삼성전기 AI전문가 양성과정 - 프로젝트 실습 (비영상)

자연어처리를 위한 행렬연산

현청천

2022.02.28

Element wise sum

$$\begin{bmatrix} a_{11} & \cdots & a_{1n} \\ \vdots & \ddots & \vdots \\ a_{m1} & \cdots & a_{mn} \end{bmatrix} + \begin{bmatrix} b_{11} & \cdots & b_{1n} \\ \vdots & \ddots & \vdots \\ b_{m1} & \cdots & b_{mn} \end{bmatrix} = \begin{bmatrix} a_{11}+b_{11} & \cdots & a_{1n}+b_{1n} \\ \vdots & \ddots & \vdots \\ a_{m1}+b_{m1} & \cdots & a_{mn}+b_{mn} \end{bmatrix}$$

A (m, n) B (m, n) (m, n)

Element wise sum

$$\begin{bmatrix} a_{11} & \cdots & a_{1n} \\ \vdots & \ddots & \vdots \\ a_{m1} & \cdots & a_{mn} \end{bmatrix} + \begin{bmatrix} b_{11} \\ \vdots \\ b_{m1} \end{bmatrix} = \begin{bmatrix} a_{11}+b_{11} & \cdots & a_{1n}+b_{11} \\ \vdots & \ddots & \vdots \\ a_{m1}+b_{m1} & \cdots & a_{mn}+b_{m1} \end{bmatrix}$$

A (m, n) B (m, 1) (m, n)

Element wise sum

$$\begin{bmatrix} a_{11} & \cdots & a_{1n} \\ \vdots & \ddots & \vdots \\ a_{m1} & \cdots & a_{mn} \end{bmatrix} + \begin{bmatrix} b_{11} & \cdots & b_{1n} \end{bmatrix} = \begin{bmatrix} a_{11} + b_{11} & \cdots & a_{1n} + b_{1n} \\ \vdots & \ddots & \vdots \\ a_{m1} + b_{11} & \cdots & a_{mn} + b_{1n} \end{bmatrix}$$

A (m, n) B (1, n) (m, n)

Element wise sum

$$\begin{bmatrix} a_{11} & \cdots & a_{1n} \\ \vdots & \ddots & \vdots \\ a_{m1} & \cdots & a_{mn} \end{bmatrix} + \begin{bmatrix} b_{11} \end{bmatrix} = \begin{bmatrix} a_{11} + b_{11} & \cdots & a_{1n} + b_{11} \\ \vdots & \ddots & \vdots \\ a_{m1} + b_{11} & \cdots & a_{mn} + b_{11} \end{bmatrix}$$

A (m, n) B (1, 1) (m, n)

Element wise product

$$\begin{bmatrix} a_{11} & \cdots & a_{1n} \\ \vdots & \ddots & \vdots \\ a_{m1} & \cdots & a_{mn} \end{bmatrix} \odot \begin{bmatrix} b_{11} & \cdots & b_{1n} \\ \vdots & \ddots & \vdots \\ b_{m1} & \cdots & b_{mn} \end{bmatrix} = \begin{bmatrix} a_{11} \times b_{11} & \cdots & a_{1n} \times b_{1n} \\ \vdots & \ddots & \vdots \\ a_{m1} \times b_{m1} & \cdots & a_{mn} \times b_{mn} \end{bmatrix}$$

A (m, n) B (m, n) (m, n)

Element wise product

$$\begin{bmatrix} a_{11} & \cdots & a_{1n} \\ \vdots & \ddots & \vdots \\ a_{m1} & \cdots & a_{mn} \end{bmatrix} \odot \begin{bmatrix} b_{11} \\ \vdots \\ b_{m1} \end{bmatrix} = \begin{bmatrix} a_{11} \times b_{11} & \cdots & a_{1n} \times b_{11} \\ \vdots & \ddots & \vdots \\ a_{m1} \times b_{m1} & \cdots & a_{mn} \times b_{m1} \end{bmatrix}$$

A (m, n) B (m, 1) (m, n)

Element wise product

$$\begin{bmatrix} a_{11} & \cdots & a_{1n} \\ \vdots & \ddots & \vdots \\ a_{m1} & \cdots & a_{mn} \end{bmatrix} \odot \begin{bmatrix} b_{11} & \cdots & b_{1n} \end{bmatrix} = \begin{bmatrix} a_{11} \times b_{11} & \cdots & a_{1n} \times b_{1n} \\ \vdots & \ddots & \vdots \\ a_{m1} \times b_{11} & \cdots & a_{mn} \times b_{1n} \end{bmatrix}$$

A (m, n) B (1, n) (m, n)

Element wise product

$$
\begin{bmatrix} a_{11} & \cdots & a_{1n} \\ \vdots & \ddots & \vdots \\ a_{m1} & \cdots & a_{mn} \end{bmatrix}
\odot
\begin{bmatrix} b_{11} \end{bmatrix}
=
\begin{bmatrix} a_{11} \times b_{11} & \cdots & a_{1n} \times b_{11} \\ \vdots & \ddots & \vdots \\ a_{m1} \times b_{11} & \cdots & a_{mn} \times b_{11} \end{bmatrix}
$$

A (m, n) B (1, 1) (m, n)

Matrix multiplication

$$\begin{bmatrix} a_{11} & \cdots & a_{1n} \\ \vdots & \ddots & \vdots \\ a_{m1} & \cdots & a_{mn} \end{bmatrix} \times \begin{bmatrix} b_{11} & \cdots & b_{1k} \\ \vdots & \ddots & \vdots \\ b_{n1} & \cdots & b_{nk} \end{bmatrix} = \begin{bmatrix} a_{11}b_{11} + \cdots + a_{1n}b_{n1} & \cdots & a_{11}b_{1k} + \cdots + a_{1n}b_{nk} \\ \vdots & \ddots & \vdots \\ a_{m1}b_{11} + \cdots + a_{mn}b_{n1} & \cdots & a_{1m}b_{1k} + \cdots + a_{mn}b_{nk} \end{bmatrix}$$

A (m, n) B (n, k) (m, k)

Matrix multiplication (row, col)

$$\begin{array}{r} \vec{a_1} \\ \\ \vec{a_m} \end{array} \begin{bmatrix} a_{11} & \cdots & a_{1n} \\ \vdots & \ddots & \vdots \\ a_{m1} & \cdots & a_{mn} \end{bmatrix} \times \begin{array}{c} \begin{array}{ccc} \vec{b_1} & \quad\quad & \vec{b_k} \end{array} \\ \begin{bmatrix} b_{11} & \cdots & b_{1k} \\ \vdots & \ddots & \vdots \\ b_{n1} & \cdots & b_{nk} \end{bmatrix} \end{array} = \begin{bmatrix} a_{11}b_{11} + \cdots + a_{1n}b_{n1} & \cdots & a_{11}b_{1k} + \cdots + a_{1n}b_{nk} \\ \vdots & \ddots & \vdots \\ a_{m1}b_{11} + \cdots + a_{mn}b_{n1} & \cdots & a_{1m}b_{1k} + \cdots + a_{mn}b_{nk} \end{bmatrix}$$

A (m, n) B (n, k)

$$\begin{bmatrix} \vec{a_1} \\ \vdots \\ \vec{a_m} \end{bmatrix} \times \begin{bmatrix} \vec{b_1} & \cdots & \vec{b_k} \end{bmatrix} = \begin{bmatrix} \vec{a_1} \bullet \vec{b_1} & \cdots & \vec{a_1} \bullet \vec{b_k} \\ \vdots & \ddots & \vdots \\ \vec{a_m} \bullet \vec{b_1} & \cdots & \vec{a_m} \bullet \vec{b_k} \end{bmatrix}$$

Matrix multiplication (col)

$$\begin{array}{ccc} \color{blue}{\vec{a}_1} & & \color{blue}{\vec{a}_n} \\ \end{array} \qquad \begin{array}{ccc} \color{red}{\vec{b}_1} & & \color{red}{\vec{b}_k} \\ \end{array}$$

$$\begin{bmatrix} a_{11} & \cdots & a_{1n} \\ \vdots & \ddots & \vdots \\ a_{m1} & \cdots & a_{mn} \end{bmatrix} \times \begin{bmatrix} b_{11} & \cdots & b_{1k} \\ \vdots & \ddots & \vdots \\ b_{n1} & \cdots & b_{nk} \end{bmatrix} = \begin{bmatrix} a_{11}b_{11} + \cdots + a_{1n}b_{n1} & \cdots & a_{11}b_{1k} + \cdots + a_{1n}b_{nk} \\ \vdots & \ddots & \vdots \\ a_{m1}b_{11} + \cdots + a_{mn}b_{n1} & \cdots & a_{1m}b_{1k} + \cdots + a_{mn}b_{nk} \end{bmatrix}$$

A (m, n) B (n, k)

$$A \times \begin{bmatrix} \vec{b}_1 & \cdots & \vec{b}_k \end{bmatrix} = \begin{bmatrix} A \times \vec{b}_1 & \cdots & A \times \vec{b}_k \end{bmatrix}$$

Matrix multiplication (col)

$$\begin{bmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{bmatrix} \times \begin{bmatrix} x \\ y \\ x \end{bmatrix} = \begin{bmatrix} a_{11}x + a_{12}y + a_{13}z \\ a_{21}x + a_{22}y + a_{23}z \\ a_{31}x + a_{32}y + a_{33}z \end{bmatrix}$$

$$x \begin{bmatrix} a_{11} \\ a_{21} \\ a_{31} \end{bmatrix} + y \begin{bmatrix} a_{12} \\ a_{22} \\ a_{32} \end{bmatrix} + z \begin{bmatrix} a_{13} \\ a_{23} \\ a_{33} \end{bmatrix}$$

Matrix multiplication (row)

$$\begin{array}{c} \overrightarrow{a_1} \\ \\ \overrightarrow{a_m} \end{array} \begin{bmatrix} a_{11} & \cdots & a_{1n} \\ \vdots & \ddots & \vdots \\ a_{m1} & \cdots & a_{mn} \end{bmatrix} \times \begin{bmatrix} b_{11} & \cdots & b_{1k} \\ \vdots & \ddots & \vdots \\ b_{n1} & \cdots & b_{nk} \end{bmatrix} \begin{array}{c} \overrightarrow{b_1} \\ \\ \overrightarrow{b_n} \end{array} = \begin{bmatrix} a_{11}b_{11} + \cdots + a_{1n}b_{n1} & \cdots & a_{11}b_{1k} + \cdots + a_{1n}b_{nk} \\ \vdots & \ddots & \vdots \\ a_{m1}b_{11} + \cdots + a_{mn}b_{n1} & \cdots & a_{1m}b_{1k} + \cdots + a_{mn}b_{nk} \end{bmatrix}$$

A (m, n) B (n, k)

$$\begin{bmatrix} \overrightarrow{a_1} \\ \vdots \\ \overrightarrow{a_m} \end{bmatrix} \times B = \begin{bmatrix} \overrightarrow{a_1} \times B \\ \cdots \\ \overrightarrow{a_m} \times B \end{bmatrix}$$

Matrix multiplication (row)

$$\begin{bmatrix} x & y & z \end{bmatrix} \times \begin{bmatrix} b_{11} & b_{12} & b_{13} \\ b_{21} & b_{22} & b_{23} \\ b_{31} & b_{32} & b_{33} \end{bmatrix} = \begin{bmatrix} b_{11}x + b_{21}y + b_{31}z & b_{12}x + b_{22}y + b_{32}z & b_{13}x + b_{23}y + b_{33}z \end{bmatrix}$$

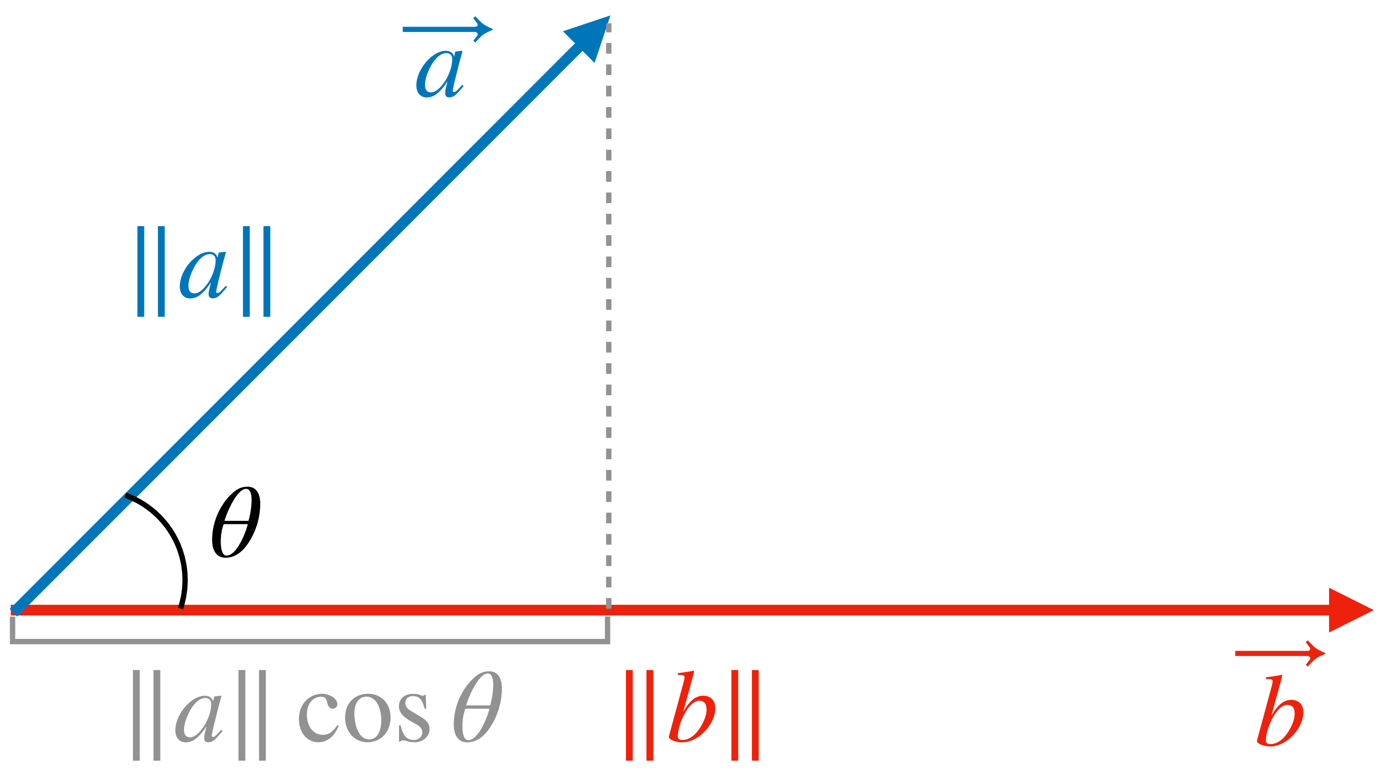
$$\Downarrow$$

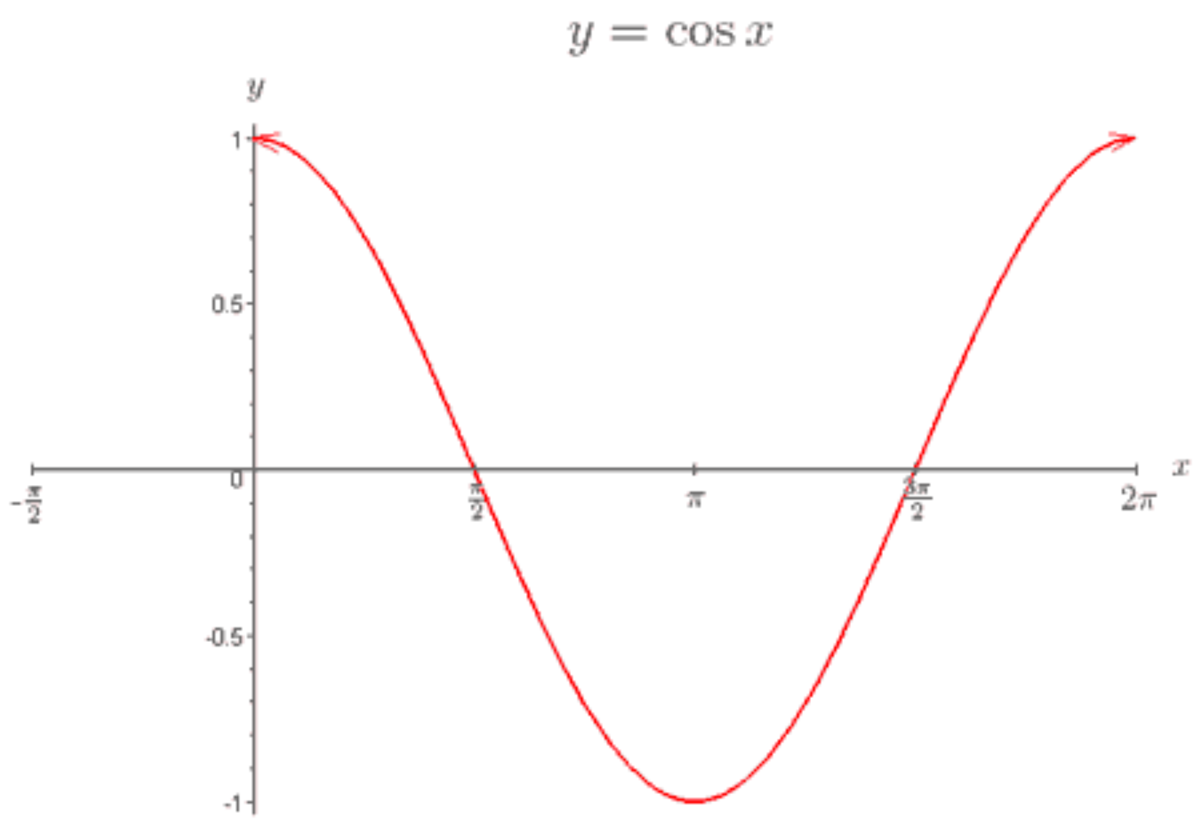
$$x \begin{bmatrix} b_{11} & b_{12} & b_{13} \end{bmatrix} + y \begin{bmatrix} b_{21} & b_{22} & b_{23} \end{bmatrix} + z \begin{bmatrix} b_{31} & b_{32} & b_{33} \end{bmatrix}$$

Dot-Product

$$\begin{bmatrix} a_1 \\ \vdots \\ a_n \end{bmatrix} \bullet \begin{bmatrix} b_1 \\ \vdots \\ b_n \end{bmatrix} = \left[a_1 b_1 + \cdots + a_n b_n\right]$$

$$= \quad \|a\| \|b\| \cos\theta$$





감사합니다.