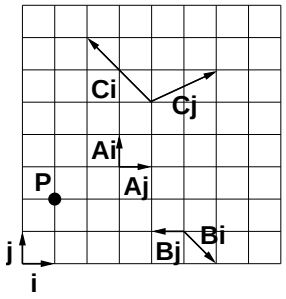
CPSC 314, Written Homework 1: Transformations

Out: Mon 22 Jan 2007
Due: Fri 2 Feb 2007 3pm
Value: 3% of final grade
Total Points: 100

1. (18 pts) The point coordinate P can be expressed as P = 1*i + 2*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. (5 pts) Write down the 4x4 matrix for rotating an object counterclockwise by 270 degrees around the Y axis.

3. (5 pts) Write down the 4x4 matrix for shearing an object by 2 in y and 3 in Z.

4. (10 pts) Decompose this matrix M into two matrices A and B such that $p' = Mp = ABp$. Write down A and B.

$$\begin{bmatrix} 1 & 0 & 0 & 3 \\ 0 & 2 & 0 & 2 \\ 0 & 0 & 1 & 1 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

5. (5 pts) Describe in words what M does, interpreting it as an operation in local coordinates that changes the coordinate frame. Be specific about the order of operations.

6. (5 pts) Describe in words what M above does, interpreting it as an operation in a fixed global coordinate system coordinates that moves the object. Be specific about the order of operations.

7. (5 pts) Give the OpenGL commands required to encode M. You may assume the matrix stack has been initialized with `glIdentity()`.

8. (6 pts) Homogenize the point (8,15,9,5).

9. (15 pts) Given a triangle T with vertices $a = (1, 1, 1, 1)$, $b = (2, 2, 1, 1)$, $c = (0, 0, -1, 1)$ and the transformation S =

$$\begin{bmatrix} 2.828 & 0 & .707 & 1 \\ 0 & 5 & 0 & 0 \\ -.707 & 1 & .707 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

   Compute the vertices of T after applying transformation S to it.

10. (10 pts) Compute the normal of T before and after applying transformation S to it.

11. (16 pts) Give the 4x4 matrices that result from the OpenGL commands at the four lines A, B, C, and D below.

```
glLoadIdentity();
glRotate(90, 0,0,1);
A
glTranslate(2,3,0);
B
glPushMatrix();
glTranslate(1,1,0);
glScale(1,.5,1);
C
glPopMatrix();
glScale(2,1,1);
D
```