# Introduction to Programming

## Lecture 1 — What's a program?

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digicrea digital creativity

Université Jean Monnet Saint-Étienne

# 00 Foreword

# Contact information

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# A little warning

First time teaching this module

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If you need me to slow down, shout it out!

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- 24 hours of lecture and practise

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The general guideline is: you should be able to understand small bits of code, and be able to produce code that does what you intended

# . . . and what it doesn't

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- Computer Science engineering

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You will not become a developper after this class. However, you should have the tools and methodology to dig deeper if you'd like.

# 01 Introduction

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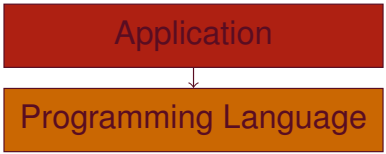

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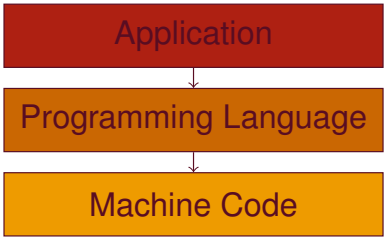

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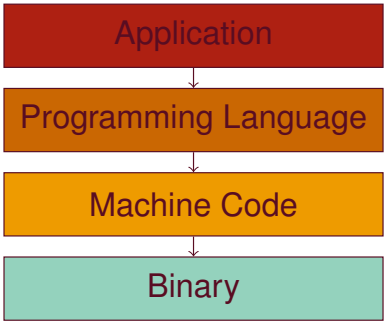

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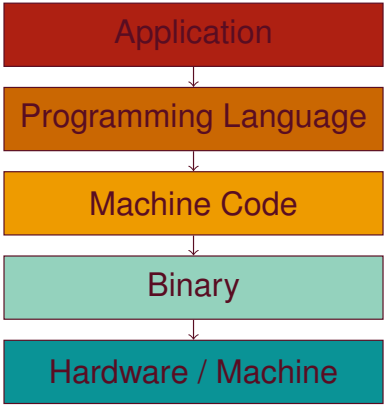

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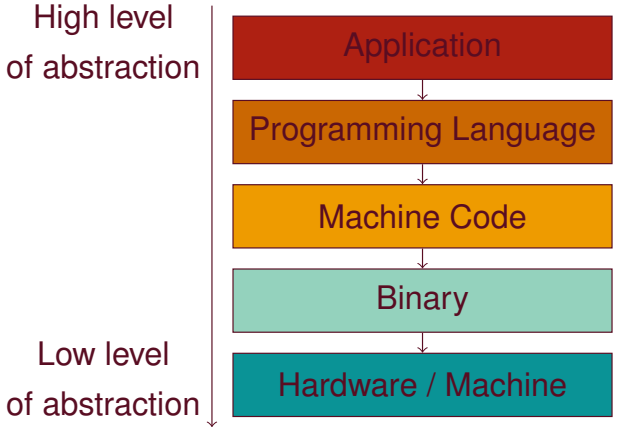

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- Sometimes, the **variables** will vary but the **method** will be the same
- If everything goes well, the **compiler** will **compile** your **code** and after some time, a **program** will come out of it

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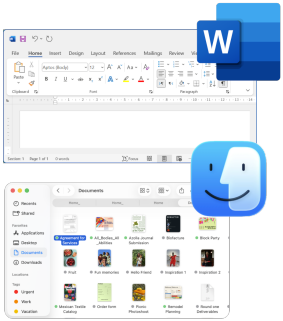

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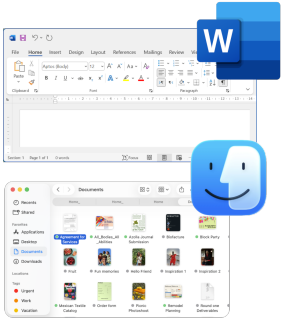

Some programs don't have a GUI ; they can be executed / run in a **terminal**.

# Your first program

The "Hello World" program !

# The entry point of your program

Every C++ program contains a "function" that is called `main`. It is the starting point of your program:

```
int main() {
    // your program starts here
    return 0;
}
```

# The end of your programm

The `main` function returns an integer value:

```
return 0;
```

Just like someone eating your cake would give feedback on the taste:

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  - Crash

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- If the program runs well, it returns zero — the person will want to have some of your cake again
- Otherwise, the program might:
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  - Crash — The person who hate your cake will spend a rough night

# Printing things in the terminal

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```
std::cout << "Hello, World" << std::endl;
```

# Core Language vs Libraries

C++ contains key words accessible to all programmers

Libraries are pieces of code made accessible to programmers by other developers

To use libraries, you should "include" them in your program with the `#include<>` directive

# 02 Ingredients in your program: Variables

# Using variables

Another example

# Variables as the program memory unit

Variables are a mean of storing things during your program. They use up program memory.

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In the same way your photos and videos occupy space on your phone or laptop disk, program's variables occupy space on the processor when being run.

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int a_variable; // declared (and default initialized)
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- An initialization

```
int a_variable {3}; // declared and initialized to 3
int a_variable = 4; // declared and initialized to 4
```

# Variable essentials 2/2

Variables have:

- A value at a certain point in time

```
int a {3}; // a contains 3
a = 6; // a contains 6
```

# Variable essentials 2/2

Variables have:

- A value at a certain point in time

```
int a {3}; // a contains 3
a = 6; // a contains 6
```

- A scope

```
{
    int a {3};
    // a is accessible in this block
}
// a is not accessible here anymore
a = 5; // invalid statement
```

# Operations on variables 1/2

What does this code print ?

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```
int a, b;
a = 6;
b = a + 1;
a = 9;
std::cout << b << std::endl;
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Solution

# Operations on variables 2/2

```
int a, b;
a = 6; // a has value 6
// we look at the value of a at this point in time
// b = 6 + 1 = 7
// b has value 7. It does not have value a + 1.
b = a + 1;
a = 9;
std::cout << b << std::endl; // prints 7
```

# Operations on variables 2/2

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int a, b;
a = 6; // a has value 6
// we look at the value of a at this point in time
// b = 6 + 1 = 7
// b has value 7. It does not have value a + 1.
b = a + 1;
a = 9;
std::cout << b << std::endl; // prints 7
```

There is a difference between an expression and its value. `a+1` is an expression; it can be evaluated by taking the value of `a` at the moment of the computation.

# Constant variables

Variables can be set as *constant* with the word `const`. Once initialized, their value cannot be altered.

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```
const int volume = 15;
volume = 3; // won't compile; volume is const
```

# Practise time!

# 03 A special type : booleans

# Boolean values

They're the result of the **evaluation** of a **logical expression**:

```
int a = 6;
bool is_even = a % 2 == 0;
bool is_figure = a < 10;
```

They take one of two values: `true` or `false`.

# Boolean operations 1/2

You can *negate* a boolean – i.e. take its opposite value: `!variable`.

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|---|---|
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You can express combination of booleans:

| $p$ | $q$ | $p\&\&q$ |
|---|---|---|
| $true$ | $true$ | $true$ |
| $true$ | $false$ | $false$ |
| $false$ | $true$ | $false$ |
| $false$ | $false$ | $false$ |

| $p$ | $q$ | $p\|\|q$ |
|---|---|---|
| $true$ | $true$ | $true$ |
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Thus, `(a && b) || (c && d)` and `a && b || c && d` are equivalent.

However, `(a || b) && (c || d)` and `a || b && c || d` are different.

# Comparison operations

You can store the evaluation of a comparison in a boolean variable :

```
bool b1;
b1 = a > b;
b1 = a >= b;
b1 = a == b; // note the difference between = and ==
b1 = a != b; // a and b are different
b1 = a <= b;
b1 = a < b;
```

# Practise time

# 04 Cooking with variables

# if . . . else . . .

Yet another example

# Conditional statements

Conditional statements makes the code behave differently depending on the value of the given condition. They can be used to apply actions when variables have a specific value.

```
if(condition 1){
    // scope 1
} else if (condition 2) {
    // scope 2
}  else { // all other cases
    // scope 3
}
```

# Practise time!

# The many cases problem

What if we want to handle cases where a variable can take more than two values?

See this example

# Enumerations

`enum class` defines a type that can take a restrained amount of values:

```
enum class Instrument { Piano, Guitar, Drums };
Instrument a_piano = Instrument::Piano;
```

It's a good way to represent a family of related constants.

# Switch-case statements 1/2

`switch-case` statement is a way to write conditional statements on *integral types*[1] or enum types.

It is prefered when possible because it is more readable, and it executes in a *constant time*.

[1] Numerical values and booleans are integral types

# Switch-case statements 2/2

`break` signals the end of case-block: we can handle several cases in the same way by omitting it.

```
switch(my_instrument) {
    case Instrument::Piano:
        // ...
        break; // end of case Piano
    case Instrument::Guitar:
        // This code is applied to Guitar only
    case Instrument::Drums:
        // This code is applied to both Guitar and Drums
        break; // end of cases Guitar and Drums
}
```

# Practise time

# 05 Repeating actions

# While . . .

We still start with an example

# The `while` loop

`while` allows repeating a piece of code as long as a certain condition evalutes to `true`.

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# The `while` loop

`while` allows repeating a piece of code as long as a certain condition evalutes to `true`.

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while(/* condition */ ) {
    // condition is evaluated to true
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}
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```

Notes:

- If the condition is not true when first encountering the loop, we never enter the loop;
- If the condition is never false, we never exit the loop: this is called *infinite* loop.

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- They can be a sign of a bug (a condition that should become false but never does, . . . ).

# Known repetition

If you know in advance how many times you want to repeat an action, you can use `for` loops.
See this example

# The `for` loop 1/3

```
for(
  auto count = 0;      // the loop counter
  count < top_value;   // the condition to check at each loop start
  ++count              // the action at each end of loop
){
}
```

Note: `count`'s scope is the `for` loop's scope: it is not usable outside of it

# The `for` loop 2/3

```
for(auto count = 0; count < top_value; ++count){
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- `auto` will determine the type of the variable if possible (usable anywhere)
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We could have written:

```
for(int count = 0; count < top_value; count += 1){}
```

```
for(int count = 0; count < top_value; count = count + 1){}
```

# The `for` loop 3/3

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*Note: why almost?*

# Practise time!

# See you next time!