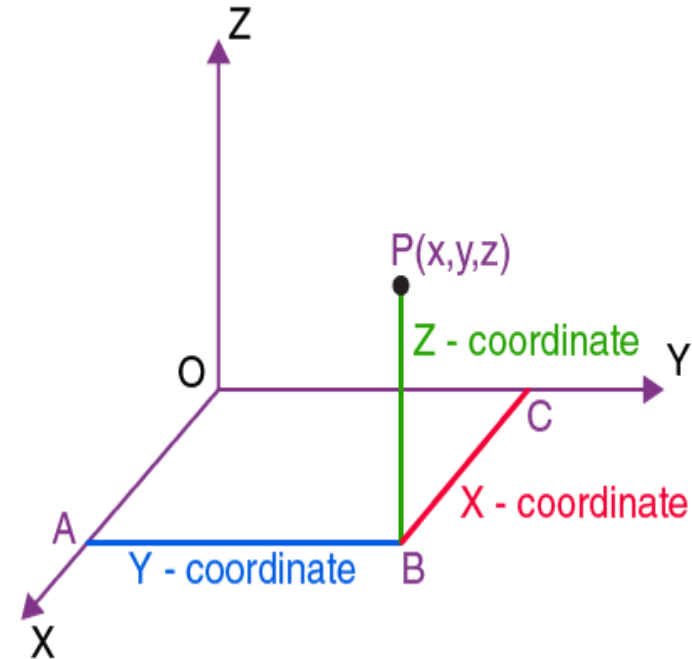
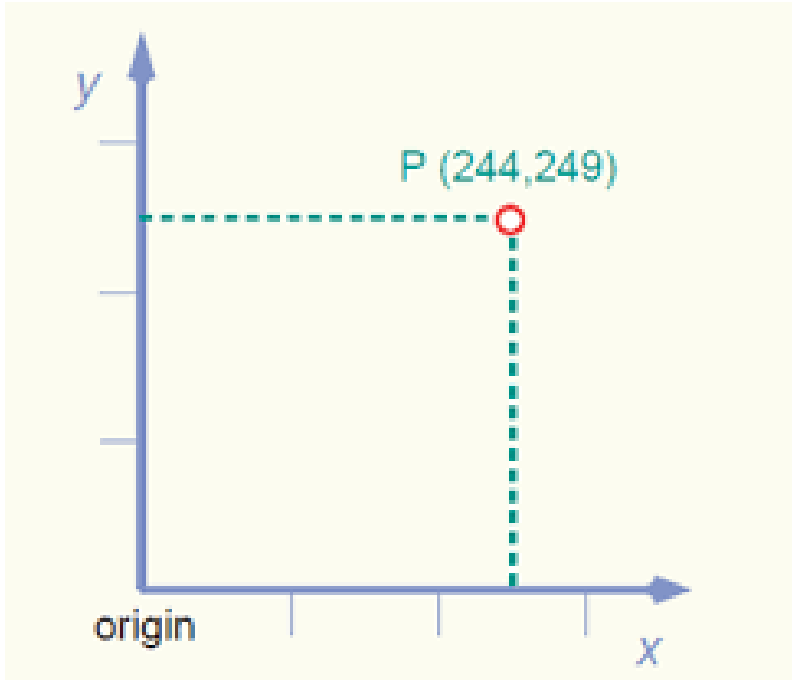


The background features abstract, overlapping green geometric shapes, primarily triangles and polygons, in various shades of green, creating a modern and dynamic visual effect. The shapes are layered, with some appearing more prominent than others, and they are set against a light gray background.

Data Science

Co-ordinates



Coordinates 2d: $p(x, y) = p(12, 25)$

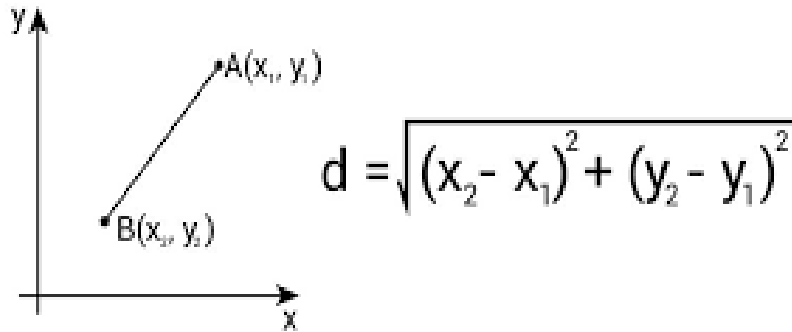
Coordinates 3d: $p(x, y, z) = p(12, 25, 64)$

Coordinates 4d: $p(x_1, x_2, x_3, x_4) = p(12, 25, 64, -23)$

Coordinates nd: $p(x_1, x_2, x_3, x_4, \dots) = p(12, 25, 64, -23, \dots)$

Distance formula

Distance Formula



The distance d between two points $P(x_1, y_1)$ and $Q(x_2, y_2)$ in a 2D Cartesian coordinate system is given by the **distance formula**:

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

The distance d between two points $P(x_1, x_2, x_3)$ and $Q(y_1, y_2, y_3)$ in a **3D Cartesian coordinate system** is given by:

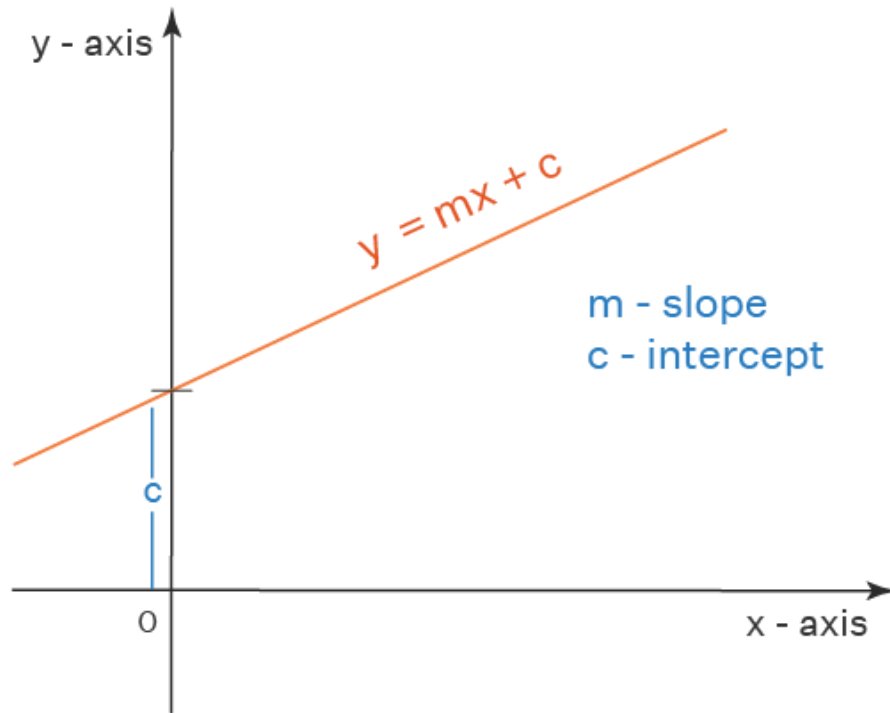
$$d = \sqrt{(x_1 - y_1)^2 + (x_2 - y_2)^2 + (x_3 - y_3)^2}$$

The distance d between two points $P(x_1, x_2, x_3, \dots, x_n)$ and $Q(y_1, y_2, y_3, \dots, y_n)$ in an **n-dimensional Euclidean space** is given by:

$$d = \sqrt{\sum_{i=1}^n (x_i - y_i)^2}$$

Line

Slope Intercept Form: $y = mx + c$



In 2d: $y = mx + c$

General form: $mx - y + c = 0 = ax + by + c = 0$ (here $a = m$ and $b = -1$)

In 3d (Plane): $ax + by + cz + d = 0$
 $w_1x_1 + w_2x_2 + w_3x_3 + w_0 = 0$

In nd (Hyper Plane): $w_1x_1 + w_2x_2 + w_3x_3 + w_0 = 0$

Line continued

n -D (hyperplane)

$$\hookrightarrow w_0 + w_1 x_1 + w_2 x_2 + \dots + w_n x_n = 0$$

Summation $\rightarrow \checkmark w_0 + \sum_{i=1}^n w_i x_i = 0$

Vec \vec{w} ,
notate $\rightarrow w_0 + \underbrace{\begin{bmatrix} w_1 & w_2 & \dots & w_n \end{bmatrix}}_{1 \times n} \underbrace{\begin{bmatrix} x_1 \\ x_2 \\ \vdots \\ x_n \end{bmatrix}}_{n \times 1} = 0$

$$w_0 + w_1 x_1 + w_2 x_2 + \dots + w_n x_n = 0$$

Line continued

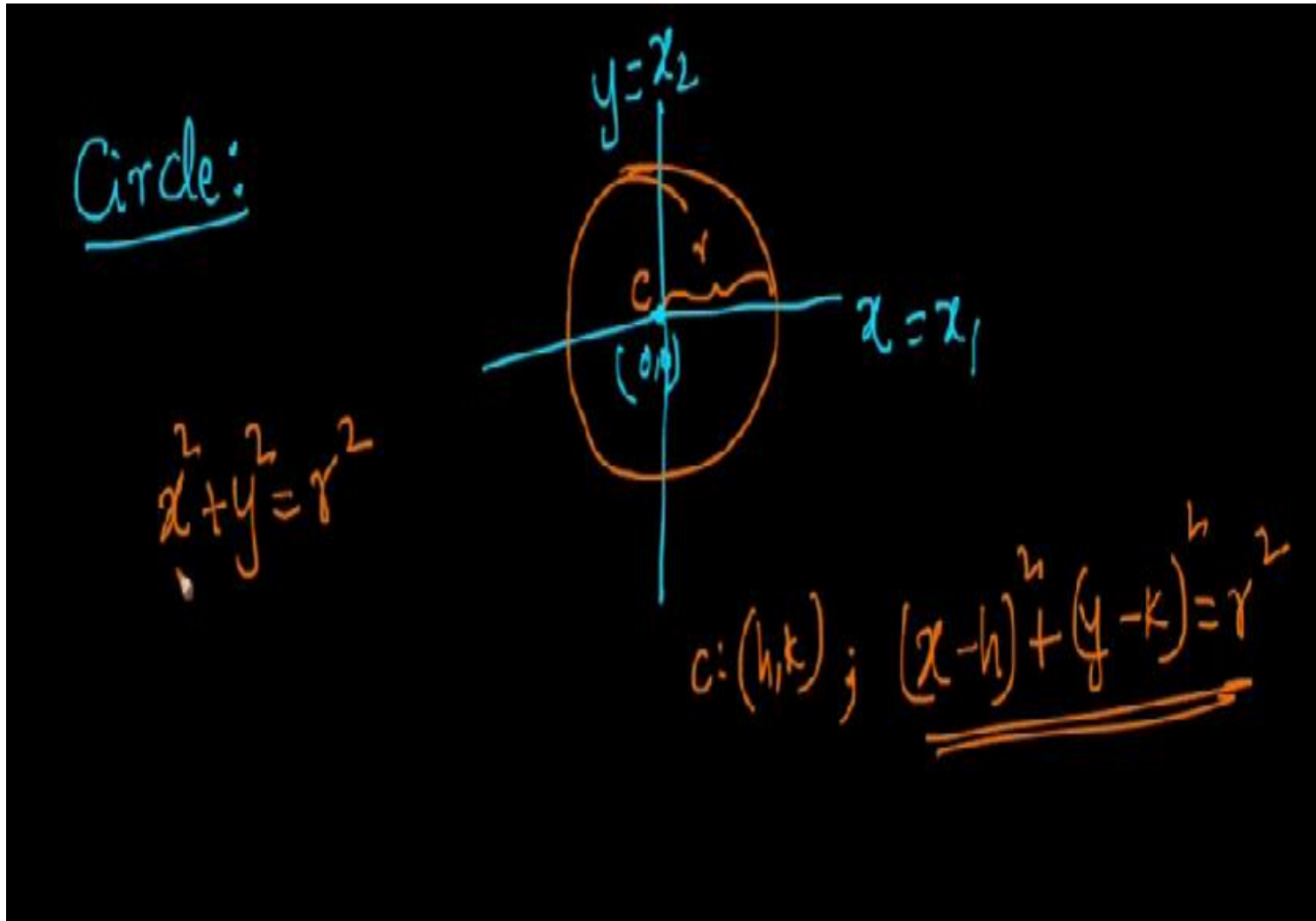
η -dim

$$\underbrace{w_0 + [w_1, w_2, \dots, w_n]}_{\text{weights}} \begin{bmatrix} x_1 \\ x_2 \\ \vdots \\ x_n \end{bmatrix} = 0$$

$$\underline{w}_{n \times 1} = \begin{bmatrix} w_1 \\ w_2 \\ \vdots \\ w_n \end{bmatrix}_{n \times 1} \quad \underline{x}_{n \times 1} = \begin{bmatrix} x_1 \\ x_2 \\ \vdots \\ x_n \end{bmatrix}$$

$$\underbrace{w_0}_{\text{bias}} + \underbrace{w^T}_{\text{weights}} x = 0$$

Circle



Circle

Similarities



Sphere

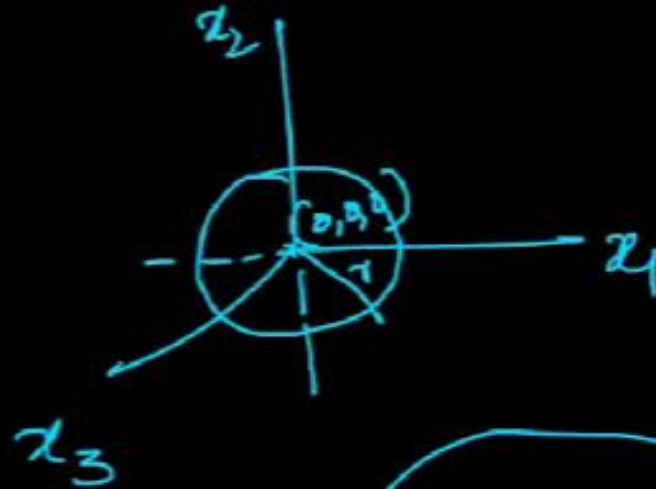
Circle continued

(3D)

x_1, x_2, x_3

Sphere

$$x_1^2 + x_2^2 + x_3^2 = r^2$$



$$\sum_{i=1}^n x_i^2 = r^2$$

(nD)

x_1, x_2, \dots, x_n

hyper sphere

$$x_1^2 + x_2^2 + \dots + x_n^2 = r^2$$

Square/rectangle

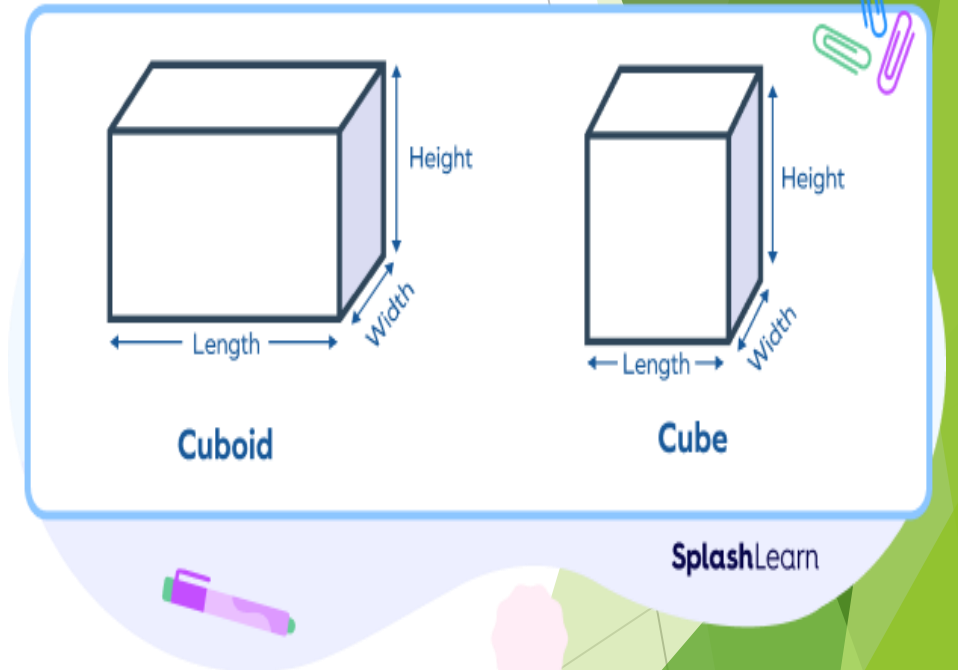
- In 2d we have two axis x,y (rectangle) and x,x (square)
- In 3d we have three axis x,y,z (cuboid) and x,x,x (cube)
- In n d we have n axis $x_1,x_2,x_3...x_n$ (hyper cuboid) and $x,x,x...x$ (hyper cube)



SQUARE



RECTANGLE



Importance of Maths in ML

- ▶ Every shape can be extended to n dimensions and therefore we can perform operations in n dimensions
- ▶ Human eye can only see upto 3 dimensions but with the help of mathematics we can reach upto any number of dimensions.