

Introduction

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- C++ Tutorial:

<http://www.cplusplus.com/doc/tutorial/>

- Transition from Java:

http://cs.brown.edu/courses/cs123/docs/java_to_cpp.shtml

- Book: C++ Primer (5th Edition). Stanley B. Lippman, Josée Lavoie, Barbara E. Moo. Addison-Wesley, 2012.



- Eigen is a C++ template library for linear algebra
 - matrices, vectors, numerical solvers, and related algorithms.
- More on <http://eigen.tuxfamily.org/>
- See slides at the end on how to compile/build/run



- Initializing a vector

```
Eigen::Vector3f u, v;  
u(0) = 1.0;  
u(1) = 0.0;  
u(2) = 0.0;  
  
// Another way of initializing a vector/matrix  
v << 0.0, 1.0, 0.0;
```

- Display them to standard input

```
cout << "u: " << u.transpose() << endl;  
cout << "v: " << v.transpose() << endl;
```



- Vector operations

```
auto w = u.cross(v);  
cout << u.transpose() << " cross " << v.transpose() << " = " << w.transpose() << endl;  
double dot = u.dot(v);  
cout << u.transpose() << " dot " << v.transpose() << " = " << dot << endl;
```

- More vector operations

```
auto uHat = u.normalized();  
u.normalize();  
auto normU = u.norm();  
auto normUHat = uHat.norm();  
cout << "normU: " << normU << endl;  
cout << "normUHat: " << normUHat << endl;
```

// Notice that these two now have the
// same value. Eigen normalizes in place.
// Note: be careful in performing
// A=A.something()! See "ALIASING" topic in Eigen



- Matrix setup

```
Eigen::Matrix2f m;  
m(0, 0) = 3;  
m(1, 0) = 2.5;  
m(0, 1) = -1;  
m(1, 1) = m(1, 0) + m(0, 1);  
cout << "\nMatrix m:\n" << m << endl;
```

```
// Again, inline initialization  
Eigen::Matrix3f n;  
n << 1, 2, 3,  
     4, 5, 6,  
     7, 8, 9;  
cout << "\nMatrix n:\n" << n << endl;
```

- Matrix operations

```
auto m1 = m + n; // This will fail.  
auto m2 = Eigen::Matrix2f::Identity();  
auto m3 = m + m2; // This will not.  
cout << "\nMatrix m3:\n" << m3 << endl;
```



- Quick documentation (for MATLAB users)
 - <http://eigen.tuxfamily.org/dox/AsciiQuickReference.txt>
- Getting started
 - <http://eigen.tuxfamily.org/dox/GettingStarted.html>
- Longer tutorial
 - http://eigen.tuxfamily.org/dox/group_TutorialMatrixClass.html
- Reference
 - http://eigen.tuxfamily.org/dox/group_QuickRefPage.html



- Download the zip for dgp17-exercise1 on Moodle
- Download g++, make and cmake from your favourite packet manager
- You can then compile the lab using a terminal:

```
~$ cd /path/to/dgp2017-exercise1/  
~$ mkdir build/  
~$ cd build/  
~$ cmake ..  
~$ make  
~$ ./lab0_eigen/lab0_eigen
```

(see slide on Qt Creator if you need an IDE for C++)



- Install Xcode from the AppStore
- Install brew (see <http://brew.sh/>)
- Using brew install cmake
- You can then compile the lab using a terminal:

```
~$ cd /path/to/dgp2017-exercise1/  
~$ mkdir build/  
~$ cd build/  
~$ cmake ..  
~$ make  
~$ ./lab0_eigen/lab0_eigen
```

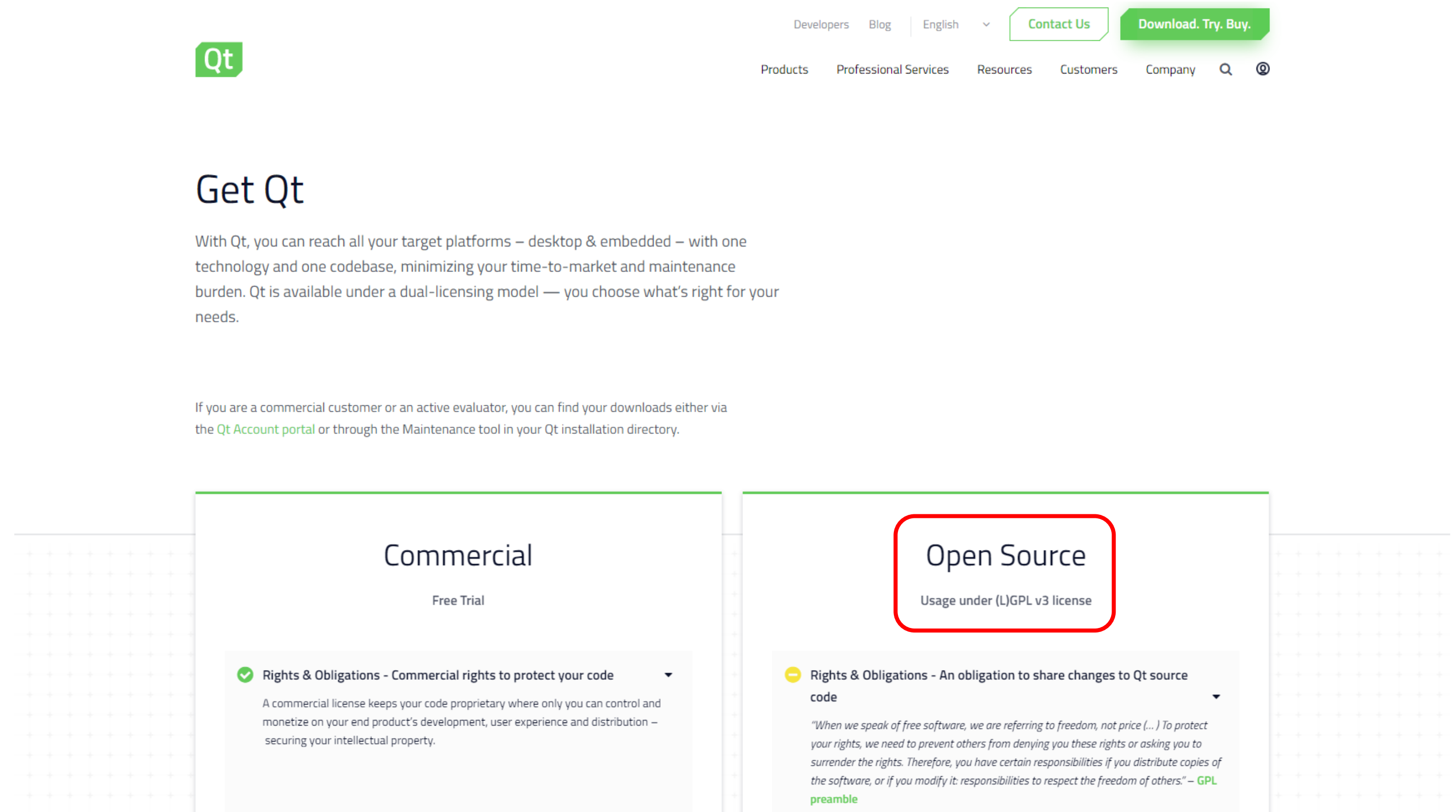
(see slide on Qt Creator if you need an IDE for C++)



- Download and install Visual Studio Community Edition from <https://www.visualstudio.com/vs/community/>
do not forget to tick Visual C++ when during installation
- Download and install CMake from <http://www.cmake.org>
- See next slide to build and run your program
(we recommend you to use Qt Creator instead of the Visual Studio IDE as it has a better CMake integration)



- Download and install QT Creator (only, not the full Qt stack) from <https://www.qt.io/download-open-source/#section-9>
- Choose “Open Source”



QT Creator (2/6)

- Select the following components to install

☐ QT 5.11.2

- ✓ MSVC 2017 64-bit
- ✓ MinGW 5.3.0 32 bit

☐ Tools

- ✓ Qt Creator 4.7.1 CDB Debugger Support 4.7.1-0
- ✓ MinGW 5.3.0

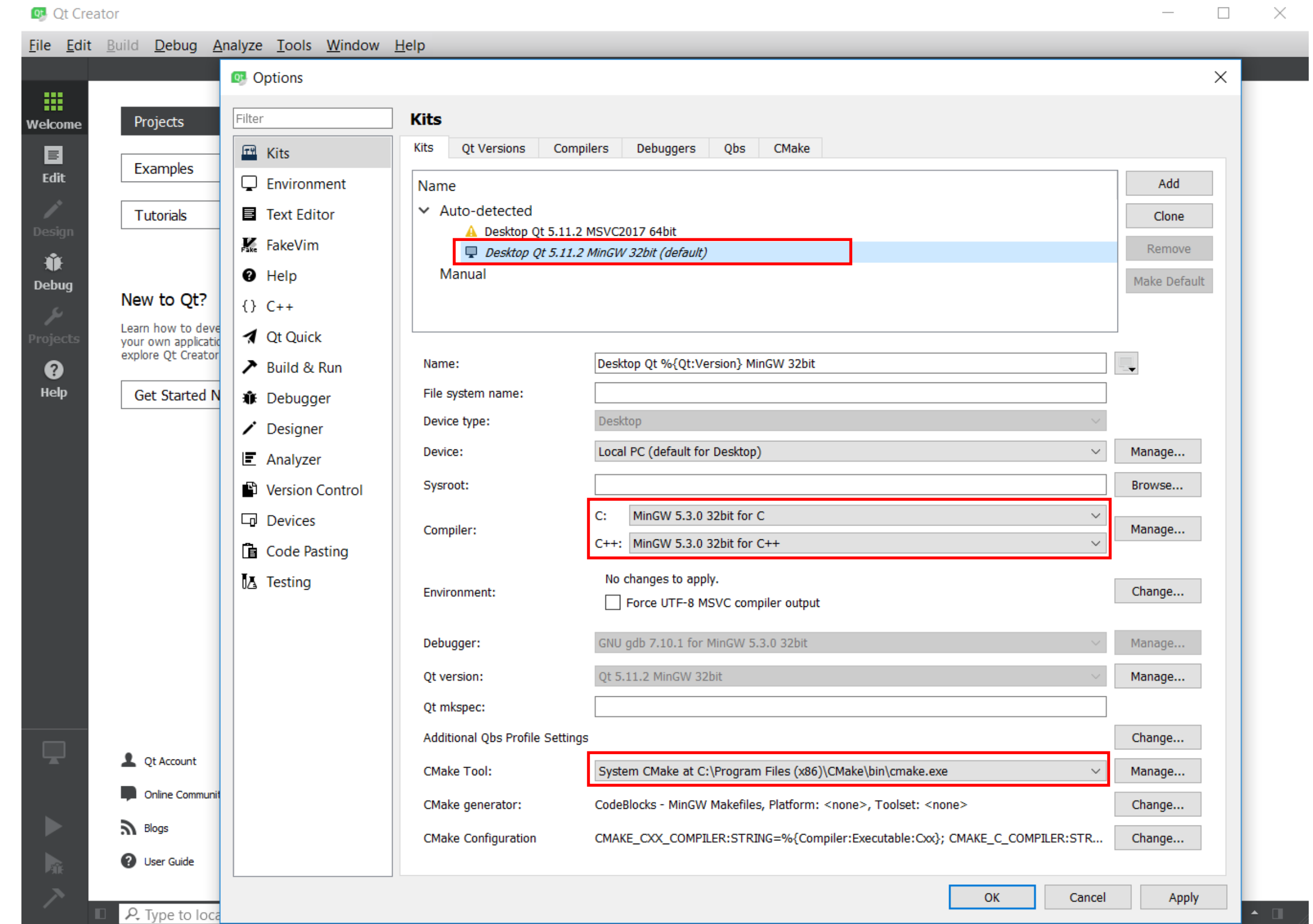
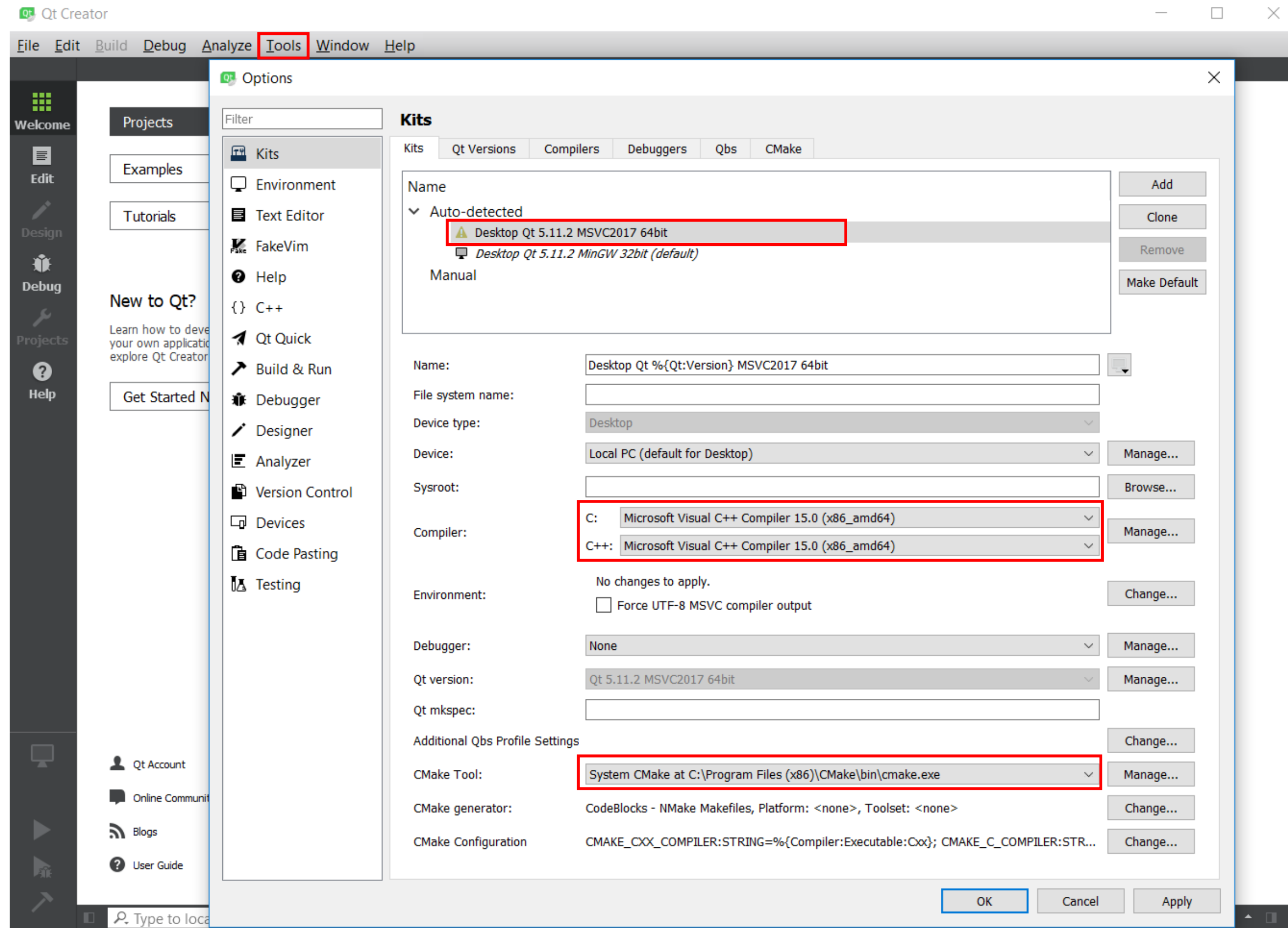
- Launch Qt Creator and follow the screenshots on the next slides

Select Components

Select the components to install. Deselect installed components to uninstall them. Any components already installed will not be updated.

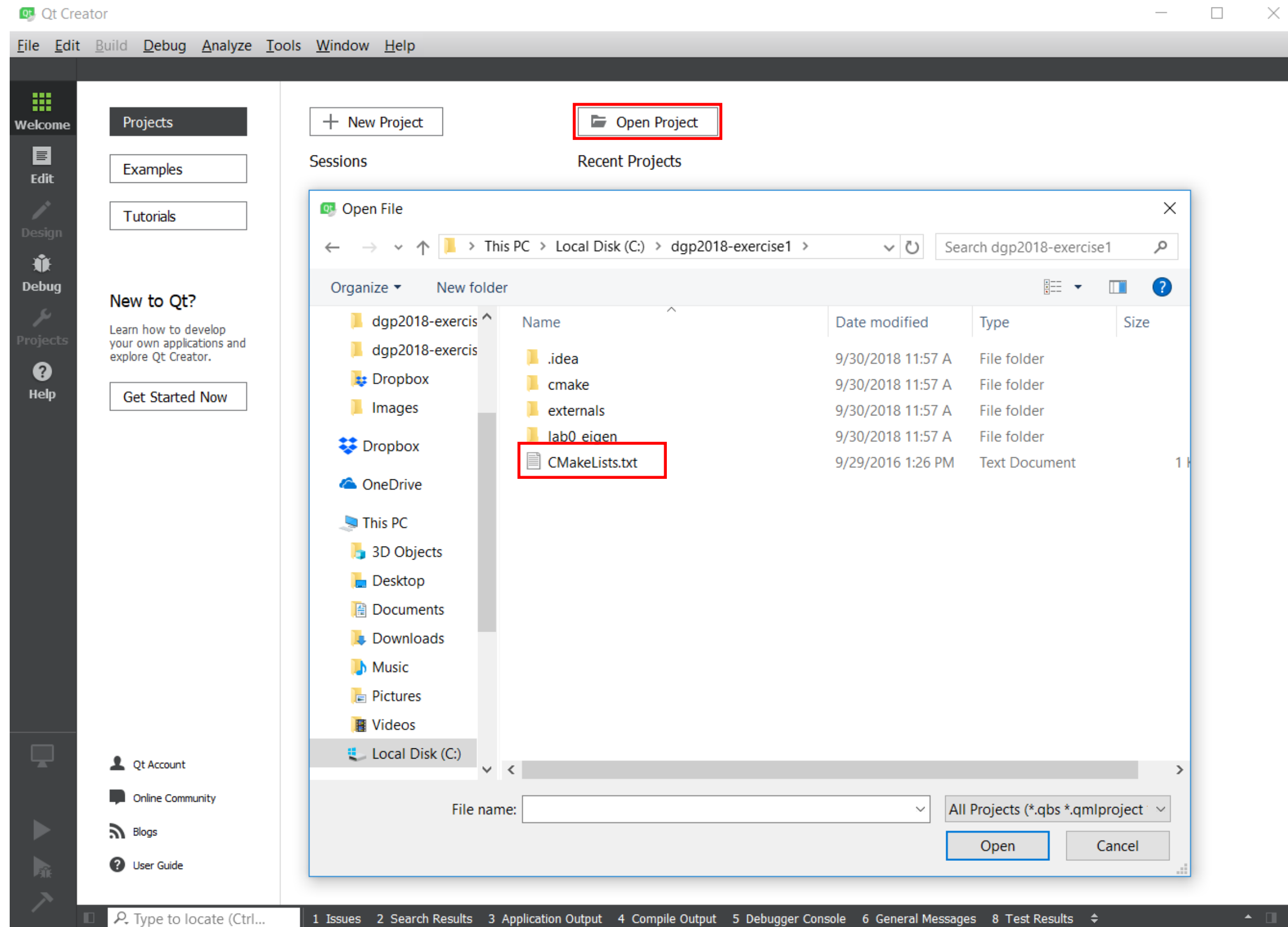
Component Name	Installed Version	New Version	Latest Qt and related package preview snapshots
Preview		1.0.0-0	
<input type="checkbox"/> Qt 5.12.0 Alpha		5.12.0-2018091	
<input type="checkbox"/> Qt 3D Studio 2.1.0-rc		2.1.0-20180921	
<input type="checkbox"/> Qt 3D Studio Runtime 2.1.0-rc for Qt 5.11.2		2.1.0-201809	
<input type="checkbox"/> Qt Creator 4.7.0-rc1		4.6.84-0-20180	
<input type="checkbox"/> Qt Creator 4.7.0-rc1 CDB Debugger Support		4.6.84-0-20180	
Qt	1.0.9	1.0.9	
<input checked="" type="checkbox"/> Qt 5.11.2	5.11.2-0-201809...	5.11.2-0-20180	
<input type="checkbox"/> MSVC 2015 32-bit		5.11.2-0-20180	
<input type="checkbox"/> MSVC 2015 64-bit		5.11.2-0-20180	
<input checked="" type="checkbox"/> MSVC 2017 64-bit		5.11.2-0-20180	
<input checked="" type="checkbox"/> MinGW 5.3.0 32 bit	5.11.2-0-201809...	5.11.2-0-20180	
<input type="checkbox"/> UWP ARMv7 (MSVC 2015)		5.11.2-0-20180	
<input type="checkbox"/> UWP x64 (MSVC 2015)		5.11.2-0-20180	
<input type="checkbox"/> UWP x86 (MSVC 2015)		5.11.2-0-20180	
<input type="checkbox"/> UWP ARMv7 (MSVC 2017)		5.11.2-0-20180	
<input type="checkbox"/> UWP x64 (MSVC 2017)		5.11.2-0-20180	
<input type="checkbox"/> UWP x86 (MSVC2017)		5.11.2-0-20180	
<input type="checkbox"/> Android x86		5.11.2-0-20180	
<input type="checkbox"/> Android ARMv7		5.11.2-0-20180	
<input type="checkbox"/> Sources		5.11.2-0-20180	
<input type="checkbox"/> Qt Charts		5.11.2-0-20180	
<input type="checkbox"/> Qt Data Visualization		5.11.2-0-20180	
<input type="checkbox"/> Qt Purchasing		5.11.2-0-20180	
<input type="checkbox"/> Qt Virtual Keyboard		5.11.2-0-20180	
<input type="checkbox"/> Qt WebEngine		5.11.2-0-20180	
<input type="checkbox"/> Qt Network Authorization		5.11.2-0-20180	
<input type="checkbox"/> Qt Remote Objects (TP)		5.11.2-0-20180	
<input type="checkbox"/> Qt WebGL Streaming Plugin (TP)		5.11.2-0-20180	
<input type="checkbox"/> Qt Script (Deprecated)		5.11.2-0-20180	
<input type="checkbox"/> Qt Debug Information Files		5.11.2-0-20180	
<input type="checkbox"/> Qt 5.11.1		5.11.1-0-20180	
<input type="checkbox"/> Qt 5.11.0		5.11.0-0-20180	
<input type="checkbox"/> Qt 5.10.1		5.10.1-0-20180	
<input type="checkbox"/> Qt 5.10.0		5.10.0-0-20171	
<input type="checkbox"/> Qt 5.9.6		5.9.6-0-201806	
<input type="checkbox"/> Qt 5.9.5		5.9.5-0-201804	
<input type="checkbox"/> Qt 5.9.4		5.9.4-0-201801	
<input type="checkbox"/> Qt 5.9.3		5.9.3-0-201711	
<input type="checkbox"/> Qt 5.9.2		5.9.2-0-201710	
<input type="checkbox"/> Qt 5.9.1		5.9.1-0-201706	
<input type="checkbox"/> Qt 5.9.0		5.9.0-0-201705	
<input type="checkbox"/> Qt 5.8		5.8.0-1	
<input type="checkbox"/> Qt 5.7		5.7.1-0	
<input type="checkbox"/> Qt 5.6.3		5.6.3-0-201709	
<input type="checkbox"/> Qt 5.6		5.6.2-0	
<input type="checkbox"/> Qt 5.5		5.5.1-0	
<input type="checkbox"/> Qt 5.4		5.4.2-0	
<input type="checkbox"/> Qt 5.3		5.3.2	
<input type="checkbox"/> Qt 5.2.1		1.0.0	
<input type="checkbox"/> Qt 5.2.0		1.0.0	
<input type="checkbox"/> Qt 5.1.1		1.0.0	
<input type="checkbox"/> Qt 5.1.0		1.0.0	
<input type="checkbox"/> Qt 5.0.2		1.0.0	
Tools	1.0.8-0	1.0.8-0	
<input type="checkbox"/> Qt Creator 4.7.1	4.7.1-0	4.7.1-0	
<input checked="" type="checkbox"/> Qt Creator 4.7.1 CDB Debugger Support	4.7.1-0	4.7.1-0	
<input type="checkbox"/> Qt 3D Studio 2.0.0		2.0.0-0-201806	
<input type="checkbox"/> Qt 3D Studio Runtime 2.0.0 for 5.11.0		5.11.0-0-20180	
<input type="checkbox"/> MinGW 4.9.2		4.9.2-1	
<input type="checkbox"/> MinGW 4.9.1		4.9.1-3	
<input type="checkbox"/> MinGW 4.8.2		4.8.2	
<input checked="" type="checkbox"/> MinGW 5.3.0	5.3.0-2	5.3.0-2	
<input type="checkbox"/> MinGW 7.3.0 64 bit		7.3.0-1	
<input type="checkbox"/> MinGW 4.8		4.8.0-1-1	
<input type="checkbox"/> Qt Installer Framework 2.0		2.0.5-2	
<input type="checkbox"/> Qt Installer Framework 3.0		3.0.4	
<input type="checkbox"/> MinGW 4.7		4.7.2-1-1	

QT Creator (3/6)

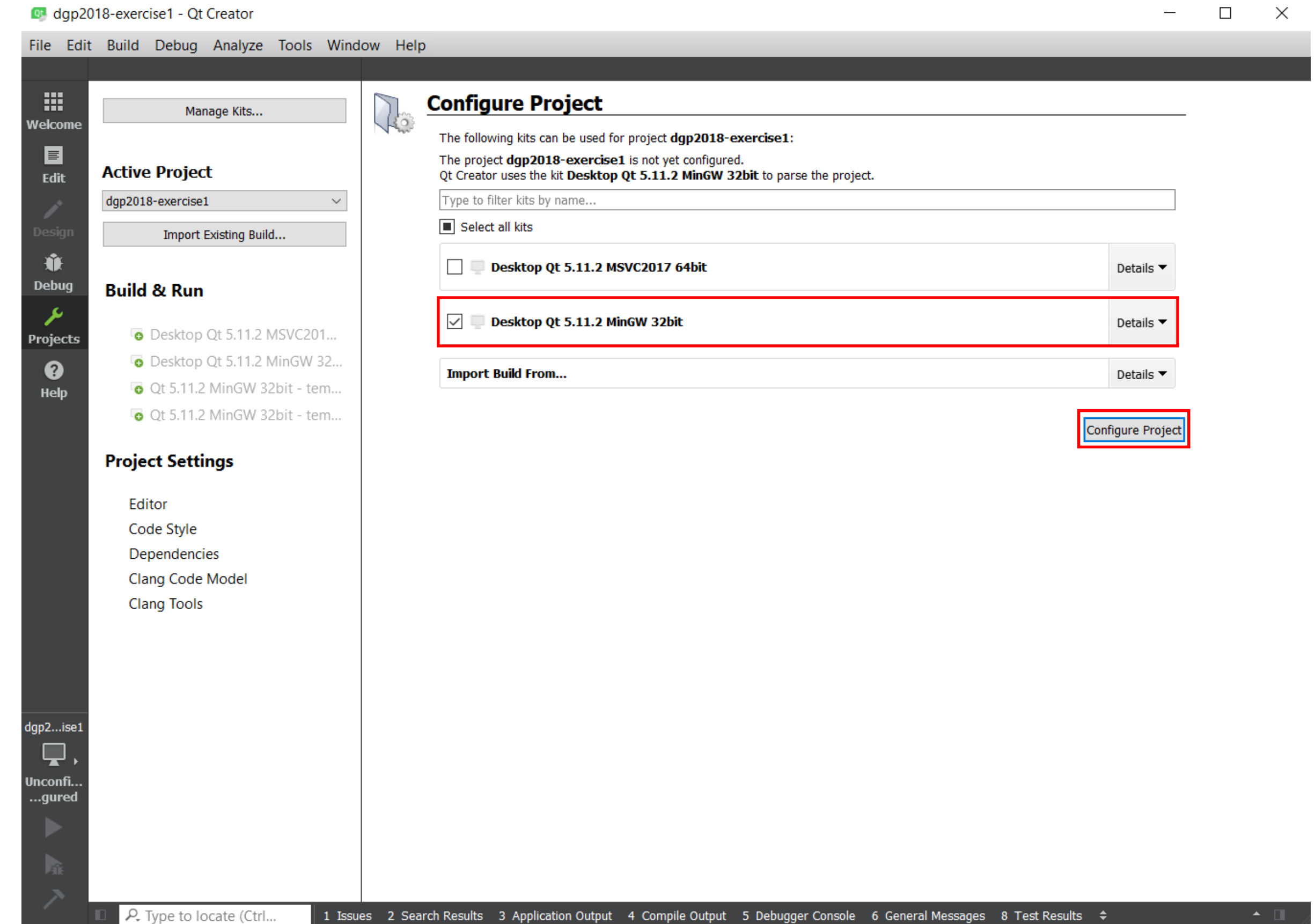


On **Windows only**, be sure that your compiler is set to be the Microsoft Visual C++-Compiler or MinGW (click “Tools” -> “Options”)

QT Creator (4/6)

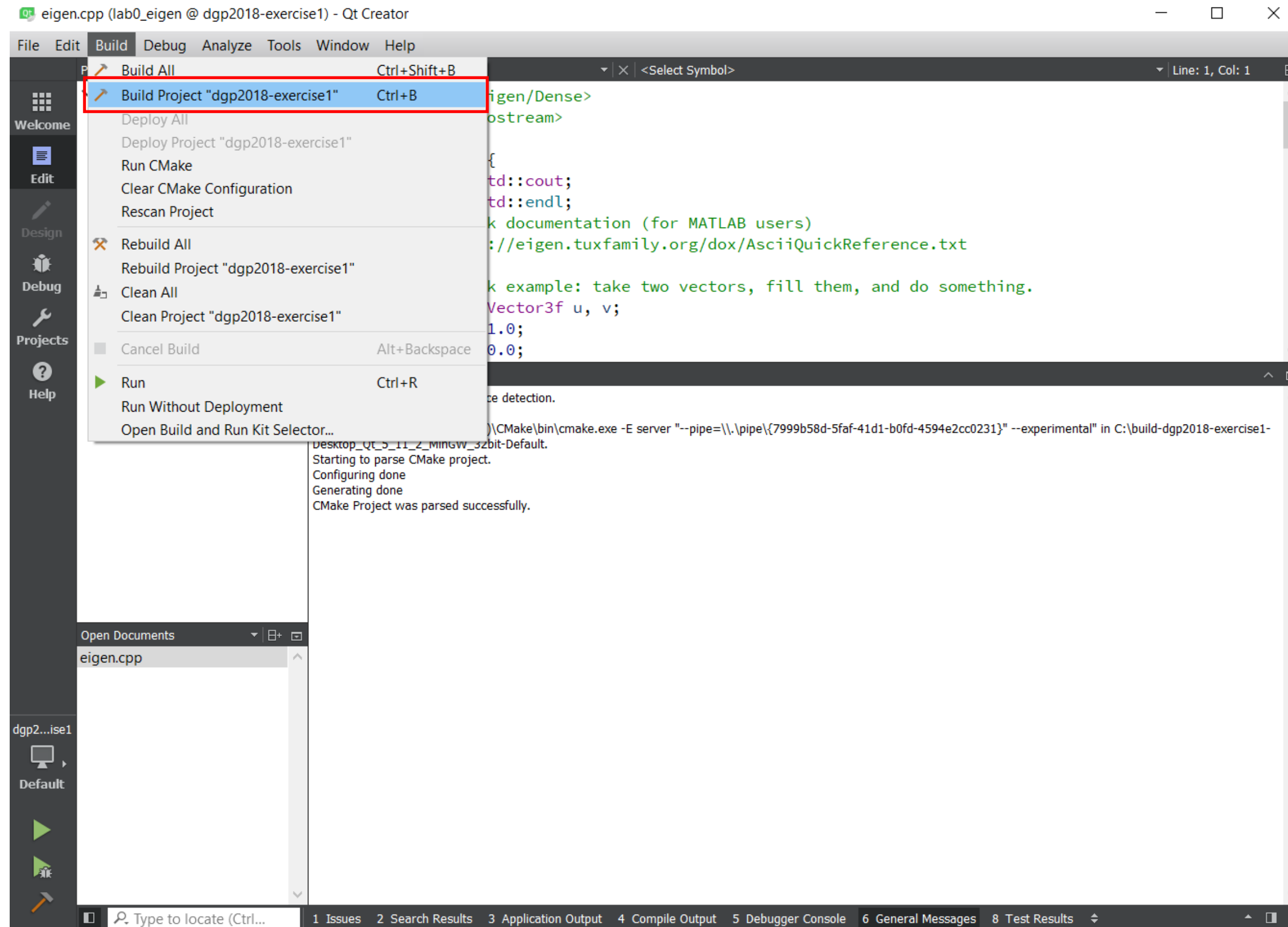


Click on “Open Project” and select the CMakeLists.txt file at the root of the dgp2018-exercise1/ directory

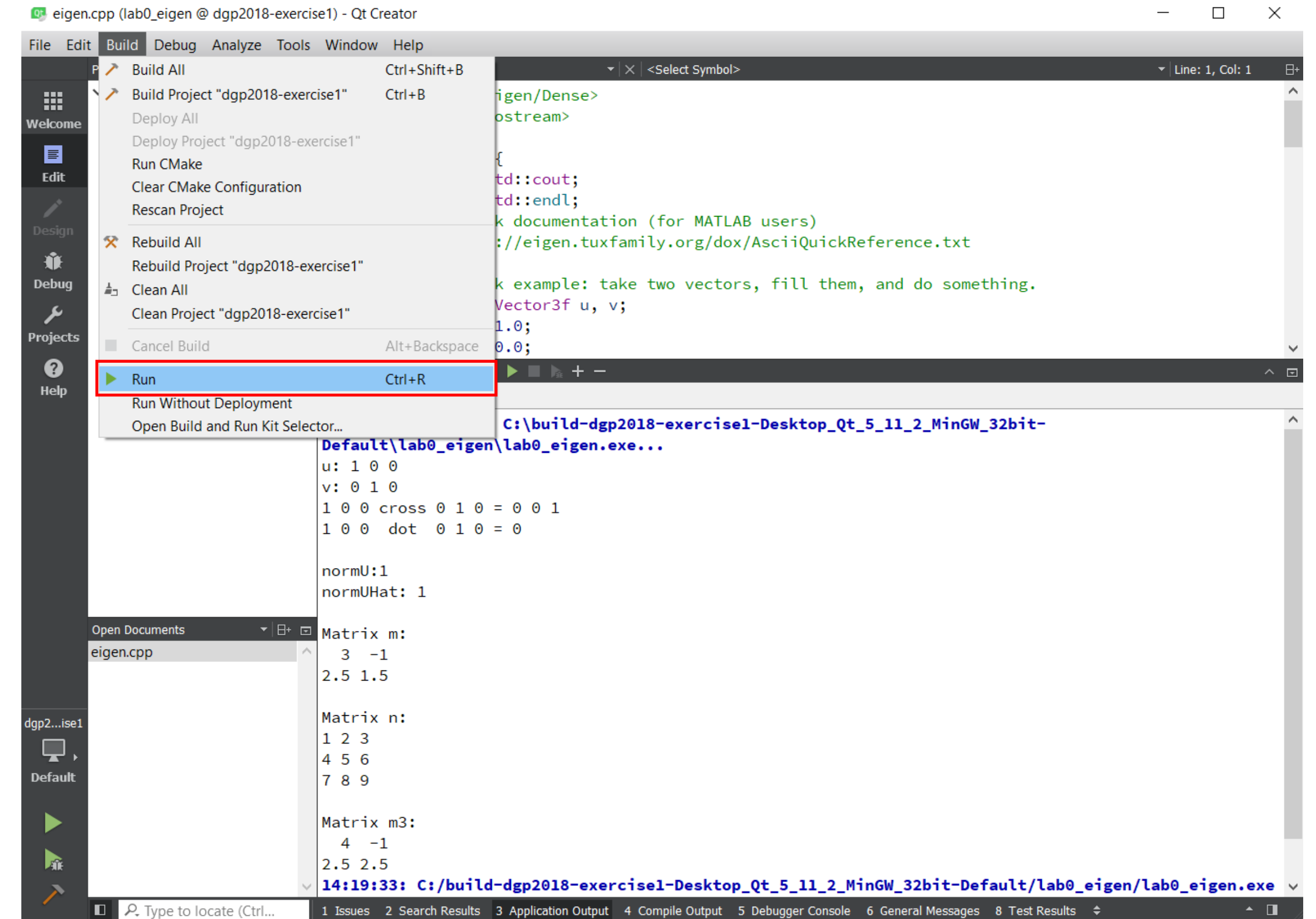


Select “Desktop QT 5.11.2 MinGW 32 bit” (or “Desktop QT 5.11.2 MSVC 2017 64bit”) and click on “Configure project”

QT Creator (5/6)



Click on “Build dgp2018-exercise1”



Click on “Run” and see the output of the program



- You can also use QT Creator on a Mac
- When install QT creator on a Mac, you only need to select the following component

☐ QT 5.11.2
✓ macOS

