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Sensing Solutions with **Machine Learning** Capabilities

STMicroelectronics

MEMS and Sensors

iNEMO

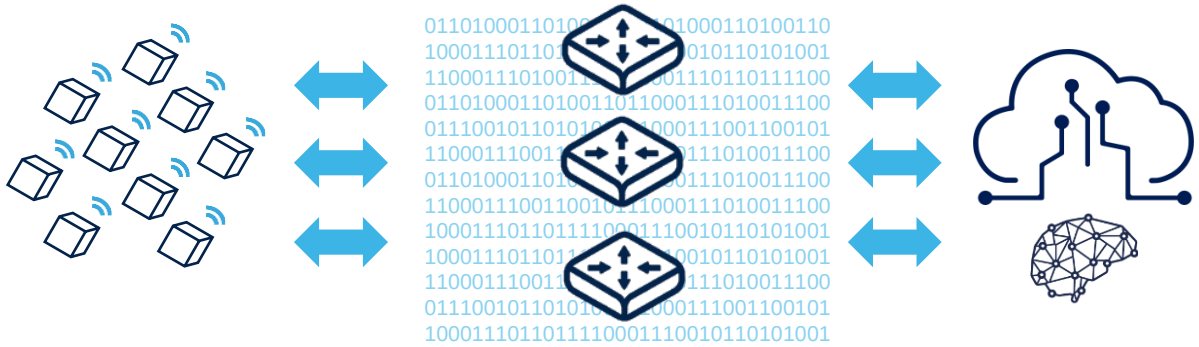
Smart System Challenges: the Move to Edge Computing

CLOUD COMPUTING

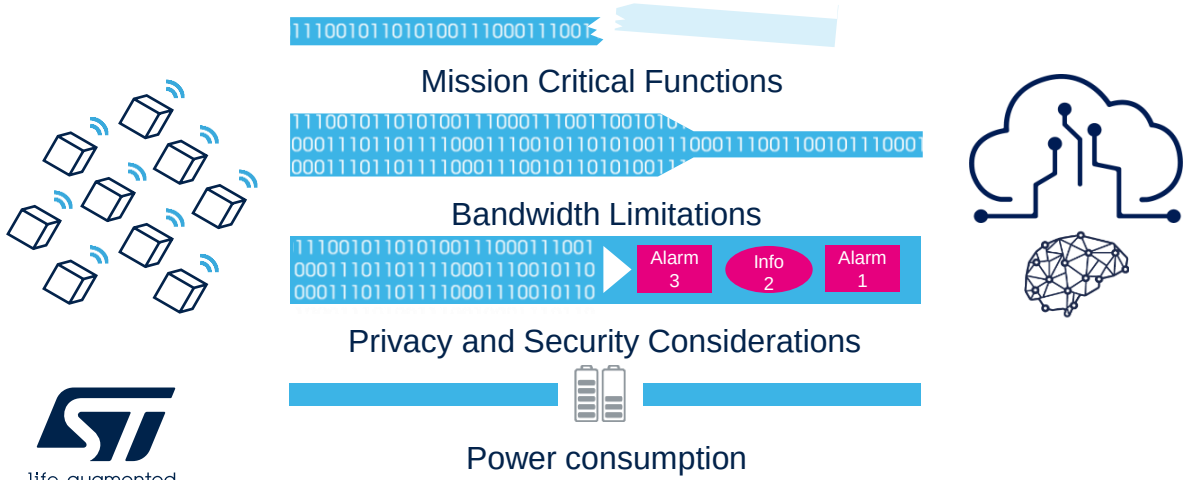
Collect and Send Data

Protocol Translation and Device Management

Big Data and Heavy computation

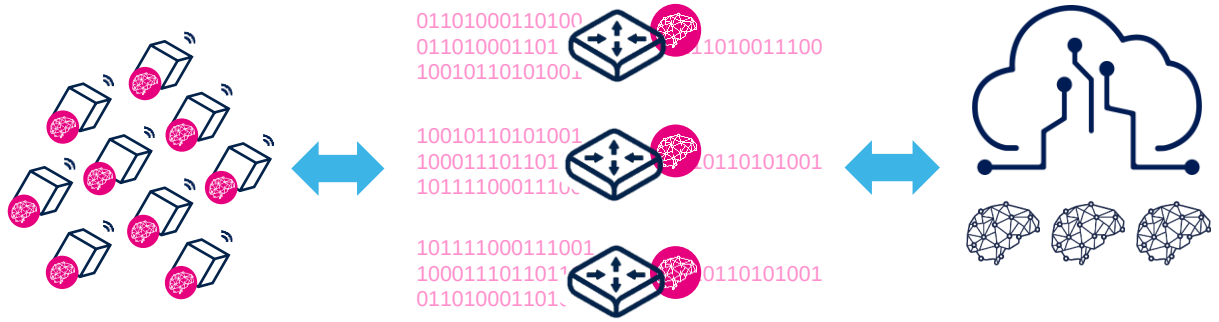


Time-sensitive applications are limited by remote cloud



EDGE COMPUTING

Time-sensitive applications should be locally processed



Collect, Process And Send Data

Local Processing of Data

Optimized computation and Advanced Analysis

Opportunity: move computation down to Sensor Nodes with local processing for real-time elaboration and best power efficiency

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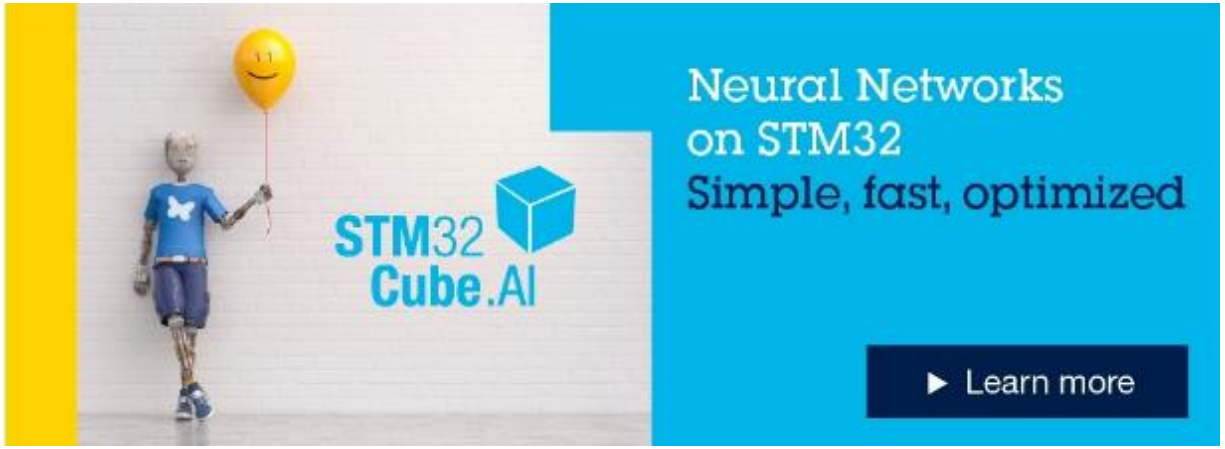
Artificial Intelligence and STMicroelectronics

- Thanks to STM32Cube.AI, you can map and run pre-trained **Artificial Neural Networks** (ANN) using the broad STM32 microcontroller portfolio.



- Advanced sensors contain a Finite State Machine (FSM), a Machine Learning Core (MLC) and advanced digital functions to run custom algorithms on the IMU and share the workload from the main processor enabling system functionality while in ultra-low power state.

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Our vision

We create the new generation of **sensors**
to allow **developers** exploiting their potential
by improving the overall system **efficiency**

thanks to:

- Reduced power consumption (both sensor and system)
- Increased accuracy (context detectability)
- Real edge computing

And we do this by leveraging Machine Learning techniques for the world of A.I.

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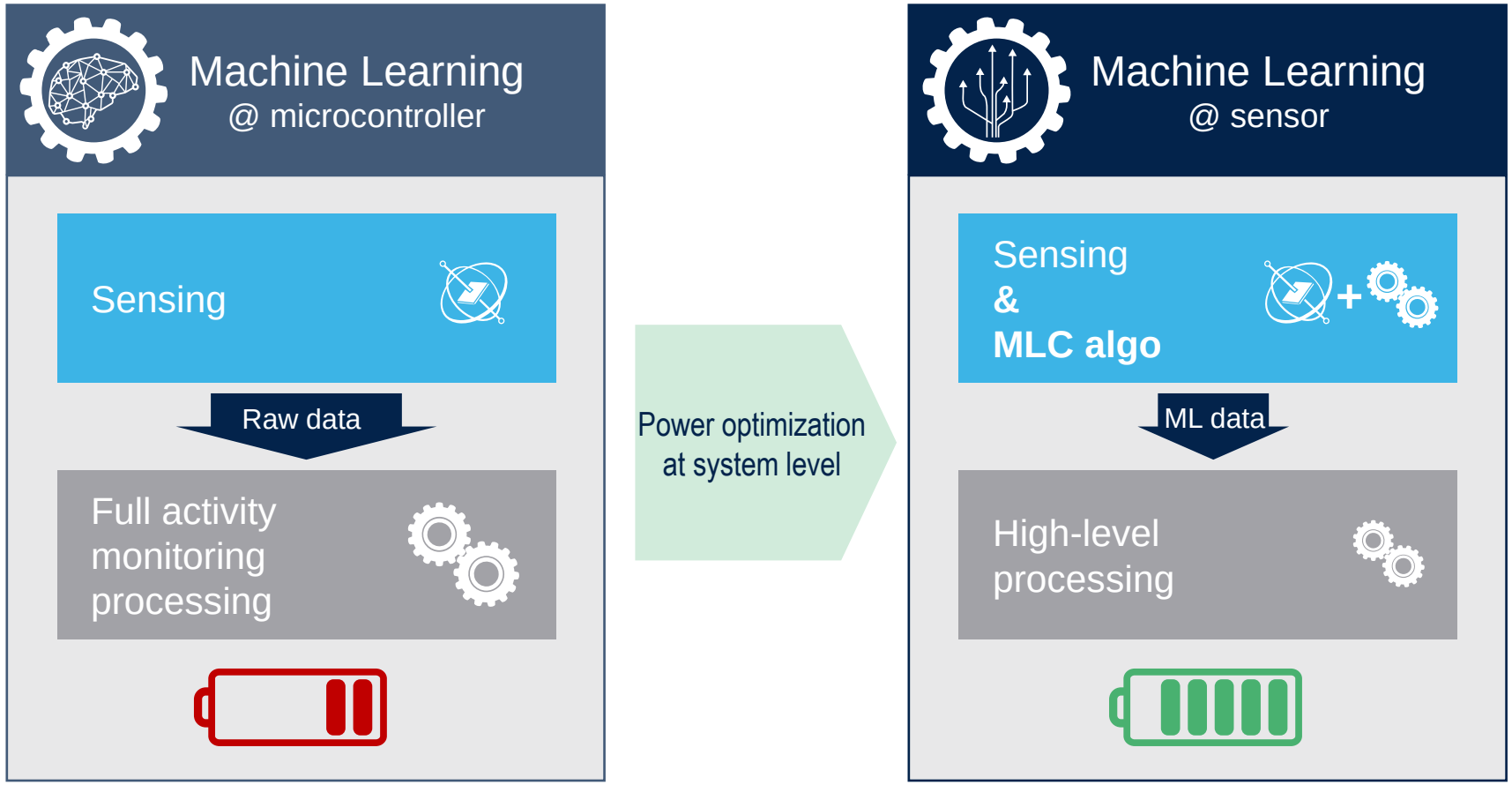
From low power sensor to low power system

Machine Learning Core (MLC) for real edge computing enables high system flexibility

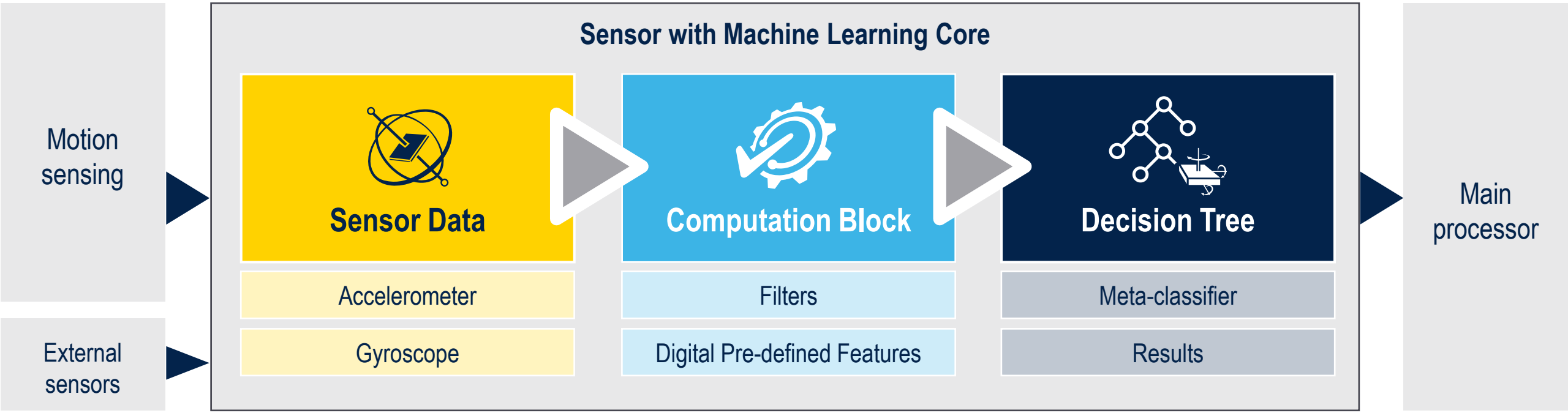


- Higher computation power at sensor level
- Lower power consumption at system level
- Cost optimized solution

This is added value!

Machine Learning Core (MLC) What is it?

MLC is an in-sensor classification engine based on Decision Tree logic



MLC is able to **increase accuracy** with a **better context detectability**, **offloading the main processor** while the built-in sensors identify motion data

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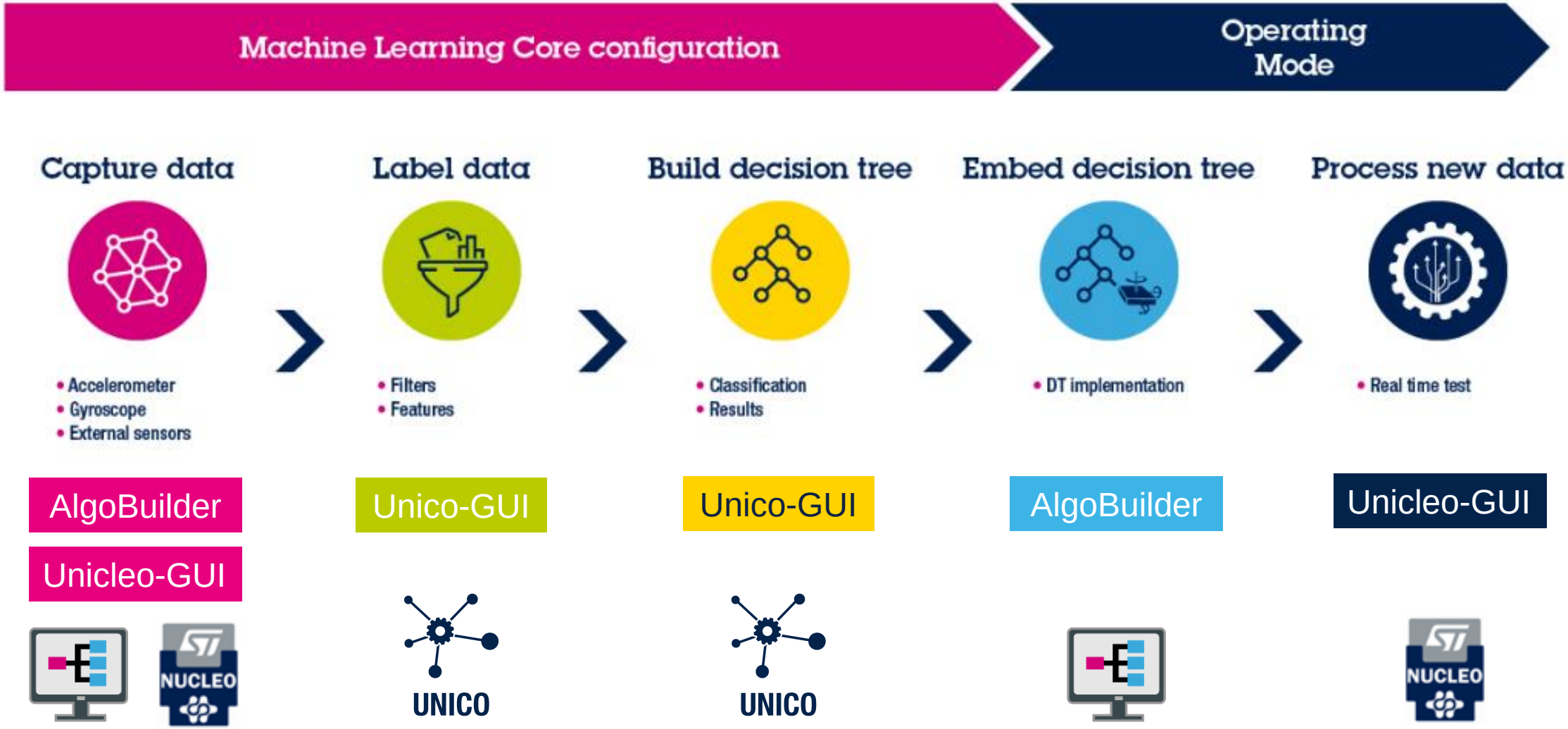
Decision Tree design with AlgoBuilder and Unico-GUI



6-Axis IMU with Machine Learning Core

1

Collect Logs for each class

2

Define Features that best characterize the identified classes

3

Machine Learning tools generate program for LSM6DSOX based on Logs and Features

4

Configure the LSM6DSOX, run the application

Detected as ->	Stationary	Walking	Fast Walking	Jogging
Stationary	99.1%	0.9%	0.0%	0.0%
Walking	0.0%	99.4%	0.2%	0.0%
Fast Walking	0.0%	3.7%	95.9%	0.2%
Jogging	0.0%	0.6%	0.7%	98.5%

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More intelligence with embedded Machine Learning Core

10 to 1,000 times power saving with real edge computing

Personal Electronics

LSM6DSOX

- Activity recognition
- Gym activity recognition
- Airplane mode detection

Personal Electronics

LSM6DSRX

- Virtual Reality
- Sensor Fusion
- Vehicle stationary detection

Industrial IoT

ISM330DHCX

- Smart antennas
- Industrial IoT
- Dynamic inclinometers

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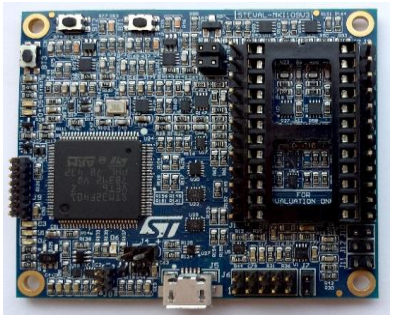
Hardware Evaluation Tools

Hardware:

- **SensorTile.box**

- **Professional MEMS Tool**



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DIL 24 adapter

Software:

- **AlgoBuilder**
- **Unicleo-GUI**
- **Unico-GUI**

Thank You!

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