

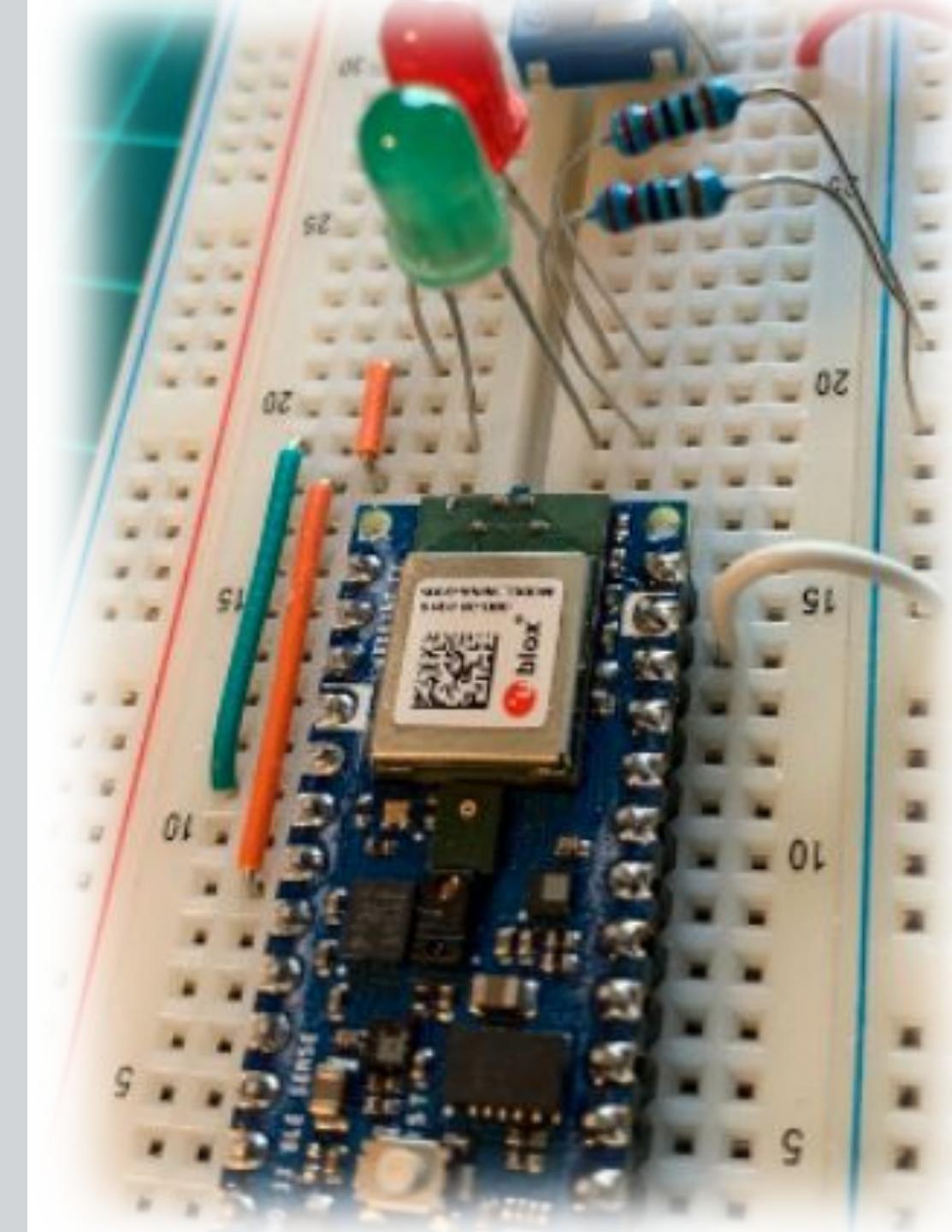
IESTI01 – TinyML

Embedded Machine Learning

20. Motion Classification using
Arduino Nano-33 BLE Sense



Prof. Marcelo Rovai
UNIFEI



Arduino Nano-33 BLE Edge Impulse – Installation

Select project - Edge Impulse

studio.edgeimpulse.com/studio/select-project

EDGE IMPULSE

MJRoBot (Marcelo Rovai)

Select project

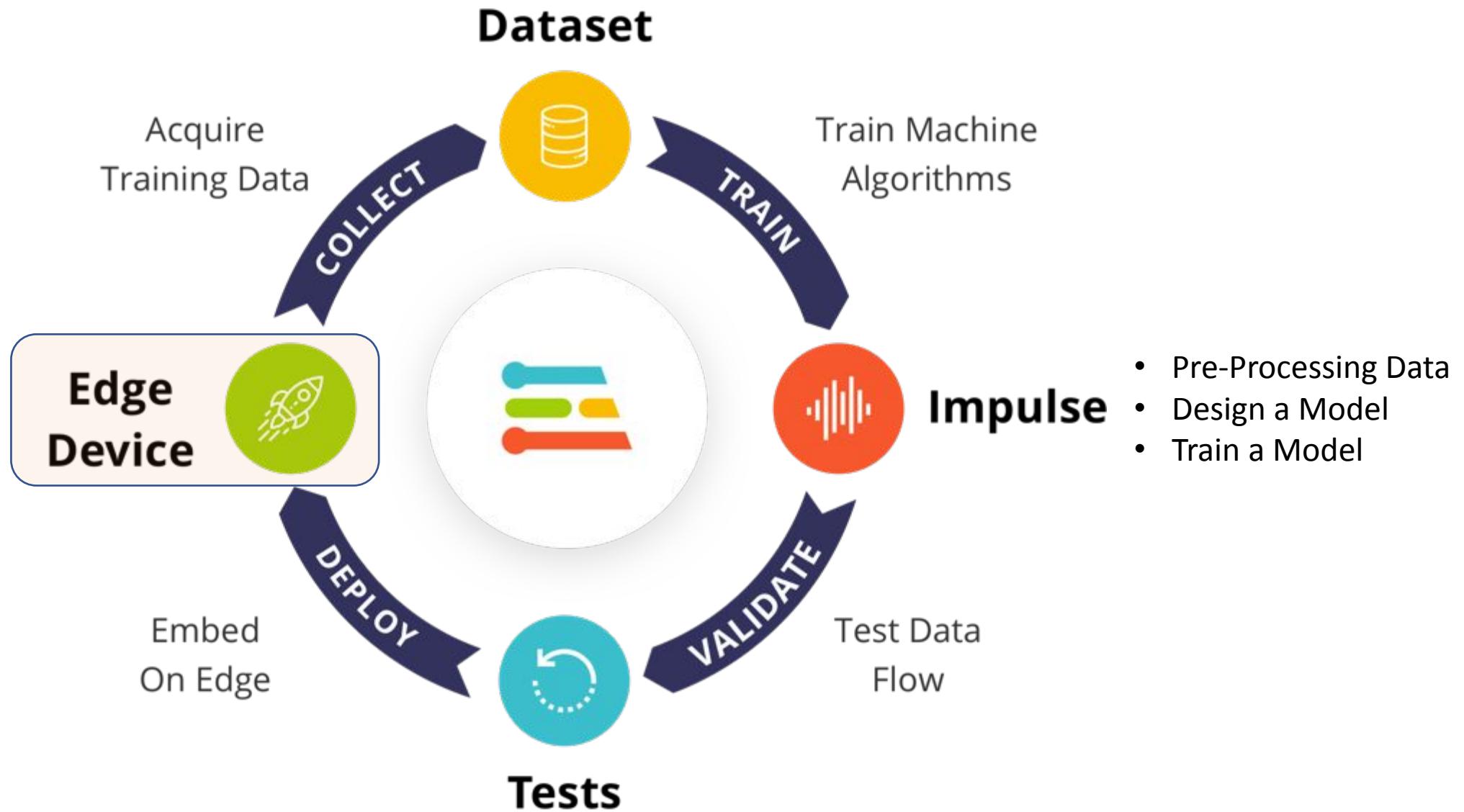
Select your Edge Impulse project, or create a new one.

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



The screenshot shows the Edge Impulse studio interface on a web browser. The left sidebar contains navigation links such as Dashboard, Devices (highlighted with a red box and number 1), Data acquisition, Impulse design, Create impulse, EON Tuner, Retrain model, Live classification, Model testing, Versioning, Deployment, Documentation, and Forums. The main content area is titled "DEVICES (IESTI01 - NANO MOTION CLASSIFICATION)" and displays a "Your devices" section with a message about connected devices. A central modal window is open, titled "Collect data", with the sub-section "Connect a fully supported development board". This section includes a "Browse dev boards" button (highlighted with a red box and number 2) and a "Show QR code" button. The modal also lists other collection methods: "Use your mobile phone", "Use your computer", "Data from any device with the data forwarder", "Upload data", and "Integrate with your cloud". The bottom of the modal has "Show docs", "Go to the uploader", and "Contact us" buttons. The URL bar at the bottom of the browser shows the page is https://docs.edgeimpulse.com/docs/fully-supported-development-boards.

Devices - IESTI01 - Nano Motion Classification

studio.edgeimpulse.com/studio/61345/devices

EDGE IMPULSE

1

2

3

Devices

Data acquisition

Impulse design

Create impulse

EON Tuner

Retrain model

Live classification

Model testing

Versioning

Deployment

GETTING STARTED

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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

Show docs

Upload data

Integrate with your cloud

Show QR code

Go to the uploader

Contact us

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

MJRoBot (Marcelo Rovai)

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

Overview

There is a list of development boards that are fully supported by Edge Impulse. These boards come with a special firmware which enables data collection from all their sensors, allows you to build new ready-to-go binaries that include your trained impulse, and come with examples on integrating your impulse with your custom firmware. These boards are the perfect way to start building Machine Learning solutions on real embedded hardware.

- [ST B-L475E-IOT01A \(or Discovery Kit\)](#)
- [Arduino Nano 33 BLE Sense](#)
- [Eta Compute ECM3532 AI Sensor](#)
- [Eta Compute ECM3532 AI Vision](#)
- [OpenMV Cam H7 Plus](#)
- [Himax WE-I Plus](#)
- [Nordic Semiconductor nRF52840 DK](#)
- [Nordic Semiconductor nRF5340 DK](#)
- [Silicon Labs Thunderboard Sense 2](#)
- [Sony's Spresense](#)
- [Arduino Portenta H7 + Vision shield](#) (preview support)
- [Raspberry Pi 4](#)
- [NVIDIA Jetson Nano](#)



Different development board? No problem, you can always collect data using the [Data forwarder](#) or the [Edge Impulse for Linux](#) SDK, and deploy your model back to the device with the [Running your impulse locally](#) tutorials.

Just want to experience Edge Impulse? You can also use your [Mobile phone](#)!

Updated 7 days ago

EI CLI

EDGE IMPULSE Home API Reference Log In

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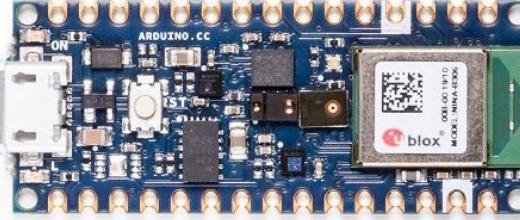
EDGE IMPULSE FOR LINUX

- Edge Impulse for Linux
- Linux Node.js SDK
- Linux Go SDK
- Linux C++ SDK
- Linux Python SDK

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.

The Edge Impulse firmware for this development board is open source and hosted on GitHub: [edgeimpulse/firmware-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.
3. On Linux:
 - GNU Screen: install for example via `sudo apt install screen`.

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

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- [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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EDGE IMPULSE FOR LINUX

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Installation - Linux/Ubuntu and Raspbian OS



Arduino CLI

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EDGE IMPULSE FOR LINUX

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- Linux C++ SDK
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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

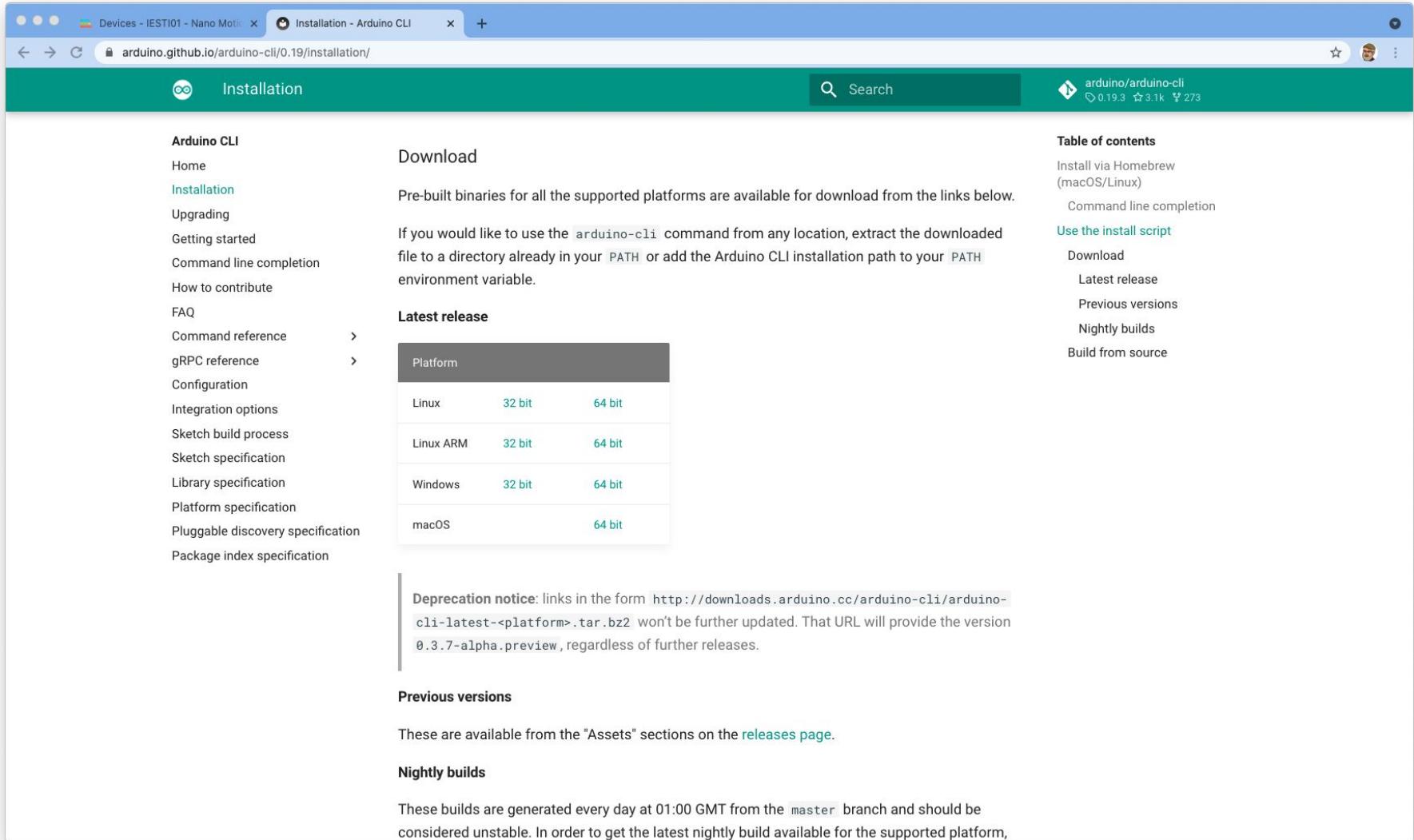
Installing dependencies

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 - Here's an [instruction video for Windows](#).
 - The [Arduino website](#) has instructions for macOS and Linux.
3. On Linux:
 - GNU Screen: install for example via `sudo apt install screen`.

A large blue arrow points from the bottom right towards the "Arduino CLI" section of the list.

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>

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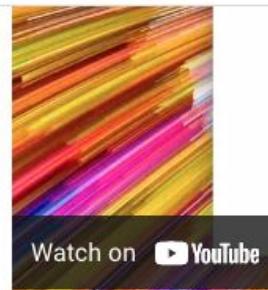
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EDGE IMPULSE CLI
Installation
Serial viewer
Uploader
Data forwarder



PRE-BUILT DATABASES
Continuous gestures
Keyword spotting
Running faucet

Arduino Nano 33 BLE Sense

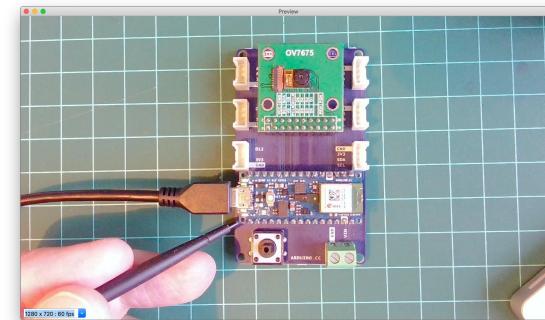
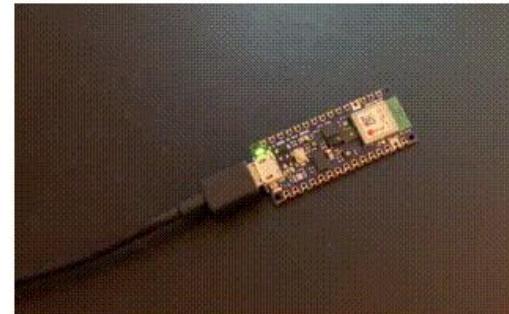
TIPS AND TRICKS
Increasing model performance
Decreasing the latency

Installing dependencies

To set this device up in Edge Impulse, you will need to install the following software:
1. Node.js v12 or higher.

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.

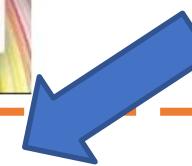


Press RESET twice quickly to launch the bootloader on the Arduino Nano 33 BLE Sense.

2. 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. Setting keys

Nano 33 BLE Sense x Overview x | +

docs/arduino-nano-33-ble-sense

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 Watch on YouTube



EDGE IMPULSE CLI

- Installation
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- Uploader
- Data forwarder

PRE-BUILT DATABASES

- Continuous gestures
- Keyword spotting
- Running faucet

ARDUINO NANO 33 BLE SENSE

Installing dependencies

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

- Node.js v12 or Higher
- Arduino IDE

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.



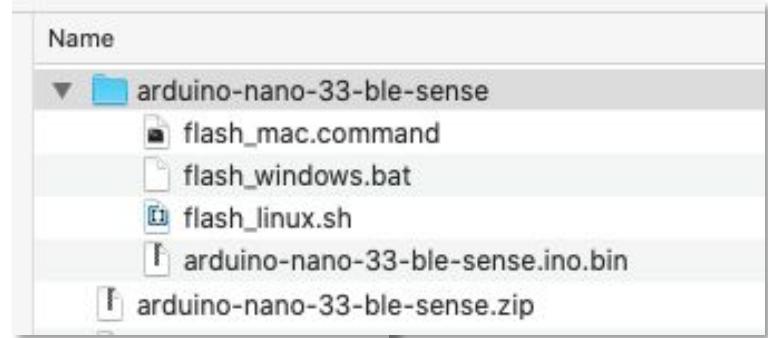
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- Wait until flashing is complete, and press the RESET button once to launch the new firmware.

3. Setting keys



1
2
2

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

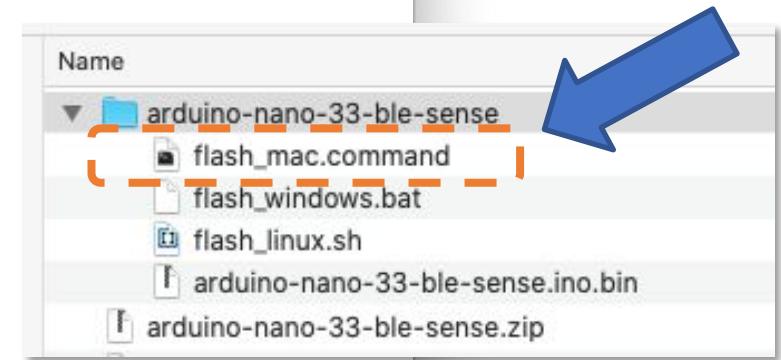
Done in 0.001 seconds
Write 280848 bytes to flash (69 pages)
[=====] 100% (69/69 pages)
Done in 10.984 seconds

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.

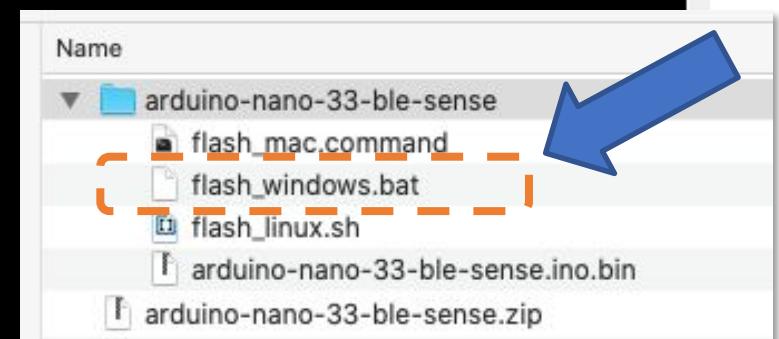
C:\Users\GUILH>arduino-cli
Arduino Command Line Interface (arduino-cli).

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.
```

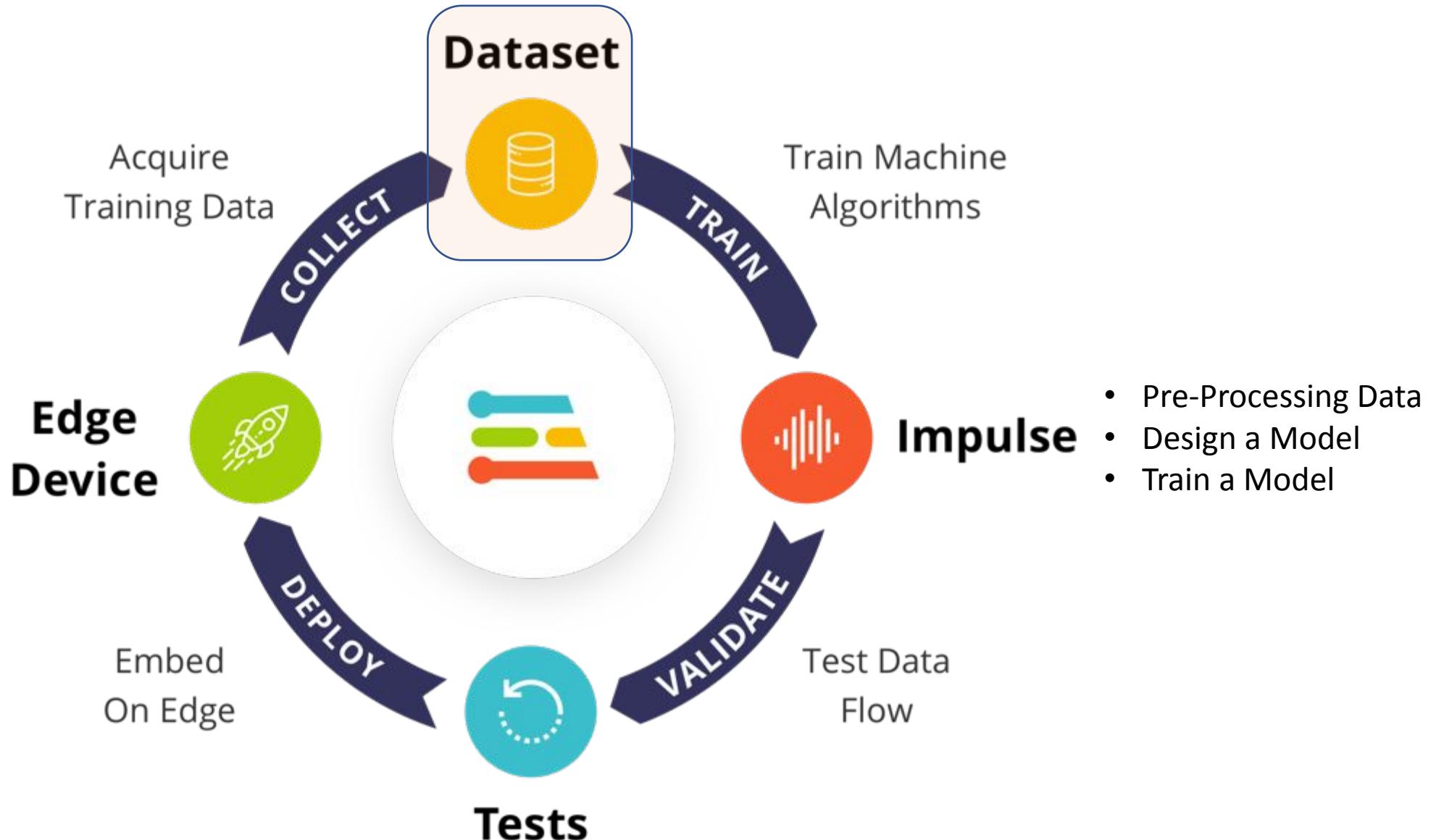
1. Press Nano-33 Reset button Twice
2. With Nano-33 LED Flashing:



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)          □ Nano-33 LED Stop Flashing
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. . .
```



The screenshot shows the Edge Impulse Studio interface on a Mac OS X system. The left sidebar contains navigation links like Dashboard, Devices, Data acquisition, and Model testing. The main workspace displays a connection dialog for a serial port and a central area for managing datasets.

Connection Dialog:

- Step 1:** A blue arrow points to the "cu.Bluetooth-Incoming-Port" option in the list.
- Step 2:** A blue arrow points to the "cu.SOC" section, which is highlighted with a dashed orange border.
- Step 3:** A blue arrow points to the "Connect" button at the bottom of the dialog.

Main Workspace:

- Step 1:** A blue arrow points to the "RAW DATA" section with the placeholder text "Click on a sample to load...".
- Step 2:** A blue arrow points to the "Record new data" section, which shows the message "No devices connected to the remote management API".
- Step 3:** A blue arrow points to the "Connect using WebUSB" button in the top right corner of the workspace.

Header:

studio.edgeimpulse.com wants to connect to a serial port

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

Record new data

No devices connected to the remote management API.

RAW DATA
Click on a sample to load...

Connect using WebUSB

MJRoBot (Marcelo Rovai)

WebUSB works fine in Windows

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

No data collected yet

Let's collect some data

Record new data

Device: 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...

A screenshot of the Edge Impulse Data Acquisition interface. On the left, a sidebar lists various project management and development tools. The main area is titled 'DATA ACQUISITION (IESTI01 - NANO MOTION CLASSIFICATION)' and shows a 'Record new data' form. This form includes fields for 'Device' (set to 36:17:55:F9:70:F7), 'Label' (set to 'terrestrial'), 'Sample length (ms.)' (set to 10000), 'Sensor' (set to 'Built-in accelerometer'), and 'Frequency' (set to 100Hz). A large blue arrow points to the 'Start sampling' button at the bottom right of the form. Below the form, a dark blue bar displays the text 'RAW DATA' and 'Click on a sample to load...'. The top of the page shows a browser header with the URL 'studio.edgeimpulse.com/studio/61345/acquisition/training?page=1'.

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

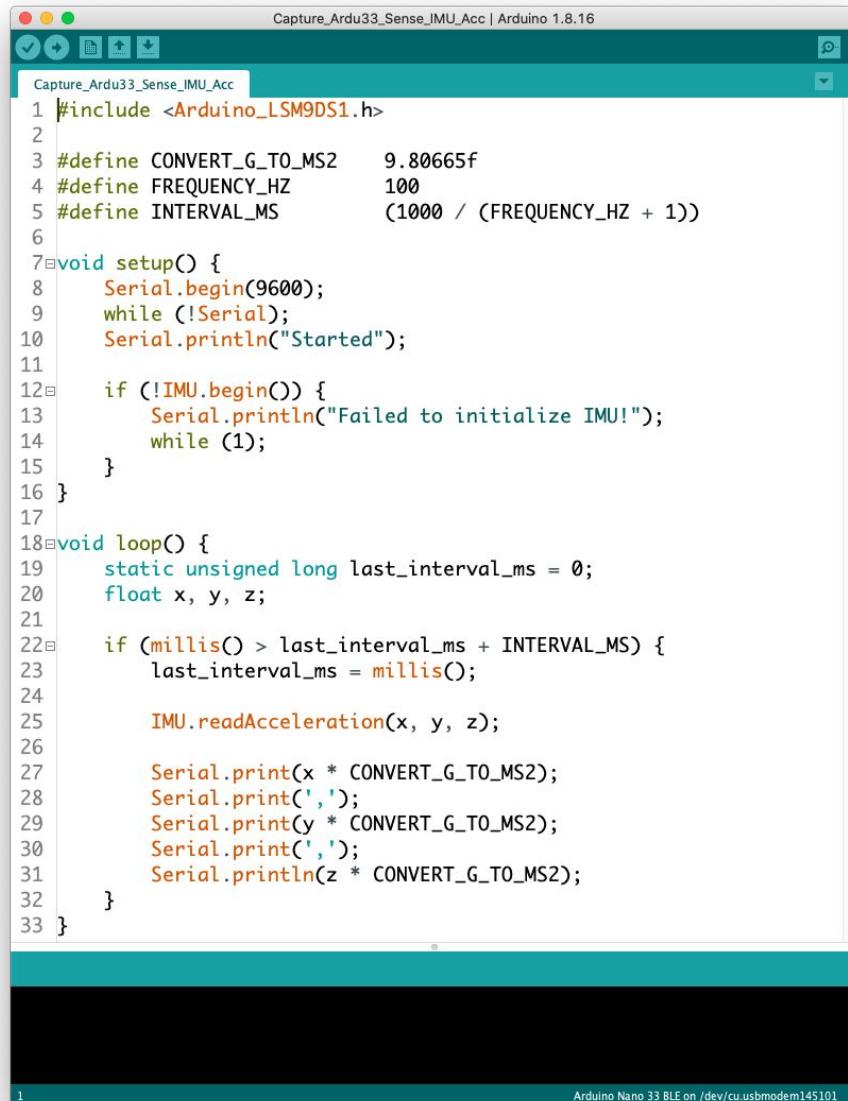
Deployment

GETTING STARTED

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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);
    }
}

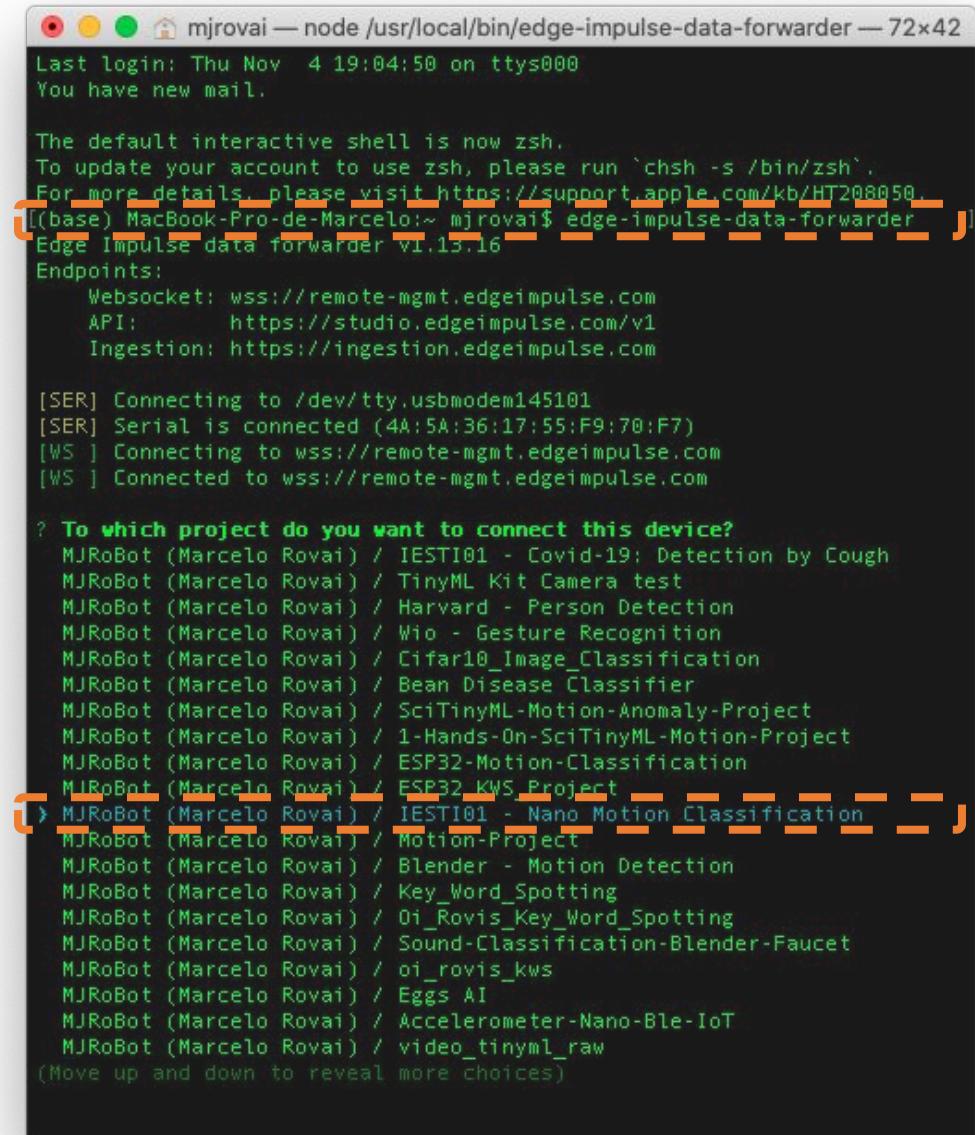
void loop() {
    static unsigned long last_interval_ms = 0;
    float x, y, z;

    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 a serial port and attempting to connect to a 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_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

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

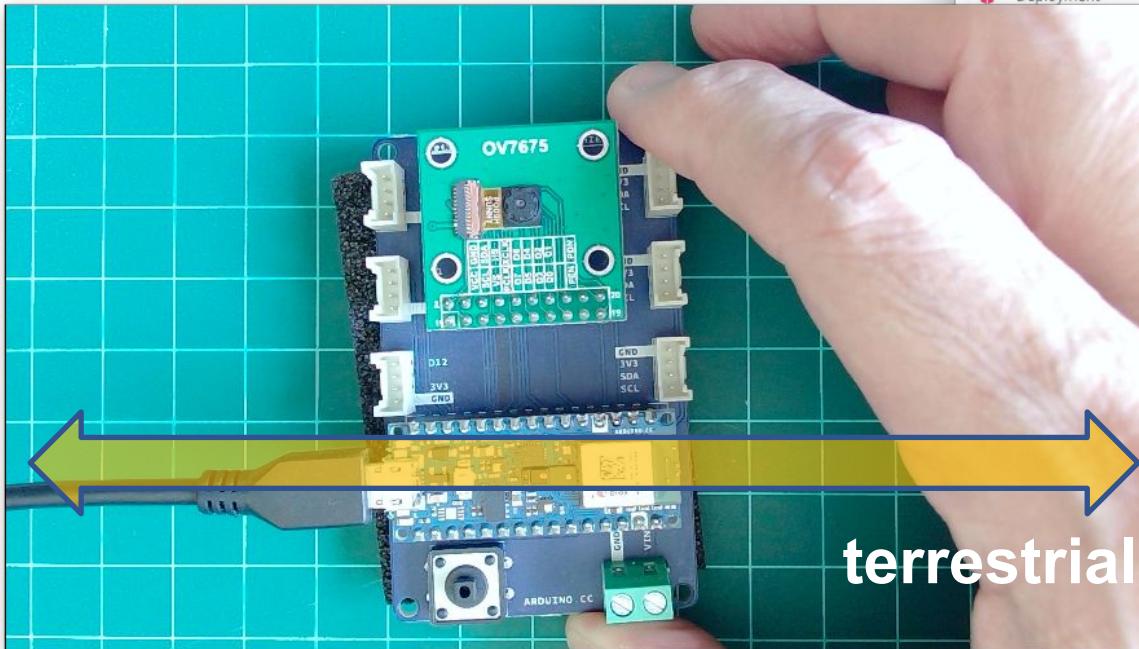
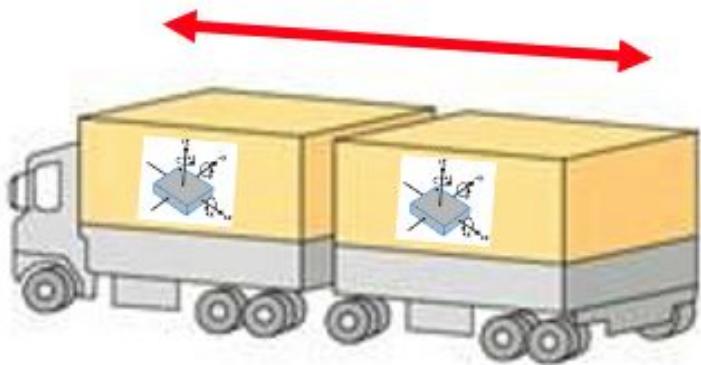
Start sampling

RAW DATA
terrestrial.json.2jbimlk

accX accY accZ

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

Label: terrestrial

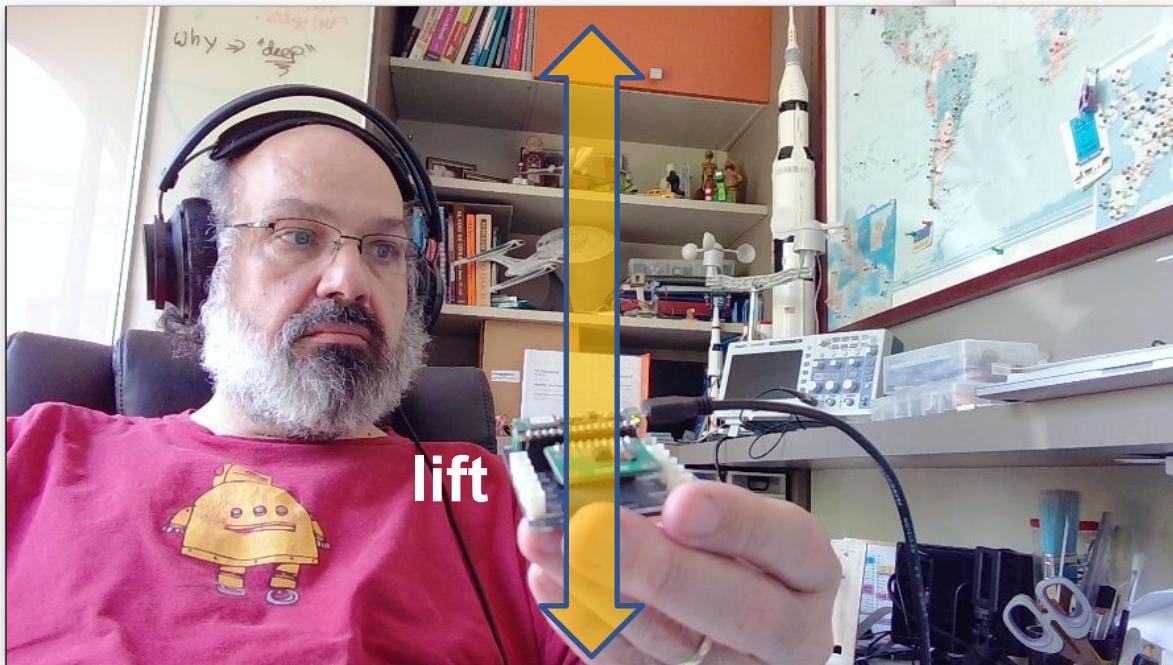
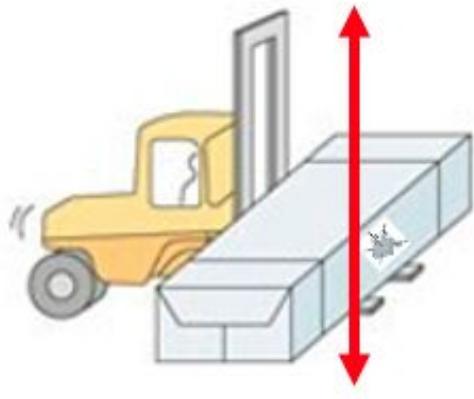


The screenshot shows the Edge Impulse Data Acquisition interface. The sidebar on the left includes options like Dashboard, Devices, Data acquisition (selected), Impulse design, Create impulse, EON Tuner, Retrain model, Live classification, Model testing, Versioning, and Deployment. The main area displays "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

The "Record new data" section shows settings for "Device" (Nano), "Label" (terrestrial), "Sample length (ms.)" (10000), "Sensor" (Sensor with 3 axes (accX, accY, accZ)), and "Frequency" (100Hz). A "Start sampling" button is present. The bottom section shows a "RAW DATA" plot for "terrestrial.json.2jvgelce" with three axes: accX (red), accY (green), and accZ (blue). The x-axis ranges from 0 to 9360, and the y-axis ranges from -20 to 20.

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)

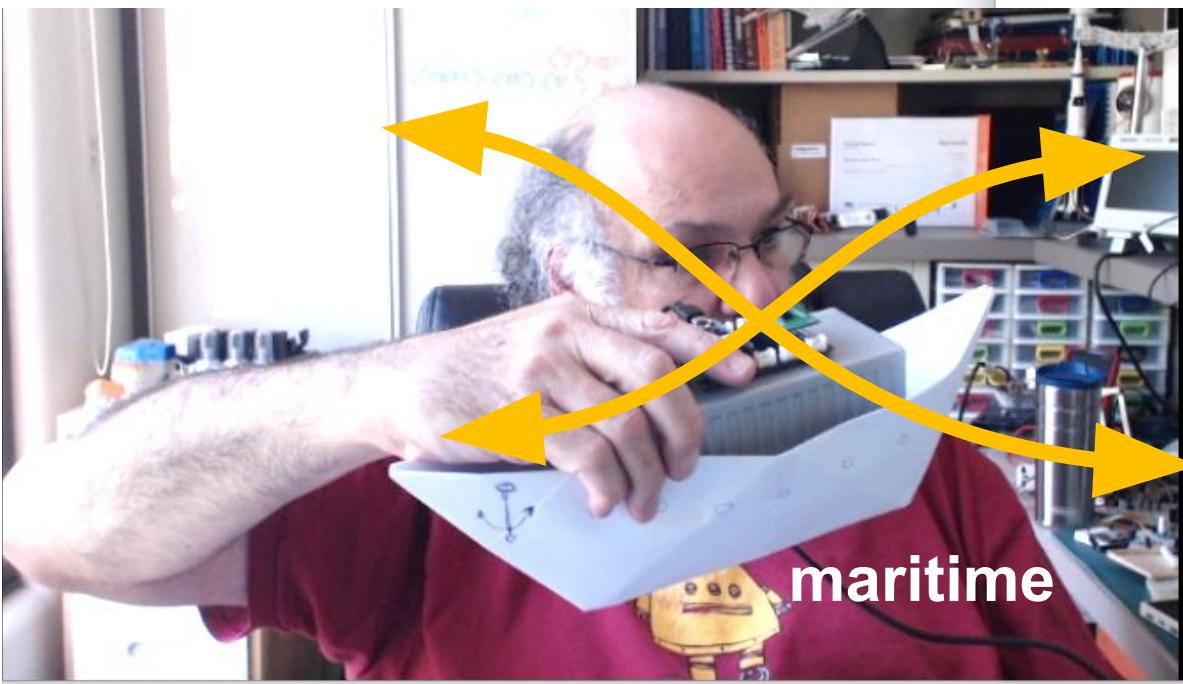
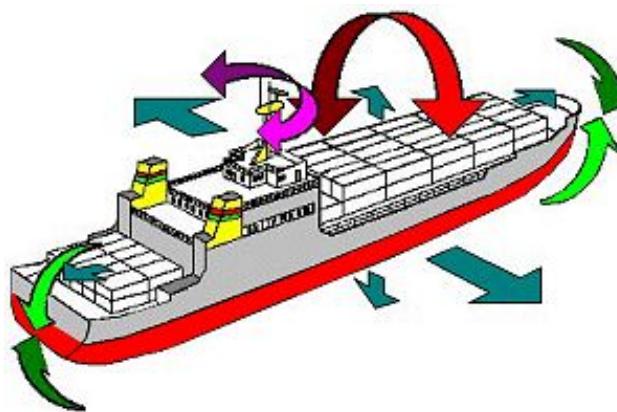
Frequency 100Hz

Start sampling

RAW DATA lift.json.2jvhbt7

The graph displays three data series: accX (red), accY (green), and accZ (blue). The x-axis represents time in milliseconds, ranging from 0 to 9360 with major ticks every 1040 units. The y-axis ranges from -20 to 20 with major ticks every 5 units. All three axes show a highly oscillatory pattern, with accX generally having the highest amplitude and accZ the lowest. The data points correspond to the samples listed in the table above.

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)

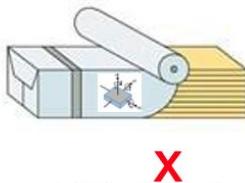
Frequency 100Hz

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

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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

Performing 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

?

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

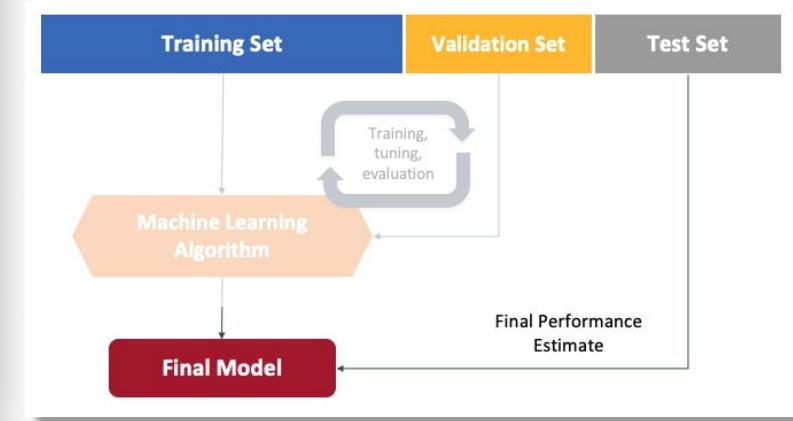
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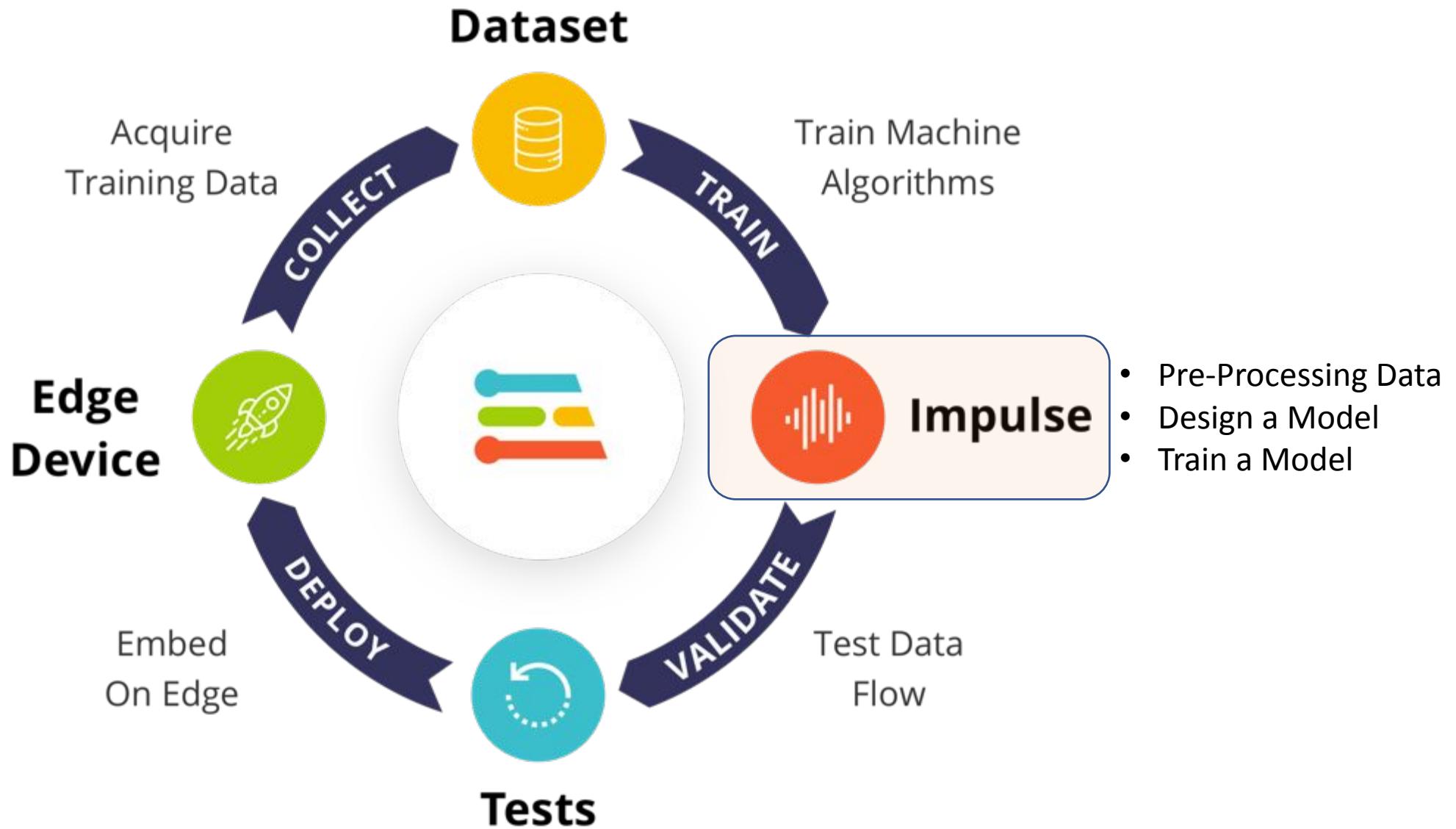
The screenshot shows the Edge Impulse studio interface for data acquisition testing. On the left, a sidebar menu is visible with options like Dashboard, Devices, Data acquisition (which is selected and highlighted with an orange dashed border), Impulse design, EON Tuner, Retrain model, Live classification, Model testing, Versioning, Deployment, Documentation, and Forums. The main area is titled "DATA ACQUISITION - TESTING (IE5000)" and shows a summary: "DATA COLLECTED 40s" with a pie chart icon, and "TRAIN / TEST SPLIT 90% / 10%" with a slider icon. Below this, a table titled "Collected data" lists four samples: "maritime.json.2jvi4..." (label: maritime), "maritime.json.2jvi1..." (label: maritime), "lift.json.2jh6uqu" (label: lift), and "terrestrial.json.2jv..." (label: terrestrial). Each sample entry includes columns for SAMPLE NAME, LABEL, ADDED, LENGTH, and three vertical ellipsis icons. A blue arrow points from the sidebar's "Data acquisition" section towards the "Test data" tab. A tooltip message at the top says: "Did you know? You can capture data from any device or development board, or upload your existing datasets - Show options". On the right, a "Record new data" form is open, showing fields for Device (set to Nano), Label (idle), Sample length (ms.) (set to 100000), Sensor (Sensor with 3 axes (accX, accY, accZ)), and Frequency (set to 100Hz). At the bottom, a dark blue bar says "RAW DATA Click on a sample to load...".

Automatic split was not
good. Proceed with
manual split

The screenshot shows the Edge Impulse studio interface for data acquisition testing. On the left, a sidebar menu includes options like Dashboard, Devices, Data acquisition (highlighted with an orange arrow), Impulse design, EON Tuner, Retrain model, Live classification, Model testing, Versioning, Deployment, Documentation, and Forums. The main area is titled "DATA ACQUISITION - TESTING (IE500 - GYROSCOPIC CLASSIFICATION)". It displays "Training data" and "Test data" tabs. A message 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 20s" and a pie chart indicating "TRAIN / TEST SPLIT 80% / 20%". A table lists "Collected data" samples: terrestrial.json.2jv... (terrestrial, 10s), lift.json.2jhbt7 (lift, 10s), idle.json.2jvjlon (idle, 20s), maritime.json.2ji4... (maritime, 10s), maritime.json.2ji1... (maritime, 10s), lift.json.2jh6uqu (lift, 10s), and terrestrial.json.2jv... (terrestrial, 10s). A "Record new data" section allows connecting via WebUSB, selecting a device (Nano), label (idle), sample length (20000 ms), sensor (Sensor with 3 axes (accX, accY, accZ)), and frequency (100Hz). A "Start sampling" button is present. A "RAW DATA" section with the placeholder "Click on a sample to load..." is also shown.

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





Create impulse - IESTI01 - Nano Motion Classification

studio.edgeimpulse.com/studio/61345/create-impulse

MJRoBot (Marcelo Rovai)

EDGE IMPULSE

CREATE IMPULSE (IESTI01 - NANO MOTION CLASSIFICATION)

An impulse takes raw data, uses signal processing to extract features, and then uses a learning block to classify new data.

Time series data

Axes: accX, accY, accZ

Window size: 2000 ms.

Window increase: 80 ms.

Frequency (Hz): 100

Zero-pad data:

Spectral Analysis

Name: Spectral features

Input axes: accX, accY, accZ

Classification (Keras)

Name: NN Classifier

Input features: Spectral features

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

Save Impulse

Add a processing block

Add a learning block

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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 99.9%	graph	LOSS 0.01
--	---------------------------------	--	----------------------------

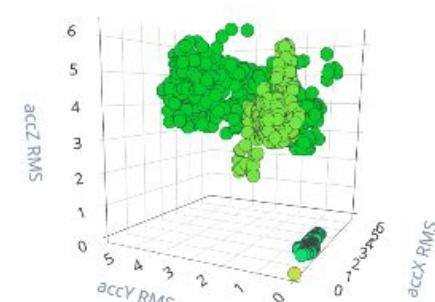
Confusion matrix (validation set)

	IDLE	LIFT	MARITIME	TERRESTRIAL
IDLE	100%	0%	0%	0%
LIFT	0%	99.4%	0.6%	0%
MARITIME	0%	0%	100%	0%
TERRESTRIAL	0%	0%	0%	100%
F1 SCORE	1.00	1.00	1.00	1.00

Feature explorer (full training set) ?

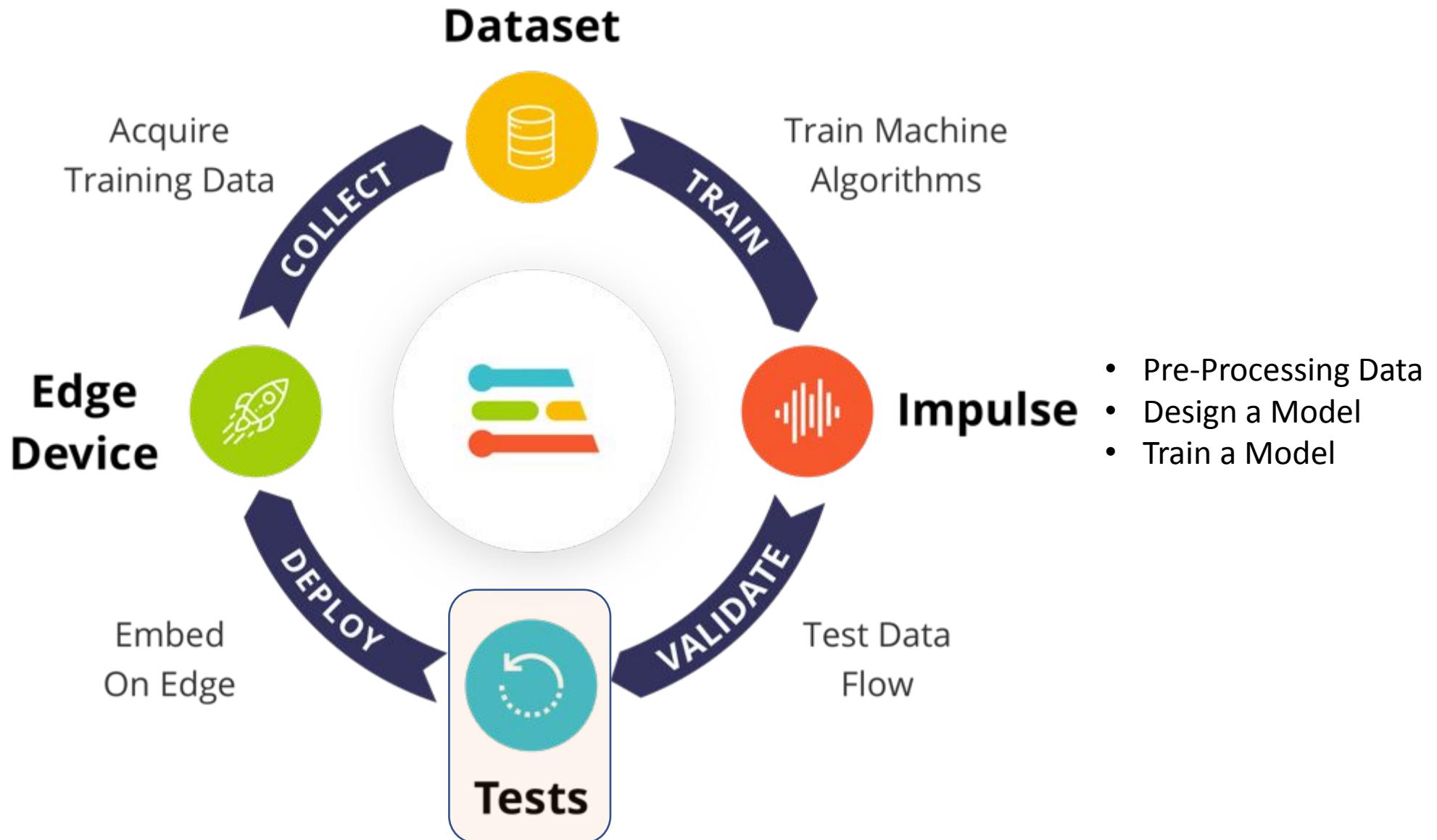
accX RMS ▼ accY RMS ▼ accZ RMS ▼

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



On-device performance ?

clock	INFERRING TIME 1 ms.	memory	PEAK RAM USAGE 1.7K	flash	FLASH USAGE 19.0K
--	---------------------------------------	---	--------------------------------------	--	------------------------------------



Model testing - IESTI01 - Nano

studio.edgeimpulse.com/studio/61345/validation

EDGE IMPULSE

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.2jvjlvn	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

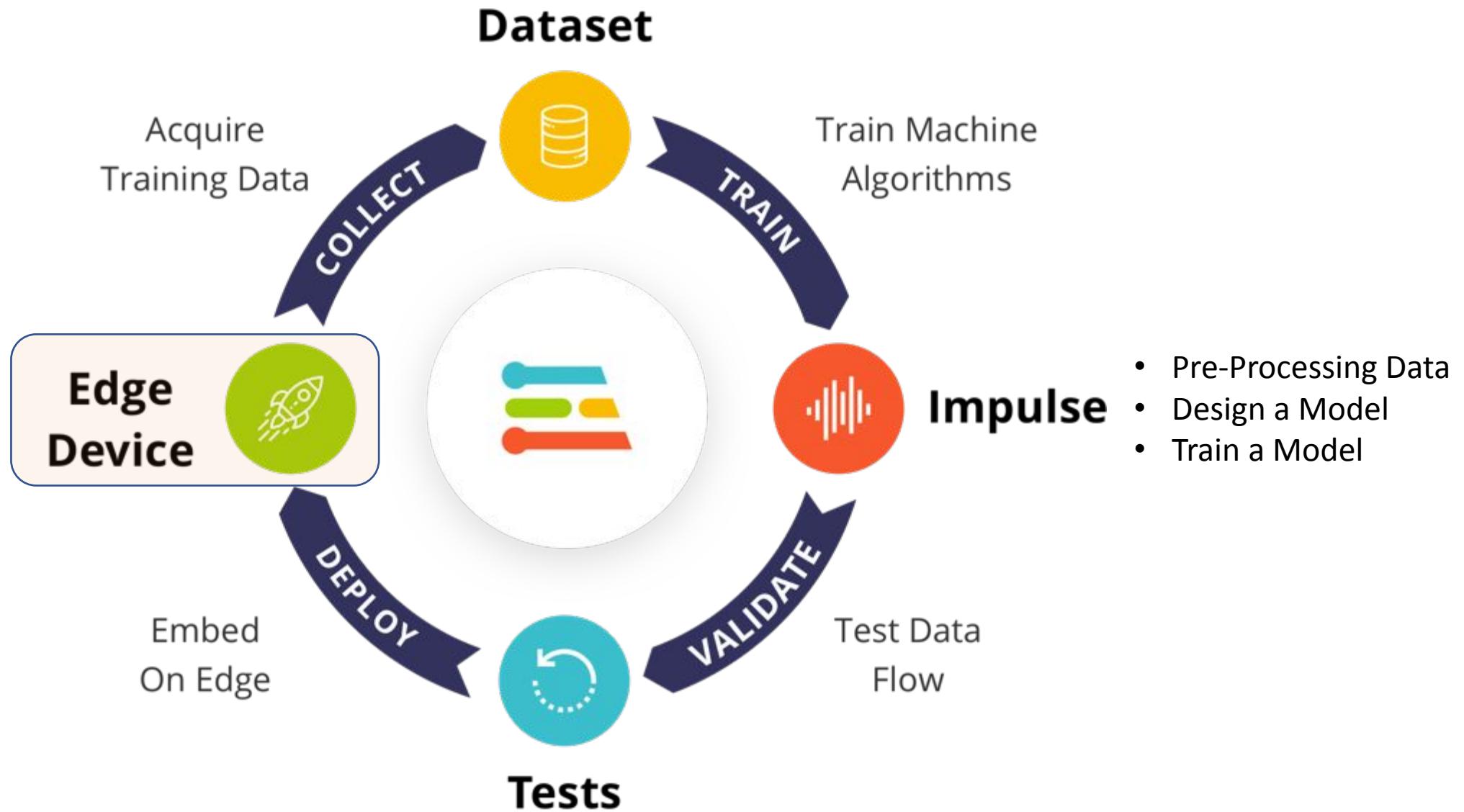
ACCURACY
100.00%

	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



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 SpreSense

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																				
Quantized (int8) ★	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																			
Unoptimized (float32)	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

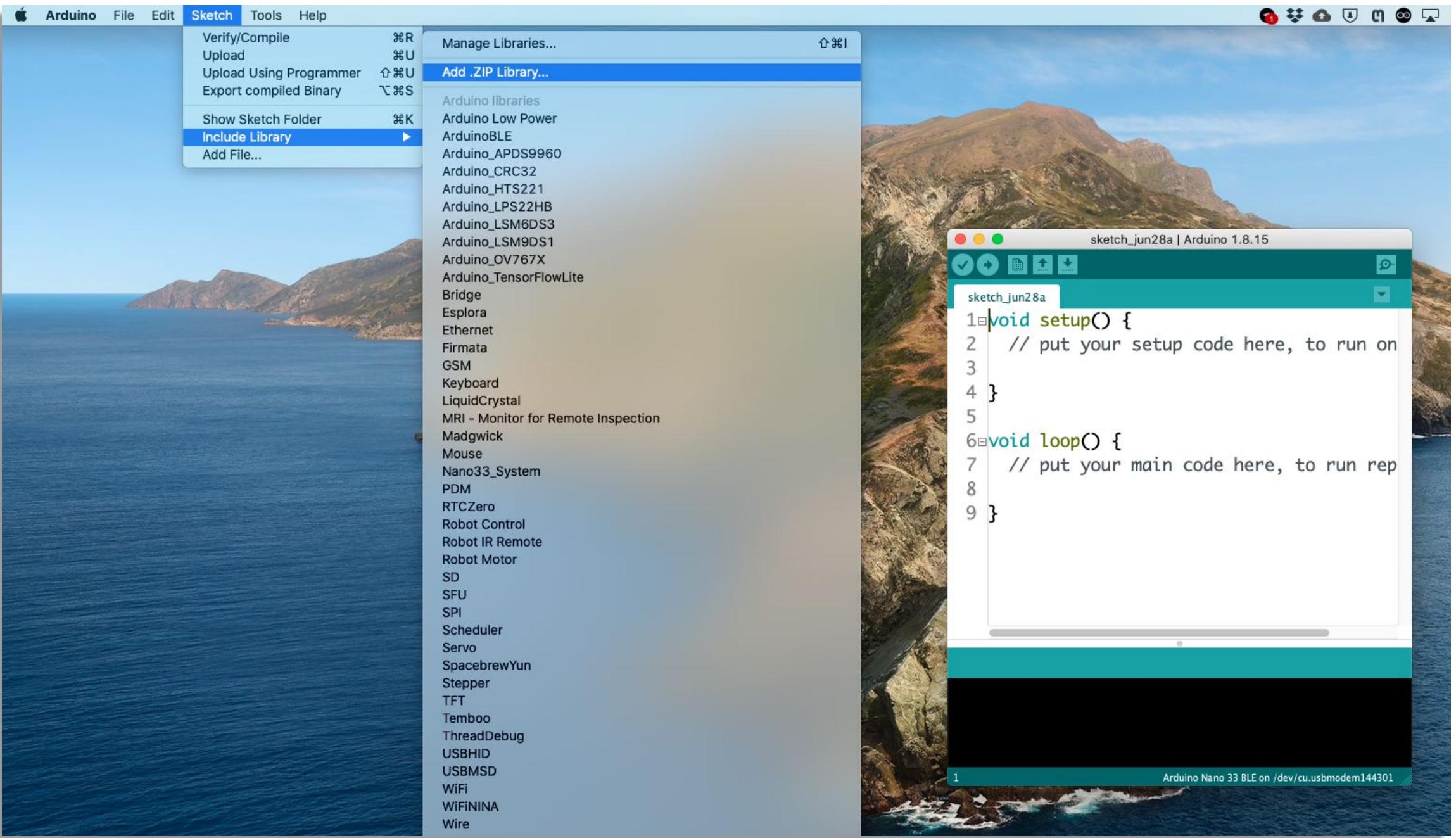
Build

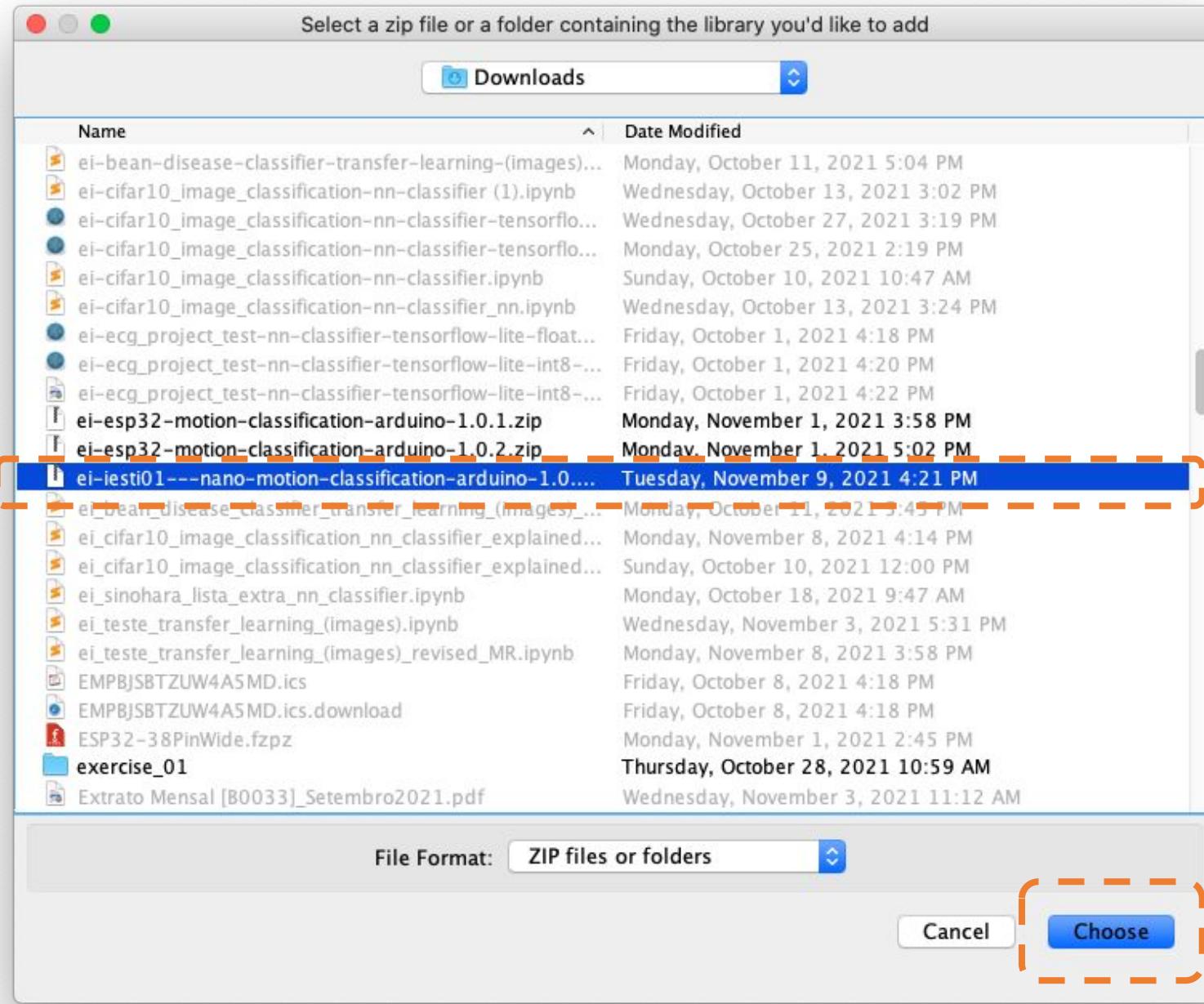
Build output

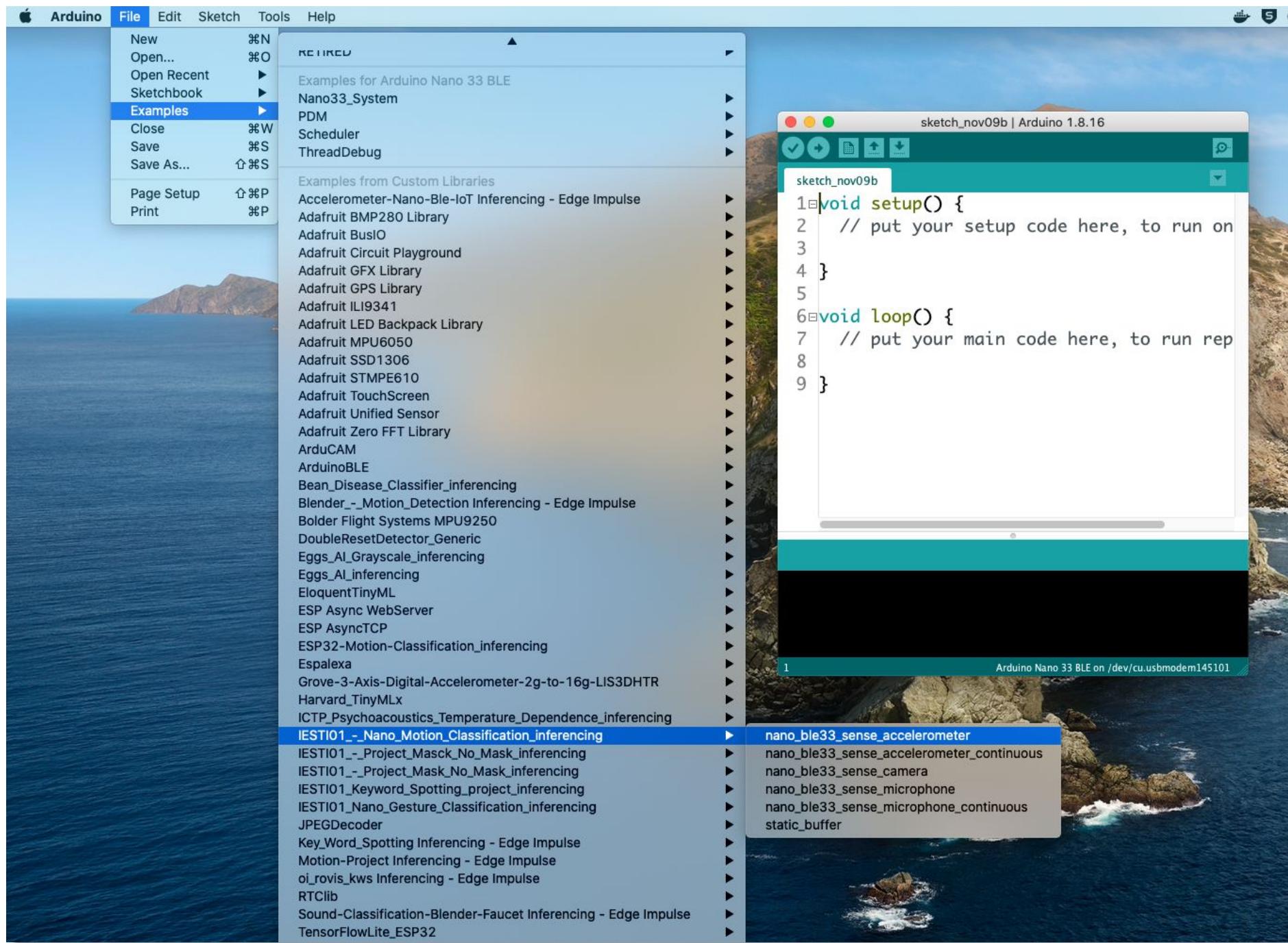
```
Creating job... OK (ID: 1646786)
Writing templates...
Writing templates OK
Copying Edge Impulse SDK...
Copying Edge Impulse SDK OK
Compiling EON model...
Compiling EON model OK
Removing clutter and updating headers...
Removing clutter and updating headers OK
Creating archive...
Archive OK
```

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...

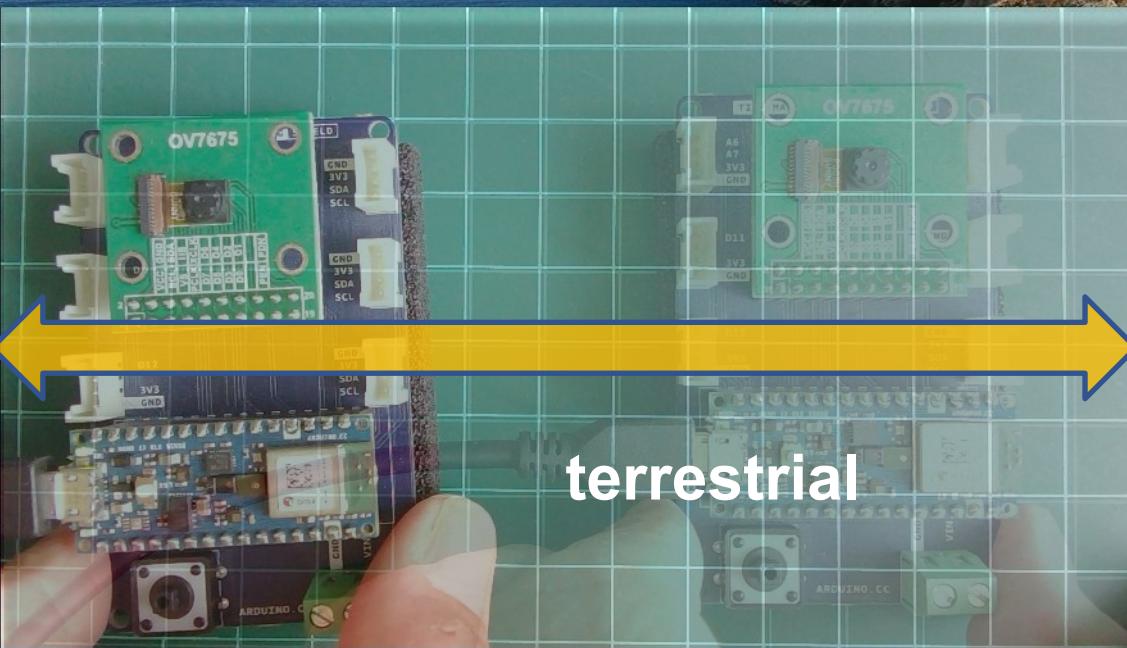
Predictions (DSP: 20 ms., Classification: 1 ms., Anomaly: 0 ms.):

- 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

Sampling...

nano_ble33_sense_accelerometer | Arduino 1.8.16

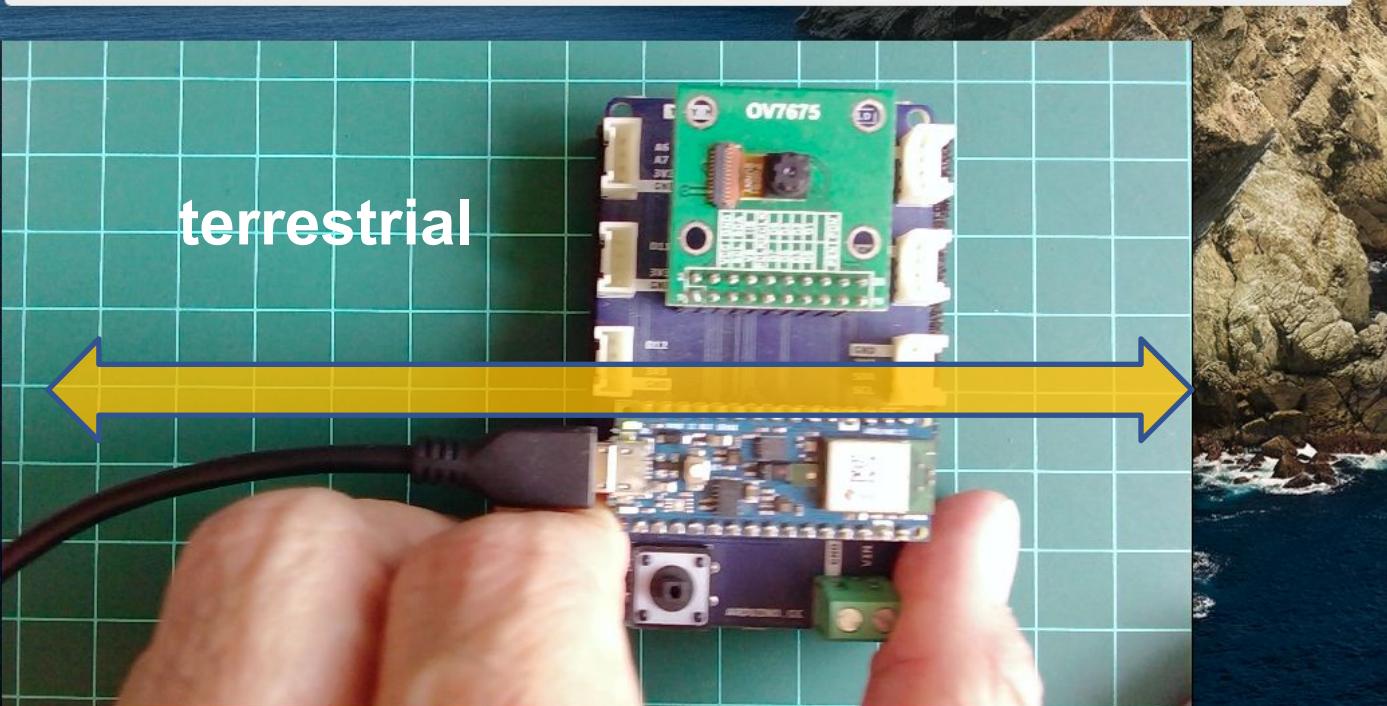
```
1/* Edge Impulse Arduino examples
2 * Copyright (c) 2021 EdgeImpulse Inc.
3 *
4 * Permission is hereby granted, free of charge, to any person obtaining a cop
5 * of this software and associated documentation files (the "Software"), to de
6 * in the Software without restriction, including without limitation the right
7 * to use, copy, modify, merge, publish, distribute, sublicense, and/or sell
8 * copies of the Software, and to permit persons to whom the Software is
9 * furnished to do so, subject to the following conditions:
10 *
11 * The above copyright notice and this permission notice shall be included in
12 * all copies or substantial portions of the Software.
13 *
14 * THE SOFTWARE IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND, EXPRESS OR
15 * IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY,
16 * FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT. IN NO EVENT SHALL THE
17 * AUTHORS OR COPYRIGHT HOLDERS BE LIABLE FOR ANY CLAIM, DAMAGES OR OTHER
18 * LIABILITY, WHETHER IN AN ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FRO
19 * OUT OF OR IN CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN T
20 * SOFTWARE.
21 */
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 generat
```

Done in 6.027 seconds

reset()

15

Arduino Nano 33 BLE on /dev/cu.usbmodem145101



```
nano_ble33_sense_accelerometer_continuous | Arduino 1.8.16

accelerometer_continuous

ESTI01_-_Nano_Motion_Classification_inferencing.h>
arduino_LSM9DS1.h>

: defines -----
IVERT_G_TO_MS2      9.80665f

variables -----
    debug_nn = false; // Set this to true to see e.g. features
32_t run_inference_every_ms = 200;
void inference_thread(osPriorityLow);
uint8_t buffer[EI_CLASSIFIER_DSP_INPUT_FRAME_SIZE] = { 0 };
uint8_t inference_buffer[EI_CLASSIFIER_DSP_INPUT_FRAME_SIZE];

declaration */
void inference_background();

Arduino setup function

()
your setup code here, to run once:
void setup() {
    Serial.begin(115200);
    Serial.println("Edge Impulse Inferencing Demo");

    IMU.begin();
    Serial.printf("Failed to initialize IMU!\r\n");

    Serial.printf("IMU initialized\r\n");
}

conds
```

TinyML motion classification uses
on **Real Life**

Cow Monitoring

Using the Internet of Things for Agricultural Monitoring

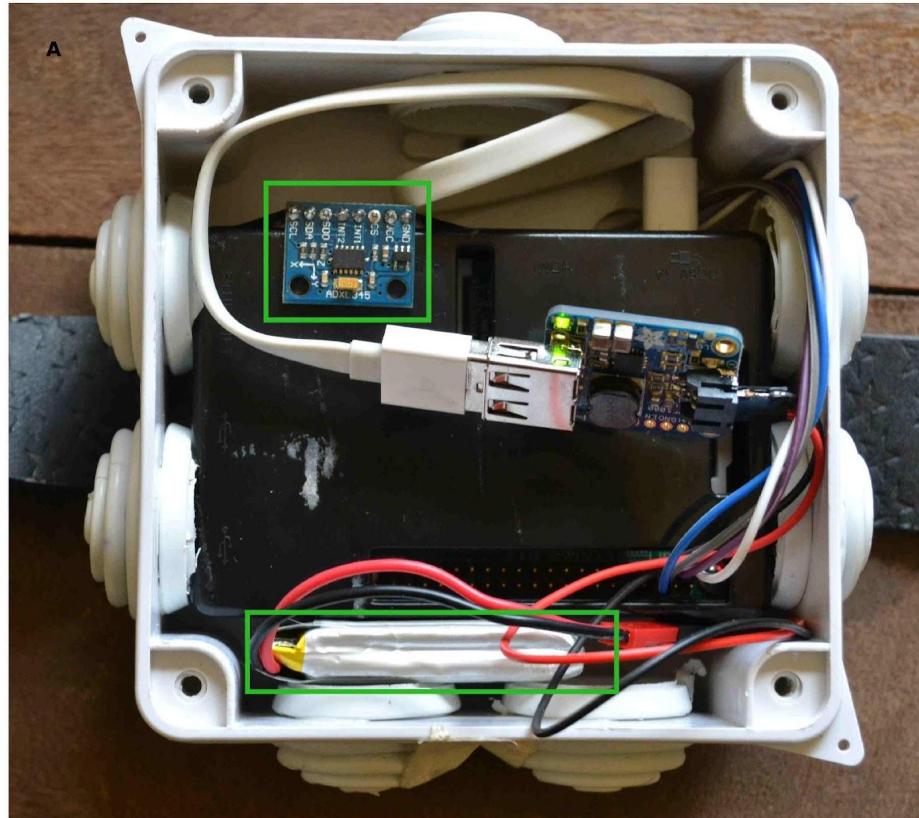
"We aim to deploy a variety of sensors for agricultural monitoring. One of the projects involves using **accelerometer sensors** to monitor activity levels in dairy cows with a view to determining when the cows are on heat or when they are sick."



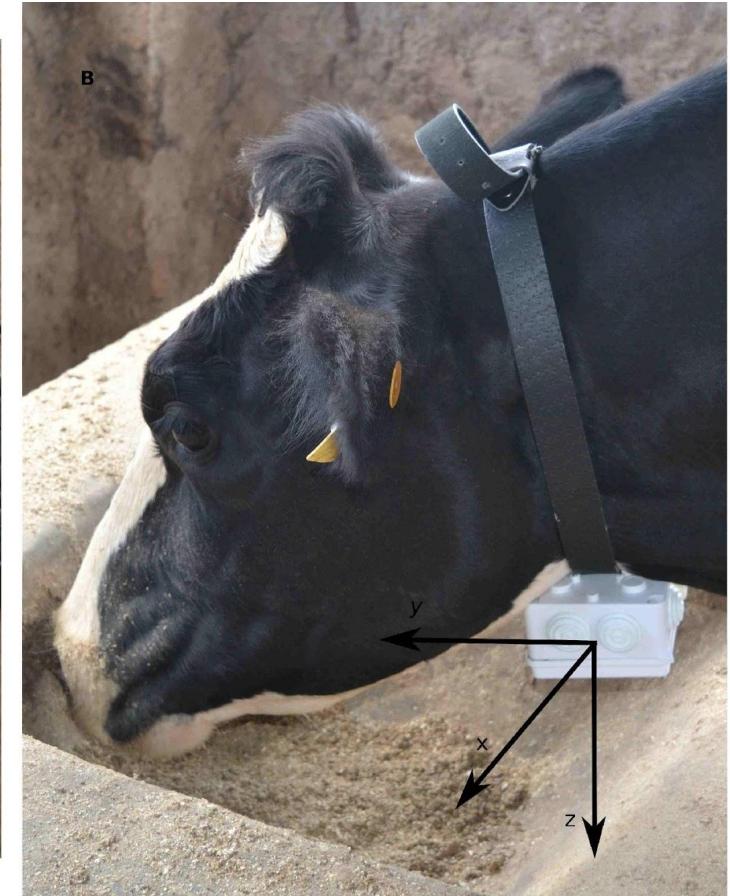
Ciira wa Maina, Ph.D.

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



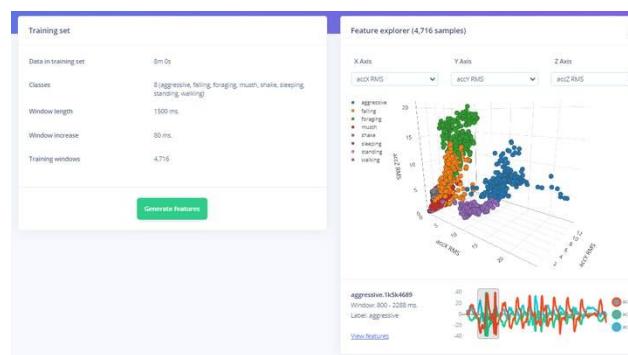
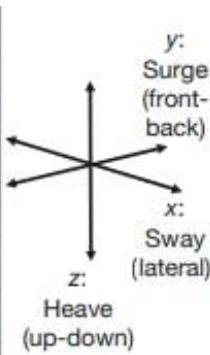
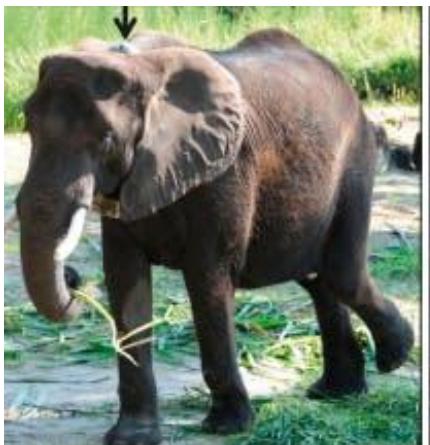
Aggressive



Standing



Sleeping



https://www.hackster.io/dhruvsheth_electet-tinyml-and-iot-based-smart-wildlife-tracker-c03e5a#toc-accelerometer-data-models-4

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!



UNIFEI