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yes ~~because~~ by the definition of matrix multiplication

2. 2×2 · $~~2 \times 2 \times~~$ B would need to have 3
    r   & 3×2 columns by the definition of
    matrix multiplication

3. $\begin{bmatrix} 1 & 0 & 1 \\ 0 & 1 & 2 \end{bmatrix} \cdot \begin{bmatrix} 3 & 5 \\ -1 & 0 \\ 2 & -1 \end{bmatrix} = \begin{bmatrix} ~~\cdots~~ \end{bmatrix}$

    2×3 3×2 2×2
    r   c

$\begin{bmatrix} (1 \cdot 3) + ~~\cdots~~ + 2, & (1 \cdot 5 + 1 \cdot 0 -1) \\ 0 -1 +4, & ~~\cdots~~(0 \cdot 5) + -2 \end{bmatrix} = \begin{bmatrix} 5 & 4 \\ 3 & -2 \end{bmatrix}$

              $r_1 \times c_2$ 3×1 1×2

4. ~~\cdots~~ 5×4 5×4 1×3 2×1

              4×5 4×5 3×1 1×1
              r   c 1×3 1×4
                                                       r   c

    Assume A is 3×1
    Assume B is 1×2
        AB is undefined

        $A^T B^T$ is defined since $1 \times 3 \cdot 2 \times 1$
    the rows and columns matches by the
    row column rule