Variables & Types

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1ère IB

B2.1 Programming fundamentals

B2.1.1 Construct and trace programs using a range of global and local variables of various data types.

- Data types: Boolean value, char, decimal, integer, string

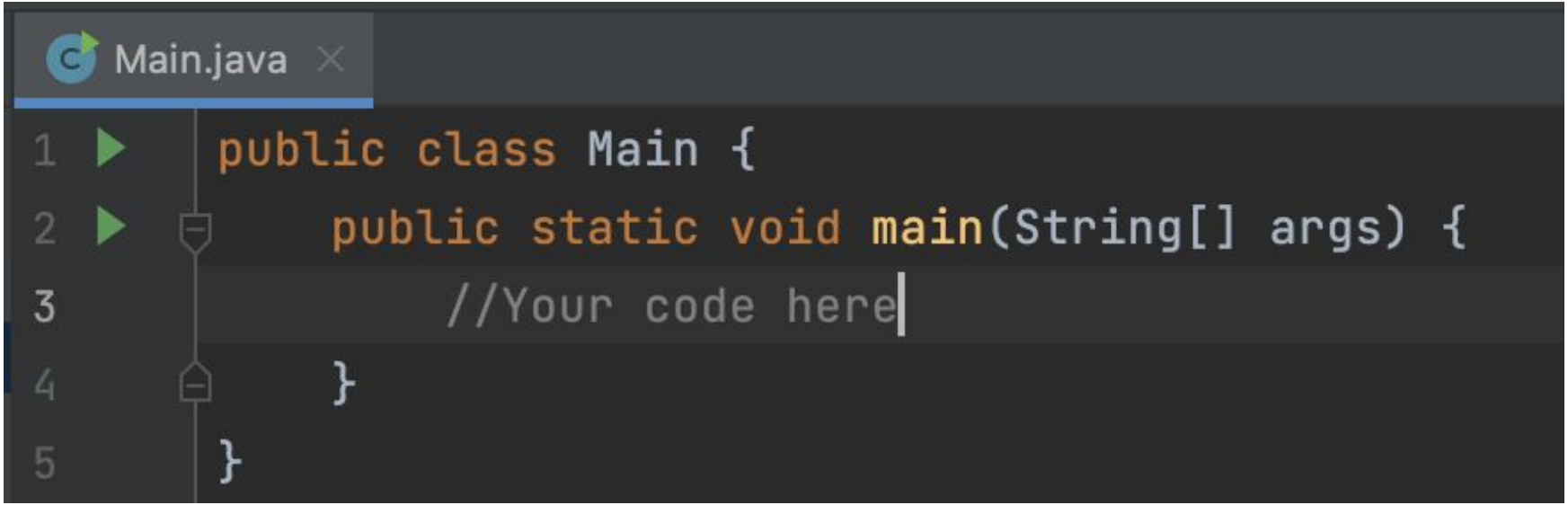
Generative AI - Traffic Light Guide

🟢Green - For this assignment using Generative AI is authorised and encouraged to help you learn and discover new ideas. Prompts must always be cited in the following way: "Text of prompt" prompt. *ChatGPT*, Day Month version, OpenAI, Day Month Year, chat.openai.com. You should also share the discussion you had with the generative AI if you used many prompts.

🟠Orange - For this assignment using Generative AI is not recommended as it will not make you practice valuable research and thinking skills. If you are finding the assignment difficult try to use online searches instead, come to office hours, send emails to your teacher or ask your peers.

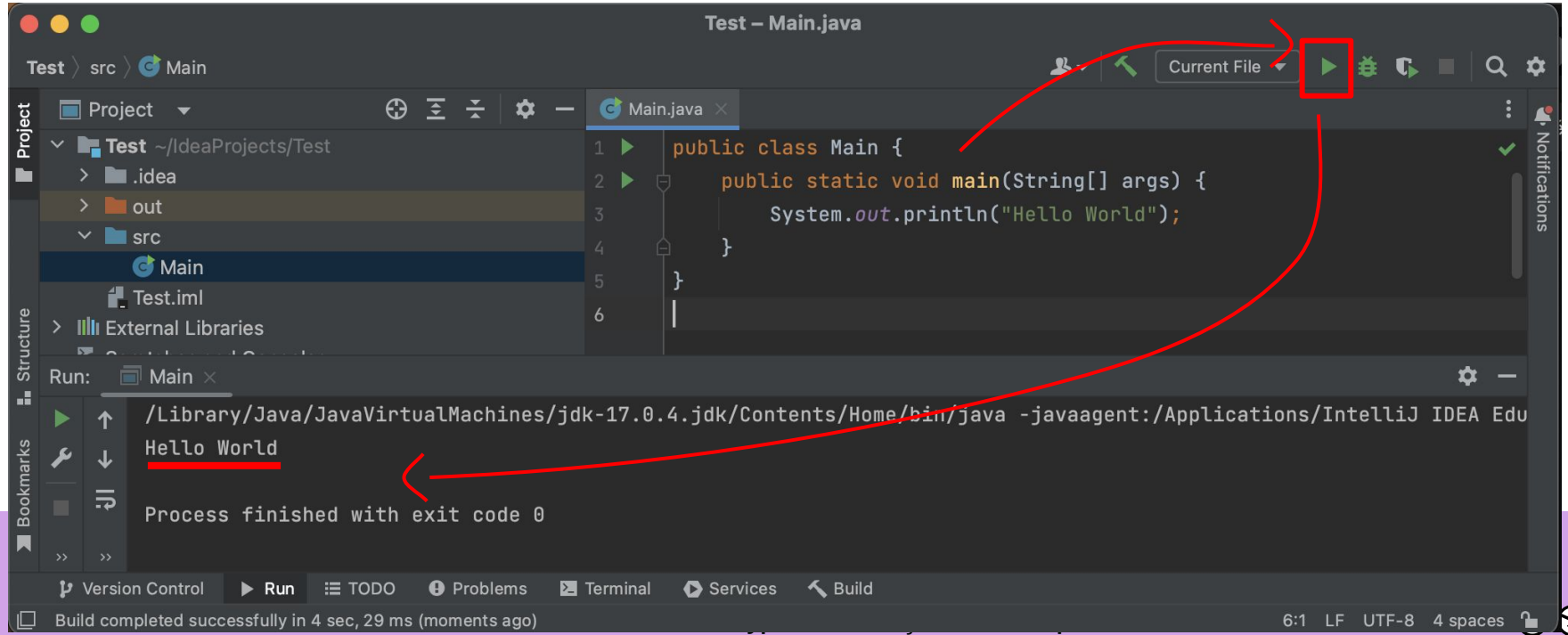
🔴Red - For this assignment using Generative AI is not allowed and goes against academic integrity rules. If Generative AI is detected you are exposing yourself to academic sanctions.

General structure of a program



Running a program

In our IDE (integrated development environment), we can use the play button to run our code.



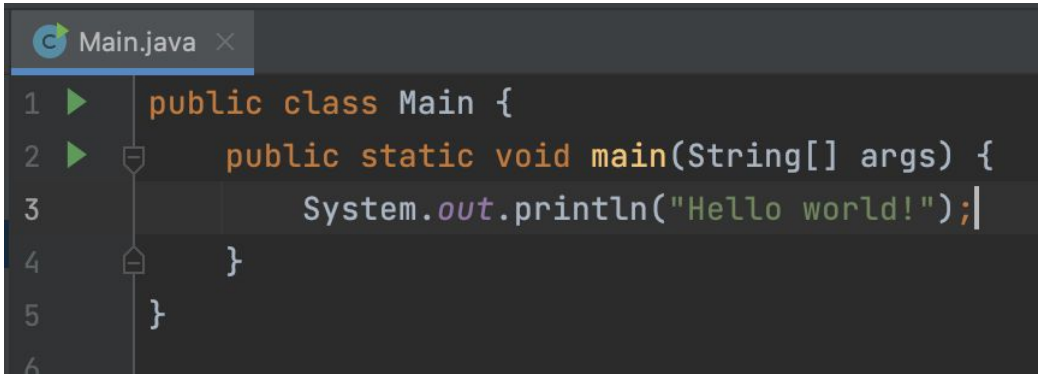
Printing

We can print text to the standard output with the function:

- `System.out.println()`

The text given in the parentheses of the function will be printed.

(tip: the shortcut for this function is sout + tab key)



Comments

- You can turn some code into a comment by adding `//` in front of some text. This means the text after the `//` will not be interpreted as code.
- Your can write multiline comments by starting with `/*` and finishing with `*/`

Statements

A statement in java is equivalent to a sentence in the common language. In the same manner that we finish our sentences with a dot, java statements need to finish with a semicolon `;`

```
System.out.println("Hello World");
```

Variables

Variables are a way
to store information.

Declaring a variable

```
int MyNum;
```

Type

Variable Name

Initializing a variable

```
int MyNum;
MyNum = 45;
```

Variable Value

Declaring + Initializing a variable

```
int MyNum = 45;
```

Variable Naming rules

- Variables names should be self explanatory
- Variable names can not start with a number
- Variables should be formatted in CamelCase
- Variables can not be named any of the following restricted keywords

abstract, assert, boolean, break, byte, case, catch, char, class, const, continue, default, do, double, else, enum, extends, false, final, finally, float, for, goto, if, implements, import, instanceof, int, interface, long, native, new, null, package, private, protected, public, return, short, static, strictfp, String, super, switch, synchronized, this, throw, throws, transient, true, try, void, volatile, while

Variable Primitive types

	Type	Example	Range of value	Memory
integers	`byte`	-16	From -128 to 127	1 byte
	`short`	1245	From - 32768 to 32767	2 bytes
	`int`	50000	From - 2147483648 to 2147483647	4 bytes
	`long`	2147483649L	From -9223372036854775808 and 9223372036854775807	8 bytes
floating point	`float`	1.23e10f	From -3.4E + 38 and 3.4E + 38	4 bytes
	`double`	1.23e100d	From -1.7E + 308 and 1.7E + 308	8 bytes
character	`char`	‘A’	From 0 to 65536 (Unicode)	2 bytes
logical	`boolean`	true, false	true or false	1 bit

Basic operators

- Addition: `+`
- Subtraction: `-`
- Multiplication: `*`
- Division: `/`
- Modulus: `%`
- Increment: `++`
- Decrement: `--`

```java
public class Main {
    public static void main(String[] args) {
        System.out.println(3 + 1);
        System.out.println(12 % 4);
        System.out.println(2 * (1 + 5));
    }
}
```

```
4
0
12
```

What differences/ similarities do you notice with python ?

Casting

Type casting is when you assign a value of one primitive data type to another type.

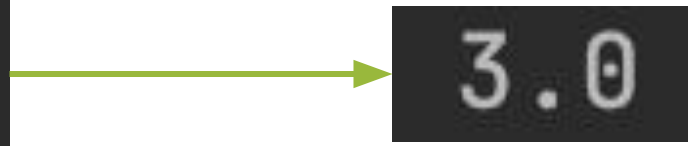
In Java, there are two types of casting:

- **Widening Casting** (automatically) - converting a smaller type to a larger type size
  `byte` -> `short` -> `char` -> `int` -> `long` -> `float` -> `double`

- **Narrowing Casting** (manually) - converting a larger type to a smaller size type
  `double` -> `float` -> `long` -> `int` -> `char` -> `short` -> `byte`

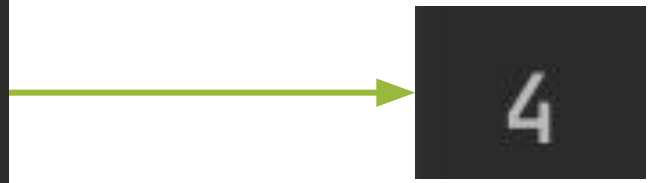
Automatic Casting

```java
public class Main {
    public static void main(String[] args) {
        int a  = 3;
        double b;
        b = a;
        System.out.println(b);
    }
}
```



Manual Casting

```java
public class Main {
    public static void main(String[] args) {
        double b = 4.6;
        int a;
        a = (int) b;
        System.out.println(a);
    }
}
```



What does this code output ?

```java
public class Main {
    public static void main(String[] args) {
        int MyNum = 45;
        System.out.println(mynum);

    }
}
```

What does this code output ?

```java
public class Main {
    public static void main(String[] args) {
        int a = 3;
        int b = 2;
        int c = a + b;
        System.out.println(c);
    }
}
```

What does this code output ?

```java
public class Main {
    public static void main(String[] args) {
        int  a = 3;
        System.out.println("Result: " + a*0.5);
    }
}
```

What does this code output ?

```java
public class Main {
    public static void main(String[] args) {
        int a = 3;
        a = 8;
        System.out.print(a);
    }
}
```

What does this code output ?

```java
public class Main {
    public static void main(String[] args) {
        int a = 3;
        int b = 3;
        System.out.println(a++);
        System.out.println(a);
        System.out.println(++b);
        System.out.println(b);
    }
}
```

What does this code output ?

```java
public class Main {
    public static void main(String[] args) {
        int a = 0;
        boolean b;
        b = (boolean) a;
        System.out.println(a);
    }
}
```

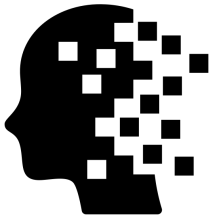
What does this code output ?

```java
public class Main {
    public static void main(String[] args) {
        char four = '4';
        double d1 = (char)four;
        System.out.println(d1);
    }
}
```

What does this code output ?

```java
public class Main {
    public static void main(String[] args) {
        double d = 52.0d;
        char four = (char) d;
        System.out.println(four);
    }
}
```

Pause & Recall



Created by Victoruler
from Noun Project

Close your eyes and try to recall as many things as possible that were covered during this lesson.

Alternatively, you can keep your eyes open and write down as many things you remember on a piece of paper.

This will help strengthen your memory of key concepts 💪

Let’s create a new Intelli J project and start the exercises

Exercise 1 *(GenAI 🟠Orange)*

I am going to the market to buy 12 apples and 26 bananas. Each apple costs 0.95€ and each banana costs 1€. We have 82.7€ in our wallet.

Define variables for each of our items and write a program that prints how much money our groceries were. Also prints how much money we have left in our wallet.

Exercise 2 *(GenAI 🟠Orange)*

I have the following function: y = 3x -5

Write a program that computes y and prints the result of the function for:

- x = -2
- x = 322

Exercise 3 *(GenAI 🟠Orange)*

Define an integer variable between 33 and 126. Convert it to float and then to char.

Exercise 4 *(GenAI 🟠Orange)*

Write a script that converts a fahrenheit temperature into celsius. The conversion formula is as follows: C = (5/9) * (F - 32). What does 365F convert to in celsius ? What about 280F ?

Exercise 5 *(GenAI 🟠Orange)*

Define an integer between 0 and 1000 and write a program that adds all the digits in the integer and prints the result.

Example: 565 => 5+6+5 => 16

Exercise 6 *(GenAI 🟠Orange)*

Write a program that takes the long 214748364986 and converts it to float and then to double.

Exercise 7 *(GenAI 🟠Orange/🟢Green)*

Write a Java program that outputs the area of a circle that has a radius of 15cm.

You will use the formula: $Area = \pi \times radius^2$

Your radius should be defined as a variable but instead of defining pi as a variable, you should define it as a constant.

What is a constant ? Check this resource:
https://www.tutorialspoint.com/what-is-a-constant-and-how-to-define-constants-in-java

Exercise 8 *(GenAI 🟠Orange)*

I have a blue cup filled with coffee and a green cup filled with tea. I would like to swap the content of the cups. What are the steps that I need to carry out in order to perform the swap ?

Instead of having cups, I have variable a = 5 and b = 3, how can I swap the contents of my two variables ? Write the code that performs the swap

Already done ? Here is an additional exercise ! *(GenAI 🟠Orange/🟢Green)*

We did some pretty simple calculus up until now but it is very frustrating because the power operator is not part of the basic maths operators in Java (in contrary to Python). So how do I compute 12 to the power of 6 without writing the whole calculation by hand ? This is where packages come into handy ! To solve this problem try understanding the following concepts:

- What are java packages ?
- How do I import a java package in my program ?

Now let's look into the documentation of the Math package:
https://docs.oracle.com/en/java/javase/17/docs/api/java.base/java/lang/Math.html

- What is the name of the function that is going to help us compute power calculation ?
- How many arguments does that function take ? What are their types ?
- What is the return type of the function ?
- What are other interesting functions in this package ?

With all that research you should be able to write a program that computes and prints 12 to the power of 6.

Additional resources

On IntelliJ: File > Learn and Teach > browse course -> search for the java course

IntelliJ tutorials:

- https://www.jetbrains.com/help/idea/feature-trainer.html
- https://www.jetbrains.com/help/idea/mastering-keyboard-shortcuts.html
- https://www.jetbrains.com/idea/guide/tips/

History of Java: https://www.jigsawacademy.com/blogs/java/history-of-java/

ASCII, Unicode and UTF-8:
https://medium.com/@apiltamang/unicode-utf-8-and-ascii-encodings-made-easy-5bfbe3a1c45a

Homework

Finish all the exercises

Create flashcards for the following terms:

Variable
Data type
Assignment
Casting
Primitive type
Constant
Operator
Identifier
Naming convention
Comment
Declaring
Initialization
Assignment
Char
Boolean
Int
Float