ELE 292 Lab 0

Software Installation

Overview

In Lab 0, we will install and test the software tools that will be used throughout this semester, including:

- ☐ Digilent WaveForms
- ☐ Arduino IDE
- ☐ Jupyter Notebook

Prelab

There is no prelab for Lab 0.

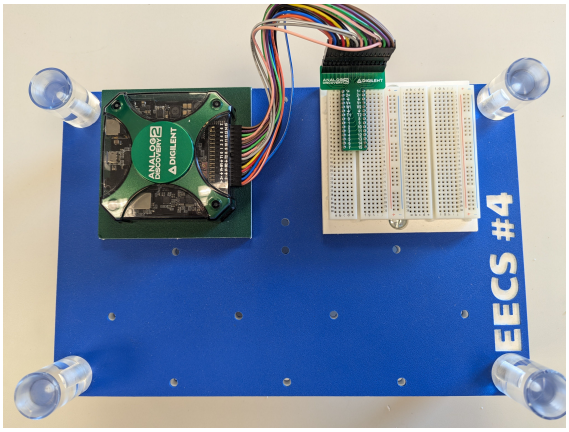
Ensure that you bring a laptop to the classroom.

Task 1 – Digilent WaveForms

Task 1.1 Know the hardware

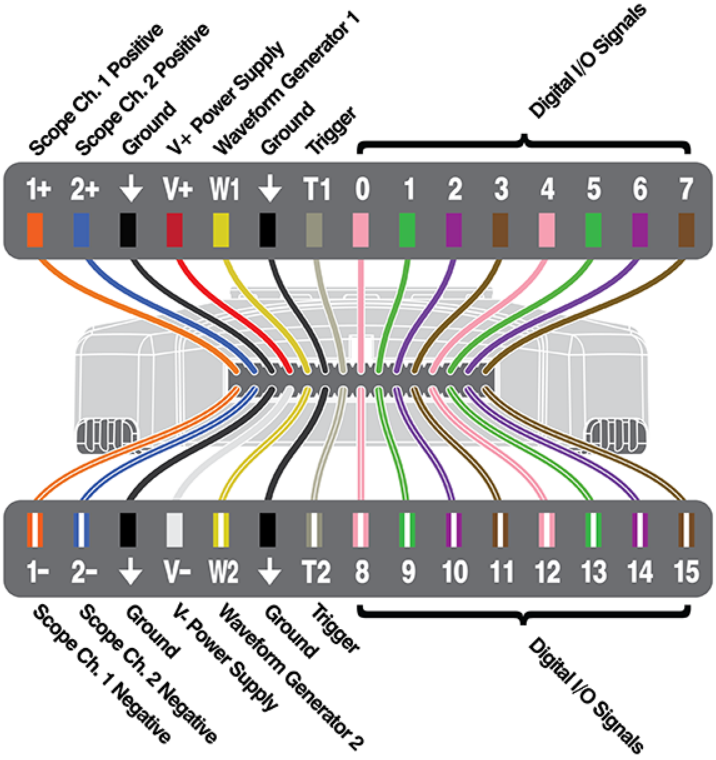
For every group, get one blue work station and one Micro USB Cable.

(a) Micro USB Cable



(b) Work station

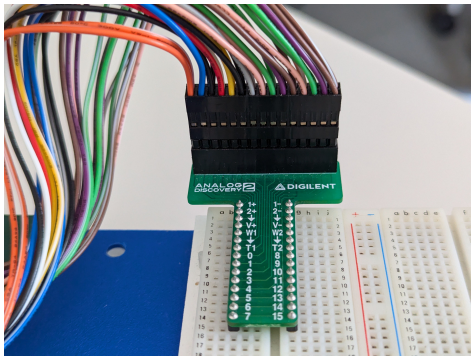
Leave the Micro USB Cable un-connected for now. Let's first take a look at the work station. The main device here is the **Analog Discovery 2**. This device is essentially a portable oscilloscope and a power supply. The pinout is shown below,



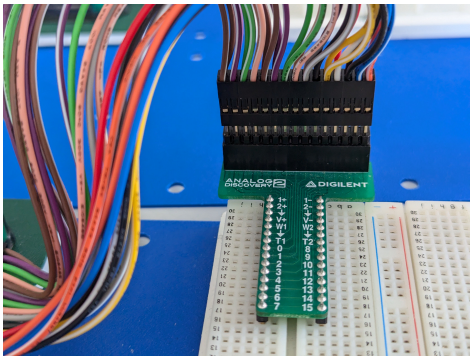
On the right side is a breadboard with a T-shape connector. The T-shape connector neatly organize cables from the Analog Discovery 2 for easier connection.
Don't worry if you don't know breadboard. It will be covered in Lab 2.

Potential Troubleshooting

Make sure on the T-shape connector,
Two orange cables are on the very left, two brown cables are on the very right.
No the flipped way.



(a) Correct



(b) Wrong

Task 1.2 Install the software

Next, we will install the software – **Digilent WaveForms** to enable the Analog Discovery 2. Visit the this website to find the version for your laptop's operating system: https://digilent.com/reference/software/waveforms/waveforms-3/previous-versions

The instructor has confirmed that the version digilent.waveforms_v3.23.4_64bit.exe works well with the Windows 11 system.

Download and install Digilent WaveForms, ensuring that you grant the highest possible admin rights during the installation process. If everything is good, we will see this window at the and:

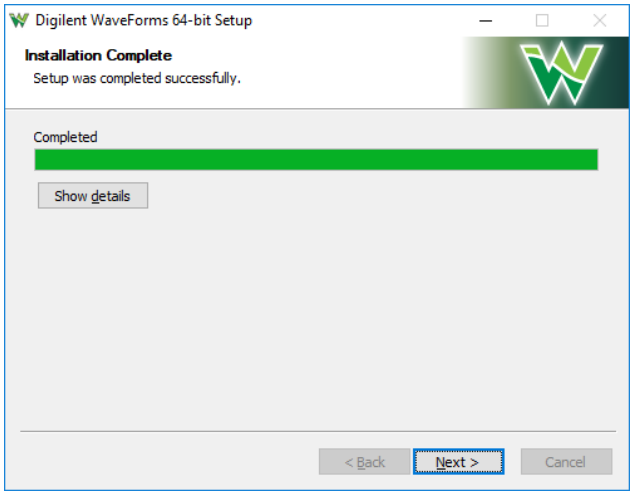


Figure 3: Successfull installation

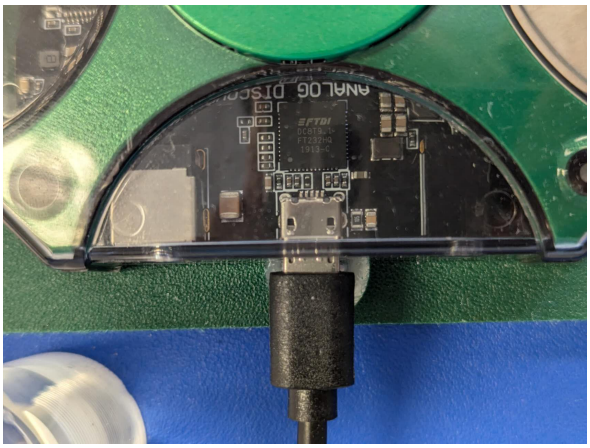
Task 1.3 Verify installation

In this part, we will verify our software installation with real hardware.

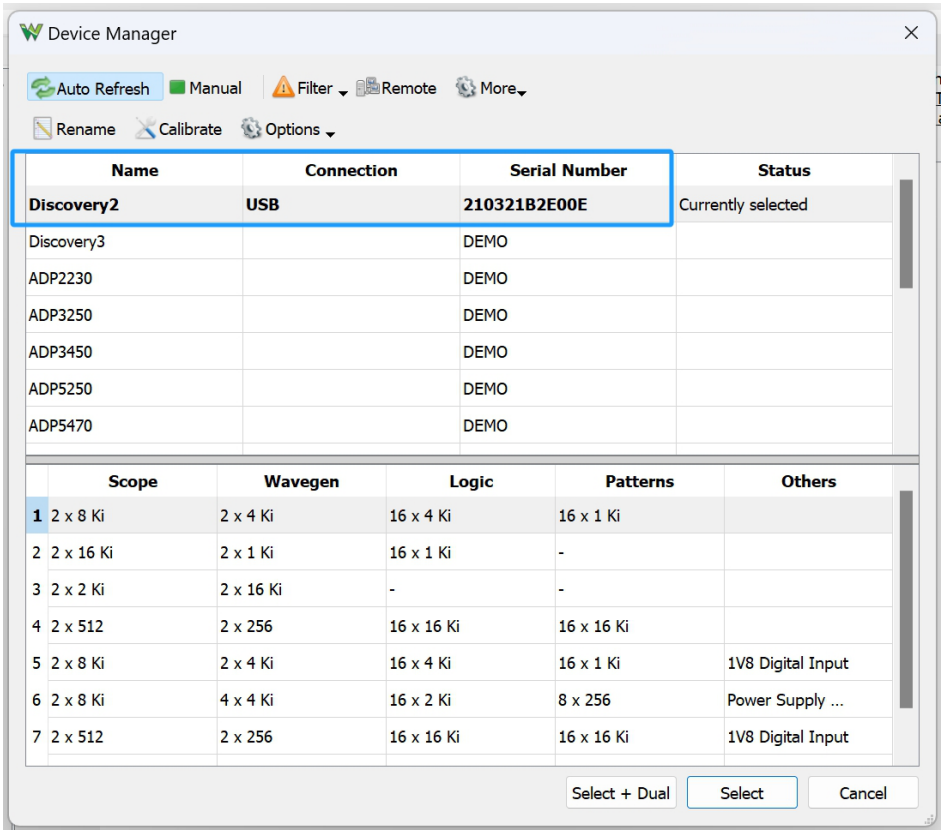
Use the Micro USB Cable to connect your laptop and the Analog Discovery 2 on the work station.

Potential Troubleshooting

Ensure that the cable is well connected.
This picture shows an example of a loose connection:



Next, open the newly installed Digilent WaveForms software. A prompt window labeled "Device Manage" will appear. If everything is functioning correctly, you should see a row displaying "Discovery2" along with a serial number, indicating that the computer has successfully detected the Analog Discovery 2.



Keep the "Scope - Wavegen - Logic - Patterns - Others" row at its default settings. Then, click the "Select" button at the bottom of the window.

In this way, we successfully establish the connection between the computer and the Analog Discovery 2. You should see a light blinking green at the center of the Analog Discovery 2, indicating that the connection is active.

Check Point 1 – Light blinking green

* Throughout this semester, whenever you see such checkpoint, you will need to check your results with the instructor or TA.

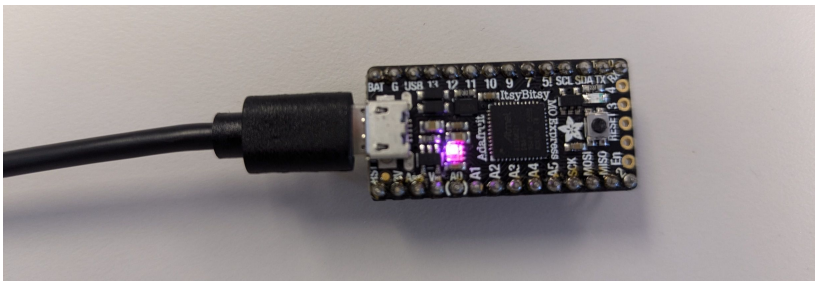
Task 2 – Arduino IDE

Task 2.1 Know the hardware

For every group, get one ItsyBitsy M0 microcontroller.

Use the Micro USB Cable to connect your laptop and the ItsyBitsy. Once connected, you should see a steady purple light. If you press the "RESET" button located near the flower logo, a red light will illuminate for 1 second. After verifying the lights, disconnect the cable to prevent overheating.

The ItsyBitsy is a compact version of Arduino boards. Although it looks in small size, it has much of the functionality of larger Arduino boards, making it suitable more space-limited designs. In some labs this semester, we will use the ItsyBitsy to process signals.



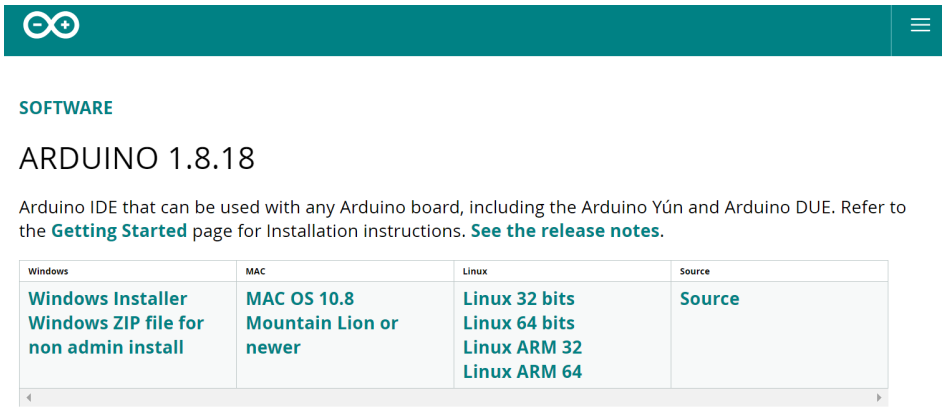
Task 2.2 Install the software

In order to use the ItsyBitsy board, we need to install Arduino IDE and additional drivers. Again, please grant the highest possible admin rights during the installation process.

Installation Step 1

The step 1 is to install the Arduino IDE. To do so, go to https://www.arduino.cc/en/software/OldSoftwareReleases, select the ARDUINO 1.8.18, download and install.

It must be in ARDUINO 1.8.18. If you already have ARDUINO 2.0 something, uninstall 2.0.
ARDUINO 2.0 has poor setting in Serial Monitor and haven't been resolved.



Installation Step 2

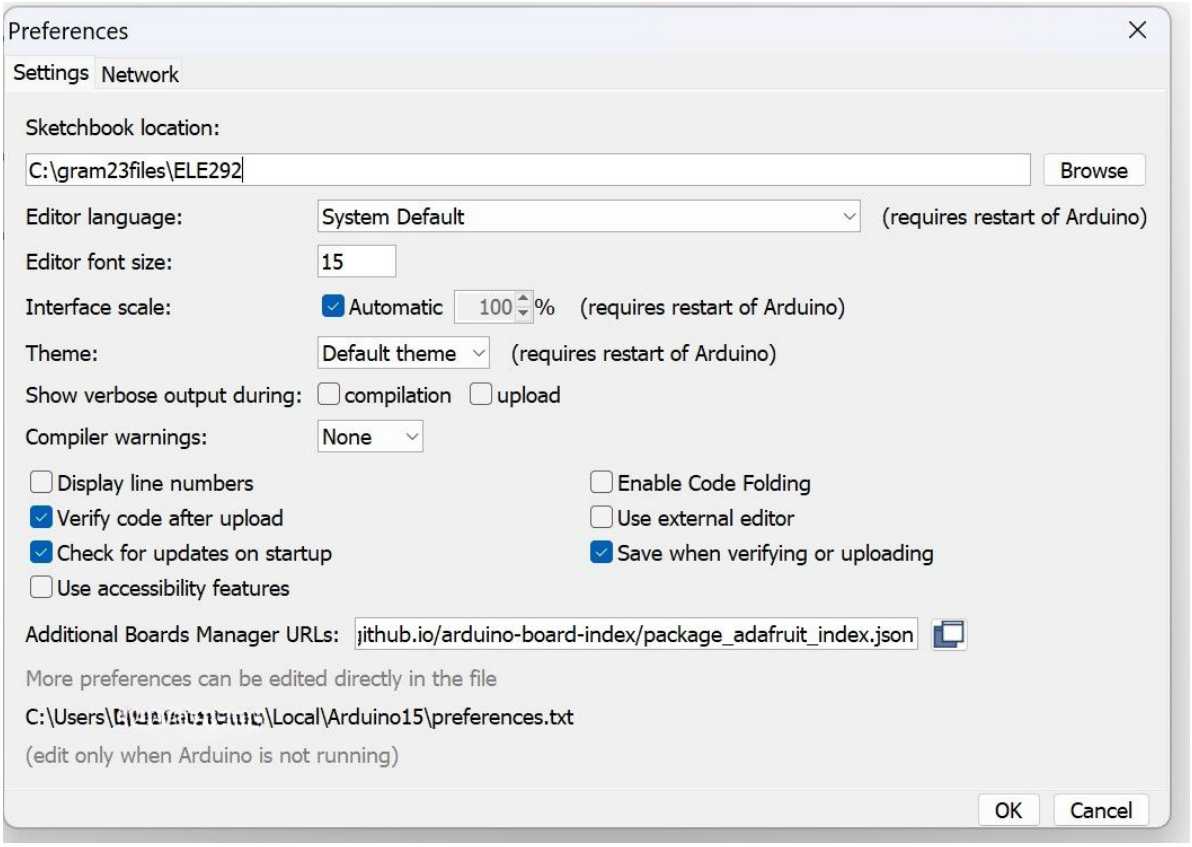
Once it is installed, step 2 is to configure the Arduino IDE. To do so, open the just installed Arduino IDE, go to the menu "File → Preferences".

Note if you are in MAC, in some versions, it is located at "Arduino (the one left to the File) → Settings".

The "Sketchbook location" is the default directory for storing your Arduino code. You can change it to a more easily accessible location on your computer.

In the "Additional Boards Manager URLs", we need to input this url:
`https://adafruit.github.io/arduino-board-index/package_adafruit_index.json`

This url add supports for third-party Arduino boards manufactured from the Adafruit company. The ItsyBitsy board used in this lab is a product of Adafruit.

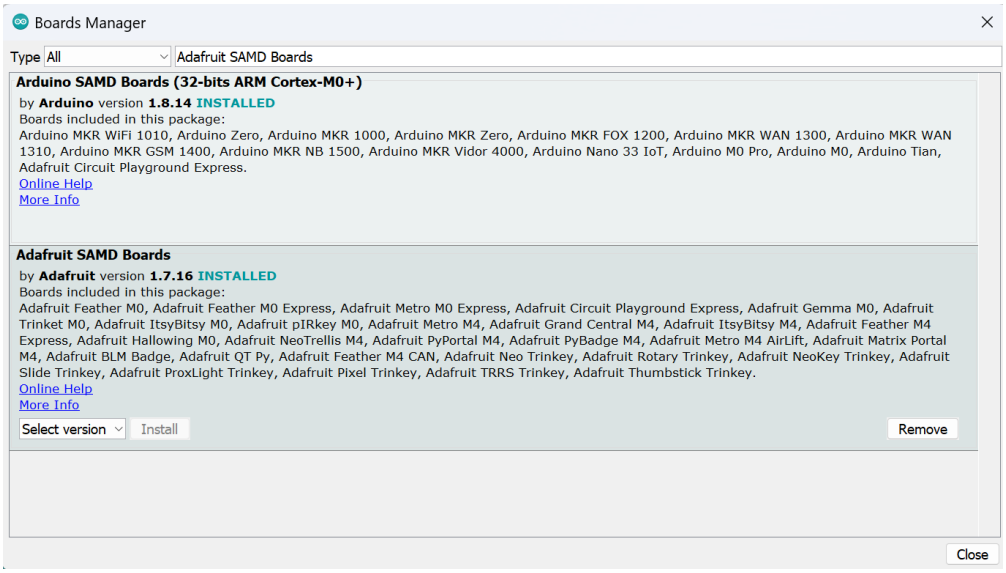


Installation Step 3

The step 3 is to install drivers especially for the ItsyBitsy board. To do so, go to the menu "Tools → Board → Board Manager".

In the Board Manager, set the "Type" as "All". In the search bar, type "Arduino SAMD" and press enter to search. You will then see a block with title "**Arduino SAMD Boards (32-bits ARM Cortext-M0+)**". Install this one.

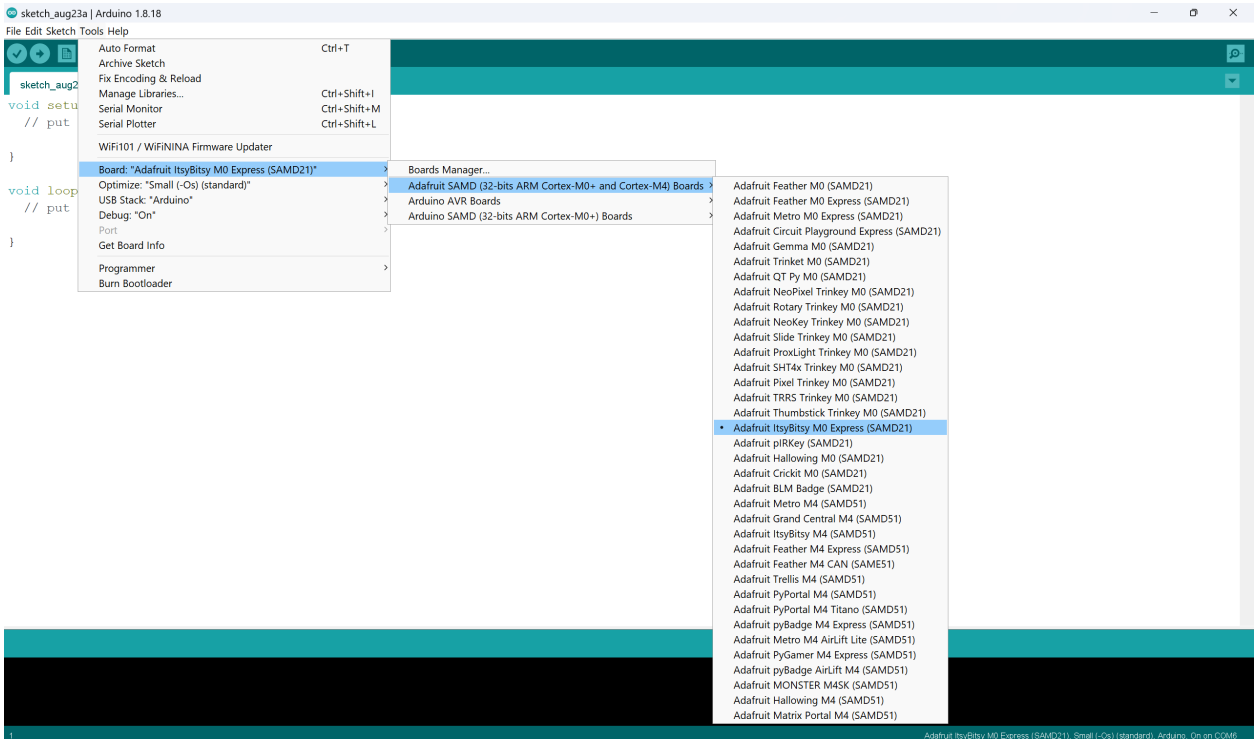
Next, in the search bar, type "Adafruit SAMD Boards" and press enter to search. You will then see a block with title "**Adafruit SAMD Boards**". Install this one.



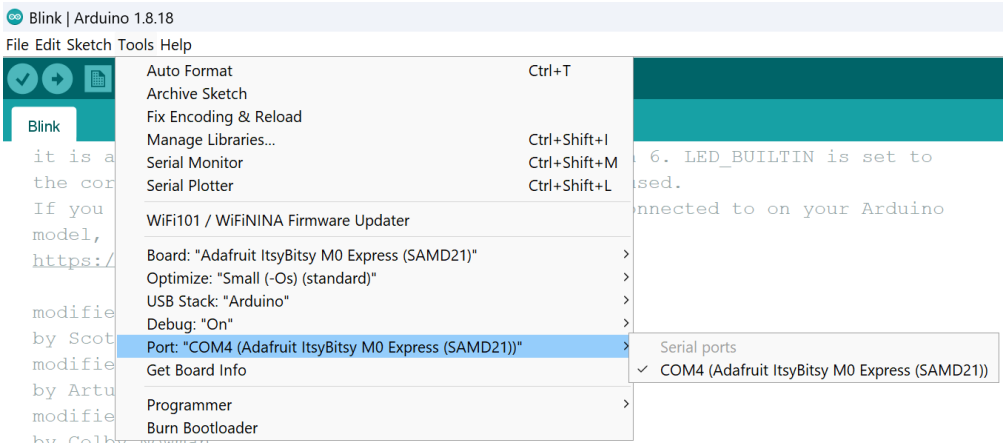
At the end, quit and reopen the Arduino IDE.

Task 2.3 Verify installation

First, go to the menu "Tools → Board → Board Manager → Adafruit SAMD (32-bits ARM Cortext-M0+ and Cortext-M4) Boards ". You should to be able select "Adafruit ItsyBitsy M0 Express (SAMD21)".



Second, go the "port", select the avaiable "COM" port. The port number doesn't matter here, such as "COM3", "COM4", "COM12", ...
Note if you are in MAC, the port will be named as "/dev/cu...".

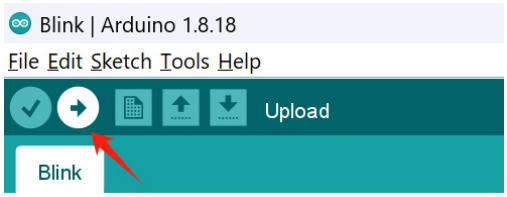


Potential Troubleshooting

If the "COM" port is not shown, the computer might recgonize the port as "HID" (human interface device) rather than "COM" (communication).
Try one of these, then go back to GUI to check again:
1. long-press the RESET button for several seconds.
2. quickly double-press the RESET button.

Third, go to the menu "File → Examples → 0.1. Basics → Blink". You will see some codes in the IDE.

Connect the cable back. Click the "Upload" (an arrow in a circle) button to compile the code and load to the microcontroller.



Once it is successfully uploaded to the board, you will observe the red light blink every second. This blink behavior is controlled by a small code fragment.

Arduino Code

```
void loop() {
  digitalWrite(LED_BUILTIN, HIGH); // turn the LED on (HIGH is the voltage
      level)
  delay(1000); // wait for a second
  digitalWrite(LED_BUILTIN, LOW); // turn the LED off by making the voltage
      LOW
  delay(1000); // wait for a second
}
```

In this code, 1000 means 1000 milliseconds, which is equivalent to 1 second. The first 1000 turns the light on for 1 second, and the second 1000 turns the light off for 1 second. This cycle continues to loop indefinitely.

Check Point 2 – Light blinking red

So far, we have completed the tasks related to hardware. Please put away all the equipment.

Task 3 – Jupyter Notebook

Throughout this lab, we will use Jupyter Notebook to perform data analysis and write lab reports.

There are multiple solutions to get to the Jupyter Notebook. Below, we list four common solutions. In today's lab, we will cover 2 solutions.

The "VS Code" solution will not be introduced. This solution requires additional download of VS Code. And the current Jupyter extension in VS Code is not stable.

You can use any solution if you prefer.

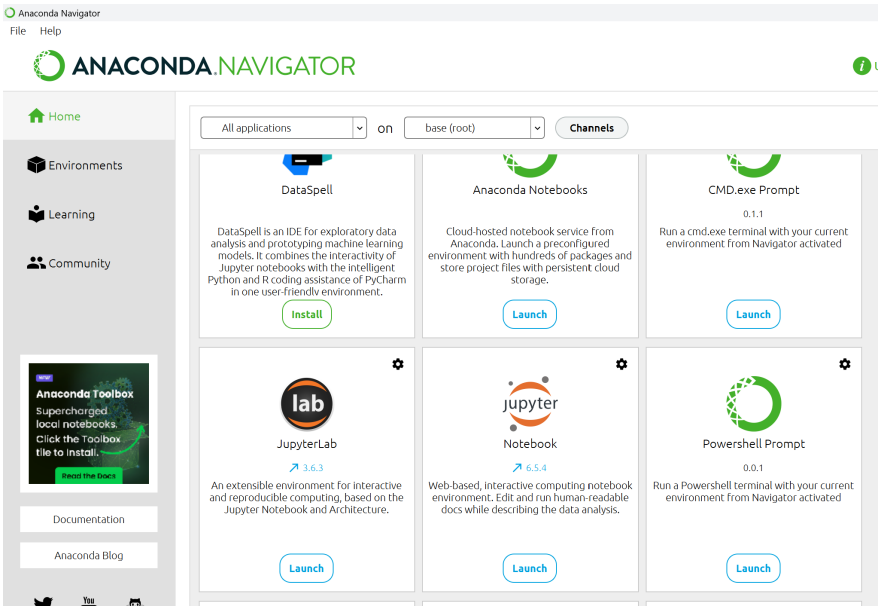
	JupyterLab	**VS Code**	**Google Colab**
Download	Anaconda	VS Code	Cloud-based
Install Difficulty	Easy	Hard	None
GUI	Moderate	Good	Minimal

Task 3.1 Install Anaconda

Visit `https://www.anaconda.com/download` and choose the appropriate version for your system. Anaconda might ask you to register an email; you can skip this step. Follow the download instructions, and if any options are shown during installation, select the default or recommended settings.

Task 3.2 Verify

Once the installation is done, open the "Anaconda Navigator". Then, launch "JupyterLab."



Your browser will open a new webpage with an address like `localhost:....`.

Create a Notebook and test such code:

Python Code

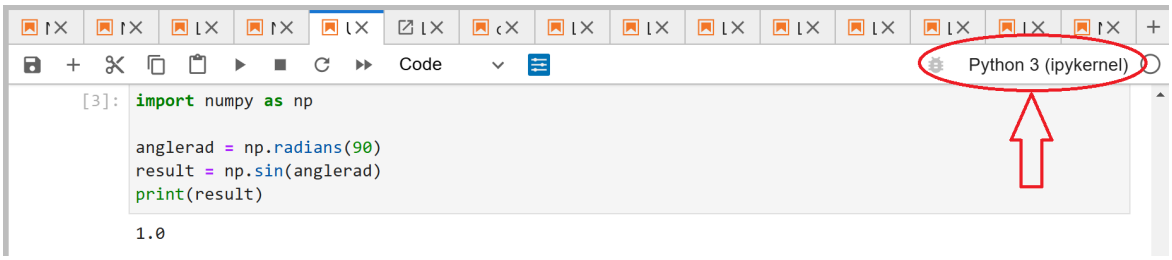
```
import numpy as np

anglerad = np.radians(90)
result = np.sin(anglerad)
print(result)
```

You should see the result will be 1.0.

For detailed usage of Jupyter Notebook, we will learn it in Lab 1.

Potential Troubleshooting

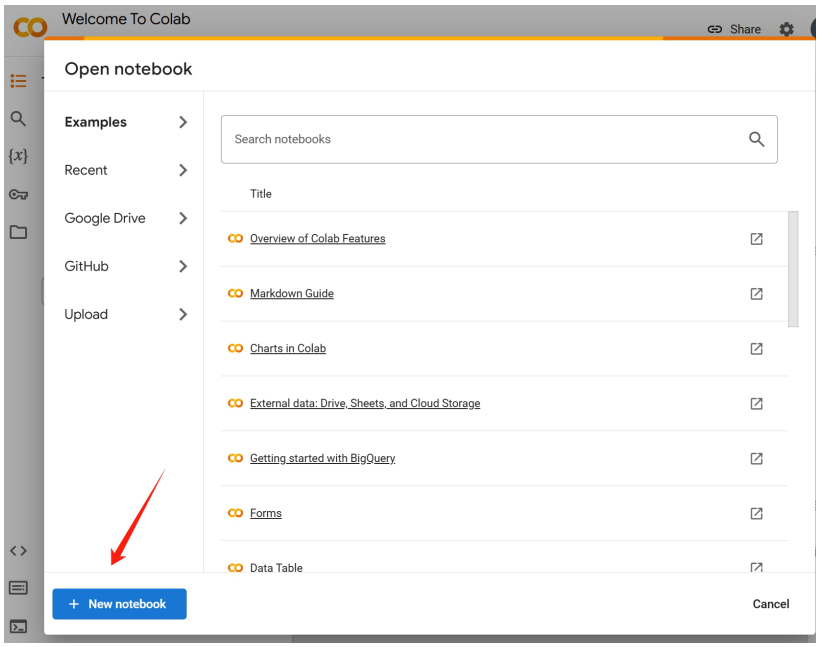
If you have installed Python in some previous courses, you may need to double check the kernel.
Set it to: Python 3 (ipykernel).

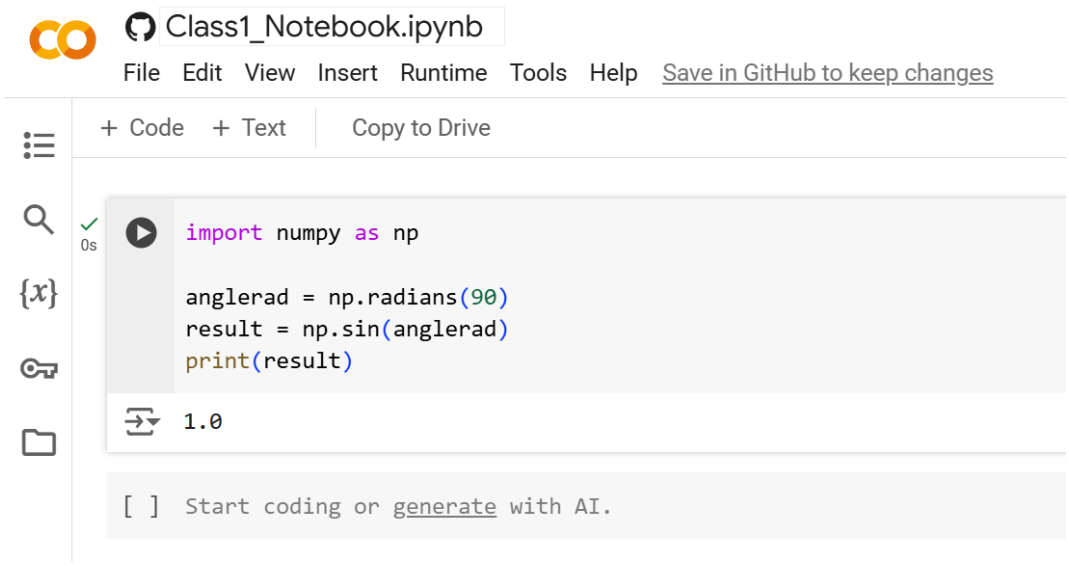


Task 3.3 Try Google Colab

Google Colab is a Cloud-based platform. You will not need to install anything on the computer. You just need a Google account and Internet connection.

Visit https://colab.research.google.com/ and you will see an "Open notebook". From the bottom-left corner, you can create a new notebook.





Lab Report

No lab report for Lab 0.

Make sure you sign the check-point sheet.