

LABORATORY03: Report and Presentation of work on Mathematical Mode

PELE TETE

December 2025

Contents

1	MathMode.tex - Basic Math Mode Introduction	2
2	MathModeSuperscripts.tex - Superscripts and Subscripts	2
3	MathModeCommands.tex - Math Commands	3
4	DisplayMathematics.tex - Display Mathematics	3
5	DisplayMathematicsEquation.tex - Numbered Equations	4
6	DisplayMathematicsDiff.tex - Custom Differential	5
7	TheAmsmathPackage.tex - AMS Math Package Introduction	6
8	TheAmsmathPackageMatrices.tex - AMS Matrices	6
9	ColumnsinMathAlignments.tex - Column Alignments	7
10	DisplayingEnvironmentAmsmathAlignments.tex - Aligned Subenvironment	8
11	FurtherAmsmathAlignments.tex - Gather and Multline	9
12	BoldMath.tex - Bold Mathematics	10
13	FontsinMathModeBoldface.tex - Boldface in Math	11
14	FontsinMathModeSpecifics.tex - Math Font Specifics	12
15	Mathtools.tex - Mathtools Package	12
16	BoldMathCommendBM.tex - pmatrix* Environment	13
17	LualatexMathMode.tex - Unicode Math with LuaLaTeX	14
18	Lab03MathMode.tex - Comprehensive Lab Examples	15
	Conclusion	16

1 MathMode.tex - Basic Math Mode Introduction

```
\documentclass{article}
\usepackage[T1]{fontenc}
\begin{document}
A sentence with inline mathematics: $y = mx + c$.
```

A second sentence with inline mathematics: $5^2=3^2+4^2$.

%A second paragraph containing display math.

\[

$$y = mx + c$$

۲۰

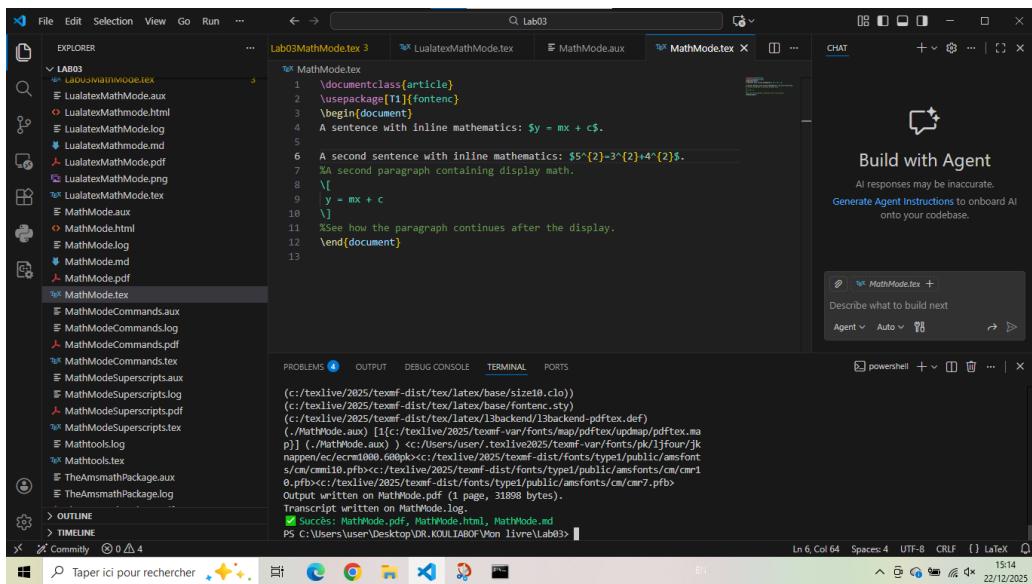
%See how the paragraph continues after the display.

```
\end{document}
```

Generated figure

Basic inline and display math mode examples.

Screenshot



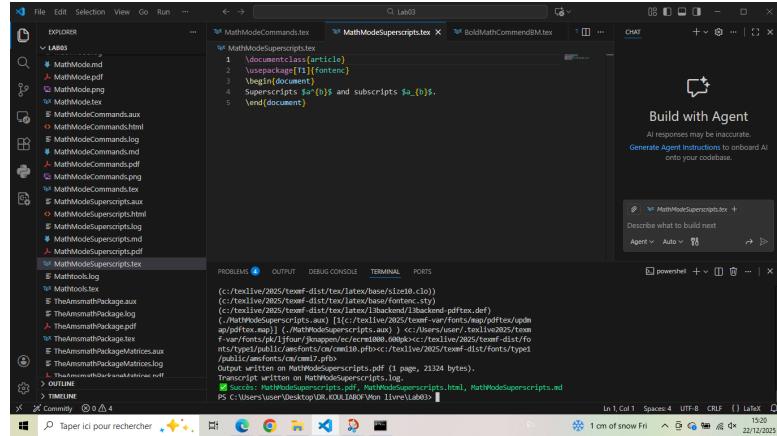
2 MathModeSuperscripts.tex - Superscripts and Subscripts

```
\documentclass{article}
\usepackage[T1]{fontenc}
\begin{document}
Superscripts  $a^b$  and subscripts  $a_b$ .
\end{document}
```

Generated figure

Demonstration of superscript and subscript notation.

Screenshot



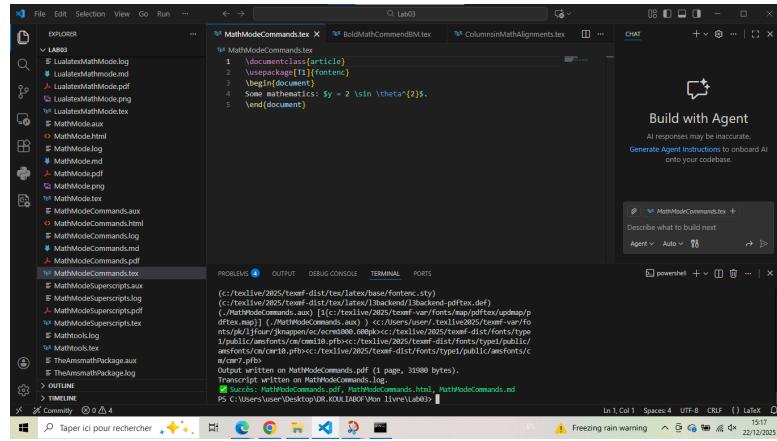
3 MathModeCommands.tex - Math Commands

```
\documentclass{article}
\usepackage[T1]{fontenc}
\begin{document}
Some mathematics: $y = 2 \sin \theta^2$.
\end{document}
```

Generated figure

Using mathematical functions like `\sin` and Greek letters.

Screenshot



4 DisplayMathematics.tex - Display Mathematics

```
\documentclass{article}
```

```

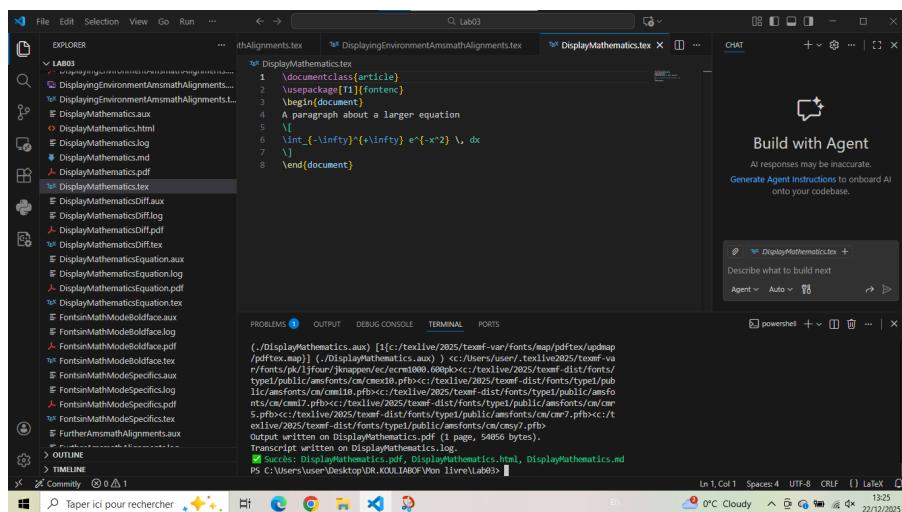
\usepackage[T1]{fontenc}
\begin{document}
A paragraph about a larger equation
\[
\int_{-\infty}^{+\infty} e^{-x^2} \, dx
\]
\end{document}

```

Generated figure

Display math with integral and Gaussian function.

Screenshot



5 DisplayMathematicsEquation.tex - Numbered Equations

```

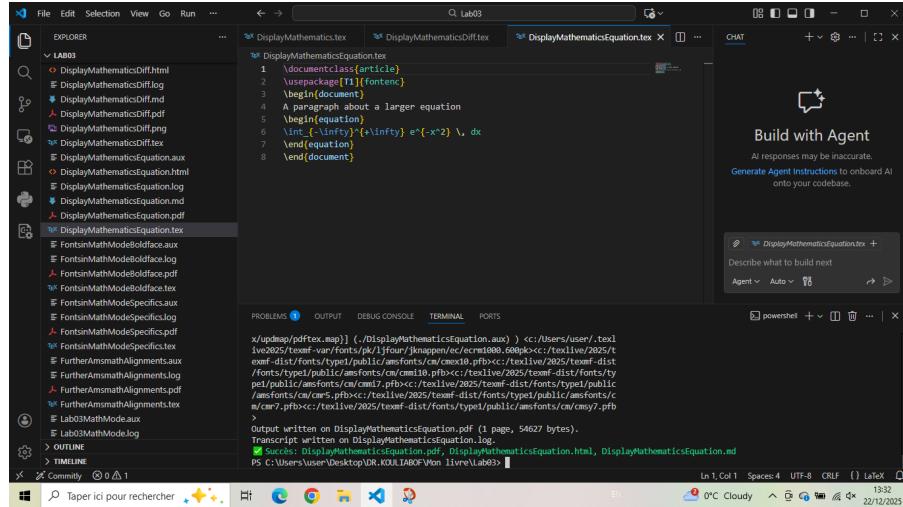
\documentclass{article}
\usepackage[T1]{fontenc}
\begin{document}
A paragraph about a larger equation
\begin{equation}
\int_{-\infty}^{+\infty} e^{-x^2} \, dx
\end{equation}
\end{document}

```

Generated figure

Numbered equation using `equation` environment.

Screenshot



6 DisplayMathematicsDiff.tex - Custom Differential

```

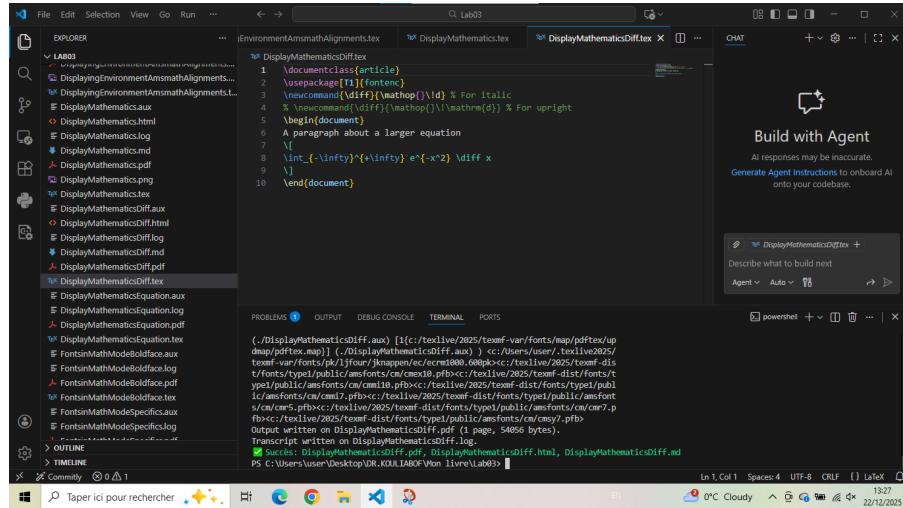
\documentclass{article}
\usepackage[T1]{fontenc}
\newcommand{\diff}{\mathop{}\!\mathrm{d}} % For italic
% \newcommand{\diff}{\mathop{}\!\mathrm{d}\mathrm{r}} % For upright
\begin{document}
A paragraph about a larger equation
\[
\int_{-\infty}^{+\infty} e^{-x^2} \, \mathrm{d}x
\]
\end{document}

```

Generated figure

Custom differential command for better spacing.

Screenshot



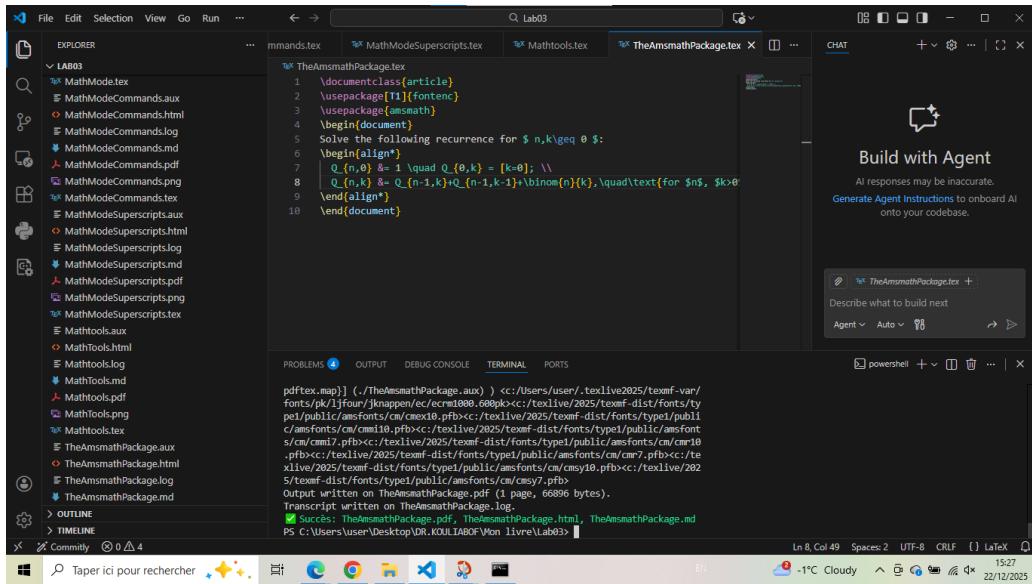
7 TheAmsmathPackage.tex - AMS Math Package Introduction

```
\documentclass{article}
\usepackage[T1]{fontenc}
\usepackage{amsmath}
\begin{document}
Solve the following recurrence for  $n, k \geq 0$  :
\begin{align*}
Q_{n,0} &\leq 1 \quad Q_{0,k} = [k=0]; \\
Q_{n,k} &= Q_{n-1,k} + Q_{n-1,k-1} + \binom{n}{k}, \quad \text{for } n \geq 1, k > 0.
\end{align*}
\end{document}
```

Generated figure

AMS align environment for multi-line equations.

Screenshot



8 TheAmsmathPackageMatrices.tex - AMS Matrices

```
\documentclass{article}
\usepackage[T1]{fontenc}
\usepackage{amsmath}
\begin{document}
AMS matrices.

```

```

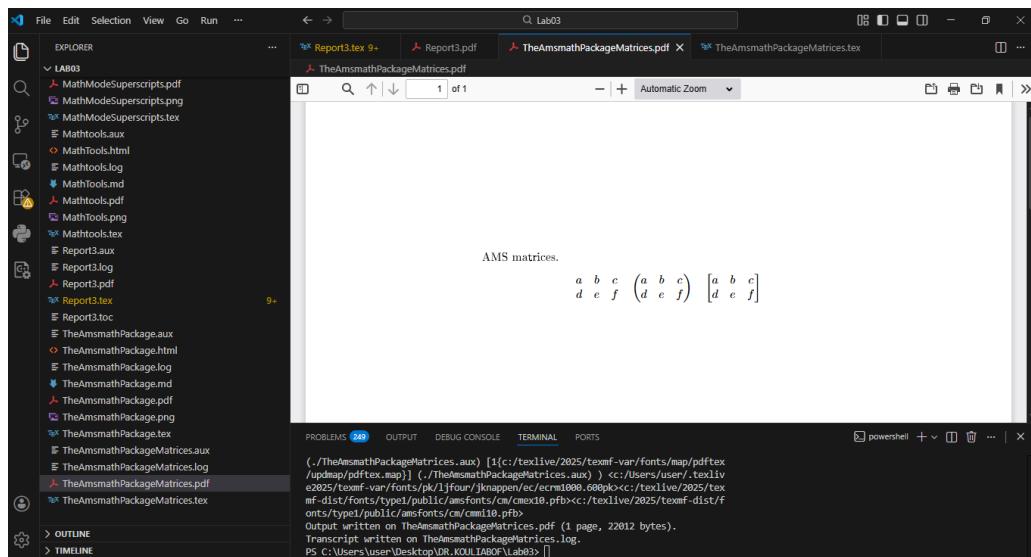
\[
\begin{matrix}
a & b & c \\
d & e & f
\end{matrix}
\quad
\begin{pmatrix}
a & b & c \\
d & e & f
\end{pmatrix}
\quad
\begin{bmatrix}
a & b & c \\
d & e & f
\end{bmatrix}
\]
\end{document}

```

Generated figure

Different matrix environments from amsmath.

Screenshot



9 Columns in Math Alignments.tex - Column Alignments

```

\documentclass{article}
\usepackage[T1]{fontenc}
\usepackage{amsmath}
\begin{document}
Aligned equations
\begin{align*}

```

```

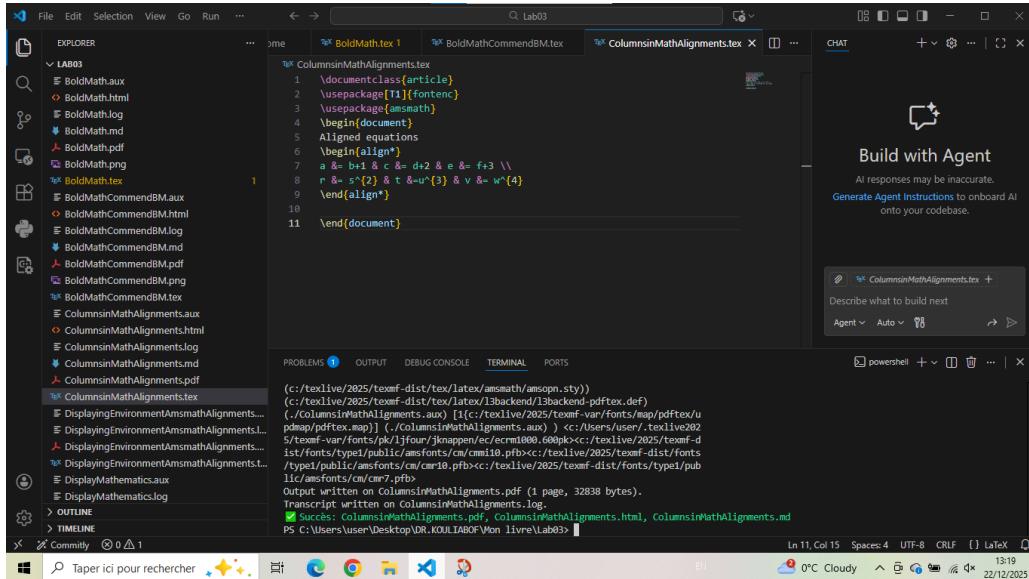
a &= b+1 & c &= d+2 & e &= f+3 \\
r &= s^{2} & t &=u^{3} & v &= w^{4}
\end{aligned*}
\end{document}

```

Generated figure

Multiple columns in align environment.

Screenshot



10 DisplayingEnvironmentAmsmathAlignments.tex - Aligned Subenvironment

```

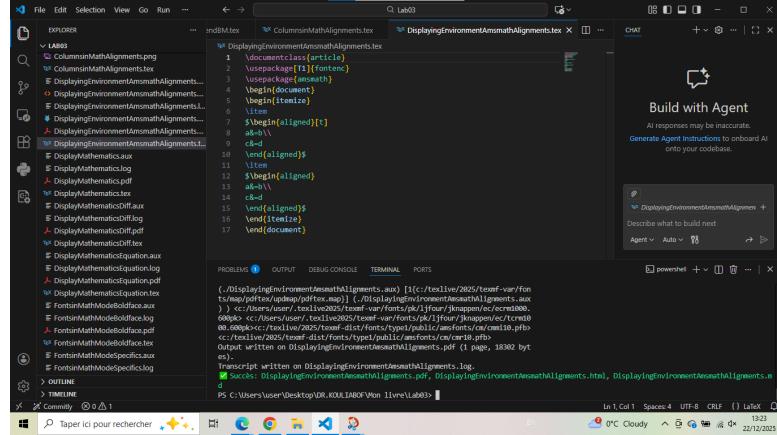
\documentclass{article}
\usepackage[T1]{fontenc}
\usepackage{amsmath}
\begin{document}
\begin{itemize}
\item
\$ \begin{aligned}[t]
a&=b \\
c&=d
\end{aligned} \\
\item
\$ \begin{aligned}
a&=b \\
c&=d
\end{aligned}
\end{itemize}
\end{document}

```

Generated figure

Aligned subenvironment with vertical positioning.

Screenshot



11 FurtherAmsmathAlignments.tex - Gather and Multline

```
\documentclass[a4paper]{article}
\usepackage[T1]{fontenc}
\usepackage{amsmath}
\begin{document}
Gather
\begin{gather}
P(x)=ax^{\{5\}}+bx^{\{4\}}+cx^{\{3\}}+dx^{\{2\}}+ex+f\\
x^{\{2\}}+x=10
\end{gather}
Multline
\begin{multline*}
(a+b+c+d)x^{\{5\}}+(b+c+d+e)x^{\{4\}} \\
+(c+d+e+f)x^{\{3\}}+(d+e+f+a)x^{\{2\}}+(e+f+a+b)x \\
+f+a+b+c
\end{multline*}
\end{document}
```

Generated figure

Gather and multiline environments for multi-line equations.

Screenshot

The screenshot shows a LaTeX editor interface with several files listed in the Explorer pane. The current file is `FurtherAmsmathAlignments.tex`, which contains the following code:

```
\documentclass[a4paper]{article}
\usepackage[T1]{fontenc}
\usepackage{amsmath}
\begin{document}
\gather
\begin{gather}
F(x)=ax^5+bx^4+cx^3+dx^2+ex+f \\
x^2>x^{10}
\end{gather}
\end{gather}
\begin{multline}
(a+b+c)x^5+(b+c+d)e)x^4 \\
+c(d+e+f)x^3+(d+e+f)a)x^2+(e+f+a)b)x \\
+f+(a+b+c)
\end{multline}
\end{document}
```

The editor interface includes tabs for PROBLEMS, OUTPUT, DEBUG CONSOLE, TERMINAL, and PORTS. Below the code, the terminal output shows the command run and its results:

```
(c:/texlive/2025/texmf-dist/tex/latex/amsmath/amsopn.sty)
(c:/texlive/2025/texmf-dist/tex/latex/l3backend/l3backend-pdftricks.def)
(/FurtherAmsmathAlignments.aux) [1/c:/texlive/2025/texmf-var/fonts/map/pdftricks/
update/pdftricks.map] (/FurtherAmsmathAlignments.aux ) <> /users/user/.texlive2
025/texmf-var/fonts/pk/jfjfrun/ec/ecrata000.600pk<> /texlive/2025/texmf-
dist/fonts/type1/public/amsfonts/cm/cmr10.pfb<> /texlive/2025/texmf-dist/fonts/type1/p
ublic/amsfonts/cm/cmr7.pfb
Output written on FurtherAmsmathAlignments.pdf (1 page, 32319 bytes).
Transcript written on FurtherAmsmathAlignments.log.
✓ Success: FurtherAmsmathAlignments.pdf, FurtherAmsmathAlignments.html, FurtherAmsmathAlignments.md
```

The status bar at the bottom right shows the date as 22/12/2025.

12 BoldMath.tex - Bold Mathematics

```

\documentclass[a4paper]{article}
\usepackage[T1]{fontenc}

\begin{document}

$(x+y)(x-y)=x^2-y^2$ \\

{\boldmath $(x+y)(x-y)=x^2-y^2$} $\pi r^2$ \\

$(x+\mathbf{y})(x-\mathbf{y})=x^2-\mathbf{y}^2$ \\

$\mathbf{\pi} r^2$ % bad use of \mathbf

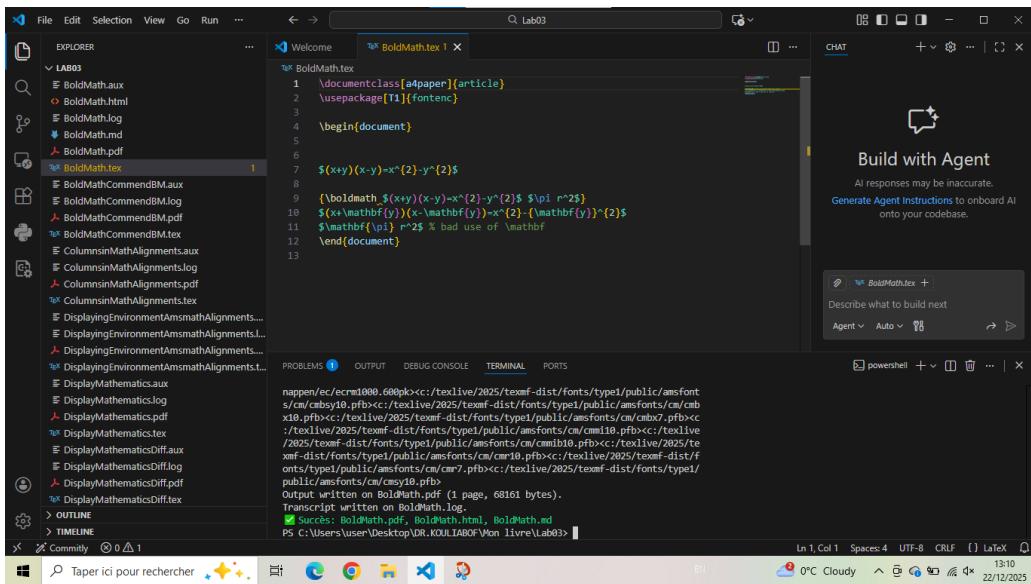
\end{document}

```

Generated figure

Bold math using `\boldsymbol` and `\mathbf`.

Screenshot



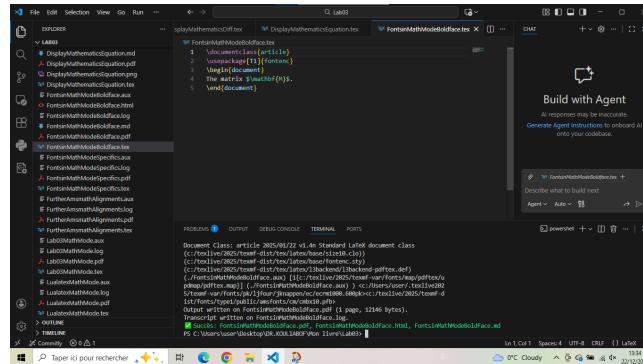
13 Fonts in Math Mode Boldface.tex - Boldface in Math

```
\documentclass{article}
\usepackage[T1]{fontenc}
\begin{document}
The matrix $\mathbf{M}$.
\end{document}
```

Generated figure

Bold math symbols.

Screenshot



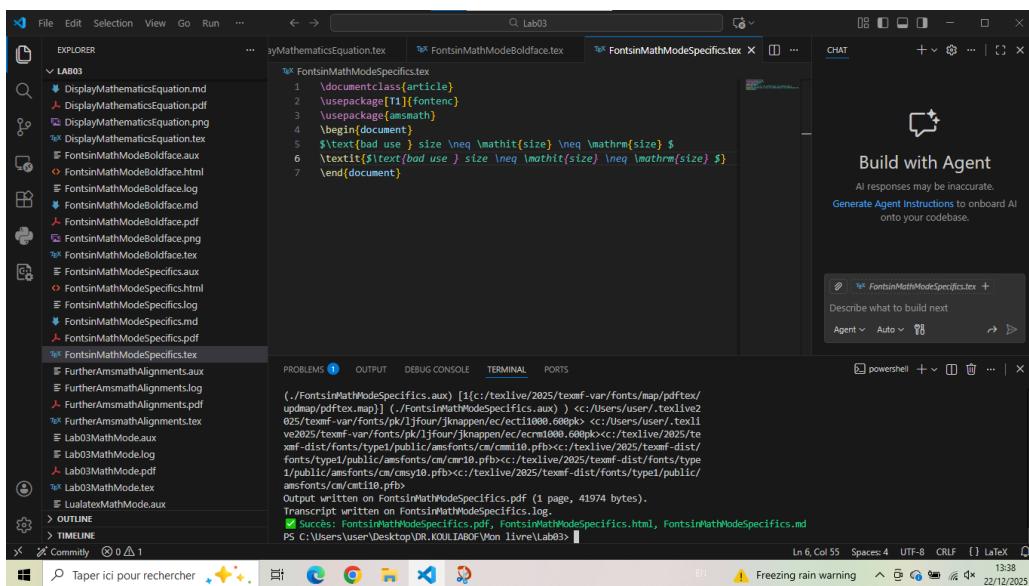
14 Fonts in Math Mode Specifics.tex - Math Font Specifics

```
\documentclass{article}
\usepackage[T1]{fontenc}
\usepackage{amsmath}
\begin{document}
$ \text{bad use } \text{size} \neq \mathit{size} \neq \mathrm{size} $
\textit{$ \text{bad use } \text{size} \neq \mathit{size} \neq \mathrm{size} $}
\end{document}
```

Generated figure

Different math font styles.

Screenshot



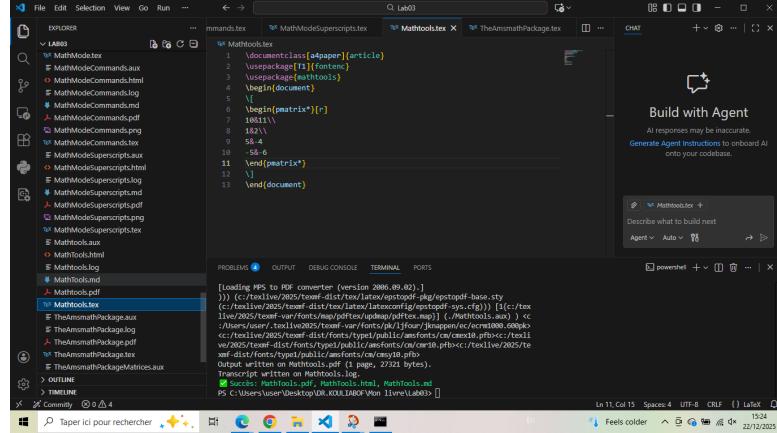
15 Mathtools.tex - Mathtools Package

```
\documentclass[a4paper]{article}
\usepackage[T1]{fontenc}
\usepackage{mathtools}
\begin{document}
\[
\begin{pmatrix*}[r]
1&1\\
1&2\\
5&4\\
-5&-6
\end{pmatrix*}
\]
\end{document}
```

Generated figure

Mathtools package with starred matrix for alignment.

Screenshot



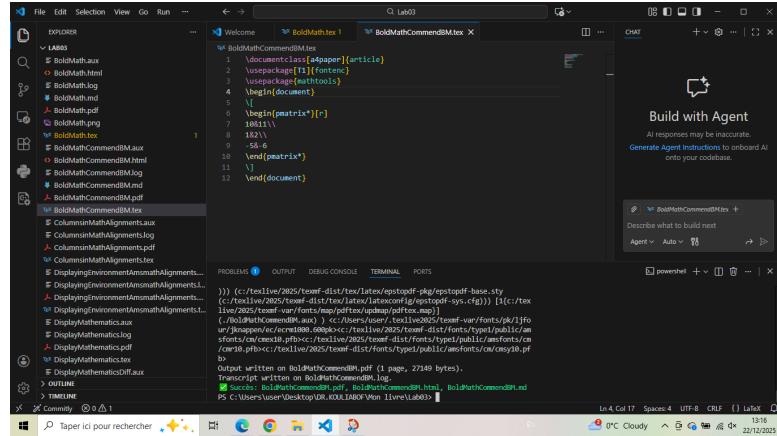
16 BoldMathCommandBM.tex - pmatrix* Environment

```
\documentclass[a4paper]{article}
\usepackage[T1]{fontenc}
\usepackage{mathtools}
\begin{document}
\begin{pmatrix*}[r]
1&1\\
1&2\\
-5&-6
\end{pmatrix*}
\end{document}
```

Generated figure

Matrix with right-aligned negative numbers.

Screenshot



17 LualatexMathMode.tex - Unicode Math with LuaLaTeX

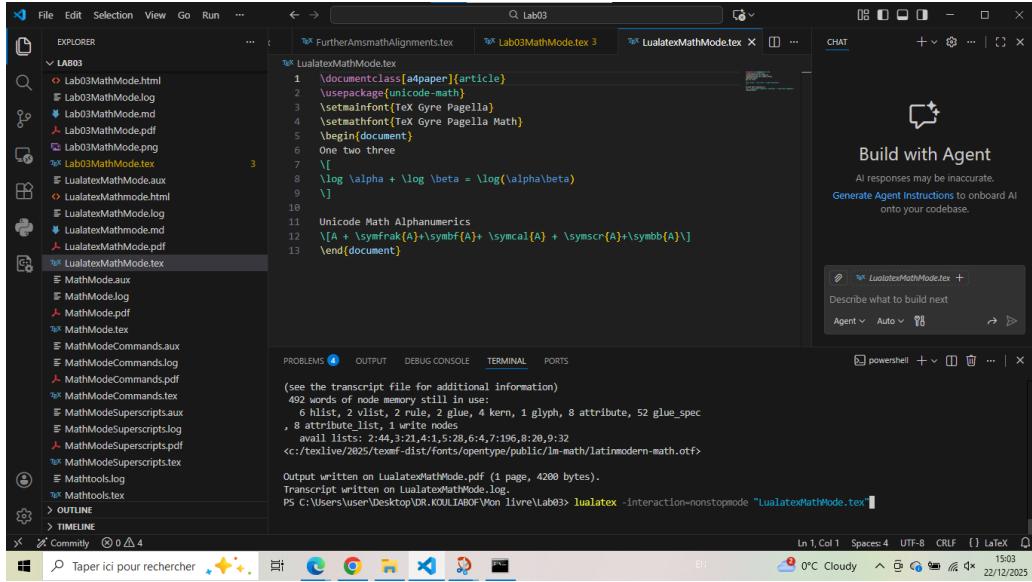
```
\documentclass[a4paper]{article}
\usepackage{unicode-math}
\setmainfont{TeX Gyre Pagella}
\setmathfont{TeX Gyre Pagella Math}
\begin{document}
One two three
\[
\log \alpha + \log \beta = \log(\alpha\beta)
\]
```

```
Unicode Math Alphanumerics
\[A + \symfrak{A}+\symbf{A}+ \symcal{A} + \symscr{A}+\symbb{A}\]
\end{document}
```

Generated figure

LuaLaTeX with unicode-math for modern font handling.

Screenshot



18 Lab03MathMode.tex - Comprehensive Lab Examples

```

\documentclass{article}
\usepackage[T1]{fontenc}
\begin{document}
%% 3-1) Math Mode
A sentence with inline mathematics: $y = mx + c$.
A second sentence with inline mathematics: $5^{2}=3^{2}+4^{2}$.

```

```

A second paragraph containing display math.
\[
y = mx + c
\]
See how the paragraph continues after the display.
\end{document}

```

```

\textasciitilde
%% 3-2) Examples where simple super- and subscripts are entered without braces
\usepackage[T1]{fontenc}
\begin{document}
Superscripts $a^{b}$ and subscripts $a_{b}$.
\end{document}

```

```

\textasciitilde
\documentclass[a4paper]{article}
\usepackage[T1]{fontenc}
\usepackage{mathtools}

```

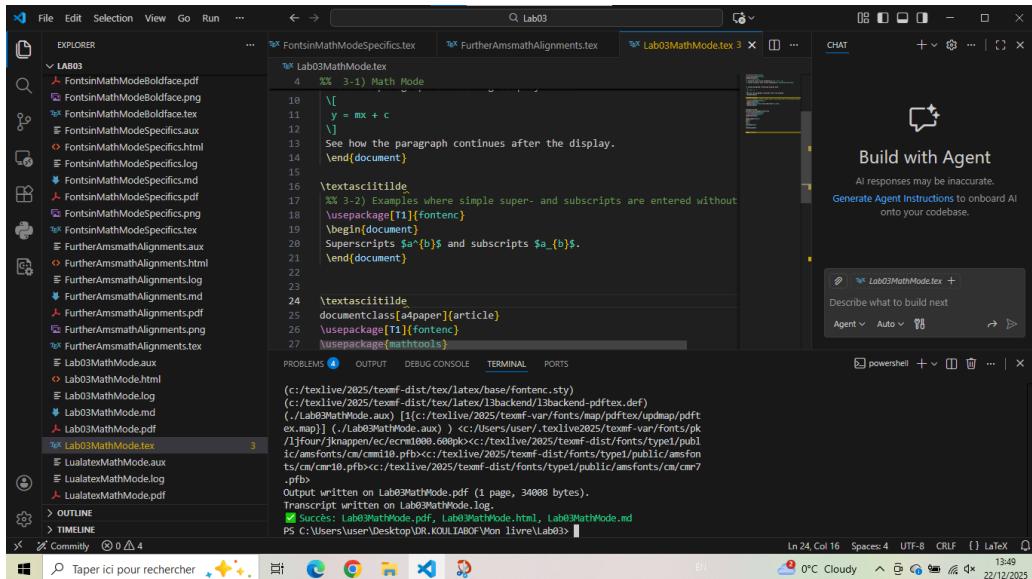
```
\begin{document}
\[
\begin{pmatrix*}[r]
1&11\\
1&2\\
-5&-6
\end{pmatrix*}
\]
\end{document}
```

```
\end{document}
```

Generated figure

Multiple examples combined from laboratory exercises.

Screenshot



Conclusion: Methodology for Mathematical Typesetting

After comprehensive analysis of mathematical mode examples, here is the structured methodology for effective mathematical typesetting in LaTeX:

1. Essential math mode structures

```
% Inline math: $...$ or \(...\)
$E = mc^2$
```

```
% Display math unnumbered: \[...\]
\[
```

```

\int_a^b f(x)\,dx
[]

% Display math numbered: \begin{equation}... \end{equation}
\begin{equation}
\sum_{i=1}^n i = \frac{n(n+1)}{2}
\end{equation}

% Multi-line equations: \begin{align}... \end{align}
\begin{align}
x &= y + z \\
u &= v + w
\end{align}

```

2. Math mode environments comparison

Environment	Package	Purpose
<code>equation</code>	<code>amsmath</code>	Numbered single equation
<code>align</code>	<code>amsmath</code>	Multi-line alignment with multiple columns
<code>gather</code>	<code>amsmath</code>	Multi-line equations without alignment
<code>multiline</code>	<code>amsmath</code>	Single equation split over multiple lines
<code>matrix</code>	<code>amsmath</code>	Unbracketed matrix
<code>pmatrix</code>	<code>amsmath</code>	Matrix with parentheses
<code>bmatrix</code>	<code>amsmath</code>	Matrix with square brackets
<code>pmatrix*</code>	<code>mathtools</code>	Matrix with column alignment options
<code>aligned</code>	<code>amsmath</code>	Subenvironment for blocks within other math

5. Essential practices

Best practices for mathematical typesetting:

1. **Always use math mode for mathematics:** Never use regular text for mathematical symbols
2. **Load amsmath:** It's essential for professional math typesetting
3. **Use appropriate brackets:** For matrices, choose the right bracket style
4. **Be careful with bold:** Use `\mathbf` for variables, `\boldsymbol` for symbols
5. **Differentiate d and e:** Consider upright d for differential, italic e for Euler's number
6. **Align at equals signs:** Use `&` in align environments
7. **Label important equations:** Use `\label` and `\ref` for cross-referencing

Final : Mastering mathematical typesetting is essential for scientific writing. Start with simple inline math, progress to displayed equations, then advance to multi-line alignments and matrices. Always use the appropriate packages (`amsmath`, `mathtools`) and choose the compilation engine that best suits your needs. Well-formatted mathematics enhances readability and professionalism of academic documents.