

Ludwig-Maximilians-Universität München  
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## Data Science & Ethics

– *Microsoft SEAL* –

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### Exercise 1: *Library for Matrix Operations*

Microsoft's *Simple Encrypted Arithmetic Library* (SEAL)<sup>1</sup> is a publicly available homomorphic encryption library. It can be found and downloaded at <http://sealcrypto.codeplex.com/>.

Implement a library `13b_MS-SEAL.h` supporting matrix operations using homomorphic encryption on basis of the MS SEAL.

**due date:** 24.01.2021 (EOB)  
**no. of students:** 2  
**deliverables:** 1. Implemenatation (including source code(s))  
2. Documentation (max. 10 pages)  
3. Presentation (10 – max. 15 minutes)

13b\_MS-SEAL.h

```
#include <float.h>
#include <stdbool.h>

typedef struct {
    double *entries;
    unsigned int width;
    unsigned int height;
} matrix;

/*
Initialize new matrix:
– reserve memory only
*/
matrix initMatrix(unsigned int width, unsigned int height);

/*
Initialize new matrix:
– reserve memory
– set any value to 0
*/
matrix initMatrixZero(unsigned int width, unsigned int height);

/*
Initialize new matrix:
– reserve memory
– set any value to random number
*/
matrix initMatrixRand(unsigned int width, unsigned int height);
```

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<sup>1</sup><https://www.microsoft.com/en-us/research/publication/simple-encrypted-arithmetic-library-seal-v2-0/#>

```

/*
copy a matrix and return its copy
*/
matrix copyMatrix(matrix toCopy);

/*
destroy matrix
- free memory
- set any remaining value to NULL
*/
void freeMatrix(matrix toDestroy);

/*
return entry at position (xPos, yPos), DBLMAX in case of error
*/
double getEntryAt(matrix a, unsigned int xPos, unsigned int yPos);

/*
set entry at position (xPos, yPos)
return true in case of success, false otherwise
*/
bool setEntryAt(matrix a, unsigned int xPos, unsigned int yPos, double value);

/*
print matrix to stdout
*/
void prettyPrint(matrix a);

/*
add two matrices
return:
- result in newly created matrix
- matrix of size 0 in case of error
*/
matrix addMatrix(matrix a, matrix b);

/*
subtract two matrices:
return: "a - b"
- result in newly created matrix
- matrix of size 0 in case of error
*/
matrix subMatrix(matrix a, matrix b);

/*
multiply two matrices
return: "a * b"
- result in newly created matrix
- matrix of size 0 in case of error
*/
matrix multMatrix(matrix a, matrix b);

/*
transpose matrix
return: "a^T"
*/
matrix transposeMatrix(matrix a);

/*
return determinant of matrix, DBLMAX in case of error
*/
double determinante(matrix a); // simple algorithm
double detQuick(matrix a);    // optional: more efficient algorithm

```