Linear Algebra

1. Let two matrices be

$$A = \begin{bmatrix} 1 & -4 \\ -2 & 1 \end{bmatrix}, B = \begin{bmatrix} 0 & 3 \\ 5 & 8 \end{bmatrix}$$

What is $A - B$?

- $\begin{bmatrix} 1 & 7 \\ 7 & 9 \end{bmatrix}$
- $\begin{bmatrix} 1 & 1 \\ -3 & -7 \end{bmatrix}$

  $\begin{bmatrix} 1 & -7 \\ -7 & -7 \end{bmatrix}$

- $\begin{bmatrix} 1 & -7 \\ -7 & 7 \end{bmatrix}$

2.

$$Let x = \begin{bmatrix} 8 \\ 2 \\ 5 \\ 1 \end{bmatrix}$$

What is $2 * x$?

- $\begin{bmatrix} 16 & 4 & 10 & 2 \end{bmatrix}$

  $\begin{bmatrix} 16 \\ 4 \\ 10 \\ 2 \end{bmatrix}$

- $\begin{bmatrix} 4 & 1 & \frac{5}{2} & \frac{1}{2} \end{bmatrix}$
- $\begin{bmatrix} 4 \\ 1 \\ \frac{5}{2} \\ \frac{1}{2} \end{bmatrix}$

Explanation: To multiply the vector x by 2, take each element of x and multiply that element by 2.

3. Let u be a 3-dimensional vector, where specifically

$$u = \begin{bmatrix} 2 \\ 1 \\ 8 \end{bmatrix}$$

What is u^T?

$\begin{bmatrix} 2 & 1 & 8 \end{bmatrix}$

- $\begin{bmatrix} 2 \\ 1 \\ 8 \end{bmatrix}$
- $\begin{bmatrix} 8 \\ 1 \\ 2 \end{bmatrix}$
- $\begin{bmatrix} 8 & 1 & 2 \end{bmatrix}$

4. Let u and v be 3-dimensional vectors, where specifically

$$u = \begin{bmatrix} 3 \\ -5 \\ 4 \end{bmatrix}$$

and

$$v = \begin{bmatrix} 1 \\ 2 \\ 5 \end{bmatrix}$$

What is $u^T v$?

(Hint: u^T is a 1x3 dimensional matrix, and v can also be seen as a 3x1 matrix. The answer you want can be obtained by taking the matrix product of u^T and v.) Do not add brackets to your answer.

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5. Let A and B be 3x3 (square) matrices. Which of the following must necessarily hold true? Check all that apply.

if $C = A * B$, then C is a 3×3 matrix.

Explanation: Since A and B are both 3×3 matrices, their product is 3×3. More generally, if A were an $m \times n$. matrix, and B a $n \times o$ matrix, then C would be $m \times o$. (In our example, $m = n = o = 3$.)

- $A * B = B * A$
- $A * B * A = B * A * B$

If B is the 3×3 identity matrix, then $A * B = B * A$

Explanation: Even though matrix multiplication is not commutative in general ($A * B \neq B * A$) for general matrices A, B), for the special case where $B = I$, we have $A * B = A * I = A$, and also $B * A = I * A = A$. So, $A * B = B * A$.