**Matrix**

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**Lecture-01: Introduction to matrix**

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**Definition:**

A matrix is a rectangular arrangement of numbers.

In short,.

is a Matrix.

In general,

**Zero Matrix:**

A matrix,**, ,** is called a **Zero Matrix** if  for all **.**

**Row Matrix:**

A matrix,**, ,** is called a **Row Matrix** if .

**Example:**

is a row matrix.

**Column Matrix:**

A matrix,**, ,** is called a **Column Matrix** if .

**Example:**

is a column matrix.

**Square Matrix:**

A matrix,**, ,** is called a **Square Matrix** if . Then we write **,** where **.** Here **“r”** is called the **order** of the matrix.

**Example:**

is a square matrix.

**Identity Matrix:**

A square matrix, **,** where is called an **Identity Matrix** if when when and otherwise.

**Example:**

is an identity matrix.

**Upper Triangular Matrix:**

A square matrix, **,** where is called an **Upper Triangular Matrix** if when .

**Example:**

are two upper triangular matrices.

**Lower Triangular Matrix:**

A square matrix, **,** where is called an **Lower Triangular Matrix** if when .

**Example:**

are two lower triangular matrices.

**Diagonal Matrix:**

A square matrix, **,** where is called an **Diagonal Matrix** if when .

**Example:**

is a diagonal matrix.

**Scalar Matrix:**

A square matrix, **,** where is called an **Scalar Matrix** if when and otherwise. Here is a constant.

**Example:**

is a scalar matrix.

**Lecture-02: Basic Operations in Matrix**

**Date: August 13, 2020**

**Addition:**

Let and be two matrices where **.** Then **,** where , is the sum of and , that is, if and only if for all **.**

* Note that if the dimensions of and are not same, then their sum is **undefined**.

**Example:**

And

**Subtraction:**

Let and be two matrices where **.** Then **,** where , is the difference of and , that is, if and only if for all **.**

* Note that if the dimensions of and are not same, then their difference is **undefined**.

**Example:**

And

**Scalar Multiplication:**

Let where **.** Then **,** where , is a scalar multiple of , that is, if an only if for all .

**Example:**

**Matrix Multiplication:**

Let where

and wherebe two matrices.

Then where is the matrix product of and , that is, if and only if .

For example,

**Example:**

Here, .

So, **Matrix Multiplication** does not follow **Communicative Law of Multiplication**.

**Transpose of A Matrix:**

Let  **,** where **.** Then **,** where , is the transpose matrix of , denoted by if an only if for all .

**Example:**

**Symmetric Matrix:**

A square matrix, **,** where **,** is called a **Symmetric Matrix** if for all .

**Remark:** If is a symmetric matrix, then .

**Skew-symmetric Matrix:**

A square matrix, **,** where **,** is called a **Symmetric Matrix** if for all .

**Remark:** If is a skew-symmetric matrix, then .

**Some Properties of Matrix Transpose:**

**Class Work:**

For any square matrix, A, do the following operations and comment about the result matrices:

**Comments:** = Symmetric, = Skew-symmetric and

= symmetric.

**Theorem:**

For any square matrix, –

1. is symmetric;
2. is skew-symmetric and
3. is symmetric.

**Home Work:**

Prove the above theorem.

**#Proof of the previous theorem:**

1. Let

We have

As , is symmetric.

1. Let

We have

As , is skew-symmetric.

1. Let

We have

As , is symmetric.

[Proved]

**#Problem:**

Let be any square matrix. Find and such that where is symmetric and is skew-symmetric.

**Solution:**

|  |
| --- |
| Theory |
| Let be three square matrices such that .  If where is symmetric and is skew-symmetric, then  For all . |