Hands-On for Basic C++ Course – Day 2

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1 Exercises

1.1 Matrices - part II

1.1.1 What's that matrix?

Project - Matrix classification: Once you have defined the matrix class and you have implemented you basic getters and setters member functions, you will have to implement different functions to, let's say, categorize your matrix. You will need to implement the following functions:

1. **function name:** isOnes

   input: -

   output: bool

   Action: Checks whether the matrix is a ones matrix (all elements equal to 1)

2. **function name:** isZero

   input: -

   output: bool

   Action: Checks whether the matrix is a zero matrix (all elements equal to 0)

3. **function name:** isIdentity

   input: -

   output: bool

   Action: Checks whether the matrix is equal to the identity matrix (elements of the main diagonal = 1, the others = 0)

4. **function name:** isSquare

   input: -

   output: bool

   Action: Checks whether the matrix is an square matrix or not.

1.1.2 Performing operations within the matrix class

Project - Performing matrices operations: It is now time to start performing operations with the matrices. You will need to implement the following functions:

1. **function name:** add

   input: matrix, matrix

   output: matrix

   Action: Performs the sum of two matrices.

2. **function name:** subtract

   input: matrix, matrix

   output: matrix

   Action: Performs the differentiation of two matrices.

3. **function name:** multiply

   input: matrix, matrix

   output: matrix

   Action: Performs the multiplication of two matrices.

$$c_{i,j} = \sum_{k=1}^{m} a_{i,k} * b_{k,j}$$

4. **function name:** determinant

   input: -

   output: int

   Action: Calculates the determinant of a matrix by using the Laplace's formula. Laplace's formula expresses the determinant of a matrix in terms of its minors. The minor $M_{i,j}$ is defined to be the determinant of the $(n-1) \times (n-1)$-matrix that results from the matrix by removing the i-th row and the j-th column. The expression $(-1)^{i+j} * M_{i,j}$ is known as a cofactor. The determinant of the is given then by

$$|A| = \sum_{j=1}^{n} (-1)^{i+j} * a_{i,j} * M_{i,j}$$

   Hint: Implementing the determinant of a matrix using the Laplace's formula could be very tough and the best tactic to head this problem directly implies using recursion. Since this is too much for the intents of the course, we will just calculate the determinant of 2×2 or 3×3 matrices.

1.1.3 Handling the errors

One of the highlights of this course is that you learn how to write good code, not just only from the point of view of the functionality, but also from the point of view of the correctness and readability. This implies of course the ability to get rid of unexpected runtime errors and react properly.

Project - Exceptions: We will propose you here to include your *try-catch* blocks and your *throw* statement to completely safe your code.