Linear Algebra for Machine Learning

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Outline

- Types of Matrices
- Transpose
- Determinant
- Inverse

Types of matrices

- A vector is a matrix which has only one row and only one column. If there is only one row it is called as a row vector and if there is only one column it is called as a column vector.

$$\boldsymbol{a} = \begin{bmatrix} 10 \\ 8 \\ 7 \end{bmatrix} \quad \boldsymbol{b} = \begin{bmatrix} -2 & 7 & 4 \end{bmatrix}$$

- Scalar matrix is a matrix with only one row and only one column.
- A square matrix is a matrix in which the number of rows equal to the number of columns.

$$\boldsymbol{A} = \begin{bmatrix} 1 & 6 \\ 3 & 2 \end{bmatrix}$$

Types of matrices

- A null matrix which is also called a zero matrix is any matrix in which all the elements are 0.

$$\boldsymbol{B} = \begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$$

- diagonal matrix is a square matrix where all the off diagonal elements are 0.

$$\boldsymbol{C} = \begin{bmatrix} 9 & 0 & 0 \\ 0 & 6 & 0 \\ 0 & 0 & 7 \end{bmatrix}$$

- An identity matrix is a diagonal matrix where all the diagonal elements are 1.

$$\boldsymbol{I}_3 = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

Matrix transpose

- Transpose of a matrix is where the rows and columns are interchanged.

$$\boldsymbol{B} = \boldsymbol{A}^T \dashrightarrow b_{ij} = a_{ji}$$

$$\boldsymbol{A} = \begin{bmatrix} 2 & 7 & 1 \\ 8 & 6 & 4 \end{bmatrix} \qquad \boldsymbol{A}^T =$$

Determinant of a matrix

Determinant is defined only for a square matrix.

$$|\boldsymbol{A}| = det(\boldsymbol{A})$$

- For a scalar matrix,

$$\boldsymbol{A} = a \dashrightarrow |\boldsymbol{A}| = a$$

- In 2×2 case,

$$\boldsymbol{A} = \begin{bmatrix} a & b \\ c & d \end{bmatrix} \dashrightarrow |\boldsymbol{A}| = ad - bc$$

- In 3×3 case

$$\boldsymbol{A} = \begin{bmatrix} a & b & c \\ d & e & f \\ g & h & i \end{bmatrix} \dashrightarrow |\boldsymbol{A}| = a(ei - fh) - b(di - gf) + c(dh - ge)$$

Inverse of a matrix

The inverse of a matrix A is denoted by A^{-1}, such that,

$$AA^{-1} = A^{-1}A = I$$

Ex:-

$$A = \begin{bmatrix} 1 & -1 & 2 \\ 4 & 0 & 6 \\ 0 & 1 & -1 \end{bmatrix}$$