Last name ______________________

First name ______________________

LARSON—MATH 310–CLASSROOM WORKSHEET 17
Matrix-Vector and Vector-Matrix Multiplication

Review: Chapter 3 of Klein's *Coding the Matrix* text

1. Book problem:

   Vector spaces

   Problem 3.8.7: Prove or give a counterexample: "$\{[x, y, z] : x, y, z \in \mathbb{R}, x + y + z = 1\}$ is a vector space."

   Problem 3.8.8: Prove or give a counterexample: "$\{[x, y, z] : x, y, z \in \mathbb{R}$ and $x + y + z = 0\}$ is a vector space."

   Problem 3.8.9: Prove or give a counterexample: "$\{[x_1, x_2, x_3, x_4, x_5] : x_1, x_2, x_3, x_4, x_5 \in \mathbb{R}, x_2 = 0$ or $x_5 = 0\}$ is a vector space."

2. What is the *transpose* of a matrix?

New

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

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

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:

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