How to Create Matrices By Using Latex

Minliang(Mandy), Olivia, Bishwo, Ashlynn

February 20, 2024

Table of Contents

Introduction

Definition

In mathematics, a matrix is a rectangular array of numbers, symbols, or expressions, arranged in rows and columns.

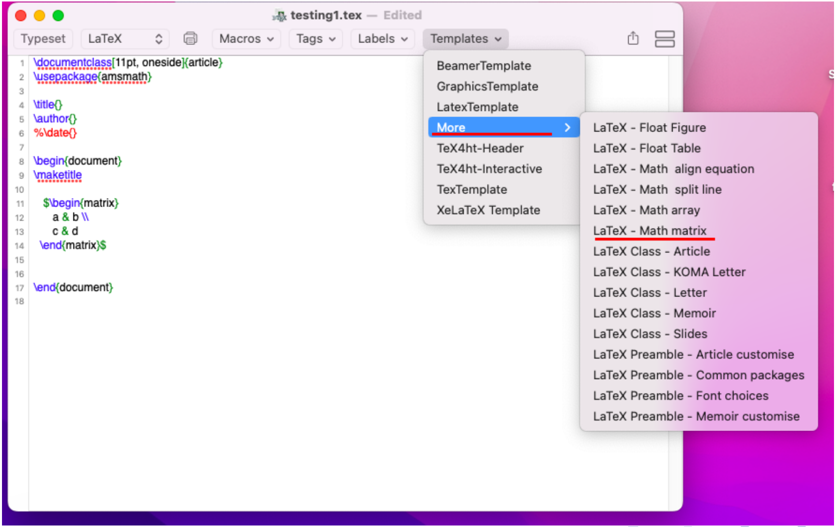
- Widely used in various fields, including algebra, computer science, physics, and engineering.
- Provides a convenient way to represent and manipulate linear transformations, systems of linear equations, and data sets.

Representation of a Matrix

Matrix A

$$A = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{m1} & a_{m2} & \cdots & a_{mn} \end{bmatrix}$$

Matrix Codes



Matrix Codes

Type	LaTeX markup	Renders as

Plain	`$\begin{matrix}`
	`1 & 2 & 3\\`
	`a & b & c`
	`\end{matrix} $`
		$\begin{matrix} 1 & 2 & 3\\ a & b & c \end{matrix}$

Parentheses; round brackets	`$ \begin{pmatrix}`
	`1 & 2 & 3\\`
	`a & b & c`
	`\end{pmatrix}$`
		$\begin{pmatrix} 1 & 2 & 3\\ a & b & c \end{pmatrix}$

Brackets; square brackets	`$ \begin{bmatrix}`
	`1 & 2 & 3\\`
	`a & b & c`
	`\end{bmatrix} $`
		$\begin{bmatrix} 1 & 2 & 3\\ a & b & c \end{bmatrix}$

Matrix Codes

Braces;
curly brackets
	`$\begin{Bmatrix}`
	`1 & 2 & 3\\`
	`a & b & c`
	`\end{Bmatrix} $`
		$\begin{Bmatrix} 1 & 2 & 3 \\ a & b & c \end{Bmatrix}$

Pipes	`$\begin{vmatrix}`
	`1 & 2 & 3\\`
	`a & b & c`
	`\end{vmatrix} $`
		$\begin{vmatrix} 1 & 2 & 3 \\ a & b & c \end{vmatrix}$

Double pipes	`$\begin{Vmatrix}`
	`1 & 2 & 3\\`
	`a & b & c`
	`\end{Vmatrix} $`
		$\begin{Vmatrix} 1 & 2 & 3 \\ a & b & c \end{Vmatrix}$

Matrix Codes

\times	$\times$
\cdots	$\cdots$
\vdots	$\vdots$
\ddots	$\ddots$
\sum	Σ

Operations

Addition

Two matrices can be added together if they have the same dimensions.

$$A + B = \begin{bmatrix} a_{11} + b_{11} & a_{12} + b_{12} & \cdots & a_{1n} + b_{1n} \\ a_{21} + b_{21} & a_{22} + b_{22} & \cdots & a_{2n} + b_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{m1} + b_{m1} & a_{m2} + b_{m2} & \cdots & a_{mn} + b_{mn} \end{bmatrix}$$

Operations

Multiplication

Multiplication of matrices is defined only if the number of columns in the first matrix equals the number of rows in the second matrix.

$$C = A \times B$$

Multiplication

```
    % First Matrix
    \[ \begin{bmatrix}
        a_{11} & a_{12} & \cdots & a_{1n}\\
        a_{21} & a_{22} & \cdots & a_{2n}\\
        \vdots & \vdots & \ddots & \vdots\\
        a_{m1} & a_{m2} & \cdots & a_{mn}
     \end{bmatrix}
     \times
     % Second Matrix
     \begin{bmatrix}
        b_{11} & b_{12} & \cdots & b_{1p}\\
        b_{21} & b_{22} & \cdots & b_{2p}\\
        \vdots & \vdots & \ddots & \vdots\\
        b_{n1} & b_{n2} & \cdots & b_{np}
     \end{bmatrix}
      =
```

Multiplication

```
        =
        % Product Matrix
       \begin{bmatrix}
           c_{11} & c_{12} & \cdots & c_{1p}\\
           c_{21} & c_{22} & \cdots & c_{2p}\\
           \vdots & \vdots & \ddots & \vdots\\
           c_{m1} & c_{m2} & \cdots & c_{mp}
       \end{bmatrix} \]
```

Multiplication

$$\begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{m1} & a_{m2} & \cdots & a_{mn} \end{bmatrix} \times \begin{bmatrix} b_{11} & b_{12} & \cdots & b_{1p} \\ b_{21} & b_{22} & \cdots & b_{2p} \\ \vdots & \vdots & \ddots & \vdots \\ b_{n1} & b_{n2} & \cdots & b_{np} \end{bmatrix} = \begin{bmatrix} c_{11} & c_{12} & \cdots & c_{1p} \\ c_{21} & c_{22} & \cdots & c_{2p} \\ \vdots & \vdots & \ddots & \vdots \\ c_{m1} & c_{m2} & \cdots & c_{mp} \end{bmatrix}$$

3*3 Matrix Multiplication

```
% First Matrix
    \[ \begin{pmatrix}
        2 & 7 & 3\\
        1 & 5 & 8\\
        0 & 4 & 1
    \end{pmatrix}
    \times
% Second Matrix
    \begin{pmatrix}
        3 & 0 & 1\\
        2 & 1 & 0\\
        1 & 2 & 4
    \end{pmatrix}
     =
```

3*3 Matrix Multiplication

```latex
% Product Matrix
        \begin{pmatrix}
            23 & 13 & 14\\
            21 & 21 & 33\\
            9 & 6 & 4
        \end{pmatrix} \]
```

3*3 Matrix Multiplication

$$\begin{pmatrix} 2 & 7 & 3 \\ 1 & 5 & 8 \\ 0 & 4 & 1 \end{pmatrix} \times \begin{pmatrix} 3 & 0 & 1 \\ 2 & 1 & 0 \\ 1 & 2 & 4 \end{pmatrix} = \begin{pmatrix} 23 & 13 & 14 \\ 21 & 21 & 33 \\ 9 & 6 & 4 \end{pmatrix}$$

Operations

Transpose

The transpose of a matrix A, denoted as A^T, is obtained by exchanging its rows and columns.

$$A = \begin{bmatrix} a & b & c \\ d & e & f \\ g & h & i \end{bmatrix} A^T = \begin{bmatrix} a & d & g \\ b & e & h \\ c & f & i \end{bmatrix}$$

Citations

1. https://www.physicsread.com/latex-matrix-multiplication/
2. https://www.overleaf.com/learn/latex/Matrices