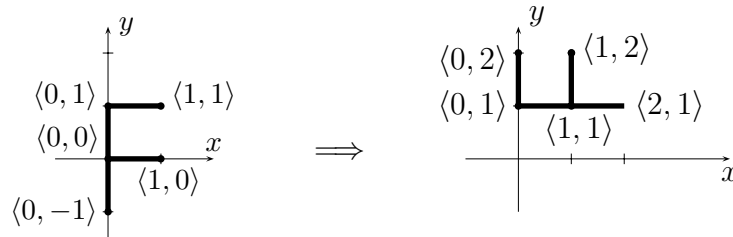Name:                                      Student ID:

## CSE 167 - Intro to Computer Graphics - Fall 2004
## Quiz #1 Answers — October 21 — Transformations in $\mathbb{R}^2$

You must show your work in order to get credit for a problem. Label your answers clearly.



The figure above shows a transformation $A$ that maps a figure "F" from standard position at the origin to the position shown on the right. The transformation is a generalized rotation around the point $\langle 0, 1 \rangle$.

**1.** Suppose there is a C routine `drawF()` that draws the "F" centered at the origin as shown in the left figure. Give a sequence of psuedo-OpenGL commands that will draw the "F" in the position shown in the figure on the right. For full credit, use as few pseudo-OpenGL commands as possible.

*Answer:* 
```
glMatrixMode( GL_MODELVIEW );
glLoadIdentity();
pglTranslatef(1,1);
pglRotatef( 90 );
drawF();
```

**2.** Express the transformation that maps the "F" on the left to the "F" on the right, in the form $A(\mathbf{x}) = M\vec{x} + \mathbf{u}$, where $M$ is a 2x2 matrix and $\mathbf{u} \in \mathbb{R}^2$.

*Answer:* $A(\mathbf{x}) = \begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix} \mathbf{x} + \begin{pmatrix} 1 \\ 1 \end{pmatrix}$.

**3.** Give a 3x3 homogeneous matrix that represents the **inverse** of the above transformation.

*Answer:* $\begin{pmatrix} 0 & 1 & -1 \\ -1 & 0 & 1 \\ 0 & 0 & 1 \end{pmatrix}$.