Lab Assignment 4
Matrix – Part 1

CS 361 – Principles of Programming Languages I

Fall 2021

In the Labs 4 to 6, we will step by step implement a class to represent a matrix. If you are unaware of matrices, read (for example) the Wikipedia article[1] up to section 3.

Assignment

You are given a header file *matrix.h* declaring a class `Matrix` with various members which are described below. Write a file *matrix.cpp* which implements the class. Do not add any additional public methods. You are, however, allowed to add private methods to avoid redundancy in your code. We will add more members in future labs.

The elements of a matrix are stored in dynamically allocated memory, namely in the private member `long values**` which is used as two-dimensional array. Therefore, when implementing the class, make sure that your implementation handles dynamically allocated memory appropriately. For example, make a copy or delete it if needed.

The Class `Matrix`

Constructors and Destructor

`Matrix()`: Creates an empty matrix of size 0×0.

`Matrix(int size)`: Creates an identity matrix of size `size` $\times$ `size`. That is, the matrix is filled with 0s except for the diagonal which has value 1 everywhere.

`Matrix(int height, int width)`: Creates a matrix of size `height` $\times$ `width` filled with 0s.

`~Matrix()`: Destructor for the matrix. Deletes all allocated memory.

$$\texttt{Matrix}(3) = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \qquad \texttt{Matrix}(3,2) = \begin{bmatrix} 0 & 0 \\ 0 & 0 \\ 0 & 0 \end{bmatrix}$$

Methods

`int getWidth()`, `int getHeight()`: Returns the width or height of the matrix, respectively.

`void resize(int height, int width)`: Changes the size of the matrix to `height` $\times$ `width`. Existing fields keep their value and new fields are set to 0. Note that it changes the matrix and does *not* create a copy.

$$\begin{bmatrix} 1 & 2 \\ 4 & 3 \\ 5 & 6 \end{bmatrix}.\texttt{resize}(2,3) = \begin{bmatrix} 1 & 2 & 0 \\ 4 & 3 & 0 \end{bmatrix}$$

[1] *https://en.wikipedia.org/wiki/Matrix_(mathematics)*

Operators

`long& operator()(int row, int col)`: Returns (a reference to) the value at the specified position in the matrix. The top-left element is at position $(0, 0)$.

Private Members

`int width`, `int height`: Store the width or height of the matrix, respectively.
`long** values`: Stores the elements of the matrix (as two-dimensional array).

Submission

For your submission, upload a single zip-file to canvas. The zip-file should contain

- a file *matrix.cpp* and
- a file *matrix.h* if you added additional private methods.

This is an individual assignment. Therefore, a submission is required from each student.

Deadline: Sunday, October 24, 11:59 pm.