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Deep Learning - Math Excercise

1. Write the transpose
what is the transpose of!

$$B = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$$

$$B^T = \begin{bmatrix} a & c \\ b & d \end{bmatrix}$$

2. Prove that the transpose of a Matrix A's transpose is A:
Show that $(A^T)^T = A$ given that $A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$

L.H.S

$$A^T = \begin{bmatrix} a & c \\ b & d \end{bmatrix}$$

$$(A^T)^T = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$$

$$= R.H.S$$

3. Show that the sum of transposes is equal to the transpose of a sum.
show that $A^T + B^T = (A+B)^T$ where $A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}, B = \begin{bmatrix} e & f \\ g & h \end{bmatrix}$

L.H.S

$$= A^T + B^T$$

$$= \begin{bmatrix} a & c \\ b & d \end{bmatrix} + \begin{bmatrix} e & g \\ f & h \end{bmatrix}$$

$$= \begin{bmatrix} a+e & c+g \\ b+f & d+h \end{bmatrix}$$

R.H.S

$$= (A+B)^T$$

$$= \left(\begin{bmatrix} a & b \\ c & d \end{bmatrix} + \begin{bmatrix} e & f \\ g & h \end{bmatrix} \right)^T$$

$$= \begin{bmatrix} a+e & b+f \\ c+g & h+d \end{bmatrix}^T$$

$$= \begin{bmatrix} a+e & c+g \\ b+f & h+d \end{bmatrix}$$

L.H.S = R.H.S

4. Show that the transpose of a product is equal to the product of transposes.

$$(AB)^T = B^T A^T$$

given that

$$A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}; \quad B = \begin{bmatrix} e & f \\ g & h \end{bmatrix}$$

L.H.S

$$= (AB)^T$$

$$= \left(\begin{bmatrix} a & b \\ c & d \end{bmatrix} \cdot \begin{bmatrix} e & f \\ g & h \end{bmatrix} \right)^T$$

$$= \left(\begin{bmatrix} ae+bg & af+bh \\ ce+dg & cf+dh \end{bmatrix} \right)^T$$

$$= \begin{bmatrix} ae+bg & ce+dg \\ af+bh & cf+dh \end{bmatrix}$$

R.H.S

$$= B^T A^T$$

$$= \begin{bmatrix} e & f \\ g & h \end{bmatrix}^T \cdot \begin{bmatrix} a & b \\ c & d \end{bmatrix}^T$$

$$= \begin{bmatrix} e & g \\ f & h \end{bmatrix} \cdot \begin{bmatrix} a & c \\ b & d \end{bmatrix}$$

$$= \begin{bmatrix} ae+gb & ce+dg \\ af+hb & fc+hd \end{bmatrix}$$

L.H.S = R.H.S