Last name _____

First name _____

LARSON—MATH 310–HOMEWORK WORKSHEET 09
Matrix Multiplications.

General Instructions

1. Write up a **neat** assignment on a **new sheet** of paper. (Do not cram your answers between the lines).
2. **Number** your problems so that it is easy to see what work matches the assigned problems.
3. Remember to **give examples** (you do not understand a concept unless you can provide an example of it).

Concepts (from **Chapter 4 of Klein's *Coding the Matrix* text**)

1. What is the linear-combination definition of matrix-vector multiplication? Give an example.
2. What is the linear-combinations definition of vector-matrix multiplication? Give an example.
3. What is the dot-product definition of matrix-vector multiplication? Give an example.
4. What is the dot-product definition of vector-matrix multiplication? Give an example.
5. What is an identity matrix? Give an example.
6. What is an upper-triangular matrix? Give an example.
7. What is a diagonal matrix? Give an example.
8. What is the inverse of a matrix? Give an example.

Problems (over)

9. Do the following problem from our text, by hand, and **explain** which definition of matrix-matrix multiplication you used.

Problem 4.17.7: Let

$$A = \begin{bmatrix} 2 & 0 & 1 & 5 \\ 1 & -4 & 6 & 2 \\ 3 & 0 & -4 & 2 \\ 3 & 4 & 0 & -2 \end{bmatrix}$$

For each of the following values of the matrix B, compute AB and BA. (I recommend you not use the computer to compute these.)

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

10. Do the following problem from our text, by hand, and **explain** which definition of matrix-matrix multiplication you used.

Problem 4.17.9: Let

$$A = \begin{bmatrix} 4 & 2 & 1 & -1 \\ 1 & 5 & -2 & 3 \\ 4 & 4 & 4 & 0 \\ -1 & 6 & 2 & -5 \end{bmatrix}$$

For each of the following values of the matrix B, compute AB and BA without using a computer. (To think about: Which definition of matrix-matrix multiplication is most useful here? What does a nonzero entry at position (i, j) in B contribute to the j^{th} column of AB? What does it contribute to the i^{th} row of BA?)

(a) $\begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}$ (b) $\begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 \end{bmatrix}$ (c) $\begin{bmatrix} 1 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}$

(d) $\begin{bmatrix} 0 & 1 & 0 & 1 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \end{bmatrix}$ (e) $\begin{bmatrix} 0 & 0 & 0 & 2 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & -3 & 0 & 0 \end{bmatrix}$ (f) $\begin{bmatrix} -1 & 0 & 0 & 0 \\ 0 & 2 & 0 & 0 \\ 0 & 0 & 2 & 0 \\ 0 & 0 & 0 & 3 \end{bmatrix}$