Institución Universitaria
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Plataformas y Librerías

INTEGRACIÓN DE ML EN EMBEBIDOS Y EDGE COMPUTING

Somos Innovación Tecnológica con Sentido Humano

Alcaldía de Medellín

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Contenido

1. Librerías y plataformas
2. Machine Learning
3. Neural Networks

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TinyML plataformas y librerías

Table 4. TinyML Frameworks & Libraries.

Framework	Algorithms	Compatible Platforms	Publicly Available	Main Developer
emlearn	Random forest Decision tree Naive Gaussian Bayes Neural networks	AVR Atmega ESP8266 Linux	Yes	Specific developer
EmbML	SVM Decision tree Neural networks	Arduino Teensy	No	Research group
weka-porter	Decision tree	Nonconstrained platforms & multiple constrained	Yes	Specific developer
TinyMLgen	Neural networks	ARM Cortex-M ESP32	Yes	Specific developer
uTensor	Neural networks	mBed boards	Yes	Specific developer
FANN-on-MCU	Neural networks	ARM Cortex-M PULP	Yes	Research group
CMix-NN	Neural networks	ARM Cortex-M	Yes	Research group

TinyML plataformas y librerías

Table 5. TinyML Frameworks & Libraries (Continued).

Framework	Algorithms	Compatible Platforms	Publicly Available	Main Developer
MicroMLGen	SVM RVM	Arduino ESP32 ESP8266	Yes	Particular developer
m2cgen	LGBM Classifier Logistic regression Linear regression SVM Neural networks Decision tree Random Forest	Multiple constrained & nonconstrained platforms	Yes	Particular developer
AIfES	Neural networks	ARM Cortex-M4 Windows (DLL) STM32 F4 Series Arduino ATMega32U4 Raspberry Pi	No	Fraunhofer IMS

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TinyML plataformas y librerías

Table 5. TinyML Frameworks & Libraries (Continued).

Framework	Algorithms	Compatible Platforms	Publicly Available	Main Developer
CMSIS-NN	Neural networks	ARM Cortex-M	Yes	ARM
ELL	Neural networks	ARM Cortex-M ARM Cortex-A Arduino micro:bit	Yes	Microsoft
TensorFlow Lite	Neural networks	ARM Cortex-M	Yes	Google
ARM-NN	Neural networks	ARM Ethos Processor ARM Mali Graphics Processors ARM Cortex-A	Yes	ARM
STM 32Cube. AI	Neural networks	STM32	Yes	STMicroelectronics

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EMLearn

Classification:

eml_trees: sklearn.RandomForestClassifier, sklearn.ExtraTreesClassifier, sklearn.DecisionTreeClassifier

eml_net: sklearn.MultiLayerPerceptron, Keras.Sequential with fully-connected layers

eml_bayes: sklearn.GaussianNaiveBayes

Regression:

eml_trees: sklearn.RandomForestRegressor, sklearn.ExtraTreesRegressor, sklearn.DecisionTreeRegressor

eml_net: Keras.Sequential with fully-connected layers (emlearn.convert(model, method='loadable', return_type='regressor'))

Unsupervised / Outlier Detection / Anomaly Detection

eml_distance: sklearn.EllipticEnvelope (Mahalanobis distance)

eml_mixture: sklearn.GaussianMixture, sklearn.BayesianGaussianMixture

Feature extraction:

eml_audio: Melspectrogram

https://github.com/emlearn/emlearn

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Otras librerias vigentes

https://github.com/lucastsutsui/EmbML
https://github.com/eloquentarduino/micromlgen
https://github.com/BayesWitnesses/m2cgen
https://github.com/Fraunhofer-IMS/AIfES_for_Arduino

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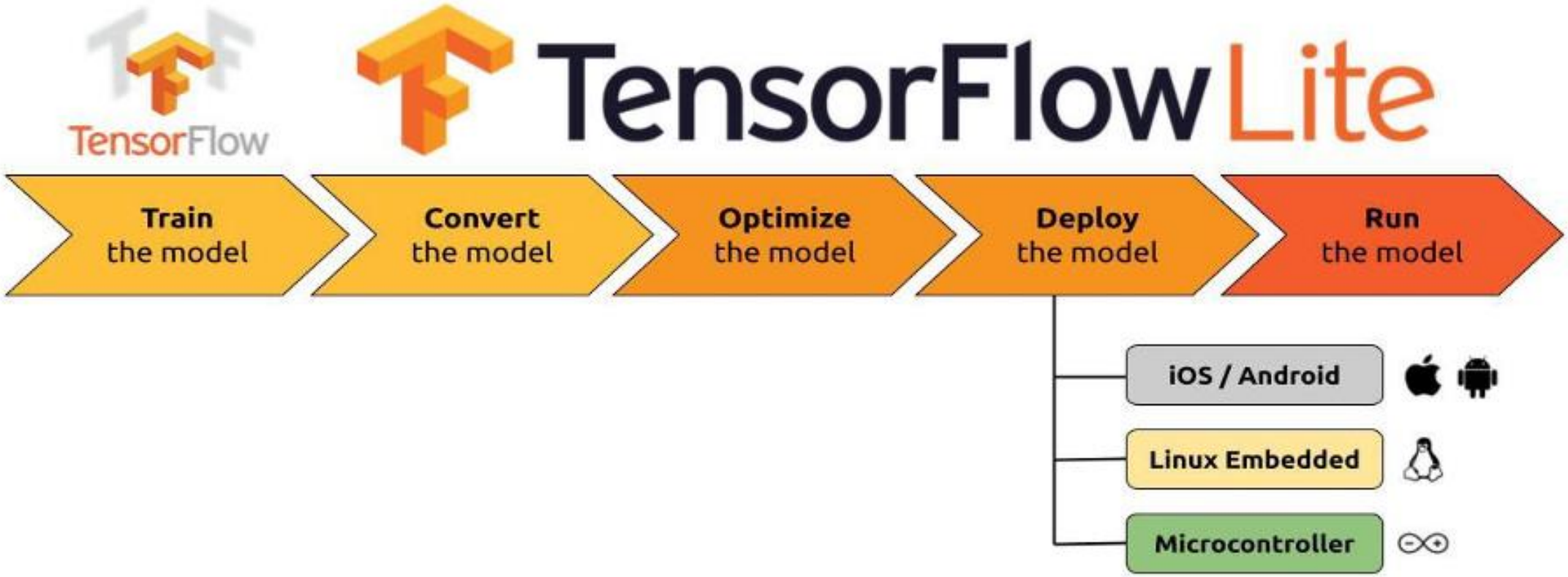
TFLite y TFLite-micro



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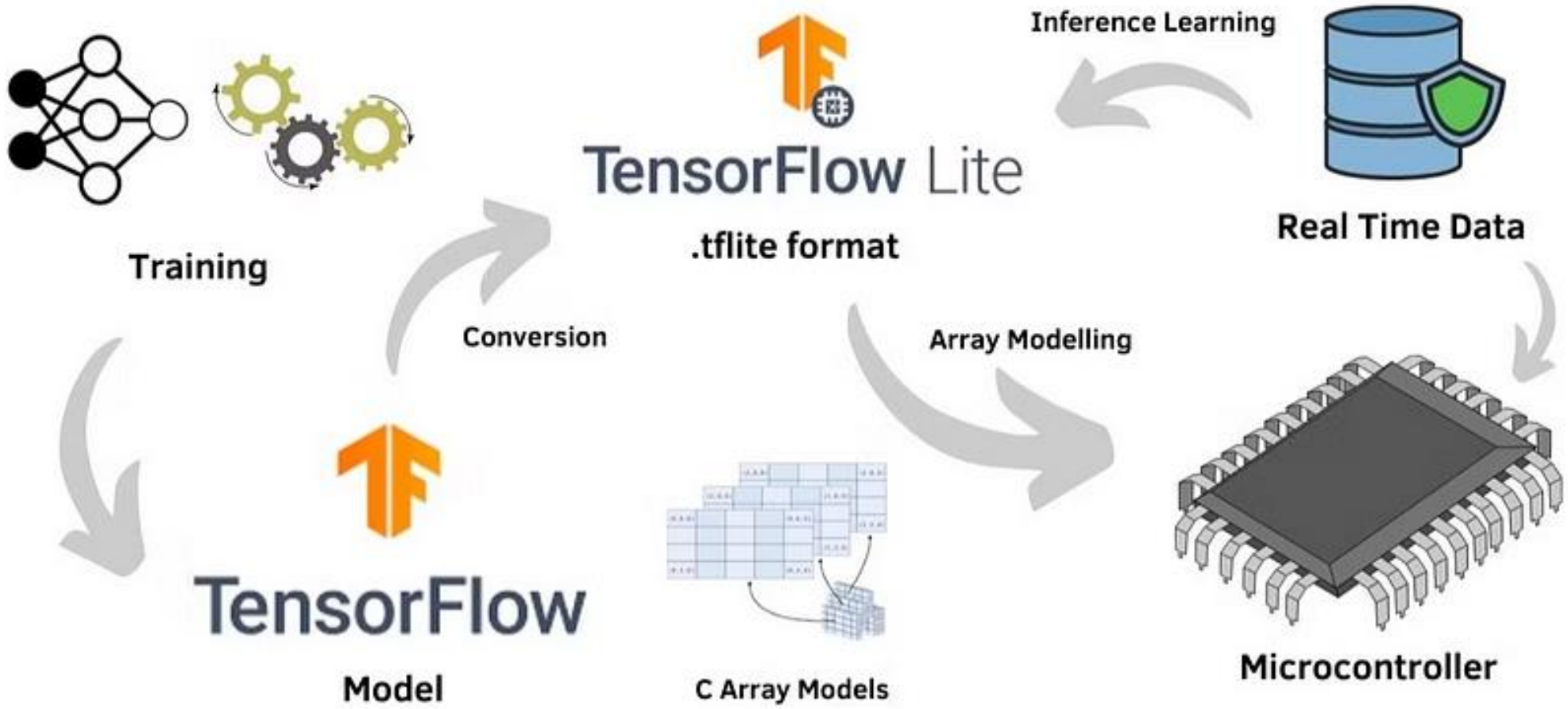
TFLite y TFLite-micro



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Otras librerías vigentes

https://github.com/microsoft/ELL
https://github.com/ARM-software/CMSIS-NN
https://github.com/ARM-software/armnn

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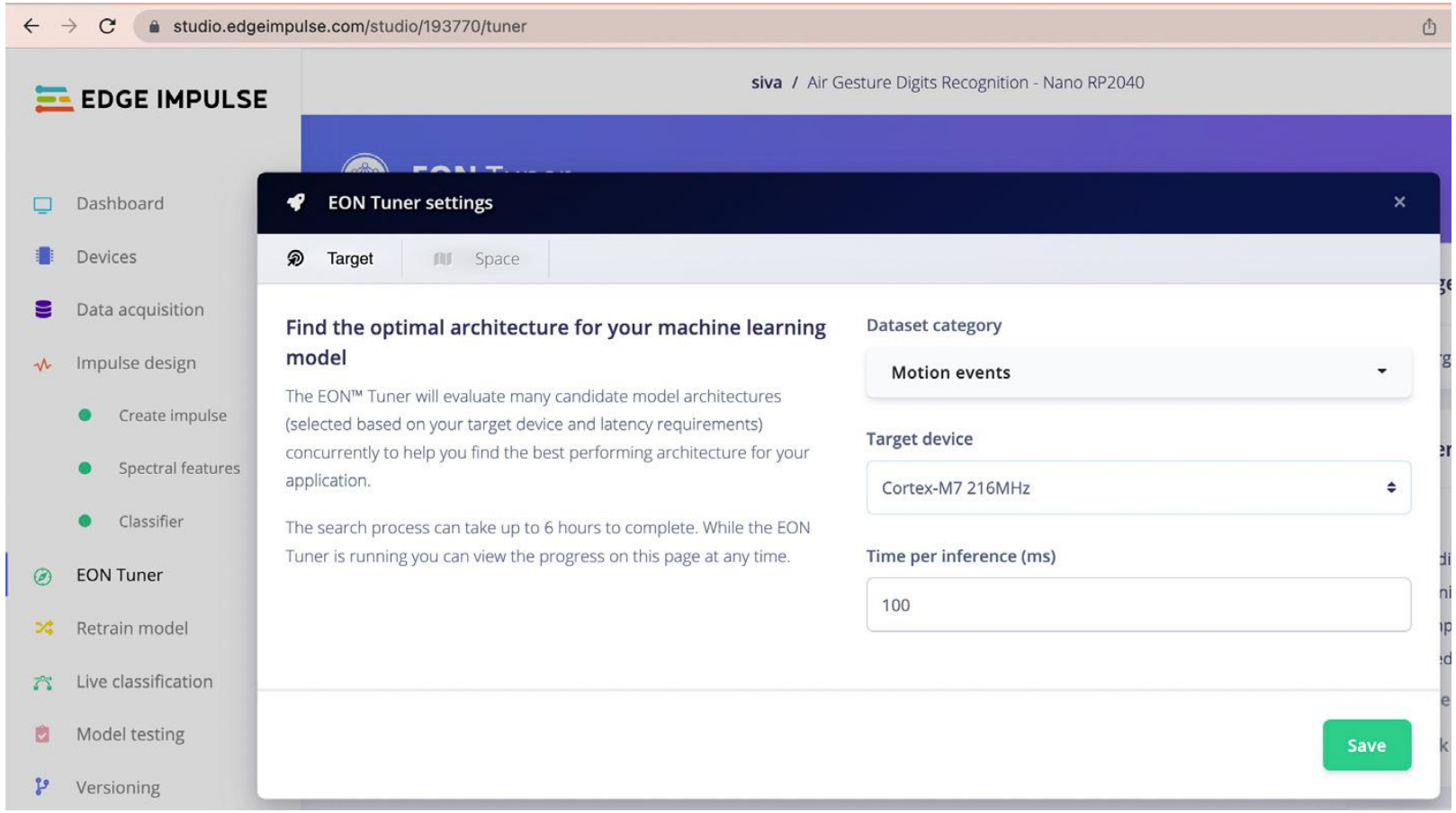
EON Compiler (Edge Impulse)



Comparado con TF lite para microcontroladores, EON usa 25-55% menos RAM y hasta 35% menos flash para ejecutar una red neuronal con el mismo acierto,

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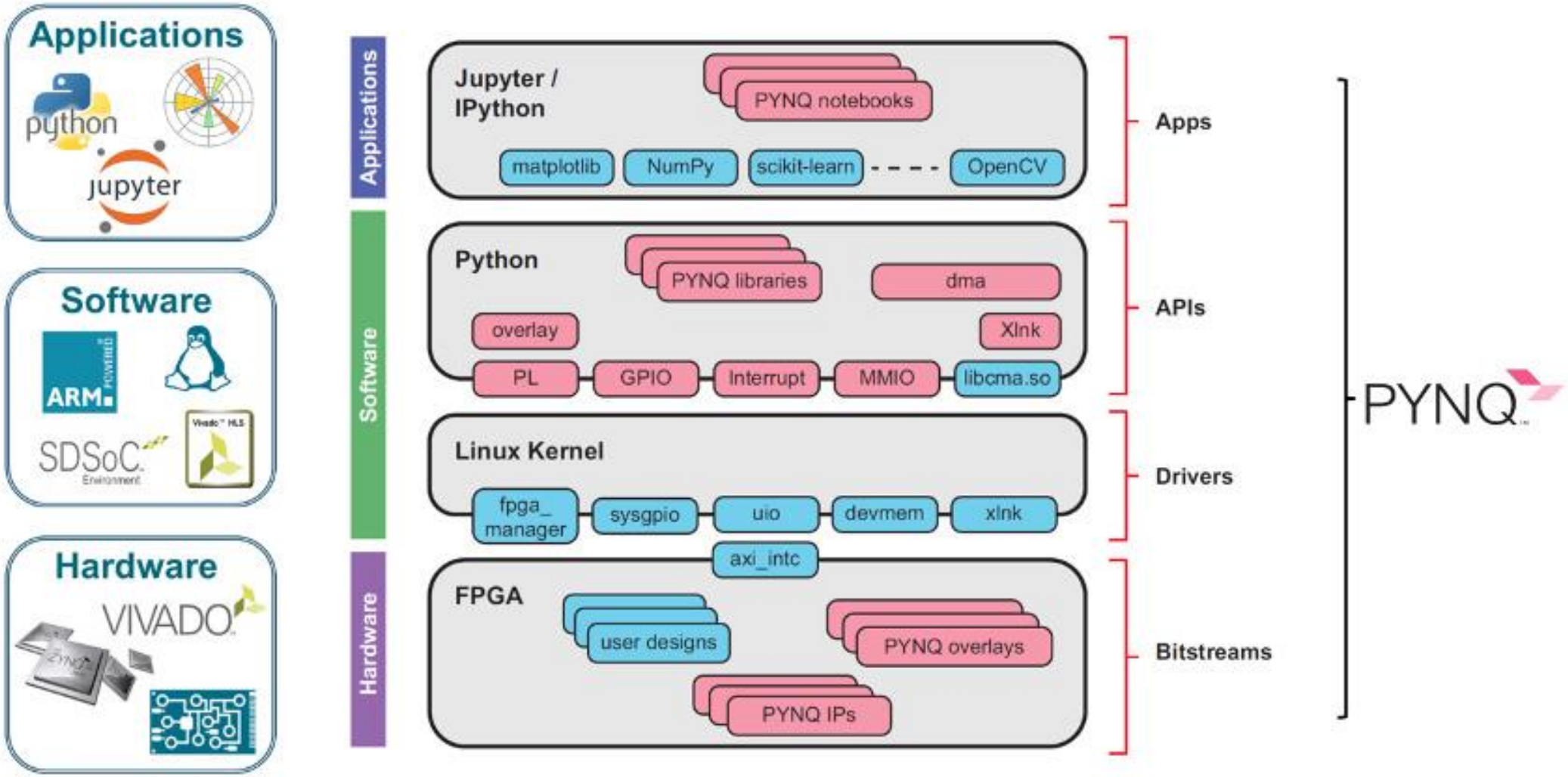
PYNQ - FPGAs



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SensiML™

https://sensiml.com/

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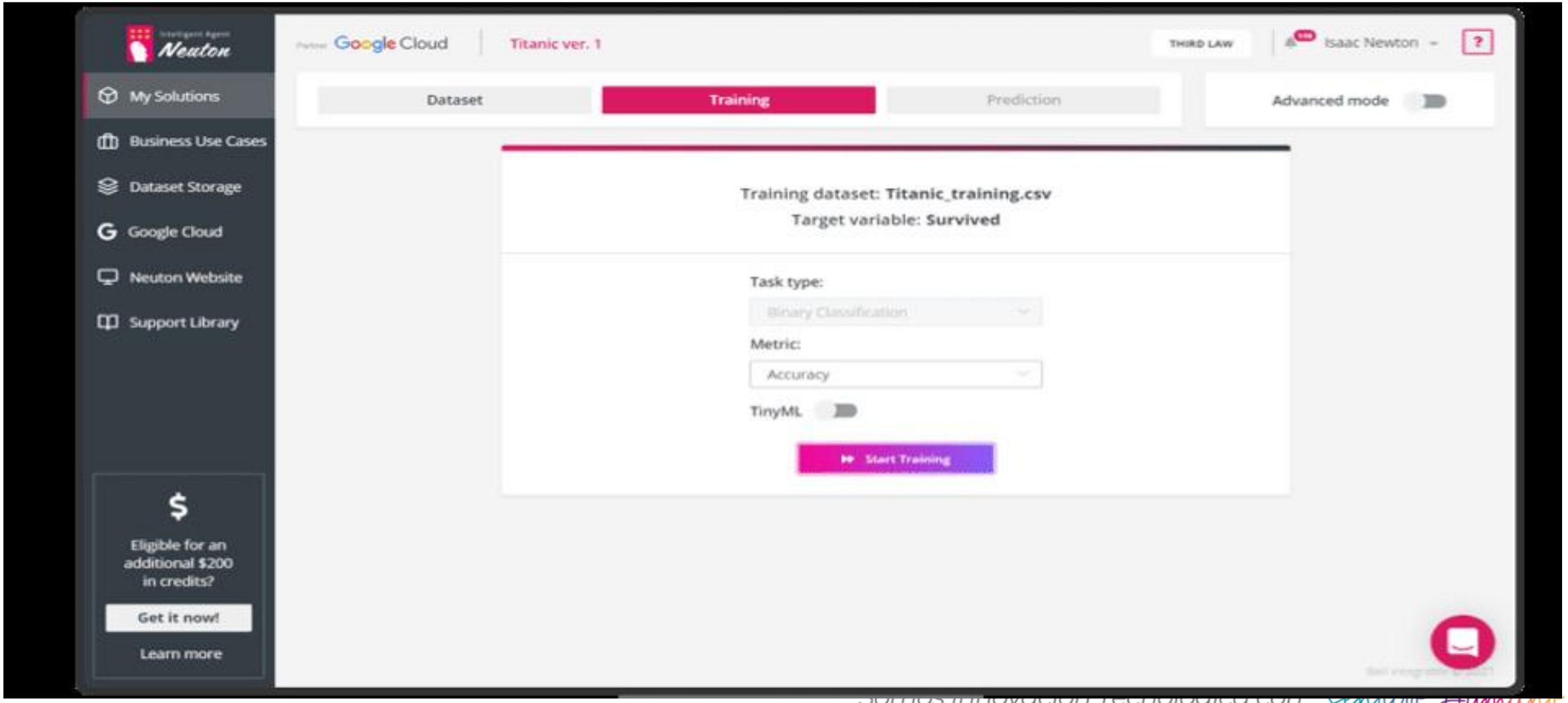
Neuton TinyML



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    1. Quantization Frameworks

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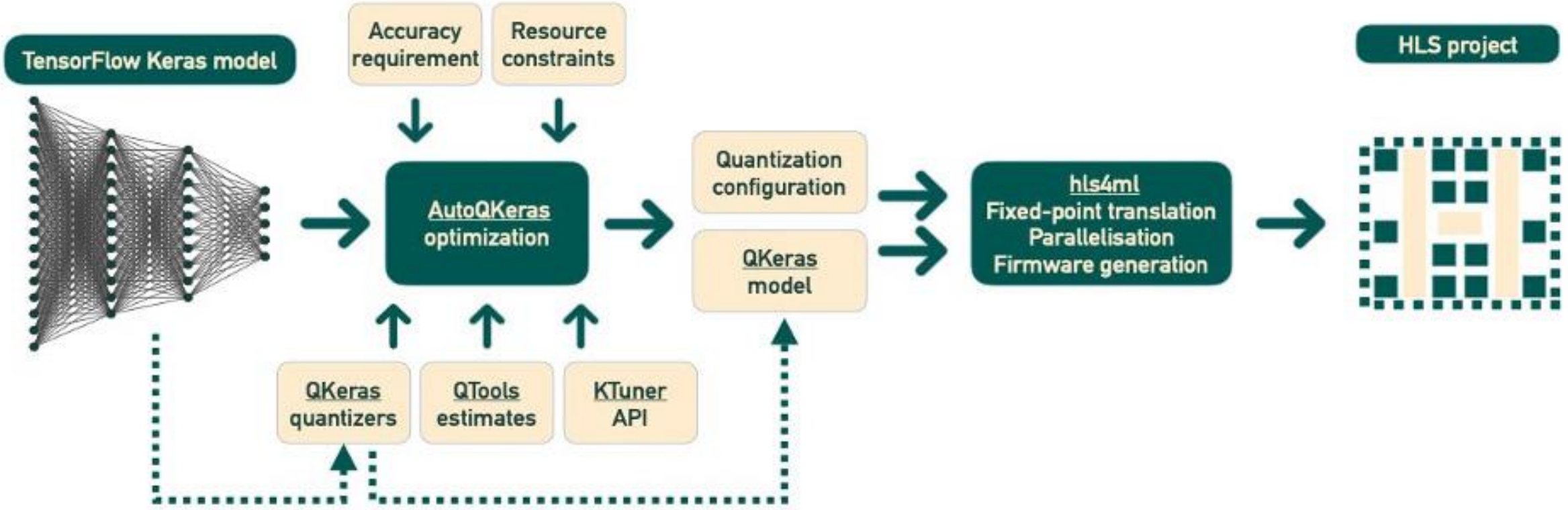
QKeras



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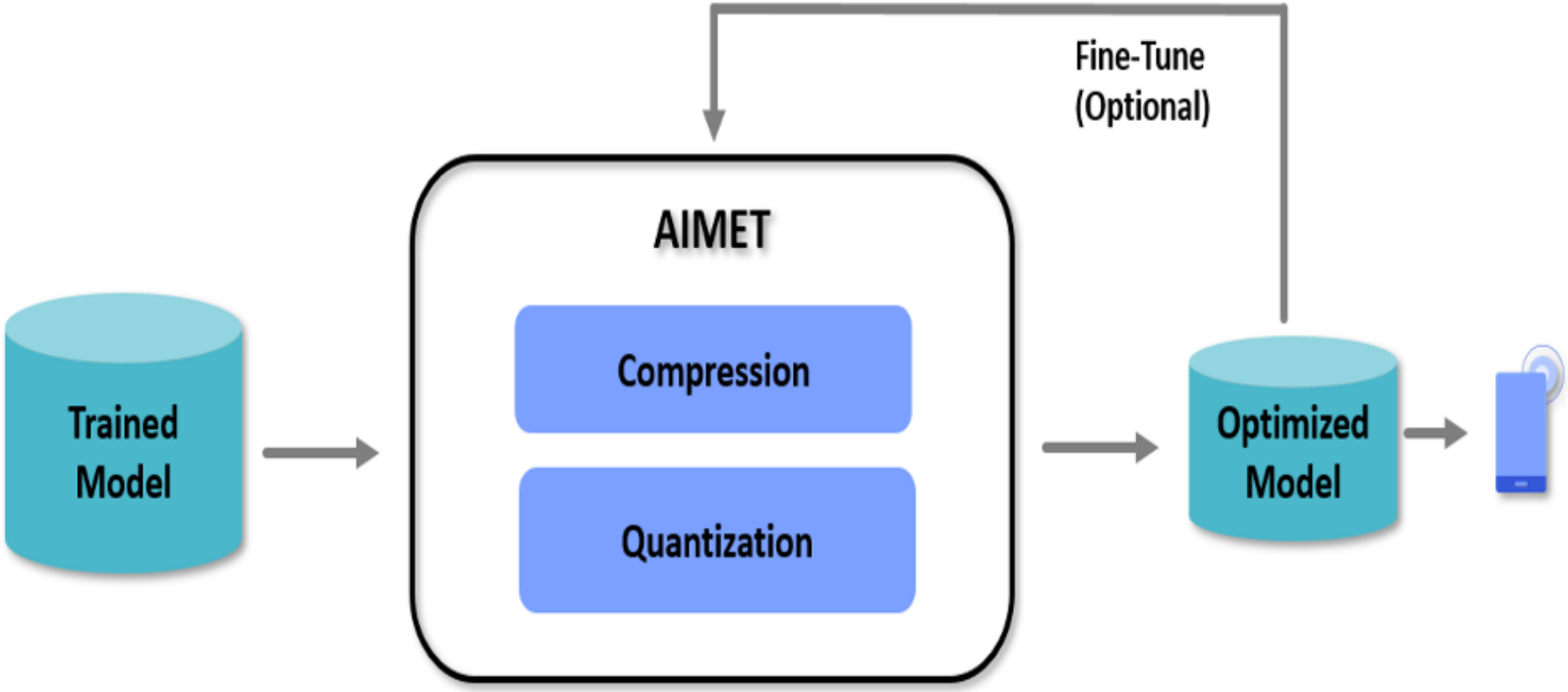
Qualcomm AIMET



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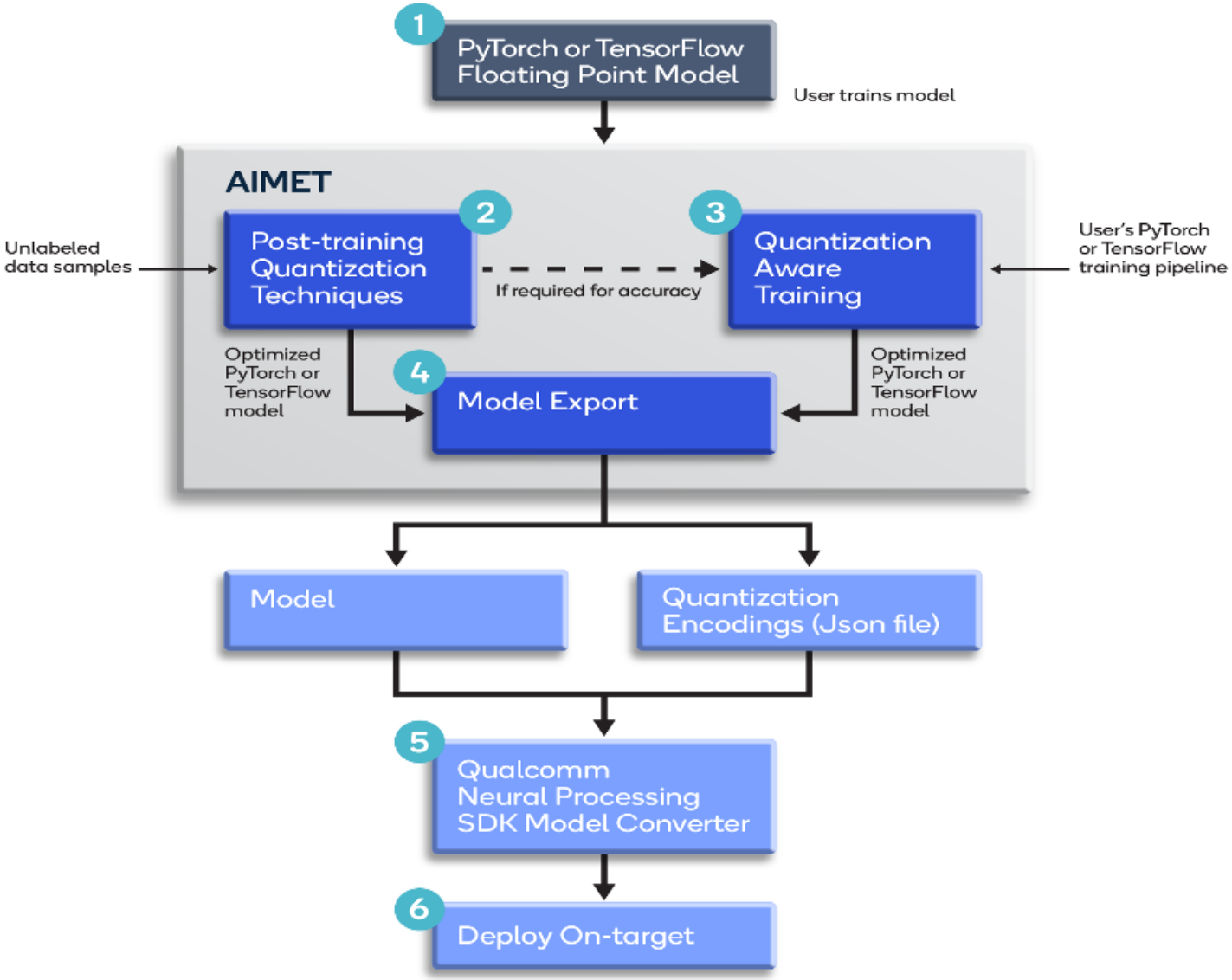
Qualcomm AIMET



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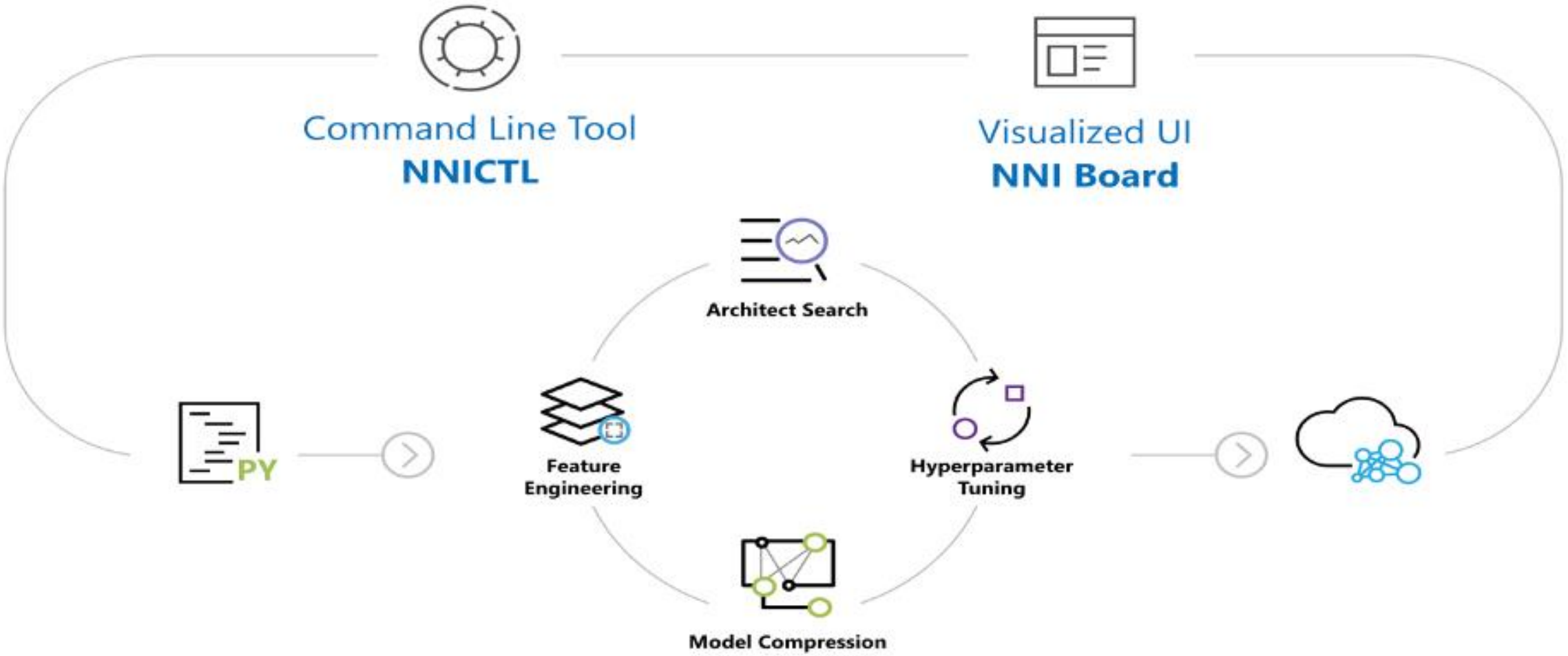
Microsoft NNI



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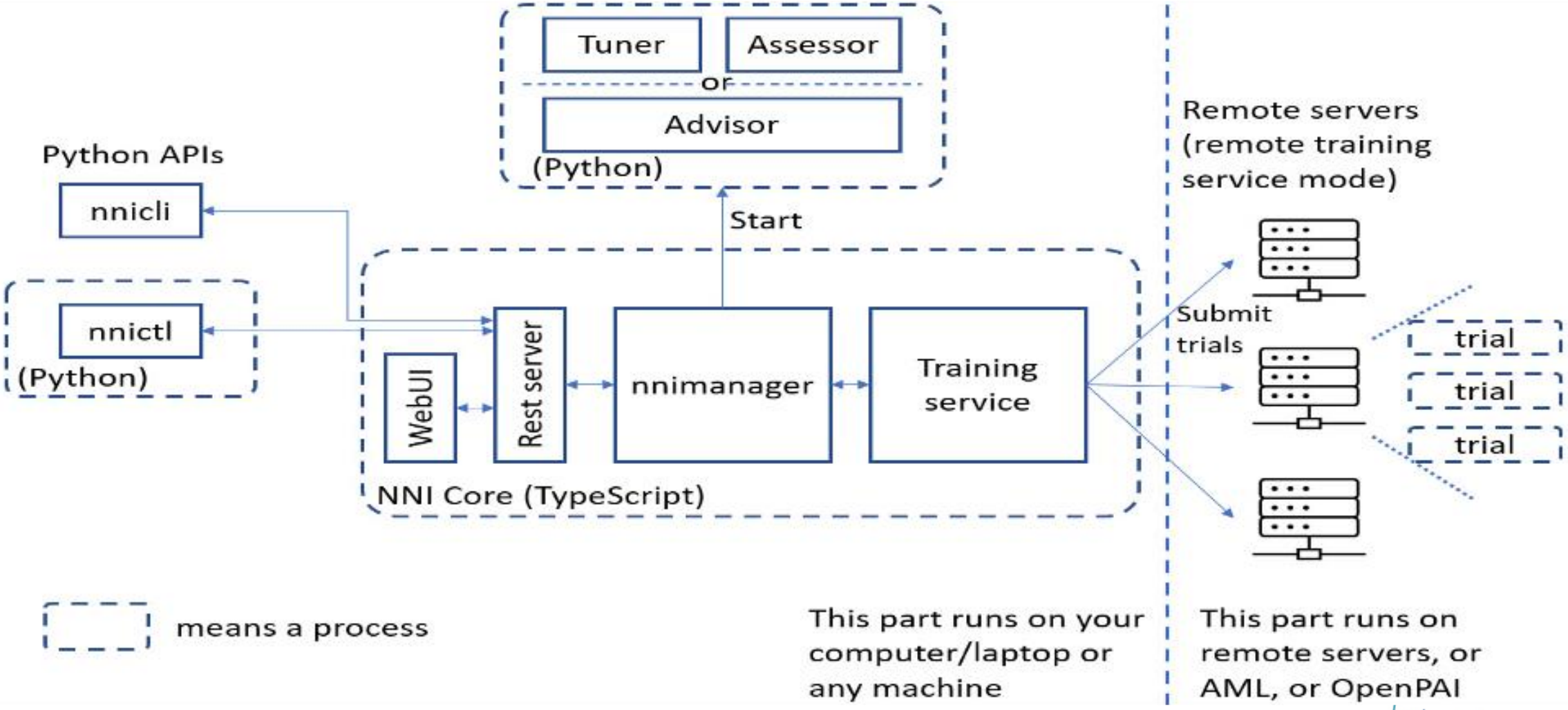
Microsoft NNI



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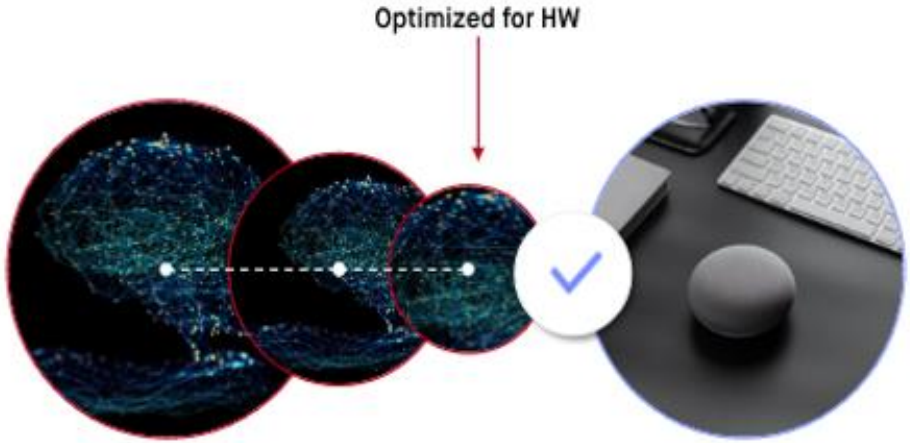
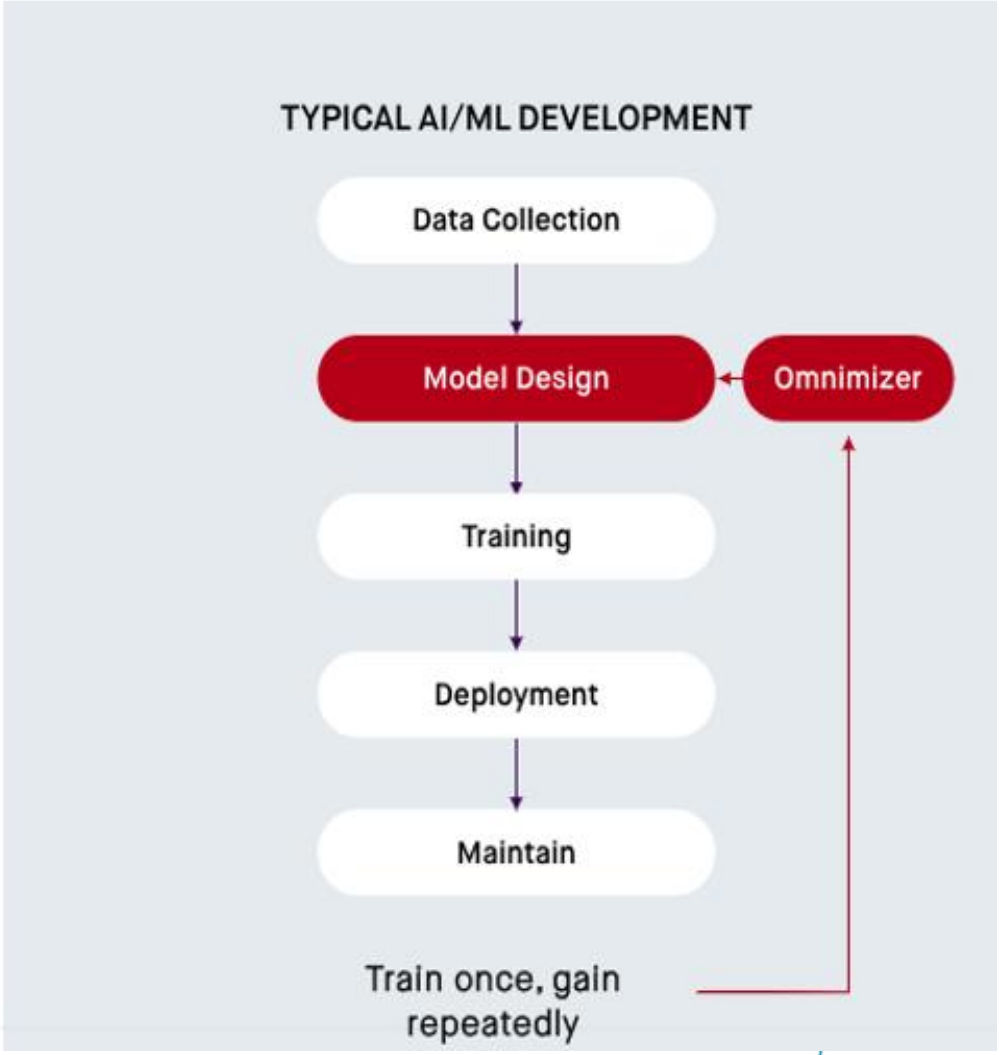
OmniML - NVDA

OmniML "Compress" the Model Before Training

Focus on Fundamental Algorithms





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Bibliografía

1. Schizas, N.; Karras, A.; Karras, C.; Sioutas, S. *TinyML for Ultra-Low Power AI and Large Scale IoT Deployments: A Systematic Review*. *Future Internet* **2022**, *14*, 363. https://doi.org/10.3390/fi14120363
2. Atul K. Gupta and Dr. Siva P. Nandyala. *Deep Learning on Microcontrollers: Learn how to develop embedded AI applications using TinyML*. 2023. ISBN 978-93-55518-057.

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¡Gracias!

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