

# the transpose of a matrix

Let  $A$  be an  $m \times n$  matrix. The transpose of  $A$ , denoted  $A^T$  or  $A'$ , is the  $n \times m$  matrix whose columns are the respective rows of  $A$ .

- A matrix is symmetric if it doesn't change when you take its transpose

*example*

If you take the transpose of matrices  $A = \begin{bmatrix} 1 & 2 & 3 & 4 \\ 5 & 6 & 7 & 8 \\ 9 & 10 & 11 & 12 \end{bmatrix}$  and  $B = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 4 & 5 \\ 3 & 5 & 6 \end{bmatrix}$

we get  $A^T = \begin{bmatrix} 1 & 5 & 9 \\ 2 & 6 & 10 \\ 3 & 7 & 11 \\ 4 & 8 & 12 \end{bmatrix}$  and  $B^T = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 4 & 5 \\ 3 & 5 & 6 \end{bmatrix}$ .

Note: matrix  $B$  is thus symmetric.

# matrix arithmetic: addition and subtraction

Let  $A$  and  $B$  be  $m \times n$  matrices. The sum of  $A$  and  $B$ , denoted  $A + B$ , is

$$\begin{bmatrix} a_{11} + b_{11} & a_{12} + b_{12} & \cdots & a_{1n} + b_{1n} \\ a_{21} + b_{21} & a_{22} + b_{22} & \cdots & a_{2n} + b_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{m1} + b_{m1} & a_{m2} + b_{m2} & \cdots & a_{mn} + b_{mn} \end{bmatrix}$$

## exercise 1

$$\text{Let } A = \begin{bmatrix} 2 & -1 \\ 3 & 6 \end{bmatrix}.$$

Find the matrix  $X$  such that  $2A + 3X = -4A$