

Assignment 1

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- 1) Consider the population (in crores) and year graph with year on x-axis, population on y-axis with points A(1985, 92), B(1995, 97). Find the slope of the line AB and using it, find what will be the population in the year 2010?

Solution: Given the points $\mathbf{A} \begin{bmatrix} 1985 \\ 92 \end{bmatrix}$, $\mathbf{B} \begin{bmatrix} 1995 \\ 97 \end{bmatrix}$
The direction vector is given by, $\mathbf{m} = \mathbf{B} - \mathbf{A}$

$$\mathbf{m} = \begin{bmatrix} 1995 \\ 97 \end{bmatrix} - \begin{bmatrix} 1985 \\ 92 \end{bmatrix}$$

$$\mathbf{m} = \begin{bmatrix} 10 \\ 5 \end{bmatrix}$$

The slope of the line is $\frac{5}{10} = \frac{1}{2}$ The normal of the line \mathbf{n} is given by,

$$\mathbf{n} = \begin{bmatrix} 5 \\ -10 \end{bmatrix}$$

Any point, \mathbf{x} on the line can be written in the form

$$\mathbf{n}^T(\mathbf{x} - \mathbf{A}) = 0$$

$$\mathbf{n}^T \mathbf{x} = \mathbf{n}^T \mathbf{A} = c$$

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

Here the value of c is given by

$$c = \begin{bmatrix} 5 & -10 \end{bmatrix} \begin{bmatrix} 1985 \\ 92 \end{bmatrix}$$

$$c = 5 * 1985 + (-10) * 92$$

$$c = 9005$$

We need to find the population in the year 2010

$$\mathbf{n}^T \mathbf{x} = c, \mathbf{x} = \begin{bmatrix} 2010 \\ y \end{bmatrix}$$

$$\begin{bmatrix} 5 & -10 \end{bmatrix} \begin{bmatrix} 2010 \\ y \end{bmatrix} = 9005$$

$$5 * 2010 + (-10)y = 9005$$

$$10y = 1045$$

$$y = 104.5$$

Hence the population in the year 2010 is 104.5 crores.