

# C programming: installing the programming environment

Version: 2023-01

The focus in this document is on computers running Windows.

This document details the process of getting started creating console-based C programs. Console-based programs are quite simple - they take input from the keyboard (or a file stored on disk) and they produce output to the text-based console window.

You will need two things to create C programs:

- A text editor to write the source code.
- A compiler to convert the source code into an executable file so the program can be run.

3 different ways are described, during the ICTS sessions, the WSL approach will be used: gcc compiler running in Ubuntu with MobaXterm as the X-server software.

*This document is a compilation from information found on the internet. No originality is claimed.*

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## Windows (Visual Studio approach)

Source: <https://www.cs.auckland.ac.nz/~paul/C/Windows/> (accessed 2022-12-08)

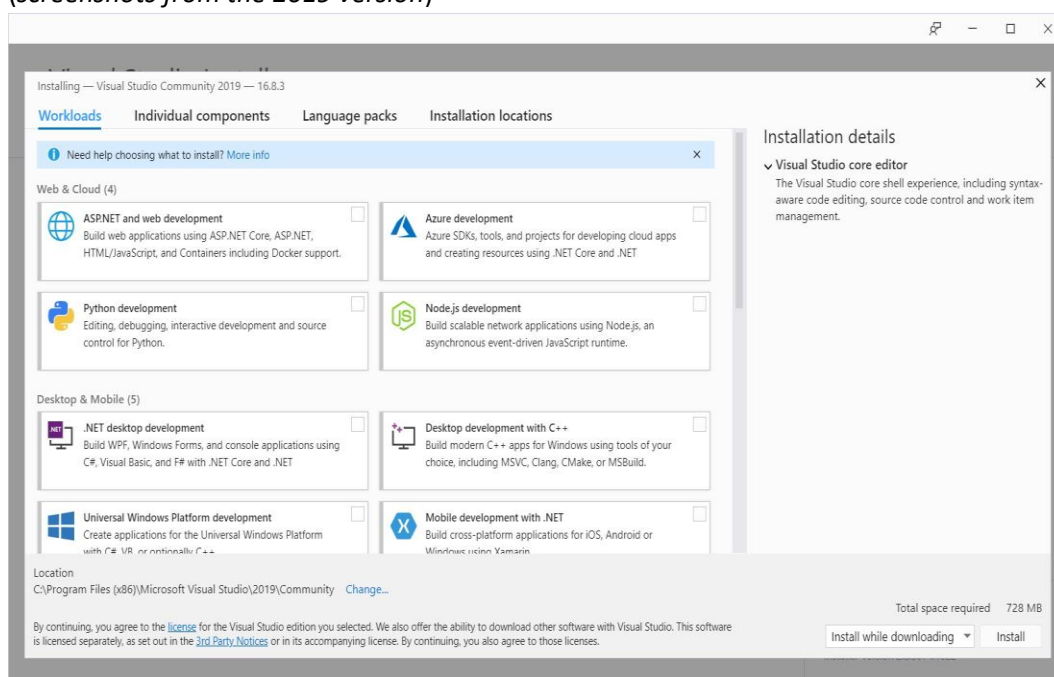
An easy way to get started with C programming on Windows is to install Visual Studio. There are different versions of Microsoft's Visual Studio - the Community version is free and includes all of the necessary libraries and tools that we need to develop C programs.



Search for *Microsoft Visual Studio Community version*  
(<https://visualstudio.microsoft.com/vs/community/>)

### Steps:

- Save the file in a convenient folder on your computer.
- Double-click this downloaded file to launch the installer program
- In the second stage of the installation you will be shown some configuration options.  
(*screenshots from the 2019 version*)



There are several tabs along the top - you only need to look at the default tab which is called *Workloads*.

- Make sure that you click the *Desktop development with C++* option
- Make sure that the *VC++ 20nn Version ... tools* and *Windows 10 SDK* options are both selected before continuing
- Click *Install*

A complete description of the installation can be found at

<https://docs.microsoft.com/en-us/visualstudio/install/install-visual-studio?view=vs-2019>  
<https://learn.microsoft.com/en-us/visualstudio/install/install-visual-studio?view=vs-2022>

(accessed 2022-12-08)

Once installed, the C compiler can be used. There are two options for developing and running C programs on Windows. The first option involves using any text editor to write the source code, and using the "cl" command within the Developer Command Prompt to compile your code. The second option involves using Visual Studio Community as the development environment, and creating a Visual Studio "project" to organize the files.

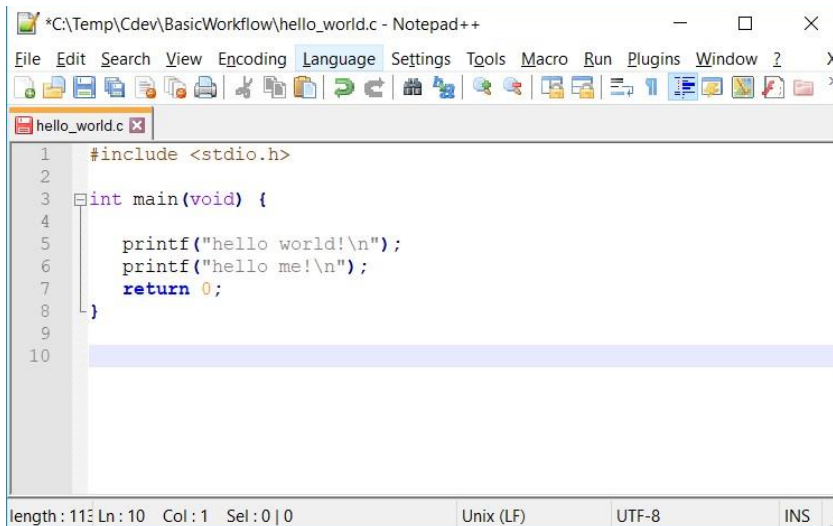
#### Prerequisites:

- Visual Studio (Community version)

#### Command line

In the first approach:

1. Use a basic text editor (you can use any editor you like: Notepad, Notepad++, etc.) to write the source code.

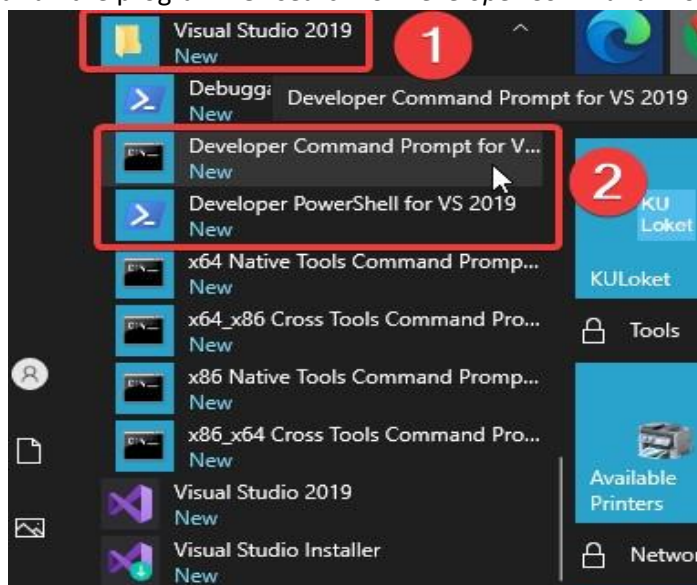


```

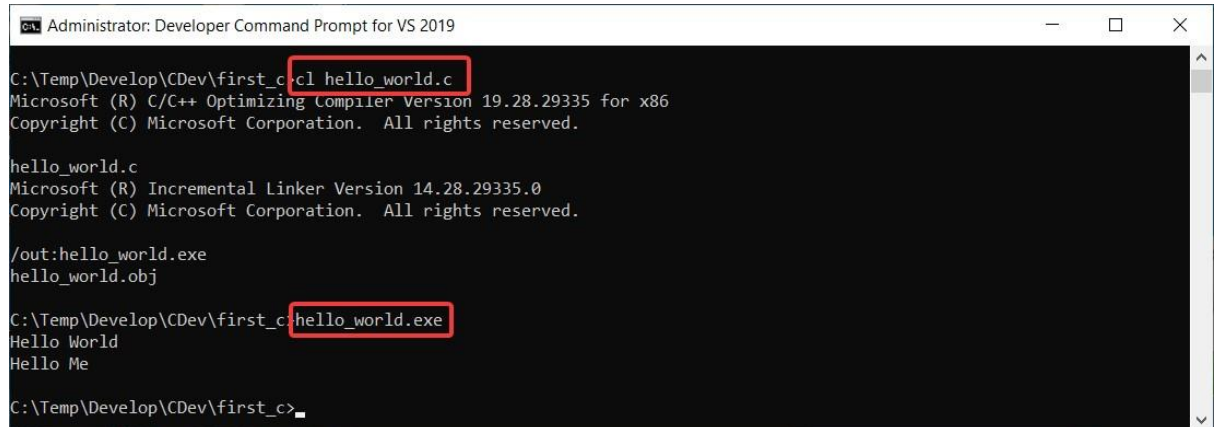
1  #include <stdio.h>
2
3  int main(void) {
4
5      printf("hello world!\n");
6      printf("hello me!\n");
7      return 0;
8  }
9
10
length: 113 Ln: 10 Col: 1 Sel: 0 | 0 Unix (LF) UTF-8 INS

```

Use the *Developer Command Prompt* or *PowerShell* - a command line based environment - to compile and run the program. Or search for *Developer Command Prompt*



The *Developer Command Prompt* is part of the Visual Studio Community software and automatically sets the correct paths for the compiler and tools, and for any required headers and libraries. Much like you can use `gcc` on Linux, Visual Studio has a command to be used from the command prompt (it must be the Visual Studio Developer Command Prompt though): `cl` (make sure the source file has the extension `.c`)



```

Administrator: Developer Command Prompt for VS 2019

C:\Temp\Develop\CDDev\first_c>cl hello_world.c
Microsoft (R) C/C++ Optimizing Compiler Version 19.28.29335 for x86
Copyright (C) Microsoft Corporation. All rights reserved.

hello_world.c
Microsoft (R) Incremental Linker Version 14.28.29335.0
Copyright (C) Microsoft Corporation. All rights reserved.

/out:hello_world.exe
hello_world.obj

C:\Temp\Develop\CDDev\first_c>hello_world.exe
Hello World
Hello Me

C:\Temp\Develop\CDDev\first_c>

```



On KU Leuven managed computers: run command line as administrator.



Get an overview of the different compiler options at <https://docs.microsoft.com/enus/cpp/build/reference/compiler-options-listed-alphabetically?view=vs-2019>

(accessed 2022-01-16) or type `cl -help` in the Developer Command Prompt.

Common options are:

- `/out:<file.exe>` - Set output file name.
- `/Zi` - Add debugging symbols to the executable
- `/c` - Doesn't link generating `*.exe` or `*.dll`, it creates only intermediate object code for further separate linking. It is useful for compiling large code bases where each compilation unit can be compiled separately.
- `/W4` - Set the level of warning to the highest.
- `/Wall` - Enables all warnings, including warnings that are disabled by default.

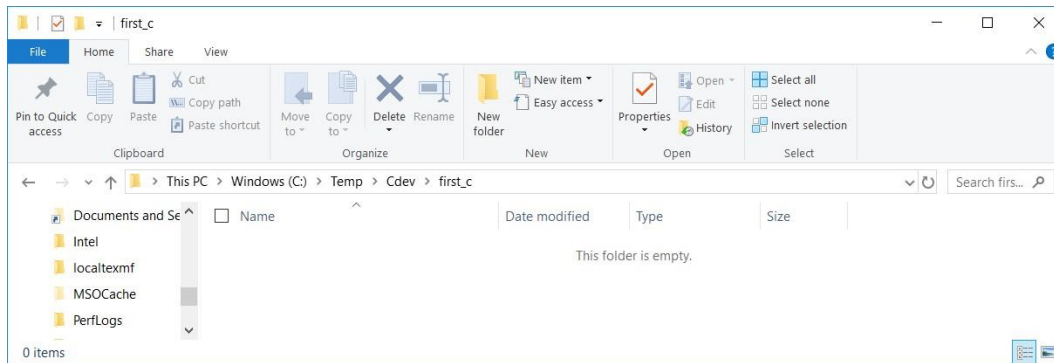
The source file can be edited, re-compiled and ran again.

See Also: <https://github.com/MicrosoftDocs/cpp-docs/blob/master/docs/build/walkthroughcompile-a-c-program-on-the-command-line.md>

## Visual Studio IDE

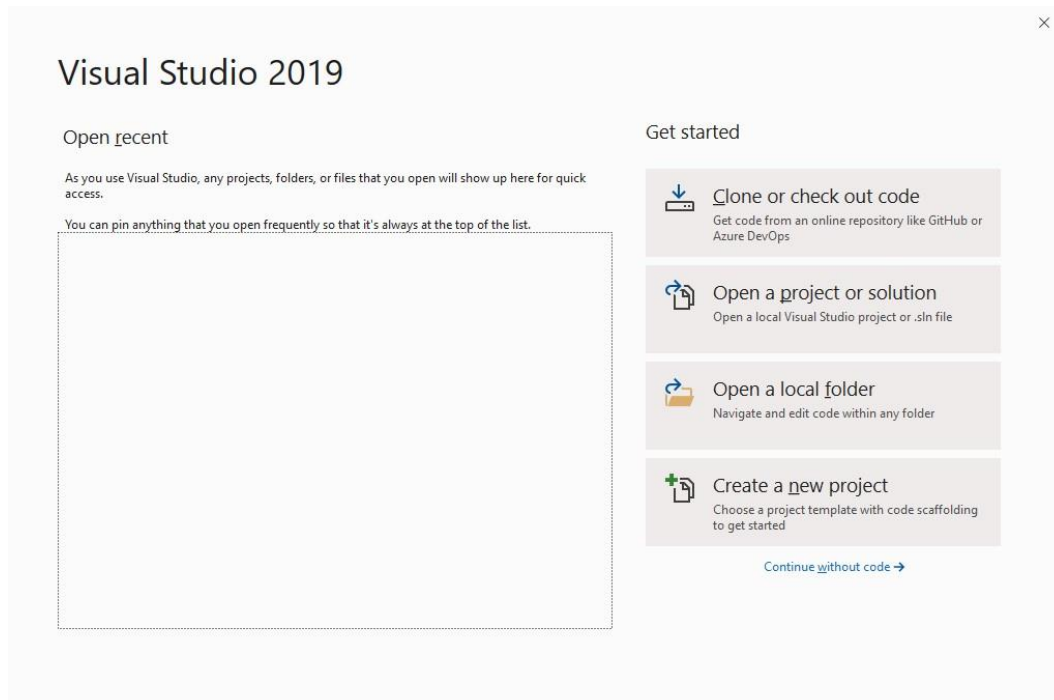
In this approach, the integrated features of Visual Studio Community will be used. The source code will be written using the Visual Studio Community code editor and then the code will be compiled and ran from within the Visual Studio Community environment.

Visual Studio organizes programs into *Projects*. So we are going to create a new Visual Studio project in a folder called *first\_c* on the computer. This folder can be created in Windows explorer.

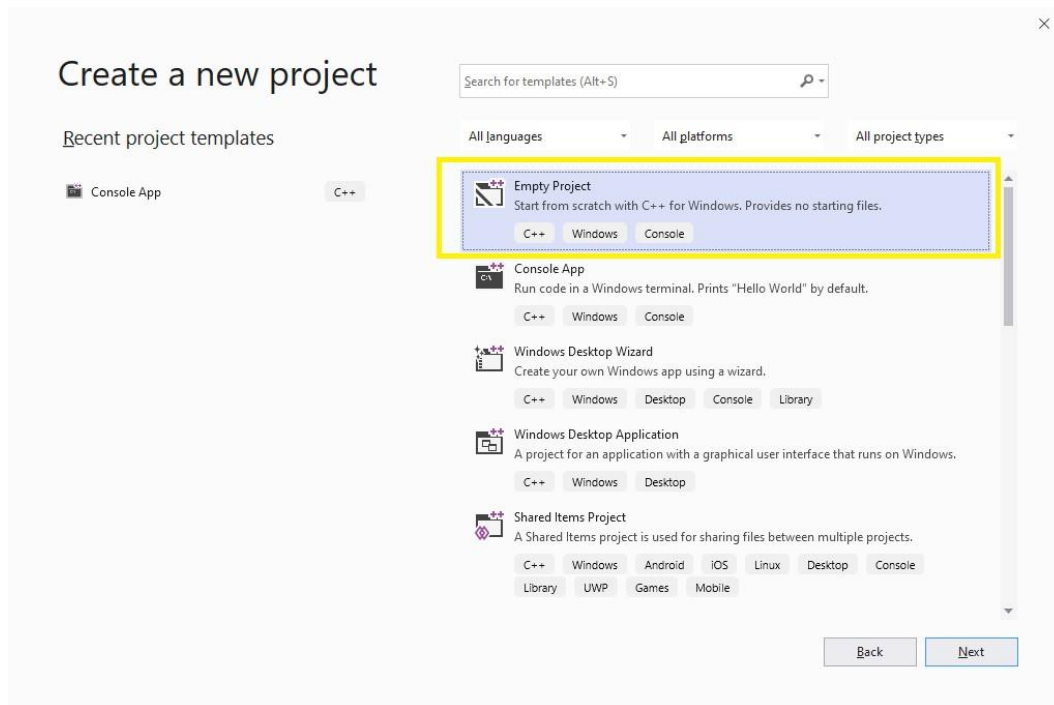


## Visual Studio 2019 flow

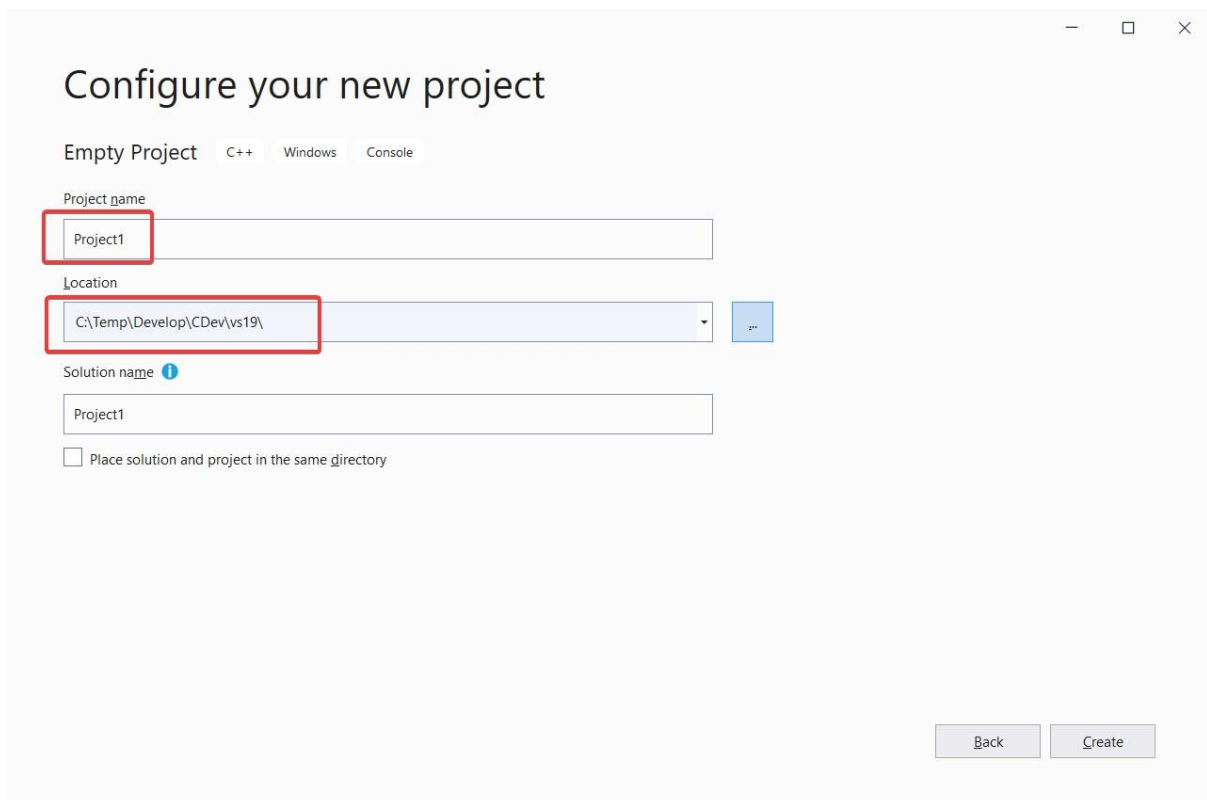
Launch Visual Studio and create a new project.



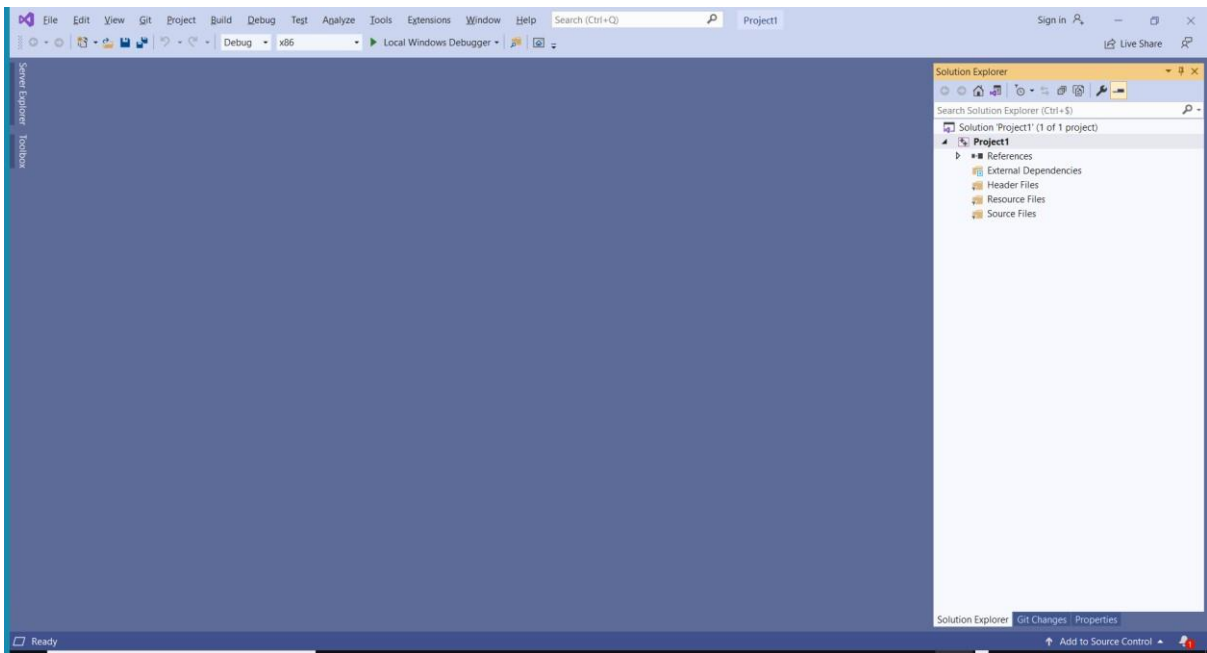
Select the Empty Project template



Click Next

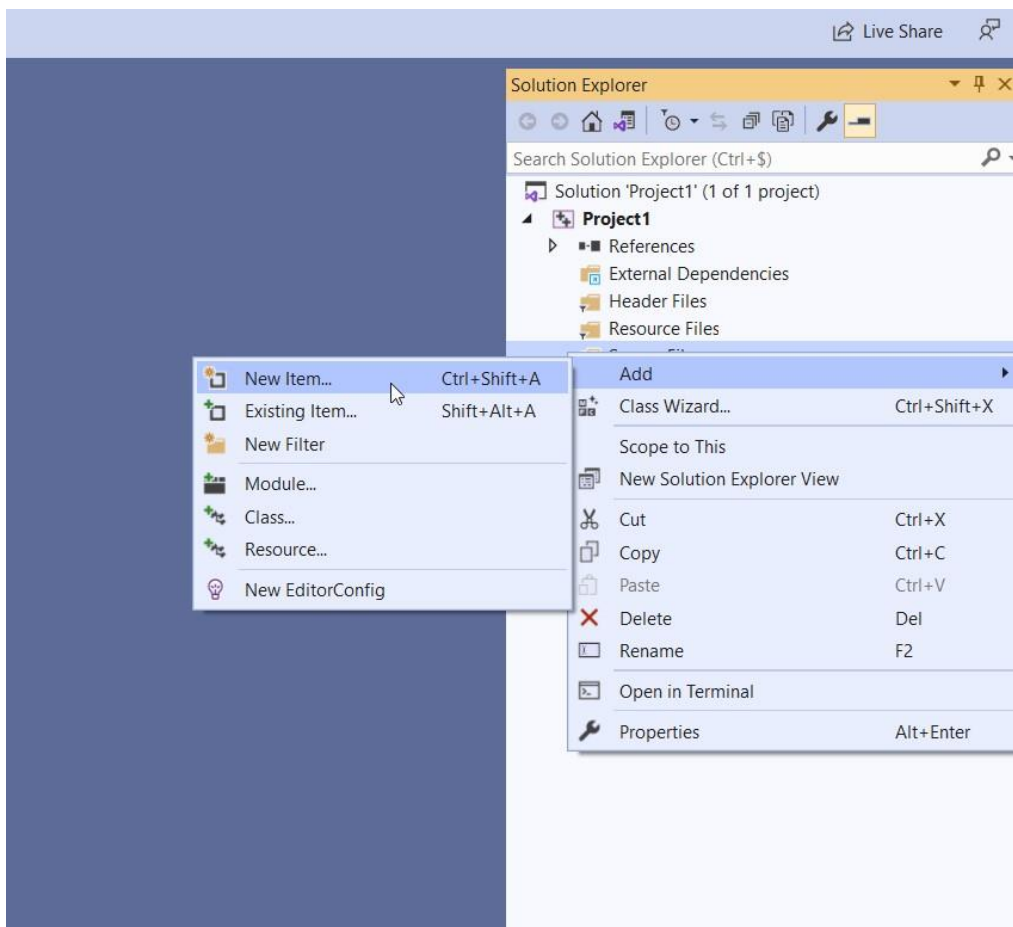


In this example the project is called Project1 (default), and the location is set to the folder C:\Temp\Develop\CDev\vs19. Click create to continue



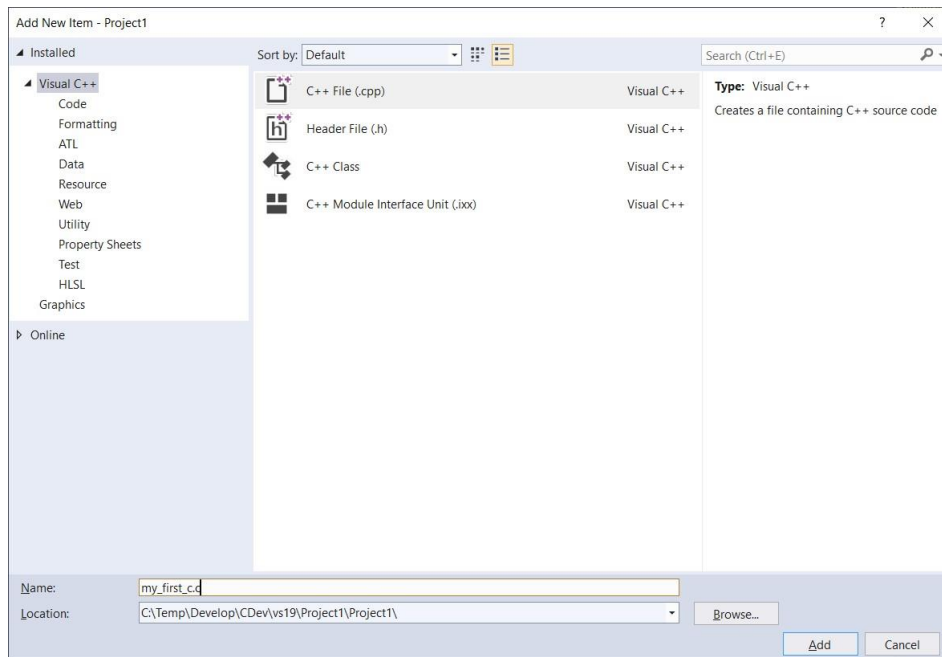
The project will then be created, the project is empty, the first thing to do is to add a source file.

Right-click on the source files item and select to add a new item

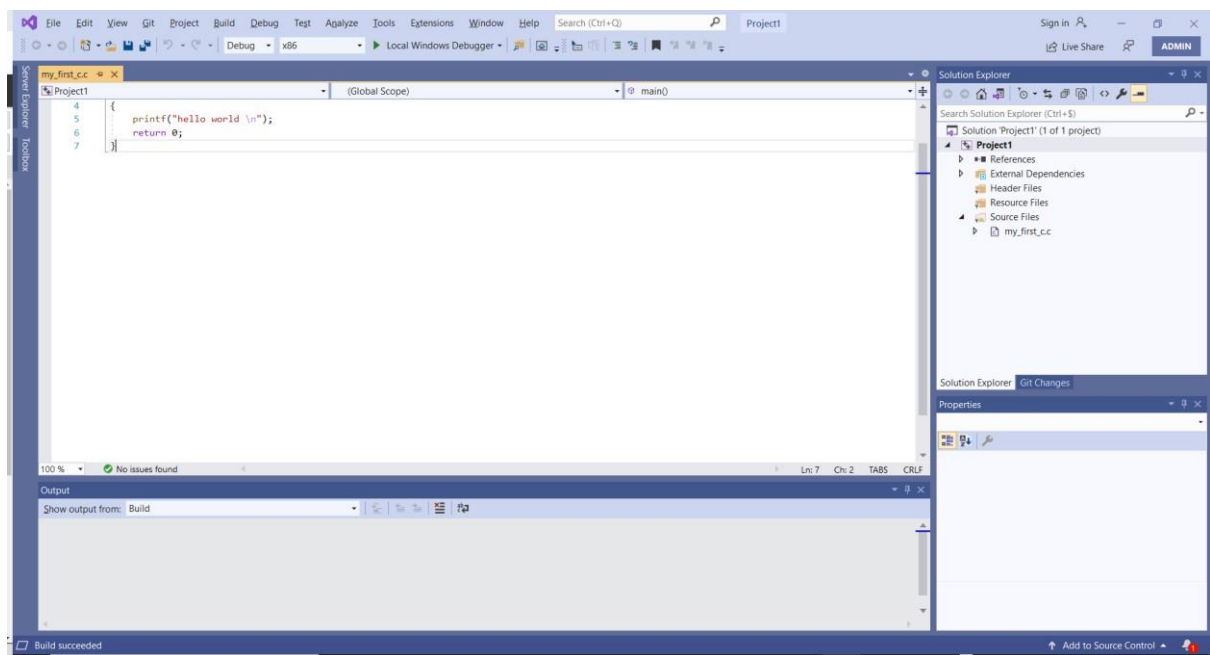




Give the file name of the source file to be created. It has to have the extension .c (my\_first\_c.c)

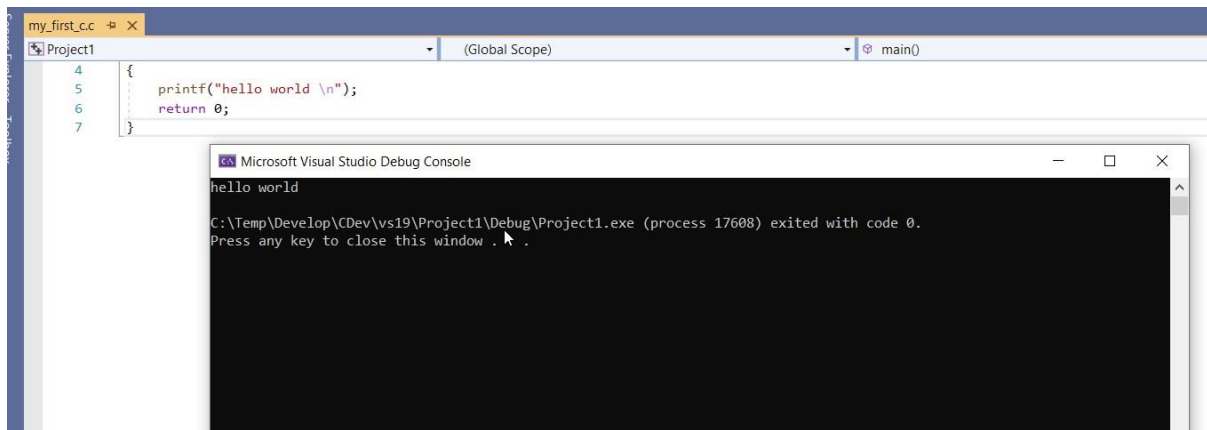


Enter the code in the newly created file.



Save the file and when the file is ready to compile , select Build solution from the Build menu.

After a successful build, the code can be executed. Select Start without debugging from the Debug menu.



It is useful to have an understanding of the files that Visual Studio creates and where these files are stored on disk.

If changes to the program are needed, return to the editor and modify the source file. To run the program again, compile it again and then run it.

## WSL (Windows Subsystem for Linux)

Microsoft added to Windows 10 (64 bit) the ability to run Ubuntu Linux in parallel with Windows: *Windows Subsystem for Linux (WSL)*, this is a very useful way to work with Linux-based software development tools from a Windows 10 machine. WSL can also be installed on Windows 11.

### See Also:

These links provided me with very useful information!

- <https://walkingrandomly.com/?p=6011>
- <https://www.cs.odu.edu/~zeil/FAQs/Public/win10Bash/>
- <https://nickjanetakis.com/blog/using-wsl-and-mobaxterm-to-create-a-linux-dev-environment-onwindows>
- <https://nccastaff.bournemouth.ac.uk/jmacey/post/wsl/wsl/>

### Books:

- [Pro Windows Subsystem for Linux \(WSL\)](#)
- [Learn Windows Subsystem for Linux](#)

### Youtube:

- <https://www.youtube.com/watch?v=J4Giu5iWigQ>

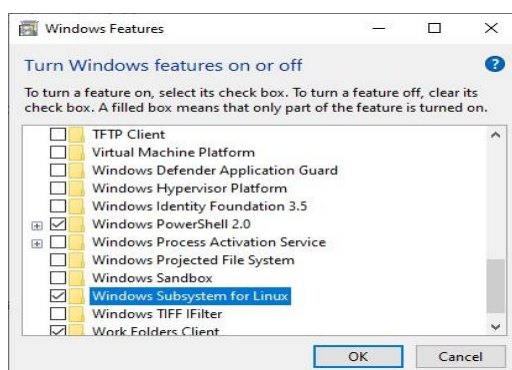
## Getting Started

Nowadays there is WSL2 (WSL 2 is presented as a new architecture, a better platform for the WSL). To enable WSL2 the WSL feature needs to be activated and afterwards a linux distribution must be installed.

Follow the steps as described by Microsoft: <https://docs.microsoft.com/en-us/windows/wsl/install-win10>

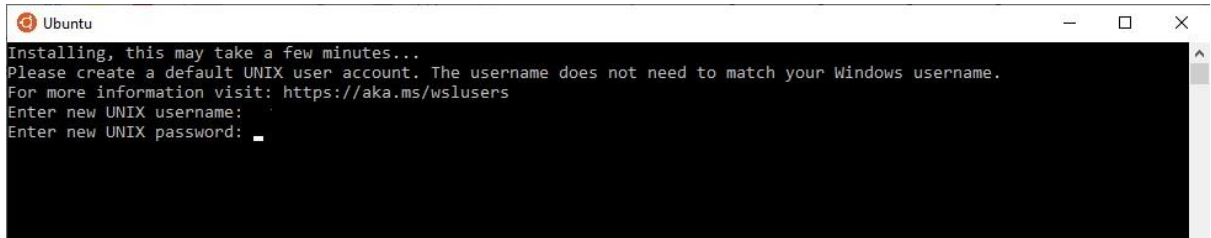
### Stepping stones:

- Make sure you have Windows 10, 64-bit
- Turn on Developer Mode: Open Settings -> Update and Security -> For Developers and select the *Developer mode*. Close the Settings window.
- Enable Linux for Windows: From the taskbar, search for *Turn Windows features on or off*. A new window will pop up (Windows Features). Select *Windows Subsystem for Linux*. Click OK.

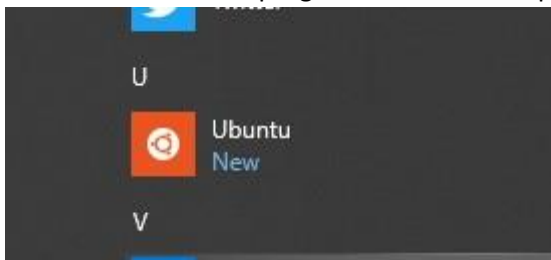


The files will be retrieved, and the system needs a reboot.

- After restart, open the Microsoft Store from the Start menu, and search for *Linux* in the store. To install a Linux distribution, click it, and then click the *Get* or *Install* button to install it like any other Store application. In the Store environment, on the current page go to the top and start the application (it can take a while). This example uses Ubuntu.
- A username and password is required



- In the list of installed programs Ubuntu will appear



- Start the Ubuntu environment. Try some simple Linux commands such as `ls`, `cd`, and `pwd`. You'll find that your Windows lettered disc drives are available under `/mnt`. For example, your C: drive is available under `/mnt`. Close the bash session with the command `exit`.

## X (running graphical programs on WSL)

Source:

- <https://virtualizationreview.com/articles/2017/02/08/graphical-programs-on-windowssubsystem-on-linux.aspx>
- <http://www.alvinsim.com/my-experience-with-wsl/>

Microsoft doesn't support graphical programs on WSL, it is intended for running *command-line* programs that developers might need, but it's possible to run graphical Linux desktop programs.

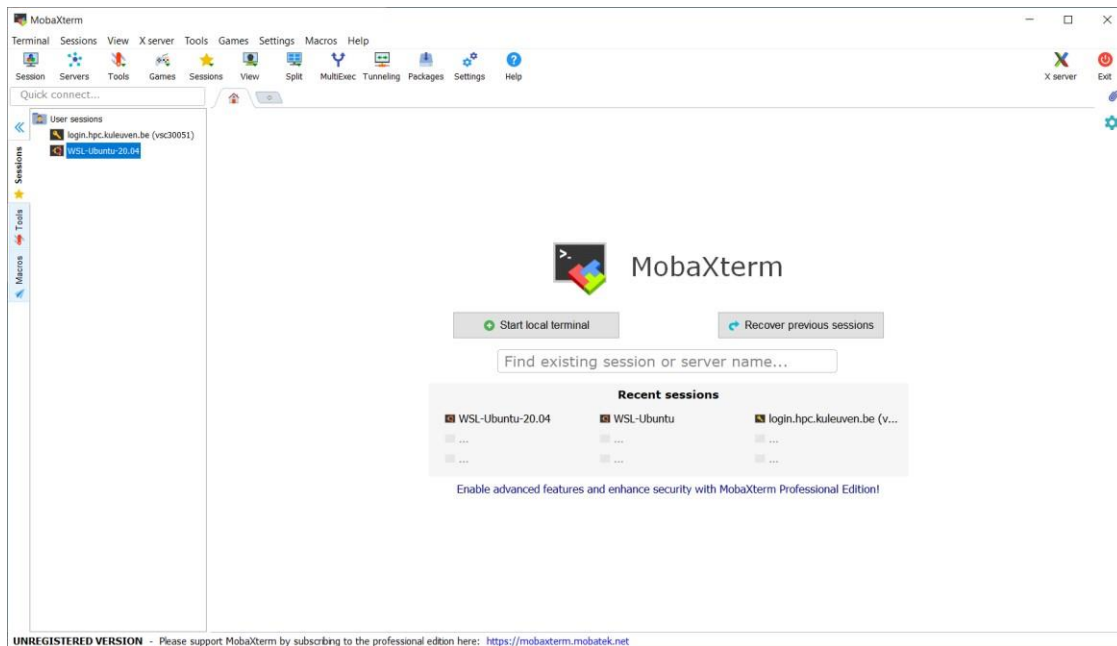
To use WSL with graphical programs, an X server will need to be installed and running on the Windows side.

## MobaXterm

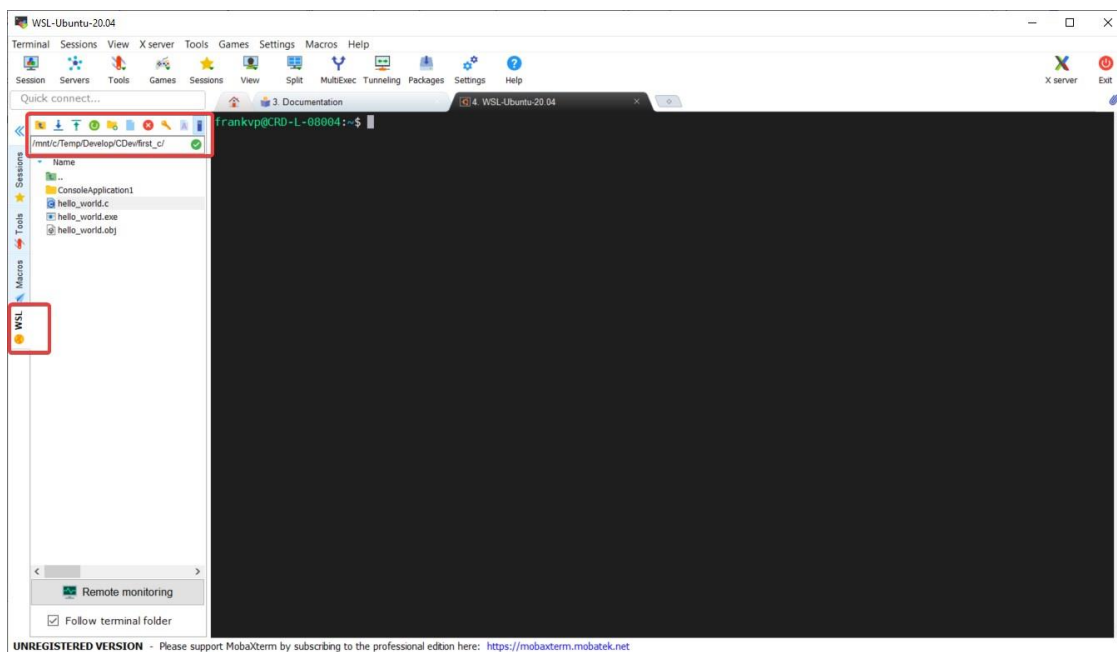
Check:

- <https://www.youtube.com/watch?v=KRpgYS-eHj8>

An easy and quick way to get started is provided by MobaXterm (<https://mobaxterm.mobatek.net/>). A portable version can be downloaded and when you start the software, you can select for opening a WSL session, no hassle.



In the recent versions of MobaXterm, a WSL tab is available in the desktop, enabling you to walk through the files in the WSL system, double clicking the file starts the MobaXterm editor. This editor can be used as a graphical editor to edit the C code.



Things to note (<http://www.macs.hw.ac.uk/~gabbay/F28PL/WSL.pdf>)

- WSL is 64-bit only. This means that 32-bit Linux programs won't run, and WSL cannot be enabled on 32-bit systems.
- Since WSL is limited to a single window, programs that try to open in a new window (for example, gimp) won't run.

- The Windows file system can be found under `/mnt`; to get to your documents folder, in the WSL terminal use `cd /mnt/c/users/WINDOWS USERNAME/Documents`, where `WINDOWS USERNAME` is your username on your computer.
- Save all of the documents you work on in the Windows filesystem somewhere - this will allow you use them with Windows programs as normal,
- Check the WSL version: open a powershell: `wsl --list -v`



```

PS C:\Users\u0015831> wsl --list -v
  NAME                STATE      VERSION
* Ubuntu-20.04        Running    2
PS C:\Users\u0015831>

```

The version will be displayed.

## Installing the compiler

In this approach, the compiler needs to be installed under WSL.

Have Ubuntu running and from the command prompt, install the GNU compiler tools and the GDB debugger by typing:

```
sudo apt-get install build-essential gdb
```

Verify that the install succeeded by locating `g++` and `gdb`. If the filenames are not returned from the `whereis` command, try running the update command again.

```
whereis g++
```

```
whereis gdb
```

```
whereis gcc
```

When the compiler is found, C code can be compiled.

Test the compiler with a small C program.

```

#include<stdio.h>

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

```

Save the file, with the extension `.c` (hello.c)

Compile it with `gcc hello.c`

A file `a.out` will be created, run this file : `./a.out`

## Optional packages

**Libraries:** In many cases you'll need to install some libraries that are needed by the code. Examples are LAPACK, BLAS, and the GSL libraries.

The GNU Scientific Library (GSL) is a collection of routines for numerical computing, open and free, easy to use, and well documented. Full documentation is available here:

<https://www.gnu.org/software/gsl/doc/html/index.html>

To do a full install:

```
sudo apt-get install libgsl-dev
```

## Windows and WSL (Visual Studio Code approach)

Source:

<https://docs.microsoft.com/en-us/windows/wsl/tutorials/wsl-vscode>

<https://code.visualstudio.com/docs/remote/wsl-tutorial>

<https://code.visualstudio.com/docs/remote/wsl>

<https://code.visualstudio.com/docs/cpp/config-wsl>

NOTE : Visual Studio Code is an editor while Visual Studio is an IDE.

This part details the configuration of Visual Studio Code to use the GCC C++ compiler (g++) and GDB debugger on Ubuntu in the Windows Subsystem for Linux (WSL). GCC stands for GNU Compiler Collection; GDB is the GNU debugger.

This setup uses the editor on Windows and the compiler under Linux, blurring the lines between Windows and Linux.

### Prerequisites:

- Windows Subsystem for Linux (WSL) and then use the links on that same page to install your Linux distribution of choice. This tutorial uses Ubuntu.
- Visual Studio Code (VS Code).
- Remote - WSL extension.

### Install WSL

See previous section

### Install VS Code

Visual Studio Code is a lightweight but powerful source code editor which runs on your desktop and is available for Windows, macOS and Linux. It comes with built-in support for JavaScript, TypeScript and Node.js and has a rich ecosystem of extensions for other languages (such as C, C++, C#, Java, Python, etc.). VS Code is a cross-platform IDE that uses a tasks.json file to describe how to compile (and perform other tasks) your project.

The software can be downloaded from <https://code.visualstudio.com/download>

Follow the install wizard to get Visual Studio Code installed.

### Remote – WSL extension

The Remote - WSL extension lets you use the Windows Subsystem for Linux (WSL) as your full-time development environment right from VS Code. This support lets you:

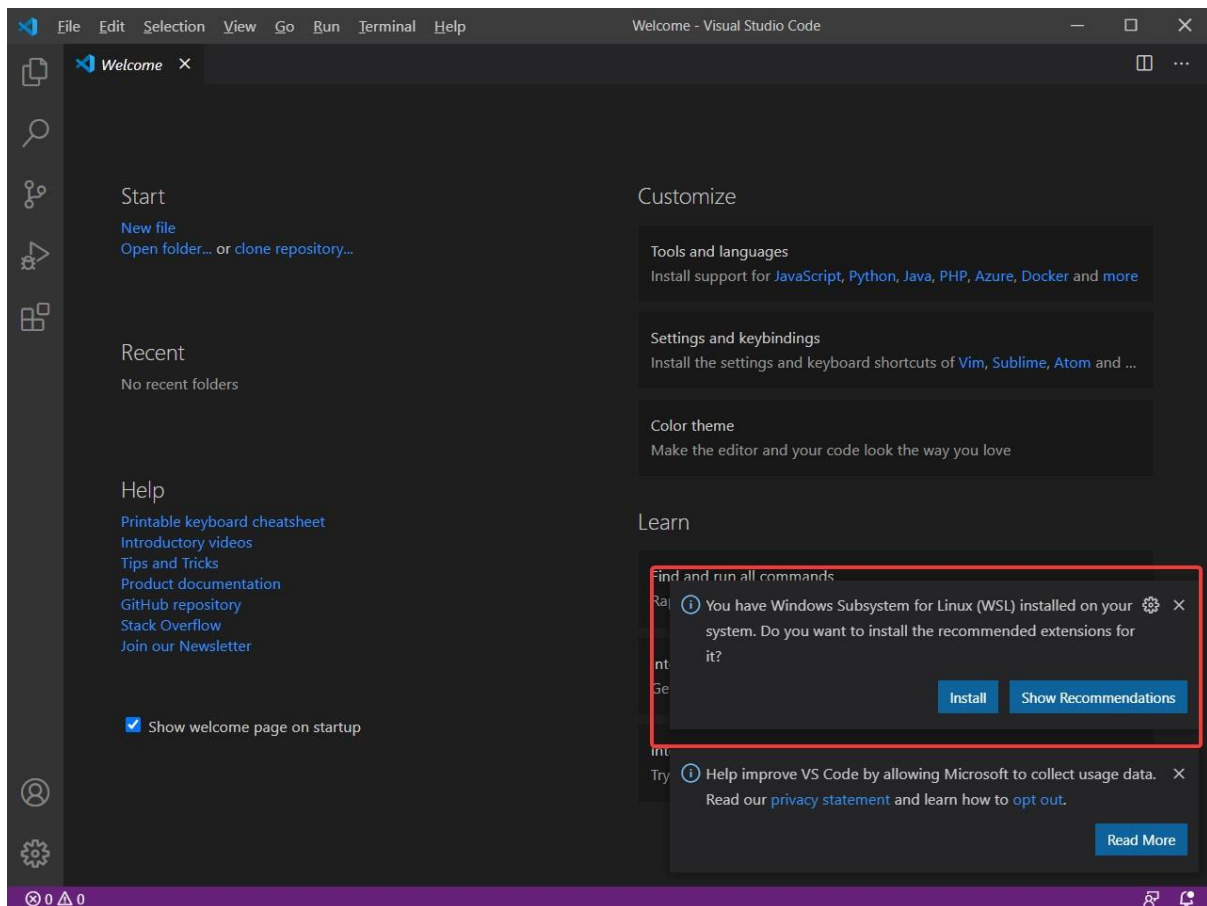
- Use Windows to develop in a Linux based environment, using Linux specific toolchains and utilities.



- Edit files located in WSL or the mounted Windows filesystem (e.g. /mnt/c).
- Run and debug your Linux based applications on Windows, in VS Code.

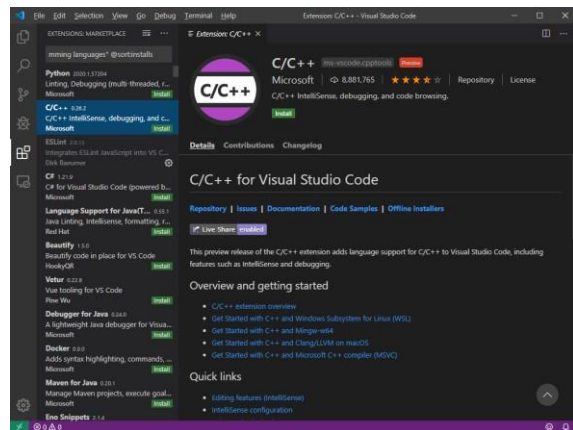
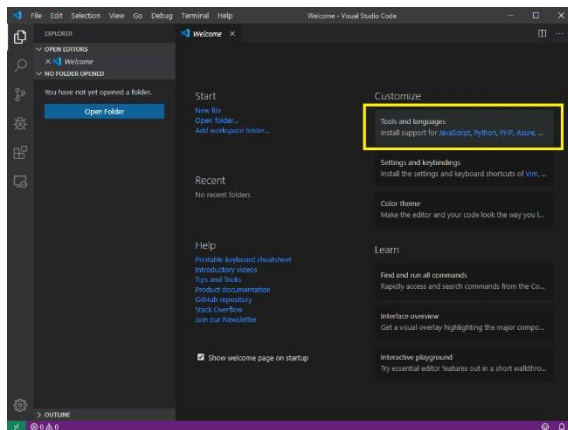
Remote - WSL runs commands and extensions directly in WSL so you don't have to worry about pathing issues, binary compatibility, or other cross-OS challenges. You're able to use VS Code in WSL just as you would from Windows.

If WSL is already installed, the VS Code proposes to install 'Remote-WSL' extension at startup. This is the magic trick to connect to the Ubuntu file system.



After installation, install a few extensions for C/C++ programming as well. After launching VS Code, click on the *Tools and Languages* box. The left part of the screen will show the support available for different languages. Select the extensions needed and click *install* to have them installed.

For C, install the C/C++ for Visual Code and C++ Intellisense extensions.



## Test the installation

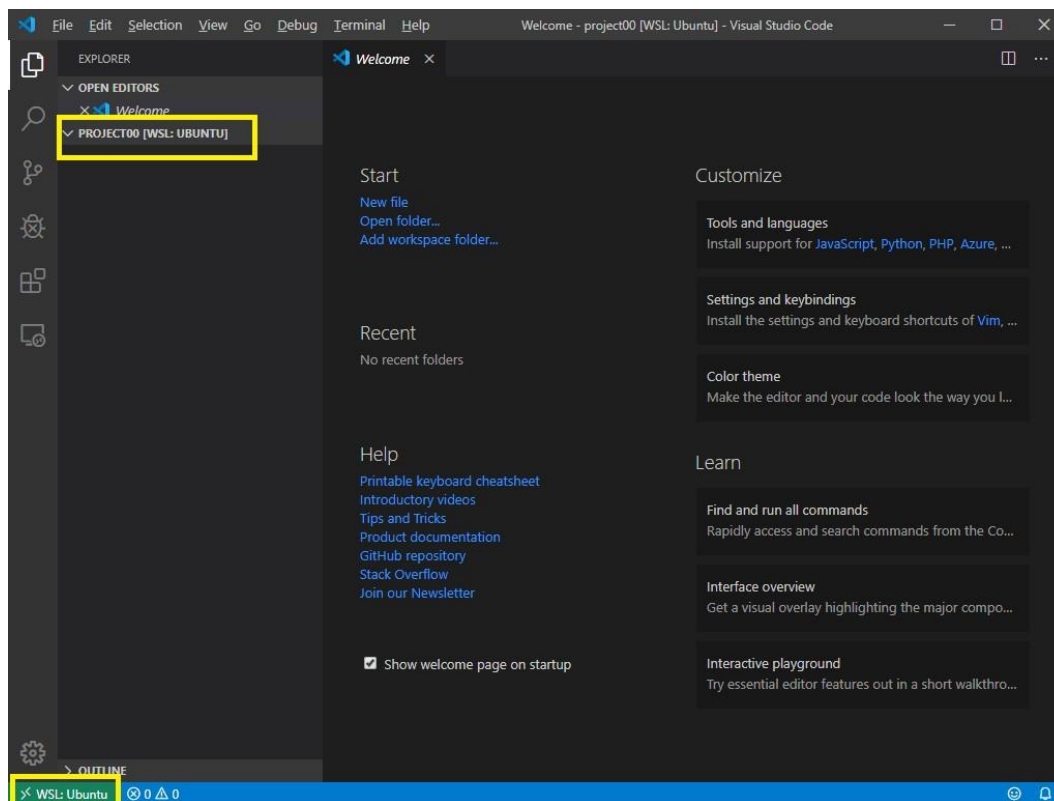
In WSL, create a folder (project00) and move into that folder

```
mkdir project00
```

```
cd project00
```

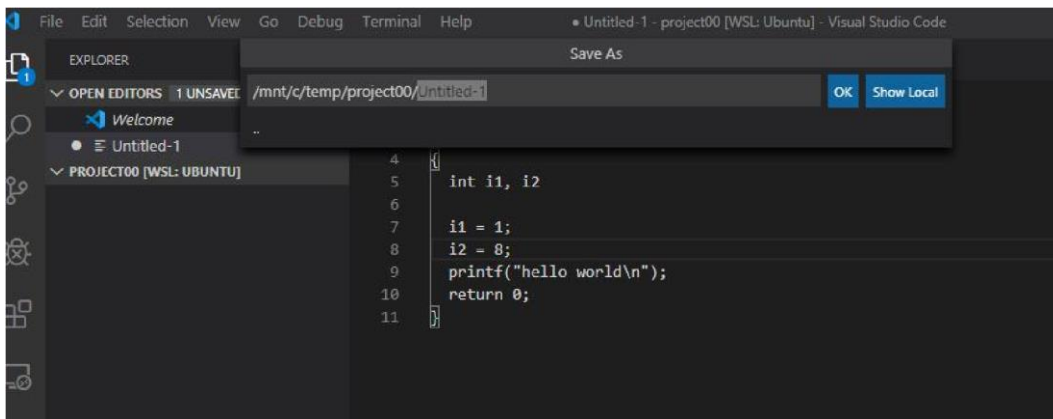
Start VSCode in the folder:

```
code . (. is important!)
```

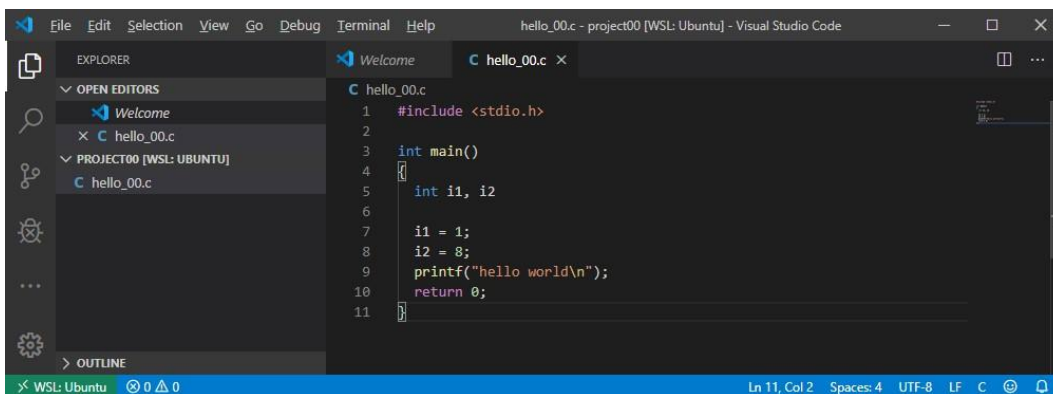


Look in the lower left corner, the WSL extension must be active, and the explorer shows the folder project00

Create a new file and enter the c code and save the file.



Save it as hello\_00.c



Now, if you want to compile files, just use Ctrl + Shift + B or choose 'Run Build Task' from the Terminal menu at the top. This should run the compiler.

Or you can type the commands into the terminal.

Open in the View menu a terminal window, this will open a terminal in WSL. Compile the code with:

```
gcc hello_00.c
```

a.out will be created

run it with ./a.out

```

File Edit Selection View Go Debug Terminal Help
hello_00.c - project00 [WSL: Ubuntu] - Visual Studio Code

EXPLORER
OPEN EDITORS
Welcome
x C hello_00.c
PROJECT00 [WSL: UBUNTU]
a.out
C hello_00.c

C hello_00.c
1 #include <stdio.h>
2
3 int main()
4 {
5     int i1, i2;
6
7     i1 = 1;
8     i2 = 8;
9     printf("hello world\n");
10    return 0;
11 }

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL 1: bash
frankix@Beast:/mnt/c/temp/project00$ gcc hello_00.c
frankix@Beast:/mnt/c/temp/project00$ a.out
a.out: command not found
frankix@Beast:/mnt/c/temp/project00$ ./a.out
hello world
frankix@Beast:/mnt/c/temp/project00$

```

Check also : <https://www.youtube.com/watch?v=dHORVBOsmAY>

## Alternative: Virtual Machine

<https://www.makeuseof.com/linux-virtual-machine-or-wsl/>

<https://www.hpe.com/us/en/insights/articles/3-good-ways-to-run-linux-on-windows-2007.html>

Installing a virtual machine is another option to have Linux on your Windows computer.

You can choose:

- Virtualbox (<https://www.virtualbox.org/>)
- VMware: VMware Workstation Player (<https://www.vmware.com/products/workstation-player/workstation-player-evaluation.html>)

Once the virtual machine software is installed, a Linux distribution can be installed.

Ubuntu might be a good choice.