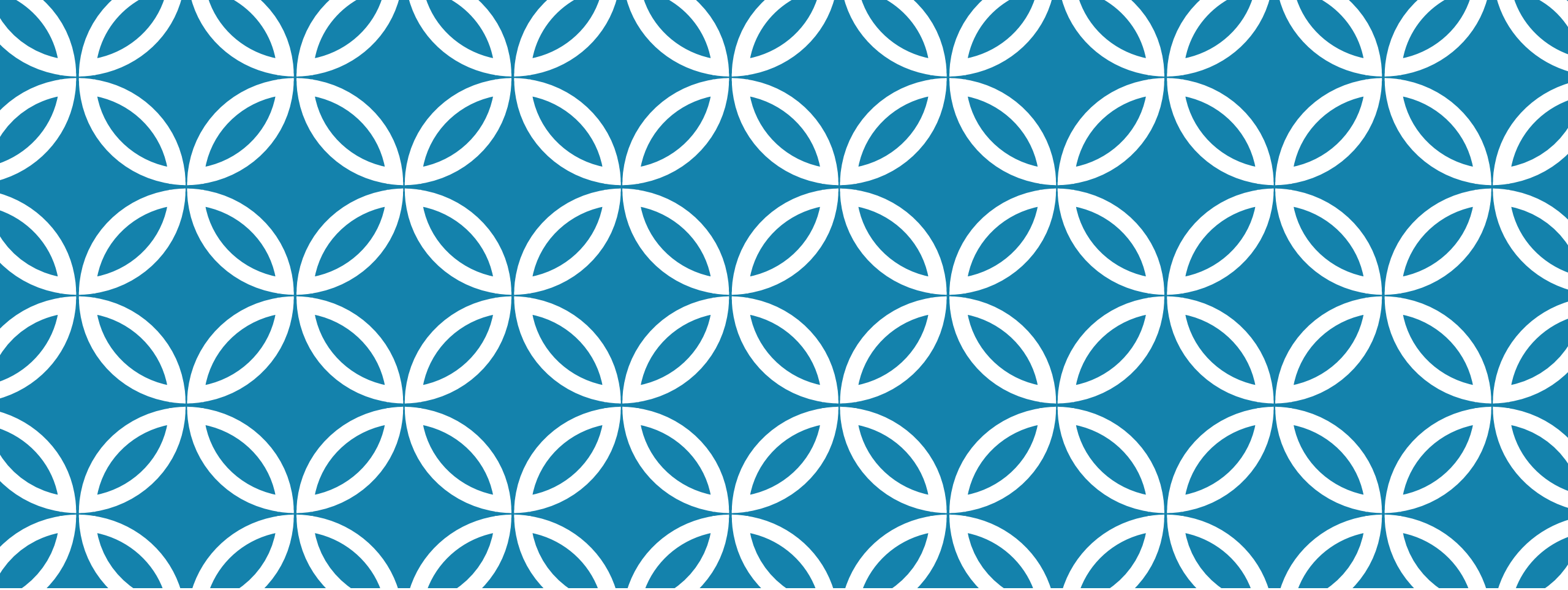


MATRIX ALMOST EXPERT

OOP project by Zuzanna Ławniczak

EXAMPLE

```
MatrixAlmostExpert - a program to perform various operations on matrices by Zuzanna Ławniczak, PUT student.
Your matrix has been added to the memory
21.0 37.0 5.0
4.0 5.0 8.0
2.9 4.7 1.9
Your matrix has been added to the memory
6.0 9.7 4.9
3.6 2.9 1.0
2.3 4.5 5.8
============================================================
                           MENU
1. Create a new matrix
2. Delete a matrix from memory
3. Print all stored matrices
-----------------------------------
4. Add selected matrices
5. Subtract selected matrices
6. Multiply selected matrices
7. Transpose a matrix
8. Multiply a matrix by a number
-----------------------------------
9. Exit
-----------------------------------
Your choice (input an integer):
6
Input the index of the matrix you want to multiply
0
input the index of the matrix you want to multiply by
1
Your matrix has been added to the memory
270.0 332.0 168.0
60.0 88.0 70.0
37.0 49.0 29.0
```

WHAT DOES IT DO?

CLASS UI

```
public class UI {
    public void printUI() {

System.out.println("=================================
====================");
        System.out.println("                    MENU                    ");
        System.out.println("1. Create a new matrix");
        System.out.println("2. Delete a matrix from memory");
        System.out.println("3. Print all stored matrices");
        System.out.println("--------------------------------");
        System.out.println("4. Add selected matrices");
        System.out.println("5. Subtract selected matrices");
        System.out.println("6. Multiply selected matrices");
        System.out.println("7. Transpose a matrix");
        System.out.println("8. Multiply a matrix by a number");
        System.out.println("--------------------------------");
        System.out.println("9. Exit");
        System.out.println("--------------------------------");
        System.out.println("Your choice (input an integer):");
    }
```

CORRESPONDING CLASS MENU

```
@Override
public void showMenu() {
    dialogue.printUI();
    int input = cin.nextInt();
    switch (input) {
        case 1 -> this.createAMatrixMenu();//creating a matrix
        case 2 -> this.deleteAMatrixMenu();//deleting a matrix from the memory
        case 3 -> this.displayMatrices();//printing matrices
        case 4 -> this.addMatrices();//adding two matrices
        case 5 -> this.subtractMatrices();//subtracting matrices
        case 6 -> this.multiplyMatrices();//multiplying matrices
        case 7 -> this.transposeAMatrix();//transposing a matrix
        case 8 -> this.multiplyByANumber();//multiplying matrix by a number
        case 9 -> System.exit(0);//exit
    }
    this.showMenu();
}
```

HOW IS IT IMPLEMENTED?

```
public class Element {
    private double value;

    Element(double initial) {
        //constructor to create an element with initial value
        this.value = initial;
    }

    Element() {
        //constructor to create an element with default initial value
        this.value = 0;
    }

    public Element newValue(double val) {
        return new Element(val);
    }

    public double printValue() {
        return value;
    }
}
```

```
public class Matrix implements Operations {
    private int numberOfRows, numberOfColumns;
    private Element[][] elements;

    Matrix(int m, int n) {
        this.numberOfRows = m;
        this.numberOfColumns = n;
        this.elements = new Element[numberOfRows][numberOfColumns];
    }

    public Matrix(int m, int n, double[][] tab) {
        this.numberOfRows = m;
        this.numberOfColumns = n;
        this.elements = new Element[numberOfRows][numberOfColumns];
        for (int i = 0; i < m; i++) {
            for (int j = 0; j < n; j++) {
                elements[i][j] = new Element(tab[i][j]);
            }
        }
    }
```

CLASS EXAMPLE & CLASS MENU PART 1

```java
package pl.poznan.put.example;
import pl.poznan.put.matrix.Matrix;

public class Example {
    //example matrices that will be added to the memory
    final private double tab[][] = {
            {21.0, 37.0, 5.0},
            {4.0, 5.0, 8.0},
            {2.9, 4.7, 1.9},
    };
    final private Matrix example1 = new Matrix(3, 3, tab);
    private double tab2[][] = {
            {6.0, 9.7, 4.9},
            {3.6, 2.9, 1.0},
            {2.3, 4.5, 5.8},
    };
    private Matrix example2 = new Matrix(3, 3, tab2);

    public Matrix firstExampleMatrix() {
        return example1;
    }

    public Matrix secondExampleMatrix() {
        return example2;
    }
}
```

```java
public class Menu implements MenuFunctions {
    private ArrayList<Matrix> matrices = new ArrayList<>();
    private Scanner cin = new Scanner(System.in);
    private UI dialogue = new UI();

    @Override
    public void insertAMatrix(Matrix m1) {
        //instead of using these 3 lines everywhere, I optimized it and used a method
        matrices.add(m1);
        System.out.println("Your matrix has been added to the memory");
        matrices.get(matrices.size() - 1).show();
    }

    @Override
    public boolean ifMatricesEmpty() {
        //instead of having try...catch block in every method, I check it here
        boolean flag = true;
        try {
            if (matrices.isEmpty()) {
                throw new InaccessibleObjectException("There are no matrices stored in memory!");
            } else flag = false;
        } catch (Exception ex1) {
            System.out.println(ex1.getMessage());
        }
        return flag;
    }
```

CLASS MENU PART (SKIPPED SHOWMENU METHOD AS IT IS SHOWN IN THE SECOND SLIDE)

```
@Override
public boolean indexOutOfRange(int id) {
    //instead of having try...catch block in every method, I check it here
    //checking if index of an object exists
    boolean flag = true;
    try {
        if (((matrices.size() - 1) < id) || id < 0) {
            throw new IllegalAccessException("Index is out of range!");
        } else flag = false;
    } catch (Exception ex1) {
        System.out.println(ex1.getMessage());
    }
    return flag;
}
```

```
@Override
public void createAMatrixMenu() {
    try {
        System.out.println("Input number of rows for the new matrix");
        int m = cin.nextInt();
        System.out.println("Input number of columns for the new matrix");
        int n = cin.nextInt();
        if (m <= 0 || n <= 0) {
            throw new IllegalArgumentException("Number of rows and columns of a matrix must be positive!");
        } else {
            double[][] tab2 = new double[m][n];
            System.out.println("Input values of the elements of the matrix. You should use your local notation (in Poland use a comma (,)
):");
            for (int i = 0; i < m; i++) {
                for (int j = 0; j < n; j++) {
                    tab2[i][j] = cin.nextDouble();
                }
            }
            Matrix mat = new Matrix(m, n, tab2);
            insertAMatrix(mat);
        }
    } catch (IllegalArgumentException ex1) {
        System.out.println(ex1.getMessage());
        this.createAMatrixMenu();
    }
}
```

CLASS MENU

```
@Override
public void displayMatrices() {
    if (!ifMatricesEmpty()) {
        for (int i = 0; i < matrices.size(); i++) {
            System.out.print(i);
            System.out.println(": ");
            matrices.get(i).show();
        }
    }
}

@Override
public void deleteAMatrixMenu() {
    if (!ifMatricesEmpty()) {
        System.out.println("Input an index of a matrix you want to delete!:");
        int id = cin.nextInt();
        if (!indexOutOfRange(id)) {
            matrices.remove(id);
            System.out.println("Your matrix has been deleted.");
        }
    }
}
```

```
@Override
public void addMatrices() {
    int id1, id2;
    System.out.println("Input the index of the matrix you want to add to:");
    id1 = cin.nextInt();
    System.out.println("Input the index of the matrix you want to add:");
    id2 = cin.nextInt();
    if (!indexOutOfRange(id1) && !indexOutOfRange(id2)) {
        if (matrices.get(id1).numberOfRows() != matrices.get(id2).numberOfRows()) {
            System.out.println("Impossible to add.");
        } else if (matrices.get(id1).numberOfColumns() != matrices.get(id2).numberOfColumns()) {
            System.out.println("Impossible to add.");
        } else {
            Matrix newMatrix = matrices.get(id1).addToThisMatrix(matrices.get(id2));
            insertAMatrix(newMatrix);
        }
    }
}
```

CLASS MENU

```
@Override
public void subtractMatrices() {
    int id1, id2;
    System.out.println("Input the index of the matrix you want to subtract from:");
    id1 = cin.nextInt();
    System.out.println("Input the index of the matrix you want to subtract:");
    id2 = cin.nextInt();
    if (!indexOutOfRange(id1) && !indexOutOfRange(id2)) {
        if (matrices.get(id1).numberOfRows() != matrices.get(id2).numberOfRows()) {
            System.out.println("Impossible to subtract.");
        } else if (matrices.get(id1).numberOfColumns() != matrices.get(id2).numberOfColumns())
{
            System.out.println("Impossible to subtract.");
        } else {
            Matrix newMatrix = matrices.get(id1).subtractFromThisMatrix(matrices.get(id2));
            insertAMatrix(newMatrix);
        }
    }
}
```

```
@Override
public void multiplyMatrices() {
    int id1, id2;
    boolean fl1 = ifMatricesEmpty();
    if (!fl1) {
        System.out.println("Input the index of the matrix you want to multiply");
        id1 = cin.nextInt();
        System.out.println("input the index of the matrix you want to multiply by");
        id2 = cin.nextInt();
        fl1 = indexOutOfRange(id1) || indexOutOfRange(id2);
        if (!fl1) {
            Matrix newMatrix = new Matrix(matrices.get(id1), matrices.get(id2));
            insertAMatrix(newMatrix);
        }
    }
}
```

CLASS MENU

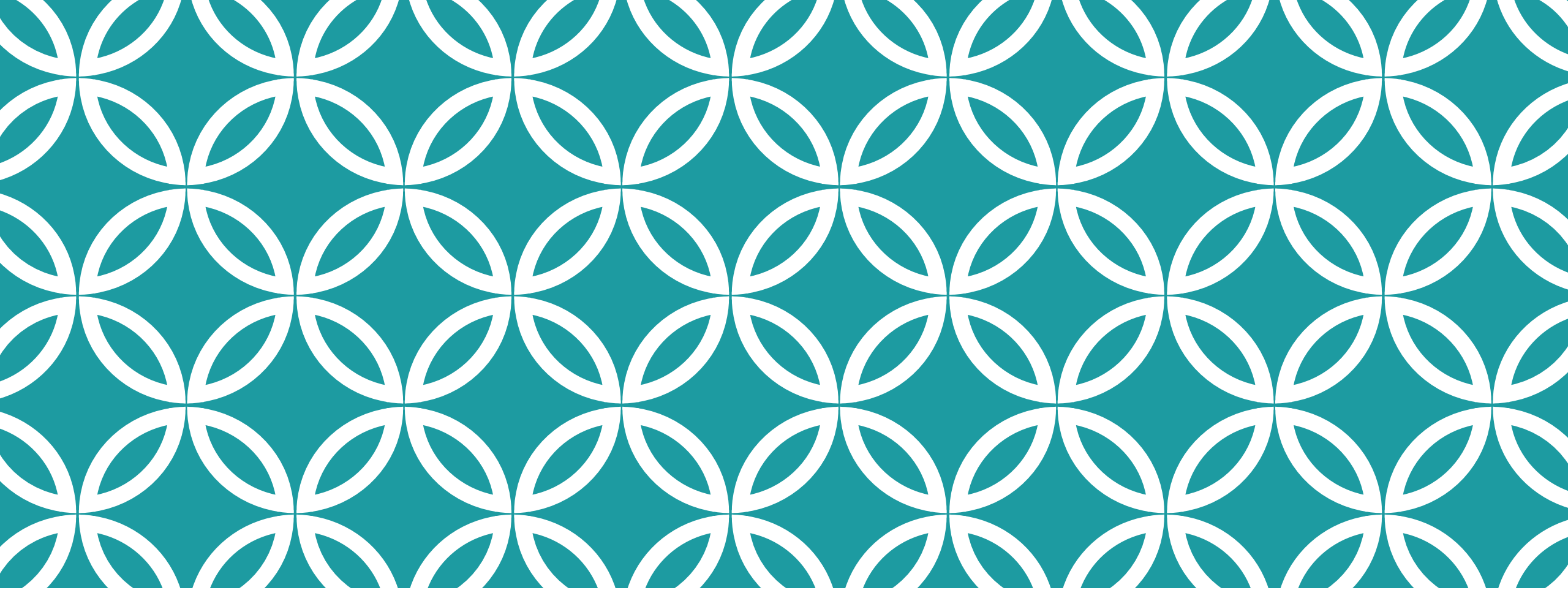
```
@Override
public void transposeAMatrix() {
    int id1;
    boolean fl1 = ifMatricesEmpty();
    if (!fl1) {
        System.out.println("Input the index of the matrix you want to transpose:");
        id1 = cin.nextInt();
        fl1 = indexOutOfRange(id1);
        if (!fl1) {
            Matrix newMatrix = new Matrix(matrices.get(id1));
            insertAMatrix(newMatrix);
        }
    }
}
```

```
@Override
public void multiplyByANumber() {
    int id1;
    double number;
    boolean fl1 = ifMatricesEmpty();
    if (!fl1) {
        System.out.println("Input the index of the matrix you want to multiply:");
        id1 = cin.nextInt();
        fl1 = indexOutOfRange(id1);
        if (!fl1) {
            System.out.println("Input the number");
            number = cin.nextDouble();
            Matrix newMatrix = new Matrix(matrices.get(id1), number);
            insertAMatrix(newMatrix);
        }
    }
}
```

THERE ARE TWO INTERFACES

```
public interface Operations {
    //this interface is implemented by the Matrix class
    //addition, subtraction are methods
    //multiplication, transposition are handled by
constructors in Matrix class
    void show();

    Operations addToThisMatrix(Matrix m1);

    Operations subtractFromThisMatrix(Matrix m2);
}
```

```
public interface MenuFunctions {
    void insertAMatrix(Matrix m1);

    boolean ifMatricesEmpty();

    boolean indexOutOfRange(int id);//checking if index of an object exists

    void showMenu();

    void createAMatrixMenu();

    void displayMatrices();

    void deleteAMatrixMenu();

    void addMatrices();

    void subtractMatrices();

    void multiplyMatrices();

    void transposeAMatrix();

    void multiplyByANumber();

}
```



PROBLEMS AND HOW I HANDLED THEM

GUI

After a few attempts…

I abandoned it

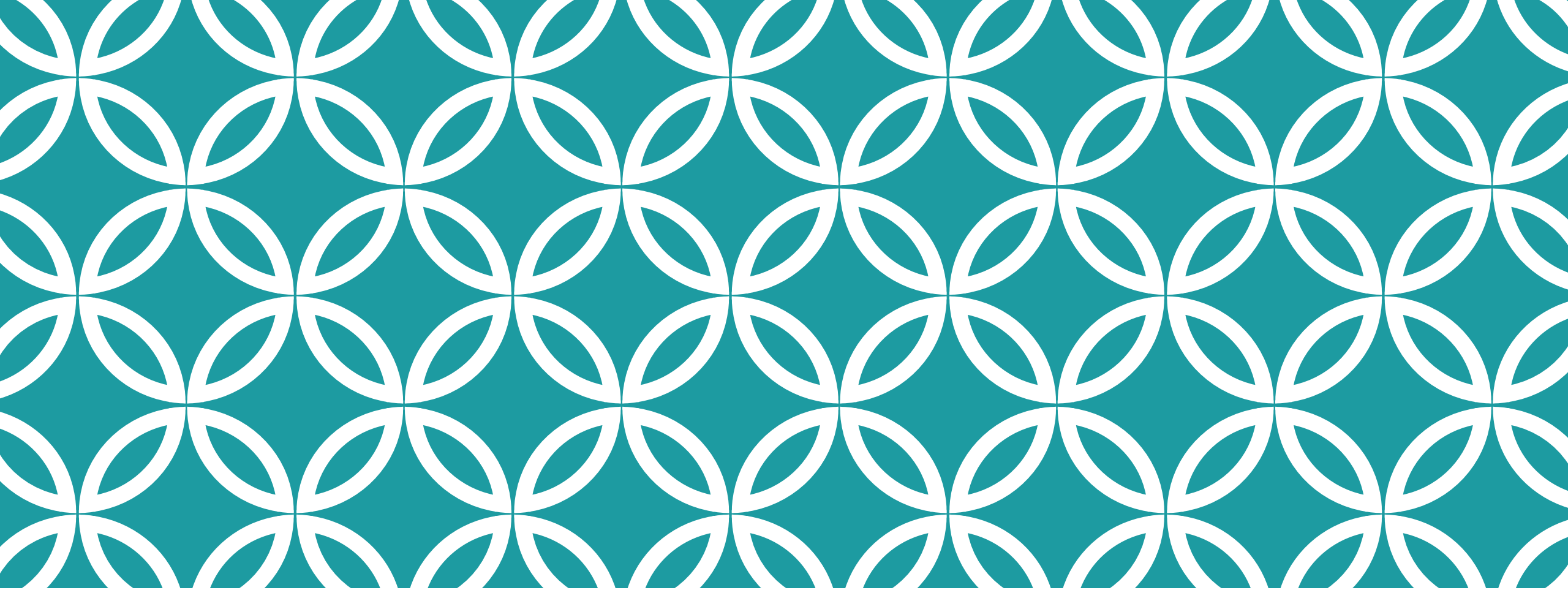
REDUNDANT ERROR CHECKING IN METHODS

I made new methods that did the same & allowed me to delete about 60 lines of code

PROJECT STRUCTURE

After finishing the project, I was told that the project structure has to be changed & I spent a few hours trying to fix all the errors

How I fixed it: importing packages

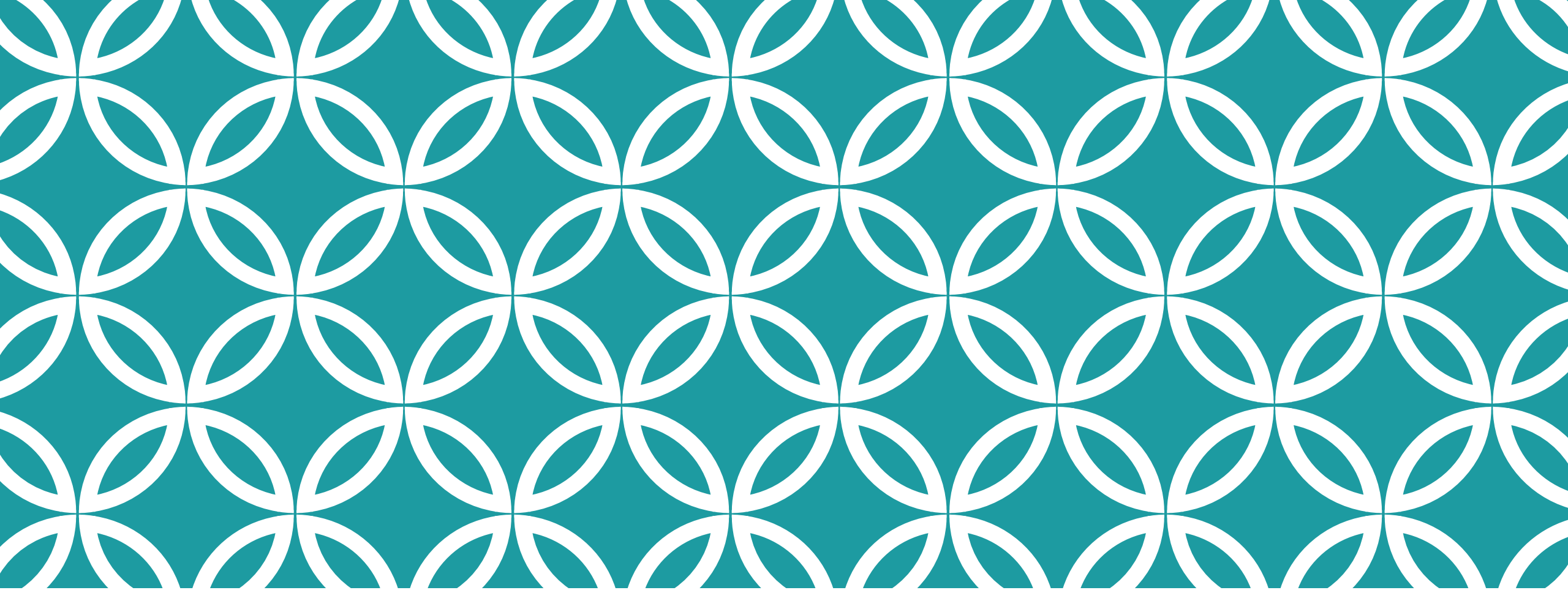


DID YOU LEARN ANYTHING NEW?

Fast answer: a lot

I REALIZED:

- It's incredibly easy to switch to Java after programming in C++ for 7 years
- Looking for an inverse matrix is a lot harder that I thought it be
- JetBrains tools are **the best**



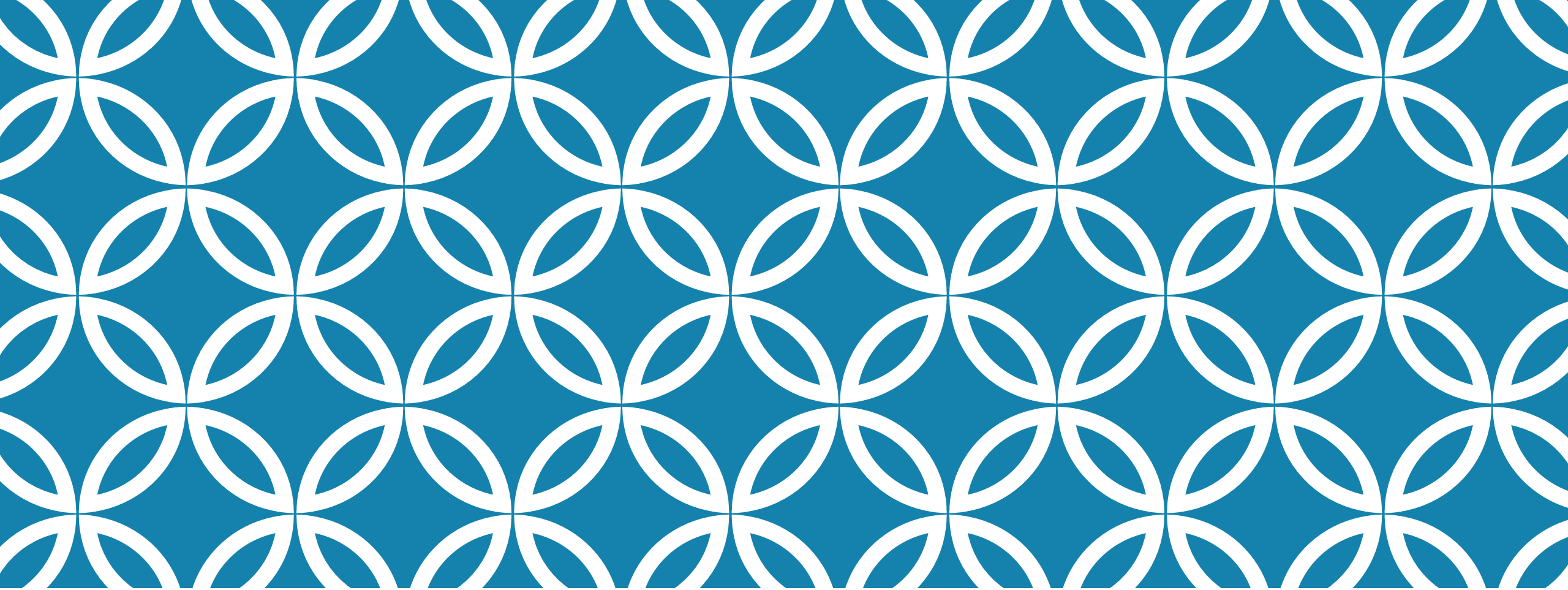
WHAT COULD BE IMPROVED?

Nothing.

WHAT COULD BE IMPROVED?

I'm happy with the result

But If I needed to find sth to improve: actually making a GUI



THANK YOU FOR YOUR ATTENTION

Zuzanna Ławniczak, 151835