Kybele Research Group

ISe Ingeniería de Servicios
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Universidad Rey Juan Carlos

3: Loops, Arrays

Assignment 2

Foo Corporation needs a program to calculate how much to pay their employees.

1. Pay = hours worked x base pay
2. Hours over 40 get paid 1.5 the base pay
3. The base pay must be no less than $8.00
4. The number of hours must be no more than 60

Frequent Issues (I)

The signature of the *main* method *cannot* be modified.

```
public static void main(String[] arguments) {
                        ...
}
```

Frequent Issues (II)

Return values: if you declare that the method is not *void*, then it has to return something!

```
public static int pay(double basePay, int hours){
      if (basePay < 8.0)
            return -1;
      else if (hours > 60)
            return -1;
      else {
            int salary = 0;
            …
            return salary;
      }
```

Frequent Issues (III)

Don't create duplicate variables with the same name

```
public static int pay(double basePay, int hours){

      int salary = 0; // OK

      int salary = 0; // salary already defined!!

      int salary = 0; // salary already defined!!


      }
```

Frequent Issues (III)

```
class WeeklyPay {
  public static void pay(double basePay, int hours) {
        if (basePay < 8.0) {
                System.out.println("You must be paid at least $8.00/hour");
                } else if (hours > 60) {
                        System.out.println("You can't work
                                        more than 60 hours a week");
        } else {
                int overtimeHours = 0;
                if (hours > 40) {
                overtimeHours = hours - 40;
                hours = 40;
                }
                double pay = basePay * hours;
                pay += overtimeHours * basePay * 1.5;

                System.out.println("Pay this employee $" + pay);
        }
  }
  public static void main(String[] arguments) {
        pay(7.5, 35);
  pay(8.2, 47);
  pay(10.0, 73);
  }
}
```

Whatwe have learned so far

- Variables & types
- Operators
- Type conversions & casting
- Methods & parameters
- *If* statement

Today's Topics

- Good programming style
- Loops
- Arrays

Good Programming Style

Good programming style

The goal of good style is to make your code more readable.

By you and by others.

Rule #1: use good (meaningful) names

```
String a1;
int a2;
double b;                    // BAD!!

String firstName;            // GOOD
String lastName;             // GOOD
Int temperature;             // GOOD
```

Rule #2: Use indentation

```
public class test {

public static void main (String[] arguments) { int x = 5;
x = x * x;
if (x > 20) {
System.out.println(x + " is greater than 20.");
}
double y = 3.4; }
}
```

```
public class test {

    public static void main(String[] arguments) {
        int x = 5;
        x = x * x;
        if (x > 20) {
            System.out.println(x + " is greater than 20.");
        }
        double y = 3.4;
    }
}
```

Rule #3: Use whitespaces

Put whitespaces in complex expressions

```
// BAD!!
double cel=fahr*42.0/(13.0-7.0);

// GOOD
double cel = fahr * 42.0 / (13.0 - 7.0);
```

Rule #4: Use whitespaces

Put blank lines to improve readability:

```
public static void main (String[] arguments) {

      int x = 5; x = x * x;
      if (x > 20) {
            System.out.println(x + " is > 20.");
      }

      double y = 3.4;
}
```

Rule #5: Do not duplicate tests

```
if (basePay < 8.0) {
        ...
}
else
        if (hours > 60) {
                ...
        }
else
        if (basePay >= 8.0 && hours <= 60) {
                ...
        }
```

Rule #5: Do not duplicate tests

```
if (basePay < 8.0) {
        ...
}
else
        if (hours > 60) {
                ...
        }
else
        if (basePay >= 8.0 && hours <= 60) {
                ...
        }
```

Good programming style (summary)

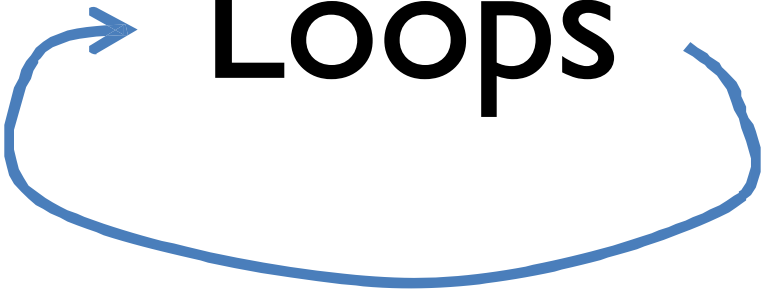
Use good names for variables and methods

Use indentation

Add whitespaces

Don't duplicate tests

Loops



Loops

What if you want to do it for 200 Rules?

```
static void main (String[] arguments) {
    System.out.println("Rule #1");
    System.out.println("Rule #2");
    System.out.println("Rule #3");
}
```

Loops

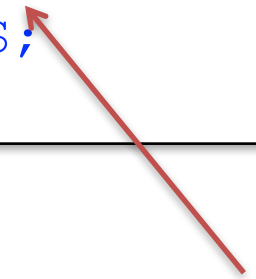
Loop operators allow to loop through a block of code.

There are several loop operators in Java.

The *while* operator

Allows a programmer to state that an action (or a block of them) will be executed as long as certain condition is met

```
while (condition){
        STATEMENTS;
}
```



Must be a boolean expression

The *while* operator

```
int i = 0;
while (i < 3) {
      System.out.println("Rule #" + i);
      i = i+1;
}
```

Count carefully

Make sure that your loop has a chance to finish

- Meeting the condition has to be closer as the number of iterations grows

The *for* operator

Execute an statement (or block of them) a given number of times

```
for (initialization; condition; update){
        STATEMENTS;
}
```

The *for* operator

```
for (int i = 0; i < 3; i = i + 1){
        System.out.println("Rule #" + i);
}
```

i = i+1 may be replaced by i++

Condition is a boolean expression, which is computed at the end of each iteration.

If it yields true, another iteration comes

The initialization expression marks the start of the loop.

In general, it consists of declaring and initializing a variable so-called *control variable*

The update expression is executed at the end of each iteration.

In general, it consists of increasing the control variable

For

- Print all the integers between 1 and 20

```
for(int i = 1; i <= 10; i++)
{
  System.out.println(i);
}
```

- Print all the even numbers between 20 and 2)

```
for(int i = 20; i >=0; i -= 2)
{
  System.out.println(i);
}
```

Branching Statements

One might want to leave the loop, even though the condition has not been met yet

- break terminates a *for* or while *loop*

```
for (int i=0; i<100; i++) {
  if(i == 50)
     break;
  System.out.println("Rule #" + i);
}
```

Branching Statements

One might want to leave the current statement and go directly to the next one

- continue skips the current iteration of a loop and proceeds directly to the next iteration

```
for (int i=0; i<100; i++) {
   if(i == 50)
      continue;
   System.out.println("Rule #" + i);
}
```

Embedded loops

Scope of the variable defined in the initialization (control variable): respective *for* block

```
for (int i = 0; i < 3; i++) {
  for (int j = 2; j < 4; j++) {
    System.out.println (i + " " + j);
  }
}
```

do - while

Regarding while loops, the statements are always executed at least once

- Since condition is not computed until the end of the first iteration

```
do {
  STATEMENTS;
}while(condicion);
```

do - while

Example

- Write down numbers between 1 and 10;

```
int i= 1;
do {
        System.out.println(i);
        i++;
} while (i <= 10);
```

Tips

Just while loop ends with ';'

```
for (int i=0; i<10; i++);
{
  System.out.println("i is " + i);
}

int i=0;
while (i < 10);
{
  System.out.println("i is " + i);
  i++;
}

int i=0;
do {
  System.out.println("i is " + i);
  i++;
} while (i<10);
```

BAD

GOOD

Arrays

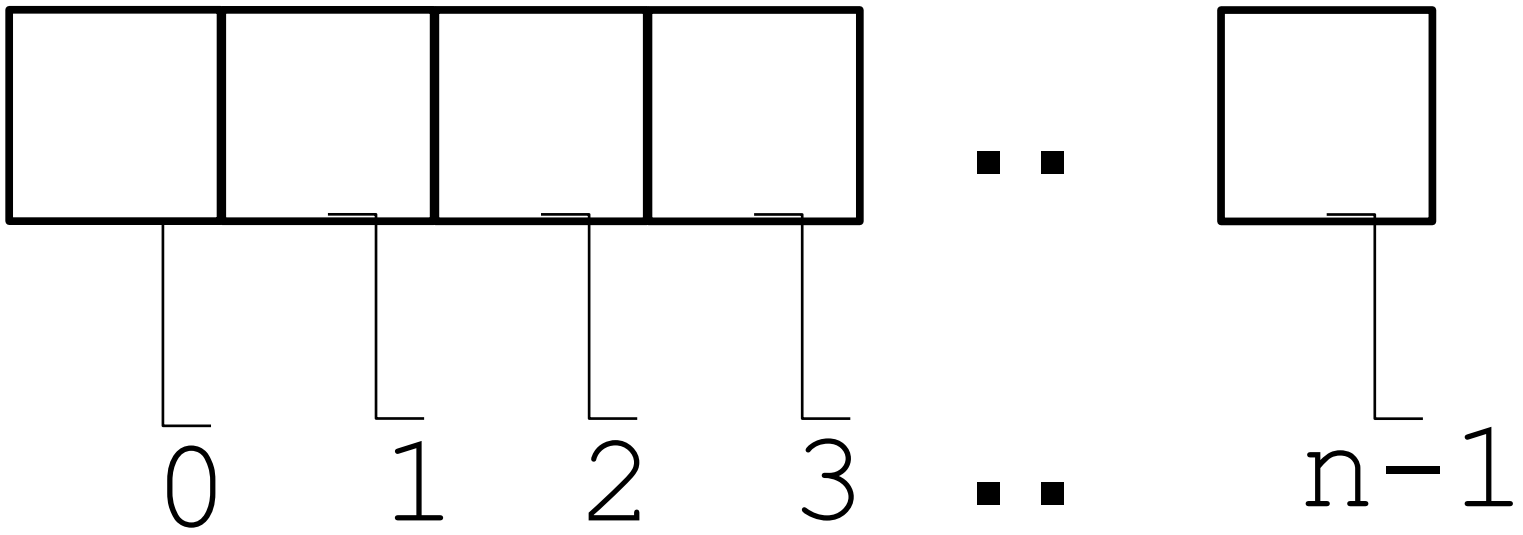
Arrays

An array is an indexed list of values

- You can make an array of **any type** (int, double, String, etc.)
- All elements of an array must have the **same type**
- We can refer to the whole list of values (the array variable) …
- ... or to one specific value
- We can, as well, modify the list of values by adding, deleting of modifying each specific value

Arrays

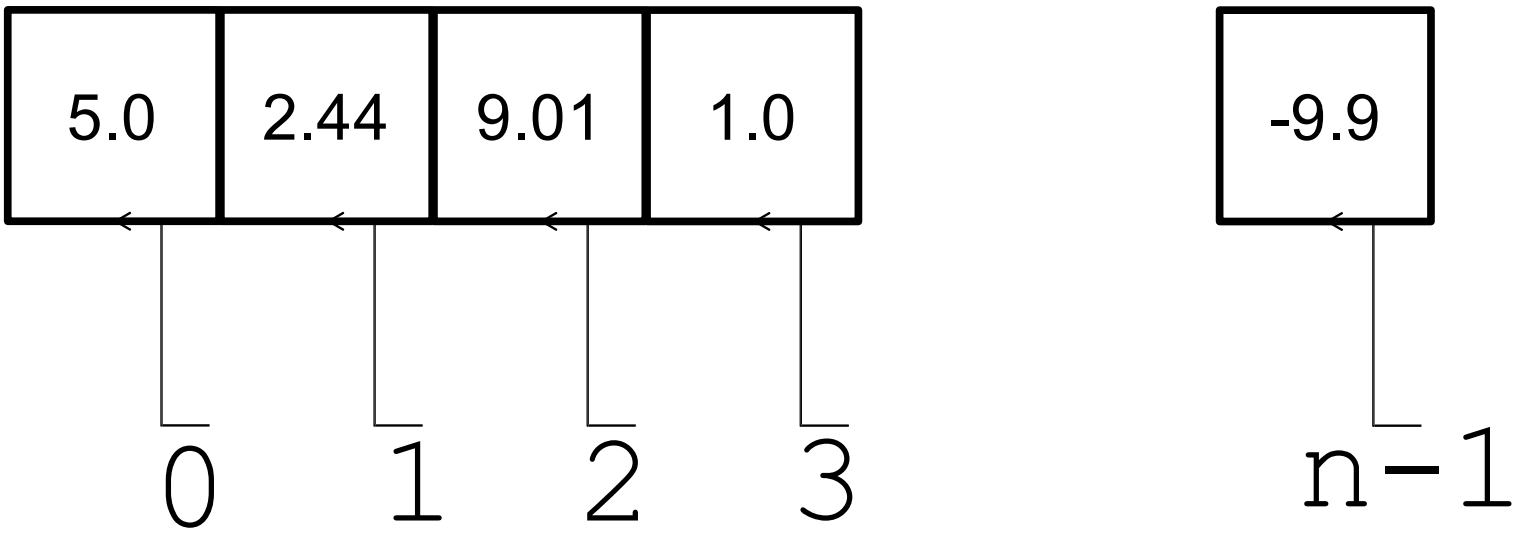
The first element of the array is located at **index 0**, while the last one is located at **index n - 1**



Arrays

The first element of the array is located at **index 0**, while the last one is located at **index n – 1**

- Example: `double [];`



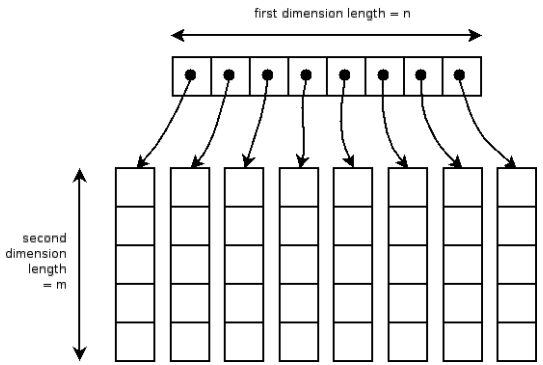
Arrays

Array definition

- TYPE []

Arrays are just another type

- Arrays of array type can be defined




```
int [] values; // array of int values
int [][] values;
// array of array of int values
```

`int []` **is a data type**

Arrays

To create an array of a given size, use the new operator

- Or you may use a variable to specify the size:

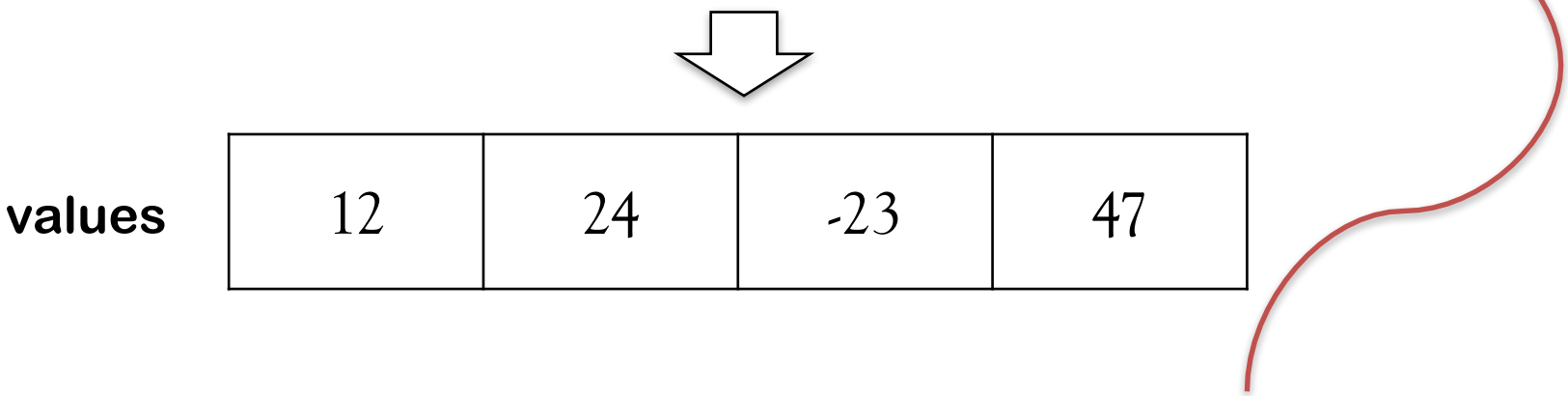
```
int[] values = new int[5];

// using a variable
int size = 12;
int[] values = new int[size];
```

Array Initialization

Curly braces can be used to initialize an array.

- It can ONLY be used when you declare the variable.

```
int[] values = {12, 24, -23, 47};
```

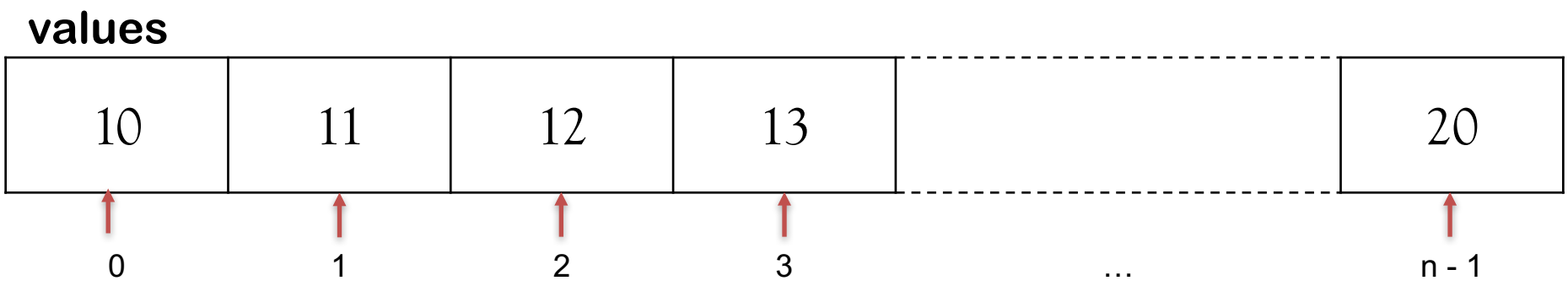


The size of the array is implicitly set to 4

Arrays

The first element of the array is located at **index 0**, while the last one is located at **index n - 1**

```
int[] values = new int[10];
values[0] = 10; // CORRECT
values[1] = 11; // CORRECT
values[2] = 12; // CORRECT
values[3] = 13; // CORRECT
values[9] = 19; // CORRECT
values[10] = 20; // WRONG!!
// compiles but throws an Exception
// at run-time (demo)
```



Quiz time!

Is there an error in this code?

```
int[] values = {1, 2.5, 3, 3.5, 4}
```

Accesing Arrays

To access the elements of an array:

- Use the [ ] operator and state the position needed

```
int[] values = {12, 24, -23, 47};
values[3] = 18; // {12, 24, -23, 18}
int x = values[1] + 3; // {12, 24, -23, 18}
```

Array starts at position 0 and ends at position length - 1

Accessing Arrays

To access the elements of an array, use the [] operator:

```
values[index]
```

Example:

```
int[] values  = { 12, 24, -23, 47 };
values[3] = 18;              // {12,24,-23,18}
int x = values[1] + 3; // {12,24,-23,18}
```

The *length* variable

Each array has a length variable built-in that contains the length of the array.

```
int[] values = new int[12];
int size = values.length; // size = 12

int[] values2 = {1,2,3,4,5}
int size2 = values2.length; // size = 5
```

String arrays

A side note

```
public static void main (String[]
    arguments){
    System.out.println(arguments.length);
    System.out.println(arguments[0]);
    System.out.println(arguments[1]);
}
```

Using Arrays

Arrays as arguments

```
// method to print an Array
public static void printArray(int[] array) {
  for (int i = 0; i < array.length; i++) {
    System.out.print(array[i] + " ");
  }
}
(…)

// method call
int[] list = {3, 1, 2, 6, 4, 2};
printArray(list);

// method call (another shape of)
printArray(new int[]{3, 1, 2, 6, 4, 2});
```

Arrays as method output

```
// Array inversion method
public static int[] reverse(int[] list) {
  int[] result = new int[list.length];
  // declaring the array to be returned

  for (int i = 0, j = result.length - 1; i < list.length; i++, j--) {
    result[j] = list[i];
  }

  return result; // devolvemos el array
}
(…)
// method call
int[] list1 = new int[]{1, 2, 3, 4, 5, 6}; // array to invert
int[] list2 = reverse(list1); // inverted array
```

Array Utils

- Arrays copy → `System.arrayCopy(...)`

```
public static void arraycopy(Object src, int srcPos,
                             Object dest, int destPos, int length)
```

```
class ArrayCopyDemo {
        public static void main(String[] args) {
                char[] copyFrom = { 'd', 'e', 'c', 'a', 'f', 'f', 'e',
                                    'i', 'n', 'a', 't', 'e', 'd' };
                char[] copyTo = new char[7];

                System.arraycopy(copyFrom, 2, copyTo, 0, 7);

                System.out.println(Arrays.toString(copyTo));
                // output: [c, a, f, f, e, i, n]
                System.out.println(new String(copyTo));
                // output: caffein
        }
}
```

Array Utils (II)

- java.util.Arrays

A method for each primitive type

```
public static char[] copyOfRange(char[] original,
                                 int from, int to)
```

```
class ArrayCopyDemo {
        public static void main(String[] args) {
                char[] copyFrom = { 'd', 'e', 'c', 'a', 'f', 'f', 'e',
                        'i', 'n', 'a', 't', 'e', 'd' };
                char[] copyTo = java.util.Arrays.copyOfRange(
                                                copyFrom, 2, 9);
                // no necesitamos crear el Array

                System.arraycopy(copyFrom, 2, copyTo, 0, 7);
                // salida: caffein
                System.out.println(Arrays.toString(copyTo));
                // salida: [c, a, f, f, e, i, n]
        }
}
```

Array Utils (III)

- java.util.Arrays

```
int binarySearch(tipo[] a, tipo key)
// returns the position of 'key' in 'a' array

boolean equals(tipo[] a, tipo[] a2)
// yields true if 'a' and 'a2' contain the same values

void fill(tipo[] a, tipo val)
// set every position of array 'a' to 'val'

void sort(tipo[] a)
// orders 'a' array (ASC)
```

Combining Loops and Arrays

Looping through an array

Example 1: iterating over an array (for)

```
int[] values = new int[5];

for (int i=0; i < valores.length; i++) {
     valores[i] = i;
     int y = valores[i] * valores[i];
     System.out.println(y);
}
```

Looping through an array

Example 2: iterating over an array

```
int[] valores = new int[5];
int i = 0;
while (i < valores.length) {
      valores[i] = i;
      int y = valores[i] * valores[i];
      System.out.println(y);
      i++;
}
```

Provided we are going to iterate over an array, a for loop seems more appropiate

Looping through an array

Iterando an array (improved `for`)

```
for(tipo variable_iteración: array)
   instrucciones;
```

```
int[] valores = {1,2,3,4,5};
int suma = 0;

for (int x: valores) {
      suma += x; // suma = suma + valores[i]
      System.out.println(suma);
}
```

Avoiding control variables, and array limits issues

Looping through an array

Iterando an array (improved `for`)

- Can leave the loop using the break statement

```
int[] valores = {1,2,3,4,5};
int suma = 0;

for (int x: valores) {
      suma += x; // suma = suma + valores[i]
      System.out.println(suma);
      if (suma > 100)
            break;
}
```

- But cannot modify the array
  - ~~x = ...~~

Summary for today

1. Programming Style
2. Loops
3. Arrays

Assignment

A group of friends participate in the Boston Marathon.

Find the best performer.

Find the second-best performer.

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