THIRUTHANGAL NADAR COLLEGE

(Belongs to the Chennaivazh Thiruthangal Hindu Nadar Uravinmurai Dharma Fund)

Selavayal, Chennai-51.

A Self-Financing Co-educational College of Arts & Science

Affiliated to the University of Madras

Accredited with 'B' Grade by NAAC

An ISO 9001: 2015 Certified Institution

NAME OF THE DEPARTMENT : MATHEMATICS

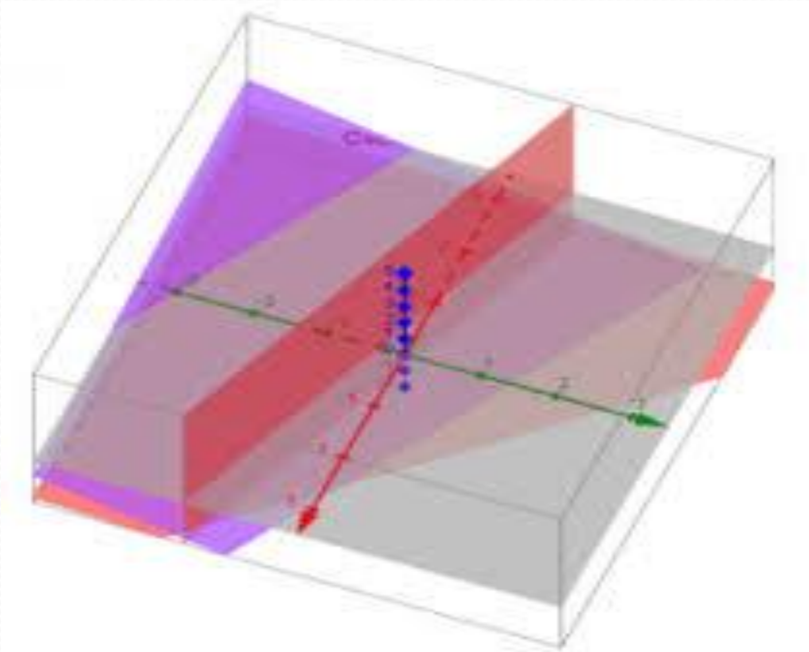
SUBJECT : ALGEBRA

TOPIC : TYPES OF MATRICES

STAFF NAME : N.AMUDHA

LINEAR ALGEBRA

MATRIX



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Types Of Matrices

(1)Real Matrix
(2)Complex Matrix
(3)Diagonal Matrix
(4)Symmetric Matrix
(5)Upper Triangular Matrix etc.

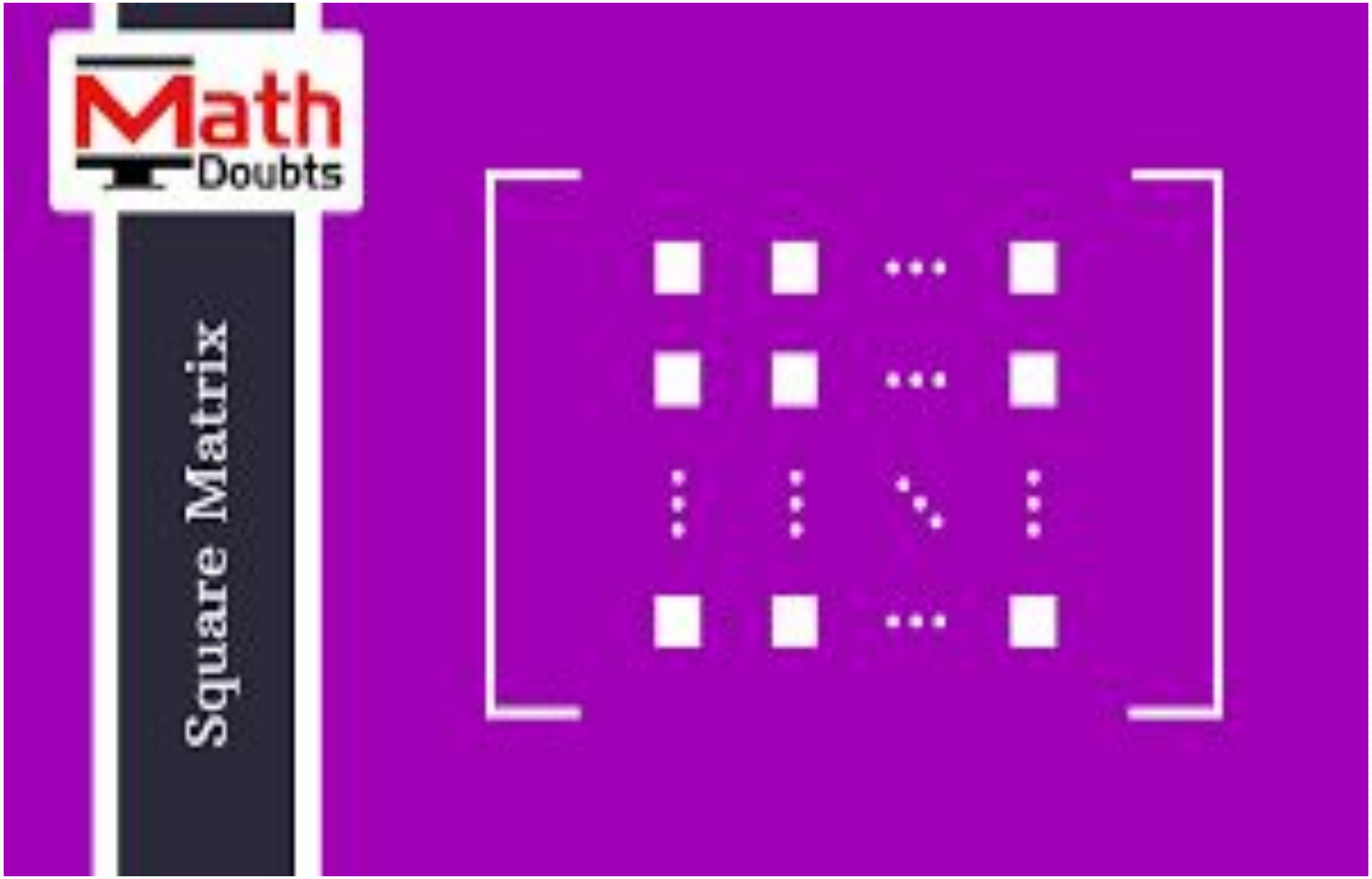
Definition of a Matrix

* Rectangular array of real numbers

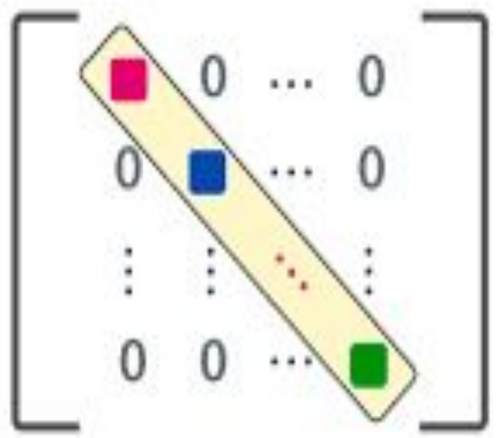
m rows by n columns

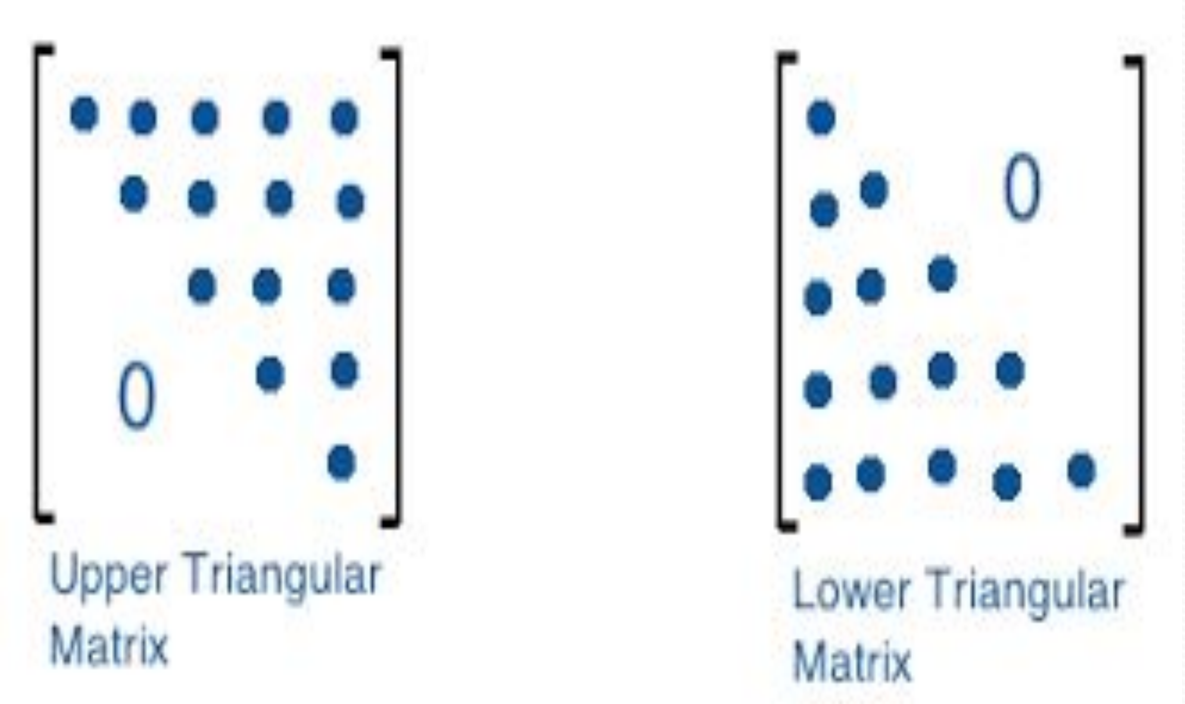
- * Named using capital letters
- * First subscript is row, second subscript is column

$$\mathbf{A}_{m \times n} = \begin{bmatrix} a_{11} & a_{12} & a_{13} & \cdots & a_{1n} \\ a_{21} & a_{22} & a_{23} & \cdots & a_{2n} \\ a_{31} & a_{32} & a_{33} & \cdots & a_{3n} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ a_{m1} & a_{m2} & a_{m3} & \cdots & a_{mn} \end{bmatrix}$$


Math
Doubts
Square Matrix

DIAGONAL MATRIX

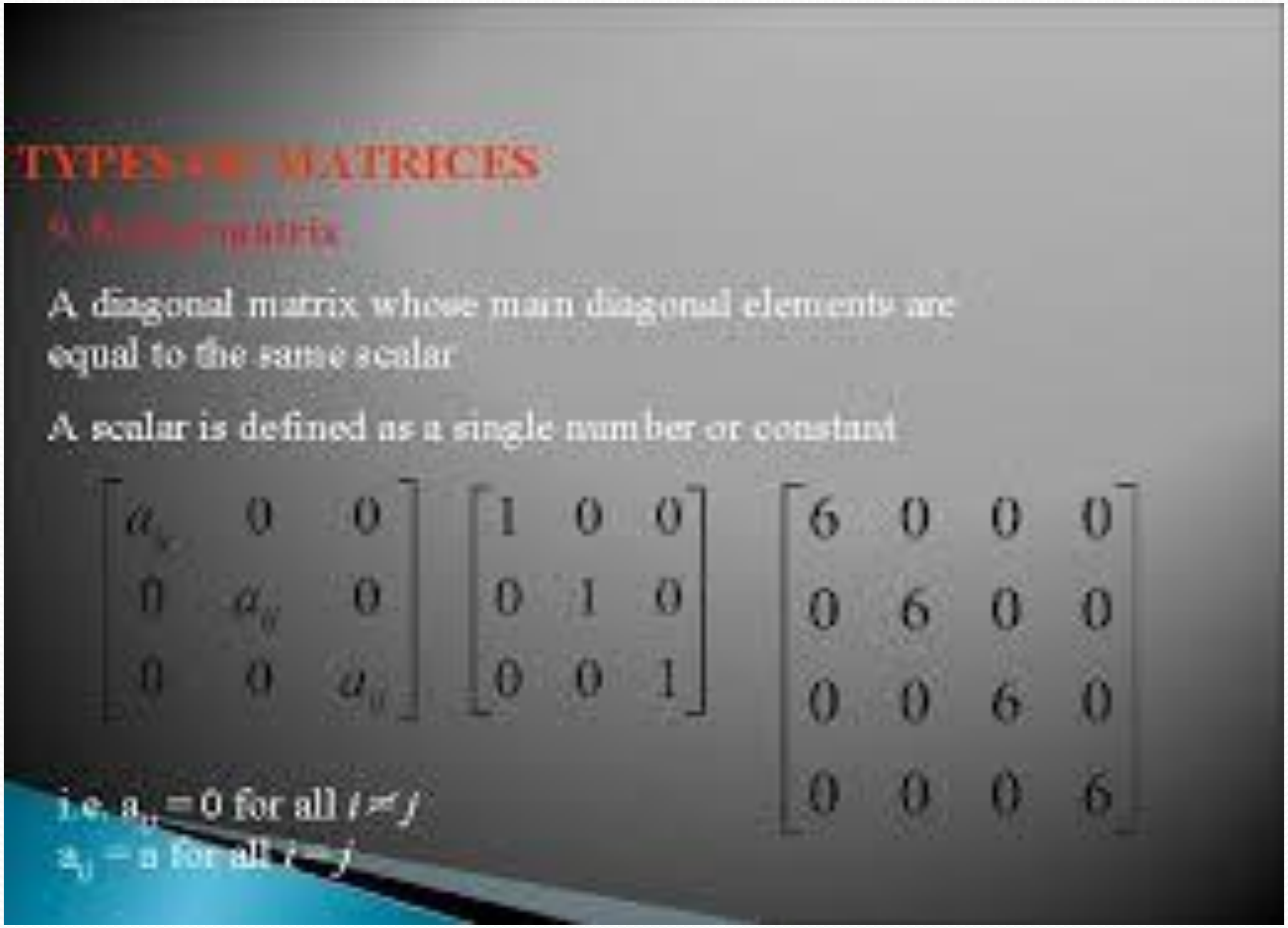



0
Upper Triangular
Matrix
0
Lower Triangular
Matrix

IDENTITY MATRIX

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

3 x 3


TYPES OF MATRICES
A diagonal matrix whose main diagonal elements are equal to the same scalar
A scalar is defined as a single number or constant
i.e. $a_{ij} = 0$ for all $i \neq j$
$a_{ij} = a$ for all $i = j$

A **Zero Matrix** is a matrix where all elements are 0.

For example: $\begin{pmatrix} 0 \\ 0 \end{pmatrix}$ $\begin{pmatrix} 0 & 0 \\ 0 & 0 \end{pmatrix}$ $\begin{pmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix}$

2.3 Symmetric Matrices

Definition

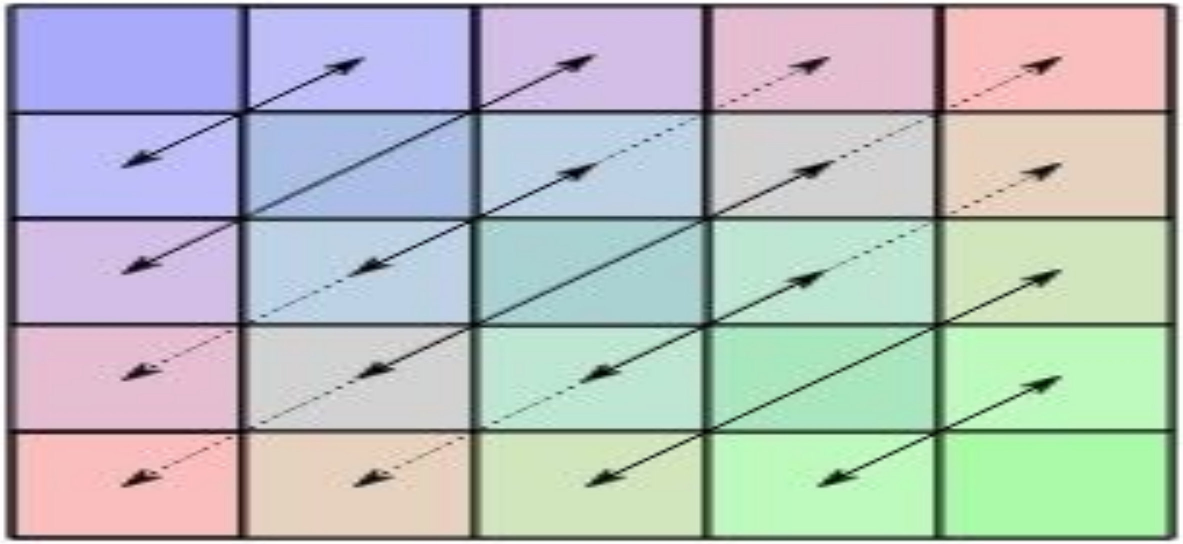
The **transpose** of a matrix A, denoted A^t, is the matrix whose columns are the rows of the given matrix A.

i.e., $A: m \times n \Rightarrow A^t: n \times m, \ (A^t)_{ij} = A_{ji} \ \ \forall i, j.$

Example 15

$$A = \begin{bmatrix} 2 & 7 \\ -8 & 0 \end{bmatrix}, B = \begin{bmatrix} 1 & 2 & -7 \\ 4 & 5 & 6 \end{bmatrix}, \text{and } C = \begin{bmatrix} -1 & 3 & 4 \end{bmatrix}$$

$$A^t = \begin{bmatrix} 2 & -8 \\ 7 & 0 \end{bmatrix} \qquad B^t = \begin{bmatrix} 1 & 4 \\ 2 & 5 \\ -7 & 6 \end{bmatrix} \qquad C^t = \begin{bmatrix} -1 \\ 3 \\ 4 \end{bmatrix}.$$



SKEW SYMMETRIC MATRICES

A square matrix A is said to be a skew symmetric if B' = – B . And all elements in the principal diagonal of a skew symmetric matrix are zeroes.

$$B = \begin{bmatrix} 0 & e & f \\ -e & 0 & g \\ -f & -g & 0 \end{bmatrix}_{3x3}$$

DEFINITION

Hermitian, Skew-Hermitian, and Unitary Matrices

A square matrix $\mathbf{A} = [a_{kj}]$ is called

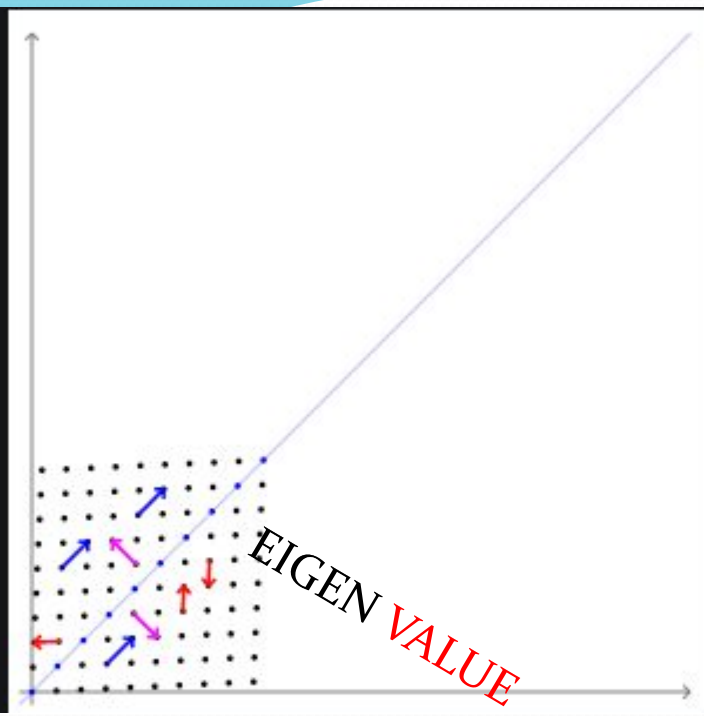
Hermitian	if $\bar{\mathbf{A}}^{\mathsf{T}} = \mathbf{A}$,	that is,	$\bar{a}_{kj} = a_{jk}$
skew-Hermitian	if $\bar{\mathbf{A}}^{\mathsf{T}} = -\mathbf{A}$,	that is,	$\bar{a}_{kj} = -a_{jk}$
unitary	if $\bar{\mathbf{A}}^{\mathsf{T}} = \mathbf{A}^{-1}$.		

EIGENVECTORS AND EIGENVALUES

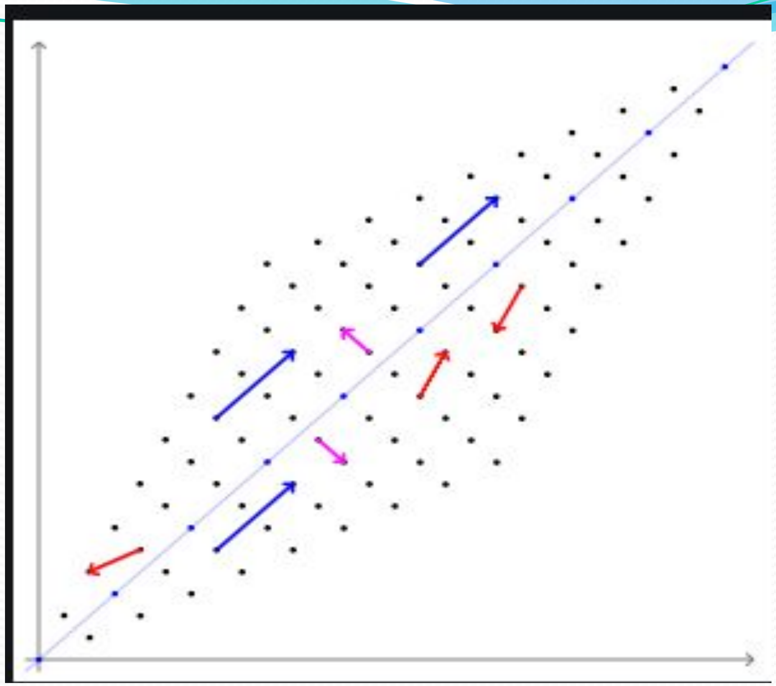
- **Definition:** An **eigenvector** of an $n \times n$ matrix A is a nonzero vector **x** such that $A\mathbf{x} = \lambda\mathbf{x}$ for some scalar λ. A scalar λ is called an **eigenvalue** of A if there is a nontrivial solution **x** of $A\mathbf{x} = \lambda\mathbf{x}$; such an **x** is called an *eigenvector corresponding to λ.*
- λ is an eigenvalue of an $n \times n$ matrix A if and only if the equation

$$(A - \lambda I)\mathbf{x} = 0 \quad \text{----(1)}$$

  has a nontrivial solution.
- The set of *all* solutions of (1) is just the null space of the matrix $A - \lambda I$.



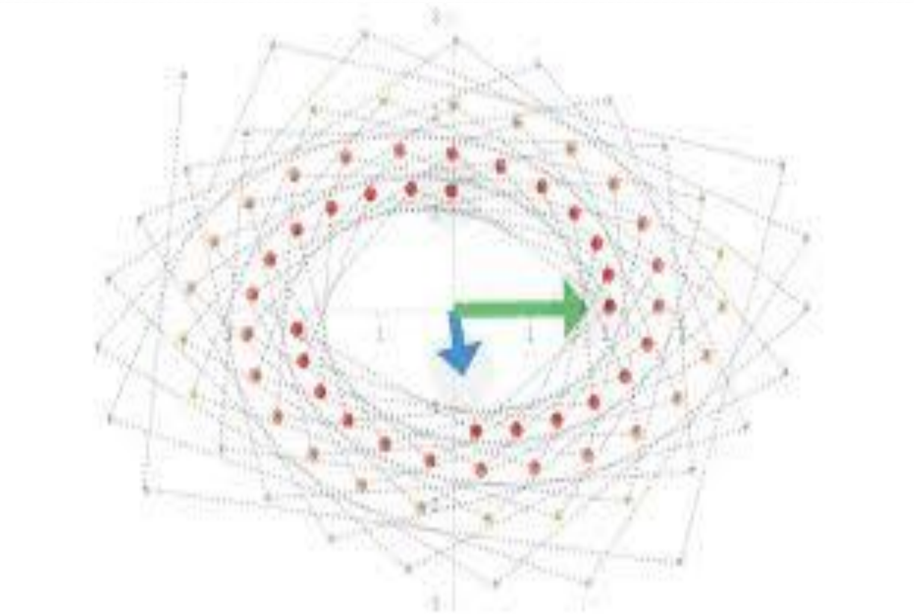
EIGEN VALUE



EIGEN VECTOR

EIGEN VALUE AND EIGEN VECTOR

EIGEN VALUE AND EIGEN VECTOR



LINEAR INDEPENDENCE

- **Definition:** An indexed set of vectors $\{\mathbf{v}_1, \ldots, \mathbf{v}_p\}$ in $\mathbb{R}^n$ is said to be **linearly independent** if the vector equation
$$x_1\mathbf{v}_1 + x_2\mathbf{v}_2 + \ldots + x_p\mathbf{v}_p = 0$$
has only the trivial solution. The set $\{\mathbf{v}_1, \ldots, \mathbf{v}_p\}$ is said to be **linearly dependent** if there exist weights $c_1, \ldots, c_p$, not all zero, such that
$$c_1\mathbf{v}_1 + c_2\mathbf{v}_2 + \ldots + c_p\mathbf{v}_p = 0 \quad \text{----(1)}$$

Determining Linear Independence

$$\begin{bmatrix}1\\1\\3\\3\end{bmatrix}\begin{bmatrix}-1\\1\\-1\\-3\end{bmatrix}\begin{bmatrix}2\\5\\9\\6\end{bmatrix}\xrightarrow{\text{linear combination}} c_1\begin{bmatrix}1\\1\\3\\3\end{bmatrix}+c_2\begin{bmatrix}-1\\1\\-1\\-3\end{bmatrix}+c_3\begin{bmatrix}2\\5\\9\\6\end{bmatrix}=\begin{bmatrix}0\\0\\0\\0\end{bmatrix}$$

$$\begin{bmatrix}1 & -1 & 2\\0 & 1 & 3/2\\0 & 0 & 1\\0 & 0 & 0\end{bmatrix} \Rightarrow \begin{aligned}c_1 &= 0\\ c_2 &= 0\\ c_3 &= 0\end{aligned}$$

then these would be **linearly independent**

Determine if the following functions are dependent or independent.

$$f_1 = \sin(2x), f_2 = \cos(2x)$$

$$W(f_1, f_2) = \begin{vmatrix} \sin(2x) & \cos(2x) \\ 2\cos(2x) & -2\sin(2x) \end{vmatrix}$$

$$W(f_1, f_2) = \begin{vmatrix} f_1 & f_2 \\ f_1' & f_2' \end{vmatrix}$$

	Sledge Hammer	Club Hammer	Sledge Mining Hammer	Copper Sledge Hammer	Ball Pein Hammer	Cross Pein Hammer	Claw Hammer	Soft Face Hammer	Hatchet	Pick
Mining	X	-	X	X	-	X	-	-	X	X
Stone Crushing	X	-	X	-	-	X	-	-	-	-
Demolition	X	-	X	-	-	-	-	-	-	-
Building & Construction	X	X	X	X	-	X	X	-	-	X
Steel Fixing	X	X	X	X	X	-	-	-	-	-
Agriculture	X	X	X	-	-	-	-	-	X	X
Forestry	-	-	-	-	-	-	-	-	X	X
Light Engineering	X	X	X	X	X	-	-	X	-	-


Thank
you