Embedded AI
DCA 0306

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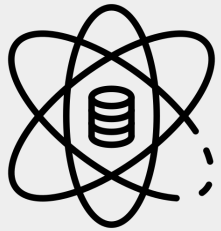
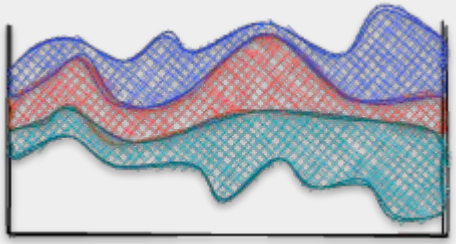
UFRN UNIVERSIDADE FEDERAL DO RIO GRANDE DO NORTE

DCA

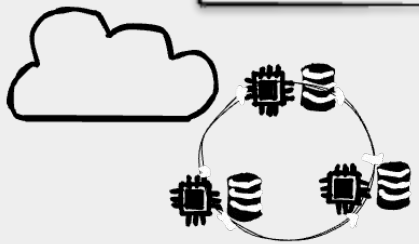
Created by DALL·E "An engineering wearing a futurist glass fixing a microwave and drinking soda"

Embedded





AI



ARTIFICIAL INTELLIGENCE

ARTIFICIAL INTELLIGENCE

Any technique which enables computer to mimic human behavior

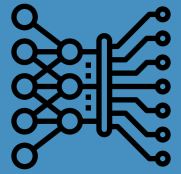
MACHINE LEARNING

AI techniques that give computers the ability to learn without being explicitly programed to do so

DEEP LEARNING

TinyML

A subset of ML which make the computation of multi-layer neural network feasible



Embedded Systems

1950 - 1980

1980 - 2010

2010 - **202X**

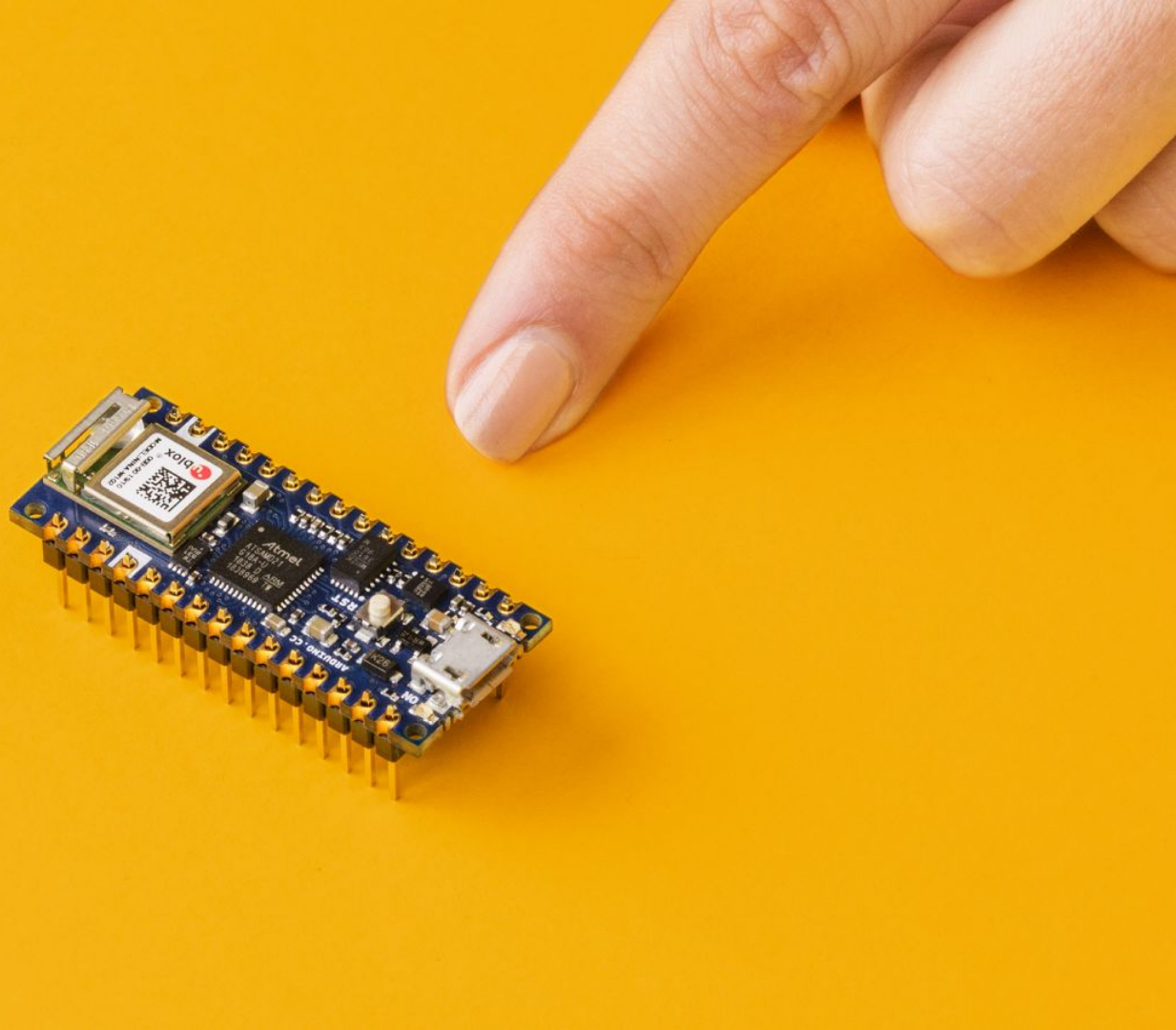
What is TinyML?

Tiny Machine Learning (TinyML) is a **fast-growing field of machine learning** technologies and applications including **algorithms, hardware and software** capable of performing **on-device sensor data analytics** (vision, audio, IMU, biomedical, etc.) at **extremely low power**, typically in the mW range and below, and hence enabling a variety of **always-on-use-cases** and targeting **battery-operated devices**.

OK Google

Alexa

Hey Siri


u-blox
Atmel

Hardware vs Model Size

TinyML EdgeML

Power

Anomaly Detection
Sensor Classification
20 KB

KeyWord Spotting
Audio Classification
50 KB

Image
Classification
250 KB+

Object Detection
Complex Voice
Processing
1 MB+

Video
Classification
2 MB+

Rpi-Pico
(Cortex-M0+)

Arduino Nano
(Cortex-M4)

Portenta – H7
(Cortex-M7)

RaspberryPi
SmartPhone
(Cortex-A)

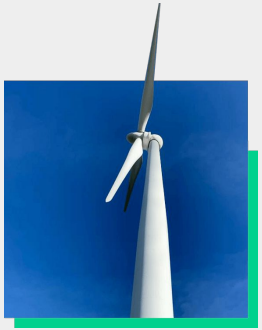
Jetson Nano
(Cortex-A + GPU)

Adapted from Edge Impulse

3Vs Applications

Voice (sound)

Vibration

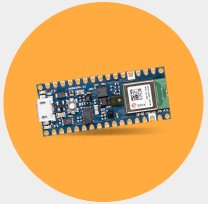


Vision

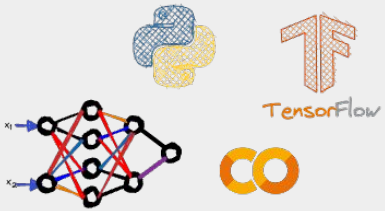
Agenda Recap

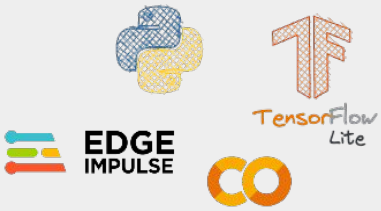
Fundamentals of TinyML

Applications of TinyML

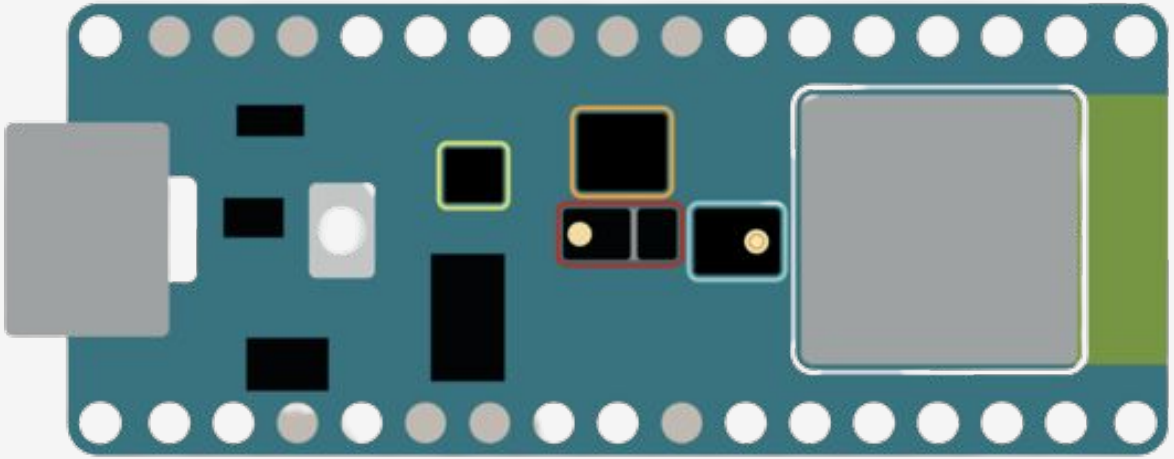


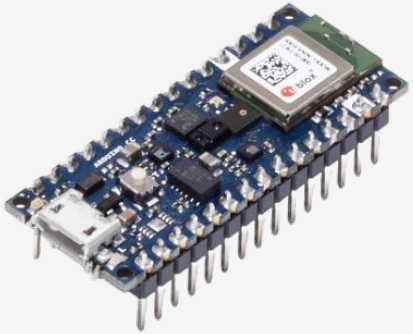
Deploying TinyML






TINY MACHINE
LEARNING KIT
ARDUINO
in partnership with
edX
TensorFlow
OV7675

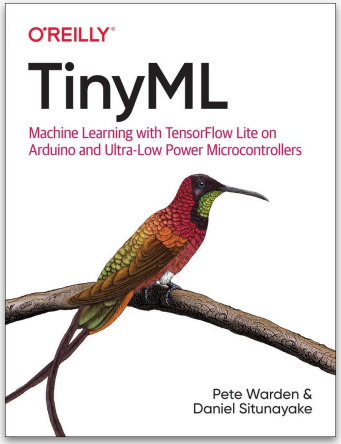


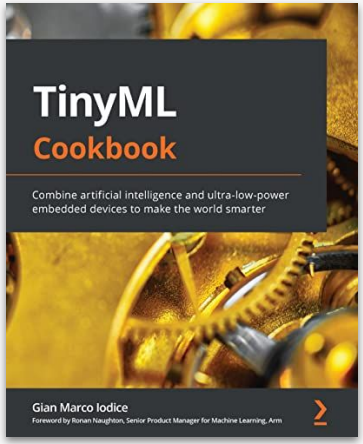


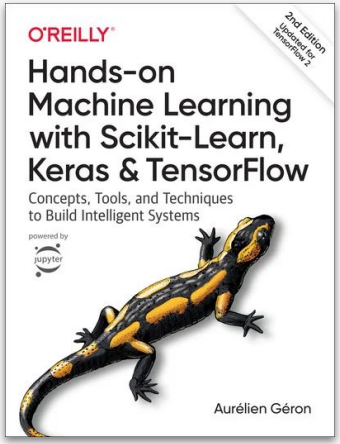
Nano 33 BLE Sense

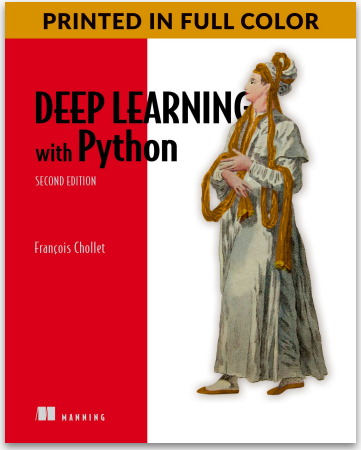
- Color, brightness, proximity and gesture sensor
- Digital microphone
- Motion, vibration and orientation sensor
- Temperature, humidity and pressure sensor
- Arm Cortex-M4 microcontroller and BLE module

Bring the power of AI to your pocket with Arduino's tiniest form factor.


O'REILLY
TinyML
Machine Learning with TensorFlow Lite on Arduino and Ultra-Low Power Microcontrollers
Pete Warden &
Daniel Situnayake


TinyML
Cookbook
Combine artificial intelligence and ultra-low-power embedded devices to make the world smarter
Gian Marco Iodice
Foreword by Ronan Naughton, Senior Product Manager for Machine Learning, Arm


O'REILLY
2nd Edition
Updated for TensorFlow 2
Hands-on Machine Learning with Scikit-Learn, Keras & TensorFlow
Concepts, Tools, and Techniques to Build Intelligent Systems
powered by
jupyter
Aurélien Géron


PRINTED IN FULL COLOR
DEEP LEARNING with Python
SECOND EDITION
François Chollet
MANNING

DATAQUEST