Last name _____

First name _____

LARSON—MATH 310–HOMEWORK WORKSHEET 07
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).

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

Definition 4.5.1 (*Linear-combinations* definition of matrix-vector multiplication): Let M be an $R \times C$ matrix over $\mathbb{F}$. Let $\boldsymbol{v}$ be a C-vector over $\mathbb{F}$. Then $M * \boldsymbol{v}$ is the linear combination

$$\sum_{c \in C} \boldsymbol{v}[c] \text{ (column } c \text{ of } M)$$

If M is an $R \times C$ matrix but $\boldsymbol{v}$ is not a C-vector then the product $M * \boldsymbol{v}$ is illegal.

1. Find:

Example 4.5.2: Let's consider a

$$\begin{bmatrix} 1 & 2 & 3 \\ 10 & 20 & 30 \end{bmatrix} * [7, 0, 4]$$

over. There are more problems of the other side.

Definition 4.5.6 (*Linear-combinations* definition of vector-matrix multiplication): Let M be an $R \times C$ matrix. Let $\boldsymbol{w}$ be an R-vector. Then $\boldsymbol{w} * M$ is the linear combination

$$\sum_{r \in R} \boldsymbol{w}[r] \, (\text{row } r \text{ of } M)$$

If M is an $R \times C$ matrix but $\boldsymbol{w}$ is not an R-vector then the product $\boldsymbol{w} * M$ is illegal.

2. Find:

Example 4.5.7:

$$[3, 4] \quad * \quad \begin{bmatrix} 1 & 2 & 3 \\ 10 & 20 & 30 \end{bmatrix}$$

3. Find each of the following (a mix of both types of multiplication):

(a) $\begin{bmatrix} 2 & 3 & 1 \\ 1 & 3 & 4 \end{bmatrix} \begin{bmatrix} 2 \\ 2 \\ 3 \end{bmatrix}$

(b) $\begin{bmatrix} 2 & 4 & 1 \end{bmatrix} \begin{bmatrix} 1 & 2 & 0 \\ 5 & 1 & 1 \\ 2 & 3 & 0 \end{bmatrix}$

(c) $\begin{bmatrix} 2 & 1 \end{bmatrix} \begin{bmatrix} 3 & 1 & 5 & 2 \\ -2 & 6 & 1 & -1 \end{bmatrix}$

(d) $\begin{bmatrix} 1 & 2 & 3 & 4 \\ 1 & 1 & 3 & 1 \end{bmatrix} \begin{bmatrix} 1 \\ 2 \\ 3 \\ 4 \end{bmatrix}$

(e) $\begin{bmatrix} 4 \\ 1 \\ -3 \end{bmatrix}^T \begin{bmatrix} -1 & 1 & 1 \\ 1 & 0 & 2 \\ 0 & 1 & -1 \end{bmatrix}$ (Remember the superscript T means "transpose".)