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
Definition: Matrix

Notation:

Matrix Fundamentals (2 / 3)

Definition: Square Matrices

Definition: Matrix Equality
Matrix Fundamentals (3 / 3)

Definition: Transposition

Definition: Matrix Symmetry

Example(s):

Matrix Operations (1 / 5)

1. Matrix Addition

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

Example(s):
2. Scalar Multiplication

**Definition:** Scalar

**Definition:** Scalar Multiplication

**Example(s):**

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3. Matrix Multiplication

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

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Identity Matrices

Remember the concept of Multiplicative Identity?

**Definition: Identity Matrices**

\[
\begin{array}{cccccccccccc}
1 & 0 & 0 & 0 \\
0 & 1 & 0 & 0 \\
0 & 0 & 1 & 0 \\
0 & 0 & 0 & 1 \\
\end{array}
\]

Matrix Powers

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

\[
\begin{array}{cccccccccccc}
1 & 0 & 0 & 0 \\
0 & 1 & 0 & 0 \\
0 & 0 & 1 & 0 \\
0 & 0 & 0 & 1 \\
\end{array}
\]

**Example(s):**
Example: Affine Transformations (1 / 3)

Used to ‘move’ objects in computer graphics.

Background:

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Example: Affine Transformations (2 / 3)

Task:

```
0 2 4
2
4
⇒
0 2 4
2
4
```

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Zero-One Matrices (1 / 3)

Three Operations:

1. ‘Join’:

2. ‘Meet’:

Example(s):
Zero-One Matrices (2 / 3)

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

Example(s):

\[
\begin{array}{cccc}
& & & \\
& & & \\
& & & \\
\end{array}
\]

Zero-One Matrices (3 / 3)

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

\[
\begin{array}{cccc}
& & & \\
& & & \\
& & & \\
\end{array}
\]