

# eIQ MACHINE LEARNING SOFTWARE DEVELOPMENT ENVIRONMENT

eIQ Machine Learning (ML) software development environment leverages inference engines, neural network compilers, optimized libraries, deep learning toolkits and open-source technologies for easier, more secure system-level application development and ML algorithm enablement, and auto-quality ML enablement.

## OVERVIEW

The NXP® eIQ (“edge intelligence”) ML software environment provides the key ingredients to do inference with neural network (NN) models on embedded systems and deploy ML algorithms on NXP microprocessors and microcontrollers for edge nodes. It includes inference engines, NN compilers, libraries, and hardware abstraction layers that support Google TensorFlow Lite, Glow, Arm® NN, Arm CMSIS-NN, and OpenCV.

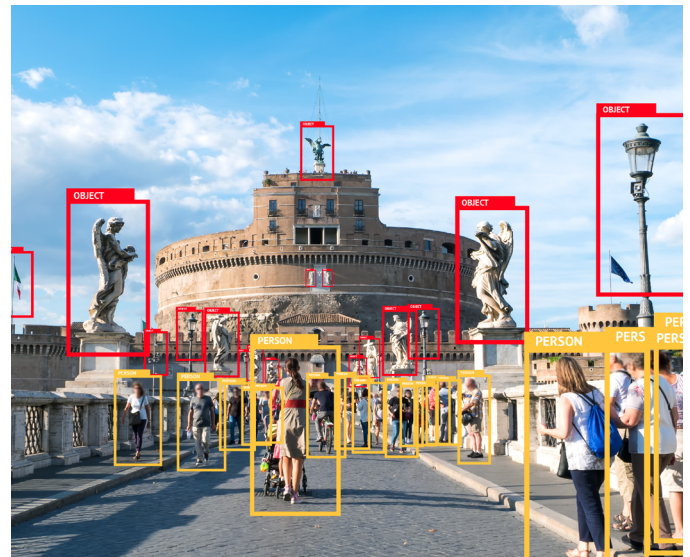
With NXP’s i.MX applications processors and i.MX RT crossover processors based on Arm Cortex®-A and M cores, respectively, embedded designs can now support deep learning applications that require high-performance data analytics and fast inferencing.

eIQ software includes a variety of application examples that demonstrate how to integrate neural networks into voice, vision and sensor applications. The developer can choose whether to deploy their ML applications on Arm Cortex A, Cortex M, and GPUs, or for high-end acceleration on the neural processing unit of the i.MX 8M Plus.

## APPLICATIONS

eIQ ML software helps enable a variety of vision and sensor applications working in conjunction with a collection of device drivers and functions for cameras, microphones and a wide range of environmental sensor types.

- Object detection and recognition



- Voice command and keyword recognition
- Anomaly detection
- Image and video processing
- Other AI and ML applications include:
  - Smart wearables
  - Intelligent factories and smart buildings
  - Healthcare and diagnostics
  - Augmented reality
  - Logistics
  - Public safety

## FEATURES

- Open-source inference engines
- Neural network compilers
- Optimized libraries
- Application samples
- Included in NXP’s Yocto Linux® BSP and MCUXpresso SDK software releases

## NXP eIQ MACHINE LEARNING SOFTWARE - INFERENCE ENGINES BY CORE

eIQ™ Inference Engine Deployment (Public version; Subject to Change; 7/6/20)												
NXP eIQ Inference Engines and Libraries	CMSIS-NN	TensorFlow Lite	Glow	arm NN	ONNX	TensorFlow Lite	OpenCV	arm NN	TensorFlow Lite	arm NN	TensorFlow Lite	
Compute Engines	Cortex-M		DSP	Cortex-A				GPU		NPU		
i.MX 8M Plus	---	---	---	---	✓	✓	✓	✓	---	---	✓	✓
i.MX 8QM	---	---	---	---	✓	✓	✓	✓	✓	✓	NA	NA
i.MX 8QXP	---	---	---	---	✓	✓	✓	✓	✓	✓	NA	NA
i.MX 8M Quad/Nano	---	---	---	---	✓	✓	✓	✓	✓	✓	NA	NA
i.MX 8M Mini	---	---	---	---	✓	✓	✓	✓	NA	NA	NA	NA
i.MX RT600	---	---	---	✓	NA	NA	NA	NA	NA	NA	NA	NA
i.MX RT1050/1060	✓	✓	✓	NA	NA	NA	NA	NA	NA	NA	NA	NA

NA = Not Applicable

--- = Not Supported

### OPEN-SOURCE INFERENCE ENGINES

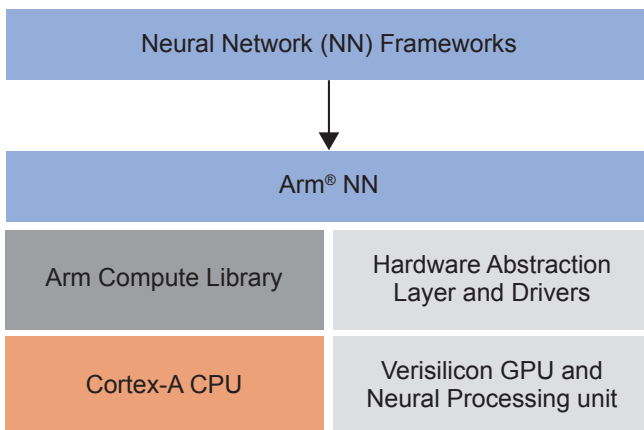
The following inference engines are included as part of the eIQ ML software development kit and serve as options for deploying trained NN models.

#### Arm NN INFERENCE ENGINE

eIQ ML software supports Arm NN SDK on the i.MX 8 series applications processor family and is available through the NXP Yocto Linux-based releases.

Arm NN SDK is open-source, inference engine software that allows embedded processors to run trained deep learning models. This tool utilizes the Arm Compute Library to optimize neural network operations running on Cortex-A cores (using Neon acceleration). NXP has also integrated Arm NN with proprietary drivers to support the i.MX GPUs and i.MX 8M Plus NPU.

#### eIQ SOFTWARE FOR Arm NN

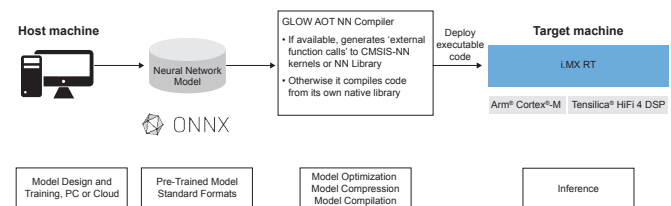


### GLOW

eIQ ML software supports Glow neural network compiler on the i.MX RT crossover MCU family and is available in the MCUXpresso SDK.

Glow is a machine learning compiler that enables ahead-of-time compilation for increased performance and smaller memory footprint as compared to a traditional runtime inference engine. NXP offers optimizations for its i.MX RT crossover MCUs based on Cortex-M cores and Cadence® Tensilica® HiFi 4 DSP.

#### eIQ FOR GLOW NEURAL NETWORK COMPILER

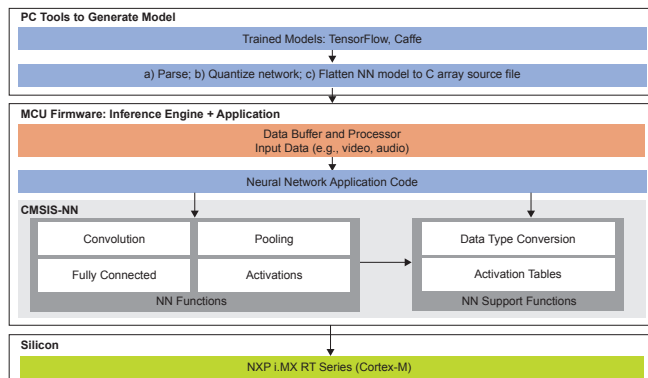


## Arm CMSIS-NN

eIQ ML software supports Arm CMSIS-NN on the i.MX RT crossover processor family and is fully integrated and available in the MCUXpresso SDK.

Arm CMSIS-NN is a collection of efficient neural network kernels used to maximize the performance and minimize the memory footprint of neural networks on Arm Cortex-M processor cores. Although it involves more manual intervention than TensorFlow Lite, it yields faster performance and a smaller memory footprint.

### eIQ SOFTWARE WITH Arm CMSIS-NN

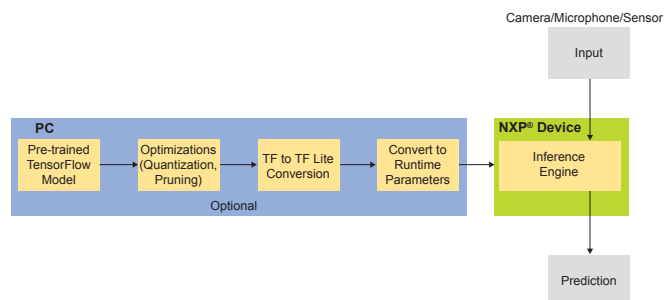


## TENSORFLOW LITE

eIQ ML software supports TensorFlow Lite on the i.MX 8 applications processor and i.MX RT crossover processor families, and is available through Yocto and MCUXpresso environments, respectively.

TensorFlow Lite is a set of tools that allows users to convert and deploy TensorFlow models to perform faster inferences. It requires less memory than TensorFlow, making it a good match for resource-constrained, low-power devices.

### eIQ SOFTWARE FOR TENSORFLOW LITE

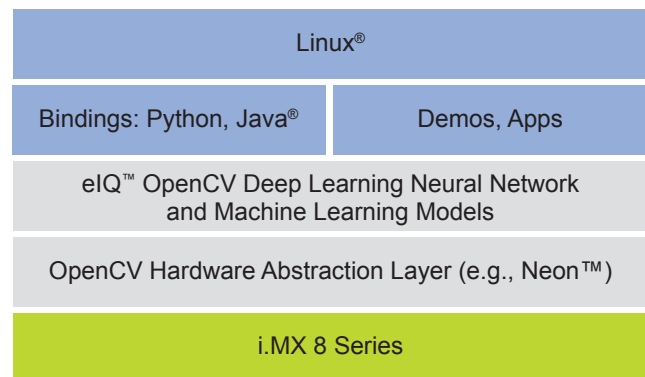


## OPENCV NEURAL NETWORK AND ML ALGORITHM SUPPORT

eIQ ML software supports the Open-Source Computer Vision Library (OpenCV) on the i.MX 8 series applications processor family and is available through the NXP Yocto-Linux-based releases.

OpenCV consists of more than 2,500 optimized algorithms for processing neural networks and machine learning algorithms for image processing, video encoding/decoding, video analysis, object detection, and processing of neural networks. This solution utilizes Arm Neon™ for acceleration.

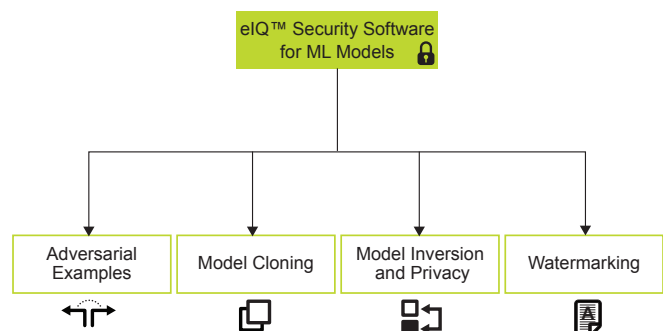
### eIQ SOFTWARE FOR OPENCV NEURAL NETWORK AND MACHINE LEARNING ALGORITHMS



## SECURITY SOFTWARE FOR MACHINE LEARNING

In addition to system-level security, NXP's eIQ Machine Learning (ML) embedded software development environment supports security measures to protect machine learning applications, including protection against model cloning, model private data extraction invasion, and adversarial attacks. This software is available through NXP Yocto Linux-based BSP releases.

### IMPROVE SECURITY OF ML SYSTEMS



## SOFTWARE AVAILABILITY

eIQ ML software currently supports NXP i.MX and i.MX RT processors, with additional MCU/MPU support planned in the future.

- eIQ ML software for i.MX applications processors is supported on the current Yocto Linux release
- eIQ ML software for i.MX RT crossover processors is fully integrated into the MCUXpresso SDK release

## GET STARTED:

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Document Number: EIQFS REV 2