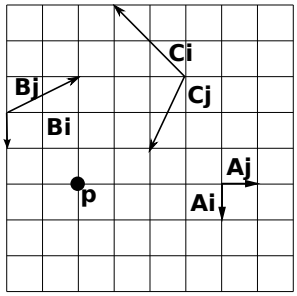
CPSC 314, Written Homework 1: Transformations

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()`.

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

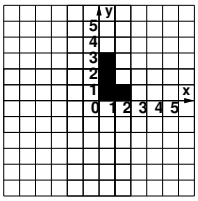
4. (4 pts) Homogenize the point (4,4,6,2).

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
```

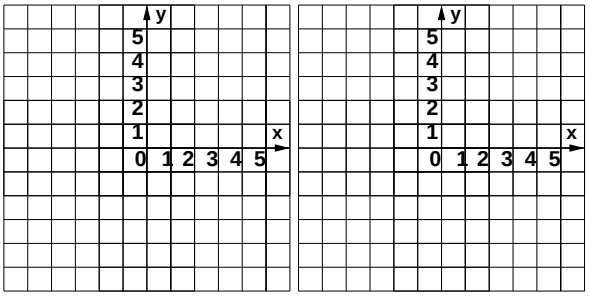
6. (54 pts) For each equation below, sketch the new location L' of the L shape on the grid and provide the OpenGL sequence needed to carry out those operations. Use the function `drawL()`, which draws an L shape with the lower left corner at the current origin as shown below. You may assume the matrix 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.

Update 18 Jan: Do these computations in both directions: from left to right (moving coordinate frame), and also from right to left (moving object). You will get different intermediate answers, but the final position of the L should be the same each way; it's a good way to cross-check your work! You'll want to print out two copies of this writeup. Make sure to indicate which direction you're doing the computation for each set of pages. You don't need to rewrite the OpenGL commands on the second set, once is enough.

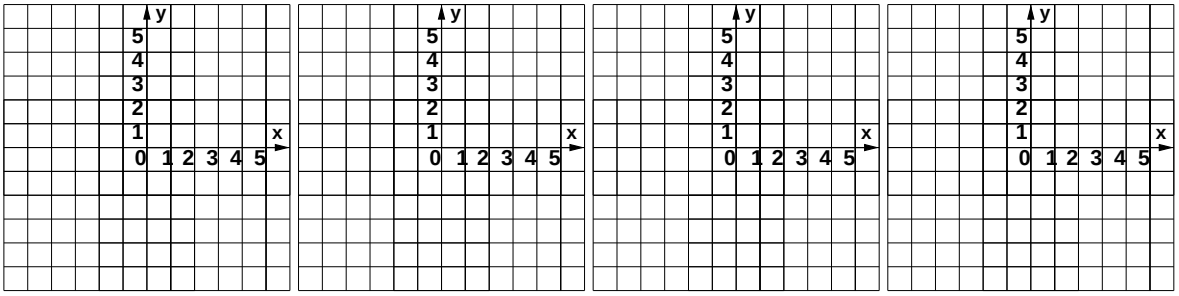


$$\mathbf{A} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 2 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}, \mathbf{B} = \begin{bmatrix} 0 & -1 & 0 & 0 \\ 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}, \mathbf{C} = \begin{bmatrix} 1 & 0 & 0 & 1 \\ 0 & 1 & 0 & 1 \\ 0 & 0 & 1 & 0 \\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

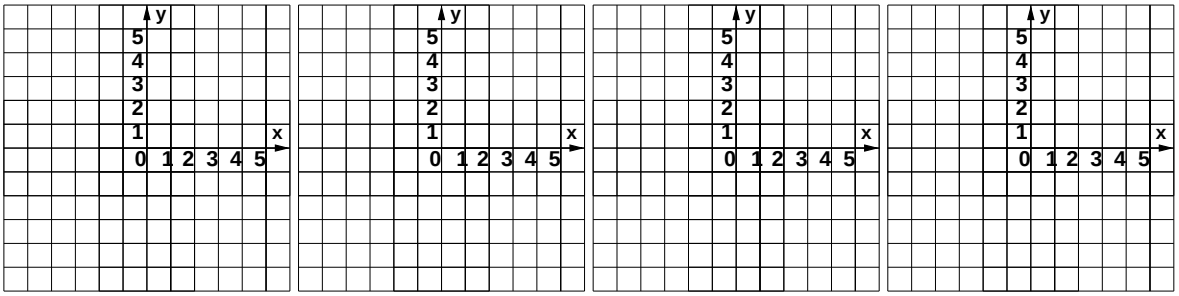
a) L' = BC L



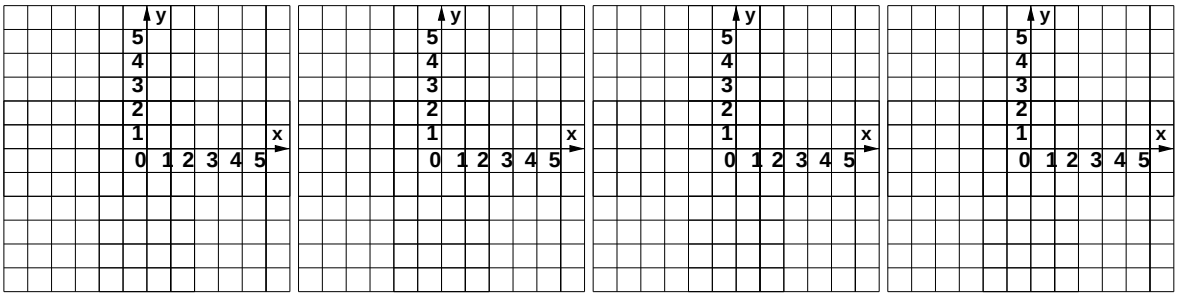
b) L' = CDAC L



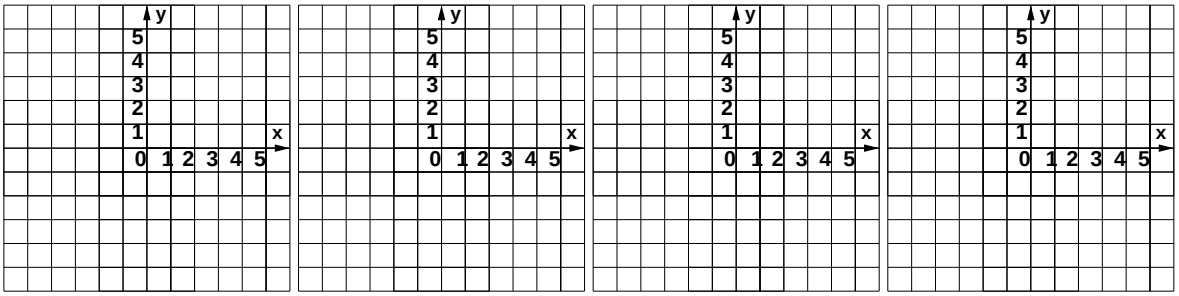
c) L' = ADCC L



d) L’ = DCBD L



e) L’ = BBCB L



f) L’ = CCBC L