JOBSHEET 10
Array 2

1. Objective

- Students are able to understand how to create 2-dimensional arrays in the Java programming language
- Students are able to access 2-dimensional array

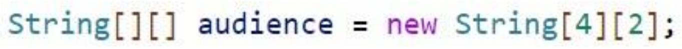
2. Laboratory

2.1 Experiment 1: Declare, Initialize, and Display 2-Dimensional Array

Experiment Time: 60 minutes

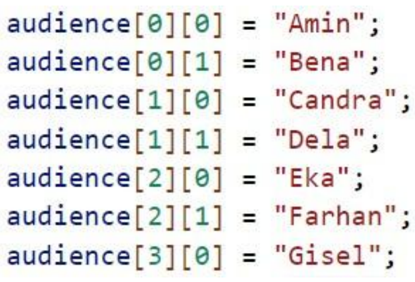
In this experiment, program code was created to declare, initialize, and display elements in a 2-dimensional array. The data stored is the name of the mini cinema audience who will be seated in the room with 4 rows and 2 columns of seats.

1. Open a text editor. Create a new file, name it **Cinema<StudentID>.java**
2. Write the basic structure of the Java programming language which contains the **main()** function
3. Create an array of String type named **audience** with a row capacity of 4 elements and a column of 2 elements



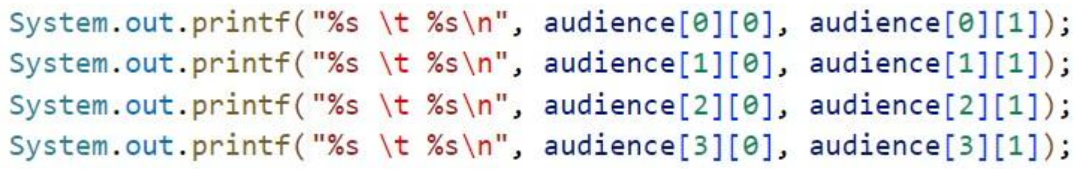
```
String[][] audience = new String[4][2];
```

4. Fill in each element of the value array as follows:



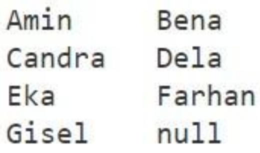
```
audience[0][0] = "Amin";
audience[0][1] = "Bena";
audience[1][0] = "Candra";
audience[1][1] = "Dela";
audience[2][0] = "Eka";
audience[2][1] = "Farhan";
audience[3][0] = "Gisel";
```

5. Display all contents of the elements to the screen



```
System.out.printf("%s \t %s\n", audience[0][0], audience[0][1]);
System.out.printf("%s \t %s\n", audience[1][0], audience[1][1]);
System.out.printf("%s \t %s\n", audience[2][0], audience[2][1]);
System.out.printf("%s \t %s\n", audience[3][0], audience[3][1]);
```

6. Compile and run the program. Match the results of the running programs that you have created according to the following display



```
Amin      Bena
Candra    Dela
Eka       Farhan
Gisel     null
```

Questions!

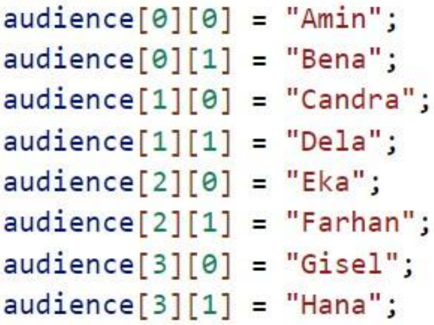
1. Do array elements have to be filled in sequentially starting from the 0th index? Please explain!

   No, they don't have to be, but it is recommended. You can access and modify any array element (e.g., audience[3][1]) at any time after the array is declared. However, filling them sequentially (from index 0 to the maximum index) ensures that no elements are accidentally missed or left with their default value (e.g., null for String or 0 for int).

2. Why is there a null in the list of audience names?

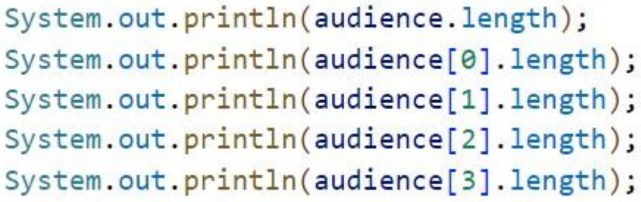
   There is a null value because that specific array element was not initialized (assigned a String value).

3. Complete the audience list in step 4 so that it looks like the following program code



```
audience[0][0] = "Amin";
audience[0][1] = "Bena";
audience[1][0] = "Candra";
audience[1][1] = "Dela";
audience[2][0] = "Eka";
audience[2][1] = "Farhan";
audience[3][0] = "Gisel";
audience[3][1] = "Hana";
```

4. Add the following program code:



```
System.out.println(audience.length);
System.out.println(audience[0].length);
System.out.println(audience[1].length);
System.out.println(audience[2].length);
System.out.println(audience[3].length);
```

   Explain the function of audience.length and audience[0].length! Do audience[0].length, audience[1].length, audience[2].length, and audience[3].length have the same value? Why?

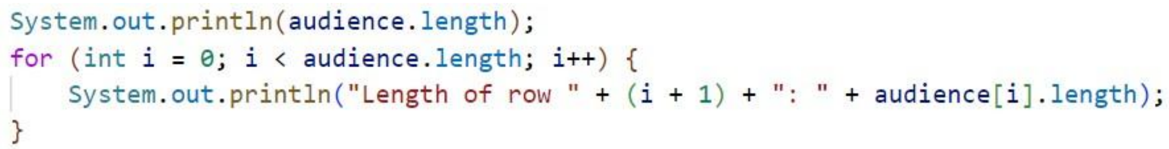
Function of .length

- **audience.length: This property returns the total number of rows in the two-dimensional array (audience). Since the array is defined as new String[4][2], this will return 4.**
- **audience[0].length: This property returns the number of columns in the first row (index 0) of the audience array. Since the array is 4 X 2 , this will return 2.**

Do the Lengths Have the Same Value?

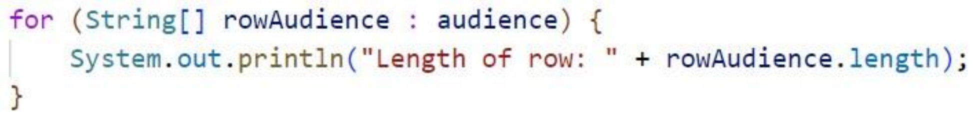
Yes, audience[0].length, audience[1].length, audience[2].length, and audience[3].length will all have the same value of 2.

5. Modify the program code in step 4 to display the length of each row in the array using a for loop. Compile, run, then commit.



```java
System.out.println(audience.length);
for (int i = 0; i < audience.length; i++) {
    System.out.println("Length of row " + (i + 1) + ": " + audience[i].length);
}
```

6. Modify the program code in step 5 to display the length of each row in the array using a foreach loop. Compile, run, then commit.



```java
for (String[] rowAudience : audience) {
    System.out.println("Length of row: " + rowAudience.length);
}
```

7. In your opinion, what are the advantages and disadvantages of foreach loop compared to for loop?

Feature	**Advantage** **(Foreach)**	**Disadvantage** **(Foreach)**
Readability	Code is more concise and easier to read (no	Cannot obtain the **index** of the element.

Feature	Advantage (Foreach)	Disadvantage (Foreach)
	index needed).	
Traversal	Ensures all elements are processed from start to finish.	Cannot process elements in reverse order.
Modification		Cannot be used to **modify** the contents of the array (read-only).

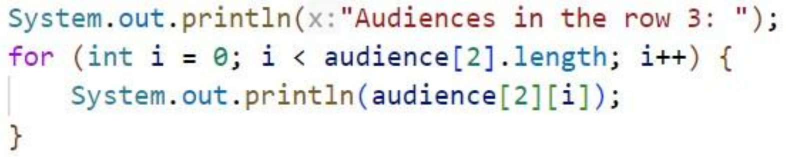
8. What is the max row index for the audience array?

   The maximum row index for the audience array (4 rows) is 3 (audience.length - 1).

9. What is the max column index for the audience array?

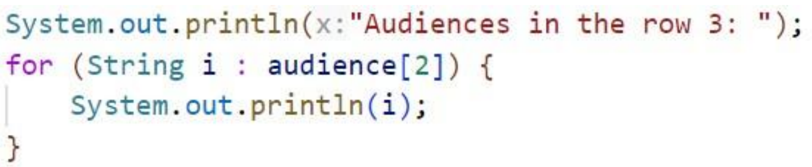
   The maximum column index for the audience array (2 columns per row) is 1 (audience[i].length - 1).

10. Add program code to display the audience’s name on the 3rd line using a for loop. Compile, run, then commit.



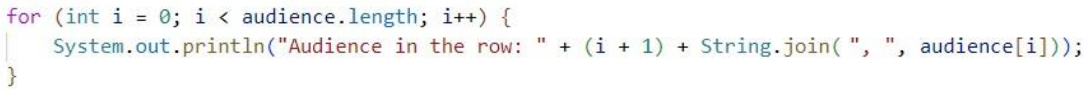
```
System.out.println(x:"Audiences in the row 3: ");
for (int i = 0; i < audience[2].length; i++) {
    System.out.println(audience[2][i]);
}
```

11. Modify the code in question number 10 to repeat using a foreach loop. Compile, run, then commit.



```
System.out.println(x:"Audiences in the row 3: ");
for (String i : audience[2]) {
    System.out.println(i);
}
```

12. Modify the program code in question number 11 again to display the audience’s name for each line. Compile and run the program then observe the results, then commit.



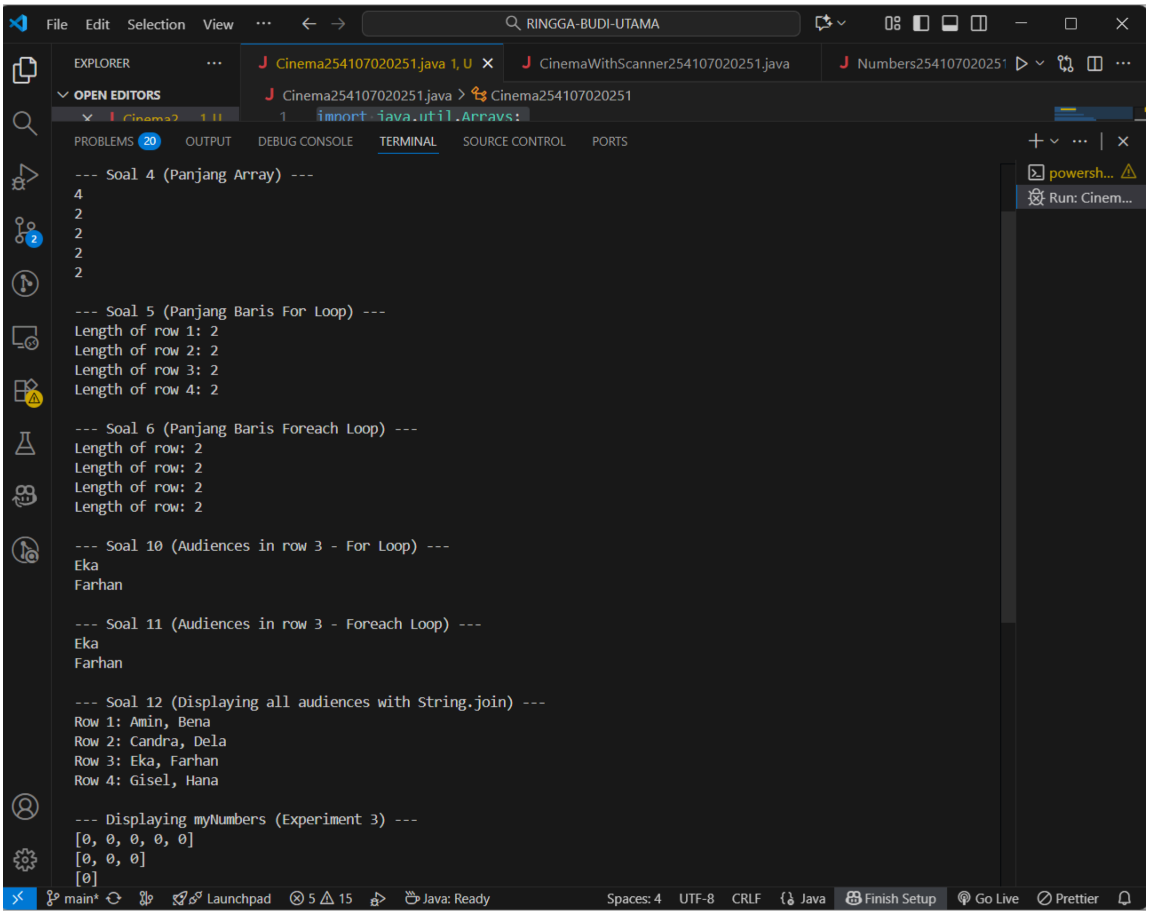
```
for (int i = 0; i < audience.length; i++) {
    System.out.println("Audience in the row: " + (i + 1) + String.join( ", ", audience[i]));
}
```

13. What is the function of String.join()?

The function String.join(delimiter, elements) is used to combine the elements of an iterable (such as a String array or list) into a single String.

- ***delimiter: Is the String that will be placed between each joined element (e.g., , or -).***
- ***elements: The collection of Strings to be joined.***

14. Commit and push to GitHub

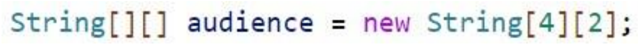


```
--- Soal 4 (Panjang Array) ---
4
2
2
2
2

--- Soal 5 (Panjang Baris For Loop) ---
Length of row 1: 2
Length of row 2: 2
Length of row 3: 2
Length of row 4: 2

--- Soal 6 (Panjang Baris Foreach Loop) ---
Length of row: 2
Length of row: 2
Length of row: 2
Length of row: 2

--- Soal 10 (Audiences in row 3 - For Loop) ---
Eka
Farhan

--- Soal 11 (Audiences in row 3 - Foreach Loop) ---
Eka
Farhan

--- Soal 12 (Displaying all audiences with String.join) ---
Row 1: Amin, Bena
Row 2: Candra, Dela
Row 3: Eka, Farhan
Row 4: Gisel, Hana

--- Displaying myNumbers (Experiment 3) ---
[0, 0, 0, 0, 0]
[0, 0, 0]
[0]
```

2.2 Experiment 2: Utilizing Scanners and Loops for Input and Output on 2-Dimensional Arrays Experiment Time: 80 minutes

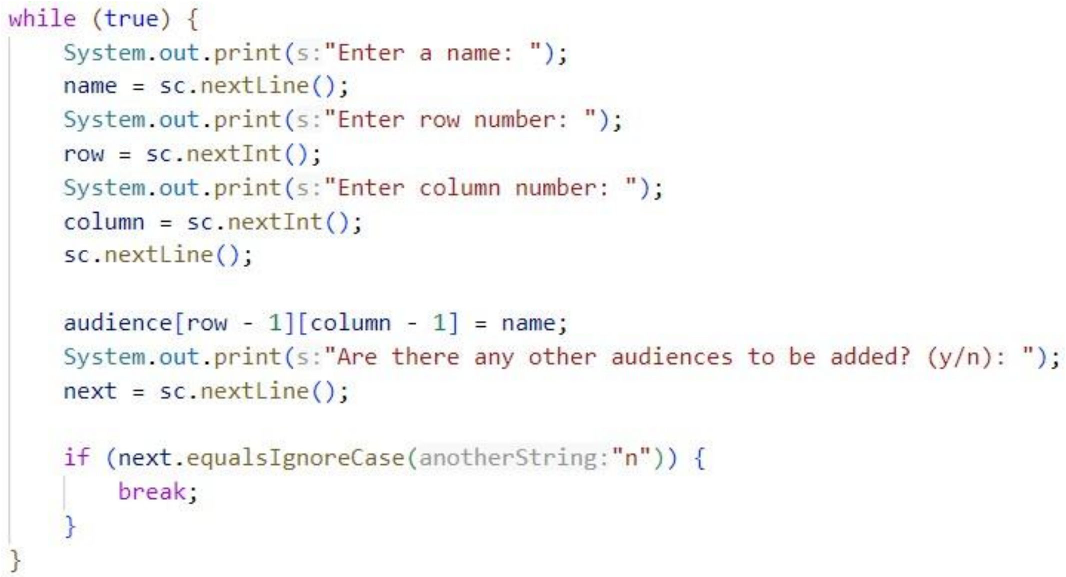
Experiment 2 is a follow-up experiment to Experiment 1. In this experiment, a program code was created to store data on the names of spectators in a mini cinema with 4 rows and 2 columns of seats using a scanner.

1. Open a text editor. Create a new file, name it **CinemaWithScanner<StudentID>.java**
2. Write the basic structure of the Java programming language which contains the **main()** function
3. Add Scanner library
4. Declare the Scanner variable
5. Declare row and column variables of type **int** and name and next of type **String**.
6. Create an array of String type named **audience** with a row capacity of 4 elements and a column of 2 elements



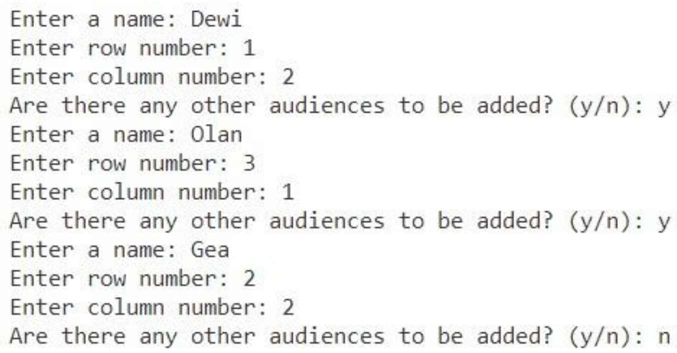
```
String[][] audience = new String[4][2];
```

7. Use the scanner to fill in the elements in the **audience** array



```
while (true) {
    System.out.print(s:"Enter a name: ");
    name = sc.nextLine();
    System.out.print(s:"Enter row number: ");
    row = sc.nextInt();
    System.out.print(s:"Enter column number: ");
    column = sc.nextInt();
    sc.nextLine();

    audience[row - 1][column - 1] = name;
    System.out.print(s:"Are there any other audiences to be added? (y/n): ");
    next = sc.nextLine();

    if (next.equalsIgnoreCase(anotherString:"n")) {
        break;
    }
}
```

8. Compile and run the program then try inputting some audience data.



```
Enter a name: Dewi
Enter row number: 1
Enter column number: 2
Are there any other audiences to be added? (y/n): y
Enter a name: Olan
Enter row number: 3
Enter column number: 1
Are there any other audiences to be added? (y/n): y
Enter a name: Gea
Enter row number: 2
Enter column number: 2
Are there any other audiences to be added? (y/n): n
```

9. Commit program code

Questions!

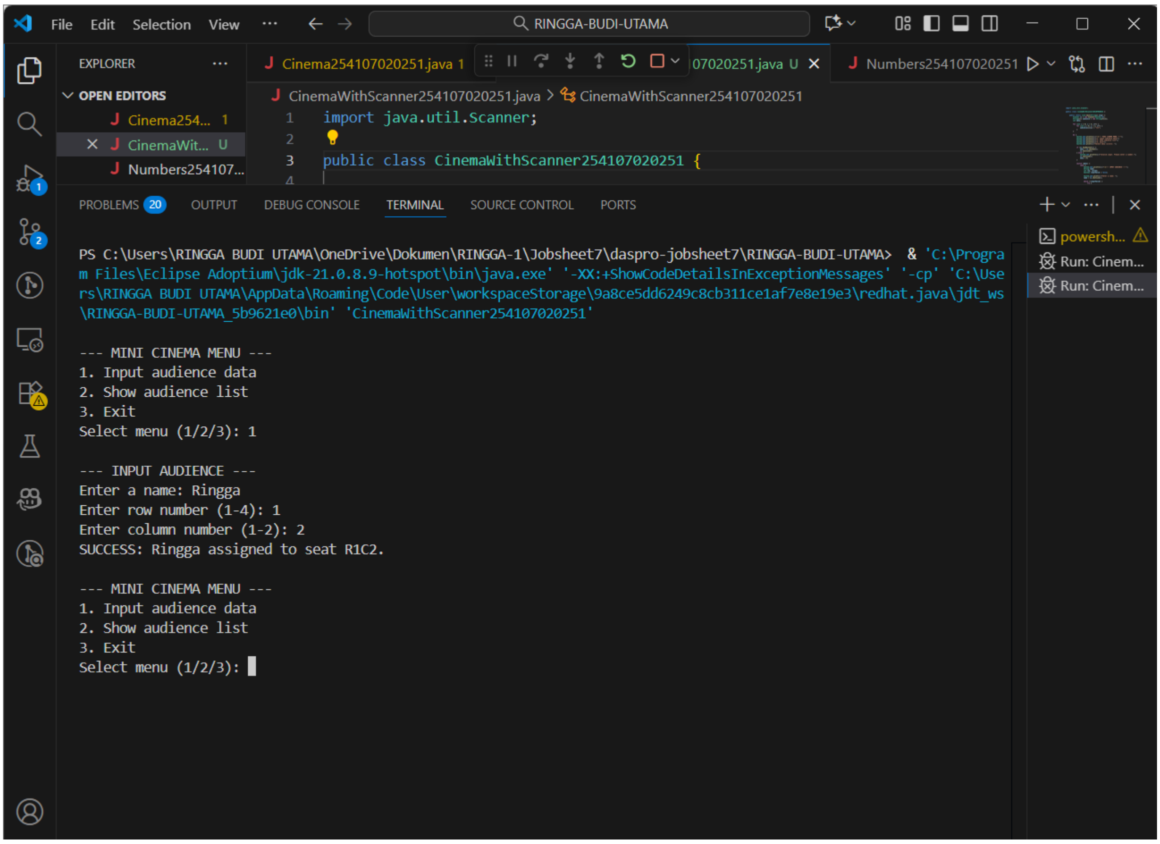
1. Should the array elements from the scanner be filled in sequentially starting from the 0th index? Please explain!

   No, they don't have to be filled sequentially.

   When using a `Scanner` for input into an array, you determine the index (`[row][column]`) where the data is stored. Since the user provides the seat number (row and column), you assign the value directly to that specific index, regardless of whether the previous indices (like `[0][0]`, `[0][1]`) have been filled or not.

   The key benefit of using a `Scanner` and asking for the index is random access, allowing data entry in any order.

2. Modify the program code to provide the following menu options:
   - Menu 1: Input audience data
   - Menu 2: Show audience list
   - Menu 3: Exit
3. Modify the program code to handle if the seat row/column number is not available
4. In menu 1, modify the program code to give a warning if the selected seat is already occupied by other audiences, then display a command to enter rows and columns again
5. In menu 2, if the seat is empty, replace null with ***
6. Commit and push the program code to GitHub



```
import java.util.Scanner;

public class CinemaWithScanner254107020251 {
```

```
PS C:\Users\RINGGA BUDI UTAMA\OneDrive\Dokumen\RINGGA-1\Jobsheet7\daspro-jobsheet7\RINGGA-BUDI-UTAMA>  & 'C:\Progra
m Files\Eclipse Adoptium\jdk-21.0.8.9-hotspot\bin\java.exe' '-XX:+ShowCodeDetailsInExceptionMessages' '-cp' 'C:\Use
rs\RINGGA BUDI UTAMA\AppData\Roaming\Code\User\workspaceStorage\9a8ce5dd6249c8cb311ce1af7e8e19e3\redhat.java\jdt_ws
\RINGGA-BUDI-UTAMA_5b9621e0\bin' 'CinemaWithScanner254107020251'

--- MINI CINEMA MENU ---
1. Input audience data
2. Show audience list
3. Exit
Select menu (1/2/3): 1

--- INPUT AUDIENCE ---
Enter a name: Ringga
Enter row number (1-4): 1
Enter column number (1-2): 2
SUCCESS: Ringga assigned to seat R1C2.

--- MINI CINEMA MENU ---
1. Input audience data
2. Show audience list
3. Exit
Select menu (1/2/3): 
```

2.3 Experiment 3: 2-Dimensional Array with Different Row Lengths Experiment

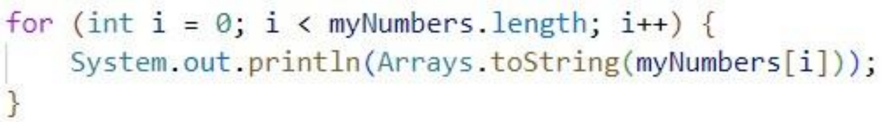
Time: 80 minutes

1. Open a text editor. Create a new file, name it **Numbers<StudentID>.java**
2. Write the basic structure of the Java programming language which contains the **main()** function
3. Declaration and instantiation of a 2-dimensional array named **myNumbers** with elements of type int. The array has 3 rows. The first row consists of 5 columns. The second row consists of 3 columns. The third row consists of 1 column.

```
int[][] myNumbers = new int[3][];
myNumbers[0] = new int[5];
myNumbers[1] = new int[3];
myNumbers[2] = new int[1];
```

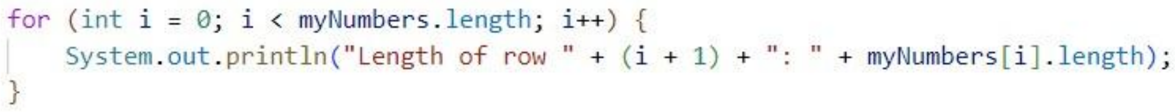
4. Commit and push the program code to GitHub **Questions!**

1. Add the following program code:



```
for (int i = 0; i < myNumbers.length; i++) {
    System.out.println(Arrays.toString(myNumbers[i]));
}
```

2. What is the function of Arrays.toString()?
3. What is the default value for elements in an array with the data type int?
4. Add the following program code:



```
for (int i = 0; i < myNumbers.length; i++) {
    System.out.println("Length of row " + (i + 1) + ": " + myNumbers[i].length);
}
```

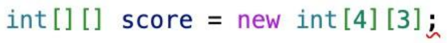
5. The **myNumbers** array has a different length for each row. How to make the length for each row the same? Can the array length be modified?

2.4 Experiment 4: SIAKAD Case Study

Experiment Time: 75 minutes

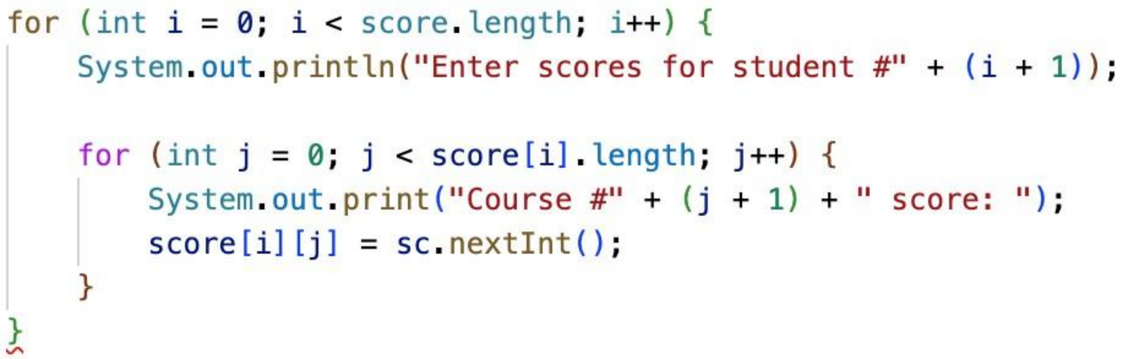
In the Academic Information System (SIAKAD), a lecturer enters grades for four students in Course 1 (Programming Basics), Course 2 (Mathematics), and Course 3 (CTPS).

1. Open a text editor. Create a new file and name it SIAKAD<AbsenteeNo>.java.
2. Write the basic structure of the Java programming language, consisting of the main() function.
3. Import the Scanner library.
4. Declare the Scanner variable.
5. Create an array of int values named values with four rows and three columns.



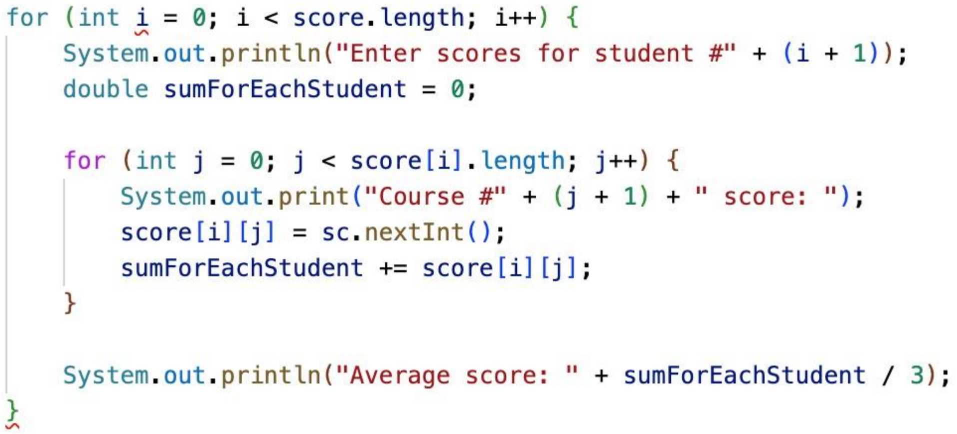
```
int[][] score = new int[4][3];
```

6. Use a scanner and a nested loop to fill in the elements in the values array. Compile and run the program code.



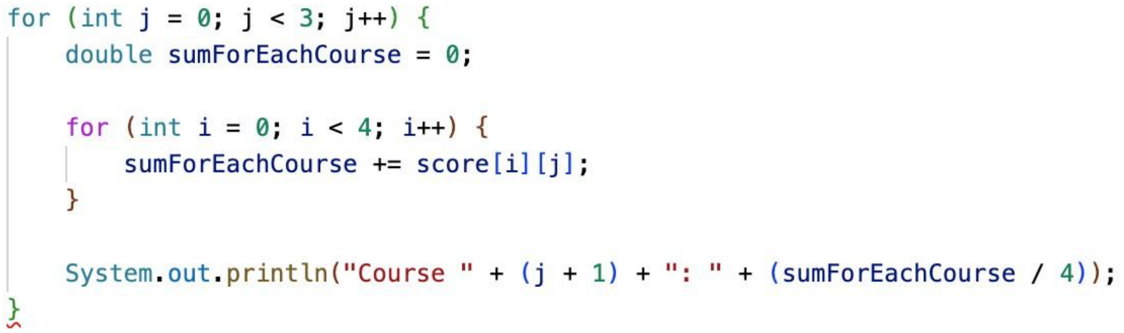
```
for (int i = 0; i < score.length; i++) {
    System.out.println("Enter scores for student #" + (i + 1));

    for (int j = 0; j < score[i].length; j++) {
        System.out.print("Course #" + (j + 1) + " score: ");
        score[i][j] = sc.nextInt();
    }
}
```

7. Modify the program code in step 6 to calculate and display the average score for each student



```
for (int i = 0; i < score.length; i++) {
    System.out.println("Enter scores for student #" + (i + 1));
    double sumForEachStudent = 0;

    for (int j = 0; j < score[i].length; j++) {
        System.out.print("Course #" + (j + 1) + " score: ");
        score[i][j] = sc.nextInt();
        sumForEachStudent += score[i][j];
    }

    System.out.println("Average score: " + sumForEachStudent / 3);
}
```

8. Add program code to calculate the average grade for each course.

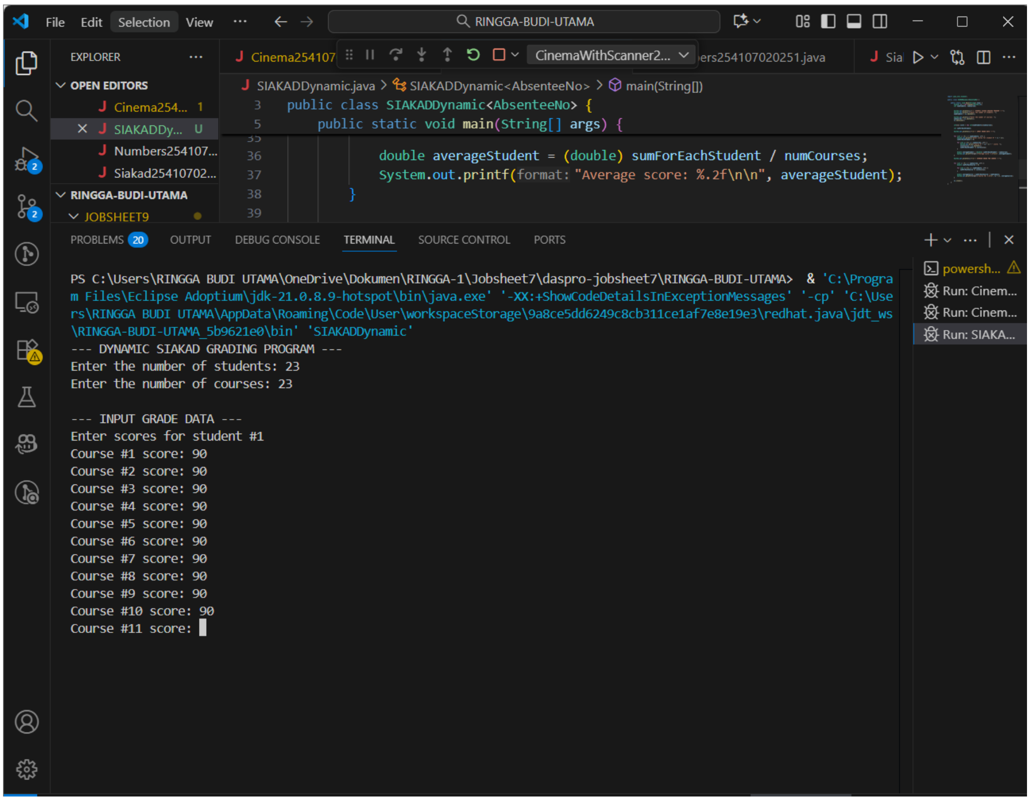


```
for (int j = 0; j < 3; j++) {
    double sumForEachCourse = 0;

    for (int i = 0; i < 4; i++) {
        sumForEachCourse += score[i][j];
    }

    System.out.println("Course " + (j + 1) + ": " + (sumForEachCourse / 4));
}
```

Question!

1. What happens if the number of students and courses changes? Modify the SIAKAD program code to accommodate the dynamic number of students and courses.

- ***Changes in the number of students and courses would make the previous static SIAKAD program code (`new int[4][3]`) inflexible. The program would either crash or produce incorrect results if you tried to input data for 5 students or 4 courses.***
- ***To accommodate a dynamic number of students and courses, we need to prompt the user for the number of rows (students) and columns (courses) at the start of the program and use those inputs to declare the array.***

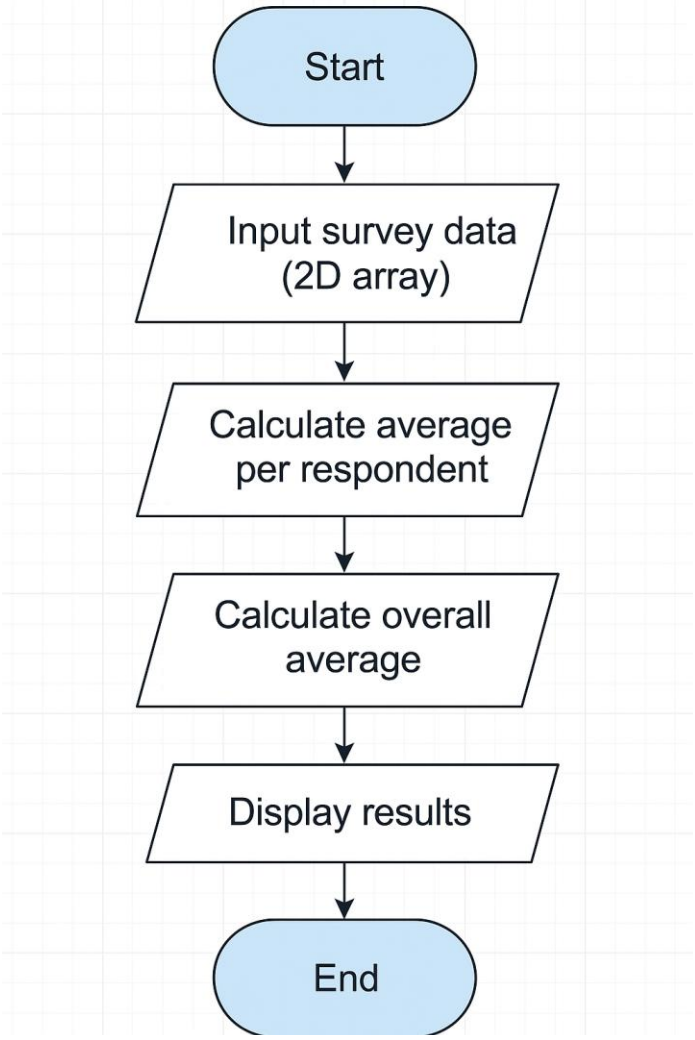


```java
public class SIAKADDynamic<AbsenteeNo> {
    public static void main(String[] args) {

            double averageStudent = (double) sumForEachStudent / numCourses;
            System.out.printf(format: "Average score: %.2f\n\n", averageStudent);
        }

```

```
PS C:\Users\RINGGA BUDI UTAMA\OneDrive\Dokumen\RINGGA-1\Jobsheet7\daspro-jobsheet7\RINGGA-BUDI-UTAMA>  & 'C:\Progra
m Files\Eclipse Adoptium\jdk-21.0.8.9-hotspot\bin\java.exe' '-XX:+ShowCodeDetailsInExceptionMessages' '-cp' 'C:\Use
rs\RINGGA BUDI UTAMA\AppData\Roaming\Code\User\workspaceStorage\9a8ce5dd6249c8cb311ce1af7e8e19e3\redhat.java\jdt_ws
\RINGGA-BUDI-UTAMA_5b9621e0\bin' 'SIAKADDynamic'
--- DYNAMIC SIAKAD GRADING PROGRAM ---
Enter the number of students: 23
Enter the number of courses: 23

--- INPUT GRADE DATA ---
Enter scores for student #1
Course #1 score: 90
Course #2 score: 90
Course #3 score: 90
Course #4 score: 90
Course #5 score: 90
Course #6 score: 90
Course #7 score: 90
Course #8 score: 90
Course #9 score: 90
Course #10 score: 90
Course #11 score: 
```

3. Assignment (75 minutes)

- Implement the flowchart created in the Basic Programming (Theory) exercise into Java program code.


Start
Input survey data (2D array)
Calculate average per respondent
Calculate overall average
Display results
End