

# MATLAB Scientific Calculator on Python

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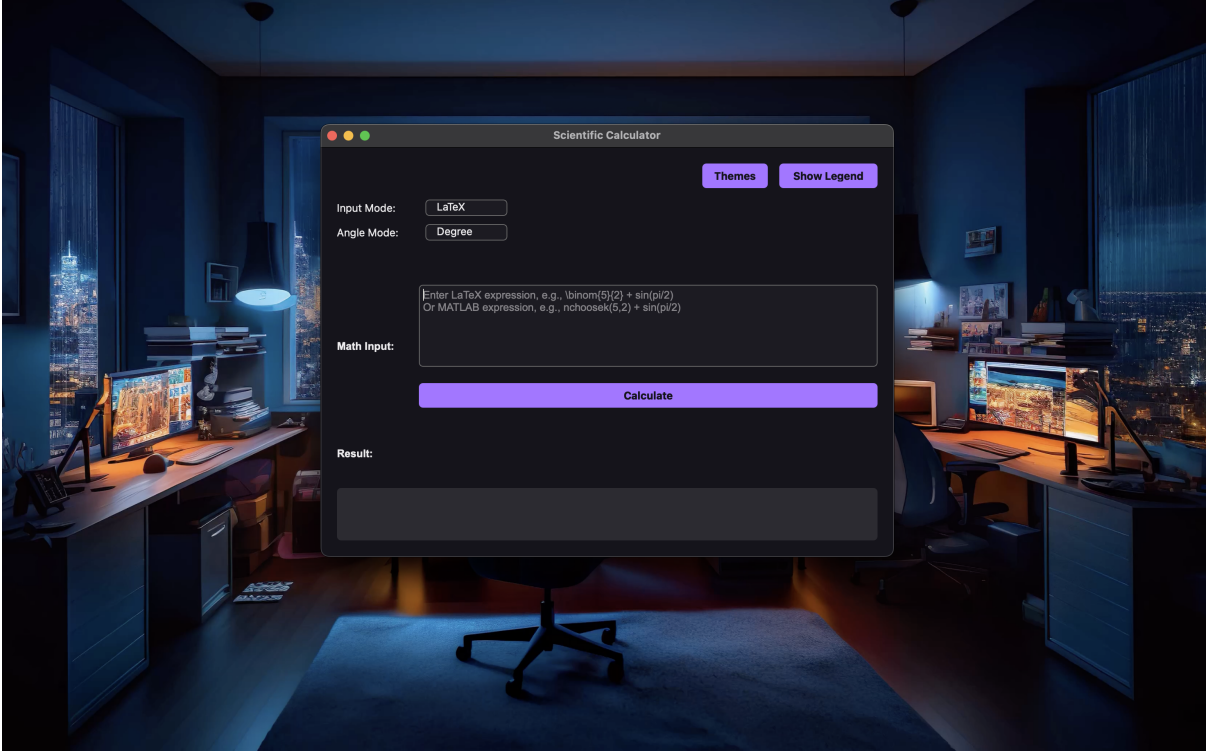


Figure 1: legend img

## 1 Introduction

A PyQt5-based scientific calculator that supports  $\text{\LaTeX}$  input, integrates with MATLAB for symbolic computation, and offers various mathematical functionalities including differentiation, integration, and matrix operations.

### 1.1 Features

- $\text{\LaTeX}$  Input: Enter mathematical expressions in  $\text{\LaTeX}$  format for easy readability and input.
- MATLAB Integration: Utilize MATLAB's symbolic toolbox for advanced computations, ensuring high precision and reliability.
- Trigonometric Functions: Supports both Degree and Radian modes for trigonometric calculations.
- Symbolic Computation: Handle derivatives and integrals symbolically, providing exact results where possible.

- Matrix Operations: Perform operations such as determinant, inverse, eigenvalues, and more on matrices.
- Theming: Multiple UI themes available to customize the appearance of the application.
- Logging: Detailed logging of operations and errors for troubleshooting and analysis.
- Auto Simplify: Automatically simplifies the result of the expression.

## 1.2 Getting Started

1. Clone the Repository:

```
git clone https://github.com/Goge052215/MATLAB-Calculator-on-py.git
```

2. Install Required Fonts:

Thanks for developers of Monospace font family! We are using the font *Monospace Neon* for the UI (partially). You can install the font by running the scripts in **fonts** folder.

So far, there are 2 scripts for following systems:

- Windows
- MacOS

For Linux users, please see the instructions in the GitHub Monospace repository.

3. Install Dependencies:

Ensure you have MATLAB installed and the MATLAB Engine API for Python set up.

```
pip install -r requirements.txt
```

The requirement list is in **requirements.txt**

4. Run the Application:

```
python main.py
```

## 1.3 Usage

1. Select Input Mode:

- $\text{\LaTeX}$ : Enter expressions in  $\text{\LaTeX}$  format for symbolic computation.
- MATLAB: Enter raw MATLAB expressions for direct evaluation.
- Matrix: Perform matrix operations (e.g., determinant, inverse).

2. Select Angle Mode:

- Degree: Use degree mode for trigonometric functions.
- Radian: Use radian mode for trigonometric functions.

3. Enter Expression:

- In the input field, type your mathematical expression.

4. Calculate:

- Click the “Calculate” button to evaluate the expression.

5. View Result:

- The result will be displayed below the calculate button.

## 1.4 Example Expressions

- Simplified L<sup>A</sup>T<sub>E</sub>X Mode:

- Differentiation: `d/dx (x^2)`, `d2/dx2 (x^2)`, etc.
- Integration: `int e^(x) dx`, `int ln(x) dx`, `int x^2 dx`, etc.
- Trigonometric: `sin(30)`, `cos(30)`, `tan(30)`, etc.

- MATLAB Mode:

- Differentiation: `diff(x^2, x)`, `diff(x^2, x, 2)`, etc.
- Integration: `int (exp(x), x)`, `int (ln(x), x)`, `int (x^2, x)`, etc.
- Trigonometric: `sin (30)`, `cos (30)`, `tan (30)`, etc.

*Note:* Simplified L<sup>A</sup>T<sub>E</sub>X input is recommended, for a guide of simplified L<sup>A</sup>T<sub>E</sub>X input, see the table below:

L <sup>A</sup> T <sub>E</sub> X	Previous L <sup>A</sup> T <sub>E</sub> X Command	Simplified L <sup>A</sup> T <sub>E</sub> X Input
$\frac{d}{dx}(f(x))$	<code>\frac{d}{dx} (f(x))</code>	<code>d/dx (f(x))</code>
$\frac{d^n}{dx^n}(f(x))$	<code>\frac{d^n}{dx^n} (f(x))</code>	<code>dn/dxn (f(x))</code>
$\int e^x dx$	<code>\int e^x dx</code>	<code>int e^x dx</code>
$\int_a^b f(x) dx$	<code>\int_{a}^{b} f(x) dx</code>	<code>int (a to b) f(x) dx</code>
$\sin, \cos, \tan, \dots$	<code>\sin, \cos, \tan, \dots</code>	<code>sin, cos, tan, \dots</code>
$\binom{n}{r}$ or ${}^nC_r$	<code>\binom{n}{r}</code>	<code>binom(n, r)</code>
$\sqrt{x}$	<code>\sqrt{x}</code>	<code>sqrt(x)</code>
$ x $	<code>\abs{x}</code>	<code>abs(x)</code>
$\ln(x)$	<code>\ln(x)</code>	<code>ln(x)</code>
$\log_{10}(x)$	<code>\log_{10}(x)</code>	<code>log10(x)</code>
$\log_n(x)$	<code>\log_{n}(x)</code>	<code>logn(x)</code>
$\alpha, \beta, \gamma, \dots$	<code>\alpha, \beta, \gamma, \dots</code>	<code>alpha, beta, gamma, \dots</code>
$\sum_{i=a}^{b-a} f(x_i)$	<code>\sum_{i = a}^{b-a} f(x_i)</code>	<code>sum (a to b) f(x)</code>
$\prod_{i=a}^{b-a} f(x_i)$	<code>\prod_{i = a}^{b-a} f(x_i)</code>	<code>prod (a to b) f(x)</code>
$\lim_{x \rightarrow a} f(x)$	<code>\lim_{x \to a} f(x)</code>	<code>lim x to a f(x)</code>
$\infty$	<code>\infty</code>	<code>infty</code>

for more shortcuts, see `shortcut.py`

### 1.4.1 Example for L<sup>A</sup>T<sub>E</sub>X Mode

1. `int 1/x dx`  $\rightarrow \int \frac{1}{x} dx = \ln(x)$
2. `int (1 to 3) x^3/(x^2 + 1) dx`  $\rightarrow \int_1^3 \frac{x^3}{x^2 + 1} dx = 4 - \left(\frac{\ln 5}{2}\right)$
3. `d2/dx2 (4x^10)`  $\rightarrow \frac{d^2}{dx^2}(4x^{10}) = 320x^8$
4. `binom(5, 2)`  $\rightarrow \binom{5}{2} = 10$
5. `tan(90)` or `tan(pi/2)`  $\rightarrow \tan(90) = \infty$
6. `sum (1 to 100) x`  $\rightarrow \sum_{i=1}^{100} x = 5050$
7. `prod (2 to 10) ln(x)`  $\rightarrow \prod_{i=2}^{10} \ln(x) = 0.0342529$

### 1.4.2 Example for Matrix Mode

1. (Determinant Mode) `[1 2; 3 4]`

$$\begin{vmatrix} 1 & 2 \\ 3 & 4 \end{vmatrix} = -2$$

2. (Inverse Mode) `[1 2; 3 4]`

$$\begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix}^{-1} = \begin{pmatrix} -2 & 1 \\ 1.5 & -0.5 \end{pmatrix}$$

3. (Eigenvalues Mode) `[1 2; 3 4]`

$$\begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix} \rightarrow \begin{pmatrix} -0.37 & 0.00 \\ 0.00 & 5.37 \end{pmatrix}$$

Output: [-0.37, 5.37]

4. (Rank Mode) `[1 2; 3 4]`

$$\begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix} \rightarrow 2$$

Output: 2

## 1.5 Troubleshooting

- **MATLAB Engine Not Starting:**

- Ensure that MATLAB is installed on your system.
- Verify that the MATLAB Engine API for Python is correctly installed.
- Check environment variables and MATLAB's path settings.

- **Invalid Expression Errors:**

- Ensure that your  $\text{\LaTeX}$  or MATLAB expressions are correctly formatted.
- Verify that all necessary functions are supported and properly replaced.

### 1.5.1 Current TODO

- ☐ Fixing the limits handling
- ☐ Fixing the expression handling for  ${}^nC_r$
- ☐ Fixing the series evaluation

## 1.6 Contributing

Contributions are welcome! Please open an issue or submit a pull request for any enhancements or bug fixes.

## 1.7 License

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