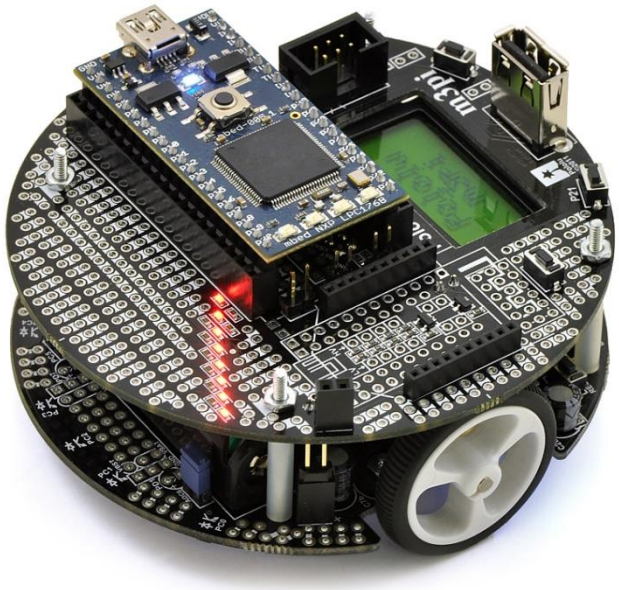
NANYANG TECHNOLOGICAL UNIVERSITY
SINGAPORE

School of Computer Science and Engineering

PROGRAMMING INTELLIGENCE TO ROBOTS



USER MANUAL

m3pi WORKSHOP

Objectives:

- To appreciate and understand the working of an embedded application.
- To provide an introduction to programming and microcontrollers.
- To develop an embedded robot control application.

Introduction:

The m3pi robot is a fully-assembled, upgraded version of the popular 3pi robot. It consists of a 3pi robot base connected to an assembled m3pi expansion board that simplifies augmenting that robot's capabilities with an mbed development board wireless modules, and sensors.

The m3pi was designed as a robot platform for an mbed development board and using an mbed as the main controller of the m3pi robot is the easiest way to take advantage of all the features of the m3pi.

Equipment and Accessories Required:

- Pololu 3pi robot base board
- Pololu m3pi expansion board
- 4 NiMH batteries
- ARM mbed development board
- USB Cable
- Work station to program the robot

Connecting m3pi to the 3pi Board:

Connect the m3pi expansion board to the 3pi robot base with all male headers on the expansion board to the female headers(highlighted in yellow) on the 3pi robot base.

Step 1 : Attach the NiMH batteries as shown in Figure 1.

Step 2 : Follow the steps below to assemble the m3pi bot:

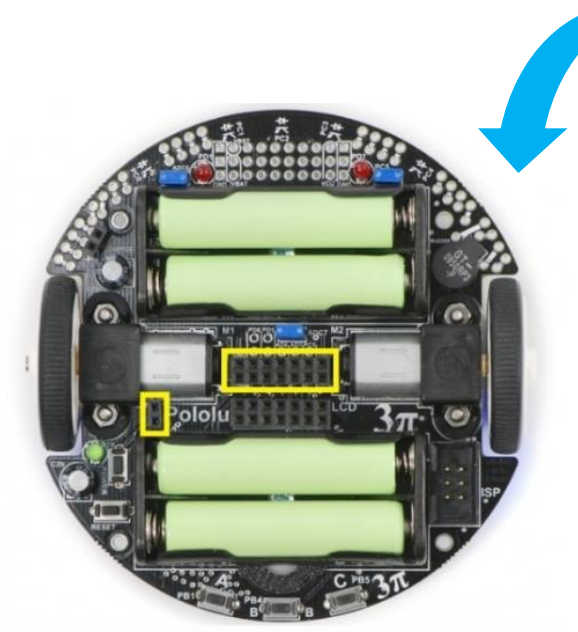


Figure 1 : 3pi Robot Base

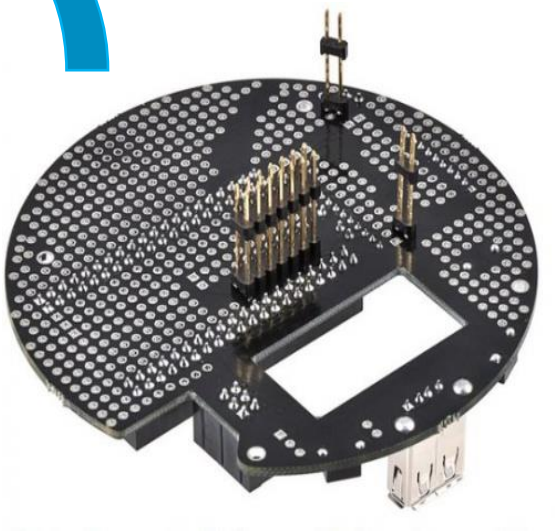


Figure 2 : m3pi Expansion Board

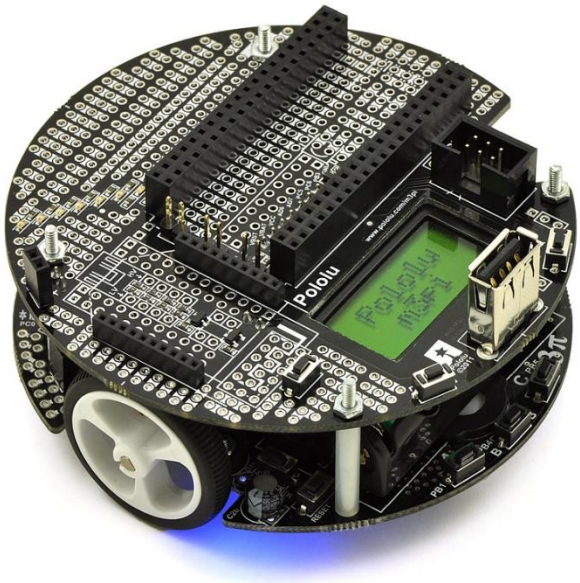
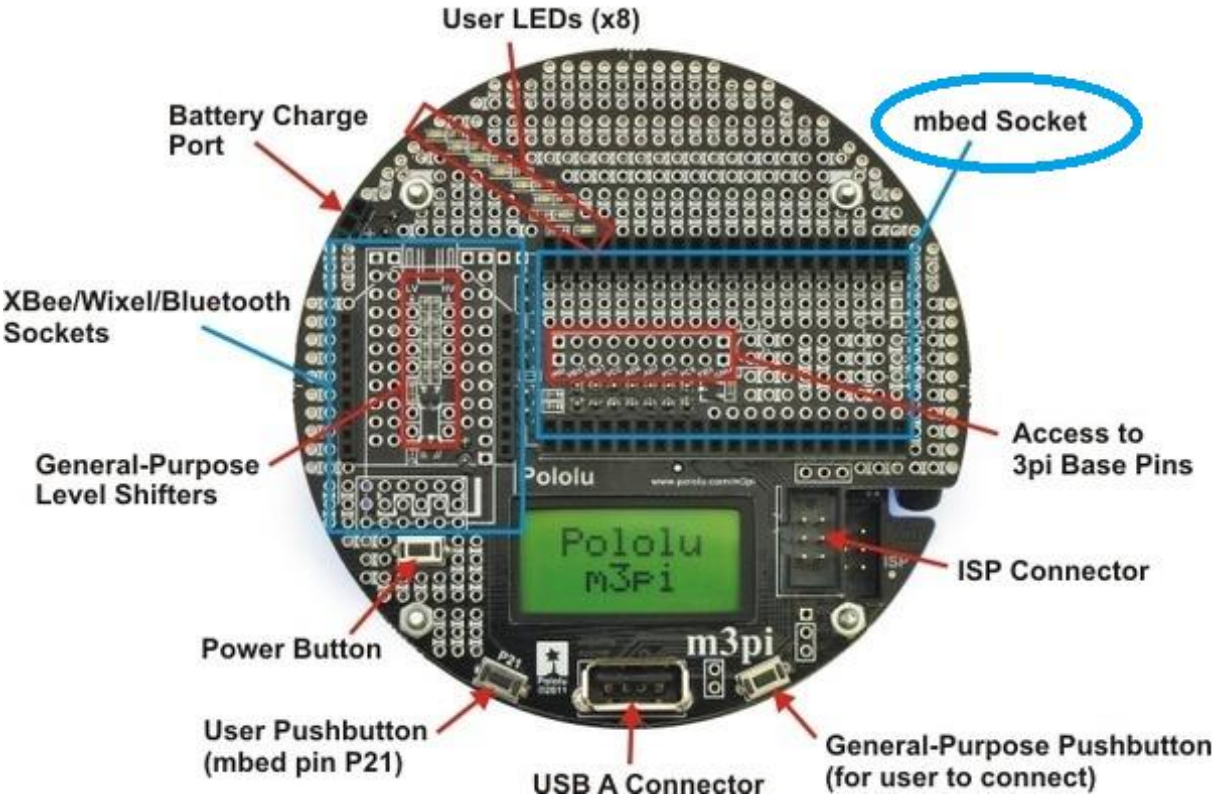


Figure 3 : Assembled m3pi Robot

Connecting mbed Development Board to m3pi



Step 1 : Connect the mbed board to the mbed socket on the m3pi board as shown in the figure.

Step 2 : Check your assembly by pressing the Power Button on the m3pi board. Your m3pi bot should switch on.

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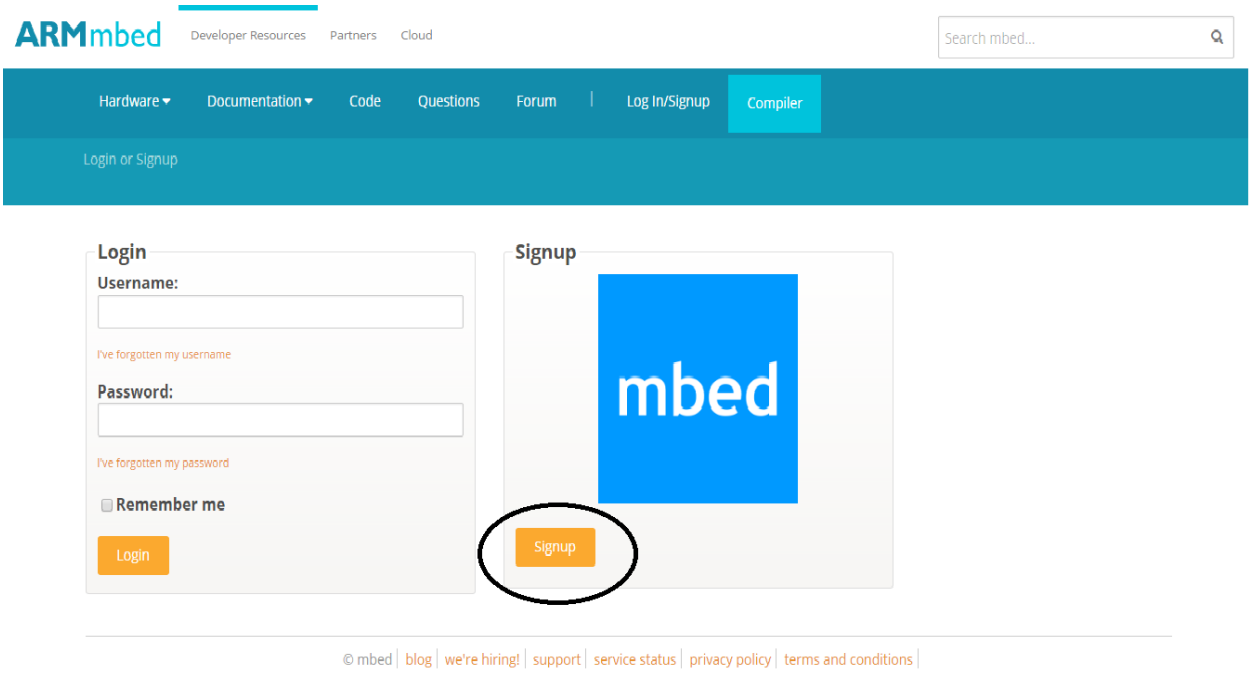
mbed Online Compiler Account Setup:

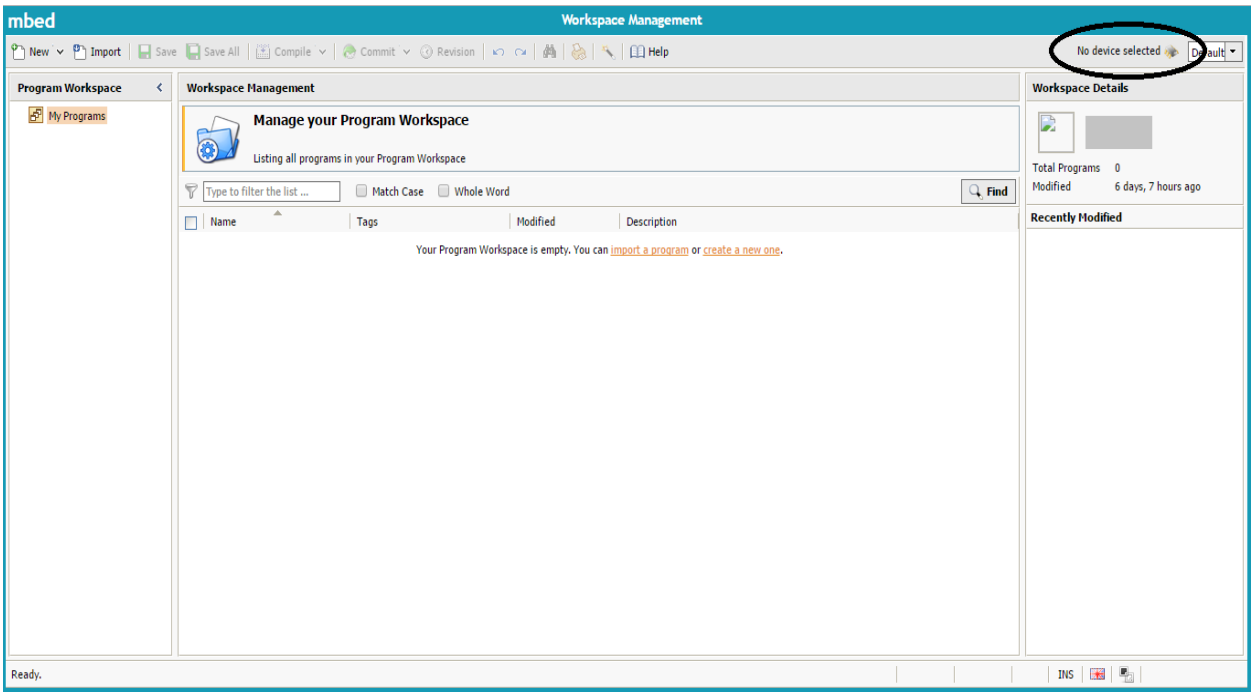
Step 1 : Opening the mbed online compiler – Access the online mbed compiler at the link https://developer.mbed.org/compiler/ and create your developer account.

Signup -> No, I haven't created an account before -> (Enter your details) -> Signup



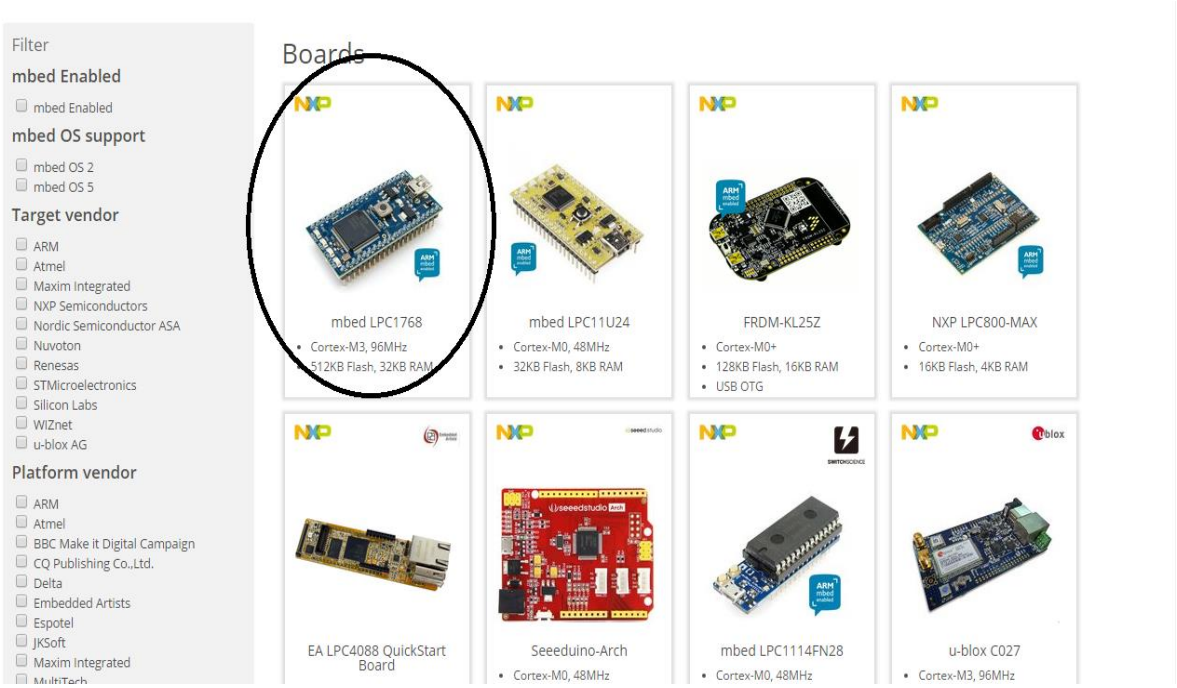
Step 2 : Once you have created your account, log in and open the compiler.

Step 3 : Click on “No device selected” on the top right of your screen to add the mbed development board to your compiler.



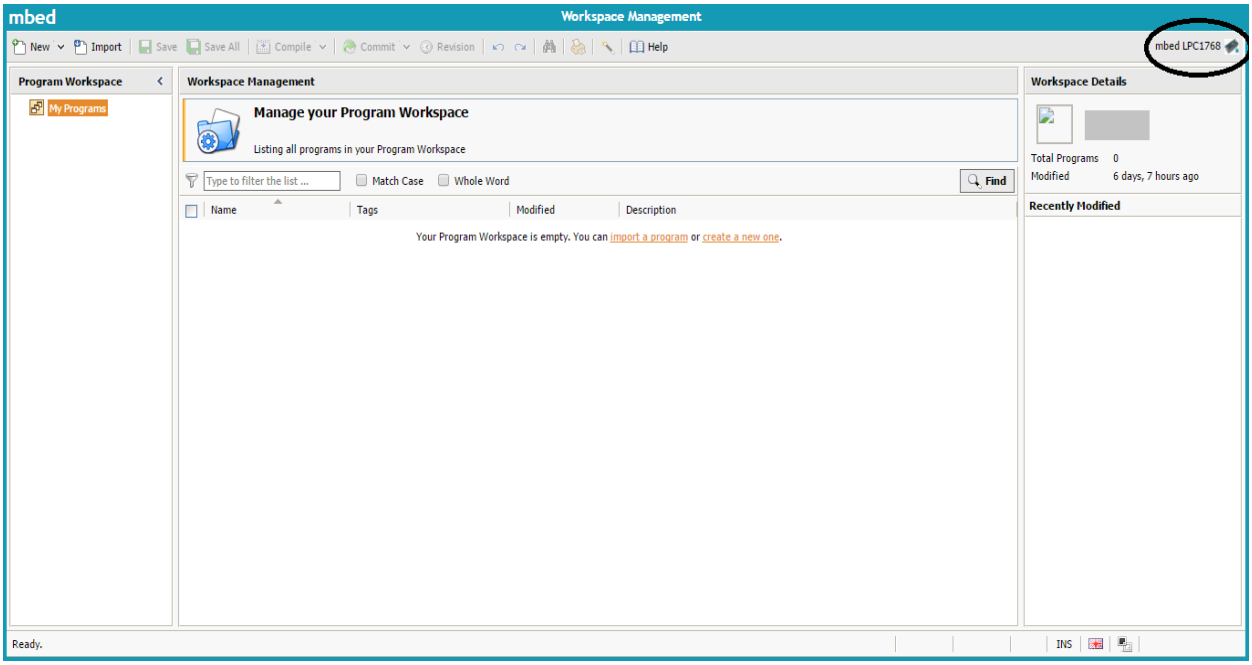
Step 4 : Click on the “Add Platform” button on the popup window.

Step 5 : Choose the mbed NXP LPC1768 board from the list of boards.



Step 6 : On the mbed NXP LPC1768 board page, click on the “Add to Board” button on the right tab.

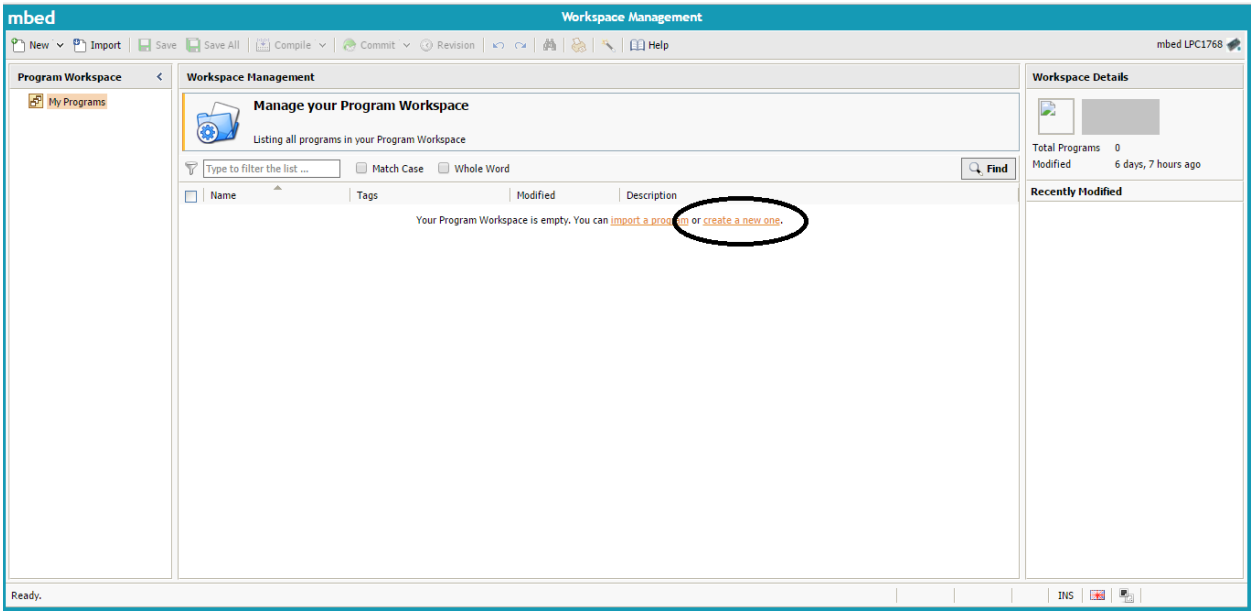
Step 7 : Refresh your compiler to note the addition of mbed board.



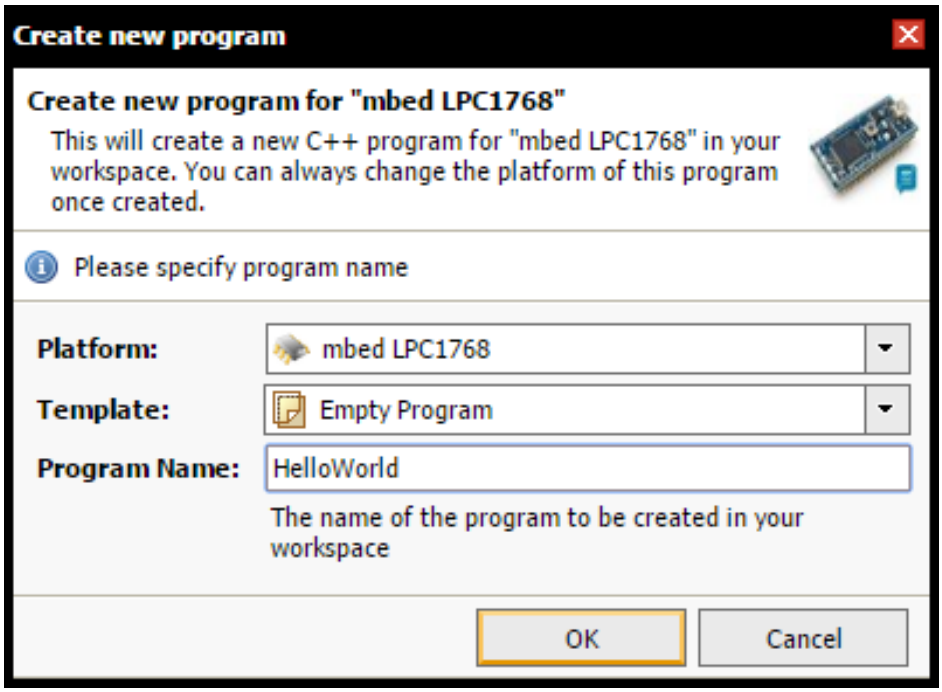
Programming

Now that you have set up your mbed online compiler and the m3pi robot, you are ready to program your instructions into mbed.

Step 1 : Click on the “create a new one” button on the centre of your screen.



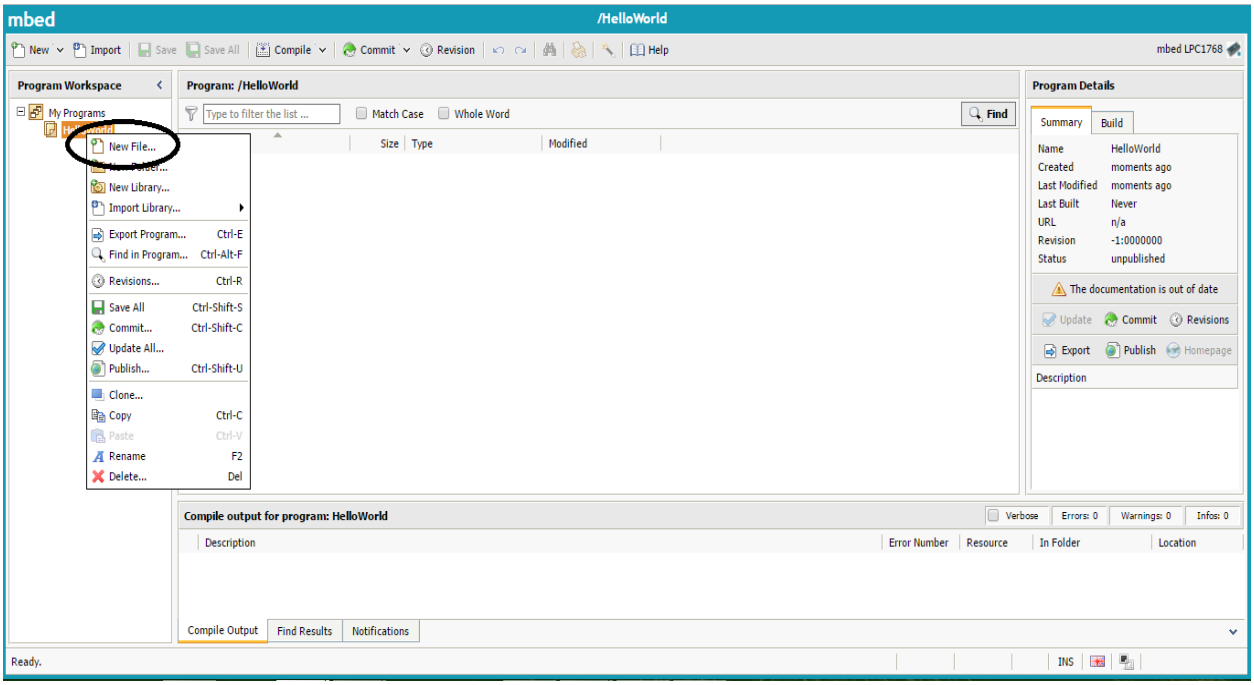
Step 2 : Choose the settings as follows and click “OK”:

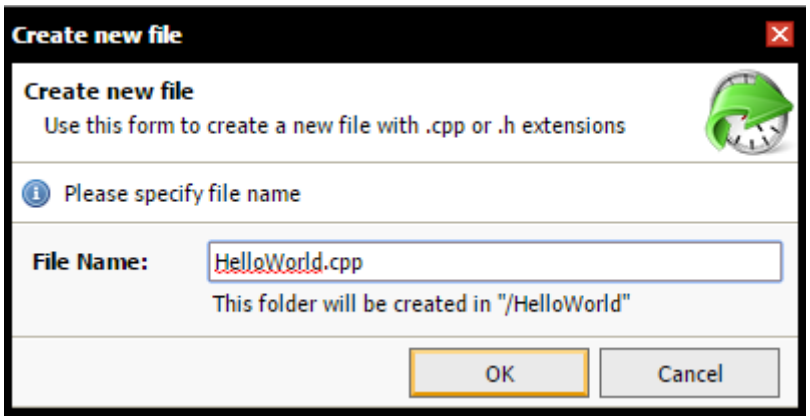


Alternatively you may choose to open any one of the existing templates available online.

Step 3 : Open new file by right clicking on “HelloWorld” on the left tab.

HelloWorld (right click) -> New File -> (Choose appropriate file name (with .cpp extension)





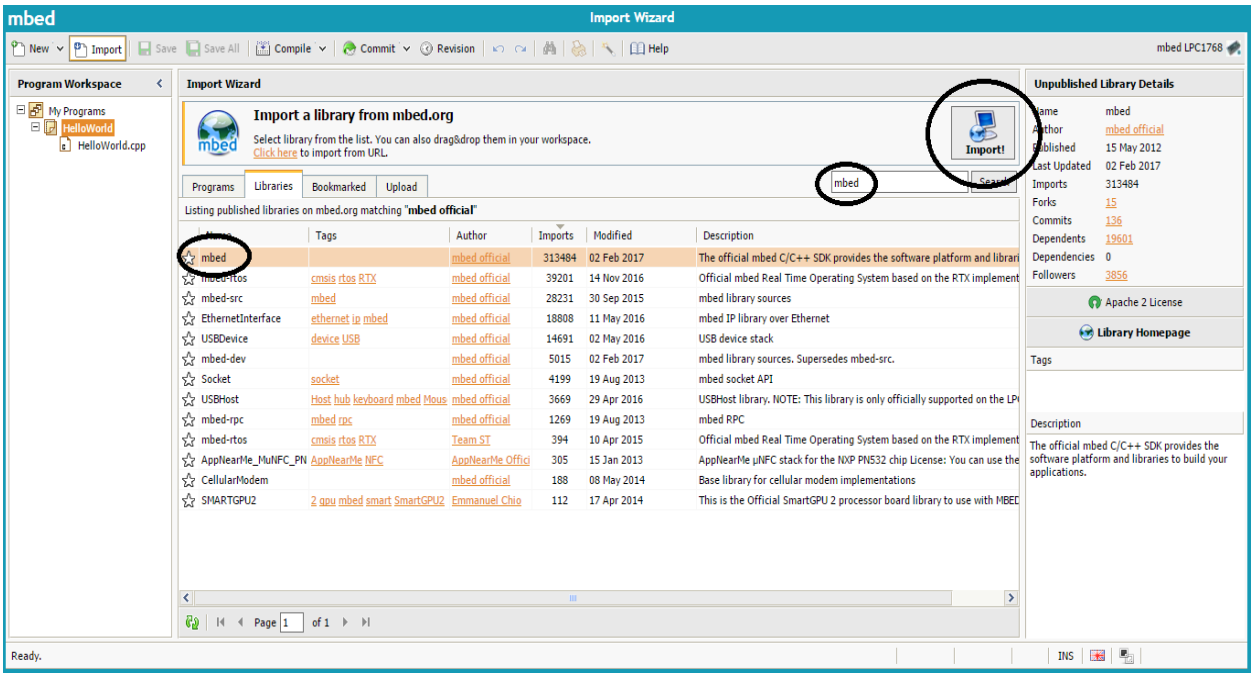
Step 4 : You now have the file to code your program.

Step 5 : Before we can continue to program, we need to import the necessary libraries. To do so, right click on “Hello World” on the left tab.

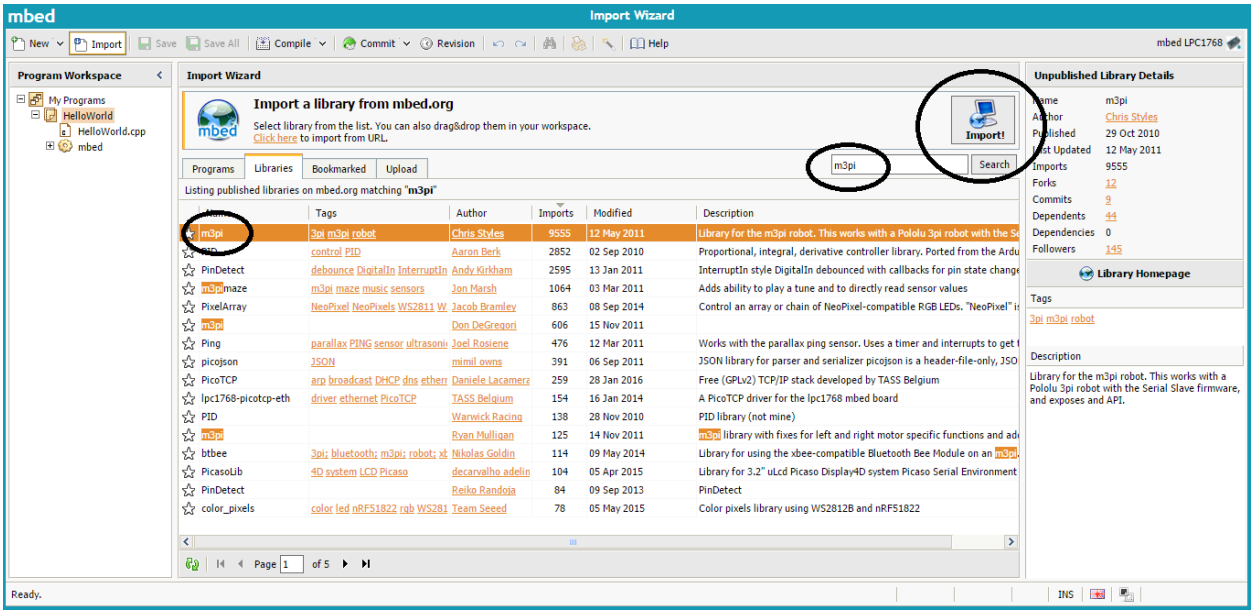
Hello World (right click) -> Import Library -> From Import Wizard

Step 6 : Choose the “Libraries” tab on the “Import Wizard” and search for “mbed”.

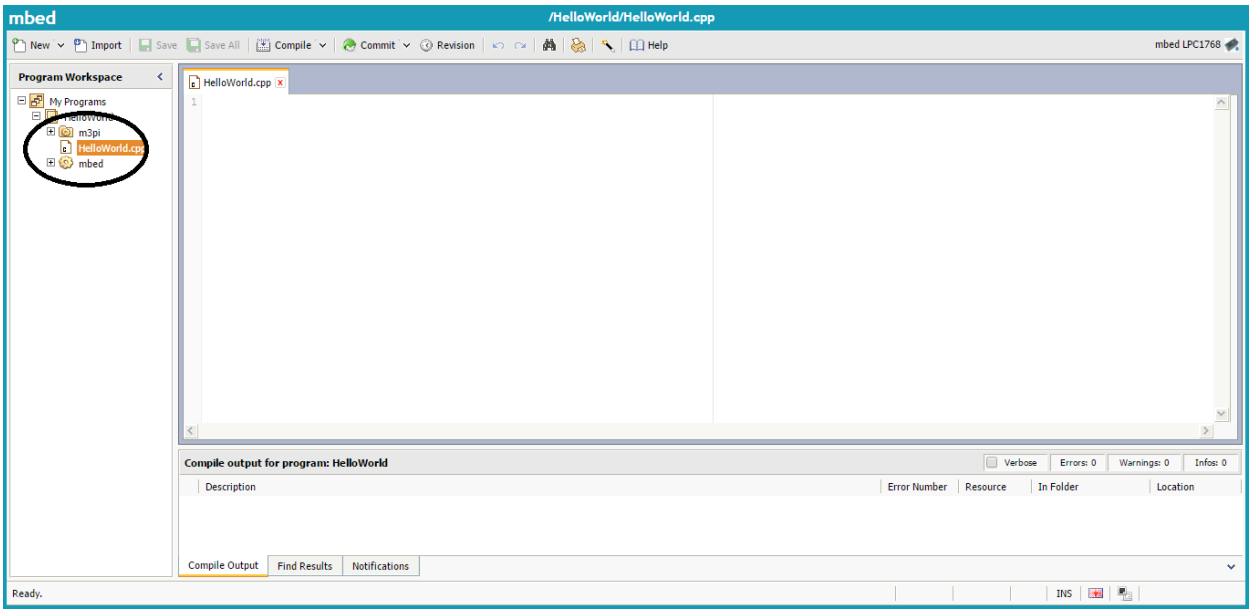
Step 7 : Select mbed and click import. Click import on the popup window also with the default settings.



Step 8: Similarly, import the m3pi library also.



Step 9 : Once you have added the libraries, you should be able to see them on the left tab.

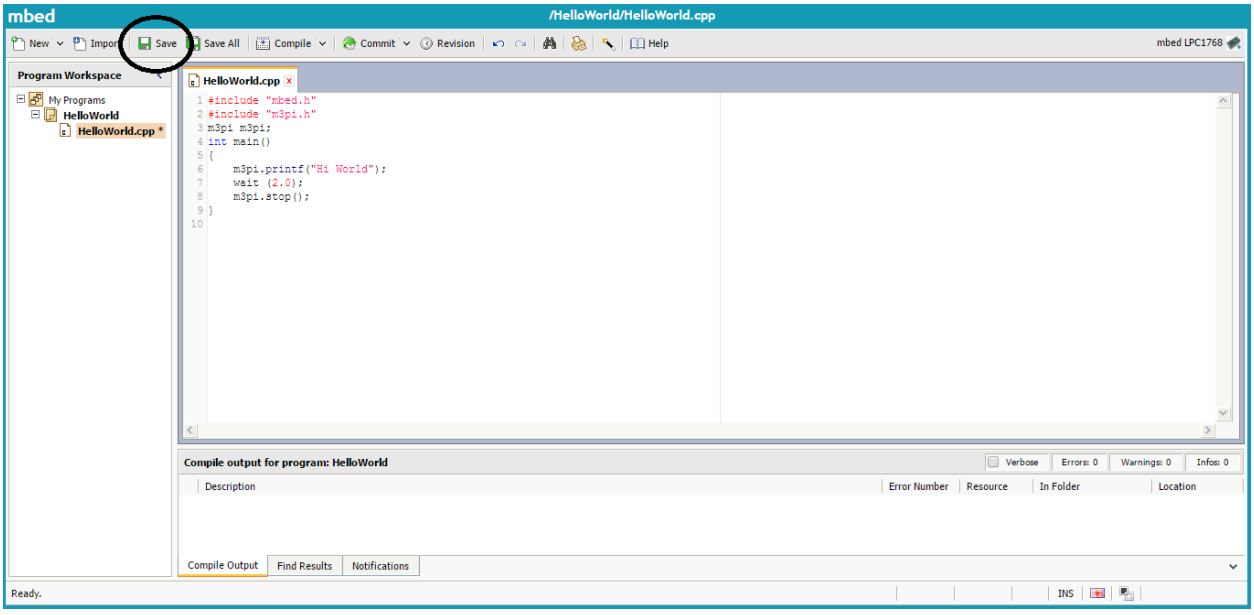


Step 10 : Now we are ready to code our program.

Step 11 : Type in the following sample program in the blank space in HelloWorld.cpp

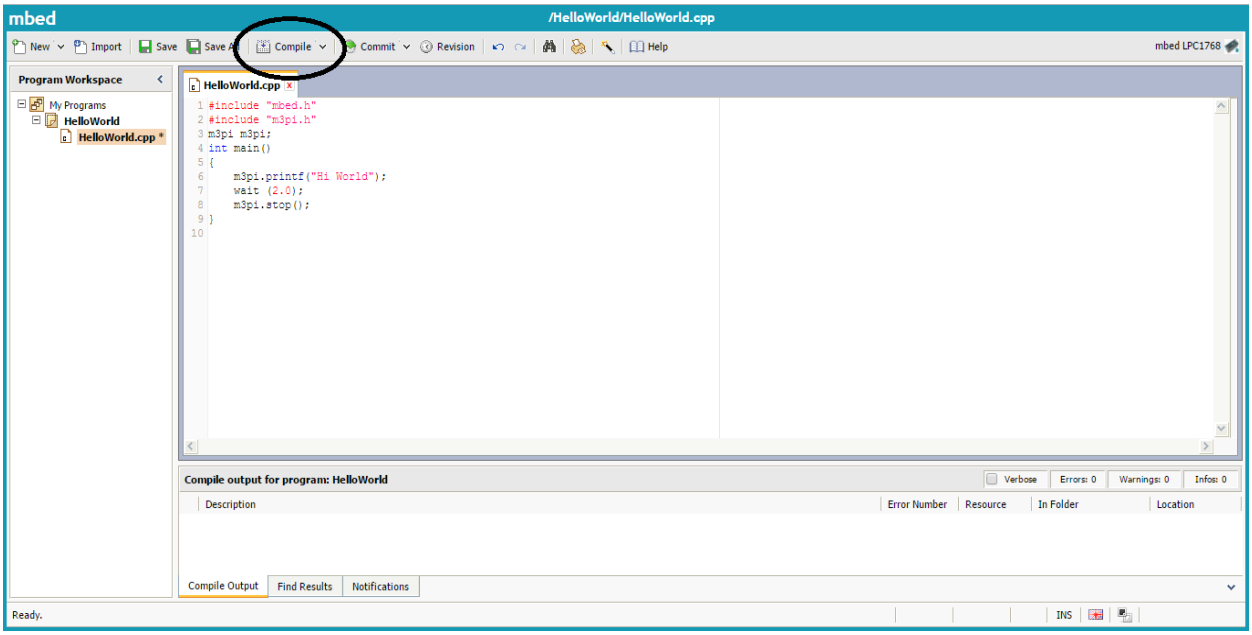
```
#include "mbed.h"
#include "m3pi.h"
m3pi m3pi;
int main()
{
    m3pi.printf("Hi World");
    wait (2.0);
    m3pi.stop();
}
```

Step 12 : Once you have typed it, save the program before we can proceed.



Compiling and Uploading

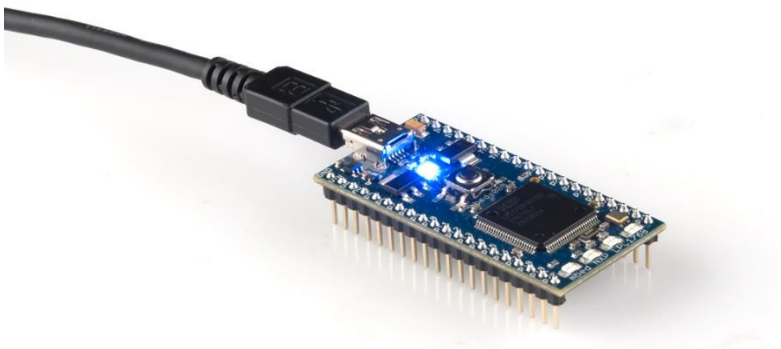
Step 1 : Click on the “Compile” button on the top tab to compile the program.



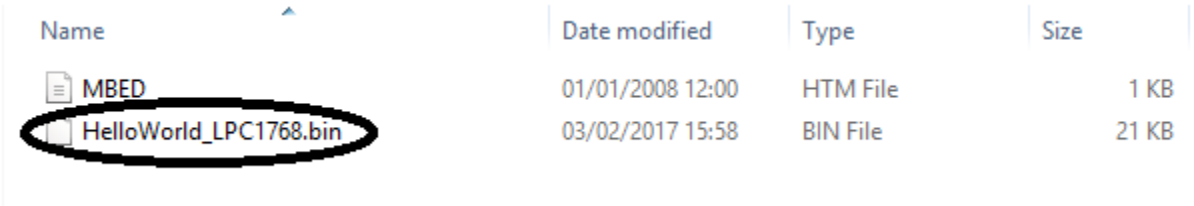
Step 2 : Once the program is compiled successfully, you should see a binary file (with .bin extension) being downloaded to your system.

Step 3 : **Remove the mbed from the m3pi robot. This is a very important step before we can upload the program to the mbed.**

Step 4 : Connect the mbed to your system using the USB cable. The blue LED on mbed should light up.



Step 5 : Copy and paste the binary file generated to the mbed directory.



Step 6 : Remove the USB connection between the mbed and your system.

Running the Program

Step 1 : Once you have downloaded the binary file to the mbed, connect the mbed back on to the m3pi robot.

Step 2 : Press the “Power On” on the m3pi board to run the program on the m3pi robot.

Further Steps.....

Code different programs and follow the same procedure to run your programs on the m3pi robot.

HAPPY CODING!!