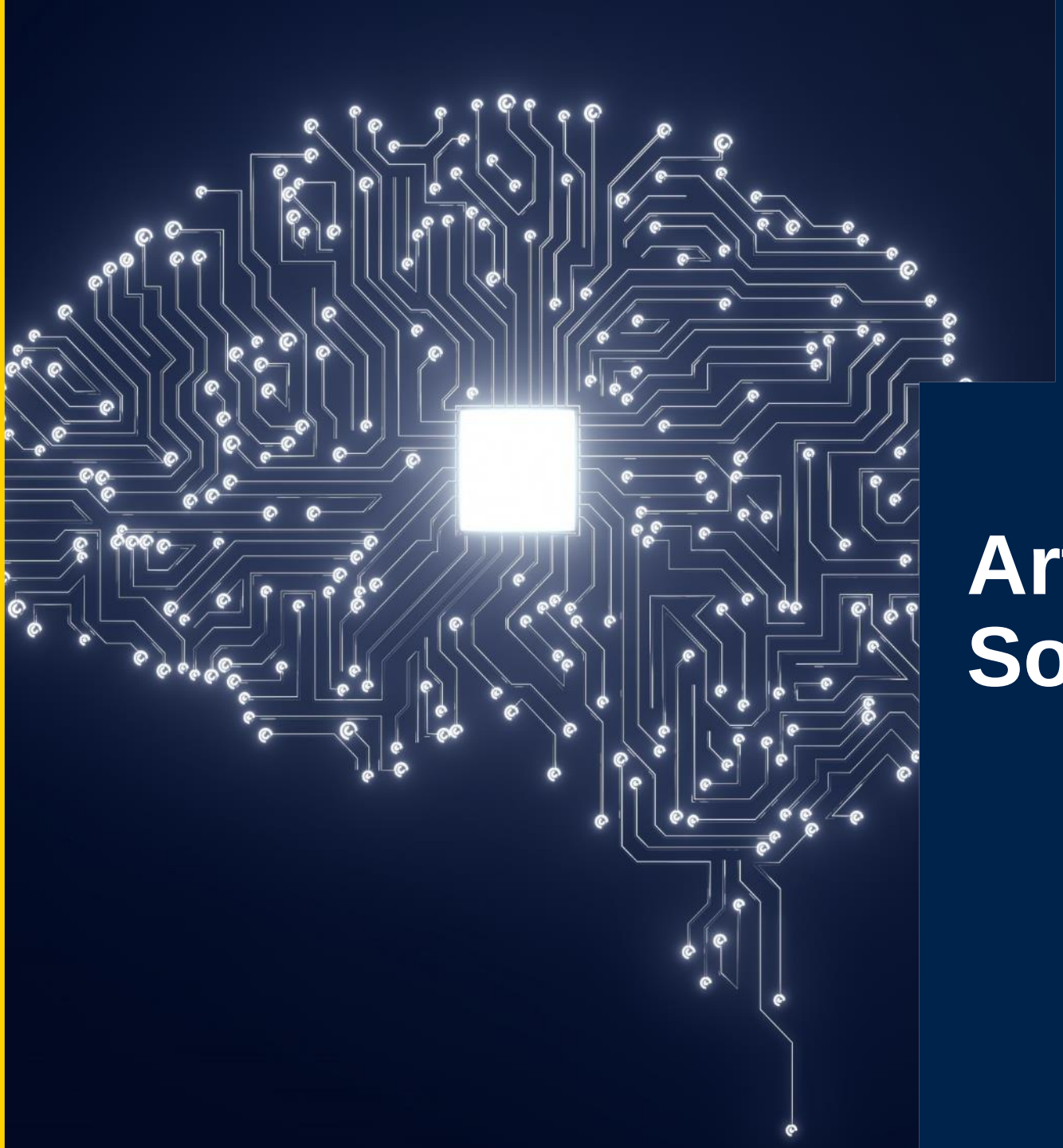

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Artificial Intelligence Solutions on STM32

STM32

MORE INFO

Machine Learning
A new way to add environment awareness to your products

Standard programming
Handcrafted rules based on experience

Input Data + Procedural algorithm

Desired Output from the system

- Requires domain expertise to code
- Need to rewrite if environment evolves

Machine Learning
Rules learnt from real-world data

Input Data + Desired Output from the system

General ML model trained for the specific problem

- Generate code from real-world observations
- Re-learn from data if environment evolves

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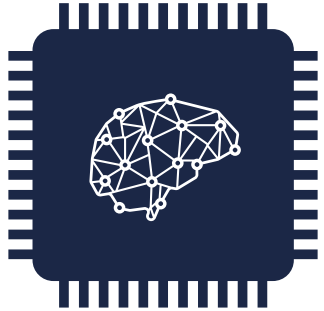
Artificial Intelligence at the Edge

Moving part of intelligence closer to the data acquisition

Better user experience

Realtime, no latency

Reliable



Add new functions and services with **Embedded AI**

Optimized Cloud usage

Privacy by design (GDPR compliant)

Sustainable on energy

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MORE INFO

A complete development ecosystem
Create your AI application on STM32

STM32 Cube.AI

AI extension for STM32CubeMX to **map pre-trained Neural Networks**

NANOEDGE AI STUDIO

Studio for ML library generation capable of **on-device learning** on STM32 MCU

STM32 **Community** with dedicated Neural Networks topic and **AI expert partners**

Trainings, hands on, MOOCs and partners **videos**

FP-AI-VISION1

Computer Vision applications

FP-AI-SENSING1

Audio and Sensing applications

FP-AI-NANOEDG1

Condition-based equipment monitoring

FP-AI-MONITOR1

Time series-based monitoring

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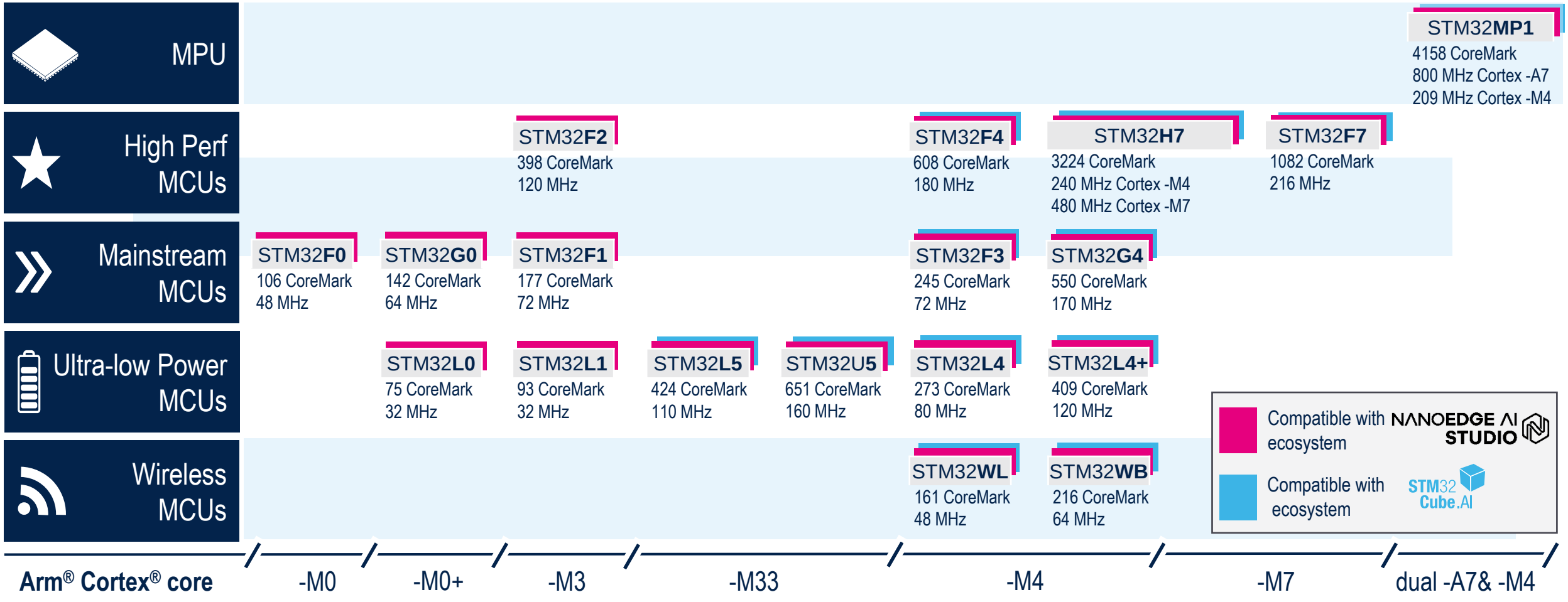
Making Deep Edge AI Accessible Now

Leader in Arm® Cortex®-M 32-bit General Purpose MCU



More than 40,000 customers

Over 4 Billion STM32 shipped since 2007

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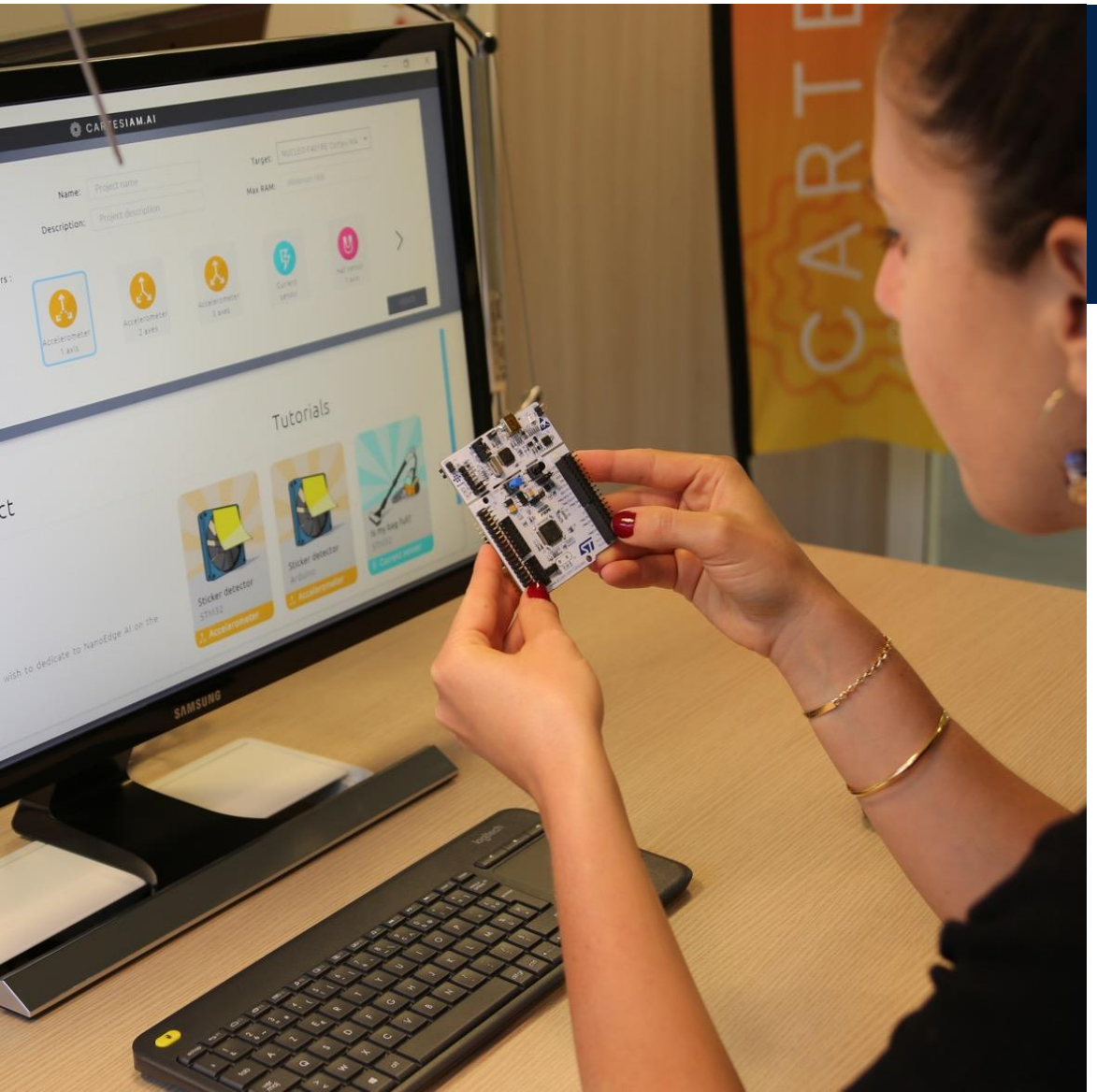
NanoEdge™ AI STUDIO is the only solution designed with embedded learning capabilities



We re-wrote, from the algebra, ML and signal processing algorithms so that they LEARN and INFER inside a microcontroller

- Designed for embedded developers
- Ultra memory efficient Flash and RAM
- Unsupervised Learning in the device
- Superior security
- Small footprint, any STM32 microcontroller
- Close to 100% accuracy and confidence

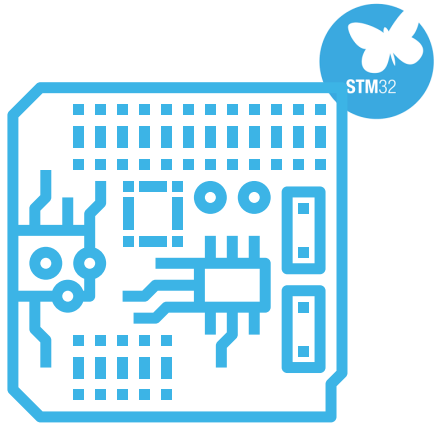
NanoEdge AI Studio bring Machine Learning to the edge

1 **Create the library ONCE**

Standalone PC (Win/Linux) solution

Create and embed a self learning engine

2 **Use the library MANY times**



Model is self-trained « at the Edge »

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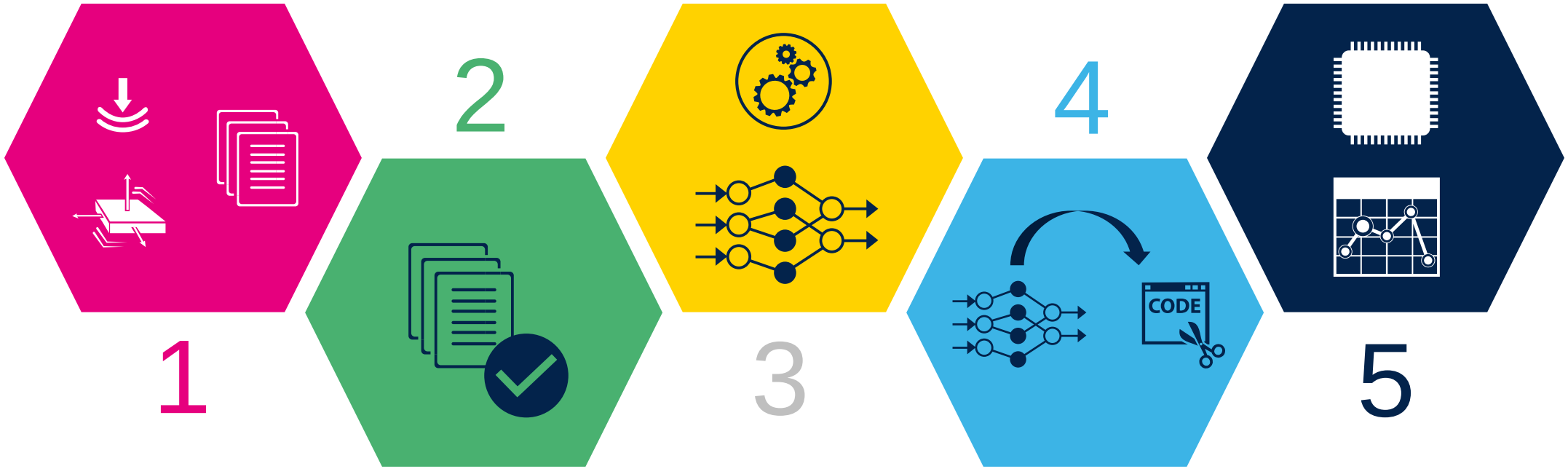
The key steps behind Neural Networks

MORE INFO

Neural Network (NN) Model Creation

Operating Mode



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Easily implement Neural Networks on STM32

Train Neural Network using any major AI frameworks

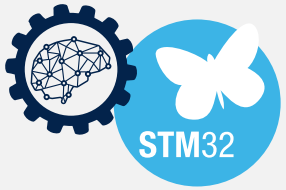
And more

Convert NN into optimized code

STM32 Cube.AI

Select most appropriate MCU
Review computation and memory consumption per layer

Run on optimized runtime



run-time

Validate code directly on target
Get accuracy and inference time
Optimize memory usage

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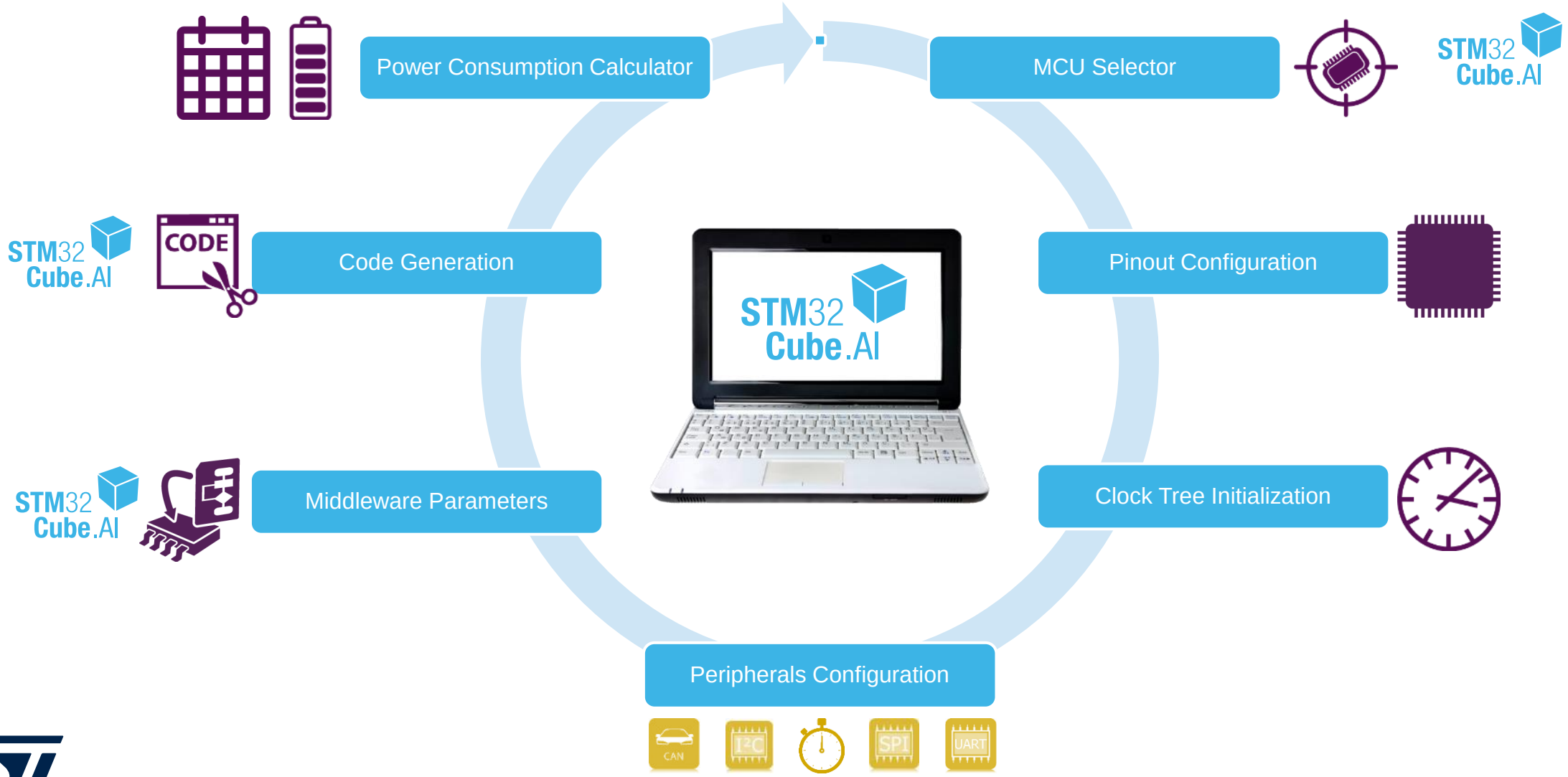
MORE INFO

STM32Cube.AI, an STM32CubeMX expansion



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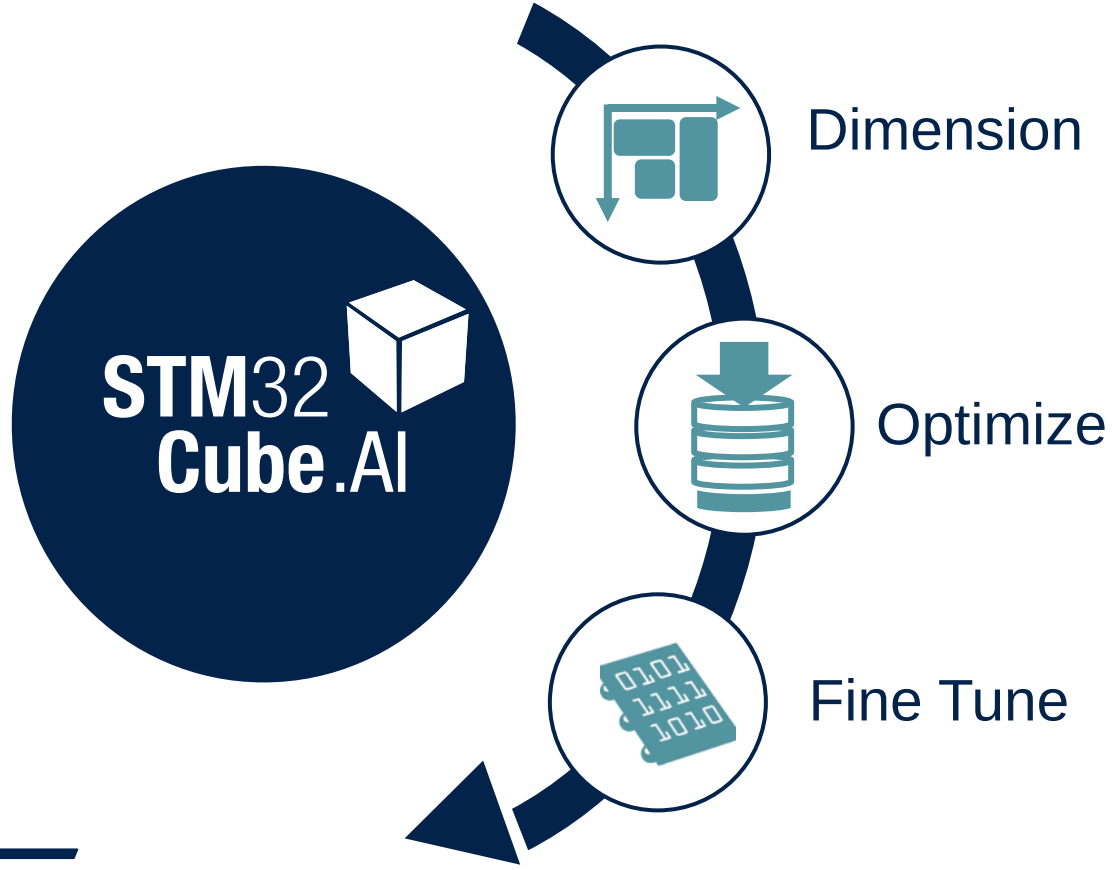
STM32Cube.AI main features

STM32Cube.AI is available both as graphical and command line interface



- ✓ Quickly assess model footprint requirements
- ✓ Select and configure MCU in STM32CubeMX
- ✓ Review model layers in STM32Cube.AI

- ✓ Generate C-code for pre-trained model
- ✓ Support quantized models to reduce RAM, flash and latency with minimal loss of accuracy
- ✓ Use light run-time libraries
- ✓ Optimize for performance

- ✓ Optimize memory allocation
- ✓ Fine control of weight mapping
- ✓ Split between internal and external memory
- ✓ Update model without full FW update

And quickly iterate thanks to on-target validation

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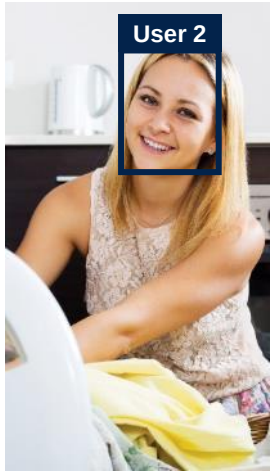
Computer Vision for STM32

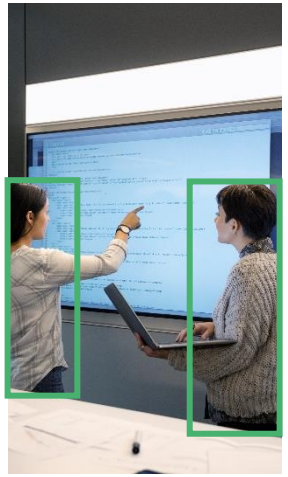
Give vision to your STM32 product for new features and add-on services

Food classification

Person presence detection



Face recognition



People counting

FP-AI-VISION1 v1.0 | FP-AI-VISION1 v2.0 | FP-AI-FACEREC v1.0 | FP-AI-VISION1 v3.0

Keras TensorFlowLite ONNX

PyTorch And more

STM32 Cube.AI ⟷ STM32 CubeMX

Optimized NN files

STM32.AI lib

Customer application

STM32.Vision lib

STM32 run-time

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Audio and sensing for STM32

Add sense to your STM32 product for new features and add-on services

Audio scene classication

Human Activity Motion recognition

FP-AI-SENSING1

Keras TensorFlowLite ONNX

PyTorch And more

STM32 Cube.AI ⟷ STM32 CubeMX

Optimized NN files

STM32.AI lib

Customer application

Audio / sensor processing

STM32 **run-time**

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Condition monitoring for STM32

Monitor STM32 equipment health for improved uptime and lower maintenance cost

Vibration monitoring for In-field retrofit of existing systems

Condition monitoring with current for build-in systems

FP-AI-NANOEDG1 v1.0 — Available on-demand

Get started using dedicated And industrial boards — STM32 CubeExpansion

NANOEDGE AI — STM32 Cube.AI ↔ STM32 CubeMX

Optimized NN files

STM32.AI lib

Customer application

ML models

STM32 **run-time**

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