Basic linear algebra for neural networks

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From : http://ml-cheatsheet.readthedocs.io/en/latest/linear_algebra.html

Vectors

1 : a scalar

$$v = \begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix}$$

A vector of size k = a point in a k dimensional space

$$\begin{bmatrix} 2 \\ 2 \\ 2 \end{bmatrix} + 1 = \begin{bmatrix} 3 \\ 3 \\ 3 \end{bmatrix}$$

Scalar operation

$$\begin{bmatrix} a_1 \\ a_2 \end{bmatrix} + \begin{bmatrix} b_1 \\ b_2 \end{bmatrix} = \begin{bmatrix} a_1 + b_1 \\ a_2 + b_2 \end{bmatrix}$$

Element wise addition

$$\begin{bmatrix} a_1 \\ a_2 \end{bmatrix} \cdot \begin{bmatrix} b_1 \\ b_2 \end{bmatrix} = a_1 b_1 + a_2 b_2$$

Dot product

Matrices

$$\begin{bmatrix} 2 & 4 \\ 5 & -7 \\ 12 & 5 \end{bmatrix} \begin{bmatrix} a^2 & 2a & 8 \\ 18 & 7a-4 & 10 \end{bmatrix}$$

2 matrices, of size (3,2) and (2,3)

$$\begin{bmatrix} 2 & 3 \\ 2 & 3 \\ 2 & 3 \end{bmatrix} + 1 = \begin{bmatrix} 3 & 4 \\ 3 & 4 \\ 3 & 4 \end{bmatrix}$$

Scalar operation

$$\begin{bmatrix} a_1 & a_2 \\ a_3 & a_4 \end{bmatrix} \odot \begin{bmatrix} b_1 & b_2 \\ b_3 & b_4 \end{bmatrix} = \begin{bmatrix} a_1 \cdot b_1 & a_2 \cdot b_2 \\ a_3 \cdot b_3 & a_4 \cdot b_4 \end{bmatrix}$$

Element wise operation

$$\begin{bmatrix} a & b \\ c & d \\ e & f \end{bmatrix} \Rightarrow \begin{bmatrix} a & c & e \\ b & d & f \end{bmatrix}$$

Transposition

Matrices

Matrix multiplication

$$\begin{matrix} & \vec{b_1} & \vec{b_2} \\ & \downarrow & \downarrow \\ \vec{a_1}\rightarrow & 1 & 7 \\ \vec{a_2}\rightarrow & 2 & 4 \end{matrix} \cdot \begin{bmatrix} 3 & 3 \\ 5 & 2 \end{bmatrix} = \begin{bmatrix} \vec{a_1} \cdot \vec{b_1} & \vec{a_1} \cdot \vec{b_2} \\ \vec{a_2} \cdot \vec{b_1} & \vec{a_2} \cdot \vec{b_2} \end{bmatrix}$$

$$\begin{bmatrix} a & b \\ c & d \\ e & f \end{bmatrix} \cdot \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix} = \begin{bmatrix} 1a + 3b & 2a + 4b \\ 1c + 3d & 2c + 4d \\ 1e + 3f & 2e + 4f \end{bmatrix}$$