

# Product requirement document

**Software title:** Matrix Calculator

**Background and motivation:** Matrix is one of the fundamental conception in mathematics. As the core content in the linear algebra. It is used in various domains like mathematical modeling, cryptology, chemistry, communication & computer science, etc. It also solve a large amount of practical problems.

## Key functions of this software:

1. Invertible matrix
2. Dot product of matrices
3. Multiple results of a type O matrix
4. Transpose matrix
5. Matrix addition
6. Matrix multiplication
7. The square of matrix
8. Eigenvalue of matrix
9. Eigenvectors of a matrix

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## Algorithm/ scientific methods:

Invertible matrix:  $A^{-1} = \frac{1}{|A|} A^*$ , where  $A^*$  is the accompanying matrix of  $A$

Matrix addition: Matrix addition is defined on two matrices of the same size. The sum of two  $m \times n$  matrices  $A$  and  $B$ , labelled  $A + B$ , is just as much an  $m \times n$  matrix, and the elements within it are the values of their corresponding elements when added together

$$\begin{bmatrix} 1 & 3 \\ 1 & 0 \\ 1 & 2 \end{bmatrix} + \begin{bmatrix} 0 & 0 \\ 7 & 5 \\ 2 & 1 \end{bmatrix} = \begin{bmatrix} 1+0 & 3+0 \\ 1+7 & 0+5 \\ 1+2 & 2+1 \end{bmatrix} = \begin{bmatrix} 1 & 3 \\ 8 & 5 \\ 3 & 3 \end{bmatrix}$$

Matrix multiplication:

$$A = \begin{bmatrix} a_{1,1} & a_{1,2} & a_{1,3} \\ a_{2,1} & a_{2,2} & a_{2,3} \end{bmatrix}$$

$$B = \begin{bmatrix} b_{1,1} & b_{1,2} \\ b_{2,1} & b_{2,2} \\ b_{3,1} & b_{3,2} \end{bmatrix}$$

$$C = AB = \begin{bmatrix} a_{1,1}b_{1,1} + a_{1,2}b_{2,1} + a_{1,3}b_{3,1}, & a_{1,1}b_{1,2} + a_{1,2}b_{2,2} + a_{1,3}b_{3,2} \\ a_{2,1}b_{1,1} + a_{2,2}b_{2,1} + a_{2,3}b_{3,1}, & a_{2,1}b_{1,2} + a_{2,2}b_{2,2} + a_{2,3}b_{3,2} \end{bmatrix}$$

Transpose matrix: Let A be a matrix of order  $m \times n$  (i.e., m rows and n. columns), replace the rows of the  $m \times n$  matrix A with columns of the same order to obtain an  $n \times m$  matrix, this matrix is called the transpose matrix of A

$$A = \begin{bmatrix} 1 & 2 & 0 \\ 3 & -1 & 4 \end{bmatrix}$$

$$A^T = \begin{bmatrix} 1 & 3 \\ 2 & -1 \\ 0 & 4 \end{bmatrix}$$

Eigenvalue of matrix: Let A be a square matrix of order n. If there exists a number m and a non-zero n-dimensional column vector x such that  $Ax=mx$  holds, then m is said to be a characteristic value or eigenvalue of the matrix A.

Eigenvectors of a matrix: The corresponding eigenvectors can be obtained by solving the eigenequation  $(A - \lambda I) v = 0$ , where v is the eigenvector to be found and I is the unit array

**Similar products in the market:** Desmos

<https://www.desmos.com/matrix?lang=zh-CN>