



Hands-on! Train from scratch your first Edge AI model with Edge Impulse



Louis MOREAU

Head of Developer Relations, Edge Impulse



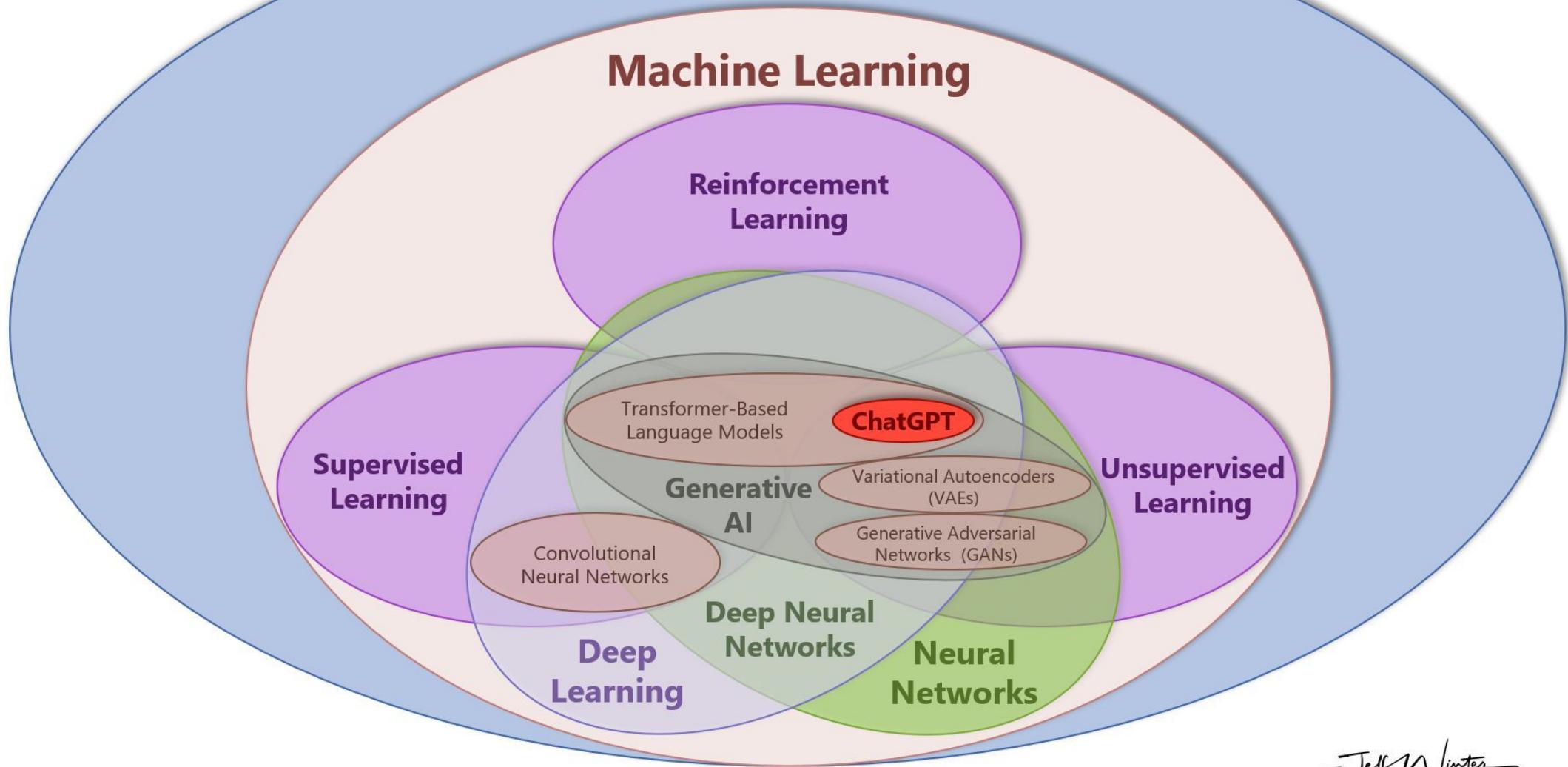
Marc POUS

Developer Relations @ Edge Impulse

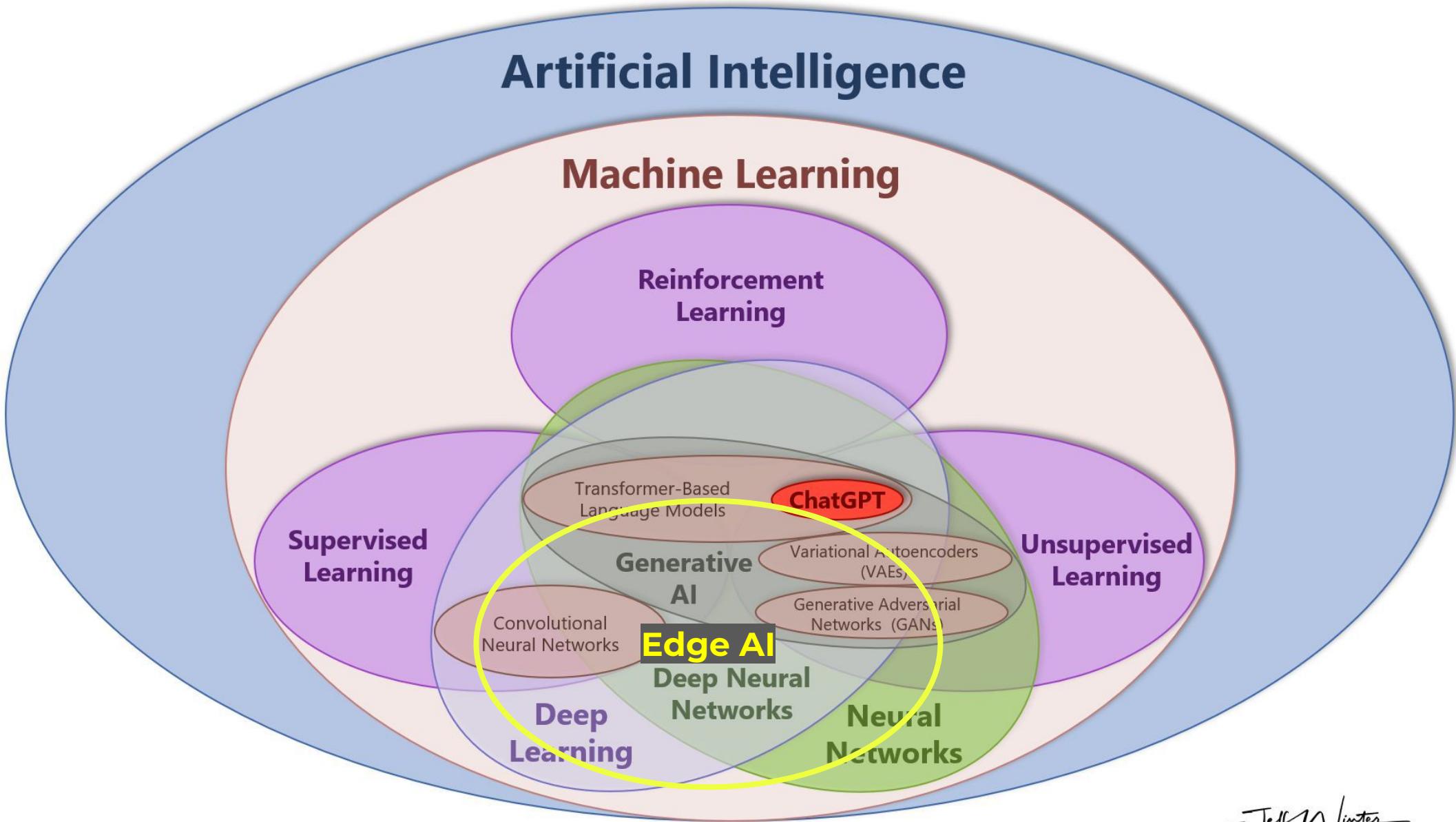
Today!

- 1. Brief introduction to the AI and ML.**
- 2. You are going to train a Voice ML with your laptop.**
- 3. You are going to train an object detection ML with your laptop and your mobile phone's camera.**

Artificial Intelligence

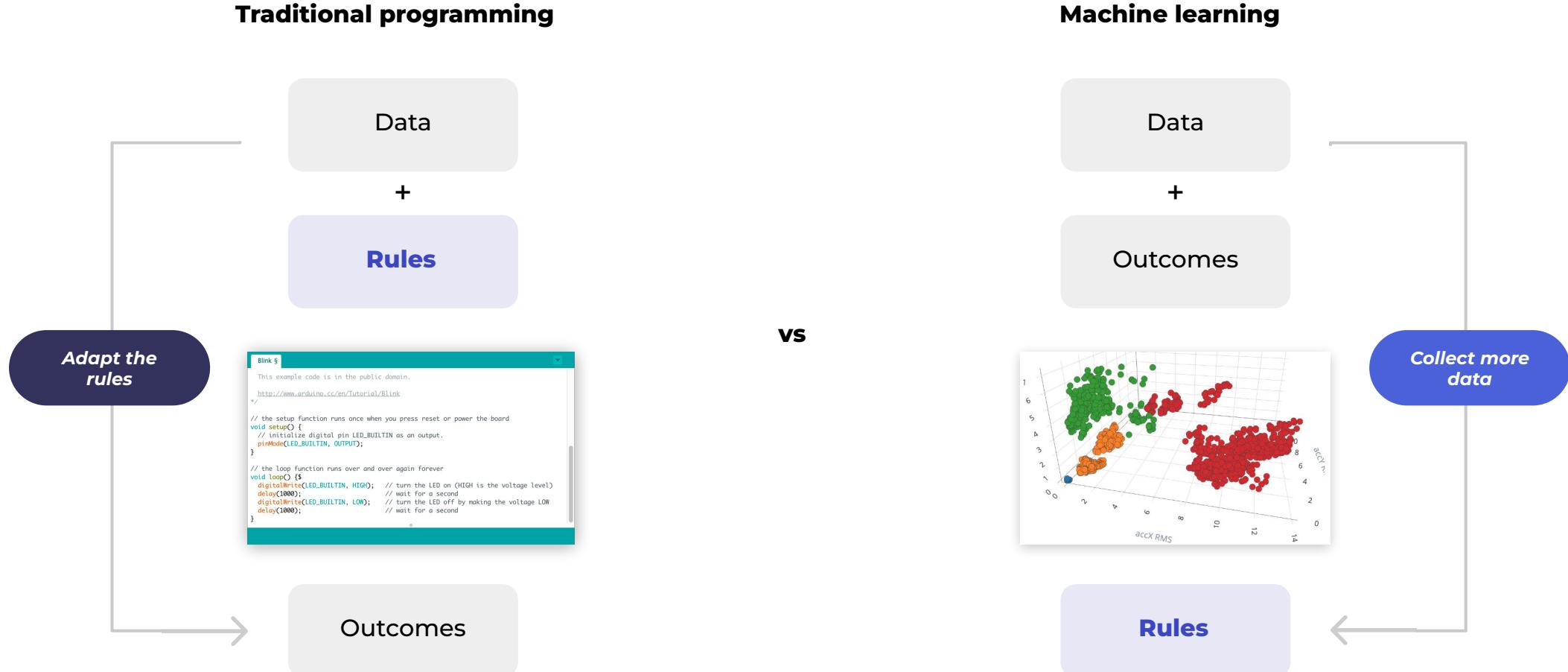


Jeff Winter



Jeff Winter

A paradigm shift

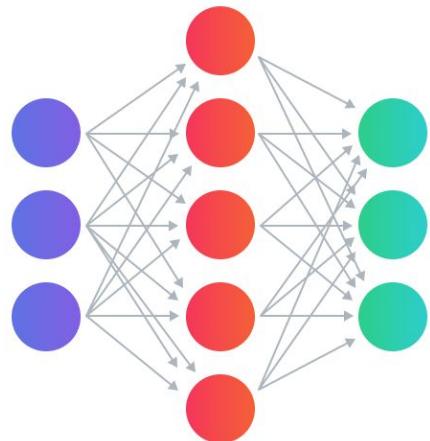


Neural Networks

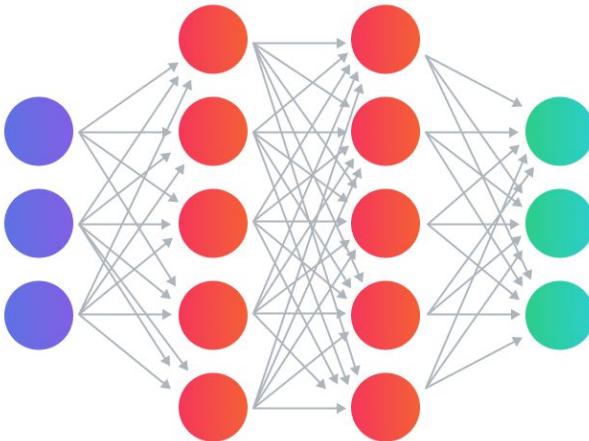
Deep Neural Network

Artificial Neural Network Architecture

Simple Neural Network

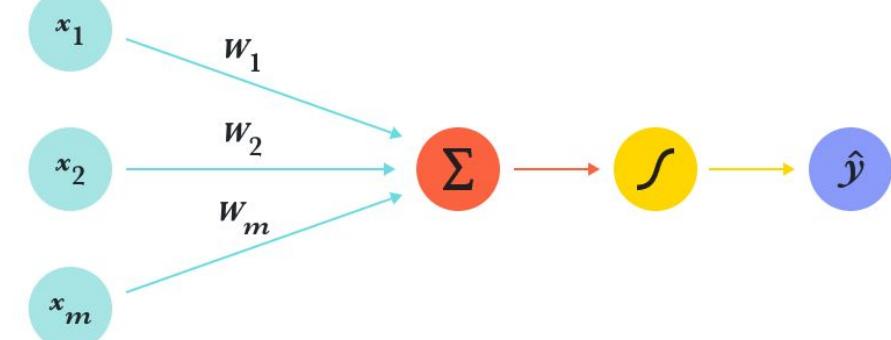


Deep Learning Neural Network



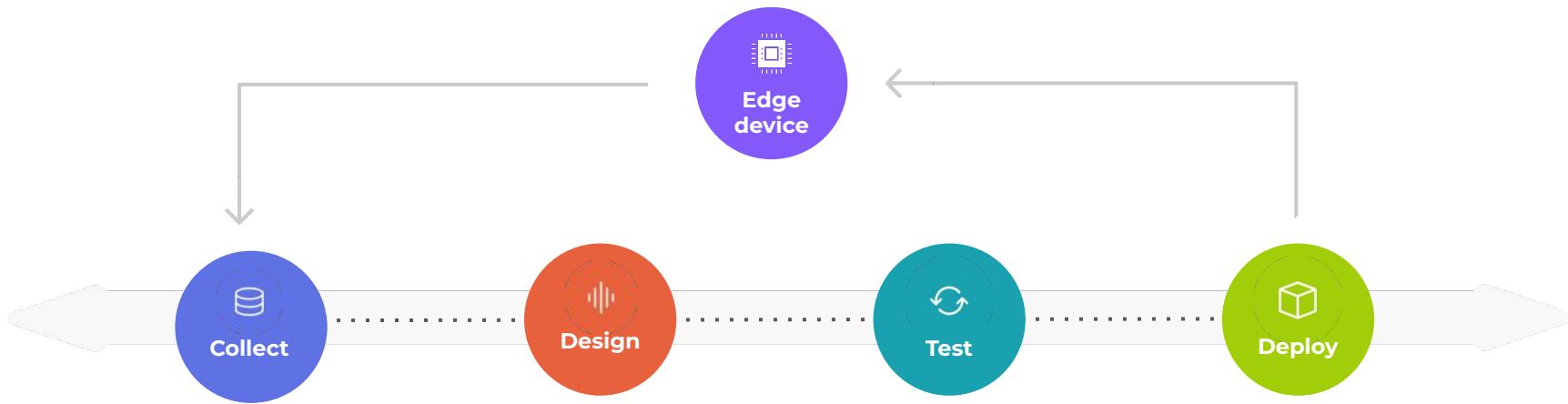
● Input Layer ● Hidden Layer ● Output Layer

Single Neuron

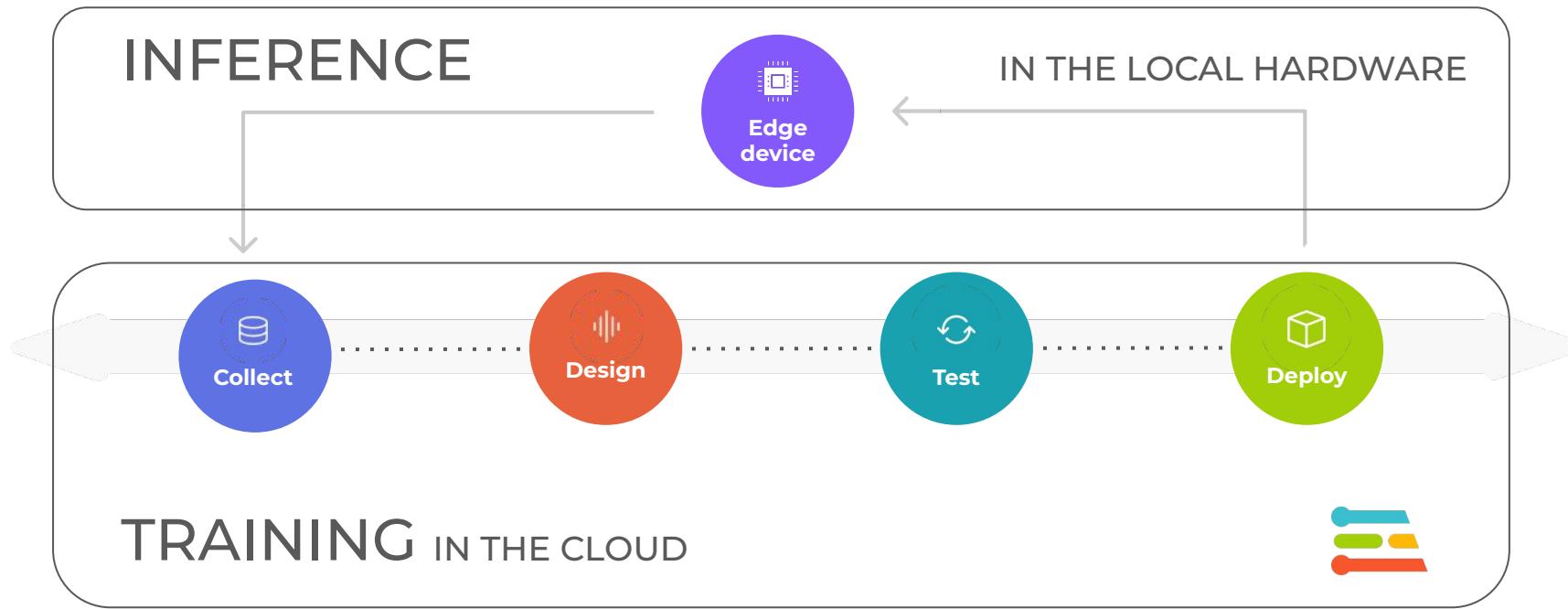


Inputs Weights Sum Non-Linearity Output

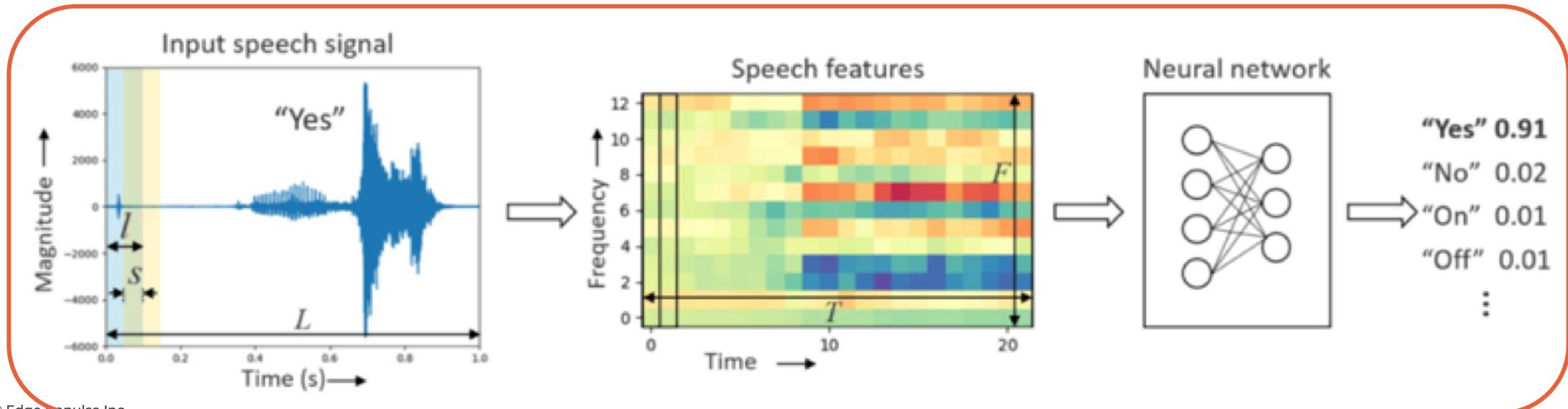
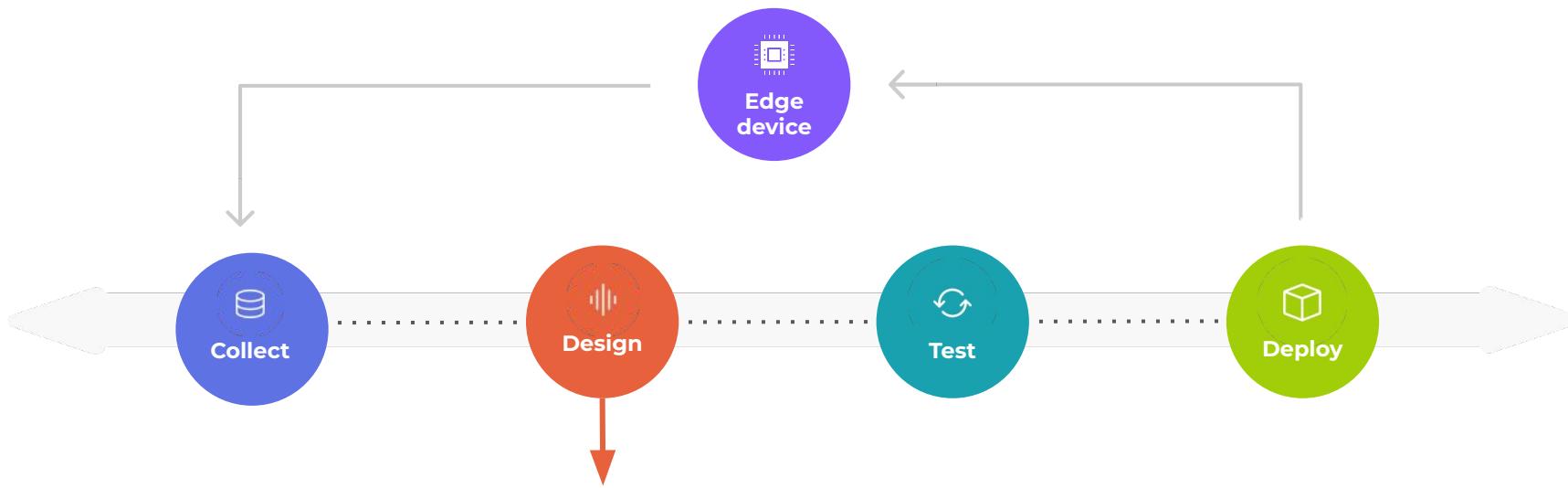
Edge AI



Edge AI



Edge AI



Benefits of edge AI



Innovation

Add new differentiating features, become a market leader by standing out from your competition



Privacy

Data stays on the device, gets processed locally and drives remote alerts, notifications, and actions



Power

Stay operational for longer periods of time



Cost

Save on storage and compute costs by not sending raw data constantly to the cloud



Reliability

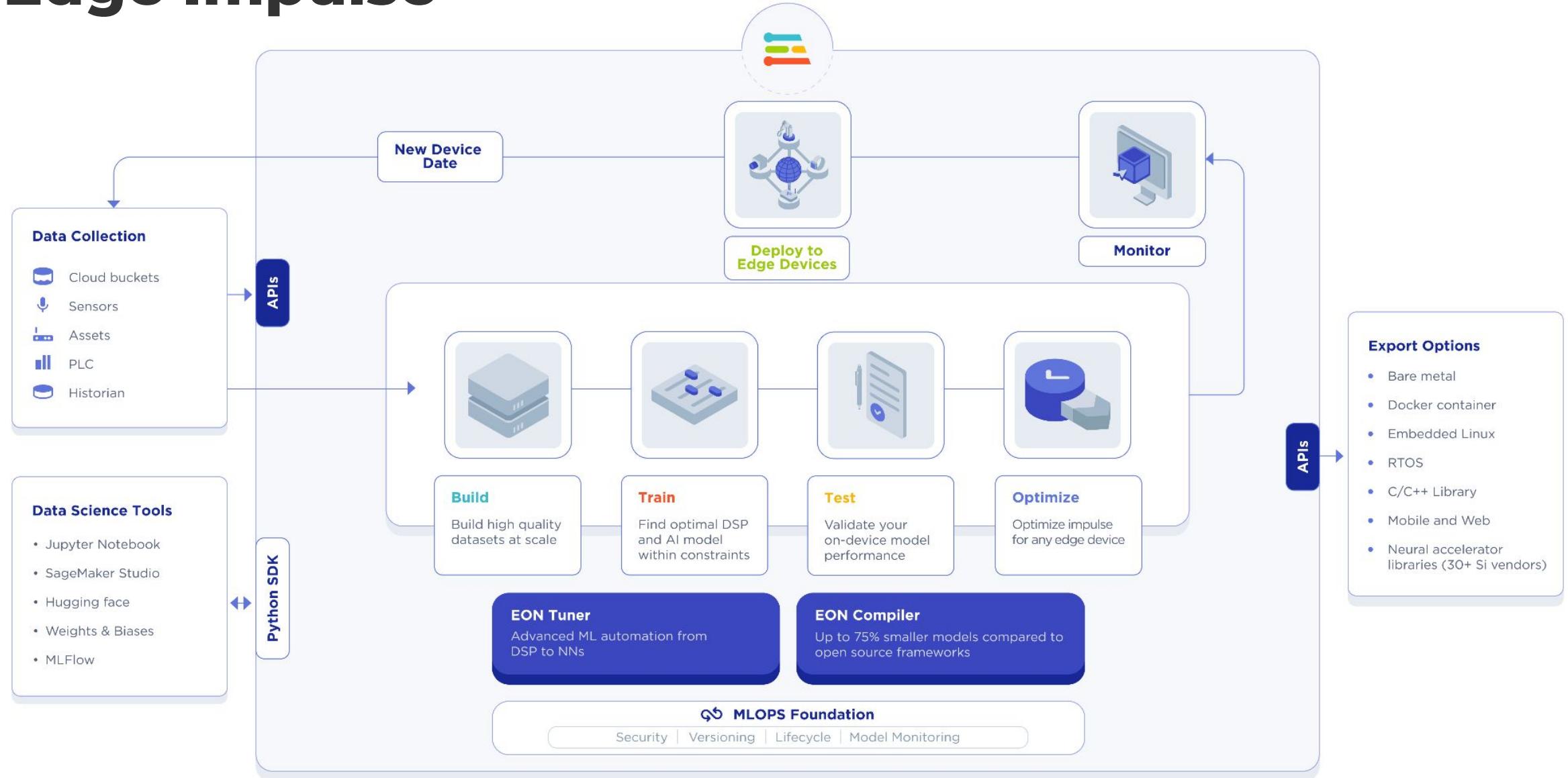
Be operational in low connectivity environments



Bandwidth & Latency

Process data real-time on the edge device, without having to wait for a response back from the cloud

Edge Impulse



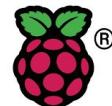


brainchip



Comprehensive hardware support

Benefit from the leading edge ML silicon ecosystem



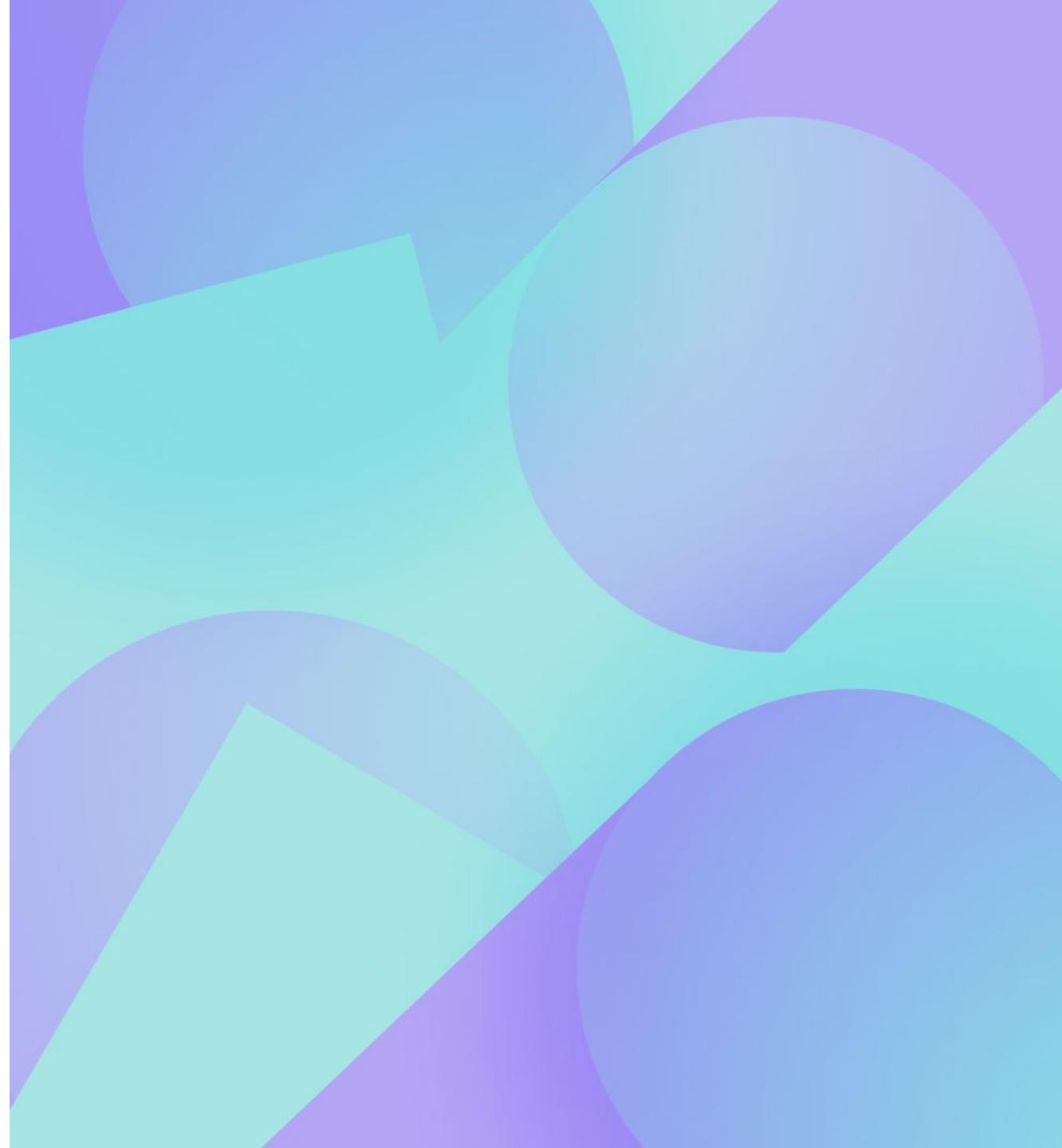
Let's start!

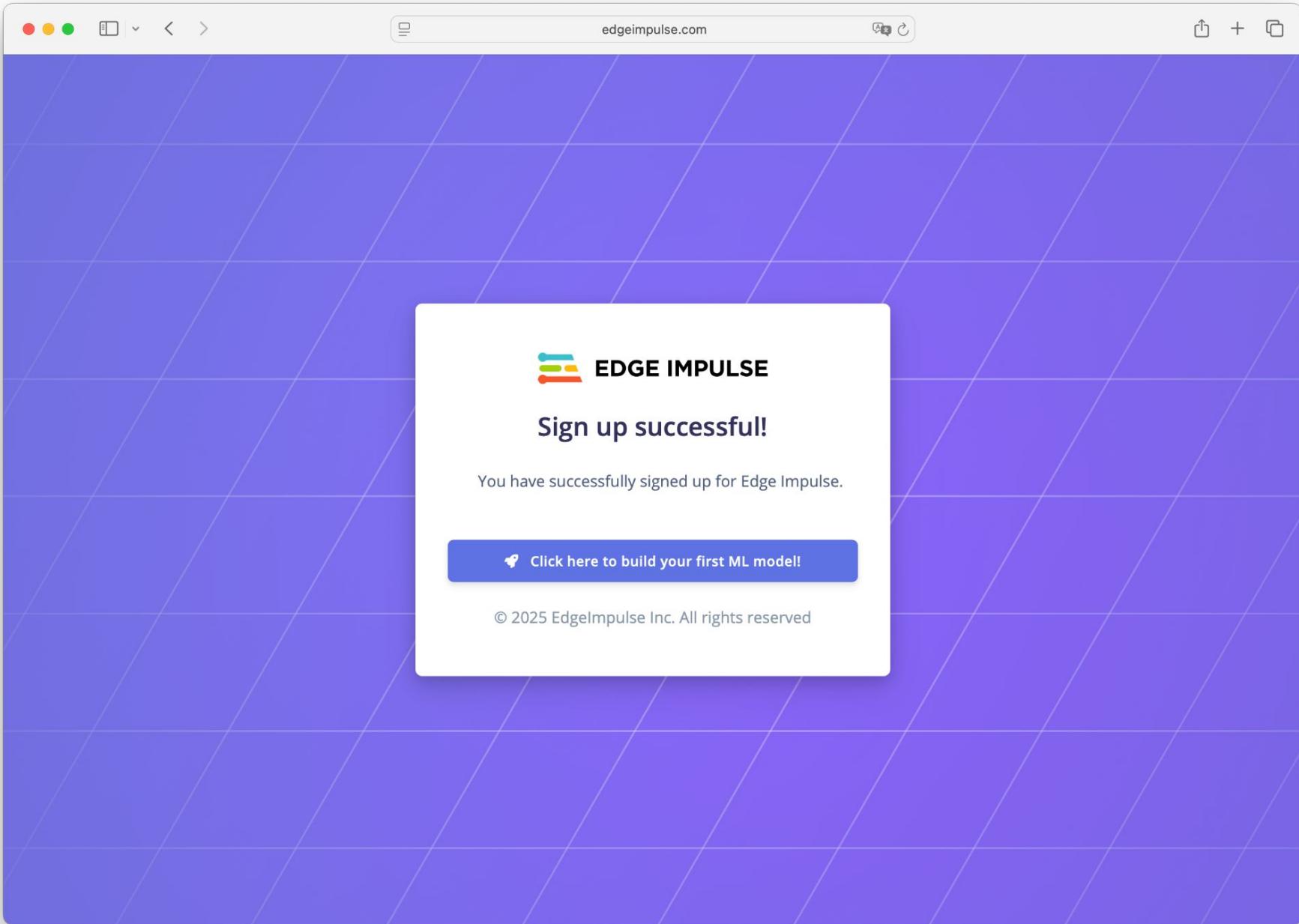
Keyword Spotting

Audio classification

1. Get your laptop
2. Sign-up here

<https://edgeimp.com/ttc25-workshop>





studio.edgeimpulse.com

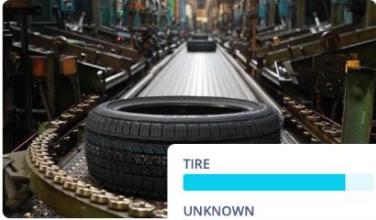
iotbcn / iotbcn-project-1 PERSONAL

Target: Cortex-M4F 80MHz

Welcome 

You're only minutes away from making your devices feel, hear and see the real world using edge AI!
Build your first model in minutes! Select a use case to get started


Audio detection
Build a keyword spotting model that can detect any wake word, like "Hey Edge Impulse" or "Hey Siri", in just a few minutes.


Image classification
Build an image classification model that can recognize and distinguish between two real-world objects, such as identifying tires.

Or, get started manually 

Private 

This project is private, only invited members can edit and view.

Published versions (0)

This project has no published versions.

Publish a version of your project

Collaborators (1/3)  

GETTING STARTED

 **Upgrade Plan**

Get access to higher job limits and more collaborators.



EDGE IMPULSE

Dashboard

Devices

Data acquisition

Experiments

EON Tuner

Impulse design

- Create impulse
- Retrain model
- Live classification
- Model testing
- Deployment
- Versioning

Or, get started manually 

Collaborators (1/3)  



The screenshot shows the Edge Impulse studio interface on a Mac OS X desktop. The window title is "iotbcn / iotbcn-project-1 PERSONAL". The top navigation bar includes "Project info", "Keys", "Export", "Jobs", and a "Target: Arduino Portenta..." dropdown.

The main content area displays the project title "iotbcn-project-1" and a step-by-step tutorial for "Step 1 of 9: Responding to your voice". The tutorial text explains how machine learning can analyze sensor data in real-time to wake up a device when it hears an audible event, similar to how a phone wakes up when it hears "OK, Google" or "Hey Siri". It instructs the user to enter a word or short sentence into a text input field labeled "Type your keyword or sentence".

Below the tutorial, there are two buttons: "Next, collect some data" and "Quit tutorial". To the right of the input field, a "Private" dropdown menu is open, showing the option "Select is private, only invited users can edit and view." A tooltip for this dropdown states: "This project is private, only invited users can edit and view." Below the input field, there is a section for "Published versions (0)" and a button to "Publish a version of your project".

The left sidebar contains a navigation menu with the following items:

- Dashboard
- Devices
- Data acquisition
- Experiments
 - EON Tuner
- Impulse design
 - Create impulse
 - Retrain model
 - Live classification
 - Model testing
 - Deployment
- Versioning

Below the sidebar, under "GETTING STARTED", there is an "Upgrade Plan" section with a blue star icon. It encourages users to "Get access to higher job limits and more collaborators." A "View plans" button is available.



The screenshot shows the Edge Impulse Studio interface on a Mac OS X system. The window title is "iotbcn / iotbcn-project-1 PERSONAL". The top navigation bar includes tabs for "Dataset", "Data explorer", "Data sources", "Synthetic data", "AI labeling (NEW)", and "CSV Wizard". A status bar at the top right indicates "Target: Arduino Portenta...".

The main content area is titled "Dataset" and features a "Collect data" section. A large blue overlay box contains the following text:

Step 2 of 9: Collecting some data 🎙

To build your machine learning model we need to have some samples of how "IoT Barcelona" sounds like.

Click the button below, then give permission to access your microphone, and say "IoT Barcelona" a number of times. Make sure to add ~1 second pause between saying the sentences.

Record yourself saying "IoT Barcelona" for 38 seconds

Want to look around? No problem. Just close this overlay, and click 'Resume tutorial' when you're ready for the next step.

[Quit tutorial](#) [Next, adding other data](#)

The left sidebar contains a vertical menu with the following items:

- Dashboard
- Devices
- Data acquisition
- Experiments
- EON Tuner
- Impulse design
 - Create impulse
 - Retrain model
 - Live classification
 - Model testing
 - Deployment
- Versioning

Below the sidebar, under "GETTING STARTED", there is an "Upgrade Plan" section with a star icon and the text "Get access to higher job limits and more collaborators.", followed by a "View plans" button.



● ○ ⬚ ⬛ ⬜ < >

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iotbcn / iotbcn-project-1 PERSONAL

Target: Arduino Portenta...

EDGE IMPULSE

Dataset Data explorer Data sources Synthetic data | AI labeling NEW CSV Wizard

Dashboard Devices Data acquisition Experiments EON Tuner Impulse design Create impulse Retrain model Live classification Model testing Deployment Versioning

GETTING STARTED

Upgrade Plan

View plans

?

Dataset

Collect data

Step 2 of 9: Collecting some data

To build your machine learning model, you need to collect data. Click the button below, then give permission to use the microphone. You can do this again later if needed.

Click the button below, then give permission to use the microphone. You can do this again later if needed. Make sure to add ~1 second between each recording. "IoT Barcelona" sounds like "IoT Barcelona" a number of times. Make sure to add ~1 second between each recording. "IoT Barcelona" a number of times.

Record

Want to look around? No problem! You can always come back to this step later when you're ready for the next step.

Permet que studio.edgeimpulse.com utilitzi el micròfon?

Pots canviar aquesta opció a la secció dels llocs web de la configuració del Safari.

Permet Mai per a aquest lloc web No permetis

Next, adding other data

g your dataset.



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iotbcn / iotbcn-project-1 PERSONAL

Target: Arduino Portenta...

EDGE IMPULSE

Dataset Data explorer Data sources Synthetic data AI labeling NEW CSV Wizard

Step 2 of 9: Collecting some data 🎙

To build your machine learning model we need to have some samples of how "IoT Barcelona" sounds like.

Click the button below, then give permission to access your microphone, and say "IoT Barcelona" a number of times. Make sure to add ~1 second pause between saying the sentences.

g your dataset.

33s

Keep saying "IoT Barcelona"

Want to look around? No problem. Just close this overlay, and click 'Resume tutorial' when you're ready for the next step.

Quit tutorial

Next, adding other data

?

Dashboard

Devices

Data acquisition

Experiments

EON Tuner

Impulse design

- Create impulse
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- Live classification
- Model testing
- Deployment

Versioning

GETTING STARTED

Upgrade Plan

Get access to higher job limits and more collaborators.

[View plans](#)



studio.edgeimpulse.com

iotbcn / iotbcn-project-1 PERSONAL

Target: Arduino Portenta...

Dataset Data explorer Data sources Synthetic data | AI labeling NEW CSV Wizard

DATA COLLECTED 9s TRAIN / TEST SPLIT 89% / ... Collect data

Step 2 of 9: Collecting some data

To build your machine learning model, you need to collect a number of samples. Click the button below to start collecting data. You can stop at any time by clicking the button again.

Just a few more!

That was great, but we need ~6 more samples. Hit the button again and add some more data!

OK

Next, adding other data

Just a few more!

Want to look at the raw data? Click here.

Quit tutorial

Upcoming steps

LABEL: iot_barcelona SAMPLE LENGTH: 1s

LABEL: iot_barcelona SAMPLE LENGTH: 1s

LABEL: iot_barcelona SAMPLE LENGTH: 1s

Metadata

No metadata.

The screenshot shows the Edge Impulse Studio interface on a Mac OS X desktop. The main window displays a dataset collection screen with various tabs like 'Dataset', 'Data explorer', 'Data sources', 'Synthetic data', 'AI labeling', and 'CSV Wizard'. A central area shows 'DATA COLLECTED' at 9s and a 'TRAIN / TEST SPLIT' of 89%. A large white modal dialog is overlaid on the screen, containing an info icon and the text 'Just a few more! That was great, but we need ~6 more samples. Hit the button again and add some more data!'. At the bottom of the modal is a blue 'OK' button. In the background, there are three small waveform preview cards labeled 'iot_barcelona' with a sample length of 1s each. Below them is a larger waveform preview card with a play button and a timestamp of '-00:00'. The bottom right corner of the screen shows the Edge Impulse logo.



Mac OS X browser window showing the Edge Impulse Studio interface at studio.edgeimpulse.com.

The sidebar on the left includes:

- Dashboard
- Devices
- Data acquisition
- Experiments
- EON Tuner
- Impulse design
 - Create impulse
- Retrain model
- Live classification
- Model testing
- Perf. calibration
- Deployment
- Versioning

An **Upgrade Plan** section offers access to higher job limits and more collaborators, with a [View plans](#) button.

The main workspace shows a dataset summary:

- DATA COLLECTED: 19s
- TRAIN / TEST SPLIT: 84% / ...

A central modal dialog box displays a green checkmark icon and the text "Great! We have recorded enough samples." with an "OK" button.

The background workspace includes:

- Collect data** section with instructions: "To build your machine learning model, you need to collect data that sounds like..." and "Click the button below to start collecting data. Click it as many times as you want. Make sure the microphone is turned on."
- A waveform visualization showing data from 4ms to 840ms.
- Three sample cards labeled "iot_barcelona" with "SAMPLE LENGTH: 1s".
- A timeline bar at the bottom labeled "-00:00".
- A **Metadata** section stating "No metadata." with a question mark icon.



Mac OS X browser window showing the Edge Impulse web interface for dataset collection.

The URL in the address bar is studio.edgeimpulse.com.

The sidebar on the left includes:

- Dashboard
- Devices
- Data acquisition
- Experiments
- EON Tuner
- Impulse design
 - Create impulse
 - Retrain model
- Live classification
- Model testing
- Perf. calibration
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- Versioning

An **Upgrade Plan** section offers access to higher job limits and more collaborators, with a [View plans](#) button.

The main workspace shows the following details:

- Dataset** tab selected.
- iotbcn / iotbcn-project-1** project selected.
- Target: Arduino Portenta...**
- DATA COLLECTED**: 19s (red progress bar).
- TRAIN / TEST SPLIT**: 84% / ... (green progress bar).
- Collect data** button.
- Step 2 of 9: Collecting some data** (with a microphone icon).
- You've collected enough data!** message.
- Next, adding other data** button.
- Metadata** section: No metadata.
- Three waveform preview cards labeled **iot_barcelona** with **SAMPLE LENGTH: 1s**.
- A large waveform visualization on the right.



studio.edgeimpulse.com

iotbcn / iotbcn-project-1 PERSONAL

Target: Arduino Portenta...

EDGE IMPULSE

Dataset Data explorer Data sources Synthetic data | AI labeling NEW CSV Wizard

Step 3 of 9: Adding other data 🎧

That was great! We now have some examples of "IoT Barcelona". Next, we also need some other keywords and background noise so the model can learn to distinguish between IoT Barcelona and other sounds. We've put together some of this for you already. Just click the button to add this data to your project.

Let's mix in other keywords and background noise

Want to look around? No problem. Just close this overlay, and click 'Resume tutorial' when you're ready for the next step.

Quit tutorial

Next, design an impulse

LABEL: iot_barcelona SAMPLE LENGTH: 1s

LABEL: iot_barcelona SAMPLE LENGTH: 1s

LABEL: iot_barcelona SAMPLE LENGTH: 1s

Metadata

No metadata.

The screenshot shows the Edge Impulse Studio interface. On the left is a sidebar with various project management and development tools. The main workspace is titled 'iotbcn / iotbcn-project-1'. It features a 'Dataset' tab, a waveform visualization, and a central overlay window titled 'Step 3 of 9: Adding other data'. The overlay contains text about adding more data to the project, a blue button labeled 'Let's mix in other keywords and background noise', and a link to 'Next, design an impulse'. At the bottom, there are three preview cards for audio samples labeled 'iot_barcelona' with a length of '1s' each, and a 'Metadata' section indicating 'No metadata.'



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iotbcn / iotbcn-project-1 PERSONAL

Target: Arduino Portenta...

EDGE IMPULSE

Dashboard

Devices

Data acquisition

Experiments

EON Tuner

Impulse design

- Create impulse
- Retrain model
- Live classification
- Model testing
- Perf. calibration
- Deployment

Versioning

Upgrade Plan

Get access to higher job limits and more collaborators.

[View plans](#)

Step 3 of 9: Adding other data 🎙

That was great! We now have some examples of "IoT Barcelona". Next, we also need some other keywords and background noise so the model can learn to distinguish between IoT Barcelona and other sounds. We've put together some of this for you already. Just click the button to add this data to your project.

[Let's mix in other keywords and background noise](#)

Creating job... OK (ID: 37680880)

✓ Job scheduled at 12 Sep 2025 09:34:17

✓ Job started at 12 Sep 2025 09:34:18

[1/400] Uploading...

[200/400] Uploading...

[400/400] Uploading...

[Cancel job](#)

Want to look around? No problem. Just close this overlay, and click 'Resume tutorial' when you're ready for the next step.

Quit tutorial [Next, design an impulse](#)

LABEL: unknown SAMPLE LENGTH: 1s

LABEL: unknown SAMPLE LENGTH: 1s

LABEL: unknown SAMPLE LENGTH: 1s

Metadata

No metadata.

on_voice_rw_21...

4ms 672ms 840ms

-00:00



The screenshot shows the Edge Impulse Studio interface on a Mac OS X desktop. The window title is "studio.edgeimpulse.com". The URL bar shows "iotbcn / iotbcn-project-1 PERSONAL". The top right corner has icons for refresh, search, and a dropdown menu.

The left sidebar contains the following navigation items:

- Dashboard
- Devices
- Data acquisition
- Experiments
 - EON Tuner
- Impulse design
 - Create impulse
 - MFE
 - Transfer learning (Key...)
 - Retrain model
 - Live classification
 - Model testing
 - Perf. calibration
- Upgrade Plan

The main workspace is titled "Impulse #1". It contains the following components:

- Time series data**: Configured for "audio" input axes, "Window size" at 1,000 ms, "Window increase (stride)" at 1,000 ms, "Frequency (Hz)" at 16000, and "Zero-pad data" checked.
- Audio (MFE)**: Name is "MFE". Input axes is "audio".
- Transfer learning (Keyword Spotting)**: Name is "Transfer learning (Keywo...)". Input features is "MFE".
- Output features**: Shows 3 categories: "iot_barcelona", "noise", and "unknown".

A green "Save Impulse" button is located on the right side of the workspace.

An overlay window titled "Step 4 of 9: Designing your impulse" provides instructions:

To detect "IoT Barcelona" we'll need an 'impulse'. An impulse takes raw data, uses signal processing to extract features, and then uses a learning block to classify new data. Here we use an MFE signal processing block, and a neural network classifier. We've loaded this impulse already for you, but feel free to look around.

Want to look around? No problem. Just close this overlay, and click 'Resume tutorial' when you're ready for the next step.

Buttons at the bottom of the overlay are "Quit tutorial" and "Next, spectrograms".



studio.edgeimpulse.com

iotbcn / iotbcn-project-1 PERSONAL Target: Arduino Portenta... i

EDGE IMPULSE

Parameters Generate features

Raw data Show: All labels IoT Barcelona.10 (iot_barcelona)

0ms 73ms 147ms 220ms 294ms 367ms 441ms 514ms 588ms 661ms 735ms 808ms 882ms 955ms

audio

Raw features Label DSP result

Mel Features (DSP Output)

Step 5 of 9: Spectrograms

Signal processing is typically the first step in an impulse. We use it to de-noise data, highlight interesting frequencies, and reduce the amount of data. For audio we typically convert this into a spectrogram, as you can see here on the right. There's a wide variety of options that you can configure here, but we will leave this as-is for now.

Want to look around? No problem. Just close this overlay, and click 'Resume tutorial' when you're ready for the next step.

Parameters

Mel-filterbank energy feature

Frame length ?

Frame stride ?

Filter number ?

FFT length ? 256

Quit tutorial

Next, generate features

The screenshot shows the Edge Impulse Studio interface. On the left, there's a sidebar with navigation links like Dashboard, Devices, Data acquisition, Experiments, EON Tuner, Impulse design (with sub-options Create impulse, MFE, Transfer learning (K...), Retrain model, Live classification, Model testing, Perf. calibration), and an Upgrade Plan section. The main workspace has tabs for Parameters and Generate features. Under Parameters, there's a 'Raw data' section showing a waveform from 0ms to 955ms, with a red 'audio' button. Below it are sections for Raw features, Label, and DSP result. A modal window titled 'Step 5 of 9: Spectrograms' is open, explaining signal processing and spectrogram creation. It includes parameters for Mel-filterbank energy feature: Frame length (256), Frame stride (128), Filter number (128), and FFT length (256). At the bottom of the modal are 'Quit tutorial' and 'Next, generate features' buttons.



The screenshot shows the Edge Impulse studio interface on a Mac OS X system. The URL in the browser is studio.edgeimpulse.com. The project is titled "iotbcn / iotbcn-project-1" and the target is set to "Arduino Portenta...".

The left sidebar contains the following navigation items:

- Dashboard
- Devices
- Data acquisition
- Experiments
- EON Tuner
- Impulse design
 - Create impulse
 - MFE
 - Transfer learning (K...)
- Retrain model
- Live classification
- Model testing
- Perf. calibration

An "Upgrade Plan" section offers access to higher job limits and more collaborators, with a "View plans" button.

The main workspace has two tabs: "Parameters" and "Generate features". The "Generate features" tab is active, showing the "Training set" and "Feature explorer" sections. The "Training set" section displays the following data:

Parameter	Value
Data in training set	5m 34s
Classes	3 (iot_barcelona, noise, unknown)
Training windows	334

A large blue button labeled "Generating features..." is centered below the training set data.

The "Feature explorer" section currently displays the message: "No features generated yet."

A modal window titled "Step 6 of 9: Generating features" provides instructions and status information:

With the signal processing parameters configured we will now generate features for every sample in our dataset. Afterwards you'll see the data explorer. This shows your complete dataset in one graph. If everything is right you should see a very clear cluster of data with "IoT Barcelona" in it, separate from the "noise" and "unknown" data.

Generating features...

Want to look around? No problem. Just close this overlay, and click 'Resume tutorial' when you're ready for the next step.

Quit tutorial

Next, train a neural network



studio.edgeimpulse.com

iotbcn / iotbcn-project-1 PERSONAL Target: Arduino Portenta...

EDGE IMPULSE

Parameters Generate features

Training set

Data in training set 5m 34s

Classes 3 (iot_barcelona, noise, unknown)

Training windows 334

Generate features

Feature explorer

iot_barcelona
noise
unknown

Feature generation output (0)

[225/334] Creating features.
[201/334] Creating features.
[212/334] Creating features.
[241/334] Creating features.
[256/334] Creating features.
[269/334] Creating features.
[284/334] Creating features.
[297/334] Creating features.
[312/334] Creating features.
[325/334] Creating features.
[334/334] Creating features.
Created features

Job completed (success)

Step 6 of 9: Generating features

With the signal processing parameters configured we will now generate features for every sample in our dataset. Afterwards you'll see the data explorer. This shows your complete dataset in one graph. If everything is right you should see a very clear cluster of data with "IoT Barcelona" in it, separate from the "noise" and "unknown" data.

Want to look around? No problem. Just close this overlay, and click 'Resume tutorial' when you're ready for the next step.

Next, train a neural network

Upgrade Plan

Get access to higher job limits and more collaborators.

View plans



The screenshot shows the Edge Impulse web studio interface. On the left, a sidebar lists various project management and development tools: Dashboard, Devices, Data acquisition, Experiments, EON Tuner, Impulse design (selected), Create impulse, MFE, Transfer learning (K...), Retrain model, Live classification, Model testing, and Perf. calibration. Below this is an **Upgrade Plan** section with a button to "View plans".

The main workspace displays two panels: "Neural Network settings" and "Training output". In the "Neural Network settings" panel, under "Training settings", the "Number of training cycles" is set to 30, "Use learned optimizer" is unchecked, "Learning rate" is 0.01, and "Training processor" is set to CPU. Under "Advanced training settings", there is a dropdown menu. In the "Neural network architecture" panel, the "Input layer" is selected, showing "MobileNetV2 0.35 (no f)".

The "Training output" panel shows a progress message: "Creating job... OK (ID: 37680949)".

A central modal window titled "Step 7 of 9: Training a neural network" provides instructions: "And now... the moment you've been waiting for: training the machine learning model. During training the model learns to distinguish between the three different classes. After training you'll see the confusion matrix and the data explorer, which show you the accuracy of your model." It also shows a progress bar labeled "Training neural network...".

At the bottom of the modal, there are buttons for "Next, take the model for a spin", "Quit tutorial", and a link to "Want to look around? No problem. Just close this overlay, and click 'Resume tutorial' when you're ready for the next step."



studio.edgeimpulse.com

Step Step 8 of 9: Taking the model for a spin

You have trained your model, now let's take it for a spin... Wait for the model to build, then click 'Give access to the microphone', and see how the model performs!

iotbcn / iotbcn-project-1

Building project...

Switch to data collection mode

This client is [open source](#).

Quit tutorial

Next, check out next steps

Metrics validation set

Target: Arduino Portenta...

(0)

': 84}, 'accuracy': 0.9101796
on': 0.8661506707946337, 'rec
ore': 0.7517432980989508, 'su
recision': 0.9069529671307541,
'f1-score': 0.8976463294623725,
735844706143325, 'loss': 0.28
weighted_average': {'precisi
0.9101796407185628, 'f1-sc
names': ['iot_barcelona', 'noi
odel training complete

version: ? Quantized (int8) ▾

on set)

LOSS 0.28

NOISE	UNKNOWN
0%	75%
94.4%	5.6%
1.2%	97.6%
0.96	0.92

Metrics validation set



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Step Step 8 of 9: Taking the model for a spin

You have trained your model, now let's take it for a spin... Wait for the model to build, then click 'Give access to the microphone', and see how the model performs!

iotbcn / iotbcn-project-1

Permission required

Give access to the microphone

Next, check out next steps

Metrics validation set

Target: Arduino Portenta...

(0)

': 84}, 'accuracy': 0.9101796
on': 0.8661506707946337, 'rec
ore': 0.7517432980989508, 'su
recision': 0.9069529671307541,
'f1-score': 0.8976463294623725,
735844706143325, 'loss': 0.28
weighted_average': {'precisi
0.9101796407185628, 'f1-sc
names': ['iot_barcelona', 'noi
odel training complete

version: ? Quantized (int8) ▾

on set)

LOSS 0.28

NOISE	UNKNOWN
0%	75%
94.4%	5.6%
1.2%	97.6%
0.96	0.92

Quit tutorial

View plans



studio.edgeimpulse.com

iotbcn / iotbcn-project-1 PERSONAL Target: Arduino Portenta...

EDGE IMPULSE

- Dashboard
- Devices
- Data acquisition
- Experiments
- EON Tuner
- Impulse design
 - Create impulse
 - MFE
 - Transfer learning (K...)
- Retrain model
- Live classification
- Model testing
- Perf. calibration

Upgrade Plan
Get access to higher job limits and more collaborators.

[View plans](#)

Congratulations!

You have trained your first embedded Machine Learning model! While you can run this model in the browser, it's also small and fast enough to run in real-time on embedded devices.

INFERENCING TIME 49 ms. **PEAK RAM USAGE** 168.5K **FLASH USAGE** 535.6K

What's next?

Make model improvements & experiment!
Want to experiment with both FOMO and MobileNet SSD simultaneously on the same dataset? No problem! Learn how you can compare multiple impulses in one project with Experiments!

[Check out experiments](#)

Create a public version to share!

Output layer (3 classes) F1 SCORE 0.38 Metrics validation set

Impulses (3 / 3)

NAME	INPUT	DSP BLOCKS	LEARN BLOCKS	F32_V_ACC
Impulse #1 (MFCC)	1,000ms.	MFCC	Classifier	-
Impulse #2 (MFE)	1,000ms.	MFE	Classifier	91.0%
Impulse #3	1,000ms.	MFCC	Classifier	78.0%

version: Quantized (int8)

LOSS 0.28

NOISE	UNKNOWN
0%	75%
94.4%	5.6%
1.2%	97.6%

(0)

```
' : 84}, 'accuracy': 0.9101796  
lon': 0.8661506707946337, 'rec  
ore': 0.7517432980989508, 'su  
recision': 0.9069529671307541,  
'1-score': 0.8976463294623725,  
1735844706143325, 'loss': 0.28  
weighted_average': {'precisio  
0.9101796407185628, 'f1-scor  
names': ['iot_barcelona', 'noi  
odel training complete
```



What is a good dataset?

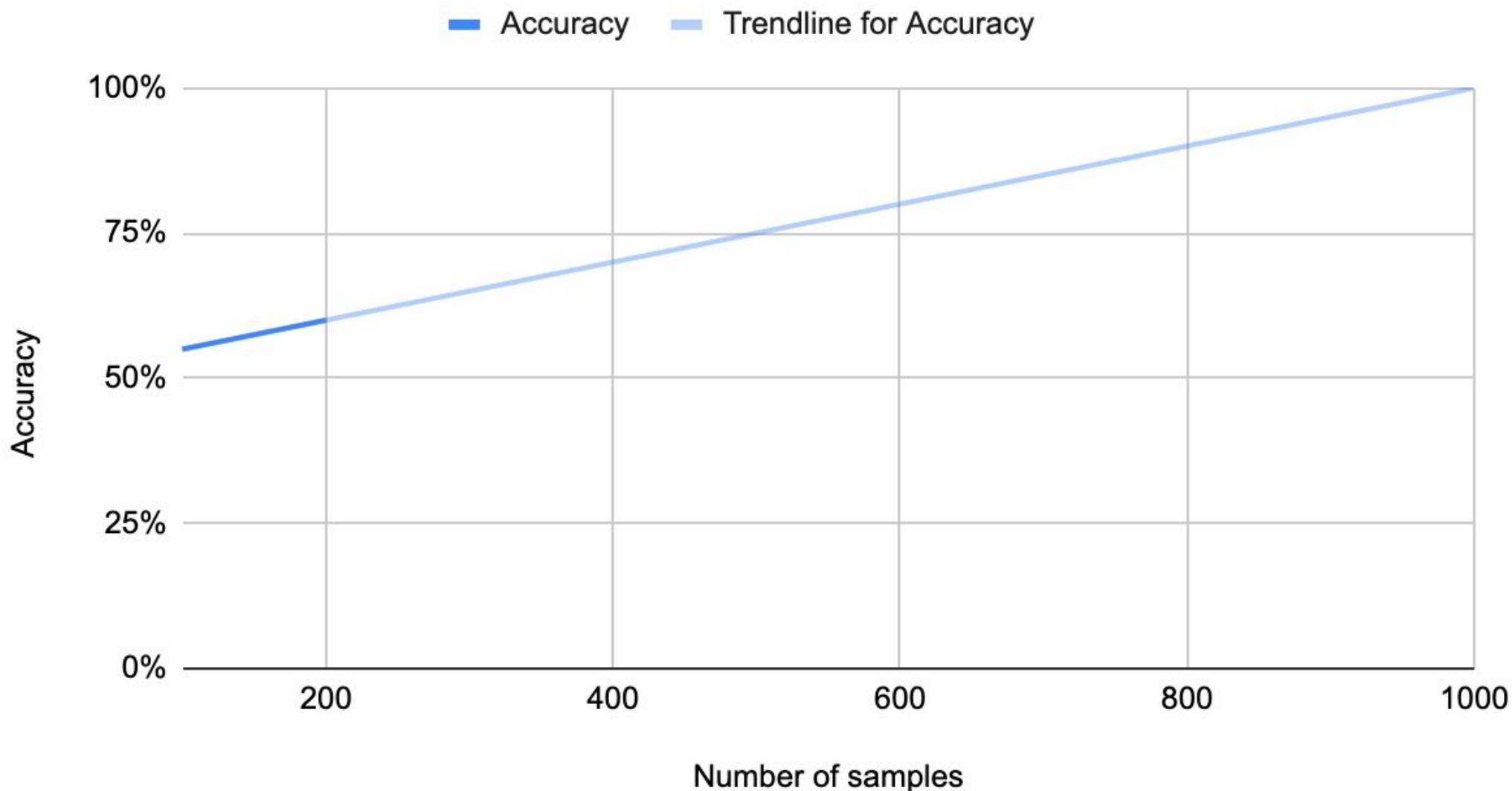
What is a good dataset?

A good dataset is **representative of the real-world scenarios** your model will encounter. This includes variations in:

- Environmental conditions: Lighting, noise, weather, etc.
- Demographic factors: Different ages, genders, accents, etc.
- Edge cases: Unusual or rare situations that might occur.

How much data is needed for a good dataset?

Accuracy vs. Number of samples



Accuracy vs. Number of samples

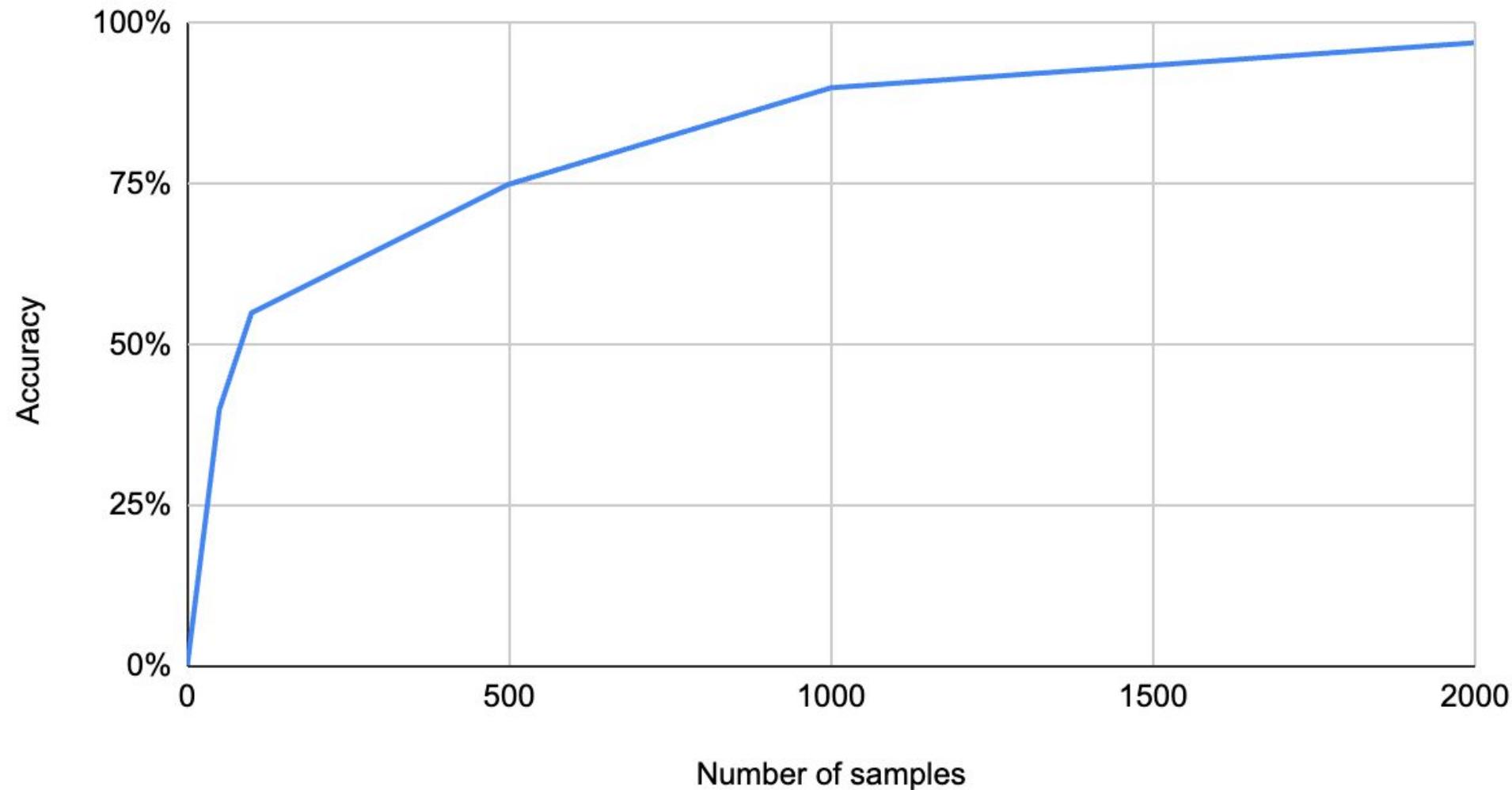


Image processing approaches

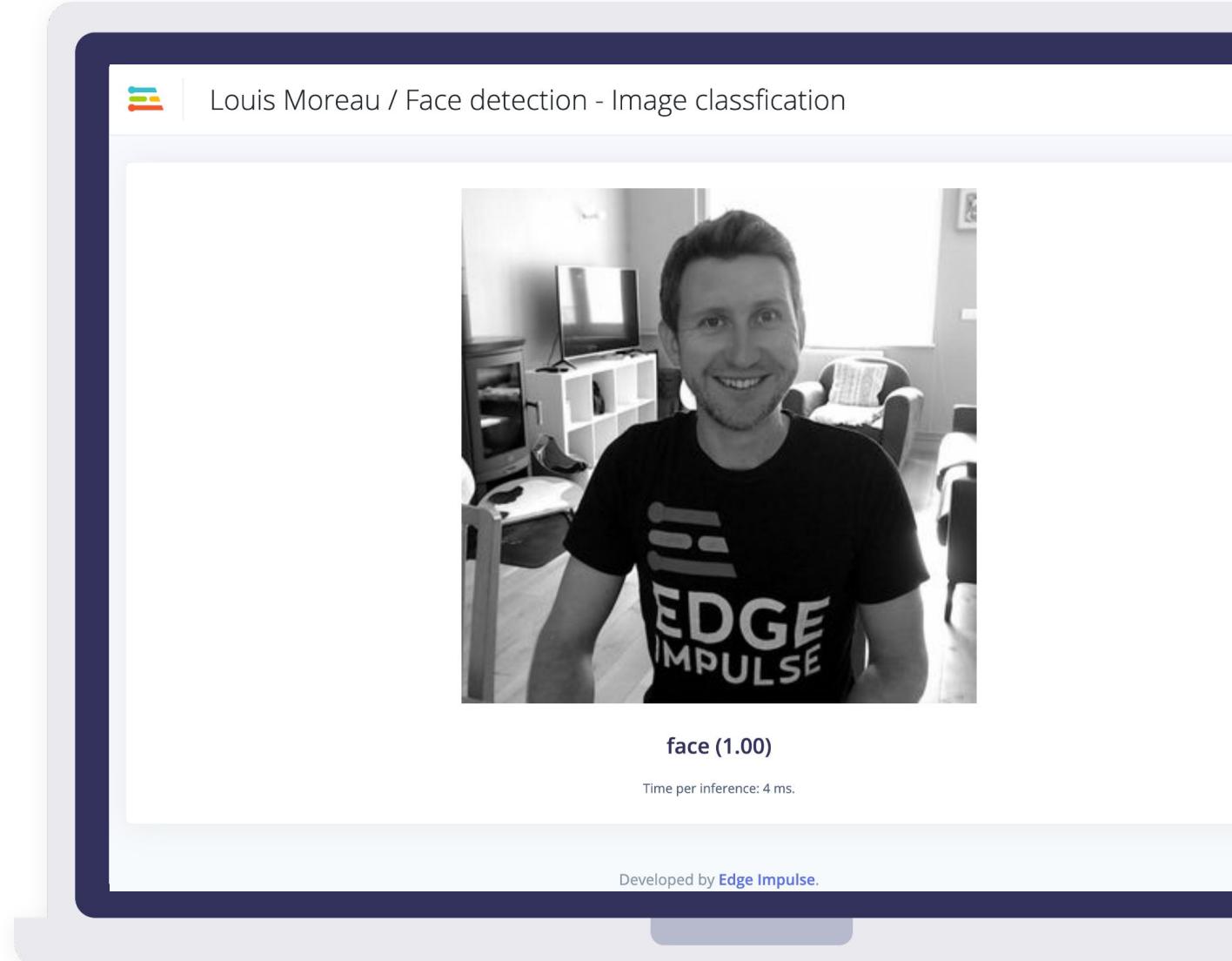
**Image classification
Object detection**



Image classification

The question the model is trying to answer is:

“Is there a face or not in the image?”



Louis Moreau / Face detection - Image classification

face (1.00)

Time per inference: 4 ms.

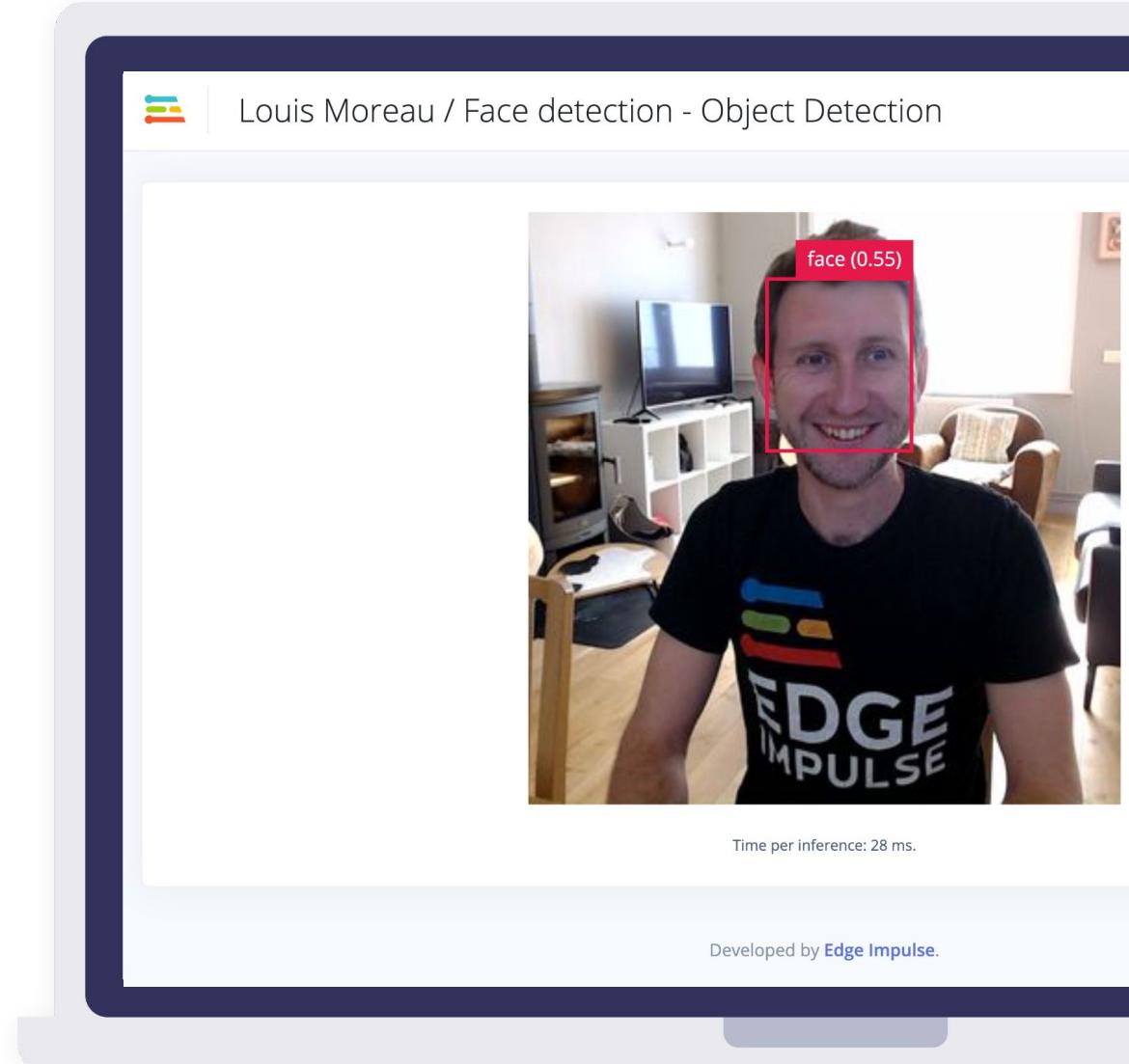
Developed by [Edge Impulse](#).

A screenshot of a computer application window titled "Louis Moreau / Face detection - Image classification". Inside the window, a black and white photograph of a smiling man with short brown hair is displayed. He is wearing a dark t-shirt with the words "EDGE IMPULSE" printed on it. The application interface includes a header with the title and a footer with developer information. The main area shows the image with a bounding box around the man's face, and the text "face (1.00)" indicating the model's confidence level. Below this, it says "Time per inference: 4 ms." and "Developed by [Edge Impulse](#)".

Object Detection using Bounding Boxes

*The question the model is trying to answer
is:*

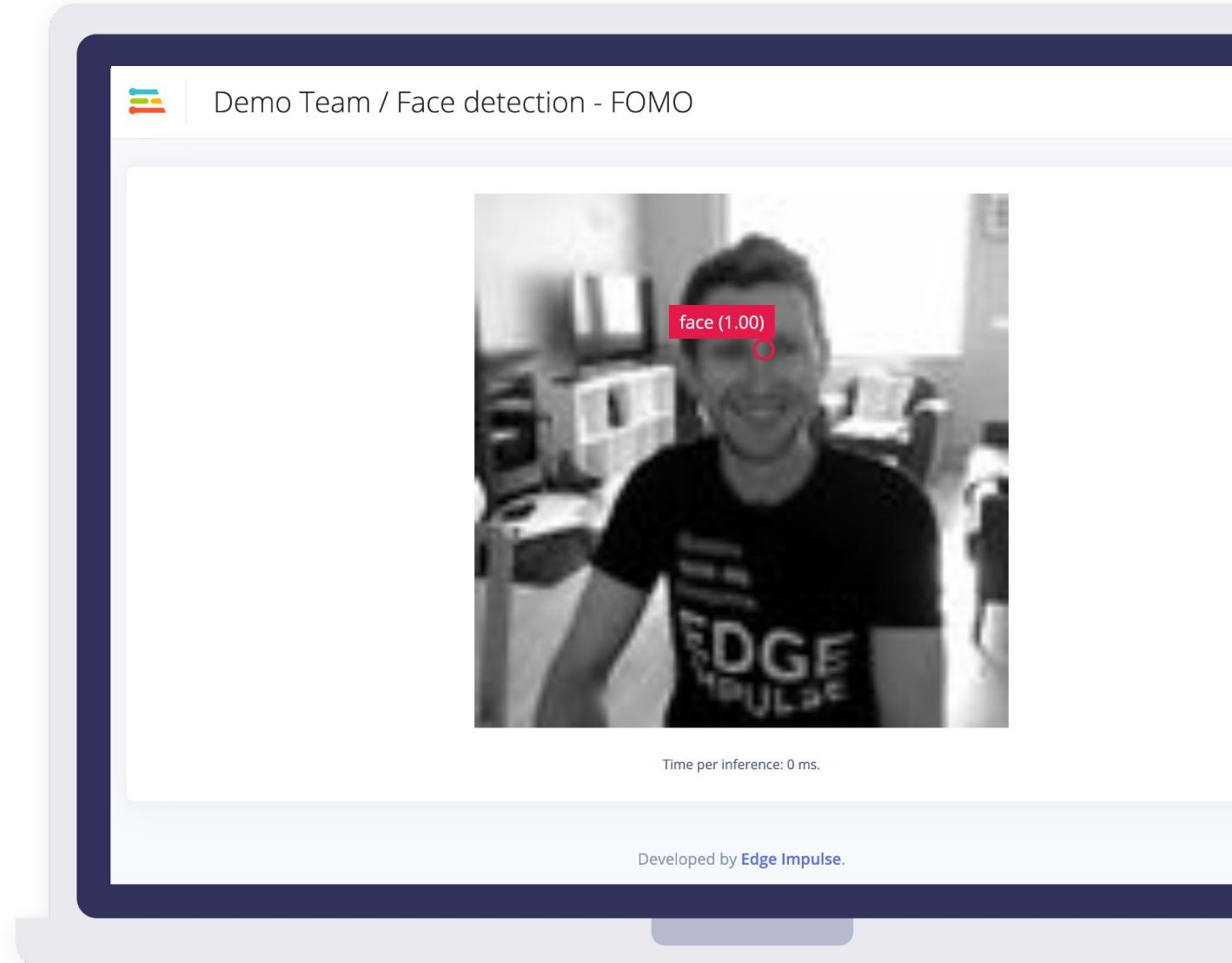
**“Are there faces in the image, where and
what size are they?”**



Object Detection using Centroids

*The question the model is trying to answer
is:*

**“Are there faces in the image, where are
they?”**



Duckies classification

1. Get your laptop
2. Sign-up here

<https://edgeimp.com/ttc25-duckies>



Object Detection - Rubber Duckies

Dashboard Data acquisition Experiments EON Tuner Impulse design Create impulse Retrain model Live classification Model testing Post-processing Deployment

Datasets by Edge Impulse / Object Detection - Rubber Duckies PUBLIC

Welcome to Edge Impulse, the largest community of edge AI developers! This is a public Edge Impulse project, use the navigation bar to see all data and models in this project; or clone to retrain or deploy to any edge device.

Object Detection - Rubber Duckies

OBJECT DETECTION

About this project

This dataset has been collected by Edge Impulse teams and contains images of rubber duckies. The images have been labeled using the OWL-VIT AI Labeling Block. A few short videos are also present in the post-processing section to test the post-processing Object Tracking feature.

Compatible Blocks

- Feature extraction: Image
- Learning block: Object Detection
- Post-processing block: Object tracking.

Not sure what to choose? Try out this dataset with the EON Tuner.

Data (206 items)

View all

Image Preview	Label
	rubber-ducky
	rubber-ducky
	rubber-ducky
	rubber-ducky

Dataset summary

DATA COLLECTED 206 items

LABELS rubber-ducky

Project info

Project ID	783690
Project version	2
License	BSD 3-Clause Clear
No. of views	3
No. of clones	0

Object Detection - Rubber D... +

studio.edgeimpulse.com/public/783690/latest

EDGE IMPULSE

Datasets by Edge Impulse / Object Detection - Rubber Duckies PUBLIC

Target: Raspberry Pi 5 | Clone this project | Feina

Welcome to Edge Impulse, the largest community of edge AI developers! This is a public Edge Impulse project, use the navigation bar to see all data and models in this project, or clone to retrain or deploy to any edge device.

Object Detection

OBJECT DETECTION

About this project

This dataset has been collected by Edge Impulse team: [Labeling Block](#). A few short videos are also present in this dataset.

Compatible Blocks

- Feature extraction: [Image](#)
- Learning block: [Object Detection](#)
- Post-processing block: [Object tracking](#).

Not sure what to choose? Try out this dataset with the [Edge Impulse Studio](#).

Data (206 items)

Picture.64rhsfhm

Picture.64rmu

View all

Clone project

Clone this project

Enter a name for the cloned project:

Choose your project type:

Personal
60 min job limit, 4GB or 4 hours of data, limited collaboration.

Enterprise
No job or data size limits, higher performance, custom blocks.

Choose your project setting:

Public
Anyone on the internet can view and clone this project under the [BSD 3-Clause Clear license](#). Only invited users will be able to edit.

Private
Only invited users can edit and view your project.

Dataset summary

DATA COLLECTED
206 items

LABELS
rubber-ducky

Project info

Project ID	783690
Project version	2
License	BSD 3-Clause Clear license
No. of views	3
No. of clones	0

Object Detection - Rubber D... X +

studio.edgeimpulse.com/studio/783798/clone

Marc Pous / Object Detection - Rubber Duckies - TTC25 PERSONAL

Target: Cortex-M4F 80MHz Feina

EDGE IMPULSE

Clone progress

Cancel

Loading logs for 37871718...
Attached to job 37871718...

Dashboard

Devices

Data acquisition

Experiments

EON Tuner

Impulse design

- Create impulse
- Retrain model
- Live classification
- Model testing
- Deployment

Versioning

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GETTING STARTED

Documentation

Upgrade Plan

Get access to higher job limits
and more collaborators.

View plans

?

Object Detection - Rubber Duckies

studio.edgeimpulse.com/studio/783798/clone

Marc Pous / Object Detection - Rubber Duckies - TTC25 PERSONAL

Target: Raspberry Pi 5 Feina

EDGE IMPULSE

- Dashboard
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- Experiments
- EON Tuner
- Impulse design**
 - Create impulse
 - Retrain model
 - Live classification
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 - Post-processing
 - Deployment
- Versioning

Clone progress

```
Downloading 783690/versioning/v2.zip OK
[2/8] Downloading version OK
[3/8] Extracting version archive...
      100%
[3/8] Extracting version archive OK
[4/8] Copying back project files...
      1% (0 MB copied)
      100% (0 MB copied)
[4/8] Copying back project files OK
[5/8] Restoring project and impulse config...
[5/8] Restoring project and impulse config OK
[6/8] Restoring 206 files...
[6/8] Restoring files (0 - 163)...
      [163/206] Scanning files...
      [163/206] Restoring files...
[6/8] Restoring files (163 - 203)...
      [203/206] Scanning files...
Job completed (success)
```

Clone succeeded

You're now ready to build your next embedded Machine Learning project!

Upgrade Plan

Get access to higher job limits and more collaborators.

[View plans](#)

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Object Detection - Rubber Du

studio.edgeimpulse.com/studio/783798/devices#collect-new-data

EDGE IMPULSE

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EON Tuner

Impulse design

- Create impulse
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- Post-processing
- Deployment

Collect new data

Collect data directly from your phone, computer, device, or development board.

Scan QR code to connect to your phone

Connect to your computer

Connect your device or development board

+ Connect a new device

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Upgrade Plan

Get access to higher job limits and more collaborators.

View plans

?

Target: Raspberry Pi 5

Feina

Object Detection - Rubber Du... +

studio.edgeimpulse.com/studio/783798/label-object-detection

Marc Pous / Object Detection - Rubber Duckies - TTC25 PERSONAL

EDGE IMPULSE

Dataset Data sources Synthetic data | **Labeling queue (1)** AI labeling

💡 Tired of labeling by hand? Try out [AI labeling](#) - our new LLM-powered labeling tool, available for everyone. X

Labeling Label suggestions: Track objects between frames

Use your mouse to drag a box around an object to add a label. Then click **Save labels** to advance to the next item.

Labeled objects

⋮

?

Get access to higher job limits and more collaborators.

View plans

Target: Raspberry Pi 5

Feina

Object Detection - Rubber Du x +

studio.edgeimpulse.com/studio/783798/impulse/1/create-impulse

EDGE IMPULSE

Marc Pous / Object Detection - Rubber Duckies - TTC25 PERSONAL

Target: Raspberry Pi 5 Feina

Impulse #1

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

Image data

Input axes
image

Image width 96 **Image height** 96

Resize mode
Fit shortest

Image

Name Image

Input axes (1)

Image image

Object Detection (Images)

Name Object detection

Input features
 Image

Output features
1 (rubber-ducky)

Output features

1 (rubber-ducky)

Save Impulse

Upgrade Plan

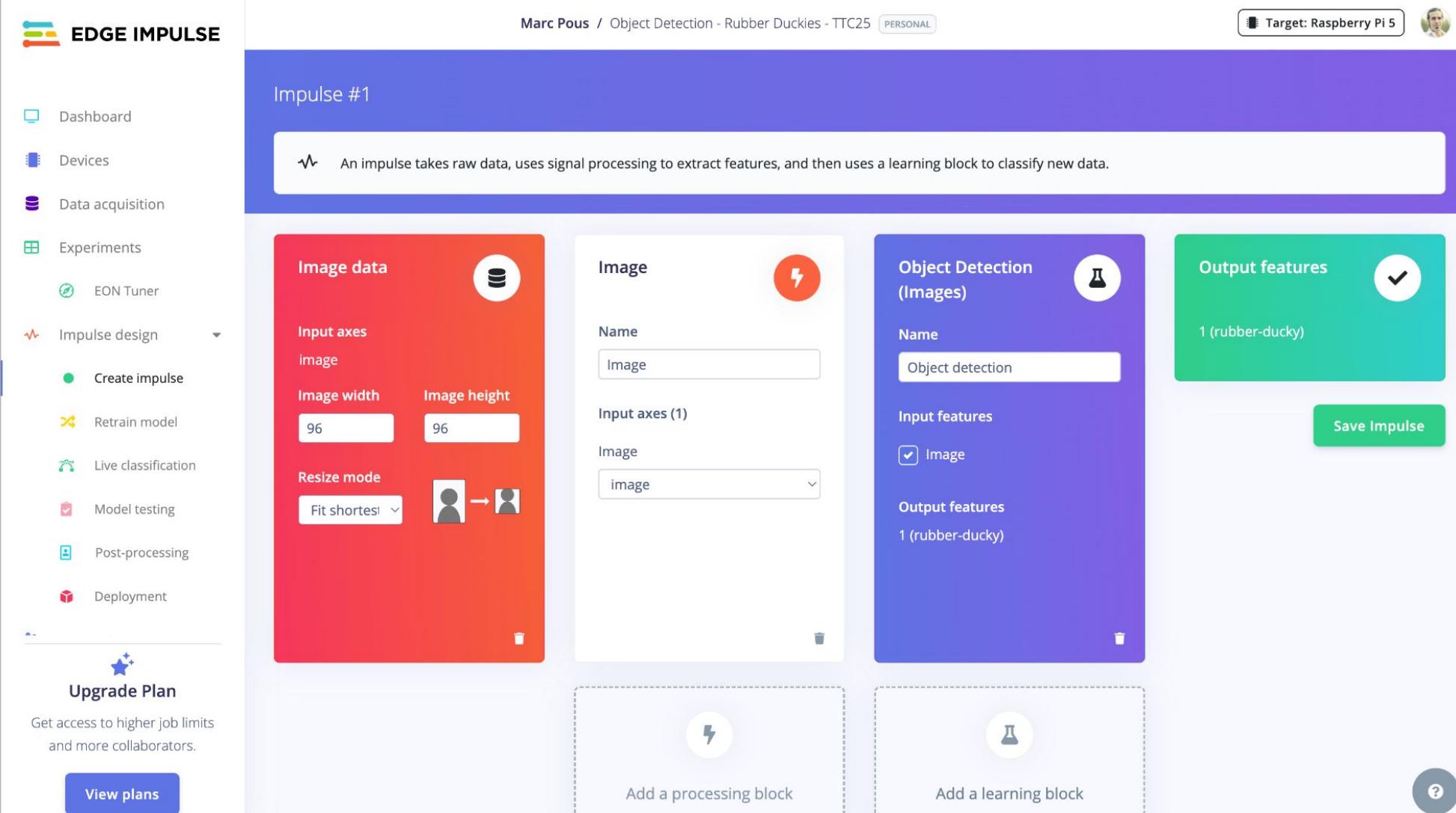
Get access to higher job limits and more collaborators.

View plans

Add a processing block

Add a learning block

?



Object Detection - Rubber D... +/-

studio.edgeimpulse.com/studio/783798/impulse/1/dsp/image/4

Marc Pous / Object Detection - Rubber Duckies - TTC25 PERSONAL

EDGE IMPULSE

Parameters Generate features

Raw data

Show: All labels Captura de pantalla 2025-09-18 a les 18.32.1

rubber-ducky
rubber-ducky
rubber-ducky

Raw features

0xd7d3cc, 0xd7d3cc, 0xd6d2cb, 0xd6d2cb, 0xd6d1cb, 0xd6d1cb, 0xd6d2cb, 0xd...

DSP result

Image

Parameters

Image

Color depth RGB

Save parameters

Processed features

0.8431, 0.8275, 0.8000, 0.8431, 0.8275, 0.8000, 0.8392, 0.8235, 0.7961, 0...

On-device performance ?

Target: Raspberry Pi 5

Feina

Dashboard

Devices

Data acquisition

Experiments

EON Tuner

Impulse design

- Create impulse
- Image
- Object detection

Retrain model

Live classification

Model testing

Upgrade Plan

Get access to higher job limits and more collaborators.

[View plans](#)

Object Detection - Rubber Ducky

studio.edgeimpulse.com/studio/783798/impulse/1/dsp/image/4/generate-features

Marc Pous / Object Detection - Rubber Duckies - TTC25 PERSONAL

EDGE IMPULSE

Target: Raspberry Pi 5 Feina

Parameters Generate features

Training set

Data in training set 164 items

Classes 1 (rubber-ducky)

Generate features

Feature generation output

✓ Job scheduled at 18 Sep 2025 16:40:09
✓ Job started at 18 Sep 2025 16:40:11
Creating windows from files...
[0/164] Creating windows from files...
[1/164] Creating windows from files...
[148/164] Creating windows from files...
[164/164] Creating windows from files...
Creating windows from files OK

Created 164 windows with 472 objects: rubber-ducky: 472

Job completed (success)

Feature explorer

rubber-ducky

On-device performance

PROCESSING TIME 1 ms.

PEAK RAM USAGE 4 KB

Object Detection - Rubber Ducky

studio.edgeimpulse.com/studio/783798/impulse/1/learning/keras-object-detection/5

Feina

EDGE IMPULSE

Training processor: CPU

Data augmentation: ✓

Advanced training settings

Neural network architecture

Input layer (27,648 features)

FOMO (Faster Objects, More Objects) MobileNetV2 0.35

Choose a different model

Output layer (1 classes)

Save & train

Model training complete
Job completed (success)

Model version: Quantized (int8)

Last training performance (validation set)

F1 SCORE: 82.9%

Confusion matrix (validation set)

	BACKGROUND	RUBBER-DUCKY
BACKGROUND	100.0%	0.0%
RUBBER-DUCKY	19.4%	80.6%
F1 SCORE	1.00	0.83

Metrics (validation set)

METRIC	VALUE
Precision (non-background)	0.85
Recall (non-background)	0.81
F1 Score (non-background)	0.83

On-device performance: Engine: EON™ Compiler (RAM optimized)

INFERENCING ...: 3 ms.

PEAK RAM USA...: 137.7K

FLASH USAGE: 81.3K

Upgrade Plan

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View plans

Object Detection - Rubber Du x +

studio.edgeimpulse.com/studio/783798/impulse/1/deployment

Marc Pous / Object Detection - Rubber Duckies - TTC25 PERSONAL

EDGE IMPULSE

Target: Raspberry Pi 5 Feina

Configure your deployment

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.](#)

Search deployment options

DEFAULT DEPLOYMENT

C++ library

A portable C++ library with no external dependencies, which can be compiled with any modern C++ compiler.

MODEL OPTIMIZATIONS

Model optimizations can increase on-device performance but may reduce accuracy.

EON™ Compiler

Same accuracy, 17% less RAM, 36% less ROM.

Quantized (int8)

Selected ✓

	IMAGE	OBJECT DETECTION	TOTAL
LATENCY	1 ms.	3 ms.	4 ms.
RAM	4.0K	239.5K	239.5K
FLASH	-	71.0K	-
ACCURACY			-

Unoptimized

IMAGE OBJECT DETECTION TOTAL

Run this model

Scan QR code or launch in browser to test your prototype

QR code

Launch in browser

?

Dashboard

Devices

Data acquisition

Experiments

EON Tuner

Impulse design

- Create impulse
- Image
- Object detection
- Retrain model

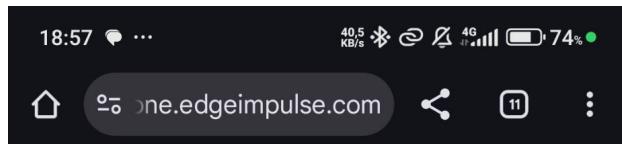
Live classification

Model testing

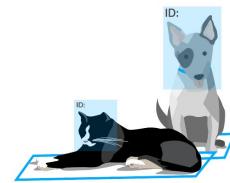
Upgrade Plan

Get access to higher job limits and more collaborators.

[View plans](#)



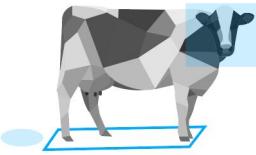
CONSERVATION X LABS WINS BEST
CONSUMER EDGE AI END PRODUCT OF THE
YEAR FOR SENTINEL AI



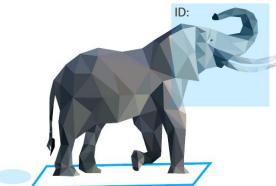
Species Detection



Behavior & Disease in video



Individual re-ID



Anomaly Detection

Thank you!

Any questions?

discord.gg/edgeimpulse

forum.edgeimpulse.com

docs.edgeimpulse.com