

LINEAR ALGEBRA

Say you will learn AI, nobody panics



But say you will learn linear algebra and optimisation, then everybody loses their minds

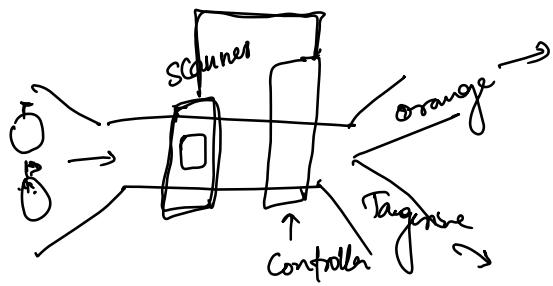
10 Lectures → Linear Algebra } Concepts + visualizations
→ calculus } {Maths + code}
→ optimization }

→ Math for MC ? Foundation 'MC'

$\left[\begin{array}{c} \text{Math} \\ \text{Relationship} \\ \text{LA} \end{array} \right] + \left[\begin{array}{c} \text{Metric} \\ \text{Loss function} \\ \text{calculus} \end{array} \right] + \left[\begin{array}{c} \text{Optimization} \\ \text{Optimizations} \end{array} \right]$

→ M L ?

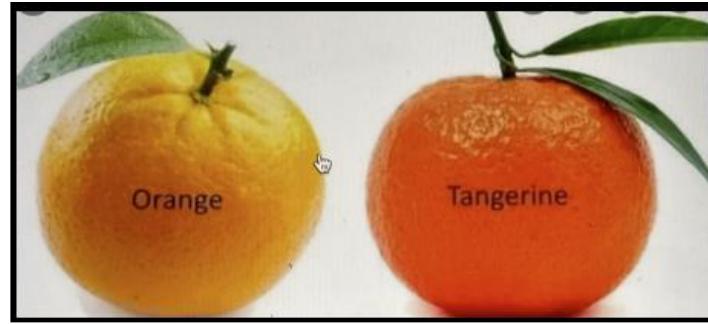
ML Problem



1. Color
2. Size (Diameter), Shape
3. Weight
- .

How do you decide Tangerine/orange?

if $w > R \text{ and } D > P$: T
else : orange



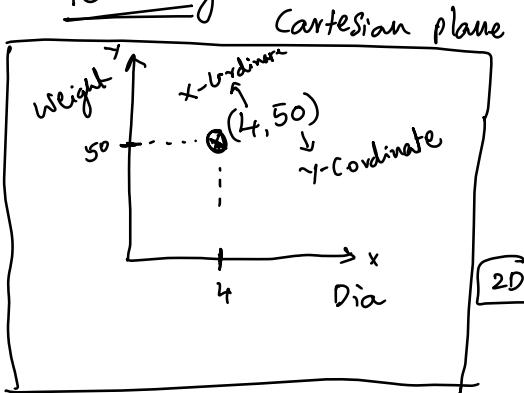
Input (features). variables			Target / outcome
X ₁ Color	Diameter	Weight	Decision
Orange	4	50	Tangerine
Yellow	3	30	Orange
Yellow	2	25	Orange
Yellow	5	45	Tangerine
Orange	3	30	Orange

data point (vector?)

Dataset

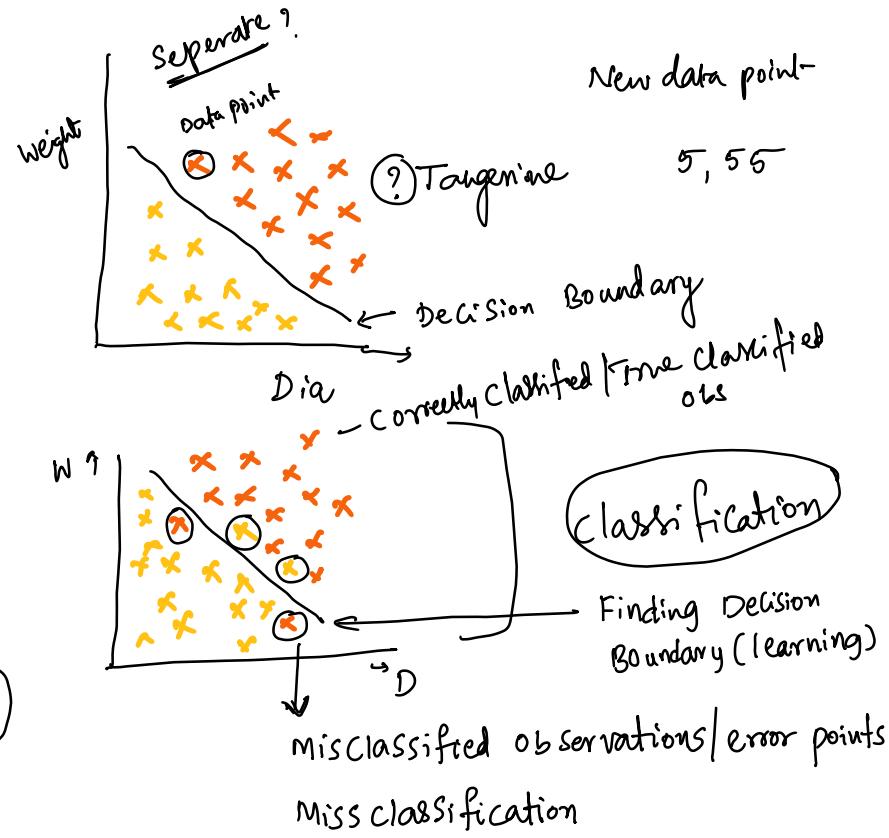
How to separate them ?

Geometry



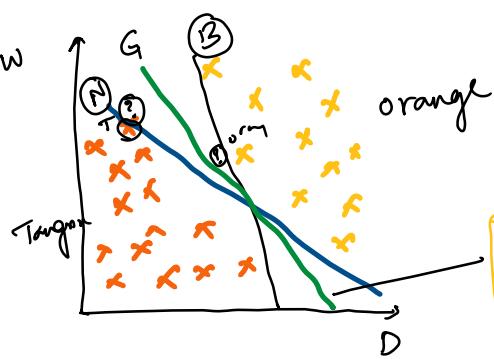
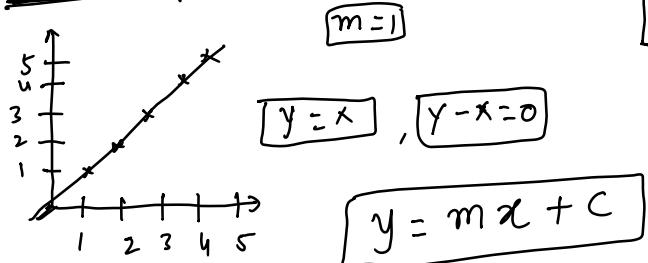
Machine Learning

Train / Training



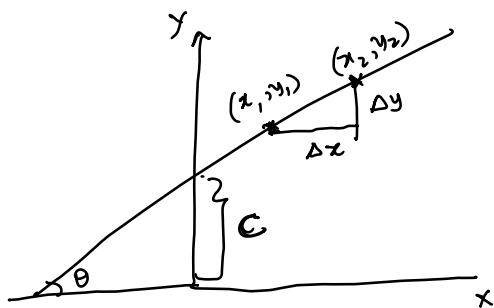
Decision Boundary

→ Line? | P



Decision Boundary far from most data points

Line | Plane | Hyperplane



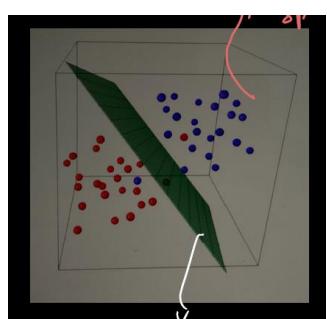
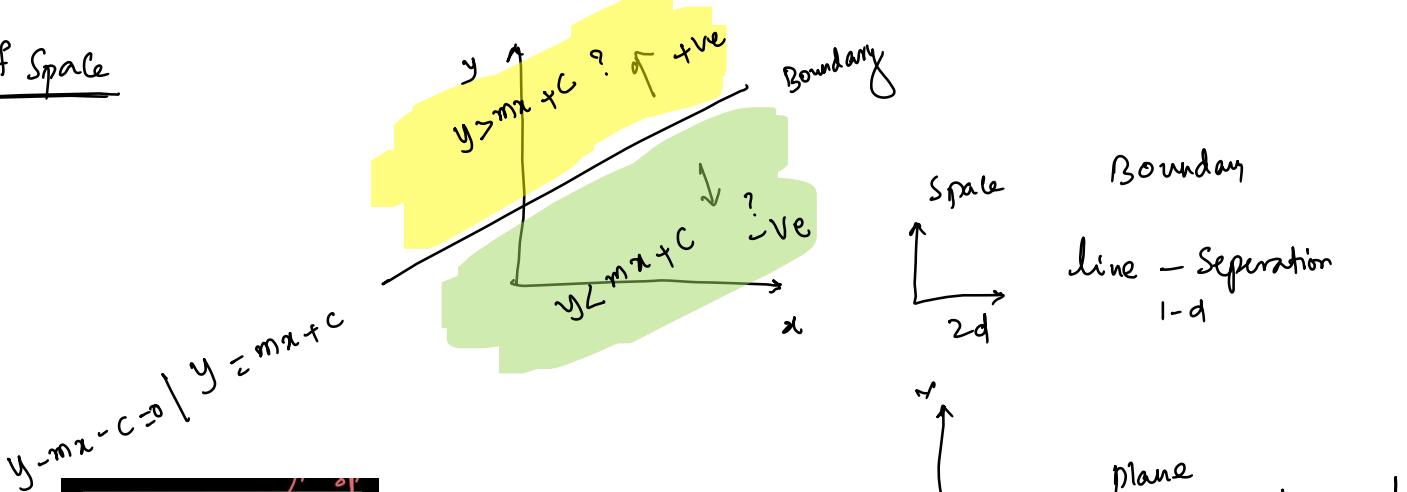
Play with Desmos ✓

c - intercept,

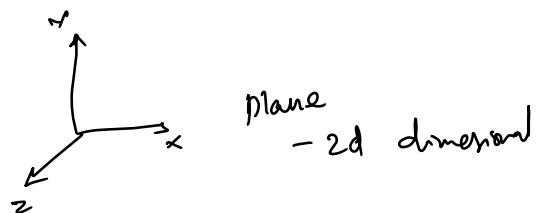
What is the value of y, when $x=0$ ← c

→ Line, Slope, Intercept, equation, what happens to line (m, c) ✓

Half Space



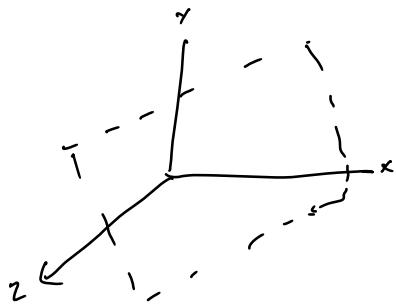
↓
(Plane)



d - dimensional Space

Decision boundary (d-1) dimensional
Hyperplane

Plane (2-d)



Hyperplane?

Space - is d dimensional

Hyperplane (d-1) dimensional

$$ax + by + cz + d = 0 \quad | \quad ax + by + cz = d$$

Line

$$w_1x_1 + w_2y + c = 0$$

$$y = w \otimes x + b$$

[w - weights]
 b - bias

$$y = w_1x_1 + w_2x_2 + b \quad - \text{Plane}$$

x - vector

$$y = w_1x_1 + w_2x_2 + w_3x_3 + b \quad - \text{Hyperplane}$$

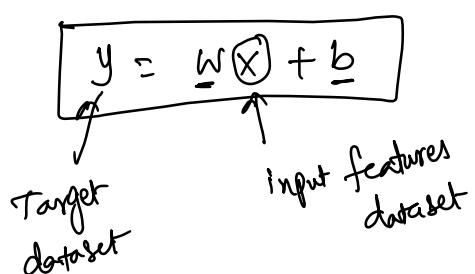
x_1, x_2, x_3, x_m

$$y = w_1x_1 + w_2x_2 + w_3x_3 + \dots + w_mx_m + b \quad \text{Hyperplane, with } m \text{ dimensions}$$

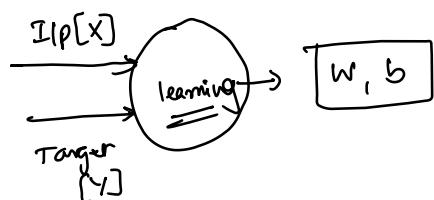
$$y = w \otimes x + b \quad \checkmark$$

w, x - d dimensional vectors

① Find the decision boundary ?



Learning the values of w and b that separates our data points (Classification) on training data

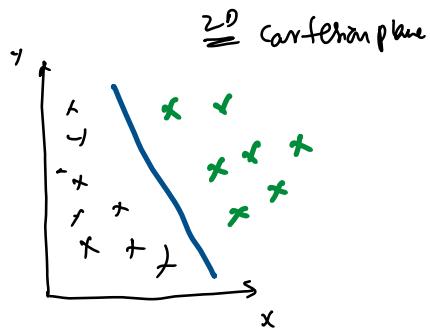


→ How to find w and b?

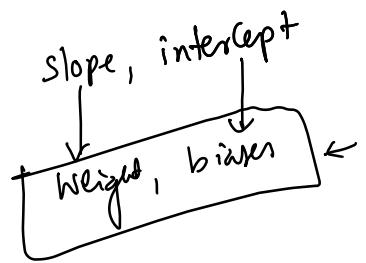
- ✓ ① Perceptron ✓ ③ SVM
- ✓ ② Logistic Regression ✓ ④ Tree (Special tree)

Boundary separator

Hyperplane



multi dimensional



Line

$$\rightarrow y = w_1 x_1 + b \text{ - line}$$

$$\rightarrow y = w_1 x_1 + w_2 x_2 + b \text{ - plane (2d)} \checkmark$$

$$\rightarrow y = w_1 x_1 + w_2 x_2 + \dots + w_m x_m + b \checkmark$$

m-dimensional hyperplane

$$y = w^T x + b \checkmark$$