tinyML® Summit

Enabling Ultra-low Power Machine Learning at the Edge

Products and applications enabled by tinyML

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Tiny spiking AI for the sensor-edge

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Outline

- Innatera
- Spiking Neural Processor
- Talamo SDK
- Ultra-low power edge applications

Made in Delft

innatera

- **Ultra-low power intelligence for sensors**
- Spun out of the Delft University of Technology in 2018
- 57 employees, offices in the Netherlands and India
- Funded by deep-tech investors Matterwave Ventures and MIG Capital

matter wave ventures

MIG CAPITAL

TU Delft

Bringing intelligence to the sensor edge

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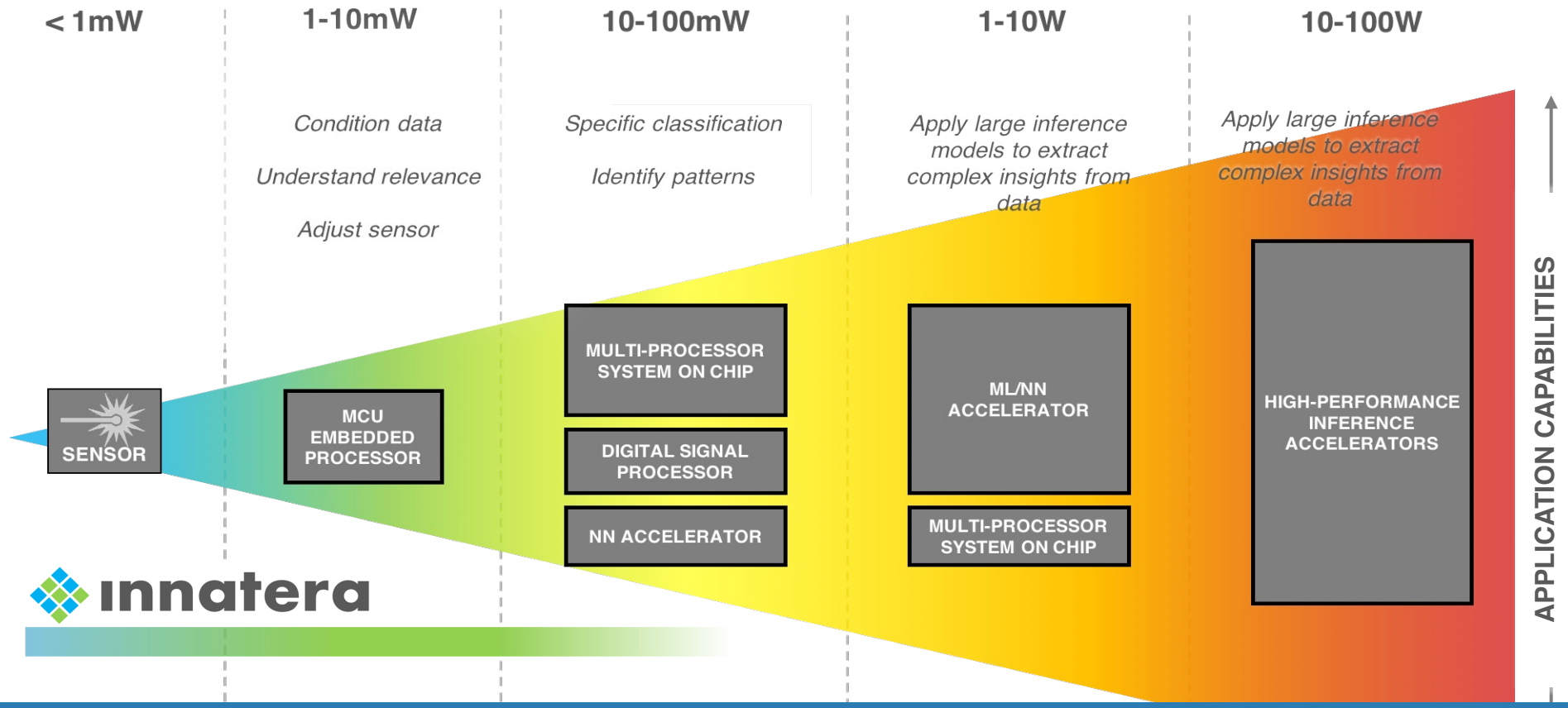
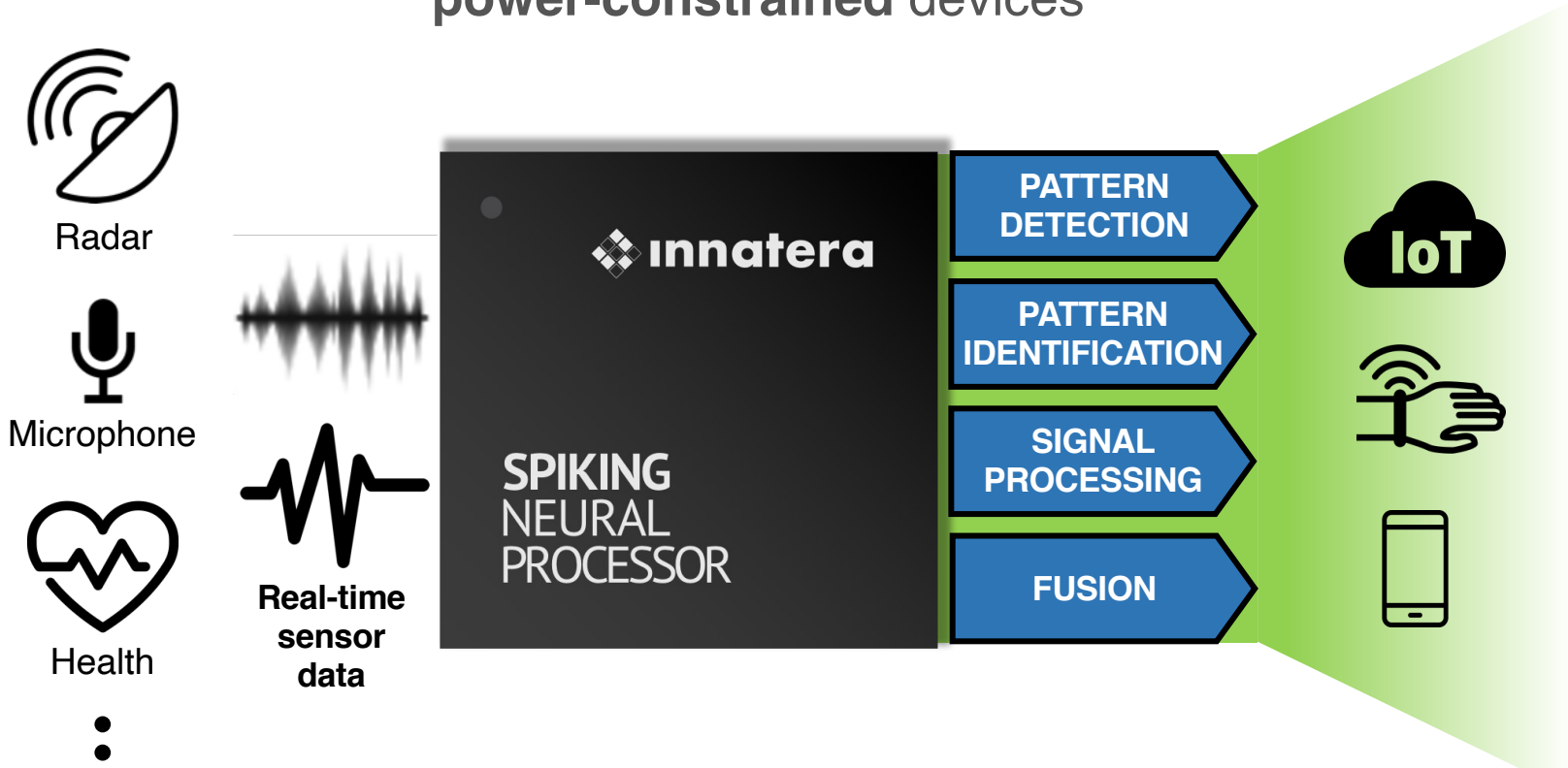


Sensor-edge constraints:

- average power < 1mW
- code size < 10 KB
- latency < 100 ms
- bill of materials

Spiking Neural Processor

Brain-inspired processor for **turn-key intelligence** in **power-constrained** devices

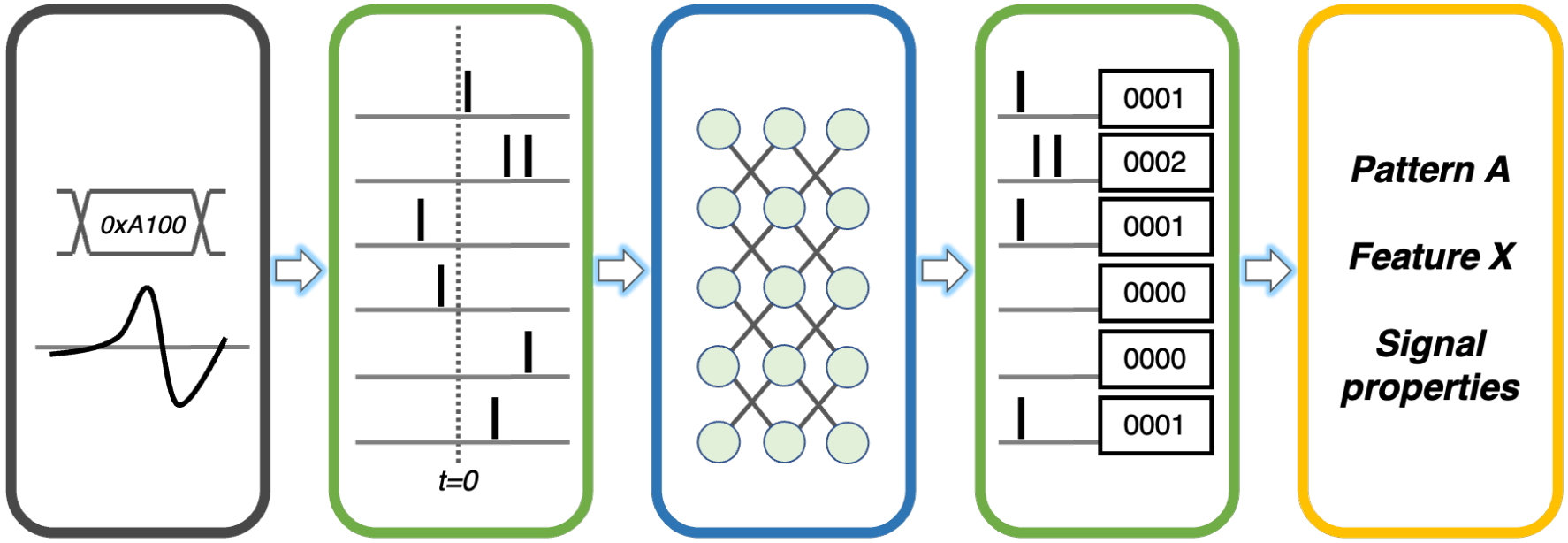


Always-on sensing applications

Millisecond-scale processing latency envelope

Milli- and sub-milliwatt power envelope

Processing sensor data with Spiking Neural Networks



Spiking Neural Network models can be up to 100x smaller than conventional Artificial / Deep Neural Networks

Spiking Neural Processor (SNP)

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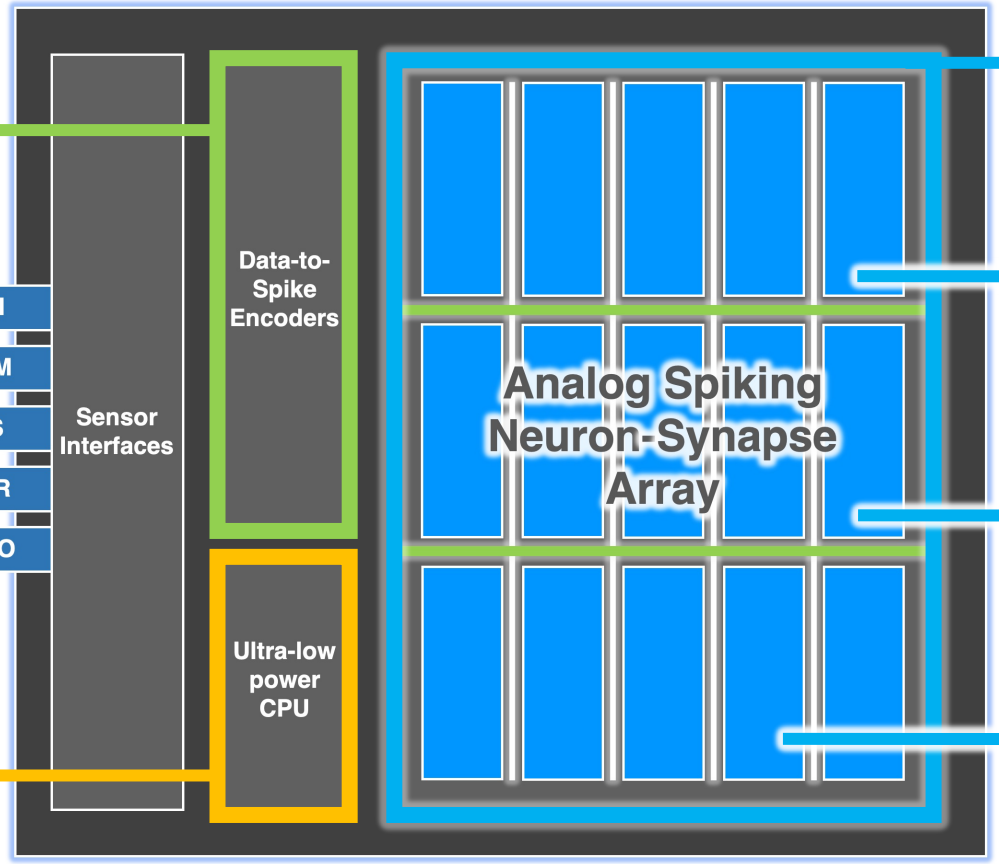
On-chip encoders automatically convert sensor data into spikes

Standard sensor interfaces

Ultra-low power CPU for standalone operation



Real-time, massively parallel inference of spiking neural networks

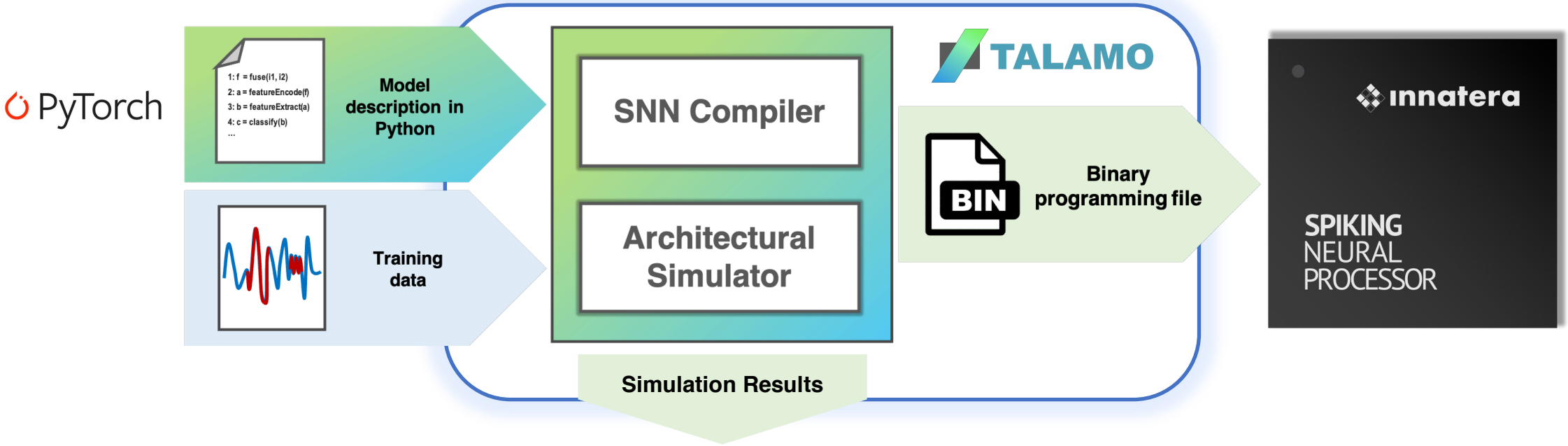
Ultra-low power, ultra-low latency computing elements

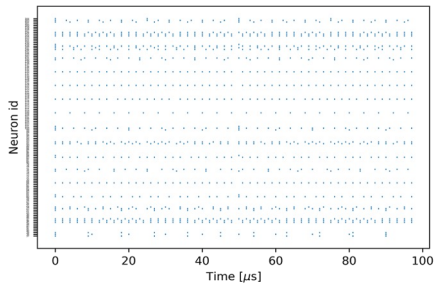
Programmable array supports complex network topologies

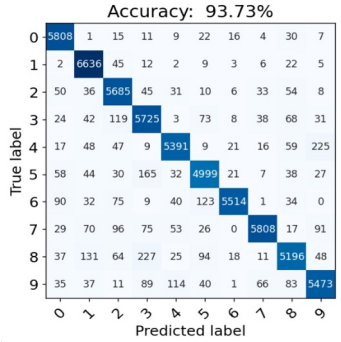
Scalable segmented architecture

The only processor needed for always-on sensing applications

Innatera's powerful Software Development Kit - Talamo







Simple	Turn-key	Standard	Fast
Easy to use, familiar workflow	Easily build and deploy models to hardware	Native integration with PyTorch, TensorBoard	Rapid simulation and deployment

Talamo's PyTorch API - spiking neural networks made easy

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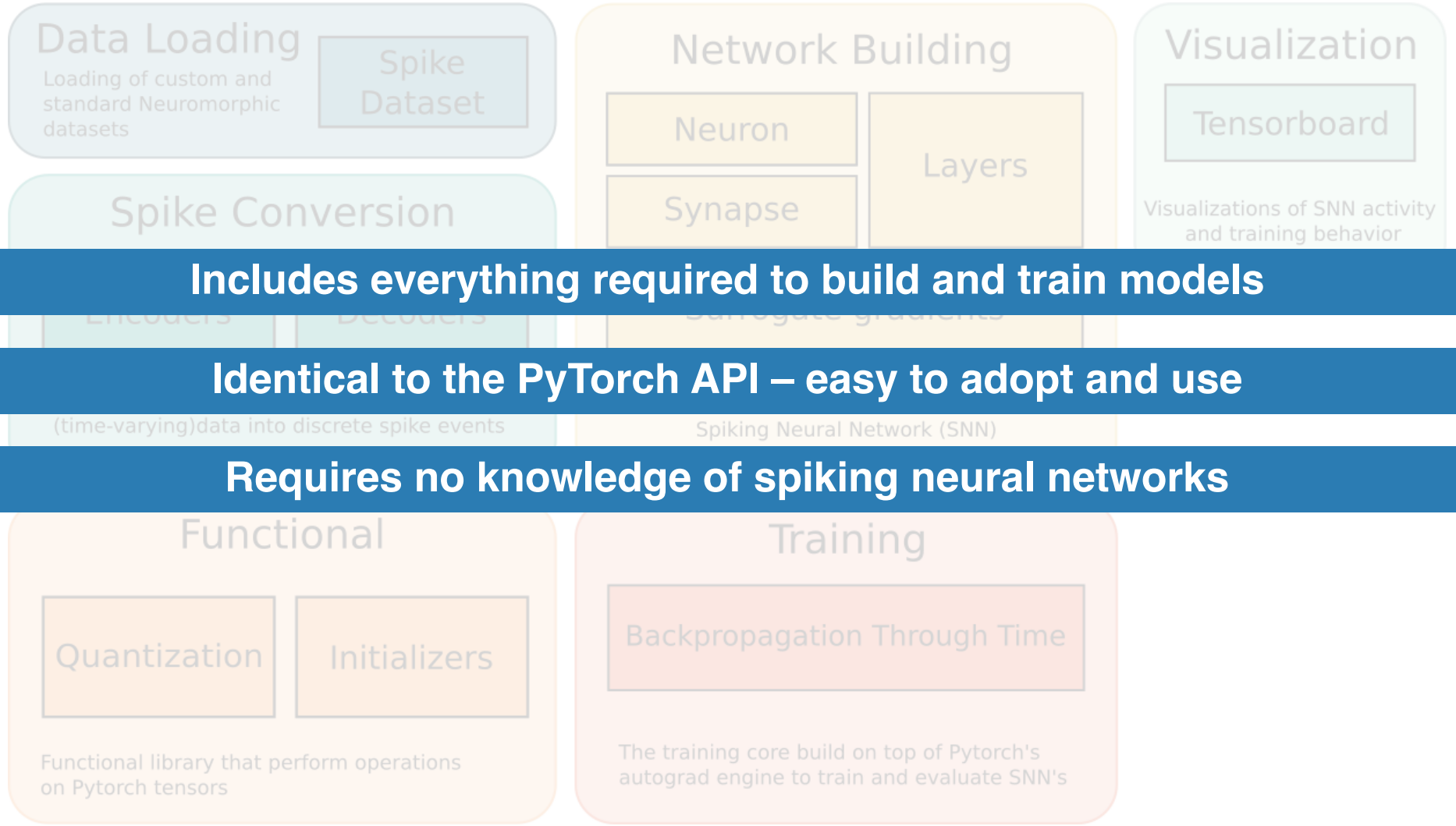
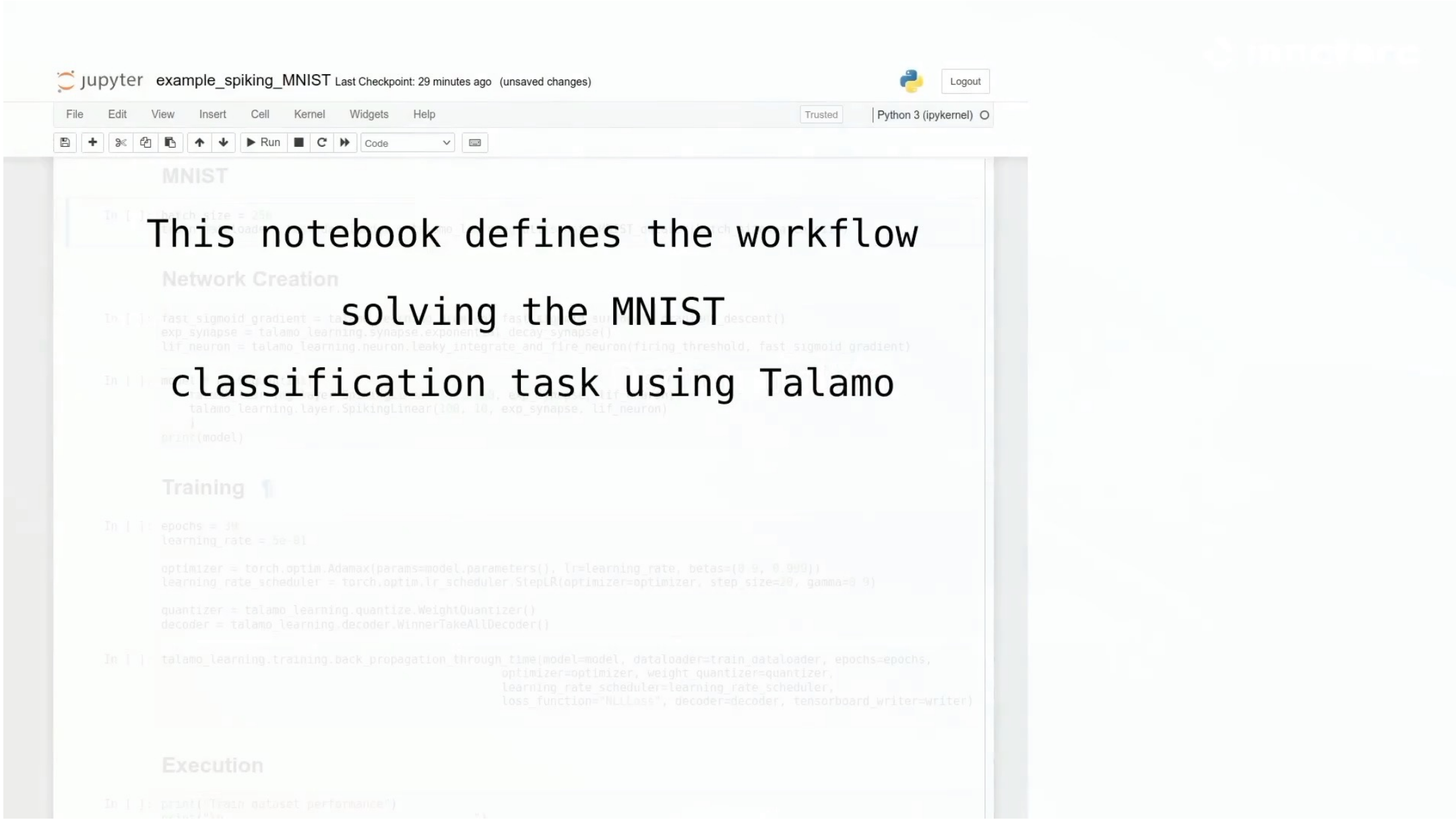


Includes everything required to build and train models

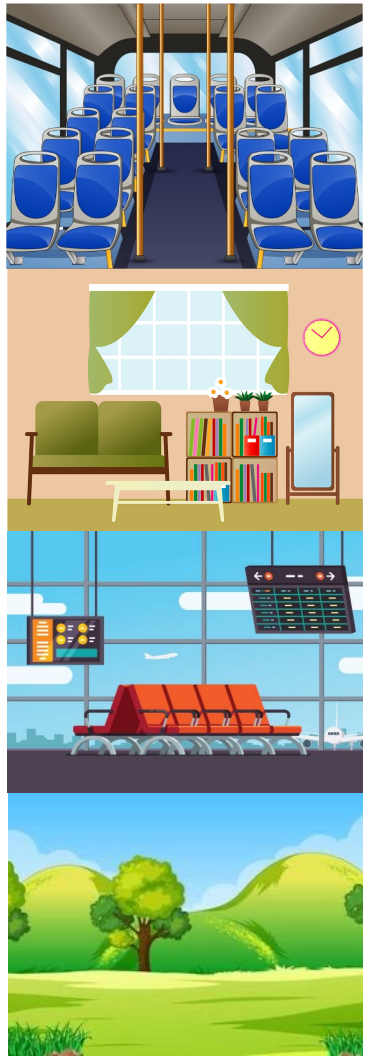
Identical to the PyTorch API – easy to adopt and use

Requires no knowledge of spiking neural networks

Building a spiking neural network in Talamo



Always-on audio scene classification in hearables



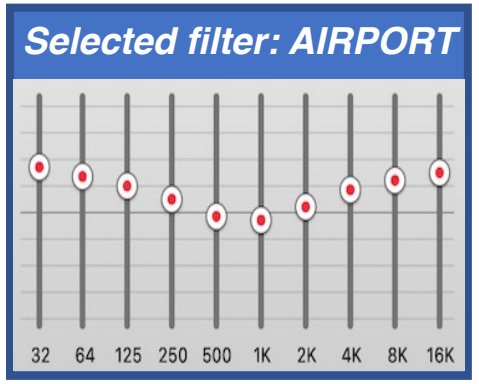
Audio scenes

Audio data

SPIKING NEURAL PROCESSOR

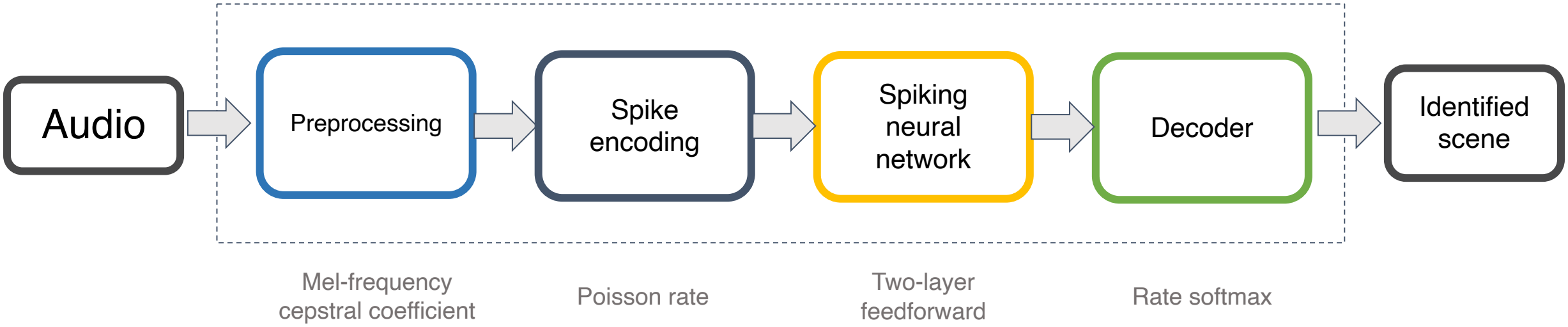
"Airport"

Identified scene



Filter selection for optimal sound quality

Solution pipeline



Audio scene classification (DCASE 2020)

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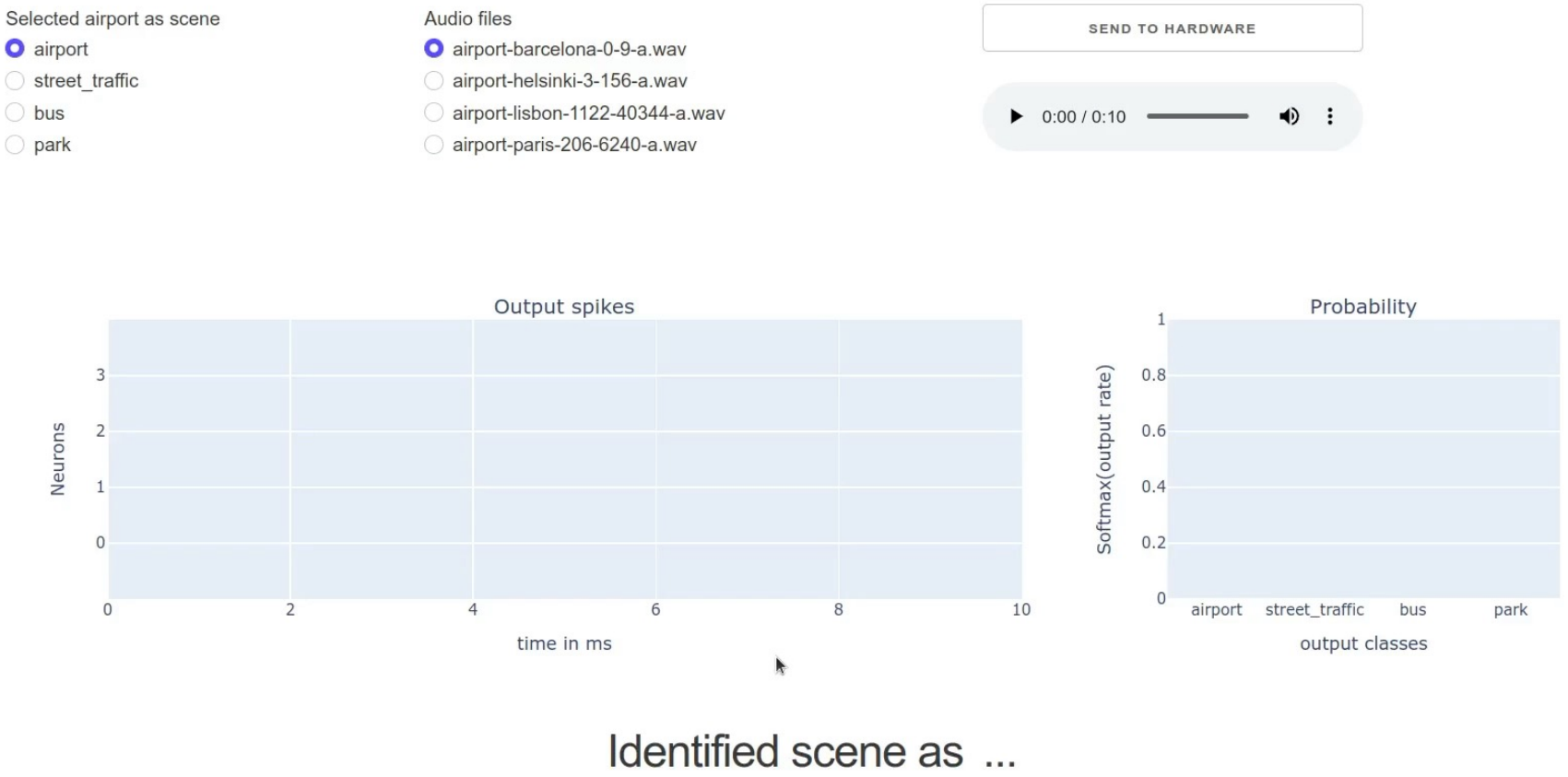
Power
(total peak)
1.06 mW

Accuracy
~85%

Inference latency
~1 ms / 1 s

Model size
~3kB



Summary

- Edge AI is:
  - Power constrained
  - Latency constrained
  - Code-size constrained
  - BOM constrained
- The Spiking Neural Processor delivers audio scene classification in
  - a power budget of ~1mW
  - an inference latency of ~1ms
  - with a code size of ~3kB
- Talamo SDK – simplifies model development with a standard, well-understood work flow
- Easy to adopt, build, and deploy sensor-edge solutions with unprecedented power-performance

The future of TinyML is Neuromorphic!

Let’s make sense together.

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