



مقام معظم رهبری:

علم برای یک ملت مهم‌ترین ابزار آبرو و پیشرفت و اقتدار است.

۱۳۹۴/۰۸/۲۰





Qt Training in C++

Lecturer: Ali Panahi

Autumn 1401

What is Qt ?

Qt is cross-platform software for creating graphical user interfaces as well as cross-platform applications that run on various software and hardware platforms such as Linux, Windows, macOS, Android or embedded systems with little or no change in the underlying codebase while still being a native application with native capabilities and speed.

Qt is currently being developed by The Qt Company, a publicly listed company, and the Qt Project under open-source governance, involving individual developers and organizations working to advance Qt. Qt is available under both commercial licenses and open-source GPL 2.0, GPL 3.0, and LGPL 3.0 licenses.

Why use Qt ?

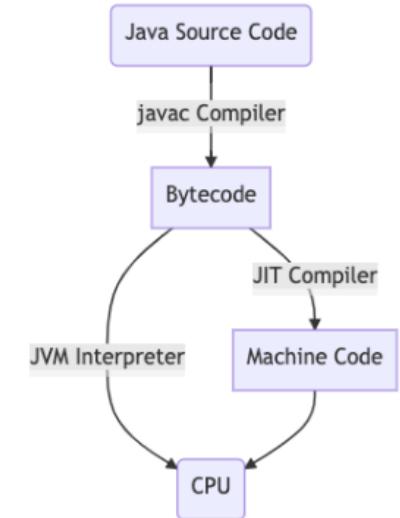
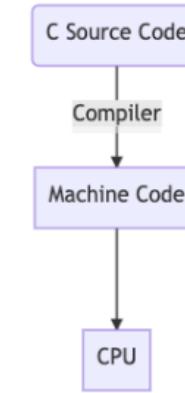
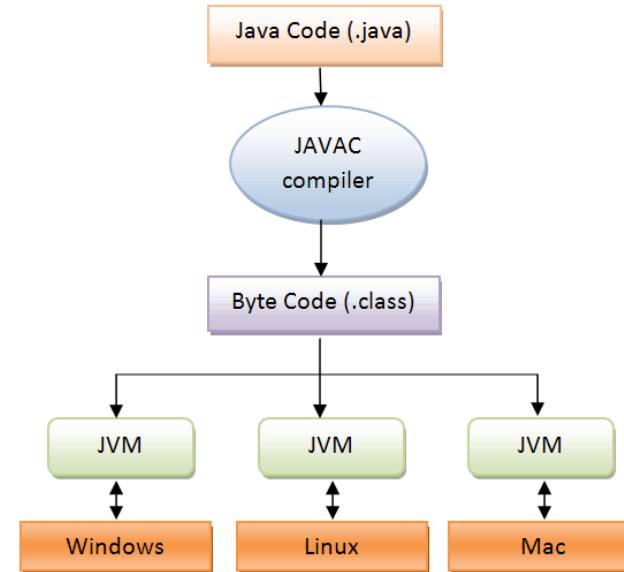
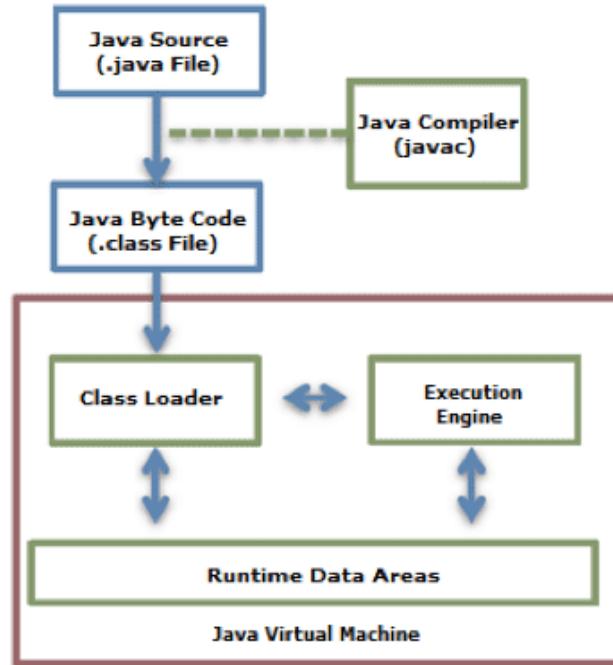
- Design and develop great user experiences
- Qt saves you money
- Get your products to market faster
- Performance, delivered
- One framework, fewer dependencies
- Develop for any platform
- We speak many languages
- Flexible. Reliable. Qt.
- Open source and future-proof

Java vs .Net vs C++ vs QT vs .Net Core

- Java
 - Java is object-oriented programming language
 - Java is a general-purpose
 - Java is cross-platform
 - Java is class-based
 - Java is managed
 - Java is free
 - Low execution speed
 - Disassembling object code
 - High development speed



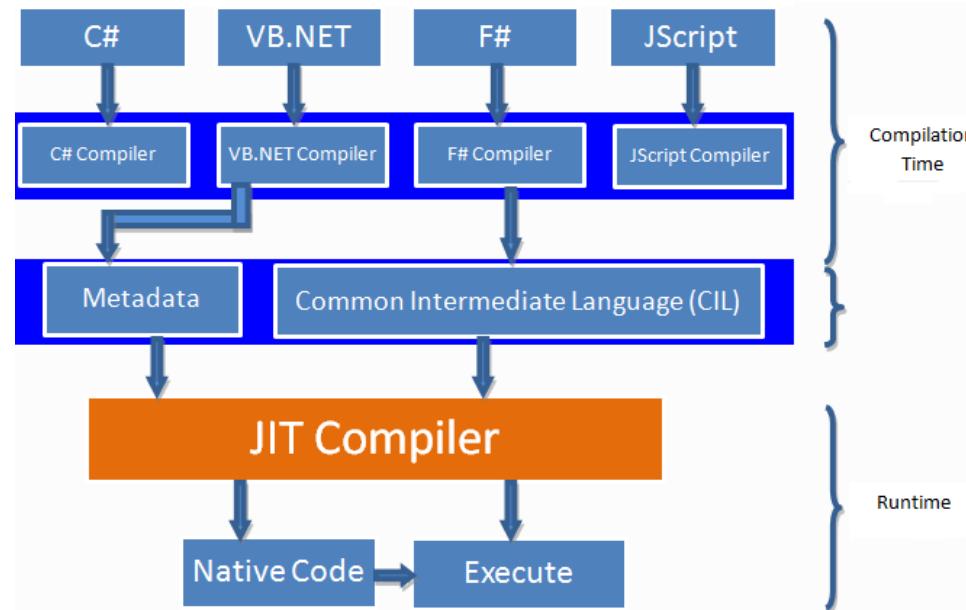
Introduction to Qt >> Java



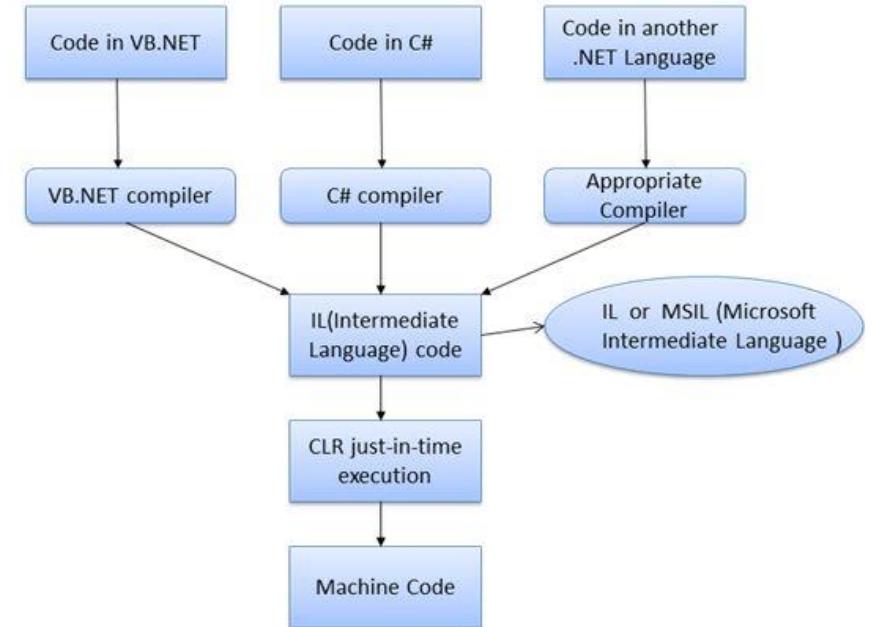
Java vs .Net vs C++ vs QT vs .Net Core

- .Net
 - Multi-language Support
 - .Net is managed
 - Automatic resource management
 - .Net is commercial (Microsoft)
 - Low execution speed
 - Disassembling object code
 - Only for windows
 - High development speed



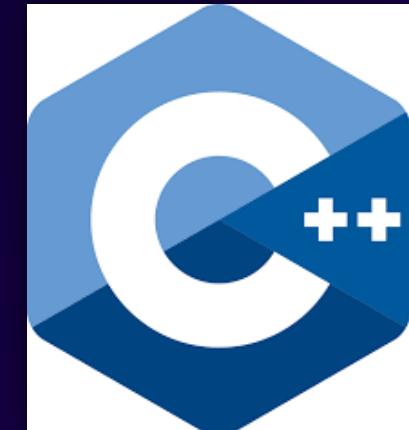


Compilation in .NET

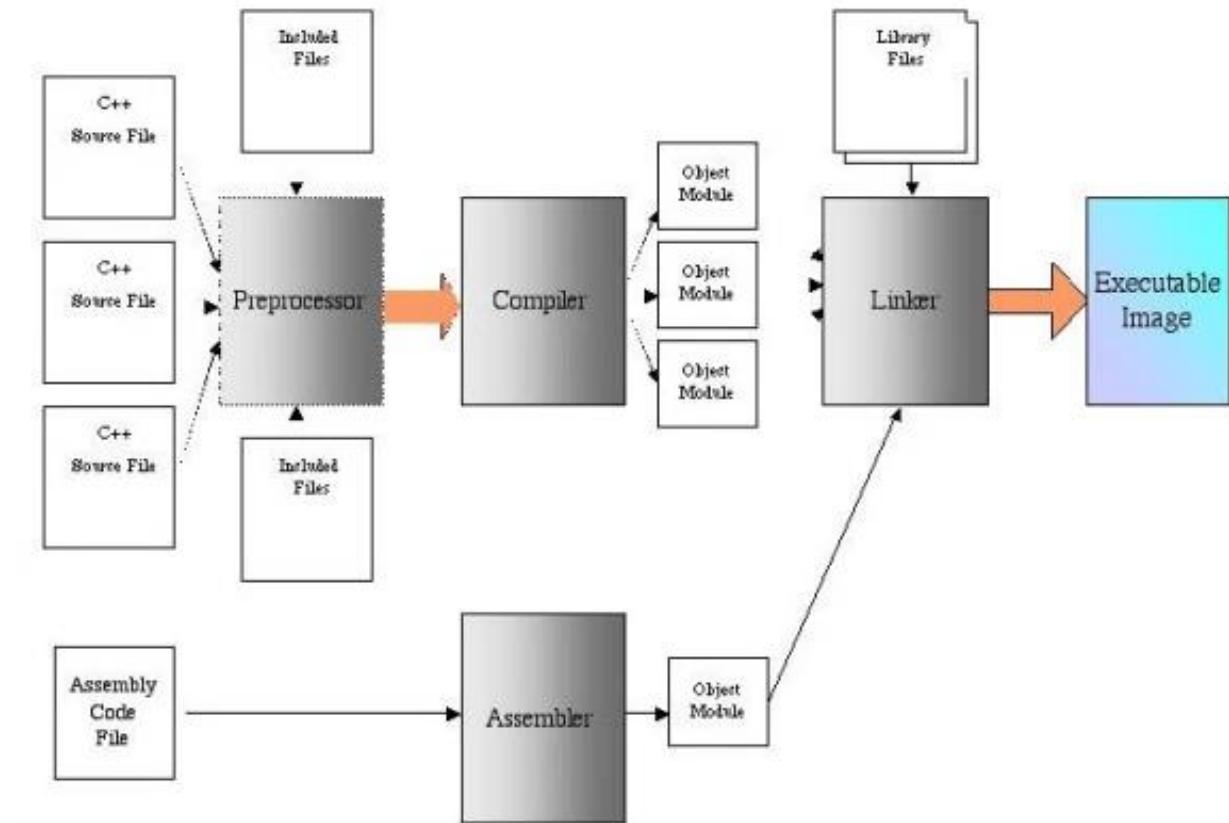
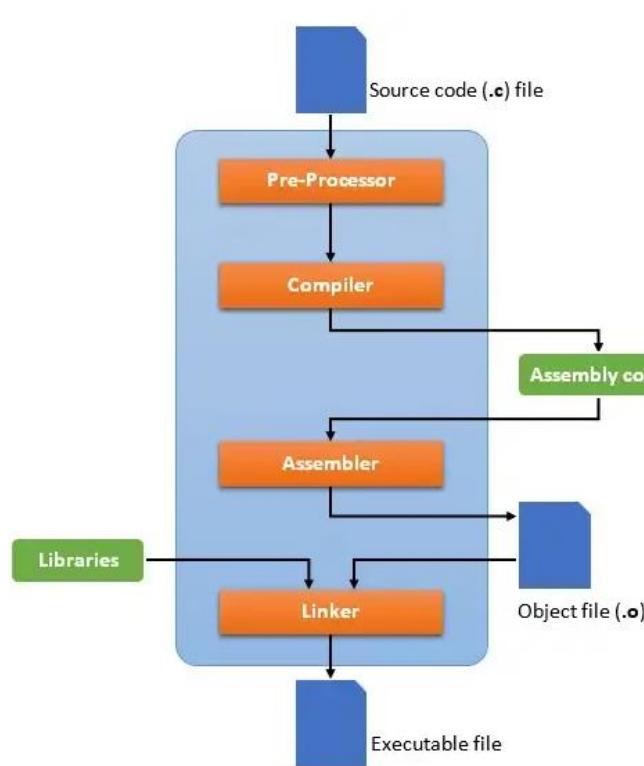


Java vs .Net vs C++ vs QT vs .Net Core

- C/C++
 - It is native
 - Creating libraries that can be used in other languages
 - Powerful & fast
 - High security
 - Platform dependent
 - Irreversibility and reverse engineering of codes
 - It has no memory management
 - Low development speed



Introduction to Qt >> C/C++



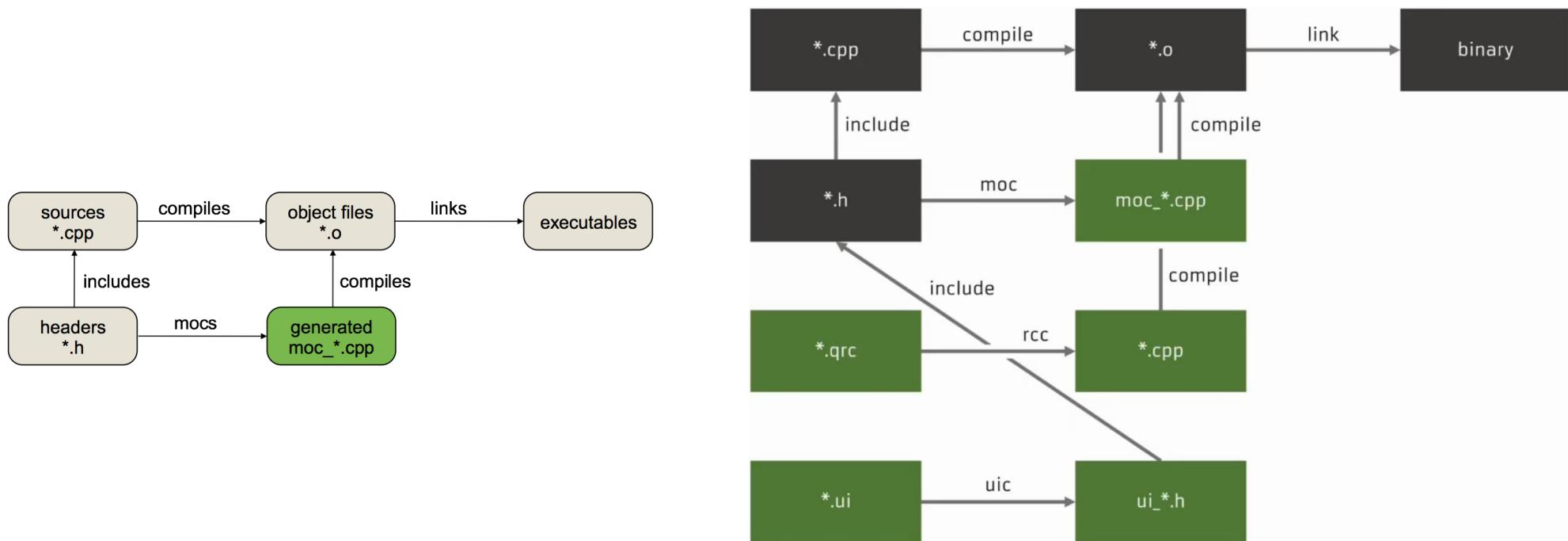
Java vs .Net vs C++ vs QT vs .Net Core

- Qt
 - It is native
 - High security
 - Cross-platform (Windows, Linux, Mac)
 - Many possibilities
 - Free and open source



Introduction to Qt

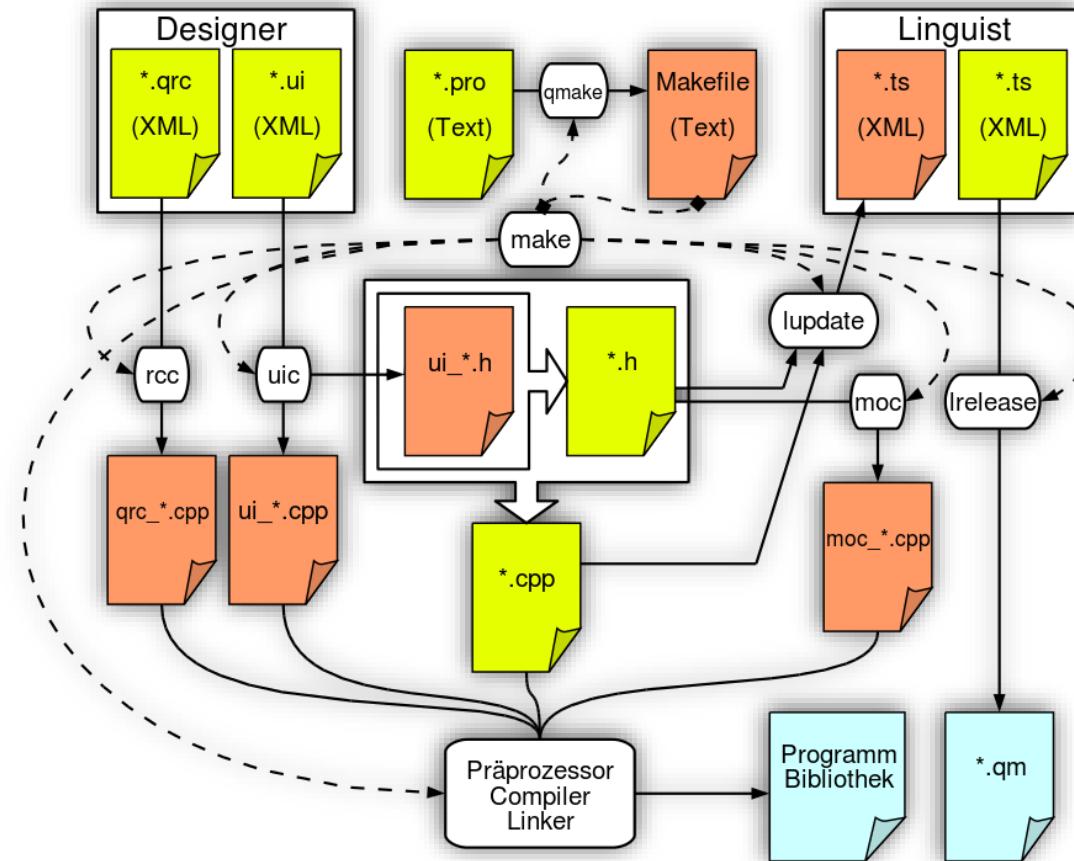
>> Qt



Introduction to Qt

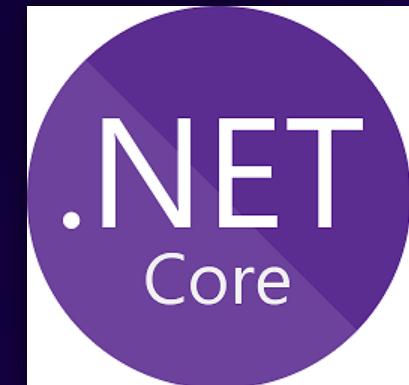
>> Qt

Qt

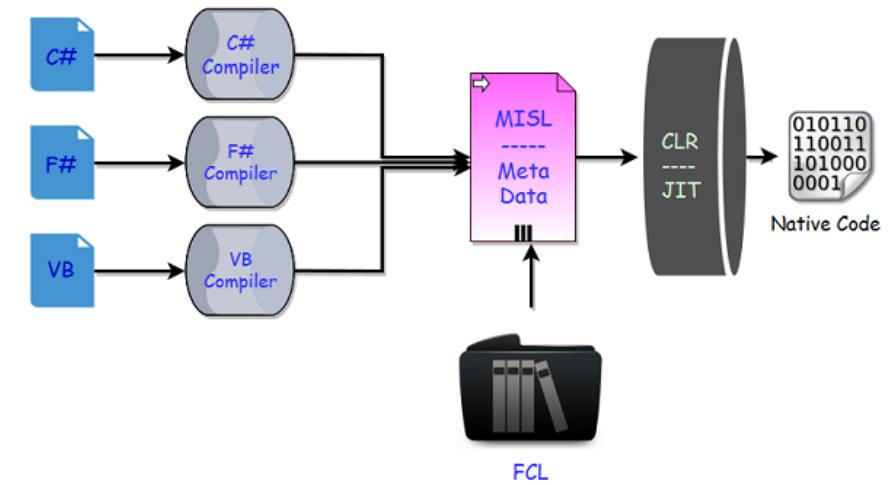
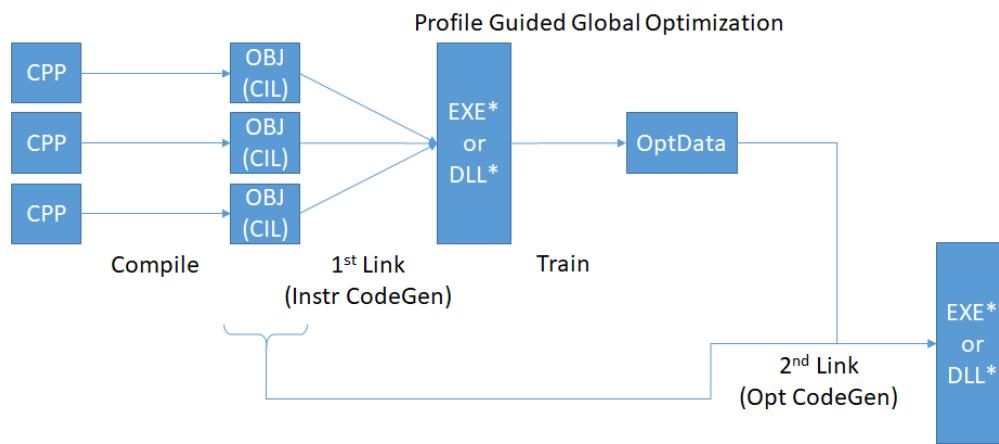


Java vs .Net vs C++ vs QT vs .Net Core

- .Net Core
 - Multi-language support
 - .Net core is managed
 - Automatic resource management
 - .Net core is free and open source (Microsoft)
 - Low execution speed
 - Disassembling object code
 - Cross-platform (Windows, Linux)
 - High development speed



Introduction to Qt >> .Net Core



Companies using Qt

Qt helps the best companies in the world deliver better user experiences faster.



In-flight
entertainment
systems



In-vehicle
infotainment
system



Graphics software



Anesthesia &
critical care
medical devices



EDA & CAD end-
to-end
engineering
solutions



Automotive
mobility
technology

| Version | Release date / Support until | Target (Windows) |
|-----------------------|------------------------------|------------------|
| Qt 0.90 | 1995 | - |
| Qt 1.0 | 1996 | - |
| Qt 2.0 | 1999 | - |
| Qt 3.0 | 2001 | - |
| Qt 4.0 | 2005 | - |
| Qt 4.8 LTS (4.8.7) | 2011 | XP, 7, 8.1, 10 |
| Qt 5.6 LTS (5.6.3) | 2016 / 2019 | - |
| Qt 5.9 LTS (5.9.9) | 2017 / 2020 | - |
| Qt 5.12 LTS (5.12.12) | 2018 / 2021 | - |
| Qt 5.15 LTS | 2020 / 2025 | 7, 8.1, 10, 11 |
| Qt 6.2 LTS (6.2.6) | 2021 / 2024 | 10, 11 |
| Qt 6.4 | 2022 / 2023 | 10, 11 |

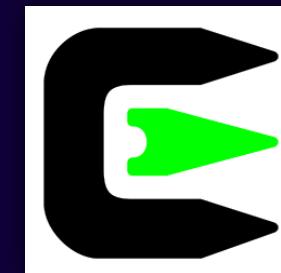
Languages that support the Qt library

Qt is developed with C++ language.

Qt can be used in several programming languages other than C++, such as Python, Javascript, C# and Rust via language bindings; many languages have bindings for Qt 5 and bindings for Qt 4.

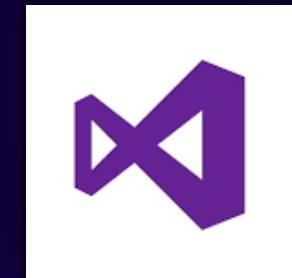
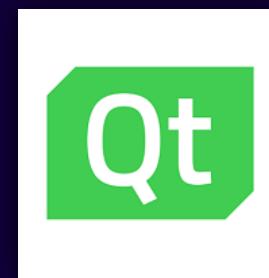
Qt compilers

- Windows
 - MSVC
 - MinGW (Gnu Based)
 - Cygwin (BSD Based)
- Linux
 - GCC/G++
 - CLang



Qt development environments

- Qt Creator
 - Windows
 - Linux
- Visual Studio
 - Windows
- PyCharm (Only for PyQt)
 - Windows
 - Linux



Installation methods

- From installer
 - Offline installer
 - Online installer
 - From Packages (Linux)
 - From Setup wizard
- From source

Offline Installer

- It can be downloaded from the link below:
 - URL: <https://www.qt.io/offline-installers>
- It is precompiled
- Only available for limited editions
- No internet required
- The installer size is large

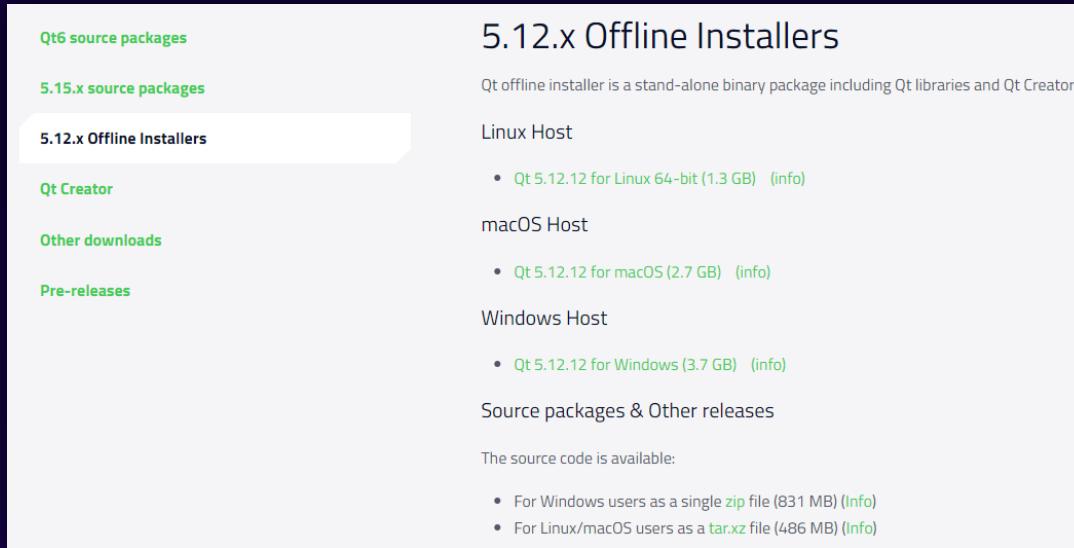
Offline Installer

On Windows

qtopensource-windows-x86-%VERSION%.exe

On Linux

qtopensource-linux-x64-%VERSION%.run



The screenshot shows the 'Downloads' section of the Qt website for version 5.12.x. The '5.12.x Offline Installers' link is highlighted in yellow, indicating it is the current section being viewed. Other links shown include 'Qt6 source packages', '5.15.x source packages', 'Qt Creator', 'Other downloads', and 'Pre-releases'. The main content area is titled '5.12.x Offline Installers' and describes it as a stand-alone binary package including Qt libraries and Qt Creator. It lists download links for 'Linux Host', 'macOS Host', and 'Windows Host'. Below this, a section for 'Source packages & Other releases' is shown with links for 'Windows' and 'Linux/macOS' users.

5.12.x Offline Installers

Qt offline installer is a stand-alone binary package including Qt libraries and Qt Creator.

Linux Host

- [Qt 5.12.12 for Linux 64-bit \(1.3 GB\)](#) (info)

macOS Host

- [Qt 5.12.12 for macOS \(2.7 GB\)](#) (info)

Windows Host

- [Qt 5.12.12 for Windows \(3.7 GB\)](#) (info)

Source packages & Other releases

The source code is available:

- For Windows users as a single [zip](#) file (831 MB) (info)
- For Linux/macOS users as a [tarxz](#) file (486 MB) (info)

Online Installer

- It can be downloaded from the link below:
 - URL: https://download.qt.io/official_releases/online_installers/
- It is precompiled
- Only available for limited editions
- Internet required
- The installer size is small

Online Installer On Windows

qt-unified-windows-x64-%VERSION%-online.exe

On Linux

qt-unified-linux-x64-%VERSION%-online.run

| Name | Last modified | Size | Metadata |
|-------------------------------------|-------------------|------|-------------------------|
| ⬆ Parent Directory | | - | |
| ⬇ qt-unified-windows-x64-online.exe | 09-Nov-2022 10:52 | 41M | Details |
| ⬇ qt-unified-mac-x64-online.dmg | 09-Nov-2022 10:52 | 18M | Details |
| ⬇ qt-unified-linux-x64-online.run | 09-Nov-2022 10:52 | 55M | Details |

For Qt Downloads, please visit qt.io/download

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The Qt Company Ltd, Bertel Jungin aukio D3A, 02600 Espoo, Finland. Org. Nr. 2637805-2

[List of official Qt-project mirrors](#)

Online Installer

On Windows

Run “qt-unified-windows-x64-%VERSION%-online.exe” as administrator

On Linux

This prerequisite must be installed in the Debian operating system

```
sudo apt-get install libxcb-xinerama0
```

A file with the name qt-unified-linux-x-online.run will be downloaded, then add exec permission.

```
chmod +x qt-unified-linux-x-online.run
```

Remember to change 'x' for the actual version of the installer. Then run the installer.

```
./qt-unified-linux-x-online.run
```

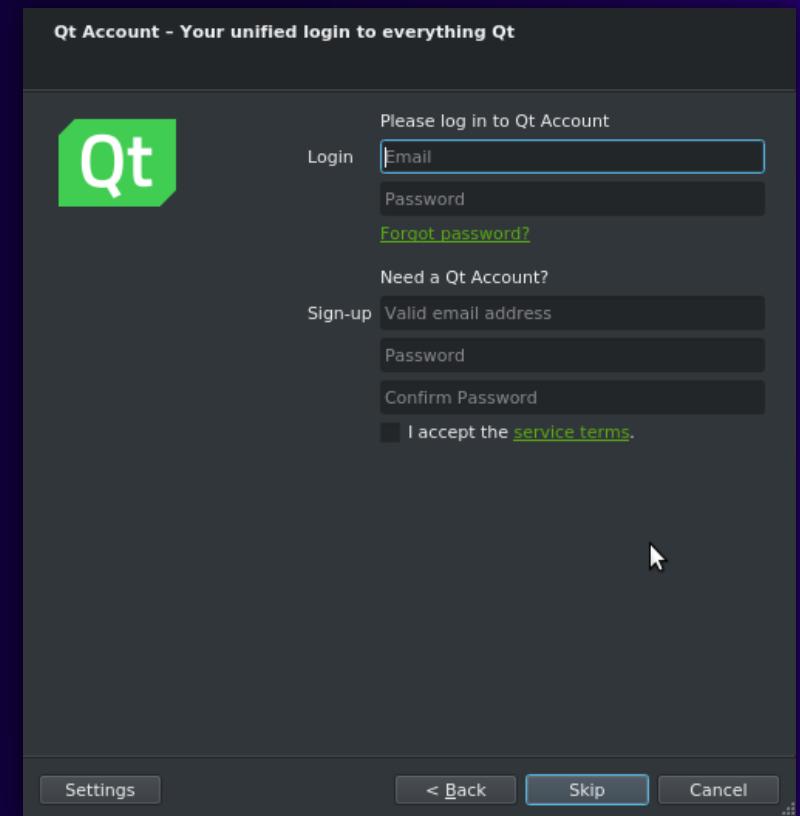
Offline/Online Installer

Install Qt in any operative system

Current sample is 4.5.0 version.

Once you've downloaded Qt and opened the installer program, the installation procedure is the same for all operative systems, although the screenshots might look a bit different. The screenshots provided here are from Linux.

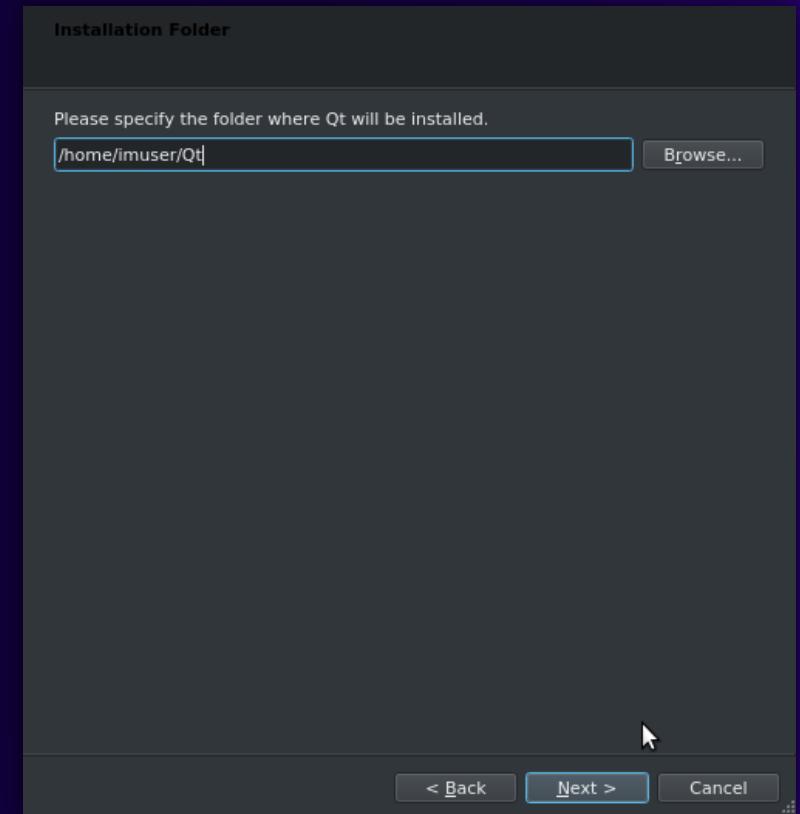
Login with a existing Qt account or create a new one:



Offline/Online Installer

Install Qt in any operative system

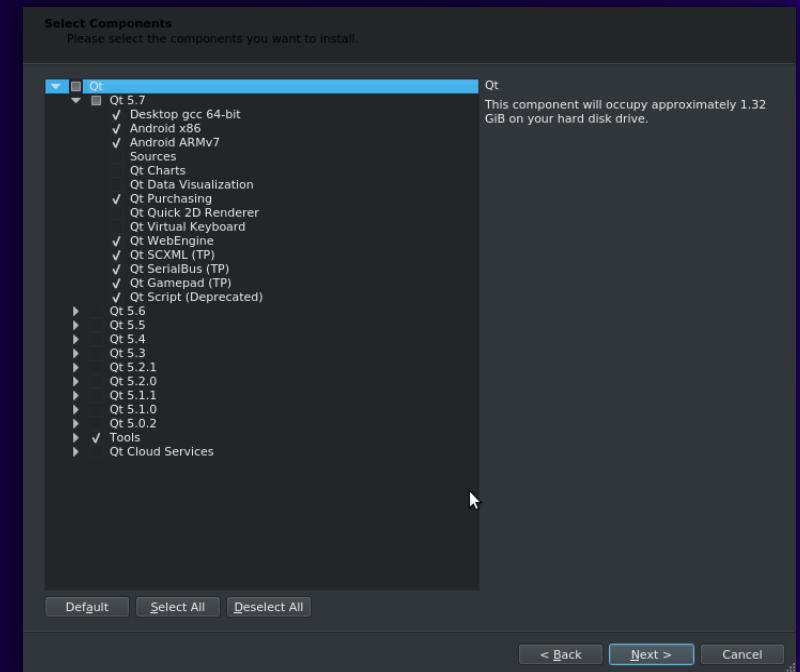
Select a path to install the Qt libraries and tools



Offline/Online Installer

Install Qt in any operative system

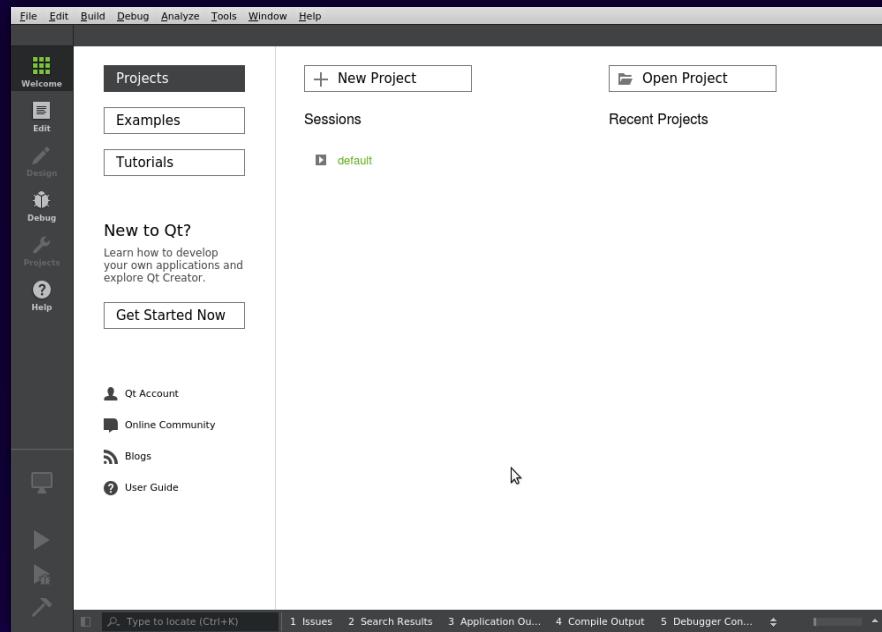
Select the library version and the features you want



Offline/Online Installer

Install Qt in any operative system

After downloading and the installation is finished, go to the Qt installation directory and launch Qt Creator or run it directly from the command line.



Installation From Packages (Linux)

Installation in Debin (11.x) distribution

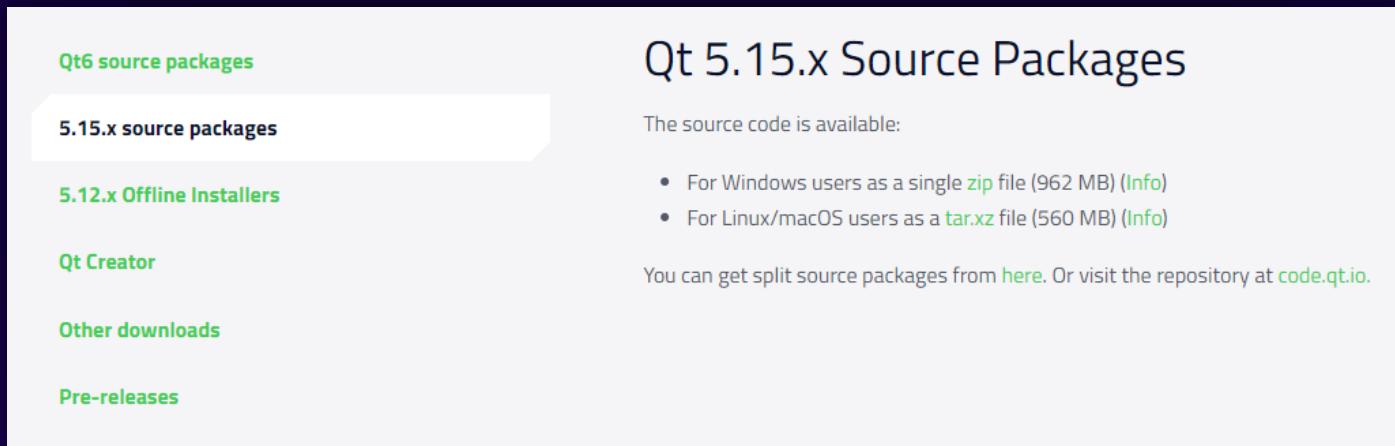
```
$ sudo apt-get update && sudo apt-get upgrade  
$ sudo apt install qtbase5-dev qt5-qmake qtbase5-dev-tools  
$ sudo apt-get install qtcreator  
$ qtcreator
```

Type of build

- Dynamic
 - Dynamic plug-in is basically a shared library which is loaded at runtime.
 - ✓ Ability to update and patch Qt libraries.
 - ✓ The Qt libraries should be included with the final executable file
- Static
 - Static plug-in is built into your executable (like a static lib).
 - ✓ The libraries are combined with the executable file and a final file is created

Build in Windows

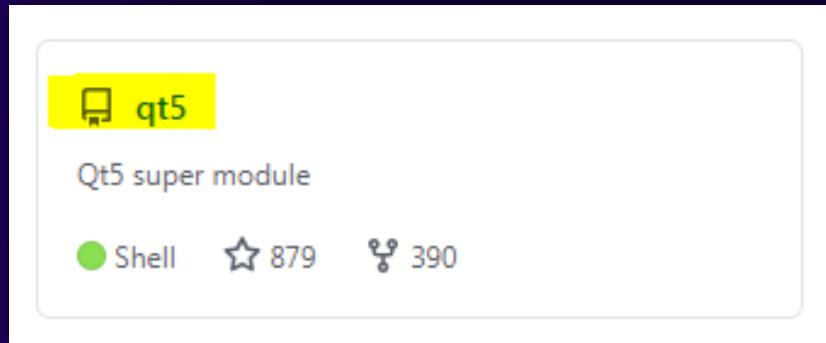
- It can be downloaded from the link below (windows version 5.15.2):
 - URL: <https://www.qt.io/offline-installers>
- Ability to customize modules
- The ability to change the source code
- Ability to compile statically



The screenshot shows the "Qt 5.15.x Source Packages" section of the Qt download page. On the left, there's a sidebar with links: "Qt6 source packages", "5.15.x source packages" (which is highlighted in blue), "5.12.x Offline Installers", "Qt Creator", "Other downloads", and "Pre-releases". The main content area has a heading "Qt 5.15.x Source Packages" and a sub-heading "The source code is available:". Below this, there are two bullet points: "For Windows users as a single [zip](#) file (962 MB) ([Info](#))" and "For Linux/macOS users as a [tar.xz](#) file (560 MB) ([Info](#))". At the bottom, it says "You can get split source packages from [here](#). Or visit the repository at [code.qt.io](#)".

Build in Windows

- Enter the following website (Qt requirements to compile):
 - URL: <https://github.com/qt/qt5>



System requirements

- CMake 3.18 or later
- Perl 5.8 or later
- Python 2.7 or later
- C++ compiler supporting the C++17 standard

It's recommended to have ninja 1.8 or later installed.

For other platform specific requirements, please see section "Setting up your machine" on:
http://wiki.qt.io/Get_The_Source

Build in Windows

- Prerequisites for compiling Qt on the windows platform

Windows:

1. Open a command prompt.
2. Ensure that the following tools can be found in the path:
 - Supported compiler (Visual Studio 2019 or later, or MinGW-builds gcc 8.1 or later)
 - Perl version 5.12 or later [<http://www.activestate.com/activeperl/>]
 - Python version 2.7 or later [<http://www.activestate.com/activepython/>]
 - Ruby version 1.9.3 or later [<http://rubyinstaller.org/>]

```
cd <path>\<source_package>
configure -prefix %CD%\qtbase
cmake --build .
```

Build in Windows

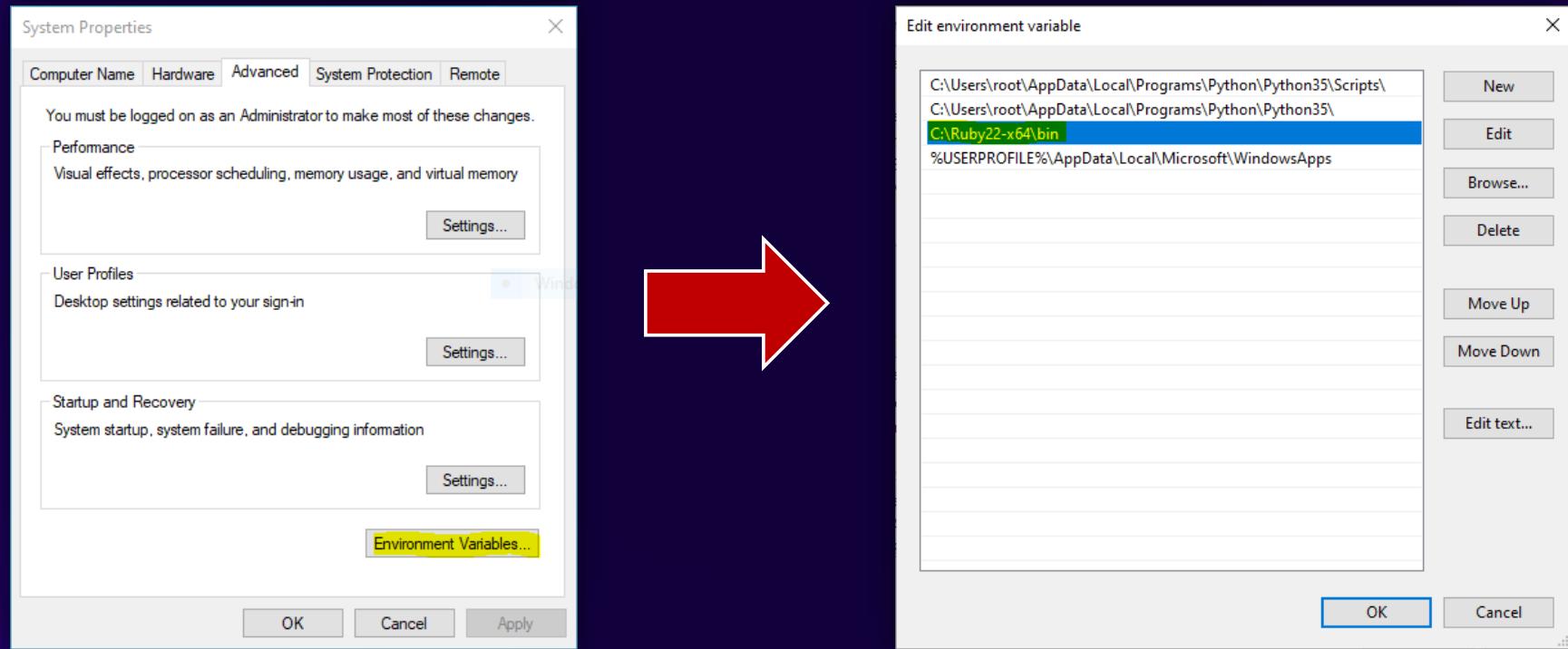
- Compiler:
 - Visual Studio 2019 or later
 - MinGW-builds gcc 8.1 or later
- Tools:
 - Perl version 5.12 or later [<http://www.activestate.com/activeperl/>]
 - Python version 2.7 or later [<http://www.activestate.com/activepython/>]
 - Ruby version 1.9.3 or later [<http://rubyinstaller.org/>]

Note: “Python” and “Perl” installation requires internet.

Note: Compilation requires Windows version 7 or higher.

Build in Windows

- After installing the tools (Perl, Python, Ruby), their path should be added to the “System Environment”



Build in Windows

- First, download the source code
 - Example: qt-everywhere-src-5.15.2.zip
- Decompress the source code in the desired path, for example "c:\\"

Build in Windows >> Compile with MSVC

- Install Visual Studio 2019
- Depending on the required architecture (32-bit or 64-bit version), we run the Visual Studio command line from start menu:
 - x86 Native Tools Command Prompt for VS 2019
 - x64 Native Tools Command Prompt for VS 2019
- Enter the following commands in the command line:

```
> SET _ROOT=C:\Qt\qt-everywhere-src-5.15.2
> SET PATH=%_ROOT%\qtbase\bin;%_ROOT%\gnuwin32\bin;%PATH%
> SET PATH=%_ROOT%\qtrepotools\bin;%PATH%
```

Build in Windows >> Compile with MSVC

- Enter the Qt source code path

```
> Cd C:\Qt\qt-everywhere-src-5.15.2
```

- Configure the compiler

```
> configure -debug-and-release -platform win32-msvc -developer-build  
-prefix "C:\Qt\5.15.2-x86" -nomake examples -nomake tests  
-skip qtwebengine -opensource -mp
```

- Start the compilation with the following command:
 - nmake
- install Qt with the following command
 - nmake install
- Clean source code
 - nmake clean

Build in Windows >> Compile with MinGW

- Install MinGW 8.1 or later
 - URL: <http://mingw-w64.org/>
- Run mingw command line or run it in the "cmd" and set mingw path in system environment (Path variable).
- Enter the following commands in the command line:

```
> SET _ROOT=C:\Qt\qt-everywhere-src-5.15.2
> SET PATH=%_ROOT%\qtbase\bin;%_ROOT%\gnuwin32\bin;%PATH%
> SET PATH=%_ROOT%\qtrepotools\bin;%PATH%
```

- Enter the Qt source code path

```
> Cd C:\Qt\qt-everywhere-src-5.15.2
```

Build in Windows >> Compile with MinGW

- Configure the compiler

```
> configure -debug-and-release -platform win32-g++ -developer-build  
-prefix "C:\Qt\5.15.2-mingw-x86" -nomake examples -nomake tests  
-skip qtwebengine -opensource -no-angle -mp
```

- Start the compilation with the following command:

```
> mingw32-make -jn (n is number of cpu for parallel build)
```

- Install Qt with the following command

```
> mingw32-make install
```

Build in Windows

- Clean source code

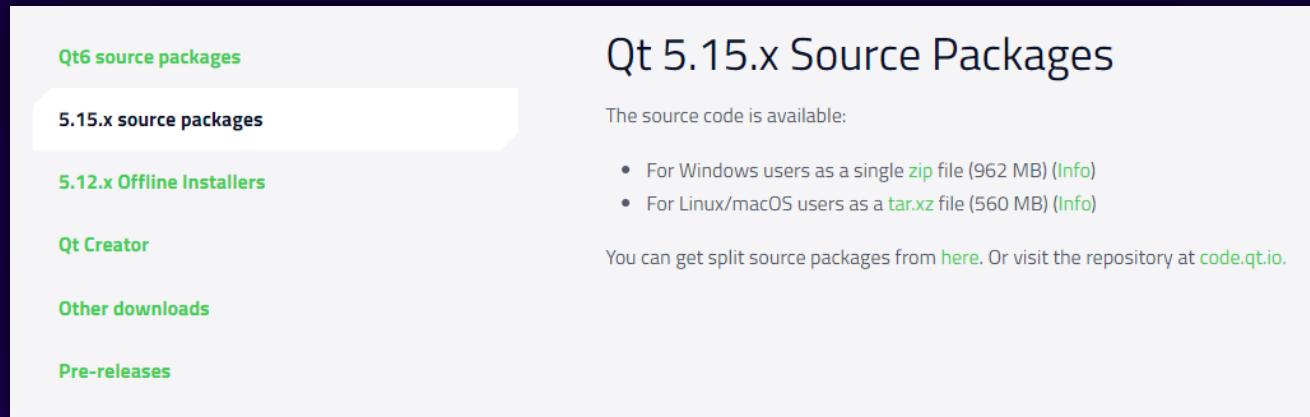
```
> mingw32-make clean
```

- Remove source code directory

```
> del /q "C:\Qt\qt-everywhere-src-5.15.2\*"  
FOR /D %%p IN ("C:\Qt\qt-everywhere-src-5.15.2\*.*") DO rmdir "%%p" /s /q
```

Build in Linux

- It can be downloaded from the link below (linux/mac version 5.15.2):
 - URL: <https://www.qt.io/offline-installers>
- Ability to customize modules
- The ability to change the source code
- Ability to compile statically



The screenshot shows the Qt download page with the "Qt 5.15.x Source Packages" section highlighted. On the left, there's a sidebar with links for "Qt6 source packages", "5.15.x source packages" (which is selected and highlighted in blue), "5.12.x Offline Installers", "Qt Creator", "Other downloads", and "Pre-releases". The main content area has a heading "Qt 5.15.x Source Packages" and a sub-heading "The source code is available:". Below this, there are two bullet points:

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At the bottom, it says "You can get split source packages from [here](#). Or visit the repository at [code.qt.io](#)".

Build in Linux

- Compiler:
 - GCC/g++
 - Clang
- Tools and library:
 - Perl (>=5.14)
 - Python (>=2.6.x)
 - build-essential
 - Libxcb

Build in Linux / Dependency Packages

- Build Essentials

| Distribution | Packages |
|-----------------------|--|
| Ubuntu and/or Debian: | \$ sudo apt-get install build-essential perl python3 git |
| Fedora 30: | \$ su - -c "dnf install perl-version git gcc-c++ compat-openssl110-devel harfbuzz-devel double-conversion-devel libzstd-devel at-spi2-atk-devel dbus-devel mesa-libGL-devel" |
| OpenSUSE: | \$ sudo zypper install git-core gcc-c++ make |

Build in Linux / Dependency Packages

- Libxcb

| Distribution | Packages |
|-----------------------|---|
| Ubuntu and/or Debian: | \$ sudo apt-get install '^libxcb.*-dev' libx11-xcb-dev libglu1-mesa-dev libxrender-dev libxi-dev libxkbcommon-dev libxkbcommon-x11-dev |
| Fedora 30: | \$ su - -c "dnf install libxcb libxcb-devel xcb-util xcb-util-devel xcb-util-*-devel libX11-devel libXrender-devel libxkbcommon-devel libxkbcommon-x11-devel libXi-devel libdrm-devel libXcursor-devel libXcomposite-devel" |
| OpenSUSE 12+: | \$ sudo zypper in xorg-x11-libxcb-devel xcb-util-devel xcb-util-image-devel xcb-util-keysyms-devel xcb-util-renderutil-devel xcb-util-wm-devel xorg-x11-devel libxkbcommon-x11-devel libxkbcommon-devel libXi-devel |
| Centos 7: | \$ yum install libxcb libxcb-devel xcb-util xcb-util-devel mesa-libGL-devel libxkbcommon-devel |

Build in Linux / Dependency Packages

- OpenGL support
 - For Qt Quick 2, a graphics driver with native OpenGL 2.0 support is highly recommended.
- Accessibility
 - It is recommended to build with accessibility enabled, install libatspi2.0-dev and libdbus-1-dev packages.

Build in Linux / Dependency Packages

- Qt WebKit

| Distribution | Packages |
|-----------------------|---|
| Ubuntu and/or Debian: | \$ sudo apt-get install flex bison gperf libicu-dev libxslt-dev ruby |
| Fedora 30: | \$ su - -c "dnf install flex bison gperf libicu-devel libxslt-devel ruby" |
| OpenSUSE: | \$ sudo zypper install flex bison gperf libicu-devel ruby |
| Mandriva/ROSA/Unity: | \$ urpmi gperf |

Build in Linux / Dependency Packages

- Qt WebEngine

| Distribution | Packages |
|-----------------------|--|
| Ubuntu and/or Debian: | \$ sudo apt-get install libxcursor-dev libxcomposite-dev libxdamage-dev libxrandr-dev libxtst-dev libxss-dev libdbus-1-dev libevent-dev libfontconfig1-dev libcap-dev libpulse-dev libudev-dev libpci-dev libnss3-dev libasound2-dev libegl1-mesa-dev gperf bison nodejs |
| Fedora/RHEL: | \$ sudo dnf install freetype-devel fontconfig-devel pciutils-devel nss-devel nspr-devel ninja-build gperf cups-devel pulseaudio-libs-devel libcap-devel alsa-lib-devel bison libXrandr-devel libXcomposite-devel libXcursor-devel libXtst-devel dbus-devel fontconfig-devel alsa-lib-devel rh-nodejs12-nodejs rh-nodejs12-nodejs-devel |
| OpenSUSE: | \$ sudo zypper install alsa-devel dbus-1-devel libXcomposite-devel libXcursor-devel libXrandr-devel libXtst-devel mozilla-nspr-devel mozilla-nss-devel gperf bison nodejs10 nodejs10-devel |

Build in Linux / Dependency Packages

- Qt Multimedia
 - You'll need at least alsa-lib (>= 1.0.15) and gstreamer (>=0.10.24) with the base-plugins package.

| Distribution | Packages |
|-----------------------|--|
| Ubuntu and/or Debian: | \$ sudo apt-get install libasound2-dev libgstreamer1.0-dev libgstreamer-plugins-base1.0-dev libgstreamer-plugins-good1.0-dev libgstreamer-plugins-bad1.0-dev |
| Fedora 30: | \$ dnf install pulseaudio-libs-devel alsa-lib-devel gstreamer1-devel gstreamer1-plugins-base-devel wayland-devel |

Build in Linux / Dependency Packages

- QDoc Documentation Generator Tool

| Distribution | Packages |
|-----------------------|--|
| Ubuntu and/or Debian: | \$ sudo apt install clang libclang-dev |
| Fedora 30: | \$ su -c 'dnf install llvm-devel' |

Build in Linux

- Enter the following website (Qt requirements to compile):
 - URL: <https://doc.qt.io/qt-5/linux-building.html>
 - URL: https://wiki.qt.io/Building_Qt_5_from_Git#Linux.2FX11
- First, download the source code
 - Example: qt-everywhere-src-5.15.2.tar.xz
- Installing the License File (Commercially Licensed Qt Only)
- Decompress the source code in the desired path, for example “/tmp”

```
$ cd /tmp
$ tar -xvf qt-everywhere-src-5.15.2.tar.xz
Or
$ cd /tmp
$ gunzip qt-everywhere-opensource-src-%VERSION%.tar.gz      # uncompress the archive
$ tar xvf qt-everywhere-opensource-src-%VERSION%.tar        # unpack it
```

Build in Linux

- Installing the license file (Commercially licensed Qt only)
- Enter the Qt source code path

```
$ cd /tmp/qt-everywhere-opensource-src-%VERSION%
```

- Compile with GCC/g++
 - Configure the compiler

```
$ ./configure -platform linux-g++ -developer-build -prefix  
"/opt/qt5.15.2-x64" -nomake examples -nomake tests -skip qtwebengine  
-opensource -mp
```

- Start the compilation with the following command:

```
$ gmake
```

Build in Linux

- Compile with GCC/g++
 - Compile Qt Docs

```
$ make docs
```

- Install Qt Docs

```
$ sudo gmake install_docs      # Need to root privileges
```

- Remove source code directory

```
$ rm -rf /tmp/*
```

Build in Linux

- Compile with GCC/g++
 - Install Qt with the following command

```
$ sudo gmake install # Need to root privileges
```

- Clean source code

```
$ gmake clean
```

WARNING: -debug-and-release is only supported on Darwin and Windows platforms. Qt can be built in release mode with separate debug information, so -debug-and-release is no longer necessary.

Build Options

- Compiler Options: Compile with GCC/g++ (32 bit)

```
-platform linux-g++-32
```

- Compiler Options: Compile with Clang

```
-platform linux-clang
```

- Compiler Options: Cross-Compilation Options. To configure Qt for cross-platform development and deployment, the development toolchain for the target platform needs to be set up. This set up varies among the Supported Platforms.

```
-xplatform
```

Build Options

- Install Directories

```
-prefix /opt/qt
```

- Excluding Qt Modules. Configure's -skip option allows top-level source directories to be excluded from the Qt build.

```
./configure -skip qtconnectivity
```

- Including or Excluding Features. The -feature-<feature> and -no-feature-<feature> options include and exclude specific features, respectively.

```
./configure -no-feature-accessibility
```

Build Options

- **Third-Party Libraries.** The Qt source packages include third-party libraries. To set whether Qt should use the system's versions of the libraries or to use the bundled version, pass either `-system` or `-qt` before the name of the library to configure.

```
./configure -no-zlib -qt-libjpeg -qt-libpng -system-xcb
```

| Library Name | Bundled in Qt | Installed in System |
|--------------------|---------------------------|-------------------------------|
| zlib | <code>-qt-zlib</code> | <code>-system-zlib</code> |
| libjpeg | <code>-qt-libjpeg</code> | <code>-system-libjpeg</code> |
| libpng | <code>-qt-libpng</code> | <code>-system-libpng</code> |
| freetype | <code>-qt-freetype</code> | <code>-system-freetype</code> |
| PCRE | <code>-qt-pcre</code> | <code>-system-pcre</code> |
| <u>HarfBuzz-NG</u> | <code>-qt-harfbuzz</code> | <code>-system-harfbuzz</code> |

Build Options

- OpenGL Options for Windows
 - Dynamic: With the dynamic option, Qt will try to use native OpenGL first. If that fails, it will fall back to ANGLE and finally to software rendering in case of ANGLE failing as well.

```
configure.bat -opengl dynamic
```

- Desktop: With the desktop option, Qt uses the OpenGL installed on Windows, requiring that the OpenGL in the target Windows machine is compatible with the application. The -opengl option accepts two versions of OpenGL ES, es2 for OpenGL ES 2.0 or es1 for OpenGL ES Common Profile.

```
configure.bat -opengl desktop
```

- You can also use -opengl dynamic, which enable applications to dynamically switch between the available options at runtime. For more details about the benefits of using dynamic GL-switching, see Graphics Drivers.

```
configure.bat -opengl es2
```

Note: For a full list of options, consult the help with `configure -help`.

Checking Build and Run Settings

- The Qt Installer attempts to auto-detect the installed compilers and Qt versions. If it succeeds, the relevant kits will automatically become available in Qt Creator.

Adding Kits

- Qt Creator groups settings used for building and running projects as kits to make cross-platform and cross-configuration development easier. Each kit consists of a set of values that define one environment, such as a device, compiler, Qt version, and debugger command to use, and some metadata, such as an icon and a name for the kit. Once you have defined kits, you can select them to build and run projects.

Specifying Kit Settings

- Select Edit > Preferences > Kits > Add
- Specify kit settings. The settings to specify depend on the build system and device type.

Kit Settings

- Name:
 - Name of the kit.
- Device type:
 - The device to build applications on.
- Device:
 - The device to run applications on.
- Compiler:
 - C or C++ compiler that you use to build the project. You can add compilers to the list if they are installed on the development PC.

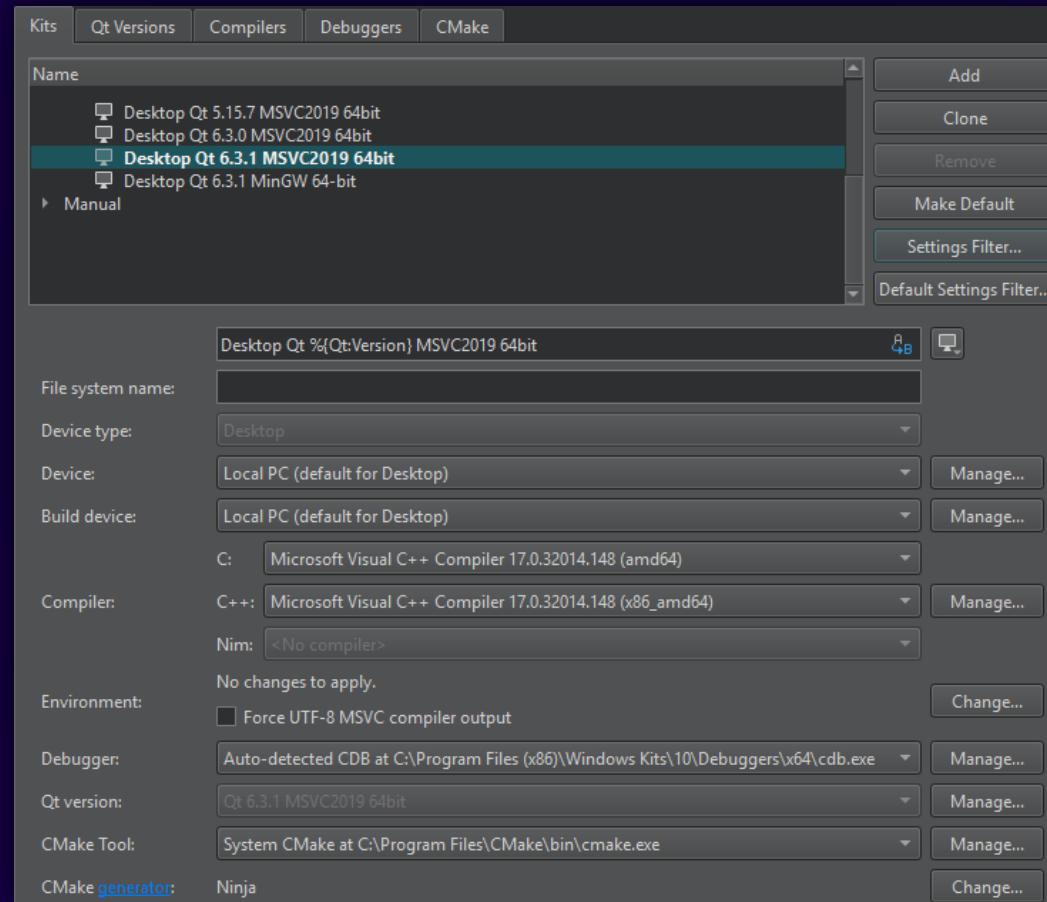
Kit Settings

- Debugger:
 - Debugger to debug the project on the target platform. Qt Creator automatically detects available debuggers and displays a suitable debugger in the field. You can add debuggers to the list.
- Qt version
 - Qt version to use for building the project. You can add Qt versions to the list if they are installed on the development PC.

Introduction to Qt Creator >> Managing Kits



Kits:



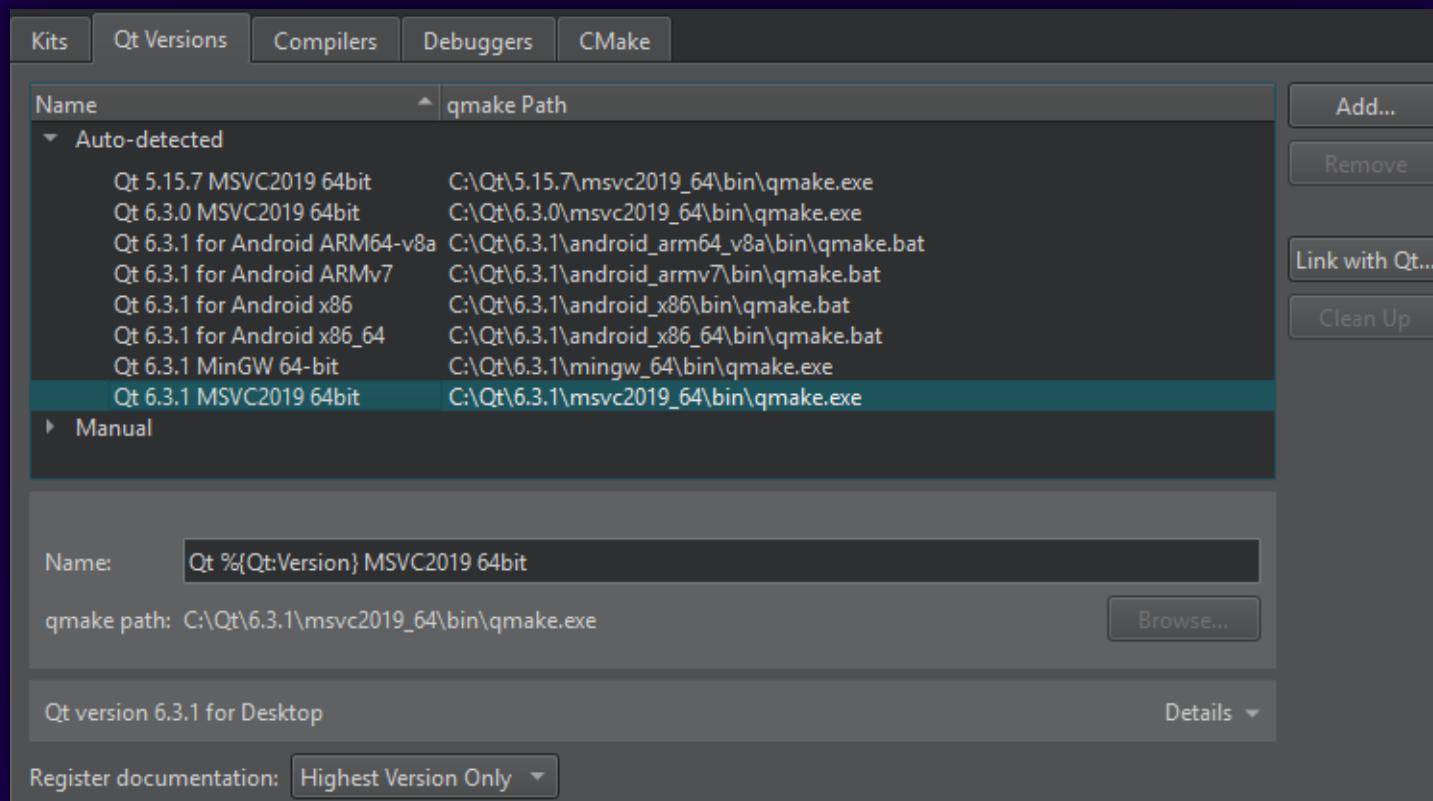
Adding Qt Versions

- Qt Creator allows you to have multiple versions of Qt installed on your development PC and use different versions to build your projects.

Setting Up New Qt Versions

- Select Edit > Preferences > Kits > Qt Versions > Add.
- Select the qmake executable for the Qt version that you want to add.

Qt Versions:



Adding Compilers

- Qt is supported on a variety of 32-bit and 64-bit platforms, and can usually be built on each platform with GCC, a vendor-supplied compiler, or a third party compiler.

You can add the following compilers to build applications

- [Clang](#) is a C, C++, Objective C, and Objective C++ front-end for the LLVM compiler for Windows, Linux, and macOS.
- [clang-cl](#) is an alternative command-line interface to Clang that is compatible with the Visual C++ compiler, cl.exe.
- [GNU Compiler Collection \(GCC\)](#) is a compiler for Linux and macOS.
- [ICC \(Intel C++ Compiler\)](#) is a group of C and C++ compilers. Only the GCC-compatible variant, available for Linux and macOS, is currently supported by Qt Creator.
- [MinGW \(Minimalist GNU for Windows\)](#) is a native software port of GCC and GNU Binutils for use in the development of native Microsoft Windows applications on Windows. MinGW is distributed together with Qt Creator and Qt for Windows.
- [MSVC \(Microsoft Visual C++ Compiler\)](#) is a C++ compiler that is installed with Microsoft Visual Studio.
- [Nim](#) is the Nim Compiler for Windows, Linux, and macOS.
- [QCC](#) is the interface for compiling C++ applications for QNX.

Note: MSVC compiler exists in Windows Software Development Kit (SDK)

Introduction to Qt Creator >> Managing Kits



Qt Compilers:

The screenshot shows the Qt Creator interface with the 'Compilers' tab selected in the top navigation bar. The main area displays a list of detected compilers under the 'Auto-detected' section. The 'MinGW 8.1.0 64-bit for C++' entry is selected and highlighted with a blue background. A context menu is open over this entry, containing the following options: 'Add', 'Clone', 'Remove', 'Remove All', 'Re-detect', and 'Auto-detection Settings...'. Below the list, there is a detailed configuration dialog for the selected compiler. The dialog fields include:

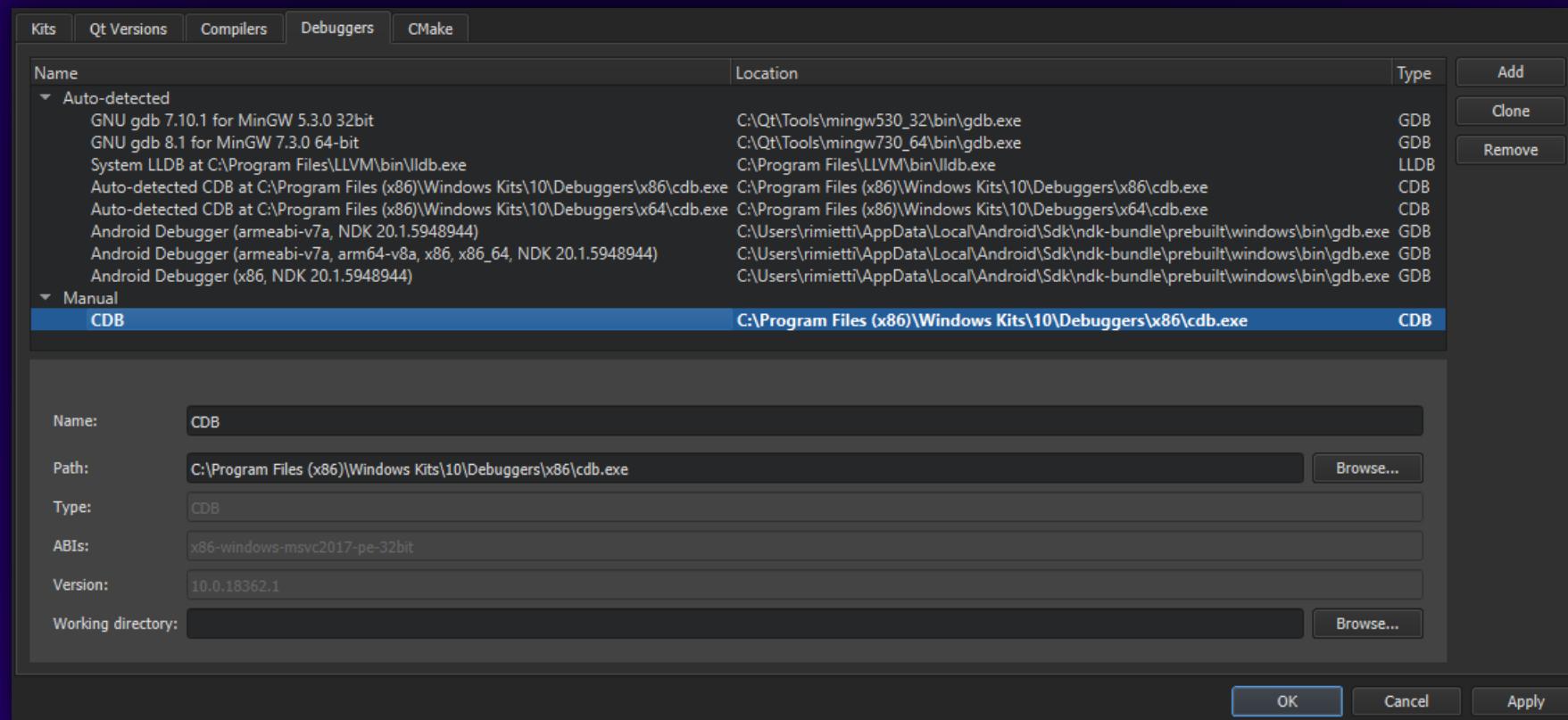
- Name: MinGW 8.1.0 64-bit for C++
- Compiler path: C:\Qt\Tools\mingw810_64\bin\g++.exe (with a 'Browse...' button)
- Platform codegen flags: (empty field)
- Platform linker flags: (empty field)
- ABI: x86-windows - x86 - windows - msys - pe - 64bit
- Target triple: x86_64-w64-mingw32 (with a checkbox for 'Override for code model')

Adding Debuggers

- The Qt Creator debugger plugin acts as an interface between the Qt Creator core and external native debuggers such as the GNU Symbolic Debugger (GDB), the Microsoft Console Debugger (CDB), a QML/JavaScript debugger, and the debugger of the low level virtual machine (LLVM) project, LLDB.
- Select Edit > Preferences > Kits > Debuggers > Add.
- In the Path field, specify the path to the debugger binary:
 - For CDB (Windows only), specify the path to the Windows Console Debugger executable.
 - For GDB, specify the path to the GDB executable. The executable must be built with Python scripting support enabled.
 - For LLDB (experimental), specify the path to the LLDB executable.

Note: CDB compiler exists in Windows Software Development Kit (SDK)

Qt Debuggers:



Concepts

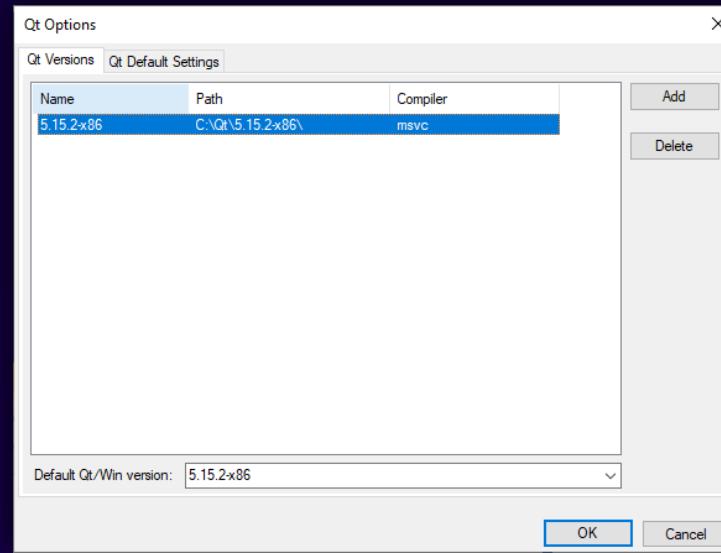
- **Shadow building** means building a project in a separate directory, the build directory. The build directory is different from the source directory. One of the benefits of shadow building is that it keeps your source directory clean, which makes it faster to switch between build configurations.
- Abi
- Illvm

Prerequisite

- Install Visual Studio (Example: Visual Studio 2019)
- Install Visual Studio addin (Example: qt-vsaddin-msvc2019-2.6.0-rev.07.vsix)

Adding Kits

- Select Extensions > Qt VS Tools > Qt Options > Add (qmake file from Compiled Qt for MSVC)



C Console Application

- Create the helloworld.c program using a Vim editor as shown below.

```
/* Hello World C Program */

#include <stdio.h>

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

- Compile the helloworld.c Program

```
$ gcc main.cpp
```

- Execute the C Program (a.out)

```
$ ./a.out
```

C++ Console Application

- Create a file titled main.cpp somewhere on your computer. Within the file, include the following:

```
#include <iostream>

int main() {
    std::cout << "Hello World\n";
    return 0;
}
```

- To compile our application we can execute the following from the command line:

```
$ g++ main.cpp -o app
```

- The app file can be ran by executing the following:

```
./app
```

Cross-Platform Development



Qt Console Application

- Let's begin with a simple C++ program. Open a text editor and enter the following source code. Create a directory "hello" and save the source code into a file hello.cpp residing in this directory.

```
#include <QTextStream>
int main() {
    QTextStream(stdout) << "Hello, world!" << endl;
    return 0;
}
```

- Now enter the "hello" directory and type: "qmake -project". This will create an qmake project file. Thereafter run just "qmake" without arguments. this will create a "Makefile" which contains the rules to build your application. Then run "make" (called nmake or gmake on some platforms), which will build your app according to the rules layed out in the "Makefile". Finally you can run the app "./hello".

```
$ cd my\dir\hello
$ qmake -project
$ qmake CONFIG+=debug|release ${qmake_options}
$ make ${make_options}
$ ./hello | ./hello &
$ make clean
```

g++

```
> cd my\dir\hello
> qmake -project
> qmake
> nmake -f Makefile.Release | nmake -f Makefile.Debug
> hello.exe | start /wait hello.exe
> nmake clean
```

MSVC

Cross-Platform Development



Qt Desktop Application

- Simply replace the source code in hello.cpp by:

```
#include <QtGui>
#include <QApplication>
#include <QLabel>

int main(int argc, char **argv) {
    QApplication app(argc, argv);
    QLabel label("Hello, world!");
    label.show();
    return app.exec();
}
```

- Add the following lines to the .pro file after the include path:

```
...
INCLUDEPATH += .

QT += gui
QT += widgets
...
```

- Run "qmake" and then "make" again. If you launch the application should see a small window saying "Hello, world!".

Running qmake

- The behavior of qmake can be customized when it is run by specifying various options on the command line.

Command Syntax

- The syntax used to run qmake takes the following simple form:

```
qmake [mode] [options] files
```

Note: If you installed Qt via a package manager, the binary may be qmake6.

Operating Modes

- qmake supports two different modes of operation. In the default mode, qmake uses the information in a project file to generate a Makefile, but it is also possible to use qmake to generate project files.
 - -makefile: qmake output will be a Makefile.
 - -project: qmake output will be a project file.

Files

- The files argument represents a list of one or more project files, separated by spaces.

General Options

- **-help**
qmake will go over these features and give some useful help.
- **-o file**
qmake output will be directed to file. If this option is not specified, qmake will try to use a suitable file name for its output, depending on the mode it is running in.
If '-' is specified, output is directed to stdout.
- **-d**
qmake will output debugging information. Adding -d more than once increases verbosity.

- **-t tmpl**
qmake will override any set TEMPLATE variables with tmpl, but only after the .pro file has been processed.
- **-tp prefix**
qmake will add prefix to the TEMPLATE variable.
- **-Wall**
qmake will report all known warnings.
- **-Wnone**
No warning information will be generated by qmake.
- **-Wparser**
qmake will only generate parser warnings. This will alert you to common pitfalls and potential problems in the parsing of your project files.
- **-Wlogic**
qmake will warn of common pitfalls and potential problems in your project file. For example, qmake will report multiple occurrences of files in lists and missing files.

Cross-Platform Development >> qmake



Makefile Mode Options

- In Makefile mode, qmake will generate a Makefile that is used to build the project.

```
qmake -makefile [options] files
```

- **-after**
qmake will process assignments given on the command line after the specified files.
- **-nocache**
qmake will ignore the .qmake.cache file.
- **-nodepend**
qmake will not generate any dependency information.
- **-cache file**
qmake will use file as the cache file, ignoring any other .qmake.cache files found.
- **-spec spec**
qmake will use spec as a path to platform and compiler information, and ignore the value of QMAKESPEC.

Note: You may also pass qmake assignments on the command line. They are processed before all of the files specified. For example, the following command generates a Makefile from test.pro:

```
qmake -makefile -o Makefile "CONFIG+=test" test.pro
qmake "CONFIG+=test" test.pro
```

Project Mode Options

- In project mode, qmake will generate a project file. Additionally, you may supply the following options in this mode:

```
qmake -project [options] files
```

- **-r**
qmake will look through supplied directories recursively.
- **-nopwd**
qmake will not look in your current working directory for source code. It will only use the specified files.

Cross-Platform Development >> .pro file



Project File Elements

- Project files contain all the information required by qmake to build your application, library, or plugin.

Variables

- In a project file, variables are used to hold lists of strings. In the simplest projects, these variables inform qmake about the configuration options to use, or supply filenames and paths to use in the build process.

| Variable | Contents |
|-----------|--|
| CONFIG | General project configuration options. |
| DESTDIR | The directory in which the executable or binary file will be placed. |
| FORMS | A list of UI files to be processed by the user interface compiler (uic). |
| HEADERS | A list of filenames of header (.h) files used when building the project. |
| QT | A list of Qt modules used in the project. |
| RESOURCES | A list of resource (.qrc) files to be included in the final project. See the The Qt Resource System for more information about these files. |
| SOURCES | A list of source code files to be used when building the project. |
| TEMPLATE | The template to use for the project. This determines whether the output of the build process will be an application, a library, or a plugin. |

Variables

- The following snippet illustrates how lists of values are assigned to variables:

```
HEADERS = mainwindow.h paintwidget.h
```

- The list of values in a variable is extended in the following way:

```
SOURCES = main.cpp mainwindow.cpp \
           paintwidget.cpp
CONFIG += console
```

- The contents of a variable can be read by prepending the variable name with **\$\$**. This can be used to assign the contents of one variable to another:

```
TEMP_SOURCES = $$SOURCES
```

Whitespace

- Usually, whitespace separates values in variable assignments. To specify values that contain spaces, you must enclose the values in double quotes:

```
DEST = "Program Files"
```

Comments

- You can add comments to project files. Comments begin with the # character and continue to the end of the same line. For example:

```
# Comments usually start at the beginning of a line, but they  
# can also follow other content on the same line.
```

Note: To include the # character in variable assignments, it is necessary to use the contents of the built-in LITERAL_HASH variable.

Built-in Functions and Control Flow

- qmake provides a number of built-in functions to enable the contents of variables to be processed. The most commonly used function in simple project files is the include() function which takes a filename as an argument.

```
include(other.pro)
```

- Support for conditional structures is made available via scopes that behave like if statements in programming languages:

```
win32 {
    SOURCES += paintwidget_win.cpp
}
```

Project Templates

- The TEMPLATE variable is used to define the type of project that will be built.

| Template | qmake Output |
|---------------|---|
| app (default) | Makefile to build an application. |
| lib | Makefile to build a library. |
| subdirs | Makefile containing rules for the subdirectories specified using the SUBDIRS variable. Each subdirectory must contain its own project file. |

General Configuration

- The CONFIG variable specifies the options and features that the project should be configured with. For example, if your application uses the Qt library and you want to build it in debug mode, your project file will contain the following line:

```
CONFIG += qt debug
```

Declaring Qt Libraries

- If the CONFIG variable contains the qt value, qmake's support for Qt applications is enabled. This makes it possible to fine-tune which of the Qt modules are used by your application. we can enable the XML and network modules in the following way:

```
QT += network xml
```

Note: QT includes the core and gui modules by default, so the above declaration adds the network and XML modules to this default list. The following assignment omits the default modules, and will lead to errors when the application's source code is being compiled:

```
QT = network xml # This will omit the core and gui modules.
```

- If you want to build a project without the gui module, you need to exclude it with the "-=" operator. By default, QT contains both core and gui, so the following line will result in a minimal Qt project being built:

```
QT -= gui # Only the core module is used.
```

Declaring Other Libraries

- The paths that qmake searches for libraries and the specific libraries to link against can be added to the list of values in the LIBS variable. For example, the following lines show how a library can be specified:

```
LIBS += -L/usr/local/lib -lmath
```

- The paths containing header files can also be specified in a similar way using the INCLUDEPATH variable. For example, to add several paths to be searched for header files:

```
INCLUDEPATH = c:/msdev/include d:/stl/include
```