

## Linear Algebra: The ML context

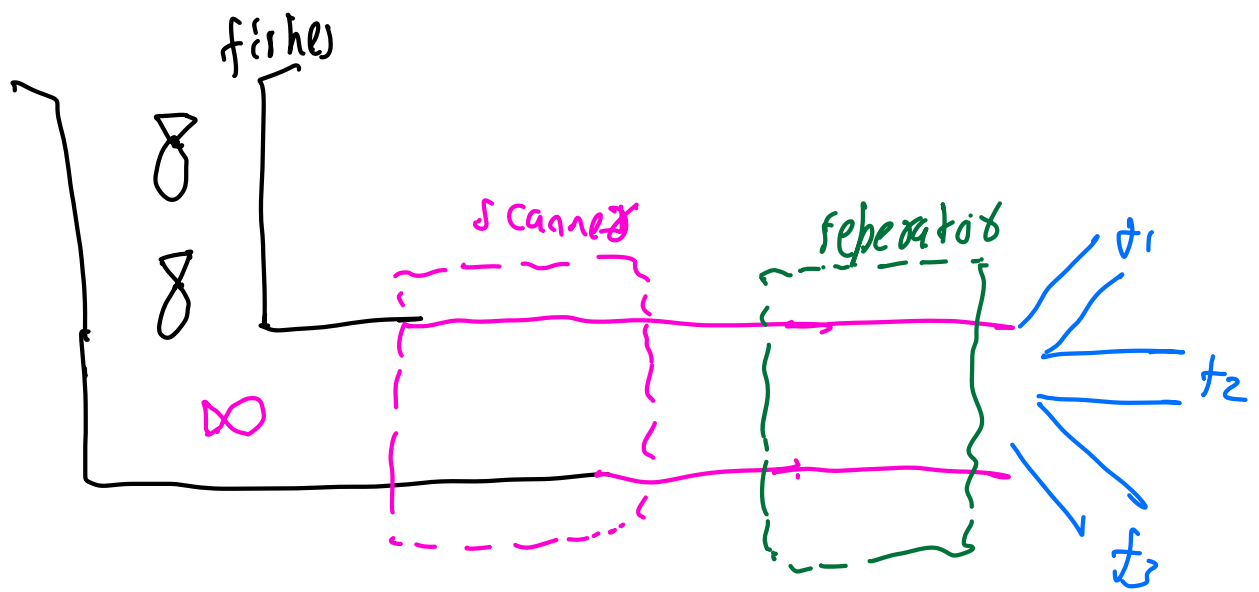
Exp	Salary
1	10K
2	20K
4	40K
3	30K

$$\text{Salary} = 10K * \text{Exp}$$

$$\begin{array}{ccccc} y & = & m x & + & c \\ \downarrow & & \downarrow & & \downarrow \\ \text{Salary} & & \text{Exp} & & 0 \end{array}$$

6 years  $\rightarrow$  ?

input  $\rightarrow$  model  $\rightarrow$  Prediction



⇒ 40 variety

① size

② weight

③ Appearance

→ color  
→ design  
→ Texture

size	weight	Appearance	Fish type
20	10	brownish	Salmon

4.1

4.2

weight	fish type
10	f <sub>1</sub>
10.2	f <sub>1</sub>
9.7	f <sub>1</sub>
8.9	f <sub>1</sub>
15	f <sub>2</sub>
15.4	f <sub>2</sub>
15.0	f <sub>2</sub>
16	f <sub>2</sub>

0.0 kg

18 kg

## Terminologies

Dataset

features

Records  
or  
data points

Target /  
Dependent  
variable

categorical  
variable

width	Length	weight	Type
—	—	—	1
—	—	—	2
—	—	—	1
—	—	—	2

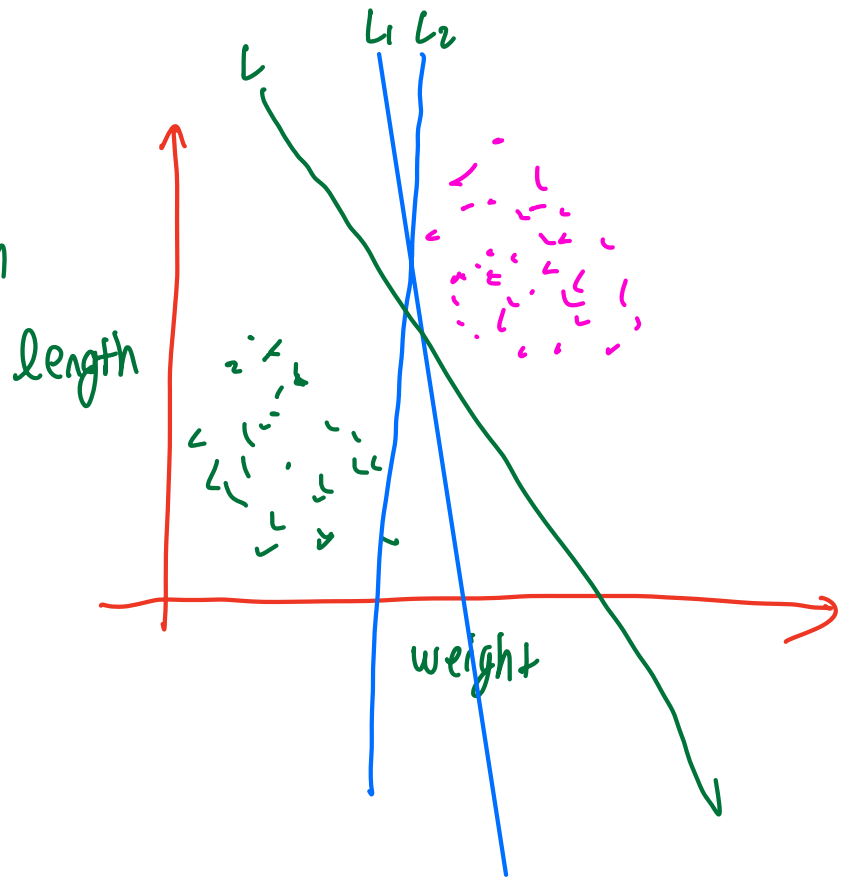
independent var

$$y = mx + c$$

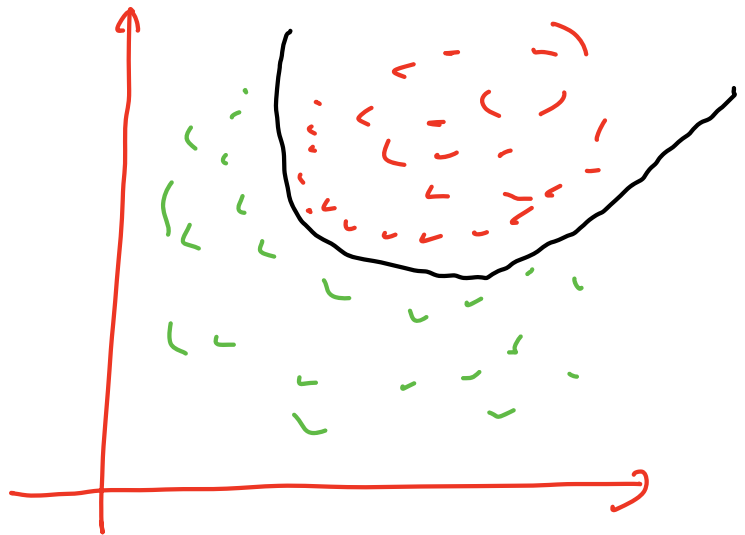
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# Visualization

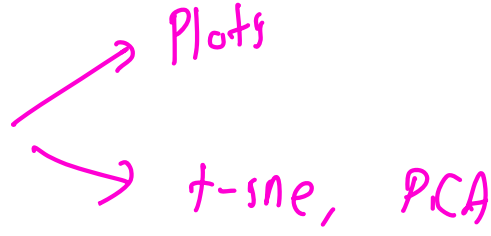
weight | length | width



PCA, t-sne



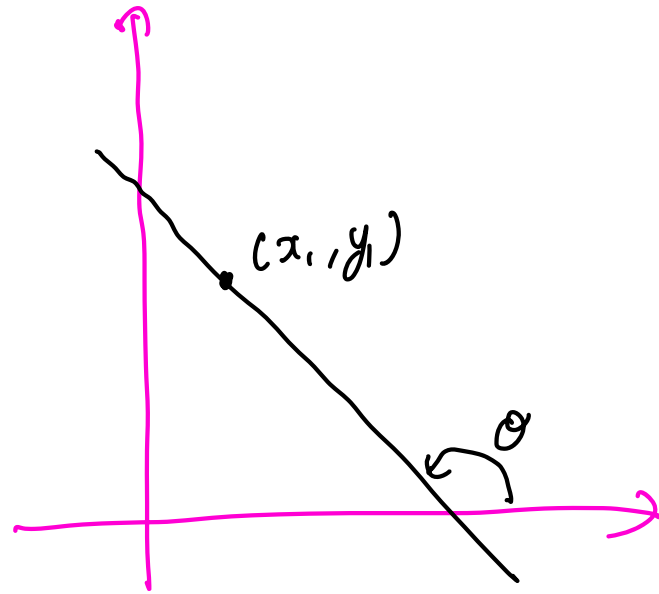
## Process involved in ML - algorithms

- ① Data collection  $\rightarrow$  label
- ② Data visualisation 
  - Plots
  - t-sne, PCA
- ③ Choose appropriate geometrical structure to separate class
- ④ Choosing a "Loss" function which help decide the best structure
- ⑤ Training / optimization

## Co-ordinate Geometry

$$y = mx + c$$

slope  $\downarrow$   $m$        $\downarrow$   $c$  y-intercept



$$y_1 = mx_1 + c$$

$$m = \tan \theta$$

$$-\infty < \tan \theta < \infty$$

$$\tan 0 = 0$$

$$\tan 90 = \infty$$

## General Eq of a Line

$$Ax + By + C = 0$$

$$w_1 x + w_2 y + w_0 = 0$$

$$w_2 y = -w_0 - w_1 x$$

$$y = \underbrace{-\frac{w_0}{w_2}}_c - \underbrace{\frac{w_1}{w_2}}_m x$$

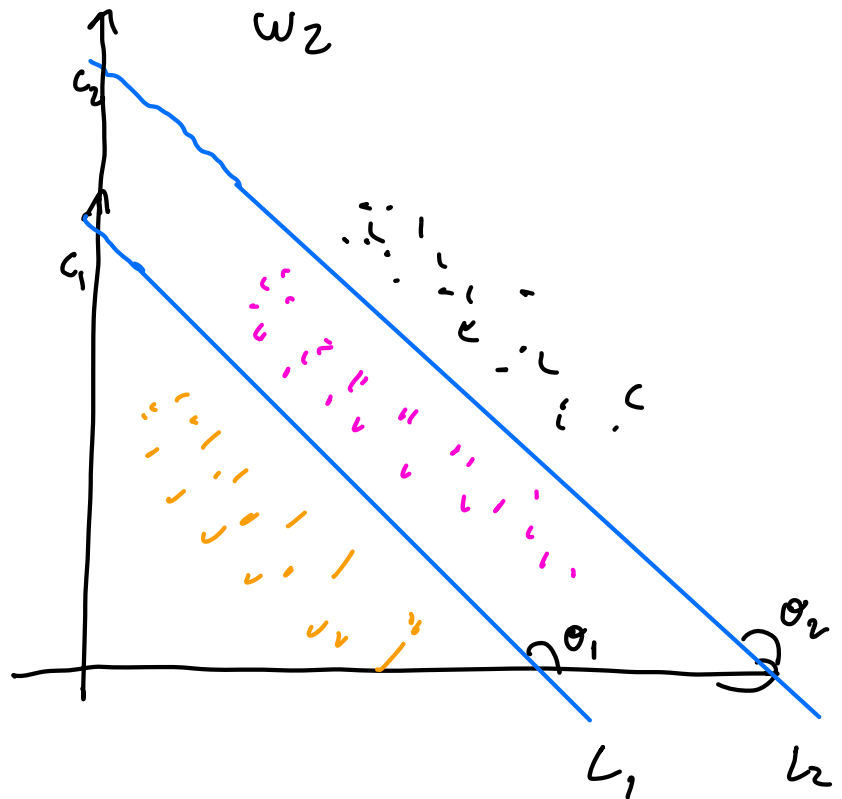
$$m = -\frac{w_1}{w_2}$$

$$c = -\frac{w_0}{w_2}$$

Multi class  
classification

$$L_1: y = m_1 x + c_1$$

$$y = m_2 x + c_2$$

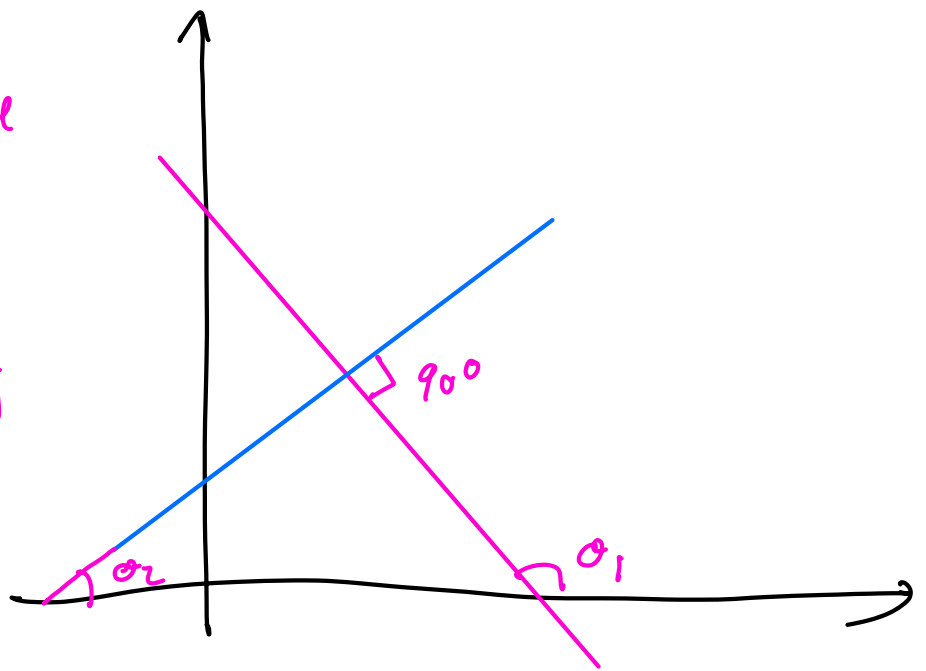


$$\theta_1 = \theta_2 \Rightarrow m_1 = m_2$$

line is parallel

If lines are  
perpendicular

$$m_1 * m_2 = -1$$



$$m_1 = -\frac{w_1}{w_2}$$

$$\Rightarrow \frac{2}{1}$$

$$\left(-\frac{2}{1}\right)$$

$$m_2 = -\frac{w_1'}{w_2'}$$

$$-\frac{1}{2}$$

$$\left(-\frac{1}{2}\right) = -1$$



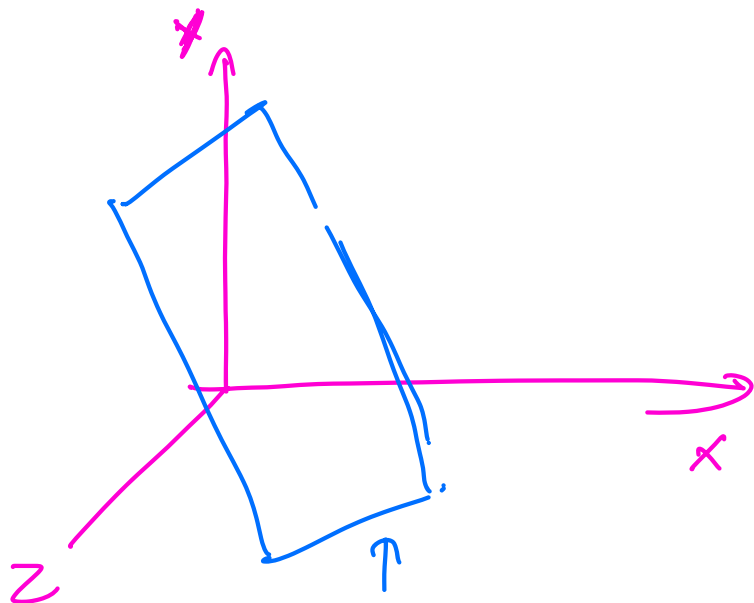
$$w_1 x + w_2 \cancel{x} + w_0 = 0$$

$$w_1 \underline{x_1} + w_2 \underline{x_2} + w_0 = 0$$

$$w_1 x_1 + w_2 x_2 + w_3 x_3 + w_0 = 0 \quad \downarrow$$

3D hyperplane

$$w_1 x_1 + w_2 x_2 + w_3 x_3 + w_4 x_4 + w_0 = 0$$



3D hyperplane