# Multidimensional Arrays



**SoftUni Team Technical Trainers** 







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### **Array in Java**



- In programming, an array is a sequence of elements
  - All elements are of the same type
  - The order of the elements is fixed
  - Has fixed size (length)

Array of 5 elements

O 1 2 3 4

Element index

Element

of an array

### **Working with Arrays in Java**



• Allocating an array:

Array of **10** elements

```
int[] numbers = new int[10];
```

• Assigning values to the array elements:

```
for (int i = 0; i < numbers.length; i++)
numbers[i] = i + 1;
All elements are of
the same type</pre>
```

• Accessing array elements:

```
numbers[3] = 20;
numbers[5] = numbers[2] + numbers[7];
Element index
```

### What is Multidimensional Array?



- An array is a systematic arrangement of similar objects
- Arrays can have more than one dimension, e.g. matrices
- The most used multidimensional arrays are the 2-dimensional

			The same of the sa		
Matrix		COLU			
_	[0][0]	[0][1]	[0][2]	[0][3]	Row Index
R O	[1][0]	[1][1]	[1][2]	[1][3]	
W	[2][0]	[2][1]	[2][2]	[2][3]	<b>Column</b> Index
5	[3][0]	[3][1]	[3][2]	[3][3]	
	R O	[0][0]  R O [1][0] W [2][0] S	[0][0] [0][1]  R [1][0] [1][1]  W [2][0] [2][1]  S	[0][0] [0][1] [0][2]  R [1][0] [1][1] [1][2]  W [2][0] [2][1] [2][2]  S	[0][0] [0][1] [0][2] [0][3]  R [1][0] [1][1] [1][2] [1][3]  W [2][0] [2][1] [2][2] [2][3]  S

#### **Declaring and Creating Multidimensional Arrays**



Declaring multidimensional arrays:

```
int[][] intMatrix;
float[][] floatMatrix;
String[][] strCube;
```

- Creating a multidimensional array
  - Use new keyword
  - Must specify the size of at least one dimension

```
int[][] intMatrix = new int[3][];
float[][] floatMatrix = new float[8][2];
String[][][] stringCube = new
String[5][5][5];
```

### **Initializing Multidimensional Arrays**



• Initializing a multidimensional array with values:

```
int[][] matrix = {
     {1, 2, 3, 4}, // row 0 values
     {5, 6, 7, 8} // row 1 values
};
```

- Matrices are represented by a list of rows
  - Each row consists of a list of values

## **Accessing Elements**



Accessing N-dimensional array element:

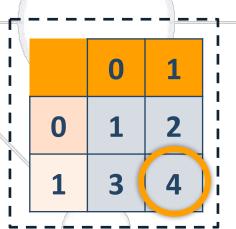
```
nDimensionalArray[index<sub>1</sub>] ... [index<sub>n</sub>]
```

Getting element value example:

```
int[][] array = {{1, 2}, {3, 4}};
int element = array[1][1]; // element<sub>11</sub> = 4
```

Setting element value example:

```
int[][] array = new int[3][4];
for (int row = 0; row < array.length; row++)
  for (int col = 0; col < array[0].length; col++)
    array[row][col] = row + col;</pre>
```



### Reading a Matrix – Example



```
public static void main(String[] args) {
  Scanner scanner = new Scanner(System.in);
  int rows = Integer.parseInt(scanner.nextLine());
  int cols = Integer.parseInt(scanner.nextLine());
  int[][] matrix = new int[rows][cols];
 for (int row = 0; row < rows; row++) {
    String[] inputTokens = scanner.nextLine().split(" ");
      for (int column = 0; column < cols; column++) {</pre>
        matrix[row][column] =
         Integer.parseInt(inputTokens[column]);
```

### **Problem: Compare Matrices**



- Write a program that reads two integer matrices (2D arrays)
   from the console and compares them element by element
- Print equal if the matrices match, and not equal if they don't match

			Input	Output
2				Equal
1	2	3		
	1			
2				
1	2	3		
2	1	3		

Check your solution here: <a href="https://judge.softuni.org/Contests/3955/Multidimensional-Arrays-Lab-RS">https://judge.softuni.org/Contests/3955/Multidimensional-Arrays-Lab-RS</a>

### **Solution: Compare Matrices (1)**



```
int[] dimentions = Arrays.stream(scanner.nextLine()
                          .split("\\s++"))
                          .mapToInt(Integer::parseInt)
                          .toArray();
int firstMatrixRows = dimentions[0];
int firstMatrixCols = dimentions[1];
// TODO: continue...
```

### **Solution: Compare Matrices (2)**



```
for (int i = 0; i < firstMatrixRows; i++) {</pre>
  int[] arr = Arrays.stream(scanner.nextLine()
                     .split("\\s+"))
                     .mapToInt(Integer::parseInt)
                     .toArray();
  firstMatrix[i] = arr;
   TODO: read the second matrix...
```

### **Solution: Compare Matrices (3)**



```
static boolean matricesAreEqual(int[][] firstMatrix, int[][] secondMatrix)
  if (firstMatrix.length != secondMatrix.length) return false;
  for (int row = 0; row < firstMatrix.length; row ++) {</pre>
    if (firstMatrix[row].length != secondMatrix[row].length)
      return false;
    for (int col = 0; col < firstMatrix[row].length; col ++) {
      if (firstMatrix[row][col] != secondMatrix[row][col]) return false;
  return true;
```

#### **Problem: Positions of**



- Write a program that reads a matrix of integers, then a number and prints all the positions at which that number appears in the matrix
- The matrix definition on the console will contain a line with two positive integer numbers R and C
- If the number does not appear in the matrix, print "not found"

				Input	Output	
	2	3			0 1	
	1	2	3		1 1	
1	4	2	2		1 2	
	2					

Check your solution here: <a href="https://judge.softuni.org/Contests/3955/Multidimensional-Arrays-Lab-RS">https://judge.softuni.org/Contests/3955/Multidimensional-Arrays-Lab-RS</a>

#### **Solution: Positions of**



```
//TODO Read matrix...
int searchNumber = Integer.parseInt(scanner.nextLine());
boolean isFound = false;
for (int row = 0; row < matrix.length; row++)
  for (int col = 0; col < matrix[row].length; col++)</pre>
    if (matrix[row][col] == searchNumber) {
      System.out.println(row + " " + col); isFound = true;
if(!isFound)
  System.out.println("not found");
```

#### **Problem: Sum of All Elements of Matrix**



- Read a matrix from the console
- Print the number of rows
- Print the number of columns
- Print the sum of all elements

			Inpu	ıt			Outp	ut	
3	, 6					3			
7	, 1	3,	3,	2,	1	6			
1	, 3	9,	8,	5,	6	76			
4	, 6	7,	9,	1,	0				

Check your solution here: <a href="https://judge.softuni.org/Contests/3955/Multidimensional-Arrays-Lab-RS">https://judge.softuni.org/Contests/3955/Multidimensional-Arrays-Lab-RS</a>

#### Solution: Sum of All Elements of Matrix



```
public static void main(String[] args) {
  String sizes = scanner.nextLine();
  int[][] matrix = matrixReader(sizes);
  //TODO implement method matrixReader(String sizes)
  System.out.println(matrix.length); 
                                              Gets length of 0<sup>th</sup>
  System.out.println(matrix[0].length);
                                              dimension (rows)
  int sum = 0;
  for (int row = 0; row < matrix.length; row++) {</pre>
    for (int col = 0; col < matrix[row].length; col++) {</pre>
       sum += matrix[row][col];
                                           Gets length of 1st
                                         dimension (columns)
  System.out.println(sum);
```

#### **Problem: Maximum Sum of 2X2 Submatrix**



- Find the 2x2 square with max sum in a given matrix
  - Read the matrix from the console
  - Find the biggest sum of 2x2 submatrix
  - Print the result in form of a new matrix

Input	Output
3, 6	9 8
7, 1, 3, 3, 2, 1	7 9
1, 3, 9, 8, 5, 6	33
4, 6, 7, 9, 1, 0	

#### **Solution: Maximum Sum of 2X2 Submatrix**



```
int bestSum = Integer.MIN_VALUE;
int resultRow;
int resultCol;
for (int row = 0; row < matrix.length - 1; row++)</pre>
 for (int col = 0; col < matrix[row].length - 1; col++)
    int sum = matrix[row][col] + matrix[row][col + 1] +
           matrix[row + 1][col] + matrix[row + 1][col + 1];
    if (sum > bestSum)
      bestSum = sum;
      resultRow = row;
      resultCol = col;
```

### Summary



- Multidimensional Array?
  - Arrays can have more than one dimension, e.g. matrices
- Declaring and Creating
  - Use new keyword
- Initializing Multidimensional Arrays





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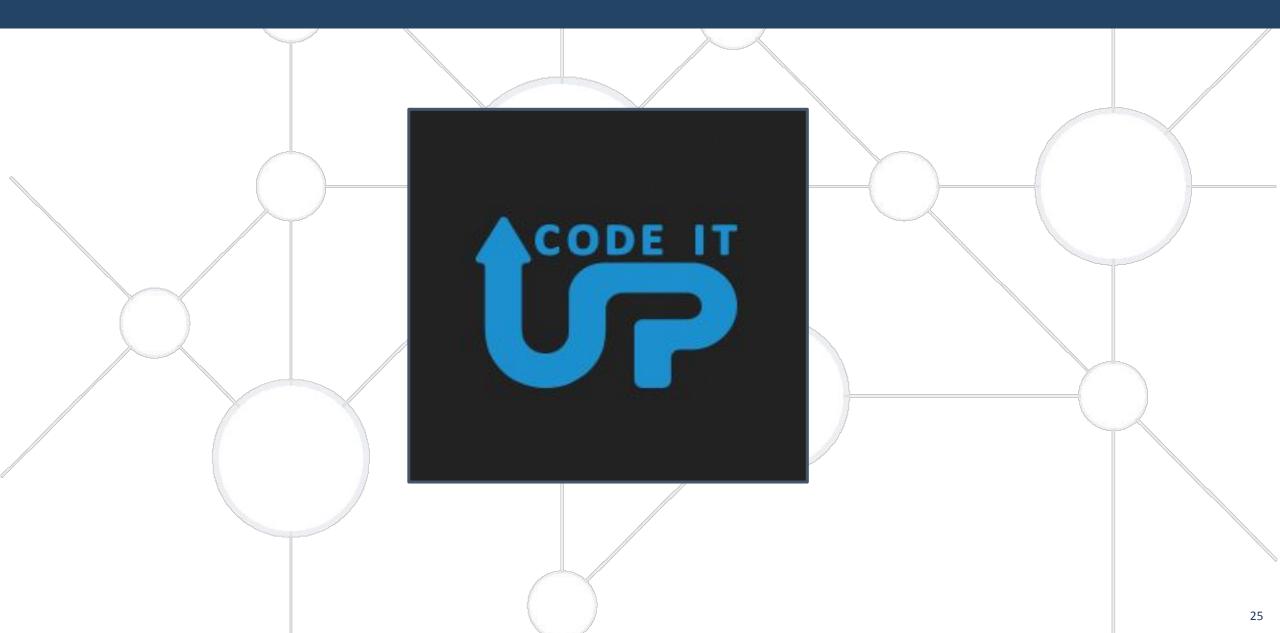






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