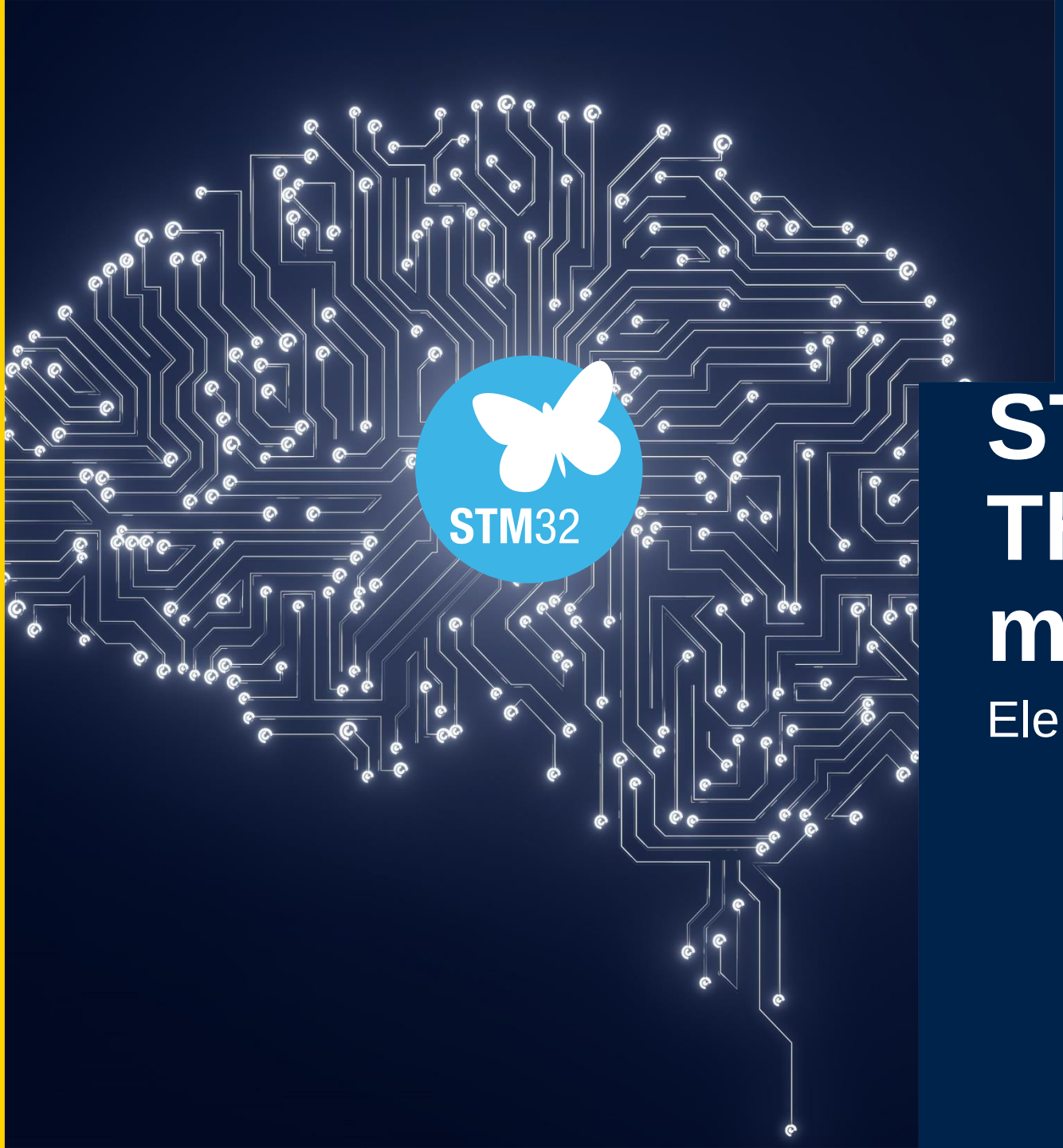


life.augmented

STM32N6
The superhero of microcontrollers

Elektor Webinar, February 2025

st.com/ai

The STM32 portfolio

Five product categories

Wireless MCU

Short- and long-range connectivity

Ultra-low-power MCU

Mainstream MCU

High-performance MCU

32-bit general-purpose microcontrollers: from 75 to 3,360 CoreMark score

Embedded MPU

32- and 64-bit microprocessors





Enabling edge AI solutions

Scalable security

MPU portfolio

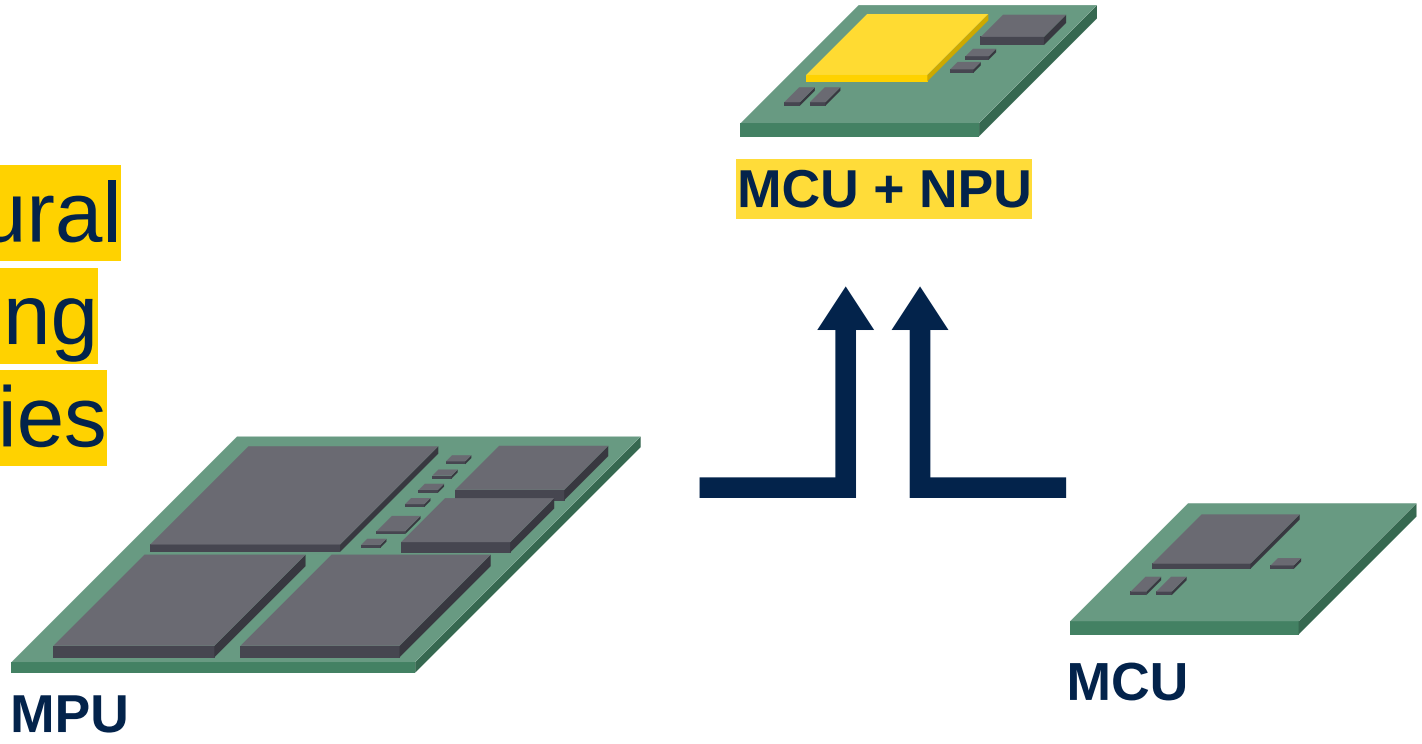
MCU portfolio

life.augmented

Enabling unmatched edge AI performance on an MCU

Benefit from extended neural network computing capabilities while leveraging the advantages of an MCU.

High neural processing capabilities



Small footprint

Lower power

Lower cost

Lower BOM

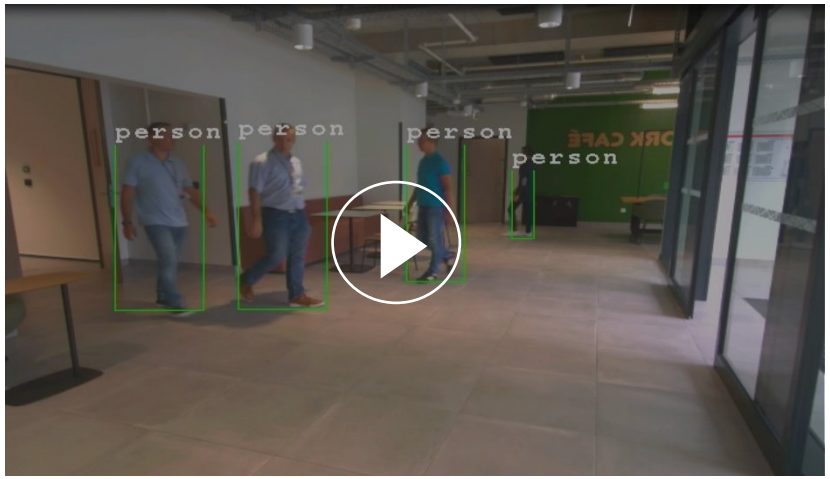
Faster boot/wkup

life.augmented

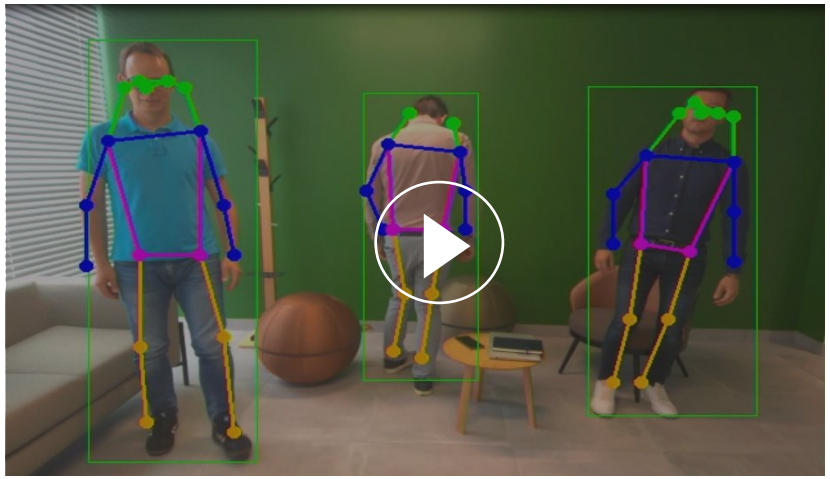
How the STM32N6 changes the game

An MPU-like end-user experience. Available on an MCU.

People detection



Pose estimation

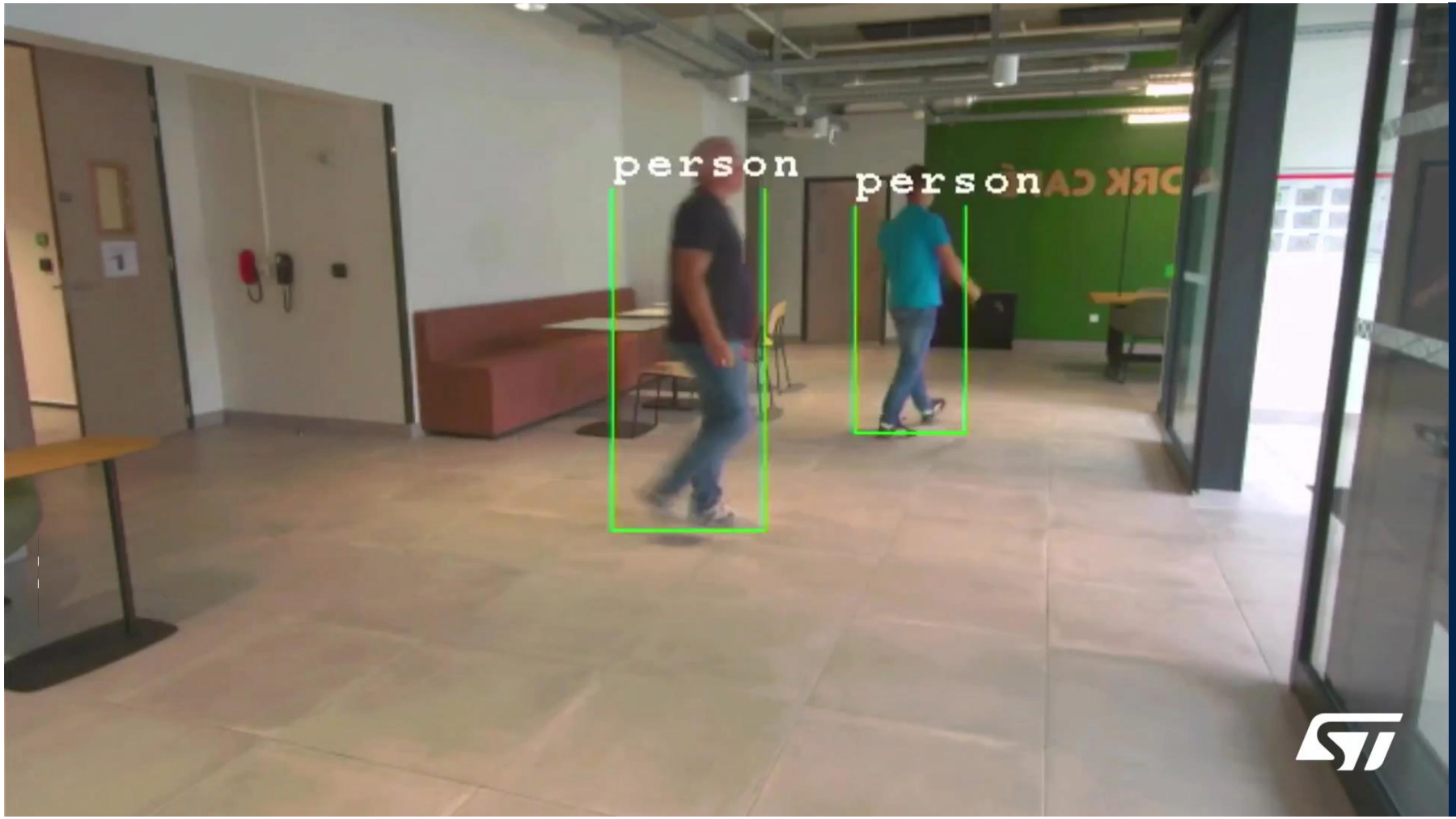


Hand landmark

Watch all videos on YouTube

life.augmented

High-accuracy people detection at a distance in varied ambient conditions



KEY METRICS

Yolo v8

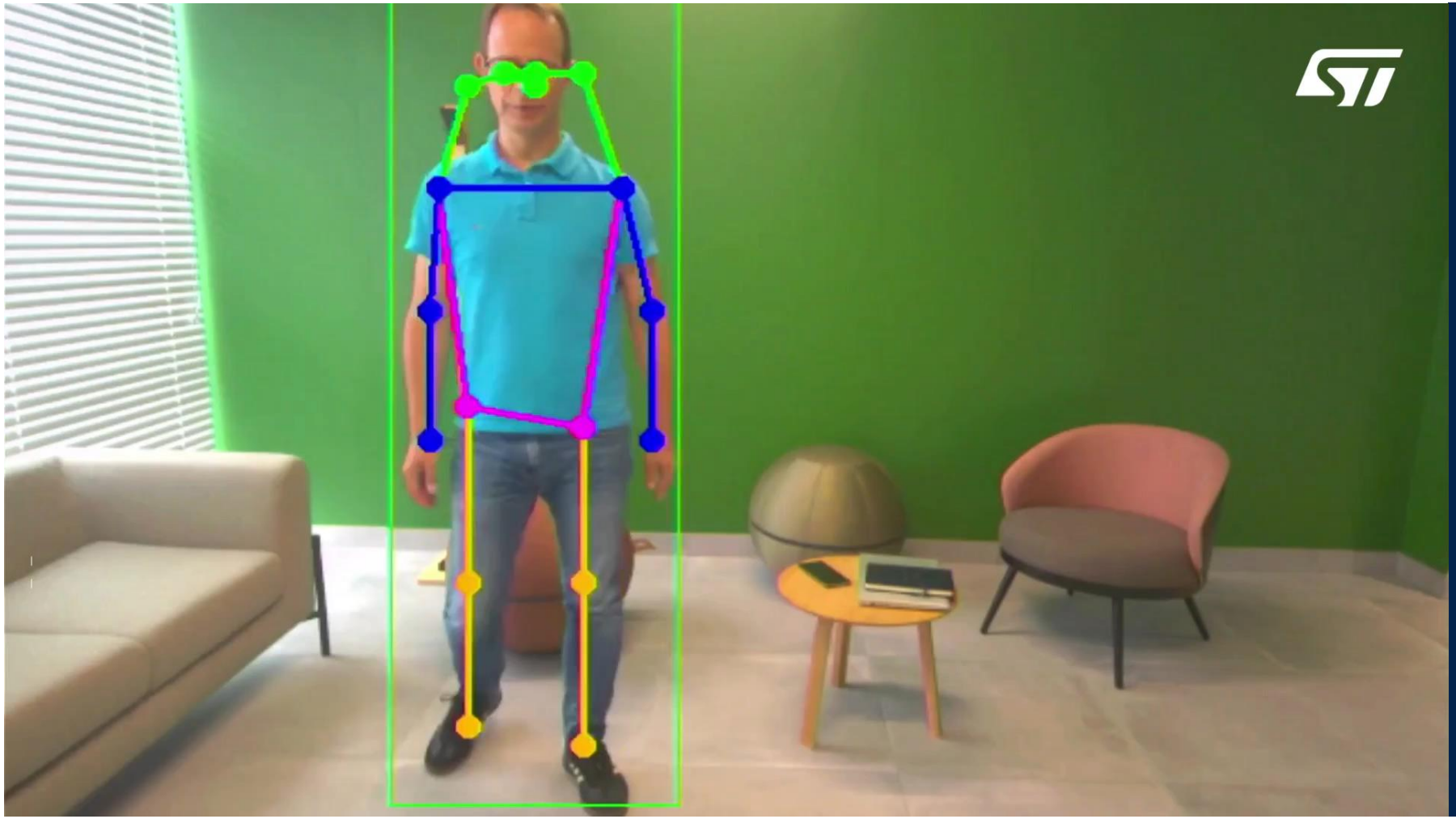
- 320 x 320
- 26 FPS
- 2.9 MB weights
- 1.6 MB activations

KEY APPLICATIONS

- Smart doorbells
- Room occupancy
- Alarm systems

life.augmented

High-accuracy multipose estimation



KEY METRICS

Yolo v8n

- 256 x 256
- 26 FPS
- 3.35 MB weights
- 2.59 MB activations

KEY APPLICATIONS

- Behavior analysis
- Activity monitoring
- Fall detection

life.augmented

Precise system control with hand landmark

KEY METRICS
(Two models in parallel)

Palm detector
- 192 x 192
- 1.1 MB weights
- 1.1 MB activations

Hand landmark
- 224 x 224
- 3.2 MB weights
- 1 MB activations

KEY APPLICATIONS

- Touchless HMIs
- Smart appliances
- Smart industry

life.augmented

STM32N6 feature overview

Dedicated embedded neural processing unit (NPU)

- 600 GOPS NPU
- 3 TOPS/W power consumption

Arm® Cortex®- M55 core

- 1280 DMIPS / 3360 CoreMark
- New DSP extensions (MVE)

Embedded RAM

- 4.2 Mbytes of embedded RAM for real-time data processing and multitasking

Computer vision pipeline

- Parallel and MIPI CSI-2 camera module I/F
- Dedicated image processor (ISP)

Extended multimedia capabilities

- 2.5D graphics accelerator
- H.264 encoder, JPEG encoder/decoder

Extended security features

- Arm® TrustZone® for the Cortex®-M55 core and the NPU
- Target certifications SESIP3, PSA L3

life.augmented

* 600 GOPS NPU vs 1 GOPS NN peak processing capabilities on STM32H7

STM32N6x7 and STM32N6x5 MCUs

Embedded memories

- 4.2 MB Contiguous RAM
- BOOT 128KB
- 8 kB Backup RAM
- 4 kB Debug RAM

External memory interfaces

- Hexa-SPI
- Octo-SPI
- 2x SD/SDIO /MMC
- Flexible Memory Controller (PSRAM, SDRAM, NOR, NAND, TFT-LCD)

Camera pipeline

- MIPI CSI-2, 2 lanes Camera I/F Parallel 16b With PSSI
- Image Signal Processor

Graphics & multimedia

- Chrom-ART Accelerator
- H.264 Encoder
- Chrom-GRC
- JPEG hardware accelerator
- NeoChrom Accelerator
- LTDC/TFT-LCD Display Controller

Arm® Cortex®-M55 800 MHz
TrustZone®
MVE

ST Neural-ART accelerator 600 Gops

System

- 96-bit unique ID
- Watchdogs
- Cyclic Redundancy Check (CRC)
- XTAL & Internal osc.

Security

- Secure boot
- Secure RTC
- Analog true RNG
- Crypto/Hash
- Tampering
- OTP Fuses 8 KB

Connectivity

- 3x CAN FD
- 2x USB 2.0 D/H HS + HS PHY
- 1x UCPD controller
- 3x I²C + 2x I3C (SDR)
- 5x UART, 5x USART
- 6x SPI (incl. 4x I2S)
- 1x ULP UART
- 1x Gbit Ethernet with TSN

Audio

- SPDIF-RX/TX
- 2x SAI
- 1x MDF (6 Filters)
- 1X ADF filter (with SAD)

Analog

- Digital Temperature Sensor
- 2 x 12-bit ADC 5 MSPS

Timers/Control

- 2x 16-bit motor control PWM synchronized AC timer
- 12x 16-bit timer
- 5x 16-bit LP timer
- 4x 32-bit advanced timers

Leading edge MCU core

Neural processing unit (STM32N6x7 MCUs only)

Large embedded memory + flexible I/F

Dedicated camera pipeline

Extended multimedia capabilities

Advanced & certified security

life.augmented

From DMIPS to TOPS, the paradigm shift
Opening a new range of embedded AI applications

- Object segmentation localization
- Pose estimation
- Object classification
- Speech recognition
- Sound analysis
- Face/people detection
- Wake word
- Time series classification
- Anomaly detection

STM32 Cores
(Arm® Cortex® -M)

Neural-ART Accelerator™

Mono-modality workloads	**Multi-modality workloads**
Static single subjects	**Faster moving multiple subject**
Low power	**High efficiency**
Optimal light conditions	**Open light conditions**
Acceptable precision	**High precision**
Low resolution and framerate	**Higher resolution and framerate**

life.augmented

Embedding innovation across product segments

Drones
Flying & landing

Smart industry
Anomaly detection

Smart homes
Event detection

Smart farming
Animal well-being

Personal healthcare
Body measurements

White goods
Smart control

Automotive
Environment sensing

Smart buildings
Building automation

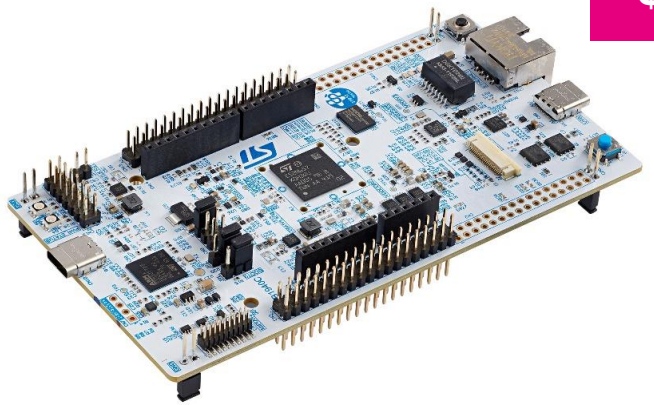
Robots
Collision detection

Personal electronics
Wearables

life.augmented

Development tools for STM32N6 series

Jump-start your evaluation, prototyping, and design



*** $56.25**

NUCLEO-N657X0-Q

Affordable prototyping

STLINK v3, ST morpho, ARDUINO®, MIPI CSI-2 connector, USB 2.0, 1GB Ethernet

Camera connector compatible with Raspberry.

*** $185**

STM32N6570-DK

Advanced prototyping including AI

STLINK v3, ST morpho, Arduino®, MIPI connector, USB 2.0, 1 Gbyte Ethernet, 32 Mbytes HexaRAM, Audio Jack, SD card

*** $77**

**Recommended resale price (RRP)*

B-CAMS-IMX expansion board

Rolling shutter camera, M12 removable lens, multizone direct Time-of-Flight sensor, inertial motion unit, Raspberry Pi compatible 22-pin connector.

Included in discovery kit.

A comprehensive ST camera offer to complete your STM32N6 design

Complete your computer vision setup with ST BrightSense advanced camera image sensors

*** $55**

STEVAL-55G1MBI camera board

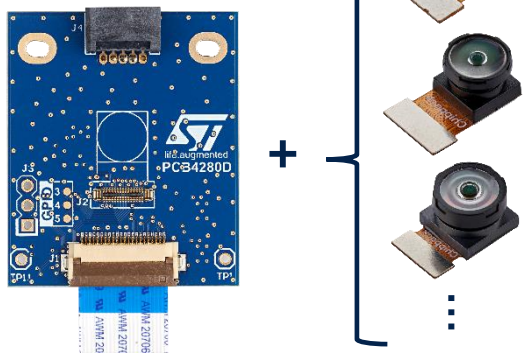
0.56MP smart global shutter camera (ST VD55G1 sensor), M12 removable lens, 22-pin connector & flex cable

*** $55**

STEVAL-66GYMAI camera board

1.5MP global shutter camera (ST VD66GY sensor), M12 removable lens, 22-pin connector & flex cable

*** $37**



STEVAL-CAM-M0I module board

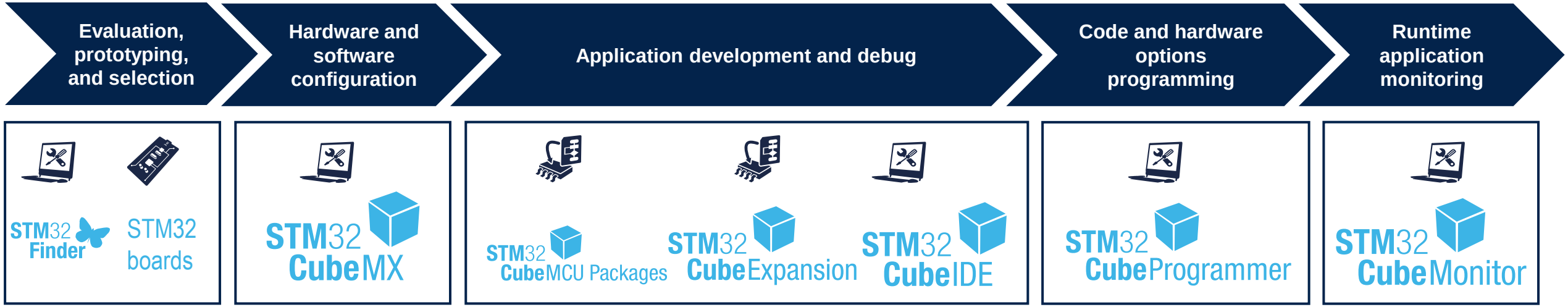
Camera module board for plugging any ST BrightSense promodule, 22-pin connector & flex cable

**Recommended resale price (RRP)*

More about ST BrightSense image sensor here

Leveraging STM32Cube framework

Tools and software supporting you during all your design steps

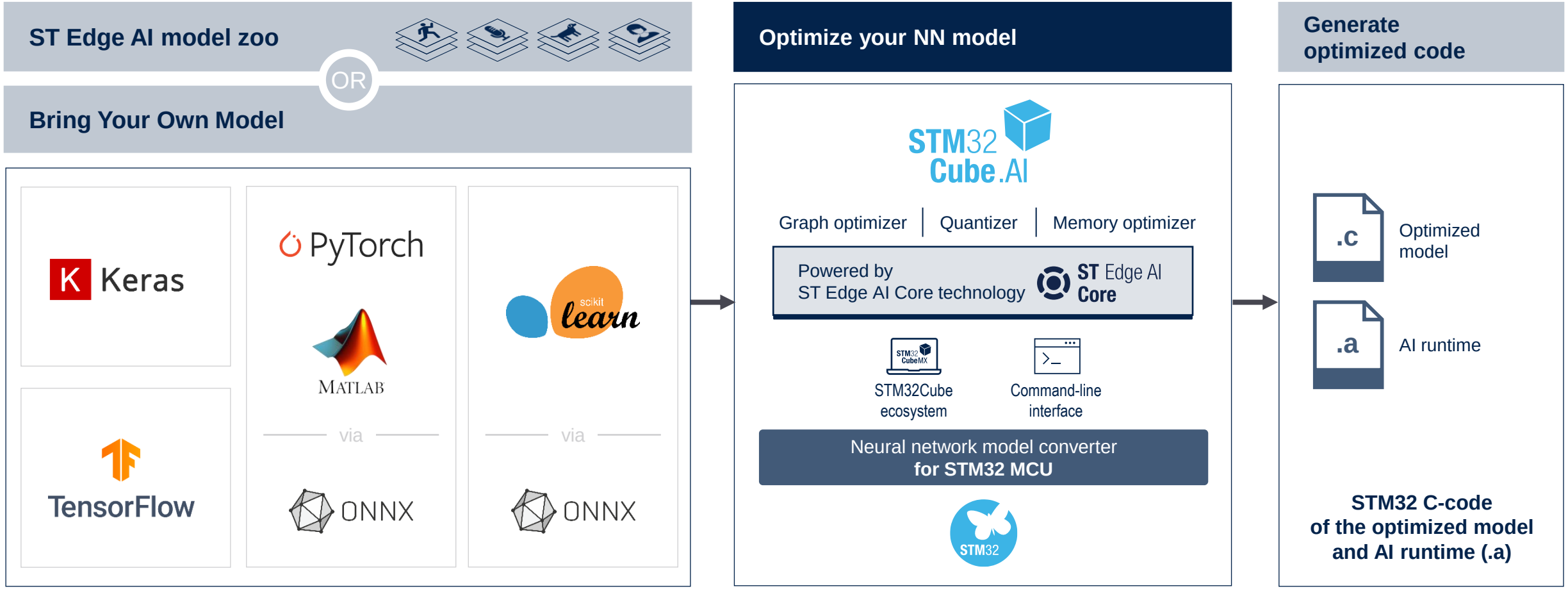


Complemented with open-source frameworks and partner solutions

FreeRTOS, ThreadX, Zephyr, IAR, Arm Keil, Visual Studio Code

life.augmented

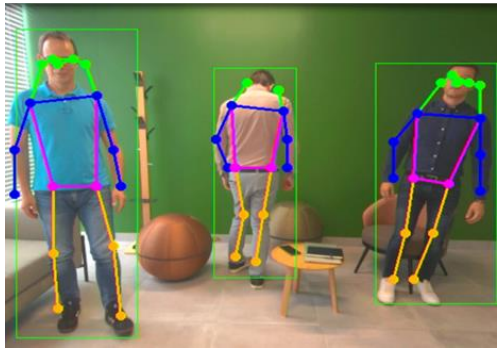
STM32Cube.AI



Get started with edge AI examples

People detection

- Application example showing a people detection use case.
- Demonstrating typical AI computer vision application: camera capture, pre-processing, single model inference and post-processing.
- RTOS-based application example.



Multipose estimation

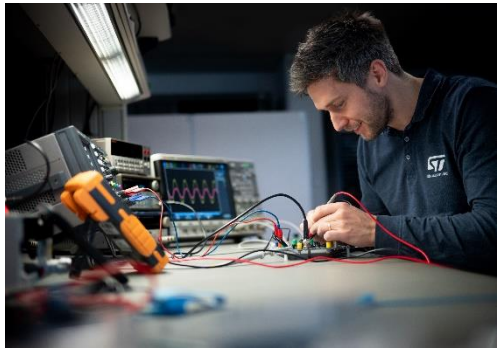
- Application like people detection but built around a multi-pose estimation use case.
- RTOS-based application example.

Hand landmark detection

- Application example showing hand landmark detections.
- Demonstrating the execution of two NN models consecutively.
- RTOS-based application example.

H264 encoding / USB UVC streaming

- Demonstrating a more complete application involving several STM32N6 multimedia features: NPU to perform the inference, H264 encoding and USB video device class stream output data to a PC.
- RTOS-based application example.



Power measurement

- Demonstrating low power optimizations.
- Enabling easy power measurement on STM32N6 discovery board.
- Bare-metal application example.

Access the source code here

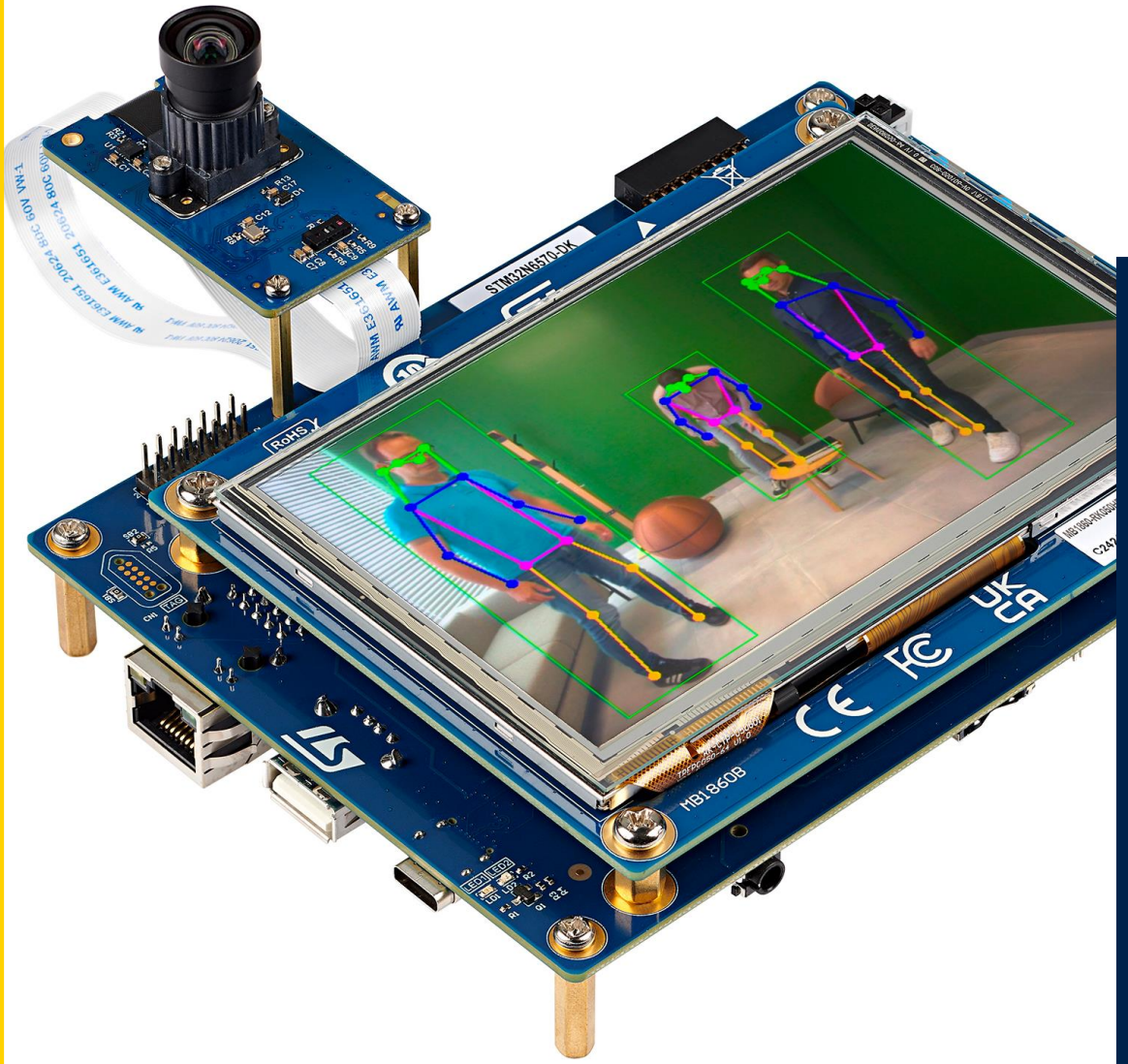
life.augmented

Our technology starts with You

Contact us at edge.ai@st.com

Find out more at st.com/STM32N6

life.augmented



life.augmented

Getting started with AI and the STM32N6 with ST Model Zoo

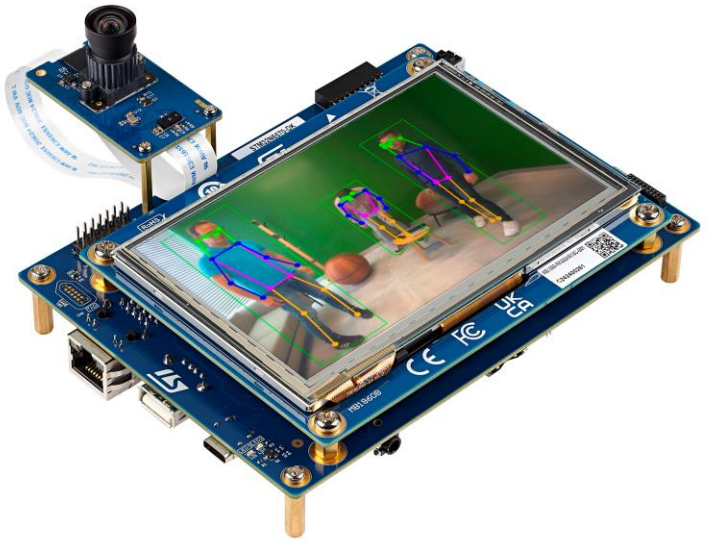
Julian ETTARIAN

Application engineer

Introduction

How can we deploy AI to my STM32N6?

- Where to get models?
- How to train models?
- How to embed a model on a STM32N6?



ST Model Zoo

ST Model Zoo:
Collection of models for multiples use cases

ST Model Zoo Services:
Scripts for training, benchmark, quantization, deployment etc.

Link: https://github.com/STMicroelectronics/stm32ai-modelzoo

ST Edge AI Core

STM32 Cube.AI

ST Edge AI Core

ST Edge AI Developer Cloud

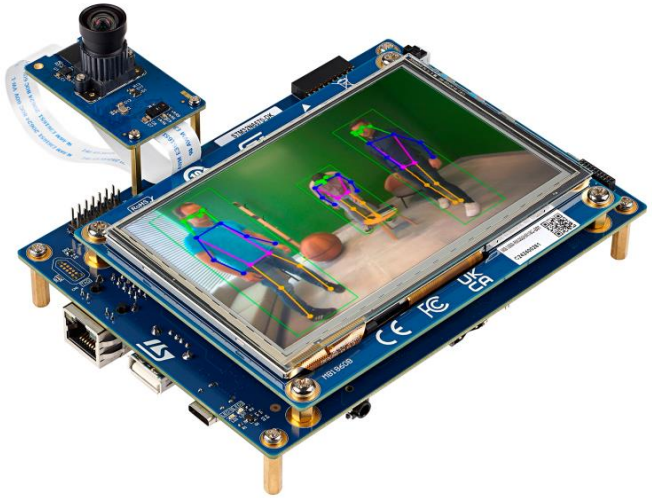
life.augmented

How to use ST Model Zoo

- Choose a use case
- Edit  user_config.yaml to define what you want to do
- Run  stm32ai_main.py to make it happens

Use cases in ST Model Zoo

- Audio Event Detection
- Image Classification
- Hand Posture
- Human Activity recognition
- Instance segmentation
- Object detection
- Pose estimation
- Semantic segmentation
- Speech enhancement



Operation modes

operation_mode attribute	Operations
`training`	Train a model from the variety of classification models in the model zoo **(BYOD)** or your own model **(BYOM)**
`evaluation`	Evaluate the accuracy of a float or quantized model on a test or validation dataset
`quantization`	Quantize a float model
`prediction`	Predict the classes some images belong to using a float or quantized model
`benchmarking`	Benchmark a float or quantized model on an STM32 board
`deployment`	Deploy a model on an STM32 board
`chain_tqeb`	Sequentially: training, quantization of trained model, evaluation of quantized model, benchmarking of quantized model
`chain_tqe`	Sequentially: training, quantization of trained model, evaluation of quantized model
`chain_eqe`	Sequentially: evaluation of a float model, quantization, evaluation of the quantized model
`chain_qb`	Sequentially: quantization of a float model, benchmarking of quantized model
`chain_eqeb`	Sequentially: evaluation of a float model, quantization, evaluation of quantized model, benchmarking of quantized model
`chain_qd`	Sequentially: quantization of a float model, deployment of quantized model

ST Model Zoo

DATA

ST Edge AI model zoo

Bring Your Own Model

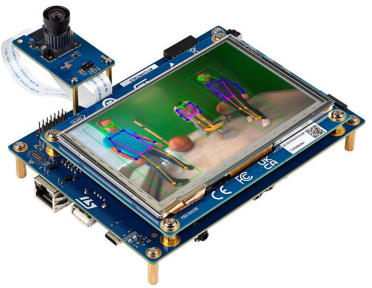
Training
Quantization
Evaluation

Python

Benchmark and Deployment

ST Edge AI Core

STM32 CubeIDE



.c Optimized model

.a AI runtime

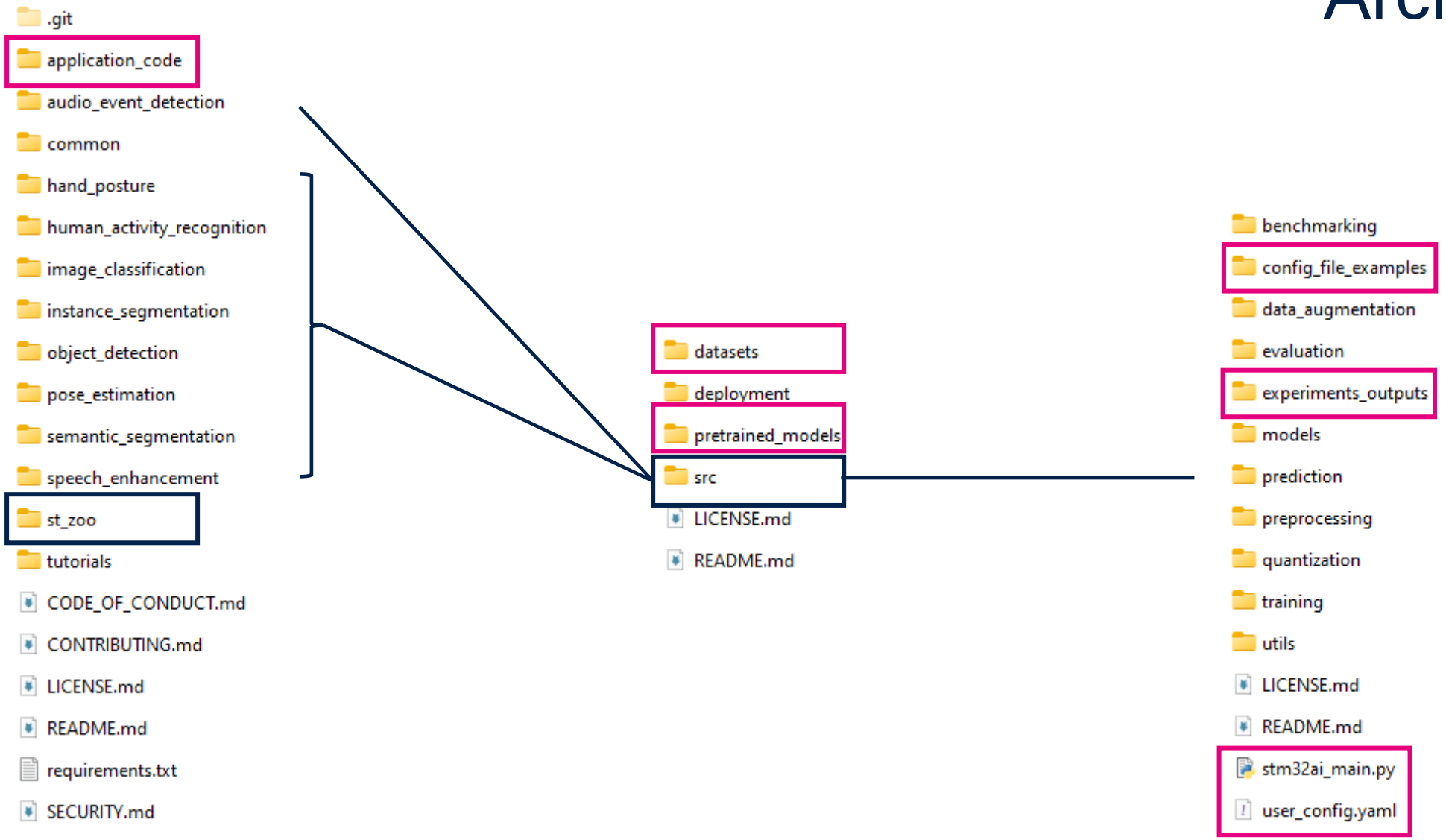
life.augmented

Model Zoo Setup

1. Clone ST Model Zoo Services
2. Follow the Before you Start to install all requirements
3. Get the N6 Getting Started applications and add it to ST Model Zoo
4. Install ST Edge AI Core and the NPU addon
5. Install STM32CubeIDE

ST Model Zoo Folder

Architecture

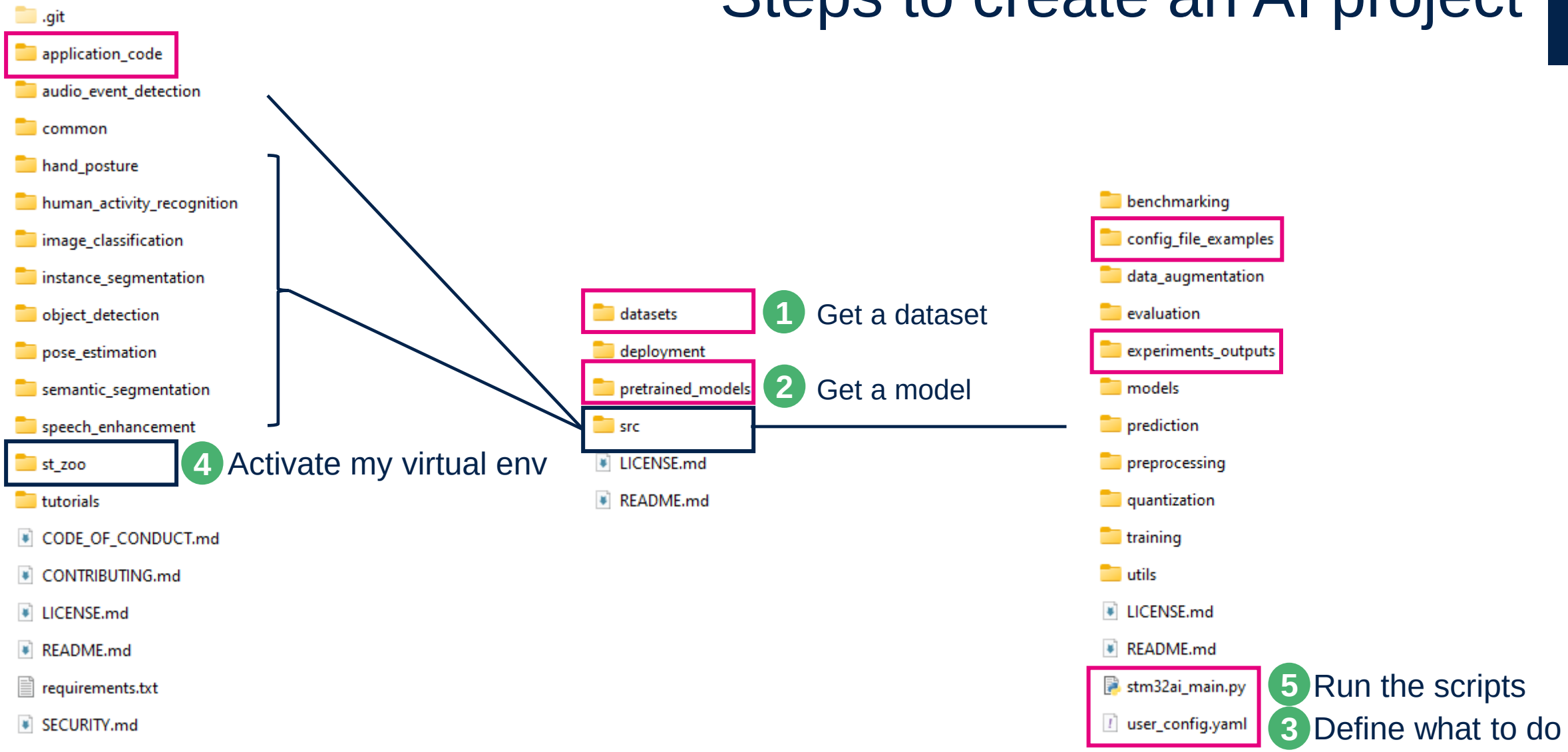


In each folder, you will find readme to help you

life.augmented

ST Model Zoo Folder

Steps to create an AI project



life.augmented

1. Get a dataset

Image classification:

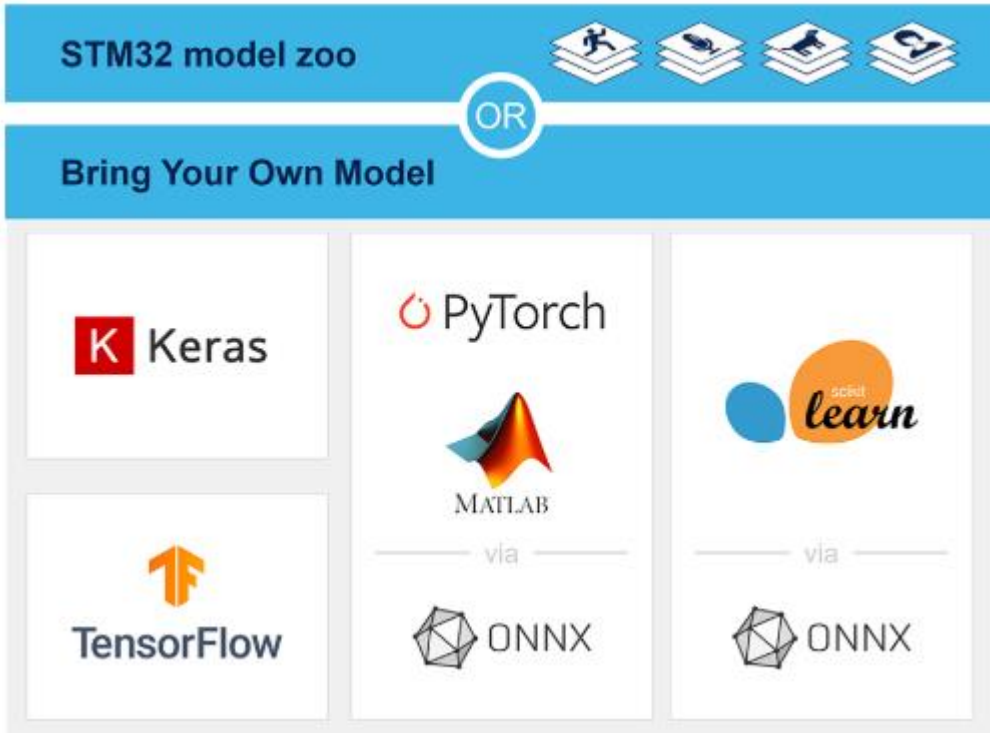
- datasets
- deployment
- pretrained_models
- src
- LICENSE.md
- README.md

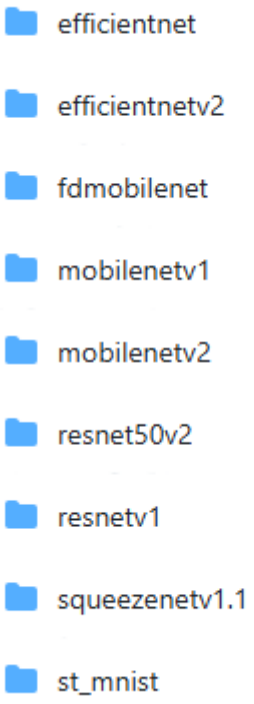
```
dataset_root_directory/
   class_a/
      a_image_1.jpg
      a_image_2.jpg
   class_b/
      b_image_1.jpg
      b_image_2.jpg
```

Required structure

life.augmented

2. Get a model





Model Zoo Image Classification Models

https://github.com/STMicroelectronics/stm32ai- modelzoo/tree/main/image_classification

3. user_config.yaml

Edit the user_config.yaml to define what you want to do:

Key parts to define:

- Model path
- Operation mode
- Class name
- Dataset paths
- Other parameters depending on the operation mode

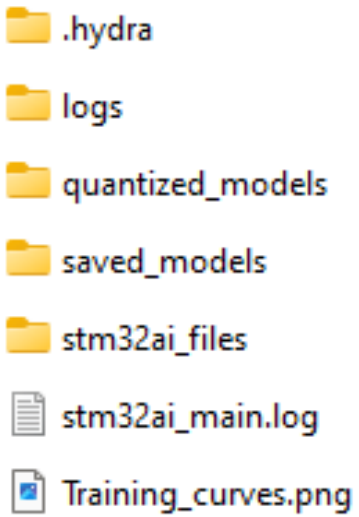
Tips:
Train -> Quantize & Benchmark -> Deploy

```yaml
general:
  project_name: imagenet
  model_path: ../pretrained_models/mobilenetv2/Public_pretrainedmodel_public_dataset/ImageNet/mobilenet_v2_0.35_128/mobilenet_v2_0.35_128.h5
  logs_dir: logs
  saved_models_dir: saved_models
  display_figures: false
  global_seed: 127
  gpu_memory_limit: 24
  num_threads_tflite: 12

operation_mode: chain_eqeb

dataset:
  name: imagenet
  class_names:
  test_path: "/local/datasets/ic_imagenet_2012/validation/"
  quantization_path: "/local/datasets/ic_imagenet_2012/quantization/"

preprocessing:
  rescaling: { scale: 1/127.5, offset: -1 }
  resizing:
    interpolation: nearest
    aspect_ratio: fit
  color_mode: rgb

quantization:
  quantizer: TFlite_converter
  quantization_type: PTQ
  quantization_input_type: uint8
  quantization_output_type: float
  export_dir: quantized_models

tools:
   stedgeai:
      version: 10.0.0
      optimization: balanced
      on_cloud: True
      path_to_stedgeai: C:/Users/<XXXXX>/STM32Cube/Repository/Packs/STMicroelectronics/X-CUBE-AI/<*.*.*>/Utilities/windows/stedgeai.exe
   path_to_cubeIDE: C:/ST/STM32CubeIDE_<*.*.*>/STM32CubeIDE/stm32cubeide.exe
```

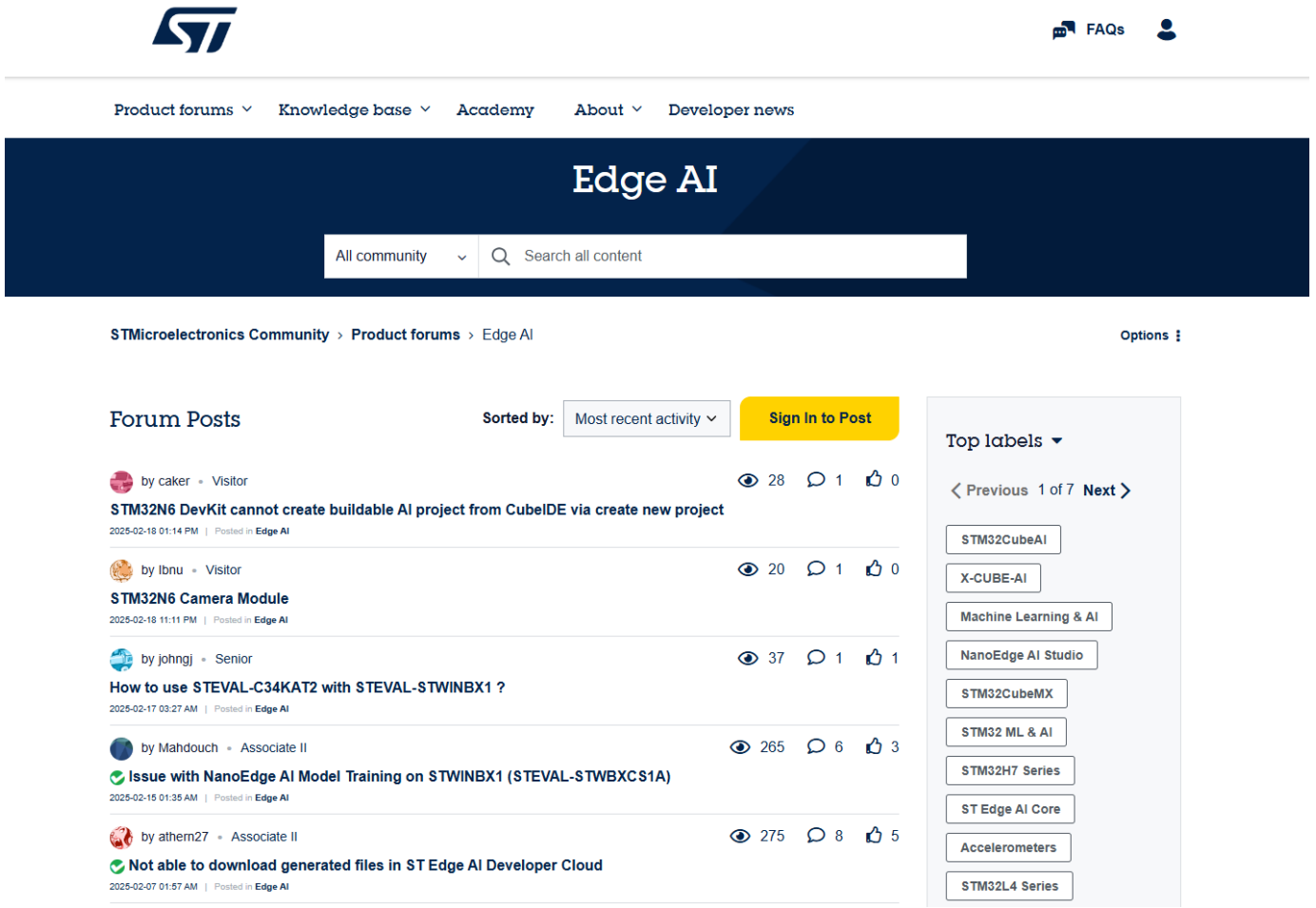
4. Run the experiment

- Open a terminal
- Activate the virtual env
- Run the stm32ai_main.py (in /src)

You get the results in /src/experiments_outputs



Seek help on ST Community – Edge AI



https://community.st.com/t5/edge-ai/bd-p/edge-ai

life.augmented

Elektor contest

Get Ready for the STM32N6 Challenge!

Timeline:

- **Challenge Launch:** 10 January 2025
- **Exclusive STM32N6 Webinar:** 20 February 2025
- **Board Shipment Begins:** 28 February 2025
- **Deadline for Project Ideas:** 30 April 2025
- **Deadline for Final Project Submissions:** 1 September 2025
- **Nominees Revealed:** 30 September 2025
- **Grand Winner Announcement:** November 2025 - Stay Tuned!

https://www.elektormagazine.com/stm32ai

Links

ST Model Zoo: https://github.com/STMicroelectronics/stm32ai-modelzoo

ST Model Zoo Services: https://github.com/STMicroelectronics/stm32ai-modelzoo-services

Application code examples: https://www.st.com/en/development-tools/stm32n6-ai.html

ST Edge AI Core https://www.st.com/en/development-tools/stedgeai-core.html

ST Edge AI Core and N6 documentation: https://stedgeai-dc.st.com/assets/embedded-docs/index.html

ST Community Edge AI: https://community.st.com/t5/edge-ai/bd-p/edge-ai

Our technology starts with You

Find out more at www.st.com

life.augmented