Linear Algebra (MATH 3333) Spring 2009 Section 2
Homework 2

Due: Wed. Feb. 4, start of class

Instructions: Please read the homework policies and guidelines posted on the course webpage. You may **not** use a calculator (or computer). Make sure to write your name, course and section numbers in the top right corner of your solution set, as well as the assignment number on top.

Conceptual Questions (not to be turned in)

1. What is a linear transformation, intuitively?
2. What is the benefit of matrix notation for linear transformations?

Written Assignment

1. Describe, as best you can, what the following linear transformations do geometrically:
a) $T(x,y) = (-x,y)$
b) $T(x,y) = (2y,x)$
c) $T(x,y) = (x-y,x+y)$.

2. Write each of the linear transformations in Problem 1 as a matrix.

3. Compute the following matrix multiplications:

a)
$$\begin{pmatrix} 2 & -1 \\ 1 & 3 \end{pmatrix} \begin{pmatrix} 2 \\ 4 \end{pmatrix}.$$

b)
$$\begin{pmatrix} 0 & 2 \\ -1 & 5 \end{pmatrix} \begin{pmatrix} 3 \\ 2 \end{pmatrix}.$$

c)
$$\begin{pmatrix} 1 & 2 \\ 0 & 1 \end{pmatrix} \begin{pmatrix} 1 & 3 \\ 0 & 1 \end{pmatrix}.$$

d)
$$\begin{pmatrix} 1 & 1 \\ 1 & -1 \end{pmatrix} \begin{pmatrix} 1 & 1 \\ 1 & -1 \end{pmatrix}.$$

e)
$$\begin{pmatrix} 2 & -1 \\ 1 & 3 \end{pmatrix} \begin{pmatrix} 0 & 2 \\ -1 & 5 \end{pmatrix}.$$

f)
$$\begin{pmatrix} 0 & 2 \\ -1 & 5 \end{pmatrix} \begin{pmatrix} 2 & -1 \\ 1 & 3 \end{pmatrix}.$$

4. Compute the multiplications
$$\begin{pmatrix} 2 & -1 \\ 1 & 3 \end{pmatrix} \begin{pmatrix} 0 \\ 0 \end{pmatrix}, \quad \begin{pmatrix} 2 & -1 \\ 1 & 3 \end{pmatrix} \begin{pmatrix} 1 \\ 0 \end{pmatrix}, \quad \begin{pmatrix} 2 & -1 \\ 1 & 3 \end{pmatrix} \begin{pmatrix} 1 \\ 1 \end{pmatrix}, \quad \text{and} \quad \begin{pmatrix} 2 & -1 \\ 1 & 3 \end{pmatrix} \begin{pmatrix} 0 \\ 1 \end{pmatrix}.$$
Using this, draw what the transformation
$$T = \begin{pmatrix} 2 & -1 \\ 1 & 3 \end{pmatrix}$$
does to the unit square with vertices (0,0), (1,0), (1,1) and (0,1).