Tutorial 01 - 09.11./12.11.2020

Group 02/11 - Moritz Makowski

Introduction

Today's Agenda

- What is "Computer Science" and "Programming"?
- Installing `gcc`
- Navigating inside a Terminal with `pwd`, `cd` and `ls`
- Writing our first program `hello_world.c`
- Using `gcc` for our first program
- Why should we use an IDE?
- Showcase: CLion
- Homework for IN8011

What is Computer Science?

> Informatics is the study of the storage, transformation, and communication of information.

Source: Department of Informatics @ TUM

What is Programming?

> Computer programming is the process of designing and building an executable computer program for accomplishing a specific computing task.

Source: Computer programming @ Wikipedia

Summary: *Computer Science* is the study of what computers (can) do - *Programming* is the practice of making computers do things.

We will cover a little bit of both topics during this semester.

Let's just cut to the chase ... What do we do here?

Programmers write computer programs in a **programming language** of their choice. Each language has its own benefits and trade offs.

We will use a programming language called **C**.

Example script `hello_world.c`:

```c
#include <stdio.h>

int main() {
    printf("Hello, World!\n");
    return 0;
}
```

And what can we do with it?

Computers cannot read these scripts directly. You have to **translate** it first so that a computer can understand it. This translating is called **compiling**.

C Script ⤳ compiles to ⤳ **Executable Program**

Compilation progress:

```
$ gcc hello_world.c -o program
$ ./program
Hello, World!
```

Install gcc on Windows - #1 *(by Philipp Kaeß)*

First, let's check if **gcc** is already installed on your computer.

1. Open the Terminal (Mac)/ Command Prompt (Windows)
2. type `gcc` and press `enter`

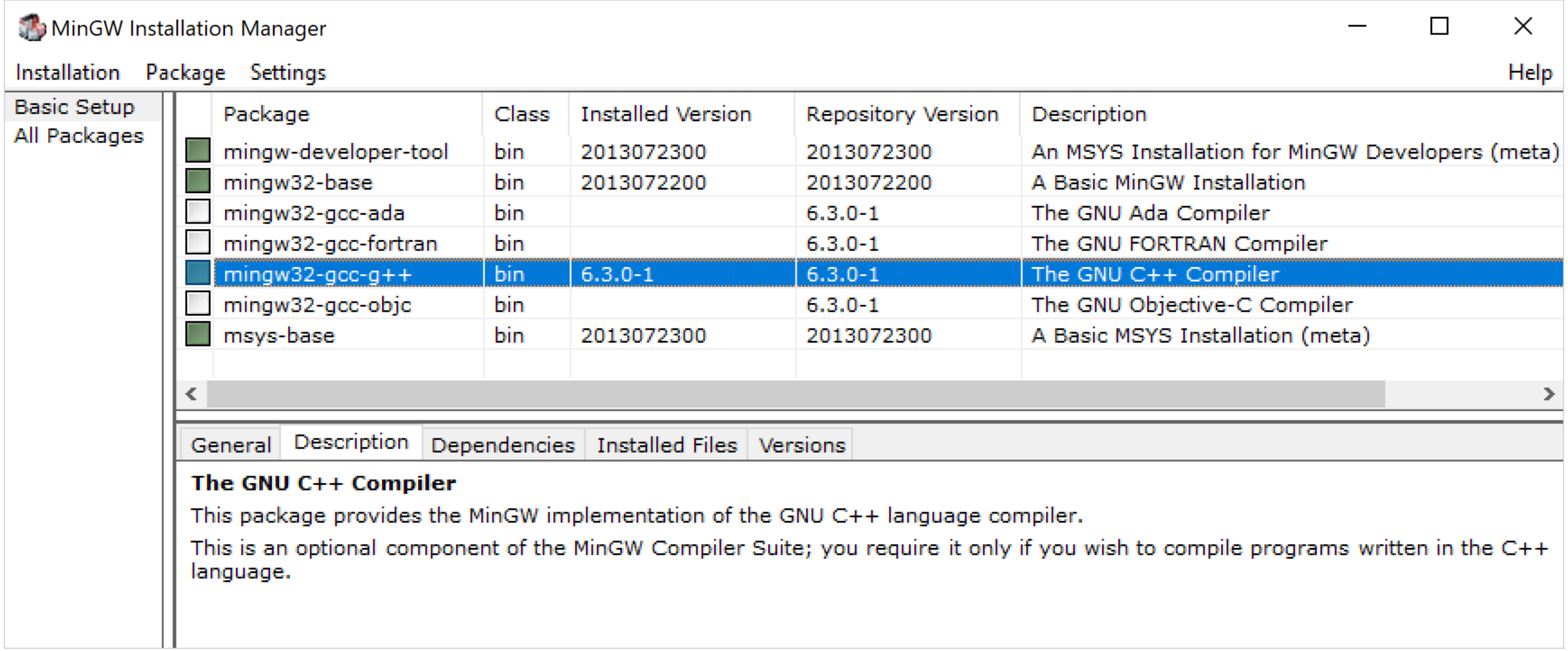
If it says **`gcc: fatal error: no input files`** **gcc** is already installed, and you can lean back.

If it doesn't recognize the command, you have to install it by executing the following instructions.

Install gcc on Windows - #2 *(by Philipp Kaeß)*

1. Go to google, type **"MinGW getting started"** (click here), open first result
2. Click on **"mingw-get-setup.exe"** (click here)
3. Open downloaded file
4. Choose **"C:\MinGW"** as path
5. Download the installation manager and open it

Install gcc on Windows - #3 *(by Philipp Kaeß)*



	Package	Class	Installed Version	Repository Version	Description
🟩	mingw-developer-tool	bin	2013072300	2013072300	An MSYS Installation for MinGW Developers (meta)
🟩	mingw32-base	bin	2013072200	2013072200	A Basic MinGW Installation
□	mingw32-gcc-ada	bin		6.3.0-1	The GNU Ada Compiler
□	mingw32-gcc-fortran	bin		6.3.0-1	The GNU FORTRAN Compiler
🟩	mingw32-gcc-g++	bin	6.3.0-1	6.3.0-1	The GNU C++ Compiler
□	mingw32-gcc-objc	bin		6.3.0-1	The GNU Objective-C Compiler
🟩	msys-base	bin	2013072300	2013072300	A Basic MSYS Installation (meta)

The GNU C++ Compiler

This package provides the MinGW implementation of the GNU C++ language compiler.

This is an optional component of the MinGW Compiler Suite; you require it only if you wish to compile programs written in the C++ language.

6. Mark `mingw32-developer-tool`, `mingw32-base`, `mingw32-gcc-g++` and `msys-base` for installation
7. Click on **installation (top left) -> apply changes -> apply**

Install gcc on Windows - #4 *(by Philipp Kaeß)*

You just installed gcc. But to be able to simply use it in the terminal, you first have to tell your system where to find the new program.

1. Close the Installation-Manager, open the explorer and go to the folder you just created (if you followed this instruction it is **"C:\MinGW"**)
2. Open **"bin"**
3. Click onto the bar with the path in it and copy the path, close explorer

Install gcc on Windows - #5 *(by Philipp Kaeß)*

4. Type **"Erweiterte Systemeinstellungen"**/**"Advanced System Settings"** into the search bar and open it
5. Click on **"Systemumgebungsvariablen bearbeiten"** and then on the button **"Umgebungsvariablen"**
6. Search for the Variable **"Path"** (IMPORTANT! Path not PATH!) in the lower part of the window (System-Variables not User Variables)
7. Double-click **"Path"** and click on **"Neu"**
8. Paste the path you just copied and click on **"OK"** to close all the windows you just opened

Install gcc on Windows - #6 *(by Philipp Kaeß)*

You did it! You can now test if your compiler works. Therefore type **"cmd"** into your searchbar and open it.

*(**IMPORTANT:** If the terminal is still open from the last time you used it, close and reopen it, otherwise the changes we just did won’t be recognized.)*

Type **"gcc"** and press `enter`.

If it now says **`gcc: fatal error: no input files`** you are finished and have successfully installed gcc!

Install gcc on Mac - #1

It is really easy to install gcc on Mac!

1. Open the program called **terminal**
2. Type in **"gcc"** and hit `enter`

If it says `clang: error: no input files` then gcc is install correctly.

3. If you haven't installed gcc already a window pops up saying something like **"Install command line tools now?"**
4. Hit confirm and wait for the installation to finish (Can take a few minutes)

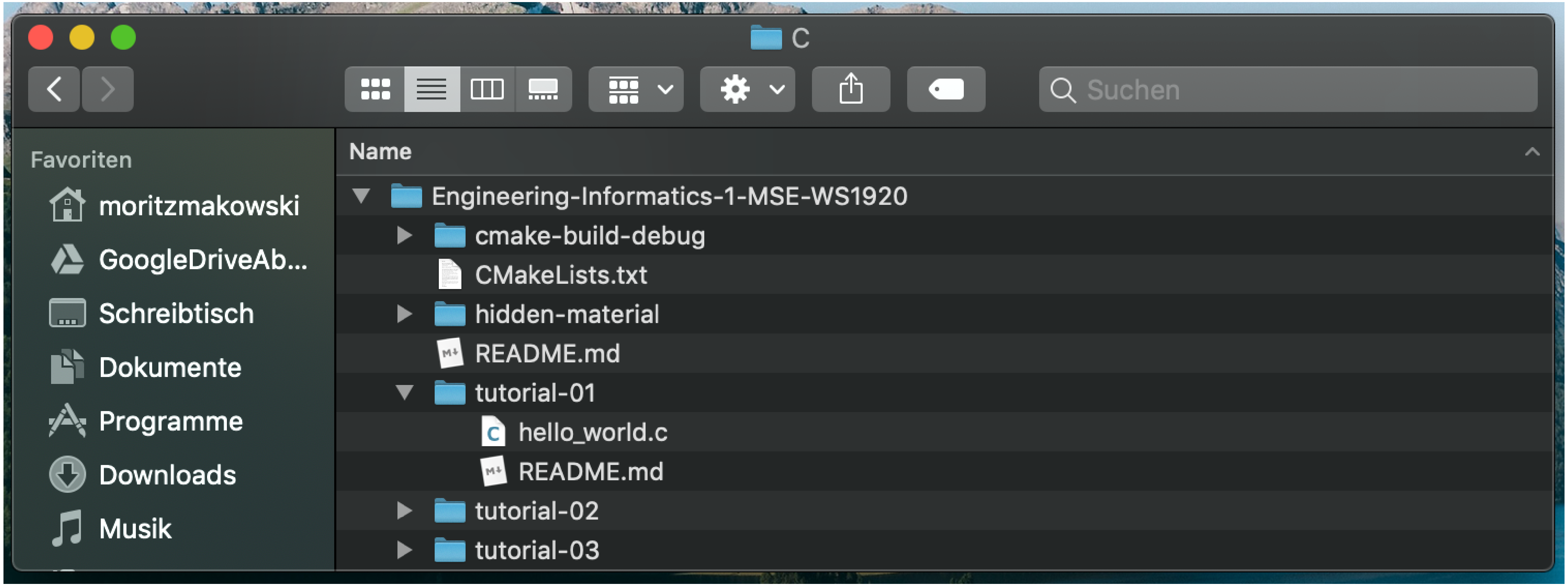
Install gcc on Mac - #2

Alternative installation via Hombrew:

1. Install Homebrew: https://brew.sh/
2. Run **"brew install gcc"** (Can take a few minutes)

Text based navigation through your file system - #1

The type of navigation you already know:



Engineering-Informatics-1-MSE-WS1920
cmake-build-debug
CMakeLists.txt
hidden-material
README.md
tutorial-01
hello_world.c
README.md
tutorial-02
tutorial-03

Text based navigation through your file system - #2

In the **console/terminal** we use three commands to navigate **without a GUI** (Graphical User Interface).

1. `pwd` ("print working directory") prints out the path of the directory we are currently in. In windows you can use `echo %cd%`.
2. `cd <directory_name>` ("change directory") switches to another directory. `cd ..` goes to the parent directory of the current directory.
3. `ls` ("list directory") prints out all files inside the current directory. `ls -a` also prints hidden files (filename begins with `.`). In windows you can use `dir`.

Text based navigation through your file system - #3

`pwd`, `cd` and `ls` in action:

```
$ pwd
/Users/moritzmakowski/ComputerScience/C

$ ls
Big Projects                            Exercises
Cheatsheet Variables.pages              Small Projects
Engineering-Informatics-1-MSE-WS1920

$ cd Engineering-Informatics-1-MSE-WS1920

$ ls
CMakeLists.txt          tutorial-01             tutorial-04
README.md               tutorial-02             tutorial-05
cmake-build-debug       tutorial-03             tutorial-06

$ pwd
/Users/moritzmakowski/ComputerScience/C/Engineering-Informatics-1-MSE-WS1920
```

Our first C-Program - #1

We are inside the directory `tutorial-01`.

Inside the file `hello_math.c` we write:

```c
#include <stdio.h>

int main() {
    int a = 2;
    int b = 7;
    int c = a + b;
    printf("Our number is: %d.\n", c);
    return 0;
}
```

You can use TextEdit (Mac) or Notepad (Window) to do that.

Our first C-Program - #2

Now we can compile it:

```
$ ls
hello_world.c

$ gcc hello_world.c -o program

$ ls
hello_world.c   program
```

We can execute the program with:

```
$ ./program
Our number is: 9.
```

Will we code with TextEdit/Notepad forever?

No! There are special programs which are exclusively made for writing code:

- Editors
- IDE's (Integrated Development Environments)

Editors are made to write code. The program highlights the text in different colors so you can read the code more easily. This is called **syntax highlighting**.

Example:

```c
#include <stdio.h>

int main() {
    int a = 2;
    int b = 7;
    int c = a + b;
    printf("Our number is: %d.\n", c);
    return 0;
}
```

IDE's (Integrated Development Environments) are not only doing syntax highlighting but a lot more, such as:

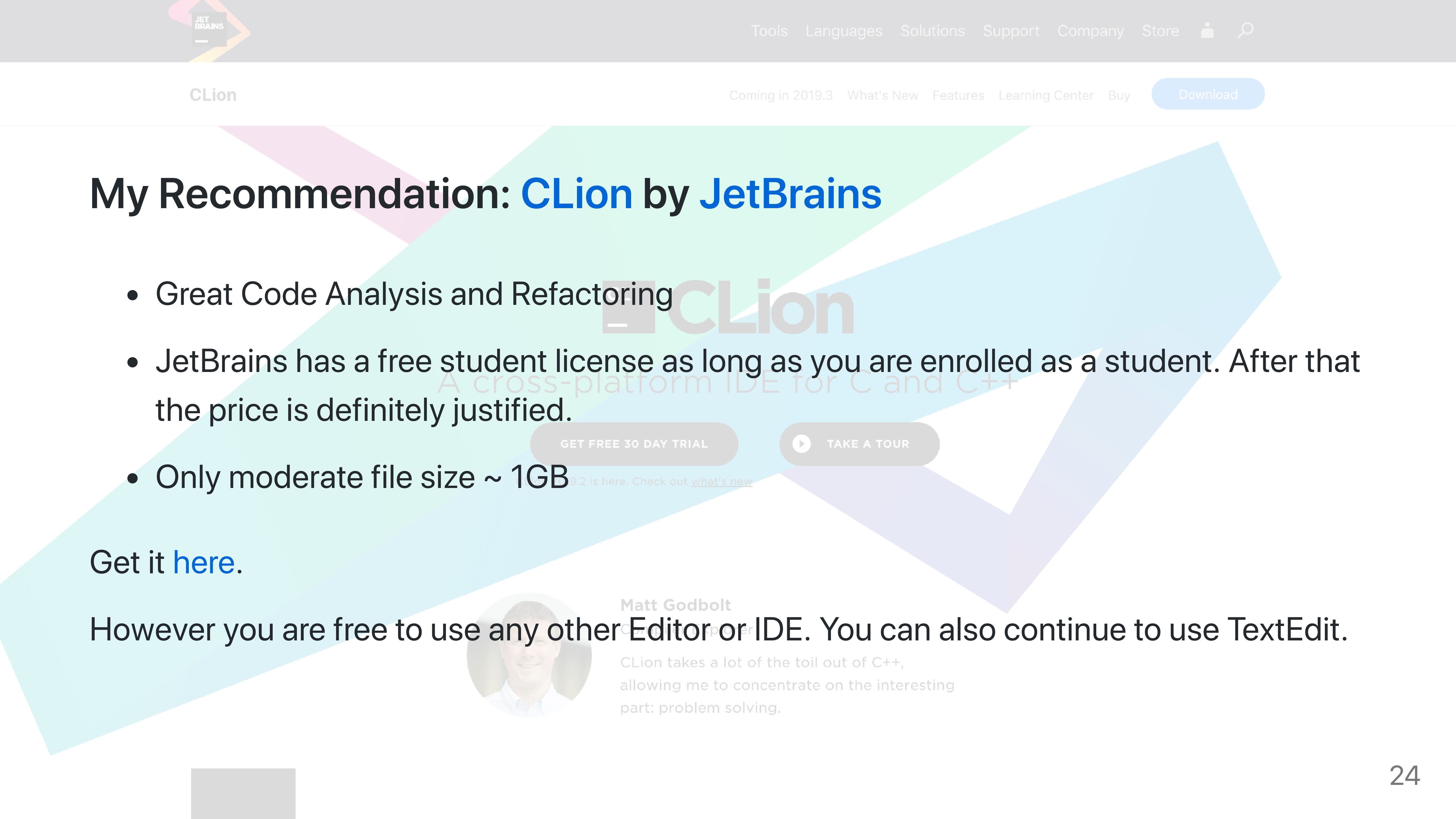
- Code analysis: The program can find errors in your code and show specific error messages - sometimes even with a proposed solution
- Refactoring: Restructure your code, e.g. change variable names, file names, etc.
- Generate files from blueprints - e.g. a `hello_world.c` file when you create a new project
- ...

My Recommendation: CLion by JetBrains

- Great Code Analysis and Refactoring
- JetBrains has a free student license as long as you are enrolled as a student. After that the price is definitely justified.
- Only moderate file size ~ 1GB

Get it here.

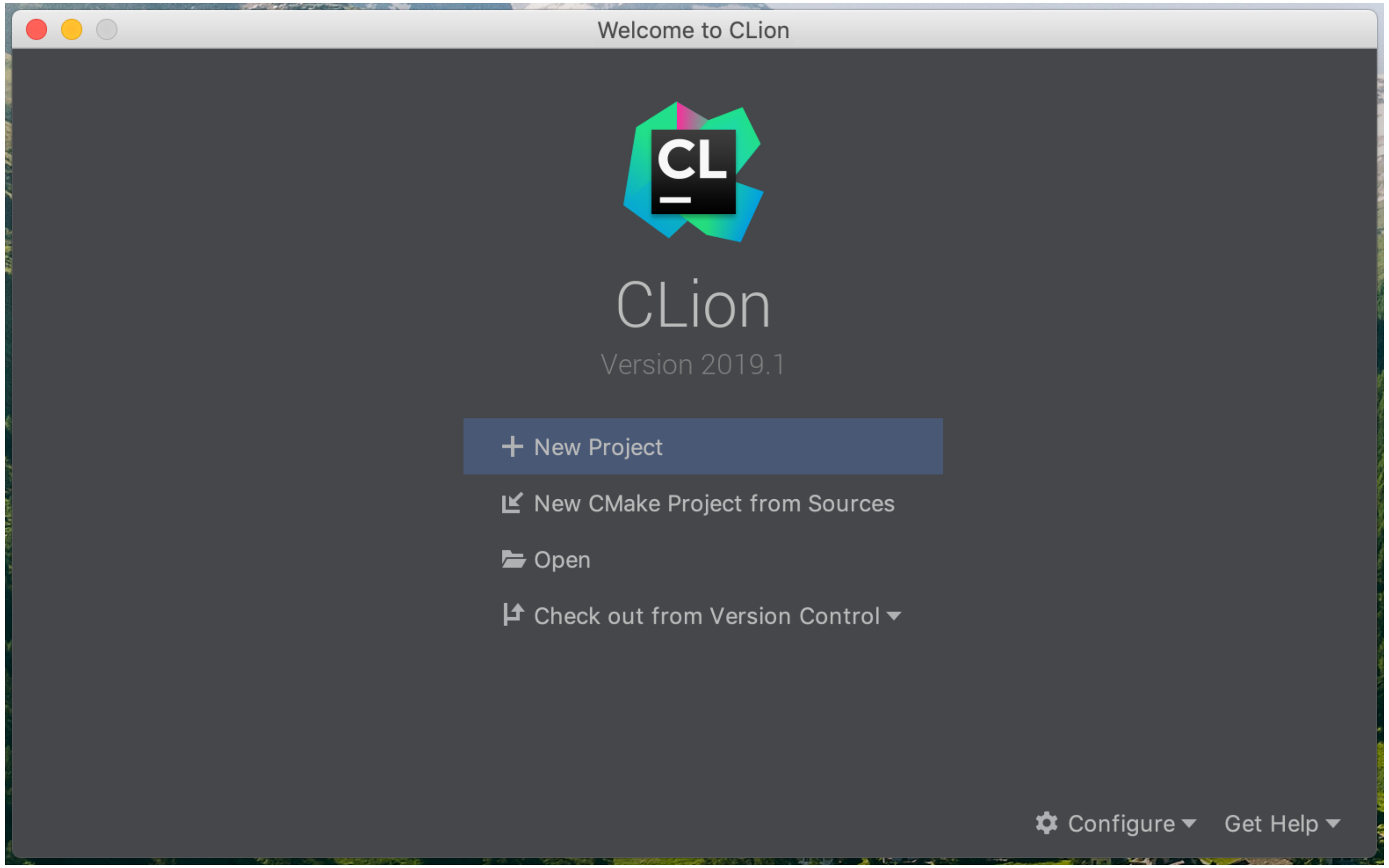
However you are free to use any other Editor or IDE. You can also continue to use TextEdit.



CLion takes a lot of the toil out of C++, allowing me to concentrate on the interesting part: problem solving.

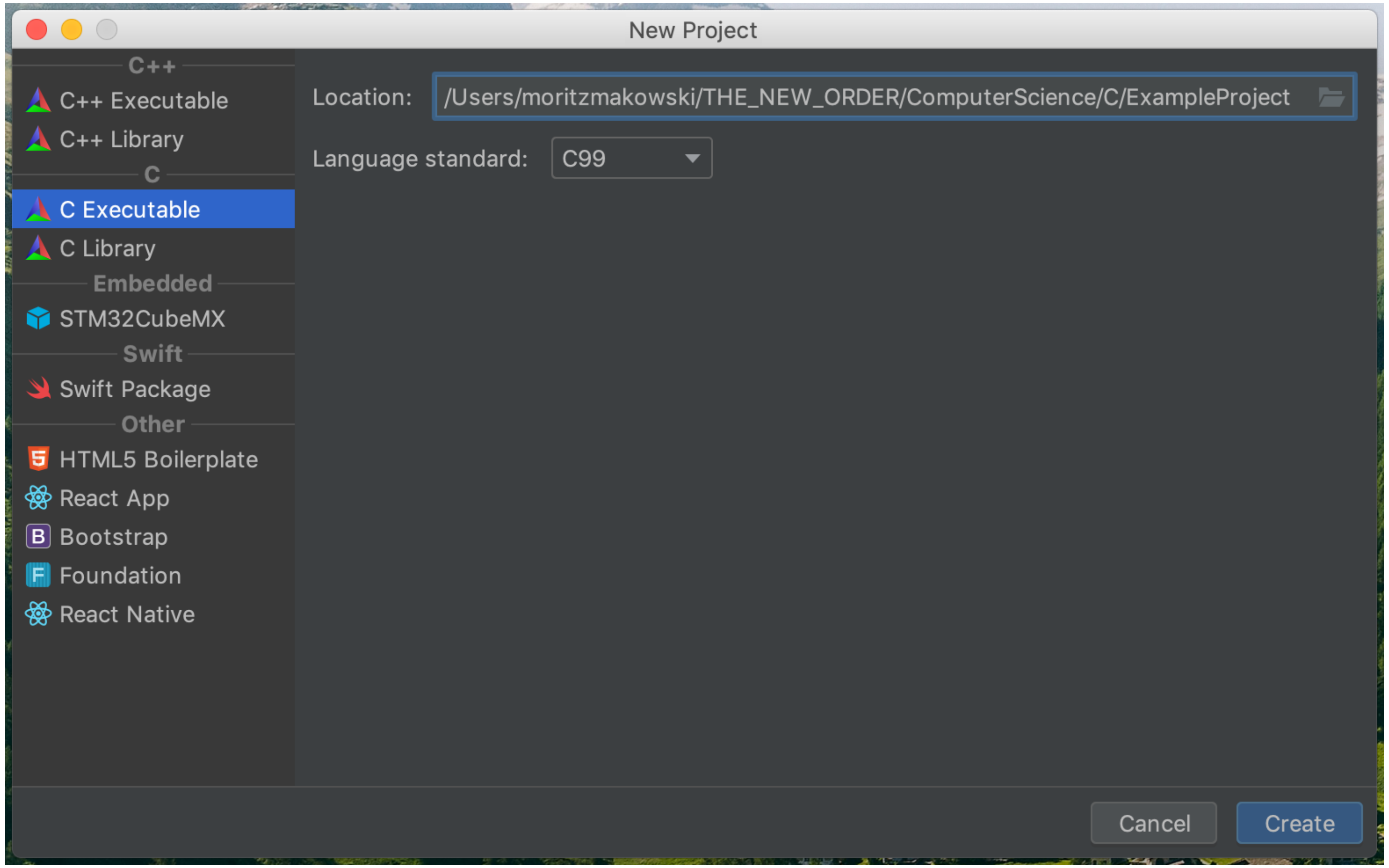
Short Intro to CLion - #1

The first time you open CLion you have to **create a project**.



Short Intro to CLion - #2

You now have to specify the **project type** (we will always choose *"C executable"* and the *"C99 Standard"*) and a **project directory**.

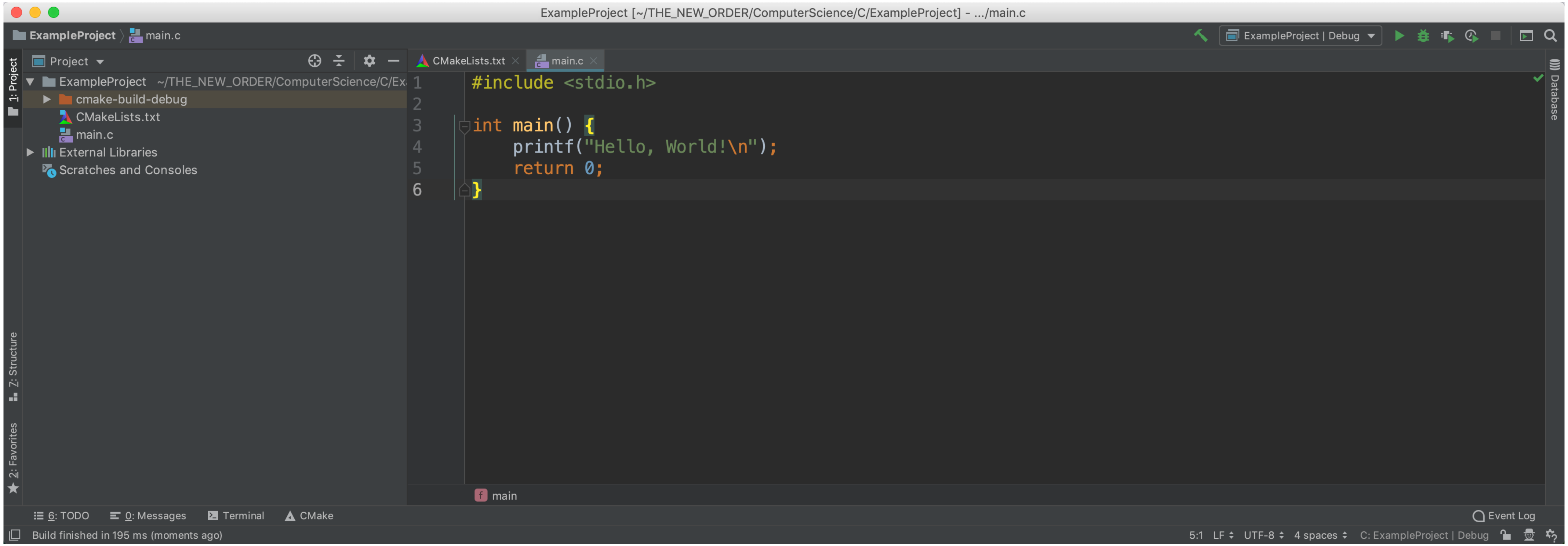


Location: /Users/moritzmakowski/THE_NEW_ORDER/ComputerScience/C/ExampleProject

Language standard: C99

Short Intro to CLion - #3

CLion automatically generates two files called `main.c` and `CMakeLists.txt`.



ExampleProject [~/THE_NEW_ORDER/ComputerScience/C/ExampleProject] - .../main.c

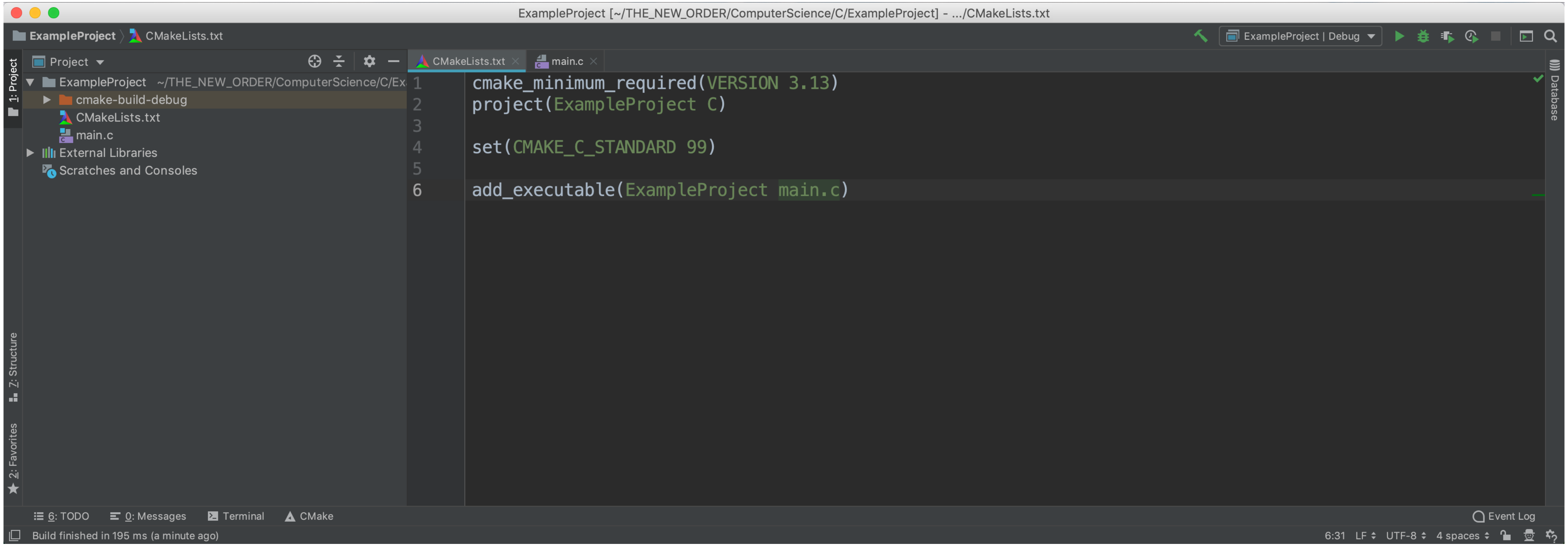
```c
#include <stdio.h>

int main() {
    printf("Hello, World!\n");
    return 0;
}
```

Build finished in 195 ms (moments ago)

Short Intro to CLion - #4

Inside `CMakeLists.txt` you can specify the files to be compiled.



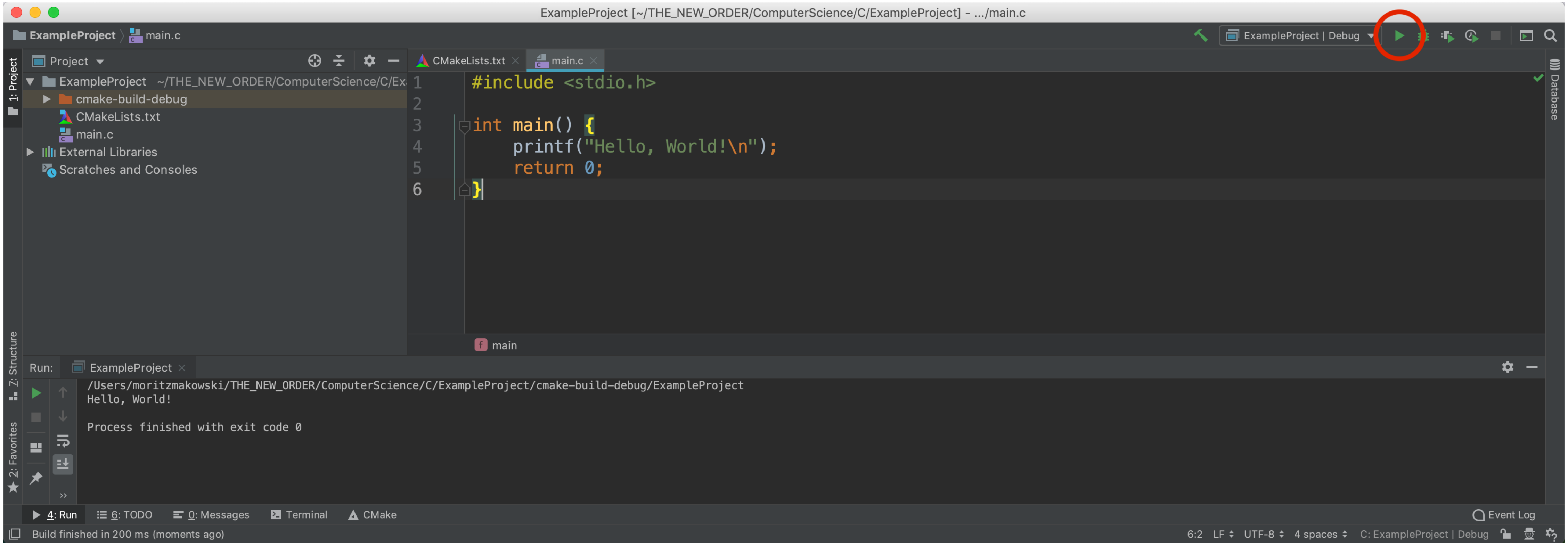
```
cmake_minimum_required(VERSION 3.13)
project(ExampleProject C)

set(CMAKE_C_STANDARD 99)

add_executable(ExampleProject main.c)
```

Short Intro to CLion - #5

On the top right is a `"Run"-Button` which compiles and executes your program.



```c
#include <stdio.h>

int main() {
    printf("Hello, World!\n");
    return 0;
}
```

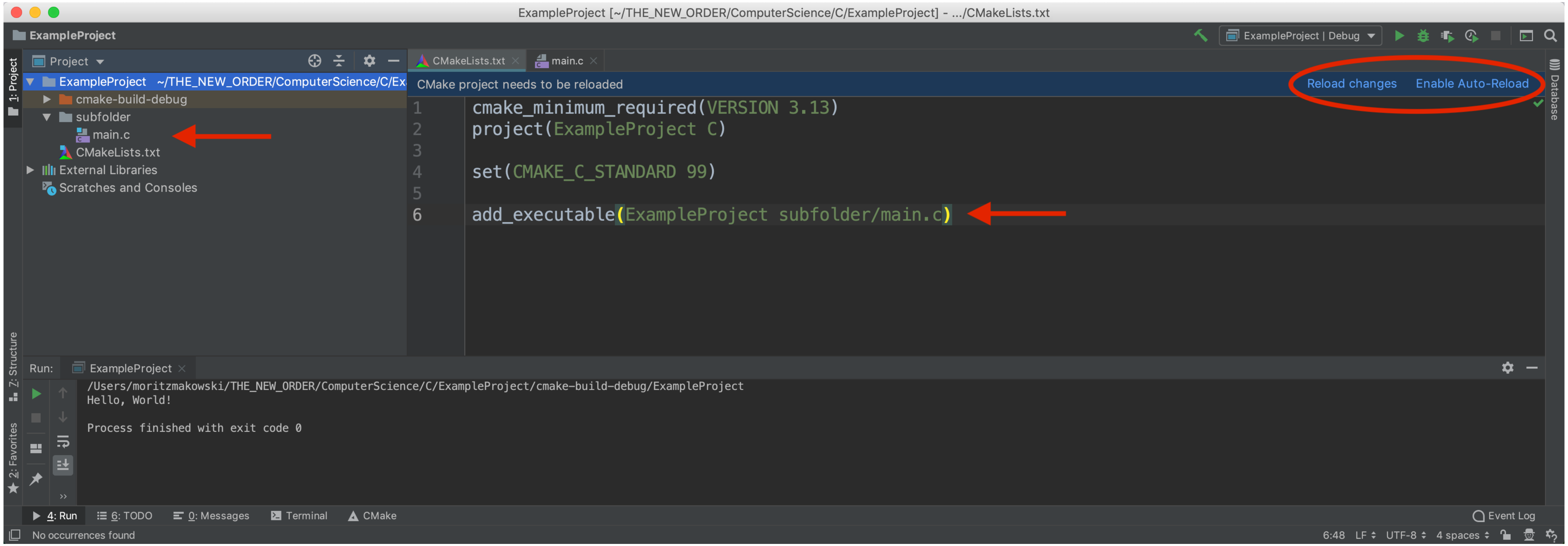
```
/Users/moritzmakowski/THE_NEW_ORDER/ComputerScience/C/ExampleProject/cmake-build-debug/ExampleProject
Hello, World!

Process finished with exit code 0
```

However, there will not be a compiled executable file next to you C file.

Short Intro to CLion - #6

When we change the location of our `main.c` we also have to modify `CMakeLists.txt`.



CMake project needs to be reloaded

```
cmake_minimum_required(VERSION 3.13)
project(ExampleProject C)

set(CMAKE_C_STANDARD 99)

add_executable(ExampleProject subfolder/main.c)
```

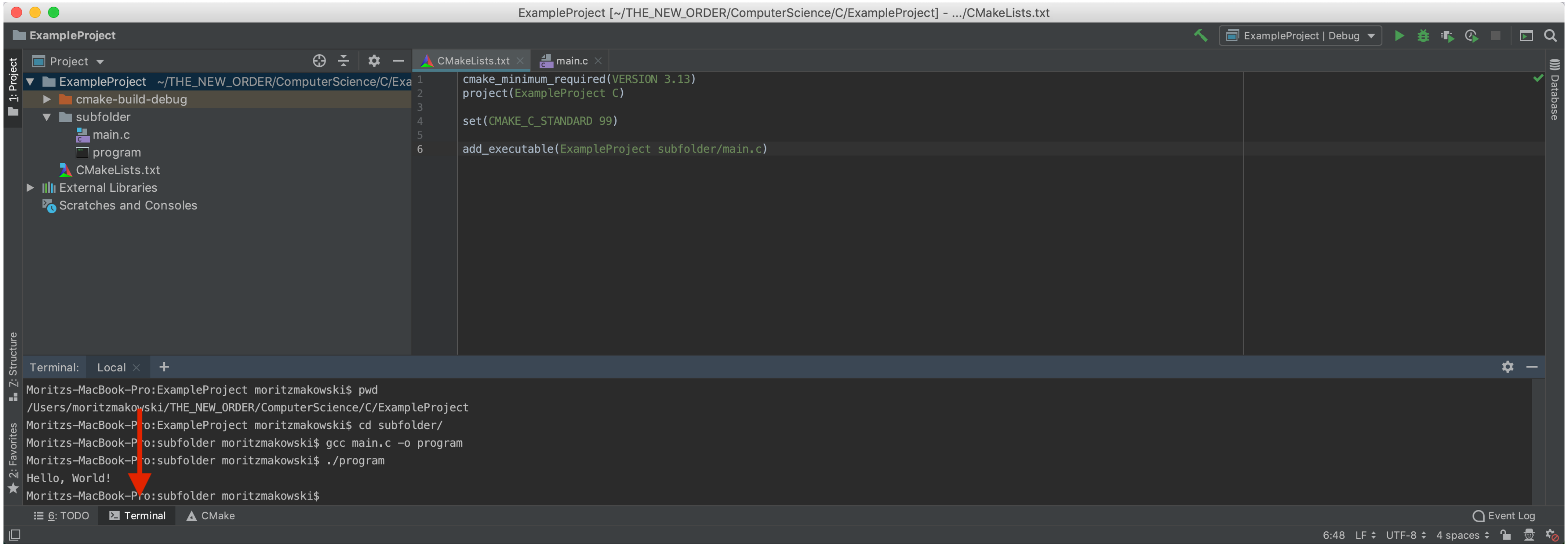
```
/Users/moritzmakowski/THE_NEW_ORDER/ComputerScience/C/ExampleProject/cmake-build-debug/ExampleProject
Hello, World!

Process finished with exit code 0
```

After changing `CMakeLists.txt` you have to click **Reload Changes** in order to use the mentioned "Run"-Button again.

Short Intro to CLion - #7

There is also a **terminal** inside the IDE which you can use to compile your program.



```
cmake_minimum_required(VERSION 3.13)
project(ExampleProject C)

set(CMAKE_C_STANDARD 99)

add_executable(ExampleProject subfolder/main.c)
```

```
Moritzs-MacBook-Pro:ExampleProject moritzmakowski$ pwd
/Users/moritzmakowski/THE_NEW_ORDER/ComputerScience/C/ExampleProject
Moritzs-MacBook-Pro:ExampleProject moritzmakowski$ cd subfolder/
Moritzs-MacBook-Pro:subfolder moritzmakowski$ gcc main.c -o program
Moritzs-MacBook-Pro:subfolder moritzmakowski$ ./program
Hello, World!
Moritzs-MacBook-Pro:subfolder moritzmakowski$
```

Short Intro to CLion - #8

If you see a red error message at the bottom right after the program opens, that says something like **"CMake Error: ... CMAKE_MAKE_PROGRAM is not set ..."**, please go back to the installation of gcc under windows and make sure that all modules are installed.

CLion also has an answer to that error message: https://www.jetbrains.com/help/clion/quick-tutorial-on-configuring-clion-on-windows.html

EDIT: The `CMakeLists.txt` file - #1

The `CMakeLists.txt` file is basically just a description on what files can be compiled and run. In CLion the "Play Button" is powered by that `CMakeLists.txt`, meaning: In that file is the description on what programs can be executed by the "Play Button".

This is optional! You can also just use the terminal/shell to compile and run your programs manually!

EDIT: The `CMakeLists.txt` file - #2

```
cmake_minimum_required(VERSION 3.16)
project(tutorial_01 C)

set(CMAKE_C_STANDARD 99)

add_executable(example_1_1 examples/example_01_hello_world.c)
add_executable(example_1_2 examples/example_02_hello_math.c)
```

Every line `example_1_1(...)` adds a different program that can be compiled to the list.

The **first value** (`example_1_1` or `example_1_2`) is the name of your program. But you can freely choose that name! This is just the name that appears next to the play button.

The **second value** (`examples/example_01_hello_world.c` or `examples/example_02_hello_math.c`) is the name of your C-file that belongs to that project.

EDIT: The `CMakeLists.txt` file - #3

When you want to add new C-scripts then you can just add one more line with `add_executable(...)` :

```
cmake_minimum_required(VERSION 3.16)
project(tutorial_01 C)

set(CMAKE_C_STANDARD 99)

add_executable(example_1_1 examples/example_01_hello_world.c)
add_executable(example_1_2 examples/example_02_hello_math.c)
add_executable(example_1_3 examples/one_more_file.c)
```

Right left of the "Play Button" there is a drop-down-menu where you can select the program to be executed by that button.

EDIT: The `CMakeLists.txt` file - #4

Some things to look out for:

- If you rename a file or move it to another folder/subfolder then you also have to make this change in the `CMakeLists.txt`
- Whenever you add new C-Files CLion might accidentally add them to existing `add_executable(...)` lines. Be careful that your `add_executable(...)` lines only have 2 arguments!
- If the "Play Button" is not green but gray there is probably an issue with your `CMakeLists.txt`
- If CLion shows some error about CMake and `gcc` is correctly installed (can be used in the terminal) then there is probably an issue with your `CMakeLists.txt`

EDIT: The `CMakeLists.txt` file - #5

- If your Anti-Virus Software blocks the execution of your program then you have to set an exception for "Executing programs of unauthorized Developers" in the Anti-Virus-Settings
- Do **not** use characters like `ä`, `Ä`, `ö`, ..., `ß`, `/`, `\`, `,`, `.`, `:`, `!`, `^`, `°`, `$`, `%`, and spaces and so on in your directory and file names. **Avoiding spaces and dots** is really important! Obviously you can use a dot for your `.c` extension.

Will there be homework?

Yes! But listen ... Learning theoretically about programming is like learning swimming in theory.

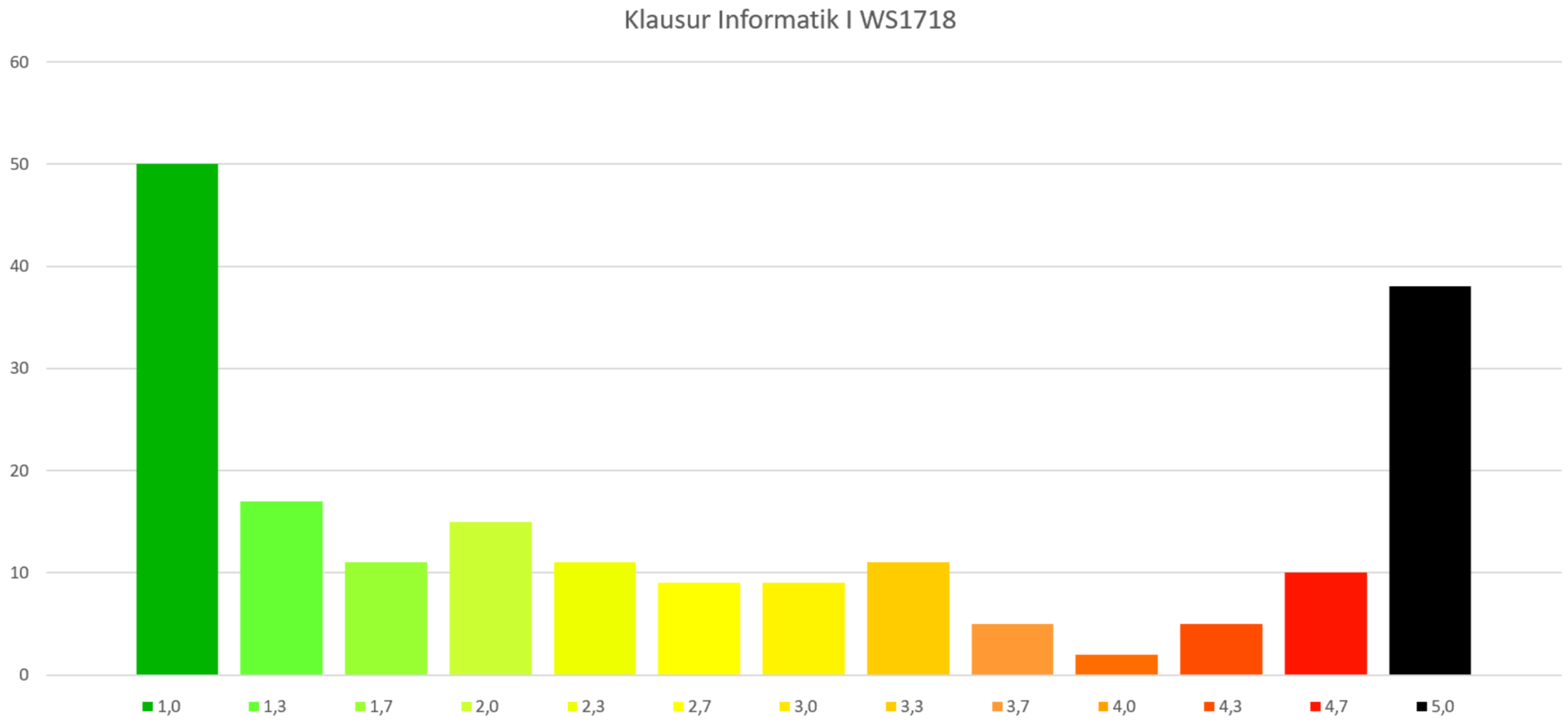
You can only learn how to program by doing it, and to get you started these homework tasks are some example exercises so that you have something to actually practice on.

How much homework? *(Only preliminary information)*

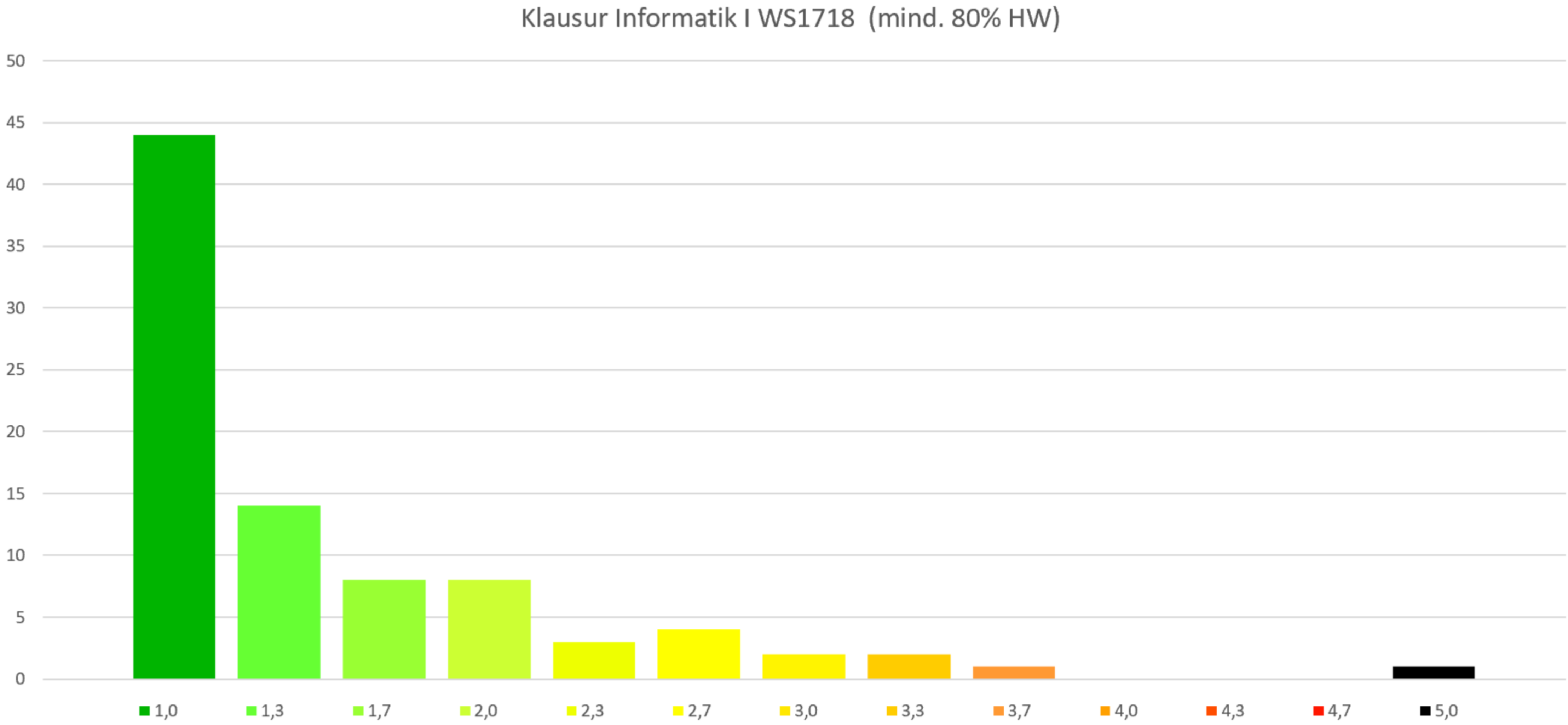
There will be **10 homework sheets**.

You don't have to do these exercises, but we strongly recommend it. If you complete at least 8/10 assignments, you will get a 0.3 bonus on your overall exam grade. However you can not surpass 1.0 and have to pass the exam without the bonus of 0.3.

You wan't to know, why we strongly recommend, doing homework assignments?



That's why ...


Klausur Informatik I WS1718 (mind. 80% HW)
50
45
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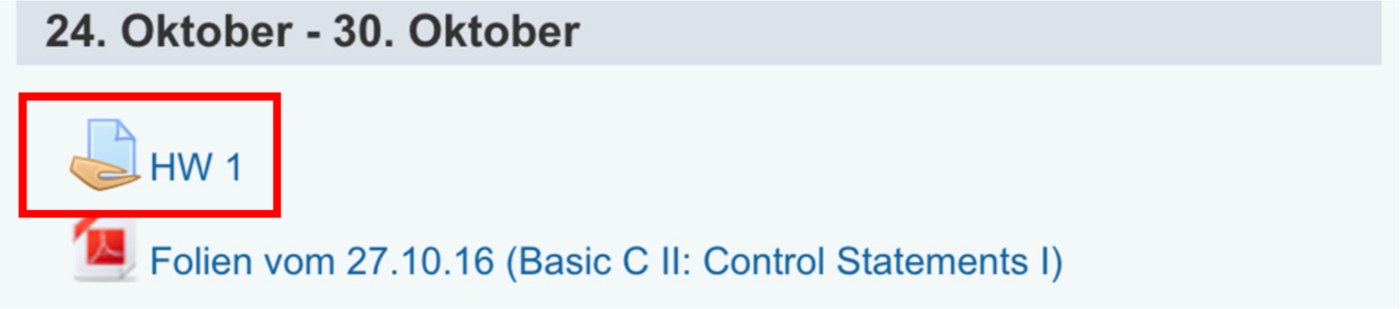
■ 1,7
■ 2,0
■ 2,3
■ 2,7
■ 3,0
■ 3,3
■ 3,7
■ 4,0
■ 4,3
■ 4,7
■ 5,0

How do we submit our homework solutions?

Once there are homework assignments due, you can upload them on Moodle:



24. Oktober - 30. Oktober

HW 1

Folien vom 27.10.16 (Basic C II: Control Statements I)

We will correct them as fast as possible and give you a short feedback on the submit page on Moodle. You can ask us in directly for a more detailed feedback. The tutor which is presenting your tutorial will also correct your homework.

Homework Assignments

Only submit your **C script(s)**, not your executables.

Make sure your scripts compile with `gcc -Wall -Werror -std=c99 <filename>.c -o program` and don't throw any errors.

Zip all the required `.c` files **without putting it in a folder** and upload it on Moodle.

Name the zip-file like: `HW<number>_<your first name>_<your last name>.zip`

GCC Compiler Flags in CLion

In order to have the **same error-behavior** when compiling manually and using the `"Run"-Button` you have to add lines `6` and `7` (below) to your `CMakeLists.txt`-file.

```
cmake_minimum_required(VERSION 3.16)
project(example_project C)

set(CMAKE_C_STANDARD 99)

set(GCC_COVERAGE_COMPILE_FLAGS "-Wall -Werror")
set(CMAKE_C_FLAGS "${CMAKE_C_FLAGS} ${GCC_COVERAGE_COMPILE_FLAGS}")

add_executable(example_project main.c)
```

Additional Resources

All **code examples** and **exercise solutions** on **GitLab** (solutions right after my tutorial):

https://gitlab.lrz.de/dostuffthatmatters/IN8011-WS20

Don't worry, you don't have to know how Git and GitLab work to access these files!

When your teacher is talking about Java and you remember Minecraft was made with Java