

# COMP 250

INTRODUCTORY SCIENCE

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<https://eduassistpro.github.io/>

Week 1-2:  
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# WHAT ARE WE GOING TO DO IN THIS VIDEO?



- Arrays
  - Multidimensional ar
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# ARRAYS

- An array is like a container that holds a **fixed number** of values of the **same type**. These values can be accessed using the same variable name.
  - The length of the array is established when the array is created and it cannot be changed. <https://eduassistpro.github.io/>
  - All the elements of an array must be the same type. Add WeChat edu\_assist\_pro
- The values in the array are called *elements*.
- The list of elements is indexed, the order matters.

## ARRAYS – DECLARATION

To create an array, we first have to declare a variable with an array type:

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`t`  `https://eduassistpro.github.io/`

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The squar indicate  
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All the elements of the array must have this type.

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## ARRAYS – DECLARATION

- To create an array, we first have to declare a variable with an array type:

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```
ty                                ;
```

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- Examples:

```
String[] days;  
int[] grades;  
double[] heights;  
String[] args;
```



## ARRAYS – DECLARATION

- To create an array, we first have to declare a variable with an array type:

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- Examples:

```
String[] days;  
int[] grades;  
double[] heights;  
String[] args;
```

**NOTE:** The declaration creates a variable, but **we still need to create the actual array object itself!**

## ARRAYS – EXAMPLE

Here is a list of the days of the week:

- 
0. Monday
  1. Tuesday
  2. Wednesday
  3. Thursday
  4. Friday
  5. Saturday
  6. Sunday

Note that we start  
counting at 0!!

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We would like to use an array to store them all.

## ARRAYS – INITIALIZATION METHOD 1

- **Using curly brackets**, we can assign values to all elements in the array at the same time as we declare the array:

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```
String[] days = {"Monday", "Tuesday", "Wednesday",  
                "Thursday", "Friday", "Saturday", "Sunday"};
```

- `days` is an array of `String` values of length 7.
- Order matters!! What is the index of "Tuesday"?
- **This method does not work if you don't know the length or the values of the array before the program runs.**

## ARRAYS – INITIALIZATION METHOD 2

- We can use the **new** operator to create an array of a certain size. We can then populate the entries one at a time, later in the program.

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## ARRAYS – INITIALIZATION METHOD 2

- We can use the **new** operator to create an array of a certain size. We can then populate the entries one at a time, later in the program.

- The following exam <https://eduassistpro.github.io/> of String values with length 7.  
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```
String[] days = new String[7];
```

```
String[] days;  
days = new String[7];
```

```
int numberOfDays = 7;  
String[] days;  
days = new String[numberOfDays];
```

## ARRAYS – INITIALIZATION METHOD 2

- We can use the **new** operator to create an array of a certain size. We can then populate the entries one at a time, later in the program.

- After the creation, <https://eduassistpro.github.io/>

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```
String[] days = new String[7];  
days[1] = "Tuesday";  
days[0] = "Monday";  
days[6] = "Sunday";  
days[5] = "Saturday";  
days[2] = "Wednesday";  
days[3] = "Thursday";  
days[4] = "Friday";
```

## DEFAULT VALUES

- As soon as we create an array object and initialize the variable, java assigns default values to each position in the array. Thus, if we don't assign any values to the array, the values assigned by default.

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- The default values are: Add WeChat edu\_assist\_pro
  - For numerical arrays: 0
  - For String/reference type arrays: null
  - For char arrays: the character with ASCII value 0
  - For boolean arrays: false.

## SIZE OF AN ARRAY

- When we create an array of size  $n$ ,  $n$  contiguous places in memory are reserved in order to store  $n$  values of the same type.

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- The size of an array cannot be assigned.

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- Any integer expression can be used for the size of an array as long as the value is nonnegative. If negative: **NegativeArraySizeException**.



## ACCESSING ELEMENTS

- Elements in an array can be access using the name of the array variable and the index of the element inside square brackets.

- `days[0] = "Sunda";`

The value "Sunda" index 0

- `String lastDay =`

The value in days at index 6 is assi ariable lastDay

- `days[0] = days[6];`

The value in days at index 6 is assigned to days at index 0.

- If we use an index that is negative or grater than the size of the array minus 1, the result is an **ArrayIndexOutOfBoundsException**.

## ARRAYS AND LOOPS

- When we wanted to traverse a `String s`, we would loop through all the indices up to (and not including) `s.length()`
- Similarly, we can access `grades` using `grades.length`

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```
double sum = 0;
for (int i = 0; i < grades.length; i++) {
    sum += grades[i];
}
double avg = sum/grades.length;
```

# ARRAYS AND LOOPS

Note the  
difference!

- When we wanted to traverse a `String s`, we would loop through all the indices up to (and not including) `s.length()`
- Similarly, we can access `grades` using `grades.length`

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```
double sum = 0;
for (int i = 0; i < grades.length; i++) {
    sum += grades[i];
}
double avg = sum/grades.length;
```

## COMMON MISTAKES

- Forgetting to initialize the entries of your array.

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```
int https://eduassistpro.github.io/  
System.out.print(Add WeChat edu\_assist\_pro);
```

- Output: 0

## COMMON MISTAKES

- Referring to an index that doesn't exist.

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```
String[] petNames = {"Bilbo", "Small cat"};  
System.out.println(petNames[5]);  
System.out.println(petNames[-2]);
```

- **ArrayIndexOutOfBoundsException** exception

## COMMON MISTAKES

- Trying to create an array with negative size.

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```
int size = -3 % 5;  
String[] petNames = new String[size];
```

- **NegativeArraySizeException** exception

## PRINTING DIFFERENCES

```
public static void myMethod(int[] a) {  
    for (int i=0; i<a.length; i++) {  
        System.out.println(a[i] - a[i+1]);  
    }  
}
```

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The above code is supposed to loop through an array and print the difference between adjacent elements.

It contains an error. What is it?

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## HOW TO CHECK EQUALITY?

```
int[] x = {1, 2, 3};
```

```
int[]
```

```
System
```

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- What do you think the program will print?

false

## HOW TO CHECK EQUALITY?

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```
int[] x = {1,2,3};  
int[] y  
System.out.println(y);
```

- What do you think the program will print?

false

## HOW TO CHECK EQUALITY?

```
int[] x = {1, 2, 3};  
int[] y =  
System.out
```

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**als(x,y);**

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- This compares the content of the two arrays.
- To use it, you need to import `java.util.Arrays;`

true

# THE ARRAYS CLASS

- Arrays contains methods for manipulating arrays.
- Arrays is part of the <https://eduassistpro.github.io/>  
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- Before using it is useful to import it.
- <https://docs.oracle.com/javase/8/docs/api/java/util/Arrays.html>

# THE IMPORT STATEMENT

- The import statement for the `Arrays` class:

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```
import java.util. Arrays;
```

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- This statement allows us to refer to the program without having to refer to the full package (`.util.Arrays`). It makes sure that the compiler knows which class we are referring to.
- All import statements are at the beginning of the file, before the class definition.

java.lang

- **Exception to the import rule** all classes in the java.lang package, therefore we did not need to import it in order to use it.
- **Remember the Math class?**

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## OTHER USEFUL METHODS?

In the `Arrays` class you can find:

- `Arrays.equals(x, y)`

It returns a Boolean value indicating whether the content of the two arrays is the same. <https://eduassistpro.github.io/>

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- `Arrays.toString(x)`

It returns the content of an array as a String.

- `Arrays.sort(x)`

It sorts the input array in increasing order.

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# ARRAYS

- We have seen arrays as object with a fixed length containing elements of the sa

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- What if the elements where of a

- How do we create arrays of arrays?

## 2D ARRAYS – HOW TO CREATE THEM

There are 3 ways to create arrays of arrays:

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1. `int[][] numbers = { {1, 2, 3} };`

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2. `int[][] numbers = new int[3][2];`

3. `int[][] numbers = new int[3][];`

## 2D ARRAYS – HOW TO CREATE THEM

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`int[][] numbers = {{1}, {1, 2, 3}, {1, 2}};`

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This creates an array of length 3, containing integer arrays. The **first element** is an array of length 1 (with value 1), the **second** an array of length 3 (with values 1, 2, 3), and the **third** an array of length 2 (with values 1, 2).

## 2D ARRAYS – HOW TO CREATE THEM

```
int [][3] numbers = new int[3][2];
```

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This creates an array of length 3. Each an integer array of length 2. You can think of it as a 3 by 2 matrix.

All the elements of the integer arrays are initialized by default to 0 (since they are int).

## 2D ARRAYS – HOW TO CREATE THEM

```
int[][] numbers = new int[3][];
```

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This creates an array of length 3. Each element will be an integer array.  
For the moment the elements are initialized by default to `null`.

To populate the element of `numbers` we need to create 3 integer arrays and assign them to the elements of `numbers` one at a time.

## 2D ARRAYS – TWO EQUIVALENT ARRAYS

```
int[][] numbers = new int[3][];  
int[] first = {1, 2, 3};  
int[]  
number  
numbers[1] = seco  
numbers[2] = new int[1];  
numbers[2][0] = 5;
```

```
int[][] num = {{1, 2, 3}, {0, 0}, {5}};
```

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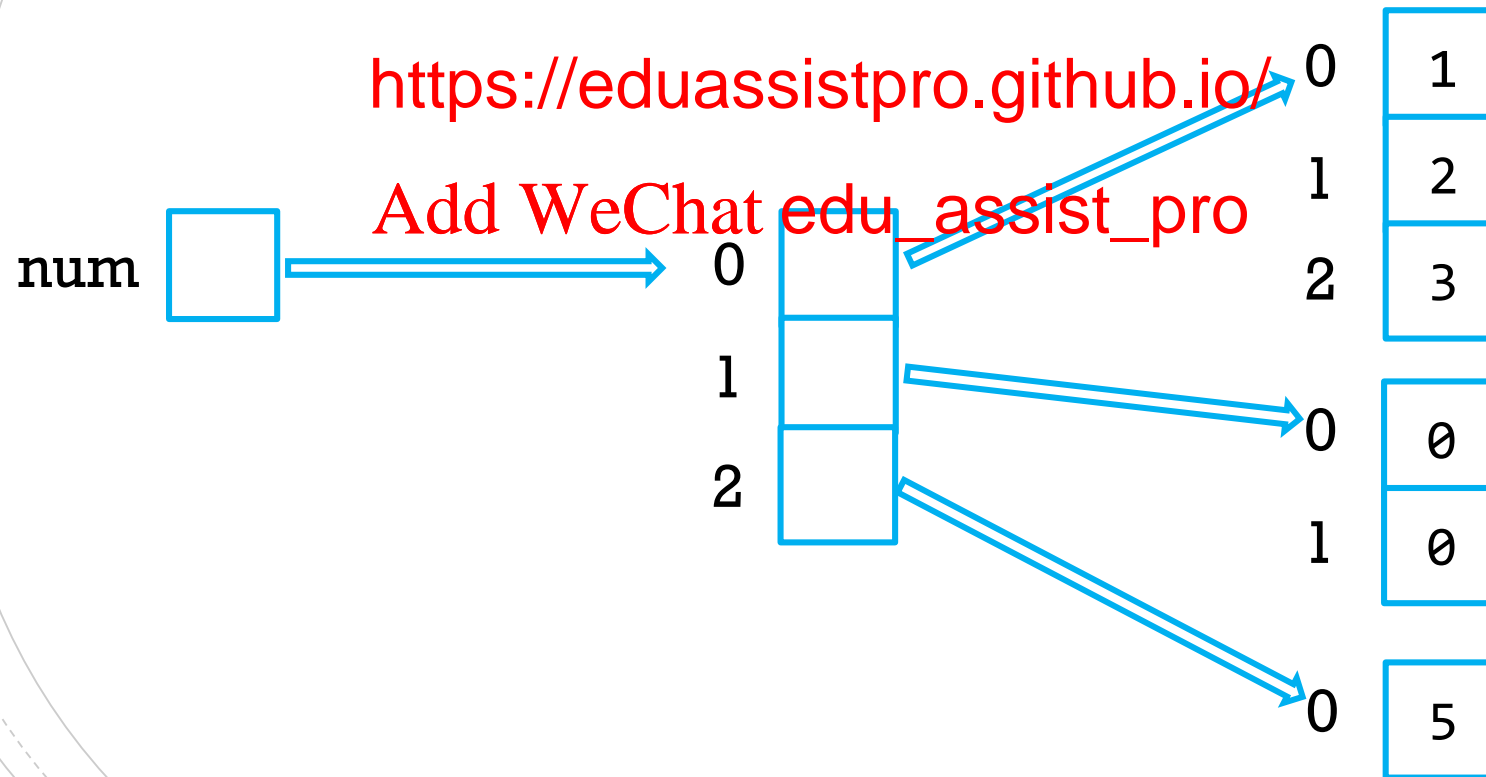
## 2D ARRAYS

```
int[][] num = {{1, 2, 3},{0, 0},{5}};
```

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## 2D ARRAYS

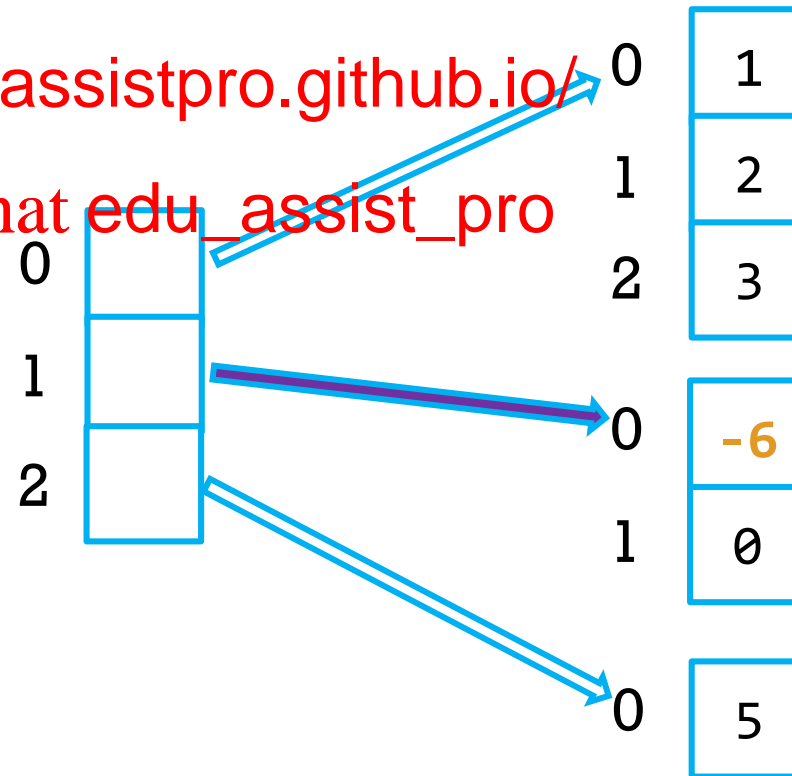
```
int[][] num = {{1, 2, 3},{0, 0},{5}};  
num[1][0] = -6
```

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num



Note:

- We changed an element of `num[1].num[1]` is an array and arrays are **mutable** → the reference stored in `num[1]` did not change!



## NOTE ON EQUALITY

- If you try to use `Arrays.equals(array1, array2)` on two arrays of arrays, it will not compare the elements of the inner arrays.

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- If you want to compare the elements of arrays you should use

`Arrays.deepEquals(array1, array2)`

# MULTIDIMENSIONAL ARRAYS

- You can create arrays with as many dimensions as you like.

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```
int[][][] mat = new int[3][3][3];  
String[][][] string4D = new String[2][][][];
```

- In practice, anything higher than 3D is rarely used.

An orange paint roller with a red handle, positioned horizontally. The roller is covered in orange paint, which is dripping down the left side. The text "Coming Soon" is written in white on the orange surface of the roller.

Coming Soon

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In the next

g about

reference

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