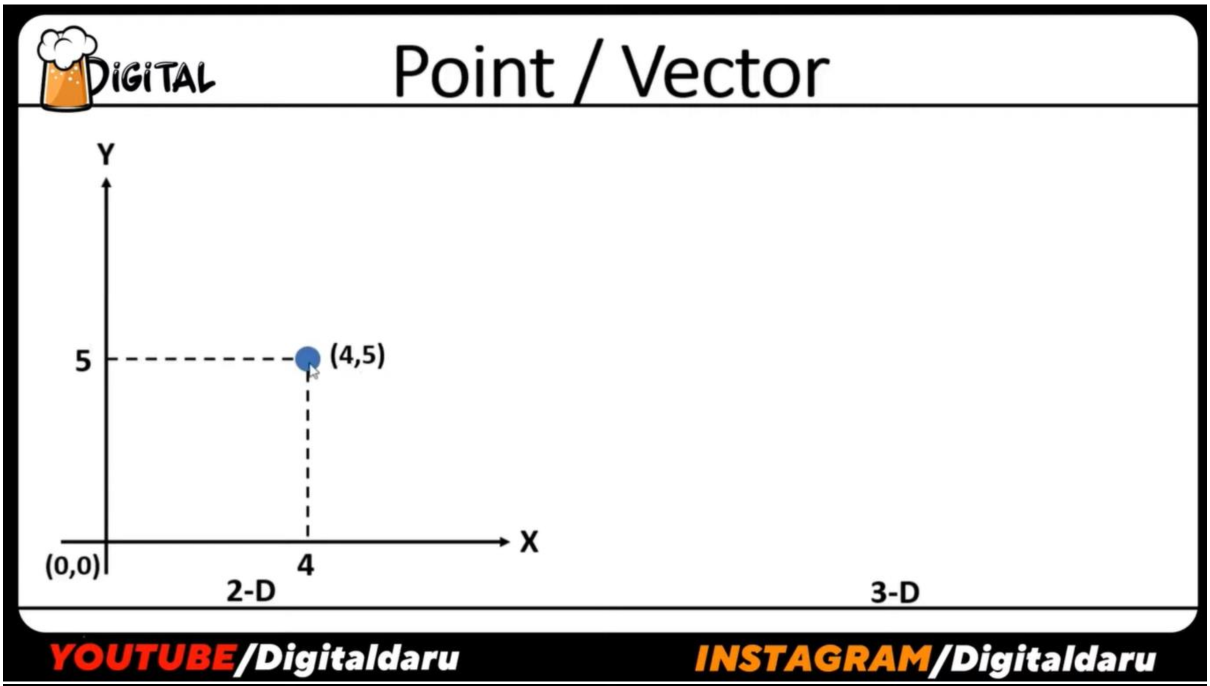
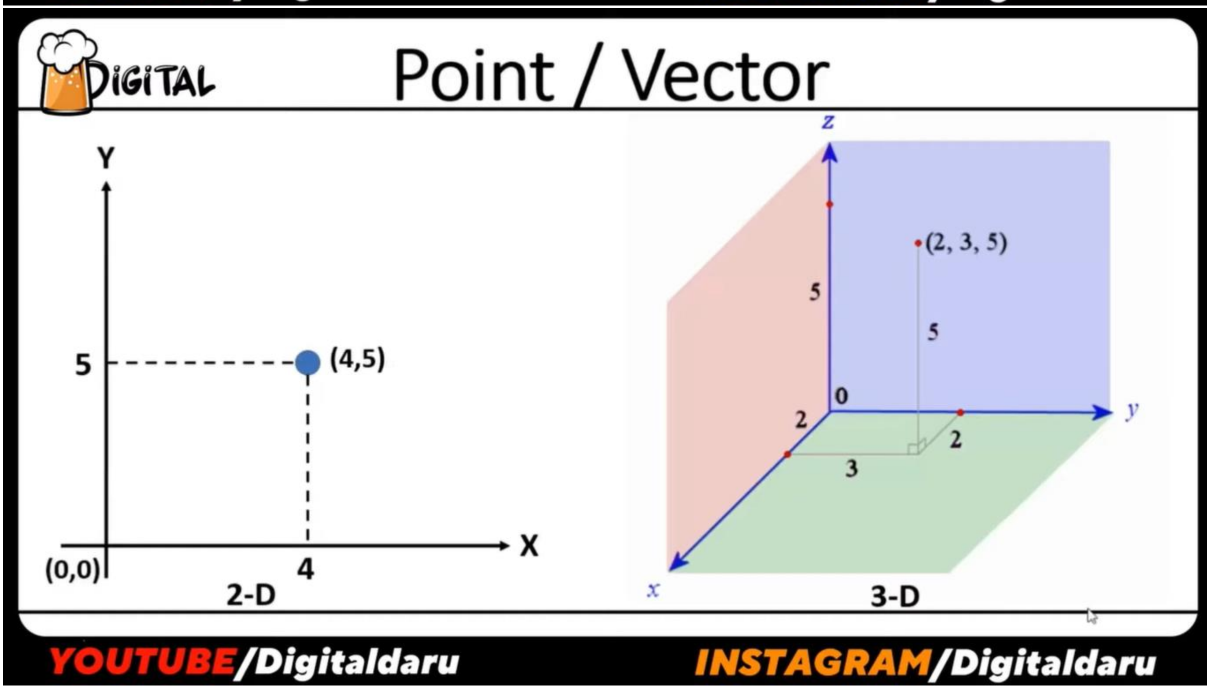
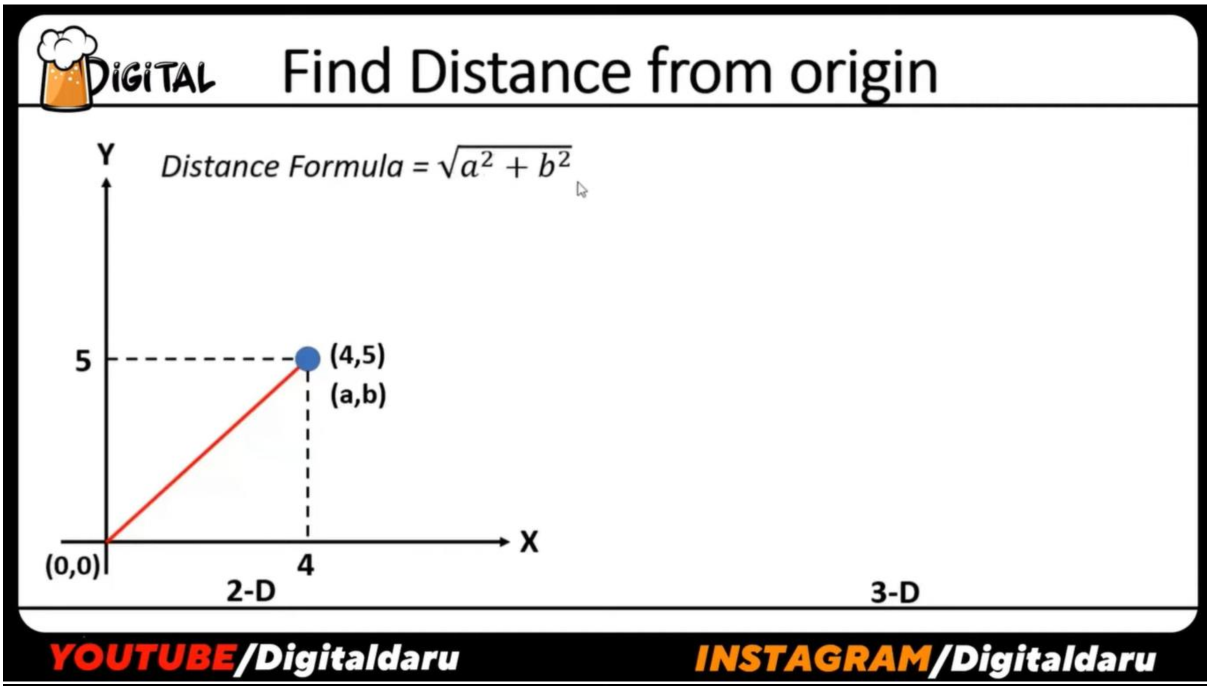
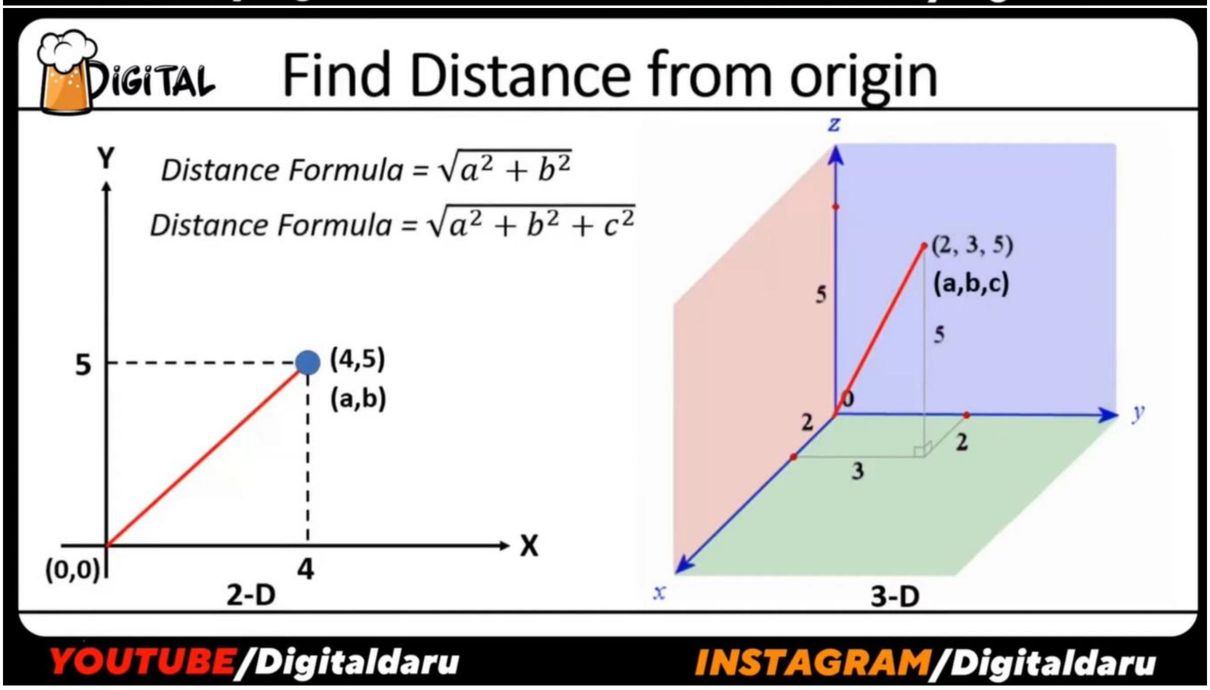


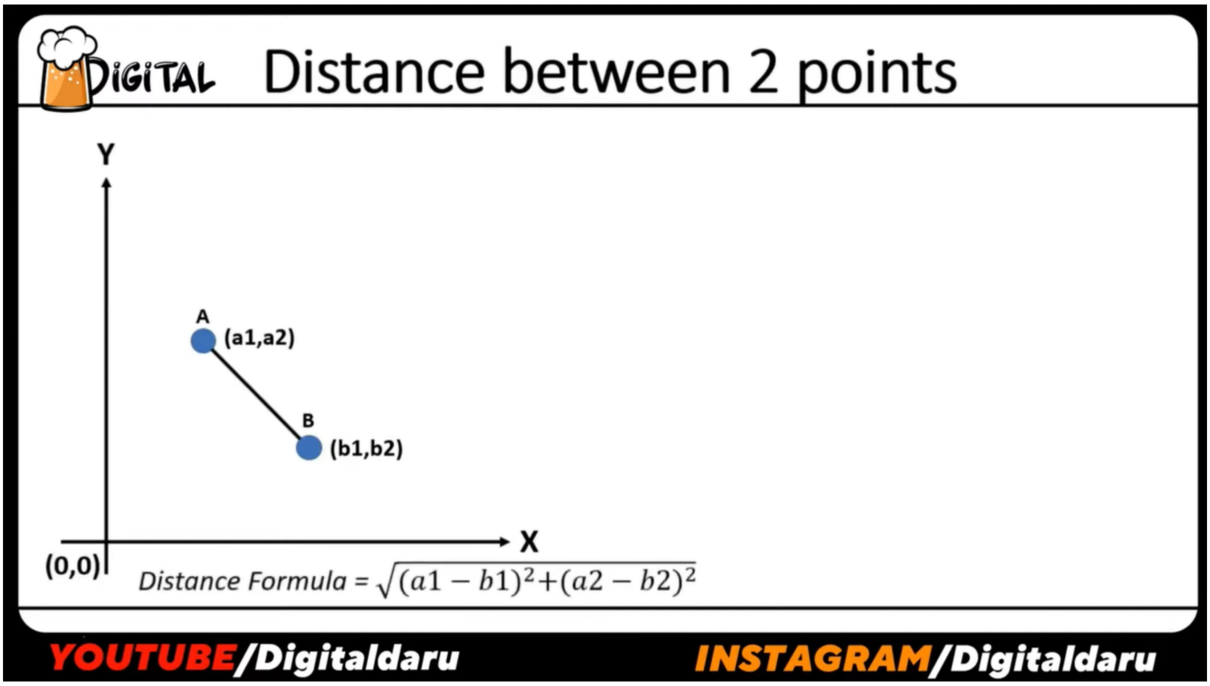
DIGITAL
Point / Vector
Y
5
(4,5)
X
(0,0)
4
2-D
3-D
YOUTUBE/Digitaldaru
INSTAGRAM/Digitaldaru



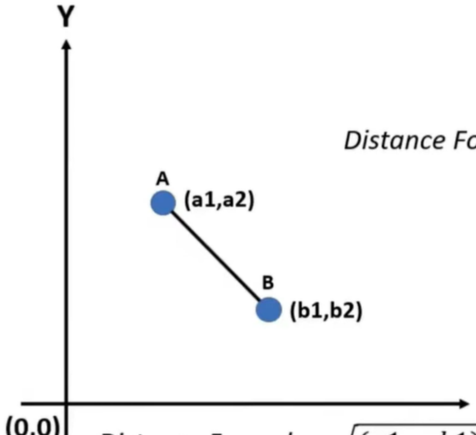
DIGITAL
Point / Vector
Y
5
(4,5)
X
(0,0)
4
2-D
z
(2, 3, 5)
5
5
0
2
2
3
y
x
3-D
YOUTUBE/Digitaldaru
INSTAGRAM/Digitaldaru


DIGITAL
Find Distance from origin
Distance Formula = $\sqrt{a^2 + b^2}$
Y
5
(4,5)
(a,b)
X
(0,0)
4
2-D
3-D
YOUTUBE/Digitaldaru
INSTAGRAM/Digitaldaru


DIGITAL
Find Distance from origin
Distance Formula = $\sqrt{a^2 + b^2}$
Distance Formula = $\sqrt{a^2 + b^2 + c^2}$
Y
5
(4,5)
(a,b)
X
(0,0)
4
2-D
z
(2, 3, 5)
(a,b,c)
5
5
0
2
2
3
y
x
3-D
YOUTUBE/Digitaldaru
INSTAGRAM/Digitaldaru


DIGITAL
Distance between 2 points
Y
A
(a1,a2)
B
(b1,b2)
X
(0,0)
Distance Formula = $\sqrt{(a1-b1)^2+(a2-b2)^2}$
YOUTUBE/Digitaldaru
INSTAGRAM/Digitaldaru

Distance between 2 points

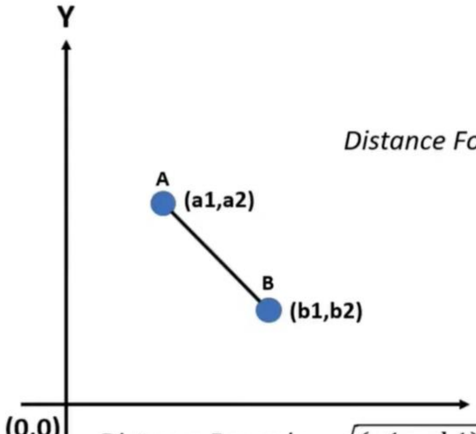


3-D

Distance Formula = $\sqrt{(a1-b1)^2+(a2-b2)^2+(a3-b3)^2}$

Distance Formula = $\sqrt{(a1-b1)^2+(a2-b2)^2}$

Distance between 2 points



3-D

Distance Formula = $\sqrt{(a1-b1)^2+(a2-b2)^2+(a3-b3)^2}$

n-D

Distance Formula = $\sqrt{\sum_{i=1}^{n}(a_i-b_i)^2}$

Distance Formula = $\sqrt{(a1-b1)^2+(a2-b2)^2}$

YOUTUBE/Digitaldaru INSTAGRAM/Digitaldaru

DIGITAL

Basics of Vectors

-> Row Vector

$A = [\ a1, a2, a3, a4, a5\ ]_{(1,5)}$

(1,5) 1 is Rows, 5 is Column

-> Column Vector

$$A = \begin{pmatrix} a1 \\ a2 \\ a3 \\ a4 \\ a5 \end{pmatrix}_{(5,1)}$$

(5,1) 5 is Rows, 1 is Column

YOUTUBE/Digitaldaru INSTAGRAM/Digitaldaru

DIGITAL

Basics of Vectors

-> Row Vector

$A = [\ a1, a2, a3, a4, a5\ ]_{(1,5)}$

(1,5) 1 is Rows, 5 is Column

(1,n)

-> Column Vector

$$A = \begin{pmatrix} a1 \\ a2 \\ a3 \\ a4 \\ a5 \end{pmatrix}_{(5,1)}$$

(n,1)

(5,1) 5 is Rows, 1 is Column

YOUTUBE/Digitaldaru INSTAGRAM/Digitaldaru

Basics of Matrix

Rows

$$A = \begin{bmatrix} 1 & 5 & 9 \\ 2 & 6 & 10 \\ 3 & 7 & 11 \\ 4 & 8 & 12 \end{bmatrix} \qquad A_{ij} = \begin{bmatrix} A_{11} & A_{12} & A_{13} \\ A_{21} & A_{22} & A_{23} \\ A_{31} & A_{32} & A_{33} \\ A_{41} & A_{42} & A_{43} \end{bmatrix}$$

Column

(Rows x Column)

(4 x 3)

Transpose of the Matrix

$A = [\ a1, a2, a3, a4, a5\ ]$

$$A^T = \begin{pmatrix} a1 \\ a2 \\ a3 \\ a4 \\ a5 \end{pmatrix}$$

$$B = \begin{pmatrix} b1 \\ b2 \\ b3 \\ b4 \\ b5 \end{pmatrix}$$

$B^T = [\ b1, b2, b3, b4, b5\ ]$

Matrix Addition

$$A = [\ a1,a2,a3,a4,a5\ ]_{(1,5)}$$
$$+\ B = [\ b1,b2,b3,b4,b5\ ]_{(1,5)}$$
$$C = [\ a1+b1\ ,\ a2+b2\ ,\ a3+b3\ ,\ a4+b4\ ,\ a5+b5\ ]$$

$$A = [\ a1,a2,a3,a4,a5\ ]_{(1,5)}$$
$$+\ B = [\ b1,b2,b3,b4\ ]_{(1,4)}$$
$$C = [\ a1+b1\ ,\ a2+b2\ ,\ a3+b3\ ,\ a4+b4\ ,\ a5+???\ ]$$

Matrix Addition

$$\begin{bmatrix} 4 & 8 \\ 3 & 7 \end{bmatrix} + \begin{bmatrix} 1 & 0 \\ 5 & 2 \end{bmatrix} = \begin{bmatrix} 4+1 & 8+0 \\ 3+5 & 7+2 \end{bmatrix}$$

Example

$$\begin{bmatrix} 3 & 2 \\ 1 & 4 \end{bmatrix} \begin{bmatrix} 3 & 2 \\ 1 & 4 \\ 5 & 3 \end{bmatrix}$$ ✗ We cannot add them

But we can add

$$\begin{bmatrix} 3 & 2 \\ 1 & 4 \end{bmatrix} \begin{bmatrix} -9 & 2 \\ -1 & 3 \end{bmatrix}$$ ✓ We can add them

$$\begin{bmatrix} 3 & 2 \\ 1 & 4 \\ 5 & 3 \end{bmatrix} \begin{bmatrix} -2 & 5 \\ -8 & 12 \\ 0 & -18 \end{bmatrix}$$ ✓ We can add them

Matrix Subtraction

$$\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix} - \begin{bmatrix} 9 & 8 & 7 \\ 6 & 5 & 4 \\ 3 & 2 & 1 \end{bmatrix} = \begin{bmatrix} 1-9 & 2-8 & 3-7 \\ 4-6 & 5-5 & 6-4 \\ 7-3 & 8-2 & 9-1 \end{bmatrix}$$

$$= \begin{bmatrix} -8 & -6 & -4 \\ -2 & 0 & 2 \\ 4 & 6 & 8 \end{bmatrix}$$

Dot Product

$A = [\ a1, a2, a3, a4, a5\ ]_{(1,5)}$

$*$ **(1,n)**

$$B = \begin{pmatrix} b1 \\ b2 \\ b3 \\ b4 \\ b5 \end{pmatrix}_{(5,1)}$$

(n,1)

$=$

C = [(a1*b1) + (a2*b2)+ (a3*b3)+ (a4*b4)+ (a5*b5)]

(1,1)

YOUTUBE/Digitaldaru INSTAGRAM/Digitaldaru

Matrix Multiplication

$$\begin{bmatrix} a_1 & a_2 & a_3 \\ a_4 & a_5 & a_6 \\ a_7 & a_8 & a_9 \end{bmatrix} \begin{bmatrix} b_1 & b_2 & b_3 \\ b_4 & b_5 & b_6 \\ b_7 & b_8 & b_9 \end{bmatrix} = \begin{bmatrix} c_1 & c_2 & c_3 \\ c_4 & c_5 & c_6 \\ c_7 & c_8 & c_9 \end{bmatrix}$$

Matrix and Vectors

$$\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix} \times \begin{bmatrix} 10 & 11 \\ 20 & 21 \\ 30 & 31 \end{bmatrix}$$

$$= \begin{bmatrix} 1\times10 + 2\times20 + 3\times30 & 1\times11 + 2\times21 + 3\times31 \\ 4\times10 + 5\times20 + 6\times30 & 4\times11 + 5\times21 + 6\times31 \end{bmatrix}$$

$$= \begin{bmatrix} 10+40+90 & 11+42+93 \\ 40+100+180 & 44+105+186 \end{bmatrix} = \begin{bmatrix} 140 & 146 \\ 320 & 335 \end{bmatrix}$$

Matrix and Vectors

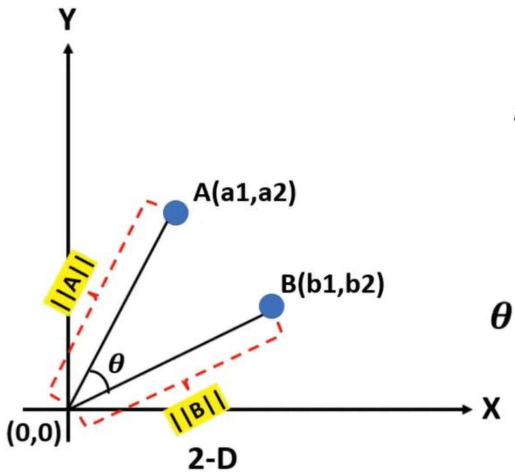
$$\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

Identity Matrix

$$\begin{bmatrix} 2 & 0 & 0 \\ 0 & 3 & 0 \\ 0 & 0 & 4 \end{bmatrix}$$

Diagonal Matrix

Angles Between 2 Vectors



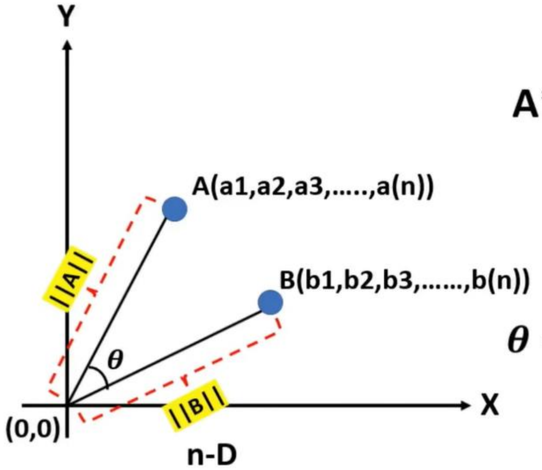
$$A*B = \|A\| * \|B\| * \cos(\theta)$$

OR

$$\theta = Cos^{-1}\left\{\frac{a1 * b1 + a2 * b2}{\|A\|\|B\|}\right\}$$

YOUTUBE/Digitaldaru INSTAGRAM/Digitaldaru

Angles Between n-Vectors



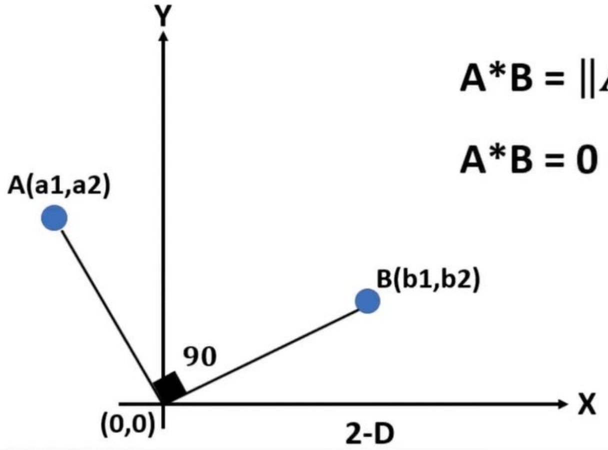
$$A*B = \|A\| * \|B\| * Cos(\theta)$$

OR

$$\theta = \ Cos^{-1}\left\{\frac{\sum_{i=1}^{n} a(i) * b(i)}{\|A\|\|B\|}\right\}$$

For n-D

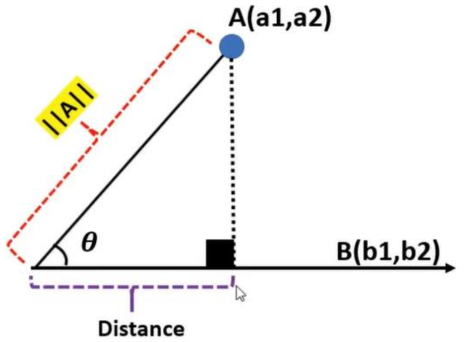
Angles Between Vectors



$$A*B = \|A\| * \|B\| * \text{Cos}(90)$$

$$A*B = 0$$

Projection



$$\text{Distance} = \|A\| Cos(\theta)$$

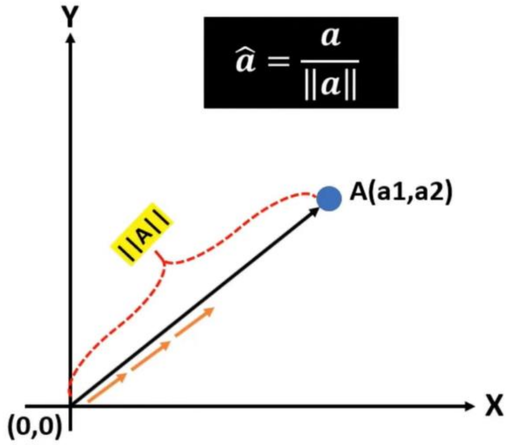
$$A*B = \|A\| * \|B\| * \text{Cos}(\theta)$$

$$A*B = \|B\| * \text{Distance}$$

$$\boxed{\text{Distance} = \frac{A*B}{\|B\|}}$$

Unit Vector

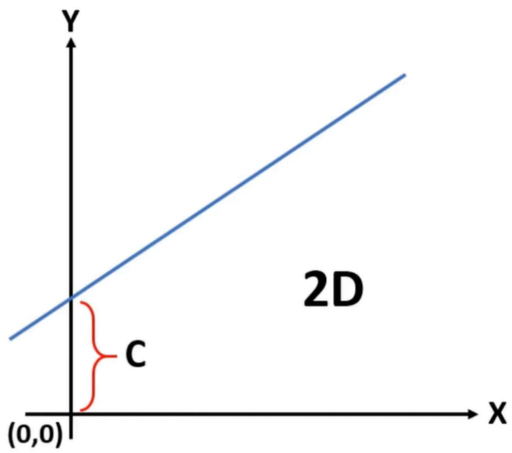
$$\hat{a} = \frac{a}{\|a\|}$$



5 Pens = Rs 50

1Pen = $\frac{50}{5} = Rs10$

Line VS Plane



y = m*X + C

A(x) + B(y) + C = 0

↓

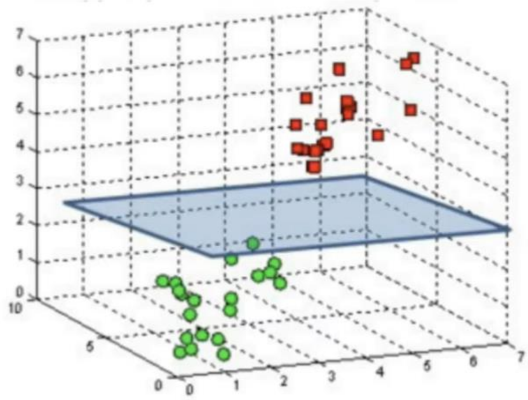
A(x1) + B(x2) + C = 0

↓

w1(x1) + w2(x2) + w0 = 0

YOUTUBE/Digitaldaru INSTAGRAM/Digitaldaru

Line VS Plane



$y = m*X + C$

$w1(x1) + w2(x2) + w3(x3) + C = 0$

$w1(x1) + w2(x2) + w3(x3) + w0 = 0$

3D

Line VS Plane

$w1(x1) + w2(x2) + w3(x3) + \ldots\ldots. + w*n(x*n) + w0 = 0$

Formula $W0 + \sum_{i=1}^{n} wi(xi) = 0$

N-D

YOUTUBE/Digitaldaru INSTAGRAM/Digitaldaru

Line VS Plane

w1(x1) + w2(x2) + w3(x3) +…….+ w*n(x*n) + w0 = 0

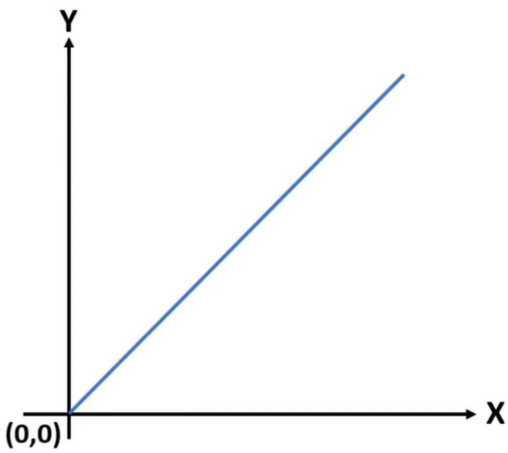
Formula $W0 + \sum_{i=1}^{n} wi(xi) = 0$

$W0 + W^T X = 0$

Vector Matrix $W0 + [w1, w2, \ldots\ldots\ldots, wn] * \begin{bmatrix} X1 \\ X2 \\ X3 \\ . \\ . \\ . \\ Xn \end{bmatrix} = 0$

N-D

Line VS Plane

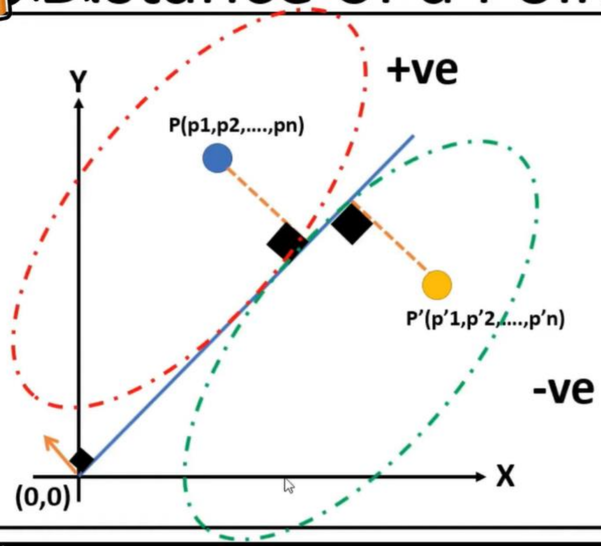


w1(x1) + w2(x2) = 0

$W^T X = 0$

YOUTUBE/Digitaldaru INSTAGRAM/Digitaldaru

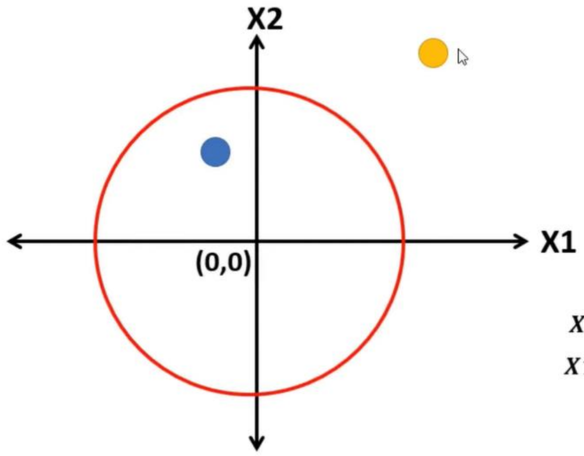
Distance of a Point from Plane



$$W^T x = 0$$

$$\text{Distance} = \frac{W^T P}{\|W\|}$$

Circle and Sphere



$$X^2 + Y^2 = R^2$$

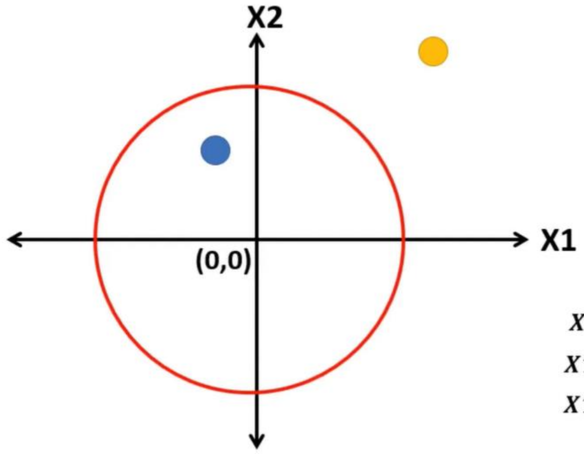
2D - Circle

$X1^2 + X2^2 < R^2$: $-$*Inside the Circle*

$X1^2 + X2^2 > R^2$: $-$*Outside the Circle*

YOUTUBE/Digitaldaru INSTAGRAM/Digitaldaru

Circle and Sphere



$$X^2 + Y^2 = R^2$$

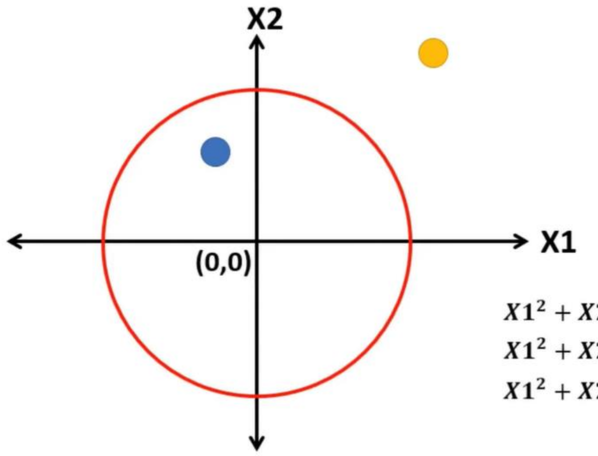
2D - Circle

$X1^2 + X2^2 < R^2$: $-$*Inside the Circle*

$X1^2 + X2^2 > R^2$: $-$*Outside the Circle*

$X1^2 + X2^2 = R^2$: $-$*On the Circle*

Circle and Sphere



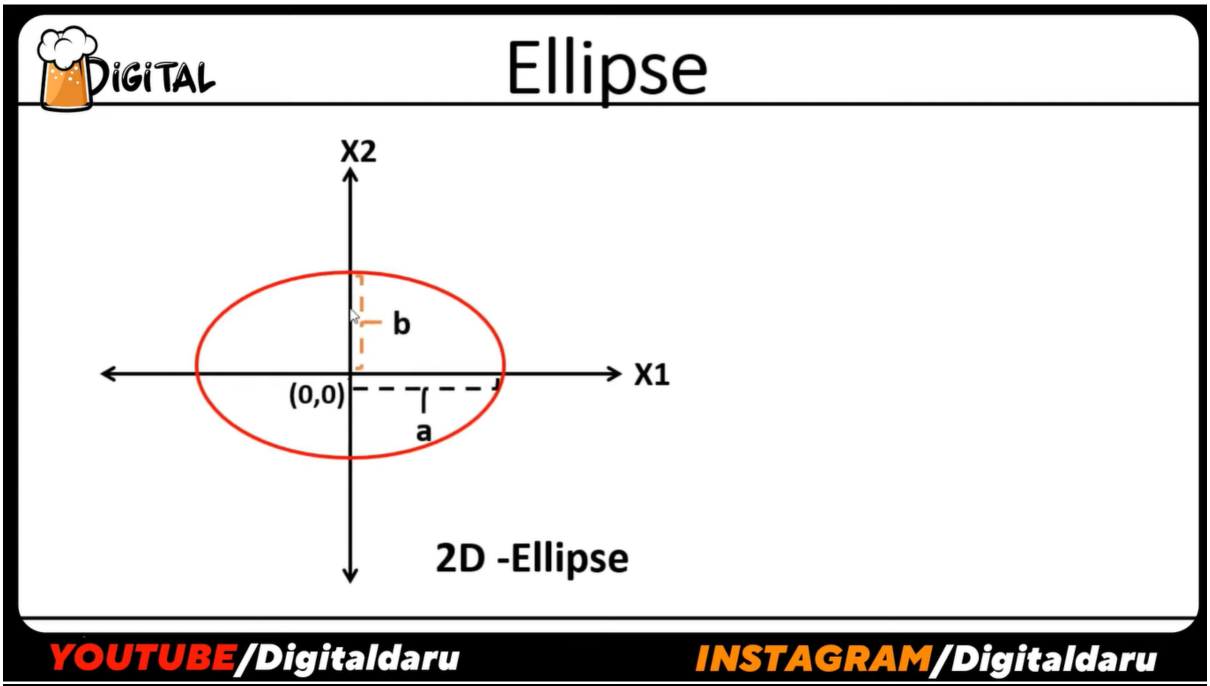
$$X^2 + Y^2 = R^2$$

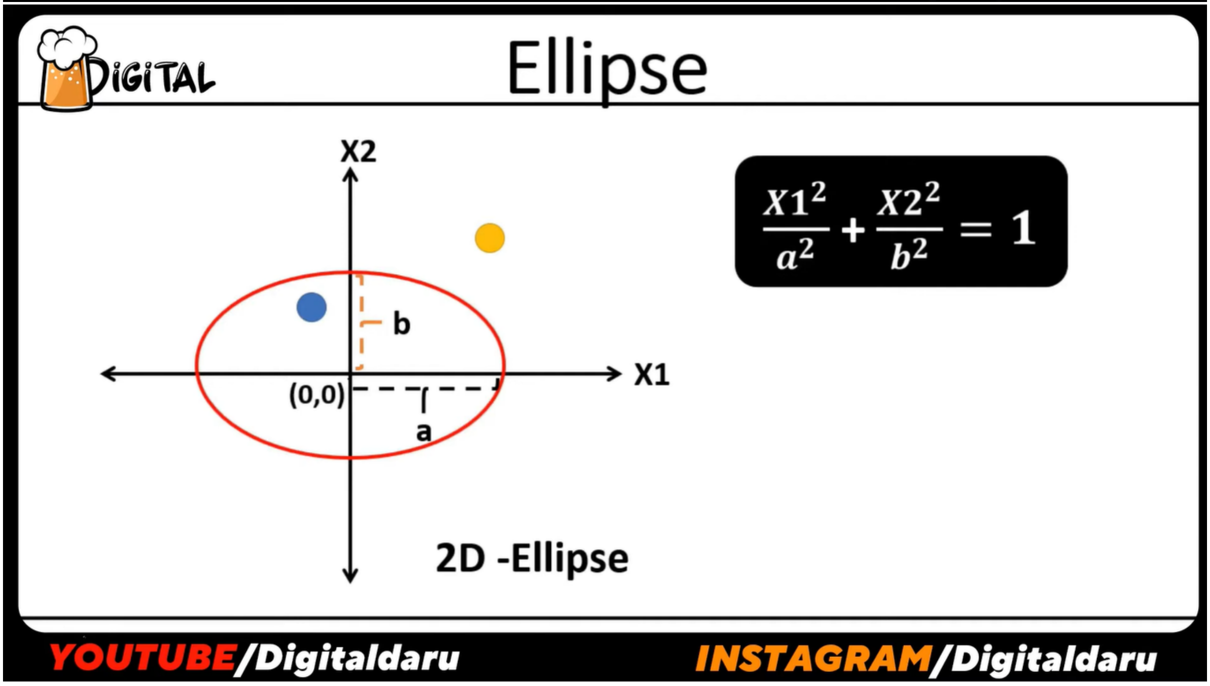
3D - Sphere

$X1^2 + X2^2 + X3^2 < R^2$: $-$*Inside the Sphere*

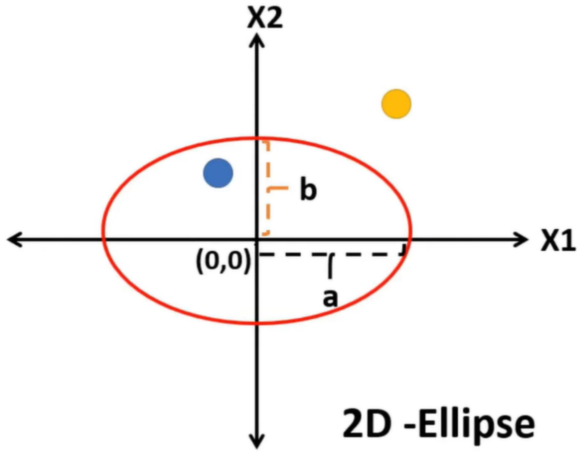
$X1^2 + X2^2 + X3^2 > R^2$: $-$*Outside the Sphere*

$X1^2 + X2^2 + X3^2 = R^2$: $-$*On the Sphere*


DIGITAL
Ellipse
X2
X1
b
a
(0,0)
2D -Ellipse
YOUTUBE/Digitaldaru
INSTAGRAM/Digitaldaru


DIGITAL
Ellipse
X2
X1
b
a
(0,0)
$\frac{X1^2}{a^2} + \frac{X2^2}{b^2} = 1$
2D -Ellipse
YOUTUBE/Digitaldaru
INSTAGRAM/Digitaldaru

Ellipse



$$\frac{X1^2}{a^2} + \frac{X2^2}{b^2} = 1$$

$$\frac{X1^2}{a^2} + \frac{X2^2}{b^2} < 1 \ :-inside$$

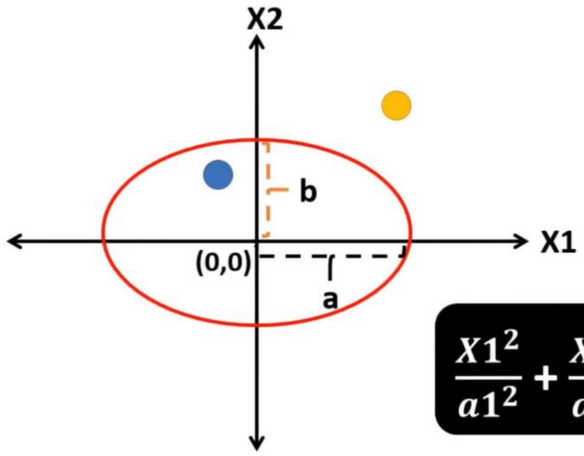
$$\frac{X1^2}{a^2} + \frac{X2^2}{b^2} > 1 \ :-outside$$

2D -Ellipse

$$\frac{X1^2}{a^2} + \frac{X2^2}{b^2} = 1 \ :-on$$

YOUTUBE/Digitaldaru INSTAGRAM/Digitaldaru

Ellipse



3D -Ellipse

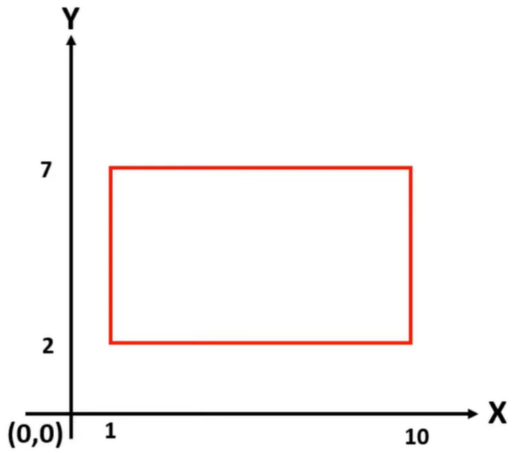
$$\frac{X1^2}{a^2} + \frac{X2^2}{b^2} + \frac{X3^2}{c^2} = 1$$

nD – hyper Ellipse

$$\frac{X1^2}{a1^2} + \frac{X2^2}{a2^2} + \frac{X3^2}{a3^2} \dots . \frac{Xn^2}{an^2} + = 1$$

YOUTUBE/Digitaldaru INSTAGRAM/Digitaldaru

DIGITAL Square Rectangle - nd



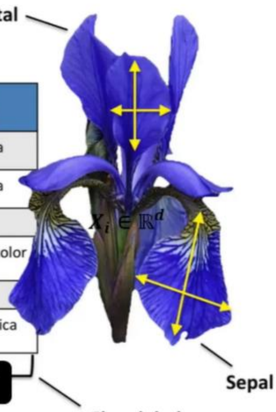

```
If p1<=10 and p1>=1:
    if p2>=2 and p2<=7 :
        inside rectangle
```


DIGITAL Dataset Representation

Samples
(instances, observations)

	Sepal length	Sepal width	Petal length	Petal width	Class label
1	5.1	3.5	1.4	0.2	Setosa
2	4.9	3.0	1.4	0.2	Setosa
			...		
50	6.4	3.5	4.5	1.2	Versicolor
			...		
150	5.9	3.0	5.0	1.8	Virginica

X_i Y



Class labels
(targets)

Features
(attributes, measurements, dimensions)

YOUTUBE/Digitaldaru INSTAGRAM/Digitaldaru

DIGITAL Dataset Representation

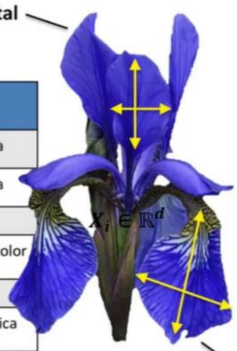
Samples
(instances, observations)

	Sepal length	Sepal width	Petal length	Petal width	Class label
1	5.1	3.5	1.4	0.2	Setosa
2	4.9	3.0	1.4	0.2	Setosa
			...		
50	6.4	3.5	4.5	1.2	Versicolor
			...		
150	5.9	3.0	5.0	1.8	Virginica

X_i Y

Features
(attributes, measurements, dimensions)

Class labels
(targets)



$$D = \{\underbrace{X_i}_{\text{Features}}, \overbrace{Y_i}^{\text{Class Labels}}\}_{i=1}^{n}$$

$$X_i \in \mathbb{R}^d \quad d = 4.$$

$$Y_i \in \{Setosa, Virginica, Versicolor\}$$

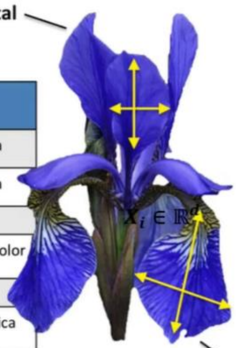
DIGITAL Dataset Representation

Samples
(instances, observations)

	Sepal length	Sepal width	Petal length	Petal width	Class label
1	5.1	3.5	1.4	0.2	Setosa
2	4.9	3.0	1.4	0.2	Setosa
			...		
50	6.4	3.5	4.5	1.2	Versicolor
			...		
150	5.9	3.0	5.0	1.8	Virginica

Features
(attributes, measurements, dimensions)

Class labels
(targets)

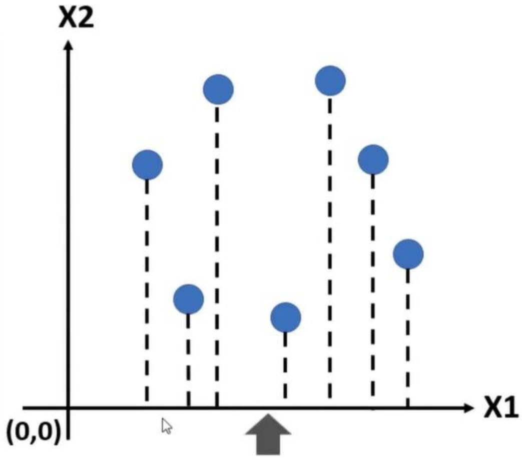


$$X = \begin{array}{c} \\ 1 \\ 2 \\ 50 \\ 150 \end{array} \begin{array}{c} \begin{array}{cccc} SL & SW & PL & PW \end{array} \\ \begin{bmatrix} 5.1 & 3.5 & 1.4 & 0.2 \\ 4.9 & 3.0 & 1.4 & 0.2 \\ 6.4 & 3.5 & 4.5 & 1.2 \\ 5.9 & 3.0 & 5.0 & 1.2 \end{bmatrix} \\ \xleftrightarrow{\quad X_i^T \quad} \end{array}$$

$$X = \begin{array}{c} \\ SL \\ SW \\ PL \\ PW \end{array} \begin{array}{c} \begin{array}{cccc} 1 & 2 & 50 & 150 \end{array} \\ \begin{bmatrix} 5.1 & 4.9 & 6.4 & 5.9 \\ 3.5 & 3.0 & 3.5 & 3.0 \\ 1.4 & 1.4 & 4.5 & 5.0 \\ 0.2 & 0.2 & 1.2 & 1.8 \end{bmatrix} \end{array} \Big\updownarrow X_i$$

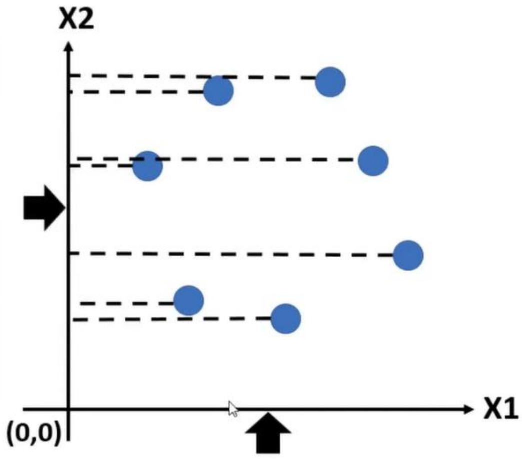
Mean Vector

Player	X1 Height (inches)	X2 Weight (pounds)
Player 1	76	225
Player 2	75	195
Player 3	72	180
Player 4	82	231
Player 5	69	185
Player 6	74	190
Player 7	75	228
Player 8	71	200
Player 9	75	230



Mean Vector

Player	X1 Height (inches)	X2 Weight (pounds)
Player 1	76	225
Player 2	75	195
Player 3	72	180
Player 4	82	231
Player 5	69	185
Player 6	74	190
Player 7	75	228
Player 8	71	200
Player 9	75	230



Column Normalization

Player	Height (inches)	Weight (pounds)
Player 1	76	225
Player 2	75	195
Player 3	72	180
Player 4	82	231
Player 5	69	185
Player 6	74	190
Player 7	75	228
Player 8	71	200
Player 9	75	230

$$A_i \epsilon [0, 1]$$

$$A_i = \frac{A_i - A_{min}}{A_{max} - A_{min}}$$

Column Standardization

Player	Height (inches)	Weight (pounds)
Player 1	76	225
Player 2	75	195
Player 3	72	180
Player 4	82	231
Player 5	69	185
Player 6	74	190
Player 7	75	228
Player 8	71	200
Player 9	75	230

Mean = 0
Std-dev= 1

Most Often in Use

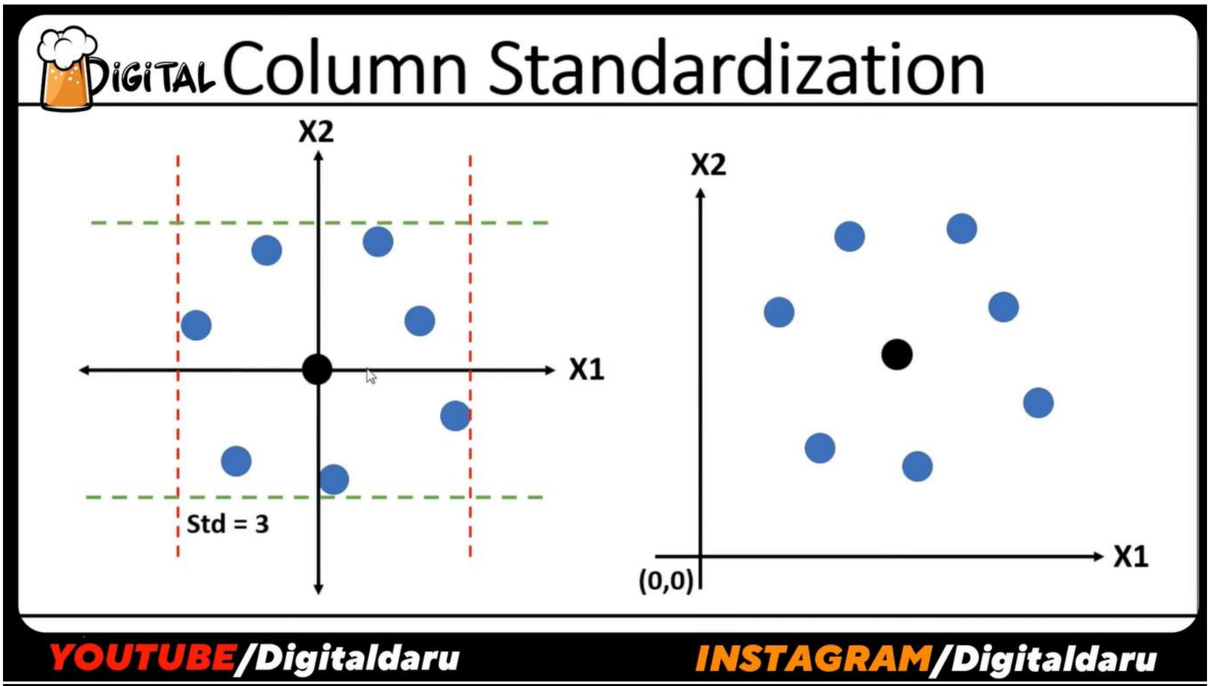
Column Standardization

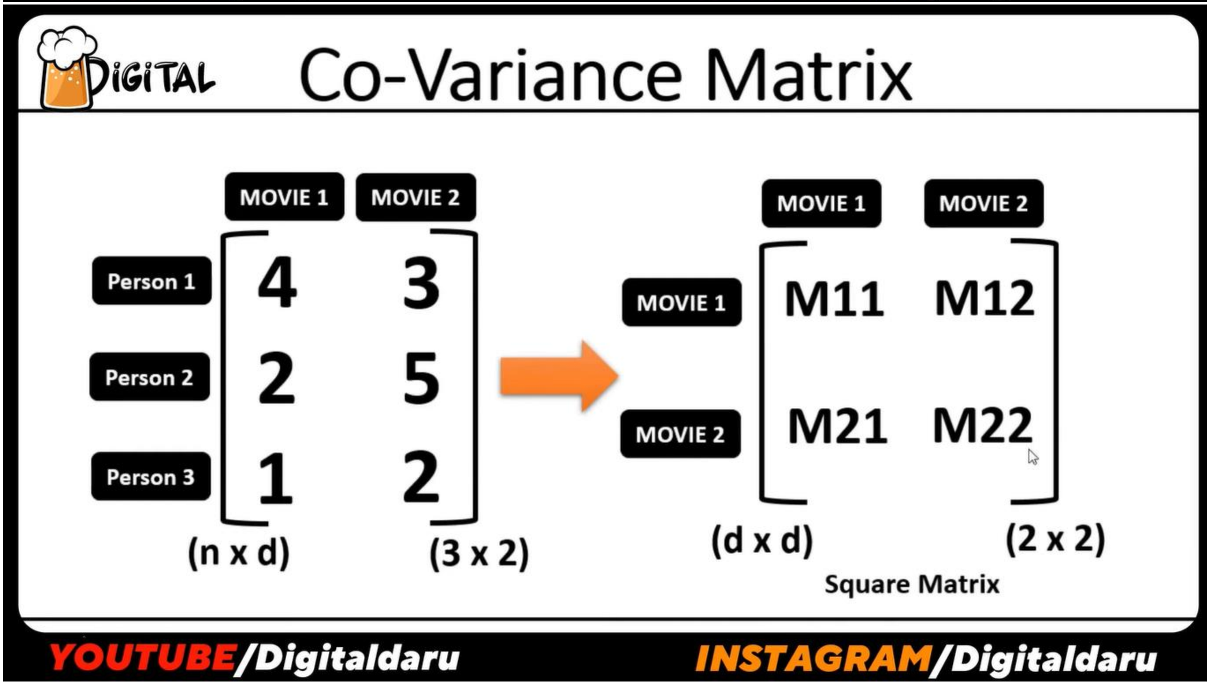
Player	Height (inches)	Weight (pounds)
Player 1	76	225
Player 2	75	195
Player 3	72	180
Player 4	82	231
Player 5	69	185
Player 6	74	190
Player 7	75	228
Player 8	71	200
Player 9	75	230

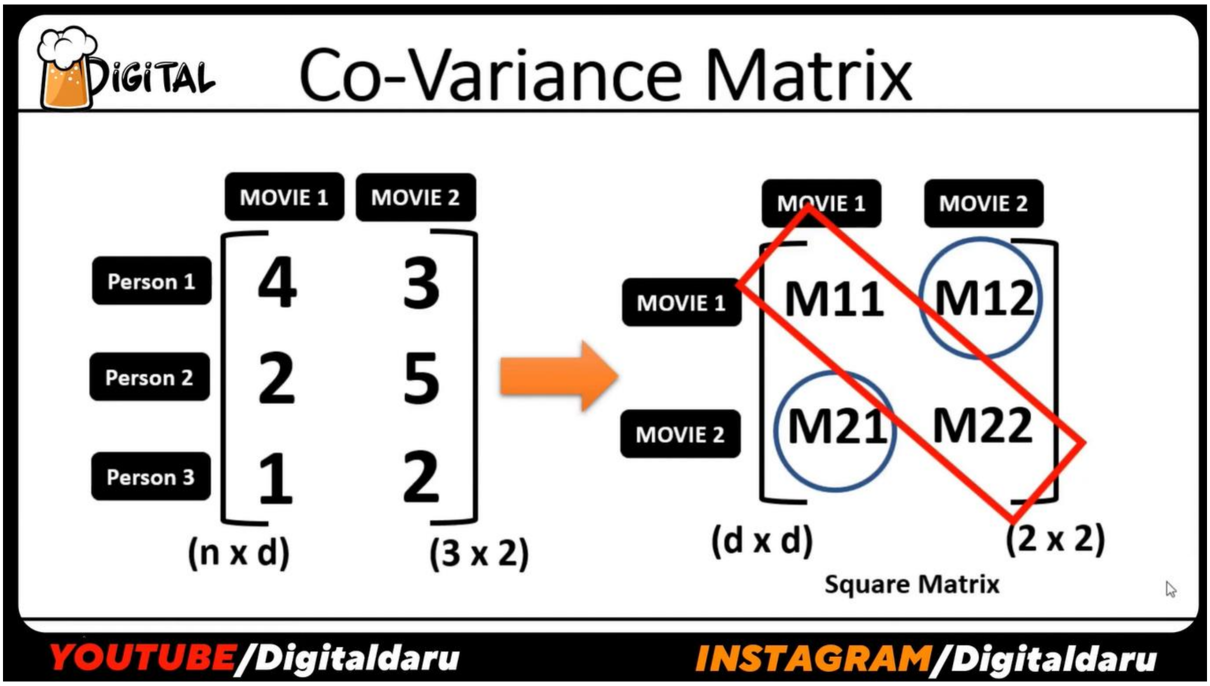
Mean = 0
Std-dev= 1

$$A_i = \frac{A_i - \bar{A}}{Std}$$

Most Often in Use


DIGITAL
Column Standardization
X2
X1
Std = 3
X2
X1
(0,0)
YOUTUBE/Digitaldaru
INSTAGRAM/Digitaldaru


DIGITAL
Co-Variance Matrix
MOVIE 1
MOVIE 2
Person 1
Person 2
Person 3
4 3
2 5
1 2
(n x d)
(3 x 2)
MOVIE 1
MOVIE 2
MOVIE 1
MOVIE 2
M11 M12
M21 M22
(d x d)
(2 x 2)
Square Matrix
YOUTUBE/Digitaldaru
INSTAGRAM/Digitaldaru



DIGITAL
Co-Variance Matrix
MOVIE 1
MOVIE 2
Person 1
Person 2
Person 3
4 3
2 5
1 2
(n x d)
(3 x 2)
MOVIE 1
MOVIE 2
MOVIE 1
MOVIE 2
M11 M12
M21 M22
(d x d)
(2 x 2)
Square Matrix
YOUTUBE/Digitaldaru
INSTAGRAM/Digitaldaru

Co-Variance Matrix

$$
\begin{array}{c c}
 & \begin{array}{cc} X & Y \\ \text{MOVIE 1} & \text{MOVIE 2} \end{array} \\
\begin{array}{c} \text{Person 1} \\ \text{Person 2} \\ \text{Person 3} \end{array} & \begin{bmatrix} 4 & 3 \\ 2 & 5 \\ 1 & 2 \end{bmatrix}
\end{array}
$$

(n x d) (3 x 2)

Co-Var(X,Y) = $\frac{1}{n}\sum_{i=1}^{n}(X_i - \overline{X}\ )(Y_i - \overline{Y}\ )$

Co-Variance Matrix

$$
\begin{array}{c c}
 & \begin{array}{cc} X & Y \\ \text{MOVIE 1} & \text{MOVIE 2} \end{array} \\
\begin{array}{c} \text{Person 1} \\ \text{Person 2} \\ \text{Person 3} \end{array} & \begin{bmatrix} 4 & 3 \\ 2 & 5 \\ 1 & 2 \end{bmatrix}
\end{array}
$$

(n x d) (3 x 2)

Co-Var(X,Y) = $\frac{1}{n}\sum_{i=1}^{n}(X_i - \overline{X}\ )(Y_i - \overline{Y}\ )$

Column Standardization

Co-Var(X,Y) = $\frac{1}{n}\sum_{i=1}^{n}(X_i)(Y_i)$

Co-Variance Matrix

$$
\begin{array}{c c}
 & \begin{array}{cc} X & Y \\ \text{MOVIE 1} & \text{MOVIE 2} \end{array} \\
\begin{array}{c} \text{Person 1} \\ \text{Person 2} \\ \text{Person 3} \end{array} & \begin{bmatrix} 4 & 3 \\ 2 & 5 \\ 1 & 2 \end{bmatrix}
\end{array}
$$

(n x d) (3 x 2)

Co-Var(X,Y) = $\frac{1}{n}\sum_{i=1}^{n}(X_i - \overline{X})(Y_i - \overline{Y})$

Column Standardization

Co-Var(X,Y) = $\frac{1}{n}\sum_{i=1}^{n}(X_i)(Y_i)$

Co-Var(X,Y) = $\frac{1}{n}(X^T * Y)$

Dimensionality Reduction

Dimensionality Reduction

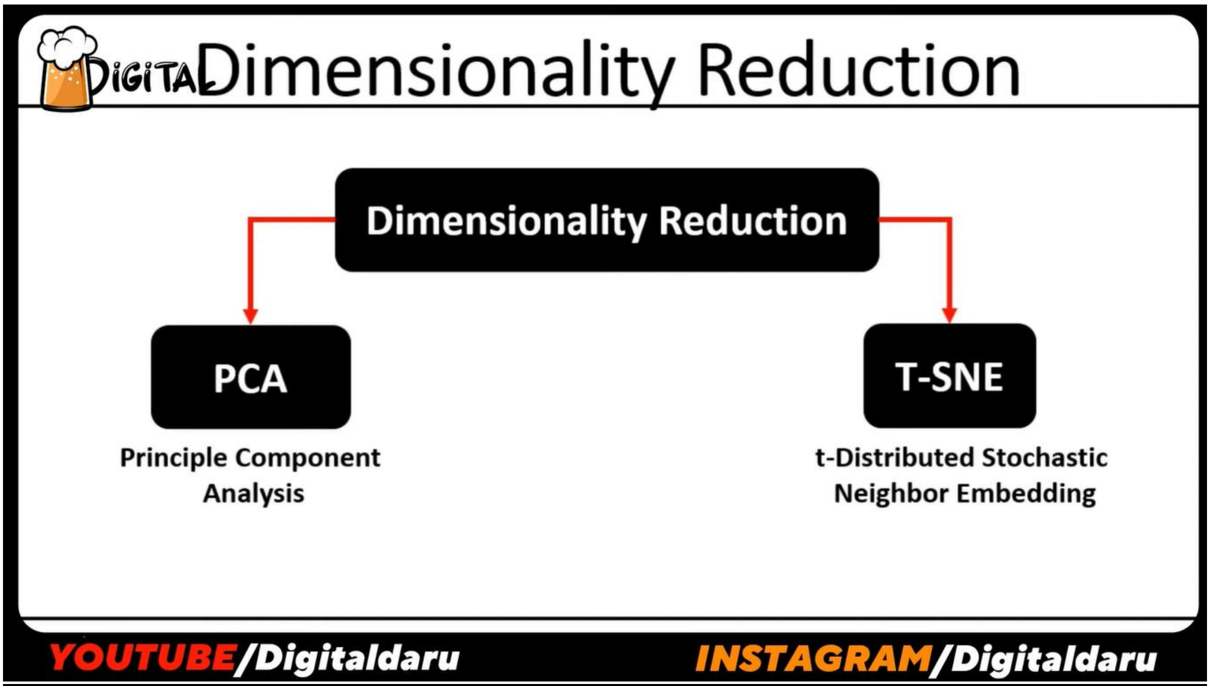
2D – 3D : Scatter Plot

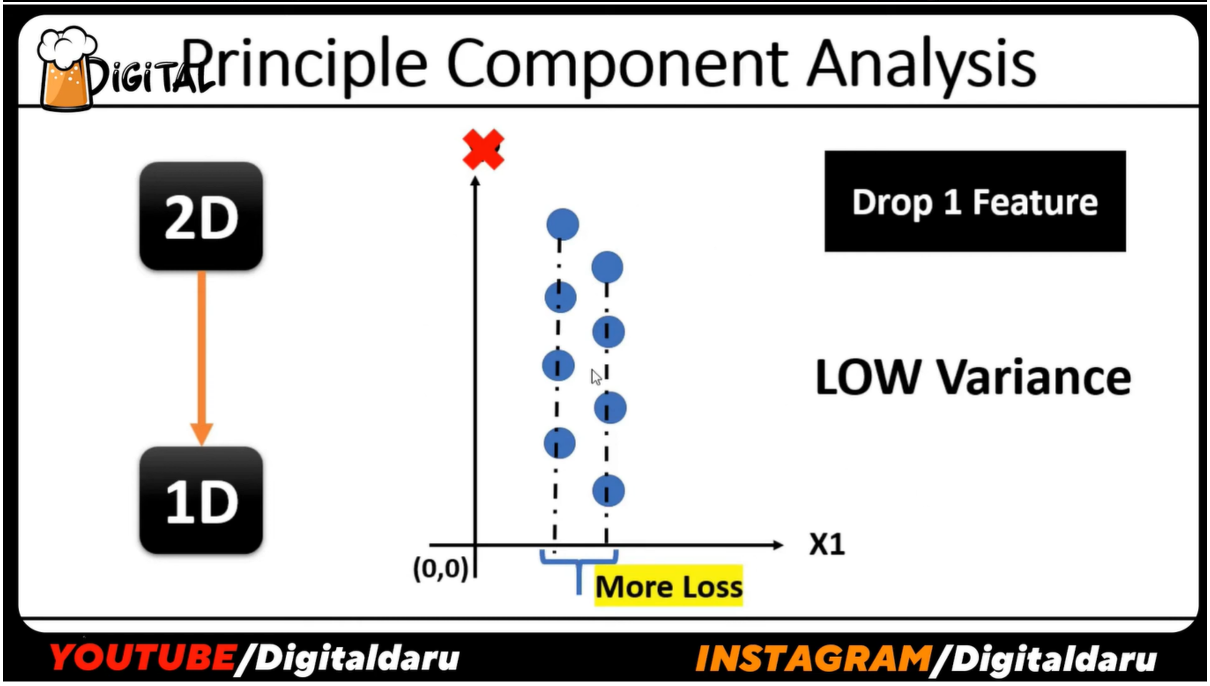
4D, 5D & 6D : Pair Plot

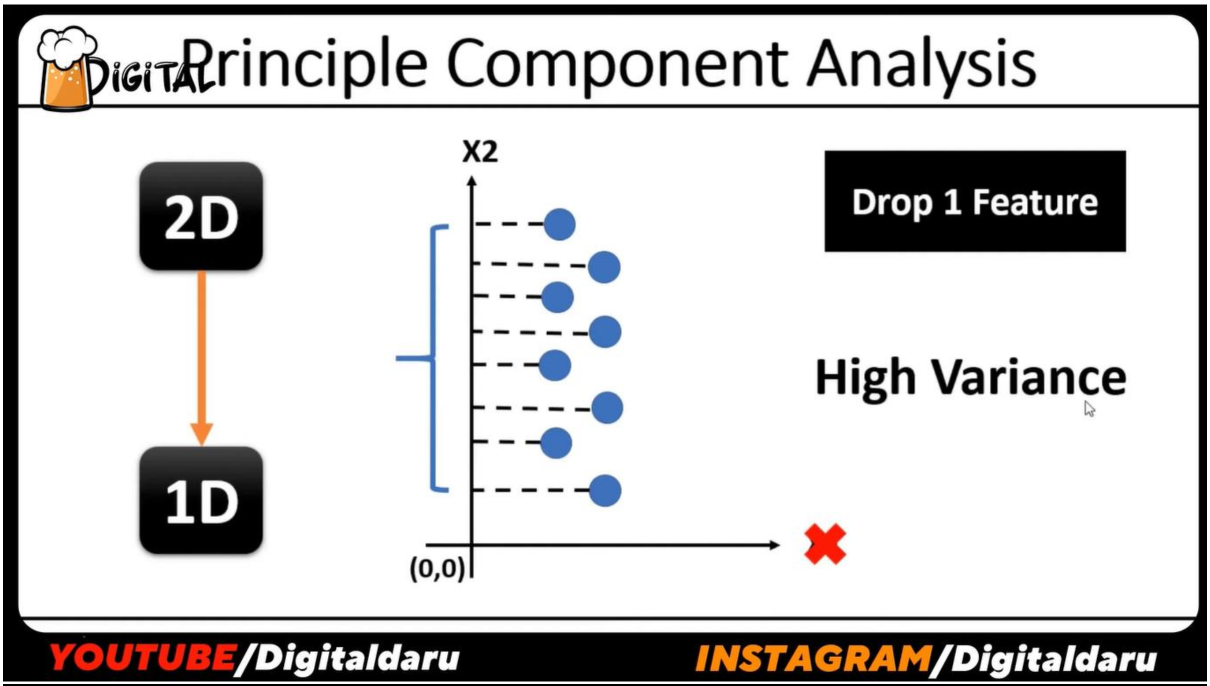
10D   100D   1000D

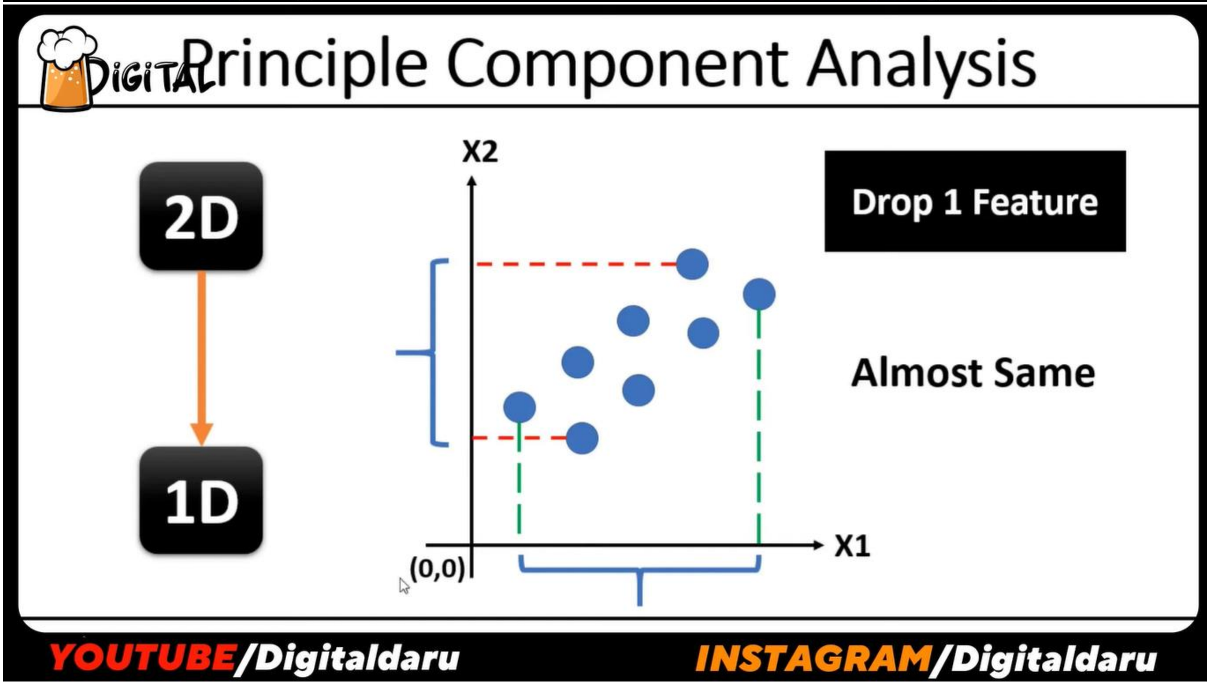
nD → 2D or 3D

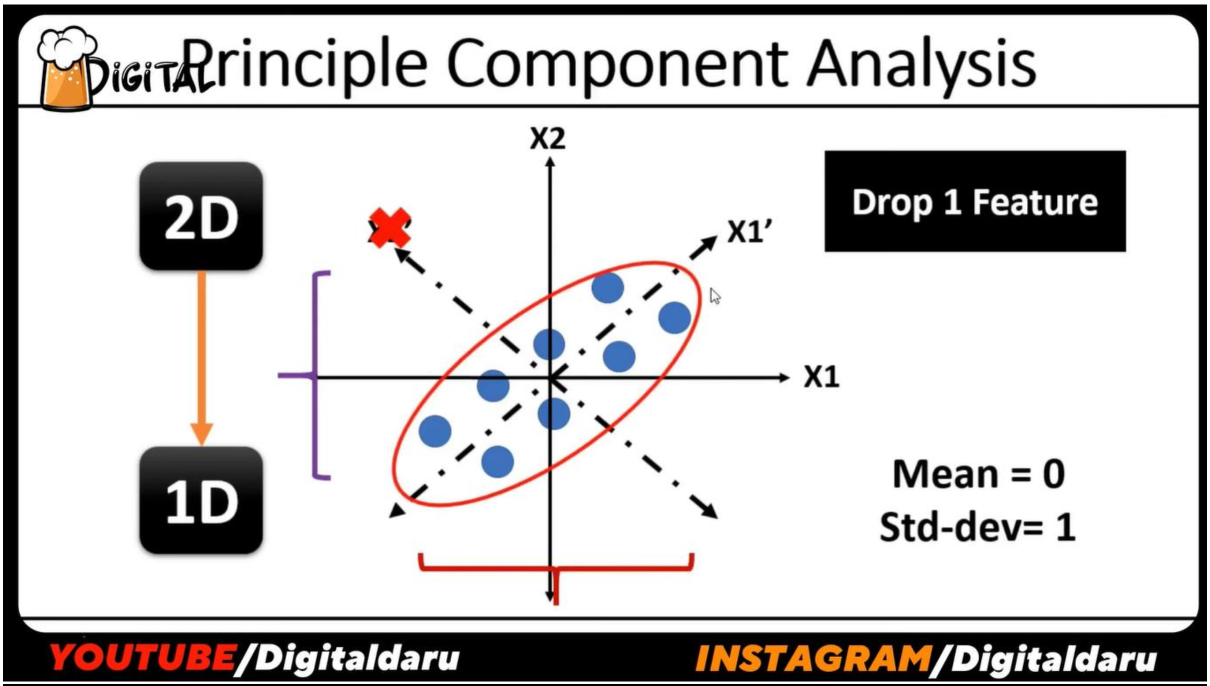
YOUTUBE/Digitaldaru INSTAGRAM/Digitaldaru

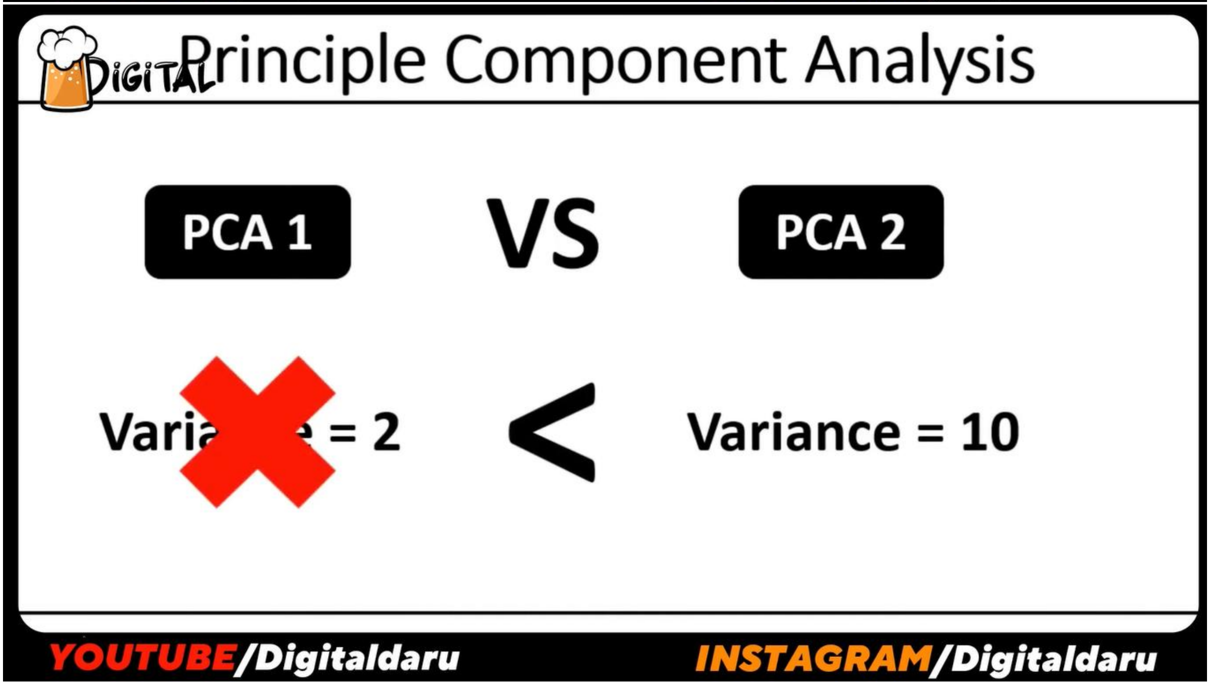

DIGITAL
Dimensionality Reduction
Dimensionality Reduction
PCA
Principle Component Analysis
T-SNE
t-Distributed Stochastic Neighbor Embedding
YOUTUBE/Digitaldaru
INSTAGRAM/Digitaldaru

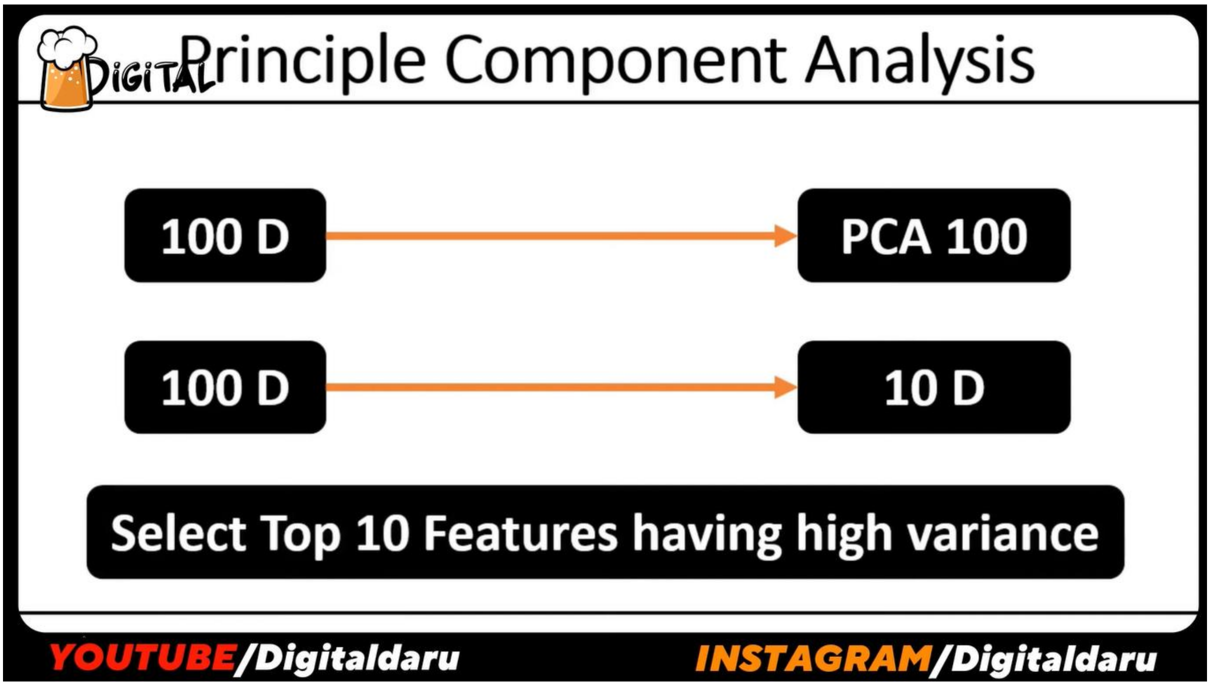

DIGITAL
Principle Component Analysis
2D
1D
Drop 1 Feature
LOW Variance
X1
(0,0)
More Loss
YOUTUBE/Digitaldaru
INSTAGRAM/Digitaldaru

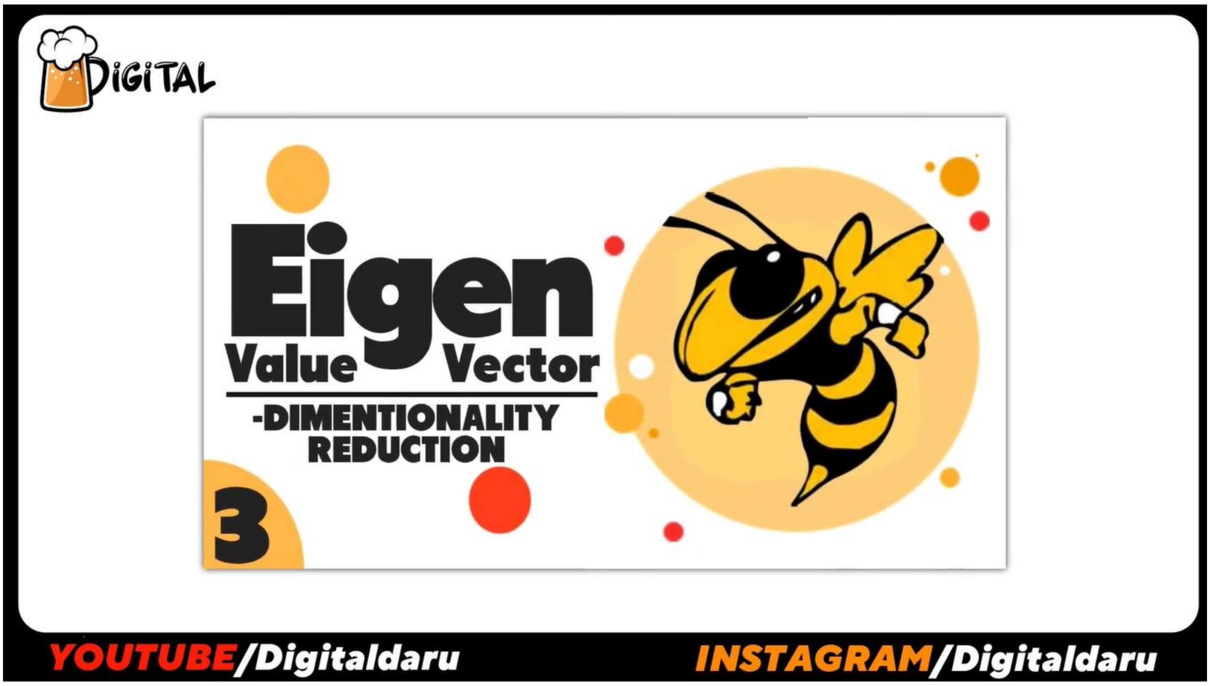

Principle Component Analysis
2D
1D
X2
(0,0)
Drop 1 Feature
High Variance
YOUTUBE/Digitaldaru
INSTAGRAM/Digitaldaru


Principle Component Analysis
2D
1D
X2
X1
(0,0)
Drop 1 Feature
Almost Same
YOUTUBE/Digitaldaru
INSTAGRAM/Digitaldaru


DIGITAL
Principle Component Analysis
2D
1D
X2
X1'
X1
Drop 1 Feature
Mean = 0
Std-dev= 1
YOUTUBE/Digitaldaru
INSTAGRAM/Digitaldaru


DIGITAL
Principle Component Analysis
PCA 1
VS
PCA 2
Vari e = 2
<
Variance = 10
YOUTUBE/Digitaldaru
INSTAGRAM/Digitaldaru


Principle Component Analysis
100 D
PCA 100
100 D
10 D
Select Top 10 Features having high variance
YOUTUBE/Digitaldaru
INSTAGRAM/Digitaldaru


Eigen
Value
Vector
-DIMENTIONALITY
REDUCTION
3
YOUTUBE/Digitaldaru
INSTAGRAM/Digitaldaru

DIGITAL

Determinant

$$A = \begin{bmatrix} 8 & -8 & -2 \\ 4 & -3 & -2 \\ 3 & -4 & 1 \end{bmatrix}$$

Determinant of A

$$|A| = ?$$

$$|A| = 8\begin{bmatrix} -3 & -2 \\ -4 & 1 \end{bmatrix} - (-8)\begin{bmatrix} 4 & -2 \\ 3 & 1 \end{bmatrix} + (-2)\begin{bmatrix} 4 & -3 \\ 3 & -4 \end{bmatrix}$$

DIGITAL

Determinant

$$A = \begin{bmatrix} 8 & & \\ & -3 & -2 \\ & -4 & 1 \end{bmatrix}$$

Determinant of A

$$|A| = ?$$

$$|A| = 8\begin{bmatrix} -3 & -2 \\ -4 & 1 \end{bmatrix} - (-8)\begin{bmatrix} 4 & -2 \\ 3 & 1 \end{bmatrix} + (-2)\begin{bmatrix} 4 & -3 \\ 3 & -4 \end{bmatrix}$$

YOUTUBE/Digitaldaru INSTAGRAM/Digitaldaru

DIGITAL

Determinant

$$A = \begin{bmatrix} & -8 & \\ 4 & & -2 \\ 3 & & 1 \end{bmatrix}$$

Determinant of A

$$|A| = ?$$

$$|A| = \mathbf{8}\begin{bmatrix} -3 & -2 \\ -4 & 1 \end{bmatrix} - (-8)\begin{bmatrix} 4 & -2 \\ 3 & 1 \end{bmatrix} + (-2)\begin{bmatrix} 4 & -3 \\ 3 & -4 \end{bmatrix}$$

DIGITAL

Determinant

$$A = \begin{bmatrix} & & -2 \\ 4 & -3 & \\ 3 & -4 & \end{bmatrix}$$

Determinant of A

$$|A| = ?$$

$$|A| = \mathbf{8}\begin{bmatrix} -3 & -2 \\ -4 & 1 \end{bmatrix} - (-8)\begin{bmatrix} 4 & -2 \\ 3 & 1 \end{bmatrix} + (-2)\begin{bmatrix} 4 & -3 \\ 3 & -4 \end{bmatrix}$$

Determinant

$$A = \begin{bmatrix} & & -2 \\ 4 & -3 & \\ 3 & -4 & \end{bmatrix}$$

Determinant of A

$$|A| = ?$$

$$|A| = 8\begin{bmatrix} -3 & -2 \\ -4 & 1 \end{bmatrix} - (-8)\begin{bmatrix} 4 & -2 \\ 3 & 1 \end{bmatrix} + (-2)\begin{bmatrix} 4 & -3 \\ 3 & -4 \end{bmatrix}$$

$$|A| = 8(-3-8) + 8(4+6) - 2(-16+9)$$

Determinant

$$A = \begin{bmatrix} 8 & -8 & -2 \\ 4 & -3 & -2 \\ 3 & -4 & 1 \end{bmatrix}$$

Determinant of A

$$|A| = 6$$

$$|A| = 8\begin{bmatrix} -3 & -2 \\ -4 & 1 \end{bmatrix} - (-8)\begin{bmatrix} 4 & -2 \\ 3 & 1 \end{bmatrix} + (-2)\begin{bmatrix} 4 & -3 \\ 3 & -4 \end{bmatrix}$$

$$|A| = 8(-3-8) + 8(4+6) - 2(-16+9)$$

DIGITAL

Eigen Value

$$A = \begin{bmatrix} 8 & -8 & -2 \\ 4 & -3 & -2 \\ 3 & -4 & 1 \end{bmatrix}$$

Eigen Value

$$\lambda^3 - [Sum\ of\ Diagonal\ Elements]\lambda^2 + [Sum\ of\ Diagonal\ Minors]\lambda - |A| = 0$$

DIGITAL

Eigen Value

$$A = \begin{matrix} -3 & -2 \\ -4 & 1 \end{matrix}\bigg]$$

Eigen Value

-11

$$\lambda^3 - [Sum\ of\ Diagonal\ Elements]\lambda^2 + [Sum\ of\ Diagonal\ Minors]\lambda - |A| = 0$$

YOUTUBE/Digitaldaru INSTAGRAM/Digitaldaru

DIGITAL

Eigen Value

$$A = \begin{bmatrix} 8 & & -2 \\ & & \\ 3 & & 1 \end{bmatrix}$$

Eigen Value

-11+14

$$\boldsymbol{\lambda^3 - [Sum\ of\ Diagonal\ Elements]\lambda^2 + [Sum\ of\ Diagonal\ Minors]\lambda - |A| = 0}$$

DIGITAL

Eigen Value

$$A = \begin{bmatrix} 8 & -8 & \\ 4 & -3 & \\ & & \end{bmatrix}$$

Eigen Value

-11+14+8=11

$$\boldsymbol{\lambda^3 - [Sum\ of\ Diagonal\ Elements]\lambda^2 + [Sum\ of\ Diagonal\ Minors]\lambda - |A| = 0}$$

Eigen Value

$$A = \begin{bmatrix} 8 & -8 & -2 \\ 4 & -3 & -2 \\ 3 & -4 & 1 \end{bmatrix}$$

Eigen Value

$$\lambda^3 - [Sum\ of\ Diagonal\ Elements]\lambda^2 + [Sum\ of\ Diagonal\ Minors]\lambda - |A| = 0$$

$$\lambda^3 - 6\lambda^2 + 11\lambda - 6 = 0$$

Eigen Value

$$A = \begin{bmatrix} 8 & -8 & -2 \\ 4 & -3 & -2 \\ 3 & -4 & 1 \end{bmatrix}$$

Eigen Value

$$\lambda = 1, 2, 3$$

$$\lambda^3 - [Sum\ of\ Diagonal\ Elements]\lambda^2 + [Sum\ of\ Diagonal\ Minors]\lambda - |A| = 0$$

$$\lambda^3 - 6\lambda^2 + 11\lambda - 6 = 0$$

YOUTUBE/Digitaldaru INSTAGRAM/Digitaldaru

DIGITAL

Eigen Vectors

$$A = \begin{bmatrix} 8 & -8 & -2 \\ 4 & -3 & -2 \\ 3 & -4 & 1 \end{bmatrix} \qquad (\mathbf{A} - \boldsymbol{\lambda} * \boldsymbol{I})\boldsymbol{X} = \mathbf{0}$$

DIGITAL

Eigen Vectors

$$A = \begin{bmatrix} 8 & -8 & -2 \\ 4 & -3 & -2 \\ 3 & -4 & 1 \end{bmatrix}$$

$$(\overset{\text{Given Matrix}}{\mathbf{A}} - \underset{\text{Constant}}{\boldsymbol{\lambda}} * \overset{\text{Identity}}{\boldsymbol{I}})\underset{\text{Unknown Matrix}}{\boldsymbol{X}} = \mathbf{0}$$

$$\left(\begin{bmatrix} 8 & -8 & -2 \\ 4 & -3 & -2 \\ 3 & -4 & 1 \end{bmatrix} - \lambda \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}\right) \begin{bmatrix} x1 \\ x2 \\ x3 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

Eigen Vectors

$$\left(\begin{bmatrix} 8 & -8 & -2 \\ 4 & -3 & -2 \\ 3 & -4 & 1 \end{bmatrix} - \lambda \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}\right) = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

$$\begin{bmatrix} 8-\lambda & -8 & -2 \\ 4 & -3-\lambda & -2 \\ 3 & -4 & 1-\lambda \end{bmatrix} = 0$$

Eigen Vectors

$\lambda = 1$

$$\begin{bmatrix} 8-\lambda & -8 & -2 \\ 4 & -3-\lambda & -2 \\ 3 & -4 & 1-\lambda \end{bmatrix} = 0$$

$$\begin{bmatrix} 7 & -8 & -2 \\ 4 & -4 & -2 \\ 3 & -4 & 0 \end{bmatrix} * \begin{bmatrix} x1 \\ x2 \\ x3 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

Eigen Vectors

$\lambda = 1$

$$\begin{bmatrix} 8-\lambda & -8 & -2 \\ 4 & -3-\lambda & -2 \\ 3 & -4 & 1-\lambda \end{bmatrix} = 0$$

$$\begin{bmatrix} 7 & -8 & -2 \\ 4 & -4 & -2 \\ 3 & -4 & 0 \end{bmatrix} * \begin{bmatrix} x1 \\ x2 \\ x3 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

Crammer's Rule

7(x1) – 8(x2) – 2(x3) = 0

4(x1) – 4(x2) – 2(x3) = 0

DIGITAL

Eigen Vectors

$\lambda = 1$

7(x1) – 8(x2) – 2(x3) = 0
4(x1) – 4(x2) – 2(x3) = 0

$$\frac{x1}{\begin{vmatrix} -8 & -2 \\ -4 & -2 \end{vmatrix}} = \frac{x2}{\begin{vmatrix} 7 & -2 \\ -4 & -2 \end{vmatrix}} = \frac{x3}{\begin{vmatrix} 7 & -8 \\ 4 & -4 \end{vmatrix}}$$

YOUTUBE/Digitaldaru INSTAGRAM/Digitaldaru

DIGITAL

Eigen Vectors

$\lambda = 1$

7(x1) – 8(x2) – 2(x3) = 0
4(x1) – 4(x2) – 2(x3) = 0

$$\frac{x1}{8} = \frac{x2}{6} = \frac{x3}{4}$$

$$\frac{x1}{\begin{vmatrix} -8 & -2 \\ -4 & -2 \end{vmatrix}} = \frac{x2}{\begin{vmatrix} 7 & -2 \\ -4 & -2 \end{vmatrix}} = \frac{x3}{\begin{vmatrix} 7 & -8 \\ 4 & -4 \end{vmatrix}}$$

YOUTUBE/Digitaldaru INSTAGRAM/Digitaldaru

Eigen Vectors

$$\lambda = 1$$

$$7(x1) - 8(x2) - 2(x3) = 0$$
$$4(x1) - 4(x2) - 2(x3) = 0$$

$$\frac{x1}{\begin{vmatrix} -8 & -2 \\ -4 & -2 \end{vmatrix}} = \frac{x2}{\begin{vmatrix} 7 & -2 \\ -4 & -2 \end{vmatrix}} = \frac{x3}{\begin{vmatrix} 7 & -8 \\ 4 & -4 \end{vmatrix}}$$

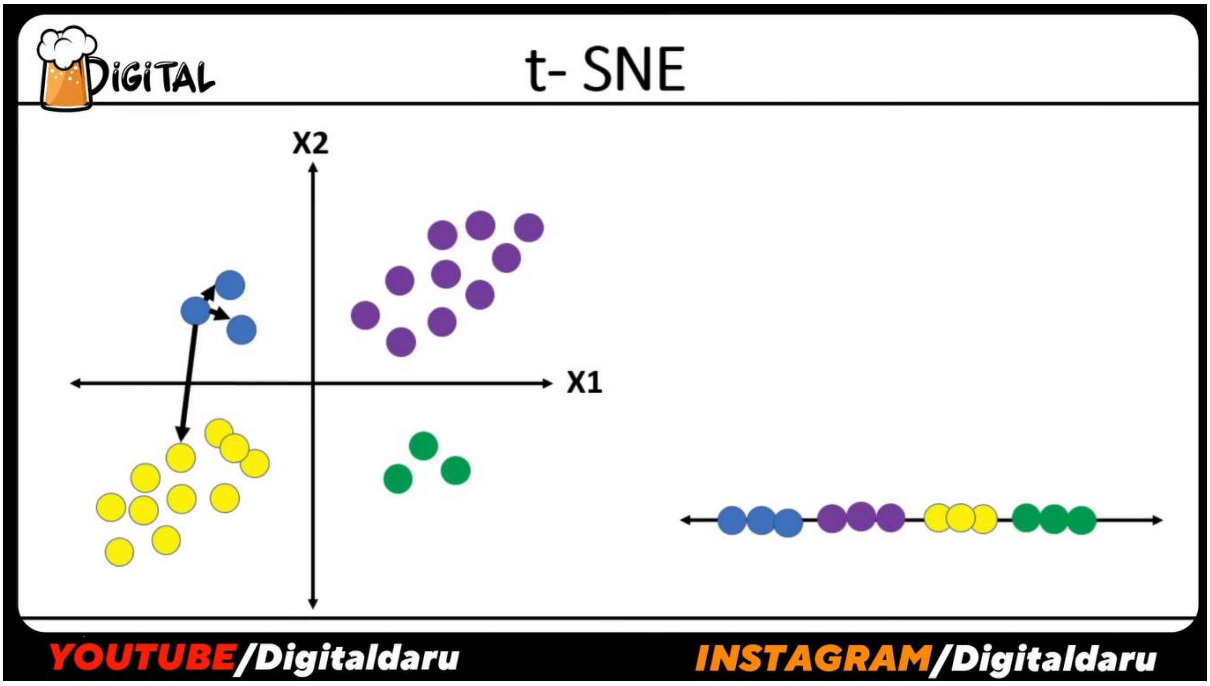
$$\frac{x1}{8} = \frac{x2}{6} = \frac{x3}{4}$$

$$Eigen\,Vector = \begin{bmatrix} 8 \\ 6 \\ 4 \end{bmatrix}$$

t-SNE (Non-Linear)

t- distributed Stochastic Neighbor Embedding

YOUTUBE/Digitaldaru INSTAGRAM/Digitaldaru


DIGITAL
t- SNE
X2
X1
YOUTUBE/Digitaldaru
INSTAGRAM/Digitaldaru