

# QUIZ 1 SOLUTIONS - MATH 225

Note that the other version of this quiz is similar, with different numbers on  $A, B, C$ .

**Question.** Let  $A = \begin{bmatrix} -1 & 5 & 3 & 4 \\ -2 & 0 & 6 & 1 \end{bmatrix}$ ,  $B = \begin{bmatrix} -4 & 0 \\ 1 & 3 \\ 1 & -4 \\ 0 & 2 \end{bmatrix}$ ,  $C = \begin{bmatrix} -1 \\ -7 \\ 4 \\ 2 \end{bmatrix}$ .

Compute the following expressions **if possible**:

1.  $A^T - 5B$

The size of  $A^T$  is  $4 \times 2$ , and the size of  $-5B$  is  $4 \times 2$ . So the subtraction makes sense. We have

$$\begin{bmatrix} -1 & -2 \\ 5 & 0 \\ 3 & 6 \\ 4 & 1 \end{bmatrix} + \begin{bmatrix} 20 & 0 \\ -5 & -15 \\ -5 & 20 \\ 0 & -10 \end{bmatrix} = \begin{bmatrix} 19 & -2 \\ 0 & -15 \\ -2 & 26 \\ 4 & -9 \end{bmatrix}.$$

2.  $C^T B$

The size of  $C^T$  is  $1 \times 4$ , and the size of  $B$  is  $4 \times 2$ . So the multiplication makes sense. We have

$$\begin{bmatrix} -1 & -7 & 4 & 2 \end{bmatrix} \begin{bmatrix} -4 & 0 \\ 1 & 3 \\ 1 & -4 \\ 0 & 2 \end{bmatrix} = [(4 - 7 + 4 + 0) \quad (0 - 21 - 16 + 4)] = [1 \quad -33].$$

3.  $A^2$

This means that we want to compute  $AA$ . However, we cannot multiply a  $2 \times 4$  matrix with a  $2 \times 4$  matrix. In other words, the multiplication does not make sense because

the number of columns of  $A = 4 \neq 2 =$  the number of rows of  $A$ .

4.  $AB$  and  $tr(AB)$

Since the number of columns of  $A = 4 =$  the number of rows of  $B$ , the multiplication makes sense. We have

$$\begin{bmatrix} -1 & 5 & 3 & 4 \\ -2 & 0 & 6 & 1 \end{bmatrix} \begin{bmatrix} -4 & 0 \\ 1 & 3 \\ 1 & -4 \\ 0 & 2 \end{bmatrix} = \begin{bmatrix} (4 + 5 + 3 + 0) & (0 + 15 - 12 + 8) \\ (8 + 0 + 6 + 0) & (0 + 0 - 24 + 2) \end{bmatrix} = \begin{bmatrix} 12 & 11 \\ 14 & -22 \end{bmatrix}.$$

Since  $AB$  is a square matrix, we can compute the trace  $tr(AB) = 12 + (-22) = -10$ .

5.  $C^T B + A$

By Part 2, we know  $C^T B$  has dimension  $1 \times 2$ . Since this is not equal to the dimension of  $A$ , the addition does not make sense.