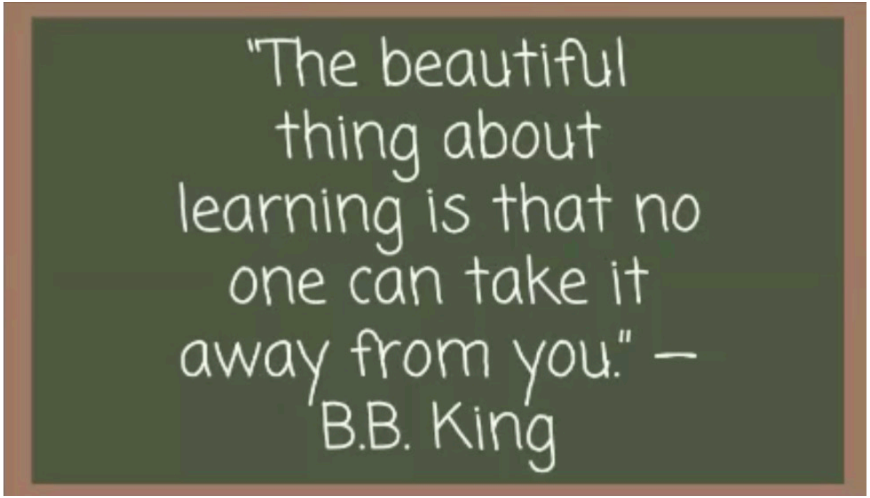
Linear Algebra-1

ML Context



"The beautiful thing about learning is that no one can take it away from you." – B.B. King

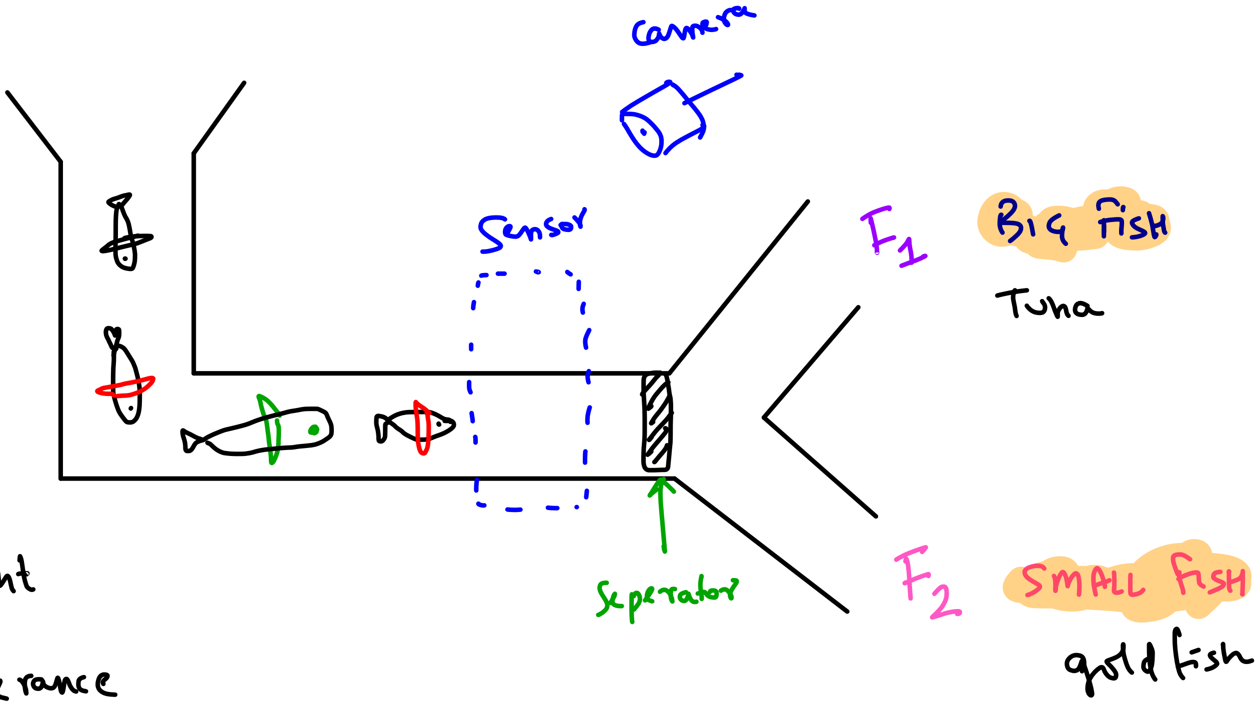
Agenda

- → Linear Algebra
- → Coordinate Geometry
- → Calculus
- → Optimization

Flow : Concept → Viz → Maths → Code

Intro. Problem Statement

Example 1 : Fish Sorting Problem



① Size

② weight

③ Apperance

Classification : finding appropriate label

- → Binary
- → multi

Terminology :

1. gather the data (manual | ——)

historical data

← features/ attributes →

width	length	weight	Type
30	50	80	1
11	23	28	2
27	43	72	1
16	31	36	2

↑ Records/ data Points ↓

← Independent var →

↳ dependent var.

Target variable | labels

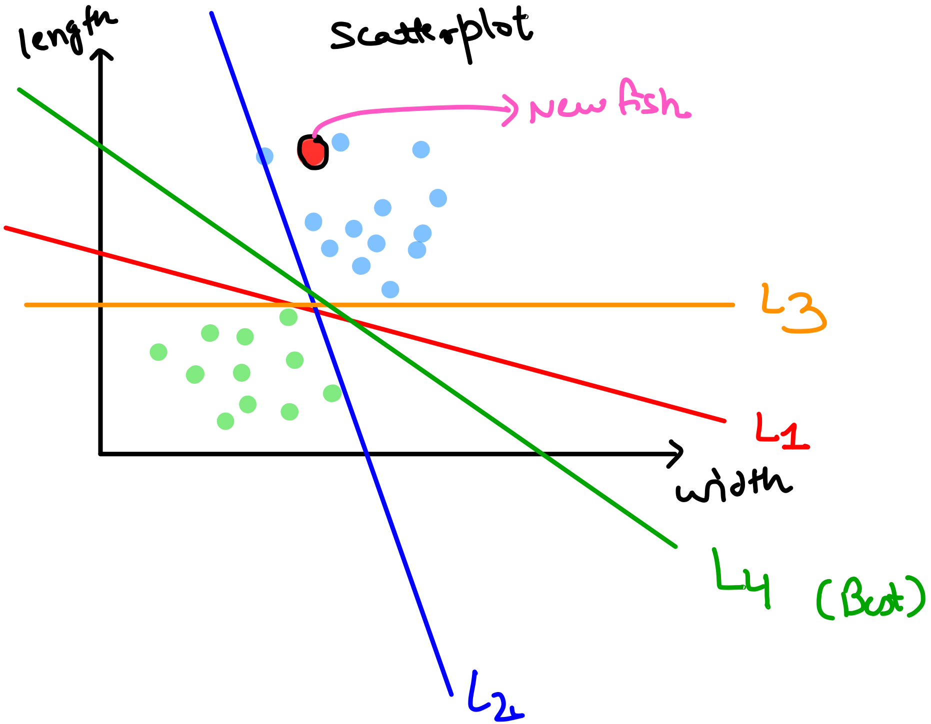
inputs → features

output → Type of fish

(∞-line)

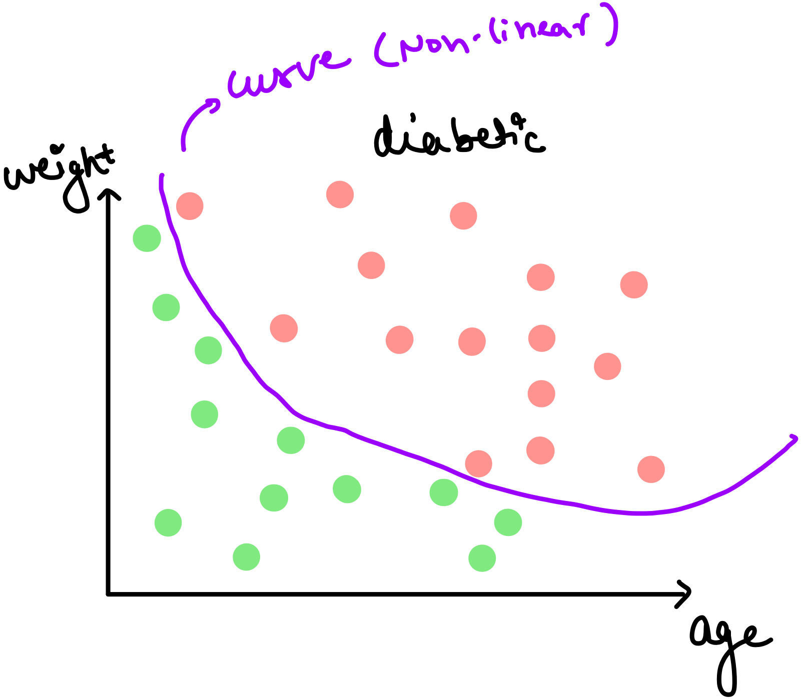
① To find Best line

② Decide → Point leftside
→ Point rightside

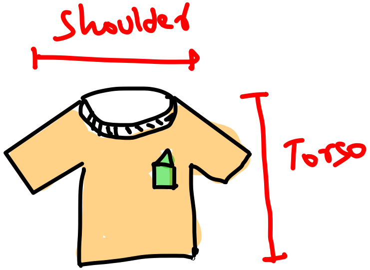


Example 2 : Diabetes Prediction

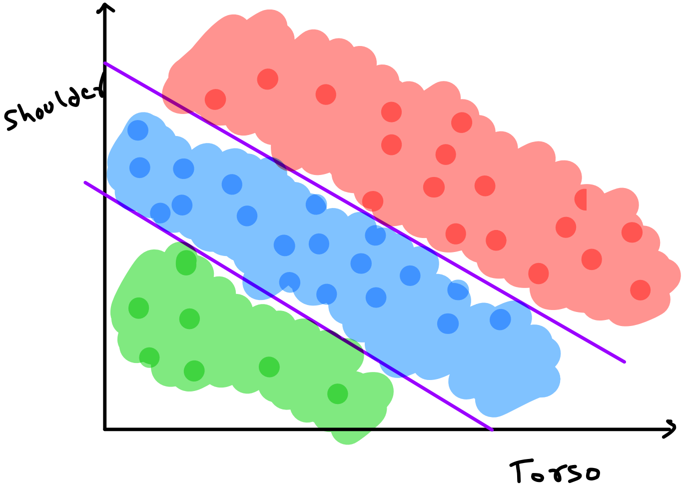
age	weight	Diabetic
24	75	No
49	80	Yes
37	92	Yes
50	68	NO



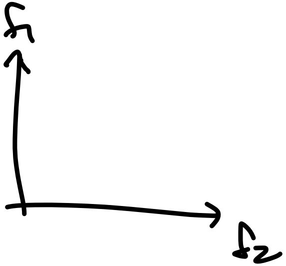
Example-3 T-shirts Size Prediction

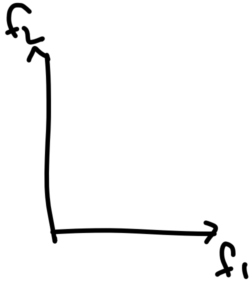


f1	f2	
Torso	Shoulder	Size
61	40	S
63	42	M
64	44	L
62	41	S
64	43	M
69	45	L

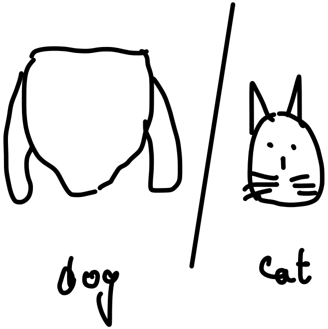


Multi-class Classification





Process of Building an ML System



1. Data Collection → Historical data (labelled data)

2. Data Visualition → EDA

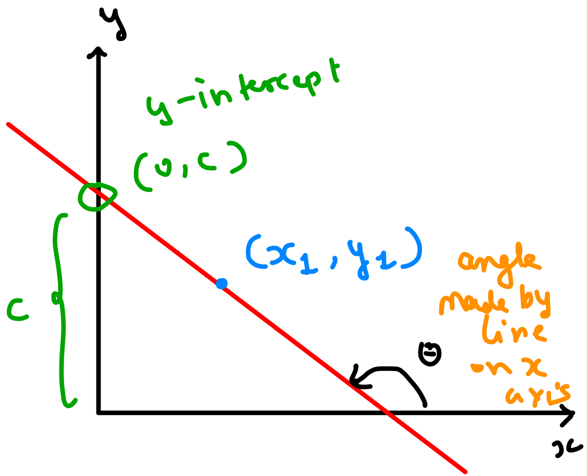
3. Choosing appropriate geometrical structure to seperate class → linear (line)
   Non-linear (Parabola, curve)

4. Choosing a Loss function which helps decide the "best" Structure

5. Training / optimisation

Coordinate Geometry

$$L_1 : \underset{\substack{\text{output} \\ \text{dependent var}}}{y} = \overset{\text{slope}}{m} . \underset{\substack{\downarrow \\ \text{input} \\ \text{independent va}}}{x} + \overset{\text{y-intercept}}{c}$$



if (x_1 , y_1) lies on the line

$$y_1 = m.x_1 + c$$

$$\boxed{\underset{\substack{\downarrow \\ \text{slope}}}{m} = \tan\theta}$$

$$\boxed{y = \underset{\substack{\downarrow \\ w}}{m} x + \underset{\substack{\downarrow \\ b}}{c}}$$

Line Eq^n : General form :

$$\boxed{ax + by + c = 0}$$

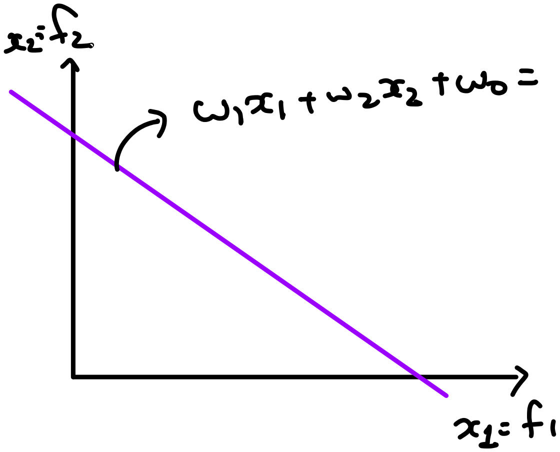
$$L_g : ax + by + c = 0$$

$$w_1 \cdot x_1 + w_2 \cdot x_2 + w_0 = 0$$

weights

bias

≈ automatically learnt during optimization



x_1	x_2	
Torso	Shoulder	Size
61	40	S
63	42	M
64	44	L
62	41	S
64	43	M
69	45	L

from Lg to L1

$$y = mx + c$$

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

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

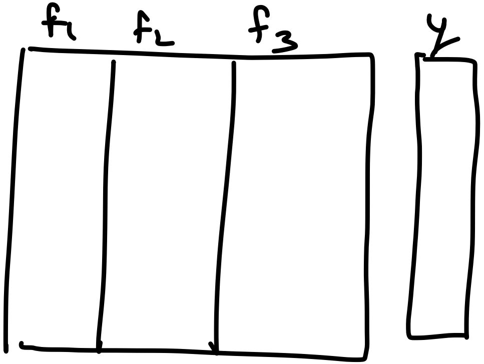
$$\boxed{y = \underbrace{-\frac{w_1}{w_2}}_{m} \cdot x \underbrace{- \frac{w_0}{w_2}}_{c}}$$

$$y = mx + c$$

$$w_1 x_1 + w_2 x_2 + w_0 = 0$$

$$\omega_1 x_1 + \omega_2 x_2 + \omega_3 x_3 + \omega_0 = 0$$

↳ plane equation



Parallel Lines

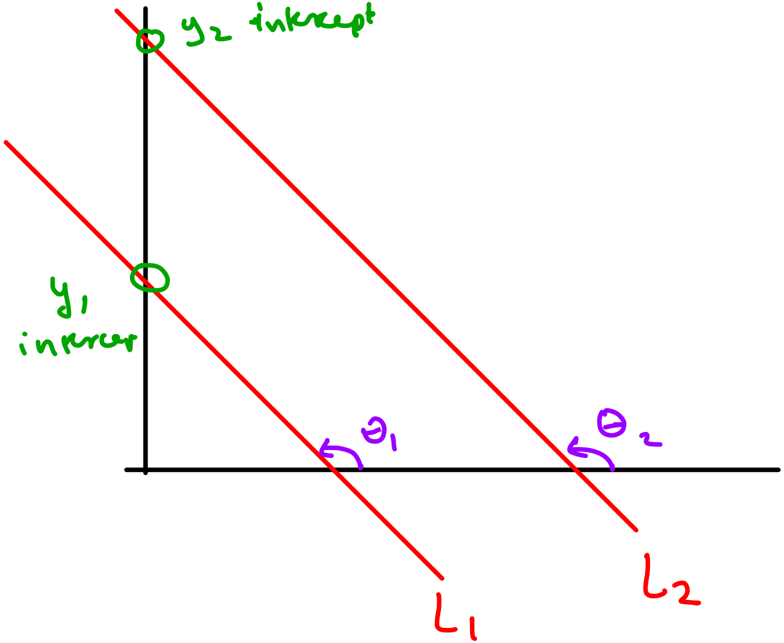
$\theta_1 = \theta_2$

$\tan\theta_1 = \tan\theta_2$

$m_1 = m_2$

$L_1 : 2x - 3y + 5 = 0$

$L_2 : 4x - 6y + 7 = 0$



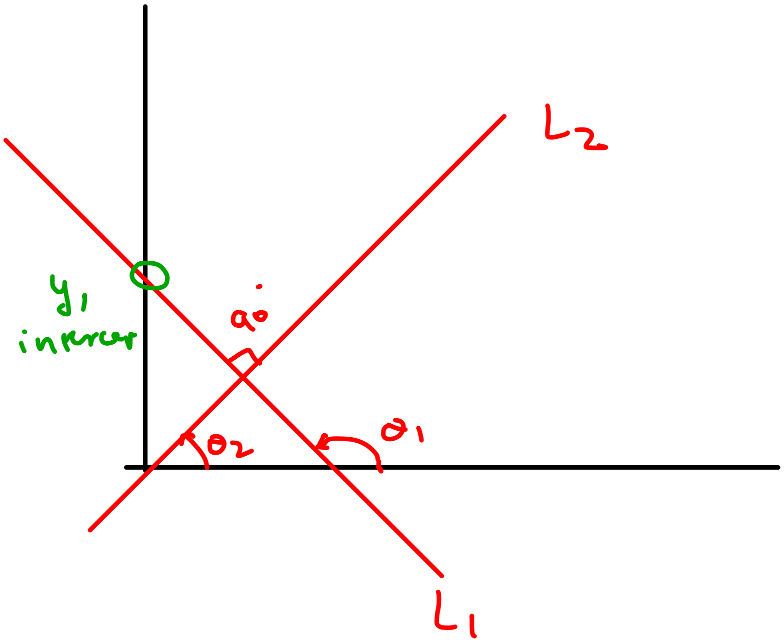
$\boxed{\text{Svm}}$

Perpendicular Lines

$$y = m_1 \cdot x + c_1$$

$$y = m_2 \cdot x + c_2$$

$$\boxed{m_1 \cdot m_2 = -1}$$



$$w_1 - w_2 + 5 = 0$$

$$w_1 + w_2 - 2 = 0$$

$$m_1 = \frac{-w_1}{w_2} = \frac{-1}{-1} = 1$$

$$m_2 = \frac{-w_1}{w_2} = \frac{-1}{1} = 1$$

true. ✓

$$m_1 \cdot m_2 = -1$$

$w_1 \cdot x_1 + w_2 x_2 + w_0 = 0$ if we have > 2 'features'

2D $w_1 x_1 + w_2 x_2 + w_0 = 0$ "line"

3D $w_1 x_1 + w_2 x_2 + w_3 x_3 + w_0 = 0$ "plane"

4D $w_1 x_1 + w_2 x_2 + w_3 x_3 + w_4 x_4 + w_0 = 0$ " 4D Hyperplane"

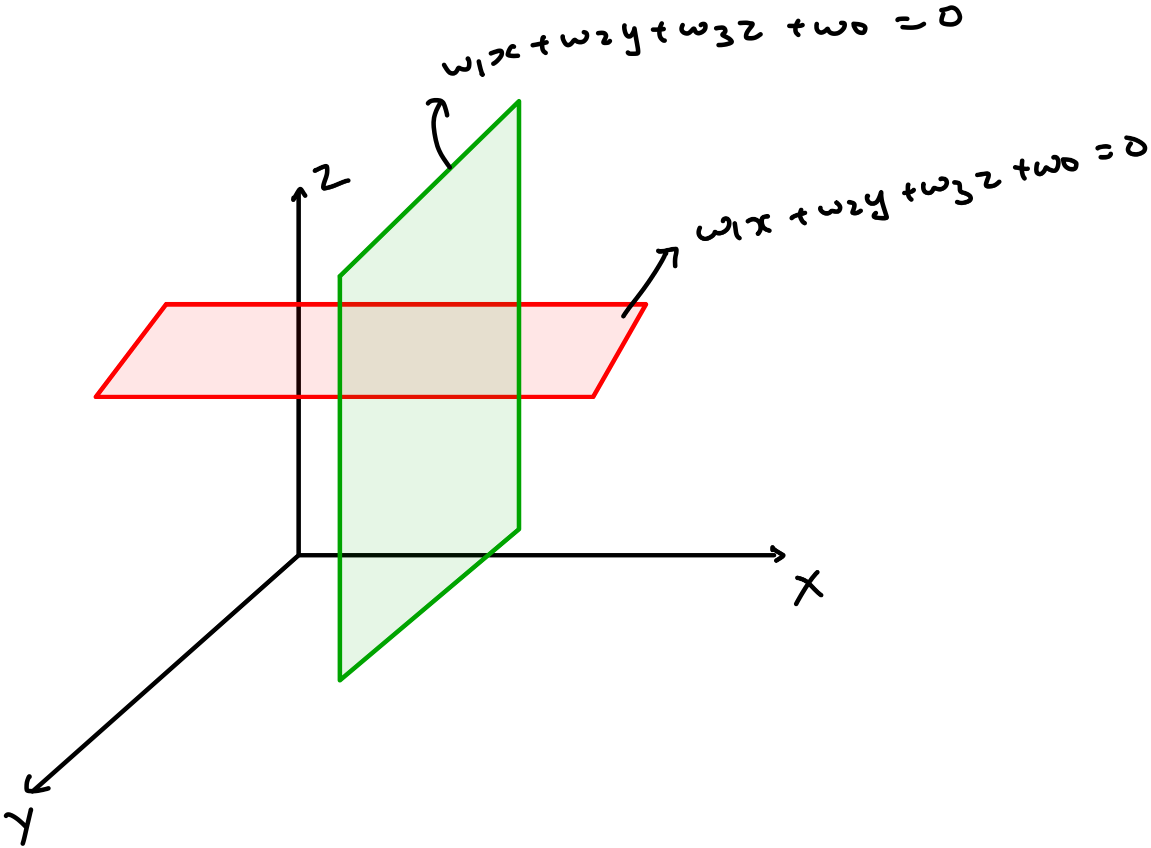
⋮

nD $w_1 x_1 + w_2 x_2 + w_3 x_3 + \cdots + w_n x_n + w_0 = 0$

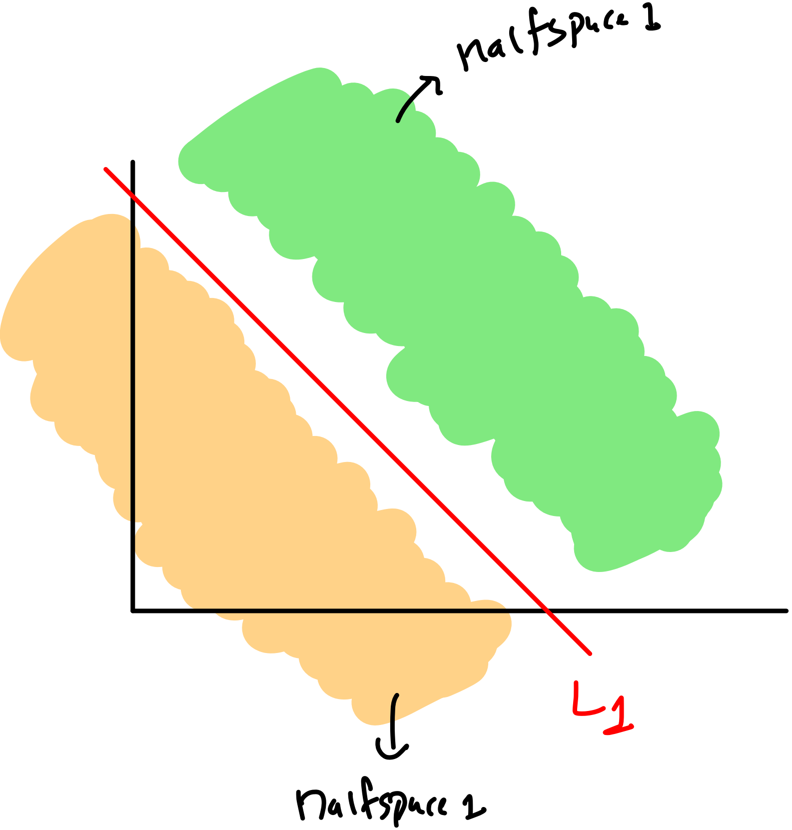
nD - Hyperplane

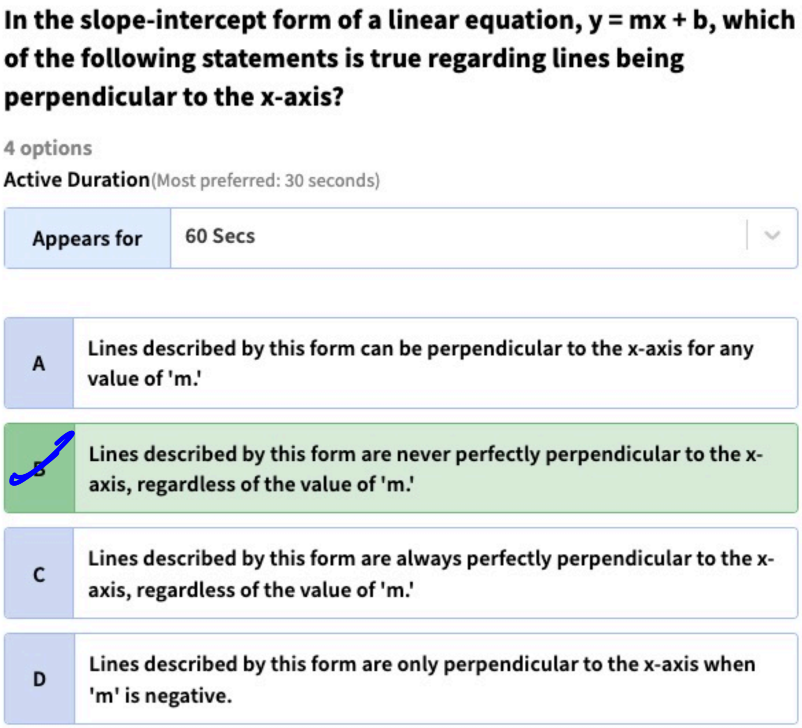
w → weights

w_0 → Bias


$w_1x + w_2y + w_3z + w_0 = 0$
$w_1x + w_2y + w_3z + w_0 = 0$
z
x
y

Halfspaces





In the slope-intercept form of a linear equation, y = mx + b, which of the following statements is true regarding lines being perpendicular to the x-axis?

4 options

Active Duration (Most preferred: 30 seconds)

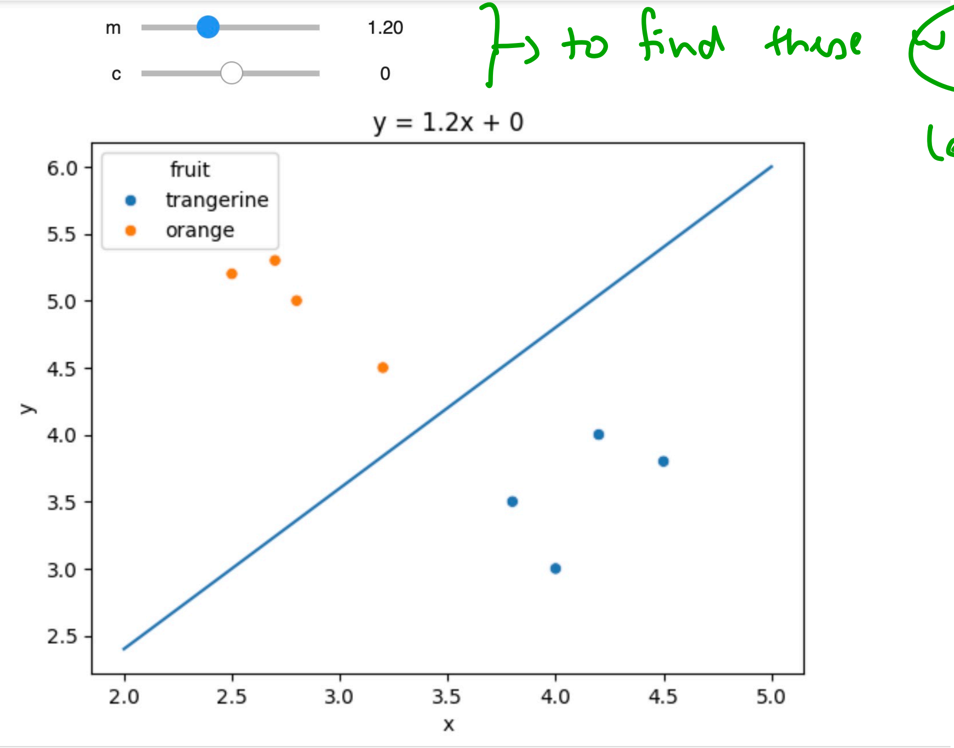
Appears for: 60 Secs

A — Lines described by this form can be perpendicular to the x-axis for any value of 'm.'

[✓ B] — Lines described by this form are never perfectly perpendicular to the x-axis, regardless of the value of 'm.'

C — Lines described by this form are always perfectly perpendicular to the x-axis, regardless of the value of 'm.'

D — Lines described by this form are only perpendicular to the x-axis when 'm' is negative.



m 1.20

c 0

} → to find these w & b or m&c automatical

learn optimization