



Institución
Universitaria
Reacreditada en Alta Calidad

INTEGRACIÓN DE ML EN EMBEBIDOS Y EDGE COMPUTING

Maestría en Automatización y Control Industrial

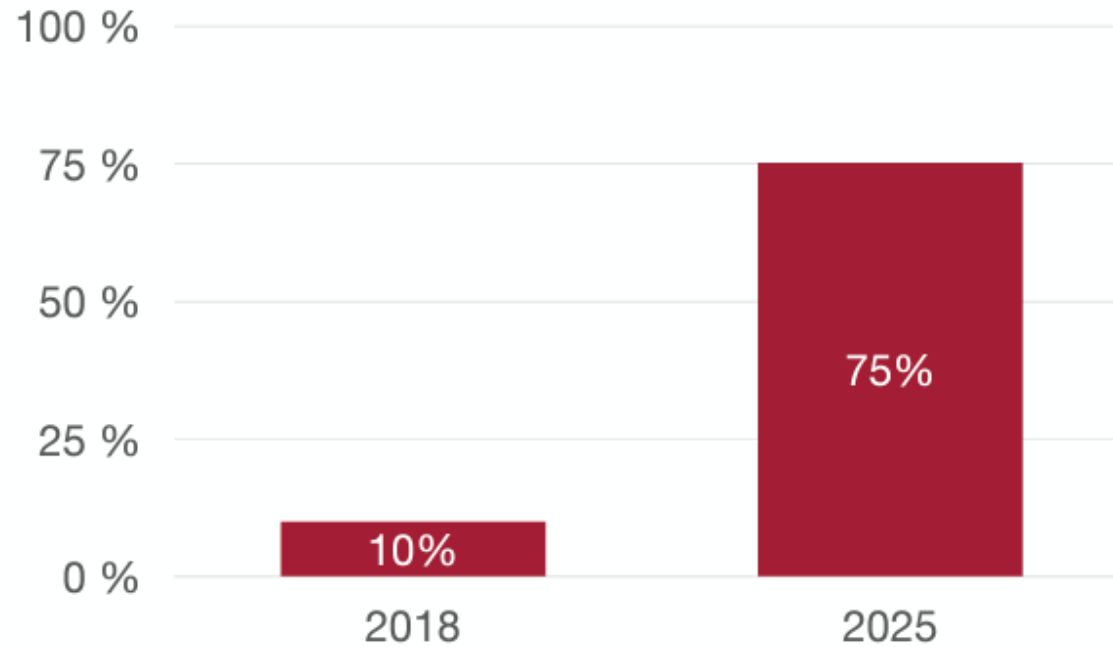
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Alcaldía de Medellín

AI is coming to the Edge

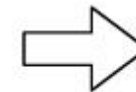
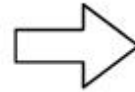
% of Enterprise Data from Edge



Number of Edge Devices 2021

- 15 Billion Mobile phones
- 1.4 Billion Cars
- 770 Million Security cameras
- 15 Million Robots

AI is coming to the Edge



Cloud AI

Mobile AI

Tiny AI

Memory (Activation)

32GB

4GB

320kB

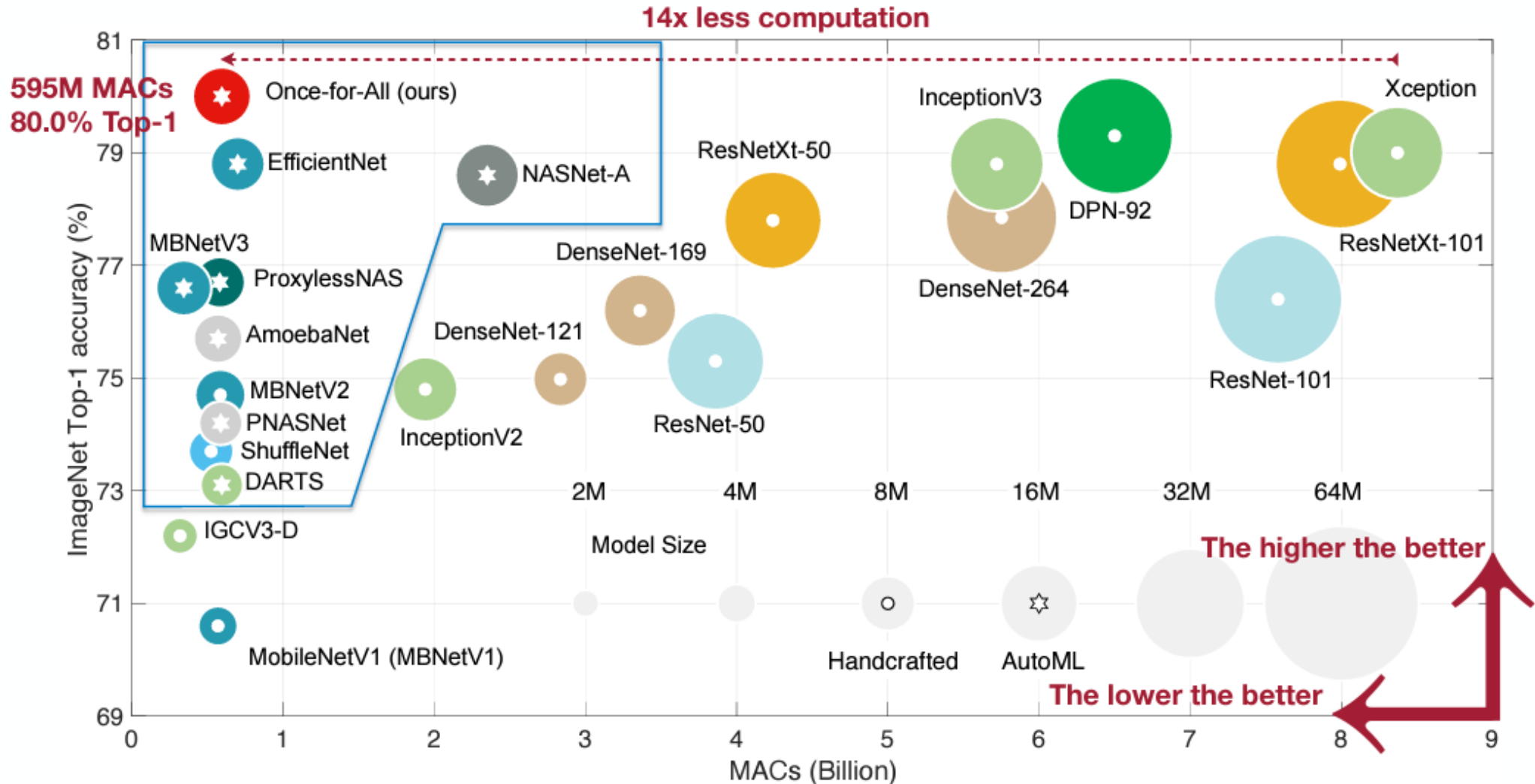
Storage (Weights)

~TB/PB

256GB

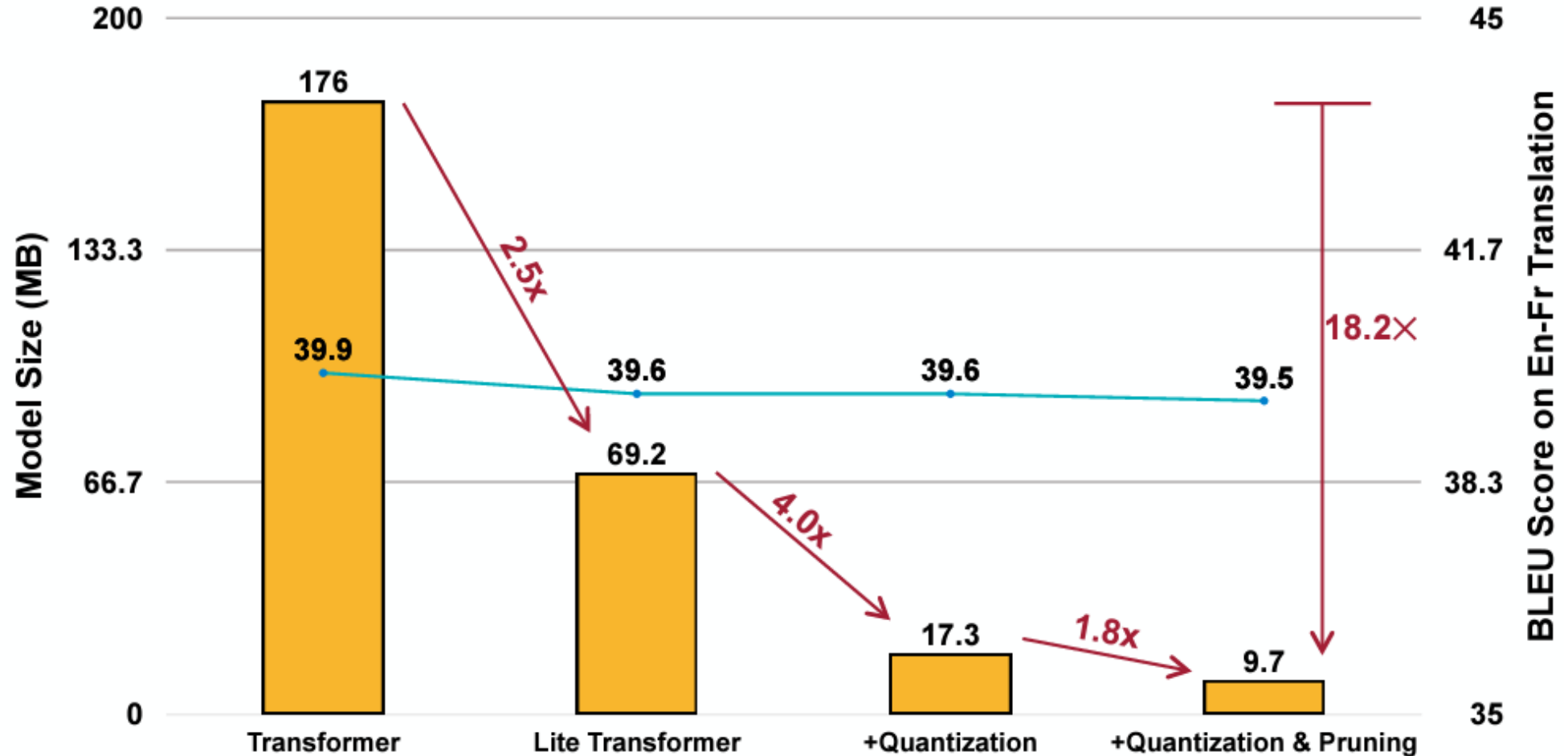
1MB

DL para clasificación de imágenes eficiente



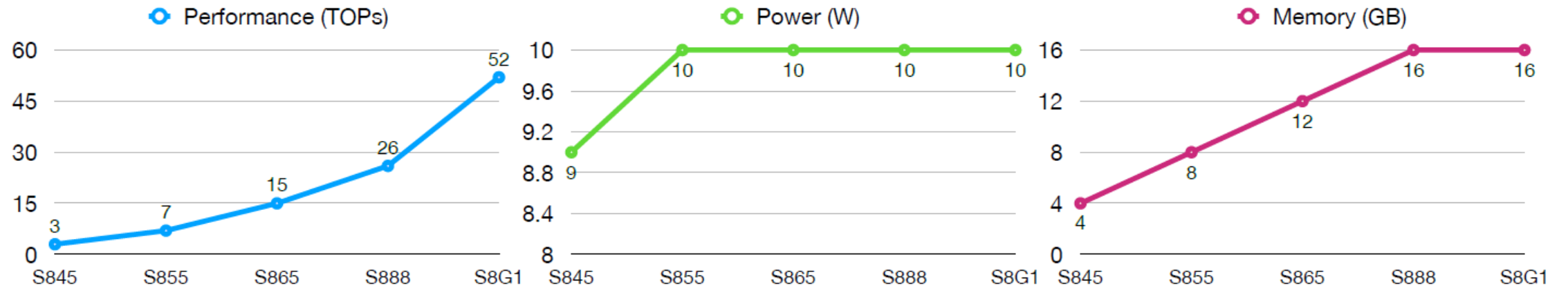
Once-for-All: Train One Network and Specialize it for Efficient Deployment
[Cai et al., ICLR 2020]

Lite Transformer



Edge AI Hardware

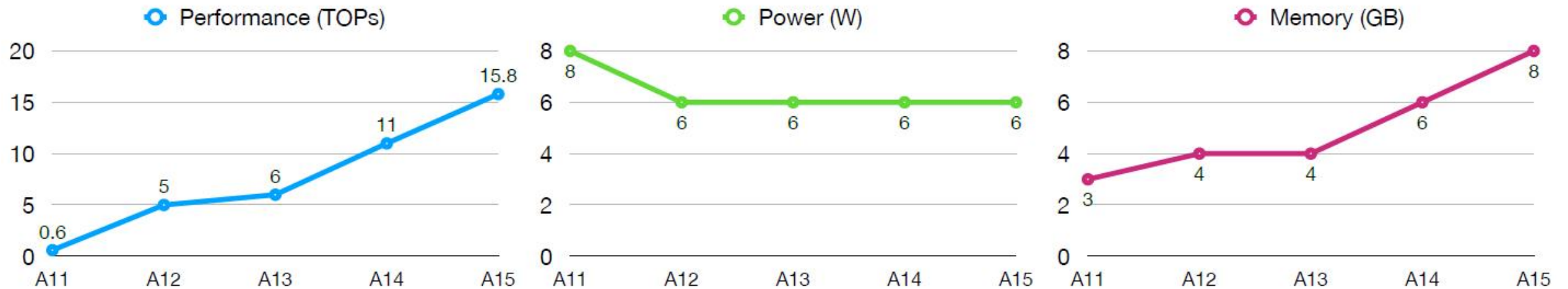
Qualcomm hexagon DSP



Edge AI Hardware

Apple Neural Engine • The Apple Neural Engine (ANE) is an energy-efficient and high-throughput engine for ML inference on Apple silicon.

Source: Apple

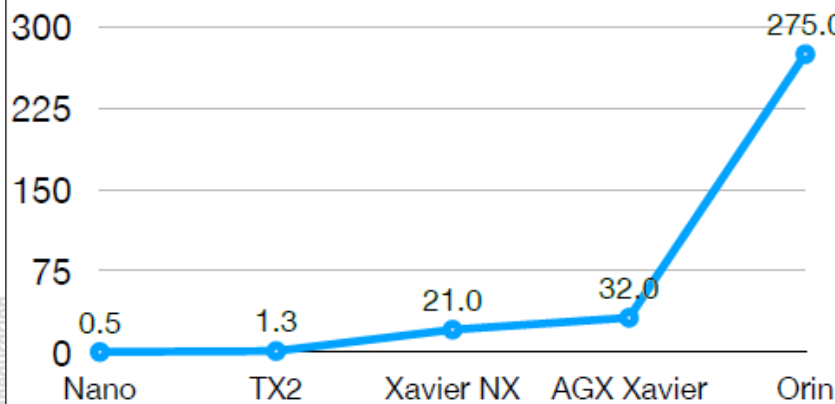


Edge AI Hardware

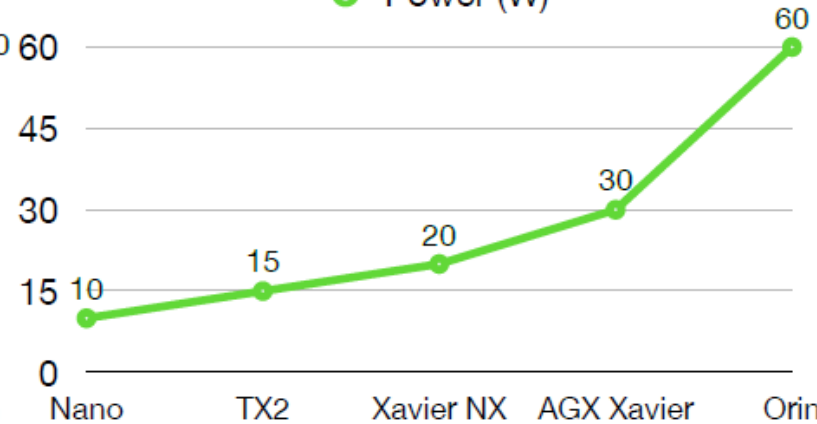
Nvidia Jetson • NVIDIA Jetson is a complete System on Module (SOM) that includes a GPU, CPU, memory, power management, high-speed interfaces, and more.



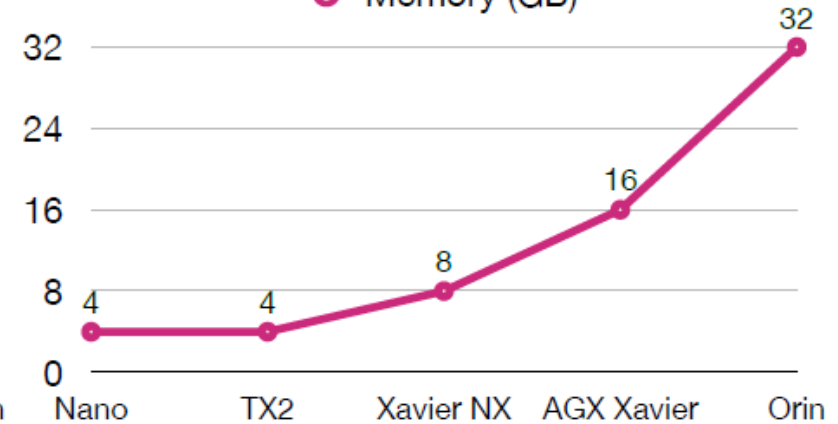
Performance (TOPs)



Power (W)



Memory (GB)

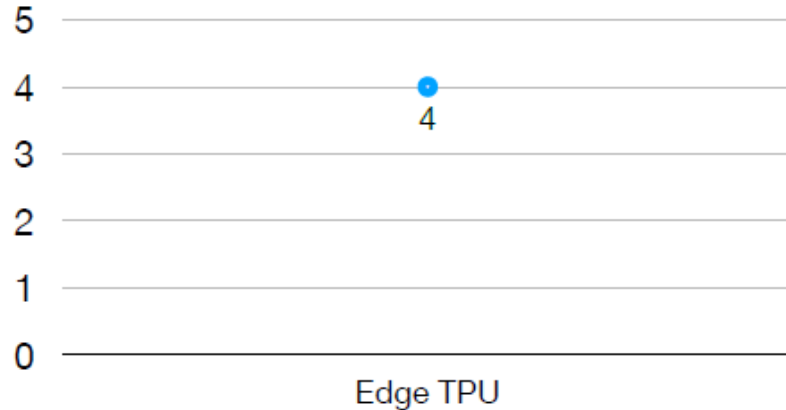


Edge AI Hardware

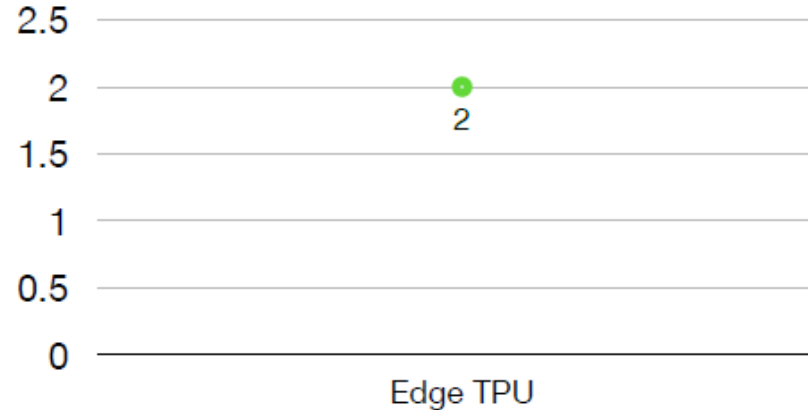
Tensor Processing Unit (TPU) is an AI accelerator application-specific integrated circuit (ASIC) developed by Google for neural network machine learning, using Google's own TensorFlow software.



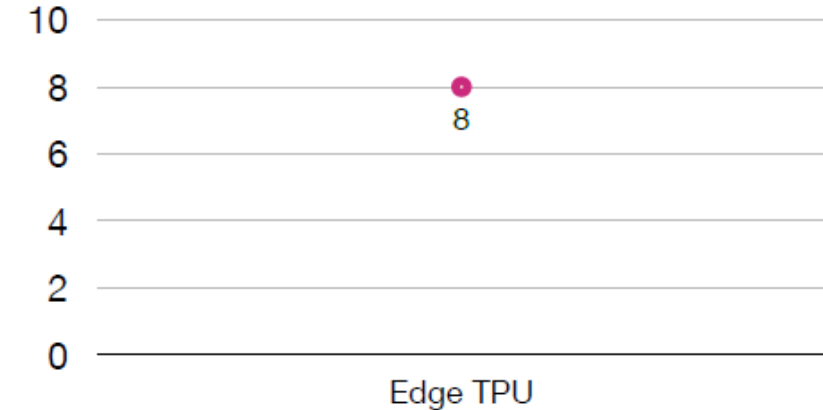
Performance (TOPs)



Power (W)

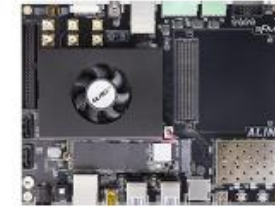


Memory (GB)

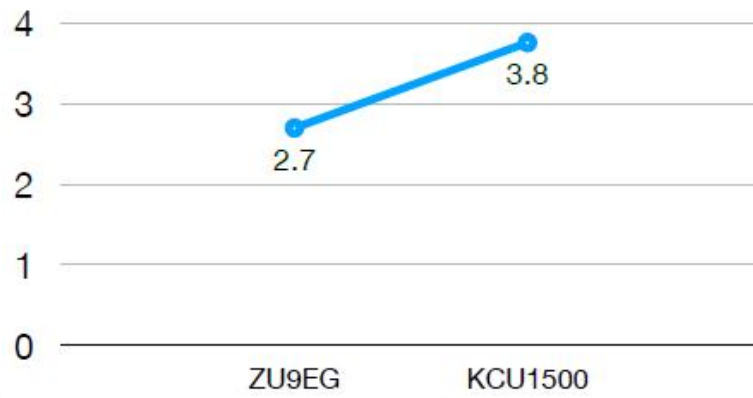


Edge AI Hardware

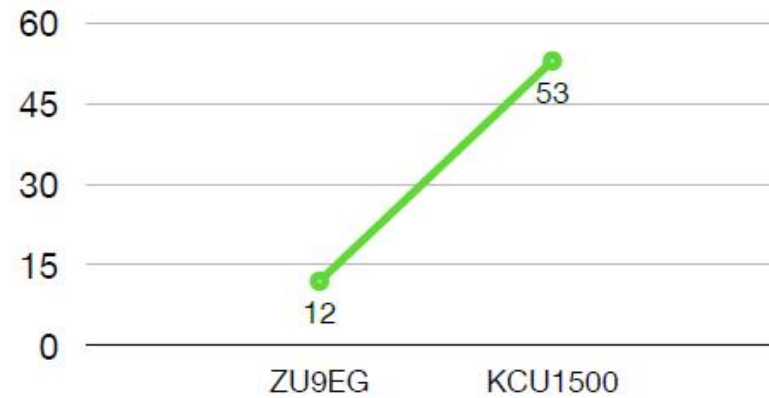
Field Programmable Gate Arrays (FPGA) delivers higher performance compared to a fixed-architecture AI accelerator like a GPU due to efficiency of custom hardware acceleration.



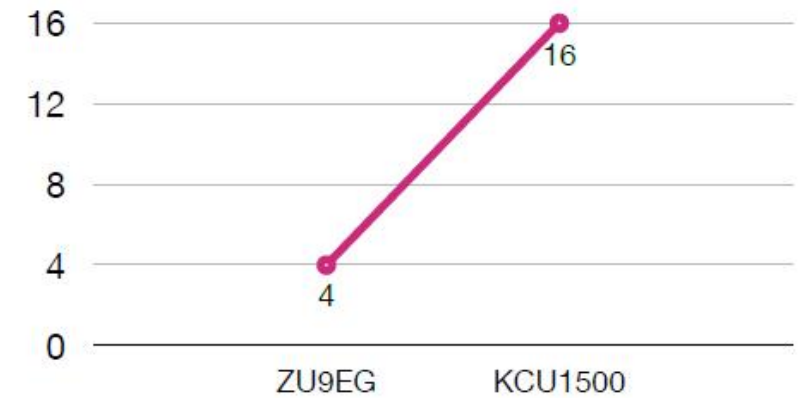
Performance (TOPs)



Power (W)



Memory (GB)



Edge AI Hardware

MCU

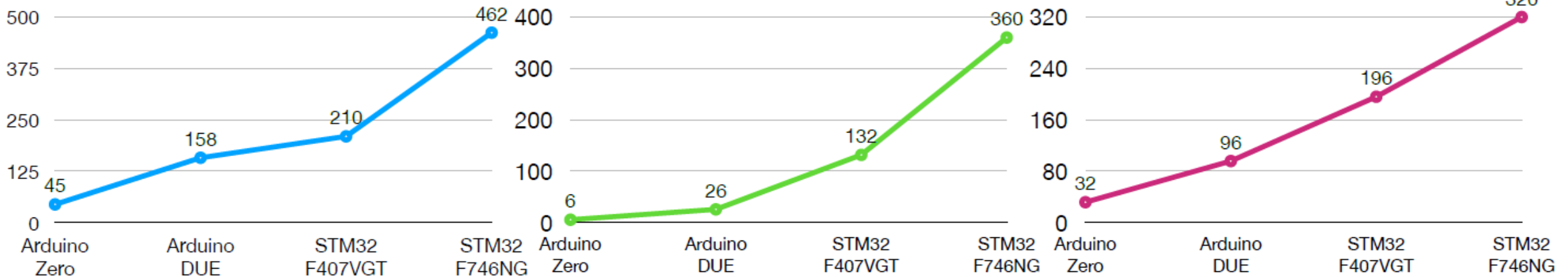
A microcontroller is a compact integrated circuit designed for embedded systems. A typical microcontroller includes a processor, memory and input/output (I/O) peripherals on a single chip.



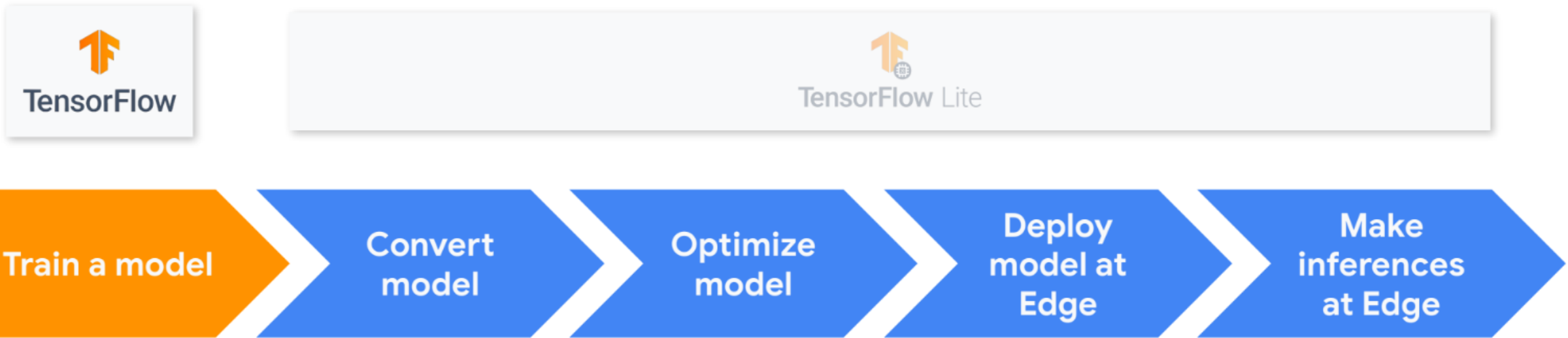
○ Performance (DMIPS*)

○ Power (mW)

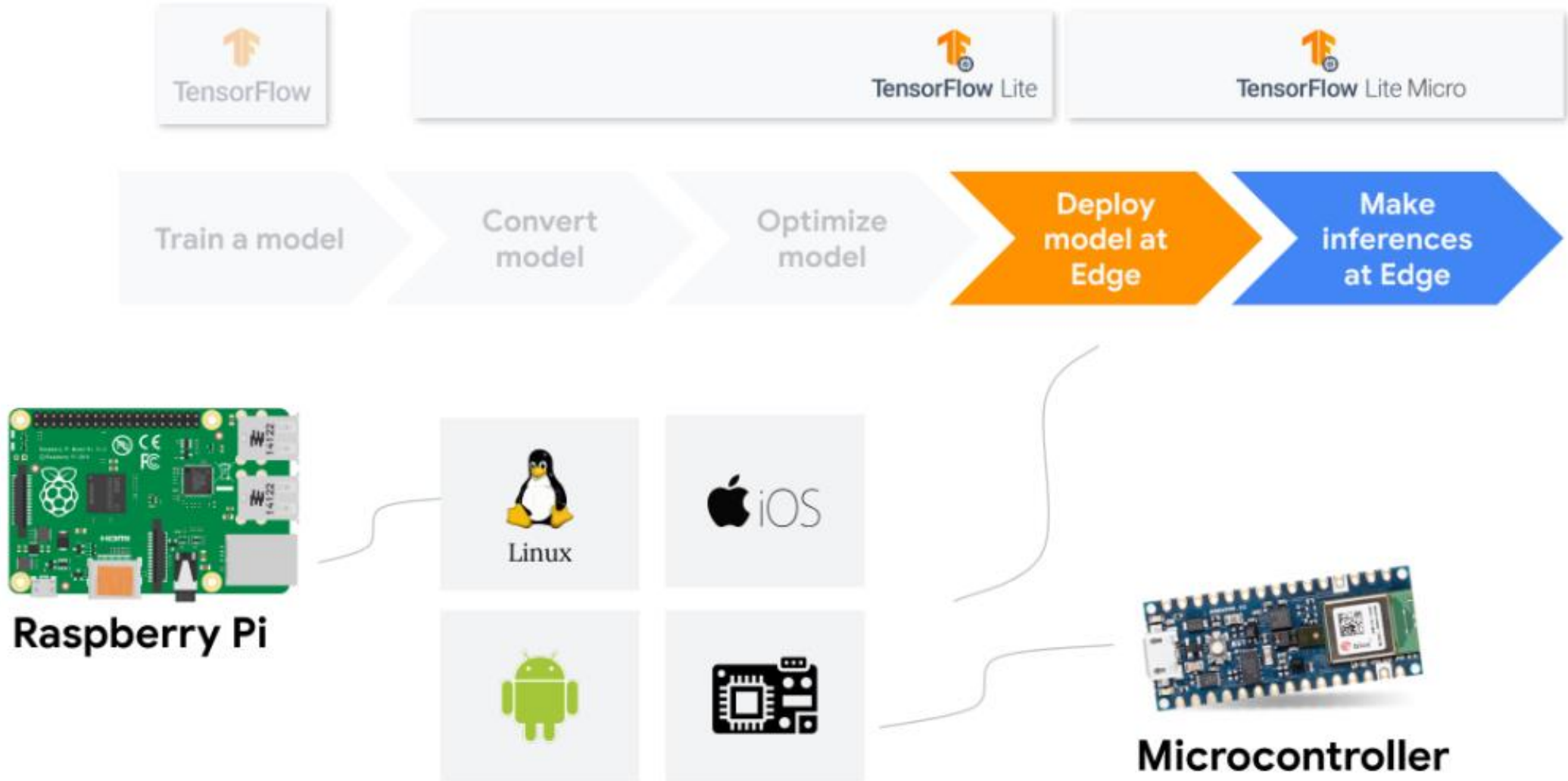
○ Memory (KB)



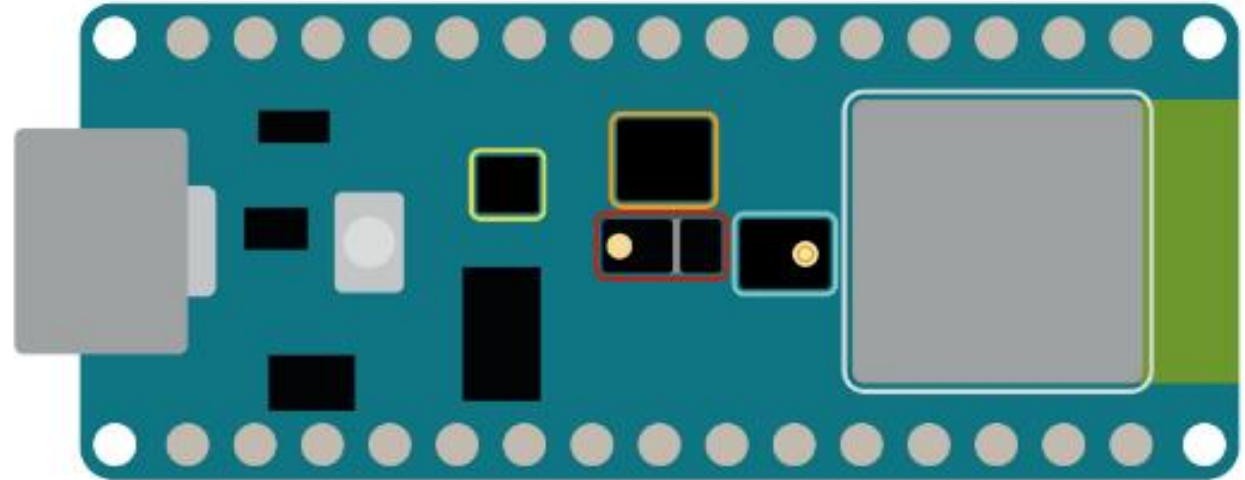
Ciclo de Desarrollo



Ciclo de Desarrollo

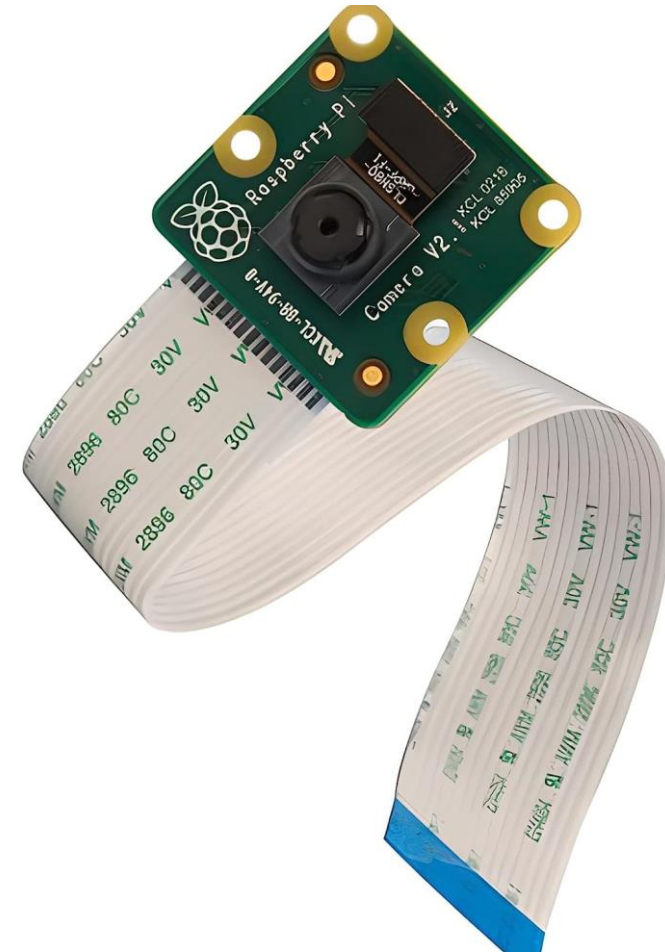
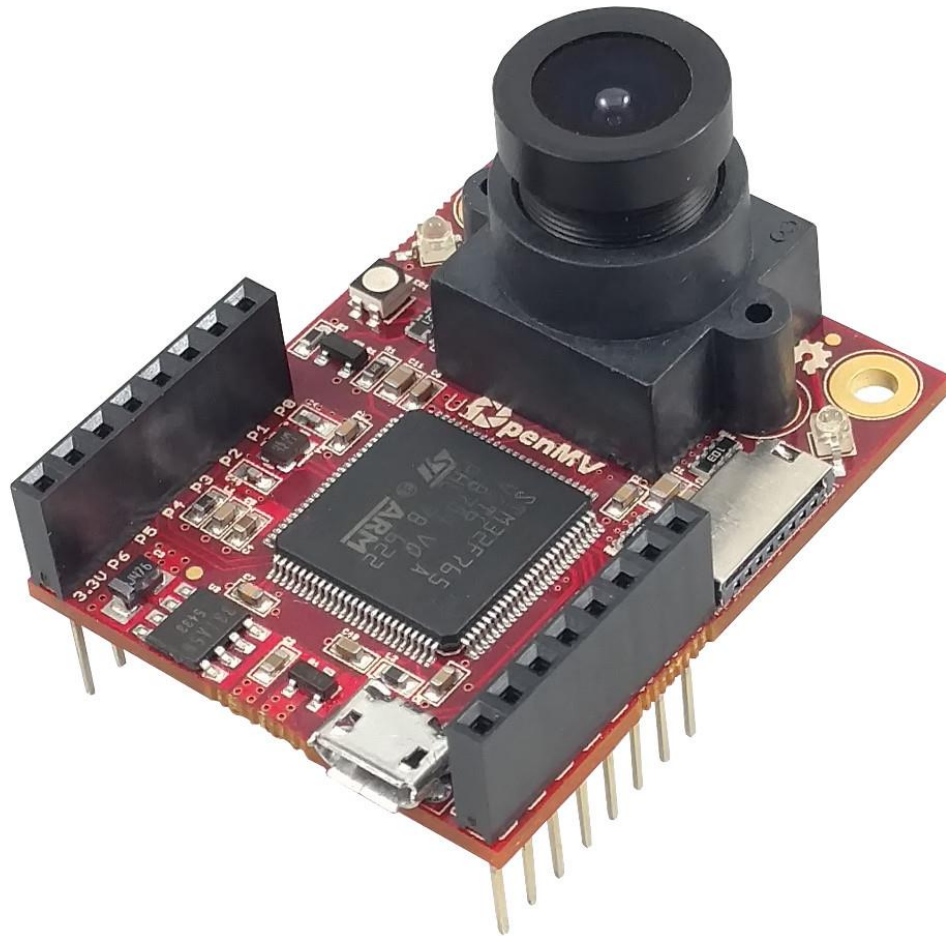


Arduino nano 33 BLE sense



- ◆ Color, brightness, proximity and gesture sensor
- ◆ Digital microphone
- ◆ Motion, vibration and orientation sensor
- ◆ Temperature, humidity and pressure sensor
- ◆ Arm Cortex-M4 microcontroller and BLE module

Vision Artificial



Evaluación

(La evaluación consiste en Exposiciones orales sobre los siguientes temas:

1. Despliegue de modelo de aprendizaje automático simple en hardware (20%).
2. Aplicación de optimización de un modelo de aprendizaje automático en problema práctico (20%).
3. Presentación de artículo de investigación del estado del arte en Búsqueda de Arquitectura Neuronal (NAS) (20%).
4. Aplicación de cuantización en problema práctico (20%).
5. Presentación proyecto final del curso (20%).



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¡Gracias!

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