CPSC 414, Midterm Exam

20 Oct 2003

Closed book, one 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: _____

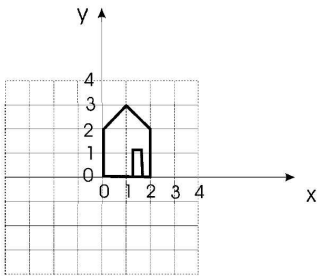
Question	Points Earned	Points Possible
1		1
2		2
3		1
4		1
5		2
6		1
7		1
8		1
9		1
10		2
11		1
12		1
13		1
14		1
15		1
16		2
17		2
Total		22

1. (1 pt) Write down the 4x4 matrix for rotating an object by 90% around the z axis.

2. (2 pts) Describe in words what this matrix does (be specific about the order of operations)

$$\begin{bmatrix} .707 & 0 & .707 & 0 \\ 0 & 2 & 0 & 0 \\ -.707 & 0 & .707 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

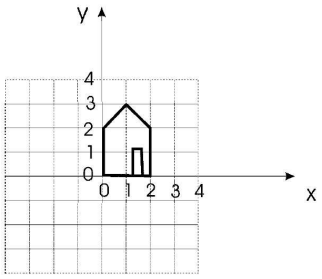
3. (1 pt) Draw a picture of the object below transformed by the above matrix



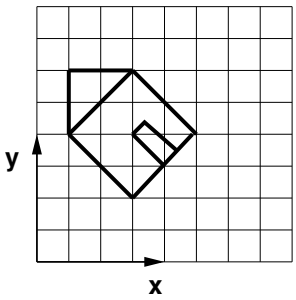
4. (1 pt) Give sequence of OpenGL commands necessary to implement the above transformation.

5. (2 pts) Draw houseA and houseB, transformed by the appropriate OpenGL commands. The untransformed house is below.

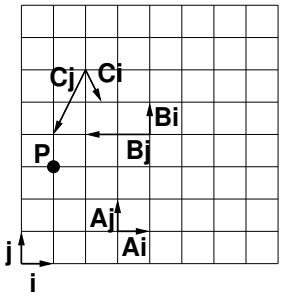
```
glIdentity();
glTranslate(1, 0, 0);
glRotate(90, 1, 0, 0);
glPushMatrix();
glTranslate(0, 2, 0);
drawHouseA();
glPopMatrix();
glTranslate(-1, 0, 0);
drawHouseB();
```



6. (1 pt) Give the series of affine transformations (assuming postmultiplying) needed to create the picture below, assuming the house started from the position shown in the above questions.



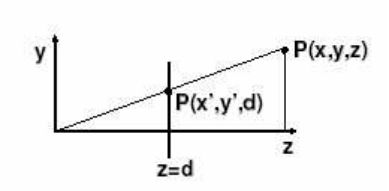
7. (1 pt) The point coordinate P, as shown below to the right, can be thought of as P = 1*i + 3*j, where i and j are basis vectors of unit length along the x and y axes, respectively. In effect, a coordinate system is defined by the location of its origin, and its basis vectors. Describe the point P in terms of the 3 other coordinate systems given below.



8. (1 pt) Normalize the homogenous point (2,4,6,2).

9. (1 pt) Draw the cavalier projection of a box of size x=4, y=2, z=6. Use a 20° projection (that is, the z axis in the scene should make a 20° angle with the x axis in the projection). The drawing doesn't have to be exactly to scale, but you must label the point locations.

10. (2 pts) Derive a 4x4 matrix that when applied to the point $(x, y, z, 1)^T$ would result in the projection in the picture below. Show your work.

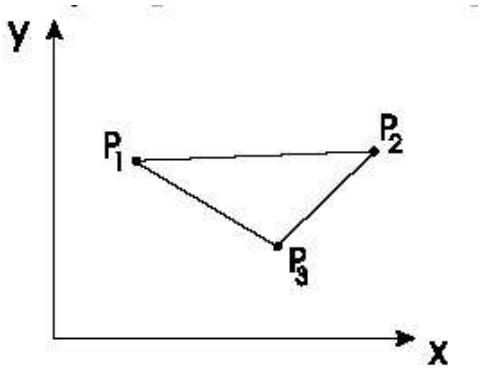


11. (1 pt) Sketch a side view (yz plane) of the perspective view frustum, in VCS, that is specified by the following parameters: near = 3, top = 2, right = 1, far = 5, bot = -1, left = -1

12. (1 pt) Write out the OpenGL perspective transformation matrix for the above configuration.

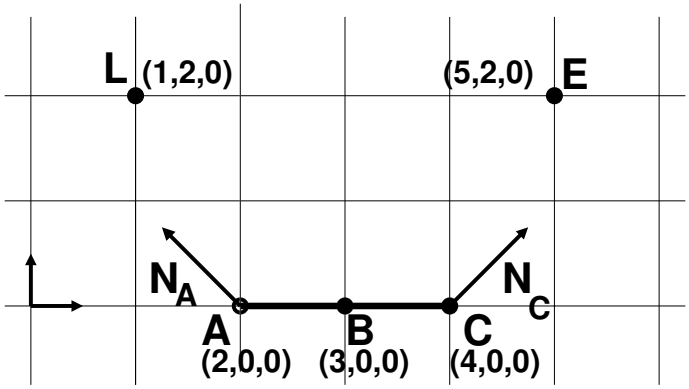
13. (1 pt) Briefly describe how to implement per-object picking using the back buffer.

14. (1 pt) A point in a triangle can be expressed using barycentric coordinates as follows: $P = \alpha P_1 + \beta P_2 + \gamma P_3$, where $0 <= \alpha, \beta, \gamma <= 1$ and $\alpha + \beta + gamma = 1$. Draw the line corresponding to $\alpha = .6$ on the following triangle which sits in the xy-plane.



15. (1 pt) Briefly describe how to use parity when scan converting a general polygon.

In the problems below, use the Phong illumination model given by $I = I_a k_a + k_d I_L(N \cdot L) + k_s I_L(R \cdot V)^n$ with parameters $I_a = .8, I_L = 1.0, k_a = .2, k_d = .9, k_s = .5, n = 30$.



16. (2 pts) Give the specular component of B, using the Gouraud shading model.

17. (2 pts) Give the specular component of B, using the Phong shading model.