EAS 596, Fall 2018, Homework 1
Due Weds. 9/5, **5 PM**, Box outside Furnas 611

Work all problems. Show all work, including any M-files you have written or adapted. Make sure your work is clear and readable - if the TA cannot read what you've written, he will not grade it. All electronic work (m-files, etc.) **must** be submitted through UBLearns (and submitted by the time class starts on the day it's due). Any handwritten work may be submitted in class. Each problem will be graded according to the following scheme: 2 points if the solution is complete and correct, 1 point if the solution is incorrect or incomplete but was using correct ideas, and 0 points if using incorrect ideas.

1. In the xy plane, mark all nine of these linear combinations:

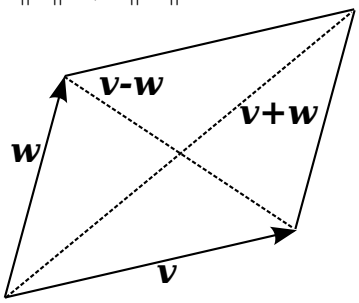
$$c\begin{bmatrix}2\\1\end{bmatrix} + d\begin{bmatrix}0\\1\end{bmatrix} \text{ with } c = 0, 1, 2 \text{ and } d = 0, 1, 2$$

2. (a) Find vector $\boldsymbol{v}$ and $\boldsymbol{w}$ so that $\boldsymbol{v} + \boldsymbol{w} = (4, 5, 6)$ and $\boldsymbol{v} - \boldsymbol{w} = (2, 5, 8)$.
   (b) This is a question with _____ unknown numbers and an equal number of equations to find those numbers.

3. (a) Find vectors $\boldsymbol{u}_1$ and $\boldsymbol{u}_2$ in the directions of $\boldsymbol{v} = (3, 1)$ and $\boldsymbol{w} = (2, 1, 2)$.
   (b) Find unit vectors $\boldsymbol{U}_1$ and $\boldsymbol{U}_2$ that are perpendicular to $\boldsymbol{u}_1$ and $\boldsymbol{u}_2$.

4. (a) If $\|\boldsymbol{v}\| = 5$ and $\|\boldsymbol{w}\| = 3$, what are the smallest and largest values of $\|\boldsymbol{v} - \boldsymbol{w}\|$?
   (b) What are the smallest and largest values of $\boldsymbol{v} \cdot \boldsymbol{w}$?

5. Consider a parallelogram with sides given by $\boldsymbol{v}$ and $\boldsymbol{w}$. Show that $\|\boldsymbol{v} + \boldsymbol{w}\|^2 + \|\boldsymbol{v} - \boldsymbol{w}\|^2 = 2\|\boldsymbol{v}\|^2 + 2\|\boldsymbol{w}\|^2$.



6. Find a combination $x_1\boldsymbol{w}_1 + x_2\boldsymbol{w}_2 + x_3\boldsymbol{w}_3$ that gives the zero vector. Are these vectors independent or dependent?

$$w_1 = \begin{bmatrix}1\\2\\3\end{bmatrix} \qquad w_2 = \begin{bmatrix}4\\5\\6\end{bmatrix} \qquad w_3 = \begin{bmatrix}7\\8\\9\end{bmatrix}$$

7. Let the following matrices be defined.

$$A = \begin{bmatrix} 4 & 7 \\ 1 & 2 \\ 5 & 6 \end{bmatrix}, B = \begin{bmatrix} 4 & 3 & 7 \\ 1 & 2 & 7 \\ 2 & 0 & 4 \end{bmatrix}, C = \begin{bmatrix} 3 \\ 6 \\ 1 \end{bmatrix}, D = \begin{bmatrix} 9 & 4 & 3 & -6 \\ 2 & -1 & 7 & 5 \end{bmatrix}$$

$$E = \begin{bmatrix} 1 & 5 & 8 \\ 7 & 2 & 3 \\ 4 & 0 & 6 \end{bmatrix}, F = \begin{bmatrix} 3 & 0 & 1 \\ 1 & 7 & 3 \end{bmatrix}, G = \begin{bmatrix} 7 & 6 & 4 \end{bmatrix}$$

Answer the following questions regarding these matrices:

(a) What are the dimensions of the matrices?

(b) Identify the square, column, and row matrices.

(c) What are the values of the elements: $a_{12}, b_{23}, d_{32}, e_{22}, f_{12}, g_{12}$.

(d) Perform the following operations or, if not well defined, explain why:

i. $E + B$
ii. $A + F$
iii. $B - E$
iv. $A \times B$
v. $B \times A$
vi. D^T
vii. $E \times B$
viii. C^T
ix. $A \times C$
x. $I \times B$
xi. $E^T \times E$
xii. $C^T \times C$

8. Let the following matrices be defined.

$$A = \begin{bmatrix} 5 & 6 & 6 & 8 \\ 2 & 2 & 2 & 8 \\ 6 & 6 & 2 & 8 \\ 2 & 3 & 6 & 7 \end{bmatrix}, B = \begin{bmatrix} 17 & -9 & 12 & 16 \\ 17 & 8.75 & -11.75 & -16 \\ -4 & -2.25 & 2.75 & 4 \\ 1 & 0.75 & -0.75 & -1 \end{bmatrix}, C = \begin{bmatrix} -17 & -9 & 12 & 16 \\ 17 & 8.75 & -11.75 & -16 \\ -4 & -2.25 & 2.75 & 4 \\ 1 & 0.75 & -0.75 & -1 \end{bmatrix}$$

Which matrix, B or C, is an inverse to matrix A?