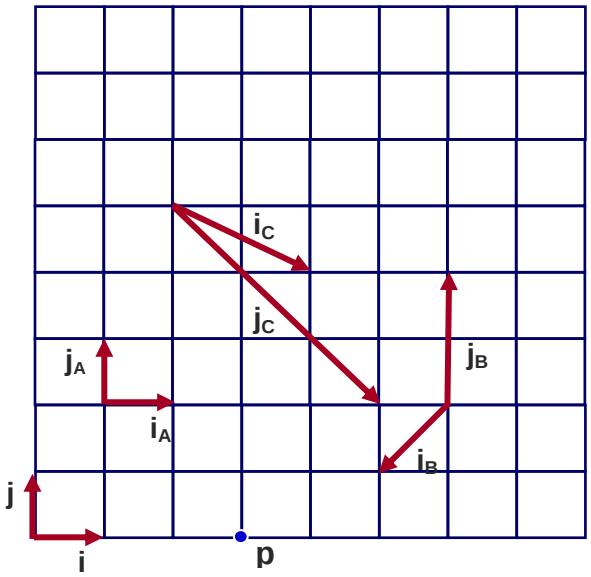
CS174A Assignment 1 - Part 1
Written Section: Transformations

Out: Wed 9 April 2014
Due: Tue 22 April 2014 12pm

Value: 5% of final grade
Total Points: 110

1. (21 pts) The point coordinate **p** can be expressed as **p** = 3***i** + 0***j**, where **i** and **j** are basis vectors of unit length along the **x** and **y** axes, respectively. Describe the point **p** in terms of the 3 other coordinate systems given below.



2. (3 pts) Write down the 4x4 matrix for scaling an object by 2 in **y** and 3 in **z**.

3. (10 pts) Give the OpenGL Shader commands required to create **M** using elementary transformations . You may assume the matrix stack has been initialized with `modelMatrix.setAsIdentity();`.

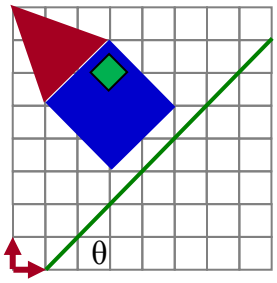
$$\begin{bmatrix} 1 & 0 & 0 & 1 \\ 0 & 1 & 0 & 1 \\ 0 & 0 & 2 & 1 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

4. (6 pts) Homogenize the point $[2\ 10\ 8\ 4]^T$.

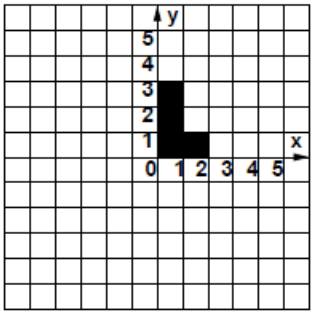
5. (20 pts) Write down the 4x4 OpenGL modelview matrix at the four lines A, B, C, and D below.

```
modelMatrix.setAsIdentity();
modelMatrix = modelMatrix * Translate(2,3,0);
//A
modelMatrix = modelMatrix * RotateY(90);
//B
matrixStack.push(modelMatrix);
modelMatrix = modelMatrix * Scale(1,.5,1);
modelMatrix = modelMatrix * Translate(1,1,0);
//C
modelMatrix = matrixStack.pop();
modelMatrix = modelMatrix * Scale(2,1,1);
//D
```

6. (24pts) Write the composite 2D matrix **M** that performs a reflection about an arbitrary tilted line using the elementary transformations and write the equivalent OpenGl Shader code that generates **M**.

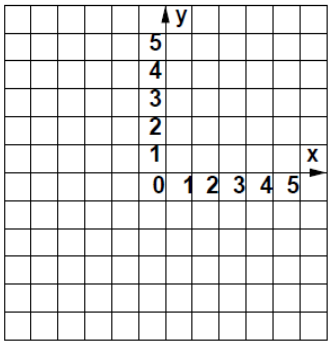


7. (26 pts) For each equation below, sketch the new location `L'` of the `L` shape on the grid and provide the sequence of commands needed to carry out those operations. Use the function `drawL()`, which draws an L shape with the lower left corner at the current origin as shown below. You may assume the matrix mode is `matrixStack.push(modelMatrix)` and that the stack has been initialized with `modelMatrix.setAsIdentity()`.

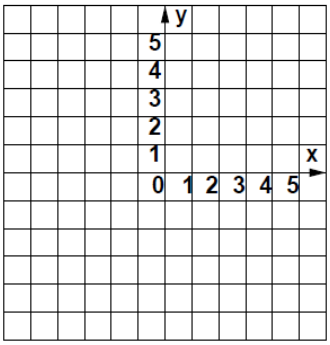


$$\mathbf{A} = \begin{bmatrix} 2 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}, \mathbf{B} = \begin{bmatrix} 1 & 0 & 0 & 1 \\ 0 & 1 & 0 & 1 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}, \mathbf{C} = \begin{bmatrix} 0 & -1 & 0 & 0 \\ 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}, \mathbf{D} = \begin{bmatrix} -1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

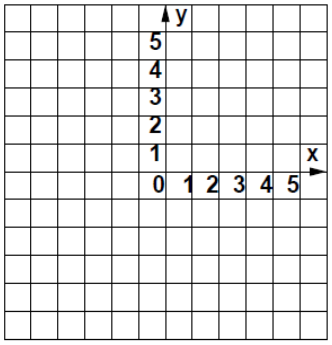
a) L' = ABC L



b) L' = CAD L



c) L' = CBD L



d) L' = DCCAD L