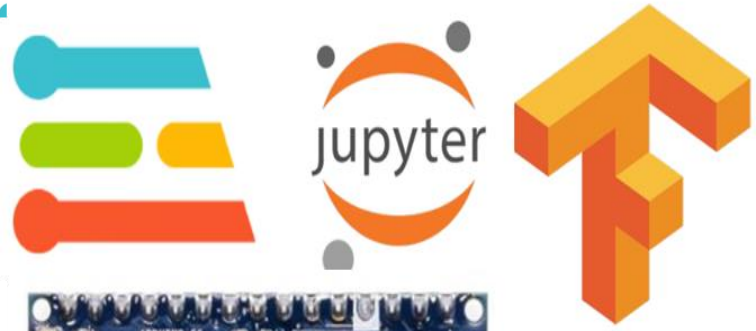
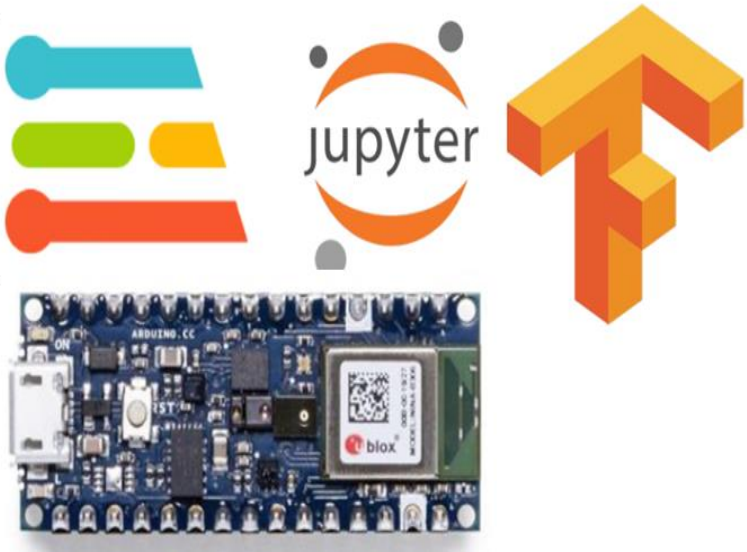
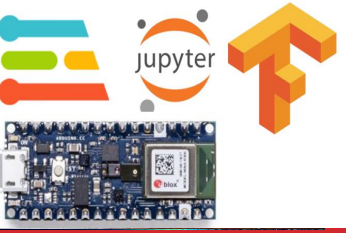


Advanced Microprocessors

OVERVIEW OF EDGE IMPULSE PLATFORM FOR MICROPROCESSORS

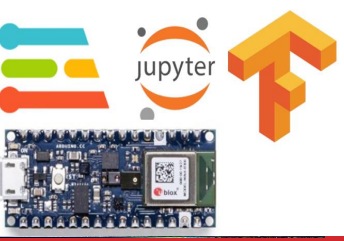
Dennis A. N. Gookyi





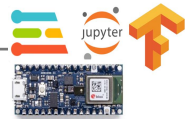
CONTENTS

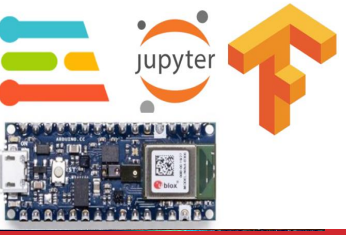
- Introduction to Edge Impulse



INTRODUCTION TO EDGE IMPULSE

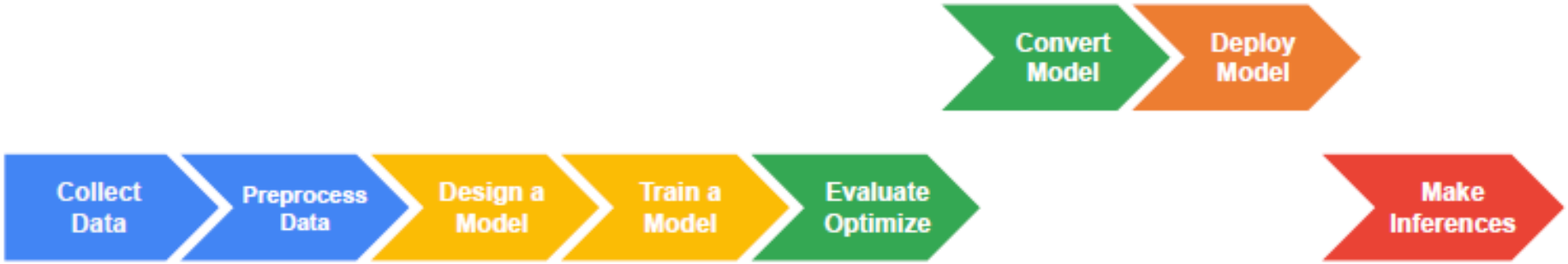
- Machine Learning workflow





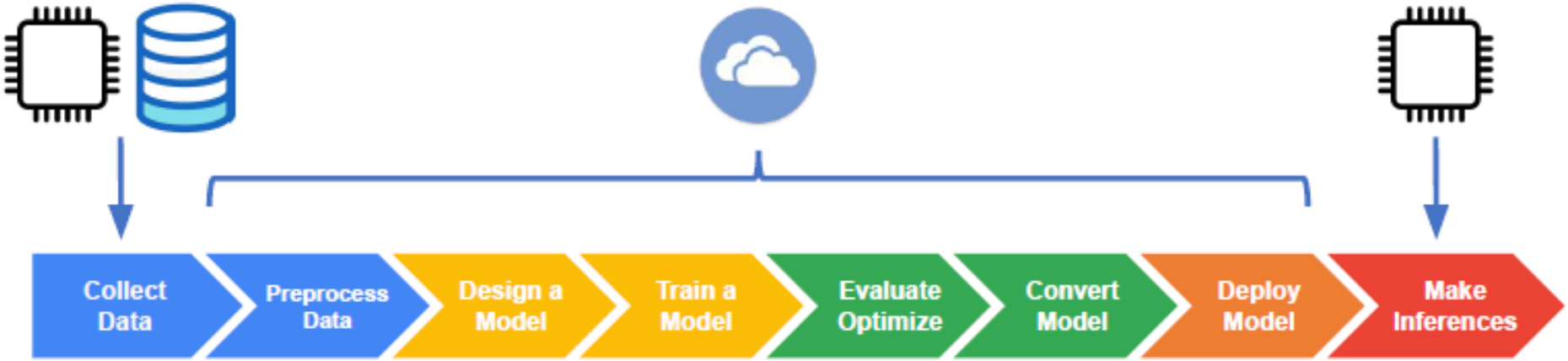
INTRODUCTION TO EDGE IMPULSE

- Tiny Machine Learning workflow



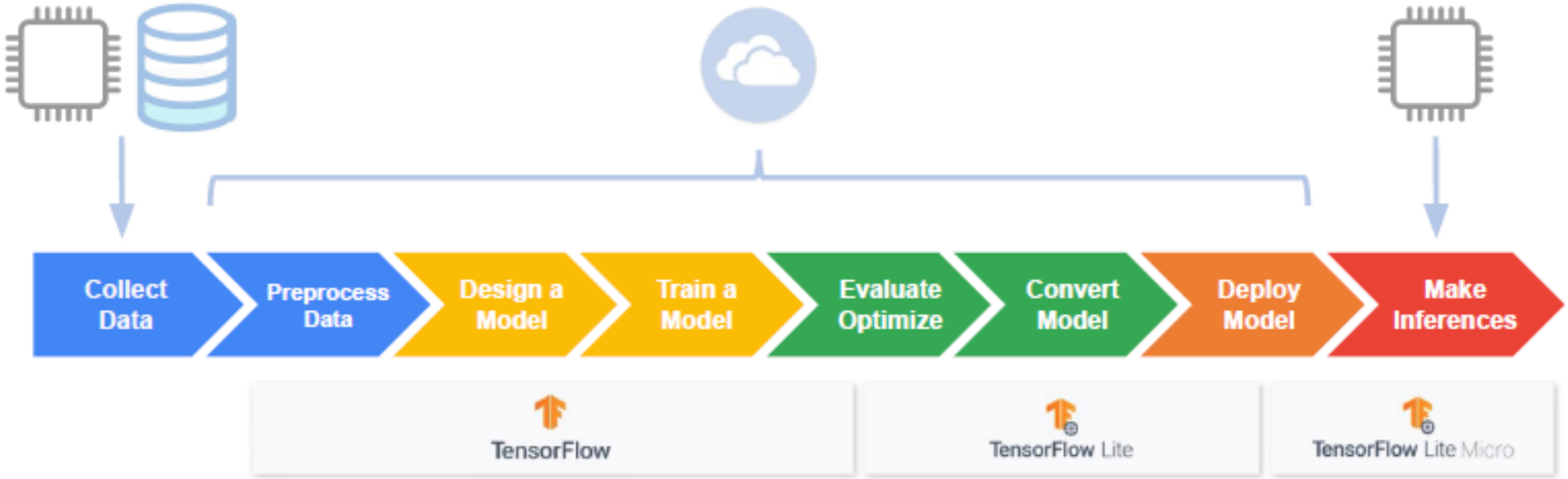
INTRODUCTION TO EDGE IMPULSE

- Tiny Machine Learning workflow



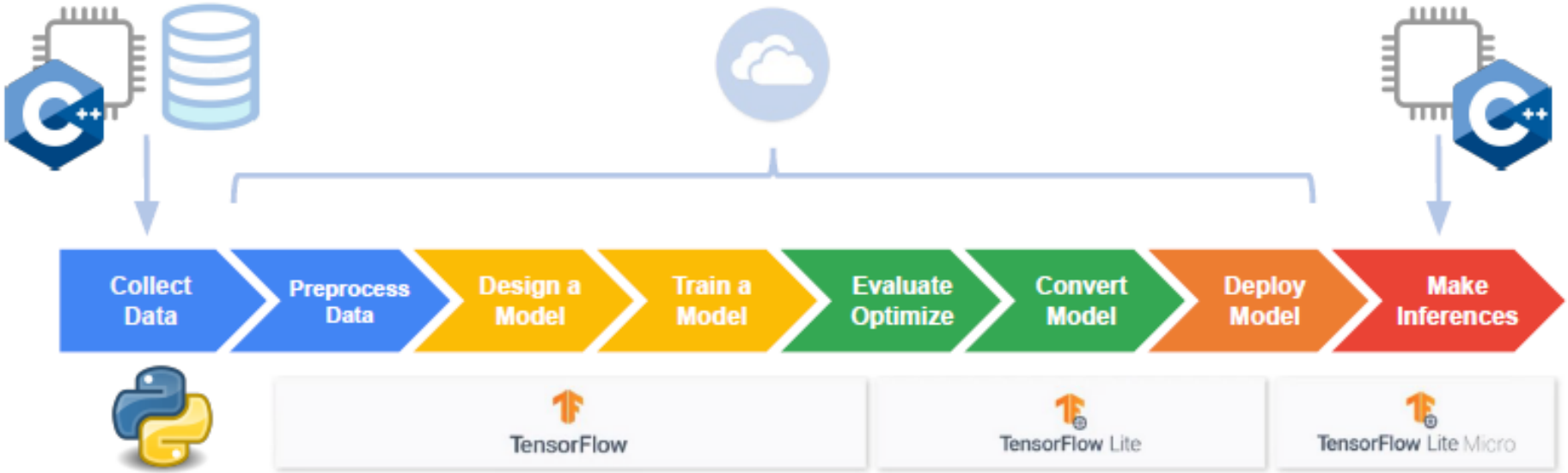
INTRODUCTION TO EDGE IMPULSE

- Tiny Machine Learning workflow



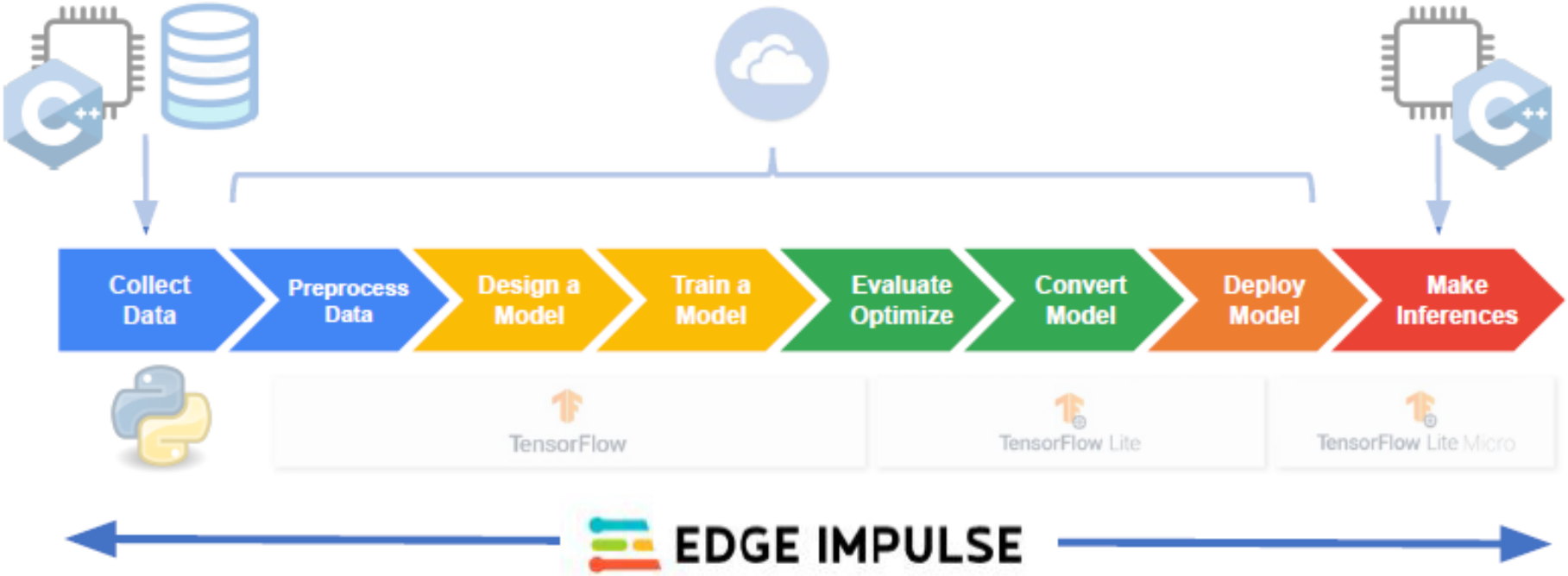
INTRODUCTION TO EDGE IMPULSE

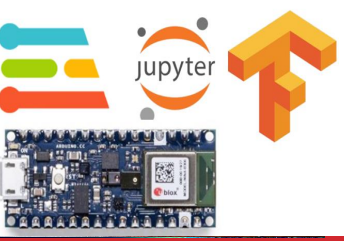
- Tiny Machine Learning workflow



INTRODUCTION TO EDGE IMPULSE

- Tiny Machine Learning workflow





INTRODUCTION TO EDGE IMPULSE

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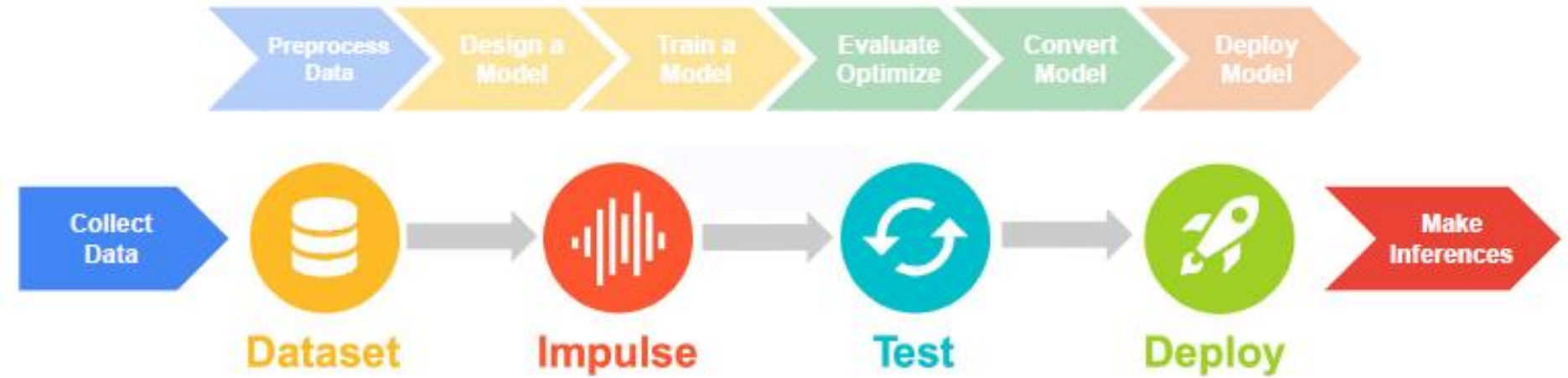
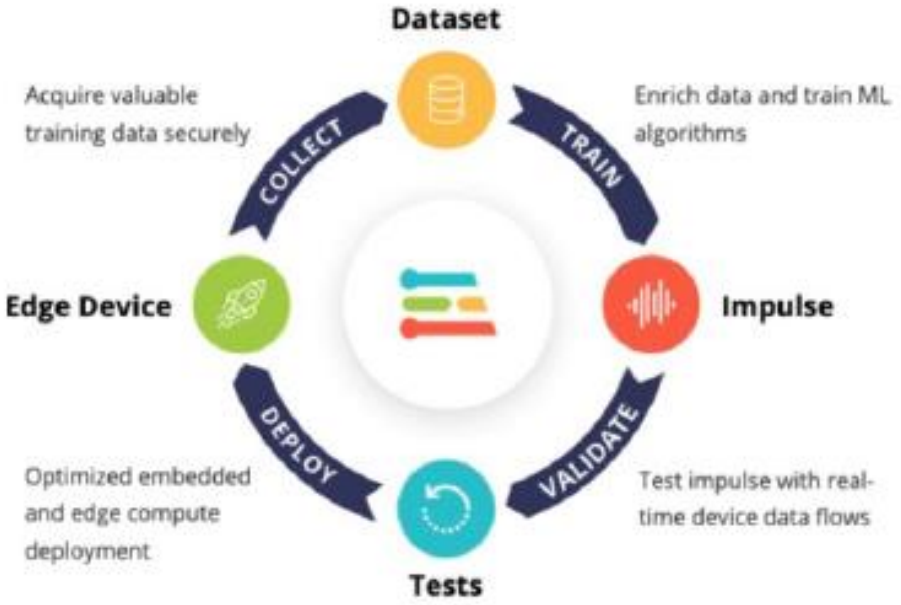
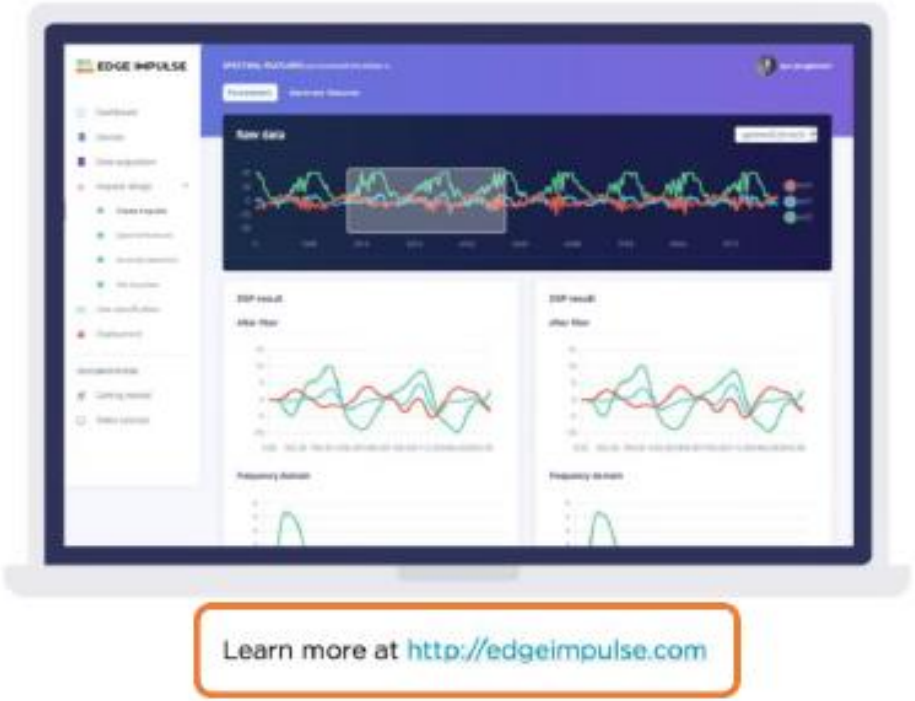
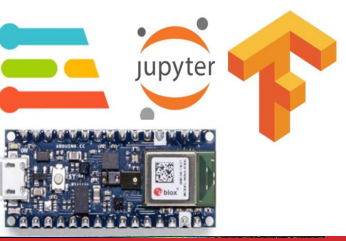


INTRODUCTION TO EDGE IMPULSE

- Edge Impulse

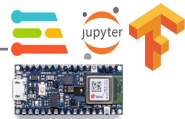






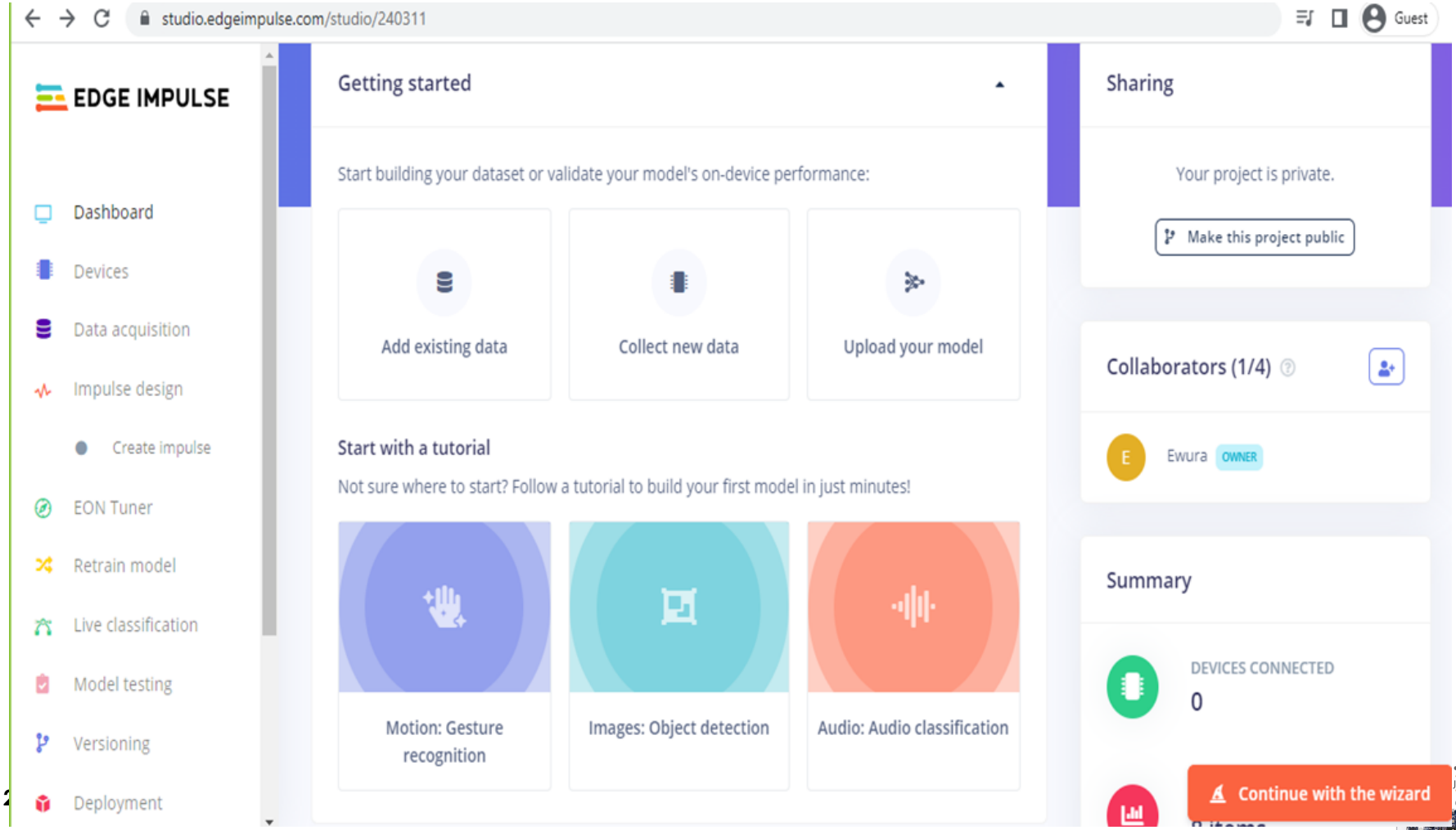
INTRODUCTION TO EDGE IMPULSE

- Edge Impulse
  - It is a cloud service for developing machine learning models in the TinyML targeted edge devices
  - This supports AutoML processing for edge platforms
  - It also supports a number of boards including smartphones to deploy learning models in such devices.
  - Training is done on the cloud platform and the trained model can be exported to an edge device by following a data forwarder-enabled path
  - The impulse can be run on local machine with the help of the in-built C++, Node.js, Python, and Go SDKs
  - Impulses are also deployable as a WebAssembly library



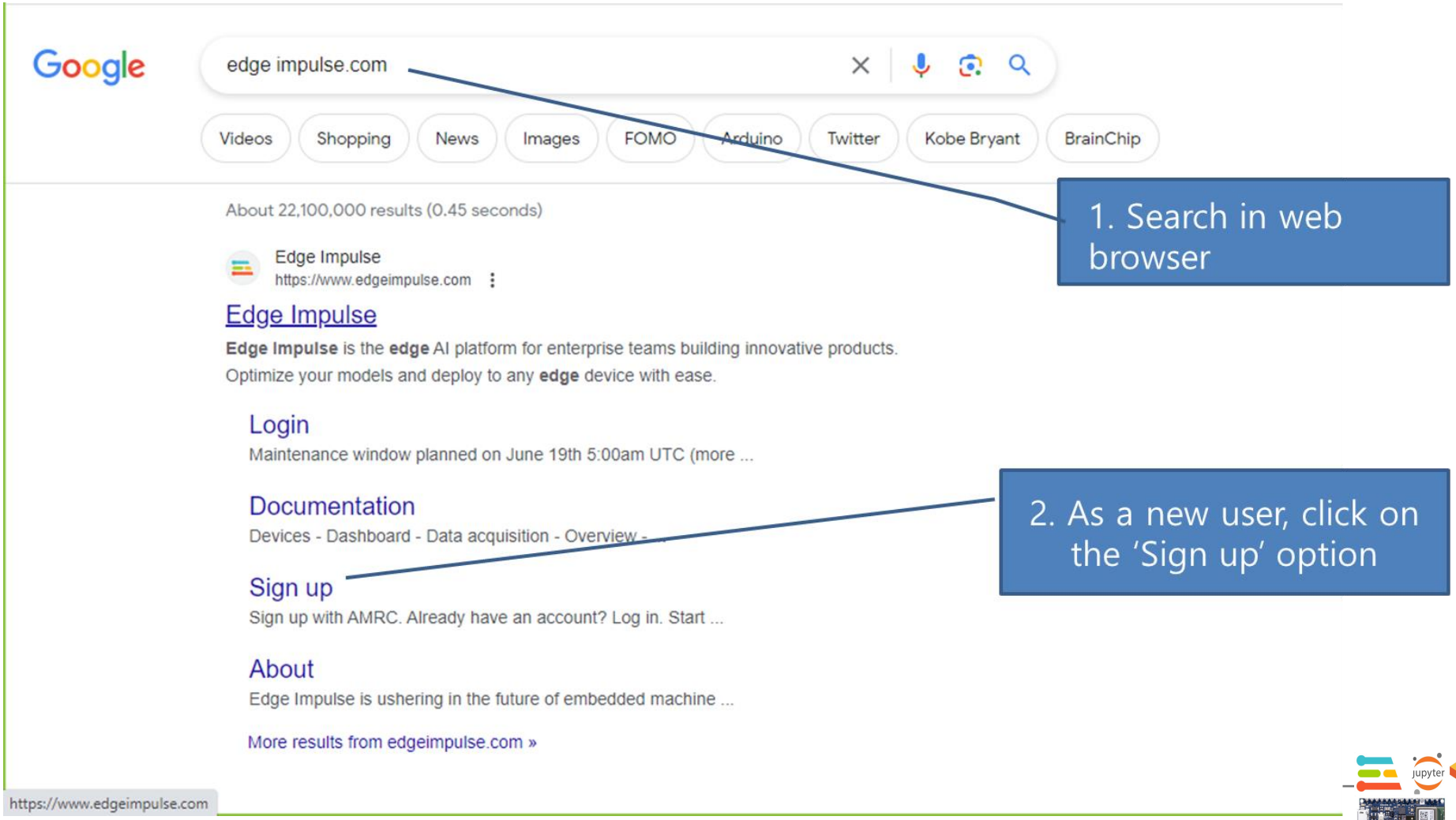
INTRODUCTION TO EDGE IMPULSE

- Edge Impulse



INTRODUCTION TO EDGE IMPULSE

- Edge Impulse installation guide



INTRODUCTION TO EDGE IMPULSE

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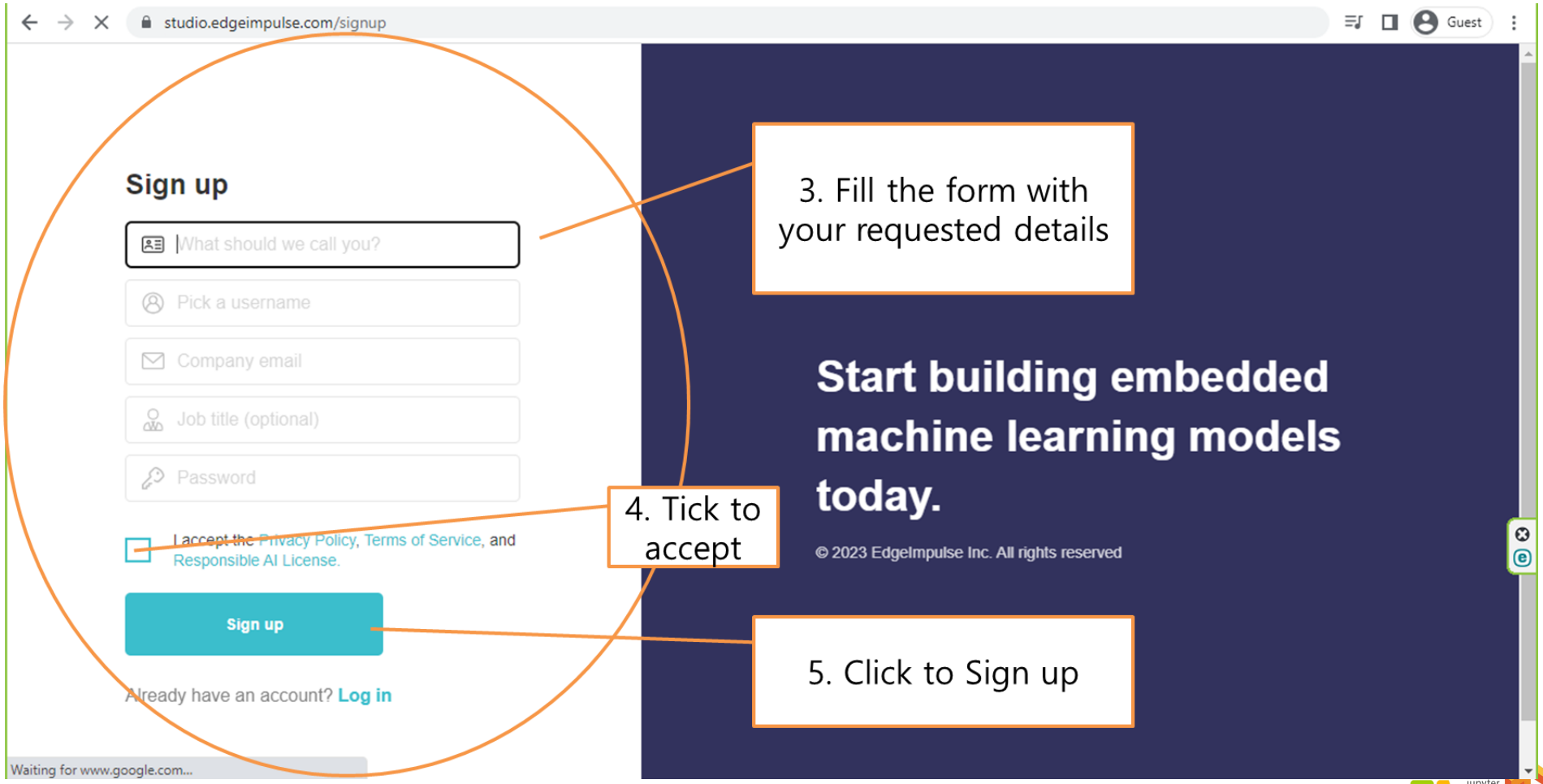

INTRODUCTION TO EDGE IMPULSE

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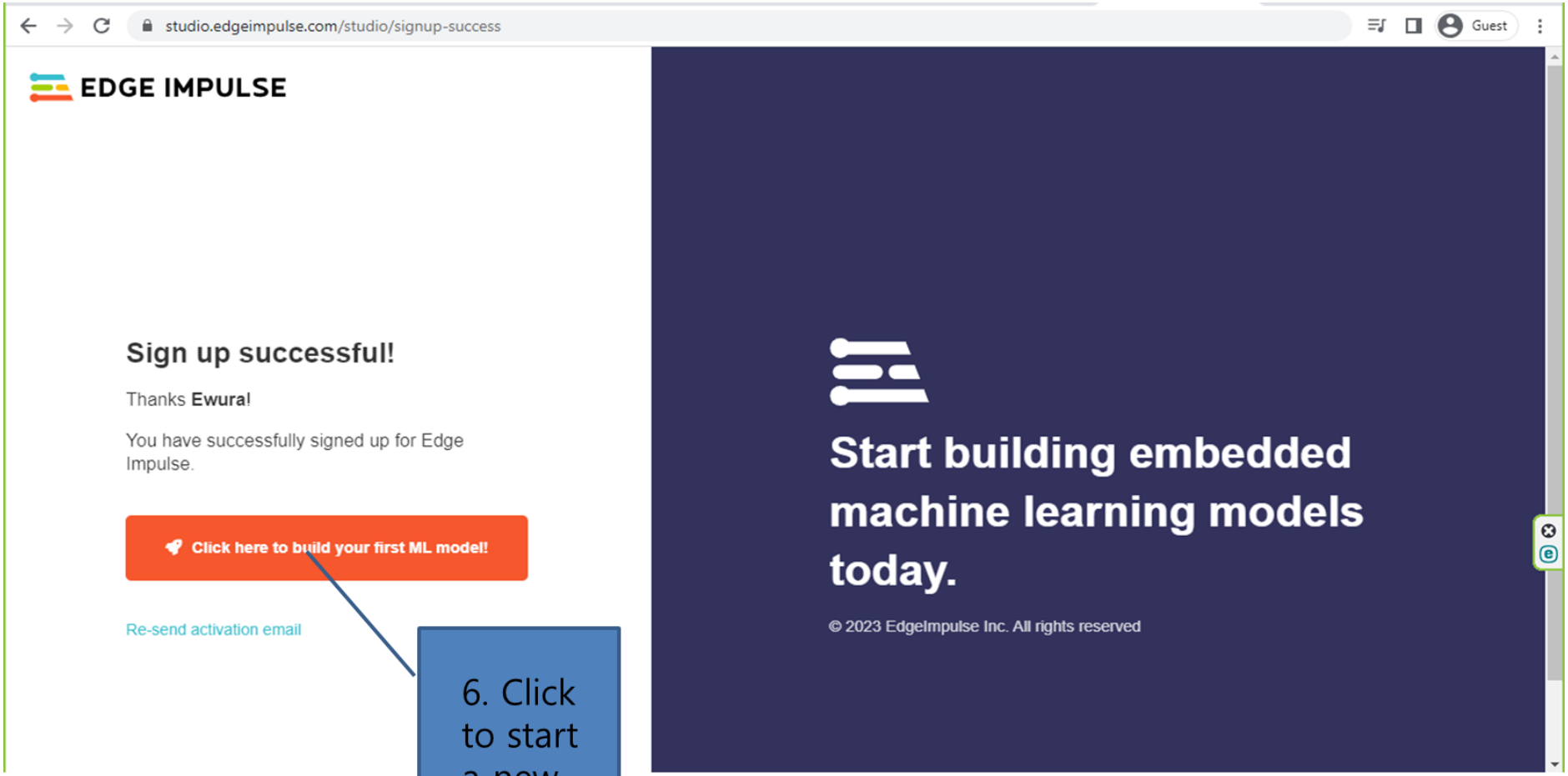
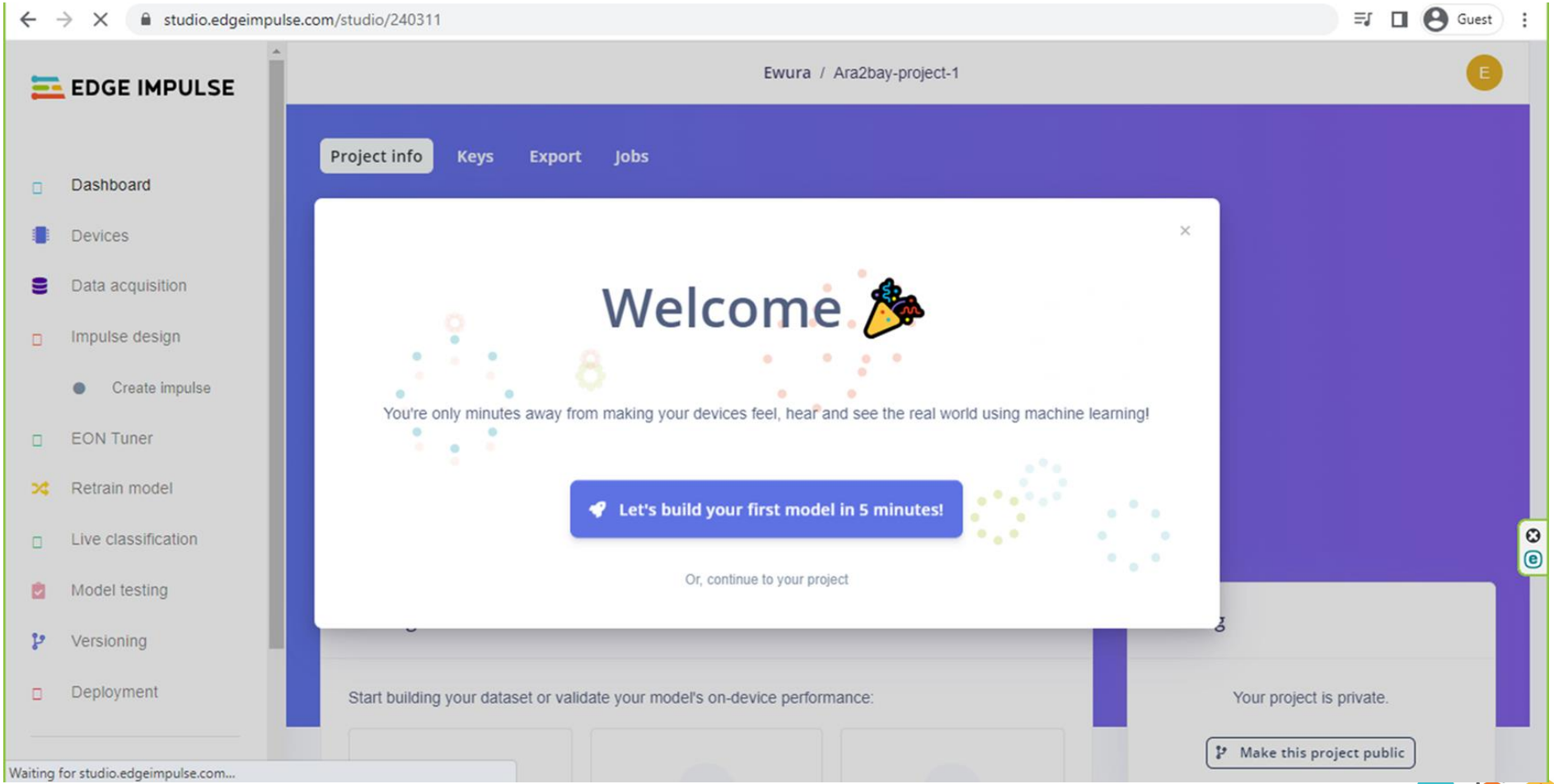


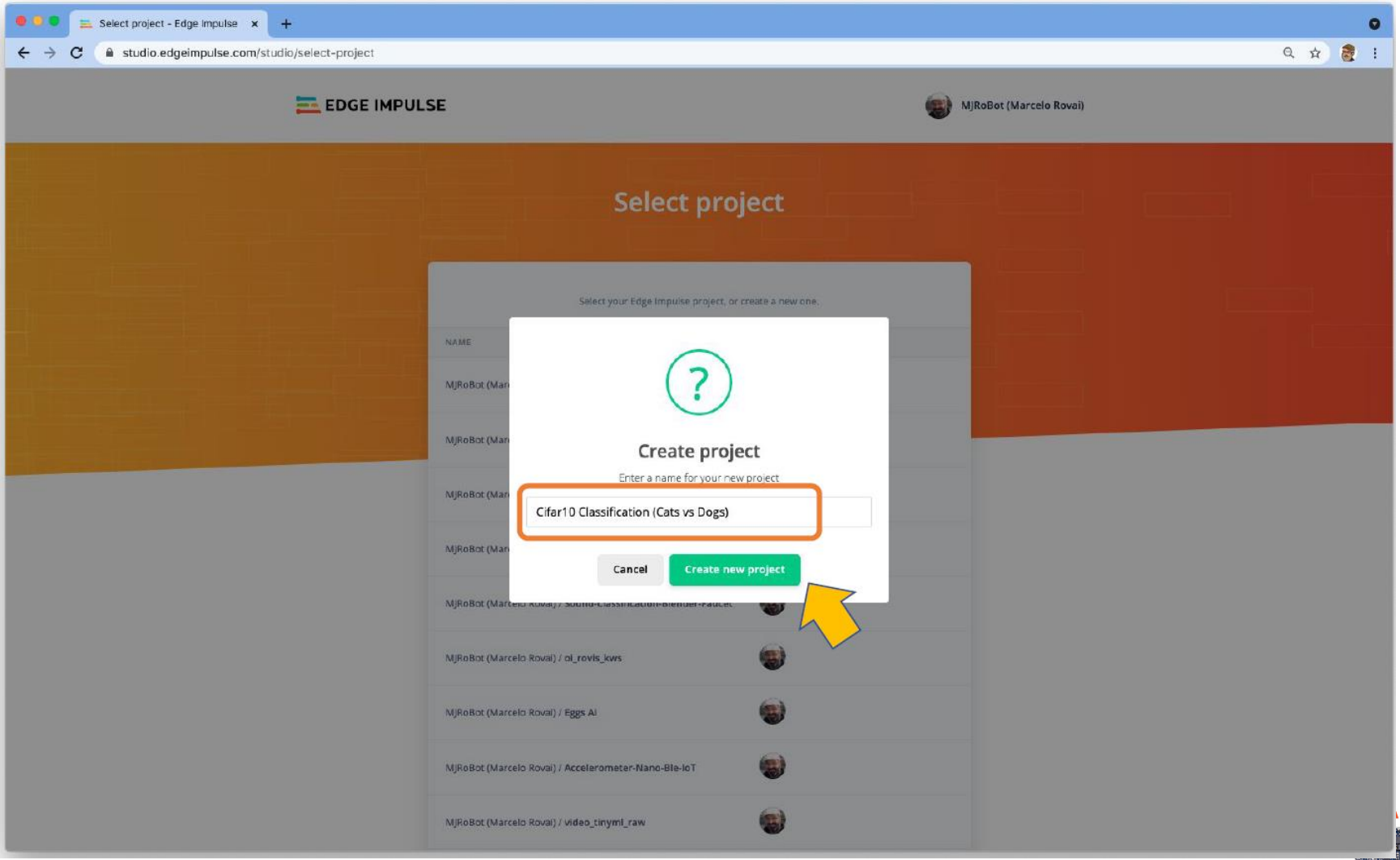
INTRODUCTION TO EDGE IMPULSE

- Edge Impulse installation guide



INTRODUCTION TO EDGE IMPULSE

- Edge Impulse example: Cifar Cats vs Dogs



INTRODUCTION TO EDGE IMPULSE

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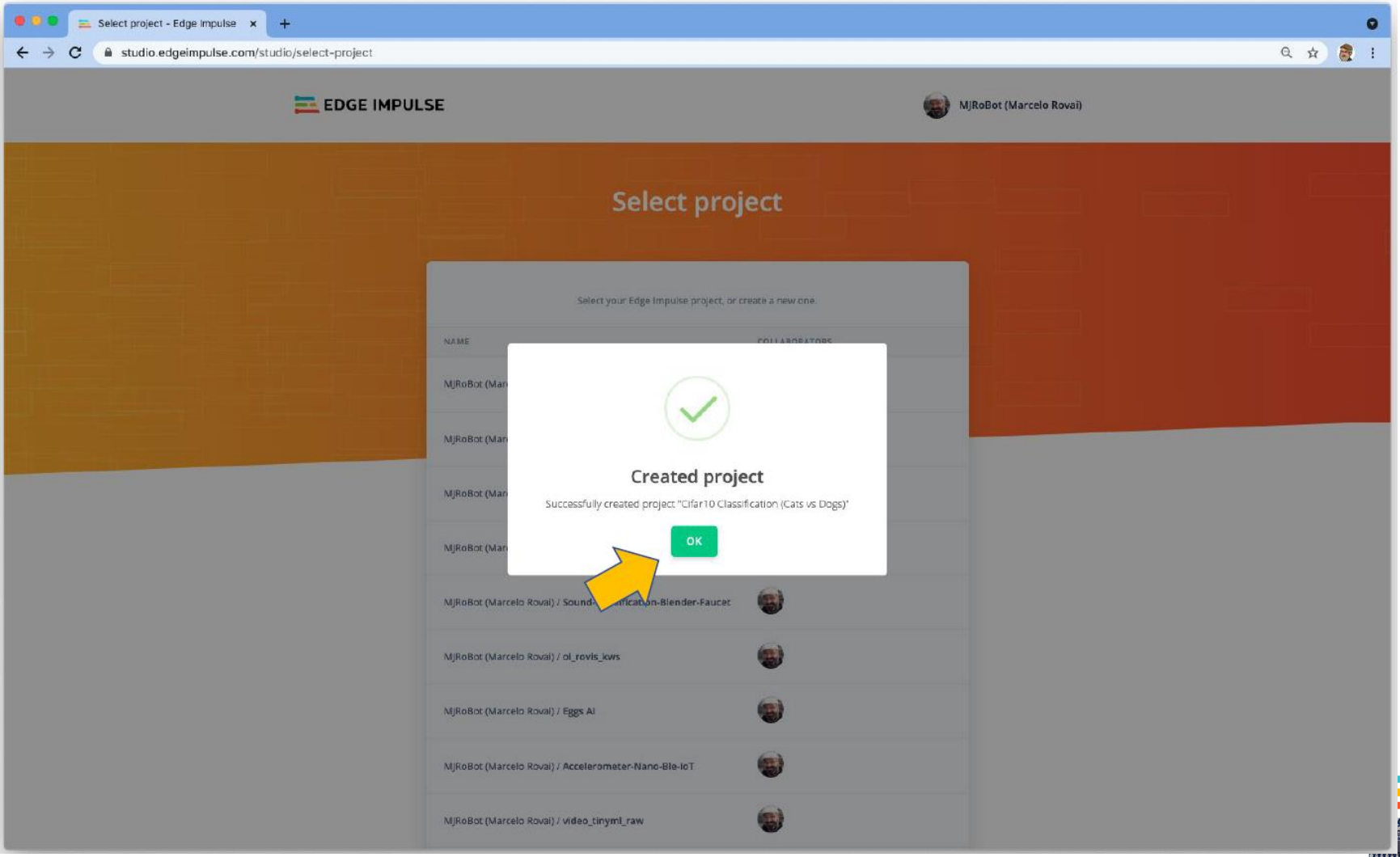

INTRODUCTION TO EDGE IMPULSE

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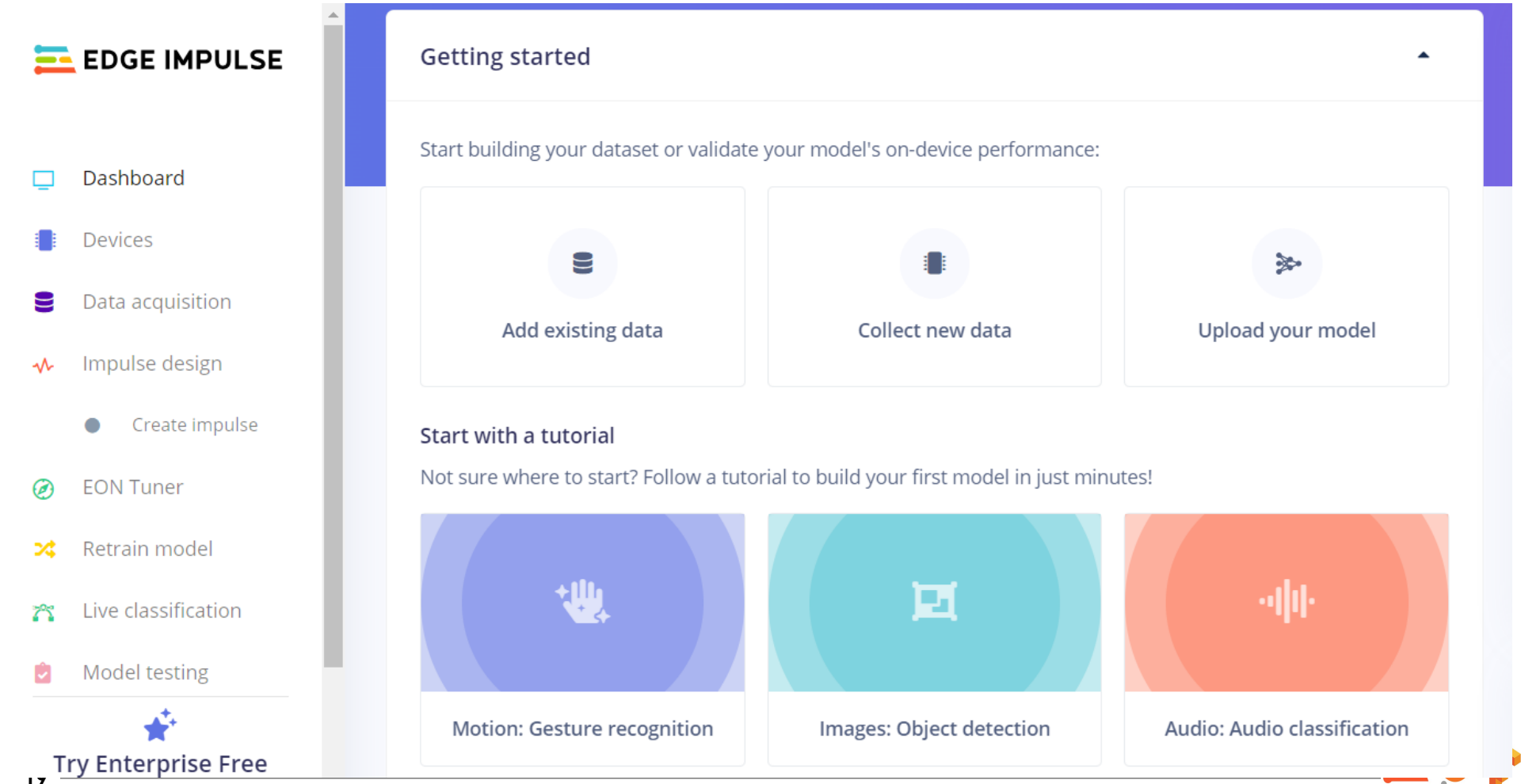
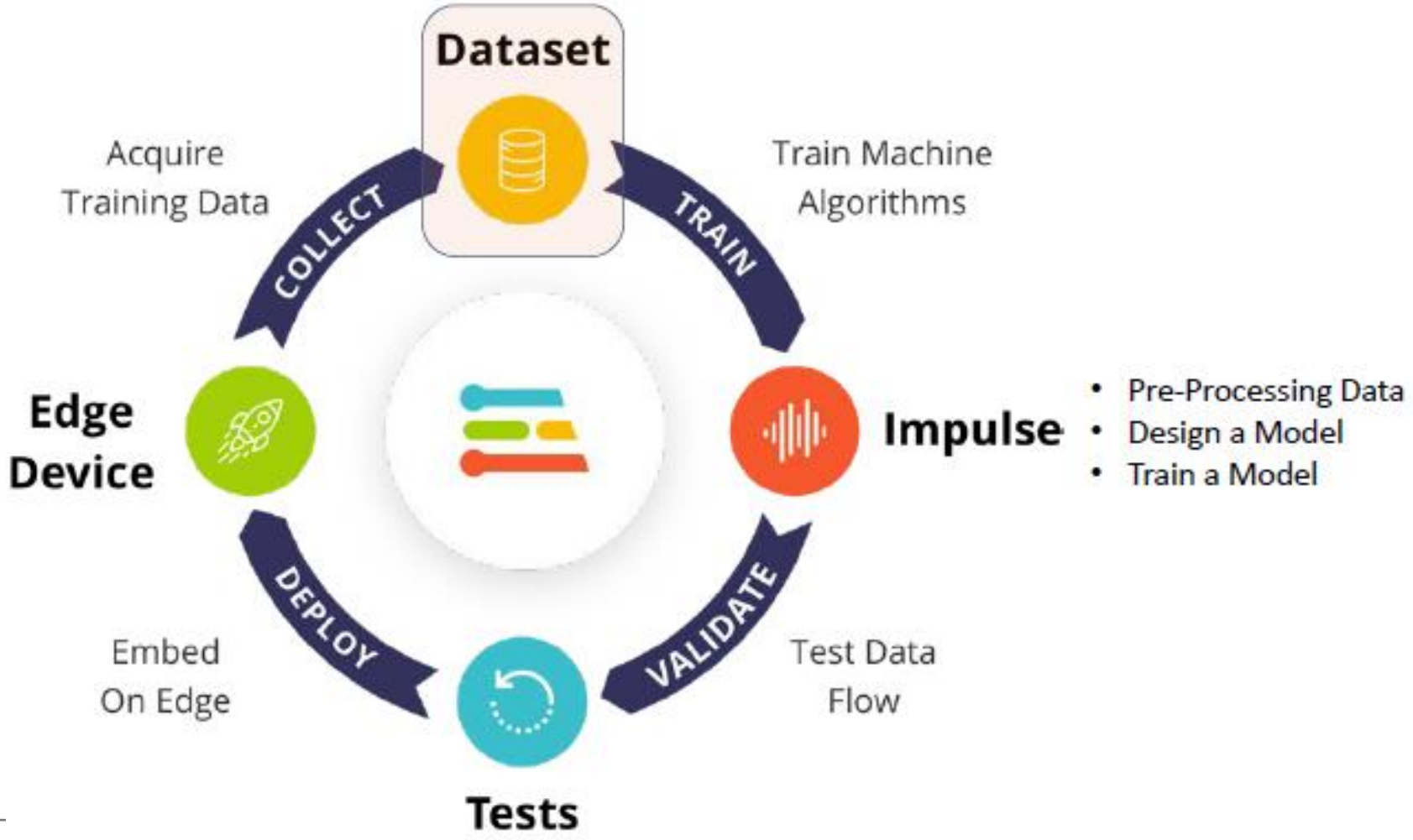


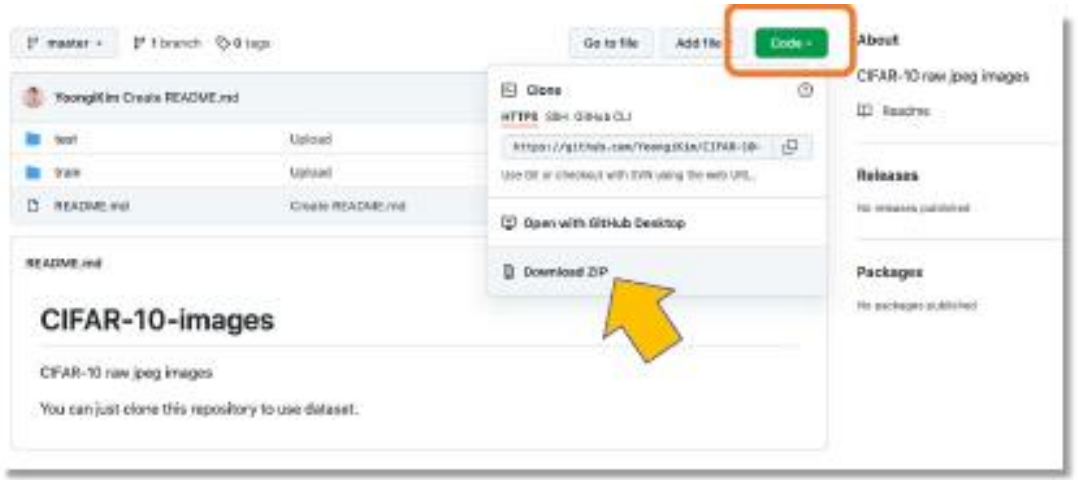
INTRODUCTION TO EDGE IMPULSE

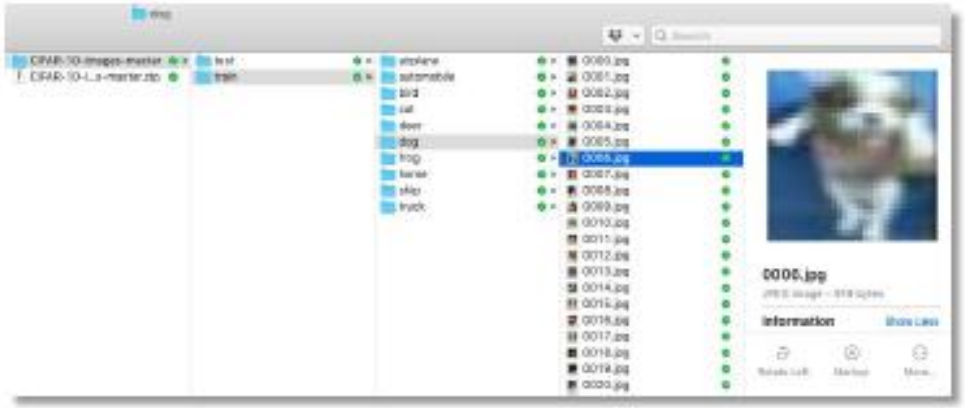
- Edge Impulse example: Cifar Cats vs Dogs



INTRODUCTION TO EDGE IMPULSE

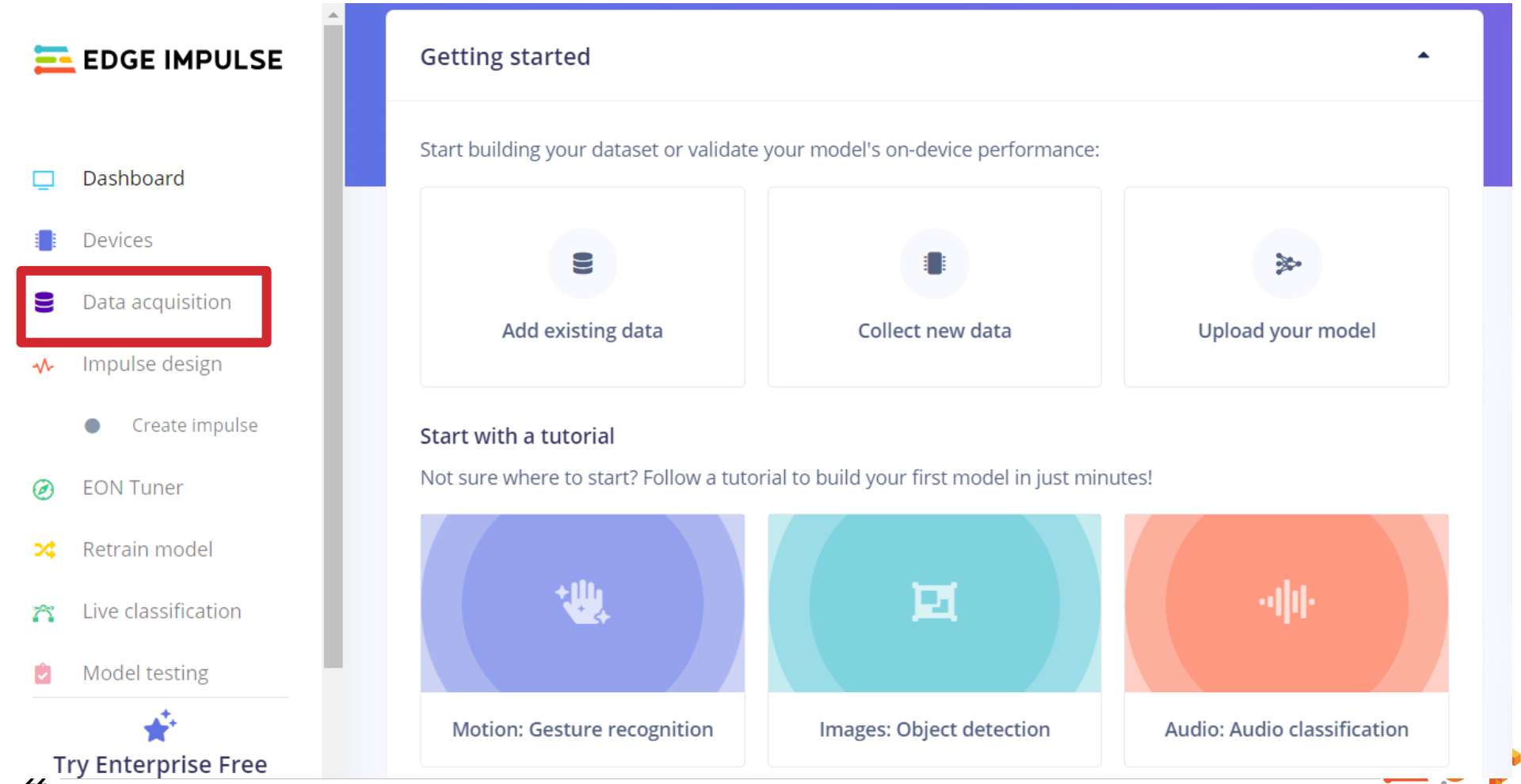
- Edge Impulse example: Cifar Cats vs Dogs
  - Download: https://github.com/YoongiKim/CIFAR-10-images





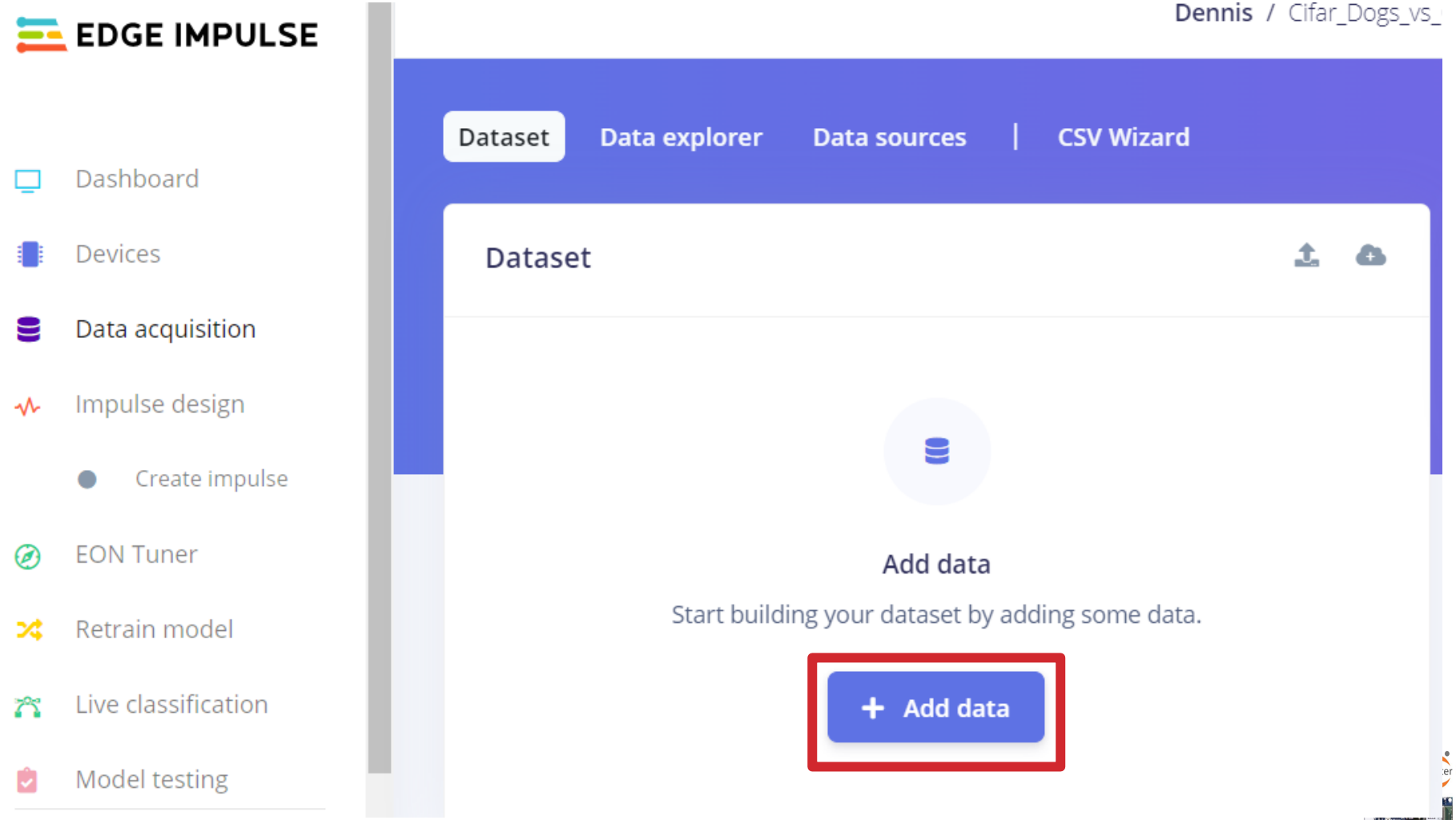
INTRODUCTION TO EDGE IMPULSE

- Edge Impulse example: Cifar Cats vs Dogs



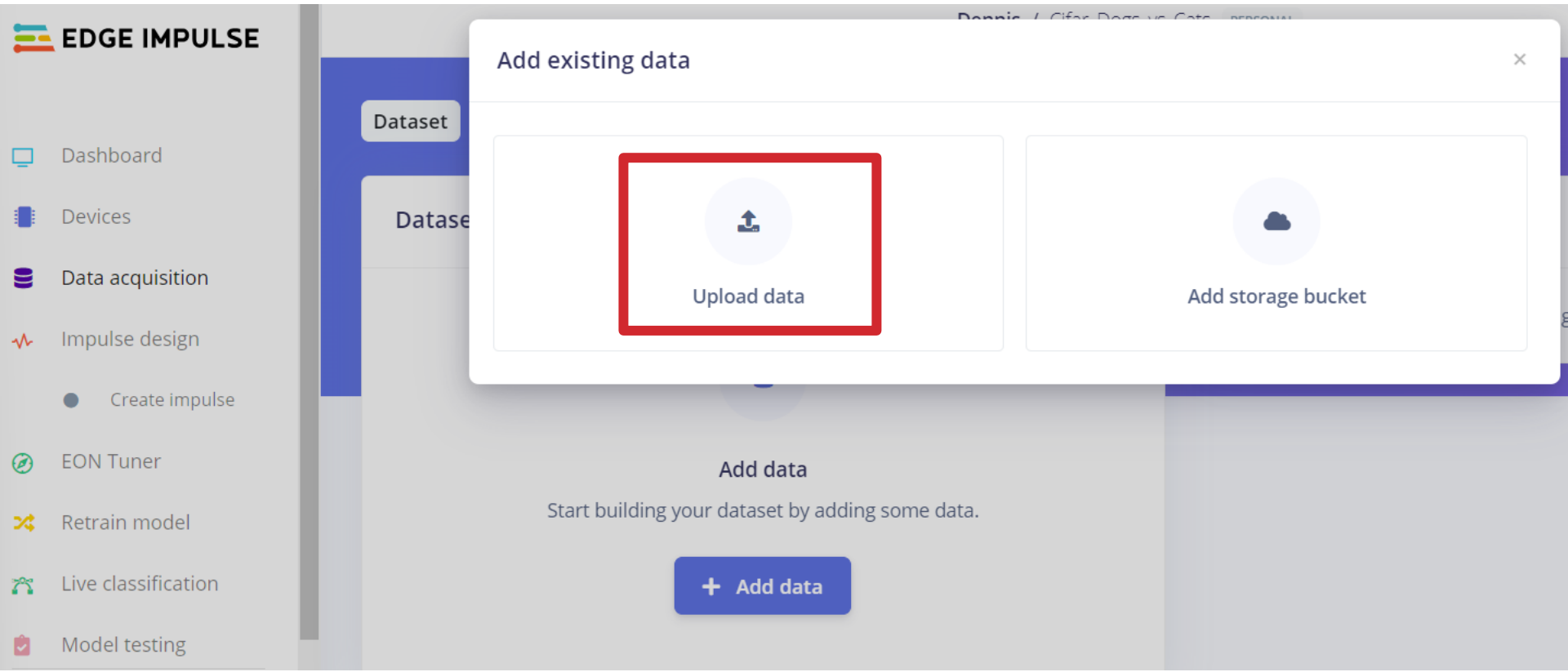
INTRODUCTION TO EDGE IMPULSE

- Edge Impulse example: Cifar Cats vs Dogs



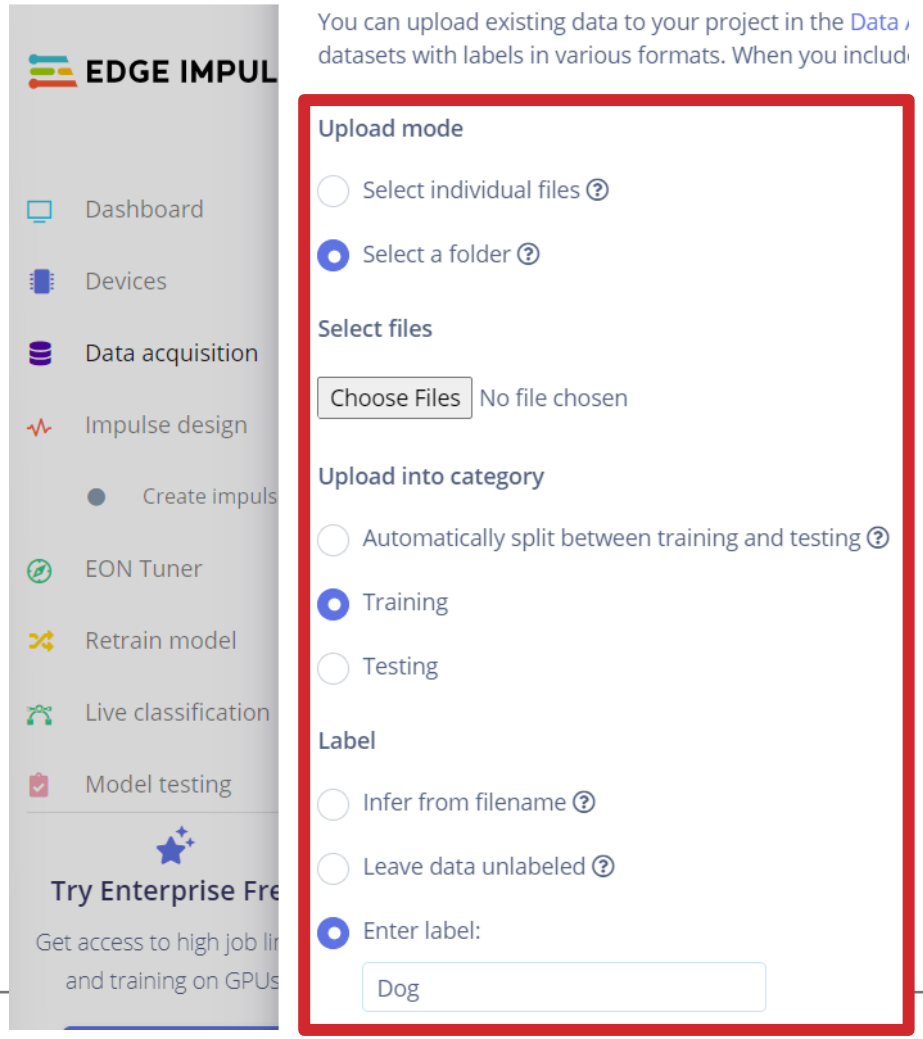
INTRODUCTION TO EDGE IMPULSE

- Edge Impulse example: Cifar Cats vs Dogs



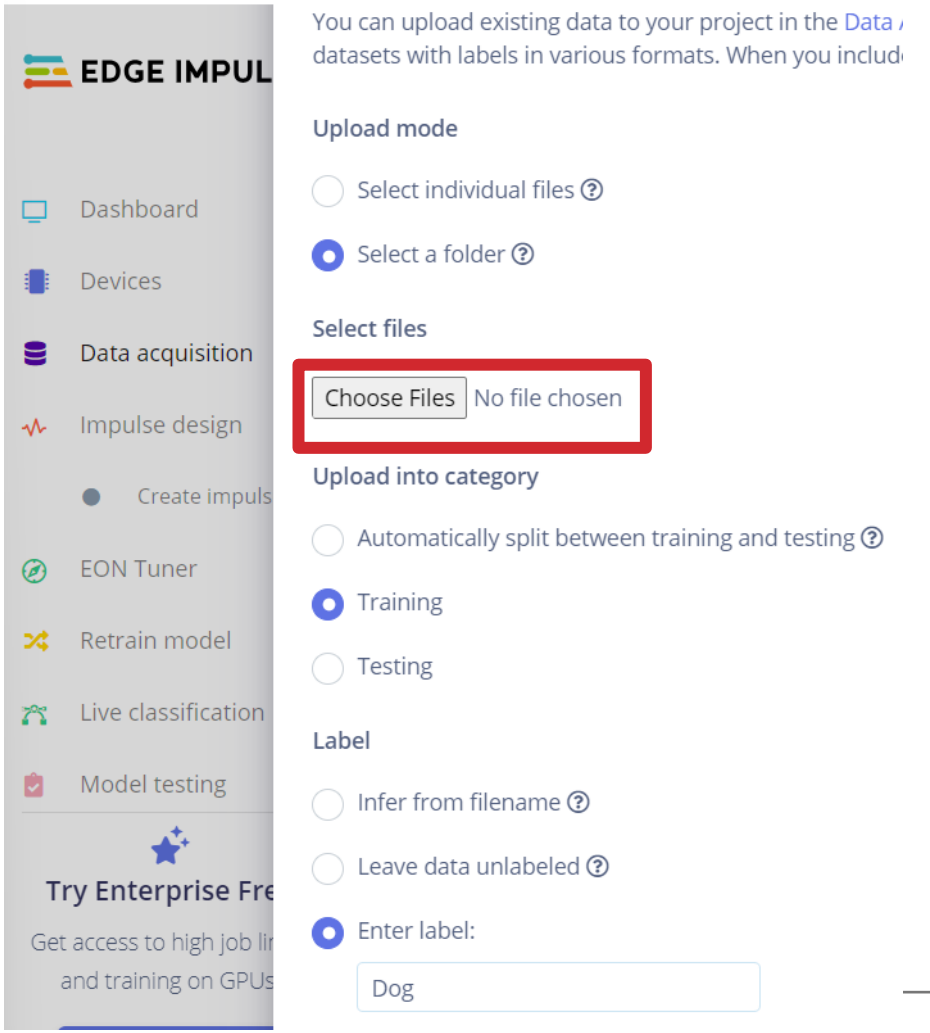
INTRODUCTION TO EDGE IMPULSE

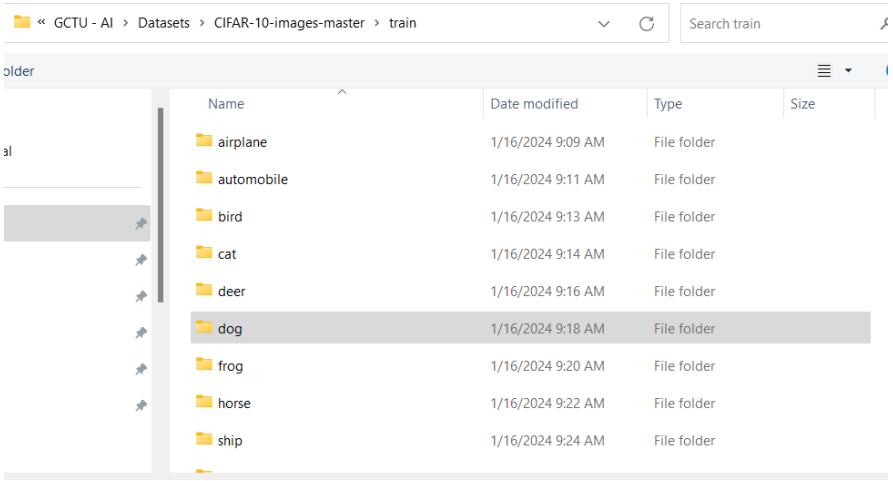
- Edge Impulse example: Cifar Cats vs Dogs

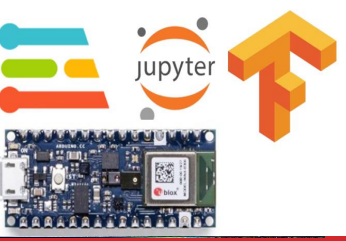


INTRODUCTION TO EDGE IMPULSE

- Edge Impulse example: Cifar Cats vs Dogs







INTRODUCTION TO EDGE IMPULSE

Edge Impulse example: Cifar Cats vs Dogs

Select individual files

Select a folder

Select files

Choose Files 5000 files

Upload into category

Automatically split between training and testing

Training

Testing

Label

Infer from filename

Leave data unlabeled

Enter label:

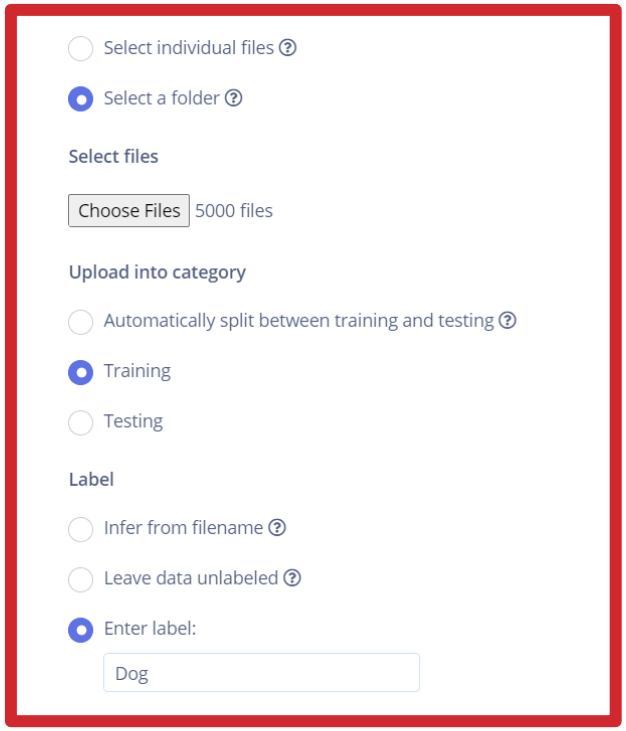
Dog

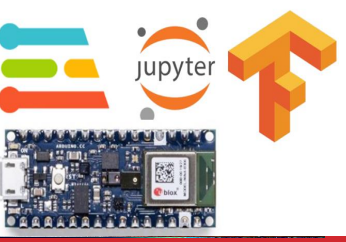
Back

Upload data

INTRODUCTION TO EDGE IMPULSE

- Edge Impulse example: Cifar Cats vs Dogs
  - Upload Dog test data, Cat train data, and Cat test data using the same method





INTRODUCTION TO EDGE IMPULSE

❖ Edge Impulse example: Cifar Cats vs Dogs

Upload data

You can upload existing data to your project in the Data Acquisition Format (CBOR, JSON, CSV), or as WAV, JPG, PNG, AVI or MP4 files. We also support uploading image datasets with labels in various formats. When you include labels during upload, we attempt to convert your dataset into a format recognized by Studio. here.

Upload mode

- ○ Select individual files
- ◉ Select a folder

Select files

Choose Files No file chosen

Upload into category

- ○ Automatically split between training and testing
- ○ Training
- ◉ Testing

Label

- ○ Infer from filename
- ○ Leave data unlabeled

Upload output

```
[ 983/1000] Uploading 0977.jpg OK
[ 984/1000] Uploading 0979.jpg OK
[ 985/1000] Uploading 0975.jpg OK
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[ 987/1000] Uploading 0987.jpg OK
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[ 998/1000] Uploading 0997.jpg OK
[ 999/1000] Uploading 0999.jpg OK
[1000/1000] Uploading 0998.jpg OK

Done. Files uploaded successful: 1000. Files that failed to upload: 0.

Job completed
```
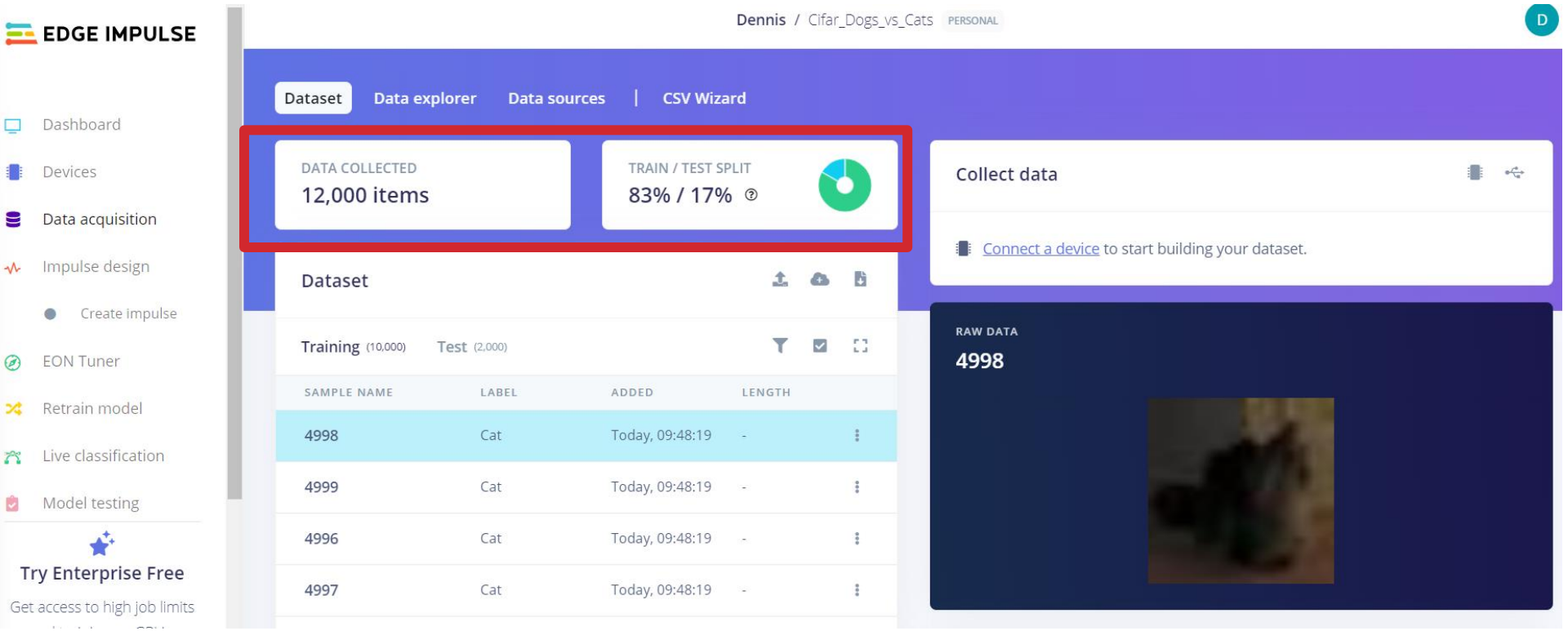
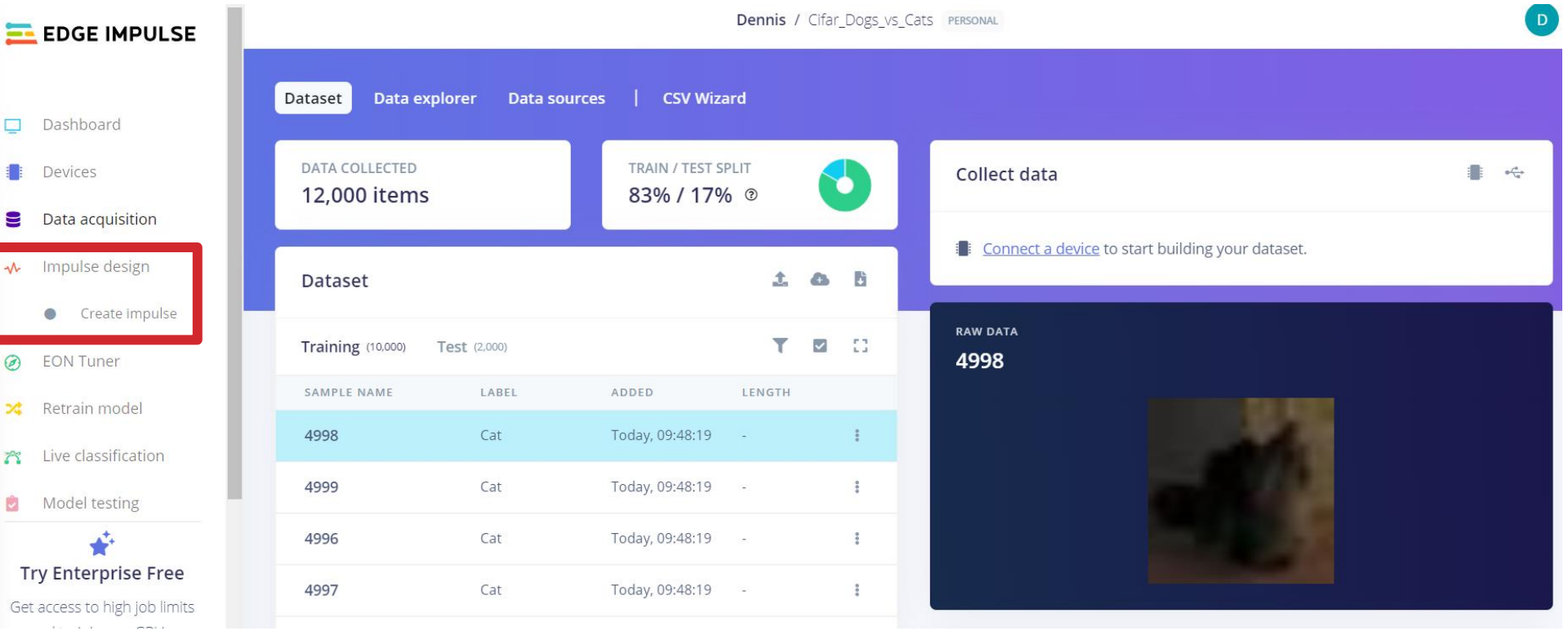

INTRODUCTION TO EDGE IMPULSE

- Edge Impulse example: Cifar Cats vs Dogs



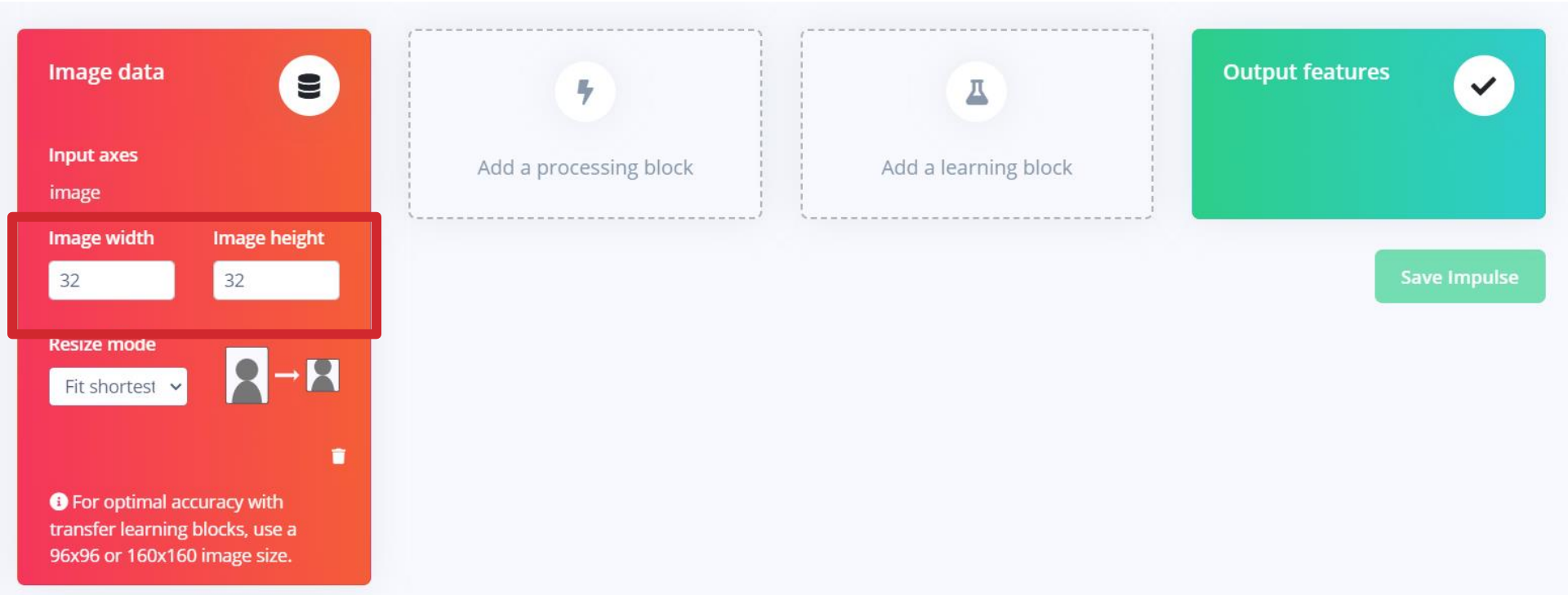
INTRODUCTION TO EDGE IMPULSE

- Edge Impulse example: Cifar Cats vs Dogs



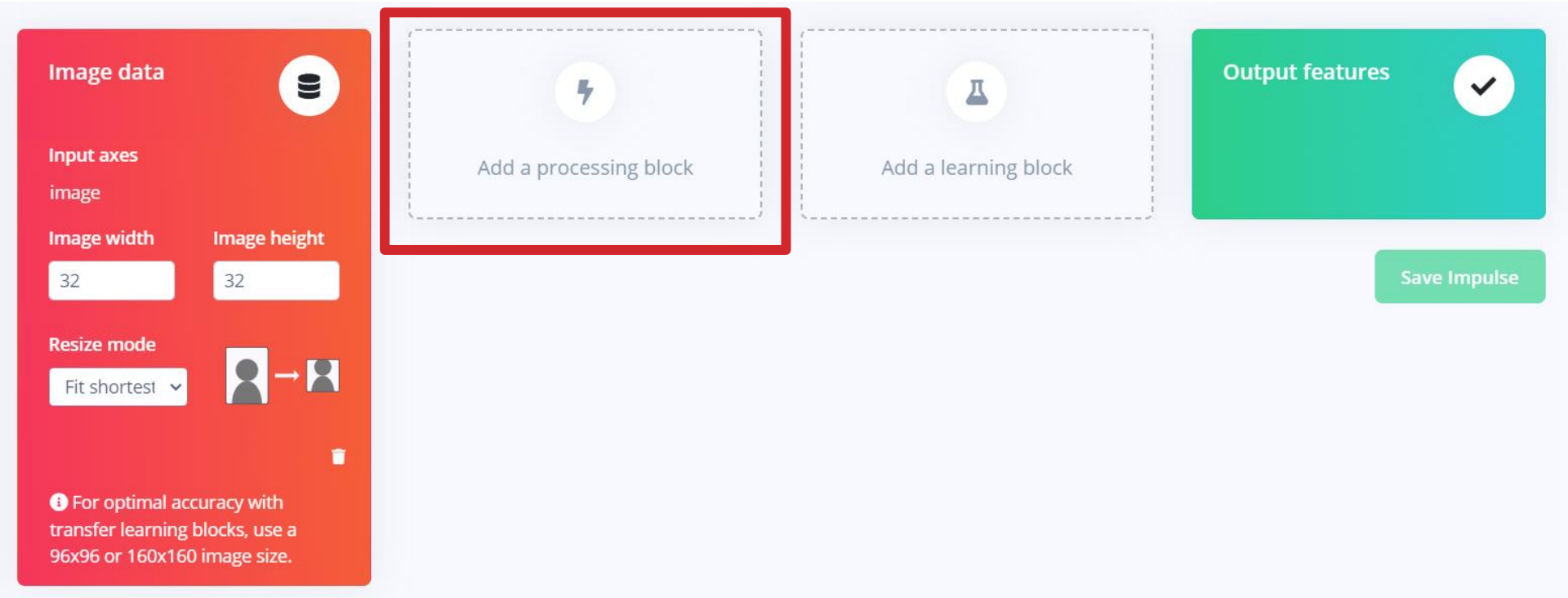
INTRODUCTION TO EDGE IMPULSE

- Edge Impulse example: Cifar Cats vs Dogs



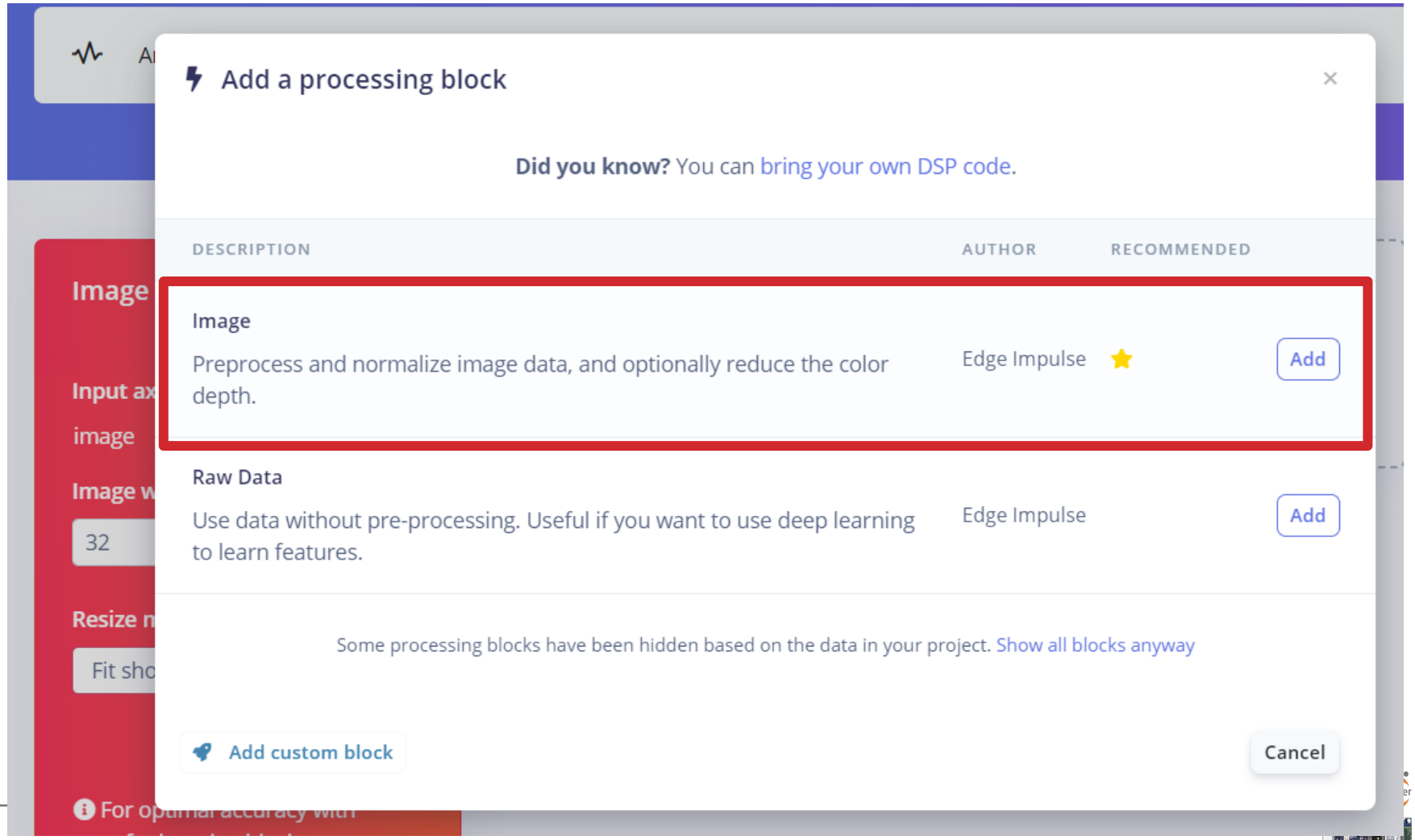
INTRODUCTION TO EDGE IMPULSE

- Edge Impulse example: Cifar Cats vs Dogs



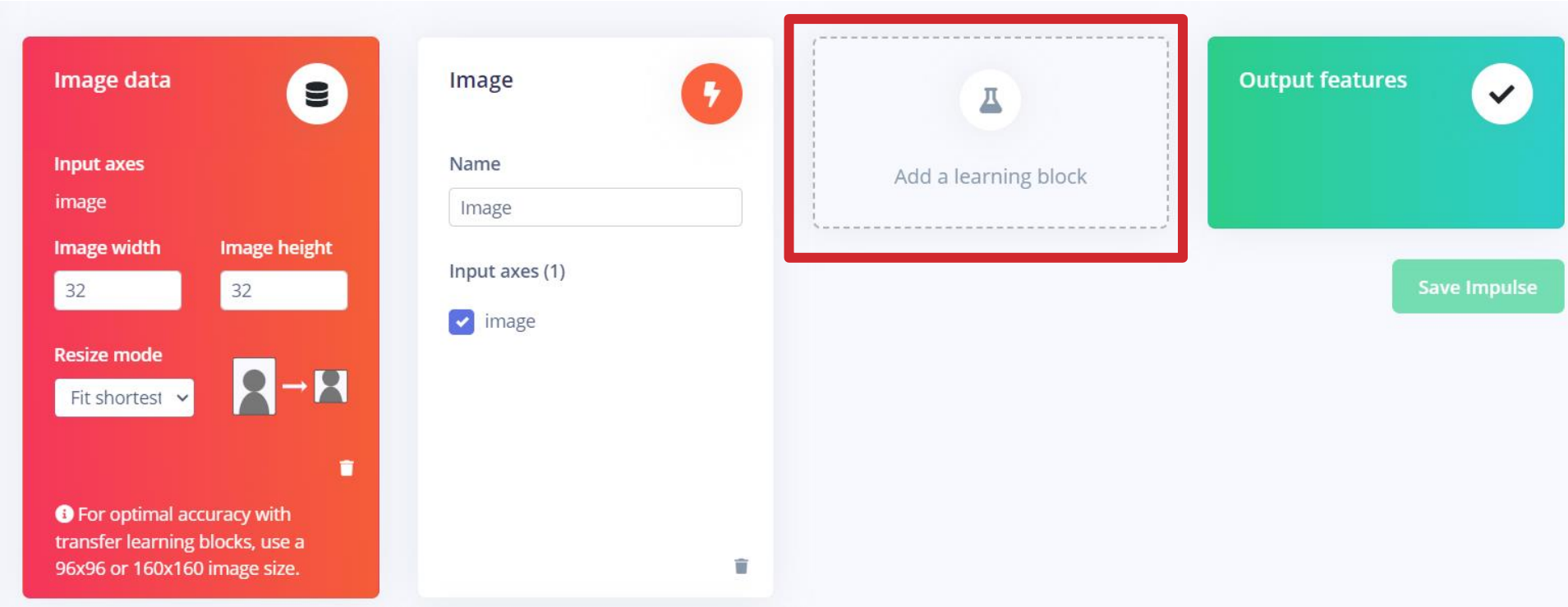
INTRODUCTION TO EDGE IMPULSE

- Edge Impulse example: Cifar Cats vs Dogs



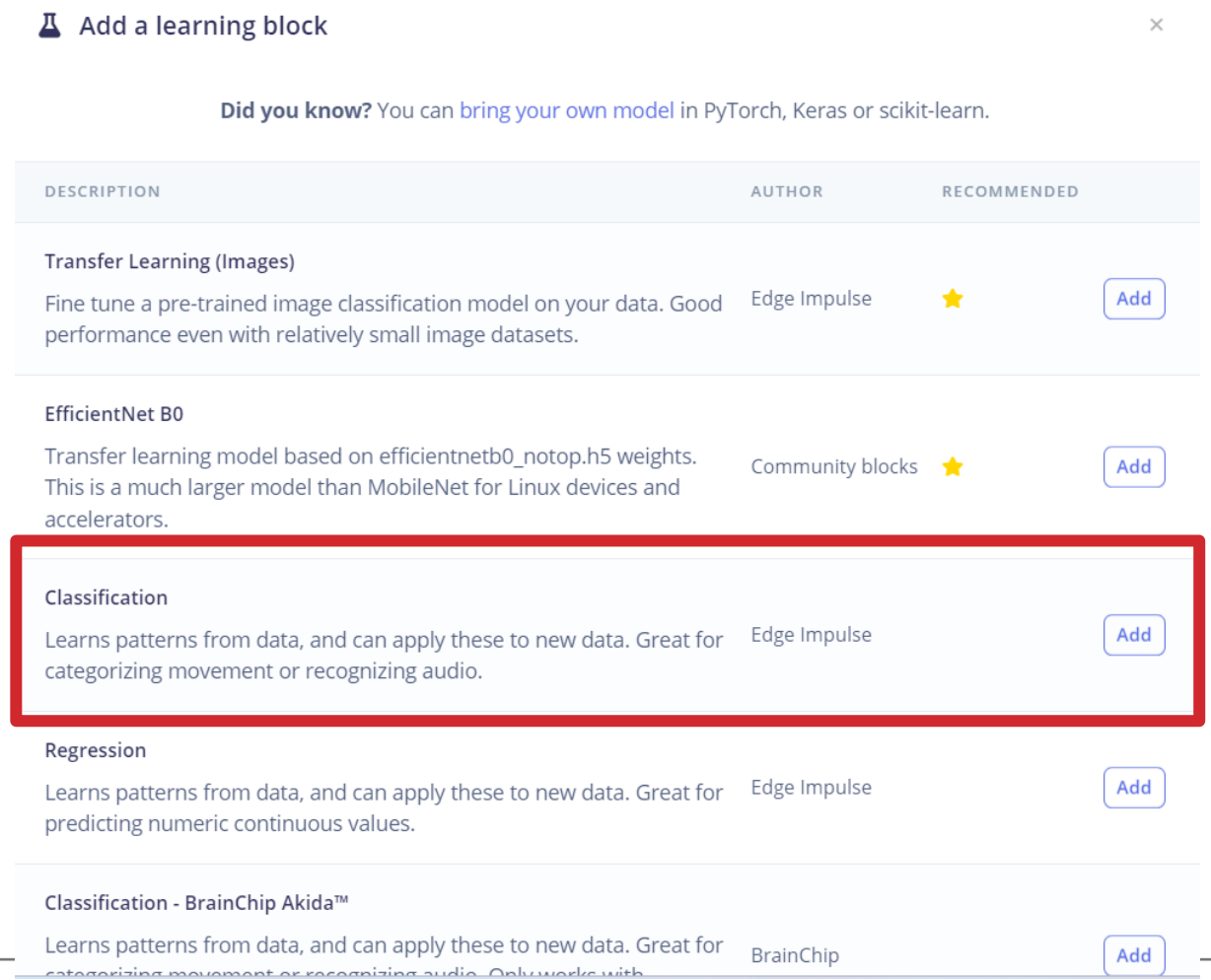
INTRODUCTION TO EDGE IMPULSE

- Edge Impulse example: Cifar Cats vs Dogs



INTRODUCTION TO EDGE IMPULSE

- Edge Impulse example: Cifar Cats vs Dogs



INTRODUCTION TO EDGE IMPULSE

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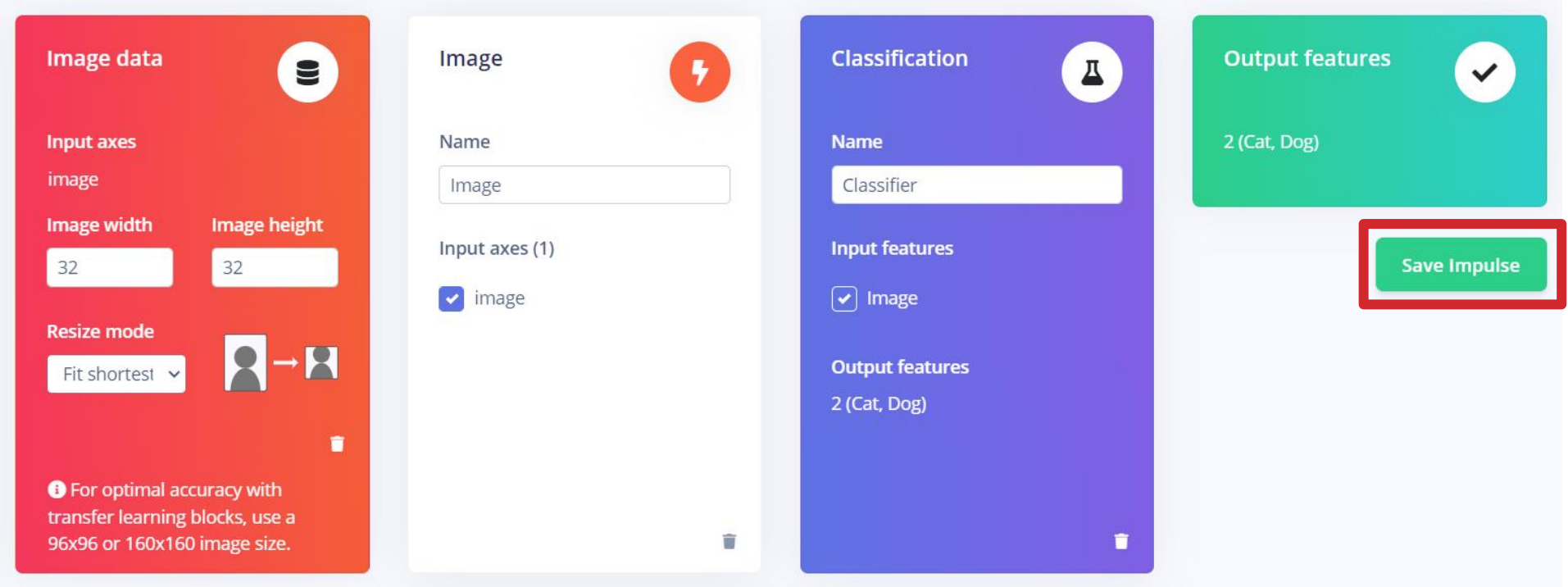

INTRODUCTION TO EDGE IMPULSE

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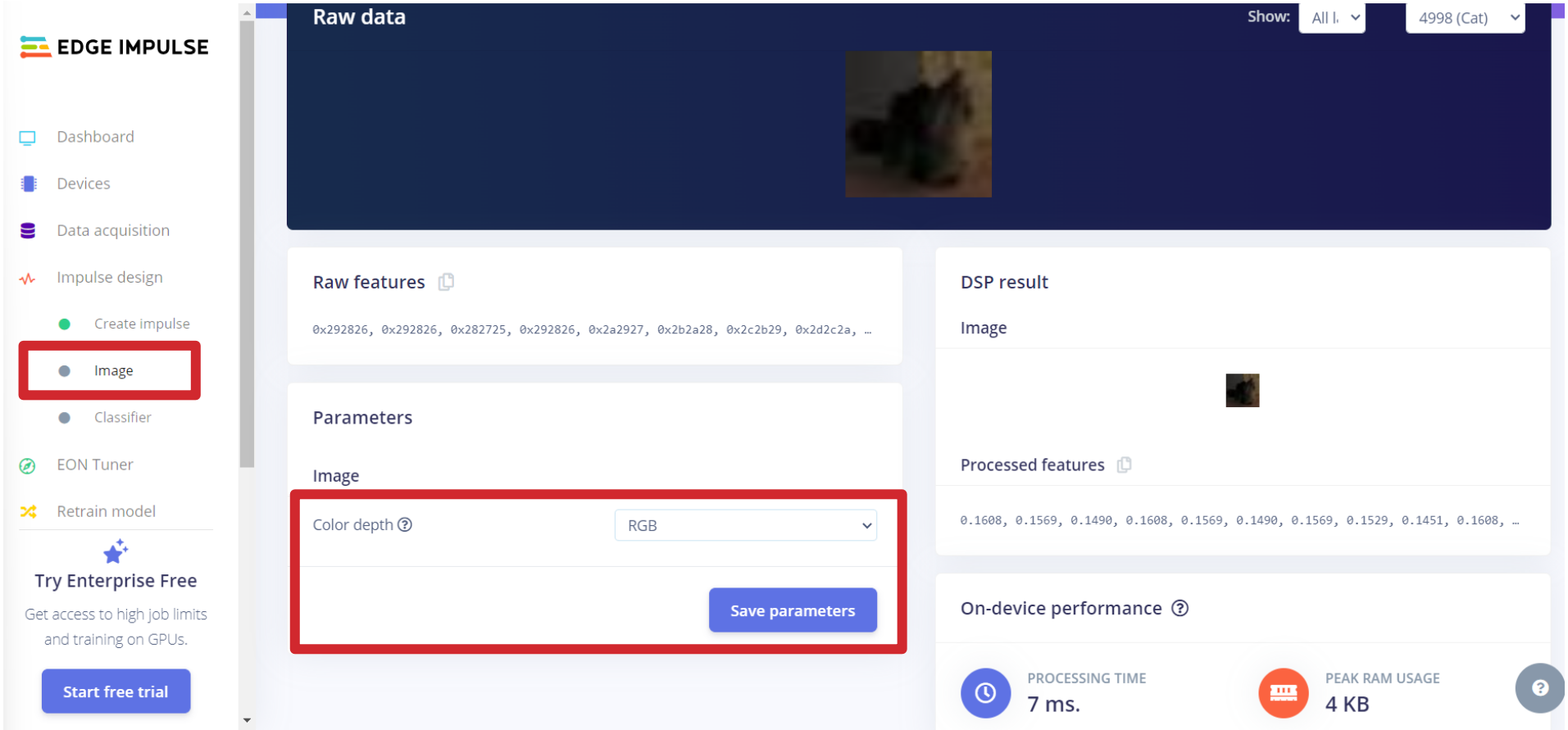

INTRODUCTION TO EDGE IMPULSE

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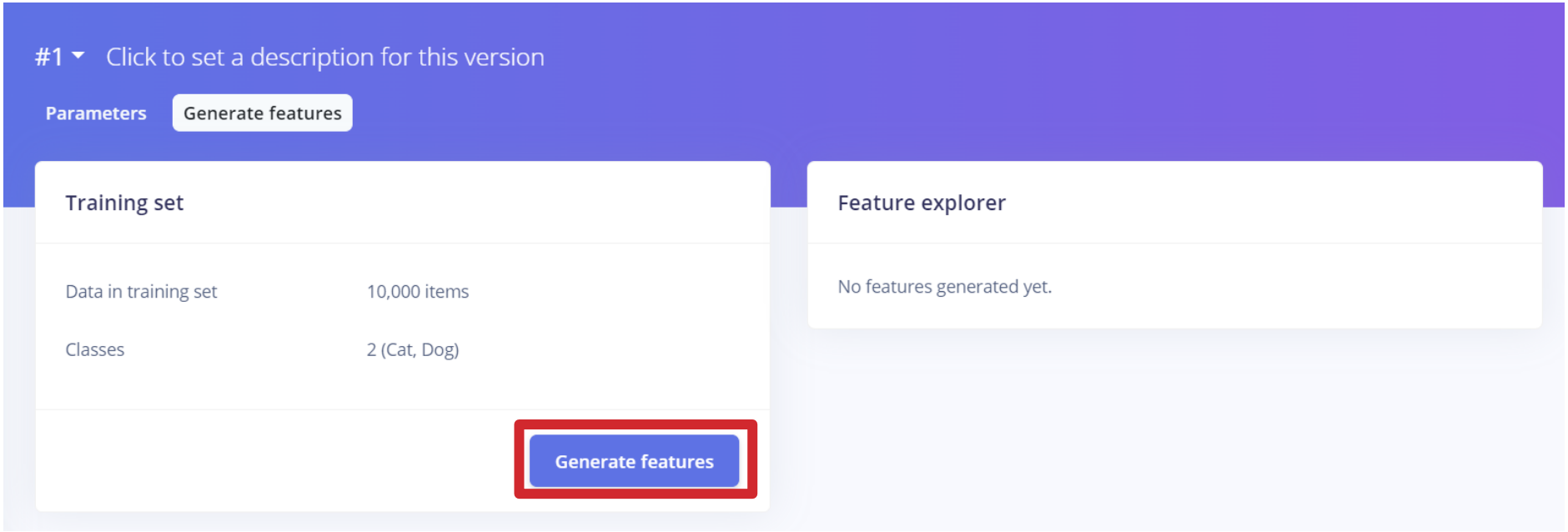


INTRODUCTION TO EDGE IMPULSE

- Edge Impulse example: Cifar Cats vs Dogs

Training set

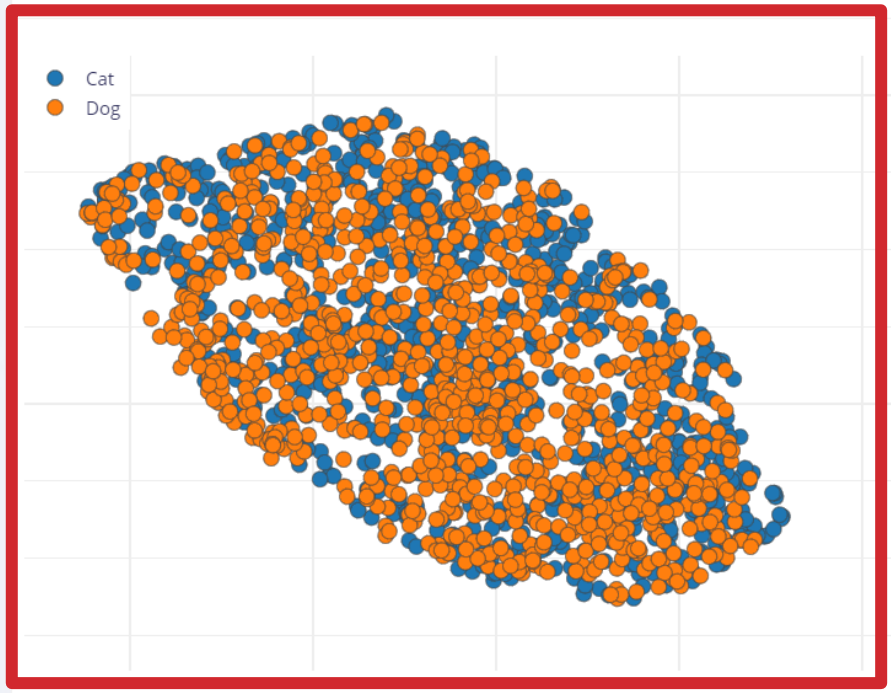
Data in training set	10,000 items
Classes	2 (Cat, Dog)

Generate features

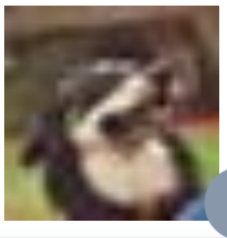
Feature generation output (0)

```
[ 2050/10000] Creating windows from files...
[ 2406/10000] Creating windows from files...
[ 2776/10000] Creating windows from files...
[ 3164/10000] Creating windows from files...
[ 3539/10000] Creating windows from files...
[ 3915/10000] Creating windows from files...
[ 4242/10000] Creating windows from files...
[ 4598/10000] Creating windows from files...
[ 4988/10000] Creating windows from files...
[ 5342/10000] Creating windows from files...
[ 5730/10000] Creating windows from files...
[ 6107/10000] Creating windows from files...
[ 6465/10000] Creating windows from files...
[ 6833/10000] Creating windows from files...
[ 7188/10000] Creating windows from files...
[ 7545/10000] Creating windows from files...
[ 7862/10000] Creating windows from files...
```

Feature explorer



2990
Label: Dog
View sample
View features



INTRODUCTION TO EDGE IMPULSE

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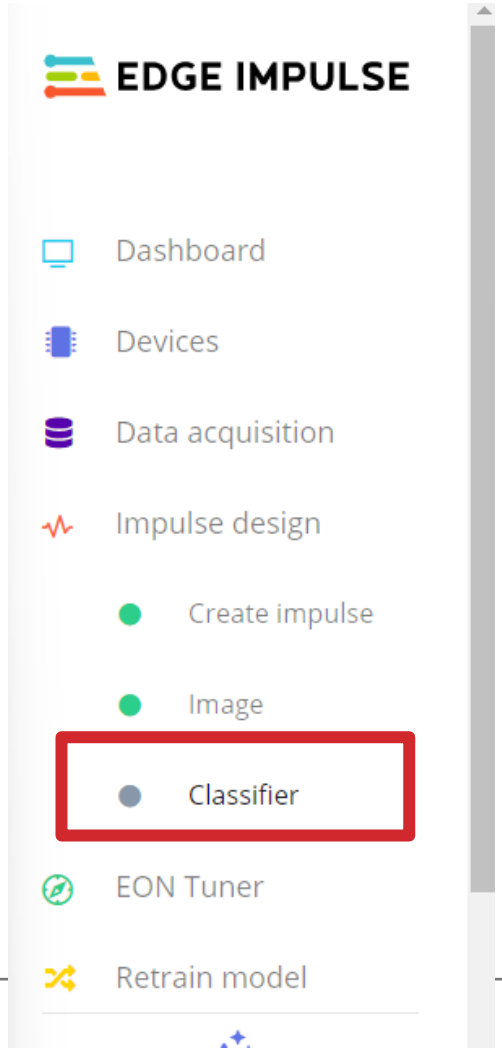

INTRODUCTION TO EDGE IMPULSE

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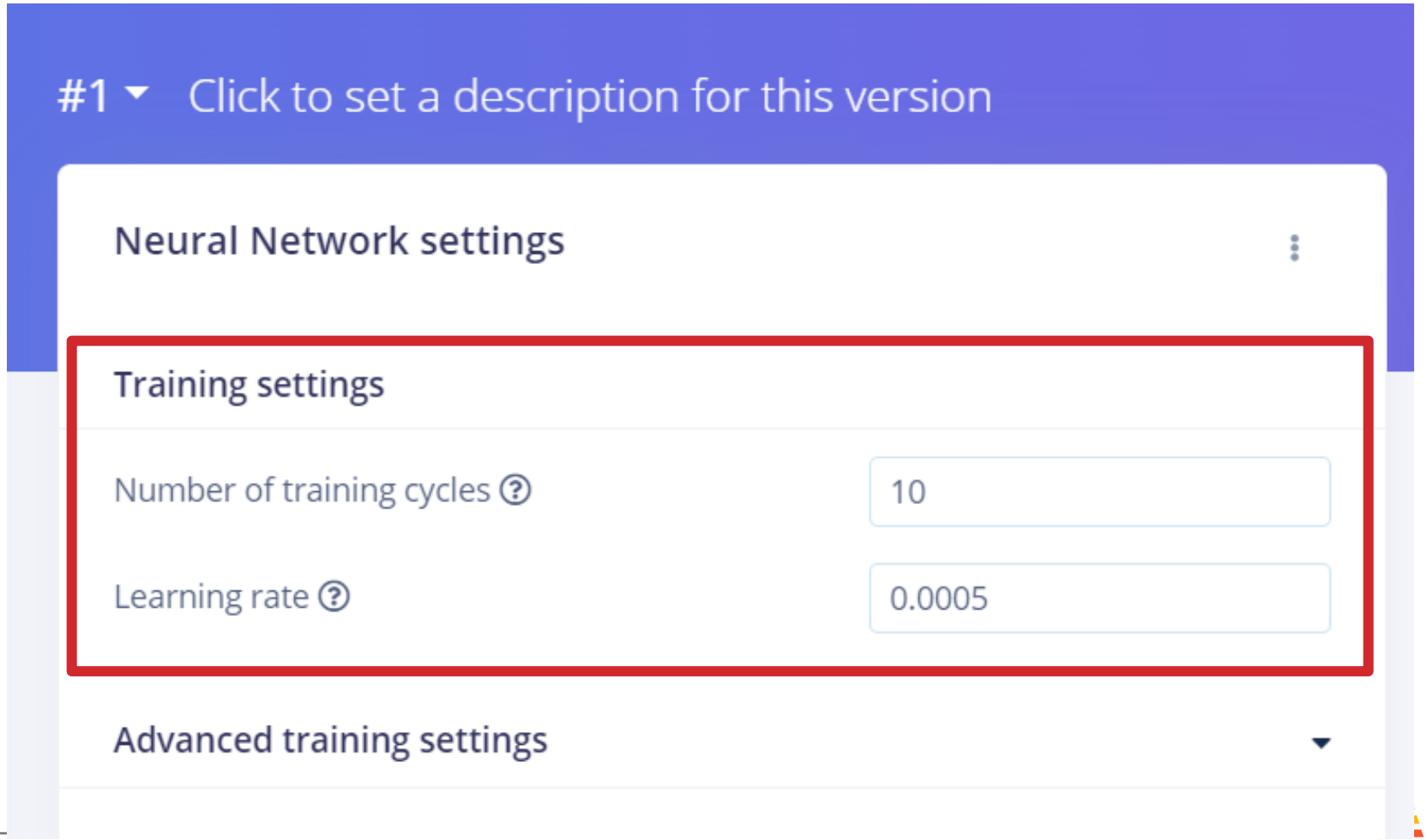

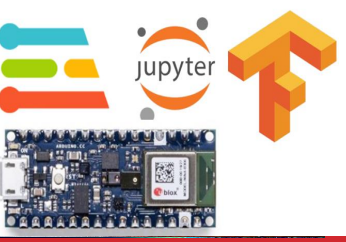

INTRODUCTION TO EDGE IMPULSE

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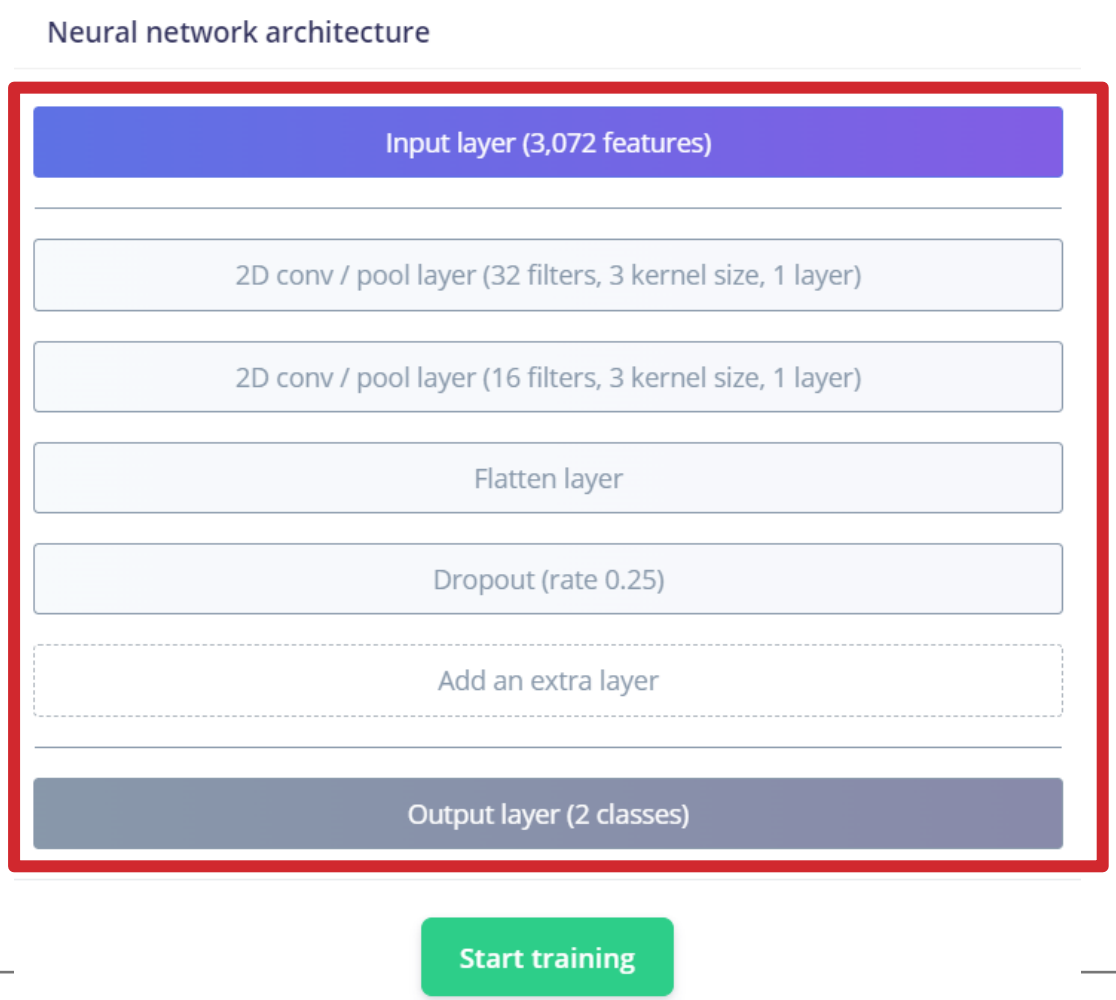

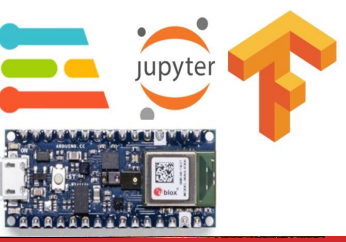

INTRODUCTION TO EDGE IMPULSE

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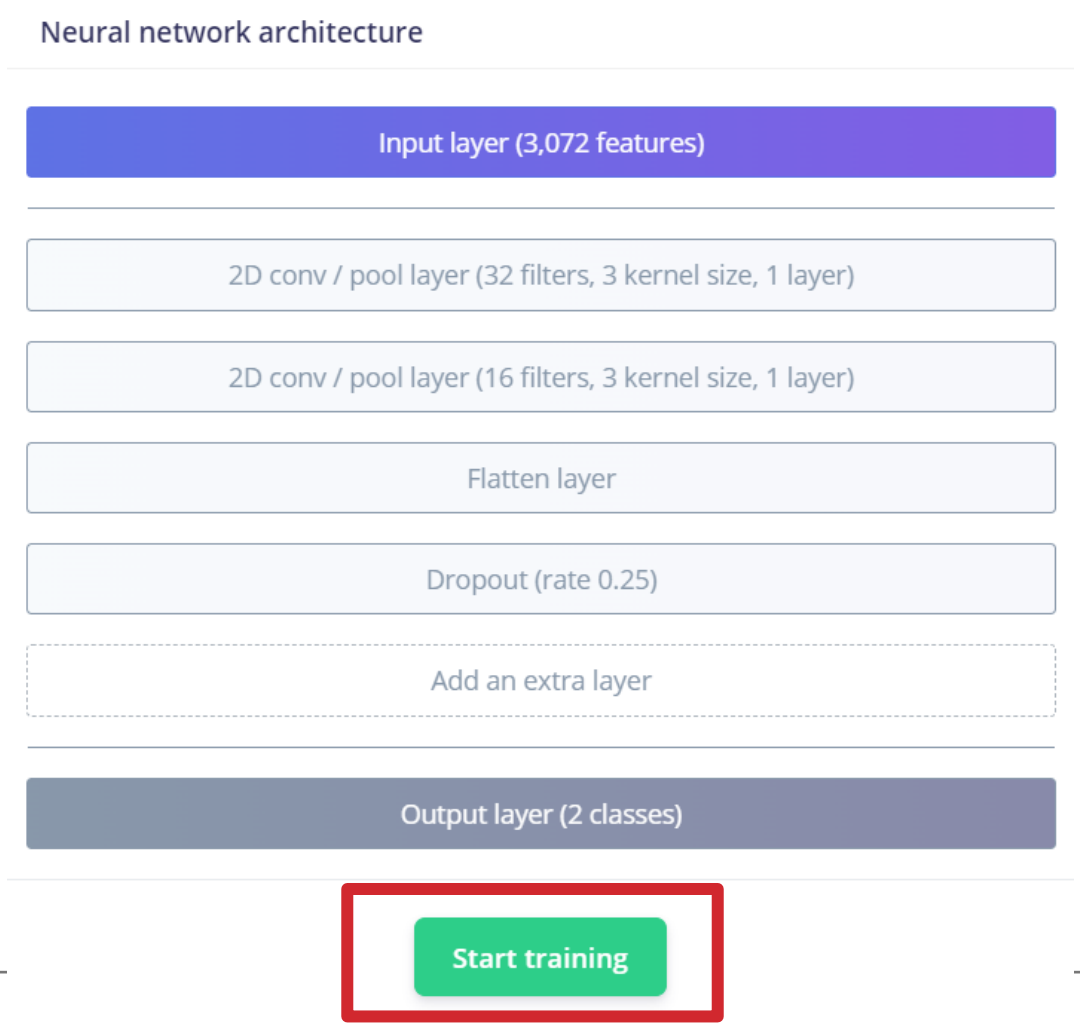

INTRODUCTION TO EDGE IMPULSE

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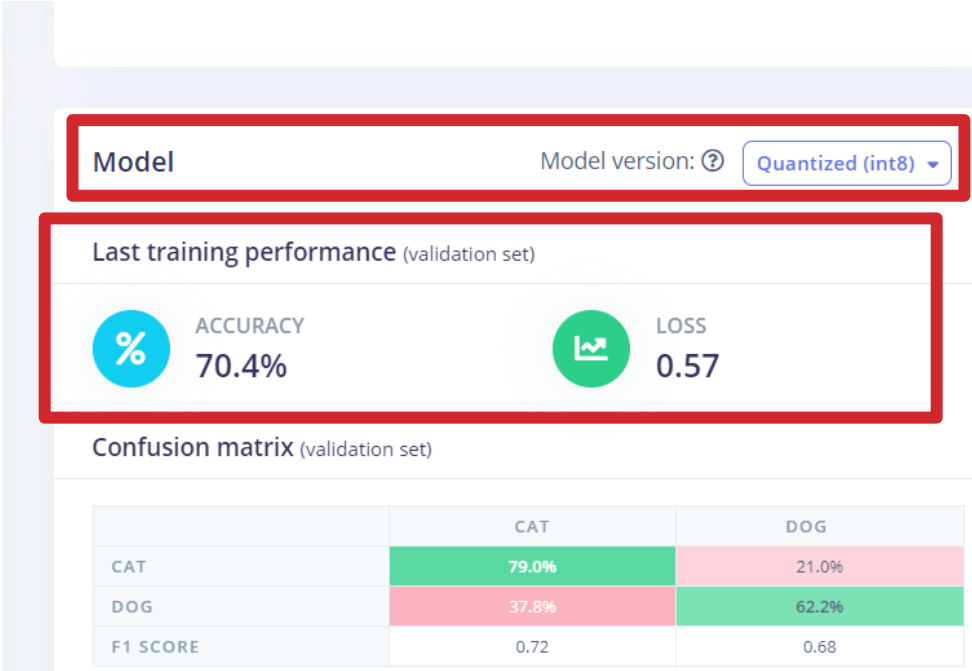

INTRODUCTION TO EDGE IMPULSE

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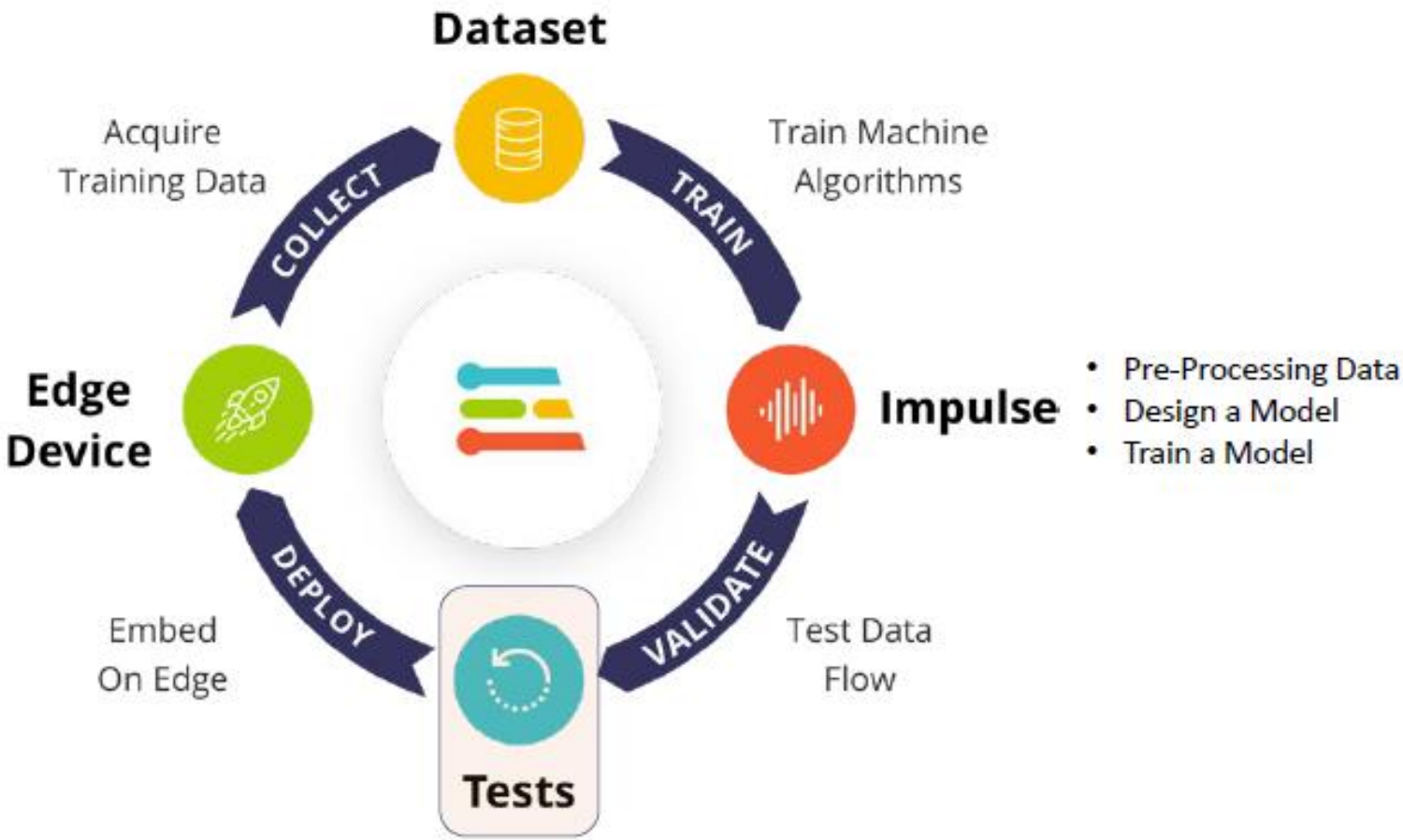

INTRODUCTION TO EDGE IMPULSE

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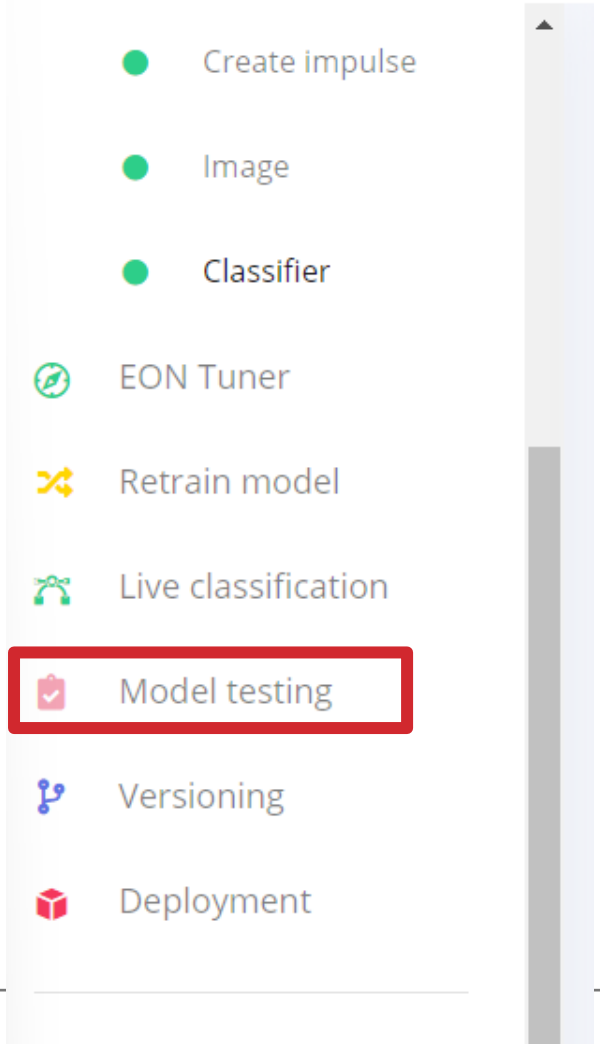

INTRODUCTION TO EDGE IMPULSE

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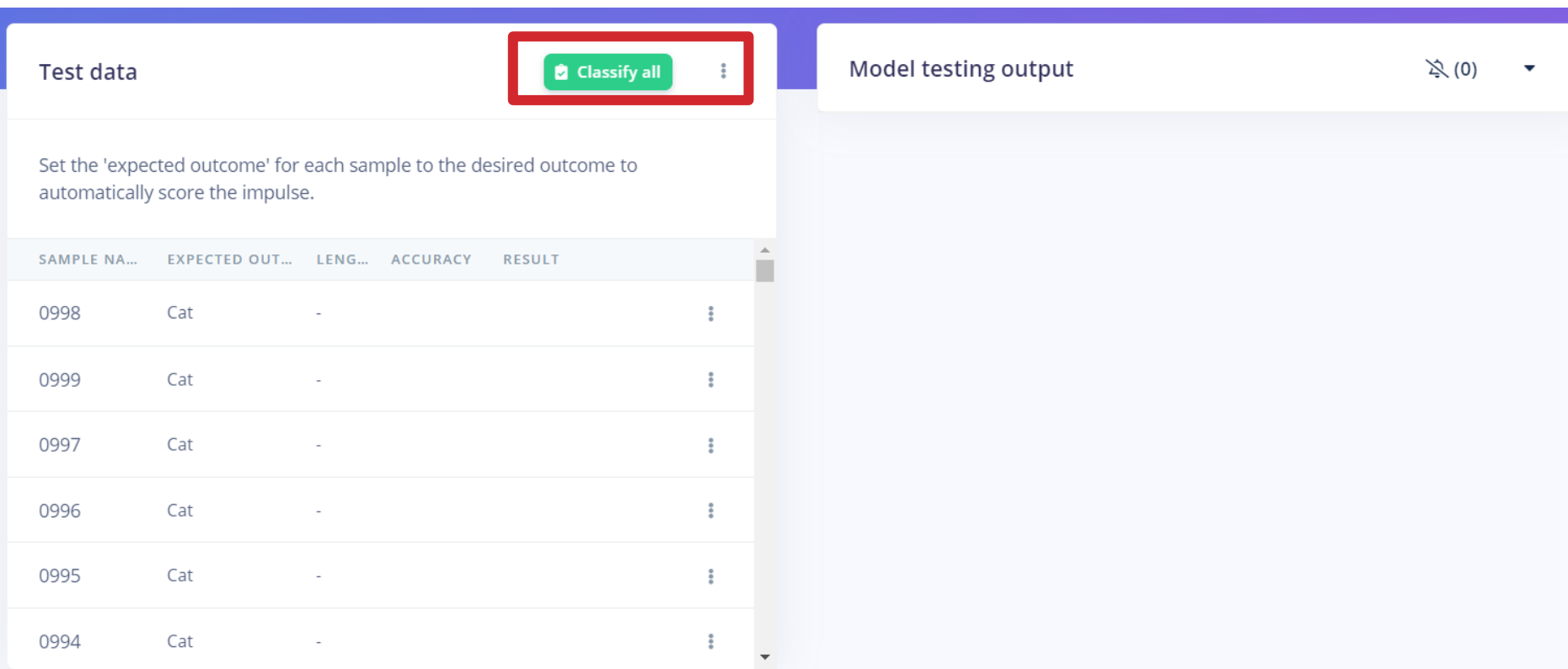

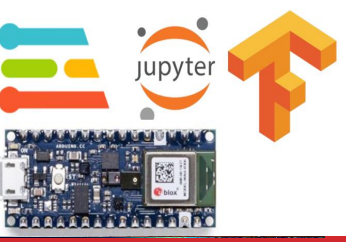

INTRODUCTION TO EDGE IMPULSE

- Edge Impulse example: Cifar Cats vs Dogs

Test data — Classify all

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

SAMPLE NA	EXPECTED OUT	LENG	ACCURACY	RESULT
0998	Cat	-	100%	1 Cat
0999	Cat	-	0%	1 uncertain
0997	Cat	-	100%	1 Cat
0996	Cat	-	100%	1 Cat
0995	Cat	-	0%	1 Dog
0994	Cat	-	100%	1 Cat

Model testing output (0)

```
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...
Container image pulled!
Job started
INFO: Created TensorFlow Lite XNNPACK delegate for CPU.
Classifying data for Classifier OK


Job completed
```

Model testing results

ACCURACY
55.10%

	CAT	DOG	UNCERTAIN
CAT	60.8%	10.5%	28.7%
DOG	21.6%	49.4%	29%
F1 SCORE	0.67	0.62	

INTRODUCTION TO EDGE IMPULSE

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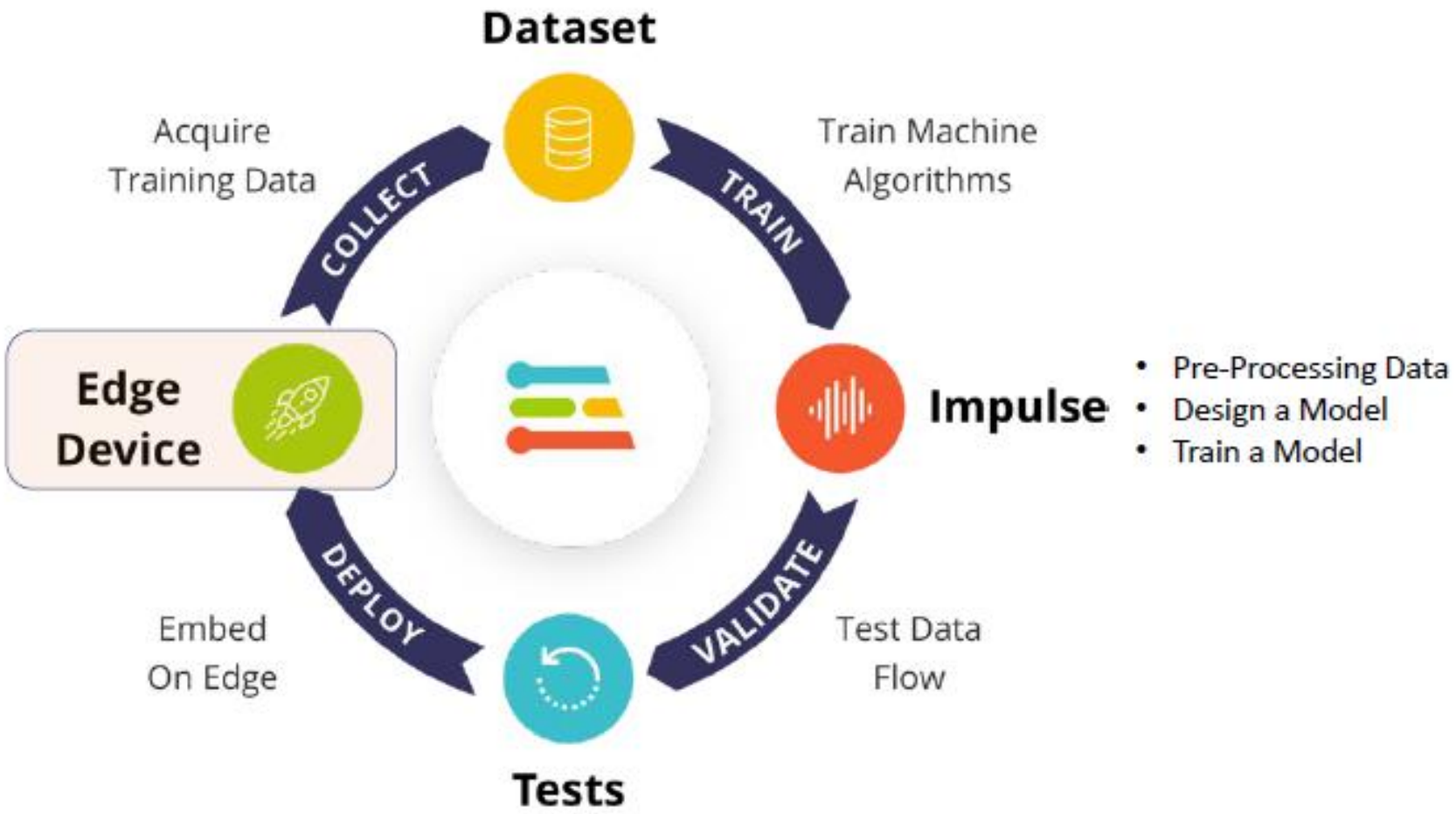

INTRODUCTION TO EDGE IMPULSE

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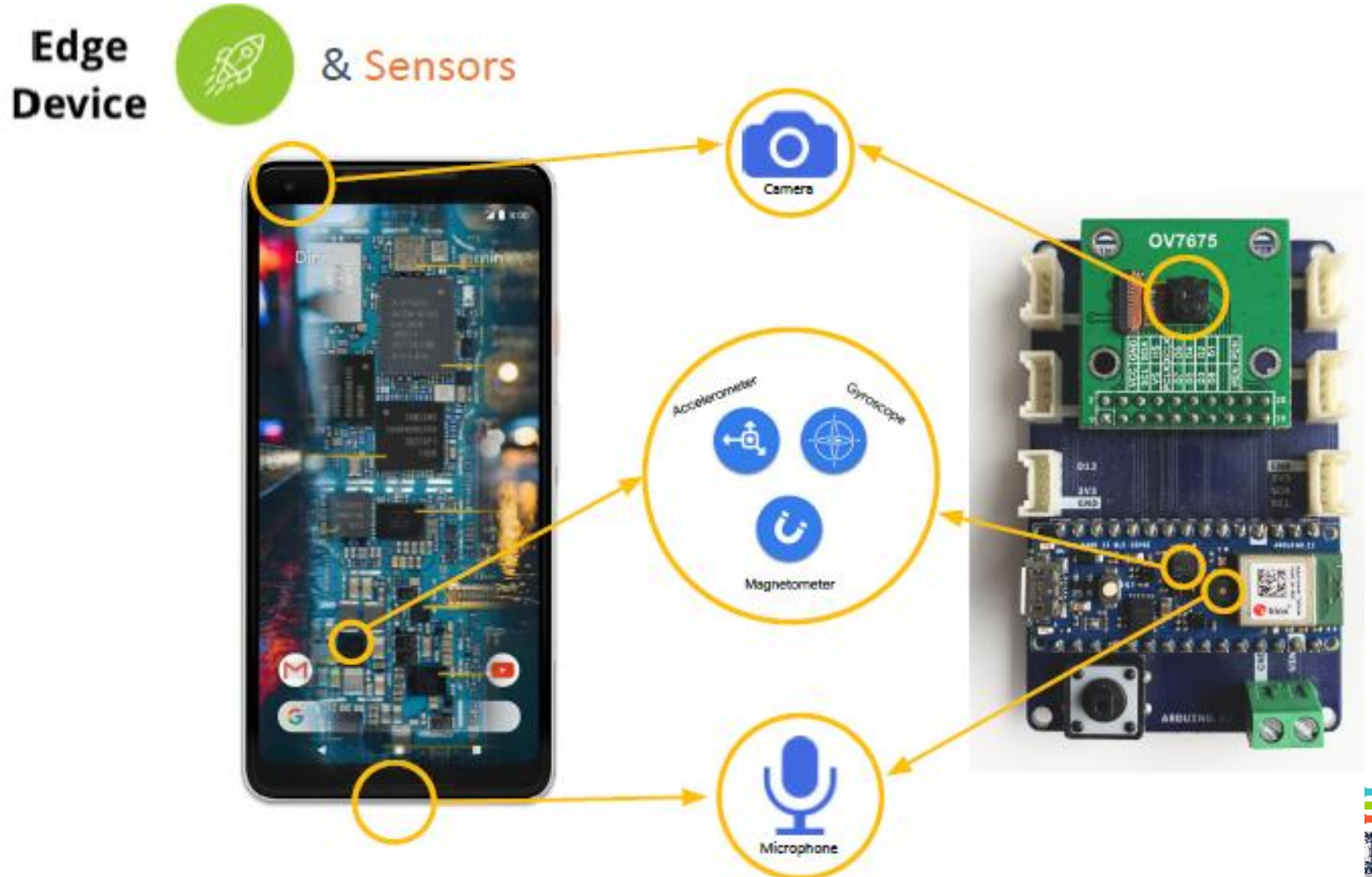

INTRODUCTION TO EDGE IMPULSE

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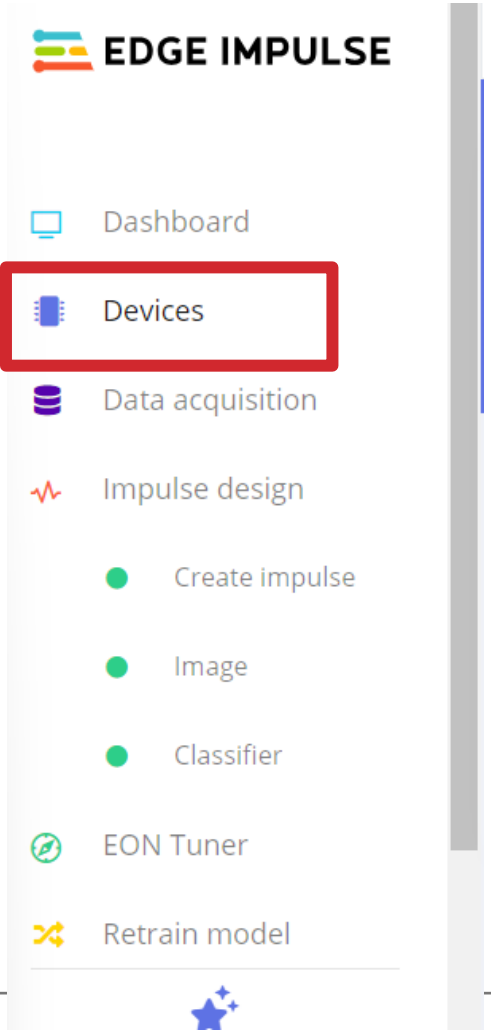

INTRODUCTION TO EDGE IMPULSE

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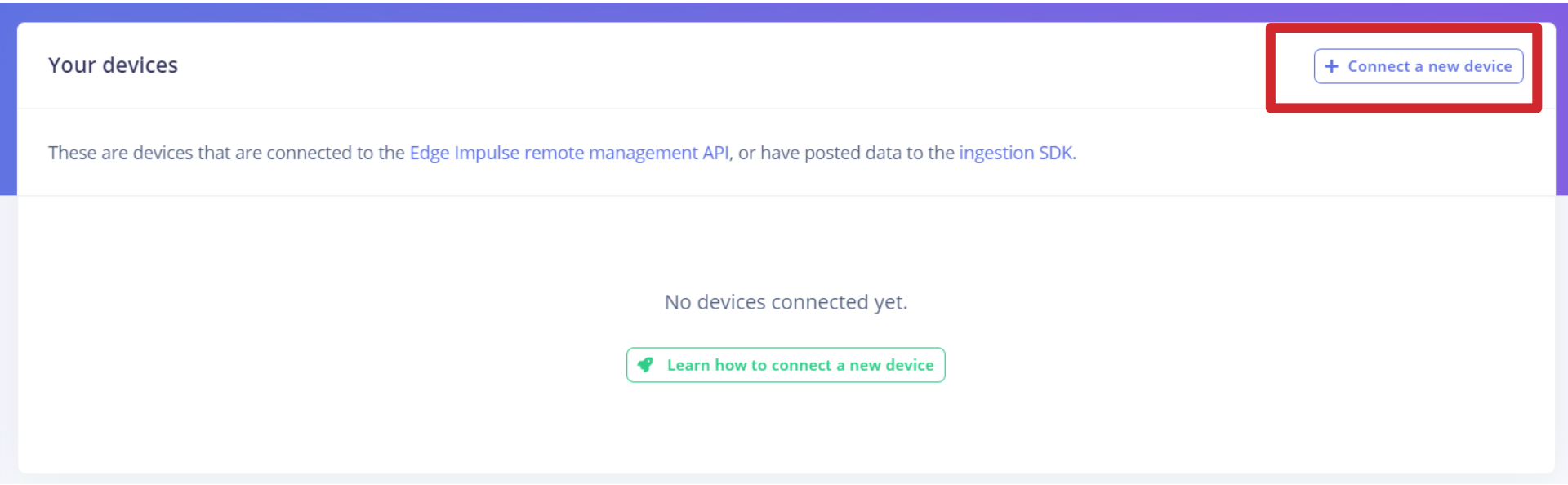

INTRODUCTION TO EDGE IMPULSE

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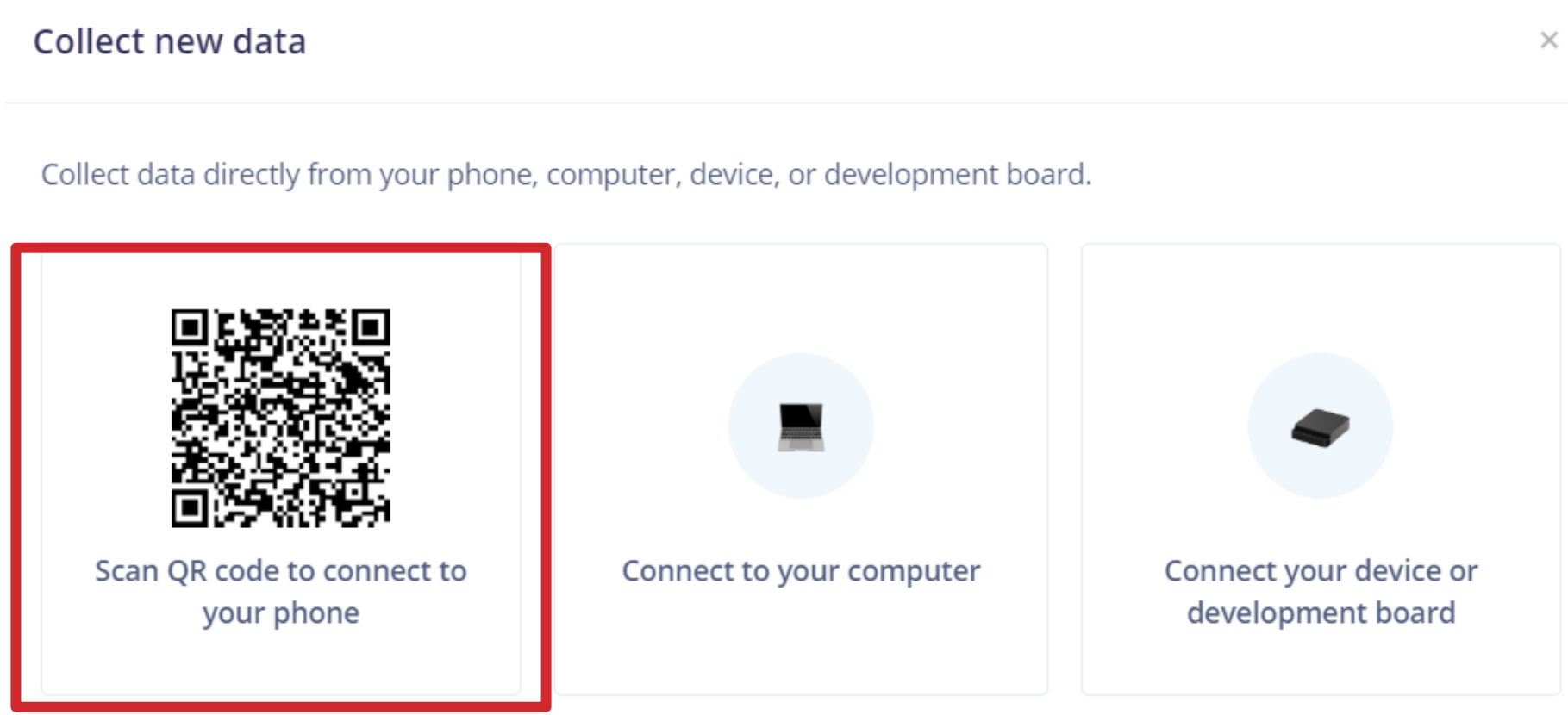

INTRODUCTION TO EDGE IMPULSE

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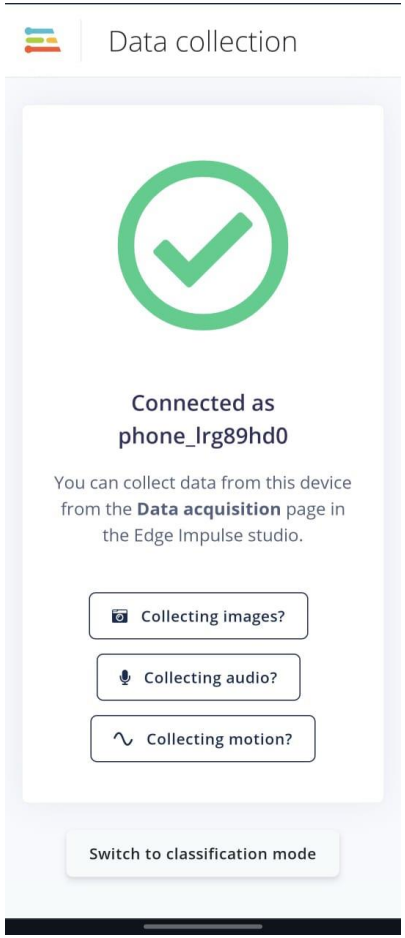

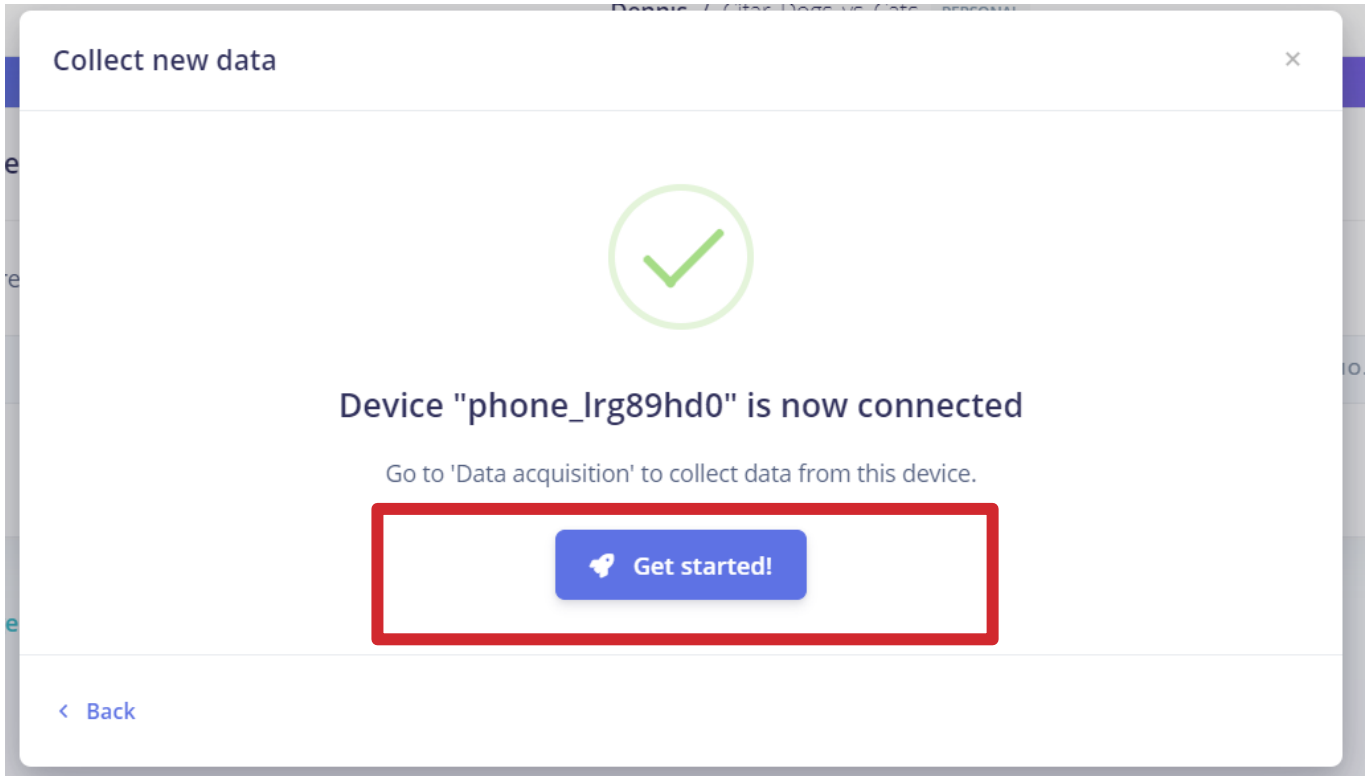

INTRODUCTION TO EDGE IMPULSE

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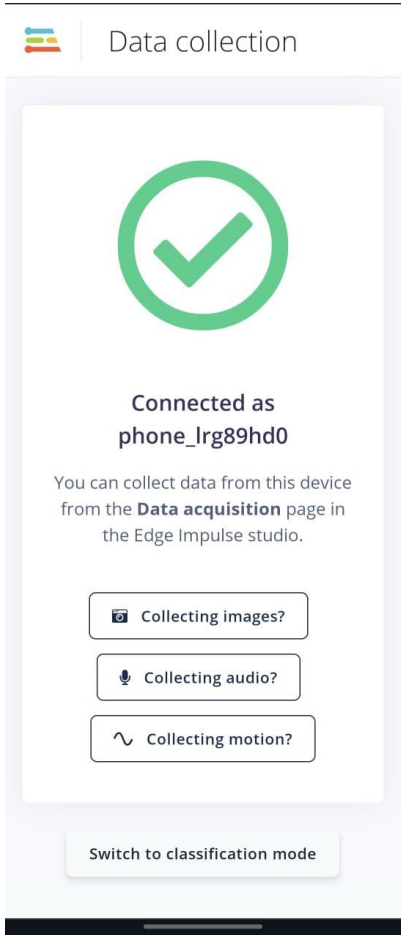

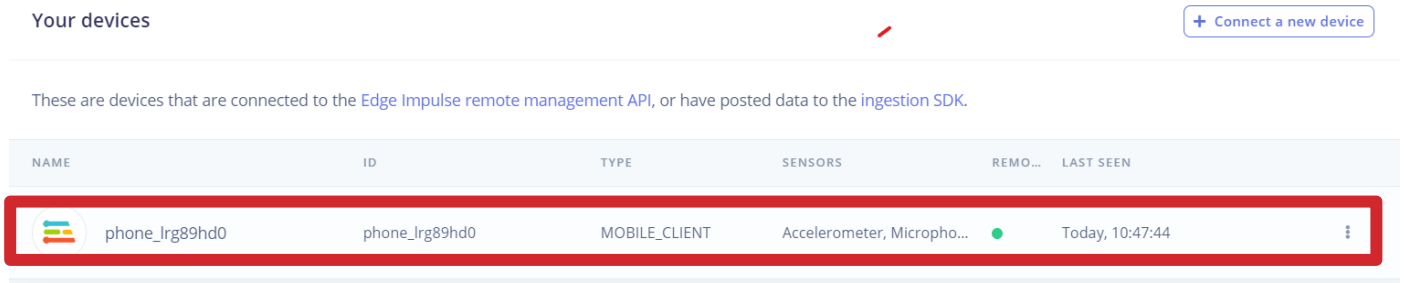

INTRODUCTION TO EDGE IMPULSE

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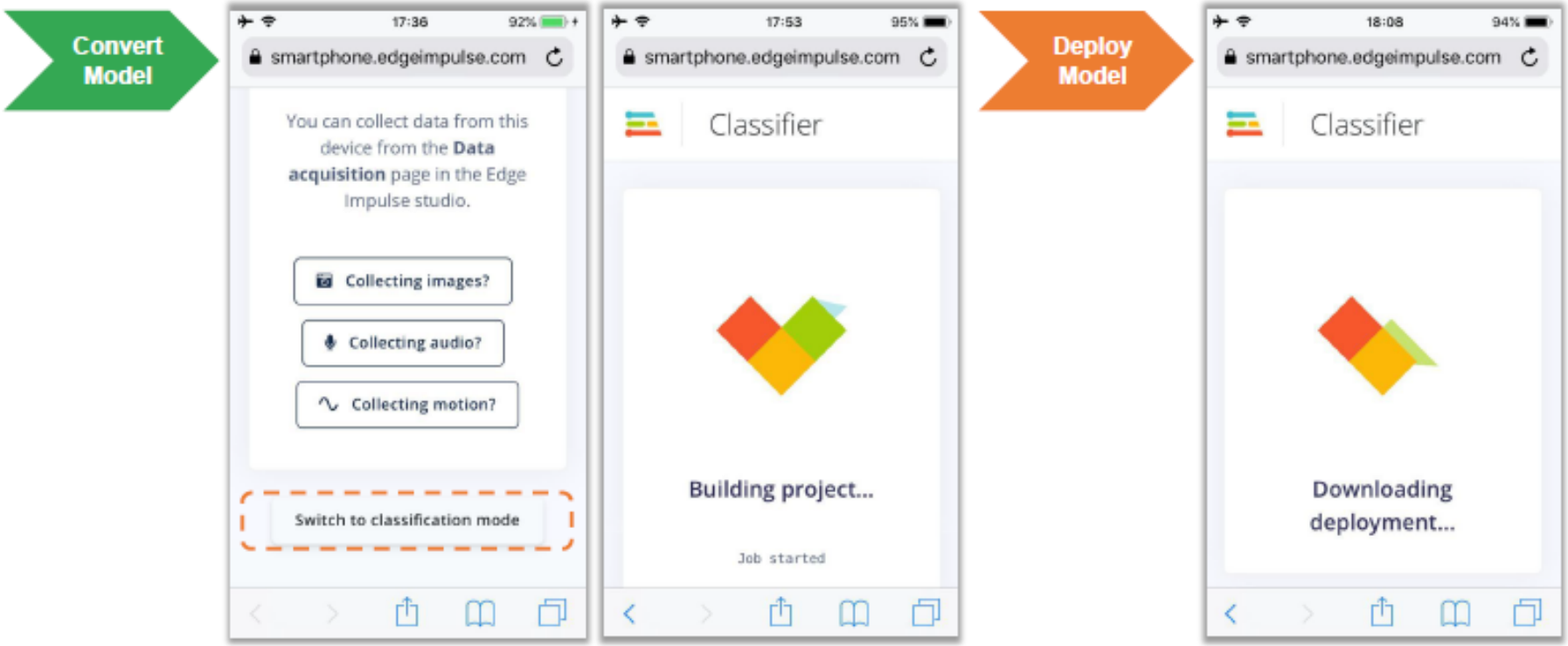
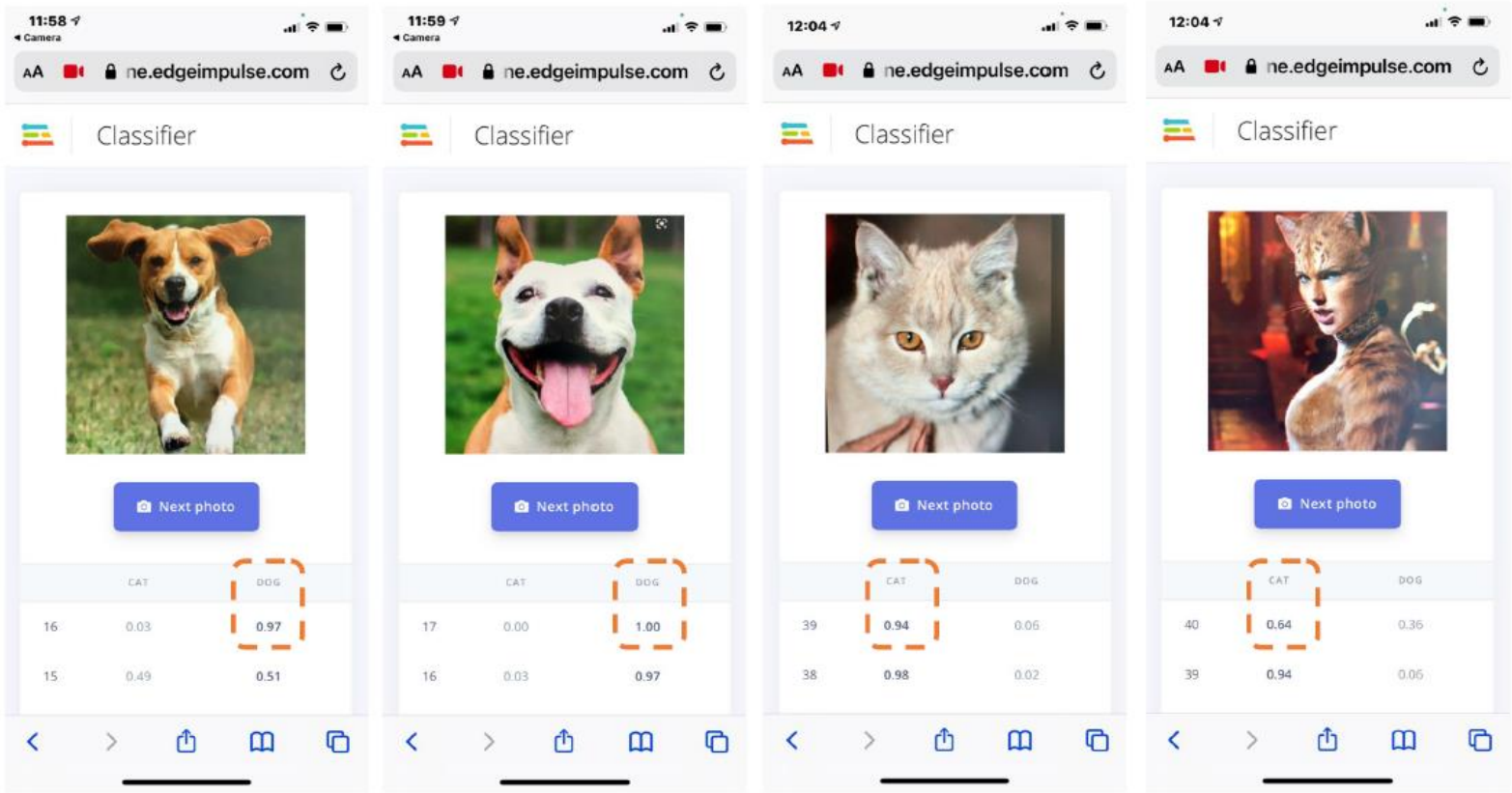


INTRODUCTION TO EDGE IMPULSE

- Edge Impulse example: Cifar Cats vs Dogs

Make Inferences



INTRODUCTION TO EDGE IMPULSE

- Edge Impulse example: Cifar Cats vs Dogs