

$$f(A) \in \mathbb{R}^{2 \times 2} \rightarrow \mathbb{R}$$

$$f(A) = A_{11} + A_{12}^2$$

$$f\left(\begin{bmatrix} 5 & 6 \\ 7 & 8 \end{bmatrix}\right) = 5 + 6^2 = 41$$

$$\nabla_A f(A) = \begin{bmatrix} \frac{\partial f}{\partial A_{11}} & \frac{\partial f}{\partial A_{12}} \\ \frac{\partial f}{\partial A_{21}} & \frac{\partial f}{\partial A_{22}} \end{bmatrix}$$

$$\nabla_A f(A) = \begin{bmatrix} 1 & 2A_{12} \\ 0 & 0 \end{bmatrix}$$

$$\nabla_A f(0) \stackrel{\text{set}}{=} \vec{0}$$

If A is a square ($A \in \mathbb{R}^{n \times n}$)

$\text{tr } A$ = sum of diagonal entries

trace of A

$$\text{tr } A = \text{tr } A^T$$

$$f(A) = \text{tr } AB$$

$$\nabla_A f(A) = B^T$$

$$\text{tr } AB = \text{tr } BA$$

$$\text{tr } ABC = \text{tr } CAB$$