

# COMP 250

## INTRODUCTORY SCIENCE

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Week 2-3: Reference 1

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# WHAT ARE WE GOING TO DO IN THIS VIDEO?



- Reference types

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- Random

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## PRIMITIVE VS REFERENCE TYPES

- Both arrays and Strings are Objects.

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- In java, except for t (those whose names start with lowercase https://eduassistpro.github.io/ , etc.), everything is an Object.

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- Variables of Objects, arrays included, don't store the values of the objects, but a **reference** to the location in memory containing that value. You can think of it as an address which points to where the data is located in memory.

## REFERENCE TYPES

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## PRIMITIVE VS REFERENCE TYPES – EXAMPLES

```
public static void main(String[] args) {  
    int x = 5;  
    int y =  
    x++;  
    System.out.println(y);  
}
```

- What does the program print?

6 5

## PRIMITIVE VS REFERENCE TYPES – EXAMPLES

```
public static void main(String[] args) {  
    int[] x = {1, 2, 3};  
    int[] y  
    y[0] = 4  
    System.out.println(x + y[0]);  
}
```

- What does the program print?

4 4

## PRIMITIVE VS REFERENCE TYPES – EXAMPLES

```
public static void main(String[] args) {  
    int x = 5;  
    example(x);  
    System.out.println(x);  
}  
public static void example(int x) {  
    x = x*5;  
}
```

- What does the program print?

5



## PRIMITIVE VS REFERENCE TYPES – EXAMPLES

```
public static void main(String[] args) {  
    int[] x = {1,2,3};  
    example(x);  
    System.  
}  
public static void example(int[] x) {  
    x[0] = 4;  
}
```

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- What does the program print?

4

# ARRAY VS STRING

- Both arrays and strings are reference types.

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- Variables of array-type store the address in memory at which object begins.

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- Arrays are mutable, Strings are **immutable!!**
  - Once a String has been created it cannot be changed!
  - The elements of an array can be updated anytime we want.

## REFERENCE TYPES

```
String[] pets = {"cat", "dog"};
```

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pets



0

1



"cat"

"dog"

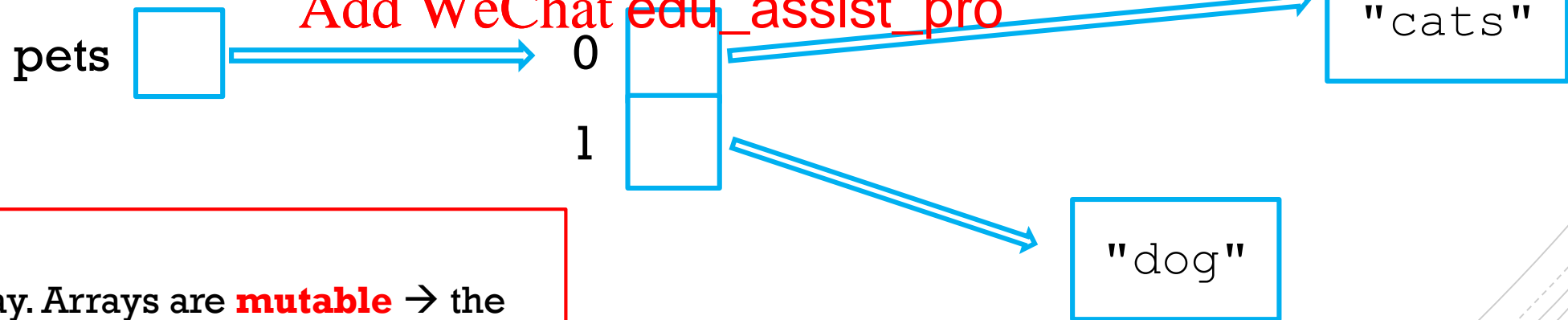
## REFERENCE TYPES

```
String[] pets = {"cat", "dog"};  
pets[0] = pets[0] + "s";
```

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To note:

- We changed the array. Arrays are **mutable** → the reference stored in `pets` did not change!
- We changed the first String. Strings are **immutable** → the reference in `pets[0]` did change!

## ARRAY VS STRING – EXAMPLE 1

```
public static void main(String[] args) {  
    int[] x = {1, 2, 3, 4};  
    myMethod(x);  
    System.out.println(Arrays.toString(x));  
}  
  
public static void myMethod(int[] a) {  
    for(int i=0; i<a.length; i++)  
        a[i] = i;  
}
```

■ What prints?

➤ [0, 1, 2, 3]

## ARRAY VS STRING – EXAMPLE 1

```
public static void main(String[] args) {  
    String s = "word";  
    myMethod(s);  
    System.  
}  
  
public static void myM      ing t) {  
    t = t + "s";  
}
```

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■ What prints?

➤ word

## ARRAY VS STRING – EXAMPLE 2

```
char[] letters = {'w', 'o', 'r', 'd'};  
for(int i=0; i<letters.length; i++){  
    if(letters  
        letters[  
    }  
}  
System.out.println(Arrays.toString(letters));
```

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■ What prints?

➤ [w, a, r, d]

## ARRAY VS STRING – EXAMPLE 2

```
String s = "word";  
for(int i=0; i<s.length(); i++) {  
    if(s.charAt(i) == 'd') {  
        s.charAt(i) = 'o';  
    }  
}  
System.out.println(s);
```

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### ■ What prints?

- compile time error: unexpected type.  
Required: variable. Found: value.



## ARRAY VS STRING – EXAMPLE 2

```
String s = "word";
String t = "";
for(int i=0; i<s.length(); i++) {
    if(s.charAt(i) == 'a') {
        t = t + "a";
    } else {
        t = t + s.charAt(i);
    }
}
System.out.println(t);
```

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# THE NULL KEYWORD

- Any reference type variable can have a `null` value.

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- `null` indicates the a

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- We can think of a variable with `null` as a box with no arrow/pointing nowhere.

```
int[] blank = null;
```

blank



## NullPointerException



- If we try to access information through a variable with value `null`, the code will throw a `NullPointerException`.

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```
int[] blank = null;  
System.out.println(blank.length);  
System.out.println(blank[0]);
```

# DEFAULT VALUES

- In java, **local variables** (those declared within the body of a method, i.e. all the variables we have seen up to now) are **not** given an initial default value!
  - This is why if we try to use a variable without initializing it, the compiler will throw the following "variable has not been initialized" error
- On the other hand, **array elements** (and **object variables**, tbd) are initialized with default values:
  - int/short/byte/long with 0
  - double/float with 0.0
  - boolean with false
  - char with 0
  - **reference types with null.**

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## EXAMPLES – LOCAL VARIABLES

```
int base;  
int area = squared(base);
```

```
String day;  
System.out.println("Today is "
```

```
int[] grades;  
int size = grades.length;
```

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**Compile-time error!**  
**Variable not  
initialized!**

## EXAMPLES – ARRAYS' ELEMENTS

```
int[] num = new int[3];  
int sum = num[0] + num[1] + num[2];
```

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sum has value 0

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```
String[] days = new String[7];  
System.out.println("Today is " + d
```

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> Today is null

```
String[] days = new String[7];  
int numLettersMonday = days[0].length();
```

NullPointerException

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## THE RANDOM CLASS

- Up to now you probably learned how to use `Math.random()` to get random numbers between a minimum value and a maximum value.

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- We can also use the `Random` class to generate random numbers.

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- The `Random` class allows us to seed it with a specific number such that we will see **the same** sequence of 'random' numbers each time.

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- Why is it useful?

Easier to debug code that is not working.

Comparing outputs from different codes (for instance your assignments)



## HOW TO USE RANDOM

**First import the Random class:** `add import java.util.Random;`

**Then you can create a random number generator using the following statement:**

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```
int seed = 123;  
Random randomGenerator = new Random();  
Random otherGenerator = new Random(seed);
```

## HOW TO USE RANDOM

**First import the Random class:** `add import java.util.Random;`

**Then you can create a random number generator using the following statement:**

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```
int seed = 123;  
Random randomGenerator = Random(dom());  
Random otherGenerator = new Random(seed);
```

**Declaration of two  
variables of type Random.**

# HOW TO USE RANDOM

**First import the Random class:** `add import java.util.Random;`

**Then you can create a random number generator using the following statement:**

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```
int seed = 123;  
Random randomGenerator = Random.  
Random otherGenerator = new Random(seed);
```

**Declaration of two variables of type Random.**

**Creation of a Random **object**. Note the **new** keyword! Random is a reference type.**

## METHODS IN RANDOM

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## DICE ROLL

Here's an example of using Random to simulate a dice roll  
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```
Random randomGenerator = new Random();  
int diceRoll = randomGenerator.nextInt(6) + 1;  
System.out.println("The dice rolled " + diceRoll);
```

An orange paint roller with a red handle, positioned horizontally. The roller is partially filled with orange paint, and there are orange paint splatters and drips around it. The text "Coming Soon" is written in white on the orange part of the roller.

# Coming Soon

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