Operating Systems and Systems Programming I
CPS1012
Environment Setup

Mark Magro

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1 Introduction

Use this guide to:

- Create a virtual machine (VM) running the Ubuntu Linux *distro* (distribution).
- Compile a C program from the command line.
- Install the CLion C/C++ integrated development environment (IDE).
- Install the Git version control system (VCS) and use Git through CLion, with a remote repository set up on GitLab.

2 VMWare Workstation Player

Download and install the latest VMWare Workstation Player (64-bit) from `https://www.vmware.com`. The current version is 14.1.1 with a download size of 90.6 MB.

The full path to the download is *Downloads - Free Product Downloads - Workstation Player - VMWare Workstation 14.1.1 Player*. The installation is straightforward. There is an option to install an enhanced keyboard driver; this is not needed.

3 Ubuntu 16.04.3 LTS

3.1 Download

Download Ubuntu version **16.04.3 LTS** (a 1.5 GB ISO file) from
`https://www.ubuntu.com/download/desktop`.

Important! Download this version even though a more recent version is available.

3.2 Installation

A bare-bones Ubuntu installation uses around 1.1 GB of memory and 4.1 GB of hard disk space. Allocating at least 2 GB of memory is strongly recommended as the system will be very slow otherwise. Allocating at least 20 GB of hard disk space is recommended. Follow the steps below for the installation.

- Launch VMWare Player.
- Click on **Create a New Virtual Machine**.
- Select the **Installer disc image file (iso)** option and point to your Ubuntu ISO.
- Create a user name and a password. If you would like to specify a short password, this is the right moment. Once the system is up and running it is possible to change the password of course, but getting around the length and complexity password requirements is a bit of a hassle.

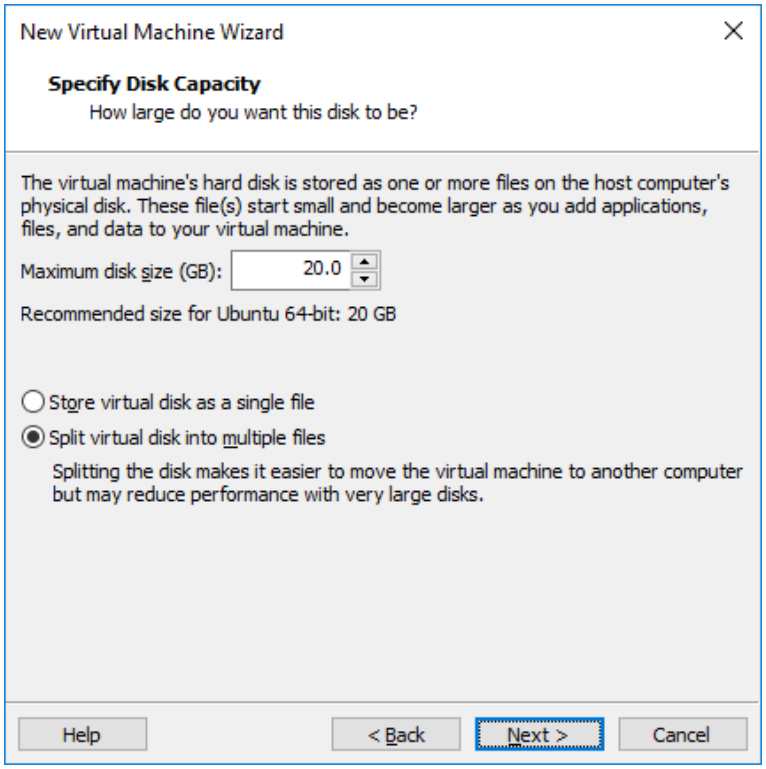

Figure 1: Specify the hard disk size.

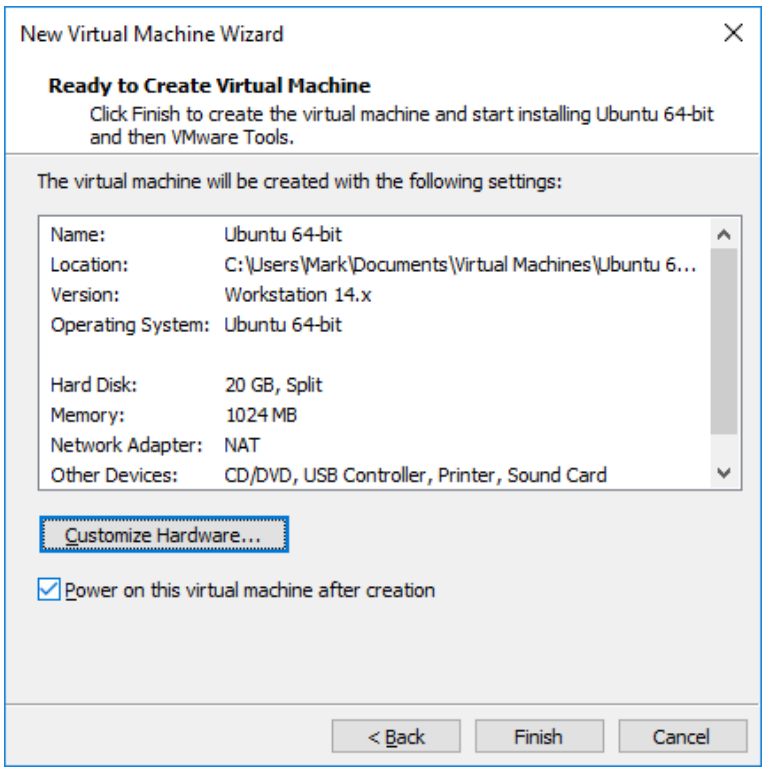

Figure 2: Hardware customisation.

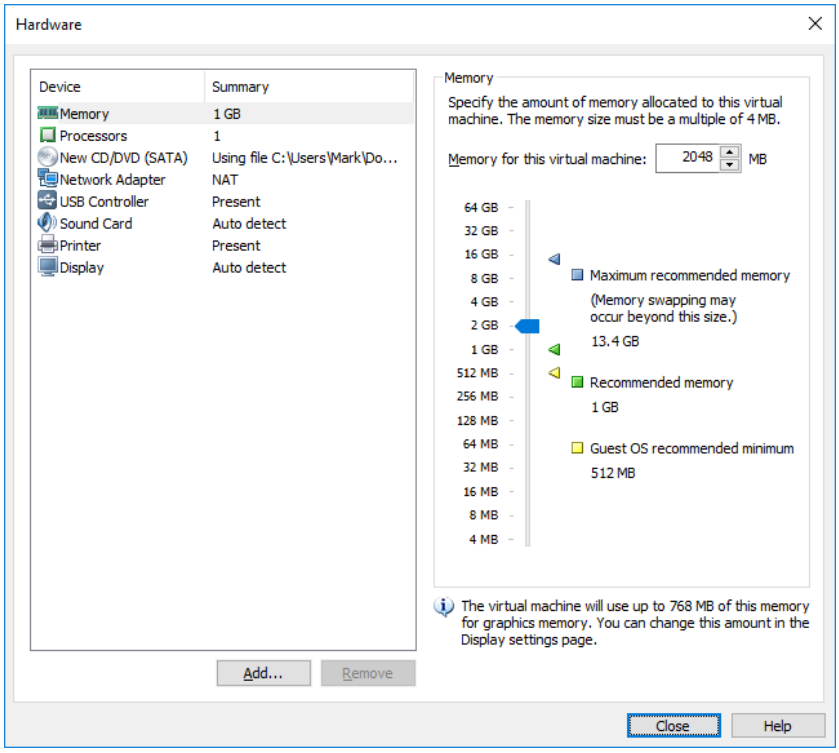

Figure 3: Allocate memory.

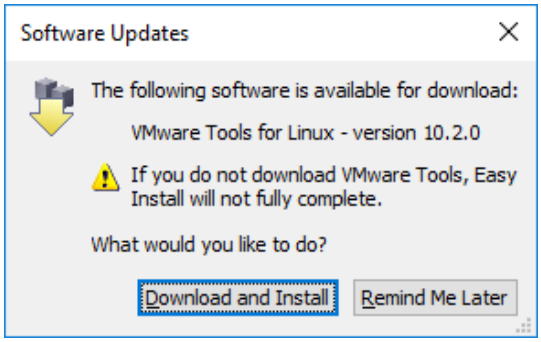

Figure 4: Install VMWare Tools.

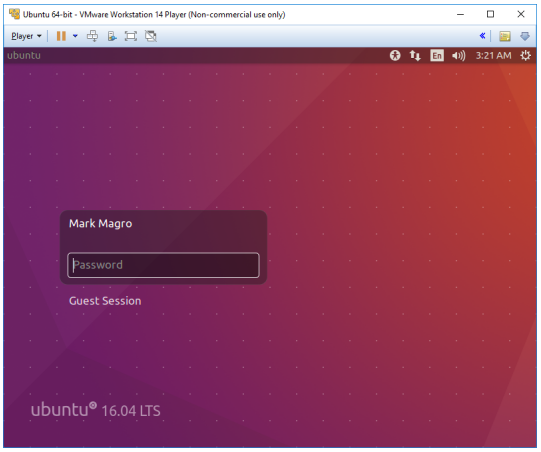

Figure 5: The Ubuntu logon screen.

- Specify the hard disk size (20 GB) (Figure 1).
- Click on the **Customize Hardware...** button (Figure 2) and allocate 2 GB of memory (Figure 3).
- When prompted, install VMWare tools (Figure 4).
- The installation is complete when the logon screen appears (Figure 5).

3.3 Getting Around

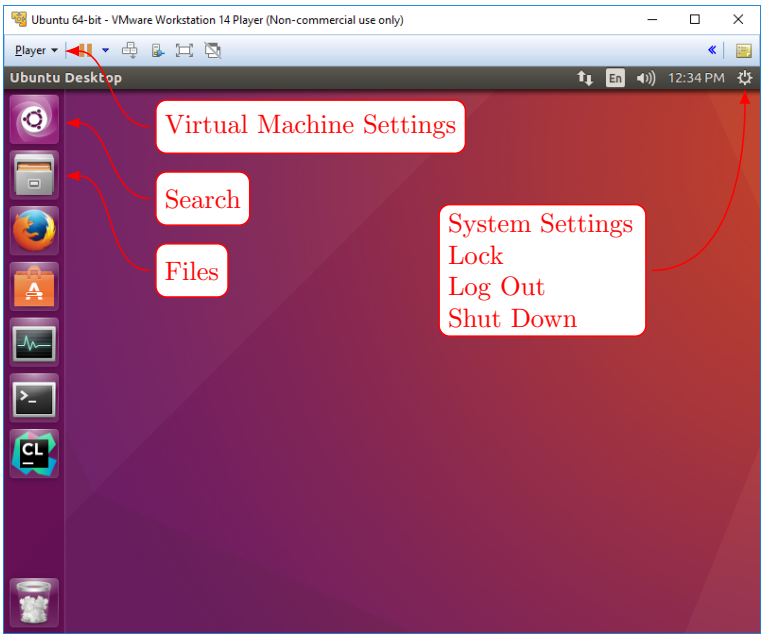

Figure 6: The desktop.

Refer to Figure 6.

System Settings, **Lock** screen, **Log Out** and **Shut Down** can all be accessed from the "cog wheel" icon close to the top right of the screen.

The **Search** icon is the Ubuntu logo close to the top left of the screen. **Files**, the file cabinet icon just below it, is used to navigate through the hard disk (it is similar to Windows Explorer).

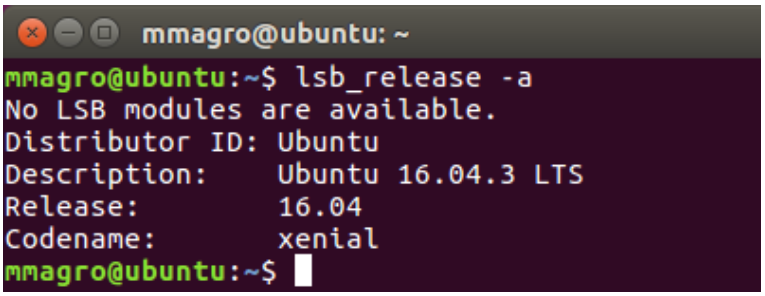

Figure 7: Displaying the Ubuntu version.

To check your Ubuntu version, open a console (click on the **Search** icon and start typing "terminal" to find it). In the console, enter the command **lsb_release -a**. Your output should be similar to that in Figure 7.

3.4 Common Issues

3.4.1 Time

If the incorrect time is displayed, most probably it is due to a wrong time zone. To fix, go to *System Settings - Time & Date* and click on the map to set the correct time zone.

3.4.2 Keyboard

To fix an incorrect keyboard layout go to *System Settings - Text Entry* and add an input source matching your layout, e.g. **English (UK)**.

3.4.3 Hardware Devices

You can get rid of unwanted hardware devices (such as the floppy disk icon in the panel on the left) by removing the device in the virtual machine's settings (go to *Player - Manage - Virtual Machine Settings*). The VM needs to be rebooted for the modifications to take effect.

3.5 Shared Folders

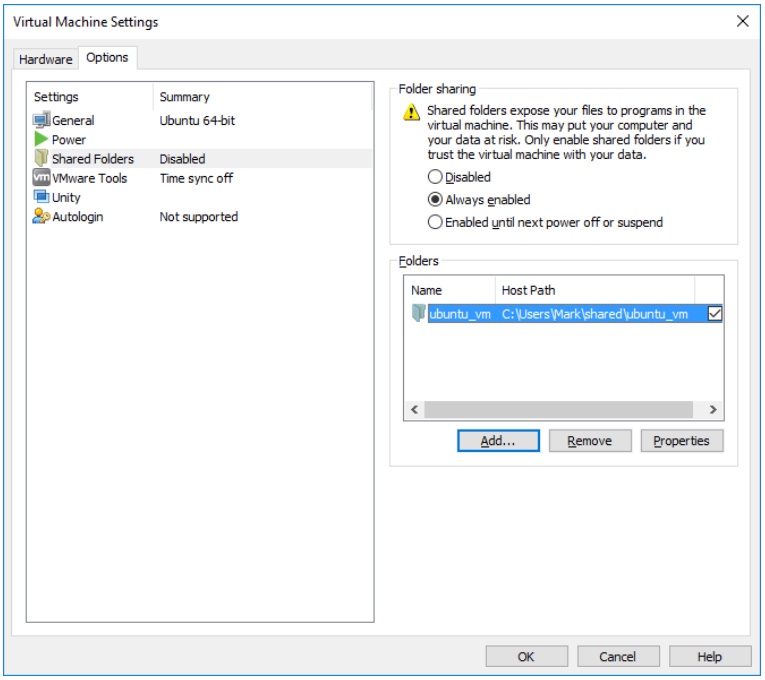

Figure 8: Creating a shared folder.

To set up a shared folder between the host OS and the guest OS, VMWare Tools need to be installed inside Ubuntu:

- Go to *Player — Manage — Install VMWare Tools*.
- Click on the DVD icon that appears in the panel on the left and locate the file with a name similar to *VMwareTools-10.2.0-7259539.tar.gz*.
- Right-click on the file and extract it to the desktop.
- Open a terminal and enter the following commands:

```
cd Desktop/vmware-tools-distrib/
sudo ./vmware-install.pl -d
```

- Reboot the VM.
- Go to *Player - Manage - Virtual Machine Settings - Options tab* and select **Shared Folders**. Choose **Always enabled** and press **Add...** to specify a folder on the host OS (Figure 8).
- The shared folder can now be accessed from *Files - Computer - mnt - hgfs*.

4 Command-Line Compilation

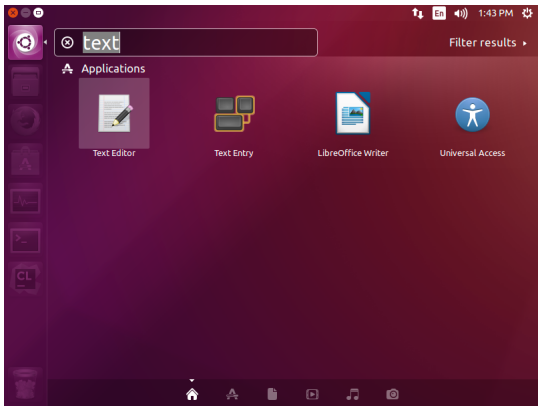

Figure 9: The text editor (called **gedit**).

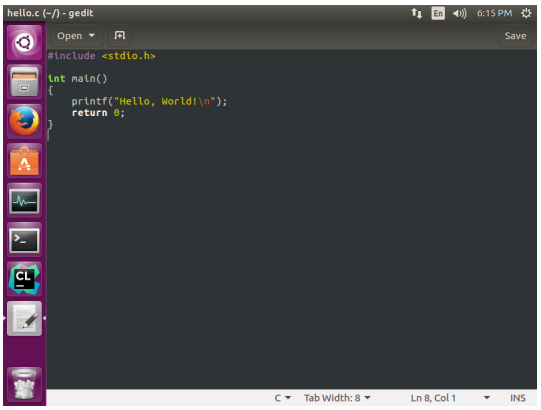

Figure 10: Hello, World!

Launch a text editor (Figure 9), enter a small "Hello, World!" C program (Figure 10) and save it as **hello.c** in your home folder.

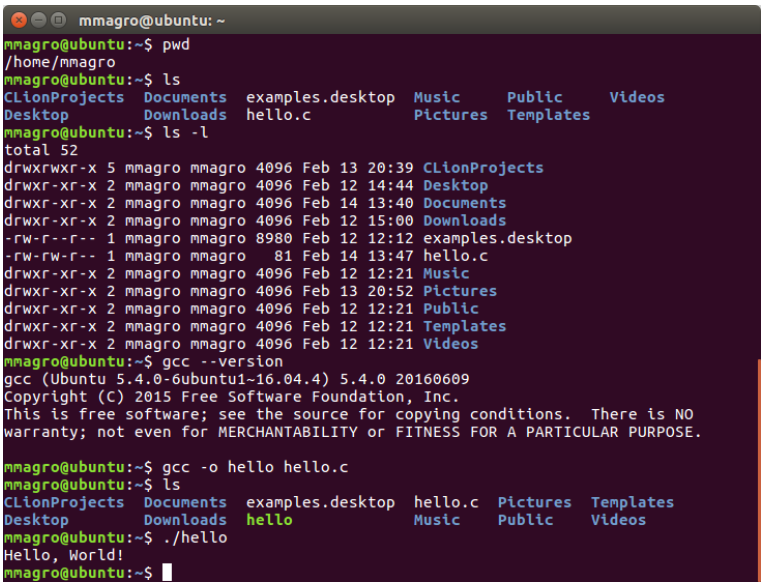

Figure 11: Command-line compilation.

Open a console. By default the console always starts in your home folder. This is indicated by the tilde character in the command prompt. Figure 11 illustrates some commands and how to compile the **hello.c** program and run it. A brief explanation of the commands used:

- **pwd** prints name of the current/working directory.
- **ls** (list) is the equivalent of **dir** on Windows. **ls -l** (long list) shows more detail.
- **gcc** is the C compiler. **gcc -o hello hello.c** compiles the program. The **-o hello** option instructs the compiler to name the output file (the executable) **hello**.
- **./hello** runs the program. Note the **./** prefix.

5 CLion

5.1 Download and Installation

Go to `https://www.jetbrains.com/student/` and sign up using your UM e-mail address (*whatever@um.edu.mt*). You should immediately receive a couple of e-mails with instructions to confirm your registration and to activate your license. Then download CLion 2017.3.3 for Linux (316 MB) onto your Ubuntu virtual machine.

To install CLion, open a terminal and navigate to your download location (the download is a file with a name similar to *CLion-2017.3.3.tar.gz*). Enter the following commands:

```
sudo tar xvzf CLion-2017.3.3.tar.gz -C /opt/
cd /opt/clion-2017.3.3/bin/
./clion.sh
```

Let the wizard guide you through the rest of the installation (you can leave everything as default).

5.2 Compilation

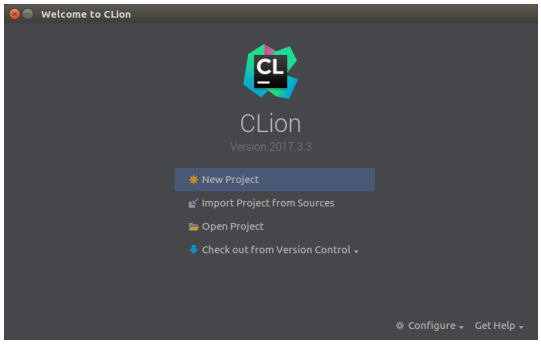

Figure 12: New CLion project.

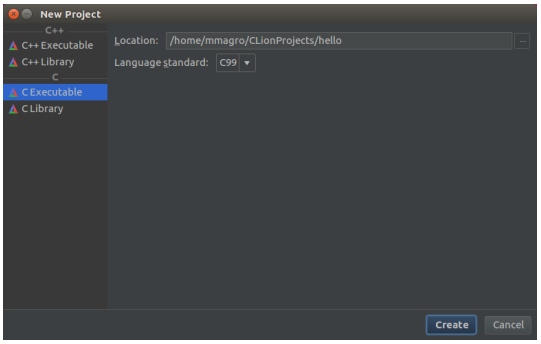

Figure 13: New C project - **hello**.

To illustrate how to compile a program, let's again use a "Hello, World!" C program. Launch CLion and create a new C project, calling it **hello** (Figures 12 and 13).

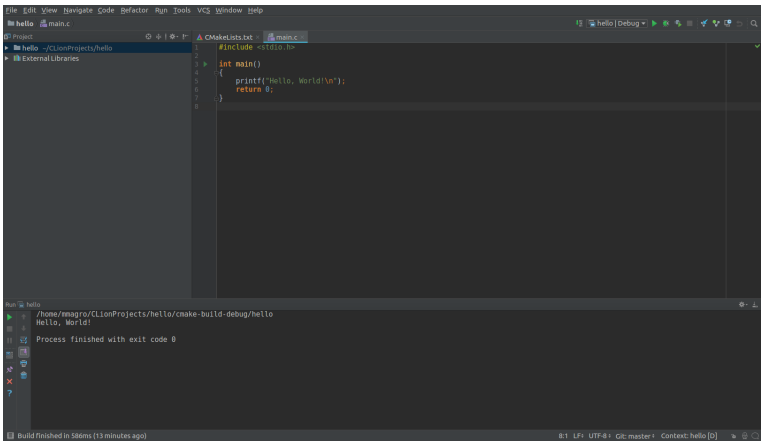

Figure 14: Running the **hello** program in CLion.

CLion generates a code snippet when creating a new project. Very conveniently for this example, the snippet is a "Hello, World!" program. To compile the program, either use *Run - Build* from the menu or the shortcut **Ctrl+F9**. To run the program, use *Run - Run 'hello'* or **Shift+F10**. You should see the program's output in the **Run** window at the bottom of the screen (Figure 14).

6 Git and GitLab

6.1 Prerequisites

- Install Git by opening a console and entering the following command:

  `sudo apt install git`

- Go to `https://about.gitlab.com` (Figure 15) and set up an account.

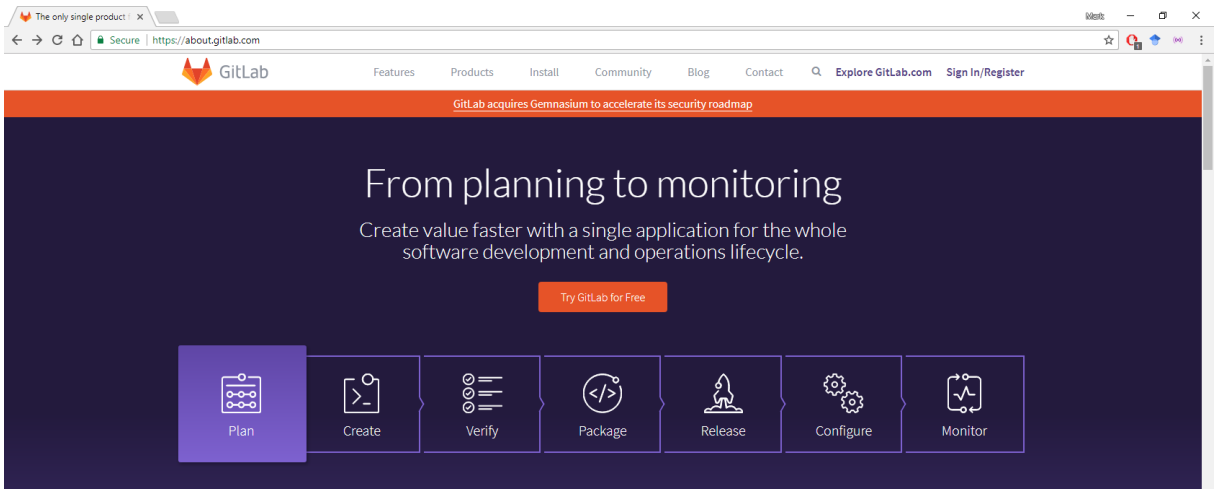

Figure 15: GitLab.

6.2 Create a new project on GitLab

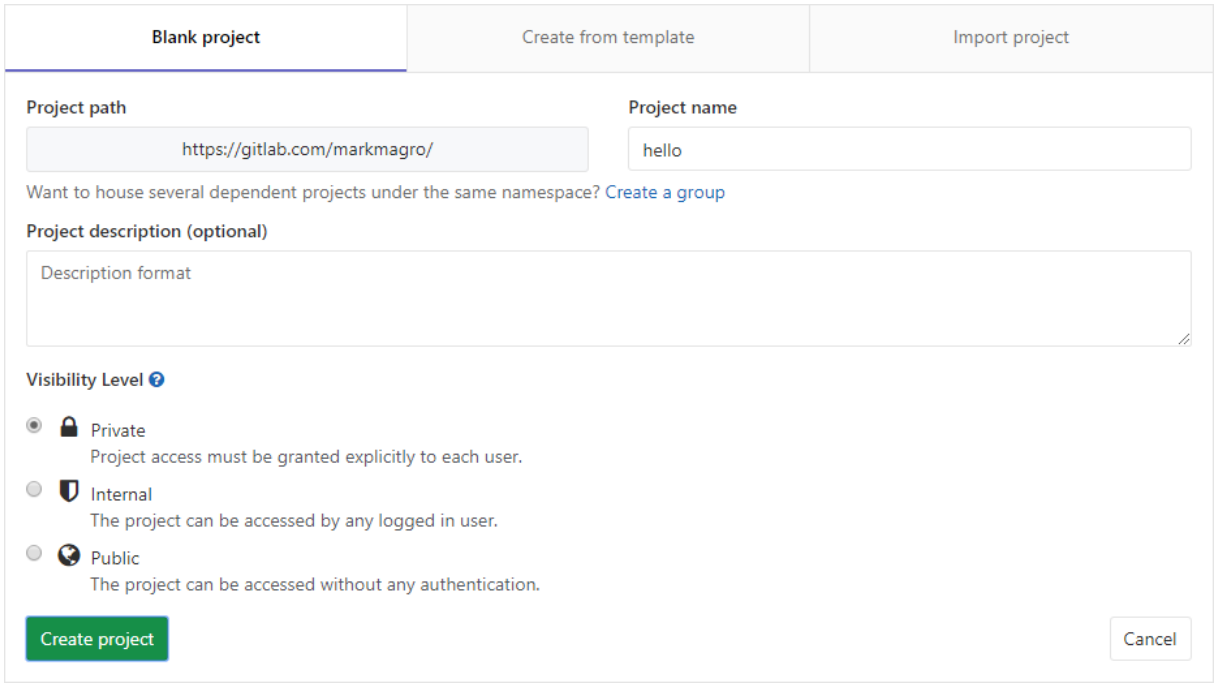

Figure 16: GitLab - Creating a new project.

On GitLab, go to *Projects - Your projects*, click on **New project**, specify a project name and optionally enter a project description (Figure 16).

To *push* files onto this project, the following information will be needed:

- Your GitLab user name and password.
- The URL of your project. Get this from your project page (go to *Projects - Your projects* and click on your project). Under the project name there is a drop-down list containing SSH and HTTPS (Figure 17). Choose HTTPS and copy the URL next to it (Figure 18). The URL should be similar to `https://gitlab.com/markmagro/hello.git` where **hello** is the name of the project. Note that the URL is not entirely visible in the figures.

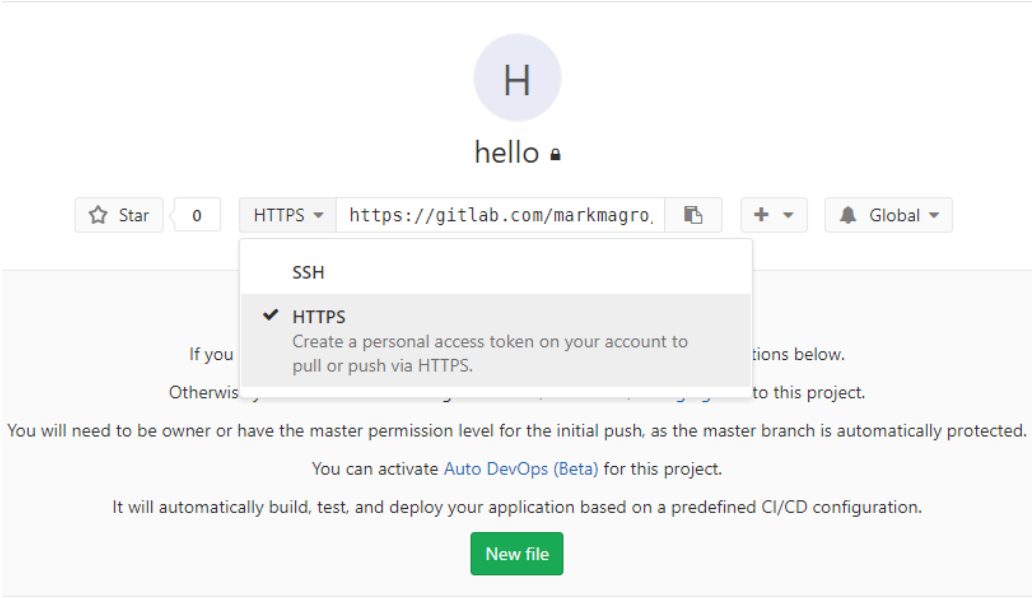

Figure 17: GitLab - The SSH and HTTPS drop-down list.

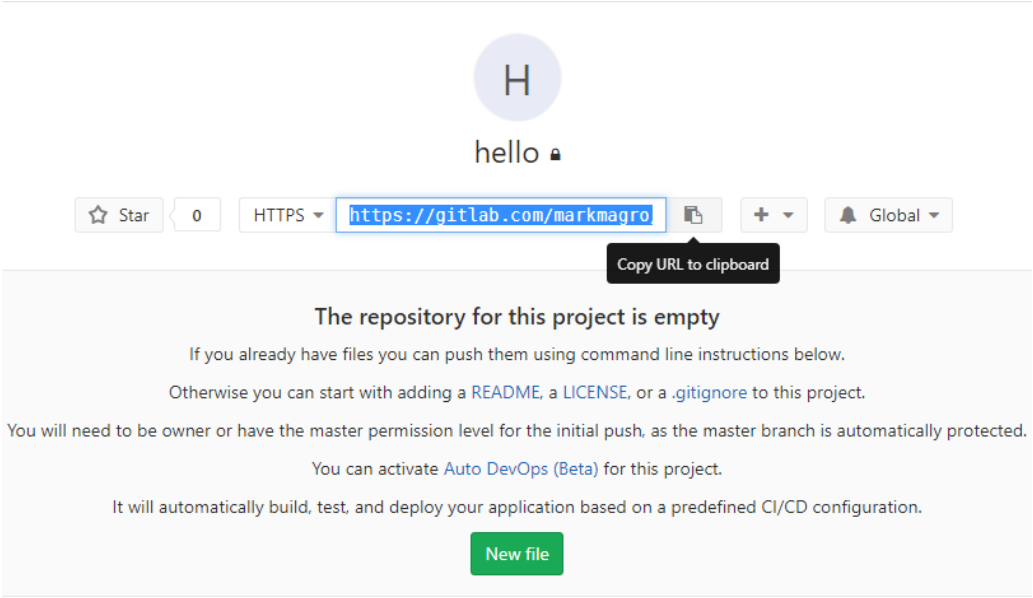

Figure 18: GitLab - The HTTPS URL.

6.3 Using Git via CLion

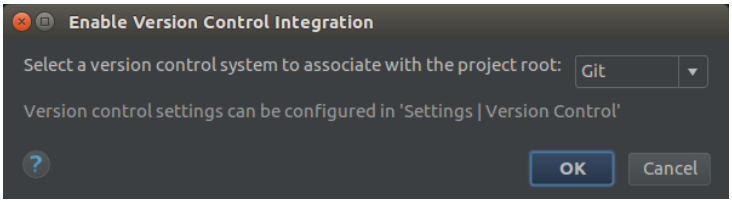

Figure 19: CLion - Enable the Git VCS.

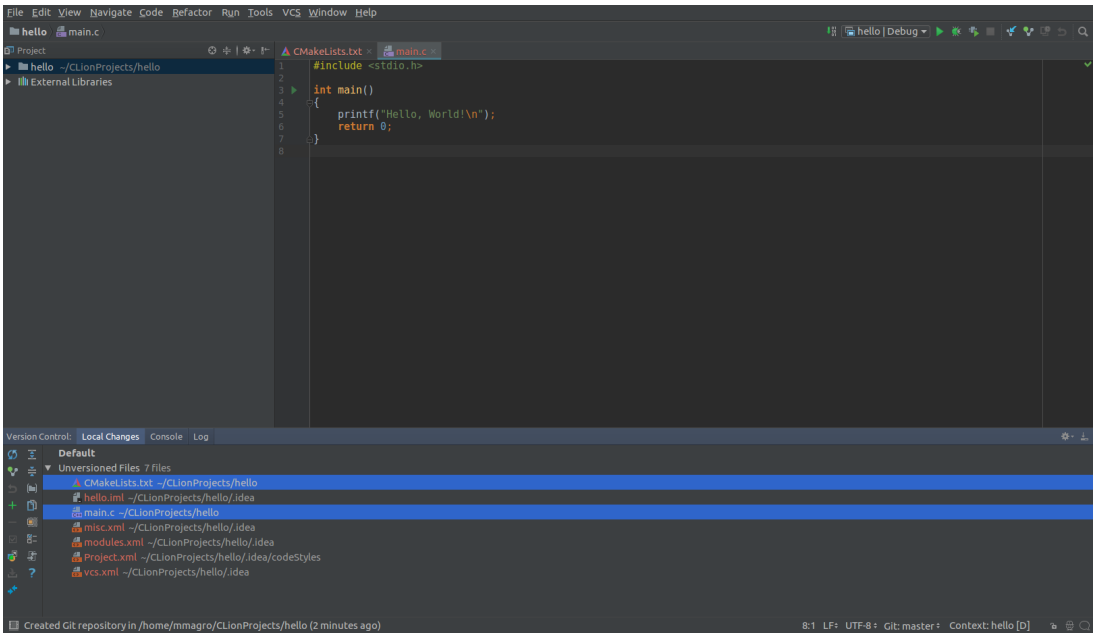

Figure 20: CLion - Select the files that are going to be *tracked* (version controlled).

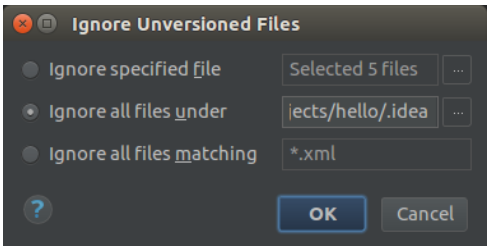

Figure 21: CLion - Ignore all files in the **.idea** directory.

- Launch CLion and open your project.
- Select *VCS - Enable Version Control Integration* and choose **Git** (Figure 19).
- Open the version control window (*View - Tool Windows - Version Control* or press Alt+9). Take note of the two labels, **Default** and **Unversioned Files**. Initially all the files will be under **Unversioned Files**.
- Select the files that are going to be version controlled (**CMakeLists.txt** and **main.c**, Figure 20). Right-click on one of the selected files and choose **Add to VCS**.

- Select the remaining files (those under the **Unversioned Files** label). Again, right-click on one of the selected files and choose **Ignore**. Choose **Ignore all files under .idea** (Figure 21).

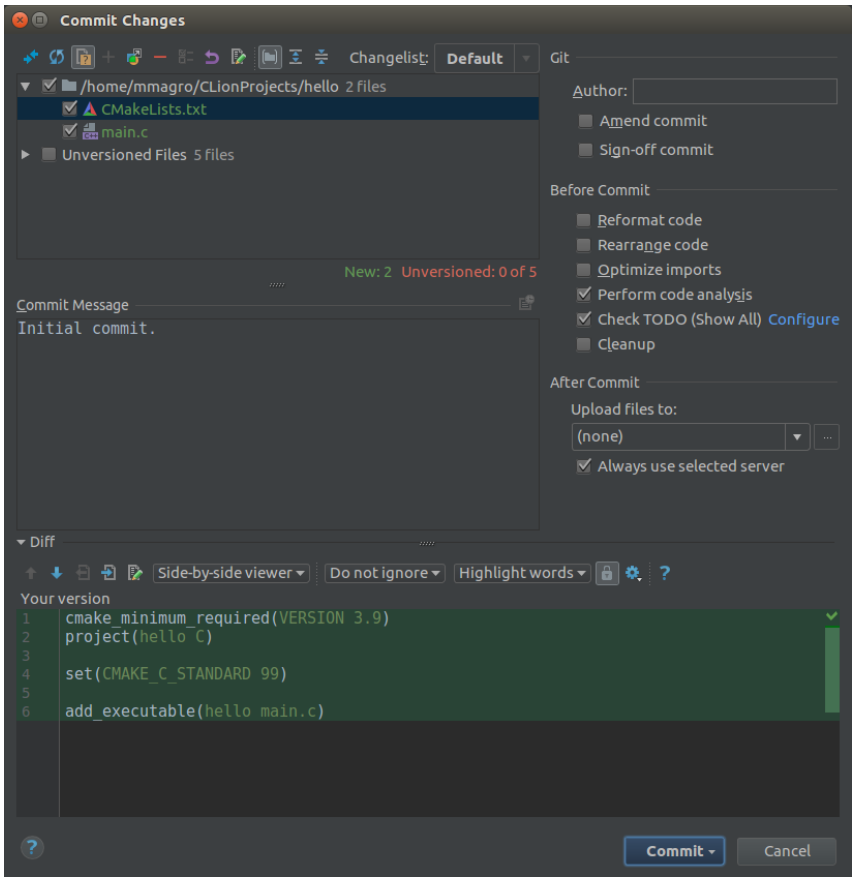

Figure 22: CLion - Commit.

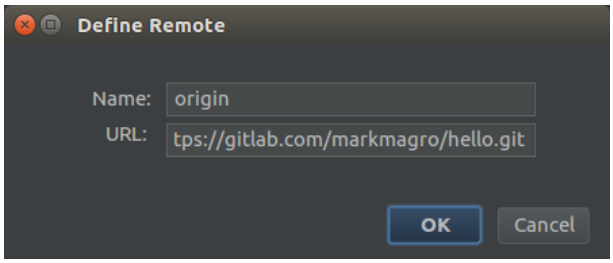

Figure 23: CLion - Specify the project's URL.

- Click on the **Default** label, then from the menu choose *VCS - Commit*. Specify the commit message, e.g. "Initial commit.", and press **Commit** (Figure 22). The committed files are now said to be *staged*.
- To push the staged files onto the remote repository, choose *VCS - Git - Push*.
- CLion now needs our project's GitLab URL. In the dialog that pops up, click on **Define remote** and enter your GitLab project's URL (Figure 23). You will now be able to click on the **Push** button.

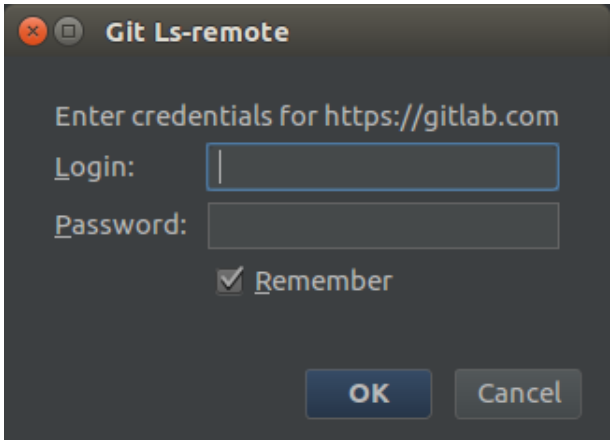

Figure 24: CLion - Enter your GitLab credentials.

- Enter your GitLab credentials when prompted (Figure 24).
- Click **Push**. You should get a notification that the files were pushed successfully.
- Go back to your GitLab project page and refresh it. The pushed files should now be visible (Figure 25).

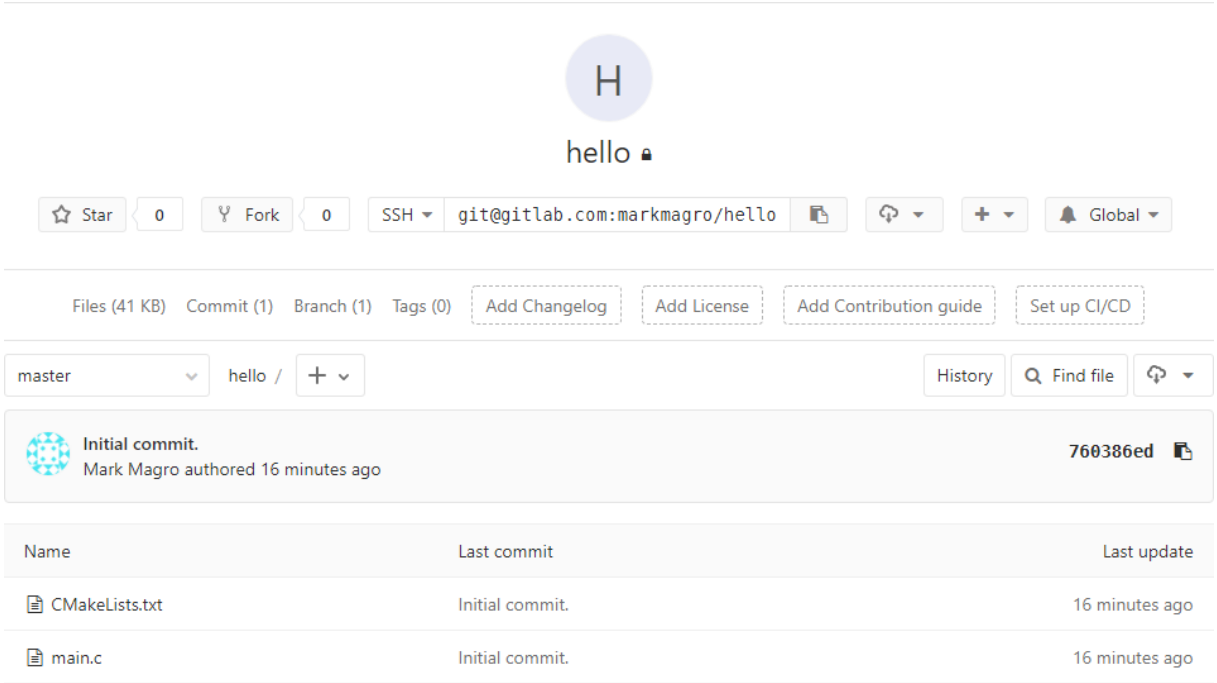

Figure 25: GitLab - The project page.