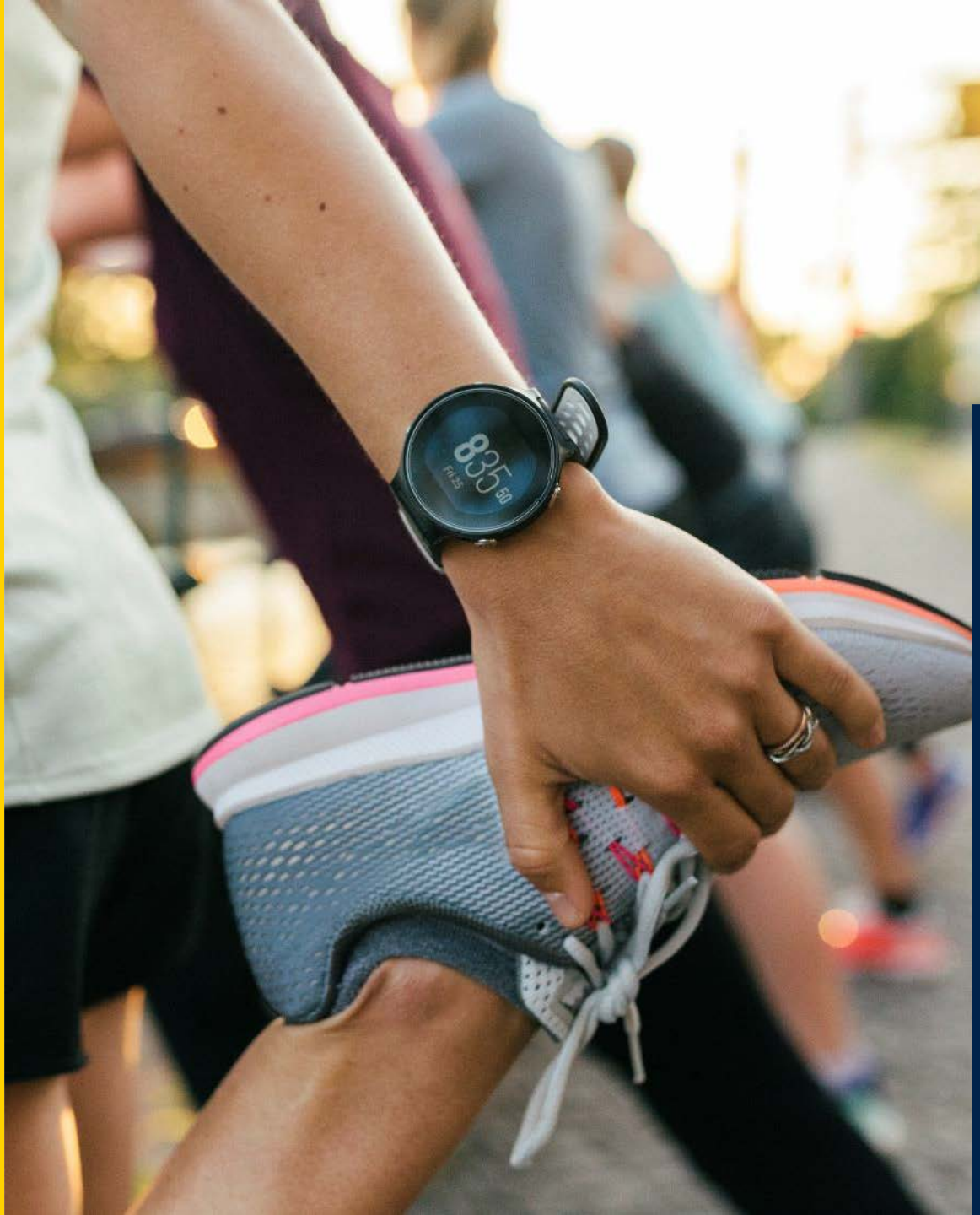

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LSM6DSO32X
iNEMO* inertial module

Tools and GUI for Machine Learning Core

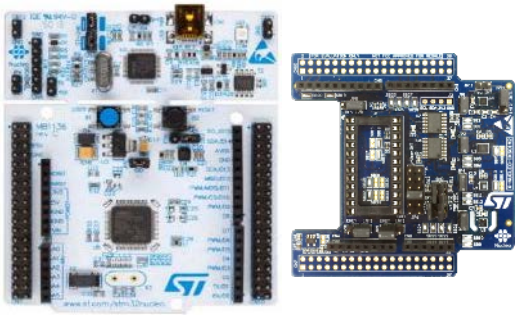
iNEMO

LSM6DSO32X form factor tool & GUI
Capture and process data

Two solutions for LSM6DSO32X Machine Learning Core

Quick Prototyping

Nucleo with Expansion board Tool & Unicleo-GUI



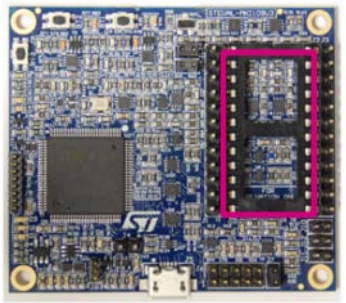
STM32 Nucleo with expansion board
X-NUCLEO-IKS01A3

DIL24 adapter board
LSM6DSO32X STEVAL-MKI221V1

Software packages:
UNICLEO GUI with X-CUBE-MEMS1
UNICO GUI for MLC development

Performance Evaluation

Professional MEMS motherboard & Unico-GUI



Professional MEMS motherboard
STEVAL-MKI109V3

DIL24 adapter board
LSM6DSO32X STEVAL-MKI221V1

Software package: Unico-GUI
Linux → STSW-MKI109L ,
Mac OS X → STSW-MKI109M
Windows → STSW-MKI109W

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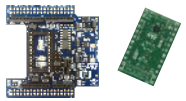
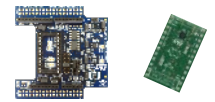
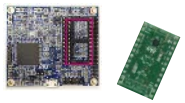
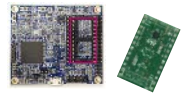
LSM6DSO32X form factors & GUI
Decision tree creation process

	Capture data	Label data	Build decision tree	Embed decision tree	Process new data
WHAT	Accelerometer Gyroscope External sensors	Filters Features	Classification Results	DT implementation	Real-time test
HOW – HW	Unicleo-GUI 				Unicleo-GUI 
HOW – SW	Unico-GUI 				Unico-GUI  AlgoBuilder

Unico-GUI*

*** External tools for building decision tree:**
Weka, RapidMiner, MATLAB, Python

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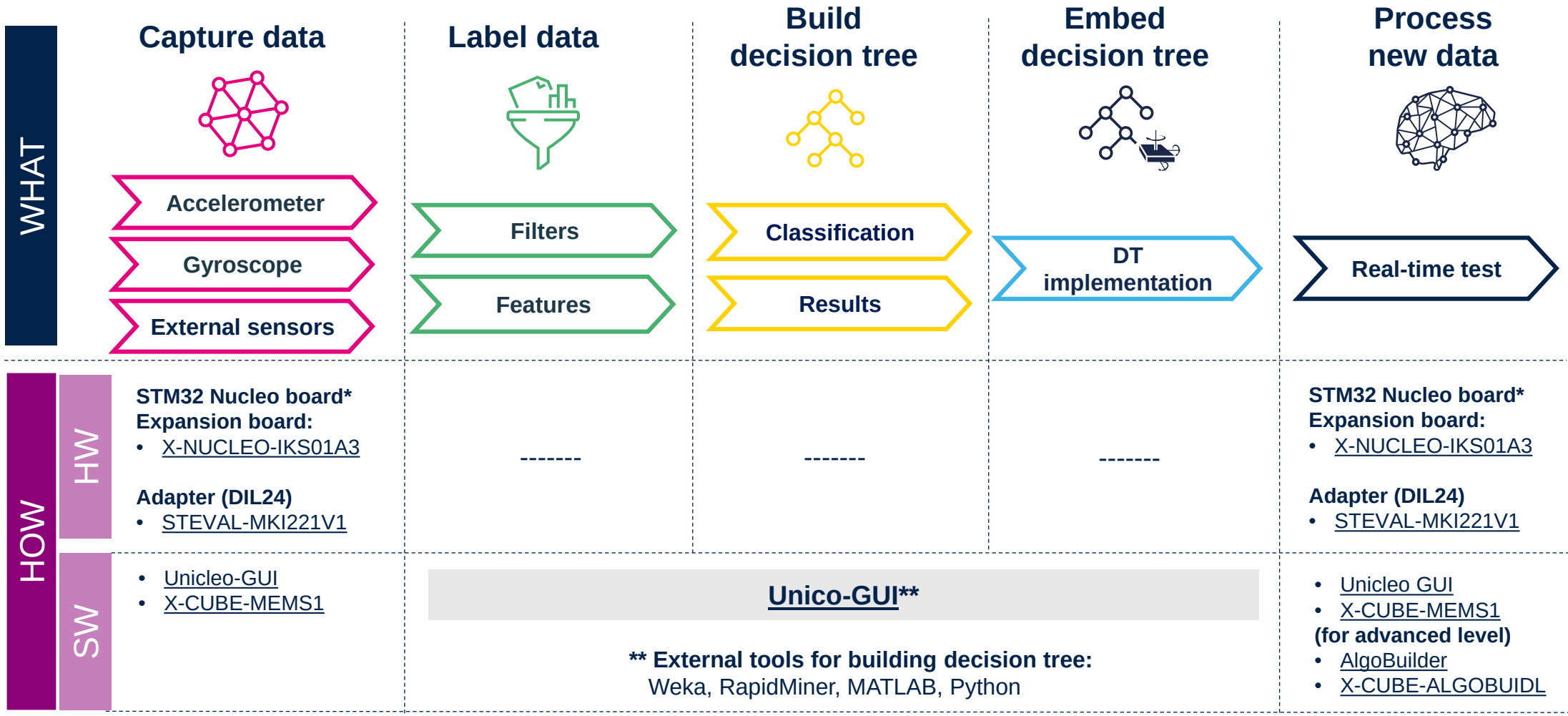
LSM6DSO32X
STM32 Nucleo with expansion board



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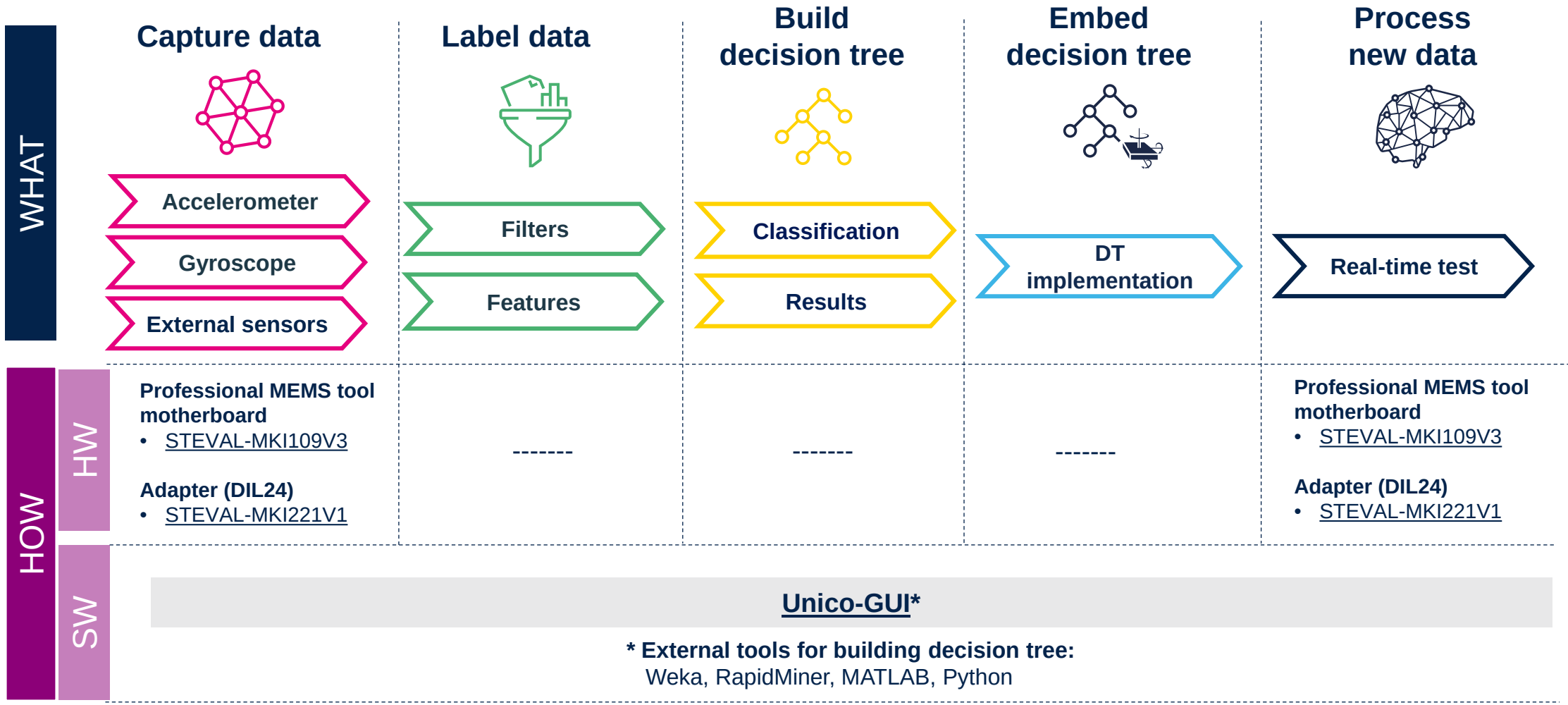
* NUCLEO-F401RE, NUCLEO-L152RE, NUCLEO-L476RG, and NUCLEO-L073RZ with STM32CubeMX for SW support

LSM6DSO32X
Professional MEMS tool motherboard



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Decision tree creation process
Dataset generation

Capture data

1

a) **Professional MEMS tool motherboard**

Unico-GUI (USB cable)

b) **STM32 Nucleo board with expansion**

Unicleo-GUI (USB cable)

Logs generation in .csv files

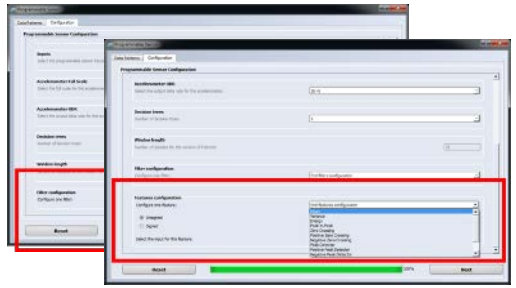
Unico-GUI → **MLC development tool**

Label data

2

STEPS

1. Import .csv files in Unico
2. Assign label (class) to the files
3. When all files are imported, start MLC configuration: sensors setup (ODR, FS, etc), windows length, filters and features
4. Generation of .arff file



from Logs in .csv files to .arff file generation

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ST sensor tools
Decision tree creation process – build & embed

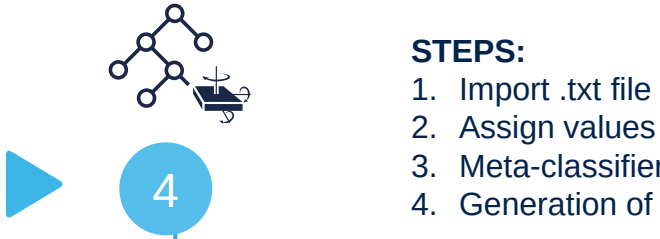
Build decision tree

Unico-GUI → **ST MLC development tool**

From .arff file to Decision Tree generation in .txt file
(only for Weka/RapidMiner copy the content in .txt file)

Embed decision tree

Unico-GUI → **MLC development tool**



STEPS:
1. Import .txt file in Unico
2. Assign values to the classes
3. Meta-classifier configuration (if needed)
4. Generation of .ucf/.h file

From . txt file to .ucf/.h file generation

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ST sensor tools
Real-time test with trained decision tree

Process new data

5

Unicleo-GUI

Unico-GUI

AlgoBuilder

- Test the Decision Tree on STM32 Nucleo board with expansion using USB cable
- Test the Decision Tree on Professional MEMS board using USB cable
- PC application for advanced development level

Import .ucf file to configure the device

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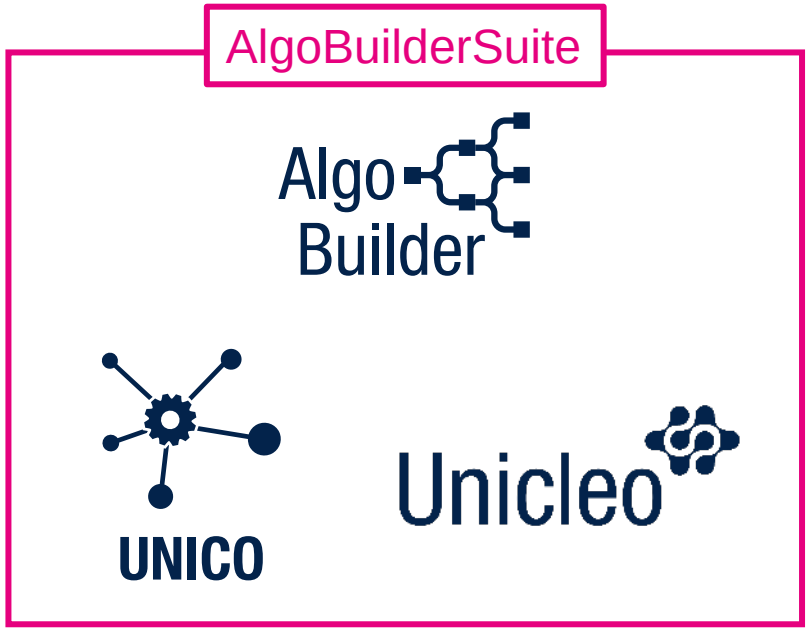
AlgoBuilderSuite GUI
PC application



- **AlgoBuilderSuite** is an all-in-one software package which contains:
  - **AlgoBuilder**, to develop firmwares and algorithms to be implemented on ST MEMS evaluation boards without writing a single line of code
  - **Unico-GUI**, to generate the decision trees starting from raw data and the configuration file to be uploaded in the sensor.
  - **Unicleo**, to check in RT or log the data coming out from the sensor (acceleration, MLC output, etc...)

Resources

MEMS Sensors ecosystem for Machine Learning

GitHub repository for MLC examples

MEMS Sensors MLC Community

Design tip for Decision Tree generation

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Thank you

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