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## **PROJECT REPORT ON “MATH SOLVER”**

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## **INTRODUCTION**

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Mathematical calculations are fundamental to Engineering, Science, and Academics. Performing long operations manually, such as solving system of equation, find inverse of a matrix, or doing statistical measures, can be very time-consuming and sometimes even prone to error.

This project aims to create an “All-in-one” Math Solver that acts as a multi-purpose math solving algorithm. It provides users with a single tool that can perform a wide variety of calculations, from Basic Calculations to Algebra and Statistics, quickly and accurately.

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## **PROBLEM STATEMENT**

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We as a human often face difficulty in performing complex or repetitive calculations manually. Therefore, we may need different software that can be used for different tasks.

To solve this, a centralized program is required that performs a wide range of tasks, quickly and accurately, with easy-to-use menu, that doesn't confuse us or make us memorize complex formulae.

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## **SCOPE**

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This program supports 9 types of Math Problems -

- Basic Calculation (Addition, Subtraction, Multiplication, Division, and Exponential)
- Quadratic Equation Solver
- Two Linear Equation with Two Variables Solver
- LCM and HCF Calculation
- Prime Number Verifier and Prime Factor Calculator
- Statistical Calculations (Mean, Median, Mode)
- Area and Perimeter Calculator (Square, Rectangle, Circle, Triangle, Parallelogram)
- Factorial Calculator
- Matrix Operations (Addition, Multiplication, and Inverse)

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## **FUNCTIONAL REQUIREMENTS**

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- Perform basic arithmetic on two numbers
- Calculate the roots of a quadratic equation
- Solve for the value of ' $x$ ' and ' $y$ ' in a system of two linear equation
- Calculate the LCM and HCF of two integers
- Verify if a number is prime or not, and find a number's prime factors.
- Calculate the mean, median, mode of a user-provided dataset
- Calculate the area and perimeter of various 2D shapes
- Calculate the factorial of a number
- Perform 2x2 or 3x3 matrix addition, multiplication, and inversion
- Display various menu that helps in navigating

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## NON-FUNCTIONAL REQUIREMENTS

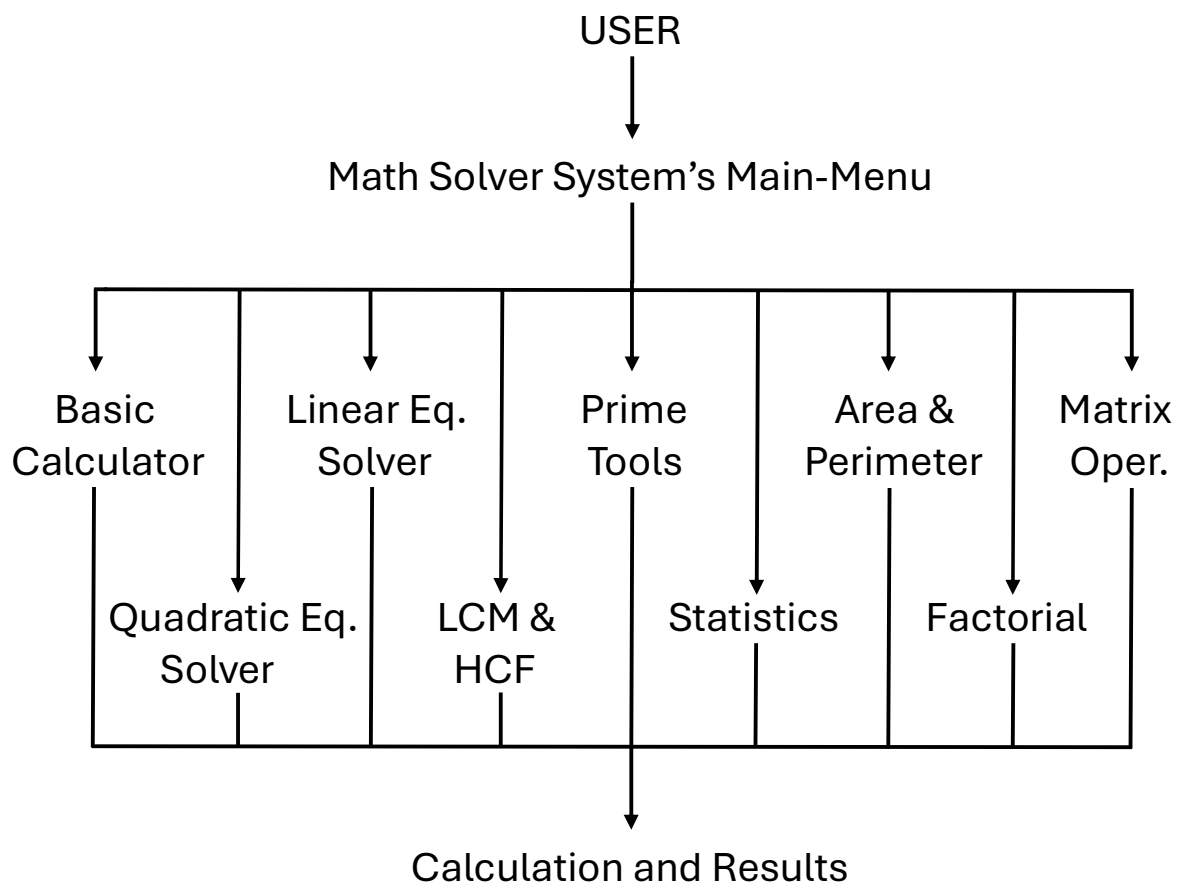
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- Usability: Easy navigation through a clear, menu-driven system
- Accuracy: Exact formulae and reliable library function (from math and NumPy)
- Performance: All calculations should provide an immediate response
- Error Handling: Warns from invalid menu inputs, division by zero, singular matrices, and other Mathematical Impossibilities

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## WORKFLOW DIAGRAM

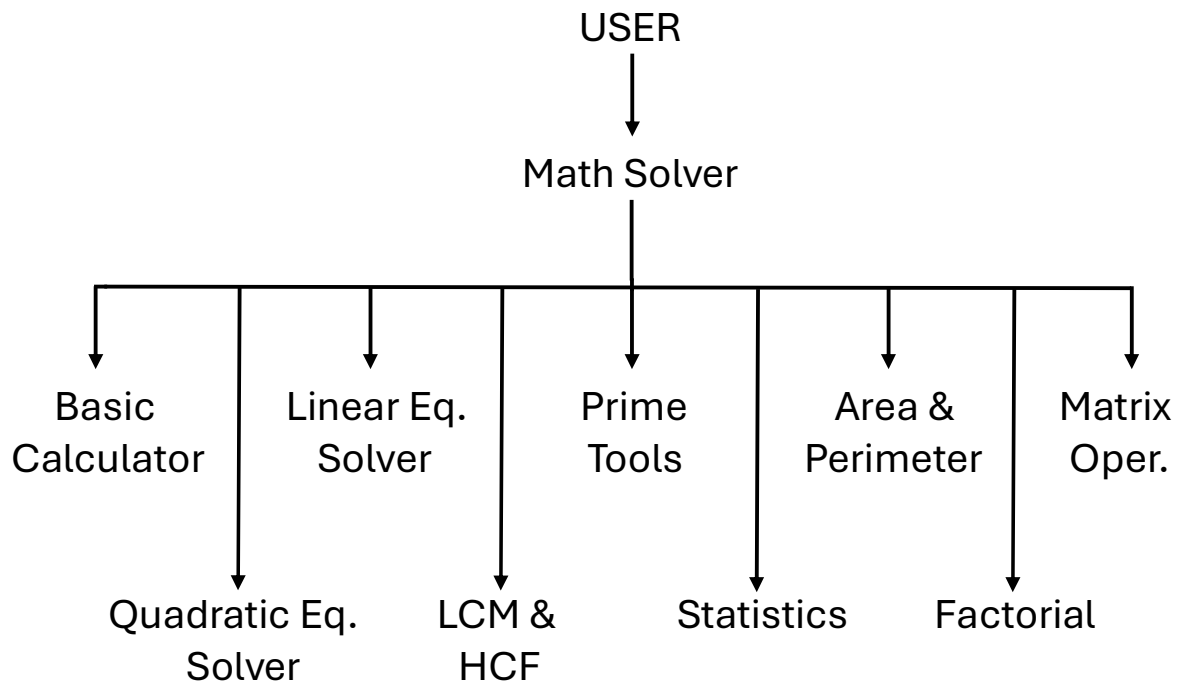
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## USE-CASE DIAGRAM

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## IMPLEMENTATION

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This program uses Python and uses –

- `import math` for advanced math functions (e.g., `math.sqrt`)
- `import numpy as np` for all matrix-related operations (in our use case, creation, addition, multiplication, inversion, and determinant)
- `input()` for all user interaction and value entry
- A primary `while True` loop for continuous usage and to keep the main-menu active
- Extensive usage of `if/elif/else` decision control blocks to navigate the main-menu and sub-menus.
- Nested `while` loops to manage sub-menus (e.g., in Basic Calculation, Quadratic Equation, etc.) and allow the user to perform multiple types of calculation within one feature

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## OUTPUT

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This is a simulated output demonstration of the Quadratic Equation Solver feature

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=== MATH SOLVER ===

What feature do you want to use?
[1] Basic Calculation between Two Numbers
[2] Quadratic Equation Solver
[3] Two Linear Equation with Two Variables
[4] LCM and HCF Calculation of Two Numbers
[5] Prime Number Verifier and Prime Factor Calculator
[6] Statistics
[7] Area and Perimeter Calculator
[8] Factorial Calculator
[9] Matrix Operations
[0] Exit

Please press the number key correspondiang to the feature you want to use: 2

--- Quadratic Equation Solver ---

What do you want to perform?
[1] Finding roots of a Quadratic Equation
[0] Back to Main-Menu

Please press the number key corresponding to the operation you want to perform: 1

You'll be asked for the values of a, b, and c, in a quadratic equation  $ax^2 + bx + c = 0$ 
What is the value of 'a'? 1
What is the value of 'b'? -5
What is the value of 'c'? 6

The roots of the equation are 3.0 and 2.0

Do you want to find another equation's root? [Y/N] N

=== MATH SOLVER ===

What feature do you want to use?
[1] Basic Calculation between Two Numbers
[2] Quadratic Equation Solver
[3] Two Linear Equation with Two Variables
[4] LCM and HCF Calculation of Two Numbers
[5] Prime Number Verifier and Prime Factor Calculator
[6] Statistics
[7] Area and Perimeter Calculator
[8] Factorial Calculator
[9] Matrix Operations
[0] Exit

Please press the number key correspondiang to the feature you want to use: 0
Thank You using The Math Solver!
Press any key to close this Window...|
```

## TESTING

TEST CASE	INPUT	EXPECTED VALUE	RESULT
Invalid Menu Input Precaution	feature: 15	Invalid Input. Please input numbers from 1 to 9 only, or 0 to exit	PASSED
Basic Calculator's Division Function	feature: 1 subFeature: 4 num1: 5 num: 10	The quotient of 5.0 and 10.0 is 0.5	PASSED
Quadratic Equation Solver	feature: 2 subFeature: 1 a: 1 b: -5 c: 6	The roots of the equation are 3.0 and 2.0	PASSED
Linear Equation Solver	feature: 3 subFeature: 1 (a1, b1, c1): (1, 1, 2) (a2, b2, c2): (1, -1, 0)	The value for 'x' is 1.0 and for 'y' is 1.0	PASSED
HCF Caluclation	feature: 4 subFeature: 2 num1: 6 num: 12	The HCF of 6 and 12 is 6	PASSED
Prime Number Verifier	feature: 5 subFeature: 1 num: 13	13 is a Prime Number	PASSED
Statistics	feature: 6 data: [1, 2, 3, 5, 5] subFeature: 1 totalElement: 5	The Mean, Median, and Mode of the Data [1, 2, 3, 5, 5] is '3.2', '3', and '[5]' respectively	PASSED
Area and Perimeter	feature: 7 subFeature: 1 shape: 3 radius: 6	The Area and Perimeter of Circle are 113.09733552923255 and 37.69911184307752 respectively	PASSED
Factorial Calculator	feature: 8 subFeature: 1 num: 21	The factorial of 21 is 51090942171709440000	PASSED
Matrix Operation	feature: 9 subFeature: 3 N: 1 (a, b, c, d): (1, 1, 1, 1)	The matrix is a singular matrix; therefore, inverse cannot be calculated	PASSED

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## CHALLENGES FACED

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- Managing the complexity of many nested `if/else` statement and `while` loops without bugs
- Ensuring all mathematical formulae were implemented correctly
- Integrating and using the numpy library correctly, especially for matrix creation and operation
- Remembering to handle all user input edge cases (e.g., Division by Zero, Value of 'a' being zero in Quadratic Equations, Singular Matrices, etc.)

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## FUTURE ENHANCEMENTS

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- GUI-Based Version,  
Rebuilding the application with a graphical user-interface using Tkinter for better usability
- More Math Problem Compatibility,  
Add more advanced modules, such as a Graphing Calculator, Calculus, and even 3D Geometry
- Save Data,  
Implement a feature to save the history of calculations to a text file
- Accessibility Features,  
Have features that can copy, paste, or even edit calculations



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## CONCLUSION

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This project successfully demonstrates a comprehensive “Math Solver” system using Python. It strengthens basic and advanced programming skills, including logical structuing, menu-dirven design, and integration of external libraries like `numpy`. It provides a useful, all-in-one tool to perform a wide array of Mathematical Calculations.

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## REFERENCES

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- [python.org](https://docs.python.org/3/) Documentation
- [numpy.org](https://docs.scipy.org/doc/numpy/) Documentation
- Class Notes
- VITyarthi's Python Essential Video Tutorials