getting started with the IoT LIB

Introduction to keil µVision ide and MBED online compiler

# Hardware/ software Setup

1. Download Keil MDK development tool in this [link](http://www2.keil.com/mdk5/install).
2. Install Keil µVision at the default directory.
3. Update hardware firmware for the board [optional]
   1. Connect the board to you PC through the USB cable.
   2. Go to the Keil directory (by default C:\Keil\_vx).
   3. Go to the STLink folder. (C:\Keil\_v5\ARM\STLink).
   4. Run application ST-LinkUpgrade.exe
   5. With the board connected press Device Connect to check the firmware in your board and press Yes>> to update the firmware to the latest version.
   6. More information can be found in this [link](http://www.st.com/web/en/catalog/tools/PF260217).
4. To use Bluetooth Low Energy communication through the X-NUCLEO-IDB04A1 expansion board we will use the API provided by ST. This have been packed together with some useful examples and the License Wizart in a software pack called BlueMicroSystem1 and can be downloaded on the following [link](http://www.stmicroelectronics.com.cn/web/catalog/tools/FM147/CL1818/SC1998/PF261772?s_searchtype=partnumber).

Further information about the use of this material will be explained on the corresponding Lab exercises.

Note that for all lab exercises, the Keil MDK project has been created for you, so that you can simply open and modify using Keil MKD as required. Alternatively you can also export a project from the mbed online compiler (see “exporting from mbed online compiler” section)

# Project Development with MDK

## Pack Installer

Open Keil µVision. If it’s the first time the Pack Installer tool will appear. The Pack Installer is a utility for installing, updating and removing software packs. This provides to our projects the needed platform support. If it does not open automatically, select **Manage** and **Pack Installer...** from the **Project** menu.

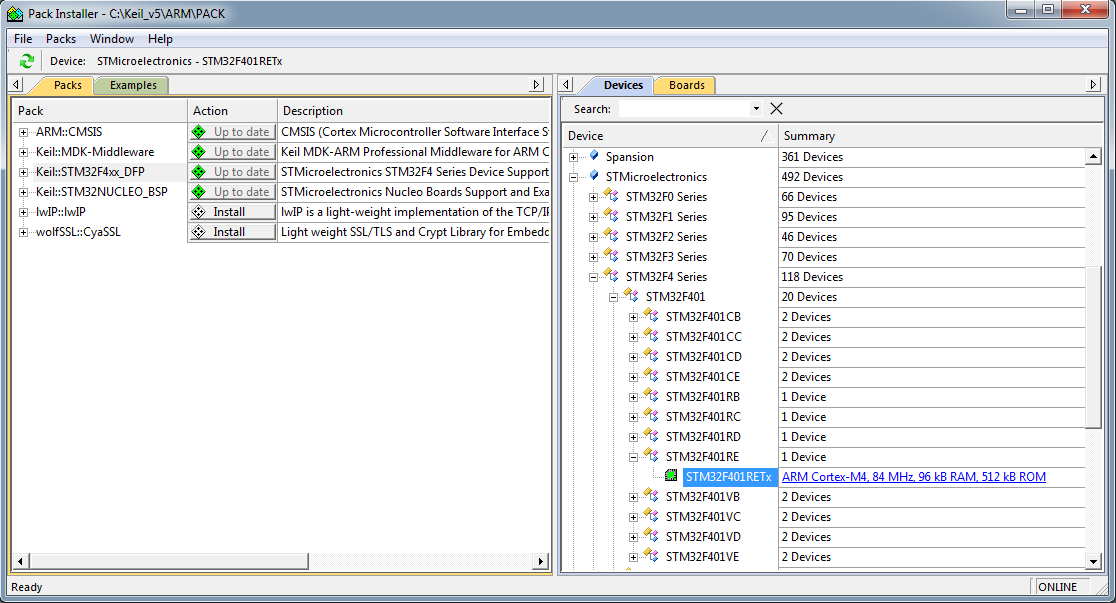
On the right hand side of the *Pack Installer* window you have to select a device. On the left hand side the software packs available for that device are displayed. You can install or update a software pack by clicking in the *Action* column.

In the *Device* window, select **STMicroelectronics – STM32F4 Series – STM32R401 – STM32F401RE – STM32F401RETx**. Then, install or update the following software packs:

* **ARM::CMSIS**
* **Keil::MDK-Middleware**
* **Keil::STM32F4xx\_DFP**
* **Keil::STM32NUCLEO\_BSP**

The *Pack Installer* window should appear as shown in the following figure, with all four software packs *Up to date*.

Close the *Pack Installer* window.



## Loading a project into MDK



Project files are displayed in File Explorer with the Microvision icon, shown above. To load a project into MDK, do one of the following:

* Menu: Within MDK, select menu item Project->Open Project…, navigate to the project directory, and select the .uvproj file.
* File Explorer: double click on the .uvprojx file.

## Building The Project



Build the project using one or more of the following toolbar buttons (listed from left to right):

* Translate current file (e.g. compile or assemble)
* Build the target files whose source files have changed and create output file
* Rebuild all of the target files and create output file

## Downloading the program IMAGE to the Microcontroller PROGAM memory (FLASH MEMORY)

Download the program to the MCU flash using one of these methods:



* Toolbar button:
* Menu: Flash->Download
* Accelerator keys: alt+a+d

Note: if the download fails, please check:

* The latest firmware has been installed on the board (hardware setup).
* Install Keil MDK5 legacy support (<http://www.keil.com/download/files/mdkcm510.exe>)

## Using the Debugger

Begin or end a debugger session using one of these methods:

* Toolbar button: 
* Menu: Debug->Start/Stop Debug Session
* Accelerator keys: ctrl+F5

Note: you may need to download the program before debugging.



Control the target program execution with the following toolbar buttons (shown from left to right above):

* Reset MCU
* Run program execution (F5)
* Stop program execution
* Step one line in program, entering a subroutine (F11)
* Step one line in program, executing and returning from a subroutine (F10)
* Step out of current function (ctrl+F11)
* Run to cursor (ctrl+F10)

Right-clicking on a line of code will bring up a context menu with various options, including:

* Setting and clearing breakpoints
* Adding a variable to a watch window
* Navigating to definitions or uses of symbols (functions and variables)

The View menu can be used to open different windows to help in debugging, including:

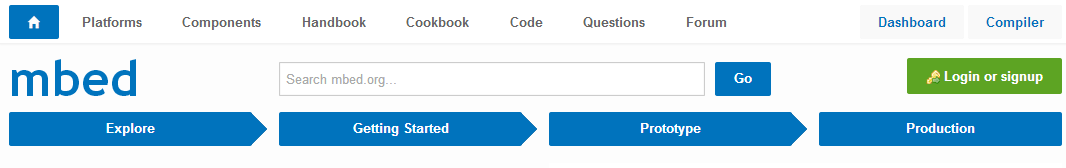
* Disassembly
* Symbols
* CPU registers
* Call stack
* Variable watch windows
* Memory windows
* System viewer (MCU and peripheral control registers)

# export from mbed online compiler

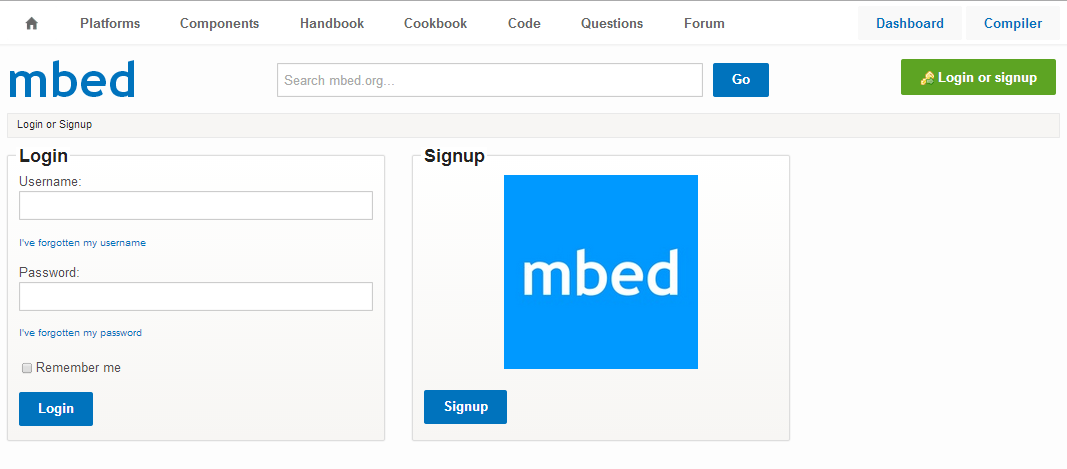
The mbed online Compiler provides a lightweight online C/C++ IDE that is pre-configured to let you quickly write programs, compile and download them to run on your mbed Microcontroller. The mbed online compiler is web based hence you don't have to install or set up anything to get running with mbed.

## create your first mbed online project

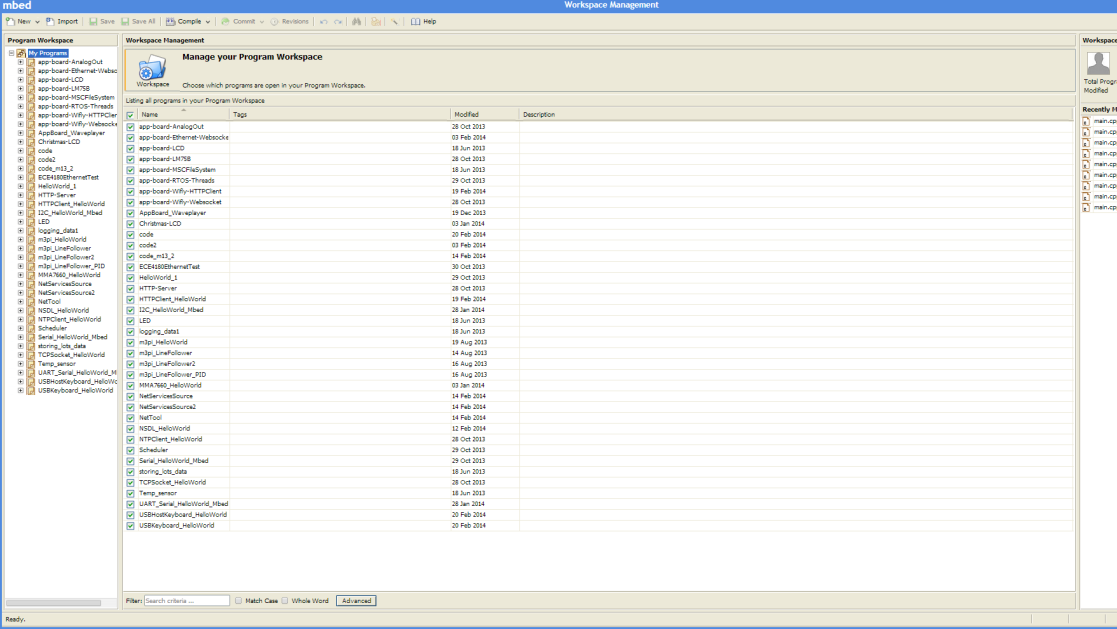
1. Go to mbed.org, and click “compiler”



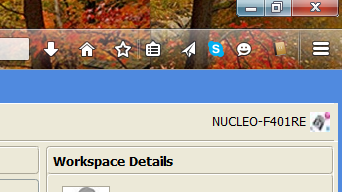
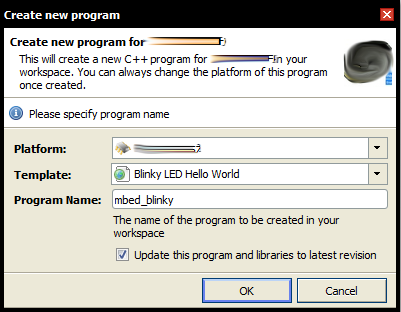
1. Register an account and then login



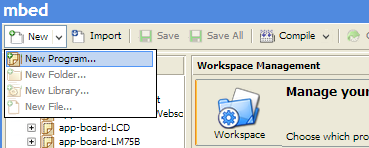
1. The main IDE of mbed online compiler will be displayed



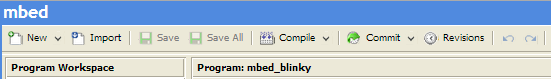
You can select the board by clicking the options on the top-right.



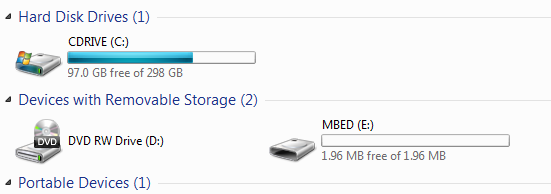
1. Create a helloworld project (blinky LED program)



1. Compile the program



1. The program file will be generated and downloaded to your default download directory (set by your web browser)
2. Connect the board to your PC via an USB cable, the mbed will appear as a removable storage device



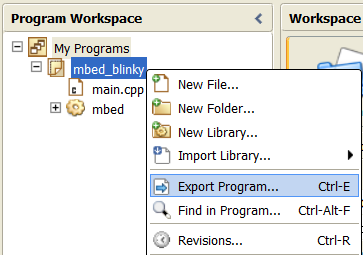
1. Copy the downloaded program file to the mbed root directory
2. Reset the mbed board, the latest copied program file will be the default program to run.

More detail can be found at <https://mbed.org/handbook/mbed-Compiler-Getting-Started>

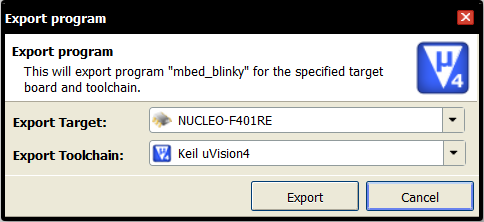
## Exporting to offline toolchains

The online project can be exported to offline toolchains, such as Keil MDK in our case.

1. Right click the project and select “export program”



1. Select Keil MDK project, and click “export”, the project folder will be downloaded to your local machine



Note: The local Keil MDK project allows you to download and debug your program (see getting started). In this set of teaching material, all the lab projects have been exported to local Keil MDK project, making it easier for you to start with.

## configure Keil settings

The first time you open an exported project from mbed with Keil-MDK, the project should be update to the latest version of Keil. Press OK and the project will be automatically converted.

Now before flash and debug the program to the ST Nucleo-F401RE let’s check that all the settings are correctly configured.

Open the Options for Target. On the Device tab ensure that the sTM32F401RERx is selected.

Then on the Debug tab the check that the ST-Link Debugger is selected from the list. Finally on the debugger settings, on the Flash Download tab you have to add the STM32F4xx 256kB Flash programming Algorithm from the Device Family Package if it haven’t been already selected.

These settings only need to be checked once as they will be saved with the project.