

EE3220 System-on-Chip Design

Tutorial 2: Hello World!

ARM Project Creation and Configuration

Objective:

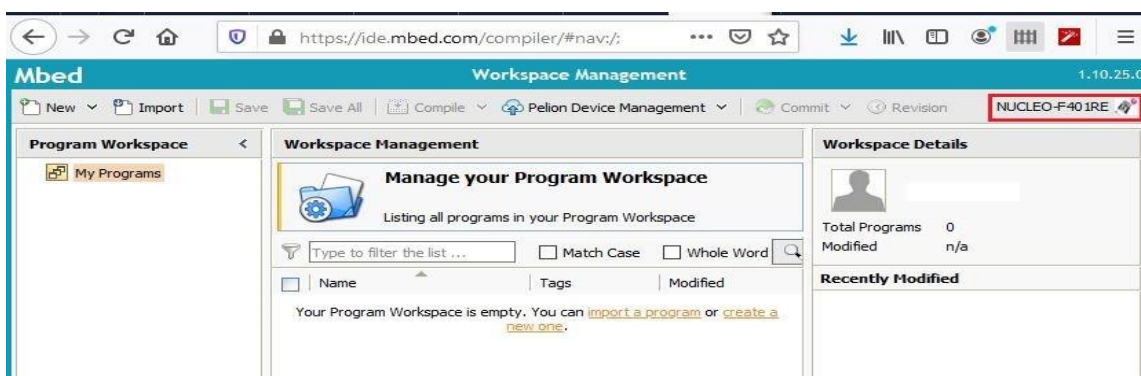
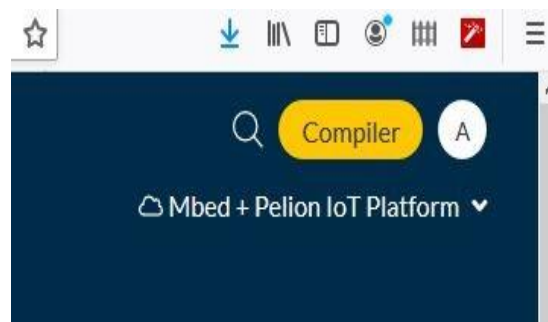
- To get familiar with the usage of ARM Mbed.
- To set up and run your first project.
- To learn how to write a C/C++ program for ARM.

In this tutorial, you will learn how to set up and run a new project for an ARM Mbed board. During this process, you will learn the required settings and finally run the compiled code on the targeted device (NUCLEO-F401RE ARM board). At the end of this tutorial, you will learn the basic usage and functions of the ARM Mbed platform.

Step 1:

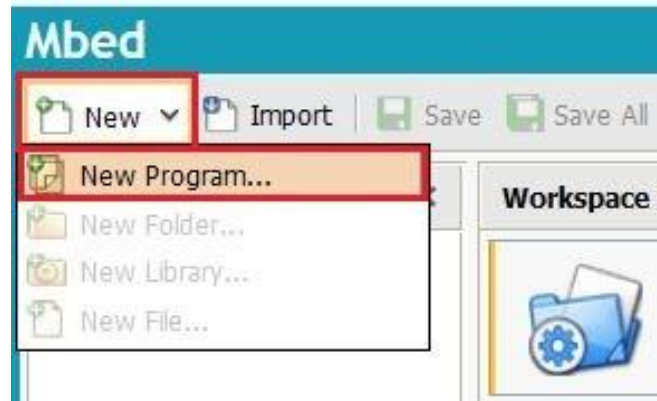
Please complete the steps in **Tutorial 1** and register an ARM Mbed account. Now you need to log in to the website.

- Go to the Mbed platform website <https://os.mbed.com/account/login>
- Click **Compiler** button at the top right hand side of the page.

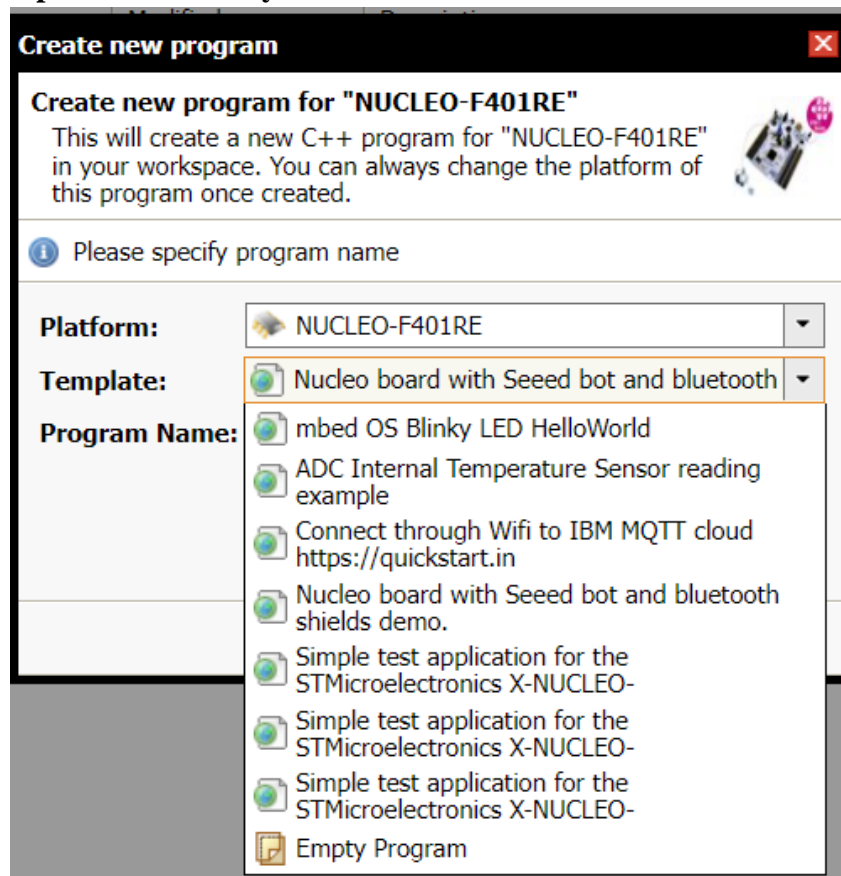


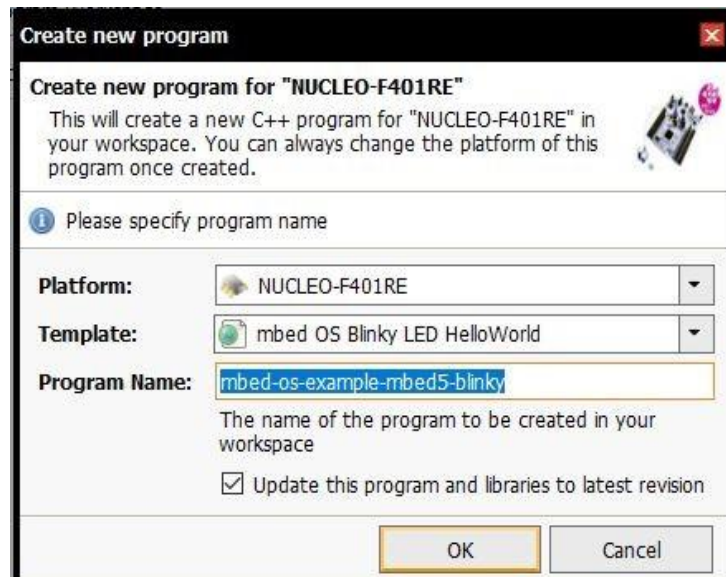
Step 2: Create your project with template.

- Click New -> New program

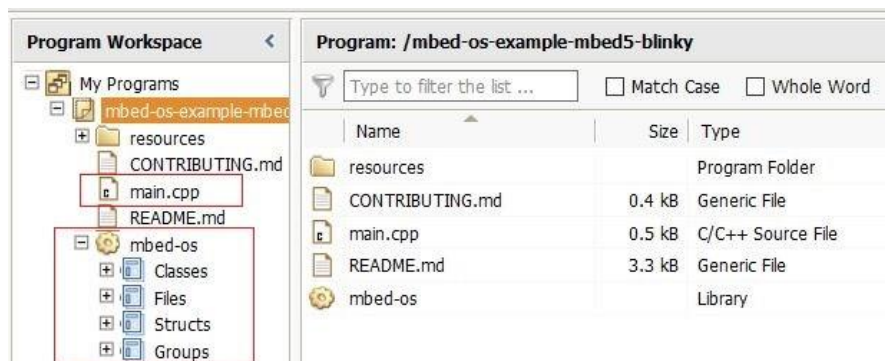


- Select NUCLEO-F401RE as Platform, click the Template and select the **mbed OS Blinky LED HelloWorld**, and leave the program name as **mbed-os-example-mbed5-blinky**.





- Click OK, the program will be created.
- Open the project folder and observe the main.cpp and the mbed OS libraries imported.



- Have a glance at the libraries contained in mbed-os.



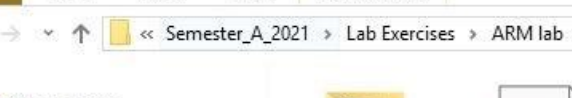
- ```
main.cpp x README.md x AbstractMesh x BilinearInterpolate x CMSIS_Core_FunctionInterface x CONTRIBUTING.md x aes.h x aesni.h x blowfish.h x cipher.h x AnalogIn x BLE
1 | | | (./resources/official_xmbed_example_badge.png)
2 # Blinky Mbed OS example
3
4 The example project is part of the [Arm Mbed OS Official Examples] (https://os.mbed.com/code/) and is the [getting started example for Mbed OS] (https://os.mbed.com/docs/mbed-os-5
5
6 You can build the project with all supported [Mbed OS build tools] (https://os.mbed.com/docs/mbed-os/latest/tools/index.html). However, this example project specifically refer
7 (Note: To see a rendered example you can import into the Arm Online Compiler, please see our [import quick start] (https://os.mbed.com/docs/mbed-os/latest/quick-start/online-w
8
9 1. [Install Mbed CLI] (https://os.mbed.com/docs/mbed-os/latest/quick-start/offline-with-mbed-cli.html).
10
11 1. Clone this repository on your system, and change the current directory to where the project was cloned:
12
13 ''bash
14 $ git clone git@github.com:armmbed/mbed-os-example-blinky && cd mbed-os-example-blinky
15
16 Alternatively, you can download the example project with Arm Mbed CLI using the 'import' subcommands:
17
18 ''bash
19 $ mbed import mbed-os-example-blinky && cd mbed-os-example-blinky
20
21 ''
22
23 ## Application functionality
24
25 The 'main()' function is the single thread in the application. It toggles the state of a digital output connected to an LED on the board.
```

- ```

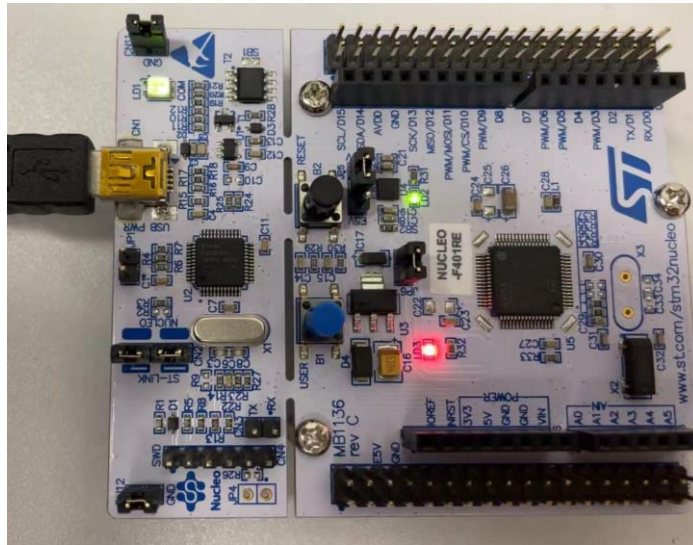
1  main.cpp x
2
3  5
4  6 #include "mbed.h"           // add the mbed header file
5  7 #include "platform/mbed_thread.h" // add header for thread
6  8
7  9
8  10 // Blinking rate in milliseconds
9  11 #define BLINKING_RATE_MS    500 // define BLINKING_RATE_MS as 500
10 12
11 13
12 14 int main()
13 15 {
14 16     // Initialise the digital pin LED1 as an output
15 17     DigitalOut led(LED1);           // set led as a digital output
16 18                                     // connected to the LED1 pin
17 19     while (true)                   // Loop forever
18 20     {
19 21         led = !led;                // Toggle LED
20 22         thread_sleep_for(BLINKING_RATE_MS); // Delay 500Ms
21 23     }
22 24 }

```

- Mbed
- New Import Save Save All **Compile**

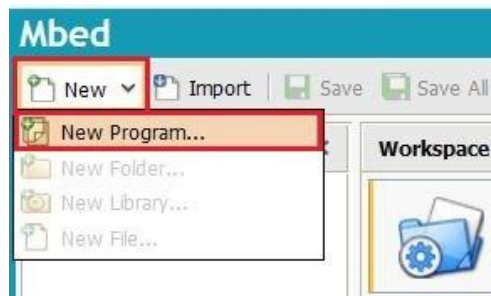
- 
- File Home Share View Picture Tools
- \ll Semester_A_2021 > Lab Exercises > ARM lab > lab1
- Quick access
- OneDrive - City University of H
- This PC
- NODE_F401RE (F:)**
- Network
- Figures
- F401RE features

- Observe the LED blinking on the board.

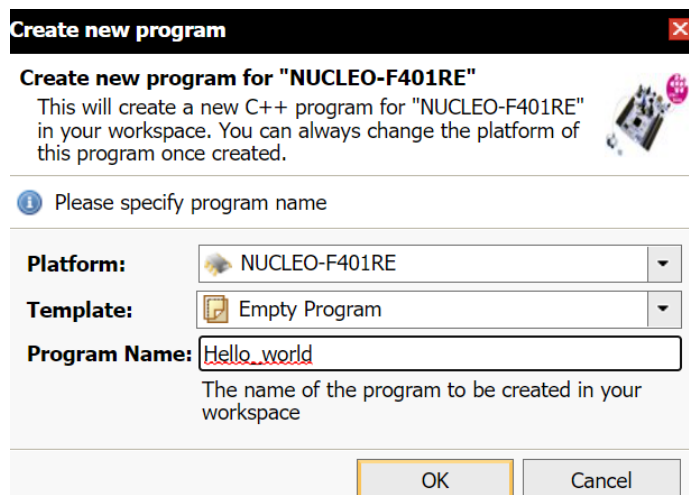


Step 3: Make your own hello word project.

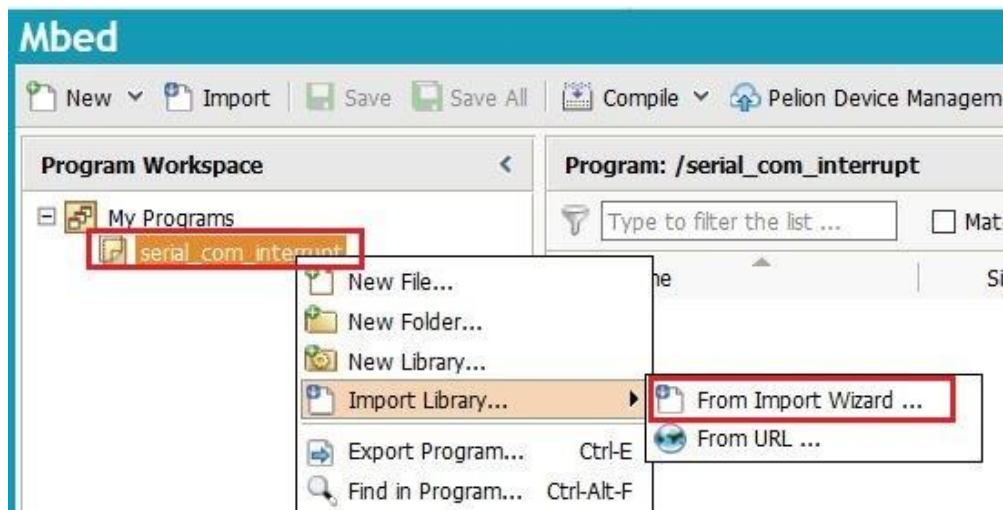
- Click New -> New program



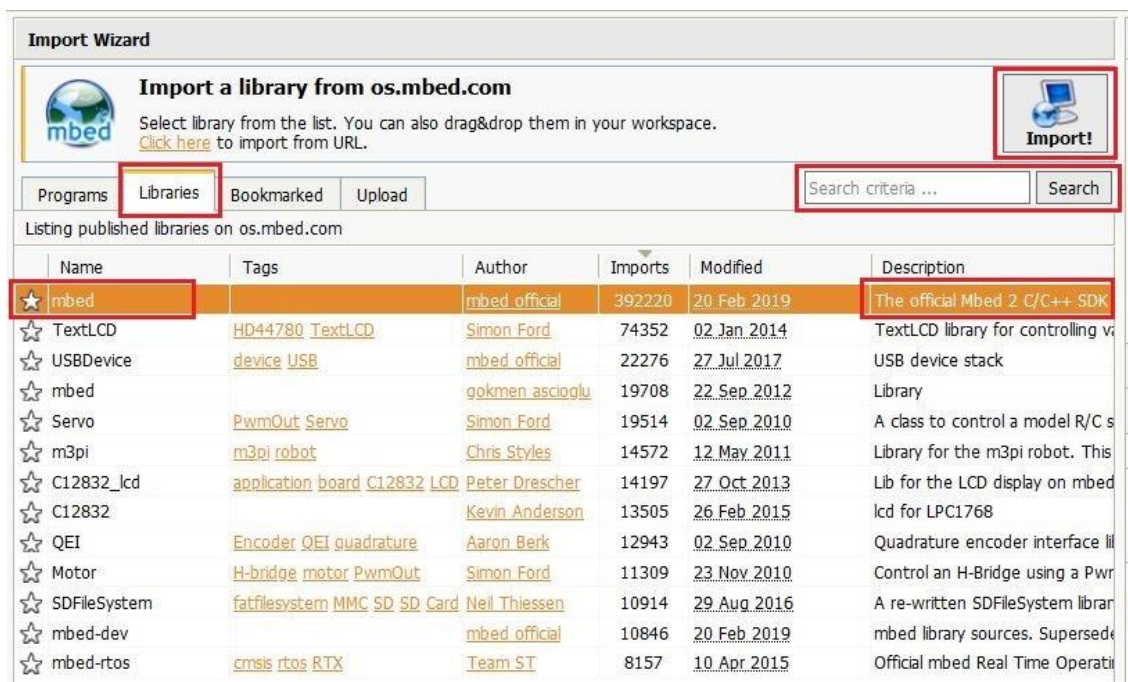
- Select Empty Project as the template and enter the program name.
(Ensure that the Platform is set to **Nucleo-F401RE**)



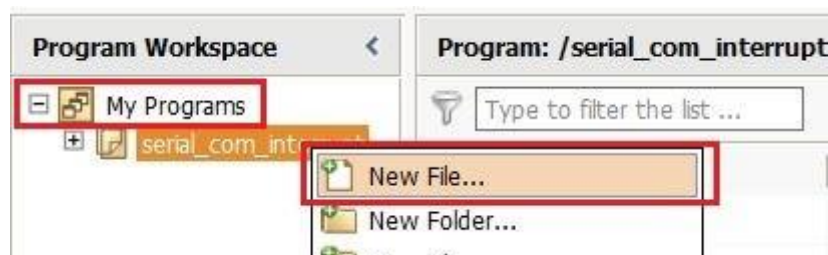
- Right click the project folder and select Import Library -> From Import Wizard to import **Mbed** library.



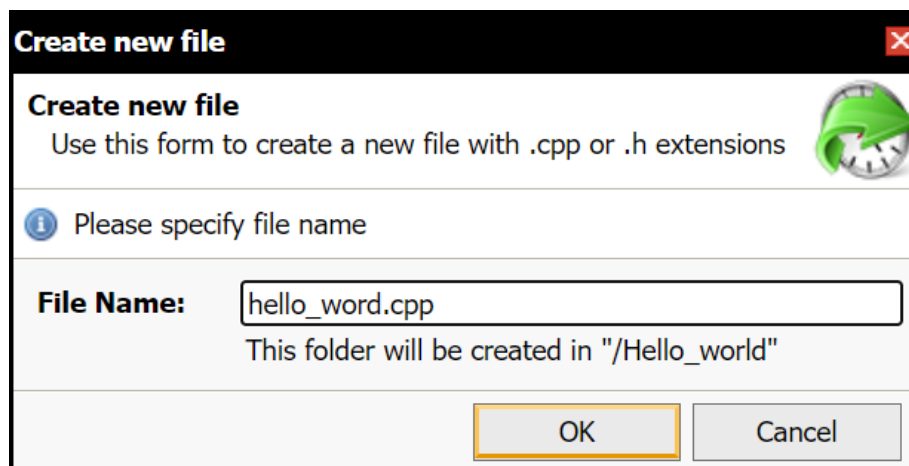
- Click on the search button (with empty text) and double click **Mbed** among the given libraries. Now the Mbed library will be imported into your project.



- To create a source code, right click the project and click New File.



- Name the source file as hello_word.cpp and click OK.



Create new file [X]

Create new file
Use this form to create a new file with .cpp or .h extensions

Please specify file name

File Name:
This folder will be created in "/Hello_world"

OK Cancel

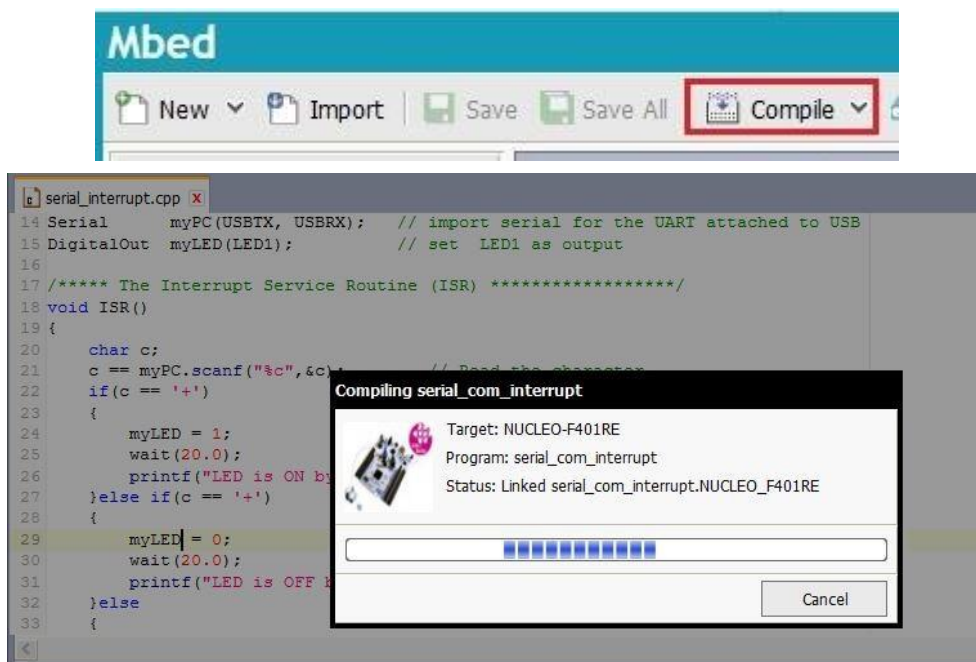
- Open the source file, write the program attached.



```

1 #include "mbed.h"
2 int main()
3 {
4     printf("hello world!\n");
5 }
  
```

- Save the file and click Compile button on the menu bar. The program will be now compiled.



Mbed

New Import Save Save All **Compile**

serial_interrupt.cpp

```

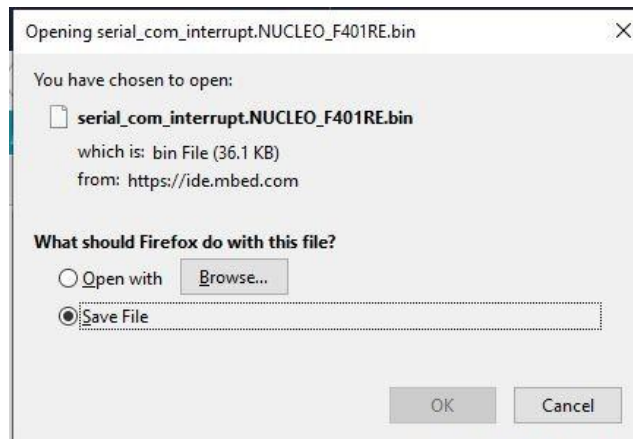
14 Serial myPC(USBTX, USBRX); // import serial for the UART attached to USB
15 DigitalOut myLED(LED1); // set LED1 as output
16
17 /***** The Interrupt Service Routine (ISR) *****/
18 void ISR()
19 {
20     char c;
21     c = myPC scanf("%c", &c); // Read the character
22     if(c == '+')
23     {
24         myLED = 1;
25         wait(20.0);
26         printf("LED is ON by\n");
27     } else if(c == '-')
28     {
29         myLED = 0;
30         wait(20.0);
31         printf("LED is OFF by\n");
32     } else
33     {
  
```

Compiling serial_com_interrupt

Target: NUCLEO-F401RE
Program: serial_com_interrupt
Status: Linked serial_com_interrupt.NUCLEO_F401RE

Cancel

- After compiling the program, the binary created will be required to be saved.



- Click OK to save the binary to your download folder.

Step 4: Loading and running the program on the board.

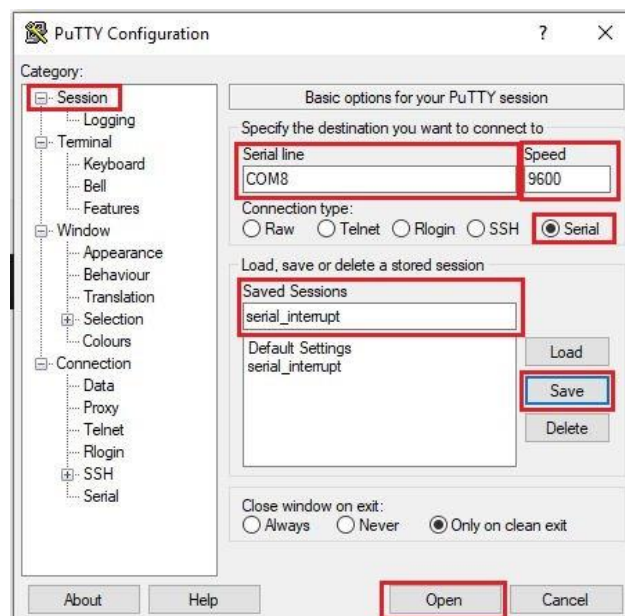
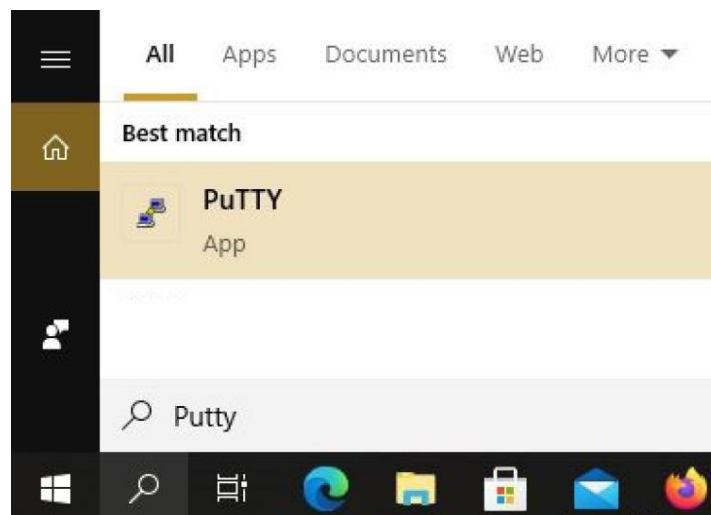
- Go to device manager from Control Panel -> System



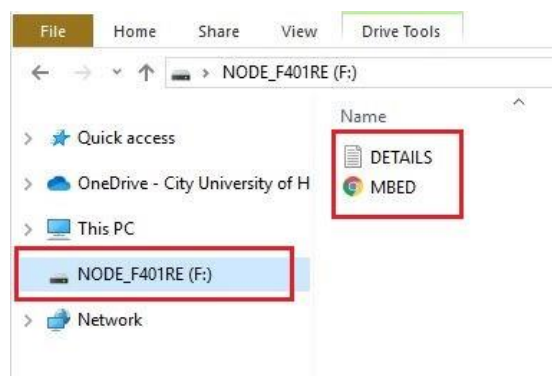
- Check Ports and make sure STLink Virtual COM Port is shown. Write down the Port number.



- Start Serial Communication with Putty.



- Open the NODE_F401RE() drive. Remember it was opened earlier when the board is ON. A Google chrome browser and a file named "DETAILS" will be found in the drive.



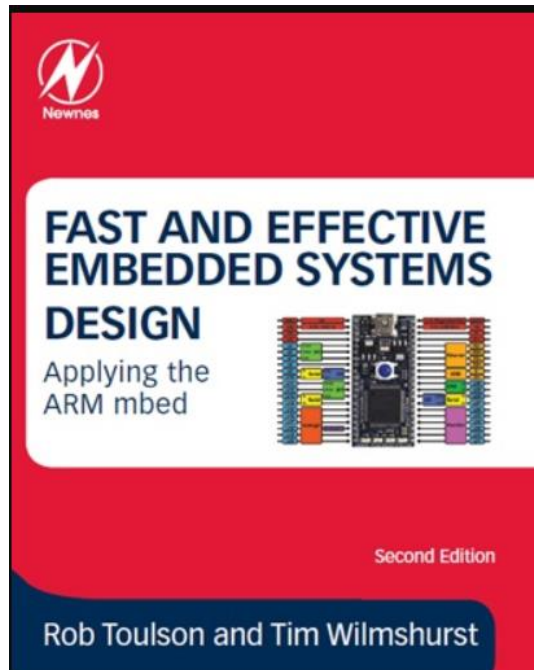
- To load the binary file onto the board, copy the saved binary file **serial_interrupt.bin** to the **NODE_F401RE()** drive.

- Open Putty terminal and see the printed hello world!

```
COM4 - PuTTY
hello world!
```

Reference book for ARM Mbed

Fast and Effective Embedded System Design: Applying the ARM mbed. Second Edition



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Book support material website

http://www.embedded-knowhow.co.uk/Book_3_Ed2.htm

Instructor Support

The mbed allows a new style of teaching about embedded systems and microcontrollers in university and college courses. Support material is available for instructors.

Powerpoint slides: These are directly linked to the book content. There is one slide presentation for each book chapter. PDFs are available for each slide.

Chapter 1	Chapter 4	Chapter 7	Chapter 10	Chapter 13
Chapter 2	Chapter 5	Chapter 8	Chapter 11	Chapter 14
Chapter 3	Chapter 6	Chapter 9	Chapter 12	Chapter 15

Solutions to Quiz questions.

For Quiz solutions or Lecture Note powerpoints, please [email](#) from a university/college email address. In your email please give brief information about your request.

Code Examples.

These are available below - copy and paste from the Word document into the mbed compiler.

Chapter 1	Chapter 4	Chapter 7	Chapter 10
Chapter 2	Chapter 5	Chapter 8	Chapter 11
Chapter 3	Chapter 6	Chapter 9	Chapter 12

END