE 5: VECTOR, MATRICES AND COORDINATE SYSTEMS

MAPPING FROM LOGICAL CO-ORDINATES TO SCREEN CO-ORDINATES

"Logical co-ordinates" are equivalent to "world co-ordinates" in the context of 2D graphics.

Whenever diagrams, such as building blueprints, are stored they are stored in some meaningful co-ordinate system such as meters. The reasons for this are various, but perhaps the main one you will be familiar with is the problem of drawing a particular figure on windows of different sizes.



We set up the mapping from logical to screen co-ordinates as described in the slides. Note that we have a lot of flexibility in doing the mapping. For example it is easy to set up zoom facilities by choosing the appropriate projection.

ORDER MATTERS

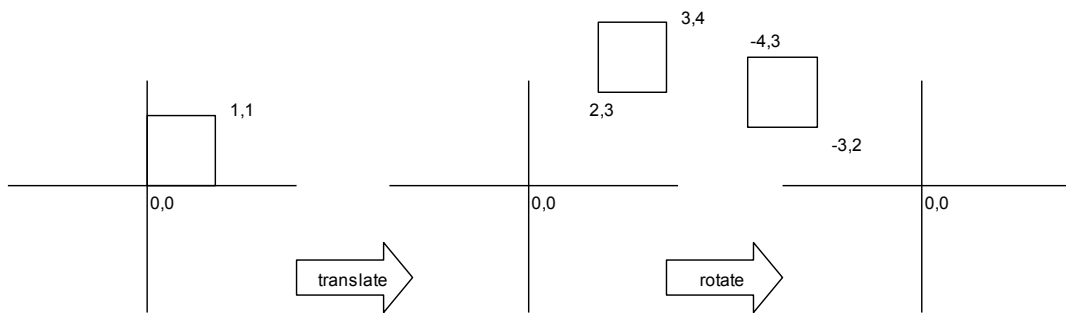
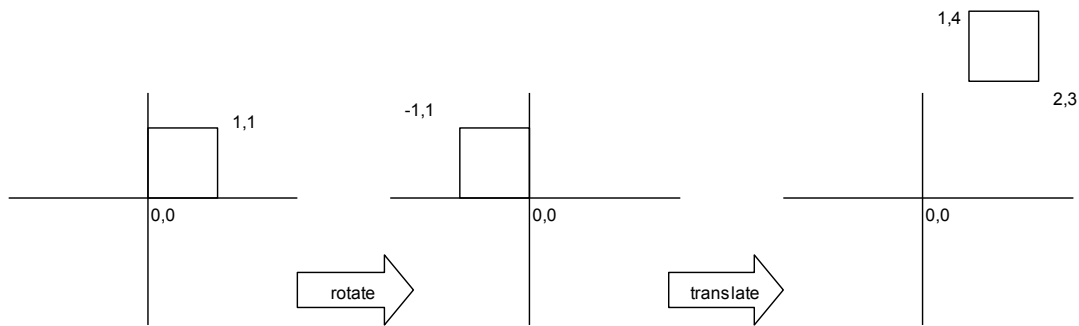
Rotate 90 degrees, then translation 2,3

$$(x \ y \ 1) \begin{pmatrix} 0 & 1 & 0 \\ -1 & 0 & 0 \\ 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 2 & 3 & 1 \end{pmatrix} = (x \ y \ 1) \begin{pmatrix} 0 & 1 & 0 \\ -1 & 0 & 0 \\ 2 & 3 & 1 \end{pmatrix} = (2 - y \ x + 3 \ 1)$$

Translation 2,3 then rotate 90 degrees

$$(x \ y \ 1) \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 2 & 3 & 1 \end{pmatrix} \begin{pmatrix} 0 & 1 & 0 \\ -1 & 0 & 0 \\ 0 & 0 & 1 \end{pmatrix} = (x \ y \ 1) \begin{pmatrix} 0 & 1 & 0 \\ -1 & 0 & 0 \\ -3 & 2 & 1 \end{pmatrix} = (-3 - y \ x + 2 \ 1)$$

The following figures illustrate the difference:



EXERCISES

1. Remember your sine and cosine rules? Show that rotation(A) followed by rotation(B) is equal to rotation(A+B) by multiplying out the rotation matrices for rotation(A) and rotation(B).
2. Make sure you understand rotation around a point. Rotate the triangle consisting of the point (1,2) (2,2) (2,0) by 90 degrees clockwise about the point (3,1).
3. Write down a single 3x3 matrix that perform a rotation of angle k , about a point (p,q) .
4. From the June 2000 exam:

A logical coordinate to screen coordinate mapping is set up so that a diagram which has an extent of (-5, -4) to (+5, +6) in logical coordinates is mapped onto a screen with pixel co-ordinates from 0,0 to 300, 400. The user clicks on pixel 200,300. What does this correspond to in the logical co-ordinates of the diagram?

5. Create the 3x3 matrix that performs the mapping from Question 4.