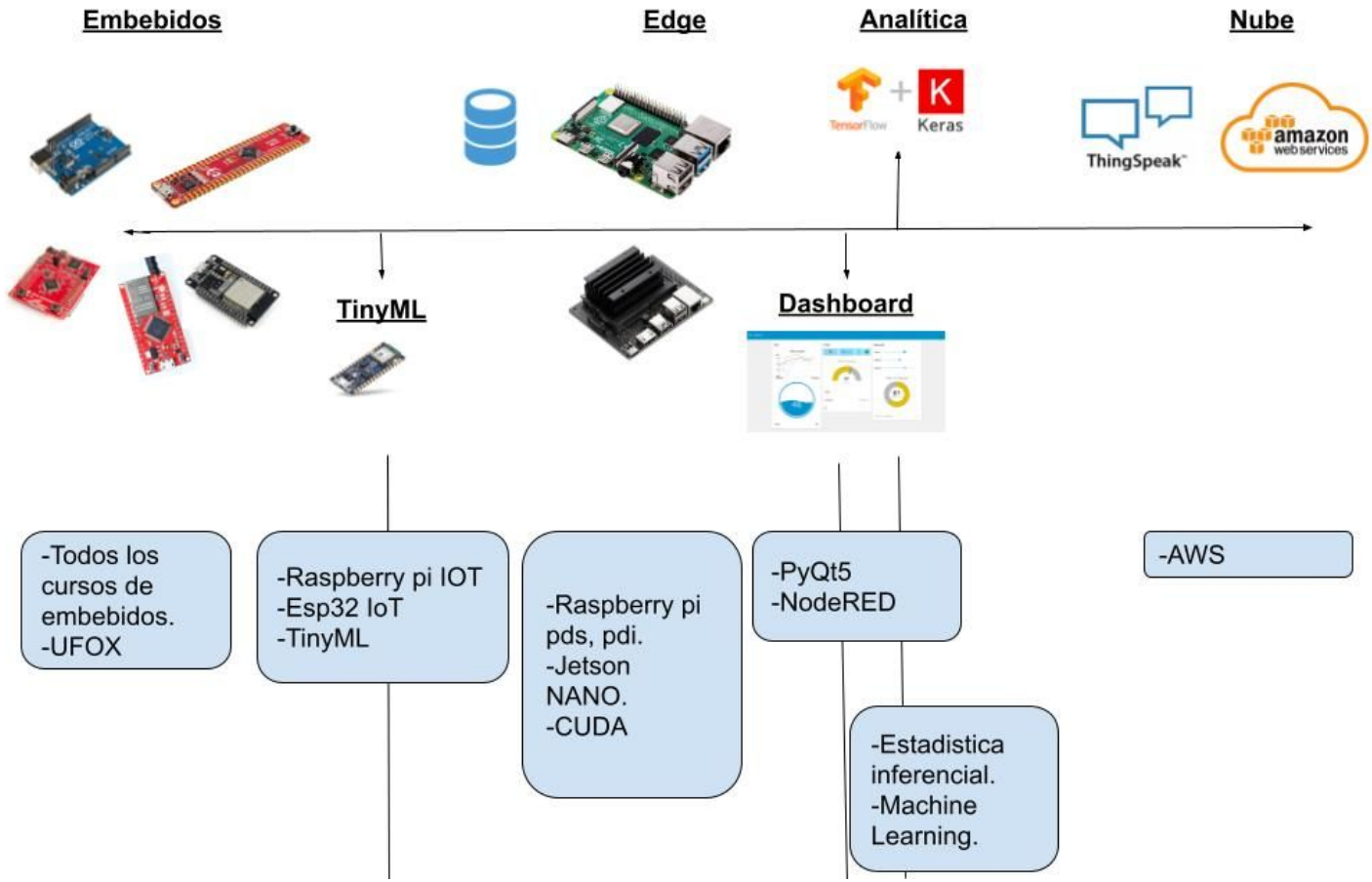
IoT Environment - UMAKER



Edge Computing: Una mirada a modelos de Machine Learning inferidos en el DevKit UFOX

ing. Moises Stevend Meza Rodriguez

Acerca de mi

Universidad Nacional del Callao
Ciencia y Tecnología rumbo al Tercer Milenio

IGP Radio Observatorio de JICAMARCA Radio Observatory

LABOTEC hardware & software

PONTIFICIA UNIVERSIDAD CATÓLICA DEL PERÚ

MAESTRIA EN

INFORMÁTICA BIOMÉDICA EN SALUD GLOBAL

OPORTUNIDAD DE BECAS CIENCIACTIVA-CONCYTEC

Beneficios:

- Matrícula y pensiones
- Manutención
- Seguro médico
- Fondo para proyectos

REQUISITOS PARA LA POSTULACION:

- 27 años hasta el momento de la postulación.
- Nacionalidad peruana.
- No haber recibido financimiento del estado para estudios de postgrado.

CIERRE DE INSCRIPCIONES

3 DE MARZO, 2017

INFORMES

Facultad de Salud Pública y Administración
Teléfono: (511) 4818283 - 319 0000 Anexo 2264
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Correo: cristina.pflucker.o@upch.pe

UNIVERSIDAD PERUANA CAYETANO HEREDIA

CIENCIACTIVA
Becas y Co-financiamiento de Concytec

INFORMÁTICA BIOMÉDICA EN SALUD GLOBAL

OBJETIVOS

Disponer de profesionales entrenados en la utilización eficiente de las Tecnologías de Informacion y Comunicacion (TIC), para el desarrollo, implementación y evaluación de nuevos sistemas de información dentro de un contexto de escasos recursos públicos.

Formar profesionales de salud y desarrolladores con habilidades para el diseño y ejecución de proyectos generadores de evidencia en las áreas de Informática Biomédica que permitan la mejora de la salud de las personas y de la salud pública.

PERFIL DEL EGRESADO

Los profesionales tendrán la capacidad de obtener y generar información relacionada a la informática y sus aplicaciones para la mejora de la salud, conociendo los fundamentos teóricos y prácticos a nivel avanzado en informática en salud, que le permitirán proponer, diseñar y conducir proyectos de investigación.

PLAN CURRICULAR

I CICLO	II CICLO	III CICLO	IV CICLO
Ética en Investigación	Informática Clínica	Seminarios ¿Cómo Hacer?	Tópicos de Tesis en Informática Biomédica - II
Introducción a la Informática Biomédica	Informática en Salud Pública		
Epidemiología Básica	Educación y Comunicación en Informática Biomédica		
Estadística para la Investigación	Manejo de Proyectos en Informática		
Metodología de la Investigación	Salud Móvil	Tópicos de Tesis en Informática Biomédica - I	
Fundamentos de Salud Global	Sistemas de Información Geográfica		
Propuesta de Investigación en Informática Biomédica	Redacción Científica		
	Telemedicina		

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https://goo.gl/2IxmVq

UNIVERSIDAD PERUANA CAYETANO HEREDIA

UNIVERSIDAD PERUANA
CAYETANO HEREDIA
FACULTAD DE SALUD PÚBLICA Y ADMINISTRACIÓN

LABORATORIO
DE INNOVACIÓN
EN SALUD


Becas:
Diplomatura en Big Data y Machine Learning contra COVID-19
ESCUELA DE POSGRADO UTEC
Inicio de clases:
29 de marzo 2021
Cierre de Admisión:
1er cierre:
12 feb. 2021
2do cierre:
12 mar. 2021
Más información aquí
PERÚ Presidencia del Consejo de Ministros
CONCYTEC
FONDECYT
UTEC


Data Science
MOISES STEVEND
Meza Rodriguez
ID: 2021015


EDGE COMPUTING:
UNA MIRADA A MODELOS DE MACHINE LEARNING INFERIDOS CON EL DEVKIT UFOX
EDGE COMPUTING
LoRa
aws
WiFi
03 DE JULIO
8:00 pm (Hora Perú)
Moises Meza
MSC. INFORMÁTICA BIOMÉDICA
UMAKER

Contenido

- **Internet of Things**
- **Machine Learning:**
- **Edge Computing:**
- **TinyML**

Internet of Things

Es un concepto que se refiere a la interconexión digital de objetos cotidianos con internet.

En la actualidad existen un montón de servicios en la nube.

amazon web services

Microsoft Azure

IBM Bluemix™

Google Cloud Platform

Vehicle,asset,person & pet monitoring & controlling

Agriculture automation

Energy consumption

Security & surveillance

Building managment

Embedded

Mobile

Internet of things

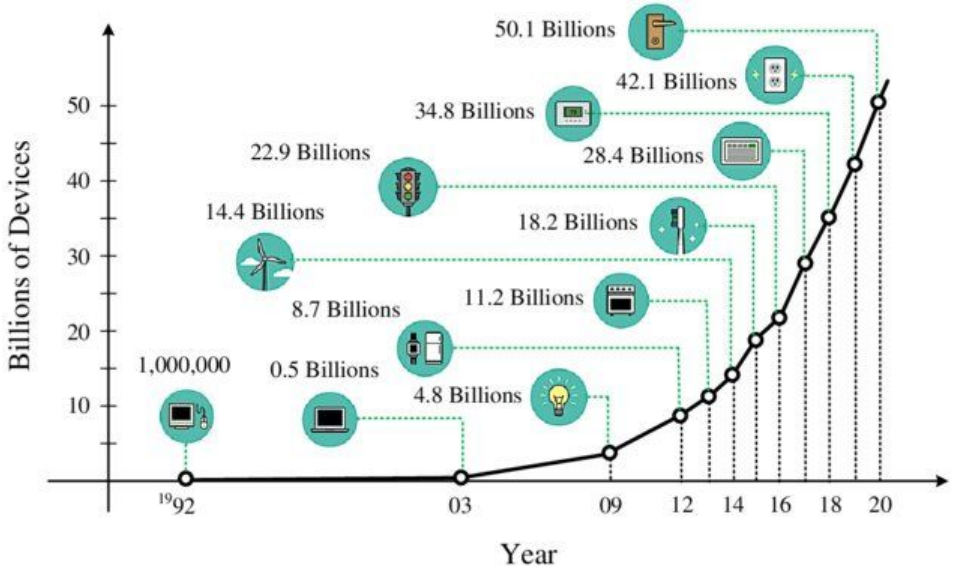
Everyday things get connected for smarter tomorrow

M2M & wireless sensor network

Everyday things

Smart homes & cities

Telemedicine & helthcare



Next Generation M2M Cellular Networks: Challenges and Practical Considerations

Expected number of connected devices to the Internet. This chart is obtained from recent reports developed by both Cisco and Ericsson. The reports discuss the expected growth in the number of connected devices by 2020 due to the introduction of the M2M market.

https://www.researchgate.net/publication/279068905_Next_Generation_M2M_Cellular_Networks_Challenges_and_Practical_Considerations

"Around 29 billion devices will be connected to the Internet by 2022. These connected IoT devices include connected cars, machines, meters, sensors, point-of-sale terminals, consumer electronics products, wearables, and others". IoT survey reported on the Forbes website

Return on IoT: dealing with the IoT skills gap. , https://www.forbes.com/sites/danielnewman/2019/07/ 30/return-on-iot-dealing-with-the-iot-skills-gap/#27017efb7091

Tecnologías LPWAN

LPWA

Low Power Wide Area Network

Low data throughput = high sensitivity = long range

Relatively low cost

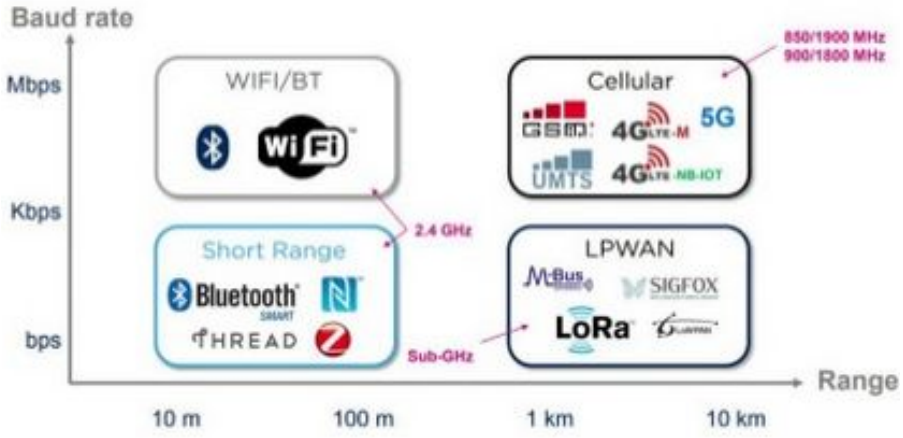
Multiple access, one-to-many architecture

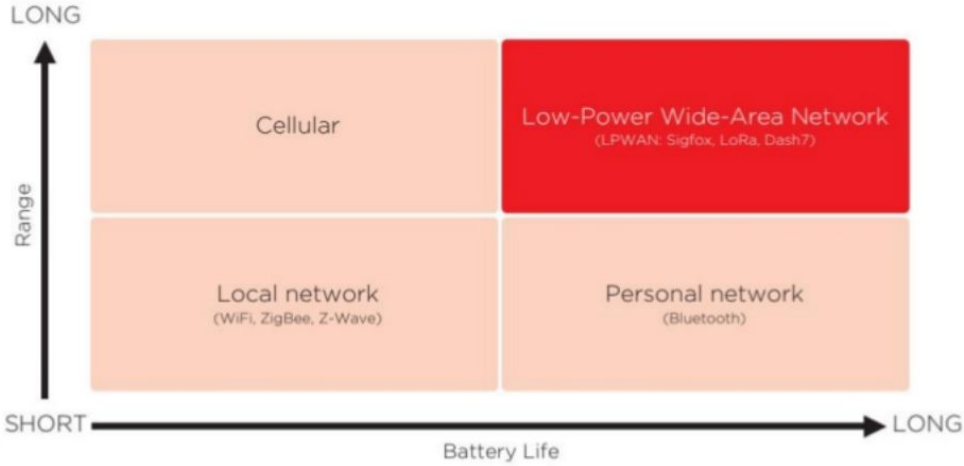
Using licensed or license-free spectrum

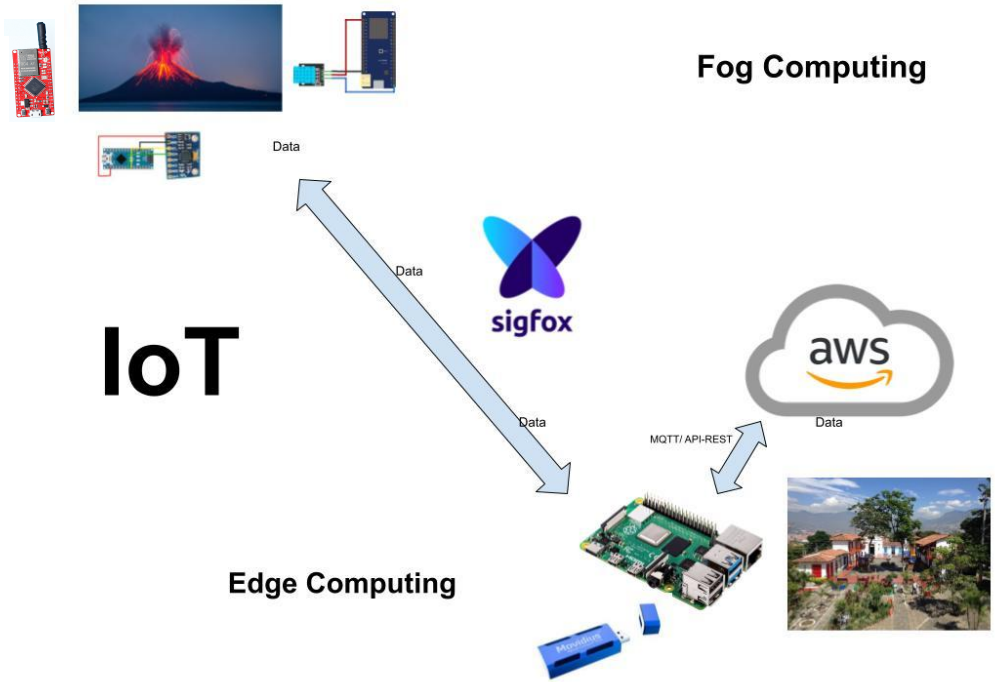
License-free spectrum

Licensed spectrum

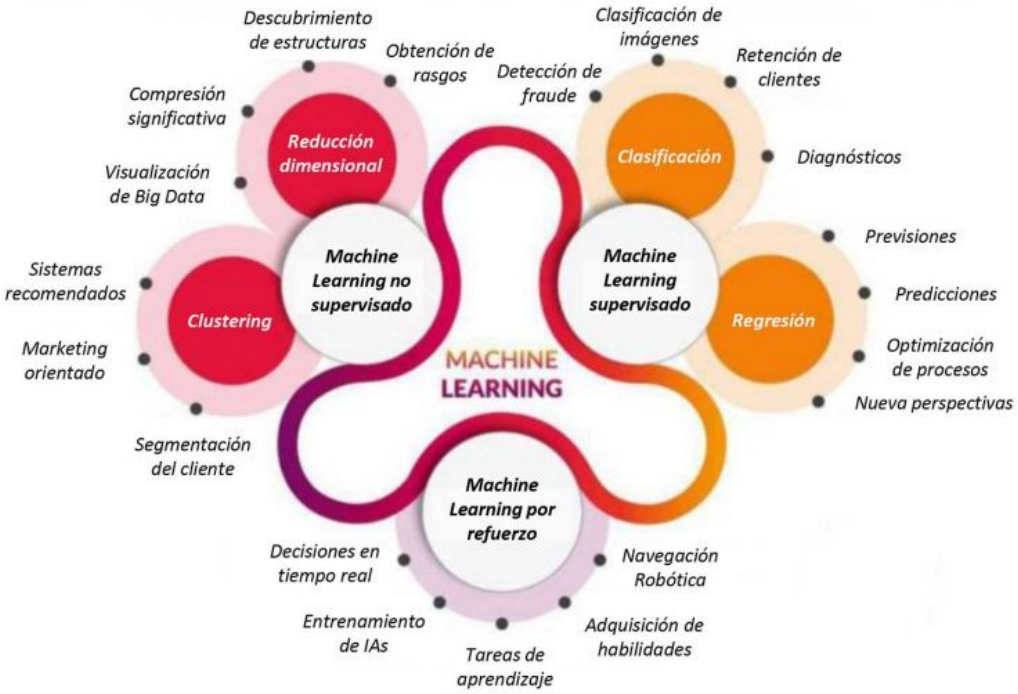
Rango vs Velocidad

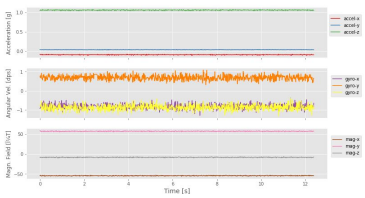


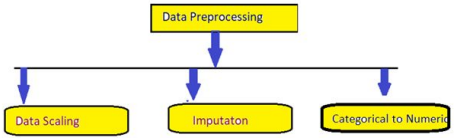



Fog Computing
Data
Data
sigfox
IoT
aws
Data
Data
MQTT/ API-REST
Edge Computing

Machine Learning





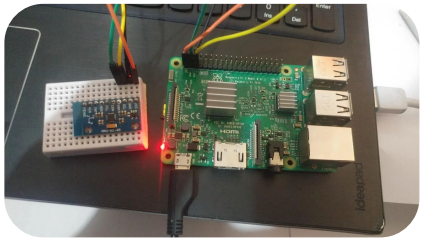


Adquisición de datos de un sensor

Normalización

Codificación

Dividir el conjunto de datos

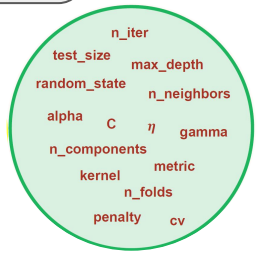


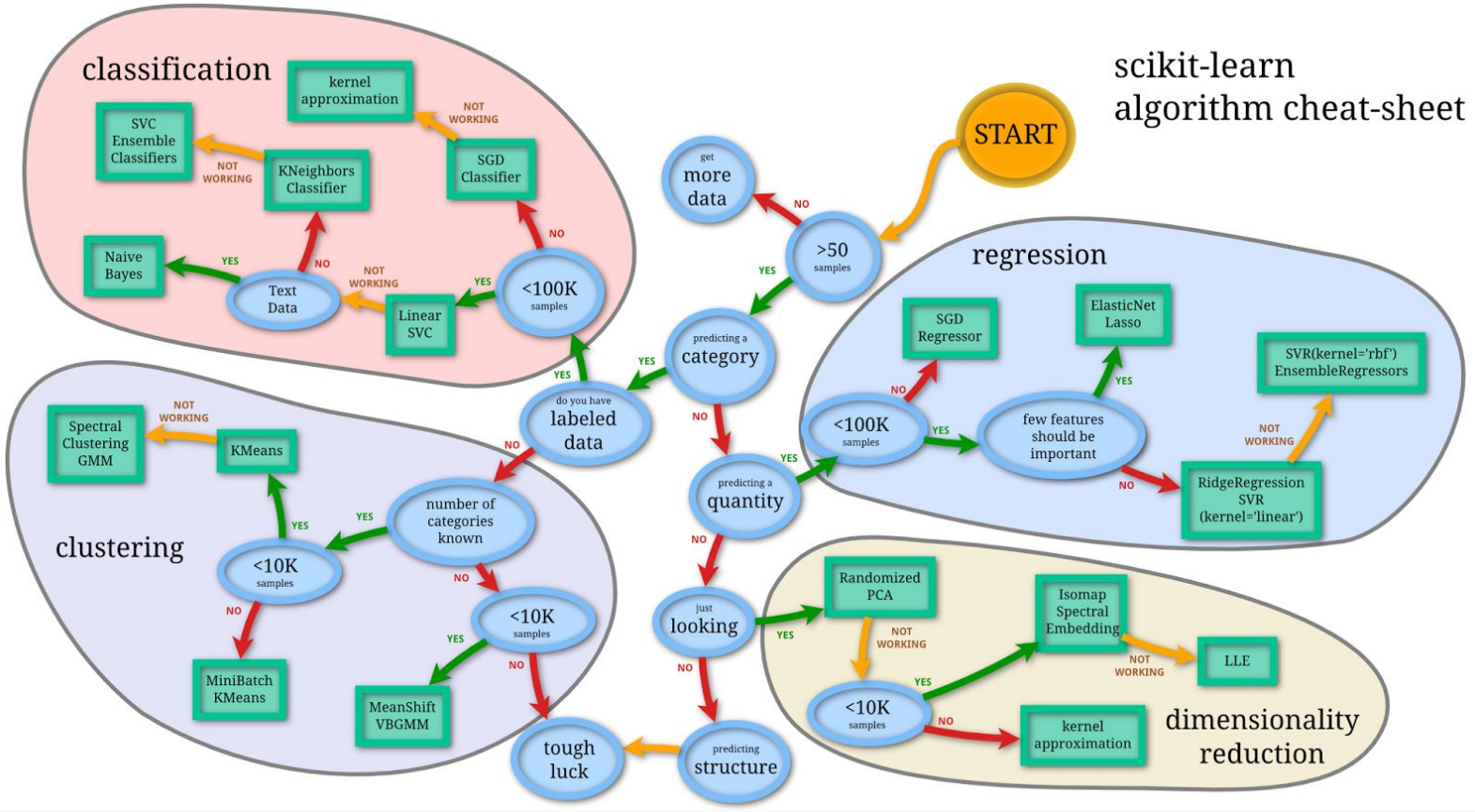
Etapas para el aprendizaje

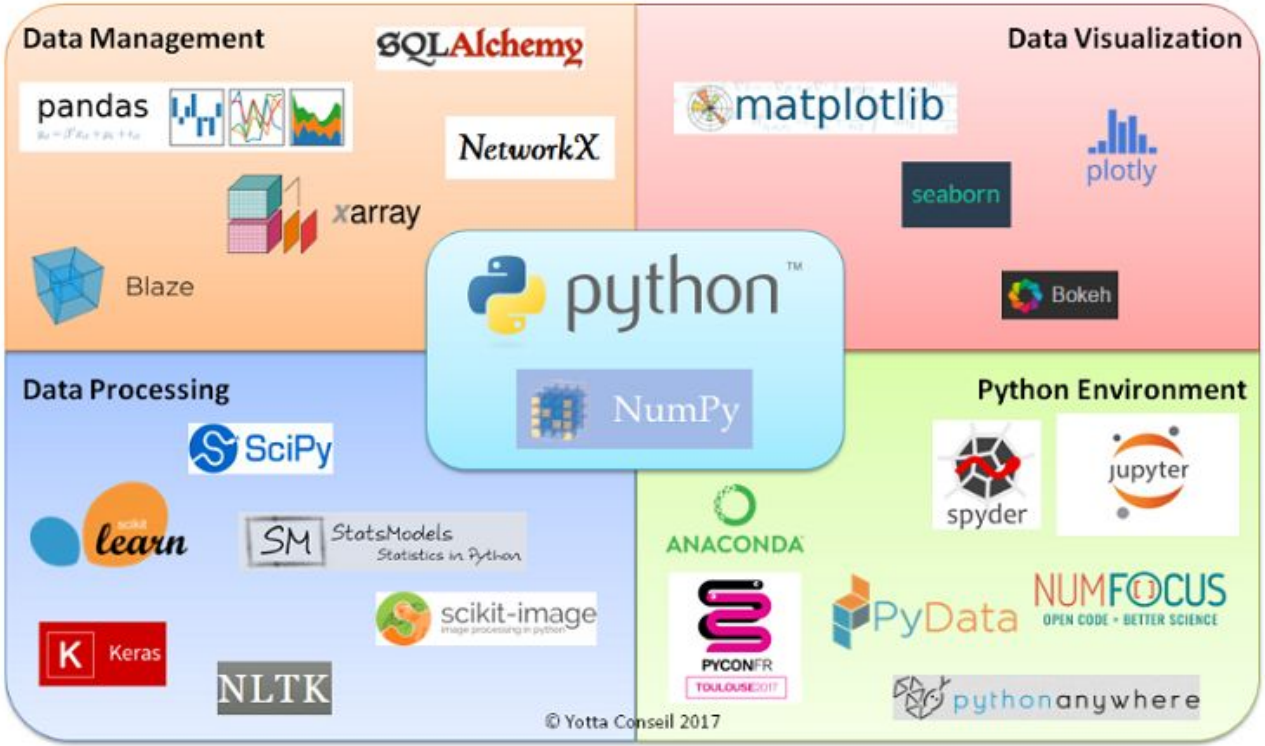
Establecer hiper-parámetros

Etapa de validación

Exportar a un microcontrolador

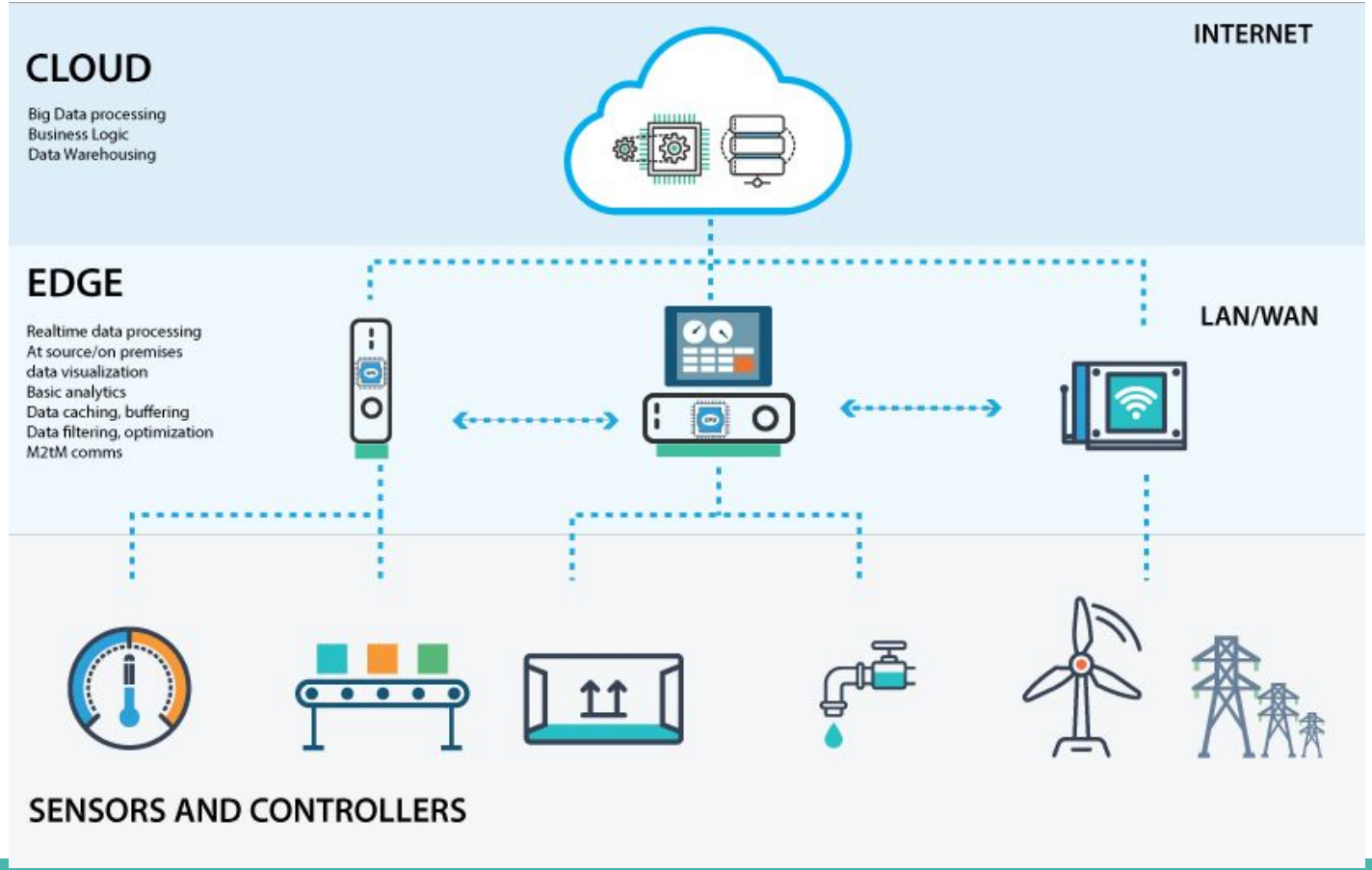



scikit-learn
algorithm cheat-sheet
START
get more data
NO
>50 samples
YES
predicting a category
YES
do you have labeled data
NO
predicting a quantity
NO
just looking
NO
predicting structure
tough luck
classification
kernel approximation
NOT WORKING
SVC Ensemble Classifiers
NOT WORKING
KNeighbors Classifier
SGD Classifier
NO
Naive Bayes
YES
Text Data
NO
NOT WORKING
Linear SVC
YES
<100K samples
NO
clustering
Spectral Clustering GMM
NOT WORKING
KMeans
YES
number of categories known
YES
<10K samples
NO
MiniBatch KMeans
NO
<10K samples
YES
MeanShift VBGMM
NO
regression
SGD Regressor
NO
<100K samples
YES
few features should be important
YES
ElasticNet Lasso
NO
RidgeRegression SVR (kernel='linear')
NOT WORKING
SVR(kernel='rbf') EnsembleRegressors
dimensionality reduction
Randomized PCA
YES
NOT WORKING
<10K samples
YES
Isomap Spectral Embedding
NOT WORKING
LLE
NO
kernel approximation


Data Management
SQLAlchemy
pandas
NetworkX
xarray
Blaze
Data Visualization
matplotlib
plotly
seaborn
Bokeh
python
NumPy
Data Processing
SciPy
scikit-learn
SM StatsModels Statistics in Python
scikit-image
Keras
NLTK
Python Environment
spyder
jupyter
ANACONDA
PYCONFR TOULOUSE2017
PyData
NUMFOCUS OPEN CODE + BETTER SCIENCE
pythonanywhere
© Yotta Conseil 2017

Edge computing - Complementary tech powering IoT

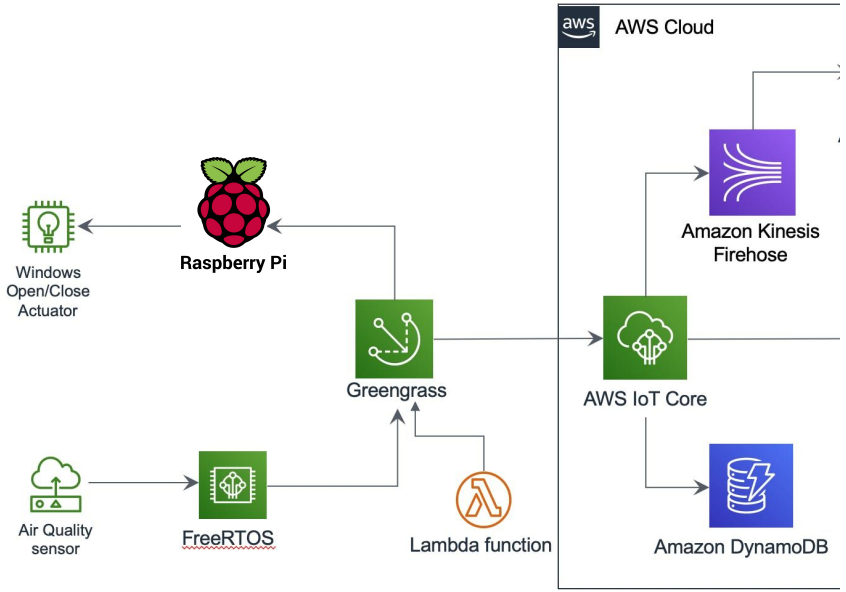
The edge
-Real time data processing
-Local processing



Edge computing en sistemas embebidos

AWS Greengrass

Mini-computadoras



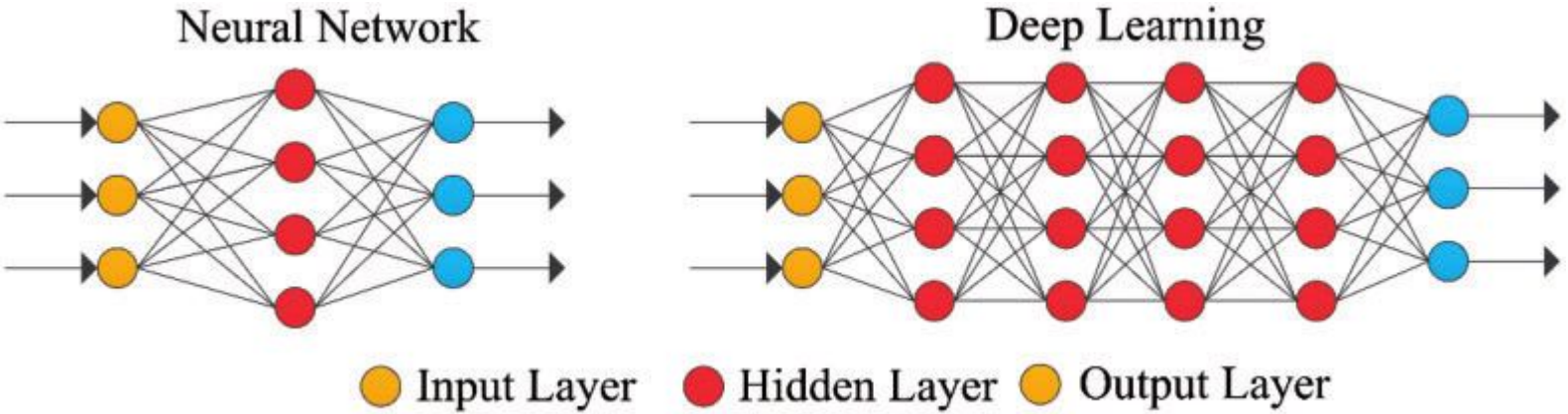
Edge computing en sistemas embebidos

Microcontroladores

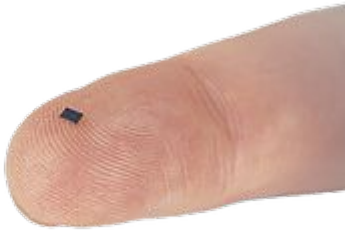
Nombre de la librería	características	instalación
micromlgen	https://www.hackster.io/news/even-smaller-machine-learning-models-for-your-mcu-up-to-82-code-size-5d7ff7d1ec85 https://medium.com/@eloquentarduino/you-can-run-machine-learning-on-arduino-and-any-other-mcu-out-there-too-ed8ea889c22e	pip install micromlgen
micro-learn	https://medium.com/analytics-vidhya/micro-learn-getting-started-with-machine-learning-on-arduino-52167bc34c1d	pip install micro-learn
tensorflow-lite	https://blog.arduino.cc/2019/10/15/get-started-with-machine-learning-on-arduino/	pip install tensorflowlite
sklear_porter	https://github.com/nok/sklearn-porter	pip install --no-cache-dir https://github.com/nok/sklearn-porter/zipball/master

Parte 1

Deep Learning

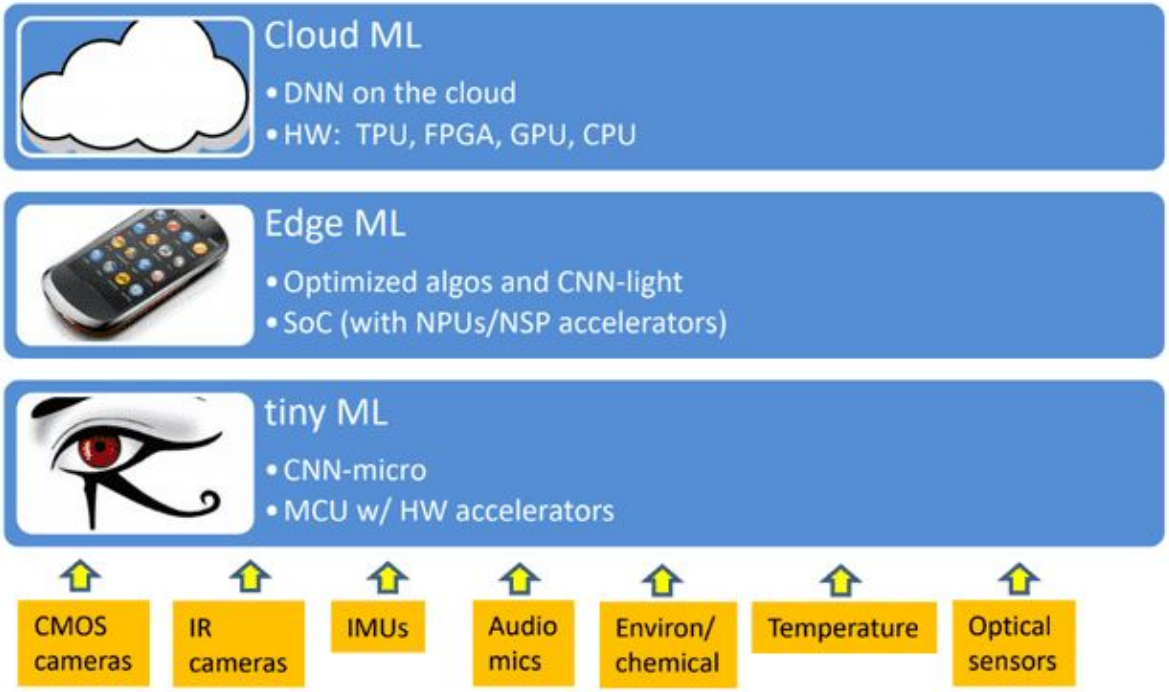


The Future of ML is Tiny and Bright



why tinyML opportunity is so enormous?

Data is a new oil(electricity) and ML is a way to produce it



Data Sources:

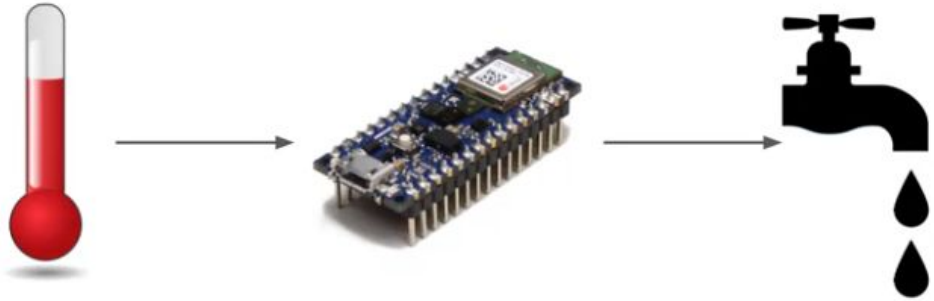
1%
Storage and sharing

User provided: **4%**
1. Pics
2. Audio
3. Clicks/likes
4. GPS, Location based

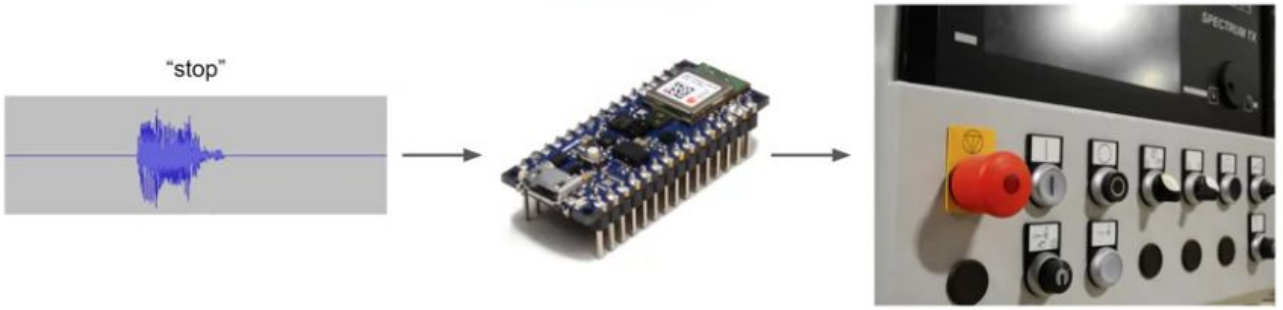
95%
Real-time in the physical world

TINY ML

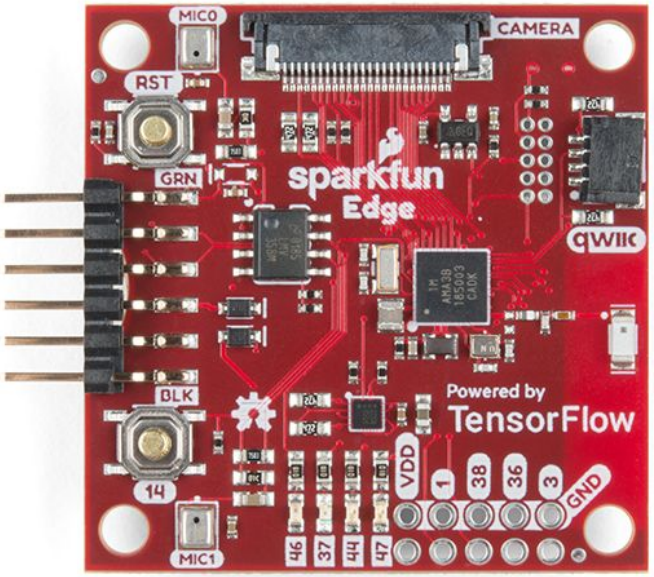
Deterministic



Probabilistic



Actualidad en embebidos



Microcontroller

- 32-bit ARM Cortex-M4F processor with Direct Memory Access
- 48MHz CPU clock, 96MHz with TurboSPOT™
- Extremely low-power usage: 6uA/MHz
- 1MB Flash
- 384KB SRAM
- Dedicated Bluetooth processor with BLE 5

Onboard

- ST LIS2DH12 3-axis accelerometer
- 2x MEMS microphones with operational amplifier
- Himax HM01B0 camera connector
- Qwiic connector
- 4 x GPIO connections
- 4 x user LEDs
- 1 x user button
- FTDI-style serial header for programming
- Bluetooth antenna
- CR2032 coin cell holder for battery operation

What It Does

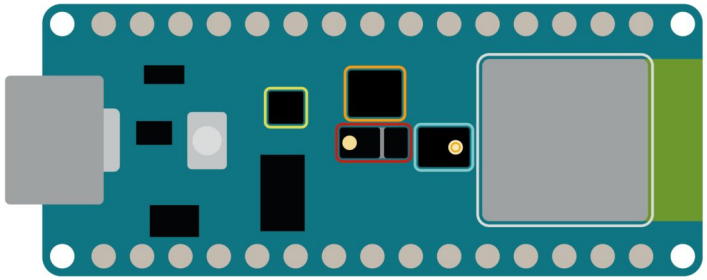
- High processing to current consumption ratio enables machine learning applications on the 'Edge' of networks, without the need for a central computer or web connection.
- Voice, gesture, or image recognition possible with TensorFlow Lite. (Note: Voice examples are provided. Gesture and image examples hope to be released by TensorFlow soon)

General

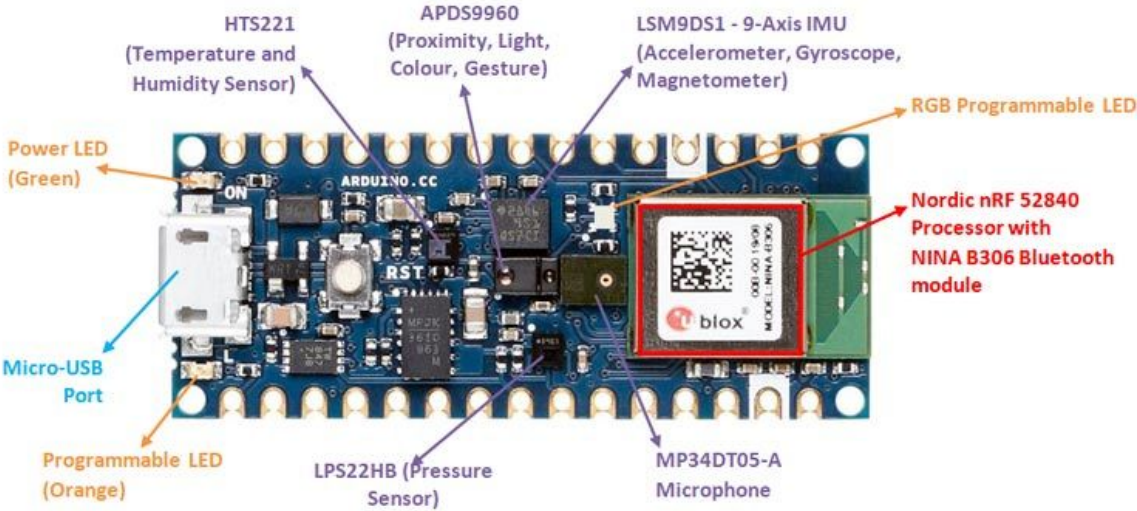
- 1.8V - 3.6V supply voltage range
- Small 1.6in x 1.6in x 0.35in (40.6mm x 40.6mm x 8.9mm) form factor

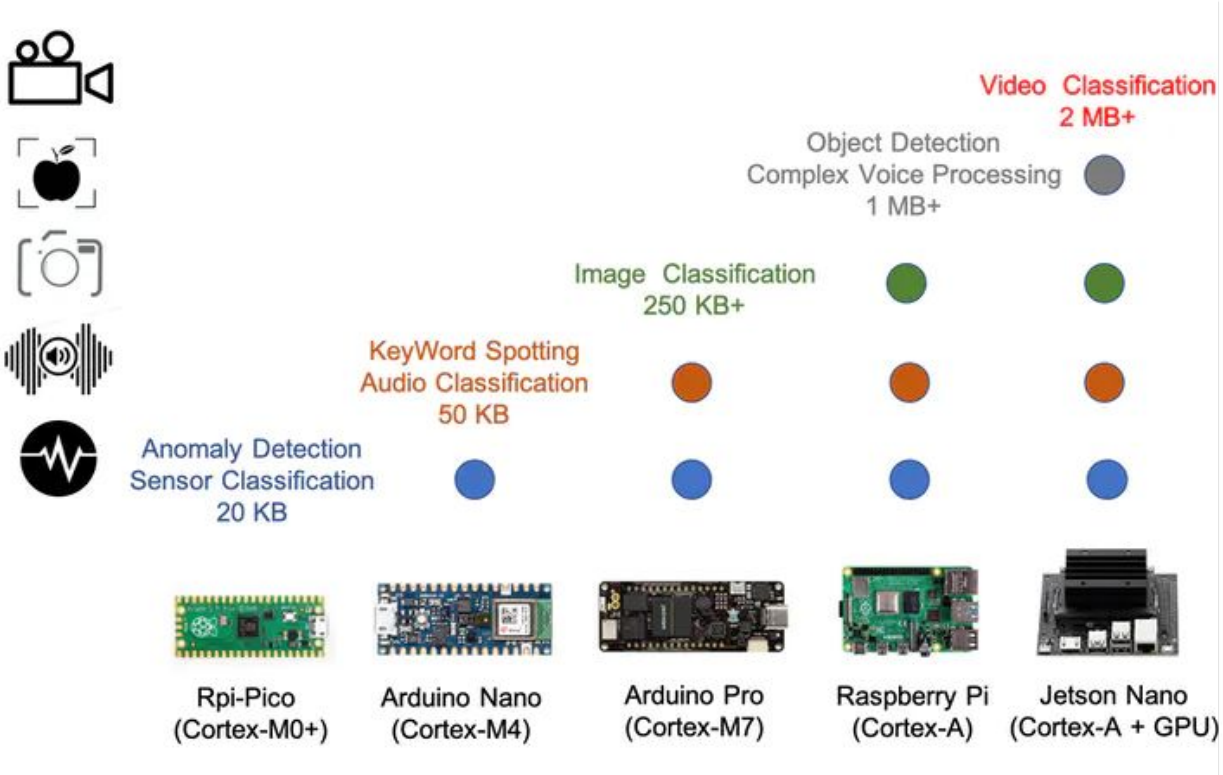
Arduino nano 33 ble

NANO 33 BLE SENSE

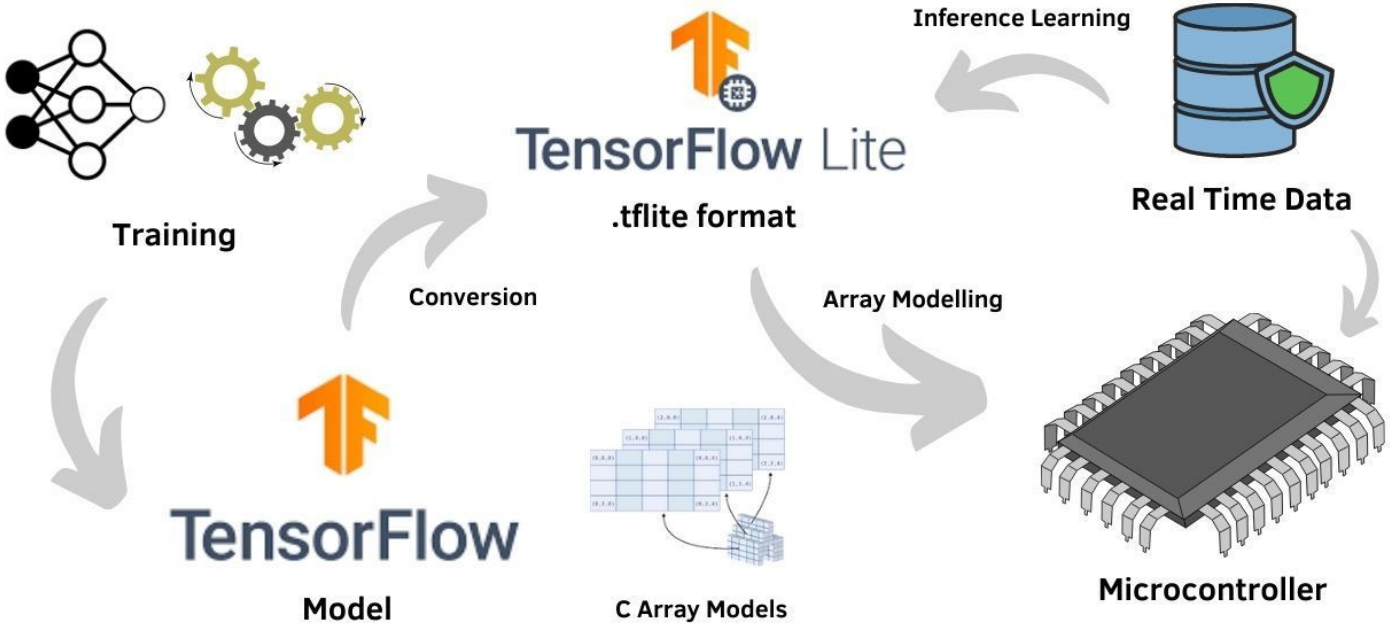


- Color, brightness, proximity and gesture sensor
- Digital microphone
- Motion, vibration and orientation sensor
- Temperature, humidity and pressure sensor
- Arm Cortex-M4 microcontroller and BLE module



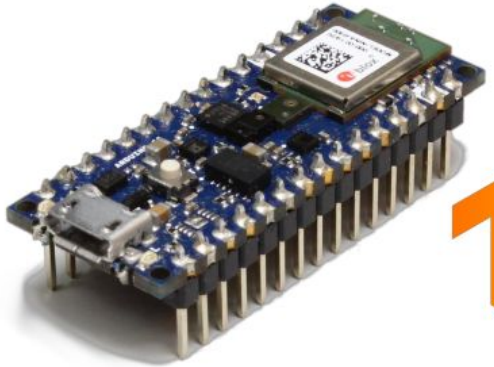

Video Classification
2 MB+
Object Detection
Complex Voice Processing
1 MB+
Image Classification
250 KB+
KeyWord Spotting
Audio Classification
50 KB
Anomaly Detection
Sensor Classification
20 KB
Rpi-Pico
(Cortex-M0+)
Arduino Nano
(Cortex-M4)
Arduino Pro
(Cortex-M7)
Raspberry Pi
(Cortex-A)
Jetson Nano
(Cortex-A + GPU)

TensorflowLite



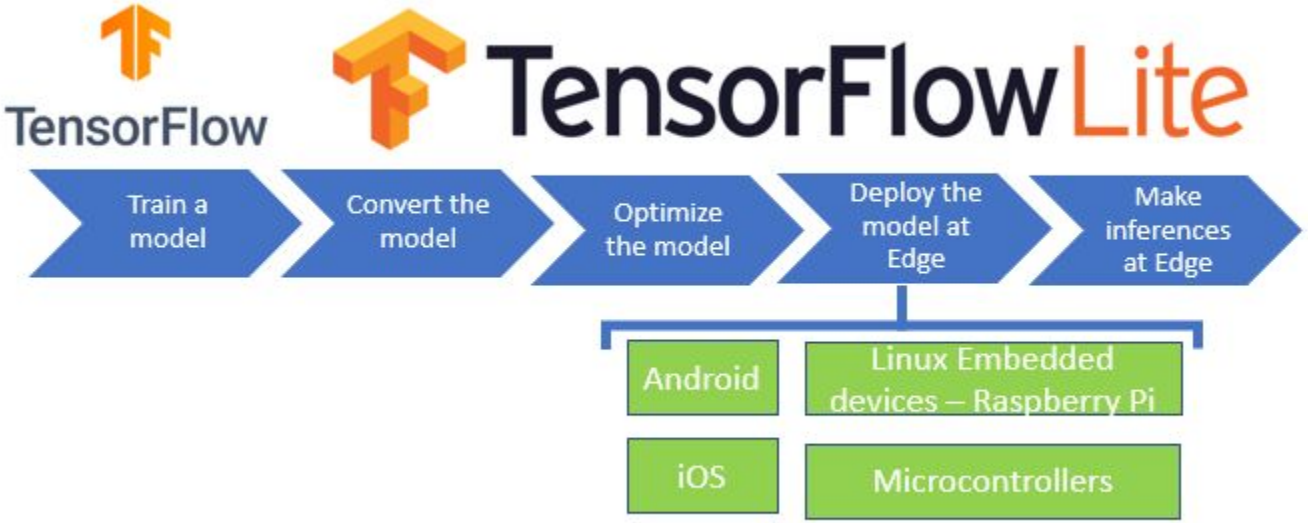
Single Board Computer

- More powerful (faster processor, more memory)
- Runs full, general purpose operating system (OS)
- Can provide full command line or graphical user interface
- Requires more power



Microcontroller

- Less powerful
- Bare-metal (superloop) or real-time operating system (RTOS)
- Limited or no user interface
- Requires less power


TensorFlow
TensorFlow Lite
Train a model
Convert the model
Optimize the model
Deploy the model at Edge
Make inferences at Edge
Android
Linux Embedded devices – Raspberry Pi
iOS
Microcontrollers

¿Qué es el tinyML? ¿Para que es útil?

On-device machine learning applications in the single mW and below

Vibration and motion

Any 'signal'

Predictive maintenance, sensor fusion, accelerometer, pressure, lidar/radar, speed, shock, vibration, pollution, density, viscosity, etc.

Voice and sound

Recognition and creation

Keyword spotting, speech recognition, natural language processing, speech synthesis, sound recognition, etc.

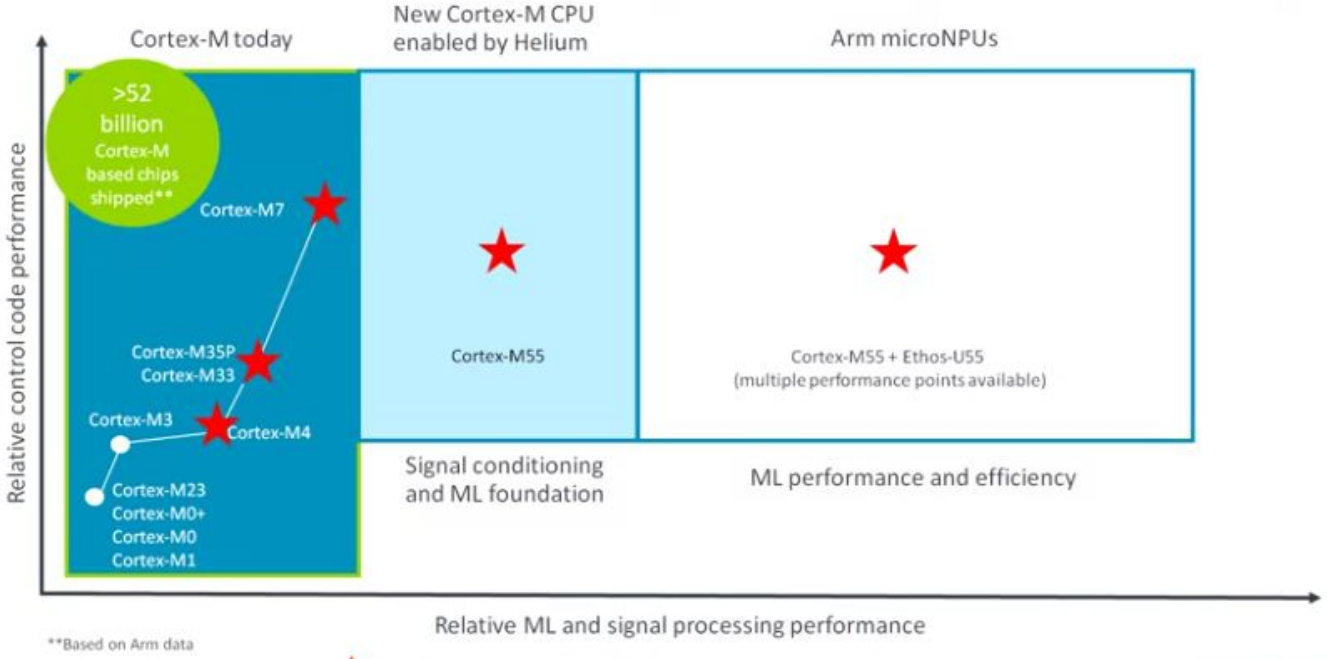
Vision

Images and video

Object detection, face unlock, object classification etc.

Sistemas operativos en microcontroladores

Pushing the Boundaries for Real-time On-device Processing



**Based on Arm data

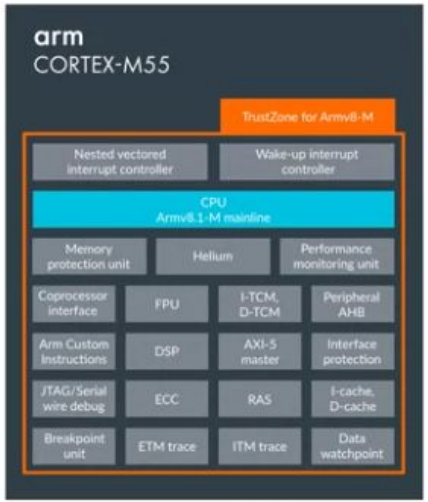
★ Well suited for ML & DSP applications

Graph not to scale

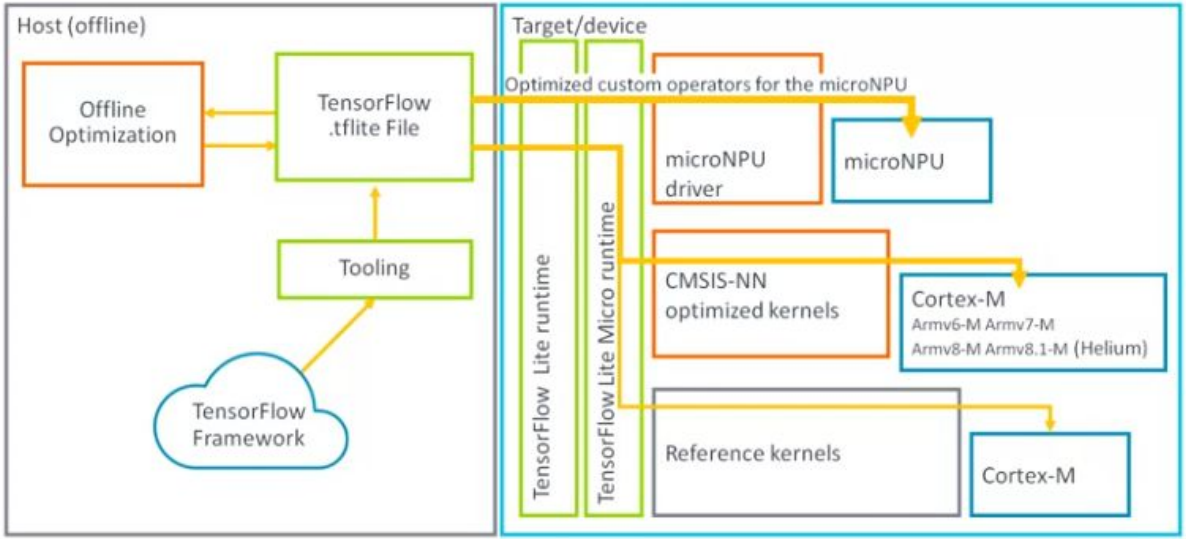
arm

Cortex-M55: The Most AI-capable Cortex-M Processor

- ✓ First CPU based on Arm Helium technology
  - Energy-efficient and configurable with vector processing capabilities
  - Delivers up to 5x DSP performance and up to 15x ML performance*
  - Versatile capability for both classical ML and NN inference
- ✓ Advanced memory interfaces for fast access to ML data and weights
- ✓ TrustZone support
- ✓ Extensive configurability



Mapping of NNs to Ethos-U using TensorFlow Lite



arm

Neural Network performance Across ARM IPs

Wav2Letter

Efficient Software (CMSIS-NN)

AI Capable Cortex-M55

AI Dedicated U55 256 MAC/cycle

arm

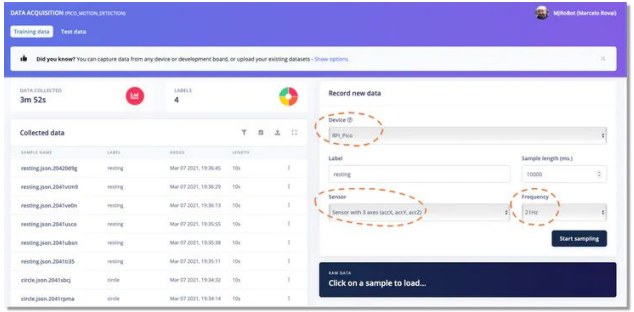
Broadest Range of ML-optimized Processing Solutions

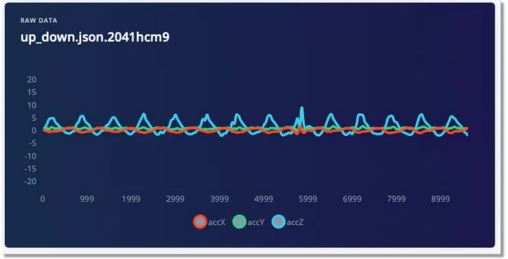
arm

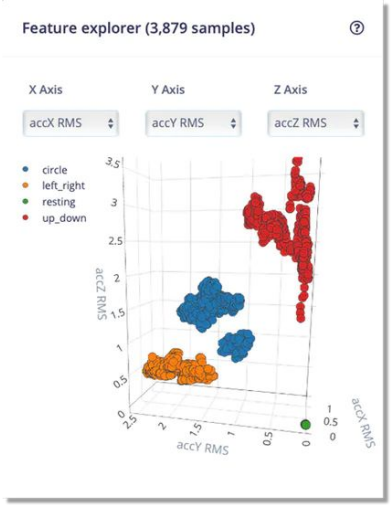
Parte 2

Edge impulse

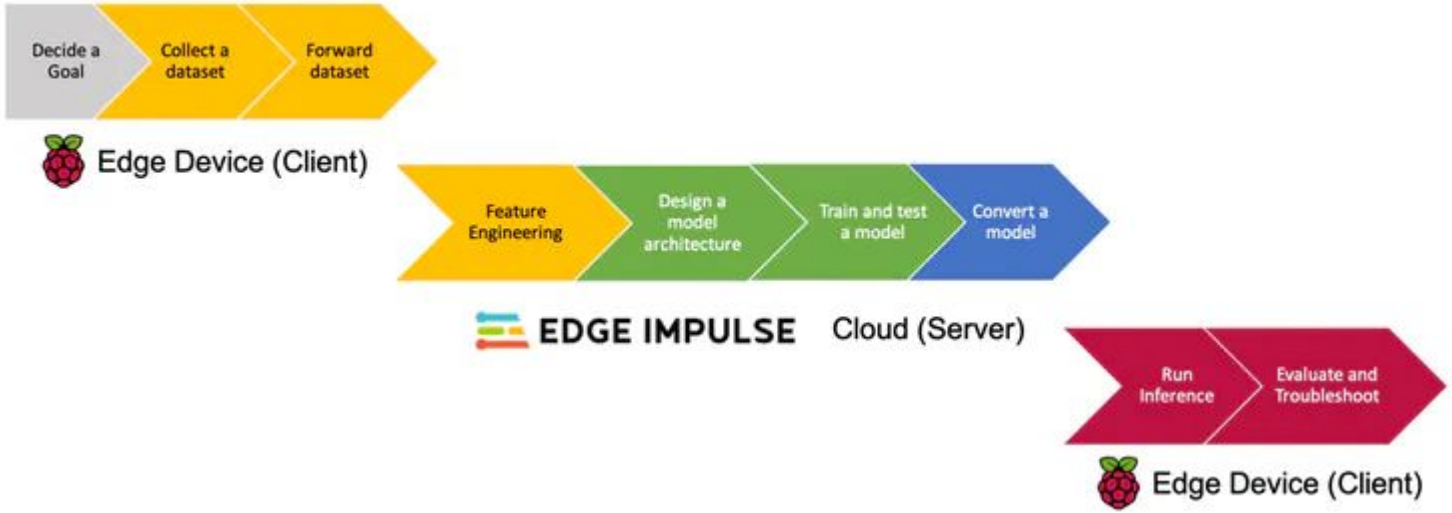
- Plataforma para desarrollar algoritmos de aprendizaje máquina enfocados a implementarse en sistemas embebidos como microcontroladores o computadoras con recursos reducidos.
- Edge Impulse es una plataforma joven, pero grandes fabricantes de semiconductores respaldan su desarrollo. Por mencionar algunos están ARM, ST Electronics, Microchip, Nordic Semiconductor y Arduino.
- Podemos destacar sobre todo la colaboración con TinyML y Hackster.io.
- Interfaz amigable y es bastante intuitiva.







Edge impulse



Endpoints Have **Sensors**, Tons of Sensors

Motion Sensors
Gyroscope, radar, magnetometer, accelerator

Acoustic Sensors
Ultrasonic, Microphones, Geophones, Vibrometers

Environmental Sensors
Temperature, Humidity, Pressure, IR, etc.

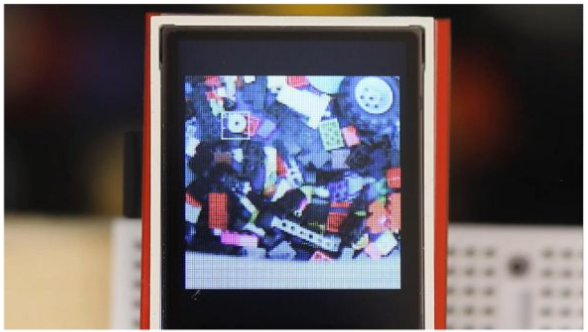
Touchscreen Sensors
Capacitive, IR

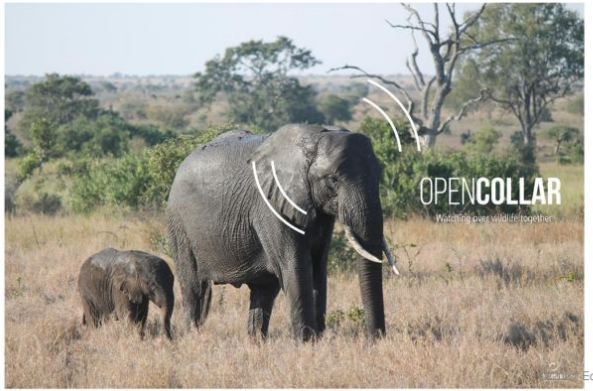
Image Sensors
Thermal, Image

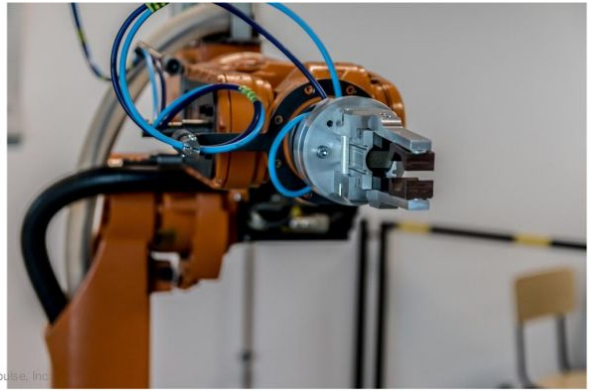
Biometric Sensors
Fingerprint, Heart rate, etc.

Force Sensors
Pressure, Strain

Rotation Sensors
Encoders

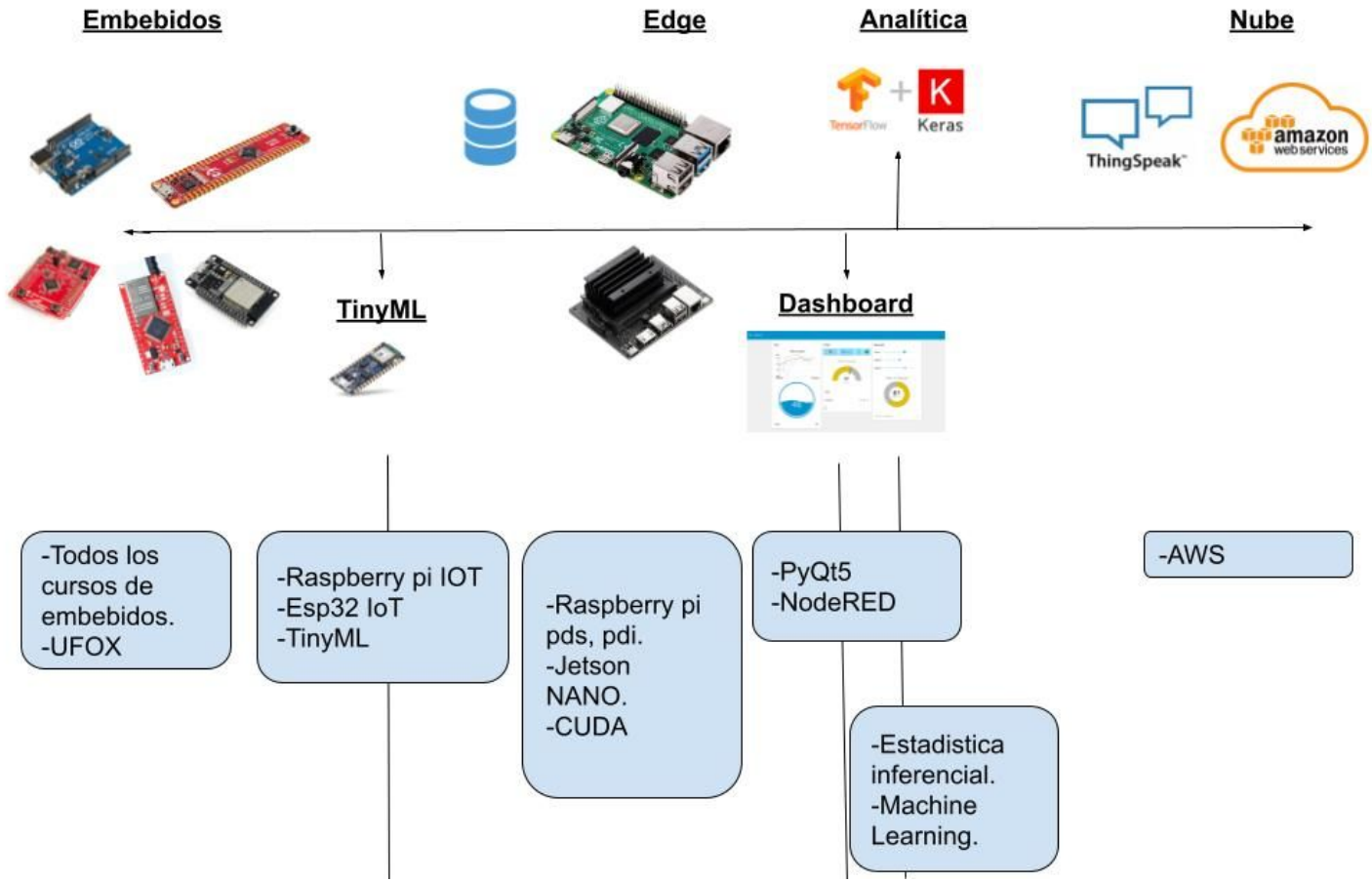







THE ETHICS
OF ARTIFICIAL
INTELLIGENCE

IoT Environment - UMAKER



GRACIAS

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