CEC Continuing Education Center

DesignNews

Developing Machine-Learning Applications on the Raspberry Pi Pico

DAY 1 : Getting Started with the Raspberry Pi Pico and Machine Learning

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Webinar Logistics

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- Submit questions for the lecturer using the Q&A widget. They will follow-up after the lecture portion concludes.

THE SPEAKER

Jacob Beningo

Visit ‘Lecturer Profile’

Beningo Embedded Group - President

Focus: Embedded Software Consulting

An independent consultant who specializes in the design of real-time, microcontroller based embedded software.
He has published two books:

- Reusable Firmware Development
- MicroPython Projects
- Embedded Software Design (https://bit.ly/3PZCtNO)

Writes a weekly blog for DesignNews.com focused on embedded system design techniques and challenges.

Visit www.beningo.com to learn more …

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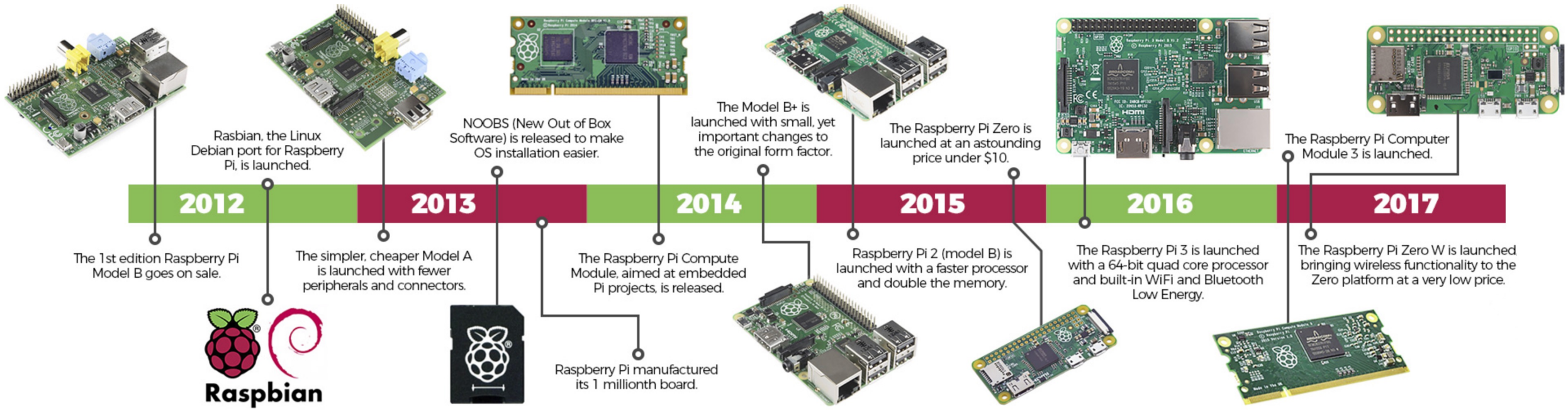
Course Sessions

- **Getting Started with the Raspberry Pi Pico and Machine Learning**
- Machine-Learning Tools and Process Flow
- Collecting Sensor Data Using Edge Impulse
- Designing and Testing a Machine-Learning Model
- Deploying Machine-Learning Models and Next Steps

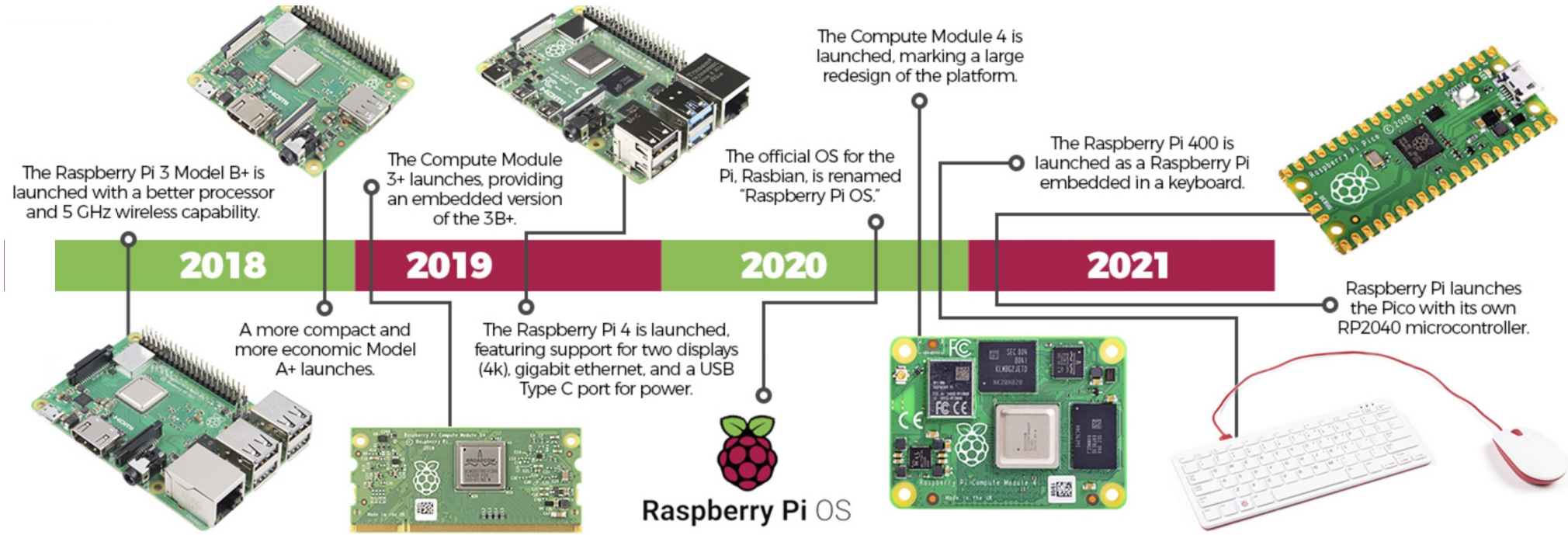
1 The Raspberry Pi

The Raspberry Pi's



Source: https://www.sparkfun.com/raspberry_pi

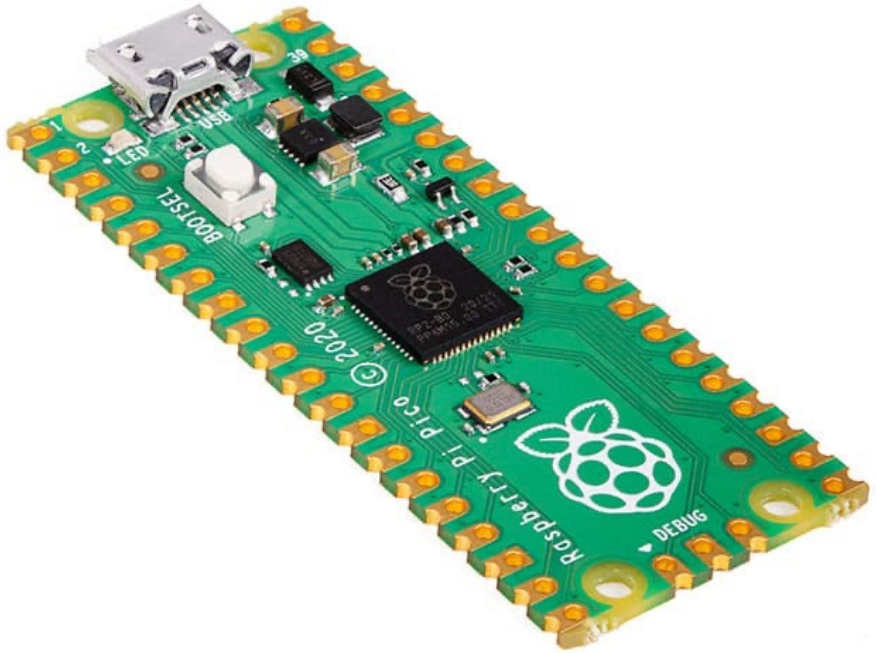
The Raspberry Pi's



Source: https://www.sparkfun.com/raspberry_pi

The Raspberry Pi Pico

- A $4 MCU board
  - RP2040
    - Dual Core
- SDK's
  - C
  - MicroPython

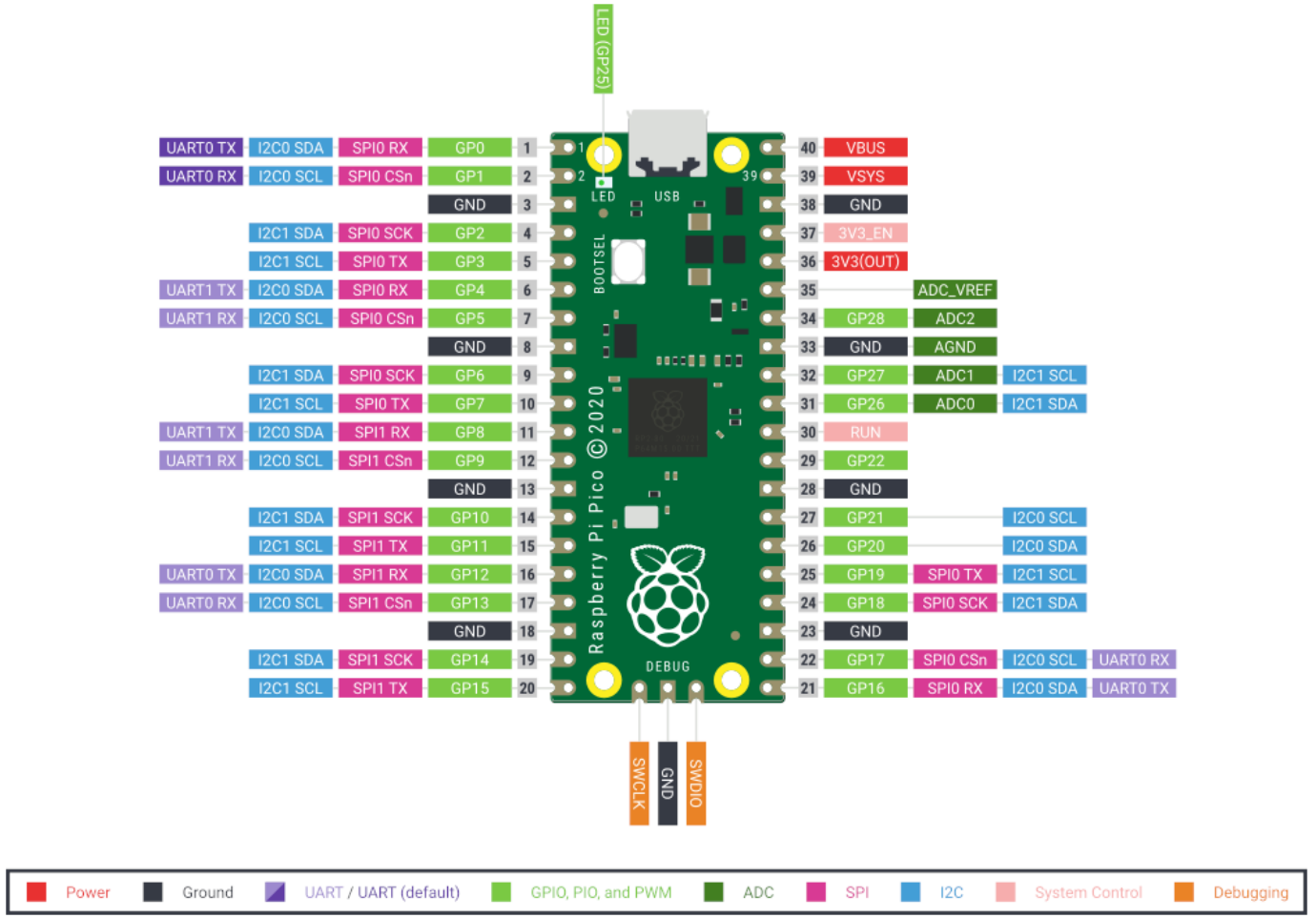


Are you planning to follow along with a Raspberry Pi Pico?
- Yes
- No
- Not sure

2 The Raspberry Pi Pico Hardware

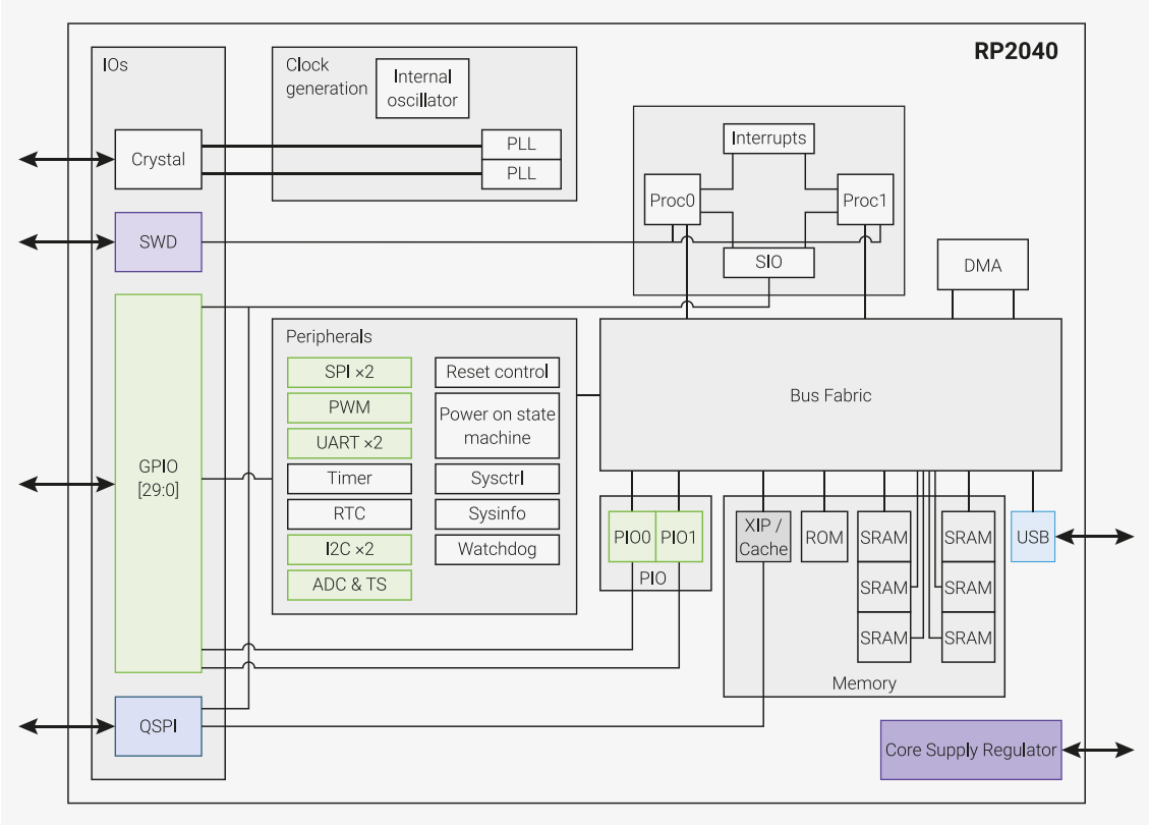
The Module Overview

- GPIO (28)
  - Any GPIO can be PWM
- UART (2)
- I2C (2)
- SPI(2)
- Analog (3)

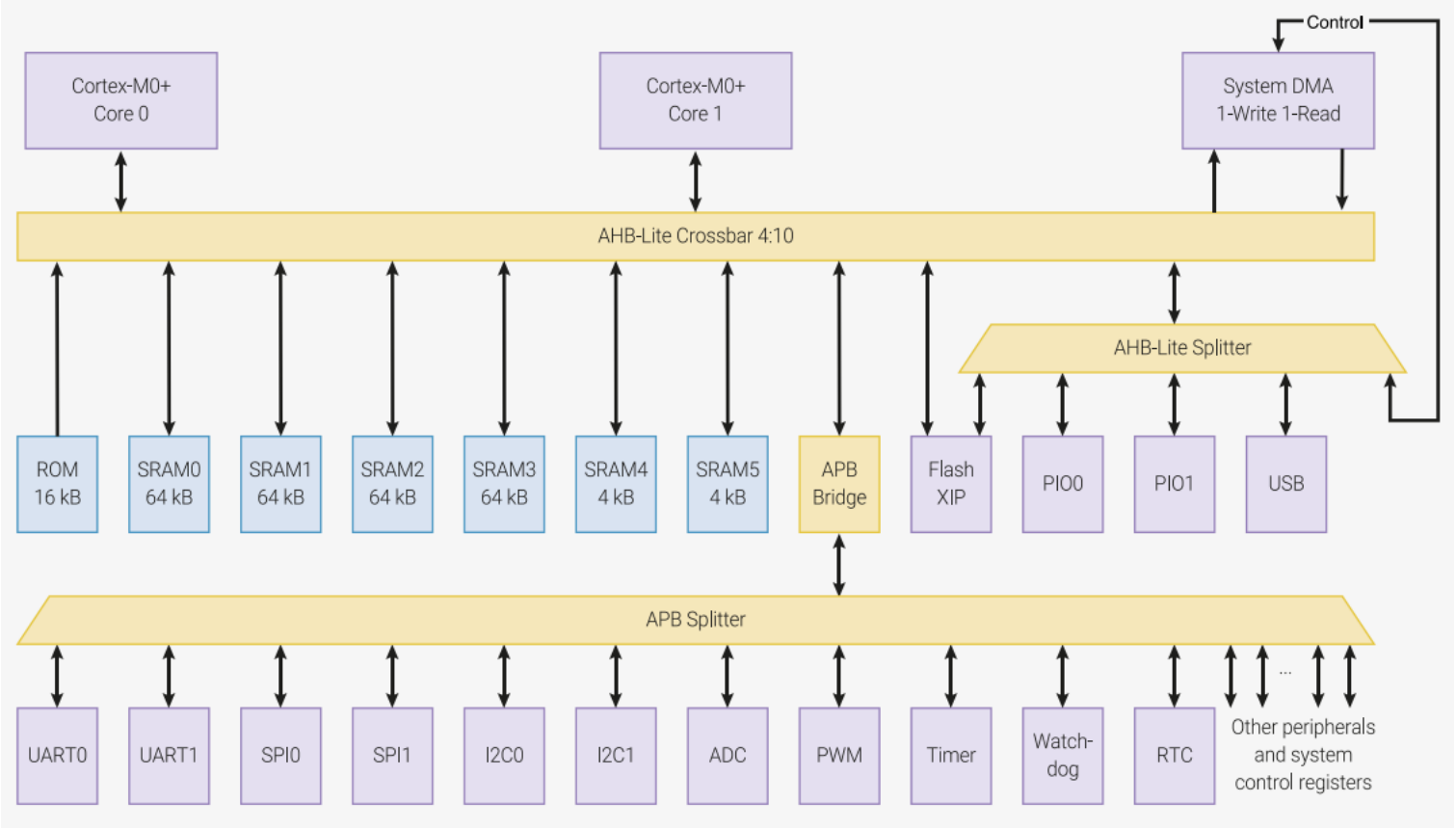


The RP2040 Microcontroller

- Dual ARM Cortex-M0+ @ 133MHz
- 264kB on-chip SRAM
- Support for up to 16MB of off-chip Flash
- DMA controller
- Interpolator and integer divider peripherals



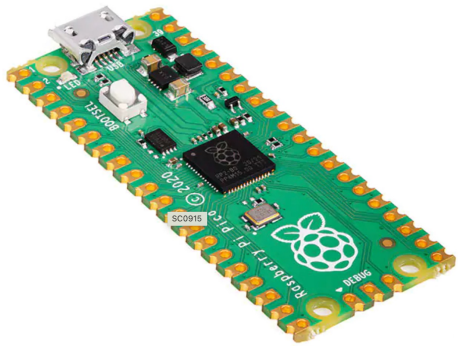
The RP2040 Microcontroller



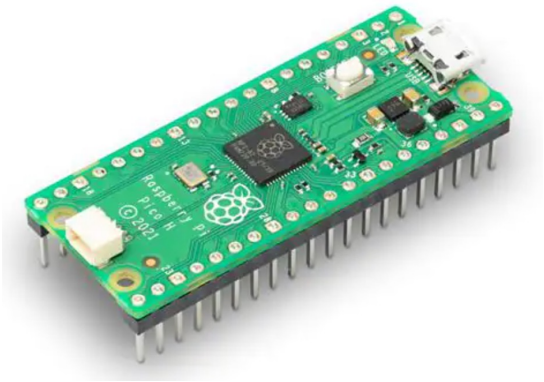
3 Development Board Options and Accessories

Raspberry Pi Pico

Raspberry Pi Pico
- PN: SC0915
- Standard Configuration



Raspberry Pi Pico H
- PN: SC0917
- With Pins

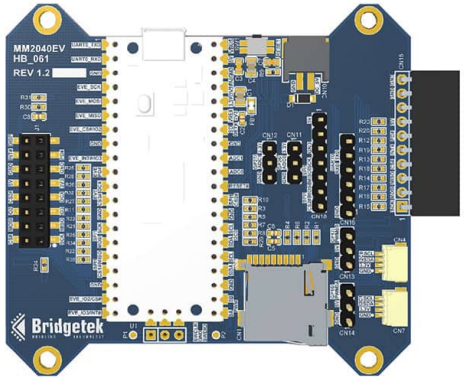


Raspberry Pi Pico W
- PN: SC0918
- Wi-Fi

Raspberry Pi Pico Expander

MM2040EV

- SWD / JTAG connector
- uSD card slot
- GPIO expansion

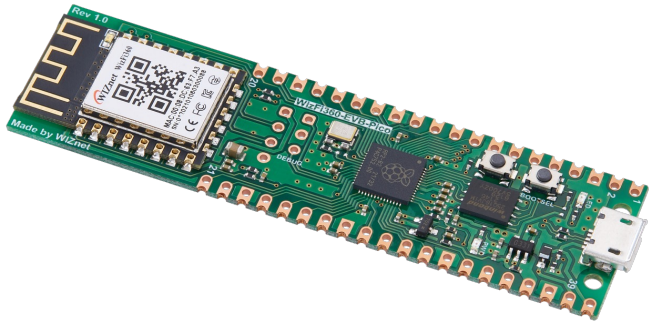


103100142

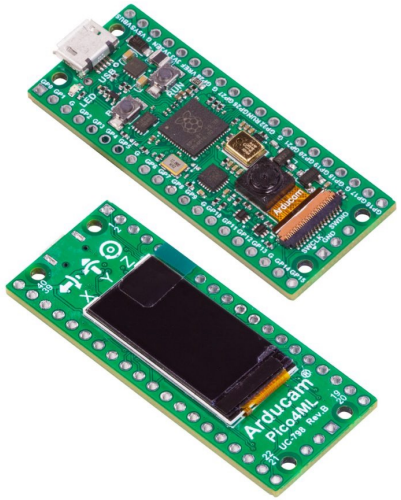
- SWD / JTAG connector
- GPIO expansion
- Sensor connectors

Raspberry Pi Pico Alternatives

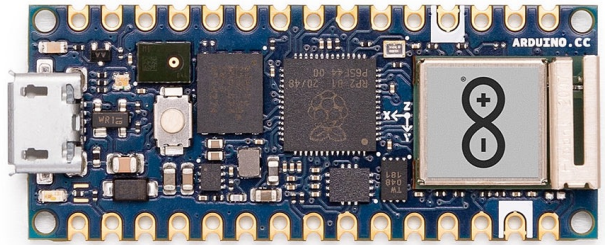
WizFi360-EVB-Pico
- PN: WizFi360-EVB-Pico
- Standard Configuration



Arducam
- PN: DEV-18439
- Camera + Display



Arduino Nano RP2040
- PN: ABX00052
- Standard Configuration



What do you think is the most interested feature of the Raspberry Pi Pico?

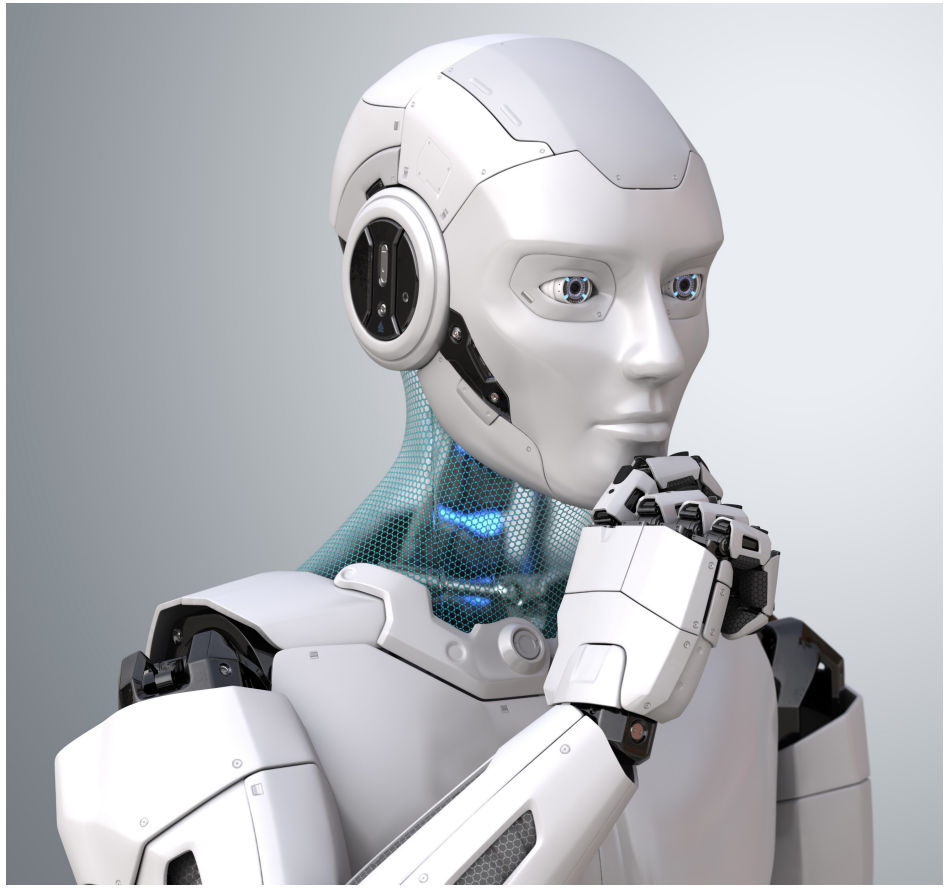
- Dual Core Microcontroller
- MicroPython Support
- I/O Capabilities
- Cost
- Development board options
- Other

3 Machine Learning

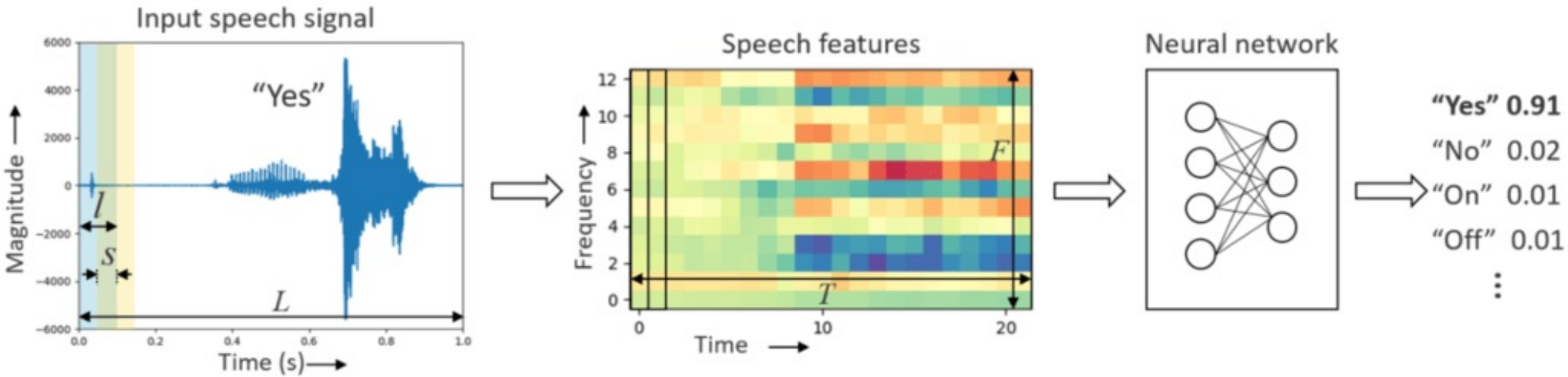
What is machine learning?

"Machine learning is a field of computer science that often uses statistical techniques to give computers the ability to 'learn' with data, without being explicitly programmed"

- Wikipedia



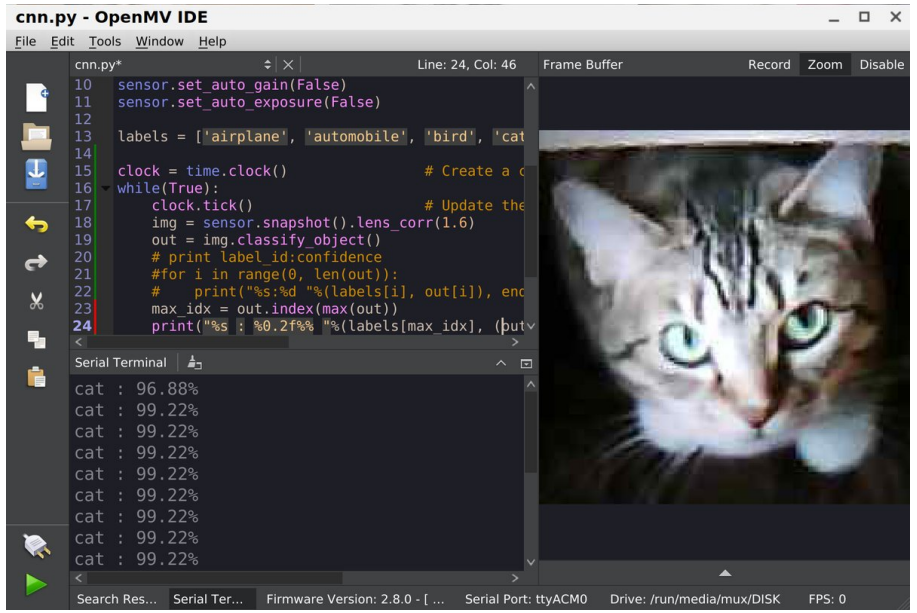
Machine Learning Application #1 – Keyword Spotting



Source: Arm

Machine Learning Application #2 – Image Recognition

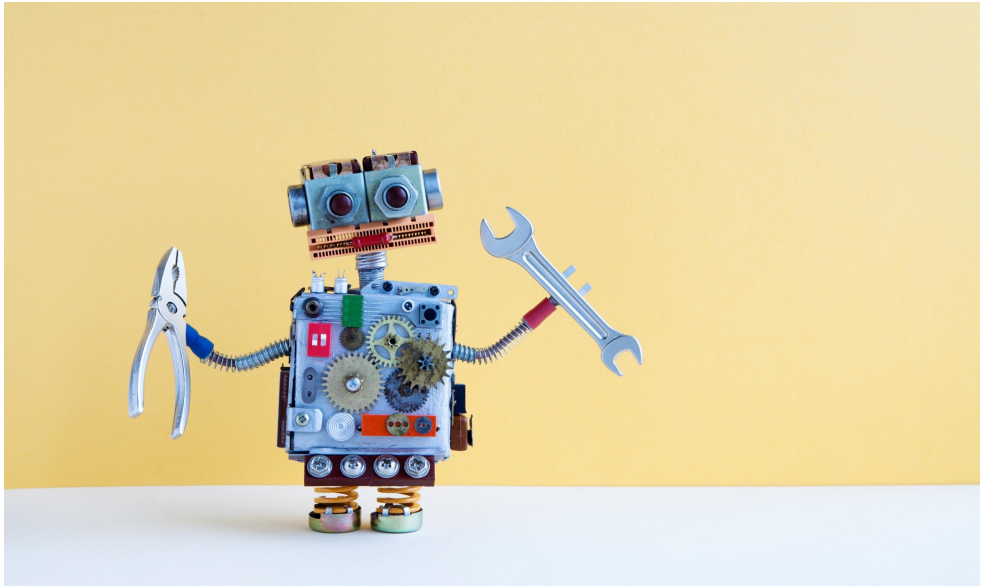
OpenMV Cam with a Cortex-M7



Video :
https://www.youtube.com/watch?v=PdWi_fvY9Og

Machine Learning Application #X – Choose your own adventure!

- Gesture classification
- Anomaly detection
- Analog meter reader
- Guidance and Control (GNC)
- Game AI
- Package detection
- (a plethora of applications)

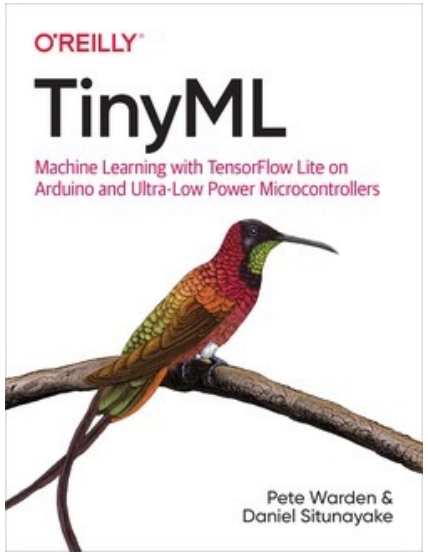


What application are you most interested in using Machine Learning for?

- Keyword spotting
- Image classification
- Predictive maintenance
- Other

4 Going Further

Machine Learning Resources



- O'Reilly TinyML by Pete Warden and Daniel Situnayake
- Machine Learning On Cortex-M Processors White Paper
- Image Recognition on Arm Cortex-M with CMSIS-NN
- TensorFlow Lite for Microcontrollers
- Keras – Deep Learning in Python
- STM32 Solutions for Artificial Neural Networks
- Edge Impulse
- Teachable Machine

Thank you for attending

Please consider the resources below:

- www.beningo.com
  - Blog, White Papers, Courses
  - Embedded Bytes Newsletter
    - http://bit.ly/1BAHYXm
  - Embedded Software Design
    - https://bit.ly/3PZCtNO

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