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| Haseeb Raza **1. Assignment** 24th March 2024  OT7DEE  [ot7dee@inf.elte.hu](mailto:ot7dee@inf.elte.hu)  Group 3 |

**Task 3**

*Implement the N matrix type which contains integers. These are square matrices that can contain nonzero entries only in their first and last column, and in their main diagonal. Don't store the zero entries. Store only the entries that can be nonzero in a sequence. Implement as methods: getting the entry located at index (i, j), adding and multiplying two matrices, and printing the matrix (in a square shape).*

**N Matrix type**

**Set of values**

*{x ∈ Z n∗n | ∀i1∈[1...n]: x[i,1] ≠ 0, ∀in∈[1..n]: x[i,n] ≠ 0}*

**Operations**

1. Getting an entry

*Getting the entry of the i-th column and j-th row (i,j [1..n]): e:=x[i,j].*

*Formally: A: Matrix × ℤ × ℤ × ℤ*

*x i j e*

This operation needs any action only if i=j, otherwise the output is zero.

1. Sum

Sum of two matrices: c:=x+b. The matrices have the same size.

Formally: A = Matrix × Matrix × Matrix

x b c

1. Multiplication

Multiplication of two matrices: c:=x\*b. The matrices have the same size.

Formally: A = Matrix × Matrix × Matrix

x b c

**Representation**

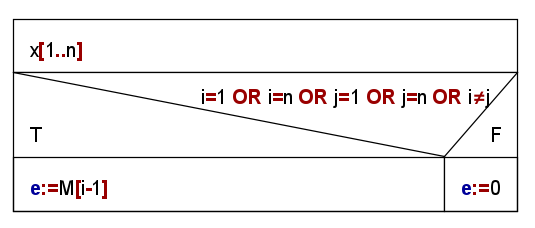
Only the main diagonal and first and last column of the n×n matrix has to be stored. Where M is the diagonal and m is index for row.

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| --- | --- | --- | --- | --- | --- | --- | --- |
| X = | X11 | 0 | 0 | … | X1n | « | *x[i,1] =<x11 x12 x13 x14 x15>*  *x[i,n] =<x1n x2n x3n … xmn>*  *M=<x11 x22 x33 xmn>* |
| X21 | X22 | 0 | … | X2n |
| X31 | 0 | X33 | … | X3n |
| X41 | 0 | 0 | … | … |
| X51 | 0 | 0 | … | Xmn |

**Implementation**

1. **Getting an entry**

*Getting the entry of the ith column and jth row (i,j∈[1..n]) e:=x[i,j] where the matrix is represented by M, 1≤i≤n, and n stands for the size of the matrix can be implemented as*

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1. **Summation**

The sum of matrices x and b (represented by arrays t and u) goes to matrix c (represented by array u), where all of the arrays have to have the same size.

1. **Multiplication**

The product of matrices x and b (represented by arrays t and u) goes to matrix c (represented by array u), where all of the arrays have to have the same size.

**Testing**

Black box testing

Getting entry

* Get the element with the same indexes (X*2,2*)
* Get the element with different indexes (X*2,3*)
* Get the element with index outside the matrix (X*3,4*)

Summation

* Add two 1x1 matrices
* Add two 2x2 matrices
* Add two 3x3 matrices
* Add two different size matrices.

Multiplication

* Multiply two 1x1 matrices
* Multiply two 2x2 matrices
* Multiply two 3 x 3 matrices
* Multiply two different size matrices.

White box testing

1. Catch the exceptions