# Homework - 1
# COEN 240-Machine Learning

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Given the following matrices, please solve the questions below and if you can't solve the problem, explain why:

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

$$F = \begin{bmatrix} 2 & 1 & 3 \\ 5 & 7 & -2 \end{bmatrix}$$

1) A + F
2) E – D
3) C + B
4) C(D)
5) A(F)
6) $C^T$
7) $F^T(E)$

**Sol:**

Sol: Given $A = \begin{bmatrix} 3 & 1 & 5 \\ 6 & 2 & 0 \end{bmatrix}$ $B = \begin{bmatrix} 6 \\ 4 \\ -1 \end{bmatrix}$ $C = \begin{bmatrix} 2 & 4 \\ 3 & 6 \\ -1 & 2 \end{bmatrix}$

$D = \begin{bmatrix} 5 & 2 \\ 3 & 1 \end{bmatrix}$ $E = \begin{bmatrix} 3 & -2 \\ 1 & 4 \end{bmatrix}$ $F = \begin{bmatrix} 2 & 1 & 3 \\ 5 & 7 & -2 \end{bmatrix}$

Q1) $A+F = \begin{bmatrix} 3 & 1 & 5 \\ 6 & 2 & 0 \end{bmatrix}_{2\times3} + \begin{bmatrix} 2 & 1 & 3 \\ 5 & 7 & -2 \end{bmatrix}_{2\times3}$

It is possible to add matrices as it has same dimensions.

$$A+F = \begin{bmatrix} 5 & 2 & 8 \\ 11 & 9 & -2 \end{bmatrix}$$ //Ans.

2) $E-D = \begin{bmatrix} 3 & -2 \\ 1 & 4 \end{bmatrix}_{2\times2} - \begin{bmatrix} 5 & 2 \\ 3 & 1 \end{bmatrix}_{2\times2}$

It is possible:

$$E-D = \begin{bmatrix} -2 & -4 \\ -2 & 3 \end{bmatrix}$$ //Ans.

3) $C+B = \begin{bmatrix} 2 & 4 \\ 3 & 6 \\ -1 & 2 \end{bmatrix} + \begin{bmatrix} 6 \\ 4 \\ 1 \end{bmatrix}$

$3\times 2 \qquad\qquad 3\times 1$

It is not possible as the above 2 matrices cann't be added as dimensions of C [3×2] & B [3×1] doesn't match with each other. In other words dimensions don't match

4) $C(D) = \begin{bmatrix} 2 & 4 \\ 3 & 6 \\ -1 & 2 \end{bmatrix} \times \begin{bmatrix} 5 & 2 \\ 3 & 1 \end{bmatrix}$

$3\times 2 \qquad\qquad 2\times 2$

It is possible as col's of 1st matrix [C] should match with row's of second matrix [D]. Here H's matching

$$= \begin{bmatrix} 2\times5+4\times3 & 2\times2+4\times1 \\ 3\times5+6\times3 & 3\times2+6\times1 \\ -1\times5+2\times3 & -1\times2+2\times1 \end{bmatrix} = \begin{bmatrix} 10+12 & 4+4 \\ 15+18 & 6+6 \\ -5+6 & -2+2 \end{bmatrix}$$

$$\therefore C(D) = \begin{bmatrix} 22 & 8 \\ 33 & 12 \\ 1 & 0 \end{bmatrix}$$

5) $A(F) = \begin{bmatrix} 3 & 1 & 5 \\ 6 & 2 & 0 \end{bmatrix}_{2\times3} \times \begin{bmatrix} 2 & 1 & 3 \\ 5 & 7 & -2 \end{bmatrix}_{2\times3}$

$r \times c \qquad r \times c$

As mentioned above the matrices cannt be multiplied or added if no. of columns of 1st matrix(A) doesn't match with no. of rows of 2nd matrix (F)

$A[2\times3] \neq F[2\times3]$

6) $C^T \Rightarrow C = \begin{bmatrix} 2 & 4 \\ 3 & 6 \\ -1 & 2 \end{bmatrix}_{3\times2}^T \quad C^T \Rightarrow \begin{bmatrix} 2 & 3 & -1 \\ 4 & 6 & 2 \end{bmatrix}_{2\times3}$ Ans.

Here, to transpose a matrix means rows will be changed to columns and colums to rows.

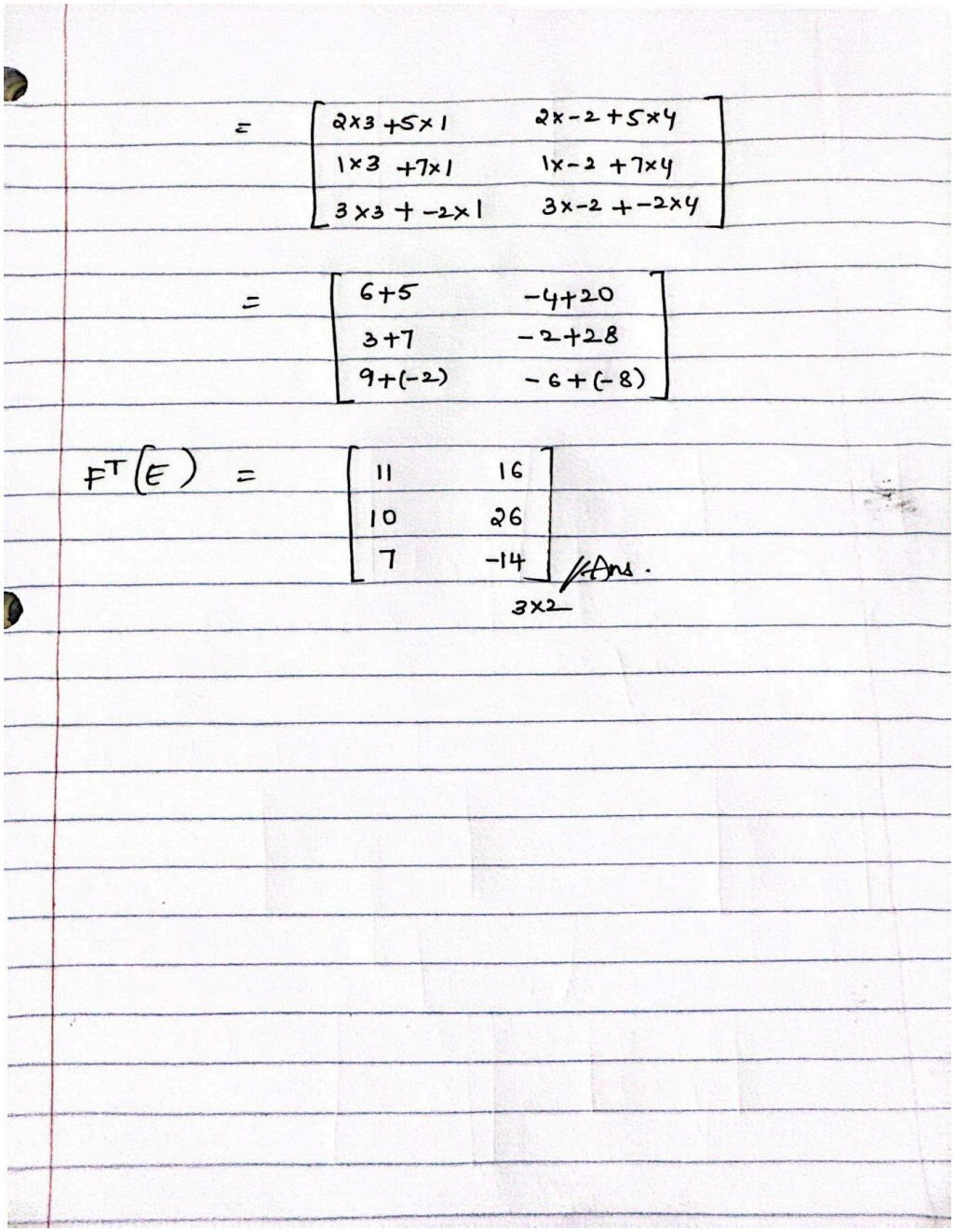
7) $F^T(E) =$

$F = \begin{bmatrix} 2 & 1 & 3 \\ 5 & 7 & -2 \end{bmatrix}_{2\times3} \qquad F^T = \begin{bmatrix} 2 & 5 \\ 1 & 7 \\ 3 & -2 \end{bmatrix}_{3\times2}$

We have $E = \begin{bmatrix} 3 & -2 \\ 1 & 4 \end{bmatrix}$

$F^T(E) = \begin{bmatrix} 2 & 5 \\ 1 & 7 \\ 3 & -2 \end{bmatrix}_{3\times2} \times \begin{bmatrix} 3 & -2 \\ 1 & 4 \end{bmatrix}_{2\times2}$

1st matrix column dimension = 2nd matrix row dimension it is possible.




**Reference:**


1. Class lecture and Basic matrix operations pdf
2. https://www.geeksforgeeks.org/matrix-operations/