

# Linear Algebra

$$\begin{aligned}
 & \sum_{i=1}^m \sum_{j=1}^n A_{ij} \sigma_{ri} \sigma_{cj} \\
 &= \sum_{i=1}^m \left( \sum_{j=1}^n A_{ij} \sigma_{cj} \right) \sigma_{ri} \\
 &= \sigma_r \left( \sum_{j=1}^n A_{ij} \sigma_{cj} \right)^T
 \end{aligned}$$

Diagram illustrating the matrix multiplication process:

- The first expression shows the double summation  $\sum_{i=1}^m \sum_{j=1}^n A_{ij} \sigma_{ri} \sigma_{cj}$ .
- The second expression shows the inner summation  $\sum_{j=1}^n A_{ij} \sigma_{cj}$  grouped together, with  $\sigma_{ri}$  outside.
- The third expression shows the final result  $\sigma_r \left( \sum_{j=1}^n A_{ij} \sigma_{cj} \right)^T$ .

Visual representations of the matrices and vectors:

- A small black rectangle represents the matrix  $A$ .
- A red rectangle represents the vector  $\sigma_r$ .
- A green rectangle represents the vector  $\sigma_c^T$ .
- A yellow rectangle represents the resulting vector  $\sigma_r$ .

Arrows indicate the flow of the calculation from the first expression to the second, and then to the third.