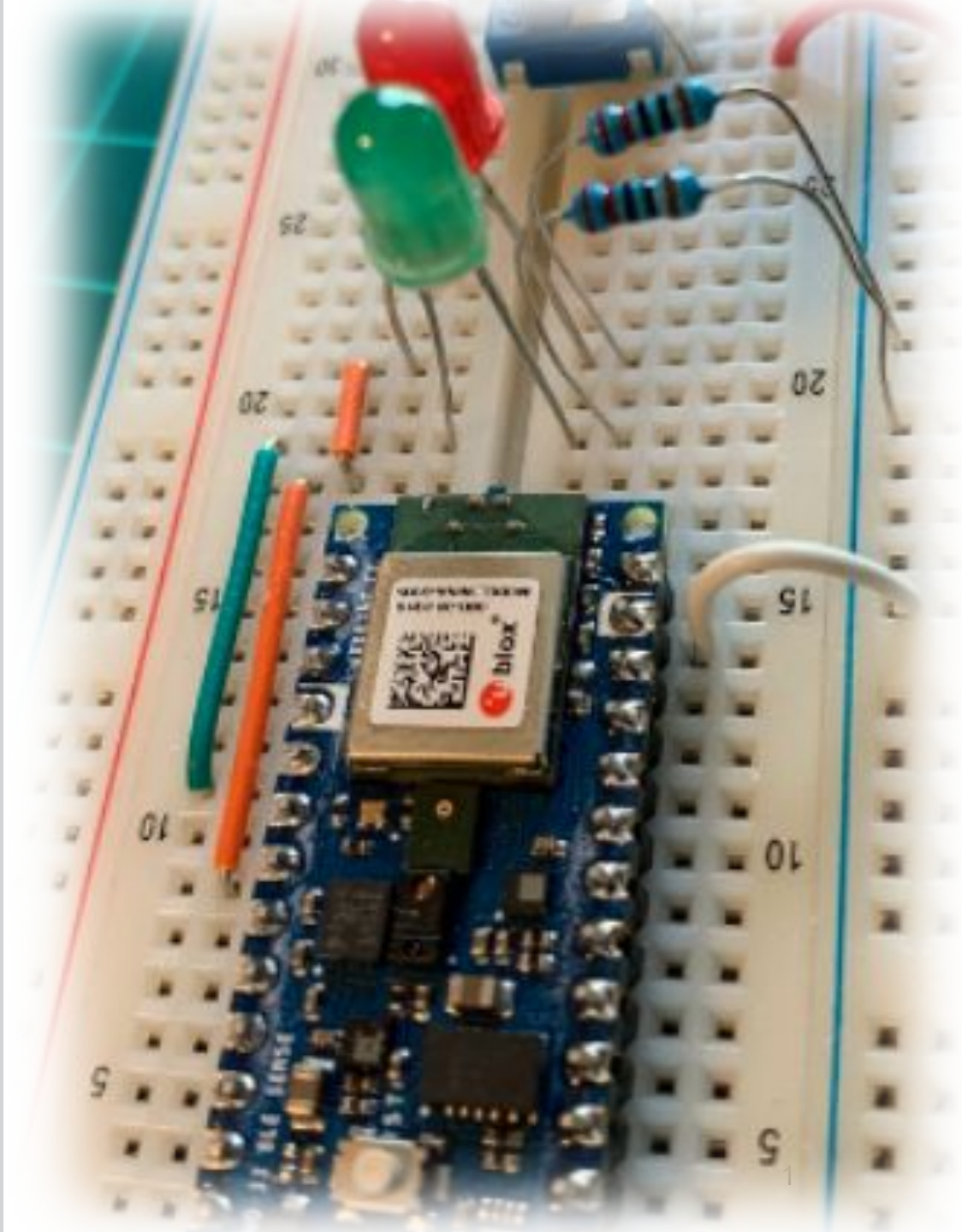
IESTI01 – TinyML

Embedded Machine Learning

17. TinyML Kit Overview - HW and SW installation & Test



Prof. Marcelo Rovai
UNIFEI

TinyML Kit Overview

ARDUINO
TINY MACHINE
LEARNING KIT
in partnership with:
edX
TensorFlow
OV7675

Nano 33 BLE Sense (+ USB cable)

Purpose

AI-enabled developmental **microcontroller board** with USB-A to microB cable

Specifications

- nRF52840 MCU (ARM Cortex-M4): 3.3V, 64MHz, 1MB flash, 256 kB RAM
- Sensors on board: microphone, IMU, color, light, proximity, temperature, humidity, and more!
- BLE module with application-adjacent protocol layers (GAP, GATT) covered by **ArduinoBLE** library

OV 7675 Camera Module

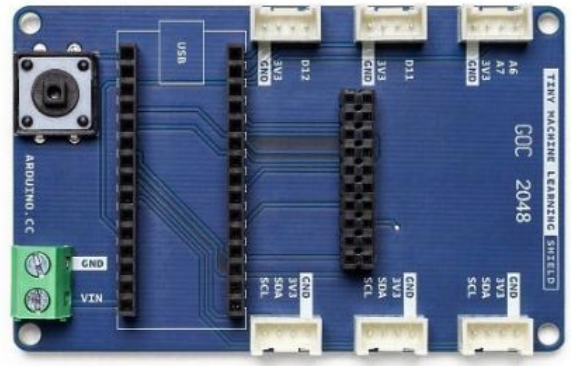
Purpose

Breakout PCB for ***tiny*** camera, for use in person-detection exercises

Specifications

- Low-voltage, 0.3 MP CMOS VGA (can step down to QVGA, QQVGA) image sensor
- Serial Camera Control Bus (SCCB) + Camera Parallel Interface (CPI) / Digital Video Port (DVP) interface
- Breaks ribbon cable out to 2x10 pin array

Tiny Machine Learning Shield

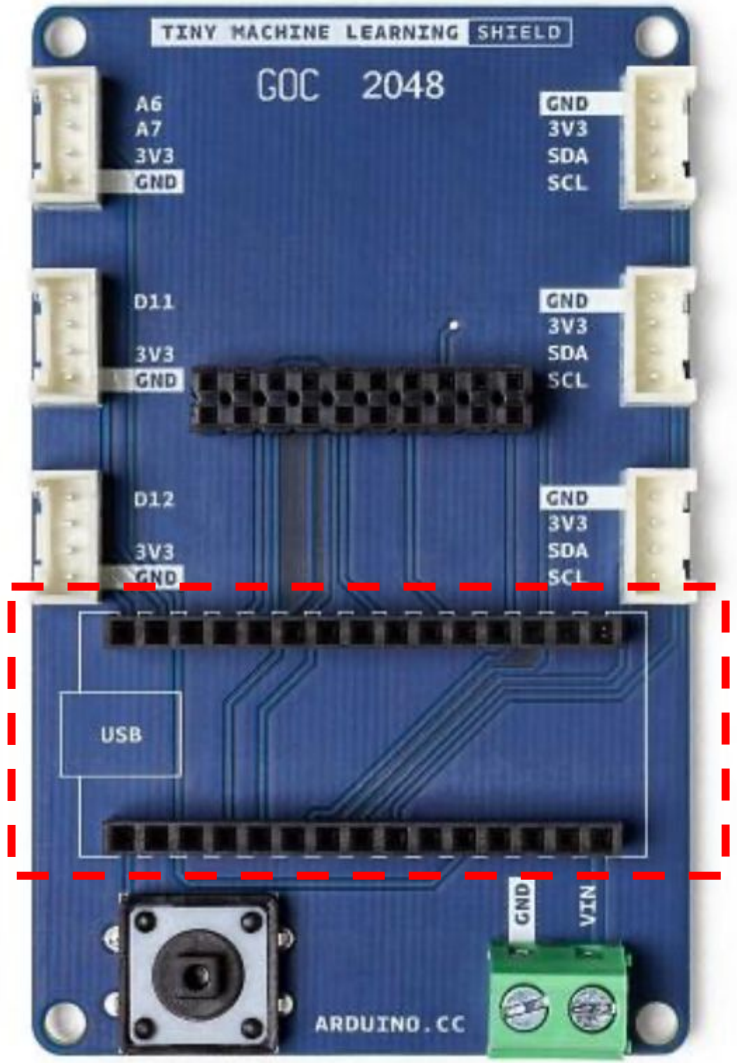


Purpose

A daughter PCB designed to **breakout the I/O** from the Nano 33 BLE sense to permit easy, reliable **communication with** other local, **off-board elements**

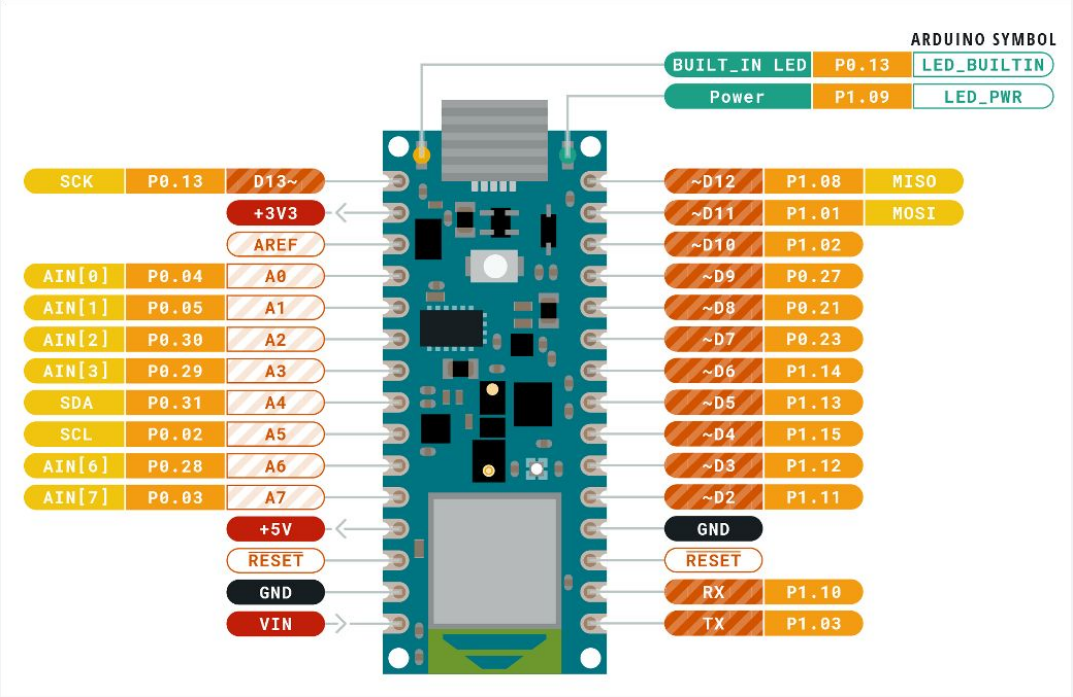
Specifications

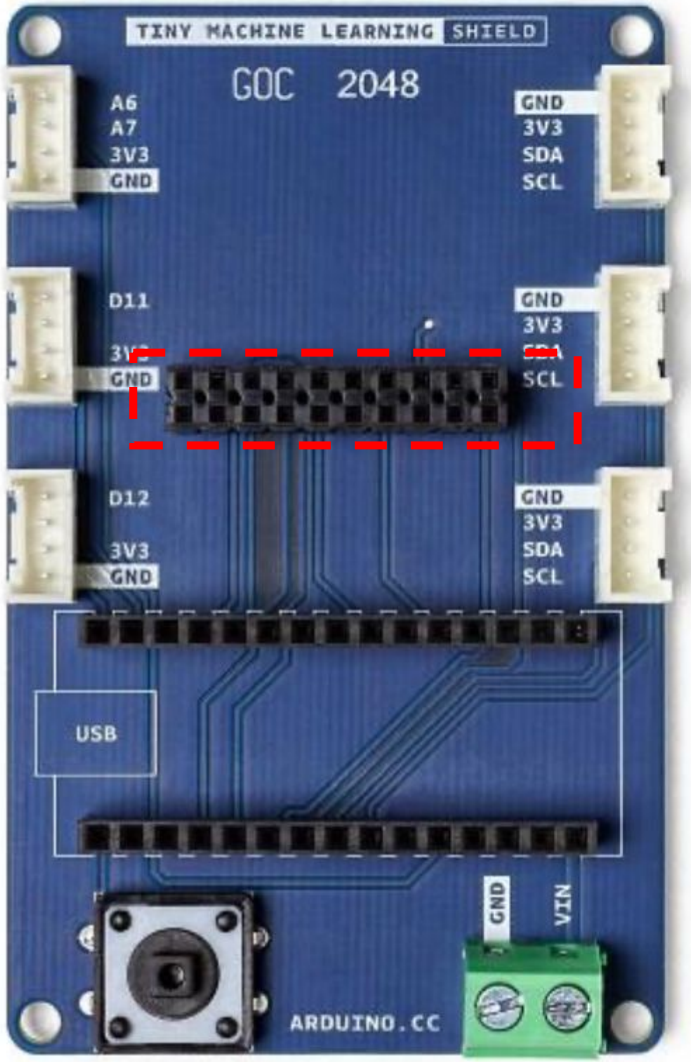
- Grove connectors (3.3V I2C and simple digital / analog - see pinouts)
- 2x10 pin array for OV7675 camera module
- Voltage input terminal block, accepts 4.5 to 21V (down regulated to 3.3V on Nano 33)



TinyML Shield

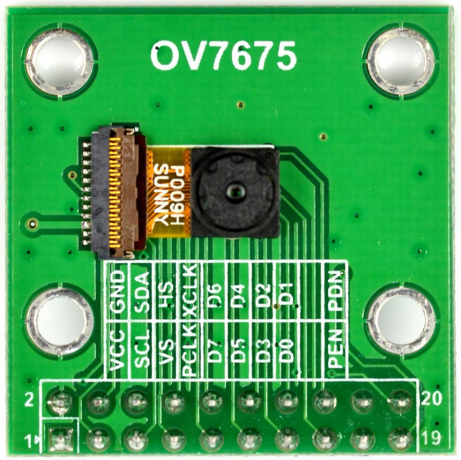
Two rows of 1x15 headers that you can slot the Nano 33 BLE sense into



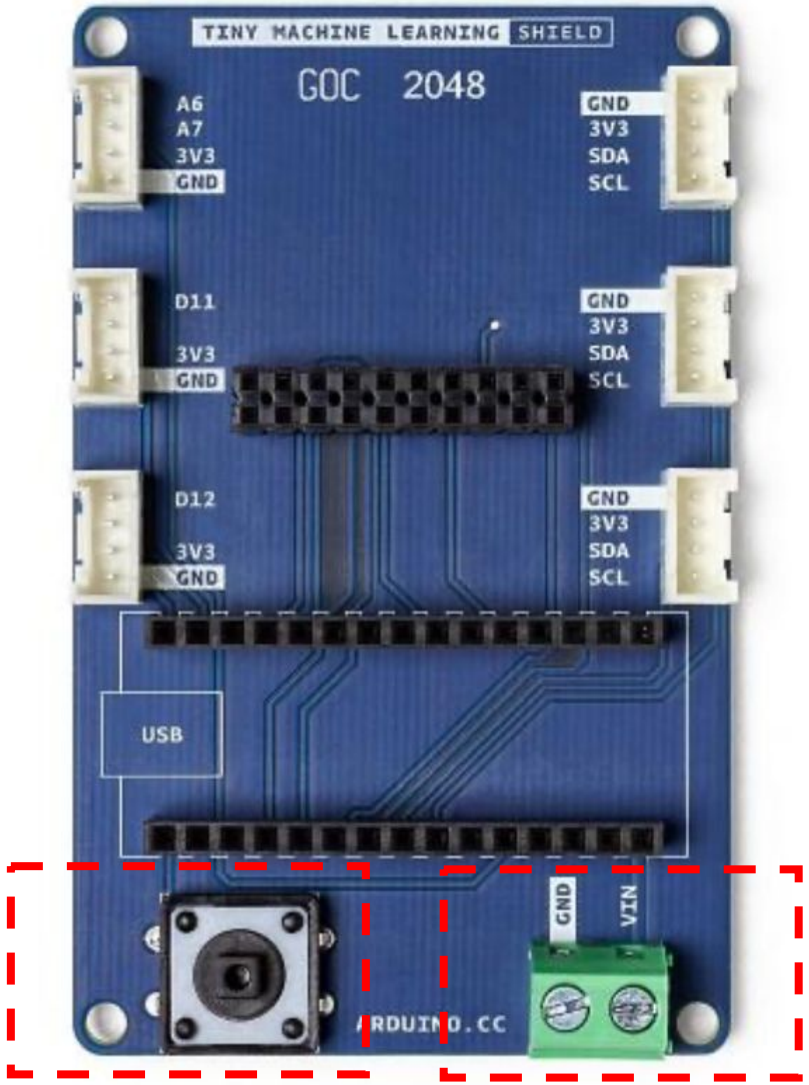


TinyML Shield

2x10 header that is intended to receive the corresponding pins of the OV7675 camera module

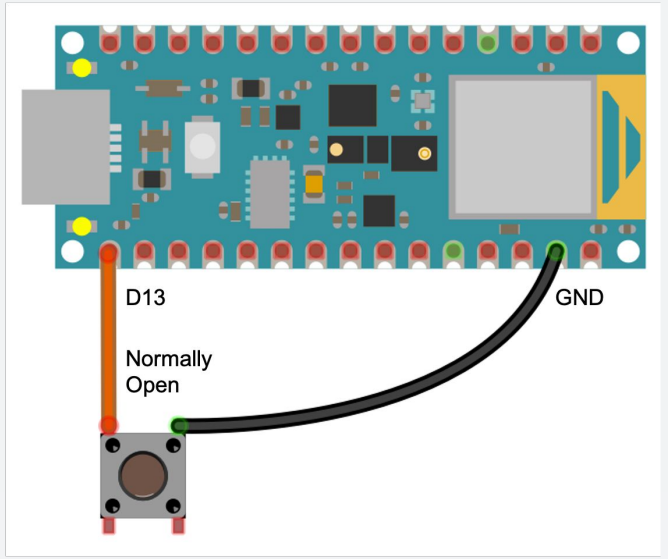


OV7670_VSYNC	8
OV7670_HREF	A1
OV7670_PLK	A0
OV7670_XCLK	9
OV7670_D0	10
OV7670_D1	1
OV7670_D2	0
OV7670_D3	2
OV7670_D4	3
OV7670_D5	5
OV7670_D6	6
OV7670_D7	4

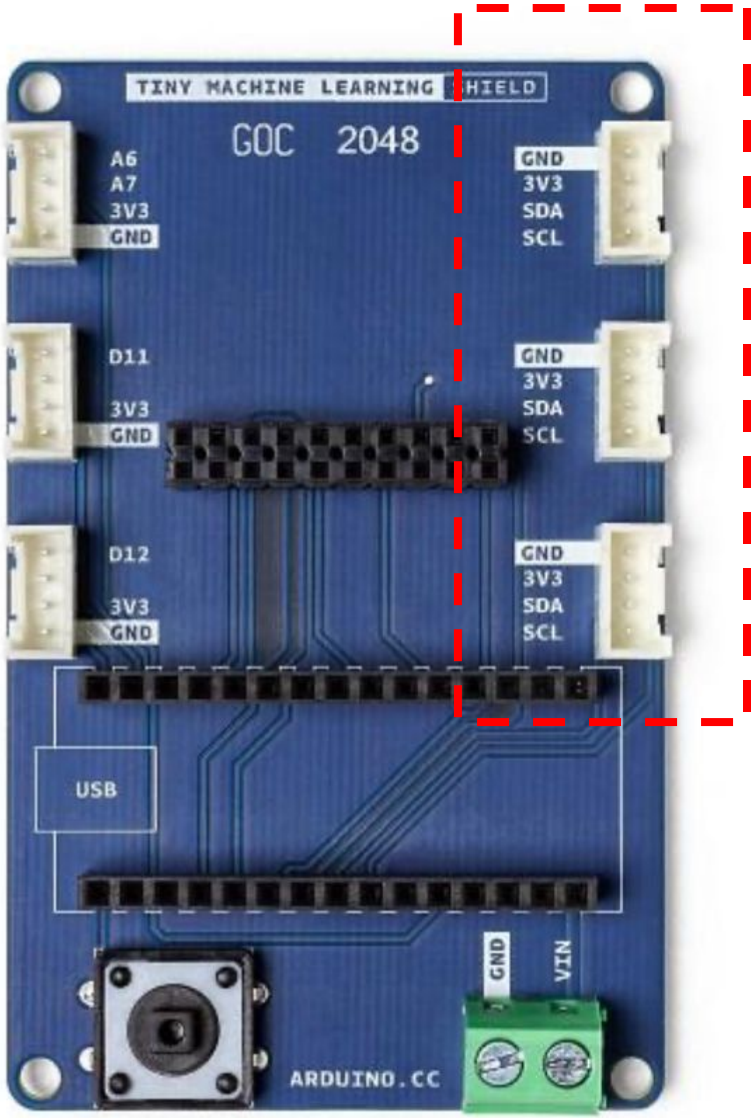


TinyML Shield

A easily programmable button on the left

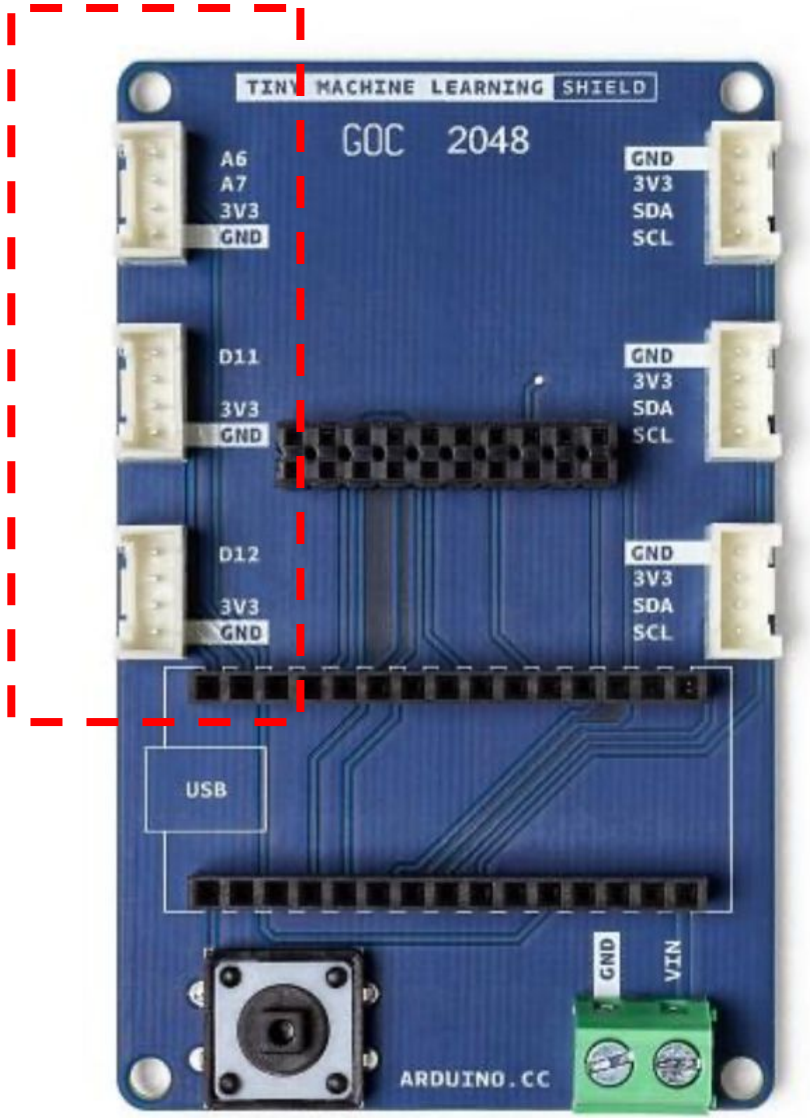


Screw-in terminal block for external (battery) power



TinyML Shield

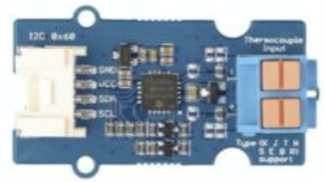
Standard Grove connectors, to permit serial communication (I2C = power + data + clock) with modules (both sensors and actuators)

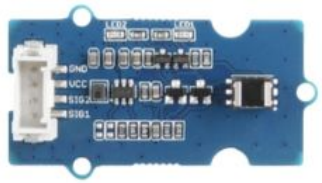


TinyML Shield

Grove connectors that break out analog and digital GPIO

Grove Connectors





Purpose

Facilitate **plug-and-play connections** to off-board modules to extend the possible scope of functionality to new **TinyML** applications

Specifications

- Proprietary connection system from SeeedStudio, similar to JST PH-type connectors
- Large catalog of sensors, actuators available at seeedstudio.com
- Be sure to check the voltage requirements and pinout of any new Grove module for compatibility with this shield before purchasing or connecting said module

TinyML Kit Installation

- Hardware Set-up
- Software Set-up

TinyML Kit Test

- MCU test (Blink)
- TFLM test (Hello World)
- Sensors Test (IMU, MIC, CAMERA)

Reading Material

Main references

- Harvard School of Engineering and Applied Sciences - CS249r: Tiny Machine Learning
- Professional Certificate in Tiny Machine Learning (TinyML) – edX/Harvard
- Introduction to Embedded Machine Learning (Coursera)
- Text Book: "TinyML" by Pete Warden, Daniel Situnayake

I want to thank Shawn Hymel and Edge Impulse, Pete Warden and Laurence Moroney from Google, and especially Harvard professor Vijay Janapa Reddi, Ph.D. student Brian Plancher and their staff for preparing the excellent material on TinyML that is the basis of this course at UNIFEI.

The IESTI01 course is part of the TinyML4D, an initiative to make TinyML education available to everyone globally.

Thanks

And stay safe!

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