Why Are We Studying Matrices?

Matrices have plenty of uses in Computer Science. E.g.:

- Representation . . .
  - . . . of the graph data structure (see CSc 345)
  - . . . of functions and relations (see Topics 8 and 9)
- Affine transformations in Computer Graphics
**Matrix Fundamentals (1 / 3)**

**Definition:** Matrix

**Notation:**

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**Matrix Fundamentals (2 / 3)**

**Definition:** Square Matrices

**Definition:** Matrix Equality
Definition: Transposition

Definition: Matrix Symmetry

Example(s):

Matrix Operations (1 / 5)

1. Matrix Addition

Definition: Matrix Addition (a.k.a. Matrix Sum)

Example(s):
Matrix Operations (2 / 5)

2. Scalar Multiplication

**Definition: Scalar**

**Definition: Scalar Multiplication**

Example(s):

Matrix Operations (3 / 5)

3. Matrix Multiplication

**Definition: Matrix Multiplication (a.k.a. Matrix Product)**
Identity Matrices

Remember the concept of Multiplicative Identity?

**Definition: Identity Matrices**

\[
\begin{pmatrix}
1 & 0 & 0 \\
0 & 1 & 0 \\
0 & 0 & 1
\end{pmatrix}
\]

Matrix Powers

**Definition: \( n^{th} \) Matrix Power**

\[
\begin{pmatrix}
\ldots & \ldots & \ldots \\
\ldots & \ldots & \ldots \\
\ldots & \ldots & \ldots
\end{pmatrix}
\]

**Example(s):**

\[
\begin{pmatrix}
\ldots & \ldots & \ldots \\
\ldots & \ldots & \ldots \\
\ldots & \ldots & \ldots
\end{pmatrix}
\]
Example: Affine Transformations (1 / 3)

Used to ‘move’ objects in computer graphics.

Background:

Example: Affine Transformations (2 / 3)

Task:
Zero-One Matrices (1 / 3)

Three Operations:

1. ‘Join’:

2. ‘Meet’:

Example(s):
3. Logical Matrix Product (a.k.a. Boolean Product):

Example(s):

Definition: \( r^{th} \) Logical Matrix Power (a.k.a. Boolean Power)