LINEAR ALGEBRA-1

THE ML CONTEXT

Overview :

Last Foundation Course

Length : ~10 Lectures

Topics :

* Linear Algebra — 6 months
* Calculus — 6 months
* Coordinate Geometry — 6 month
* Optimisation — 6 months

In the context of ML

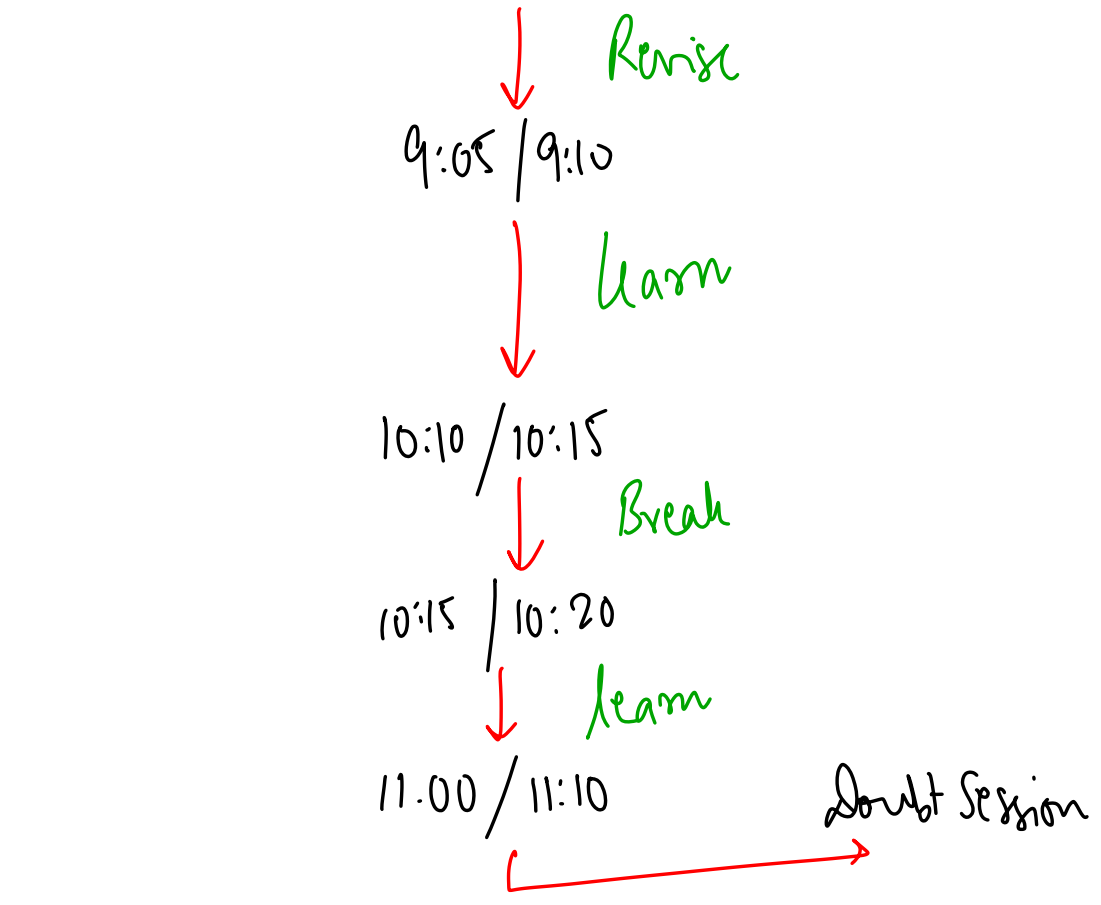
Focus : Automate tasks requiring "HUMAN INTELLIGENCE"

Flow : Concept → Visualisation → Math → Code

TIS

Evening

9:00PM → 9:02 PM



Google drive (Link)

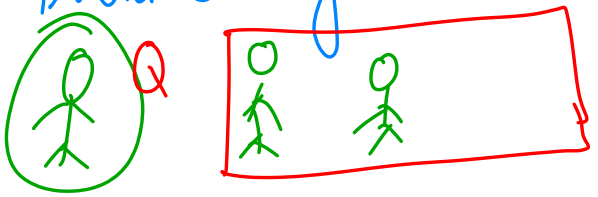
ipynb
Scribble notes
Dataset
pdf (ipynb)

→ Zipped folder

Lecture Notes

Assessment → Qs X

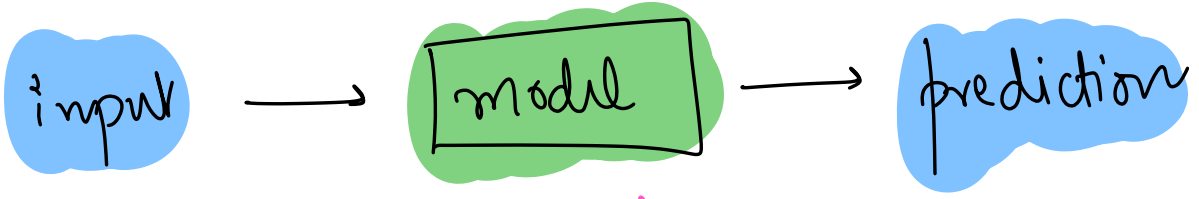
Problem Solving Session



Learn (1st) → Repeat (2nd) → Repeat (3rd) → Doubt Session

only if req.

GOAL- UNDERSTAND ~~MEMORISE~~



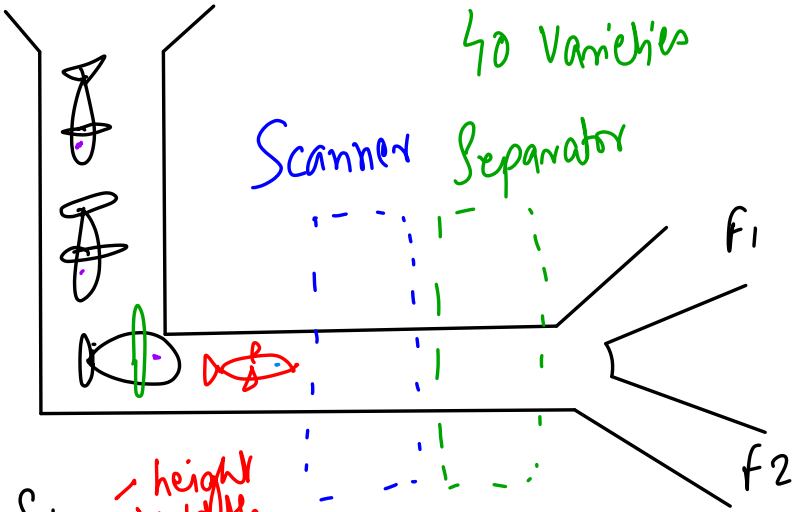
mathematical function or Algorithm

1. Prob Stats ✓
2. Hypothesis Testing ✓
3. Calculus
4. Coordinate Geometry
5. Linear Algebra
6. optimisation.

} 5

Machine Learning Applications

Example 1: Fish Sorting Machine



1. Size → height, width, length
2. Weight
3. Appearance → Design pattern, Color

F1 BIG FISH
SHEER, TUNA, CATFISH

F2 SMALL FISH
MATHI, POMPFRET

Obtain labelled data

Terminologies:

DATASET

features / attributes

TARGET VARIABLE LABELS

dependant

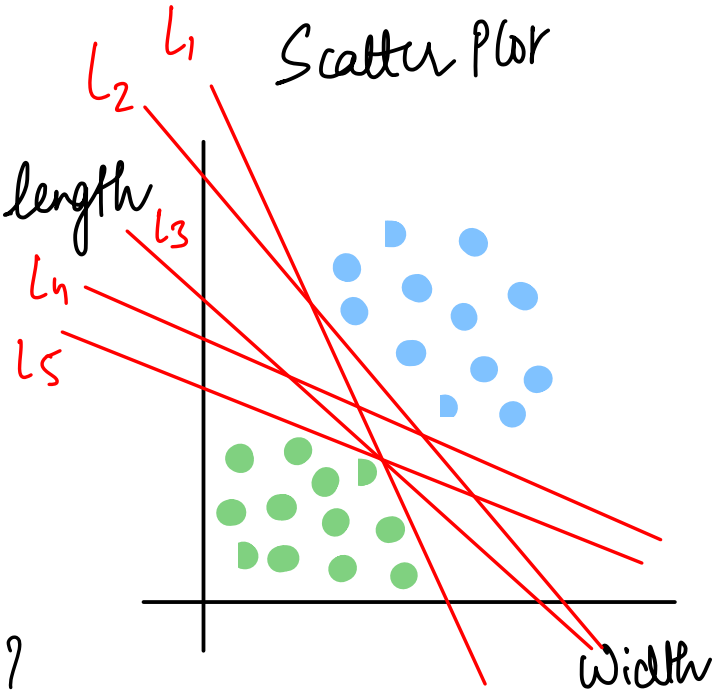
Record / datapoint

Width	Length	Weight	Type
30	50	80	1
11	23	28	2
27	43	72	1
16	31	36	2

Independant

Visualisation:

Width	Length	Weight	Type
30	50	80	1
11	23	28	2
27	48	72	1
16	31	36	2



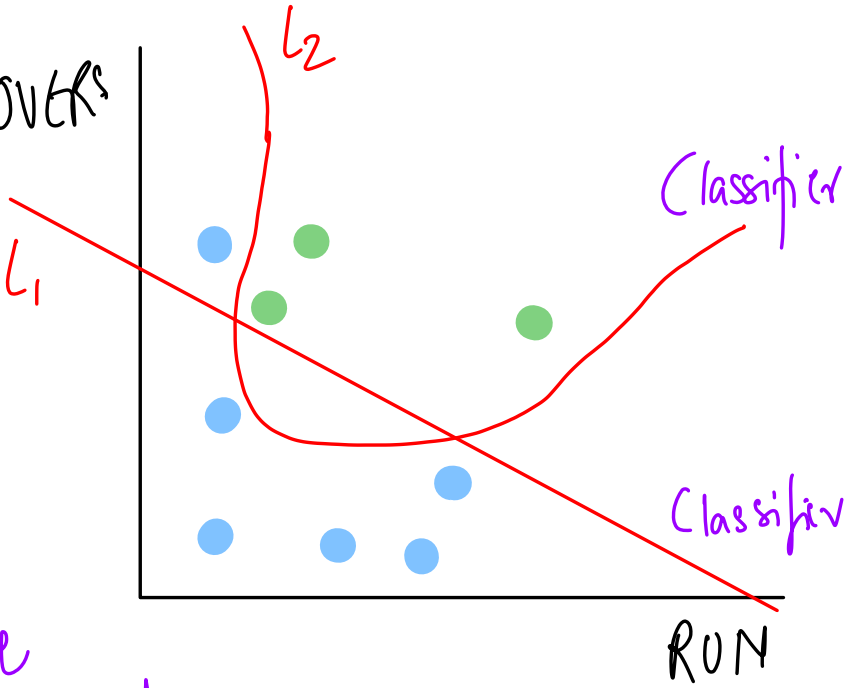
∞ lines b/w Green & Blue point

Q. Which line is the Best one?

Machine Learning Applications

Example 2: IPL Win Prediction.

RUNS	OVERS	OUTCOME
90	6	WIN
90	15	LOSS
18	1	WIN
30	7	LOSS

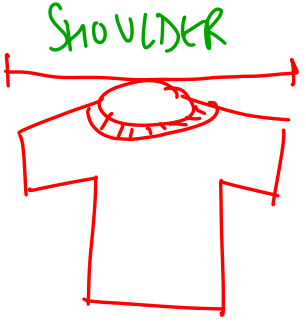


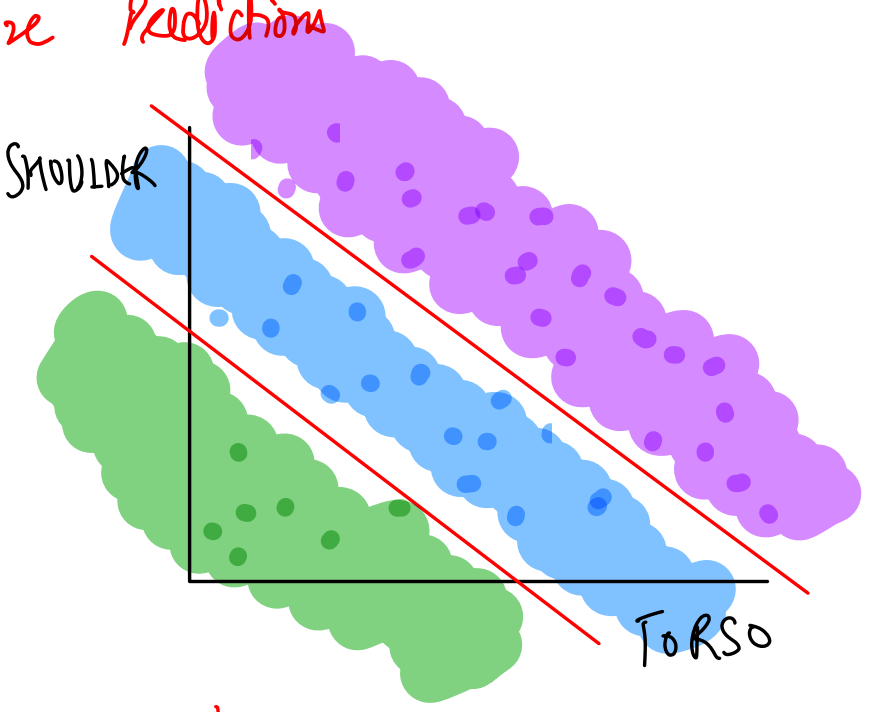
* Straight lines might not be the best option everytime.

Machine Learning Applications

Example 3 : T Shirt Size Predictions

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 Algorithm.

a) Data Collection → labelled data

b) Data Visualisation → Plot
tSNE, PCA

c) Choosing an appropriate geometrical structure to separate class

d) Choosing a LOSS function which helps decide the 'best' structure

e) Training / optimisation

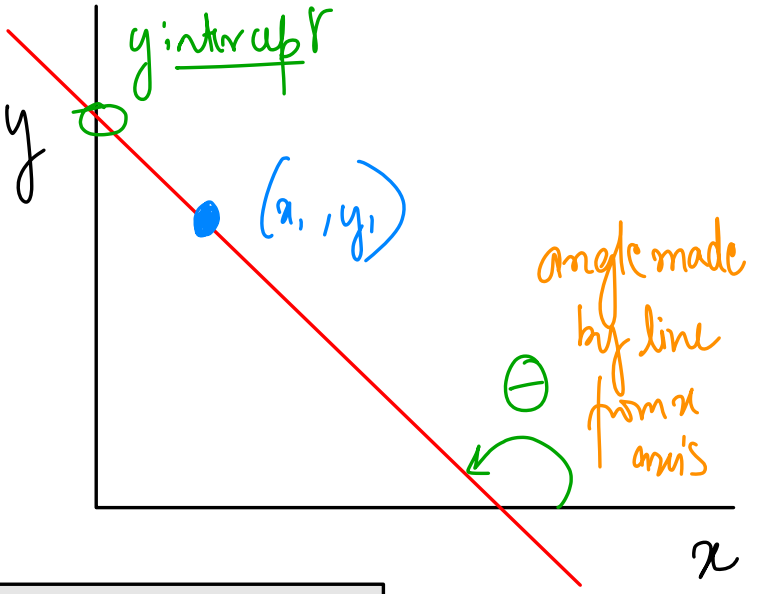
Coordinate Geometry

L_1: $y = mx + C$

slope, y intercept

output — dependant

input — independant



if point (x_1, y_1) lies on the line:

$y_1 = mx_1 + C$

$m = \tan(\theta)$

$$-\infty \leq \tan(\theta) \leq \infty$$

Line Eq^n General form. $Ax + By + C = 0$

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

$w_1 x_1 + w_2 x_2 + w_0 = 0$

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

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

parameters: w_1, w_2, w_0

how $L_g : L_1$

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

$\Rightarrow w_1 x + w_2 y = -w_0$

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

$\Rightarrow y = \left(-\frac{w_1}{w_2}\right) x \left(-\frac{w_0}{w_2}\right)$

$y = m x + c$

Parallel lines

$\theta_1 = \theta_2$

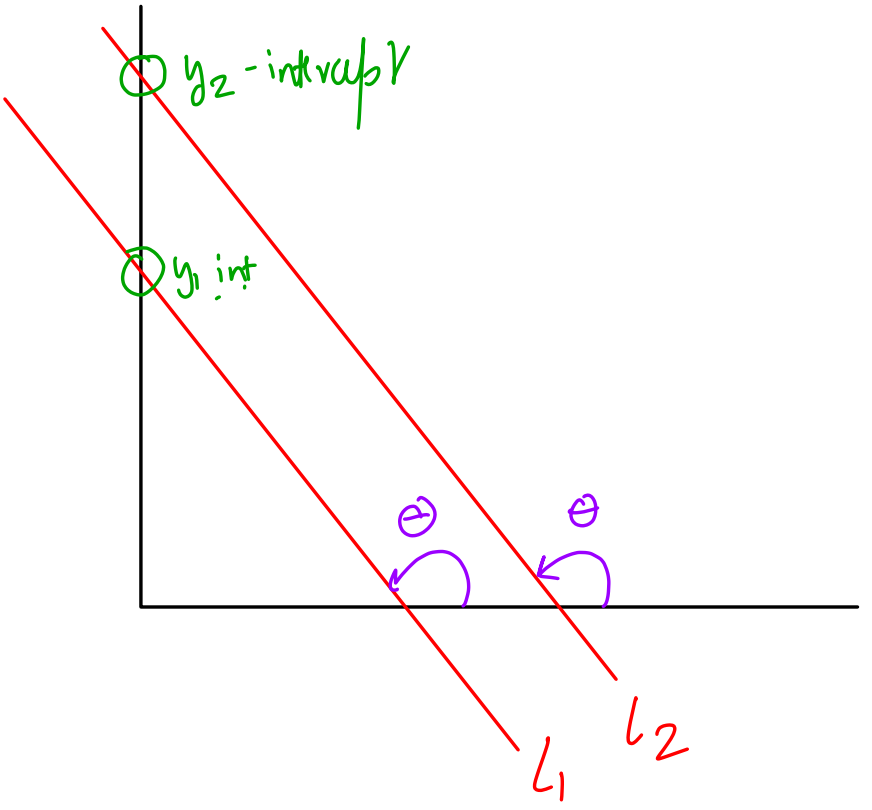
$\tan(\theta_1) = \tan(\theta_2)$

$m_1 = m_2$

$w_1 x + w_2 y + w_0 = 0$

$w_3 x + w_4 y + w_5 = 0$

$$-\frac{w_1}{w_2} = \frac{-w_3}{w_4}$$



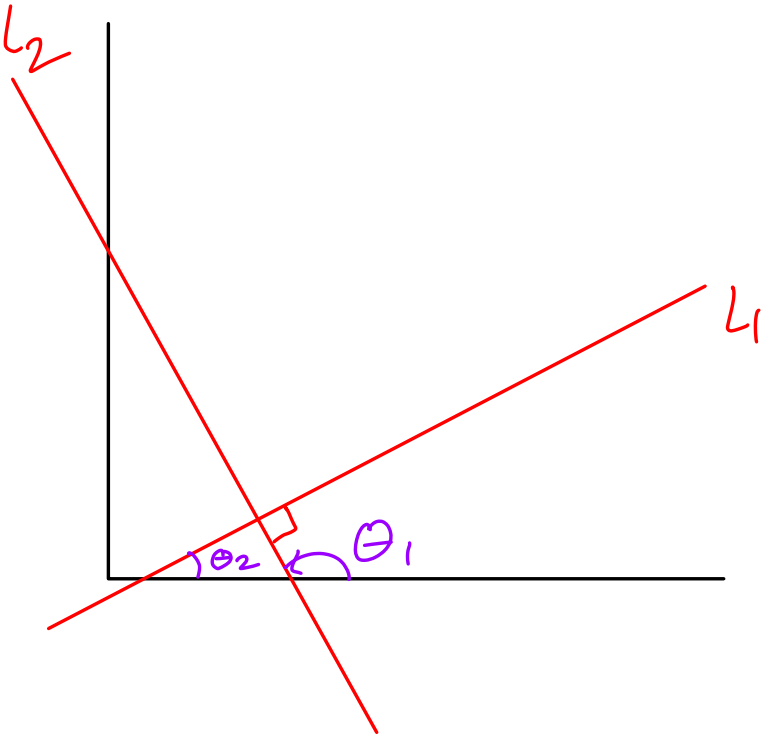
Perpendicular Lines

$$m_1 * m_2 = -1$$

$$\frac{+w_1}{w_2} \times \frac{+w_3}{w_4} = -1$$

2 -1

1 2



What will we do if we have > 2 dimensions?

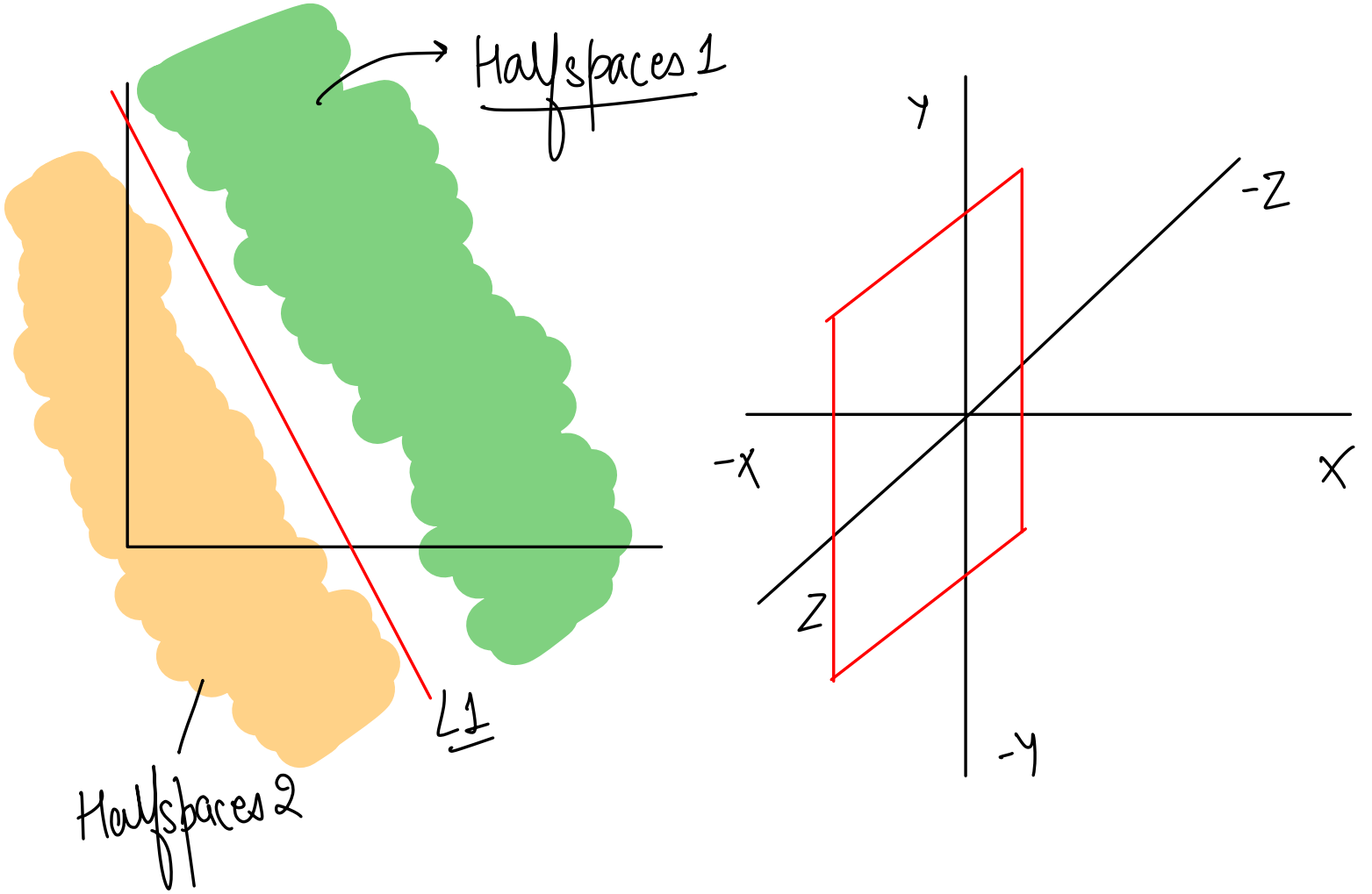
2D $w_1 x_1 + w_2 x_2 + w_0 = 0$ 2D Hyperplane

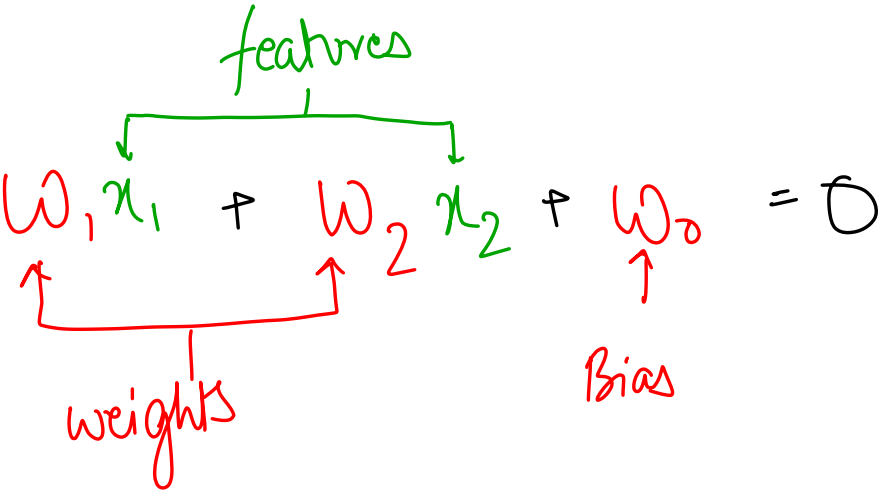
3D $w_1 x_1 + w_2 x_2 + w_3 x_3 + w_0 = 0$ 3D Hyperplane

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

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

nD Hyperplane.


Halfspaces 1
L1
Halfspaces 2
y
-z
-x
x
z
-y


features
$w_1 x_1 + w_2 x_2 + w_0 = 0$
weights
Bias