

# SciTinyML

Scientific Use of Machine Learning on Low Power Devices

## Regional Workshop - Africa

Arduino Nano-33 BLE Sense set-up and Hands-on  
Lab with Edge Impulse (Motion Detection)

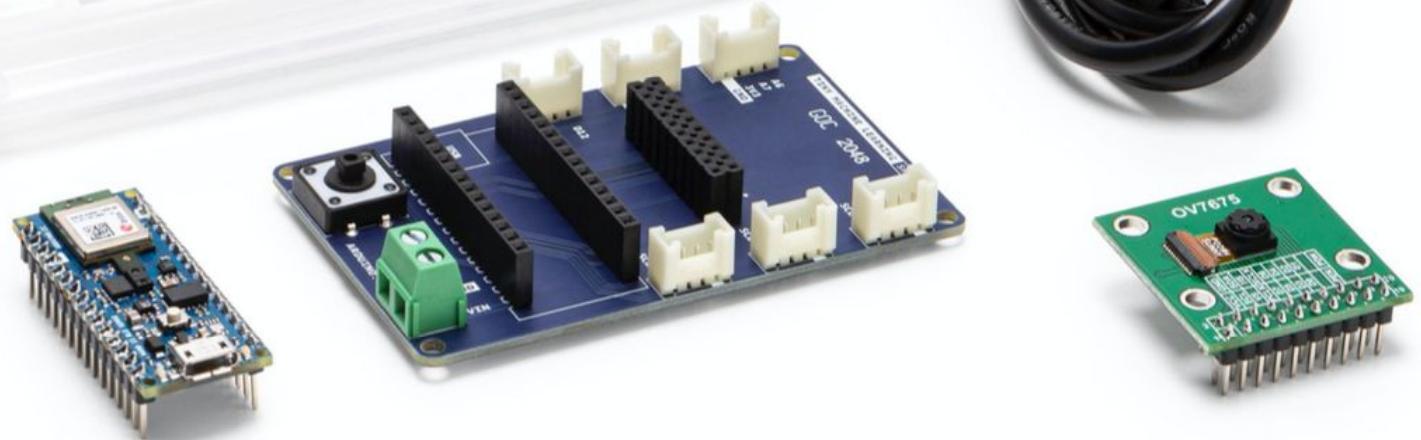
Marcelo Rovai  
Professor, UNIFEI - Brazil

Shawn Himel  
Senior DevRel Engineer, Edge Impulse

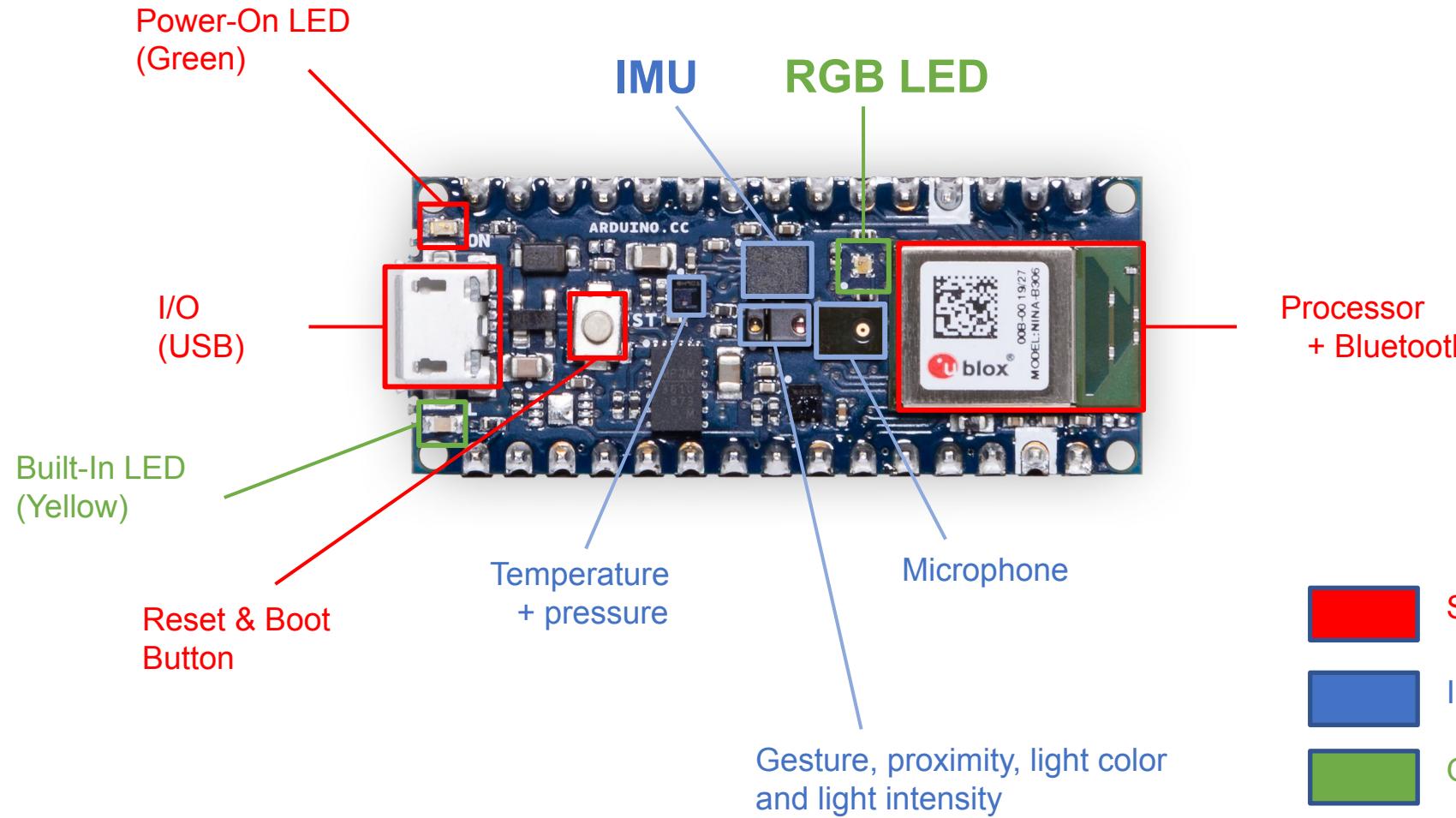


# Arduino Nano-33 BLE

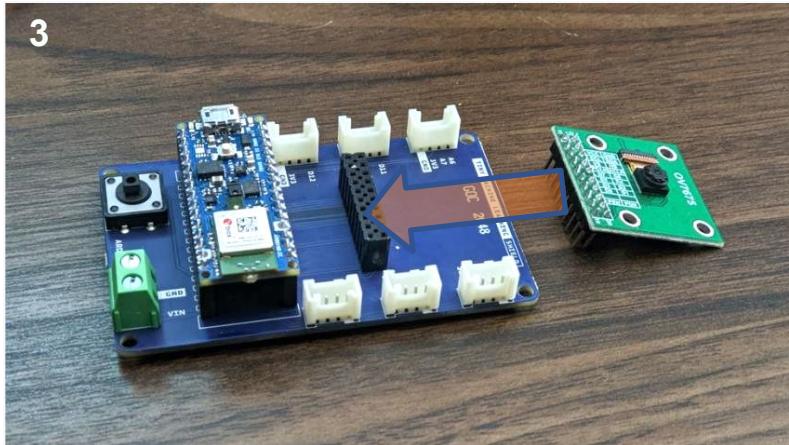
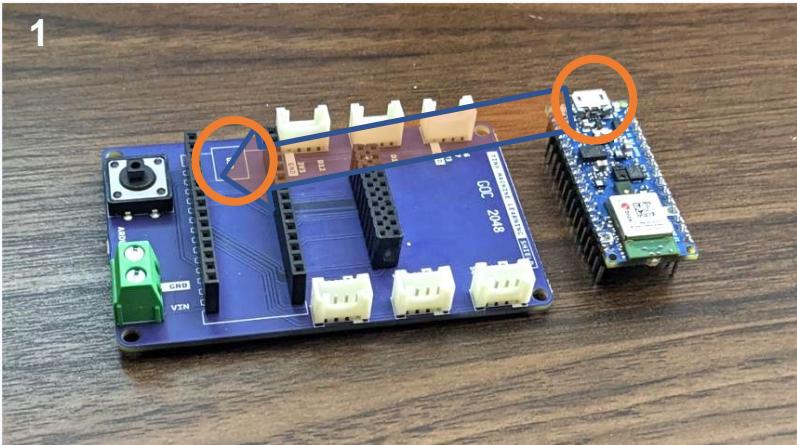
## Set up board and Arduino IDE



# 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](#)

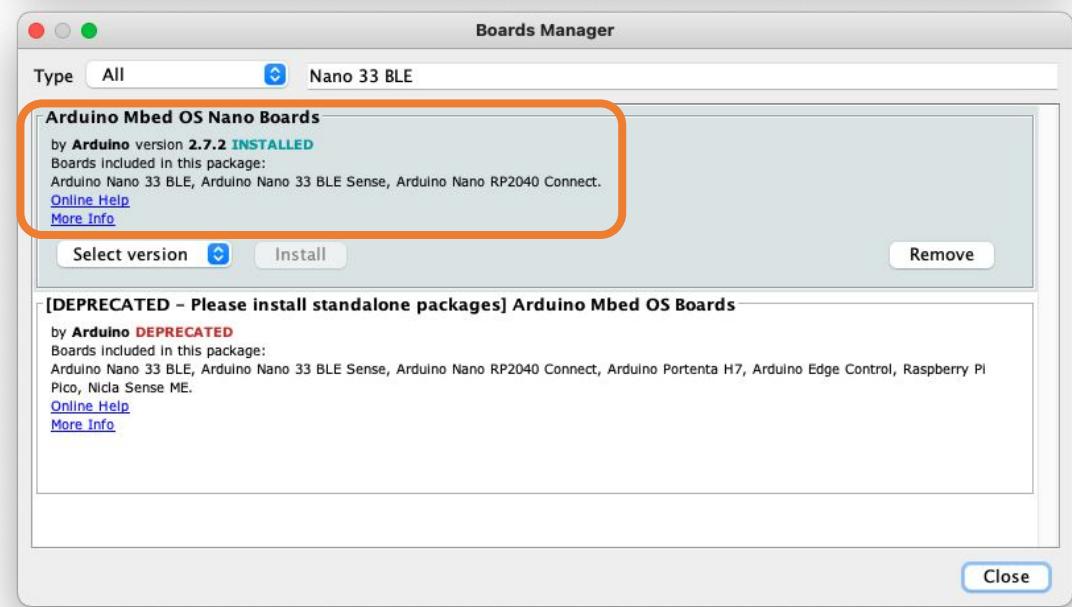
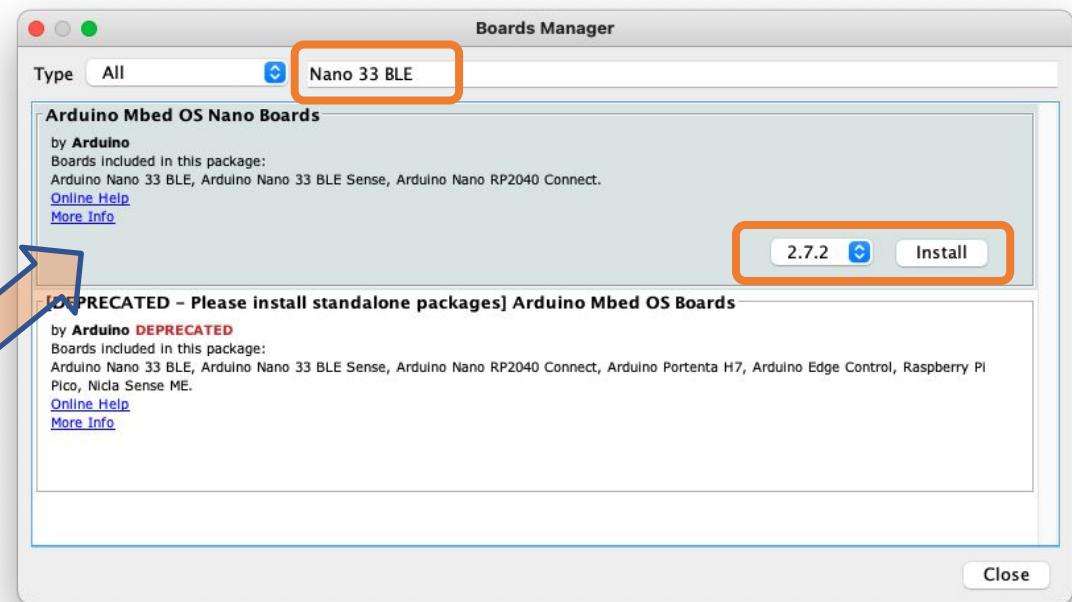
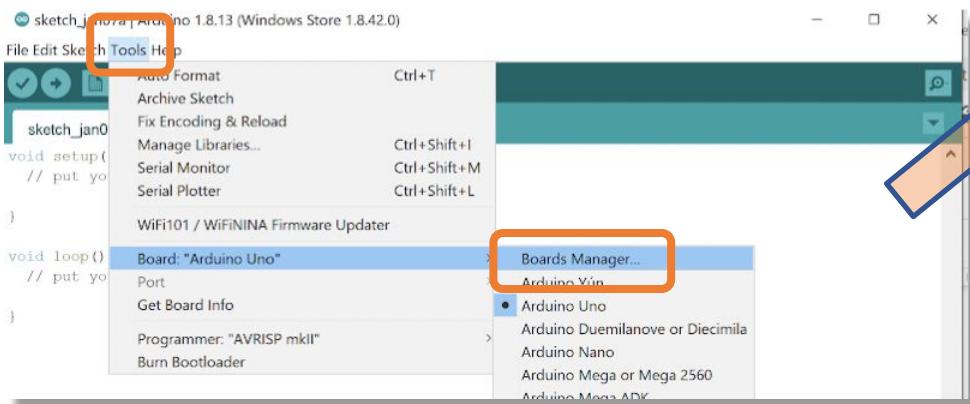
**Linux** 32 bits  
**Linux** 64 bits  
**Linux** ARM 32 bits  
**Linux** ARM 64 bits

**Mac OS X** 10.10 or newer

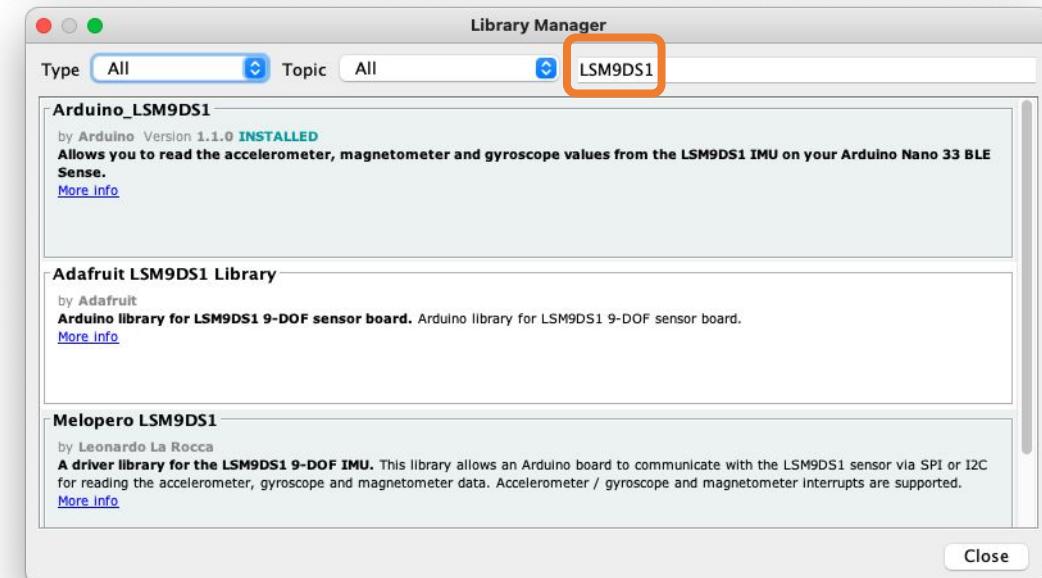
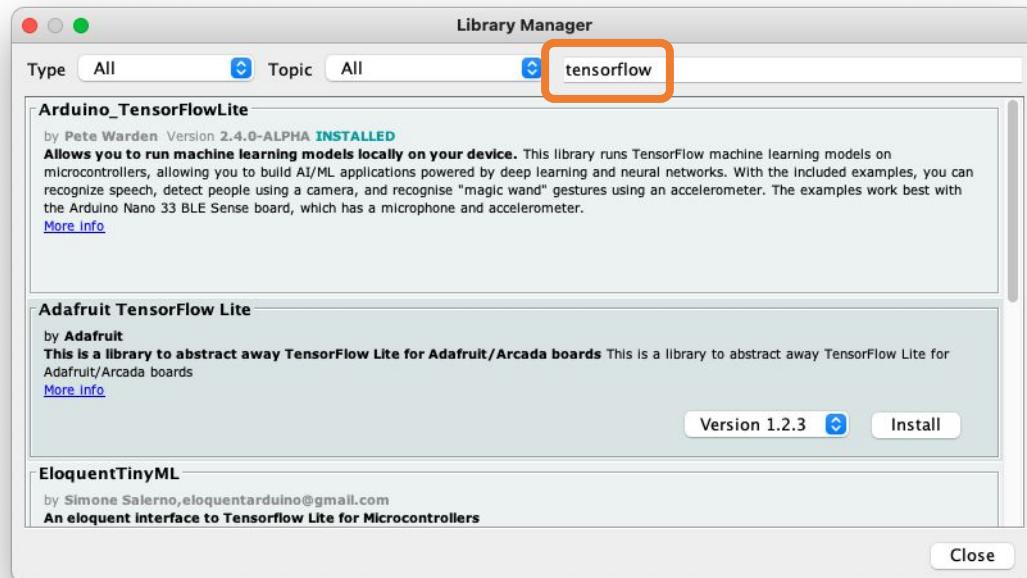
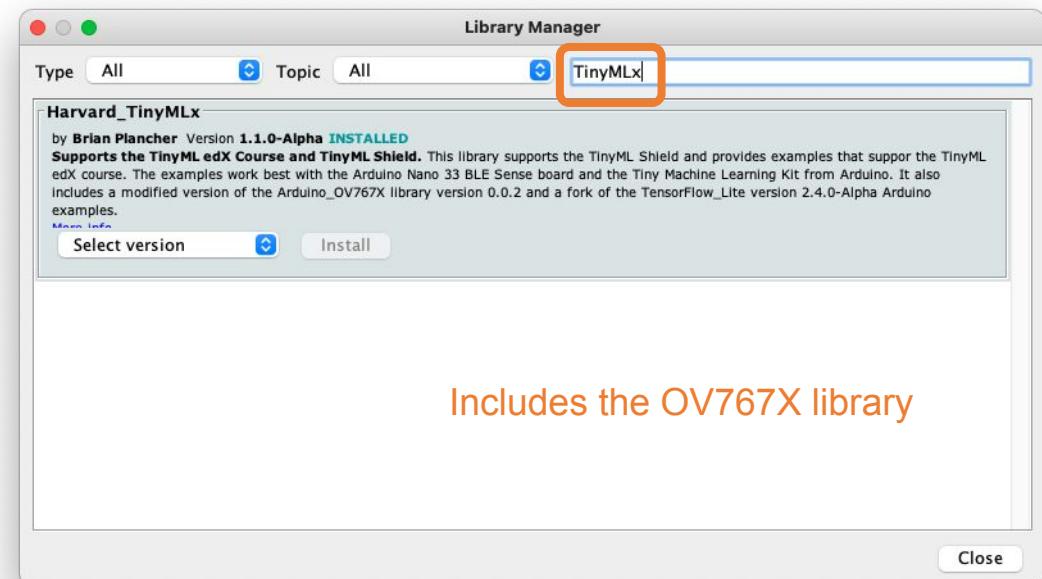
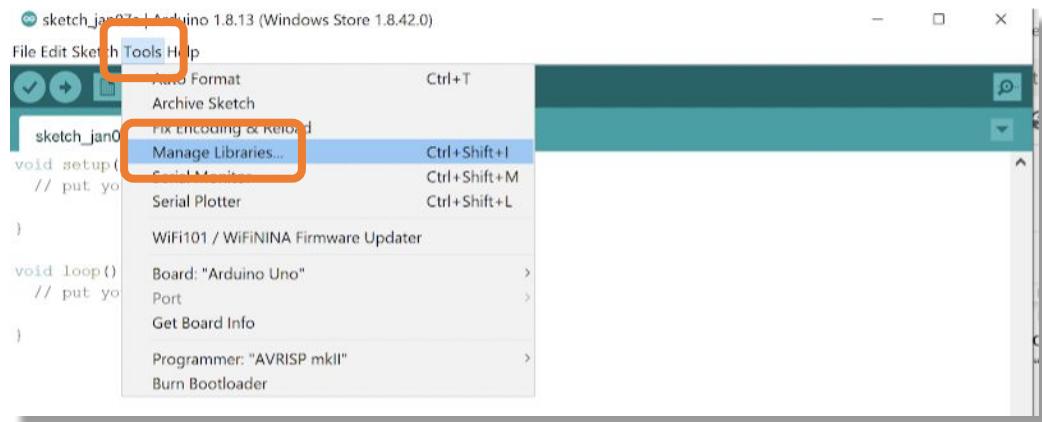
[Release Notes](#)  
[Checksums \(sha512\)](#)

[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

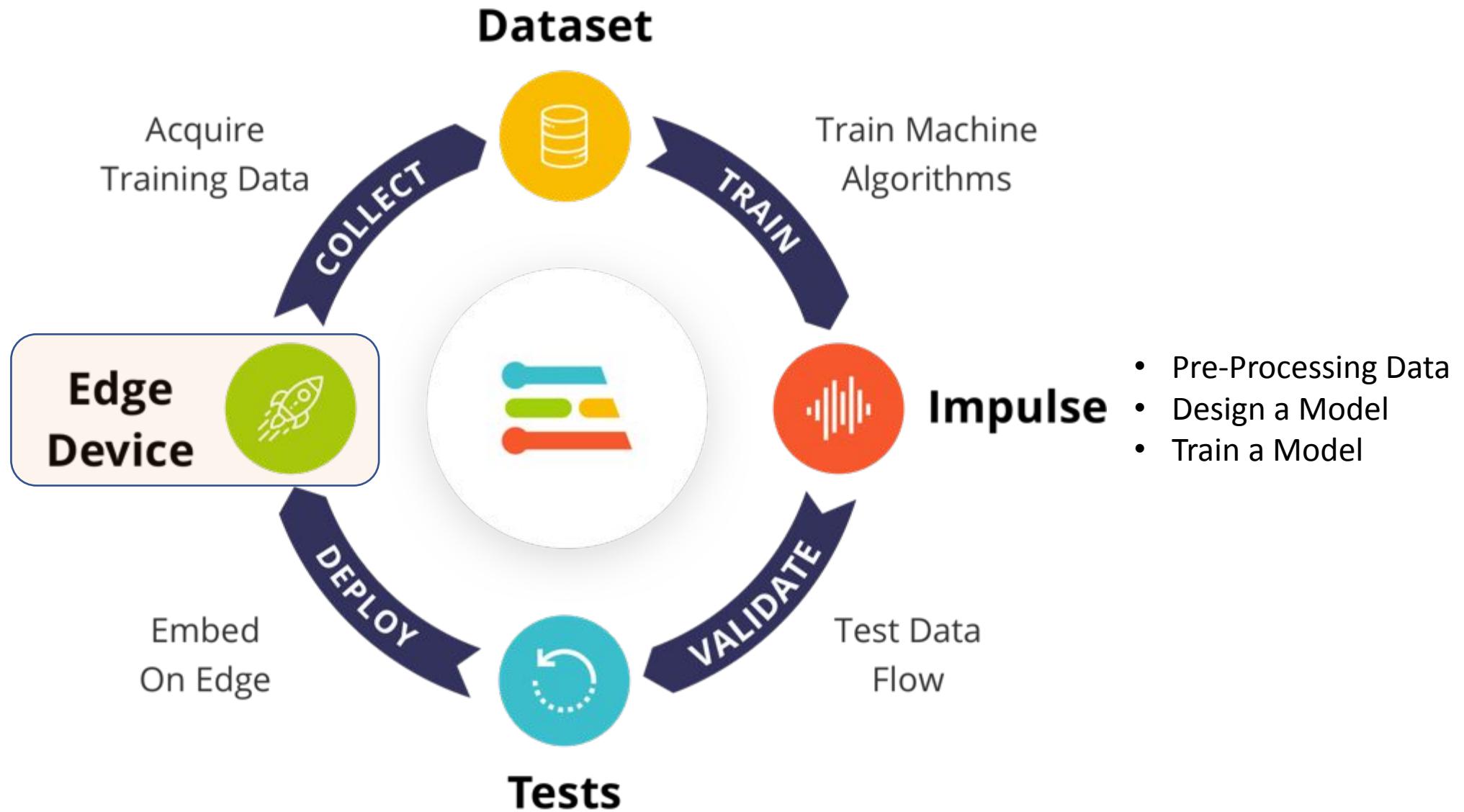
Select your Edge Impulse project, or create a new one.

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

Devices

1

Dashboard

Devices

Data acquisition

Impulse design

Create impulse

EON Tuner

Retrain model

Live classification

Model testing

Versioning

Deployment

GETTING STARTED

Documentation

Forums

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

2

+ Connect a new device

3

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

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

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

EDGE IMPULSE

Guides API Reference Forum

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

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

The screenshot shows a web browser window displaying the Edge Impulse documentation for the Arduino Nano 33 BLE Sense. The page title is "Arduino Nano 33 BLE Sense". The left sidebar lists various development boards, with "Arduino Nano 33 BLE Sense" highlighted. The main content area describes the board and its features, including its Cortex-M4 microcontroller, motion sensors, microphone, and BLE support. It also mentions the availability from Arduino and its use with the Arduino Tiny Machine Learning Kit. A blue arrow points from the text "Go to 2. Arduino CLI" to the "Installing dependencies" section at the bottom of the page.

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

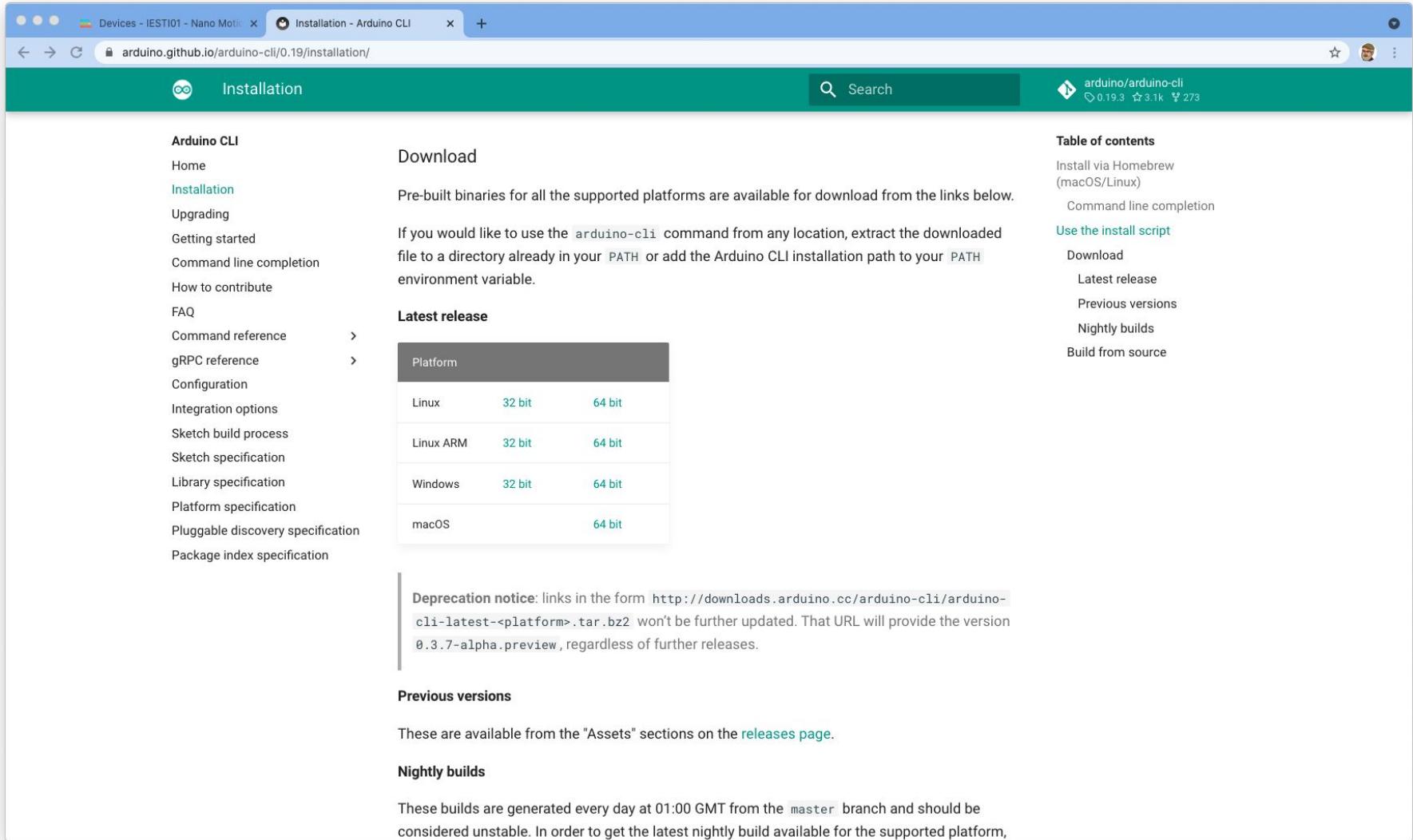
Go to 2. Arduino CLI

## 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.

# 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/](https://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, followed by a "Latest release" table, a "Deprecation notice" warning, a "Previous versions" section, and a "Nightly builds" section.

**Table of contents**

- Install via Homebrew (macOS/Linux)
- Command line completion
- Use the install script**
- Download
- Latest release
- Previous versions
- Nightly builds
- Build from source

**Latest release**

Platform	32 bit	64 bit
Linux	<a href="#">32 bit</a>	<a href="#">64 bit</a>
Linux ARM	<a href="#">32 bit</a>	<a href="#">64 bit</a>
Windows	<a href="#">32 bit</a>	<a href="#">64 bit</a>
macOS		<a href="#">64 bit</a>

**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.

**Previous versions**

These are available from the "Assets" sections on the [releases page](#).

**Nightly builds**

These builds are generated every day at 01:00 GMT from the `master` branch and should be considered unstable. In order to get the latest nightly build available for the supported platform,



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...

Getting Started

API and SDK references

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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

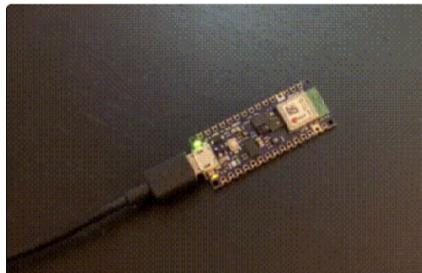
Sony's Spresense

Syntiant Tiny ML Board

Powered By GitBook

**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

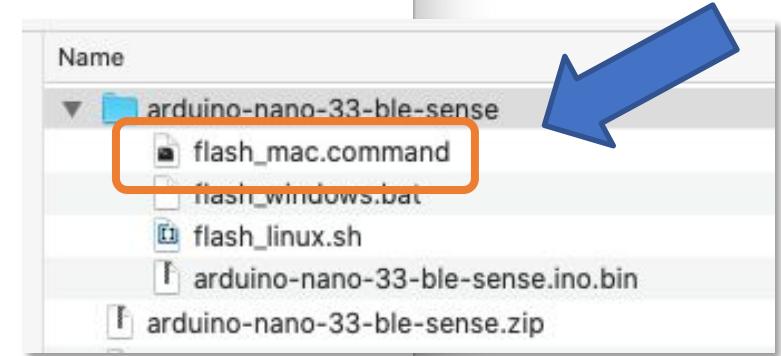
Done in 0.001 seconds
Write 280848 bytes to flash (69 pages)
[=====] 100% (69/69 pages)
Done in 10.984 seconds

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.

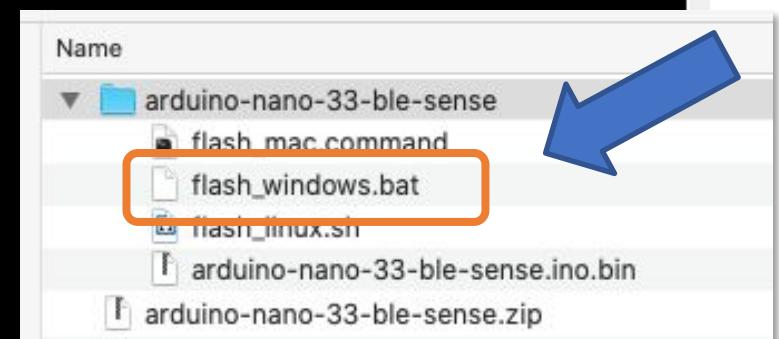
C:\Users\GUILH>arduino-cli
Arduino Command Line Interface (arduino-cli).

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

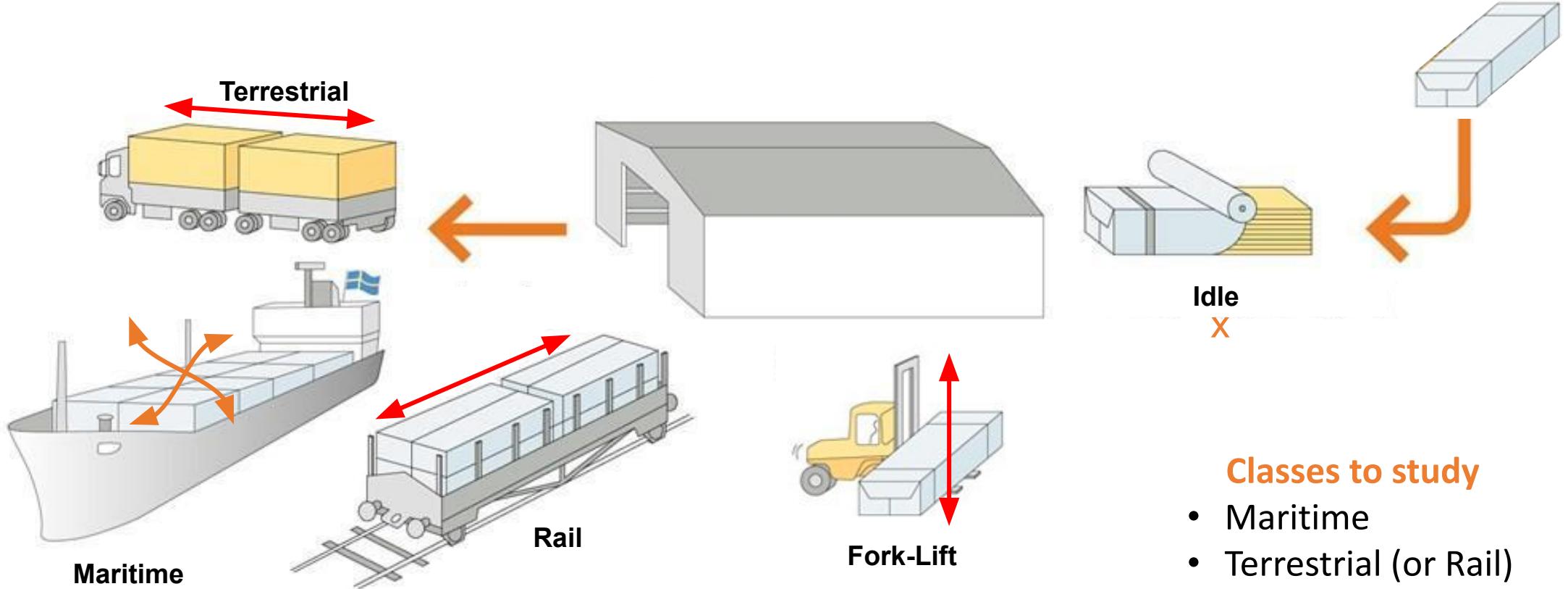
```
cmd C:\WINDOWS\system32\cmd.exe
Finding Arduino Mbed core...
arduino:mbed_nano 2.0.0      2.0.0  Arduino Mbed OS Nano Boards
Finding Arduino Mbed core OK
Finding Arduino Nano 33 BLE...
Finding Arduino Nano 33 BLE OK at COM11
arduino:mbed_nano 2.0.0      2.0.0  Arduino Mbed OS Nano Boards
Device      : 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

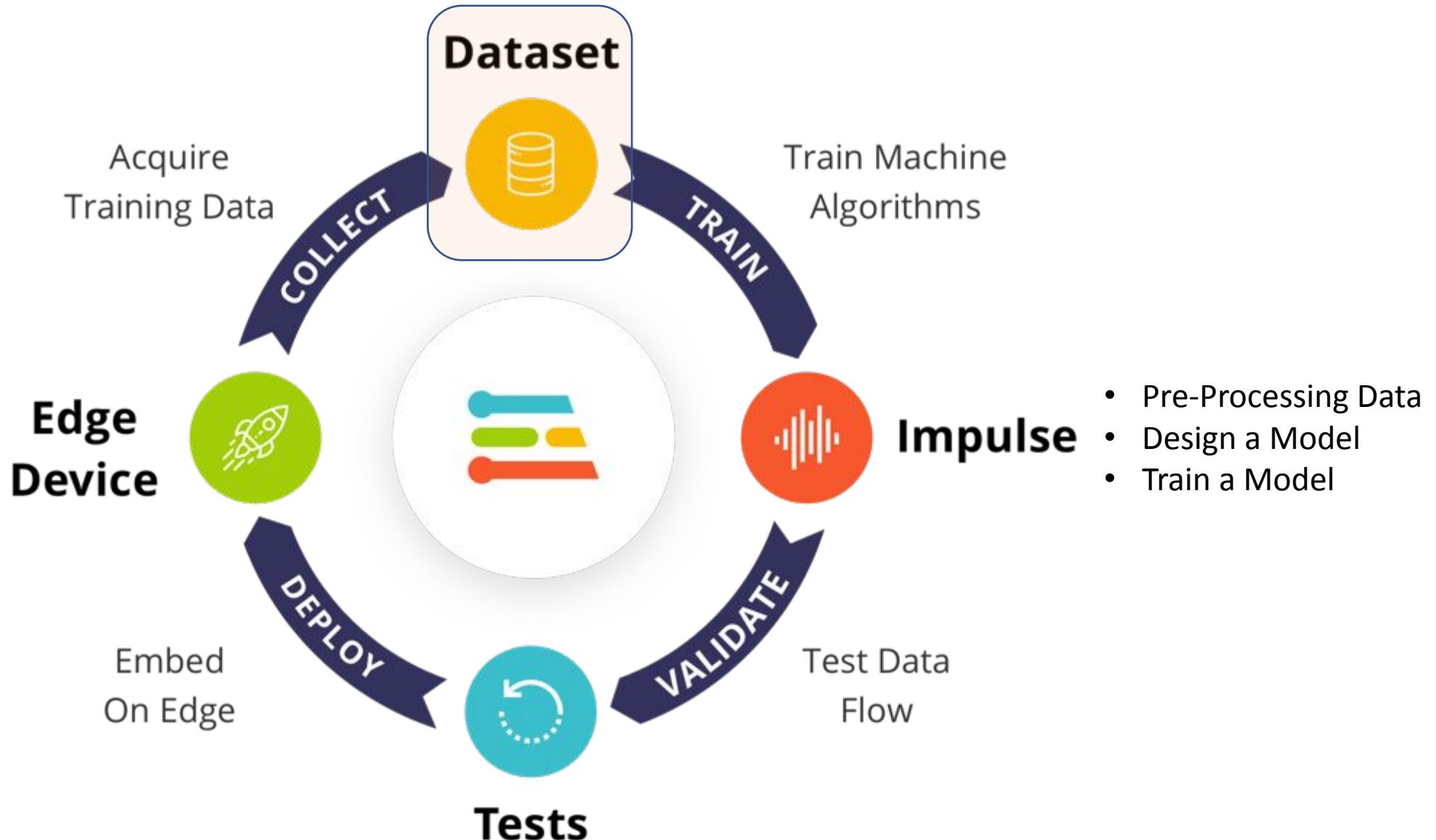
# Hands-on lab for motion classification

# Case Study: Mechanical Stresses in Transport



## Classes to study

- Maritime
- Terrestrial (or Rail)
- Lift
- Idle



The screenshot shows the Edge Impulse Studio interface for data acquisition. A modal window titled "studio.edgeimpulse.com wants to connect to a serial port" is open, listing available ports:

- cu.Bluetooth-Incoming-Port
- cu.MALS
- cu.RovaisAirPods-Wirelessi
- cu.SOC
- Nano 33 BLE (cu.usbmodem145101)**

A blue arrow labeled "2" points to the "Nano 33 BLE" entry. An orange box highlights the "cu.SOC" entry, and another orange box highlights the "Connect" button at the bottom of the modal. A large blue arrow labeled "3" points from the bottom of the modal towards the main studio interface.

The main studio interface has a purple header bar with the text "Acquisition mode or development board, or upload your existing datasets - Show options". On the right, there's a user profile for "MJRoBot (Marcelo Rovai)".

The main content area includes:

- A "Record new data" section with a message: "No devices connected to the remote management API."
- A "RAW DATA" section with the text "Click on a sample to load..."
- A "Connect using WebUSB" button with a small icon.

Blue arrows labeled "1" point to the "Connect using WebUSB" button and the "RAW DATA" section.

At the bottom left, the sidebar shows navigation links like Dashboard, Devices, Data acquisition, and Model testing. The "Data acquisition" link is highlighted with an orange box.

At the bottom right, there are links for Documentation and Forums.

**WebUSB works fine with Chrome**

DATA ACQUISITION (IESTI01 - NANO MOTION CLASSIFICATION)

Training data Test data

Did you know? You can capture data from any device or development board, or upload your existing datasets - [Show options](#)

DATA COLLECTED

Collected data

No data collected yet

Let's collect some data

Record new data

Device ②  
36:17:55:F9:70:F7

Label  
terrestrial

Sample length (ms.)  
10000

Sensor  
Built-in accelerometer

Frequency  
100Hz

Start sampling

RAW DATA  
Click on a sample to load...

The screenshot shows the Edge Impulse Data Acquisition interface. On the left sidebar, under the 'Data acquisition' section, there is a 'Label' field which is highlighted with an orange border. Two large blue arrows point from this highlighted field towards the 'Start sampling' button located on the right side of the interface. The 'Start sampling' button is a dark blue button with white text.

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
 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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Dashboard

Devices

Data acquisition

Impulse design

Create impulse

EON Tuner

Retrain model

Live classification

Model testing

Versioning

Deployment

GETTING STARTED

Documentation

Forums

DATA ACQUISITION (IESTI01 - NANO MOTION CLASSIFICATION)

Training data Test data

Did you know? You can capture data from any device or development board, or upload your existing datasets - [Show options](#)

DATA COLLECTED 10s TRAIN / TEST SPLIT 100% / 0% ⚠

Collected data

SAMPLE NAME	LABEL	ADDED	LENGTH
terrestrial.json.2jbimlk	terrestrial	Today, 13:01:46	10s

Record new data

Device ② Nano

Label terrestrial Sample length (ms.) 10000

Sensor Sensor with 3 axes (accX, accY, accZ) Frequency 100Hz

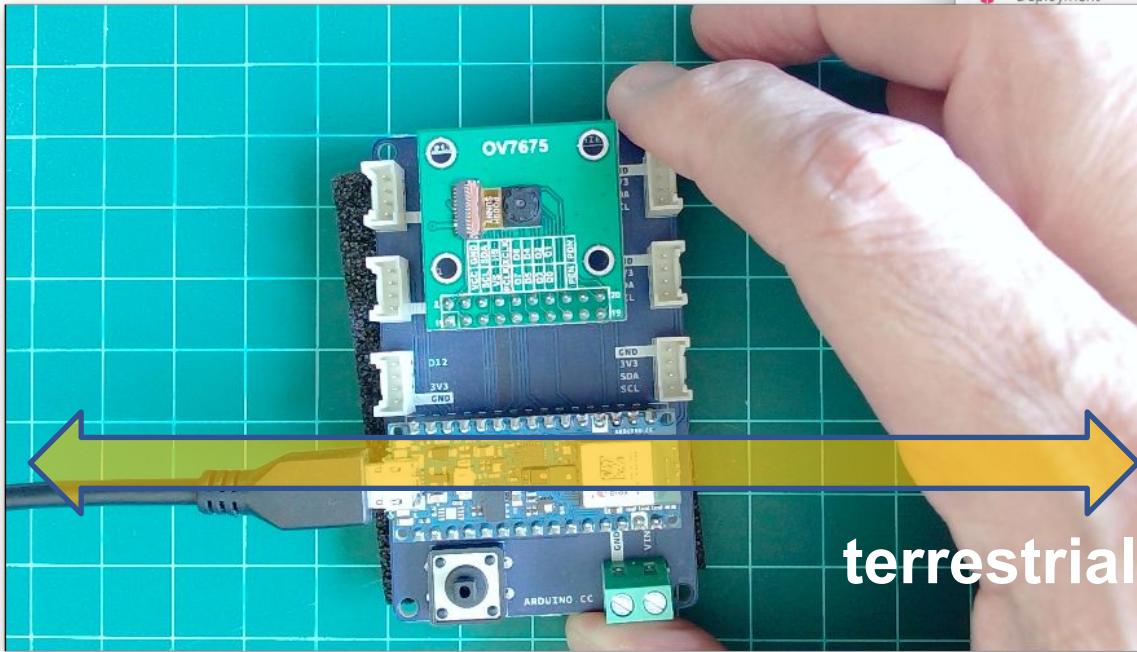
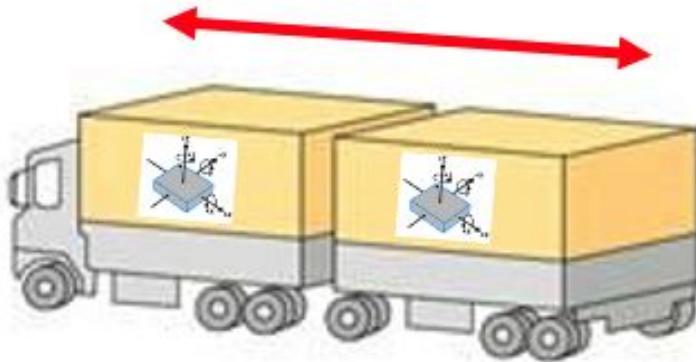
Start sampling

RAW DATA  
terrestrial.json.2jbimlk

accX accY accZ

<https://studio.edgeimpulse.com/studio/61345/acquisition/training?page=1#>

# Label: terrestrial

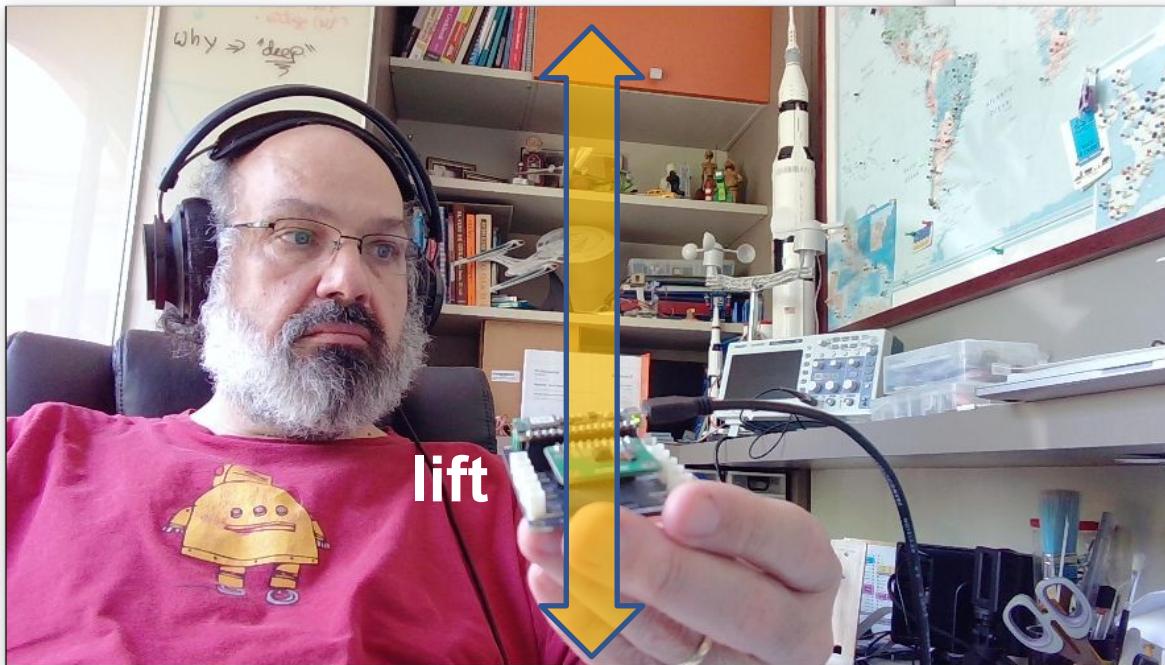
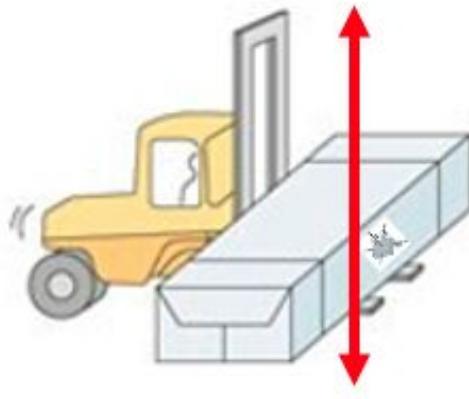


The screenshot shows the Edge Impulse Data Acquisition interface. On the left, a sidebar lists options: Dashboard, Devices, Data acquisition (selected), Impulse design, Create impulse, EON Tuner, Retrain model, Live classification, Model testing, Versioning, and Deployment. The main area displays "DATA ACQUISITION (IESTI01 - NANO MOTION CLASSIFICATION)" with tabs for "Training data" (selected) and "Test data". A message box says: "Did you know? You can capture data from any device or development board, or upload your existing datasets - Show options". Below this, a summary shows "DATA COLLECTED 1m 40s" and "TRAIN / TEST SPLIT 100% / 0%". A table titled "Collected data" lists ten entries, all labeled "terrestrial":

SAMPLE NAME	LABEL	ADDED	LENGTH
terrestrial.json.2jv...	terrestrial	Today, 14:26:56	10s
terrestrial.json.2jv...	terrestrial	Today, 14:26:29	10s
terrestrial.json.2jv...	terrestrial	Today, 14:26:06	10s
terrestrial.json.2jv...	terrestrial	Today, 14:25:48	10s
terrestrial.json.2jv...	terrestrial	Today, 14:25:29	10s
terrestrial.json.2jv...	terrestrial	Today, 14:25:04	10s
terrestrial.json.2jv...	terrestrial	Today, 14:24:45	10s
terrestrial.json.2jv...	terrestrial	Today, 14:24:21	10s
terrestrial.json.2jvf...	terrestrial	Today, 14:17:45	10s

To the right, a "Record new data" section allows connecting via WebUSB, selecting a device (Nano), setting a label (terrestrial), sample length (10000 ms), sensor (Sensor with 3 axes (accX, accY, accZ)), and frequency (100Hz). A "Start sampling" button is present. At the bottom, a "RAW DATA" plot titled "terrestrial.json.2jvgelce" shows three axes (accX, accY, accZ) over time.

# Label: LIFT



studio.edgeimpulse.com/studio/61345/acquisition/training?page=1

EDGE IMPULSE

DATA ACQUISITION (IESTI01 - NANO MOTION CLASSIFICATION)

MJRoBot (Marcelo Rovai)

Training data Test data

Did you know? You can capture data from any device or development board, or upload your existing datasets - Show options

DATA COLLECTED 3m 20s TRAIN / TEST SPLIT 100% / 0%

SAMPLE NAME	LABEL	ADDED	LENGTH
lift.json.2jvhbt7	lift	Today, 14:42:04	10s
lift.json.2jvh9pe3	lift	Today, 14:41:45	10s
lift.json.2jvh96uh	lift	Today, 14:41:26	10s
lift.json.2jvh8j6q	lift	Today, 14:41:06	10s
lift.json.2jvh80rg	lift	Today, 14:40:47	10s
lift.json.2jvh7g2v	lift	Today, 14:40:30	10s
lift.json.2jvh6uqu	lift	Today, 14:40:12	10s
lift.json.2jvh6c6a	lift	Today, 14:39:53	10s
lift.json.2jvh5qbe	lift	Today, 14:39:35	10s
lift.json.2jvh55hs	lift	Today, 14:39:14	10s
terrestrial.json.2jv...	terrestrial	Today, 14:26:56	10s
terrestrial.json.2jv...	terrestrial	Today, 14:26:29	10s

Record new data

Device Nano

Label lift

Sample length (ms.) 10000

Sensor Sensor with 3 axes (accX, accY, accZ)

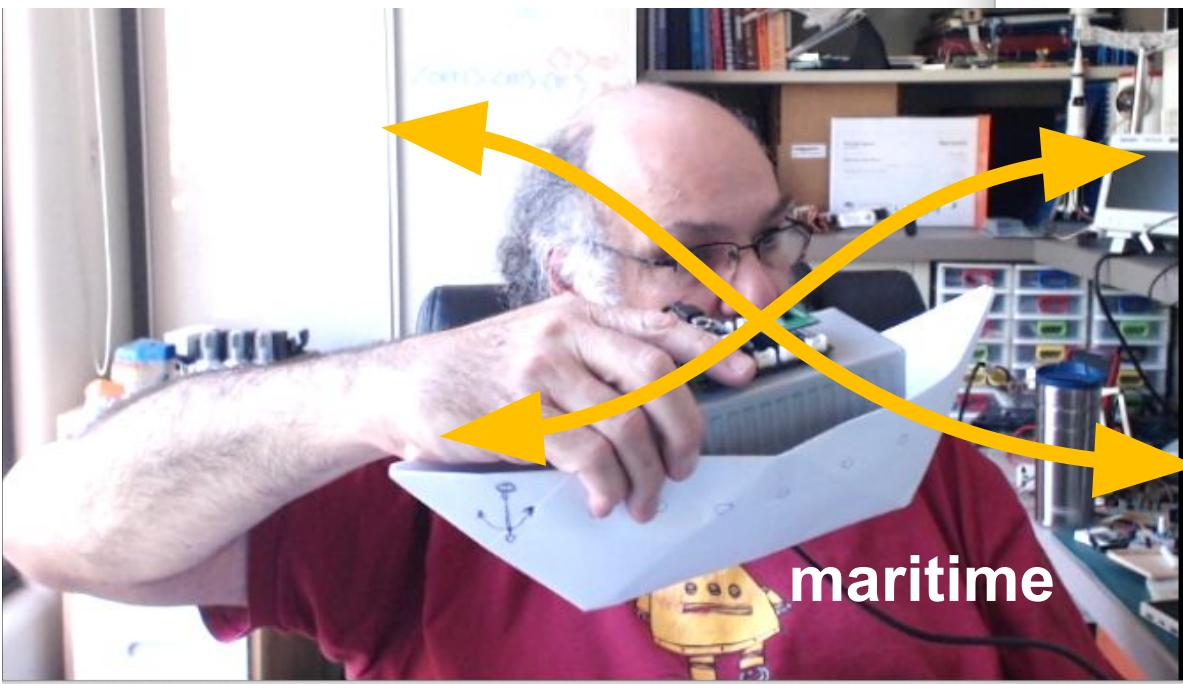
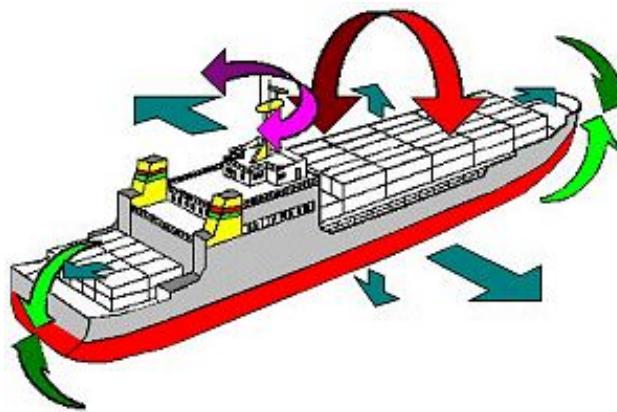
Frequency 100Hz

Start sampling

RAW DATA lift.json.2jvhbt7

A line graph titled "RAW DATA lift.json.2jvhbt7". The vertical axis ranges from -20 to 20 with increments of 5. The horizontal axis shows time points at 0, 1040, 2080, 3120, 4160, 5200, 6240, 7280, 8320, and 9360. Three data series are plotted: accX (red), accY (green), and accZ (blue). All three series show a highly oscillatory pattern between approximately -15 and 15 across the entire time range.

# Label: maritime



Data acquisition - IESTI01 - Na

studio.edgeimpulse.com/studio/61345/acquisition/training?page=1

MJRoBot (Marcelo Rovai)

EDGE IMPULSE

DATA ACQUISITION (IESTI01 - NANO MOTION CLASSIFICATION)

Training data Test data

Did you know? You can capture data from any device or development board, or upload your existing datasets - Show options

DATA COLLECTED 5m 0s TRAIN / TEST SPLIT 100% / 0% ▲

SAMPLE NAME	LABEL	ADDED	LENGTH
maritime.json.2jvi6...	maritime	Today, 14:57:35	10s
maritime.json.2jvi6...	maritime	Today, 14:57:13	10s
maritime.json.2jvi5...	maritime	Today, 14:56:48	10s
maritime.json.2jvi4...	maritime	Today, 14:56:31	10s
maritime.json.2jvi4...	maritime	Today, 14:56:13	10s
maritime.json.2jvi3...	maritime	Today, 14:55:55	10s
maritime.json.2jvi3...	maritime	Today, 14:55:36	10s
maritime.json.2jvi2...	maritime	Today, 14:55:19	10s
maritime.json.2jvi2...	maritime	Today, 14:55:00	10s
maritime.json.2jvi1...	maritime	Today, 14:54:42	10s
lift.json.2jhbt7	lift	Today, 14:42:04	10s
lift.json.2vh9pe3	lift	Today, 14:41:45	10s

Record new data

Device Nano

Label maritime

Sample length (ms.) 10000

Sensor Sensor with 3 axes (accX, accY, accZ)

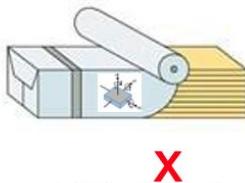
Frequency 100Hz

Start sampling

RAW DATA maritime.json.2jvi6p3r

accX accY accZ

# Label: idle



Data acquisition - IESTI01 - Na +

studio.edgeimpulse.com/studio/61345/acquisition/training?page=1

MJRoBot (Marcelo Rovai)

EDGE IMPULSE

DATA ACQUISITION (IESTI01 - NANO MOTION CLASSIFICATION)

Training data Test data

Did you know? You can capture data from any device or development board, or upload your existing datasets - Show options

DATA COLLECTED 6m 40s TRAIN / TEST SPLIT 100% / 0% ▲

Record new data Connect using WebUSB

Device Nano

Label idle Sample length (ms.) 100000

Sensor Sensor with 3 axes (accX, accY, accZ) Frequency 100Hz

Start sampling

Collected data

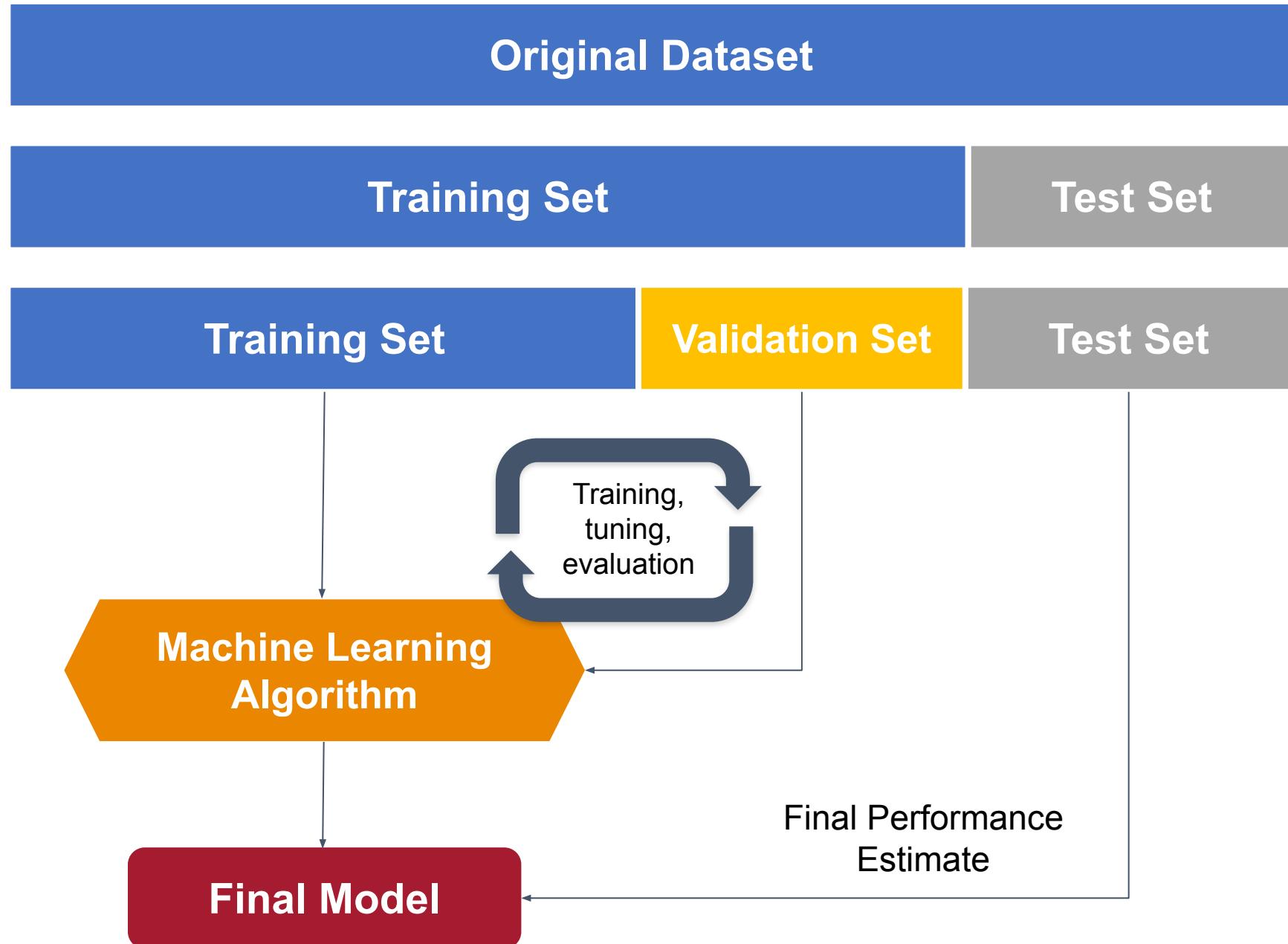
SAMPLE NAME	LABEL	ADDED	LENGTH	⋮
idle.json.2jvif14	idle	Today, 15:06:09	1m 40s	⋮
maritime.json.2jvi6...	maritime	Today, 14:57:35	10s	⋮
maritime.json.2jvi6...	maritime	Today, 14:57:13	10s	⋮
maritime.json.2jvi5...	maritime	Today, 14:56:48	10s	⋮
maritime.json.2jvi4...	maritime	Today, 14:56:31	10s	⋮
maritime.json.2jvi4...	maritime	Today, 14:56:13	10s	⋮
maritime.json.2jvi3...	maritime	Today, 14:55:55	10s	⋮
maritime.json.2jvi3...	maritime	Today, 14:55:36	10s	⋮
maritime.json.2jvi2...	maritime	Today, 14:55:19	10s	⋮
maritime.json.2jvi2...	maritime	Today, 14:55:00	10s	⋮
maritime.json.2jvi1...	maritime	Today, 14:54:42	10s	⋮
lift.json.2jhbt7	lift	Today, 14:42:04	10s	⋮

RAW DATA idle.json.2jvif14

accX accY accZ

10 5 0 -5 -10 -15 -20

0 10400 20800 31200 41600 52000 62400 72800 83200 93600



Dashboard - IESTI01 - Nano M

studio.edgeimpulse.com/studio/61345

EDGE IMPULSE

**Dashboard**

Devices

Data acquisition

Impulse design

- Create impulse

EON Tuner

Retrain model

Live classification

Model testing

Versioning

Deployment

GETTING STARTED

Documentation

Forums

Download block output

No downloads available yet

Performance settings

Use GPU for training

Parallel DSP jobs

Job limit in minutes

DSP file size limit (MB)

Administrative zone

Show Linux deploy options

Save experiments

Danger zone

Perform train / test split

Delete this project

Delete all data in this project

Project info

Project ID 61345

Labeling method One label per data

Latency calculations Cortex-M4F 80M

Dashboard - IESTI01 - Nano M

studio.edgeimpulse.com/studio/61345

EDGE IMPULSE

Download block output

No downloads available yet

Performance settings

Use GPU for training

Parallel DSP jobs

Job limit in minutes

DSP file size limit (MB)

Administrative zone

Show Linux deploy options

Save experiments

Danger zone

Performing split...

Delete this project

Delete all data in this project

?

Perform train / test split

Are you sure you want to rebalance your dataset? This splits all your data automatically between the training and testing set, and resets the categories for all data. This is irrevocable!

Cancel Yes, perform the train / test split

**DATA ACQUISITION - TESTING (EINSTEIN CLASSIFICATION)**

Training data **Test data**

Did you know? You can capture data from any device or development board, or upload your existing datasets - Show options

**DATA COLLECTED**  
40s

**TRAIN / TEST SPLIT**  
90% / 10%

**Collected data**

SAMPLE NAME	LABEL	ADDED	LENGTH	⋮
maritime.json.2jvi4...	maritime	Today, 14:56:13	10s	⋮
maritime.json.2jvi1...	maritime	Today, 14:54:42	10s	⋮
lift.json.2jvh6uqu	lift	Today, 14:40:12	10s	⋮
terrestrial.json.2jv...	terrestrial	Today, 13:01:46	10s	⋮

**Record new data**

Device **Nano**

Label **idle**

Sample length (ms.) **100000**

Sensor **Sensor with 3 axes (accX, accY, accZ)**

Frequency **100Hz**

**Start sampling**

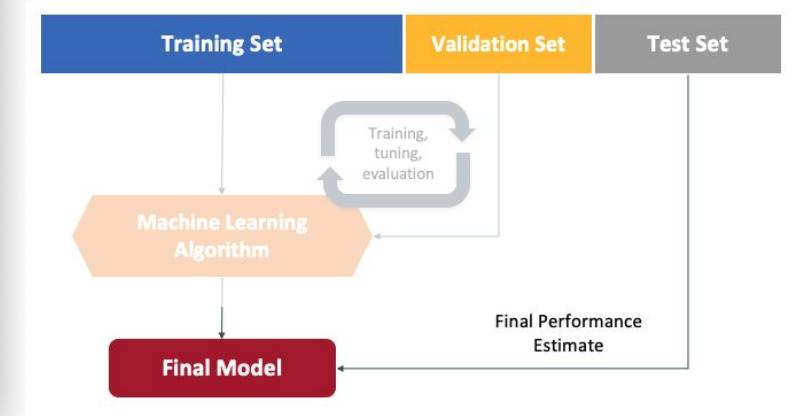
**RAW DATA**

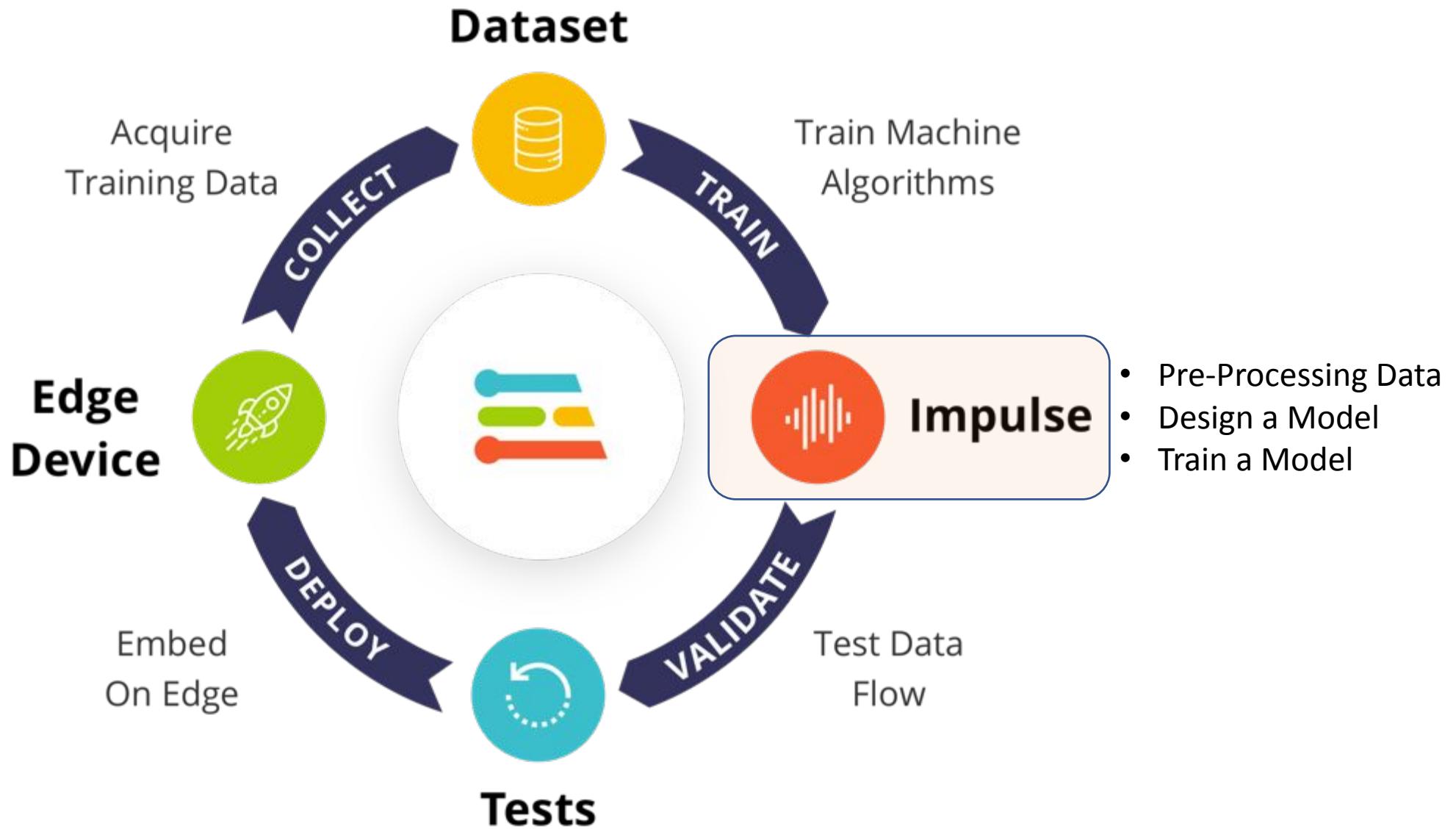
Click on a sample to load...

If automatic split is not good, proceed with manual split

The screenshot shows the Edge Impulse Studio interface. On the left, a sidebar menu includes options like Dashboard, Devices, Data acquisition (which is highlighted with an orange box), Create impulse, EON Tuner, Retrain model, Live classification, Model testing, Versioning, Deployment, Documentation, and Forums. The main area is titled "DATA ACQUISITION - TESTING (IE500 - ACTION CLASSIFICATION)". It displays "DATA COLLECTED 1m 20s" and a "TRAIN / TEST SPLIT 80% / 20%" button. Below this is a table titled "Collected data" with columns: SAMPLE NAME, LABEL, ADDED, LENGTH. The table lists several samples: "terrestrial.json.2jv...", "lift.json.2jhbt7", "idle.json.2jvjlon", "maritime.json.2ji4...", "maritime.json.2ji1...", "lift.json.2jh6uqu", and "terrestrial.json.2jv...". A large orange arrow points from the sidebar's "Data acquisition" option to the "Test data" tab in the top navigation bar.

Dataset is balanced (has representative samples from all classes) and split 80%/20%





**Time series data**

Axes  
accX, accY, accZ

Window size  
 2000 ms.

Window increase  
 80 ms.

Frequency (Hz)  
62.5

Zero-pad data

**Spectral Analysis**

Name  
Spectral Analysis

Input axes  
 accX  
 accY  
 accZ

**Neural Network (Keras)**

Name  
Neural Network (Keras)

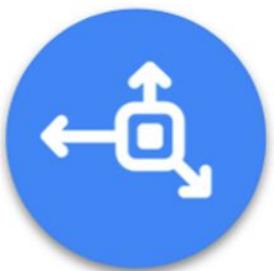
Input features  
 Spectral Analysis

Output features  
4 (idle, lift, maritime, terrestrial)

**Output features**

4 (idle, lift, maritime, terrestrial)

**Save Impulse**



**Spectral Analysis**



**NN Classifier**



### Classes

- Lift
- Terrestrial
- Maritime
- Idle

Spectral features - IESTI01 - N

studio.edgeimpulse.com/studio/61345/dsp/spectral-analysis/3

### Raw data

terrestrial.json.2jvgdqv9 (terrestrial)

accX accY accZ

### Raw features

1.6400, -0.9700, 9.8000, 1.7100, -0.6400, 9.8100, 1.8500, -0.4200, 9.7900, 1.7800, -0.5200, 9.7500, 1.7100,...

### Parameters

#### Scaling

Scale axes

#### Filter

Type  Cut-off frequency  Order

#### Spectral power

FFT length  No. of peaks  Peaks threshold  Power edges

Save parameters

### DSP result

#### After filter

#### Frequency domain

Spectral features - IESTI01 - N

studio.edgeimpulse.com/studio/61345/dsp/spectral-analysis/3/generate-features

**EDGE IMPULSE**

**SPECTRAL FEATURES (IESTI01 - NANO MOTION CLASSIFICATION)**

#1 ▾ Click to set a description for this version

**Parameters** **Generate features**

**Training set**

Data in training set 5m 20s

Classes 4 (idle, lift, maritime, terrestrial)

Window length 2000 ms.

Window increase 80 ms.

Training windows 3,400

**Feature explorer (3,400 samples)**

X Axis accX RMS Y Axis accY RMS Z Axis accZ RMS

idle (blue), lift (orange), maritime (green), terrestrial (red)

**Feature generation output**

Job started  
Creating windows from 25 files...  
[ 0/25] Creating windows from files...  
[ 1/25] Creating windows from files...  
[25/25] Creating windows from files...  
Created 3400 windows: idle: 976, lift: 808, maritime: 808, terrestrial: 808

Creating features  
[ 1/3400] Creating features...  
[ 898/3400] Creating features...  
[1798/3400] Creating features...  
[2704/3400] Creating features...  
[3400/3400] Creating features...  
Created features

Job completed

**On-device performance**

PROCESSING TIME 9 ms. PEAK RAM USAGE 5 KB

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MJRoBot (Marcelo Rovai)

### Neural Network settings

#### Training settings

Number of training cycles ?  
30

Learning rate ?  
0.0005

#### Neural network architecture

- Input layer (33 features)**
- Dense layer (20 neurons)
- Dense layer (10 neurons)
- Add an extra layer
- Output layer (4 classes)**

**Start training**

### Model

Model version: ? Quantized (int8) ▼

#### Last training performance (validation set)

	ACCURACY <b>99.9%</b>		LOSS <b>0.01</b>
--	--------------------------	--	---------------------

#### Confusion matrix (validation set)

	IDLE	LIFT	MARITIME	TERRESTRIAL
IDLE	<b>100%</b>	0%	0%	0%
LIFT	0%	<b>99.4%</b>	0.6%	0%
MARITIME	0%	0%	<b>100%</b>	0%
TERRESTRIAL	0%	0%	0%	<b>100%</b>
F1 SCORE	1.00	1.00	1.00	1.00

#### Feature explorer (full training set) ?

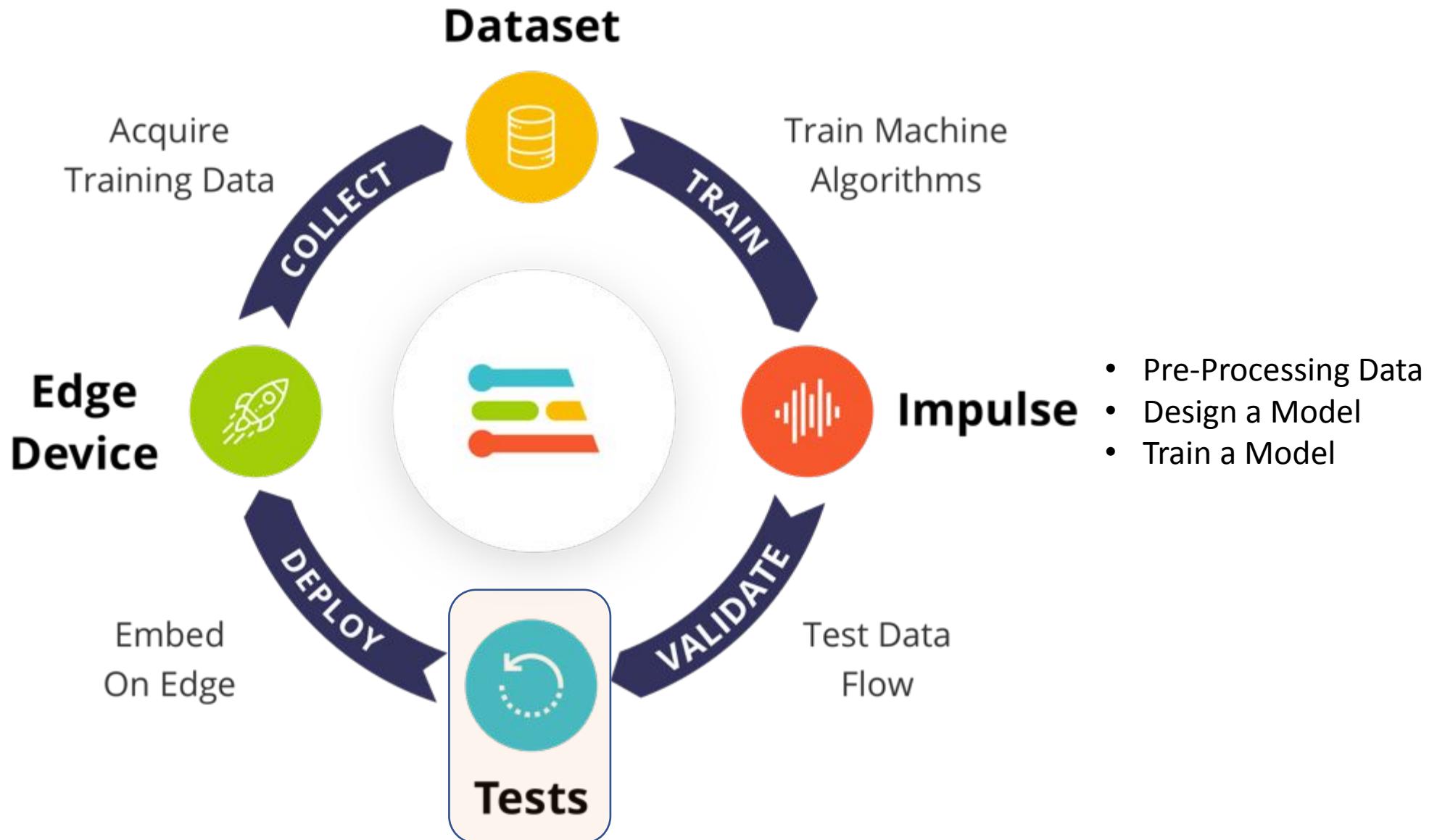
accX RMS ▼ accY RMS ▼ accZ RMS ▼

Legend:

- idle - correct
- lift - correct
- maritime - correct
- terrestrial - correct
- lift - incorrect

#### On-device performance ?

	INFERRING TIME <b>1 ms.</b>		PEAK RAM USAGE <b>1.7K</b>		FLASH USAGE <b>19.0K</b>
--	--------------------------------	--	-------------------------------	--	-----------------------------



Model testing - IESTI01 - Nano

studio.edgeimpulse.com/studio/61345/validation

### Test data

Set the 'expected outcome' for each sample to the desired outcome to automatically score the impulse.

SAMPLE NAME	EXPECTED OUTCOME	LENGTH	ACCURACY	RESULT	⋮
terrestrial.json.2...	terrestrial	10s	100%	101 terrestrial	⋮
lift.json.2jhbt7	lift	10s	100%	101 lift	⋮
idle.json.2jvjl0v	idle	20s	100%	226 idle	⋮
maritime.json.2j...	maritime	10s	100%	101 maritime	⋮
maritime.json.2j...	maritime	10s	100%	101 maritime	⋮
lift.json.2jh6uqu	lift	10s	100%	101 lift	⋮
terrestrial.json.2...	terrestrial	10s	100%	101 terrestrial	⋮

### Model testing output

Classifying data for NN Classifier...  
 Copying features from processing blocks...  
 Copying features from DSP block...  
 Copying features from DSP block OK  
 Copying features from processing blocks OK

Classifying data for float32 model...  
 Scheduling job in cluster...  
 Job started  
 Classifying data for NN Classifier OK

**Job completed**

### Model testing results

**ACCURACY**  
**100.00%**

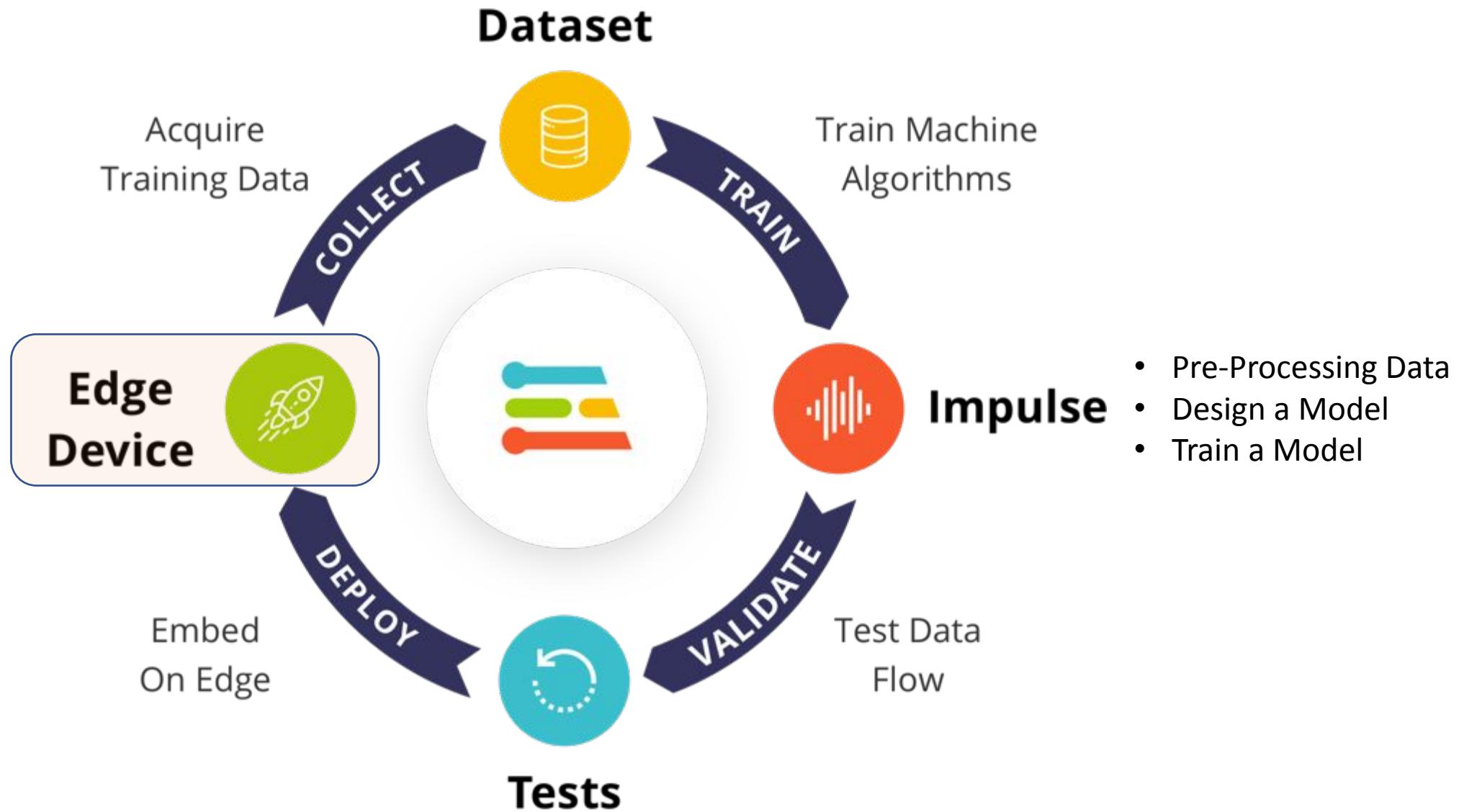
	IDLE	LIFT	MARITIME	TERRESTRIAL	UNCERTAIN
IDLE	100%	0%	0%	0%	0%
LIFT	0%	100%	0%	0%	0%
MARITIME	0%	0%	100%	0%	0%
TERRESTRIAL	0%	0%	0%	100%	0%
F1 SCORE	1.00	1.00	1.00	1.00	

### Feature explorer

accX RMS   accY RMS   accZ RMS

- idle - correct
- lift - correct
- maritime - correct
- terrestrial - correct

The Feature explorer displays a 3D scatter plot with axes accX RMS, accY RMS, and accZ RMS. The plot shows four distinct clusters of points corresponding to the four classes: idle, lift, maritime, and terrestrial. Each cluster contains points labeled as 'correct' for their respective class.



Deployment - IESTI01 - Nano Motion Classification

studio.edgeimpulse.com/studio/61345/deployment

EDGE IMPULSE

DEPLOYMENT (IESTI01 - NANO MOTION CLASSIFICATION)

MJRoBot (Marcelo Rovai)

Deploy your impulse

You can deploy your impulse to any device. This makes the model run without an internet connection, minimizes latency, and runs with minimal power consumption. [Read more.](#)

Create library

Turn your impulse into optimized source code that you can run on any device.

C++ library Arduino library Cube.MX CMSIS-PACK

WebAssembly TensorRT library

Build firmware

Or get a ready-to-go binary for your development board that includes your impulse.

ST IoT Discovery Kit Arduino Nano 33 BLE Sense Eta Compute ECM3532 AI Sensor

SiLabs Thunderboard Sense 2 Himax WE-I Plus Nordic nRF52840 DK + IKS02A1

Nordic nRF5340 DK + IKS02A1 Nordic nRF9160 DK + IKS02A1 Nordic Thingy:91

ei-iesti01---nano....zip

Show All

Build output

```
Creating job... OK (ID: 1646786)
Writing templates...
Writing templates OK
Copying Edge Impulse SDK...
Copying Edge Impulse SDK OK
Compiling EON model...
Compiling EON model OK
Removing clutter and updating headers...
Removing clutter and updating headers OK
Creating archive...
Job started
Creating archive OK
Job completed
```

Deployment - IESTI01 - Nano Motion Classification

studio.edgeimpulse.com/studio/61345/deployment

**EDGE IMPULSE**

- Dashboard
- Devices
- Data acquisition
- Impulse design
  - Create impulse
  - Spectral features
  - NN Classifier
- EON Tuner
- Retrain model
- Live classification
- Model testing
- Versioning
- Deployment

**GETTING STARTED**

- Documentation
- Forums

SiLabs Thunderboard Sense 2

Himax WE-I Plus

Nordic nRF52840 DK + IKS02A1

Nordic nRF5340 DK + IKS02A1

Nordic nRF9160 DK + IKS02A1

Nordic Thingy:91

Sony's Spsesense

**Select optimizations (optional)**

Model optimizations can increase on-device performance. Choose from recommended choices for your target. Click [View all optimizations](#) to see more.

**Enable EON™ Compiler**

Same accuracy, up to 50% less RAM usage.

**Available optimizations for NN Classifier**

Optimization	RAM Usage	Latency	Confusion Matrix																				
<b>Quantized (int8) ★</b>	1.1K	1 ms	<table border="1"><tr><td>100</td><td>0</td><td>0</td><td>0</td><td>0</td></tr><tr><td>0</td><td>100</td><td>0</td><td>0</td><td>0</td></tr><tr><td>0</td><td>0</td><td>100</td><td>0</td><td>0</td></tr><tr><td>0</td><td>0</td><td>0</td><td>100</td><td>0</td></tr></table>	100	0	0	0	0	0	100	0	0	0	0	0	100	0	0	0	0	0	100	0
100	0	0	0	0																			
0	100	0	0	0																			
0	0	100	0	0																			
0	0	0	100	0																			
<b>Unoptimized (float32)</b>	19.0K	100%	<table border="1"><tr><td>100</td><td>0</td><td>0</td><td>0</td><td>0</td></tr><tr><td>0</td><td>100</td><td>0</td><td>0</td><td>0</td></tr><tr><td>0</td><td>0</td><td>100</td><td>0</td><td>0</td></tr><tr><td>0</td><td>0</td><td>0</td><td>100</td><td>0</td></tr></table>	100	0	0	0	0	0	100	0	0	0	0	0	100	0	0	0	0	0	100	0
100	0	0	0	0																			
0	100	0	0	0																			
0	0	100	0	0																			
0	0	0	100	0																			

Currently selected

This optimization is recommended for best performance.

Click to select

Estimate for Cortex-M4F 80MHz

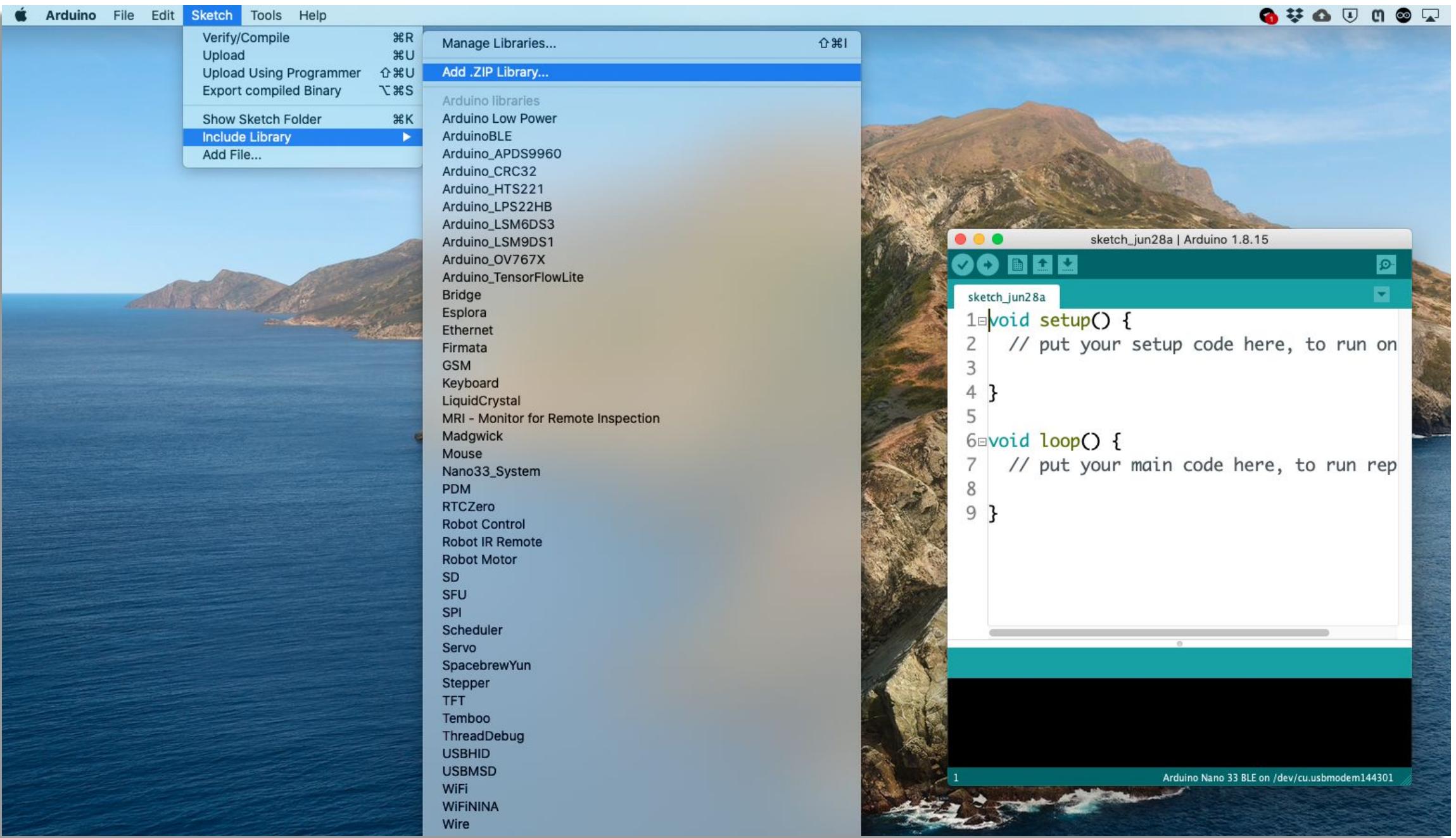
Build

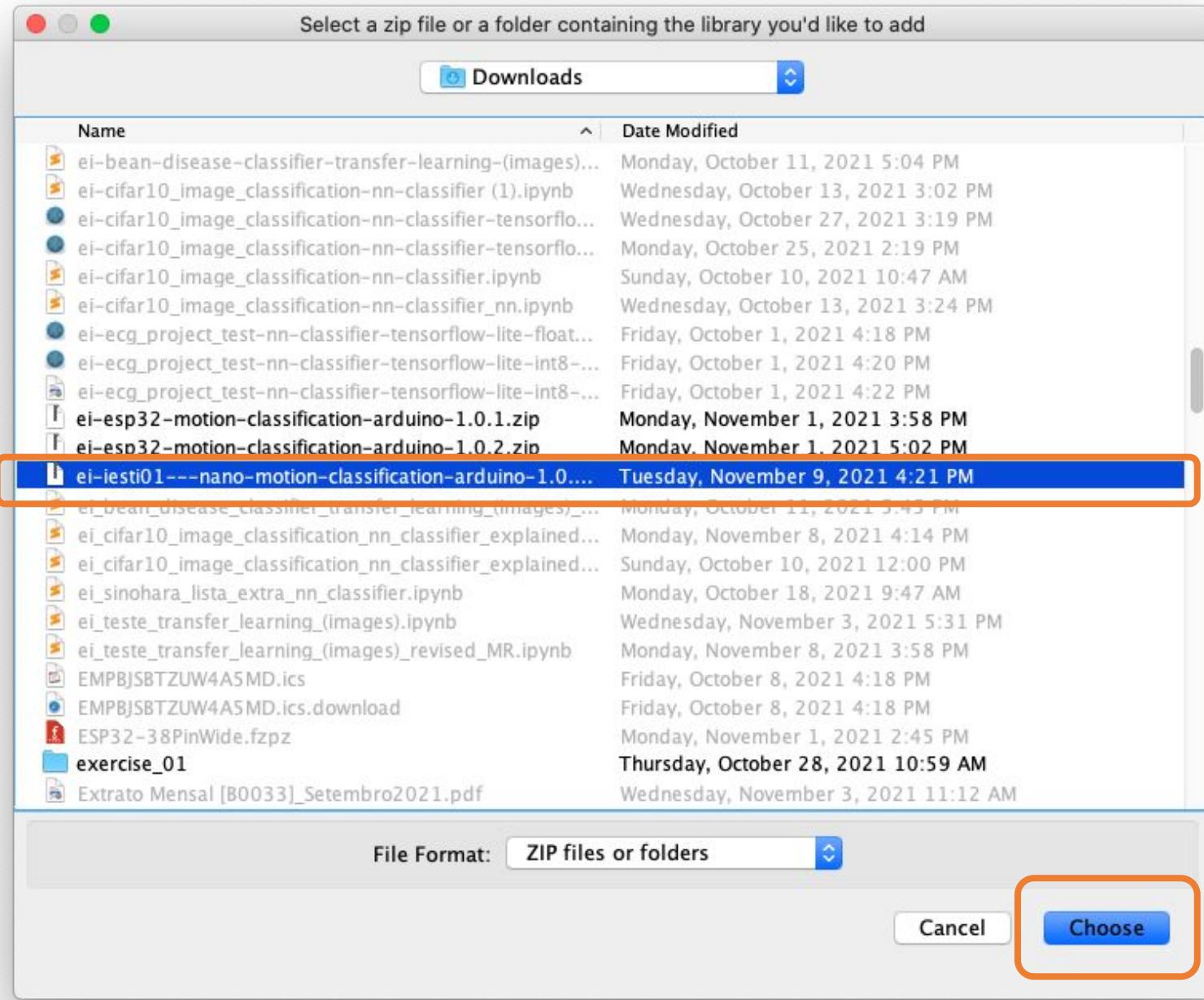
**Build output**

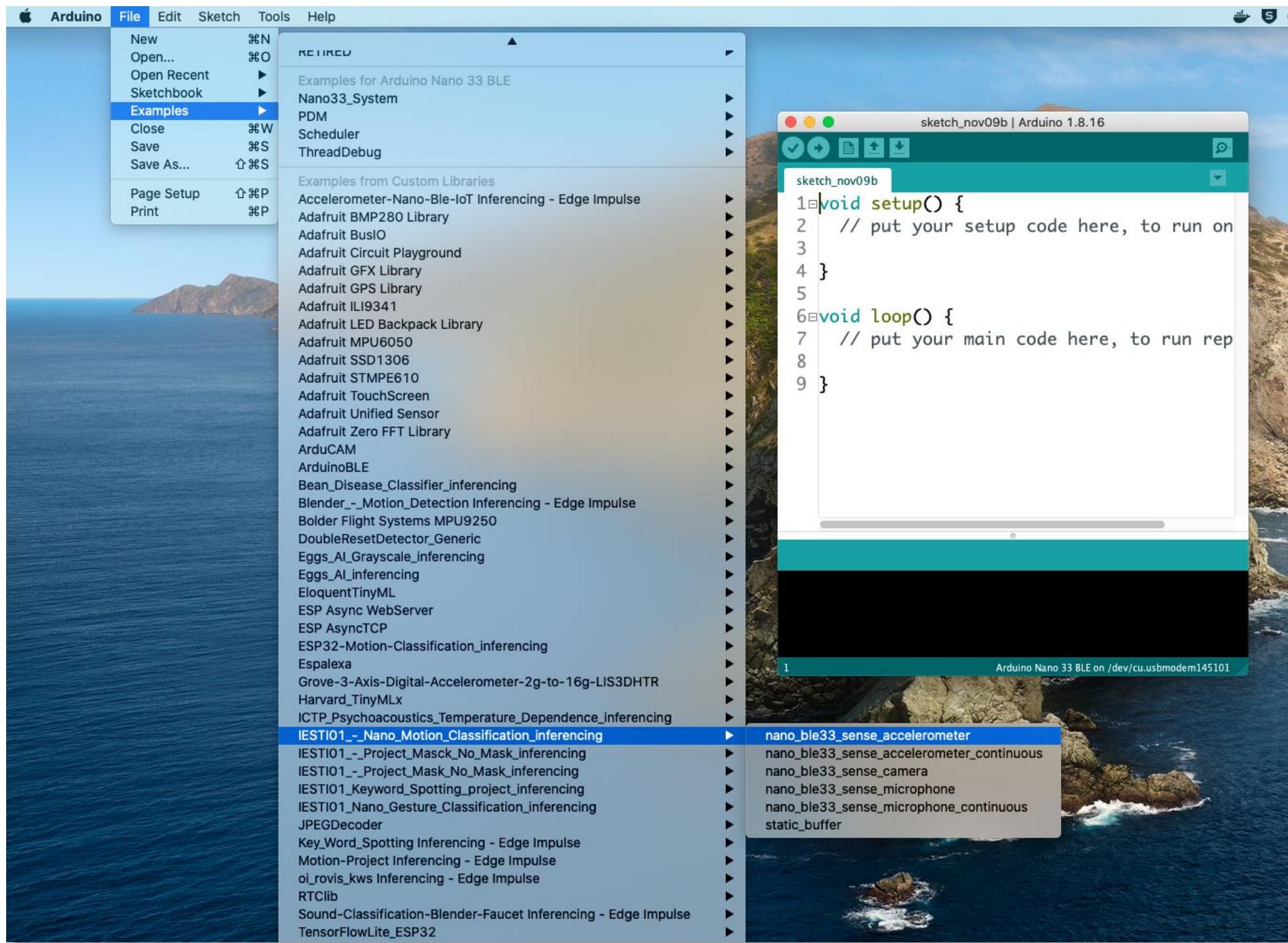
```
Creating job... OK (ID: 1646786)
Writing templates...
Writing templates OK
Copying Edge Impulse SDK...
Copying Edge Impulse SDK OK
Compiling EON model...
Compiling EON model OK
Removing clutter and updating headers...
Removing clutter and updating headers OK
Creating archive...
Archive OK
```

ei-iesti01---nano....zip

Show All







# Model Inference

Arduino File Edit Sketch Tools Help

/dev/cu.usbmodem145101

Sampling...

Predictions (DSP: 20 ms., Classification: 0 ms., Anomaly: 0 ms.):

- idle: 0.00000
- lift: 0.00000
- maritime: 0.00000
- terrestrial: 0.99609

Starting inferencing in 2 seconds...

Sampling...

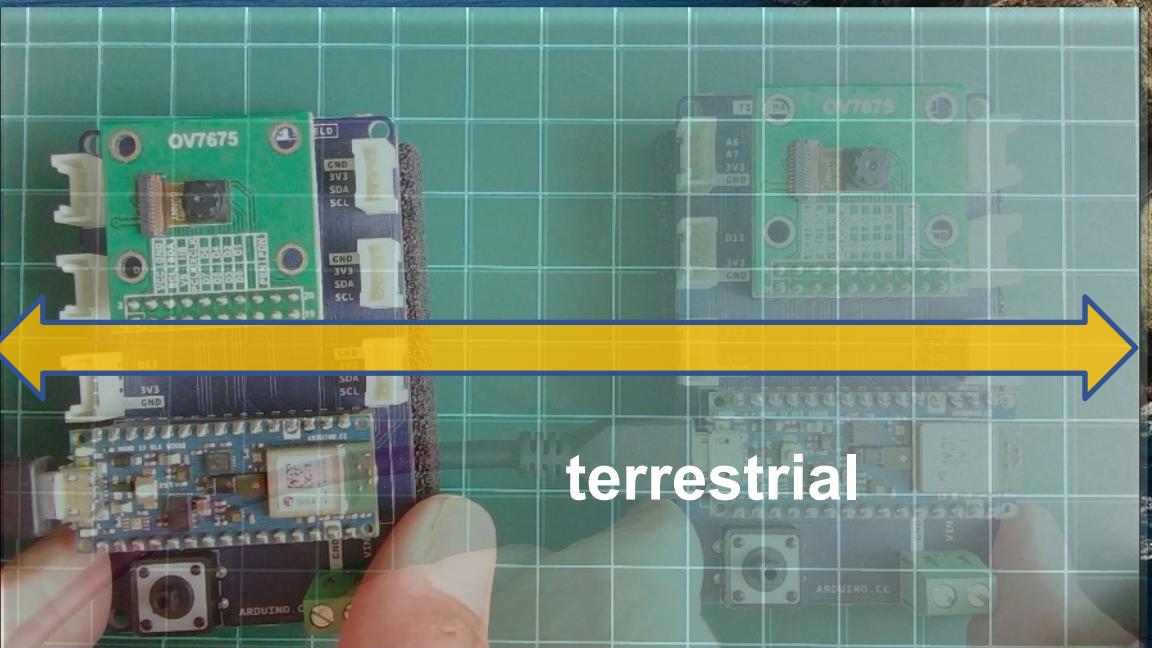
Predictions (DSP: 20 ms., Classification: 1 ms., Anomaly: 0 ms.):

- idle: 0.00000
- lift: 0.00000
- maritime: 0.00000
- terrestrial: 0.99609

Starting inferencing in 2 seconds...

Autoscroll  Show timestamp

Both NL & CR 115200 baud Clear output



terrestrial

nano\_ble33\_sense\_accelerometer | Arduino 1.8.16

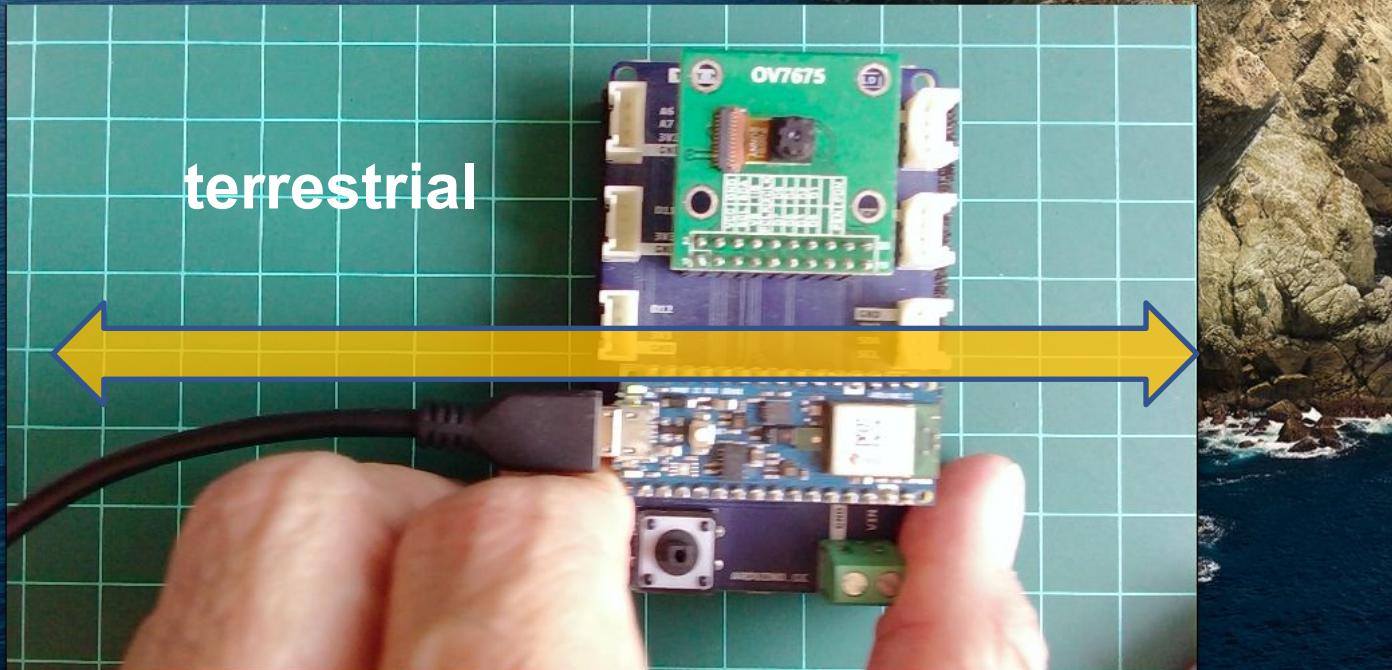
```
/* Edge Impulse Arduino examples
 * Copyright (c) 2021 EdgeImpulse Inc.
 *
 * Permission is hereby granted, free of charge, to any person obtaining a copy
 * of this software and associated documentation files (the "Software"), to
 * deal in the Software without restriction, including without limitation the rights
 * to use, copy, modify, merge, publish, distribute, sublicense, and/or sell
 * copies of the Software, and to permit persons to whom the Software is
 * furnished to do so, subject to the following conditions:
 *
 * The above copyright notice and this permission notice shall be included in
 * all copies or substantial portions of the Software.
 *
 * THE SOFTWARE IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND, EXPRESS OR
 * IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY,
 * FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT. IN NO EVENT SHALL THE
 * AUTHORS OR COPYRIGHT HOLDERS BE LIABLE FOR ANY CLAIM, DAMAGES OR OTHER
 * LIABILITY, WHETHER IN AN ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM
 * OUT OF OR IN CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN
 * THE SOFTWARE.
 */
/*
 * Includes -----
#include <IESTI01_-_Nano_Motion_Classification_inferencing.h>
#include <Arduino_LSM9DS1.h>
*
/* Constant defines -----
#define CONVERT_G_TO_MS2 9.80665f
*
/* Private variables -----
static bool debug_nn = false; // Set this to true to see e.g. features generated by the neural network
*/
Done in 6.027 seconds
reset()
```

15

Arduino Nano 33 BLE on /dev/cu.usbmodem145101

```
/dev/cu.usbmodem145101
Predictions (DSP: 29 ms., Classification: 0 ms., Anomaly: 0 ms.): terrestrial [ 0, 0, 0, 10, 0, 0,
Predictions (DSP: 29 ms., Classification: 0 ms., Anomaly: 0 ms.): terrestrial [ 0, 0, 0, 10, 0, 0,
Predictions (DSP: 29 ms., Classification: 0 ms., Anomaly: 0 ms.): terrestrial [ 0, 0, 0, 10, 0, 0,
Predictions (DSP: 29 ms., Classification: 0 ms., Anomaly: 0 ms.): terrestrial [ 0, 0, 0, 10, 0, 0,
Predictions (DSP: 29 ms., Classification: 0 ms., Anomaly: 0 ms.): terrestrial [ 0, 0, 0, 10, 0, 0,
Predictions (DSP: 29 ms., Classification: 0 ms., Anomaly: 0 ms.): terrestrial [ 0, 0, 0, 10, 0, 0,
Predictions (DSP: 29 ms., Classification: 0 ms., Anomaly: 0 ms.): terrestrial [ 0, 0, 0, 10, 0, 0,
Predictions (DSP: 29 ms., Classification: 0 ms., Anomaly: 0 ms.): terrestrial [ 0, 0, 0, 10, 0, 0,
Predictions (DSP: 29 ms., Classification: 0 ms., Anomaly: 0 ms.): terrestrial [ 0, 0, 0, 10, 0, 0,
Predictions (DSP: 29 ms., Classification: 0 ms., Anomaly: 0 ms.): terrestrial [ 0, 0, 0, 10, 0, 0,
Predictions (DSP: 29 ms., Classification: 0 ms., Anomaly: 0 ms.): terrestrial [ 0, 0, 0, 10, 0, 0,
Predictions (DSP: 29 ms., Classification: 0 ms., Anomaly: 0 ms.): terrestrial [ 0, 0, 0, 10, 0, 0,
Predictions (DSP: 29 ms., Classification: 0 ms., Anomaly: 0 ms.): terrestrial [ 0, 0, 0, 10, 0, 0,
Predictions (DSP: 29 ms., Classification: 0 ms., Anomaly: 0 ms.): terrestrial [ 0, 0, 0, 10, 0, 0,
Predictions (DSP: 29 ms., Classification: 0 ms., Anomaly: 0 ms.): terrestrial [ 0, 0, 0, 10, 0, 0,
Predictions (DSP: 29 ms., Classification: 0 ms., Anomaly: 0 ms.): terrestrial [ 0, 0, 0, 10, 0, 0,
```

Autoscroll  Show timestamp      Both NL & CR      115200 baud      Clear output



```
nano_ble33_sense_accelerometer_continuous | Arduino 1.8.16
nano_ble33_sense_accelerometer_continuous
22
23 /* Includes -----
24 #include <IESTI01_-_Nano_Motion_Classification_inferencing.h>
25 #include <Arduino_LSM9DS1.h>
26
27 /* Constant defines -----
28 #define CONVERT_G_TO_MS2 9.80665f
29
30 /* Private variables -----
31 static bool debug_nn = false; // Set this to true to see e.g. features
32 static uint32_t run_inference_every_ms = 200;
33 static rtos::Thread inference_thread(osPriorityLow);
34 static float buffer[EI_CLASSIFIER_DSP_INPUT_FRAME_SIZE] = { 0 };
35 static float inference_buffer[EI_CLASSIFIER_DSP_INPUT_FRAME_SIZE];
36
37 /* Forward declaration */
38 void run_inference_background();
39
40 /**
41 * @brief      Arduino setup function
42 */
43 void setup()
44{
    // put your setup code here, to run once:
    Serial.begin(115200);
    Serial.println("Edge Impulse Inferencing Demo");

    if (!IMU.begin())
        ei_printf("Failed to initialize IMU!\r\n");
    else
        ei_printf("IMU initialized\r\n");
}
Done uploading.
Done in 6.034 seconds
reset()
```

40

Arduino Nano 33 BLE on /dev/cu.usbmodem145101

TinyML motion classification uses  
on **Real Life**

# Cow Monitoring

## Using the Internet of Things for Agricultural Monitoring

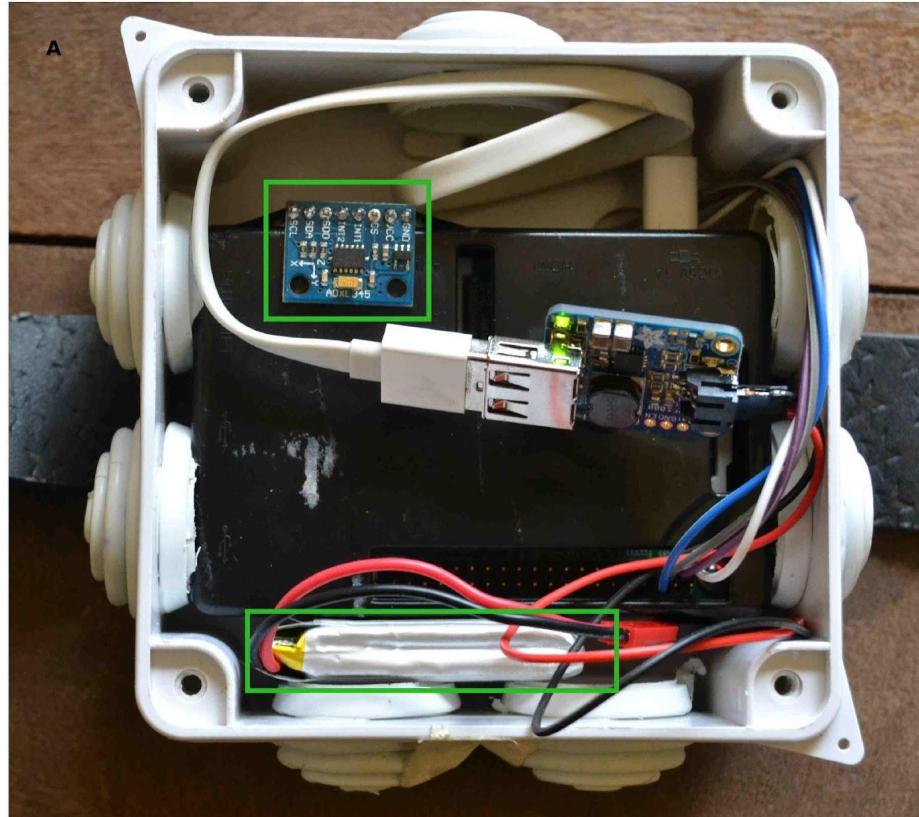
"We aim to deploy a variety of sensors for agricultural monitoring. One of the projects involves using **accelerometer sensors** to monitor activity levels in dairy cows with a view to determining when the cows are on heat or when they are sick."



Ciira wa Maina, Ph.D.

Senior Lecturer  
Department of Electrical and Electronic Engineering  
Dedan Kimathi University of Technology  
Nyeri Kenya  
Email: ciira.maina@dkut.ac.ke

Kenia



<https://sites.google.com/site/cwamainadekut/research>



# Predict and classify common Elephant behavior



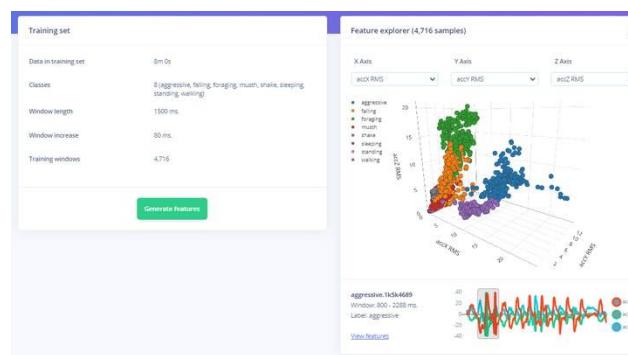
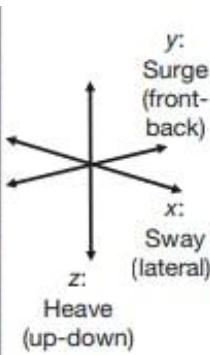
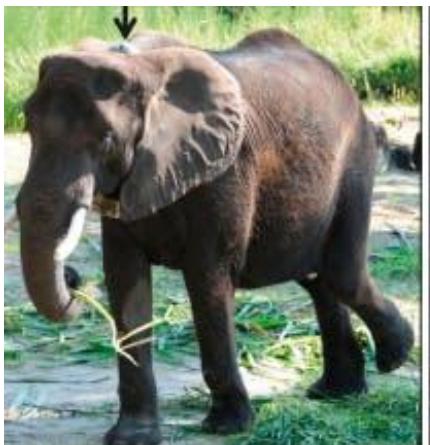
Aggressive



Standing

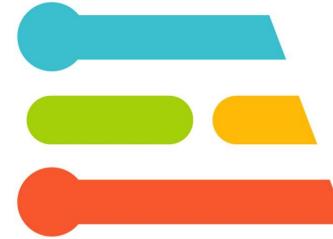


Sleeping



[https://www.hackster.io/dhruvsheth\\_electet-tinyml-and-iot-based-smart-wildlife-tracker-c03e5a#toc-accelerometer-data-models-4](https://www.hackster.io/dhruvsheth_electet-tinyml-and-iot-based-smart-wildlife-tracker-c03e5a#toc-accelerometer-data-models-4)

# Thanks



# Addendum: Using Edge Impulse CLI

**DOCUMENTATION**

- [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](#)
- [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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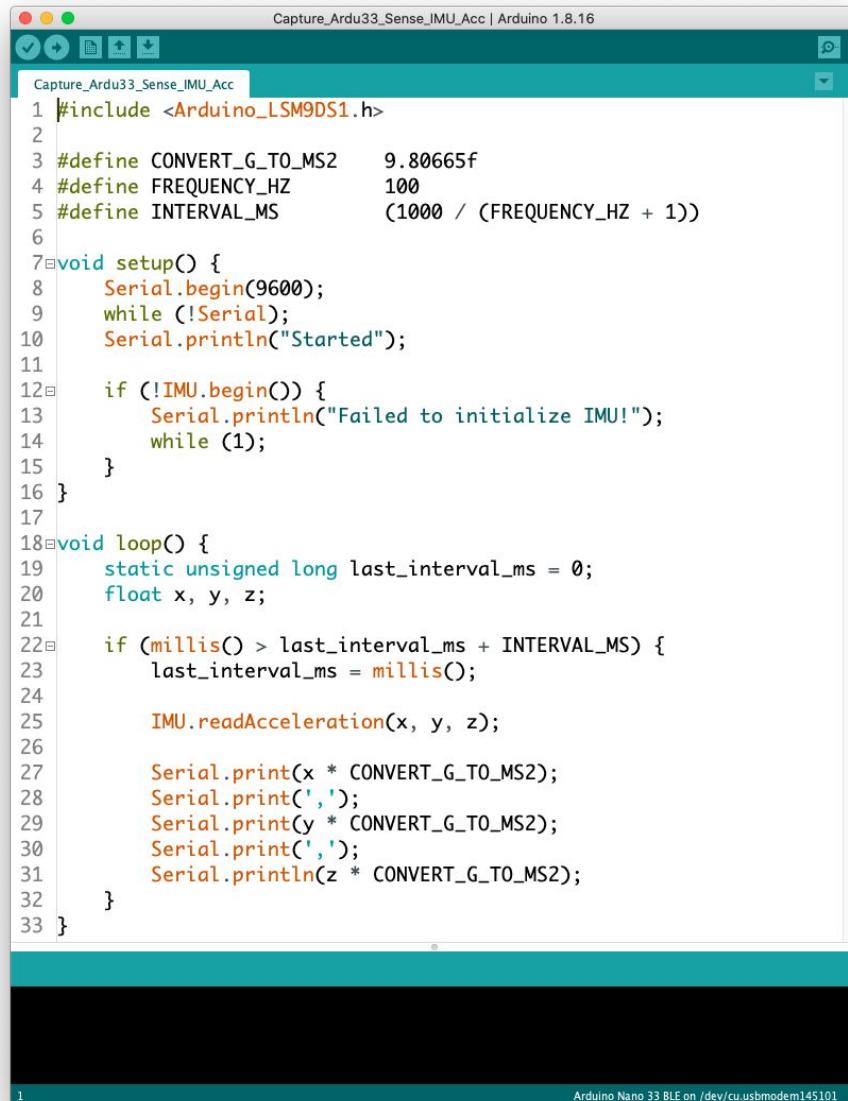
```
npm install -g edge-impulse-cli --force
```

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);
    }
}

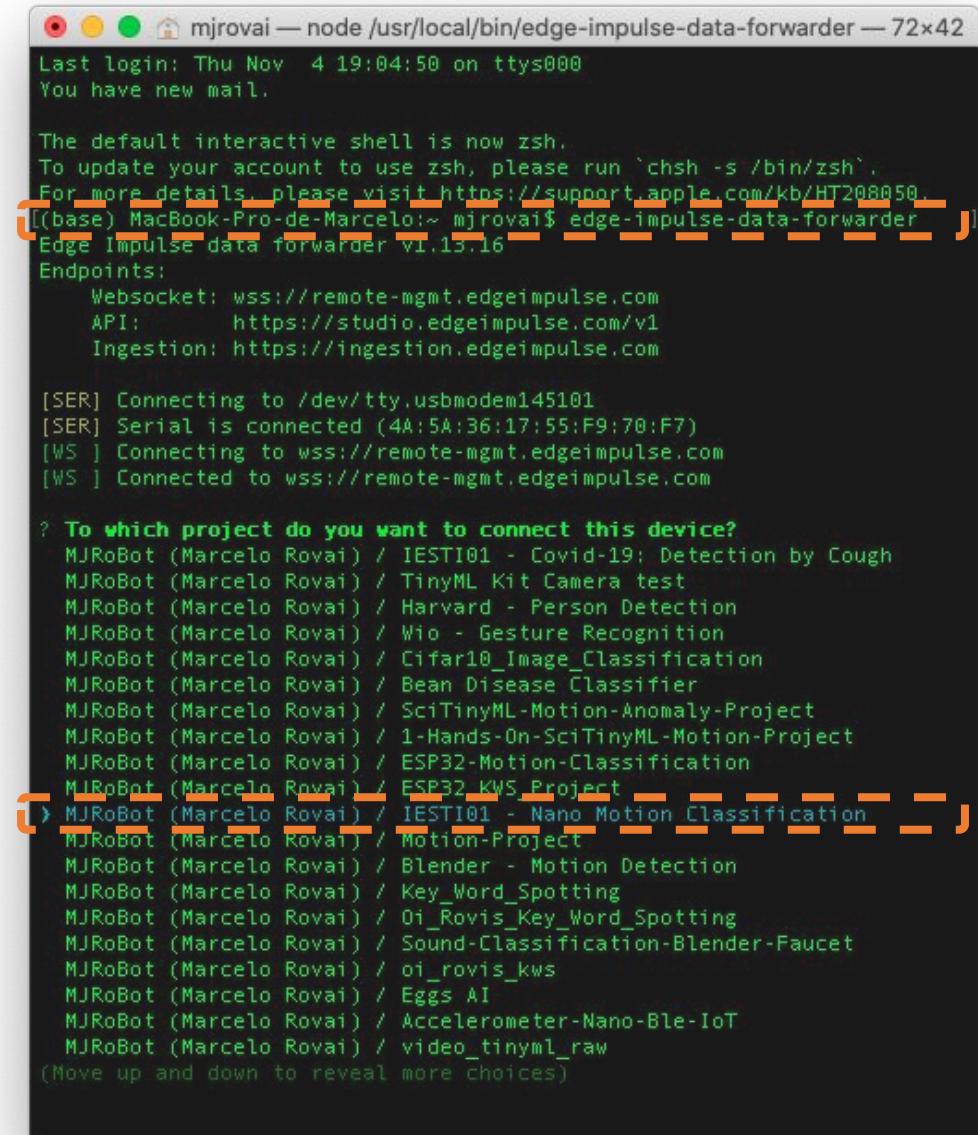
void loop() {
    static unsigned long last_interval_ms = 0;
    float x, y, z;

    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 (`/dev/tty.usbmodem145101`) and establishing a websocket connection to the remote management endpoint (`wss://remote-mgmt.edgeimpulse.com`). The terminal then prompts the user to select a project to connect the device to, listing several projects owned by "MJRobot (Marcelo Rovai)".

```
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_rovics_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

Documentation

Forums