Computer Graphics Topics for Programmers Assignment 1

Name:

Remember the homogeneous representation of the basic 2D transformation matrices:

Translation: $$T = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ t_x & t_y & 1 \end{bmatrix}$$

Rotation: $$R = \begin{bmatrix} \cos\theta & \sin\theta & 0 \\ -\sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

Scale: $$S = \begin{bmatrix} s_x & 0 & 0 \\ 0 & s_y & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

And remember the way to multiply a point by a matrix:

$$pM = [p_x \quad p_y \quad W]\begin{bmatrix} a & b & c \\ d & e & f \\ g & h & i \end{bmatrix} = \left[ap_x + dp_y + gW \quad bp_x + ep_y + hW \quad cp_x + fp_y + iW\right]$$

And the way to compose two matrices:

$$NM = \begin{bmatrix} a & b & c \\ d & e & f \\ g & h & i \end{bmatrix}\begin{bmatrix} j & k & l \\ m & n & o \\ p & q & r \end{bmatrix} = \begin{bmatrix} aj + bm + cp & ak + bn + cq & \ldots \\ dj + em + fp & \ldots & \ldots \\ \ldots & \ldots & gl + ho + ir \end{bmatrix}$$

1. Sign up for the class email list at lists.hampshire.edu (it's cs223). Be sure to respond to the email you receive or else you won't be put on the list.

2. Derive a composite matrix C resulting from multiplying an arbitrary rotation matrix R by an arbitrary translation matrix T (C = RT).

3. Derive a composite matrix D where D = TR.

4. Under what conditions does C = D?

5. Rotations and scales occur about the origin of the coordinate frame in which they are applied. Derive a composite matrix that scales about an arbitrary point q. Hint: don't forget to move back!