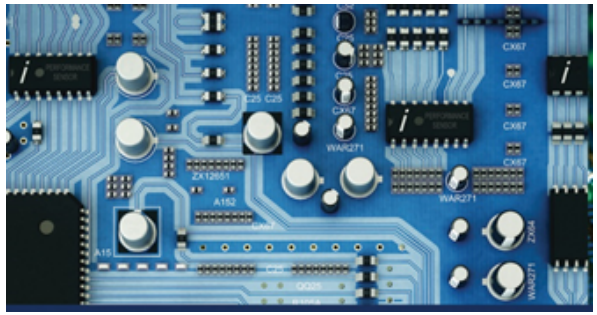
UESTC1008: Microelectronic Systems

Academic year 2019/2020 – Semester 2 – Presentation 2

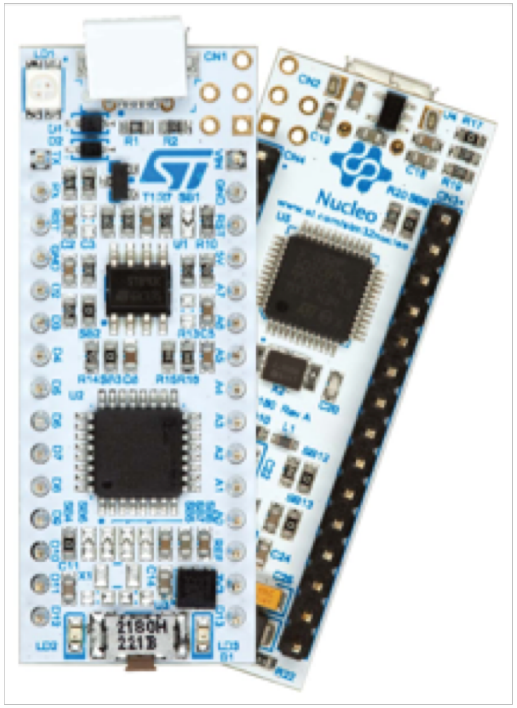
Qammer H. Abbasi, Lei Zhang, Sajjad Hussain, Muhammad Ali Imran and Guodong Zhao
{*qammer.abbasi,Lei.zhang,sajjad.Hussain,Muhammad.Imran,guodong.zhao*}*@glasgow.ac.uk*

"A good student never steals or cheats"

Agenda



- Review of previous lecture
- Mbed details
- Mbed programming
- Summary



Toolkit and mbed box

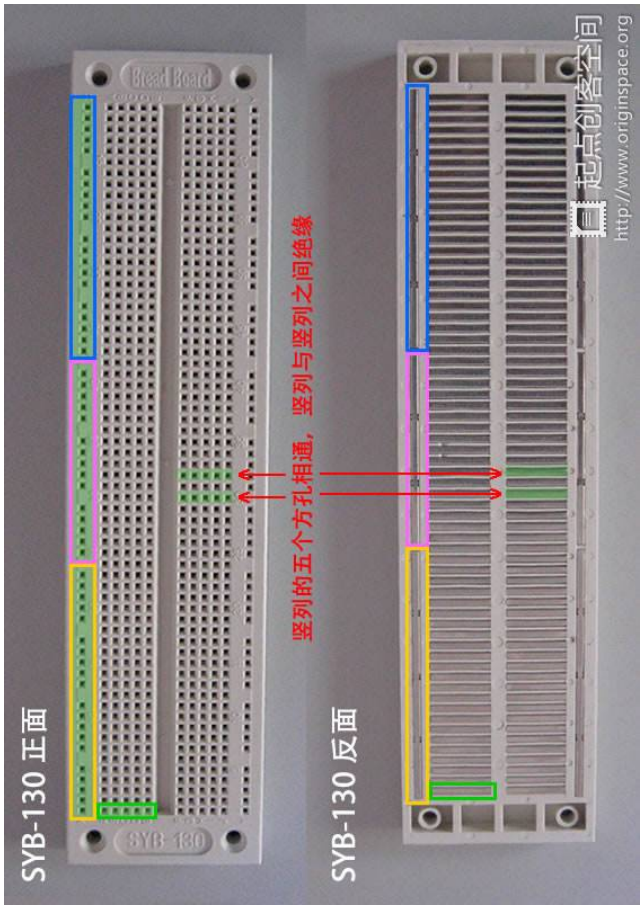
- The set of experiments is based around the mbed microcontroller development board
- Each student will be given a toolkit and an mbed, which you will use widely throughout your years of study at Glasgow College, UESTC
- You need to keep your mbed for several courses so treat it well and protect it
- You will also be given a small breadboard to enable you to easily connect components to your beloved mbed

Toolkit


UNI-T
新型掌上数字万用表
Palm Size Digital Multimeters
UT33系列


RICHENGJIAPIN
MADE IN CHINA
Chest

Breadboard


SYB-130 正面
SYB-130 反面
竖列的五个方孔相通，竖列与竖列之间绝缘
起点创客空间
http://www.originspace.org

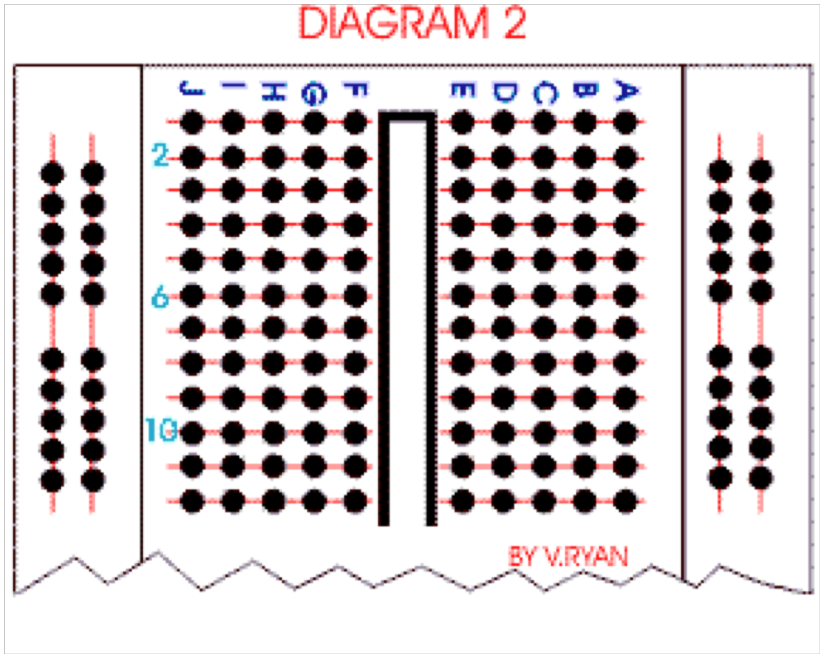
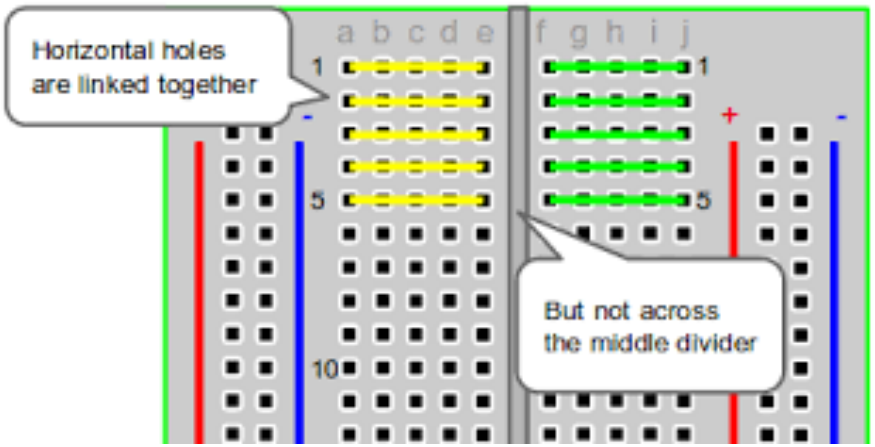
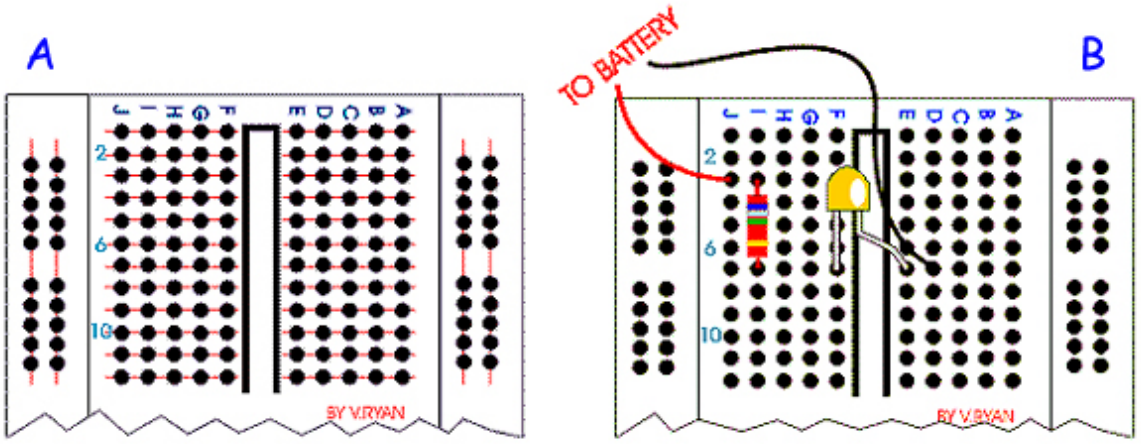


DIAGRAM 2
J I H G F E D C B A
2
6
10
BY V.RYAN

Breadboard

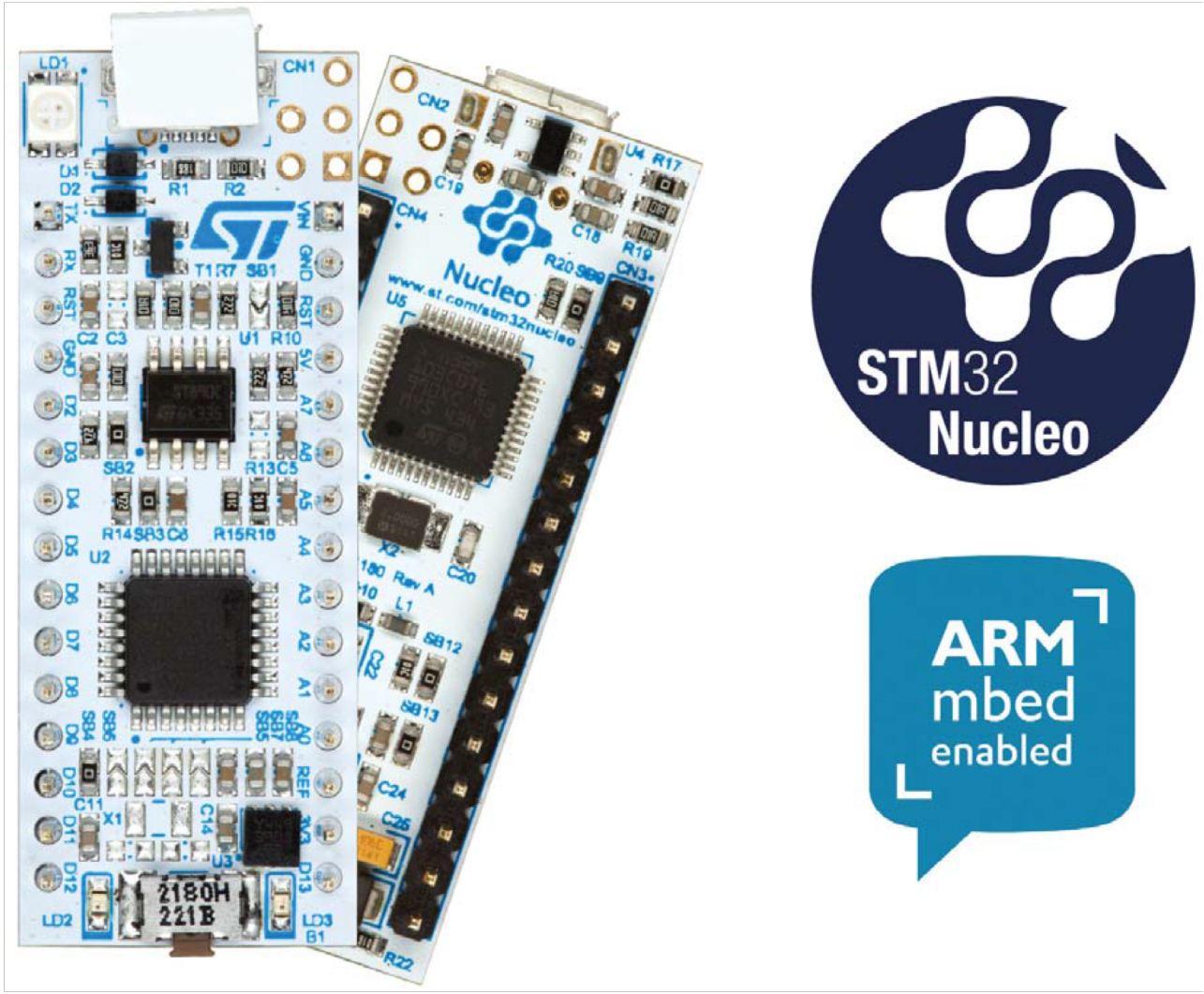

Horizontal holes
are linked together
a b c d e
f g h i j
1
5
10
But not across
the middle divider


A
B
TO BATTERY
BY V.RYAN
BY V.RYAN

mbed Box

mbed STM32 Nucleo-32 board

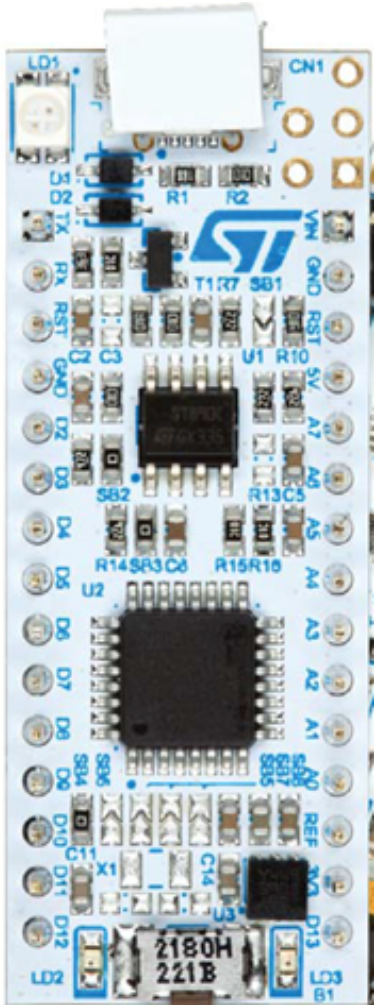
- The development board is based on the Nucleo L432KC microcontroller.
- 32-bit ARM Cortex-M4 core running at 80 MHz.
- ARM processors are used in many contemporary products including iphones.

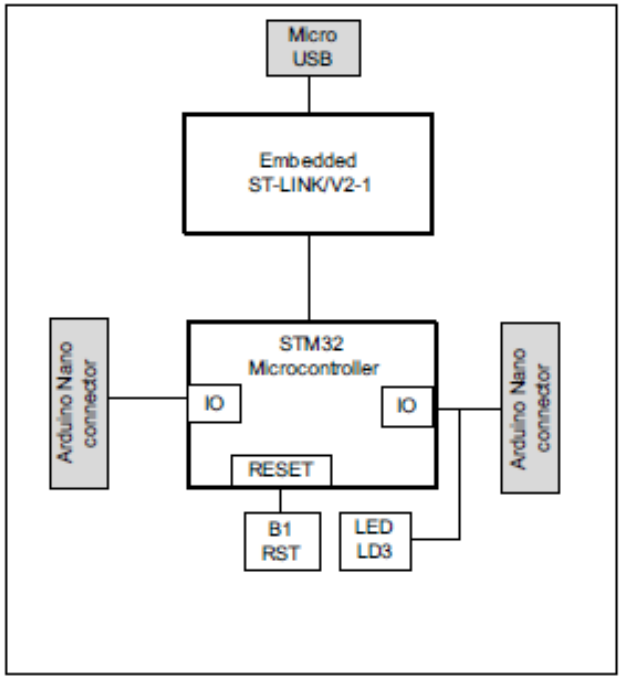


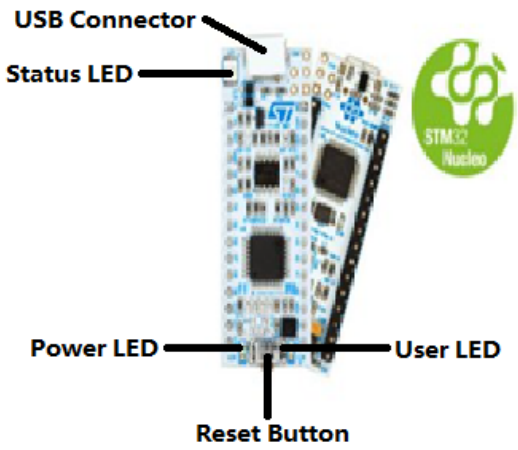
STM32 Nucleo

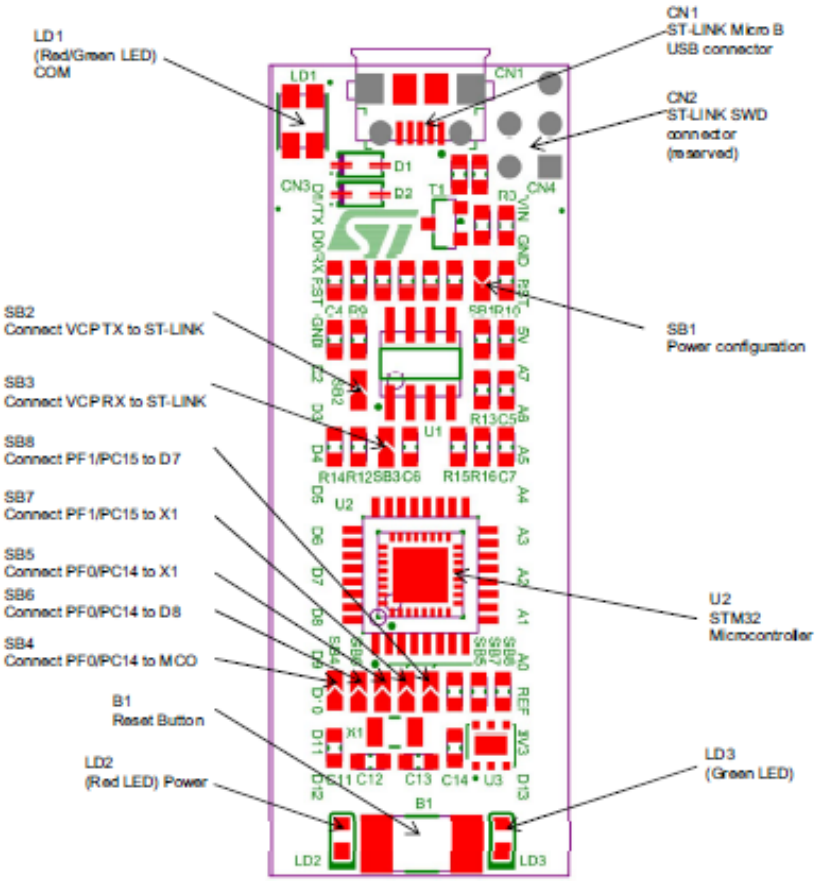
ARM mbed enabled

Top-view of the mbed

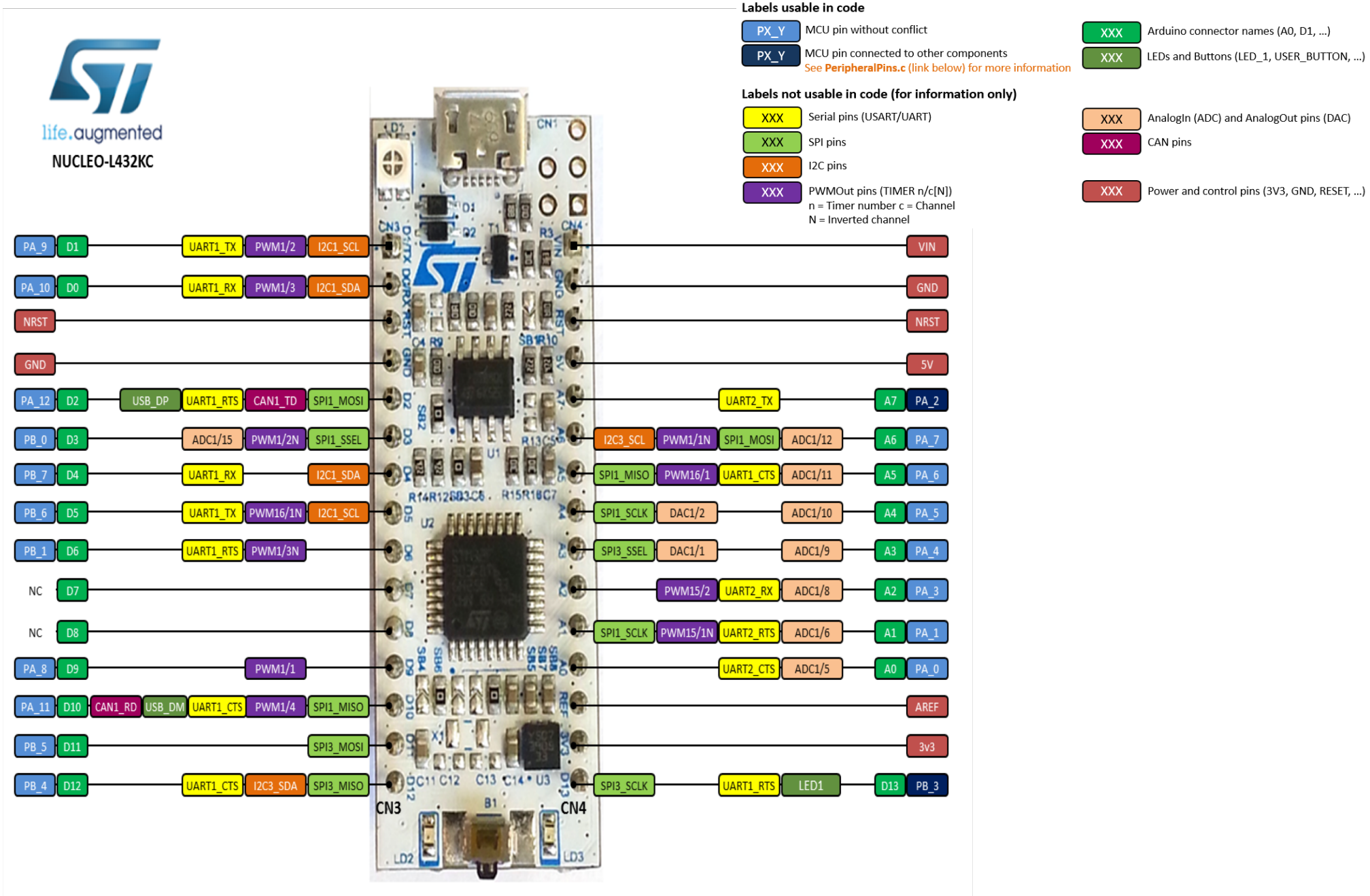








Pinout Diagram of mbed



Benefits

- Get started right away, with nothing to install
- Get working fast, using high-level APIs
- Explore, test, and demonstrate ideas more effectively
- Write clean, compact code that’s easy to modify
- Log in from anywhere, on Windows, Mac or Linux

Features

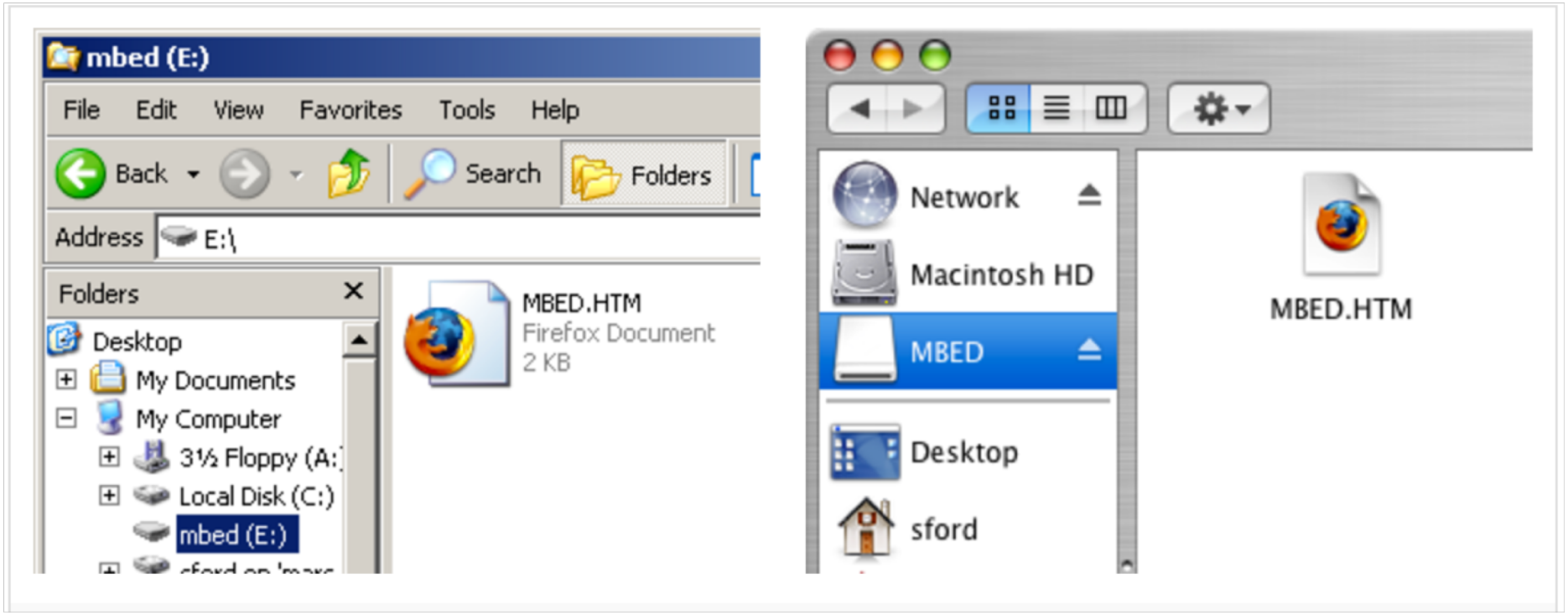
- STM32 microcontrollers in 32-pin packages
- Three LEDs: USB communication (LD1), power LED (LD2) and user LED (LD3)
- Reset push-button
- Board expansion connector:
  - Arduino™ Nano
- Flexible power-supply options: ST-LINK USB V_{BUS} or external sources
- On-board ST-LINK/V2-1 debugger/programmer with USB re-enumeration capability: mass storage, Virtual COM port and debug port
- Support of a wide choice of Integrated Development Environments (IDEs) including IAR™, Keil®, GCC-based IDEs, Arm® Mbed™
- Arm® Mbed Enabled™ compliant (only for some Nucleo part numbers)

Hassle-free startup

- Getting started is as simple as using a USB Flash drive
- Simply connect the mbed stm32l432kc board to a Windows, Mac or Linux computer and it will appear as a USB drive
- Follow the link on the board to connect to the mbed website, where you can sign up and begin designing
- There are no drivers to install or setup programs to run
- It’s so easy, in fact, that you can have a “Hello World!” program running in as little as five minutes.

Connect your mbed to a PC

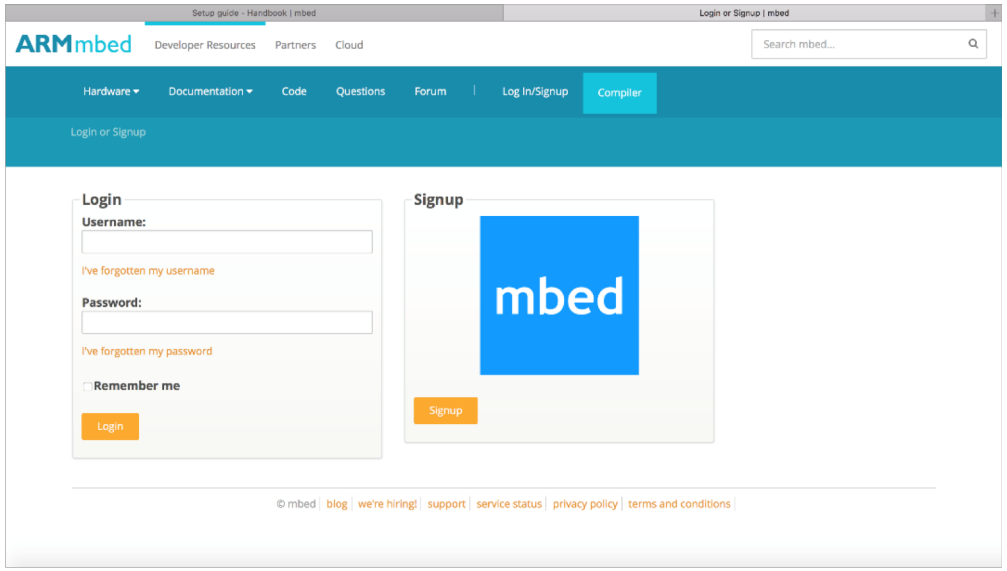
- Use the USB lead to connect your mbed to a PC
- The status light will come on, indicating it has power
- After a few seconds of activity, the PC will recognise the mbed Microcontroller as a standard USB drive

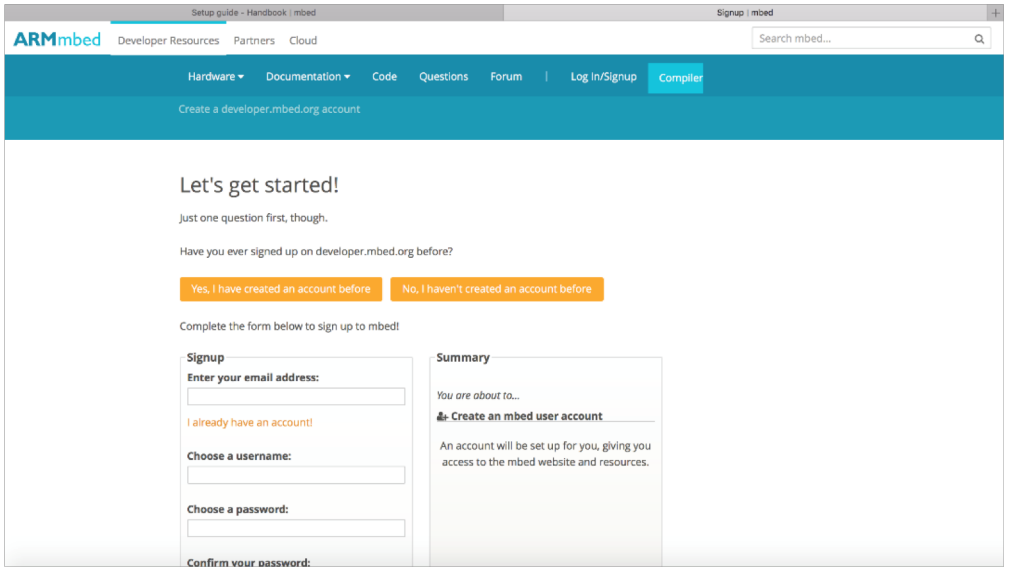


mbed Account

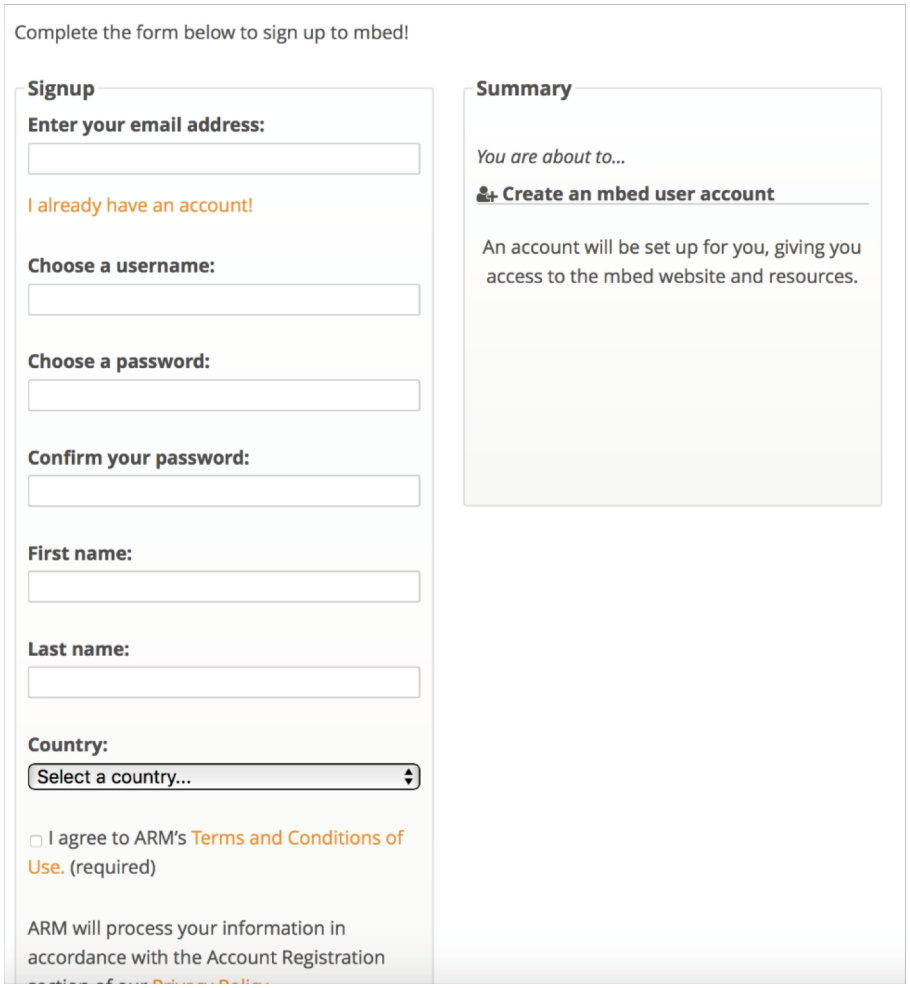
- Go to the new USB Drive, and click MBED.HTM to open it in a web browser
- If you do not have an mbed account, choose "Signup", and create your mbed Account
- Once you have created an account, log in with your username and password
- This will give you access to the website, tools, libraries and documentation

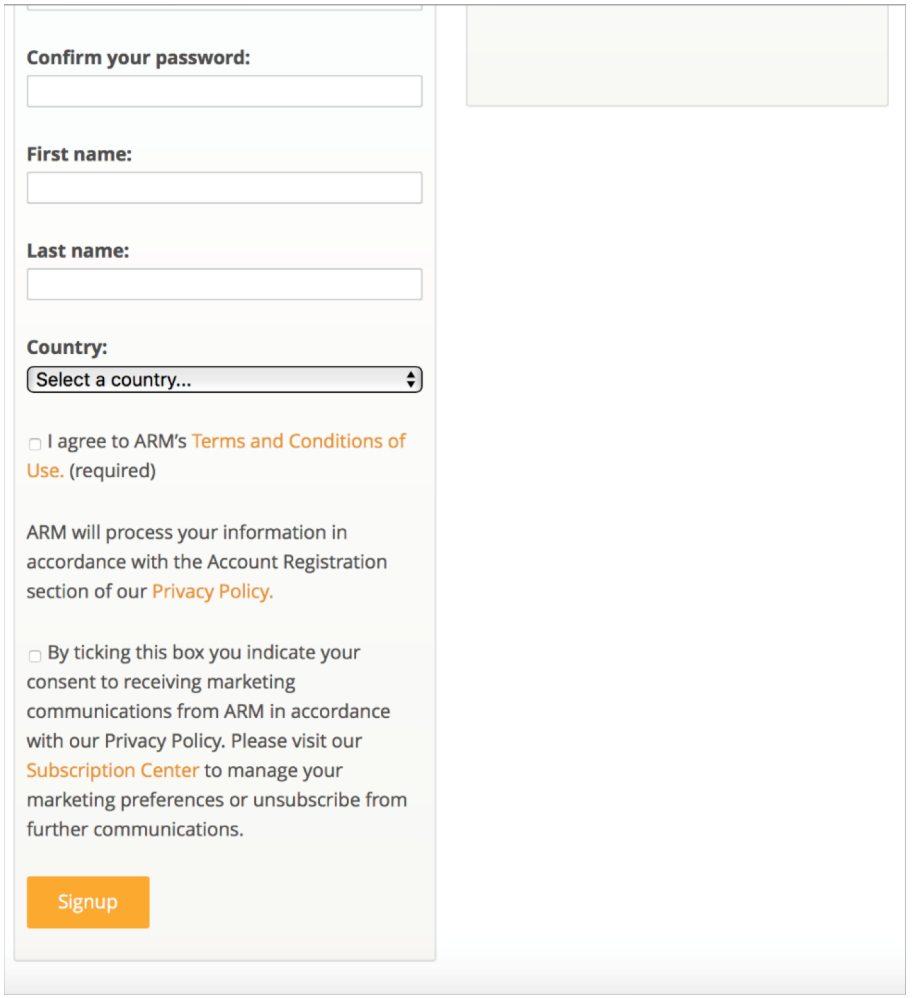
mbed Account





mbed Account





mbed – Getting Started

https://os.mbed.com/platforms/ST-Nucleo-L432KC/

arm MBED Overview Hardware Docs Code Support Built with Mbed

Boards » NUCLEO-L432KC

NUCLEO-L432KC

Affordable and flexible platform to ease prototyping using a STM32L432KCU6 microcontroller.

Table of Contents

Overview

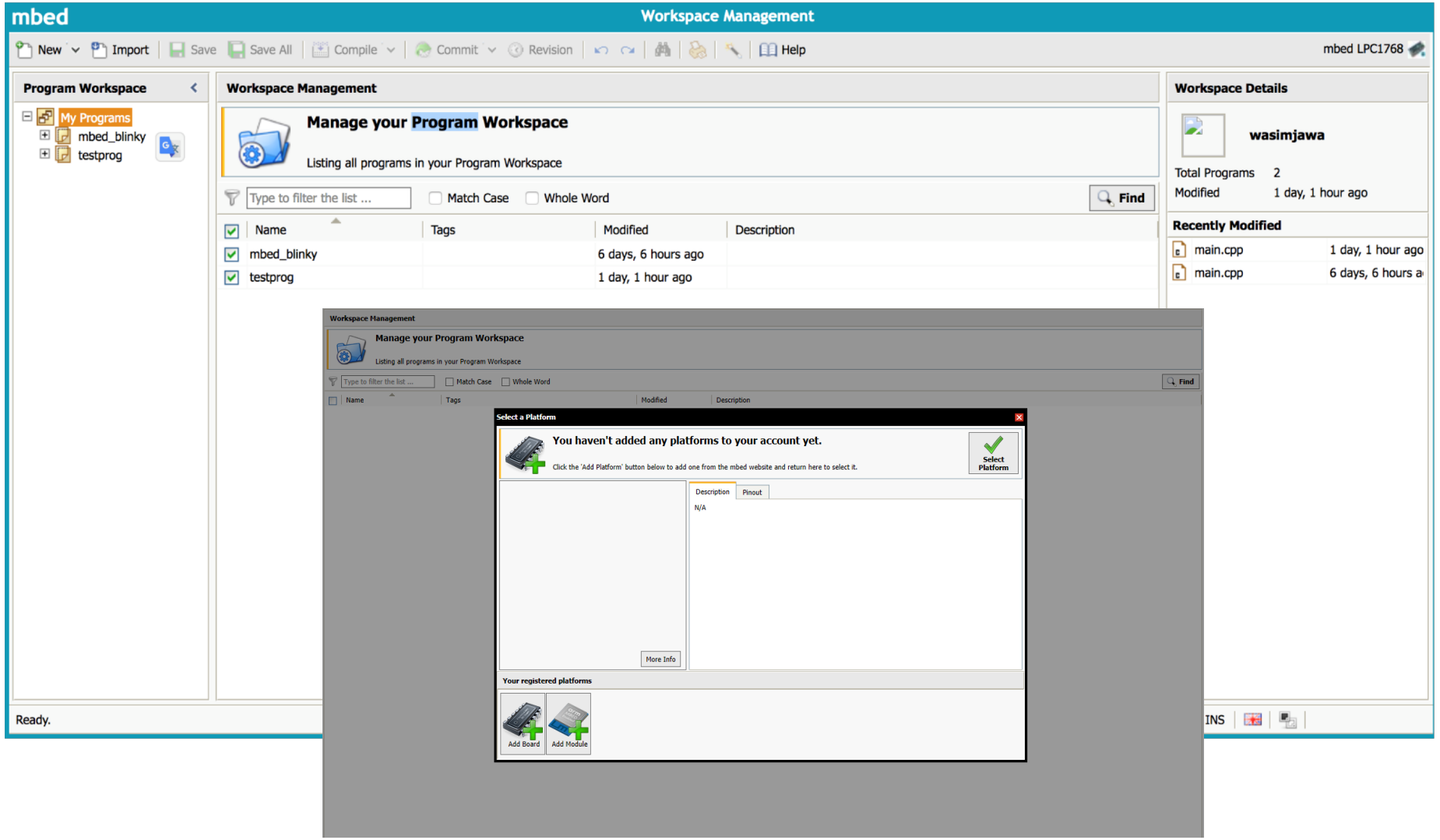
The STM32 Nucleo board provides an affordable and flexible way for users to try out new ideas and build prototypes with any STM32 microcontroller line, choosing from the various combinations of performance, power consumption and features.

The Arduino™ connectivity support and ST Morpho headers make it easy to expand the functionality of the STM32 Nucleo open development platform with a wide choice of specialized shields.

mbed Online Compiler

- The mbed Compiler lets you write programs in C++ and then compile and download them to run on the mbed Nucleo L432KC microcontroller.
- There's no need to run an install or setup program, since the compiler runs online
- Supported browsers include Internet Explorer, Firefox, Safari, or Chrome running on a Windows, Mac, or Linux PC
- You can log in from anywhere and simply pick up where you left off. And, since you're working with a web-based tool, you can be confident that it's already configured and will stay up-to-date

mbed Online Compiler

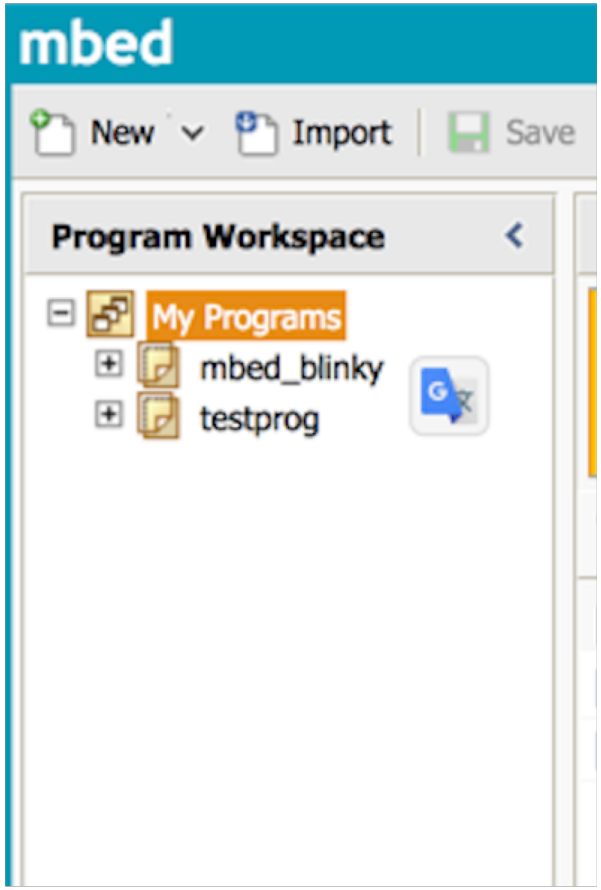


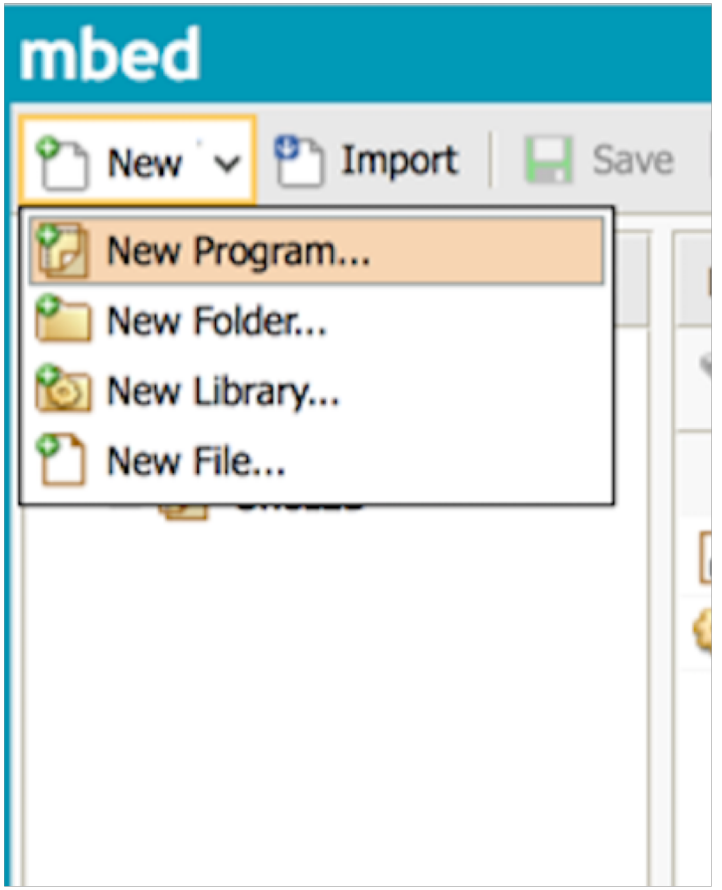
NUCLEO-L432KC as the platform

Create a New Program

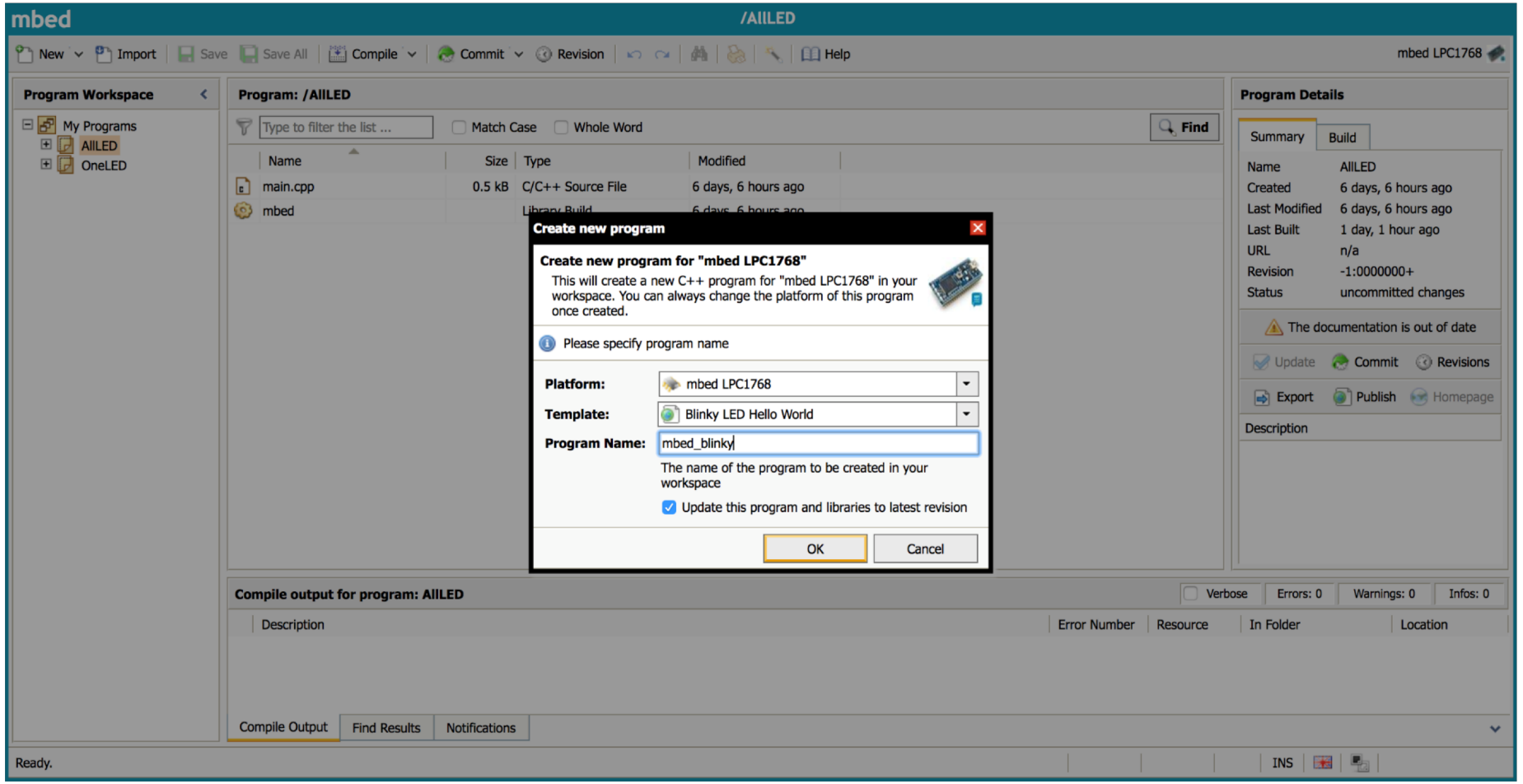
- Click **New** to create a new program, and enter a filename
- Your newly created program will appear in the Program Workspace on the left of the screen
- If you expand the program by clicking on the **+**, you will see something called **main.cpp** - double click on this
- It will open your program in the compiler environment
- As you can see, any new program already has some lines of code

Create a New Program

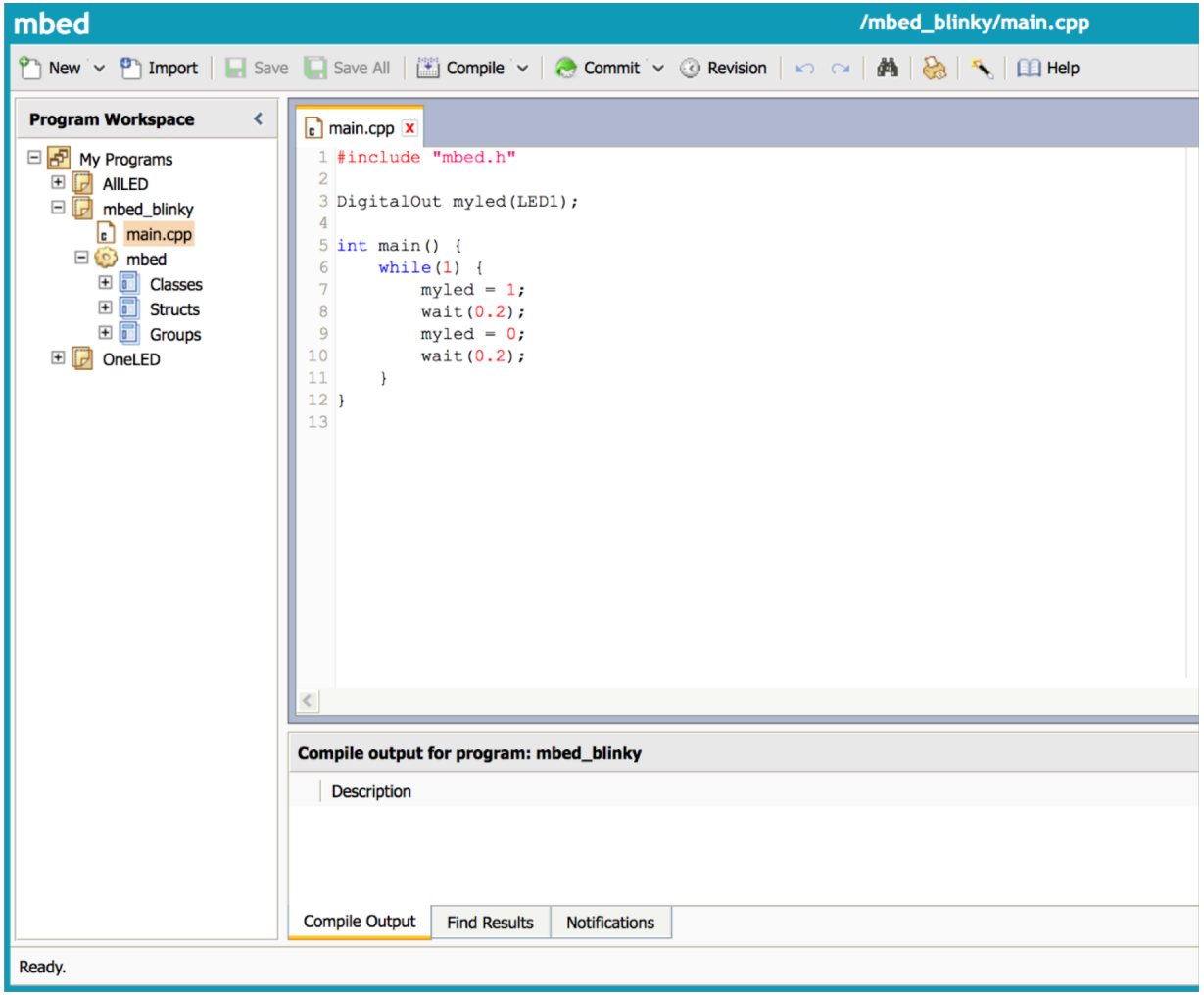




Platform and Program Name



First Program - mbed_blinky



Download program to mbed

- To get the program onto the mbed, you first have to compile it, by clicking the "**Compile**" button in the toolbar
- This will create the binary code, which will ultimately be downloaded to the mbed
- If the compiling goes well, you will get a "**Success!**" message in the compiler output, and a popup will prompt you to download the compiled **.bin** file to the mbed
- Whilst the program is downloading, the status LED on the mbed will flash
- Once this has stopped, press the **Reset Button** on the mbed to start your program running
- You should see **LED1** flashing on and off every 0.2 seconds

mbed_blinky Program

#include "mbed.h"	This is a header that needs to be at the start of each mbed.
DigitalOut myled(LED1);	Essentially, what you are doing here is using the DigitalOut component to set LED1 as a digital output, and to give that "port" a name, myled. You can do something similar for each of pins 5-30, using the format: DigitalOut variablename (pinnumber) For example DigitalOut greenled (p5) would set pin 5 as a digital output, with the name greenled.
int main() {	The action of any C++ program is contained within its main() function. The function definition, what goes on inside the function, is contained within the curly brackets, starting immediately after main(), and continuing until the last closing curly bracket.
while(1) {	Many embedded systems programs contain endless infinite loop, a section of the program that just goes on repeating forever. In other branches of programming, this is bad practice, but for embedded systems, this is quite standard. The endless loop is created using the while keyword; this controls the code within the curly brackets, which follow. Normally, while is used to set up a loop, which repeats if a certain condition is satisfied, but if we write while(1), this will make the loop repeat endlessly.

mbed_blinky Program

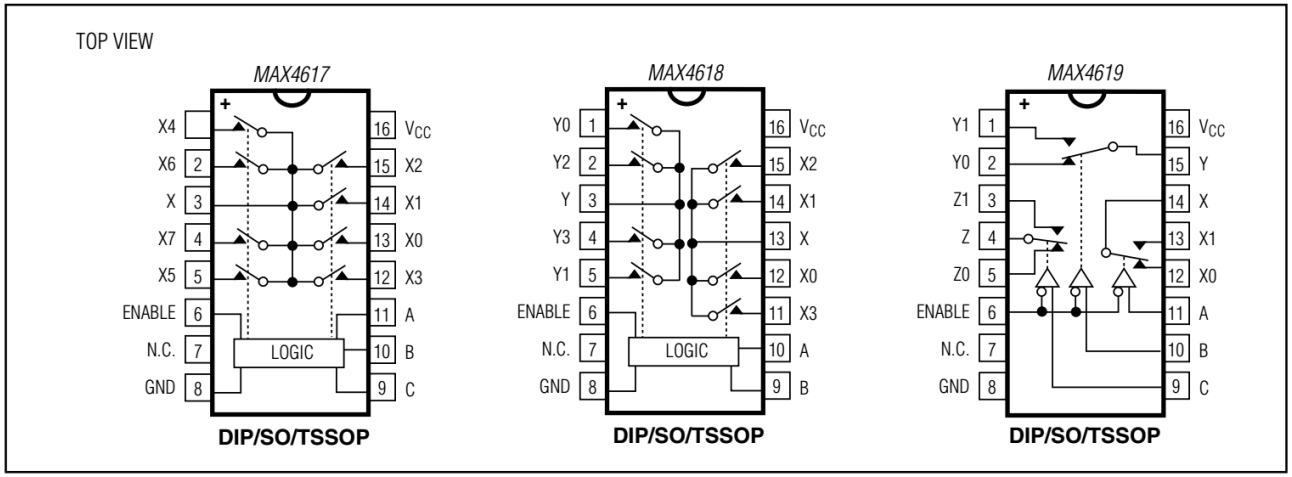
myled=1;	means that the variable myled is set to the value 1, no matter what its previous value was. In C++, this is different to "equals", which is represented by "= =". "=" has the meaning "is set to". This sets a logic 1, or voltage of ~3.3V on the pin to which LED1 is connected. This will case the LED to light up.
wait(0.2);	function is from the mbed library - you can find out more about it on the mbed website. The 0.2 parameter is in seconds, and defines the delay length caused by this function. So, the LED will be lit for 0.2s
myled=0;	means that the variable myled is set to the value 0, whatever its previous value was. This sets a logic 0, or voltage of 0 V on the pin to which LED1 is connected. This will cause the LED to switch off. Note that this will not always turn an LED off; it depends on how the LED is wired in the circuit.
wait(0.2);	the LED will be switched off for 0.2 s

MAX4617/MAX4618/ MAX4619

The MAX4617/MAX4618/MAX4619 are high-speed, low voltage, CMOS analog ICs configured as an 8-channel
multiplexer (MAX4617), two 4-channel multiplexers
(MAX4618), and three single-pole/double-throw (SPDT)

switches (MAX4619)

Pin Configurations/Functional Diagrams



High-Speed, Low-Voltage, CMOS Analog Multiplexers/Switches

Table 1. Truth Table/Switch Programming

ENABLE INPUT	SELECT INPUTS			ON SWITCHES		
	C*	B	A	MAX4617	MAX4618	MAX4619
H	X	X	X	All switches open	All switches open	All switches open
L	L	L	L	X–X0	X–X0, Y–Y0	X–X0, Y–Y0, Z–Z0
L	L	L	H	X–X1	X–X1, Y–Y1	X–X1, Y–Y0, Z–Z0
L	L	H	L	X–X2	X–X2, Y–Y2	X–X0, Y–Y1, Z–Z0
L	L	H	H	X–X3	X–X3, Y–Y3	X–X1, Y–Y1, Z–Z0
L	H	L	L	X–X4	X–X0, Y–Y0	X–X0, Y–Y0, Z–Z1
L	H	L	H	X–X5	X–X1, Y–Y1	X–X1, Y–Y0, Z–Z1
L	H	H	L	X–X6	X–X2, Y–Y2	X–X0, Y–Y1, Z–Z1
L	H	H	H	X–X7	X–X3, Y–Y3	X–X1, Y–Y1, Z–Z1

X = Don't care

**C not present on MAX4618.*

Note: *Input and output pins are identical and interchangeable. Either may be considered an input or output; signals pass equally well in either direction.*

Summary

- Mbed
- Mbed online compiler
- What will we study in next lecture