4.2.13

EE25BTECH11010 - Arsh Dhoke

Question:
Find the direction and normal vector for the line y = x.
Solution:

The line can be written as:

$$x - y = 0 \tag{0.1}$$

This equation can be expressed in terms of matrices
Let

$$\mathbf{x} = \begin{pmatrix} x \\ y \end{pmatrix} \tag{0.2}$$

$$\mathbf{n^T} = \begin{pmatrix} 1 & -1 \end{pmatrix} \tag{0.3}$$

$$c = 0 \tag{0.4}$$

The line equation can be written as:

$$\mathbf{n^T x} = c \tag{0.5}$$

Where **n** is the normal vector of the given line
The direction vector of the line is:

$$\mathbf{m} = \begin{pmatrix} 1 \\ 1 \end{pmatrix} \tag{0.6}$$

If the director vector is given by

$$\mathbf{m} = \begin{pmatrix} 1 \\ m \end{pmatrix} \tag{0.7}$$

then the normal vector can be written as

$$\mathbf{n} = \begin{pmatrix} -m \\ 1 \end{pmatrix} \tag{0.8}$$

We can prove this using

$$\mathbf{n^T m} = 0 \tag{0.9}$$

$$\begin{pmatrix} 1 & -1 \end{pmatrix} \begin{pmatrix} 1 \\ 1 \end{pmatrix} = 0 \tag{0.10}$$

The normal vector of the line is $\mathbf{n} = \begin{pmatrix} 1 \\ -1 \end{pmatrix}$ The director vector of the line is $\mathbf{m} = \begin{pmatrix} 1 \\ 1 \end{pmatrix}$

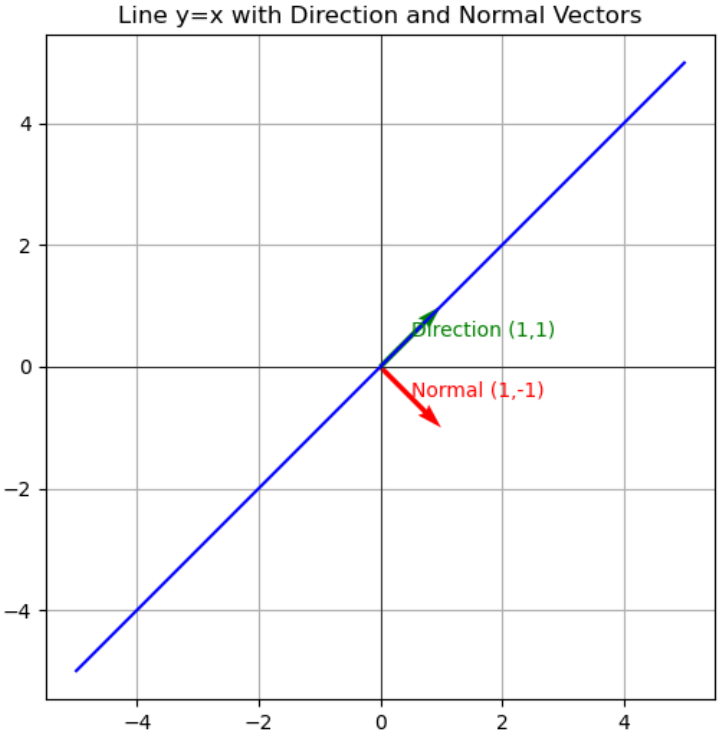

Fig. 0.1: Graph