Development setup

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Prepare for cross-compilation

Install developer tools

```
$ sudo apt install ubuntu-dev-tools
```

We're only using these tools to easily manage chroot environments and to run `apt` to manage cross-compilation dependencies. If you're interested, you can find more information on the Ubuntu and Debian Wiki, but most of it is far beyond the scope of this guide: https://wiki.ubuntu.com/SimpleSbuild, https://wiki.debian.org/sbuild.

Create a Raspberry Pi OS root filesystem

We'll use `debootstrap` to create a minimal Raspberry Pi OS root filesystem in a folder on our computer. It has all the system libraries of the Raspberry Pi installed and you can install third-party libraries as well, these are necessary to link your executables when cross-compiling.
This root filesystem folder is often referred to as the *sysroot*, and it will later be passed as an option to CMake, the compiler, the linker, GDB, etc. so they can find the necessary files (we cannot use the actual root file system of our computer, because the libraries there have the wrong architecture, most likely x86_64, but we need armv6 libraries).

```
$ wget -qO- https://archive.raspbian.org/raspbian.public.key | gpg --import -
$ mk-sbuild --arch=armhf buster --debootstrap-mirror=http://raspbian.raspberrypi.org/raspbian --name=rpizero-buster --
  debootstrap-keyring "$HOME/.gnupg/pubring.kbx --merged-usr" --skip-proposed --skip-updates --skip-security
```

If this is the first time you use `mk-sbuild`, you'll be asked to edit your `~/.sbuildrc` file. Since we're not actually going to be publishing any packages, you can just accept the defaults. After this first run, reboot your computer (or log out and back in again, or use `su - $USER`, to flush group memberships), and run the second command again:

```
$ mk-sbuild --arch=armhf buster --debootstrap-mirror=http://raspbian.raspberrypi.org/raspbian --name=rpizero-buster --
  debootstrap-keyring "$HOME/.gnupg/pubring.kbx --merged-usr" --skip-proposed --skip-updates --skip-security
```

This will install a minimal version of Raspberry Pi OS in a folder on your computer. The Ubuntu development tools allow you to install libraries into this folder using `apt install`, which makes it very easy to manage the cross-compilation dependencies.

The `--merged-usr` option is included in the `--debootstrap-keyring` option so that it is passed on to `debootstrap`, the `mk-sbuild` script currently lacks this option.

If something went wrong or if you no longer need it, you can use `sudo sbuild-destroychroot rpizero-buster-armhf`, it will give instructions how to remove the root filesystem and the schroot configuration.

If you used a different name for your build environment, remember to replace it in the commands throughout the rest of the tutorial.

Install the toolchain

The cross-compilation toolchains in the Ubuntu repositories are not compatible with Raspberry Pi OS, so you'll have to build or install your own. It's easiest to just download the crosstool-NG toolchain from https://github.com/tttapa/docker-arm-cross-toolchain.

In this example, I'll be using the ARMv6 toolchain, because it is compatible with all Raspberry Pi boards. If you only need to support newer boards, or if you're using a 64-bit version of Raspberry Pi OS, you might want to use the ARMv8 or AArch64 toolchain (see the README of tttapa/docker-arm-cross-toolchain for more details).

```
$ mkdir -p ~/opt
$ wget -qO- https://github.com/tttapa/docker-arm-cross-toolchain/releases/latest/download/x-tools-armv6-rpi-linux-
  gnueabihf.tar.xz | tar xJ -C ~/opt
```

This installs the toolchain to `~/opt/x-tools/armv6-rpi-linux-gnueabihf`. You can add it to your path using:

```
$ echo 'export PATH="$HOME/opt/x-tools/armv6-rpi-linux-gnueabihf/bin:$PATH"' >> ~/.profile
```

This will only take effect after you log out and back in again, so you might want to do that now, or execute the following command to add it to your path in the current terminal:

```
$ export PATH="$HOME/opt/x-tools/armv6-rpi-linux-gnueabihf/bin:$PATH"
```

Verify that the toolchain is installed correctly by running:

```
$ armv6-rpi-linux-gnueabihf-g++ --version
  armv6-rpi-linux-gnueabihf-g++ (crosstool-NG UNKNOWN) 11.2.0
  Copyright (C) 2021 Free Software Foundation, Inc.
  This is free software; see the source for copying conditions.  There is NO
  warranty; not even for MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.
```

You can find more information about this toolchain and instructions on how to customize it here.

Install the C++ standard library to the Pi

Out of the box, Raspberry Pi OS uses an older compiler and has an older version of the C++ standard library installed. Since we're going to use a new toolchain, we need to install a newer version of `libstdc++` to the Pi to be able to run our programs:

```
$ scp ~/opt/x-tools/armv6-rpi-linux-gnueabihf/armv6-rpi-linux-gnueabihf/sysroot/lib/libstdc++.so.6.0.29 RPi0:~
$ ssh RPi0 bash << 'EOF'
      sudo mkdir -p /usr/local/lib/arm-linux-gnueabihf
      sudo mv libstdc++.so.6.0.29 $_
      sudo ldconfig
  EOF
```

The library is installed in `/usr/local/lib` so it doesn't interfere with the libraries managed by the system in `/usr/lib`.

Also do the same for the root filesystem on your computer, this comes in handy when debugging later:

```
$ sudo mkdir -p /var/lib/schroot/chroots/rpizero-buster-armhf/usr/local/lib/arm-linux-gnueabihf
$ sudo cp ~/opt/x-tools/armv6-rpi-linux-gnueabihf/armv6-rpi-linux-gnueabihf/sysroot/lib/libstdc++.so.6.0.29 $_
$ sudo schroot -c source:rpizero-buster-armhf -u root -d / ldconfig
```

Install and configure the IDE

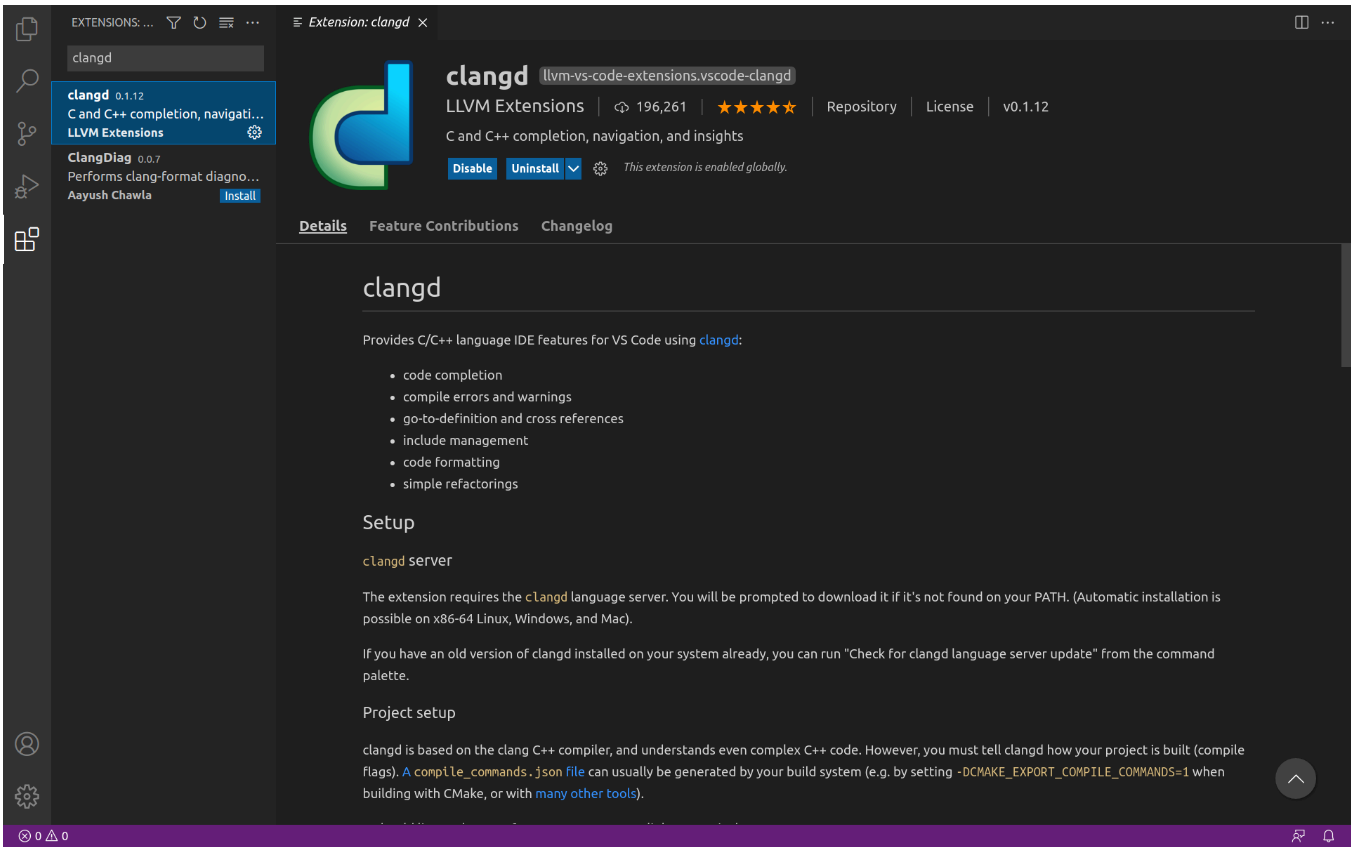
Install Visual Studio Code

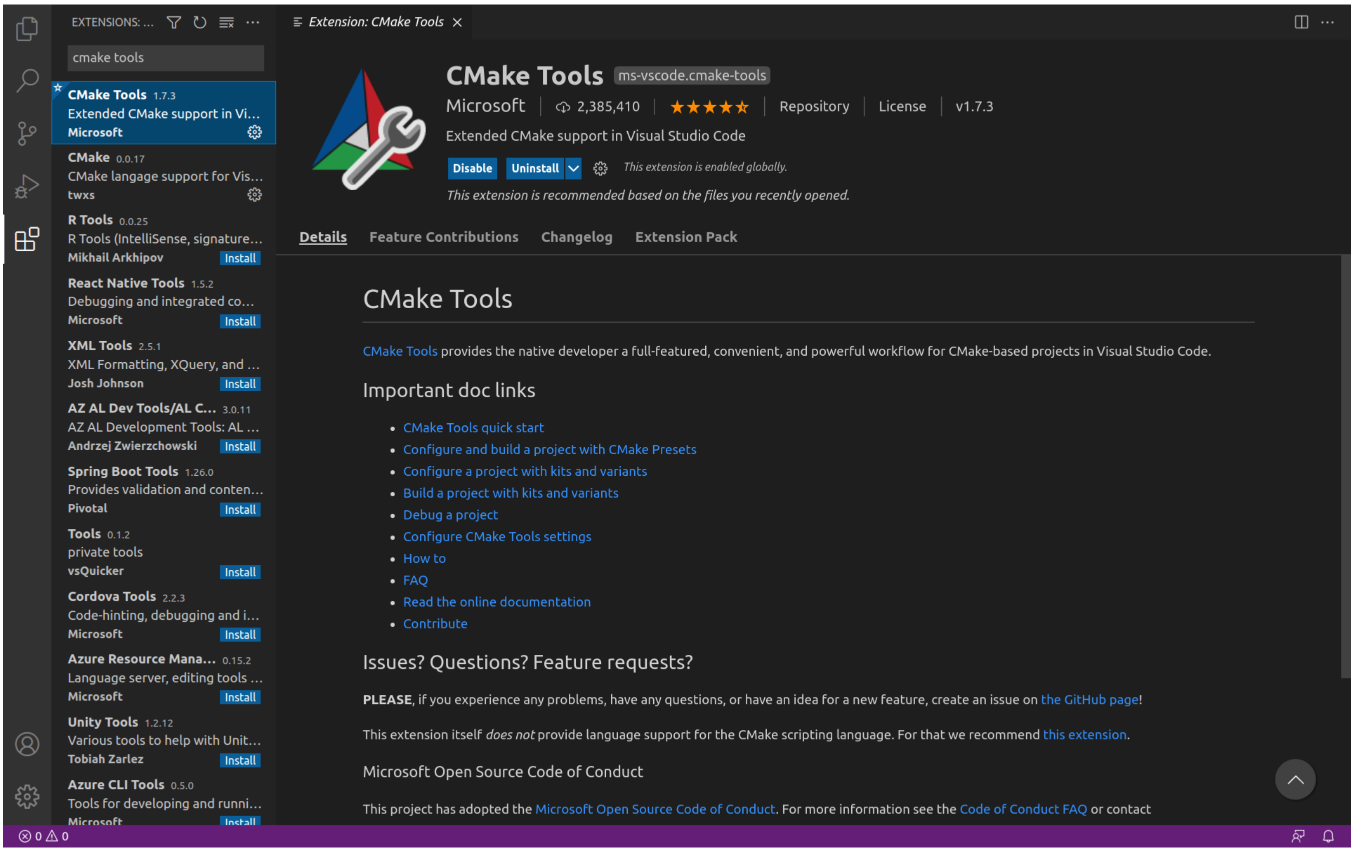
You can download and install VSCode from https://code.visualstudio.com/Download.

Install the extensions

You'll need the following extensions:

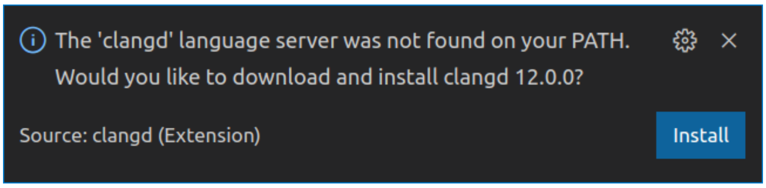
- "clangd" by LLVM Extensions
- "CMake Tools" by Microsoft

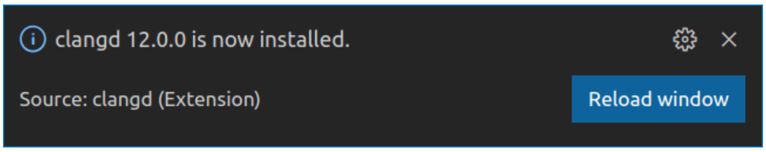




Installing clangd

If this is the first time you're using the clangd extension, you'll have to install the language server. When you open a C++ file for the first time, the extension will automatically give you a prompt:





Once the language server is installed, you get all features you'd expect from an IDE, such as semantic syntax highlighting, go-to-definition, autocomplete, documentation, refactoring options, etc.