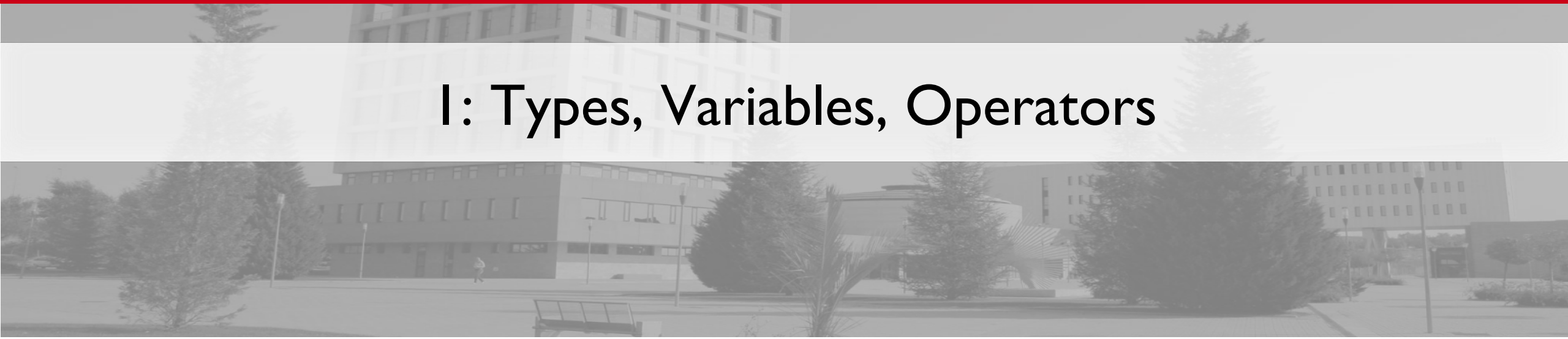
Kybele Research Group

ISe Ingeniería de Servicios
www.ssme.es

Universidad Rey Juan Carlos



1: Types, Variables, Operators

Goal

Learn enough Java to do something useful

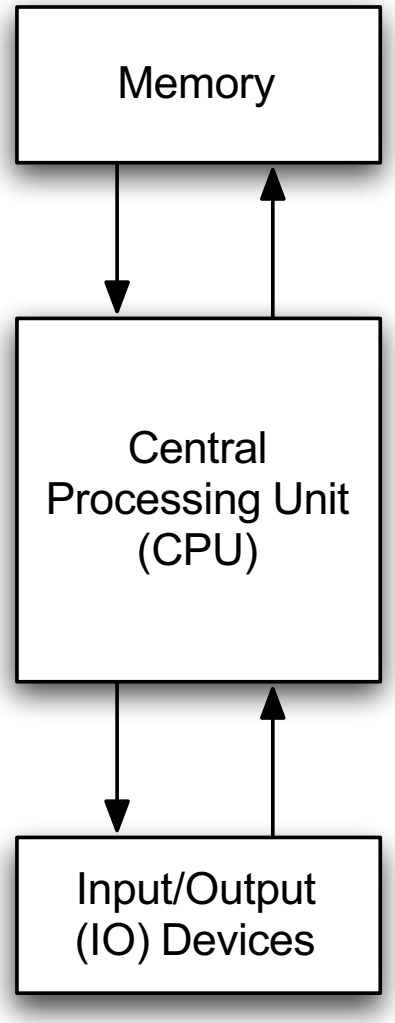
Examples

- Automate mathematical operations
- Process data
- Create and play around with objects
- Draw some graphics

Assignments

- View and submit via Codeboard.io
- Collaborate with others
- Write your **own** code
- Must submit every assignment

The Computer



CPU Instructions

z = x + y

Read location x

Read location y

Add

Write to location z

Programming Languages

- Easier to understand than CPU instructions
- Needs to be translated for the CPU to understand it

Java

- "Most popular" programming language
- Runs on a "virtual machine" (JVM)
- More complex than some others (eg. Python)
- Simpler than others (eg. C++)

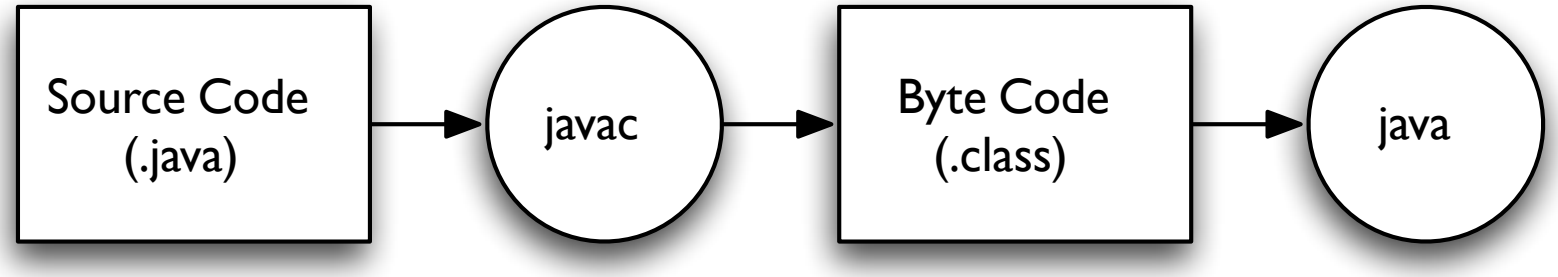
What is Java

- Object Oriented programming language from the 90s
- A programming tool developd by 13 people manged by James Gosling for the *7 project
- Syntactically similar to C/C++ but much more simple
- Platform independent: "write once, run anywhere"
- Oak → Green → Java
  - Just Another Vague Acronym
  - James Gosling, Arthur Van Hoff, Andy Bechtolsteim

Java history

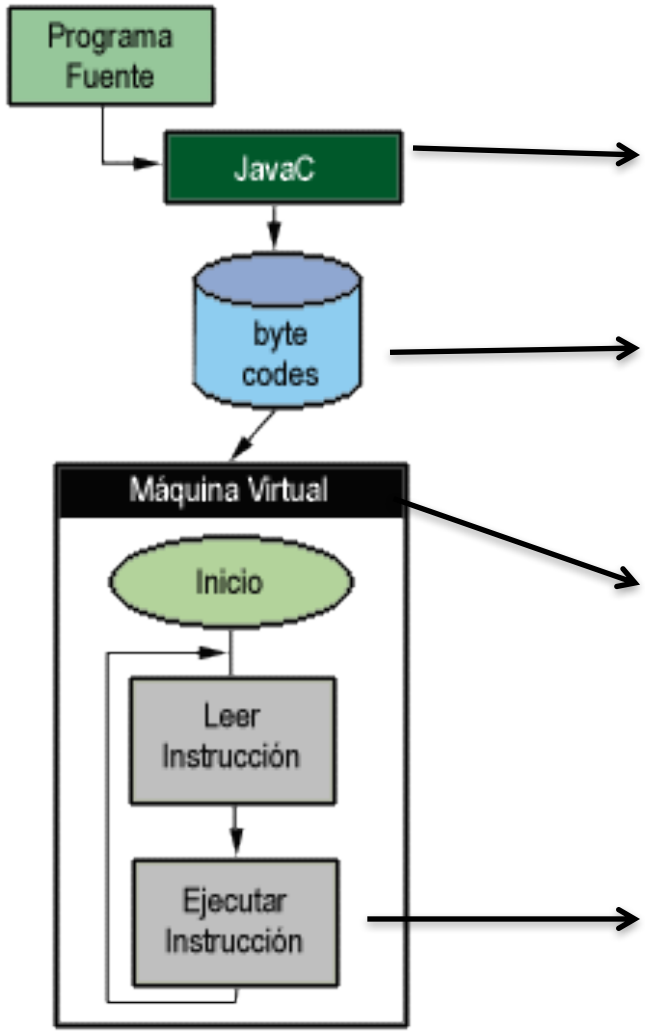
- Java 1.0 -1995
- Java 1.1 - 1997
- Java 1.2 - 1998 (Playground) → Java 2
- Java 1.3 - 2000 (Kestrel)
- Java 1.4 - 2002 (Merlín)
- Java 1.5 - 2004, (Tiger) → Java 5
- Java 1.6.0 - 2006, (Mustang) → Java 6
- Java SE7 - 2011, (Dolphin) → Java 7
- Java SE8 - 2014, (Spider) → Java 8

Java Virtual Machine



– A JVM is needed to run a Java program

Compiling Java



Compilador Java

Traduce código fuente a código intermedio.

Interprete de Java

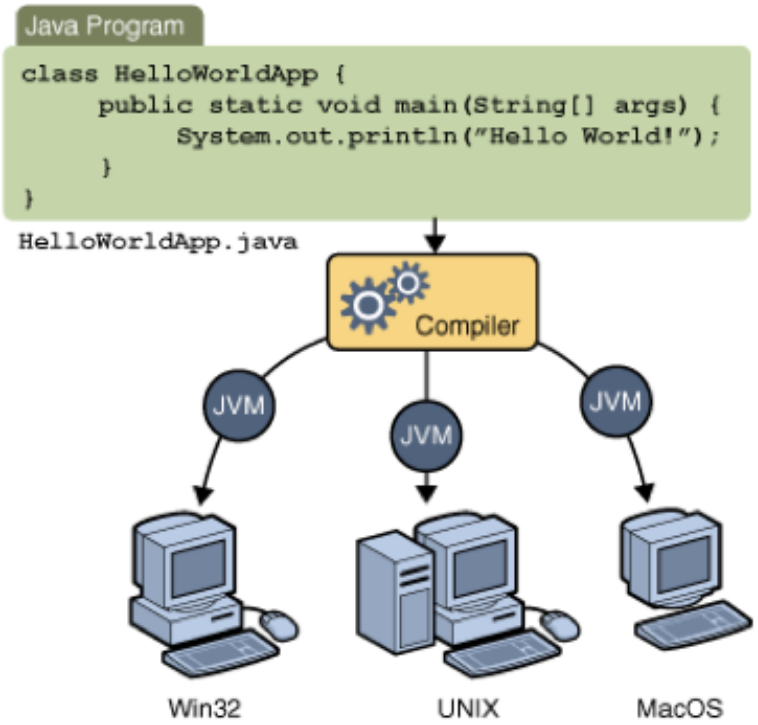
ByteCodes interpretados (ejecutados)

Compiling Java

Bytecode

- Native language for any JVM.
- A Java program runs in any platform

Write once, Run anywhere



First Program

```
class Hello {
  public static void main(String[] arguments)
  {
    // Program execution begins here
    System.out.println("Hello
    world.");
  }
}
```

Program Structure

```
class CLASSNAME {
  public static void main(String[]
  arguments) {
    STATEMENTS
  }
}
```

Output

System.out.println(*some String*) outputs to the console

Example:

- System.out.println("output");

Second Program

```
class Hello2 {
   public static void main(String[] arguments) {
      System.out.println("Hello world."); // Print once
      System.out.println("Line number 2");  // Again!
   }
}
```

Types

Kinds of values that can be stored and manipulated.

- **boolean**: Truth value (true or false).
- **int**: Integer (0, 1, -47).
- **double**: Real number (3.14, 1.0, -2.1).
- **String**: Text ("hello", "example").

Variable declaration

Named location that stores a value of one particular type.

- Form:
  - ***TYPE* NAME**;
- Example

```
String foo;
```

Start with lower case and use an upper case for every new "word"

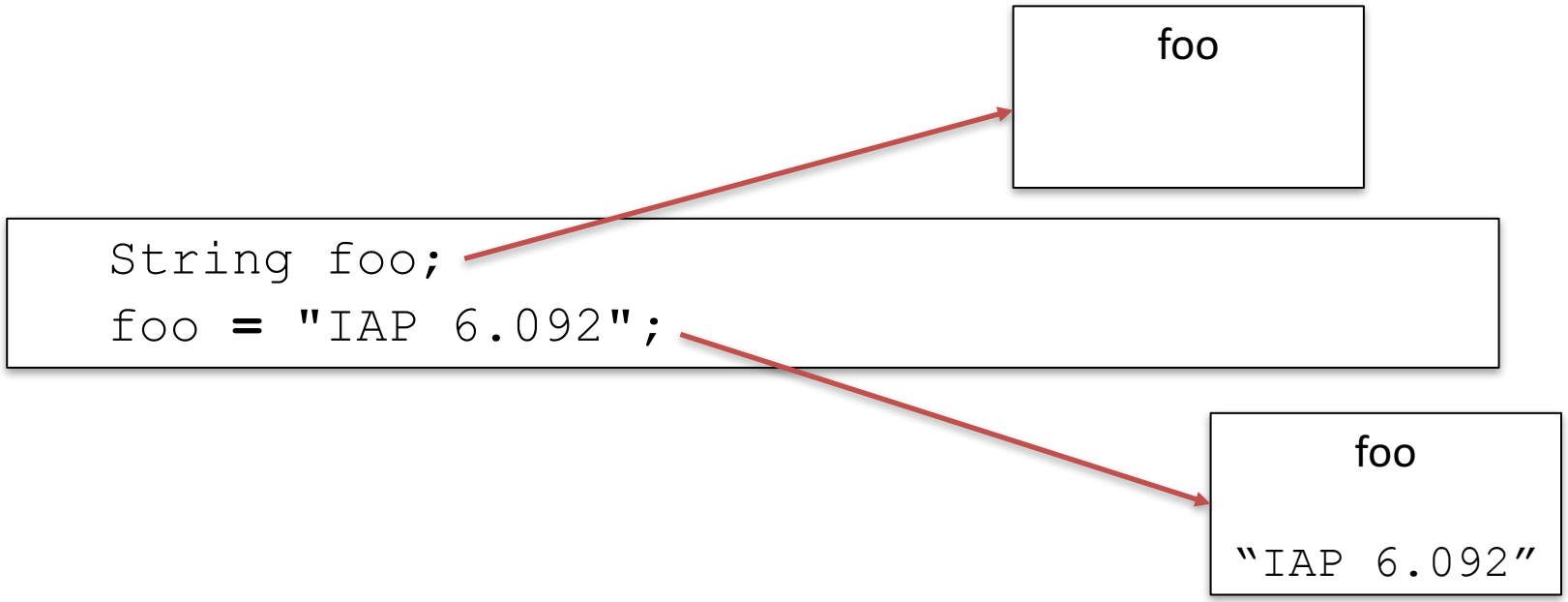
- Use intuitive and significative names for variables

Assignment

Use = to give variables a value.

- Computes right part of the assignment and assigns the result to the variable on the left

Example:



Assignment

Can be combined with a variable declaration.

Example

```
double badPi = 3.14;
boolean isJanuary = true;
```

```
class Hello3 {

   public static void main(String[] arguments)

   {
       String foo = "IAP 6.092";
       System.out.println(foo);
       foo = "Something else";
       System.out.println(foo);
   }
}
```

Operators

Symbols that perform simple computations

- Simple arithmetic

Operador	Descripción	Ejemplo de expresión	Resultado del ejemplo
-	operador unario de cambio de signo	-4	-4
+	Suma	2.5 + 7.1	9.6
-	Resta	235.6 - 103.5	132.1
*	Producto	1.2 * 1.1	1.32
/	División (tanto entera como real)	0.050 / 0.2 7 / 2	0.25 3
%	Resto de la división entera	20 % 7	6

- Combined arithmetic

Operador	Descripción	Ejemplo de expresión	Resultado del ejemplo
+=	Suma combinada	a+=b	a=a+b
-=	Resta combinada	a-=b	a=a-b
*=	Producto combinado	a*=b	a=a*b
/=	División combinada	a/=b	a=a/b
%=	Resto combinado	a%=b	a=a%b

String Concatenation (+)

The + operator is overriden

- Conventional add operator when used with numbers
- String concatenation when used with Strings

```
int a = 3;
int b = 2;
int c = a + b;
// c = 5
String text = a + "000" + b;
// text = "30002"
System.out.println(c);
System.out.println(text);
```

Operators

Relational

Operador	Descripción	Ejemplo de expresión	Resultado del ejemplo
==	igual que	`7 == 38`	`false`
!=	distinto que	`'a' != 'k'`	`true`
<	menor que	`'G' < 'B'`	`false`
>	mayor que	`'b' > 'a'`	`true`
<=	menor o igual que	`7.5 <= 7.38`	`false`
>=	mayor o igual que	`38 >= 7`	`true`

Logical

Operador	Descripción	Ejemplo de expresión	Resultado del ejemplo
!	Negación - NOT (unario)	`!false` `!(5==5)`	`true` `false`
|	Suma lógica – OR (binario)	`true | false` `(5==5)|(5<4)`	`true` `true`
^	Suma lógica exclusiva – XOR (binario)	`true ^ false` `(5==5)|(5<4)`	`true` `true`
&	Producto lógico – AND (binario)	`true & false` `(5==5)&(5<4)`	`false` `false`
||	Suma lógica con cortocircuito: si el primer operando es `true` entonces el segundo se salta y el resultado es `true`	`true || false` `(5==5)||(5<4)`	`true` `true`
&&	Producto lógico con cortocircuito: si el primer operando es `false` entonces el segundo se salta y el resultado es `false`	`false && true` `(5==5)&&(5<4)`	`false` `false`

Truth tables

A	B	A OR B
F	F	F
F	V	V
V	F	V
V	V	V

A	B	A AND B
F	F	F
F	V	F
V	F	F
V	V	V

A	NOT A
F	V
V	F

Order of Operations

Follows standard (math) rules:

1. Parentheses
2. Arithmethic operators
    1. Multiplication and division
    2. Addition and subtraction
3. Relational operators
4. Logic operators

Operators

Which is the resut of the following expression?

```
3 + 5 < 5 * 2 || 3 > 8 && 7 > 6 - 2
```

Operators

Which is the resut of the following expression?

```
10 <= 2 * 5 && 3 < 4 || !(8 > 7) && 3 * 2 <= 4 * 2 - 1
```

Operators

Which is the resut of the following expressions?

Datos	Expresión	Resultado
`int x = 3;` `int y = 6;`	`!(x<5)&&!(y>=7)`	
`int i = 22;` `int j = 3;`	`!((22>4)||(3<=6))`	

`int a = 34;`
`int b = 12;`
`int c = 8;`
	`!(a+b==c)||(c!=0)&&(b-c>=19)`	

Operators

Which is the resut of the following expressions?

```
int i = 7;
float f = 5.5F;
char c = 'w';
```

Expresión	Resultado
`(i >= 6) && (c == 'w')`	
`(i >= 6) || (c == 119)`	
`(f < 11) && (i > 100)`	
`(c != 'p') || ((i + f) <= 10)`	
`i + f <= 10`	
`i >= 6 && c == 'w'`	
`c != 'p' || i + f <= 10`	

```
class DoMath {
   public static void main(String[] arguments) {
      double score = 1.0 + 2.0 * 3.0;
      System.out.println(score);
      score = score / 2.0;
      System.out.println(score);
   }
}
```

```
class DoMath2 {

   public static void main(String[] arguments) {
      double score = 1.0 + 2.0 * 3.0;
      System.out.println(score);
      double copy = score;
      copy = copy / 2.0;
      System.out.println(copy);
      System.out.println(score);
   }
}
```

Hands on

Every Java program must contains at least one Class

- Java methods container

A Java file could contain several classes, but just one of them being Public

- File name must be that of the Public class (ClassName.java)

```
public class PayrollApp {

    public static void main(String[] args) {
        int hours = 40;
        double payRate = 25.0, grossPay;

        grossPay = hours * payRate;
        System.out.print("Gross Pay: $");
        System.out.println(grossPay);
    }
}
```

Hands on

Defining classes

- Class definition starts with the **Class** keyword
- Every declaration and instruction is located between the start and end brackets of the class
- They are referred to as the **body** of the class

```
public class PayrollApp {

    public static void main(String[] args) {
        int hours = 40;
        double payRate = 25.0, grossPay;

        grossPay = hours * payRate;
        System.out.print("Gross Pay: $");
        System.out.println(grossPay);
    }
}
```

Body
Class

The main method

- Every program needs a **main** method
- It is the starting point of the program
- Always the same heading
- Always invoked when the program is run

```
public class PayrollApp {

    public static void main(String[] args) {
        int hours = 40;
        double payRate = 25.0, grossPay;

        grossPay = hours * payRate;
        System.out.print("Gross Pay: $");
        System.out.println(grossPay);
    }
}
```

Punctuation | Indentation

Each pair of brackets identifies a code block

```
class DoMath2 {

    public static void main(String[] arguments) {
        double score = 1.0 + 2.0 * 3.0;
        System.out.println(score);
        double copy = score;
        copy = copy / 2.0;
        System.out.println(copy);
        System.out.println(score);
    }
}
```

Code inside each block is indented to ease identificaction

Comments

Human readable information in the code

- Comments are intended to introduce information that will be ignored by the compiler inside the code
- End line comment (//)

```
int usu = 0; // el número de usuarios
```

- Block comment (/* … */)

```
/*
 * A program to list the good things in life
 * Author: Barry Burd, BeginProg2@BurdBrain.com
 * February 13, 2005
 */

class ThingsILike {

    public static void main(String args[]) {
        System.out.println("Chocolate, royalties, sleep");
    }
}
```

- Javadoc comment (/** ...*/)

```
/**
 * Print a String and then terminate the line.
 */
```

Hands on

Punctuation symbols have well-defined purposes

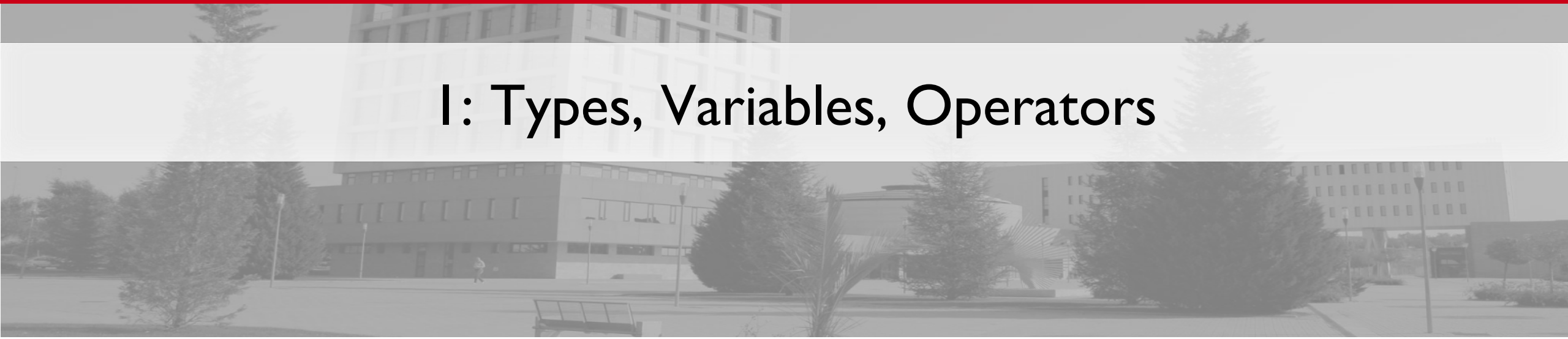
- ; → end of instruction
- “” → Strings are located between
- {} → blocks delimitation
- () → methods arguments
- [ ] → arrays indexing

They also guide indentation and ease the identification of the different blocks

Kybele Research Group

ISe Ingeniería de Servicios
www.ssme.es

Universidad Rey Juan Carlos



1: Types, Variables, Operators