CPSC 314, Midterm Exam

31 May 2005

Closed book, one single-sided sheet of handwritten notes allowed. Answer the questions in the space provided. If you run out of room for an answer, continue on the back.

Name: _____

Student Number: _____

Question	Points Earned	Points Possible
1		24
2		4
3		8
4		12
5		10
6		13
7		13
8		2
9		4
10		10
Total		100

1. (24 pts) Using the matrices

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

Sketch a picture of the six houses h1 = **A** h, h2 = **A B** h, h3 = **A B C** h, h4 = **A B C D** h, h5 = **A B D** h, and h6 = **B A** h in the six grids below that show h. Make sure to label each grid with the name of the house.
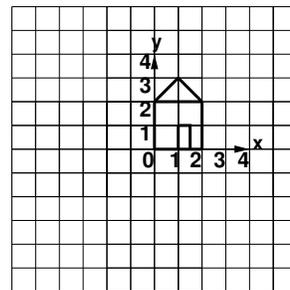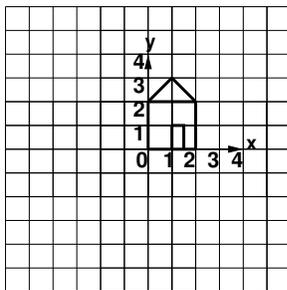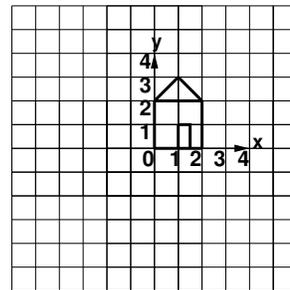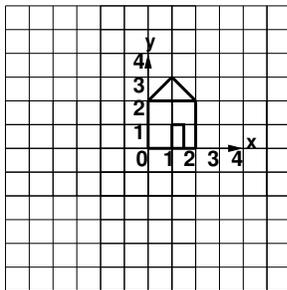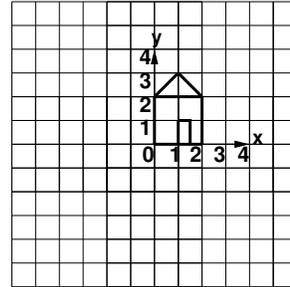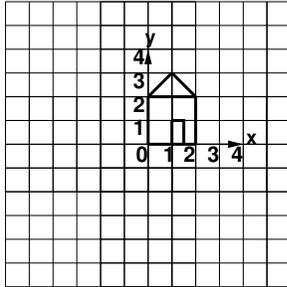
2. (4 pts) Give sequence of OpenGL commands necessary to implement h5 = **A B D** h. You can draw a house with the `drawHouse()` command.

3. (8 pts) Draw houseP and houseQ transformed by the appropriate OpenGL commands. The untransformed house is below.
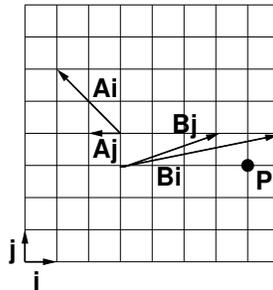
```
glIdentity();
glTranslate(-3, -2, 0);
glScale(2, 1, 1);
glPushMatrix();
glRotate(-90, 0, 0, 1);
drawHouseP();
glPopMatrix();
drawHouseQ();
```
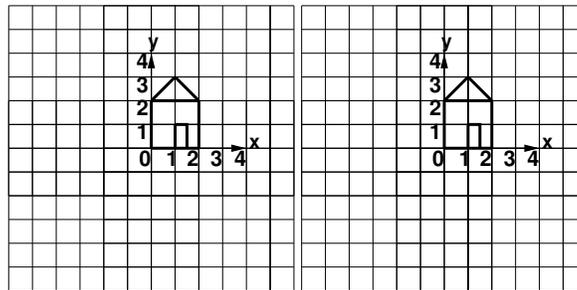
4. (12 pts) If p' = ABp, give the the $4x4$ matrices A and B needed to create the picture below, assuming the house started from the initial position as shown in the above questions.
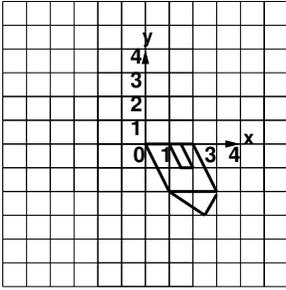
5. (10 pts) Specify the coordinates of point P with respect to coordinate frames A and B.

6. (13 pts) True/false

- Display lists can be nested hierarchically.
- The homogeneous points (1,2,3,4) and (1,4,8,16) map to the same Cartesian point after homogenization.
- The homogeneous points (2,2,2,4) and (4,4,4,4) map to the same Cartesian point after homogenization.
- Nonuniform scaling is in the class of affine transformations but is not a linear transformation.
- A normal vector to a surface transformed by a nonuniform scale is still perpendicular to that surface.
- Moving the camera 4 units forward in z is indistinguishable from moving the world 4 units backward in z.
- An asymmetric viewing frustum has a center of projection at infinity.
- An orthographic projection has a center of projection at infinity.
- Perspective division happens after the modelview transformation and before the projection transformation.
- After perspective division, all points have been projected onto the image plane.
- gluLookAt can be expressed as a combination of translations, scales, and rotations.
- Perspective transformations are in the class of affine transformations.
- Cavalier projections have three vanishing points.

7. (13 pts) Derive the rotation matrix for rotating around the x axis. Your derivation should include a figure, a set of equations, and the final matrix itself. Show all steps.

Use this code to answer the following questions

```
<coordinate system L>
glMatrixMode(GL_PROJECTION);
glLoadIdentity();
glFrustum(-5,5,-5,5,2,10)
<coordinate system M>
glMatrixMode(GL_MODELVIEW);
glLoadIdentity();
glTranslate(0,0,-5);
<coordinate system N>
glVertex(-1,-1,1);
```

8. (2 pts) If N is the world coordinate system, then name the coordinate systems L and M.

9. (4 pts) Compute the location of the vertex in the M coordinate system.

10. (10 pts) Compute the location of the vertex in the L coordinate system.