

SciTinyML

Scientific Use of Machine Learning on Low Power Devices

Regional Workshop - Africa

Arduino Nano-33 BLE Sense EI set-up and
Getting Started with Edge Impulse

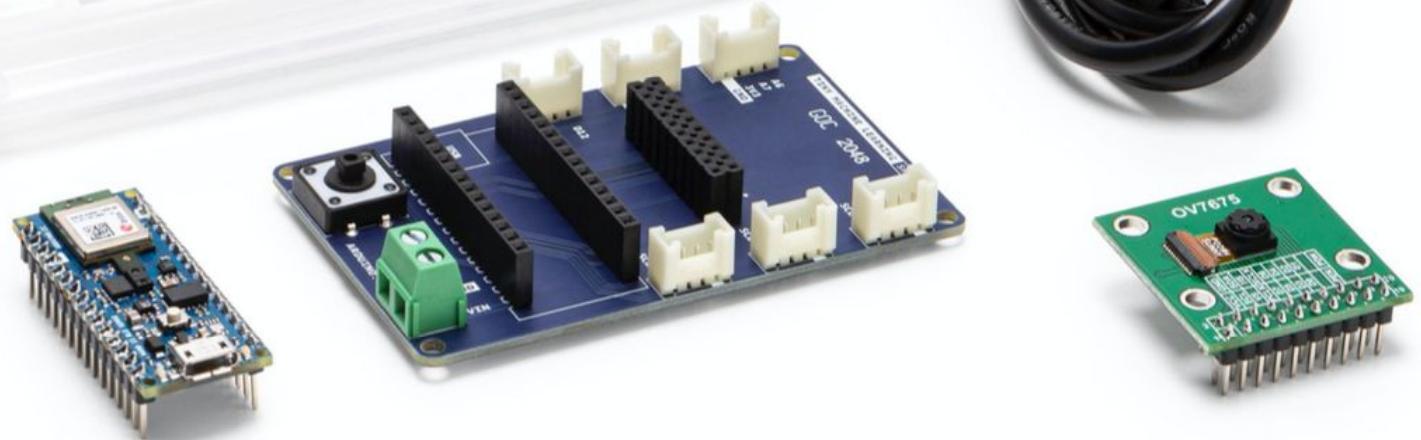
*Marcelo Rovai
Professor, UNIFEI - Brazil*

*Shawn Himel
Senior DevRel Engineer, Edge Impulse*

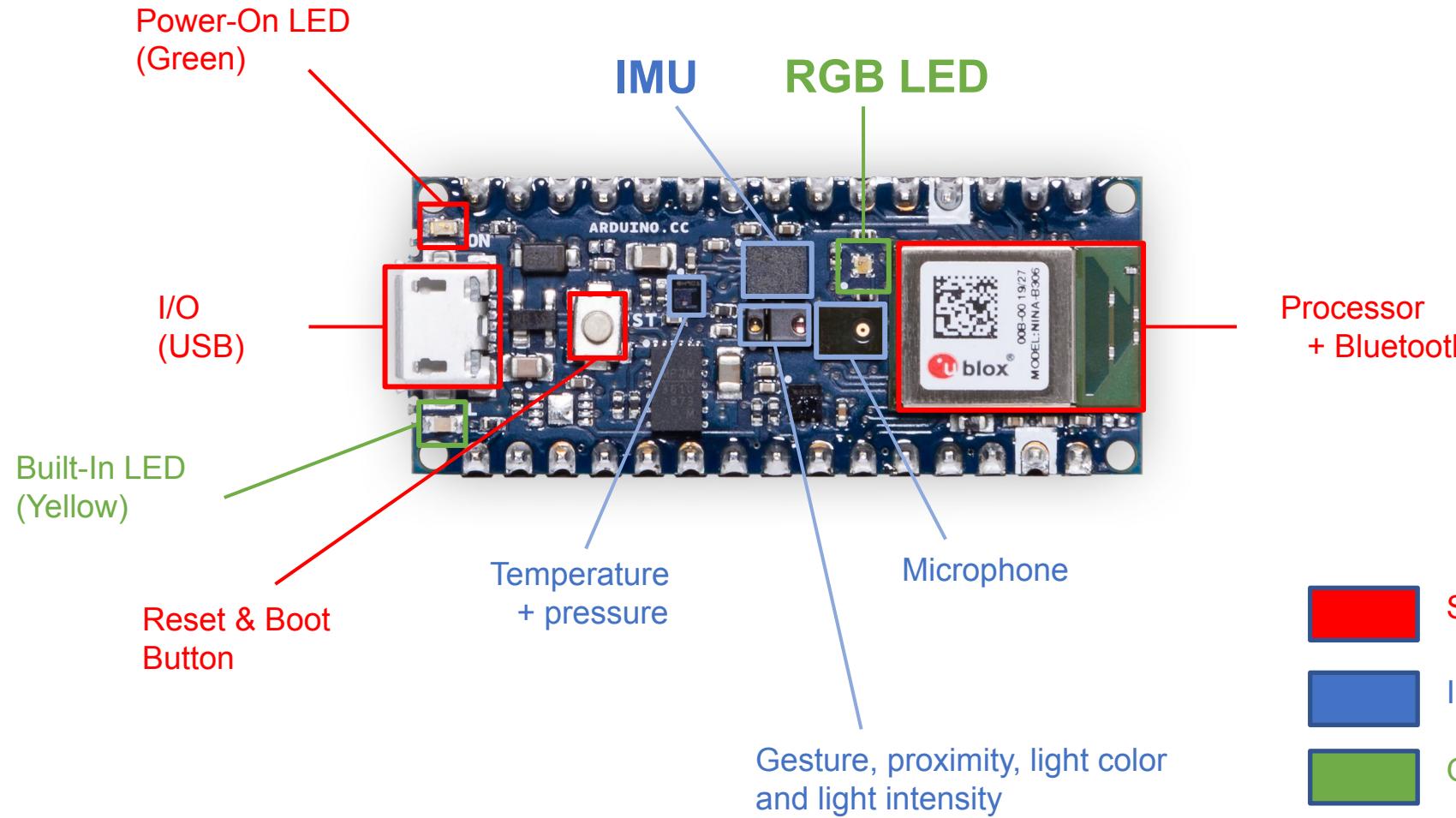


Arduino Nano-33 BLE

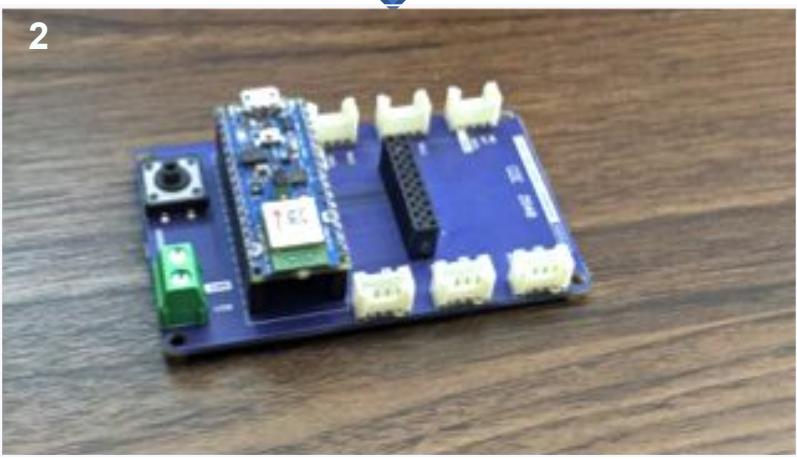
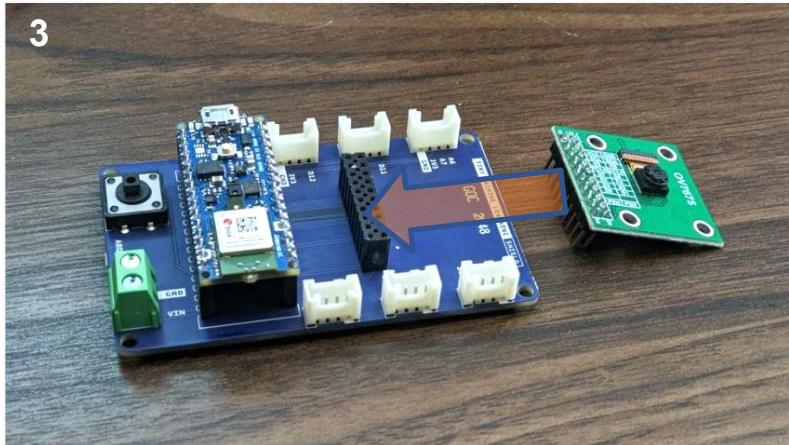
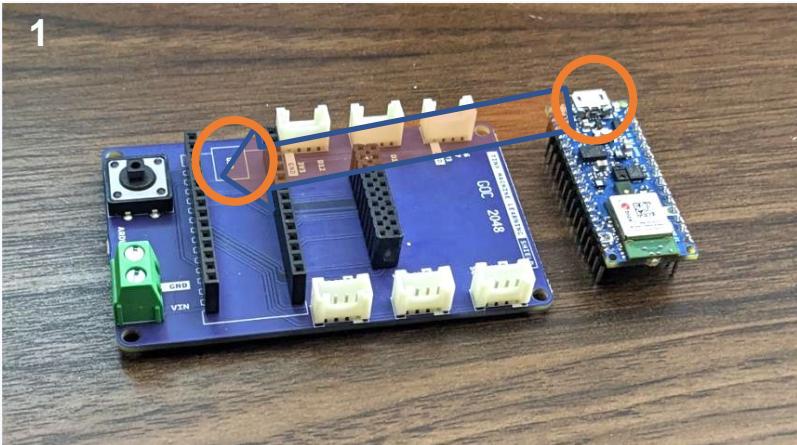
Set up board and Arduino IDE



Nano 33 BLE Sense (Development board)



Installing the Hardware



Installing the Arduino IDE

This page is available in another language. Switch to: English

Arduino Web Editor
Start coding online and save your sketches in the cloud. The most up-to-date version of the IDE includes all libraries and also supports new Arduino boards.

[CODE ONLINE](#) [GETTING STARTED](#)

Arduino Cloud
Set up automated lighting in minutes.
[Get started!](#)

Downloads

Arduino IDE 1.8.19

The open-source Arduino Software (IDE) makes it easy to write code and upload it to the board. This software can be used with any Arduino board.

Refer to the [Getting Started](#) page for Installation instructions.

SOURCE CODE
Active development of the Arduino software is [hosted by GitHub](#). See the instructions for [building the code](#). Latest release source code archives are available [here](#). The archives are PGP-signed so they can be verified using [this gpg key](#).

DOWNLOAD OPTIONS

Windows Win 7 and newer
Windows ZIP file

Windows app Win 8.1 or 10 [Get](#)

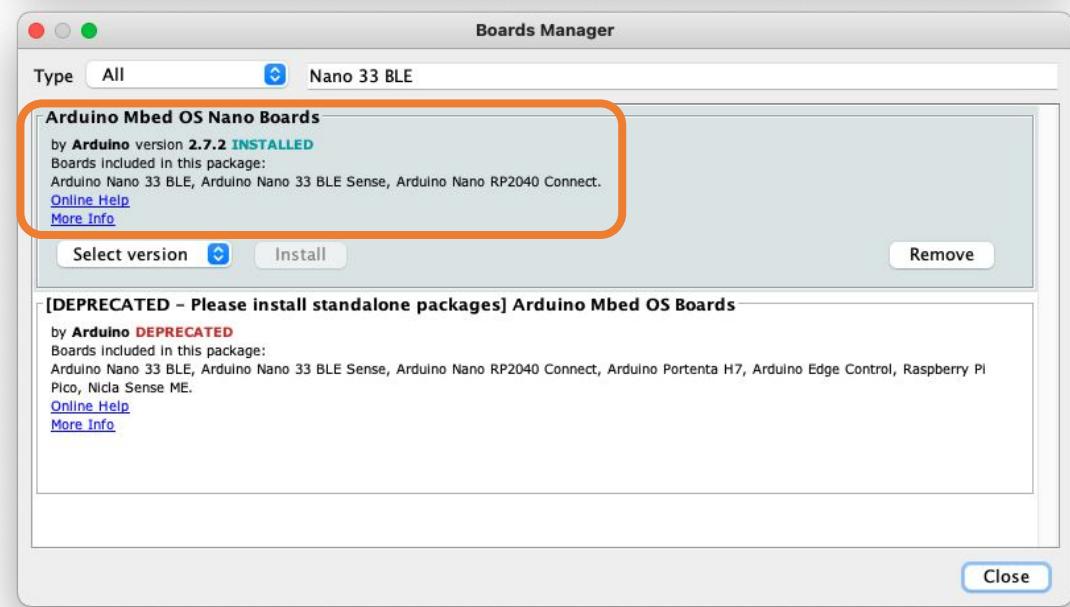
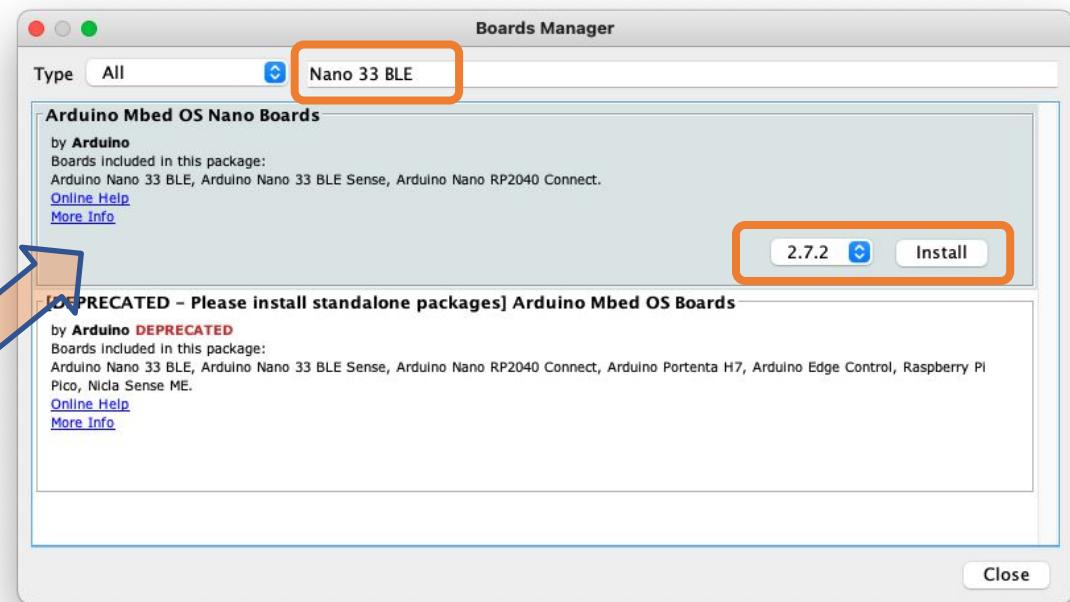
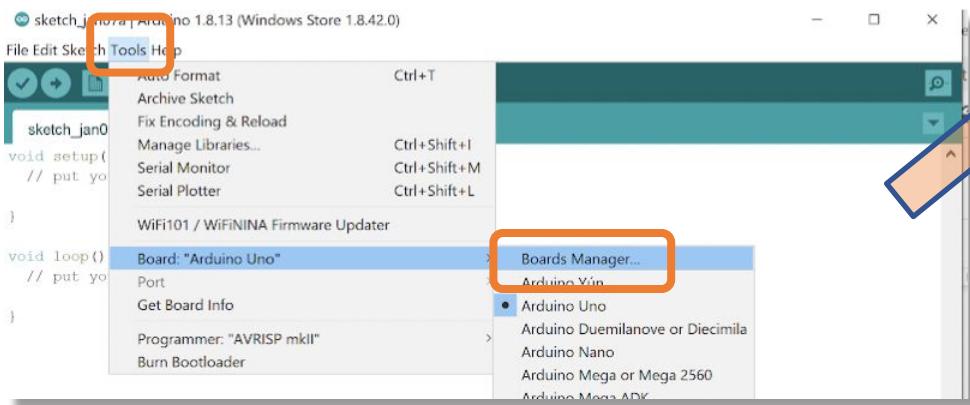
Linux 32 bits
Linux 64 bits
Linux ARM 32 bits
Linux ARM 64 bits

Mac OS X 10.10 or newer

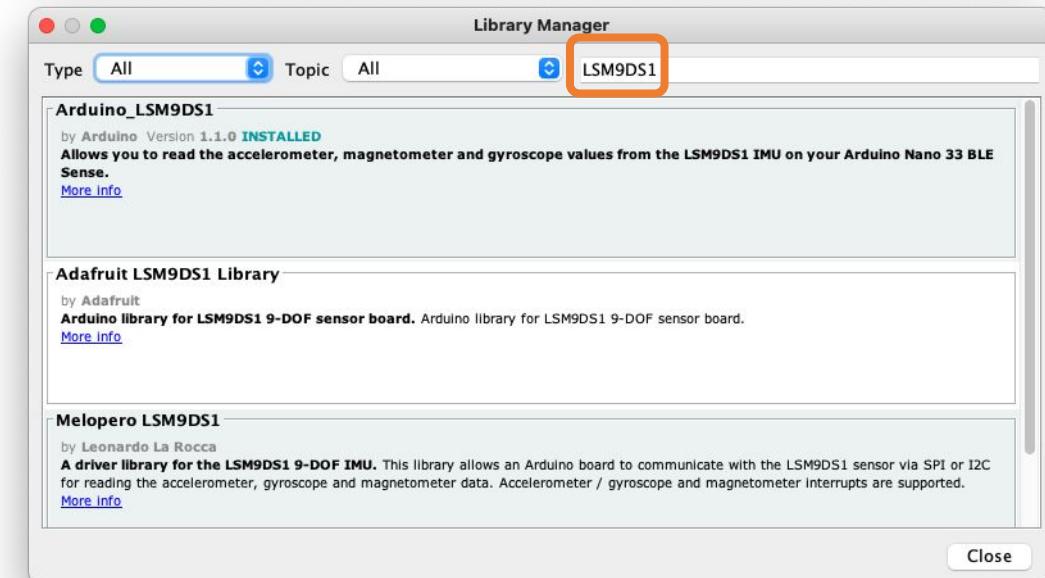
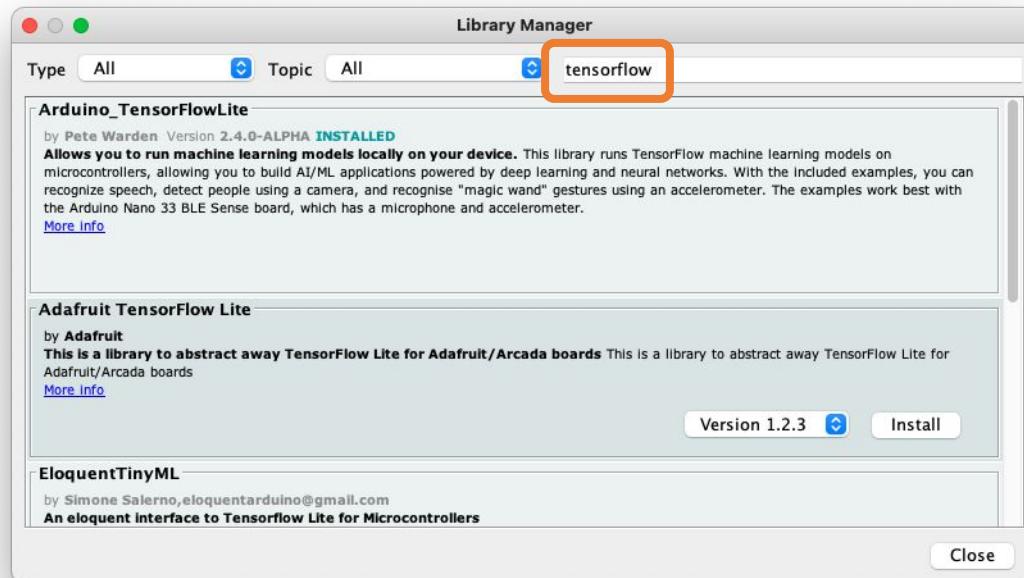
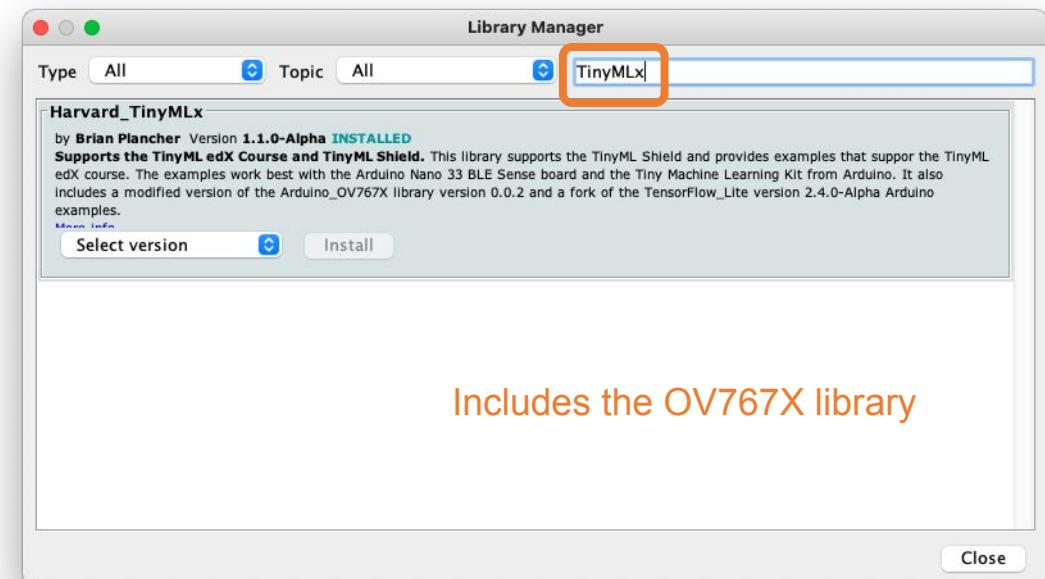
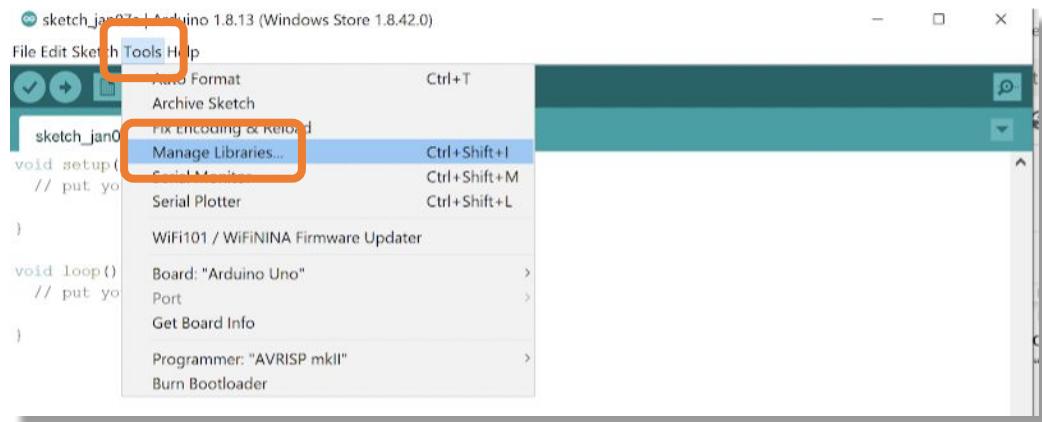
[Release Notes](#)
[Checksums \(sha512\)](#)

[Help](#)

Installing the Board Files



Installing the Main Libraries



Set up connection between Arduino Nano
and Edge Impulse

Login - Edge Impulse

studio.edgeimpulse.com/login

EDGE IMPULSE

Log in

rovai@mjrobot.org

.....

[Forgot your password?](#)

[Log in](#)

Don't have an account? [Sign up](#)



Start building embedded machine learning models today.

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Select project - Edge Impulse

studio.edgeimpulse.com/studio/select-project

EDGE IMPULSE

MJRoBot (Marcelo Rovai)

Select project

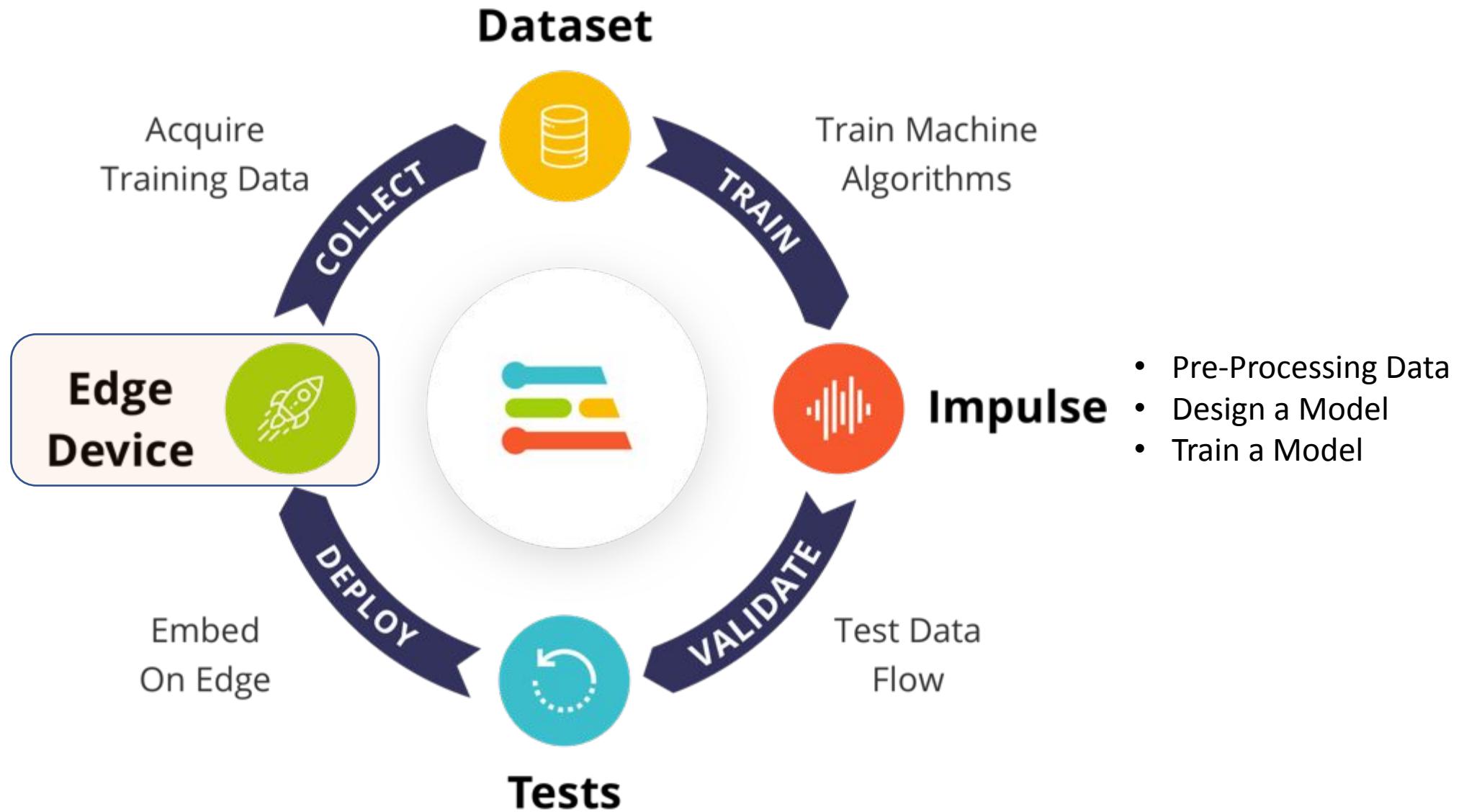
Select your Edge Impulse project, or create a new one.

NAME	COLLABORATORS
MJRoBot (Marcelo Rovai) / IESTI01 - Nano Motion Classification	?
MJRoBot (Marcelo Rovai) / oi_rovis_kws	
MJRoBot (Marcelo Rovai) / Eggs AI	
MJRoBot (Marcelo Rovai) / Accelerometer-Nano-Ble-IoT	
MJRoBot (Marcelo Rovai) / video_tinyml_raw	
MJRoBot (Marcelo Rovai) / Pico_Motion_Detection	
MJRoBot (Marcelo Rovai) / oi_rovis_kws_meetup	

Create project

Enter a name for your new project

Cancel Create new project



Devices - IESTI01 - Nano Motion Classification

studio.edgeimpulse.com/studio/61345/devices

MJRoBot (Marcelo Rovai)

EDGE IMPULSE

1 Devices

2 + Connect a new device

3 Browse dev boards

DEVICES (IESTI01 - NANO MOTION CLASSIFICATION)

Your devices

These are devices that are connected to the Edge Impulse remote management API, or have posted data to the ingestion SDK.

Collect data

You can collect data from development boards, from your own devices, or by uploading an existing dataset.

Connect a fully supported development board

Get started with real hardware from a wide range of silicon vendors - fully supported by Edge Impulse.

Browse dev boards

Use your mobile phone

Use your computer

Data from any device with the data forwarder

Upload data

Integrate with your cloud

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GETTING STARTED

Documentation

Forums

<https://docs.edgeimpulse.com/docs/fully-supported-development-boards>

The screenshot shows the Edge Impulse studio interface. The left sidebar has a 'Devices' item highlighted with an orange box and the number '1'. The top right corner shows a user profile with the name 'MJRoBot (Marcelo Rovai)'. A large orange box labeled '2' surrounds the '+ Connect a new device' button in the top right. A third orange box labeled '3' surrounds the 'Browse dev boards' button in the 'Collect data' modal window. The main content area displays a 'Your devices' section with a message about connected devices and a 'Collect data' modal with various data collection options.

Devices - SciTinyML-Motion-A Page not found - Edge Impulse

docs.edgeimpulse.com/docs/fully-supported-development-boards

EDGE IMPULSE

Guides API Reference Forum

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Frequently asked questions

DEVELOPMENT BOARDS

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ST B-L475E-IOT01A

Arduino Nano 33 BLE Sense

Arduino Portenta H7 + Vision Shield

Open MV Cam H7 Plus

Himax WE-I Plus

Nordic Semi nRF52840 DK

Nordic Semi nRF5340 DK

Nordic Semi nRF9160 DK

Nordic Semi Thingy:91

SiLabs Thunderboard Sense 2

Sony's Spresense

Syntiant Tiny ML Board

Powered By GitBook

Page not found

Sorry, but the page you were looking for could not be found.

Back to front page



EI/Arduino CLI

Devices - SciTinyML-Motion-A X Arduino Nano 33 BLE Sense - E Arduino Nano 33 BLE Sense - E +

docs.edgeimpulse.com/docs/development-boards/arduino-nano-33-ble-sense

EDGE IMPULSE Guides API Reference Forum Search... Search...

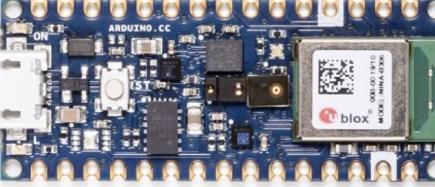
Getting Started API and SDK references What is embedded ML, anyway? Frequently asked questions DEVELOPMENT BOARDS Overview ST B-L475E-IOT01A Arduino Nano 33 BLE Sense Arduino Portenta H7 + Vision Shield Open MV Cam H7 Plus Himax WE-I Plus Nordic Semi nRF52840 DK Nordic Semi nRF5340 DK Nordic Semi nRF9160 DK Nordic Semi Thingy:91 SiLabs Thunderboard Sense 2 Sony's Spresense Syntiant Tiny ML Board TI CC1352P Launchpad Raspberry Pi 4 Raspberry Pi RP2040 NVIDIA Jetson Nano Intel Based Macs Linux x86_64 Mobile Phone Powered By GitBook

Arduino Nano 33 BLE Sense

The Arduino Nano 33 BLE Sense is a tiny development board with a Cortex-M4 microcontroller, motion sensors, a microphone and BLE - and it's fully supported by Edge Impulse. You'll be able to sample raw data, build models, and deploy trained machine learning models directly from the studio. It's available for around 30 USD from [Arduino](#) and a wide range of distributors.

You can also use the [Arduino Tiny Machine Learning Kit](#) to run image classification models on the edge with the Arduino Nano and attached OV7675 camera module (or [connect the hardware together via jumper wire and a breadboard](#) if purchased separately).

The Edge Impulse firmware for this development board is open source and hosted on GitHub:
[edgeimpulse/firmware-arduino-nano-33-ble-sense](#).



Arduino Nano 33 BLE Sense

Installing dependencies

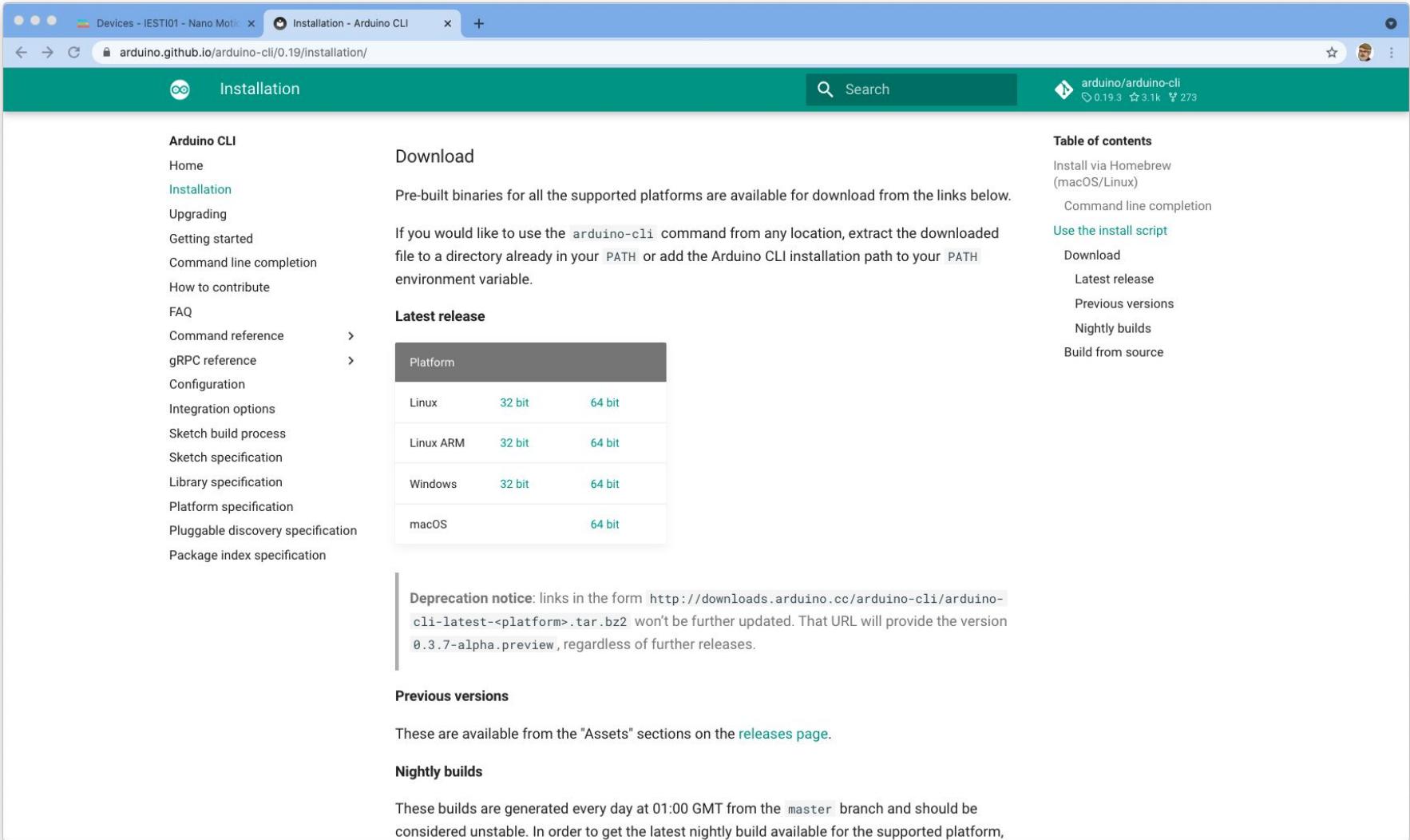
To set this device up in Edge Impulse, you will need to install the following software:

1. [Edge Impulse CLI](#).
2. [Arduino CLI](#).
 - Here's an [instruction video for Windows](#).
 - The [Arduino website](#) has instructions for macOS and Linux.

(Note that the 1. Edge Impulse CLI is not necessary for Arduino Nano-33. We will use [WebUSB](#) instead)

Go to 2. Arduino CLI

Arduino CLI



The screenshot shows the "Installation" page for the Arduino CLI on GitHub. The URL in the address bar is arduino.github.io/arduino-cli/0.19/installation/. The page has a green header with the title "Installation". On the left, there's a sidebar with links like Home, Installation (which is active), Upgrading, Getting started, Command line completion, How to contribute, FAQ, Command reference, gRPC reference, Configuration, Integration options, Sketch build process, Sketch specification, Library specification, Platform specification, Pluggable discovery specification, and Package index specification. The main content area starts with a "Download" section, which says "Pre-built binaries for all the supported platforms are available for download from the links below." It then provides instructions for using the command line and shows a "Latest release" table:

Platform	32 bit	64 bit
Linux	32 bit	64 bit
Linux ARM	32 bit	64 bit
Windows	32 bit	64 bit
macOS		64 bit

Below the table, there's a "Deprecation notice" message: "Deprecation notice: links in the form <http://downloads.arduino.cc/arduino-cli/arduino-cli-latest-<platform>.tar.bz2> won't be further updated. That URL will provide the version 0.3.7-alpha.preview, regardless of further releases." Further down, there are sections for "Previous versions" (with a note about assets on the releases page) and "Nightly builds" (with a note about builds from the master branch).



See this video for Windows installation: <https://www.youtube.com/watch?v=1jMWsFER-Bc>

Devices - SciTinyML-Motion-A X Arduino Nano 33 BLE Sense - E Installation - Arduino CLI x +

docs.edgeimpulse.com/docs/development-boards/arduino-nano-33-ble-sense

EDGE IMPULSE Guides API Reference Forum Search...

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ST B-L475E-IOT01A

Arduino Nano 33 BLE Sense

Arduino Portenta H7 + Vision Shield

Open MV Cam H7 Plus

Himax WE-I Plus

Nordic Semi nRF52840 DK

Nordic Semi nRF5340 DK

Nordic Semi nRF9160 DK

Nordic Semi Thingy:91

SiLabs Thunderboard Sense 2

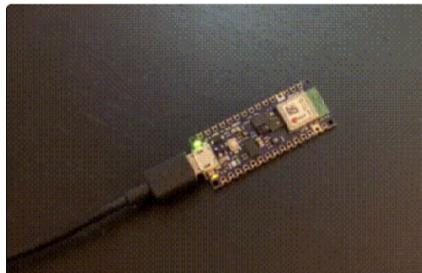
Sony's Spresense

Syntiant Tiny ML Board

Powered By GitBook

1 **1. Connect the development board to your computer**

Use a micro-USB cable to connect the development board to your computer. Then press RESET twice to launch into the bootloader. The on-board LED should start pulsating to indicate this.



Press RESET twice quickly to launch the bootloader on the Arduino Nano 33 BLE Sense.

2 **2. Update the firmware**

The development board does not come with the right firmware yet. To update the firmware:

1. Download the latest Edge Impulse firmware, and unzip the file.
2. Open the flash script for your operating system (`flash_windows.bat` , `flash_mac.command` or `flash_linux.sh`) to flash the firmware.
3. Wait until flashing is complete, and press the RESET button once to launch the new firmware.

3 **3. Setting keys**

From a command prompt or terminal, run:

1_edge-impulse-daemon

MacOS

```
mjrovai — flash_mac.command — 126x44
Last login: Tue Nov  9 12:15:56 on ttys002
You have new mail.
/Users/mjrovai/Downloads/arduino-nano-33-ble-sense\ \(2\)/flash_mac.command ; exit;

The default interactive shell is now zsh.
To update your account to use zsh, please run `chsh -s /bin/zsh`.
For more details, please visit https://support.apple.com/kb/HT208050.
(base) MacBook-Pro-de-Marcelo:~ mjrovai$ /Users/mjrovai/Downloads/arduino-nano-33-ble-sense\ \(2\)/flash_mac.command ; exit;
Finding Arduino Mbed core...
Finding Arduino Mbed OK
Finding Arduino Nano 33 BLE...
Finding Arduino Nano 33 BLE OK
Flashing board...
Device      : nRF52840-QIAA
Version     : Arduino Bootloader (SAM-BA extended) 2.0 [Arduino:IKXYZ]
Address     : 0x0
Pages       : 256
Page Size   : 4096 bytes
Total Size  : 1024KB
Planes      : 1
Lock Regions: 0
Locked      : none
Security    : false
Erase flash

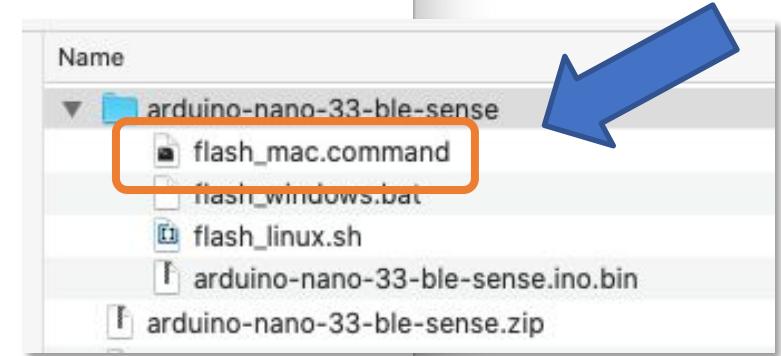
Done in 0.001 seconds
Write 280848 bytes to flash (69 pages)
[=====] 100% (69/69 pages)
Done in 10.984 seconds

Flashed your Arduino Nano 33 BLE development board.
To set up your development with Edge Impulse, run 'edge-impulse-daemon'
To run your impulse on your development board, run 'edge-impulse-run-impulse'
logout
Saving session...
...copying shared history...
...saving history...truncating history files...
...completed.

[Process completed]
```

3.Nano-33 LED Stop Flashing

1. Press Nano-33 Reset button Twice
2. With Nano-33 LED Flashing:



Windows 10

```
Prompt de Comando
Microsoft Windows [versão 10.0.19041.1052]
(c) Microsoft Corporation. Todos os direitos reservados.

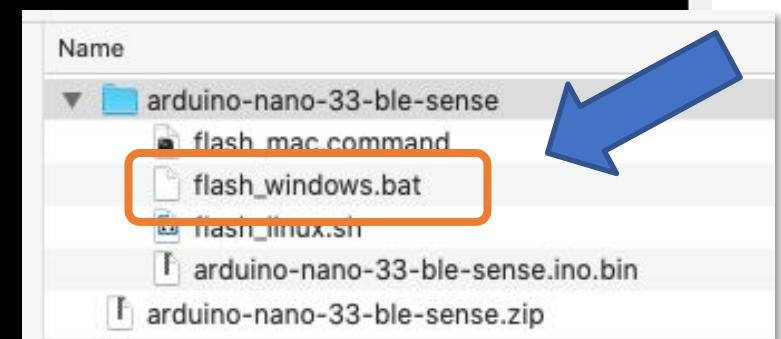
C:\Users\GUILH>arduino-cli
Arduino Command Line Interface (arduino-cli).

Usage:
  arduino-cli [command]

Examples:
  arduino-cli <command> [flags...]

Available Commands:
  board           Arduino board commands.
  burn-bootloader Upload the bootloader.
  cache           Arduino cache commands.
  compile         Compiles Arduino sketches.
  completion     Generates completion scripts
  config          Arduino configuration commands.
  core            Arduino core operations.
  daemon          Run as a daemon on port 50051
  debug           Debug Arduino sketches.
  help            Help about any command
  lib              Arduino commands about libraries.
  outdated        Lists cores and libraries that can be upgraded
  sketch          Arduino CLI sketch commands.
  update          Updates the index of cores and libraries
  upgrade         Upgrades installed cores and libraries.
  upload          Upload Arduino sketches.
  version         Shows version number of Arduino CLI.
```

1. Press Nano-33 Reset button Twice
2. With Nano-33 LED Flashing:



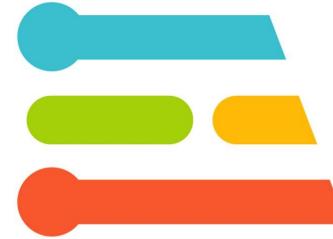
Windows 10

```
cmd C:\WINDOWS\system32\cmd.exe
Finding Arduino Mbed core...
arduino:mbed_nano 2.0.0      2.0.0  Arduino Mbed OS Nano Boards
Finding Arduino Mbed core OK
Finding Arduino Nano 33 BLE...
Finding Arduino Nano 33 BLE OK at COM11
arduino:mbed_nano 2.0.0      2.0.0  Arduino Mbed OS Nano Boards
Device      : nRF52840-QIAA
Version     : Arduino Bootloader (SAM-BA extended) 2.0 [Arduino:IKXYZ]
Address     : 0x0
Pages       : 256
Page Size   : 4096 bytes
Total Size  : 1024KB
Planes      : 1
Lock Regions: 0
Locked      : none
Security    : false
Erase flash

Done in 0.002 seconds
Write 525440 bytes to flash (129 pages)
[=====] 100% (129/129 pages)
Done in 22.296 seconds
Flashed your Arduino Nano 33 BLE development board
To set up your development with Edge Impulse, run 'edge-impulse-daemon'
To run your impulse on your development board, run 'edge-impulse-run-impulse'
Pressione qualquer tecla para continuar. . .
```

□ Nano-33 LED Stop Flashing

Thanks



Addendum: Using Edge Impulse CLI

DOCUMENTATION

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- [What is embedded ML, anyway?](#)
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DEVELOPMENT BOARDS

- [Overview](#)
- [ST B-L475E-IOT01A](#)
- [Arduino Nano 33 BLE Sense](#)
- [Eta Compute ECM3532 AI Sensor](#)
- [Eta Compute ECM3532 AI Vision](#)
- [OpenMV Cam H7 Plus](#)
- [Himax WE-I Plus](#)
- [Nordic Semi nRF52840 DK](#)
- [Nordic Semi nRF5340 DK](#)
- [SiLabs Thunderboard Sense 2](#)
- [Sony's Spresense](#)
- [Arduino Portenta H7 + Vision shield \(preview\)](#)
- [Raspberry Pi 4](#)
- [NVIDIA Jetson Nano](#)
- [Mobile phone](#)
- [Porting guide](#)

COMMUNITY BOARDS

- [Seeed Wio Terminal](#)
- [Agora Product Development Kit](#)

EDGE IMPULSE FOR LINUX

Installation

Edge Impulse CLI optional Installation

This Edge Impulse CLI is used to control local devices, act as a proxy to synchronise data for devices that don't have an internet connection, and to upload and convert local files. The CLI consists of seven tools:

- [edge-impulse-daemon](#) - configures devices over serial, and acts as a proxy for devices that do not have an IP connection.
- [edge-impulse-uploader](#) - allows uploading and signing local files.
- [edge-impulse-data-forwarder](#) - a very easy way to collect data from any device over a serial connection, and forward the data to Edge Impulse.
- [edge-impulse-run-impulse](#) - show the impulse running on your device.
- [edge-impulse-blocks](#) - create organizational transformation blocks.
- [eta-flash-tool](#) - to flash the Eta Compute ECM3532 AI Sensor.
- [himax-flash-tool](#) - to flash the Himax WE-I Plus.

Connect to devices without the CLI? Recent versions of Google Chrome and Microsoft Edge can connect directly to fully-supported development boards, without the CLI. See [this blog post](#) for more information.

Installation - macOS and Windows

- 
- 1. Install [Python 3](#) on your host computer.
 - 2. Install [Node.js](#) v14 or higher on your host computer.
 - For Windows users, install the **Additional Node.js tools** when prompted. You may skip this setup if you have Visual Studio 2015 or more.
 - 3. Install the CLI tools via:

```
npm install -g edge-impulse-cli --force
```

You should now have the tools available in your PATH.

Installation - Linux/Ubuntu and Raspbian OS

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3. Install the CLI tools via:

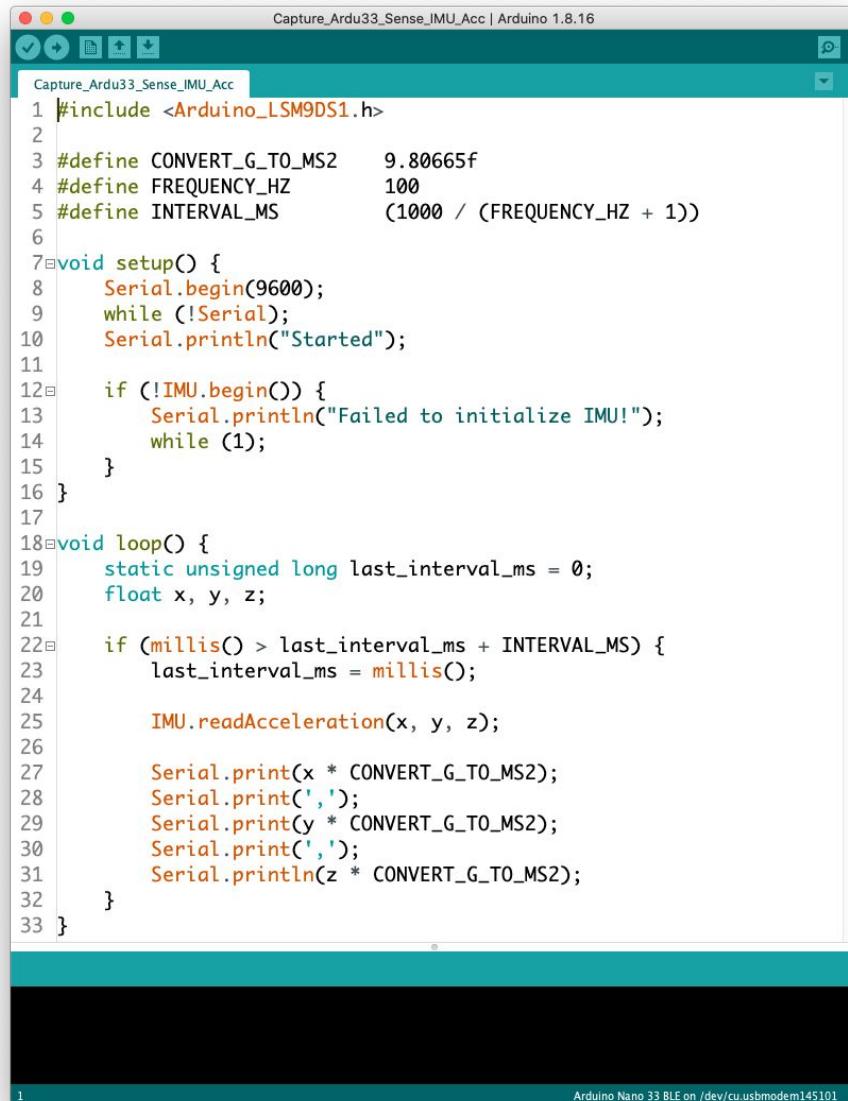
```
npm install -g edge-impulse-cli --force
```

You should now have the tools available in your PATH.

Installation - Linux/Ubuntu and Raspbian OS



Alternative Data Capture using EI CLI: \$ edge-impulse-data-forwarder



The screenshot shows the Arduino IDE interface with a sketch titled "Capture_Ardu33_Sense_IMU_Acc". The code is written in C++ and uses the Arduino library "Arduino_LSM9DS1.h". The code initializes the IMU, sets up the serial port at 9600 baud, and then enters a loop where it reads acceleration data from the IMU and prints it to the serial port. The print statement includes commas to separate the x, y, and z values.

```
#include <Arduino_LSM9DS1.h>
#define CONVERT_G_TO_MS2 9.80665f
#define FREQUENCY_HZ 100
#define INTERVAL_MS (1000 / (FREQUENCY_HZ + 1))

void setup() {
    Serial.begin(9600);
    while (!Serial);
    Serial.println("Started");

    if (!IMU.begin()) {
        Serial.println("Failed to initialize IMU!");
        while (1);
    }
}

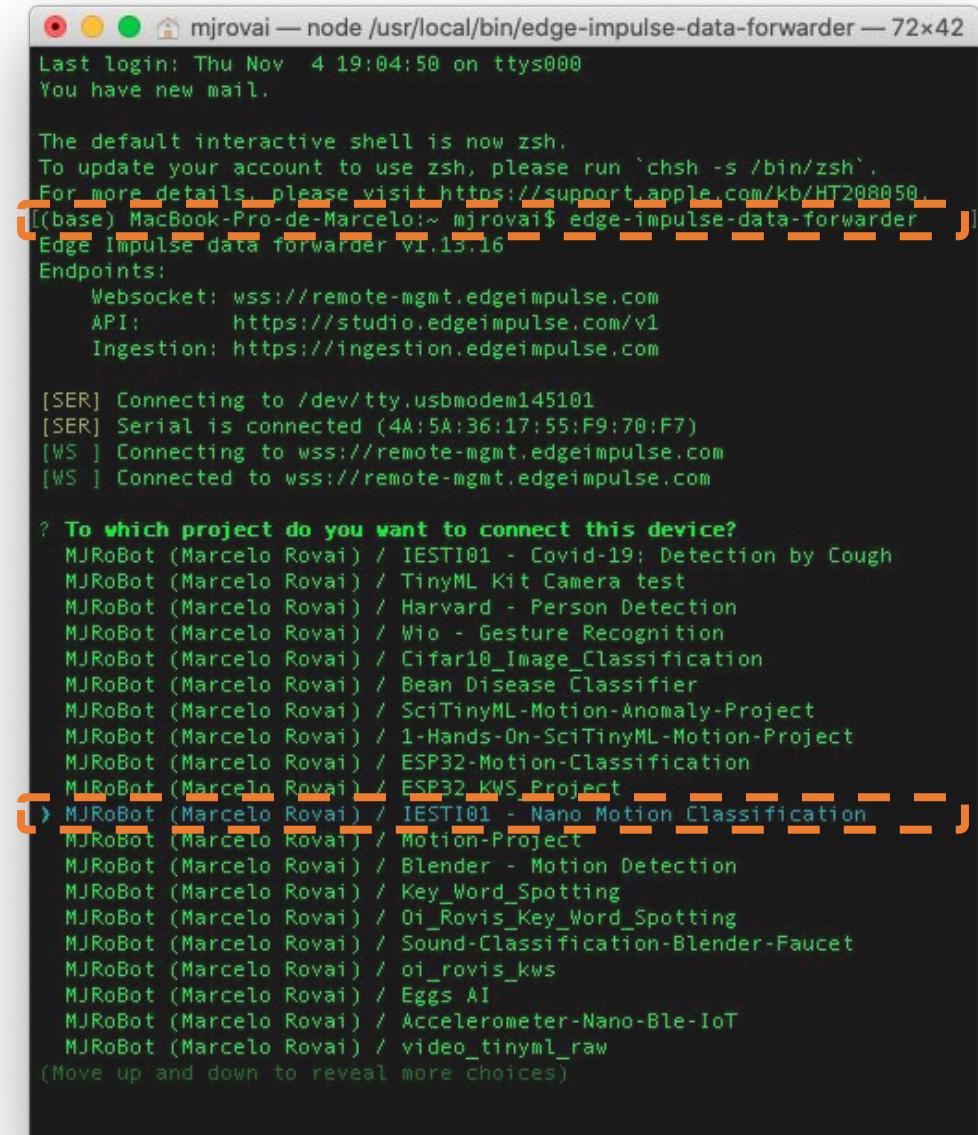
void loop() {
    static unsigned long last_interval_ms = 0;
    float x, y, z;

    if (millis() > last_interval_ms + INTERVAL_MS) {
        last_interval_ms = millis();

        IMU.readAcceleration(x, y, z);

        Serial.print(x * CONVERT_G_TO_MS2);
        Serial.print(',');
        Serial.print(y * CONVERT_G_TO_MS2);
        Serial.print(',');
        Serial.println(z * CONVERT_G_TO_MS2);
    }
}
```

Arduino Nano 33 BLE on /dev/cu.usbmodem145101



The screenshot shows a terminal window on a Mac OS X system. The user has run the command `edge-impulse-data-forwarder`. The terminal displays the default interactive shell (zsh), system login information, and the Edge Impulse data forwarder version (v1.13.16). It then lists the available endpoints: Websocket, API, and Ingestion. Subsequent lines show the forwarder connecting to the serial port and attempting to connect to the Edge Impulse management websocket endpoint. Finally, the user is prompted to select a project to connect the device to, listing several projects owned by "MJRobot (Marcelo Rovai)" such as IESTI01 - Covid-19: Detection by Cough, TinyML Kit Camera test, and others.

```
mjrovai — node /usr/local/bin/edge-impulse-data-forwarder — 72x42
Last login: Thu Nov  4 19:04:50 on ttys000
You have new mail.

The default interactive shell is now zsh.
To update your account to use zsh, please run `chsh -s /bin/zsh`.
For more details, please visit https://support.apple.com/kb/HT208050.

[base] MacBook-Pro-de-Marcelo:~ mjrovai$ edge-impulse-data-forwarder
Edge Impulse data forwarder v1.13.16
Endpoints:
  Websocket: wss://remote-mgmt.edgeimpulse.com
  API: https://studio.edgeimpulse.com/v1
  Ingestion: https://ingestion.edgeimpulse.com

[SER] Connecting to /dev/tty.usbmodem145101
[SER] Serial is connected (4A:5A:36:17:55:F9:70:F7)
[WS ] Connecting to wss://remote-mgmt.edgeimpulse.com
[WS ] Connected to wss://remote-mgmt.edgeimpulse.com

? To which project do you want to connect this device?
MJRobot (Marcelo Rovai) / IESTI01 - Covid-19: Detection by Cough
MJRobot (Marcelo Rovai) / TinyML Kit Camera test
MJRobot (Marcelo Rovai) / Harvard - Person Detection
MJRobot (Marcelo Rovai) / Wio - Gesture Recognition
MJRobot (Marcelo Rovai) / Cifar10_Image_Classification
MJRobot (Marcelo Rovai) / Bean Disease Classifier
MJRobot (Marcelo Rovai) / SciTinyML-Motion-Anomaly-Project
MJRobot (Marcelo Rovai) / 1-Hands-On-SciTinyML-Motion-Project
MJRobot (Marcelo Rovai) / ESP32-Motion-Classification
MJRobot (Marcelo Rovai) / ESP32_KWS_Project
MJRobot (Marcelo Rovai) / IESTI01 - Nano Motion Classification
MJRobot (Marcelo Rovai) / Motion-Project
MJRobot (Marcelo Rovai) / Blender - Motion Detection
MJRobot (Marcelo Rovai) / Key_Word_Spotting
MJRobot (Marcelo Rovai) / Oi_Rovis_Key_Word_Spotting
MJRobot (Marcelo Rovai) / Sound-Classification-Blender-Faucet
MJRobot (Marcelo Rovai) / oi_roviz_kws
MJRobot (Marcelo Rovai) / Eggs AI
MJRobot (Marcelo Rovai) / Accelerometer-Nano-Ble-IoT
MJRobot (Marcelo Rovai) / video_tinyml_raw
(Move up and down to reveal more choices)
```

```
mjrovai — node /usr/local/bin/edge-impulse-data-forwarder — 117x26
(base) MacBook-Pro-de-Marcelo:~ mjrovai$ 
(base) MacBook-Pro-de-Marcelo:~ mjrovai$ 
(base) MacBook-Pro-de-Marcelo:~ mjrovai$ edge-impulse-data-forwarder
[Edge Impulse data forwarder v1.13.16
[Endpoints:
[ Websocket: wss://remote-mgmt.edgeimpulse.com
  API:      https://studio.edgeimpulse.com/v1
  Ingestion: https://ingestion.edgeimpulse.com

[SER] Connecting to /dev/tty.usbmodem145101
[SER] Serial is connected (4A:5A:36:17:55:F9:70:F7)
[WS ] Connecting to wss://remote-mgmt.edgeimpulse.com
[WS ] Connected to wss://remote-mgmt.edgeimpulse.com

? To which project do you want to connect this device? MJRobot (Marcelo
Rovai) / IESTI01 - Nano Motion Classification
[SER] Detecting data frequency...
[SER] Detected data frequency: 100Hz

? 3 sensor axes detected (example values: [-0.13, -0.34, 9.81]). What do y
ou want to call them? Separate the names with ','; accX, accY, accZ
? What name do you want to give this device? Nano
[WS ] Device "Nano" is now connected to project "IESTI01 - Nano Motion Classification"
[WS ] Go to https://studio.edgeimpulse.com/studio/61345/acquisition/training to build your machine learning model!
```

Devices - IESTI01 - Nano Motion Classification

studio.edgeimpulse.com/studio/61345/devices

EDGE IMPULSE

DEVICES (IESTI01 - NANO MOTION CLASSIFICATION)

MJRoBot (Marcelo Rovai)

Your devices

+ Connect a new device

These are devices that are connected to the Edge impulse remote management API, or have posted data to the ingestion SDK.

NAME	ID	TYPE	SENSORS	REMOTE M...	LAST SEEN
 Nano	4A:5A:36:17:55:F9:70:F7	DATA_FORWARDER	 Sensor with 3 axes (accX, accY, accZ)		Today, 12:42:15
 36:17:55:F9:70:F7	36:17:55:F9:70:F7	ARDUINO_NANO33BLE	 Built-in accelerometer, Built-in microphone		Today, 12:26:49

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GETTING STARTED

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