CS314 Homework 1 Summer 2005

1. $P = 4i + 4j$

$= -3A_i - A_j$

$= \frac{B_i}{4} + 3B_j$

$= C_i - C_j$

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

3. $\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 0.2 & 0 & 0 \\ 0 & 0 & 0.5 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$

4. Two possible answers:

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

$= T_y(-2)\, R_z(90°)$

local coordinate system (left to right):

1. translate 2 units along y axis in negative direction
2. rotate 90° CCW around z-axis of modified coordinate frome.

OR: ② $\begin{bmatrix} 0 & -1 & 0 & 0 \\ 1 & 0 & 0 & -2 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} 0 & -1 & 0 & 0 \\ 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 & -2 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$

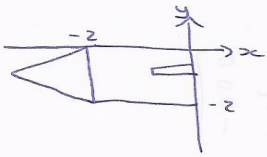
$= R_z(90°)\, T_x(-2)$

local coordinates:

1. rotate 90° CCW around z-axis
2. translate −2 units along modified x-axis.

5. ① global coordinate system (right to left)
   1. rotate 90° ccw around z-axis
   2. translate by -2 along <u>original</u> y-axis.

   or: ② 1. translate -2 along x-axis
   2. rotate 90° ccw around <u>original</u> z-axis.

6. 

7. $p' = m_1 m_2 m_3 p$
$= T(p_f) R_y(90) T(-p_f)$ $\quad p_f = (4, -1, 2, 1)$

$$m_1 = \begin{bmatrix} 1 & 0 & 0 & 4 \\ 0 & 1 & 0 & -1 \\ 0 & 0 & 1 & 2 \\ 0 & 0 & 0 & 1 \end{bmatrix} \qquad m_2 = \begin{bmatrix} 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 \\ -1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$m_3 = \begin{bmatrix} 1 & 0 & 0 & -4 \\ 0 & 1 & 0 & 1 \\ 0 & 0 & 1 & -2 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

8. glTranslate(4, -1, 2);
glRotate(90, 0, 1, 0);
glTranslate(-4, 1, -2);

9. (4, 5, 3, 1)

10. Shear by 2 in x, then 3 in y uses matrix A

$$A = \begin{bmatrix} 1 & 2 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 \\ 3 & 1 \end{bmatrix} = \begin{bmatrix} 1 & 2 \\ 3 & 7 \end{bmatrix}$$

Shear simultaneously uses matrix B

$$B = \begin{bmatrix} 1 & 2 \\ 3 & 1 \end{bmatrix}$$

and $A \neq B$ ∴ they are not the same operation.