

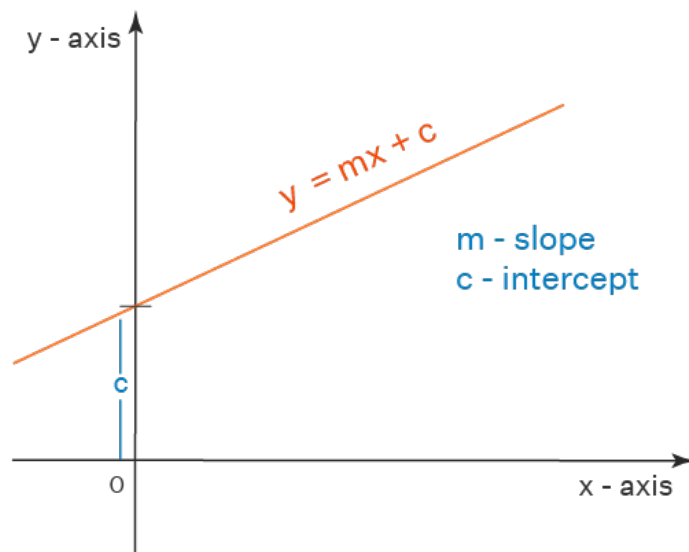
Hyperplane

1. What is HP ?

If we consider geometric intuition of hyperplane, the vector with 1 point will be a point. Vector with two points, will be an arrow, with three points it will be a plane and so on. So this line or plane is called 'hyperplane'. The beauty of linear algebra is that we can generalise to n dimensional. We can not imagine in 4D or above, in that case the geometric representation of vector will be the hyperplane. Below we derive the equation of hyperplane which is very important.

2. Equation of hyperplane

Slope Intercept Form: $y = mx + c$



- Consider the above line, we represent equation of line as, $y = mx + c$.
- The same line can be represented by $ax + by + c = 0$.
- We can represent same line by $w_1x + w_2y + w_0 = 0$.
- The point on line can be represented by (x_1, x_2) .
- Now, $w_1x_1 + w_2x_2 + w_0 = 0$, becomes the equation of line.
- This equation can be represented in the matrix form.

$$\begin{bmatrix} w_1 & w_2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + w_0 = 0.$$

- Now the same equation can be represented as follows,

$$W^T X + w_0 = 0$$

- Now this equation can also be simplified to,

$$W^T X = 0$$

- Here $W = [w_1 \ w_2 \ w_0]$ and $X = \begin{bmatrix} x_1 \\ x_2 \\ 1 \end{bmatrix}$.

- Note that this final equation can be applied to any number of dimensions.

3. Application in ML

If you consider a problem, in which from study hours we need to predict CPI. Now imagine this as linear problem, means the CPI and hours studied will be in linear relationship. So we can say that,

$$CPI = m * hr + c.$$

Using ML we need to find m and c. So the above equation can be represented as,

$$CPI = W^T X + w_0$$

In this case, $W = [m]$ and $X = [hr]$. Now the same equation can be applied for n number of input parameters. Think carefully.