# MATLAB Scientific Calculator on Python

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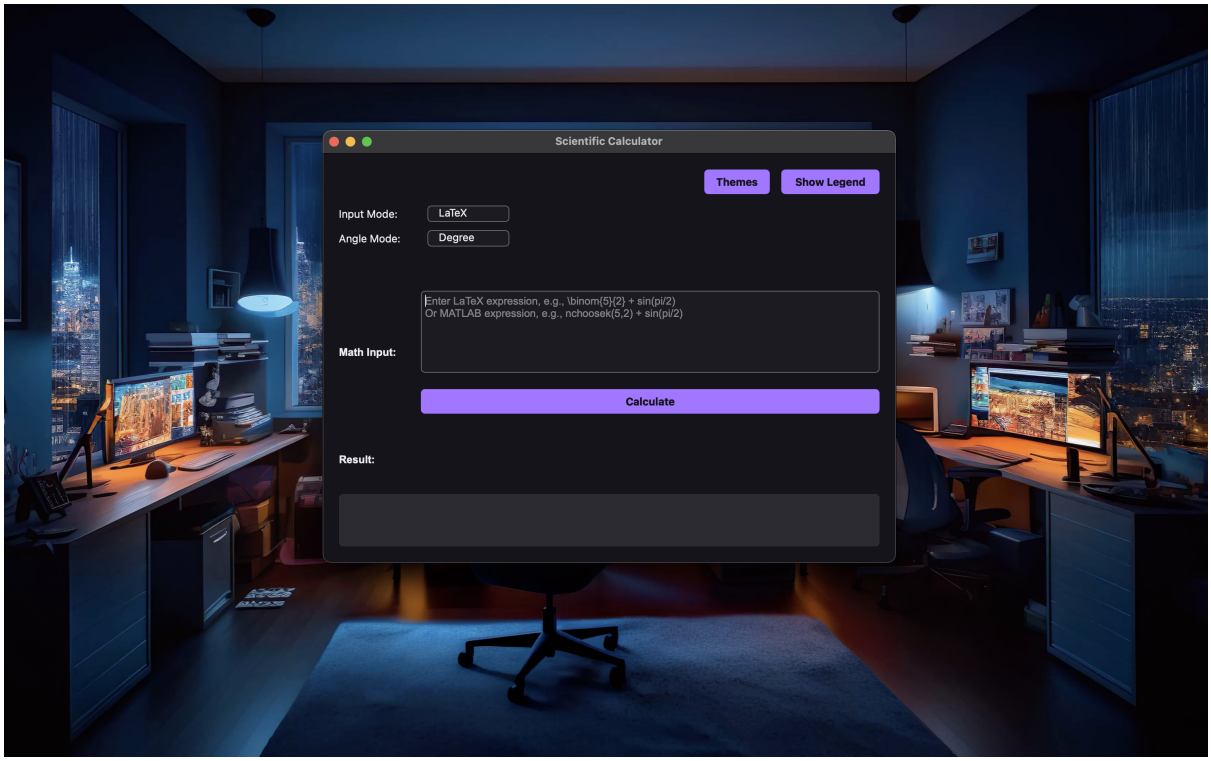


Figure 1: legend img

## 1 Introduction

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

### 1.1 Features

- LaTeX Input: Enter mathematical expressions in 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 Monaspace font family! We are using the font *Monaspace 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 Monaspace 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:

   - LaTeX: Enter expressions in 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 LaTeX 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 LaTeX input is recommended, for a guide of simplified LaTeX input, see the table below:

| LaTeX | Previous LaTeX Command | Simplified LaTeX Input |
|---|---|---|
| $\frac{\mathrm{d}}{\mathrm{d}x}(f(x))$ | `\frac{d}{dx} (f(x))` | `d/dx (f(x))` |
| $\frac{\mathrm{d}^n}{\mathrm{d}^n x}(f(x))$ | `\frac{d^n}{dx^n} (f(x))` | `dn/dxn (f(x))` |
| $\int e^x \, \mathrm{d}x$ | `\int e^{x} dx` | `int e^x dx` |
| $\int_a^b f(x) \, \mathrm{d}x$ | `\int_{a}^{b} f(x) dx` | `int (a to b) f(x) dx` |
| $\sin, \cos, \tan, \ldots$ | `\sin, \cos, \tan, ...` | `sin, cos, tan, ...` |
| $\binom{n}{r}$ or ${}^n\mathrm{C}_r$ | `\binom{n}{r}` | `binom(n, r)` |
| $\sqrt{x}$ | `\sqrt{x}` | `sqrt(x)` |
| $\lvert x \rvert$ | `\abs{x}` | `abs(x)` |
| $\ln(x)$ | `\ln(x)` | `ln(x)` |
| $\log_{10}(x)$ | `\log_{10}(x)` | `log10(x)` |
| $\log_n(x)$ | `\log_{n}(x)` | `logn(x)` |
| $\alpha, \beta, \gamma, \ldots$ | `\alpha, \beta, \gamma, ...` | `alpha, beta, gamma, ...` |
| $\sum_{i=a}^{b-a} f(x_i)$ | `\sum_{i = a}^{b-a} f(x_i)` | `sum (a to b) f(x)` |
| $\prod_{i=a}^{b-a} f(x_i)$ | `\prod_{i = a}^{b-a} f(x_i)` | `prod (a to b) f(x)` |
| $\lim_{x \to a} f(x)$ | `\lim_{x \to a} f(x)` | `lim x to a f(x)` |
| $\infty$ | `\infty` | `infty` |

for more shortcuts, see shortcut.py

### 1.4.1 Example for LaTeX Mode

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

### 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 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 ${}^{n}\mathrm{C}_{r}$
- ☐ 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

MIT License