Definition

For $A \in \mathbf{R}^{n \times n}$ and $x \in \mathbf{R}^n$,

$$x^\top A x = \sum_{i,j} A_{ij} x_i x_j,$$

is a quadratic form.

Under trace

Observe that $\operatorname{tr} x^\top A x = \operatorname{tr} A x x^\top = \operatorname{tr} x x^\top A$.