

**STATISTICAL PATTERN RECOGNITION & LEARNING**  
**FALL 2016**  
**PRACTICE EXERCISES 1**

**QUESTION 1**

- a. Draw the span of the vector  $\mathbf{a} = [1 \ 2]^T$  and  $\mathbf{b} = [2 \ 4]^T$   
 b. Find the null space of the given matrices:

$$A = \begin{pmatrix} 1 & 4 & 3 \\ -1 & 1 & 7 \end{pmatrix} \quad B = \begin{pmatrix} 1 & 4 & 3 & 9 \\ -1 & 1 & 7 & 2 \end{pmatrix}$$

$$C = \begin{pmatrix} 1 & 4 & 1 & 3 \\ -1 & -4 & 2 & 6 \end{pmatrix}$$

- c. What is the row rank, column rank and rank of the above matrices

**QUESTION 2 (from last year)**

Given the following:

$$X = \begin{pmatrix} 1 & 2 & 4 \\ 2 & 4 & 5 \\ 7 & 9 & 11 \end{pmatrix} \quad Y = \begin{pmatrix} 1 & 2 & 2 \\ 2 & 3 & 5 \\ 7 & 1 & 11 \end{pmatrix}$$

$$Z = \begin{pmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 1 & 0 & 3 \end{pmatrix} \quad W = \begin{pmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & 0 & 3 \end{pmatrix}$$

- a. Find the determinant and inverse of all of the above if possible  
 b. Find  $XZ$  and  $ZX$   
 c. Find  $Y+W$  and  $X(Y+Z)$   
 d. given the following vectors:

$$\mathbf{a} = \begin{pmatrix} 2 \\ 9 \\ 5 \end{pmatrix} \quad \mathbf{b} = \begin{pmatrix} 1 \\ 3 \\ 6 \end{pmatrix}$$

Find  $Z\mathbf{a}$  and  $W\mathbf{b}$  and find the Euclidean norm of both vectors and then normalize them  
 Find the  $L_1$ ,  $L_2$ ,  $L_3$  and  $L_\infty$  norms of both the above vectors.

- e. What is the inverse of a diagonal matrix?  
 f. What is the determinant of a diagonal matrix?  
 g. What is the inverse of an identity matrix?  
 Find  $Z\mathbf{a}$  and  $W\mathbf{b}$  and find the norm of both vectors and then normalize them to unit vectors

find the row rank, column rank and null rank of the