MATH 260, Linear Algebra, Spring '14
Activity 2: Matrix Operations
Honor Code: **Names:**

Directions: Everyone should work on the assignment and should fill out their paper. You are expected to make corrections based on what is presented on the board. You will NOT turn in the assignment today. It may be collected in the future.

In-Class Learning Goals

1. Be comfortable multiplying matricies
2. Be able to correctly identiy the dimensions for the result of a matrix operation
3. Be able to find the transpose of a matrix
4. Develop intuition and experience with matrix operation properties.

Matrices for today's problems:

$$\mathbf{A} = \begin{bmatrix} 2 \\ 4 \\ -1 \end{bmatrix} \quad \mathbf{B} = \begin{bmatrix} 3 & 2 & -5 \end{bmatrix}$$

$$\mathbf{C} = \begin{bmatrix} 1 & 4 \\ -3 & 5 \end{bmatrix} \quad \mathbf{D} = \begin{bmatrix} 2 & 7x \\ x^2 & 3x^3 \end{bmatrix} \quad \mathbf{E} = \begin{bmatrix} 3x & 8 & 2x^2+1 \\ x & x^2+x & x^3 \end{bmatrix}$$

Warmup: Constants and Matrices

a) Find $k\mathbf{C}$ where k is a constant. What is $k\mathbf{C}$ if $k=3$?

b) Show that: $k\mathbf{C} + g\mathbf{C} = (k+g)\mathbf{C}$ where k and g are constants. This is a 'distributive' property.

It is also true (you don't have to prove/show this one) that if $\mathbf{A}$ and $\mathbf{B}$ are both $m \times n$ matrices then:
$k(\mathbf{A}+\mathbf{B}) = k\mathbf{A} + k\mathbf{B}$
c) Show that: $k(g\mathbf{C}) = (kg)\mathbf{C}$. This is an 'associtivity' property.

Problem 1:Vectors, and Vectors with Matrices

Notes on finding expected dimensions of multiplication:

a) Find the expected dimension of **AB**, **BA**, and **BE**

b) Now calculate each product.

Problem 2: Matrix on Matrix

a) Find **CD**

b) Make a prediction: Is the statement: **CD** = **DC** true or false?
Feel free to discuss this at your table!

c) Find $\mathbf{DC}$. Were you correct?

d) Can you find any matrices ($\mathbf{A}$ and $\mathbf{B}$) for which $\mathbf{AB} = \mathbf{BA}$? Note that here, $\mathbf{A}$ and $\mathbf{B}$ are NOT the matrices given on page 1. *Hint: This is a SPECIAL circumstance*

Problem 3: More Matrix on Matrix

a) Which of these are true (give some reasoning, you don't *have* to prove them):
$(\mathbf{AB})\mathbf{C} = \mathbf{A} + \mathbf{BC}$ $\quad$ $\mathbf{A}(\mathbf{B} + \mathbf{C}) = \mathbf{AB} + \mathbf{AC}$ $\quad$ $(\mathbf{B} + \mathbf{C})\mathbf{A} = \mathbf{AB} + \mathbf{CA}$

b) Under certain circumstances we can raise a matrix to a power. Discuss at your table what some requirements might be, and what the resultant dimensions would be.

c) Find $\mathbf{CC}$. This is equivalent to $\mathbf{C}^2$.

d) Find $\mathbf{C}^3$. *Hint: Use your result from (c) to reduce your work*

e) Could you find $\mathbf{D}^3$? What would it's dimensions be or if you can't find it why not?

Problem 4: Transposing Matrices

We can find what's called the 'transpose' of a matrix by flipping a matrix over its "diagonal" . This only works for square matrices, and lets us do some nifty solving later.... specifically to find the transpose of $\mathbf{A}$, denoted by $\mathbf{A}^\intercal$ for all i, j $[a_{ij}]^\intercal = [a_{ji}]$
a) Find $\mathbf{C}^\intercal$

b) Predict how you think the transpose of $\mathbf{C}$ would change if we first multiplied by 3 (i.e. did: $(3\mathbf{C})^\intercal$)

Homework:

1. Finish Worksheet (you may work with others on this)
2. Find: $3\mathbf{X}^2 + \mathbf{Y}^T$ for $\mathbf{X}$ and $\mathbf{Y}$ given below. You will turn this in next week. You MUST show intermediate calculations to get full credit.

$$\mathbf{X} = \begin{bmatrix} 1 & 4 & 0 \\ -3 & 5 & 1 \\ 1 & 0 & -6 \end{bmatrix} \quad \mathbf{Y} = \begin{bmatrix} 0 & 1 & w \\ 1 & -z & 3 \\ 0 & 9 & -4 \end{bmatrix}$$