**Product Requirements Document**

Made by: Mher Baburyan

**Project Information**

This is a C console application project designed to perform a variety of simple matrix operations. The application will permit users to execute addition, subtraction, multiplication, transposition, scalar multiplication, LU factorization, determinant calculation, and row echelon form conversion all under a terminal interface. The tool is designed to provide students, educators, and engineers with a simple and efficient way of working with matrices independent of potentially resource-intensive software or even network access.

**Objectives/Goals**

* Provide a simple and fast way to perform matrix operations.
* Support a variety of linear algebra and some numerical analysis operations.
* Ensure computational accuracy.
* Dynamic memory allocation.

**Assumptions & Constraints**

* Assumptions:

1. The user is familiar with basic matrix terminology, linear algebra and some numerical analysis concepts.
2. The program will be used in a standard console environment.

* Constraints:

1. No GUI, meaning entirely terminal-based application.
2. Only Integers and Floats are supported while complex numbers are not.

**Background & Strategic Fit**

Matrices have a very significant role in science and engineering fields, so operations with them are unavoidable. This project will simplify users' operations with matrices and make them much faster. This project will be an excellent addition to the already existing programs like MATLAB, online web sites and etc.

**Scope**

The users require a program that, apart from simplicity, is highly efficient at making matrix manipulation a less cumbersome task. The program should be capable of performing basic tasks such as addition and subtraction, along with some advanced tasks such as LU factorization, finding the determinant and Row Echelon Form calculation. It would also be highly convenient to have a small program that does not need an internet connection, hence allowing users to easily utilize it from any location without any restrictions.

**Requirements**

* Input two matrices and compute their sum or difference.
* Multiplication of matrices (if dimensions are compatible).
* Transpose a matrix.
* Multiply a matrix by a scalar.
* Compute determinant of a square matrix using Laplace expansion.
* Perform LU factorization of a square matrix.
* Convert a matrix to row echelon form.

**Product Features**

|  |  |  |
| --- | --- | --- |
| Feature | Description | Goal |
| Matrix Addition | Adds two matrices of the same dimensions | Simplify calculation |
| Matrix Subtraction | Subtracts two matrices of same size | Basic linear operations |
| Matrix Multiplication | Multiplies compatible matrices | Perform complex operations |
| Transposition | Transposes a matrix | Used in vector transformations |
| Scalar Multiplication | Multiplies every element by a constant | Scaling operations |
| Determinant | Computes determinant for square matrices | Solving linear equations |
| LU Factorization | Breaks matrix into L and U matrices | Pre-solving linear systems |
| Row Echelon Form | Converts matrix for solving equations | Gaussian elimination |

**Release Criteria**

* Functionality: All listed operations should return correct results.
* Reliability: Should detect and prevent invalid operations (e.g., wrong dimensions).
* Supportability: Code should be clear and modular to allow future upgrades.

**Success Metrics**

* Accurate computations of the features.
* The calculations must be done fairly quick.
* The program must dynamically allocate memory for any size matrix.
* Easy to use.

**Exclusions**

* This program will be purely console-based. No graphical components or windowed applications will be developed.
* Only integers and floats will be supported. Operations on complex number matrices are excluded.