

20/9/10/10

2.2

Sum of squares - mostly used for variance or standard deviation

$$x^T x = [x_1, x_2, \dots, x_N] \begin{bmatrix} x_1 \\ x_2 \\ \vdots \\ x_N \end{bmatrix} = \sum_{i=1}^N x_i^2$$

Inner product between matrices

$$C = AB \rightarrow c_{ij} = a_i^T b_j$$

$$A \in \mathbb{R}^{N \times L}, B \in \mathbb{R}^{L \times M} \rightarrow AB \in \mathbb{R}^{N \times M}$$

$$\begin{bmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \\ a_{41} & a_{42} & a_{43} \end{bmatrix} \begin{bmatrix} b_{11} & b_{12} \\ b_{21} & b_{22} \\ b_{31} & b_{32} \end{bmatrix} = \begin{bmatrix} a_{11}b_{11} + a_{12}b_{21} + a_{13}b_{31} & a_{11}b_{12} + a_{12}b_{22} + a_{13}b_{32} \\ a_{21}b_{11} + a_{22}b_{21} + a_{23}b_{31} & a_{21}b_{12} + a_{22}b_{22} + a_{23}b_{32} \\ a_{31}b_{11} + a_{32}b_{21} + a_{33}b_{31} & a_{31}b_{12} + a_{32}b_{22} + a_{33}b_{32} \\ a_{41}b_{11} + a_{42}b_{21} + a_{43}b_{31} & a_{41}b_{12} + a_{42}b_{22} + a_{43}b_{32} \end{bmatrix}$$

4x3

3x2

→ 4x2

$$A = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix}, B = \begin{bmatrix} 1 & 2 \\ 3 & 4 \\ 5 & 6 \end{bmatrix}, C = AB = \begin{bmatrix} 22 & 28 \\ 49 & 64 \end{bmatrix}$$

Practice

(1) Calculate AB with your hands.

$$\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix} \begin{bmatrix} 1 & 2 \\ 3 & 4 \\ 5 & 6 \end{bmatrix} = \begin{bmatrix} (1+6+15) & (2+8+18) \\ (4+15+36) & (8+20+36) \end{bmatrix} = \begin{bmatrix} 22 & 28 \\ 49 & 64 \end{bmatrix}$$

2x3

3x2

→ 2x2

(2) Calculate BA with your hands. See whether it is same with AB.

$$\begin{bmatrix} 1 & 2 \\ 3 & 4 \\ 5 & 6 \end{bmatrix} \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix} = \begin{bmatrix} (1+8) & (2+10) & (3+12) \\ (3+6) & (6+20) & (9+24) \\ (5+24) & (10+30) & (15+36) \end{bmatrix} = \begin{bmatrix} 9 & 12 & 15 \\ 19 & 26 & 33 \\ 29 & 40 & 51 \end{bmatrix}$$

3x2

2x3

$$\boxed{AB \neq BA}$$