

SWE 325 Software Construction

Matrix Calculator

Team Members

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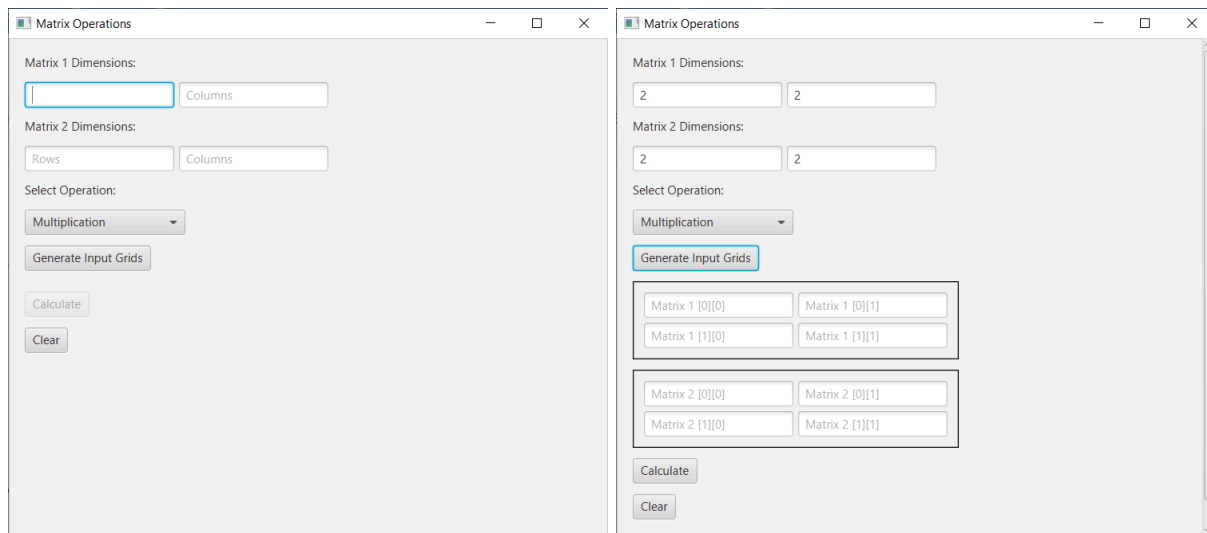
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1. Problem

- Many problems in linear algebra and other related mathematical fields require performing various operations on matrices. These operations tend to be tedious to perform by hand, especially on large matrices. Most calculators don't have support for matrix operations and online calculators require an internet connection. Our goal is to make a calculator that is able to calculate matrix operations.

2. Solution

- We used javaFx to create a GUI that allows users to select an operation and input the dimensions of each operand matrix.
- After the operation and dimensions are selected, clicking the “Generate Input Grids” button, will generate the fields that allow the user to enter the elements for each matrix.



- After the user inputs the values for each matrix, clicking the calculate button will calculate the result of the operation and display it to the user.

The left screenshot shows the 'Matrix Operations' window with 'Multiplication' selected. Matrix 1 dimensions are 2x2, and Matrix 2 dimensions are 2x2. The input grids are populated with values: Matrix 1 has [1, 2; 3, 4] and Matrix 2 has [1, 0; 0, 1]. The result grid shows the product: [1, 2; 3, 4].

The right screenshot shows the same window after clicking 'Calculate'. The result grid now displays the calculated product: [19, 22; 43, 50].

- Some operations don't use two matrices as operands, such as the determinant operation which only uses one matrix or the exponent operation which requires a matrix and a scalar. These operations use the dimensions of matrix 1 for the matrix operand and ignore the dimensions of matrix 2.

The left screenshot shows the 'Matrix Operations' window with 'Determinant' selected. Matrix 1 dimensions are 3x3. The input grid is populated with values: [1, 2, 3; 4, 5, 6; 7, 8, 9]. The result grid shows the determinant: 0.

The right screenshot shows the same window with 'Exponent' selected. Matrix 1 dimensions are 2x2. The input grid is populated with values: [1, 2; 3, 4]. The result grid shows the matrix raised to the power of 3: [37, 54; 81, 118].

- If the user would like to perform another calculation, they can either change the values and click calculate again, click the "Generate Input Grids" button to reset all of the input grids, or click the clear button to clear all fields and reset to the beginning.
- All of the mathematical operations are handled in Java using 2D integer arrays. Unit tests are used to ensure that the computations are returning accurate results.
- All inputs are validated before computations. Meaningful error messages are displayed when input is invalid.

3. Demo

- https://youtu.be/_pvff4Q8tto

4. Lessons Learned

- We learned the importance of developing with modularity in mind from the start, as it allows for greater testability, understandability, and ease of expansion.
- We learned the importance of identifying our scope and features early on in the process, as it would have saved time by not having to rewrite code to add new features.

5. Issues/Bugs Known

- Changing the operation after the input grids are generated can lead to undefined behavior.
- Entering a negative value when raising a matrix to a power results in the matrix being raised to the first power.

6. Future Versions

- Allow users to enter doubles as values.
- Add a convert to Reduced Row Echelon Form operation.
- Add a matrix inverse operation.
- Add a diagonalization operation.
- Add an operation to check if a matrix is orthogonal.
- Add a calculate Eigenvalues operation.
- Add a calculate Eigenvectors operation.
- Add a button to move a calculated matrix to one of the input slots.
- Add the ability to copy/paste entire matrices.

7. References

- <https://www.cuemath.com/algebra/matrix-operations/>

- <https://openjfx.io/openjfx-docs/>
- <https://stackoverflow.com/questions/59909712/how-to-compute-the-determinant-of-a-matrix-in-c-using-recursive-functions>