ASSIGNMENT 9

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1 MATRICES 2.67

Express the matrix $\mathbf{B} = \begin{pmatrix} 2 & -2 & -4 \\ -1 & 3 & 4 \\ 1 & -2 & -3 \end{pmatrix}$ as the sum of a symmetric and a skew symmetric matrix.

2 SOLUTION

Given $\mathbf{B} = \begin{pmatrix} 2 & -2 & -4 \\ -1 & 3 & 4 \\ 1 & -2 & -3 \end{pmatrix}$

Let $\mathbf{C} = \frac{\mathbf{B}+\mathbf{B}^\top}{2}$ and $\mathbf{D} = \frac{\mathbf{B}-\mathbf{B}^\top}{2}$.

We know that $\frac{\mathbf{B}+\mathbf{B}^\top}{2}$ is a symmetric matrix and $\frac{\mathbf{B}-\mathbf{B}^\top}{2}$ is a skew symmetric matrix.

$$\mathbf{B}^\top = \begin{pmatrix} 2 & -1 & 1 \\ -2 & 3 & -2 \\ -4 & 4 & -3 \end{pmatrix} \tag{1}$$

$$\mathbf{C} = \frac{\mathbf{B}+\mathbf{B}^\top}{2} = \begin{pmatrix} 2 & -\frac{3}{2} & -\frac{3}{2} \\ -\frac{3}{2} & 3 & 1 \\ -\frac{3}{2} & 1 & -3 \end{pmatrix} \tag{2}$$

$$\mathbf{D} = \frac{\mathbf{B}-\mathbf{B}^\top}{2} = \begin{pmatrix} 0 & -\frac{1}{2} & -\frac{5}{2} \\ \frac{1}{2} & 0 & 3 \\ \frac{5}{2} & -3 & 0 \end{pmatrix} \tag{3}$$

Note that $\mathbf{C} + \mathbf{D} = \mathbf{B}$.

Hence from (2) and (3), $\mathbf{B}$ can be expressed as the sum of a symmetric and a skew symmetric matrix.