

# How to Create Matrices By Using Latex

Minliang(Mandy), Olivia, Bishwo, Ashlynn

February 20, 2024

# Table of Contents

- Introduction
- Representation of a Matrix
- Matrix Codes
- Operation
  1. Addition
  2. Multiplication
  3. Transpose

# Introduction

## Definition

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

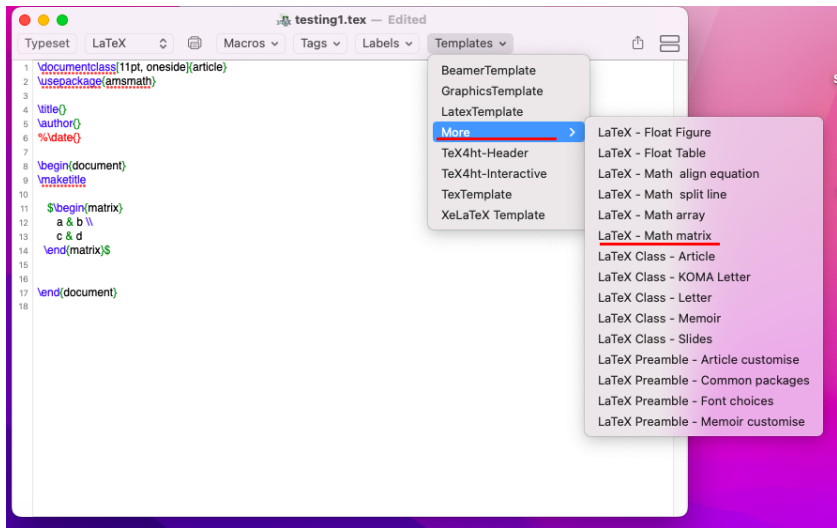
- Widely used in various fields, including algebra, computer science, physics, and engineering.
- Provides a convenient way to represent and manipulate linear transformations, systems of linear equations, and data sets.

# 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	L <sup>A</sup> T <sub>E</sub> X markup	Renders as
Plain	$  \begin{matrix}  \text{\texttt{\$ \begin{u}{matrix}}} \\  1 \ \& \ 2 \ \& \ 3 \\  a \ \& \ b \ \& \ c \\  \text{\texttt{\end{u}{matrix} \$}}  \end{matrix}  $	$  \begin{matrix}  1 & 2 & 3 \\  a & b & c  \end{matrix}  $
Parentheses; round brackets	$  \begin{matrix}  \text{\texttt{\$ \begin{u}{pmatrix}}} \\  1 \ \& \ 2 \ \& \ 3 \\  a \ \& \ b \ \& \ c \\  \text{\texttt{\end{u}{pmatrix} \$}}  \end{matrix}  $	$  \begin{pmatrix} 1 & 2 & 3 \\ a & b & c \end{pmatrix}  $
Brackets; square brackets	$  \begin{matrix}  \text{\texttt{\$ \begin{u}{bmatrix}}} \\  1 \ \& \ 2 \ \& \ 3 \\  a \ \& \ b \ \& \ c \\  \text{\texttt{\end{u}{bmatrix} \$}}  \end{matrix}  $	$  \begin{bmatrix} 1 & 2 & 3 \\ a & b & c \end{bmatrix}  $

# Matrix Codes

	<code>\$\begin{\u{Bmatrix}}</code>	
Braces;	<code>1 &amp; 2 &amp; 3\\</code>	$\begin{Bmatrix} 1 & 2 & 3 \end{Bmatrix}$
curly brackets	<code>a &amp; b &amp; c</code>	$\begin{Bmatrix} a & b & c \end{Bmatrix}$
	<code>\end{\u{Bmatrix}} \$</code>	

	<code>\$\begin{\u{vmatrix}}</code>	
Pipes	<code>1 &amp; 2 &amp; 3\\</code>	$\begin{vmatrix} 1 & 2 & 3 \end{vmatrix}$
	<code>a &amp; b &amp; c</code>	$\begin{vmatrix} a & b & c \end{vmatrix}$
	<code>\end{\u{vmatrix}} \$</code>	

	<code>\$\begin{\u{Vmatrix}}</code>	
Double pipes	<code>1 &amp; 2 &amp; 3\\</code>	$\begin{Vmatrix} 1 & 2 & 3 \end{Vmatrix}$
	<code>a &amp; b &amp; c</code>	$\begin{Vmatrix} a & b & c \end{Vmatrix}$
	<code>\end{\u{Vmatrix}} \$</code>	

# Matrix Codes

<code>\times</code>	$\times$
<code>\cdots</code>	$\cdots$
<code>\vdots</code>	$\vdots$
<code>\ddots</code>	$\ddots$
<code>\sum</code>	$\Sigma$



# 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

```

53      % First Matrix
54 ▾    \[ \begin{bmatrix}
55          a_{11} & a_{12} & \cdots & a_{1n} \\
56          a_{21} & a_{22} & \cdots & a_{2n} \\
57          \vdots & \vdots & \ddots & \vdots \\
58          a_{m1} & a_{m2} & \cdots & a_{mn}
59      \end{bmatrix}
60      \times
61      % Second Matrix
62 ▾    \begin{bmatrix}
63          b_{11} & b_{12} & \cdots & b_{1p} \\
64          b_{21} & b_{22} & \cdots & b_{2p} \\
65          \vdots & \vdots & \ddots & \vdots \\
66          b_{n1} & b_{n2} & \cdots & b_{np}
67      \end{bmatrix}
68      =

```

# Multiplication

```

68      =
69      % Product Matrix
70 \begin{bmatrix}
71      c_{11} & c_{12} & \cdots & c_{1p} \\
72      c_{21} & c_{22} & \cdots & c_{2p} \\
73      \vdots & \vdots & \ddots & \vdots \\
74      c_{m1} & c_{m2} & \cdots & c_{mp} \\
75 \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

```

73 % First Matrix
74 \[ \begin{pmatrix}
75     2 & 7 & 3 \\
76     1 & 5 & 8 \\
77     0 & 4 & 1
78 \end{pmatrix}
79 \times
80 % Second Matrix
81 \begin{pmatrix}
82     3 & 0 & 1 \\
83     2 & 1 & 0 \\
84     1 & 2 & 4
85 \end{pmatrix}
86 =

```

# 3\*3 Matrix Multiplication

```
87 % Product Matrix
88 \begin{pmatrix}
89     23 & 13 & 14\\
90     21 & 21 & 33\\
91     9  & 6  & 4
92 \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.

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

# Citations

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