the matrix

- A diagonal matrix is a square matrix with non-zero elements only on the main diagonal
- An identity matrix is a diagonal matrix in which all elements on the main diagonal are 1:

$$D_{n\times n} = \begin{bmatrix} a_{11} & 0 & 0 & 0 \\ 0 & a_{22} & 0 & 0 \\ 0 & 0 & a_{33} & 0 \\ 0 & 0 & 0 & a_{44} \end{bmatrix} \qquad I_{n\times n} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

- The identity matrix is special because, when multiplied by another matrix, it produces the original matrix back again (we'll return to this later after covering matrix multiplication)
- A lower triangular matrix has non-zero elements only on or below the main diagonal
- An upper triangular matrix has non-zero elements only on or above the main diagonal
- A symmetric matrix is a square matrix with elements symmetric such that $a_{ij} = a_{ji}$

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.