scalar and matrix operation

$$\begin{gathered} 5+\begin{bmatrix}1 & 2\\ 3 & 4\end{bmatrix}=\begin{bmatrix}6 & 7\\ 8 & 9\end{bmatrix} \\ a+\boldsymbol{B}=\boldsymbol{C} \end{gathered} \tag{1}$$

$$\begin{gathered} 5-\begin{bmatrix}1 & 2\\ 3 & 4\end{bmatrix}=\begin{bmatrix}4 & 3\\ 2 & 1\end{bmatrix} \\ a-\boldsymbol{B}=\boldsymbol{C} \end{gathered} \tag{2}$$

$$\begin{gathered} 5\cdot\begin{bmatrix}1 & 2\\ 3 & 4\end{bmatrix}=\begin{bmatrix}5 & 10\\ 15 & 20\end{bmatrix} \\ a\cdot\boldsymbol{B}=\boldsymbol{C} \end{gathered} \tag{3}$$

$$\begin{gathered} 12\div\begin{bmatrix}1 & 2\\ 3 & 4\end{bmatrix}=\begin{bmatrix}12 & 6\\ 4 & 3\end{bmatrix} \\ a\div\boldsymbol{B}=\boldsymbol{C} \end{gathered} \tag{4}$$

matrix and matrix operation

$$\begin{gathered} \begin{bmatrix}1 & 1\\ 2 & 2\end{bmatrix}+\begin{bmatrix}1 & 2\\ 3 & 4\end{bmatrix}=\begin{bmatrix}2 & 3\\ 5 & 6\end{bmatrix} \\ \boldsymbol{A}+\boldsymbol{B}=\boldsymbol{C} \end{gathered} \tag{5}$$

$$\begin{gathered} \begin{bmatrix}1 & 2\\ 3 & 4\end{bmatrix}-\begin{bmatrix}1 & 1\\ 2 & 2\end{bmatrix}=\begin{bmatrix}0 & 1\\ 1 & 2\end{bmatrix} \\ \boldsymbol{A}-\boldsymbol{B}=\boldsymbol{C} \end{gathered} \tag{6}$$

$$\begin{bmatrix}1 & 1\\2 & 2\end{bmatrix}\begin{bmatrix}1 & 2\\3 & 4\end{bmatrix} = \begin{bmatrix}4 & 6\\8 & 12\end{bmatrix}$$

$$\boldsymbol{AB} = \boldsymbol{C} \tag{7}$$

$$\begin{bmatrix}1 & 1\\2 & 2\end{bmatrix}\begin{bmatrix}1 & 1\\2 & 2\end{bmatrix}^{-1} = \begin{bmatrix}1 & 0\\0 & 1\end{bmatrix}$$

$$\boldsymbol{AA}^{-1} = \boldsymbol{I} \tag{8}$$

Hadamard product

$$\begin{bmatrix}1 & 1\\2 & 2\end{bmatrix} \odot \begin{bmatrix}1 & 2\\3 & 4\end{bmatrix} = \begin{bmatrix}1 & 2\\6 & 8\end{bmatrix}$$

$$\boldsymbol{A} \odot \boldsymbol{B} = \boldsymbol{C} \tag{9}$$

Dot product

when $\boldsymbol{a} = \begin{bmatrix}1\\2\end{bmatrix}$ and $\boldsymbol{b} = \begin{bmatrix}3\\4\end{bmatrix}$

$$\boldsymbol{a} \cdot \boldsymbol{b} = \boldsymbol{a}^T\boldsymbol{b} = \begin{bmatrix}1 & 2\end{bmatrix}\begin{bmatrix}3\\4\end{bmatrix} = 11 \tag{10}$$

linear equation

$$\boldsymbol{A}\boldsymbol{x} = \boldsymbol{b} \tag{11}$$

$$\begin{bmatrix} a_0 & a_1 \\ a_2 & a_3 \end{bmatrix} \begin{bmatrix} x_0 \\ x_1 \end{bmatrix} = \begin{bmatrix} b_0 \\ b_1 \end{bmatrix} \tag{12}$$

$$\begin{aligned} b_0 = a_0 x_0 + a_1 x_1 \\ b_1 = a_2 x_0 + a_3 x_1 \end{aligned} \tag{13}$$

Linear Dependence and Span

$$equation \tag{14}$$

Norm

Definition

$$\|\boldsymbol{x}_p\| = \left(\sum_i |x_i|^p \right)^{\frac{1}{p}} \tag{15}$$

$$L^p = \|\boldsymbol{x}\| \tag{16}$$

L1 norm

$$\begin{aligned} L^1 = \sum_i |x_i| \\ = |x_0| + |x_1| + |x_2| \dots |x_n| \end{aligned} \tag{17}$$

L2 norm

$$\begin{aligned} L^2 = \left(\sum_i |x_i|^2 \right)^{\frac{1}{2}} \\ = \sqrt{x_0^2 + x_1^2 + x_2^2 \dots x_n^2} \end{aligned} \tag{18}$$

Squared L2 norm

$$\begin{aligned} squared L^2 = \boldsymbol{x}^T \boldsymbol{x} \\ = x_0^2 + x_1^2 + x_2^2 \dots x_n^2 \end{aligned} \tag{19}$$

Frobenius norm

$$\|\boldsymbol{A}\|_F = \sqrt{\sum_{i,j} \boldsymbol{A}_{i,j}^2} \tag{20}$$