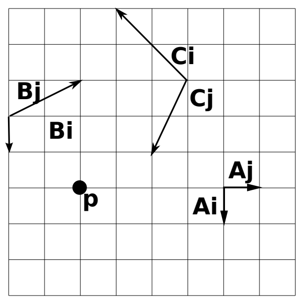
CPSC 314, Written Homework 1: Transformations

Out: Mon 14 Jan 2010
Due: Fri 25 Jan 2010 5pm
Value: 4% of final grade
Total Points: 100

1. (15 pts) The point coordinate P can be expressed as (2,3): that is, P = 2*i + 3*j, where i and j are basis vectors of unit length along the x and y axes, respectively, with an origin at the lower left of the grid. Describe the point P in terms of the three other coordinate systems given below (A, B, C).



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

3. (8 pts) Give the OpenGL commands required to encode M. You may assume the matrix stack has been initialized with `glIdentity()`.

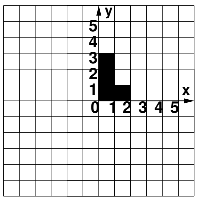
$$\begin{bmatrix} 0 & 0 & 1 & 1 \\ 0 & 1 & 0 & 1 \\ -1 & 0 & 0 & 1 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

4. (4 pts) Homogenize the point (4,4,6,2).

5. (16 pts) Give the 4x4 OpenGL modelview matrix at the four lines A, B, C, and D below.

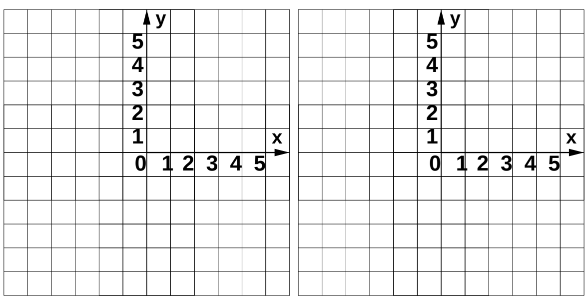
```
glLoadIdentity();
glTranslate(1,1,0);
A
glRotate(90, 1,0,0);
B
glPushMatrix();
glScale(1,2,1);
glTranslate(1,1,0);
C
glPopMatrix();
glTranslate(1,1,0);
D
```

6. (54 pts) For each equation below, sketch the new location L' of the L shape on the grid and provide the OpenGL sequence 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 `GL_MODELVIEW` and that the stack has been initialized with `glLoadIdentity()`. For reference, the OpenGL command syntax is `glRotatef(angle,x,y,z)`, `glTranslatef(x,y,z)`, `glScalef(x,y,z)`. Show your partial work, with the position that the L would be drawn after each matrix multiplication.

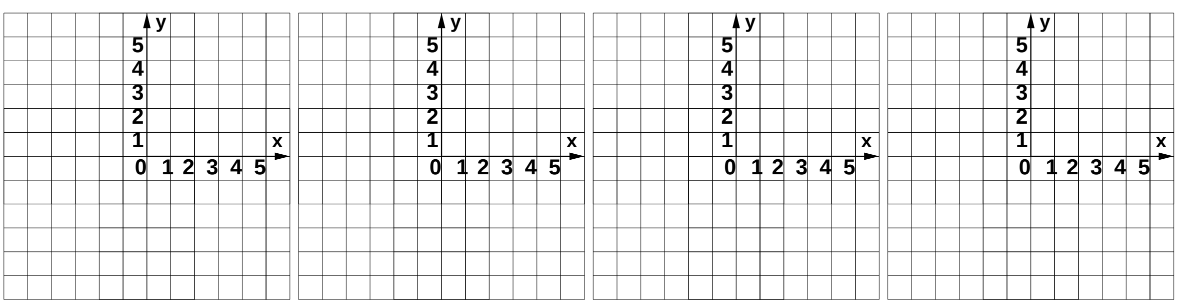


$$\mathbf{A} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 2 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}, \mathbf{B} = \begin{bmatrix} 0 & -1 & 0 & 0 \\ 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}, \mathbf{C} = \begin{bmatrix} 1 & 0 & 0 & 1 \\ 0 & 1 & 0 & 1 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}, \mathbf{D} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & -3 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

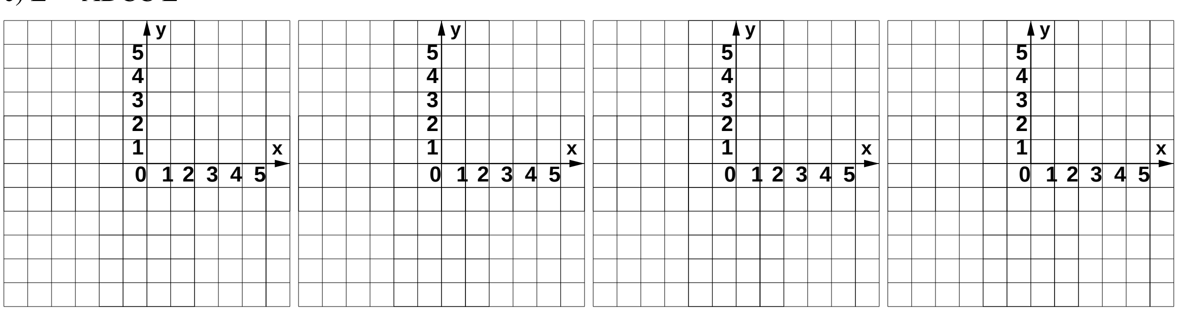
a) L' = BC L



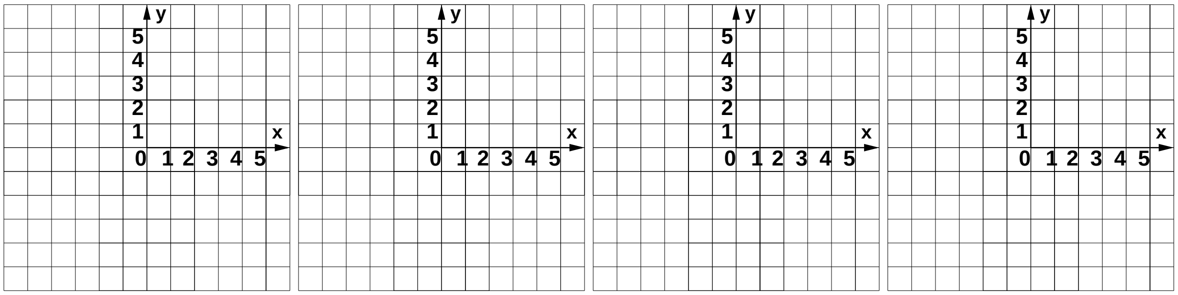
b) L' = CDAC L



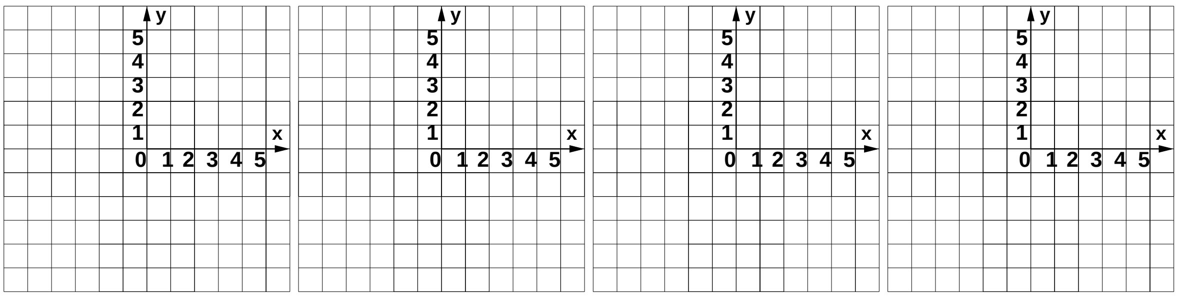
c) L' = ADCC L



d) L’ = DCBD L



e) L’ = BBCB L



f) L’ = CCBC L