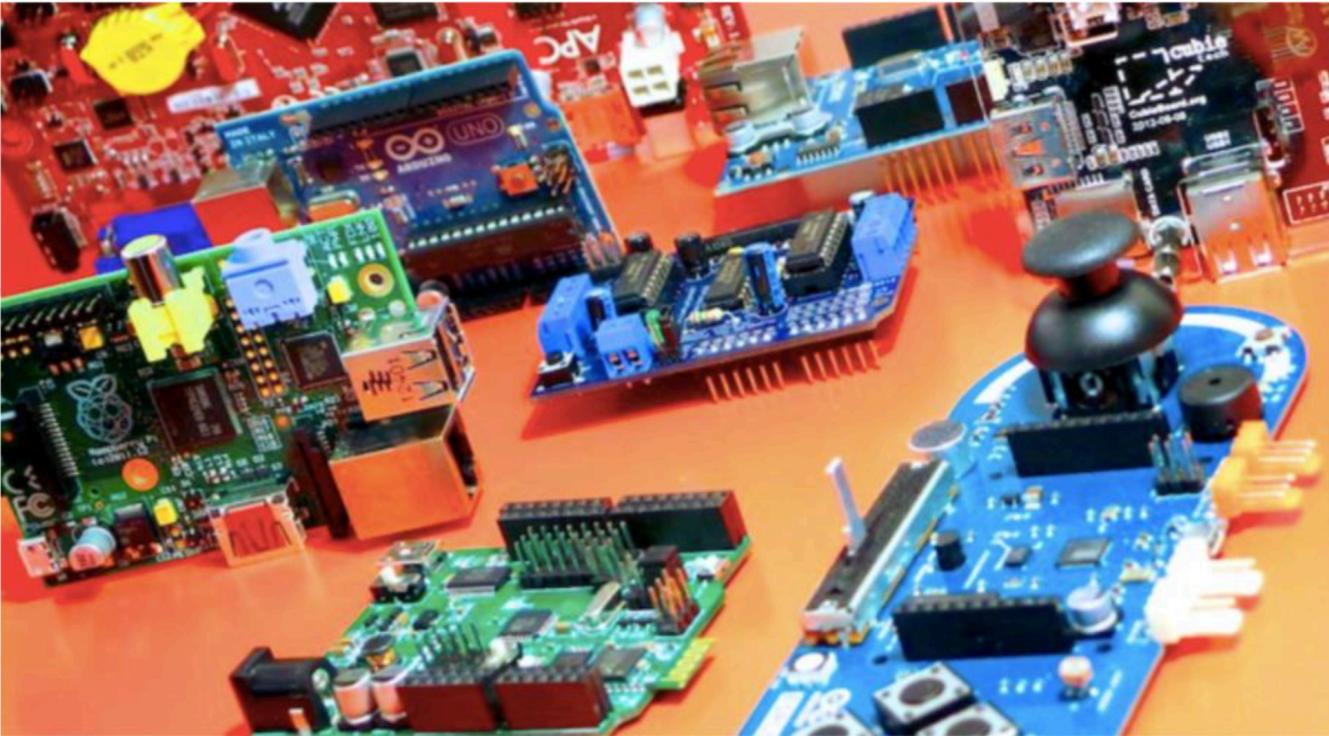


IoT: Challenges & Opportunities

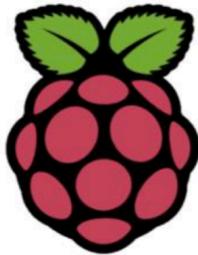
Ronald Criollo, Msig.
ESPOL



Hardware de Bajo Costo



Raspberry Pi



RaspberryPi



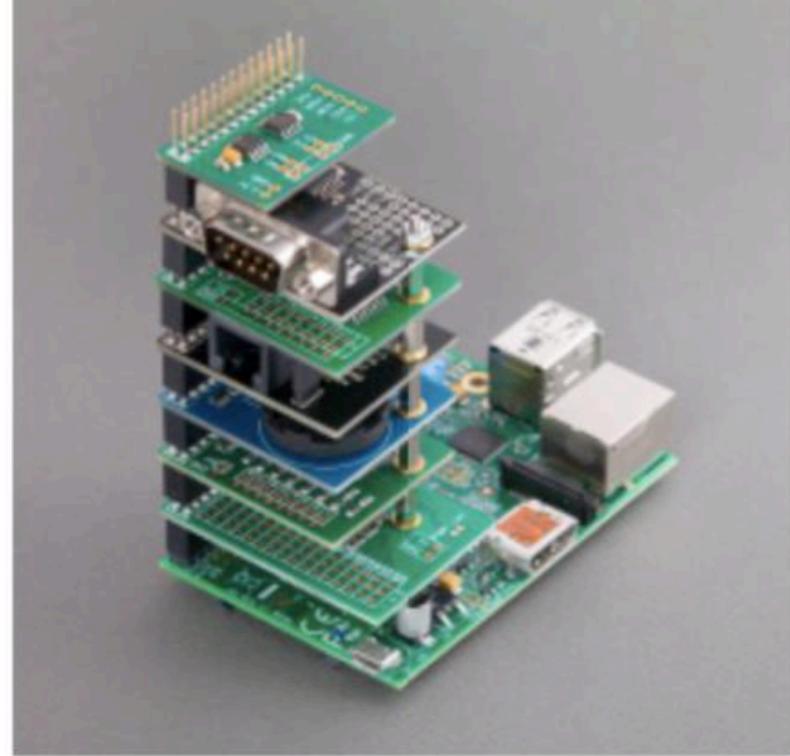
RASPBIAN



ubuntu core



Windows 10 IoT Core



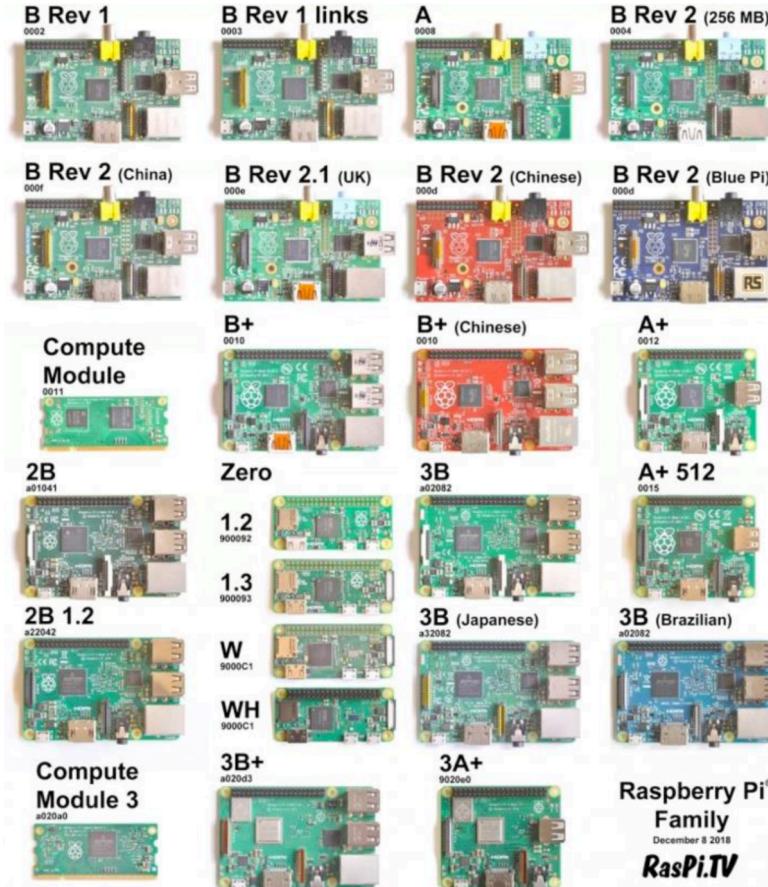
Raspberry Pi



Raspberry Pi Zero is a real \$5 computer. Learn to code while you play Minecraft, or do just about anything else you can dream up!



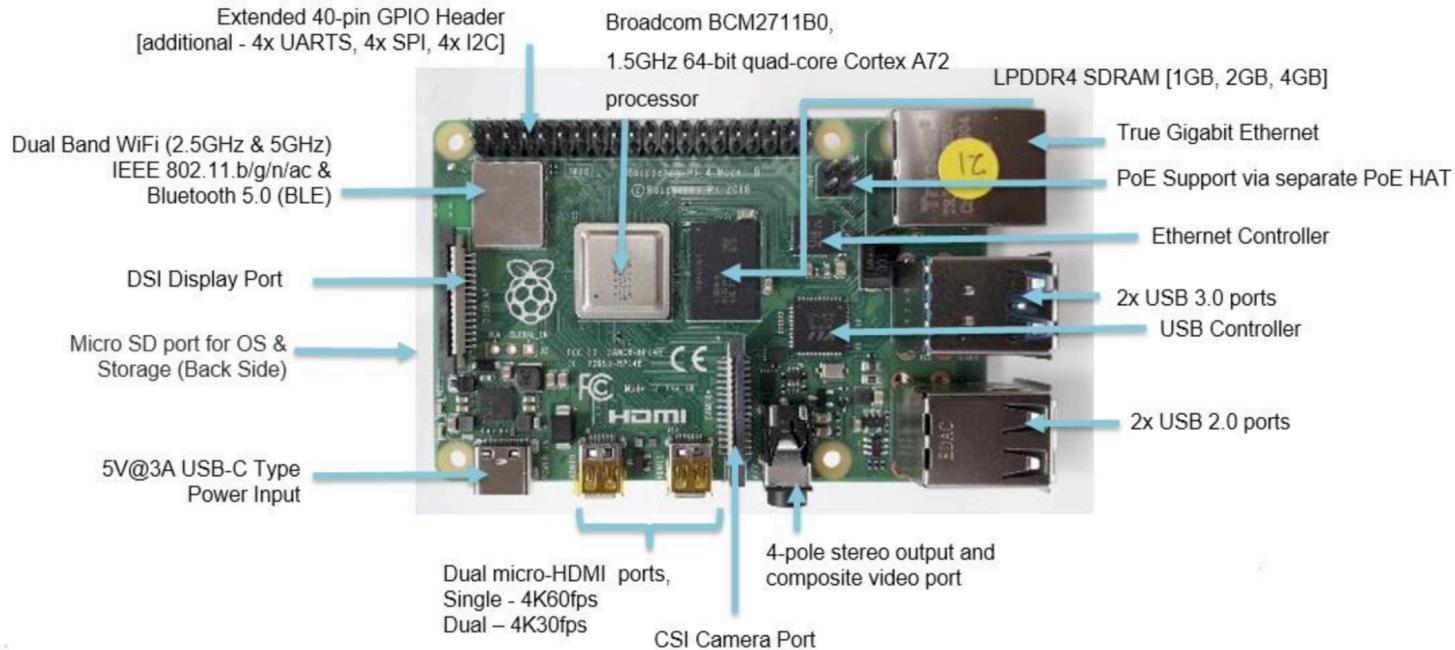
PLUM ASTRO PI IS EN ROUTE TO THE INTERNATIONAL SPACE STATION



WALC
GUATEMALA 2019

ICIP

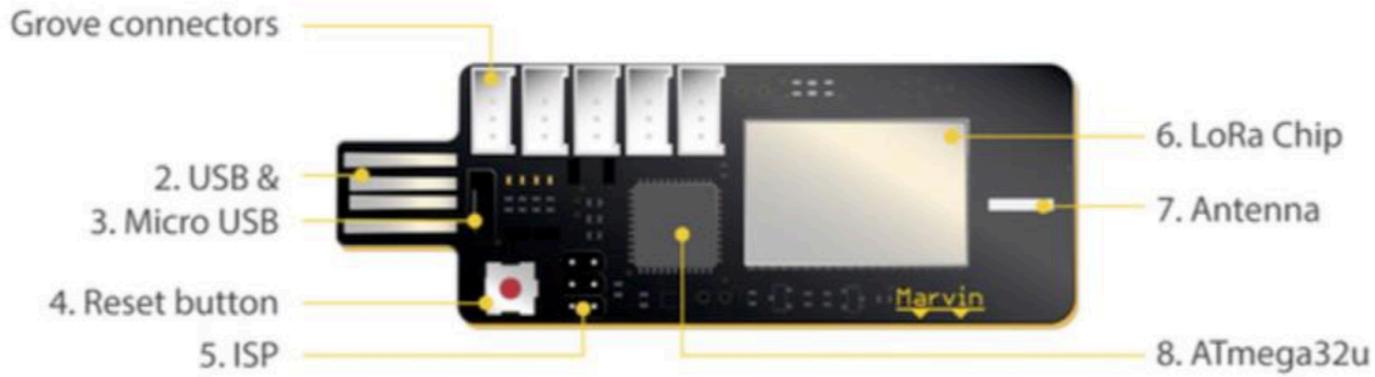
Raspberry Pi



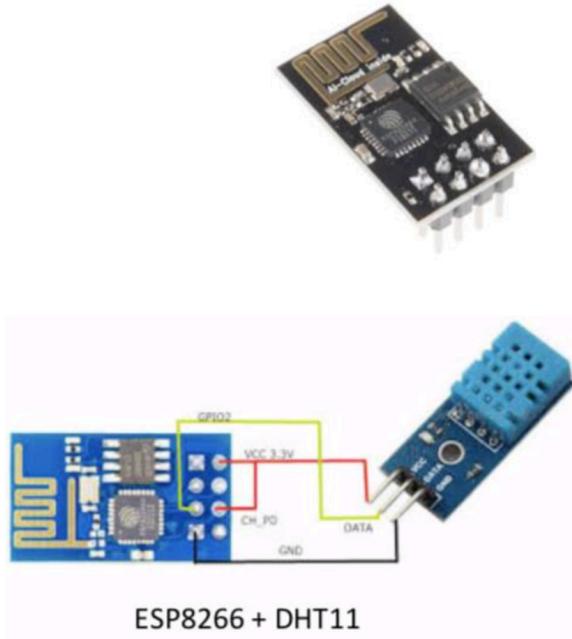
Raspberry Pi



Marvin



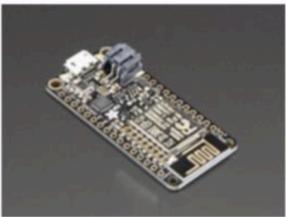
ESP8266



ESP8266 + DHT11



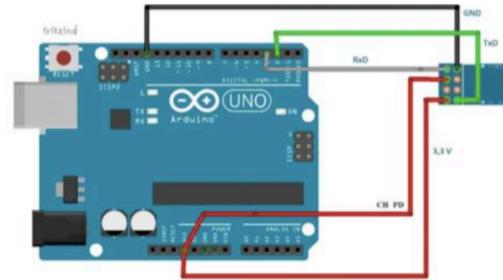
ESP8266



Adafruit HUZZAH



SparFun ESP8266 Thing



WeMos D1



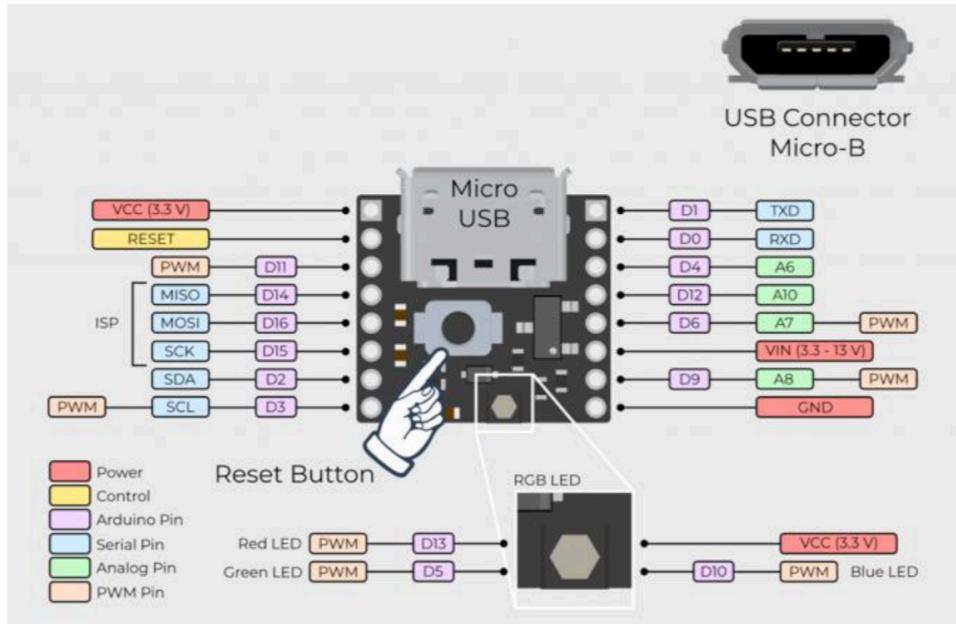
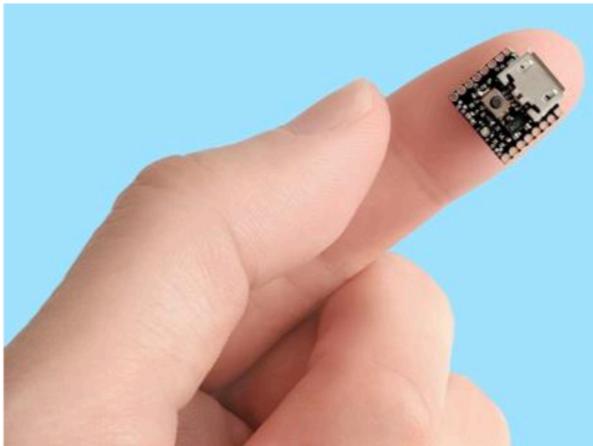
WeMos D1 mini

Espruino



Espruino

Atto



ESP32-CAM



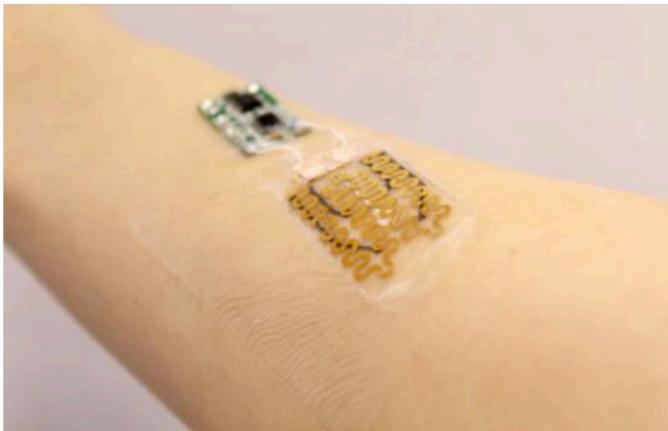
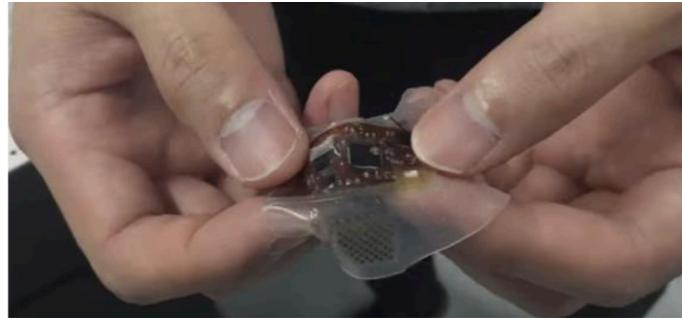
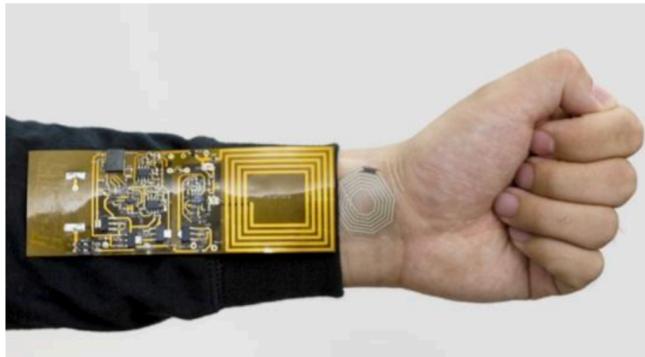
Soluciones IoT



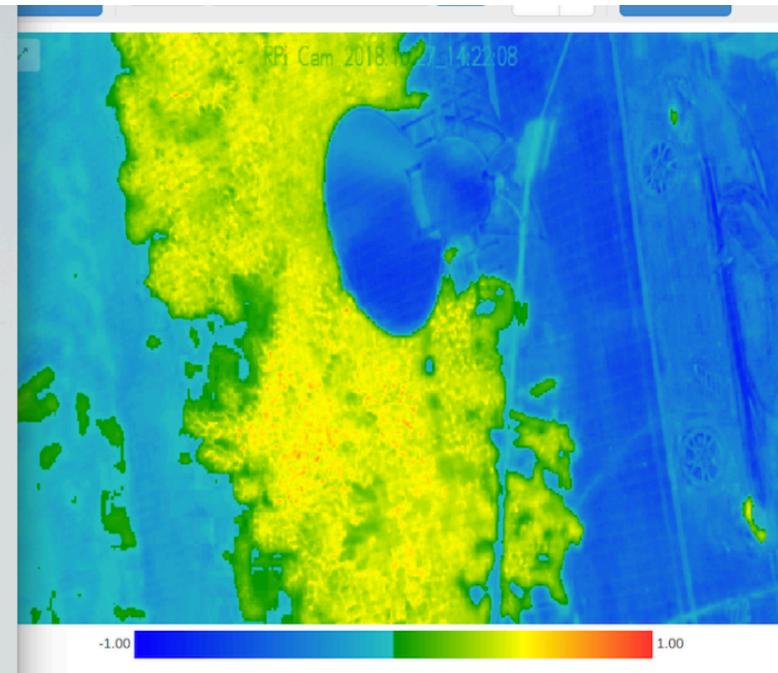
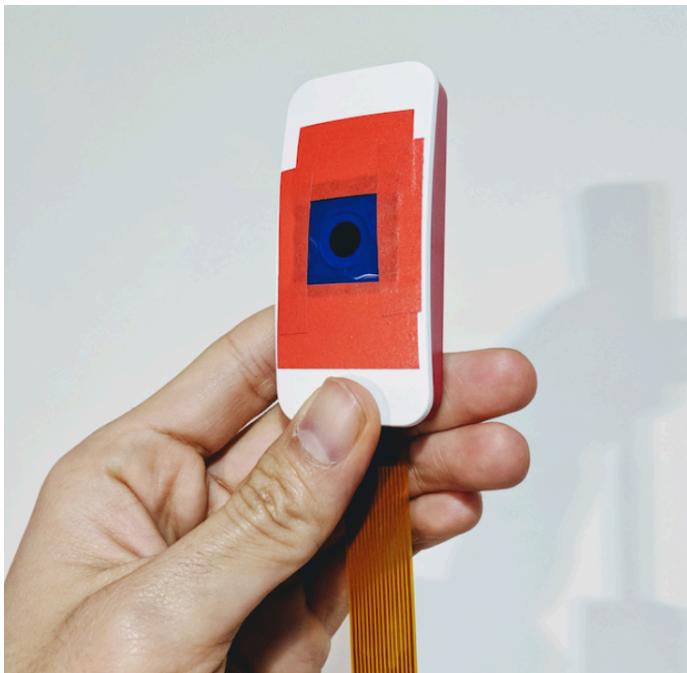
 **AutoPi Cloud**

 **AutoPi Dongle**

Soluciones IoT



Soluciones IoT



<https://publiclab.org/wiki/raspberry-pi-infragram>

Soluciones IoT



<https://publiclab.org/wiki/balloon-mapping>

Soluciones IoT

BRIEF
Plume Labs' technology helps limit exposure to air pollution. In a city where 10,000 people died last year because of air pollution, the challenge was how to engage the public with this invisible problem in a way that was impossible to ignore.

RESPONSE
The Pigeon Air Patrol became the world's first flock of pigeons monitoring air quality data. Real-time data from each bird is sent to users in real-time, location-specific updates – from a pigeon wearing ultra-light gear.

RESULTS
2000+ NEWS STORIES GLOBALLY
667+ MILLION IMPRESSIONS
93% OF THOSE ENGAGED SAID THEY NOW CARED MORE ABOUT AIR POLLUTION
40000+ PIGEONAIR MENTIONS
100% CROWDFUNDING GOAL MET

FLOW 2

NEW

The personal air pollution sensor

Strapped to your bag, your bike, your belt, the real-time measure of what's in the air, anywhere.



<https://plumelabs.com>

<https://twitter.com/pigeonair?lang=es>

Soluciones IoT



Soluciones IoT

Ruuvitag Senses

Ruuvitag is a weatherproof Bluetooth sensor capable of sending accurate information of its surroundings directly to your mobile phone.



AIR HUMIDITY



TEMPERATURE



AIR PRESSURE

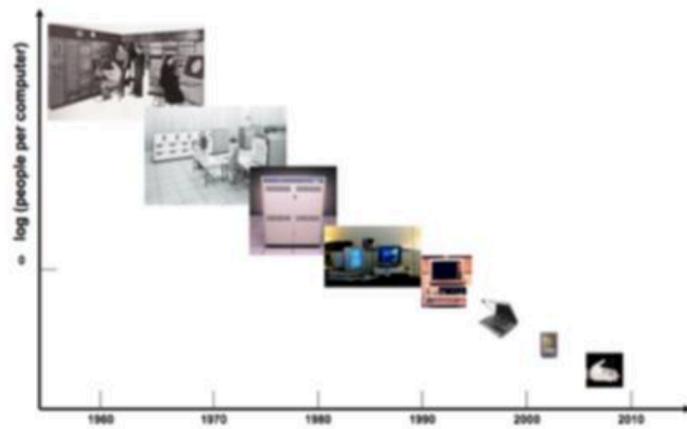


MOVEMENT

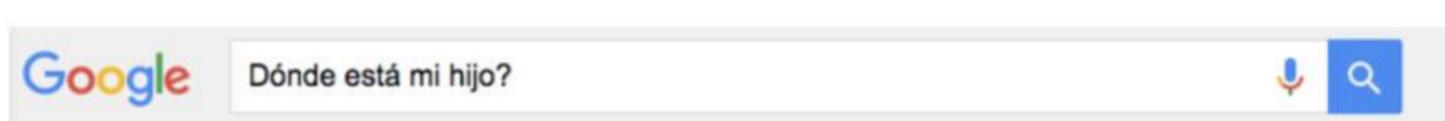


PROXIMITY

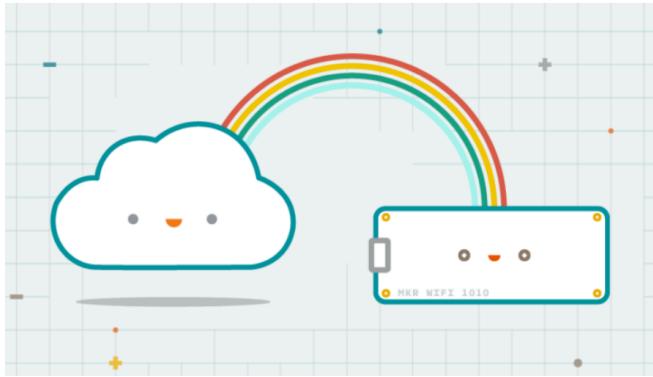
Internet of Nano Things



Internet of
Nano Things



Cloud IoT



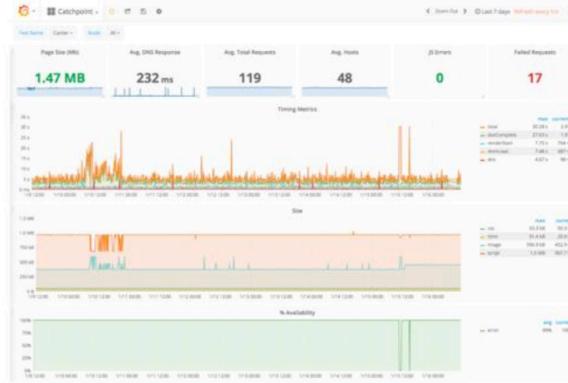
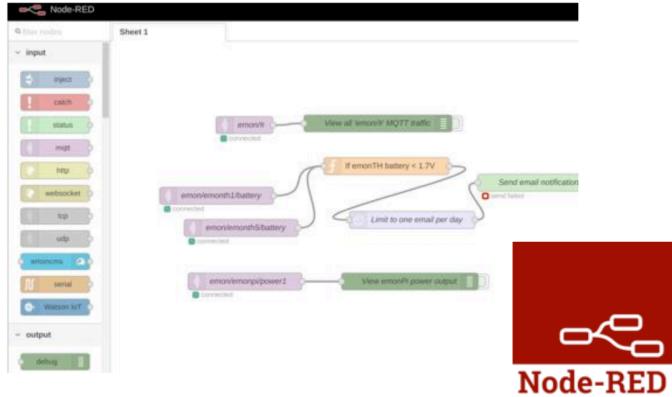
The Ubidots website homepage. It features a large banner with a night-time city skyline and bridge. The tagline "Accelerate Internet of Things Innovation" is prominently displayed. The Ubidots logo is at the top left, and a navigation bar with links for About, Features, Developers, Blog, Community, and Pricing is at the top right. Buttons for "SIGN UP" and "LOGIN" are in the top right corner.

The ThingSpeak website homepage. It has a dark, star-filled background. The main heading "Billions and Billions" is displayed in large white letters, with the subtitle "The open data platform for the Internet of Things" below it. Navigation links for Channels, Apps, Blog, and Support are at the top left, and Account and Sign Out options are at the top right. A "Get Started" button is in the bottom left, and a "Contact Us" button is in the bottom center.

APIs



NodeRed+InfluxDB+Grafana



time	butterflies	honeybees	location	scientist
2015-08-18T00:00:00Z	12	23	1	langstroth
2015-08-18T00:00:00Z	1	30	1	perpetua
2015-08-18T00:06:00Z	11	28	1	langstroth
2015-08-18T00:06:00Z	3	28	1	perpetua
2015-08-18T05:54:00Z	2	11	2	langstroth
2015-08-18T06:00:00Z	1	10	2	langstroth
2015-08-18T06:06:00Z	8	23	2	perpetua
2015-08-18T06:12:00Z	7	22	2	perpetua



NodeRed+InfluxDB+Grafana

Tipos de Bases de Datos

Relacional



ORACLE

No Relacional

Llave-Valor



ORACLE
BERKELEY DB



Documentos



Columnas



Gráfica



Series de Tiempo

Graphite

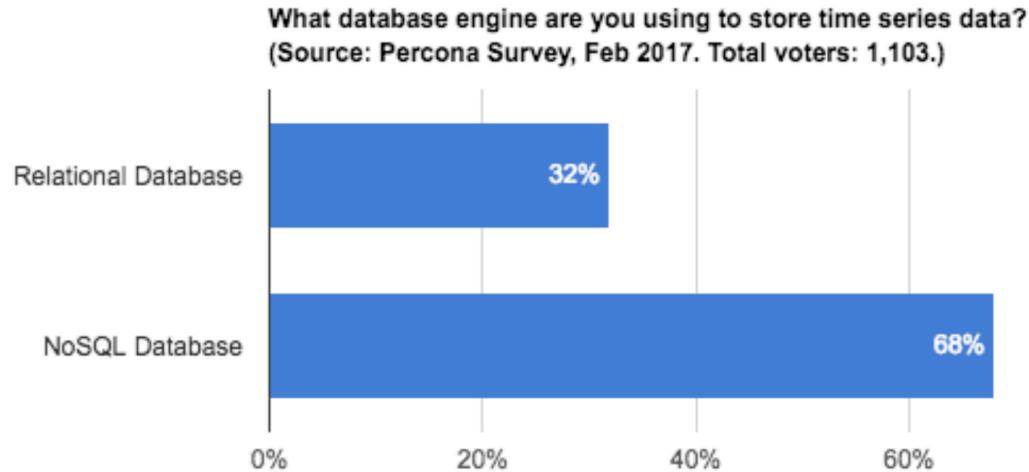


InfluxDB

- Motor de Base de Datos de Series de Tiempo.
- Open Source desarrollado por InfluxData.
- Desarrollado con el lenguaje de programación Go (desarrollado por Google).
- Optimizado para un almacenamiento y recuperación rápida de datos de series de tiempo.
- Monitoreo de operaciones, análisis de métricas, sensado de datos IoT, análisis en tiempo real, etc.



InfluxDB



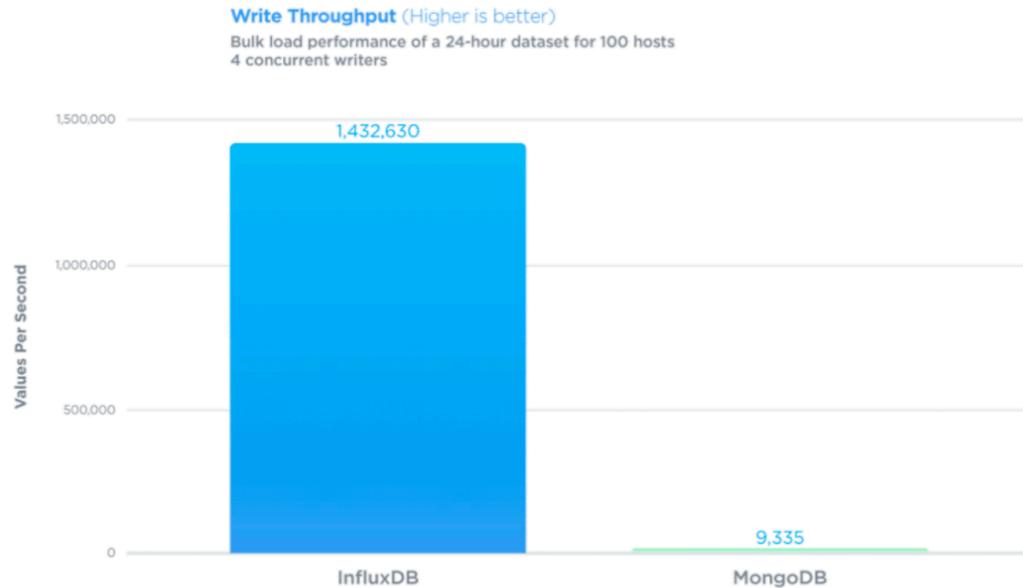
InfluxDB

Overview of the parameters for the sample dataset

Number of Servers	100
Values measured per Server	100
Measurement Interval	10s
Dataset Duration(s)	24h
Total values in dataset	87,264,000

InfluxDB

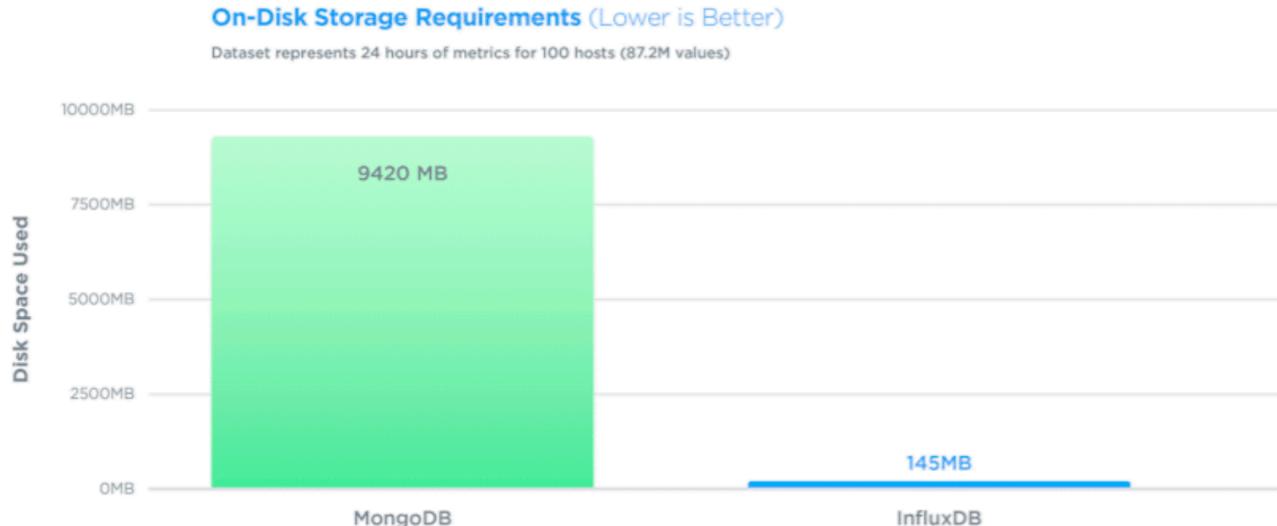
Desempeño en escritura (throughput) (153 veces mejor)



InfluxDB

Compresión en disco (64 veces mejor)

Dataset requiere 9.2 GB de espacio en disco para MongoDB vs. los 145 MB para InfluxDB



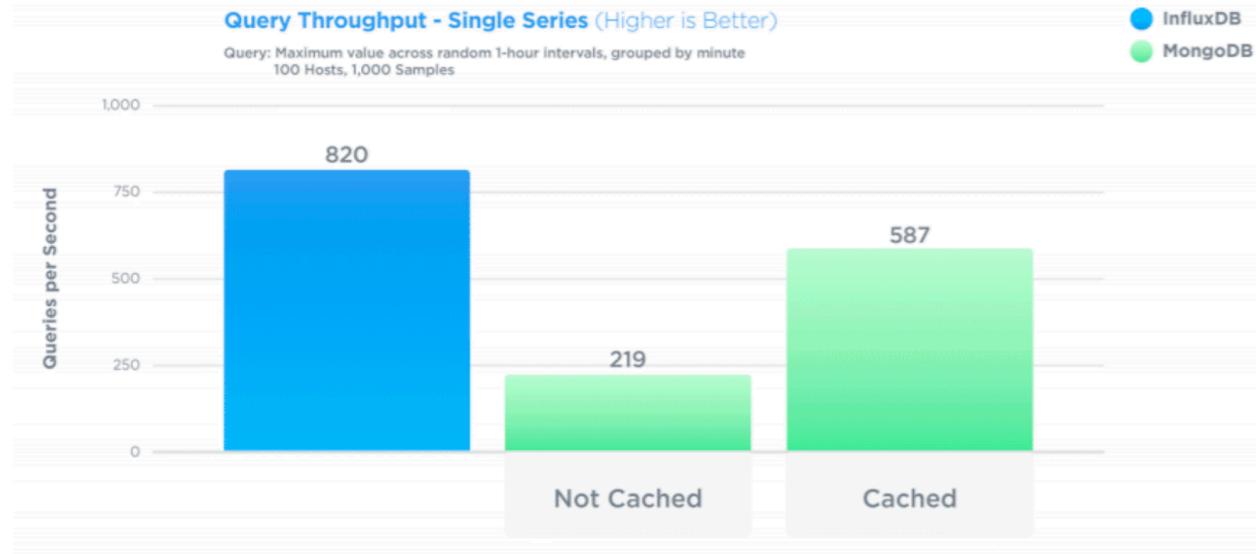
InfluxDB

En el dataset de prueba, aproximadamente se representa 1.74 bytes por cada valor almacenado en InfluxDB vs. los 204 bytes por cada valor para MongoDB.

El almacenamiento adicional requerido para MongoDB viene dado por su diseño al ser orientado al almacenaje de documentos.

InfluxDB

Desempeño en consultas (3.73 veces más rápido)



MongoDB (Not Cached)

InfluxDB

MongoDB (Cached)

4.56 ms equivalente a (219.19 queries/sec)

1.22 ms equivalente a (820 queries/sec)

1.70 ms equivalente a (587 queries/sec)

InfluxDB

- Un **measurement** actua como un contenedor de **tags**, **fields** y la columna de **tiempo**. El nombre del **measurement** es la descripción de los datos que son almacenados en los **fields** (**butterflies**, **honeybees**)

name: census				
time	butterflies	honeybees	location	scientist
2015-08-18T00:00:00Z	12	23	1	langstroth
2015-08-18T00:00:00Z	1	30	1	perpetua
2015-08-18T00:06:00Z	11	28	1	langstroth
2015-08-18T00:06:00Z	3	28	1	perpetua
2015-08-18T05:54:00Z	2	11	2	langstroth
2015-08-18T06:00:00Z	1	10	2	langstroth
2015-08-18T06:06:00Z	8	23	2	perpetua
2015-08-18T06:12:00Z	7	22	2	perpetua

InfluxDB

Datatype	Element(s)	Description
Float	Field values	IEEE-754 64-bit floating-point numbers. This is the default numerical type. Examples: <code>1</code> , <code>1.0</code> , <code>1.e+78</code> , <code>1.E+78</code> .
Integer	Field values	Signed 64-bit integers (-9223372036854775808 to 9223372036854775807). Specify an integer with a trailing <code>i</code> on the number. Example: <code>1i</code> .
String	Measurements, tag keys, tag values, field keys, field values	Length limit 64KB.
Boolean	Field values	Stores TRUE or FALSE values. TRUE write syntax: <code>[t, T, true, True, TRUE]</code> . FALSE write syntax: <code>[f, F, false, False, FALSE]</code>
Timestamp	Timestamps	Unix nanosecond timestamp. Specify alternative precisions with the HTTP API . The minimum valid timestamp is <code>-9223372036854775806</code> or <code>1677-09-21T00:12:43.145224194Z</code> . The maximum valid timestamp is <code>9223372036854775806</code> or <code>2262-04-11T23:47:16.854775806Z</code> .

InfluxDB

- InfluxDB utiliza un lenguaje similar a SQL con funciones enfocados al tiempo llamado InfluxQL.

```
SELECT <field_key>[,<field_key>,<tag_key>]  
FROM <measurement_name>[,<measurement_name>]
```

Example:

```
SELECT "usage_user" FROM "cpu"
```

InfluxDB

```
> INSERT "mymeas" value=200
> SHOW MEASUREMENTS
name: measurements
-----
name
"mymeas"
> SELECT * FROM mymeas
> SELECT * FROM "mymeas"
> SELECT * FROM "\"mymeas\""
name: "mymeas"
-----
time                      value
2016-06-14T20:36:21.836131014Z 200
```

InfluxDB

```
> CREATE DATABASE "NOAA_water_database"
>

    > DROP DATABASE "NOAA_water_database"
    >

> DROP SERIES FROM "h2o_feet" WHERE "location" = 'santa_monica'

    > DELETE FROM "h2o_quality" WHERE "randtag" = '3'

    > DROP MEASUREMENT "h2o_feet"
```

InfluxDB

```
root@debian:~# influx
Connected to http://localhost:8086 version 1.5.2
InfluxDB shell version: 1.5.2
> -
```

```
>show databases
>create database nombre_base
>use nombre_base
>show measurements
>insert temperatura value=20.0
>select * from temperatura
```

```
_internal
> show databases
name: databases
name
-----
_internal
> create database base_taller
> use base_taller
Using database base_taller
> show databases
name: databases
name
-----
_internal
base_taller
> use base_taller
Using database base_taller
> show measurements
> insert temperatura value=20.0
> select * from temperatura
name: temperatura
time
-----
153016115885859573
```

InfluxDB

- Plataforma open source para la visualización, análisis, consulta y alerta.
- Provee acceso a diferentes fuentes de datos tales como InfluxDB, MySQL, Postgres, Azure, etc.



InfluxDB

Custom range

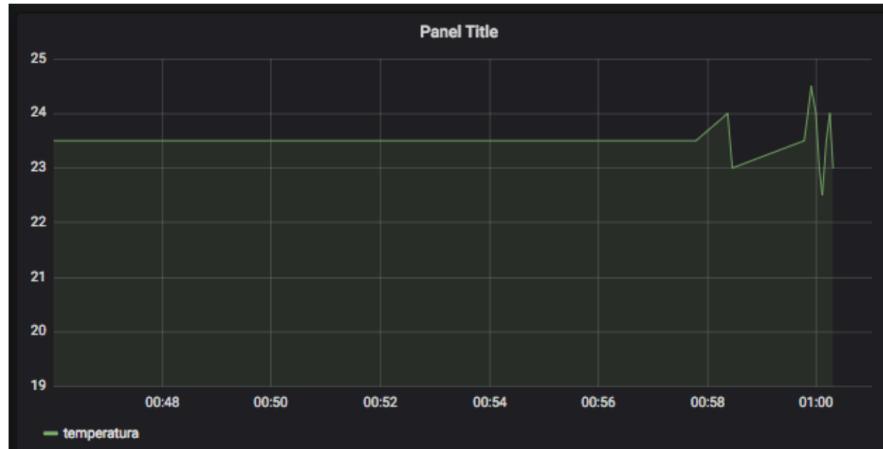
From: now-15m

To: now

Refreshing every: 5s

Quick ranges

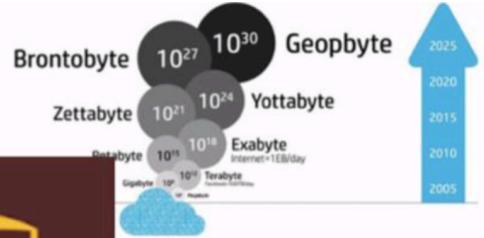
Last 2 days	Yesterday	Today	Last 5 minutes
Last 7 days	Day before yesterday	Today so far	Last 15 minutes
Last 30 days	This day last week	This week	Last 30 minutes
Last 90 days	Previous week	This week so far	Last 1 hour
Last 6 months	Previous month	This month	Last 3 hours
Last 1 year	Previous year	This month so far	Last 6 hours
Last 2 years		This year	Last 12 hours
Last 5 years		This year so far	Last 24 hours



NodeRed+InfluxDB+Grafana



IoT+Big Data

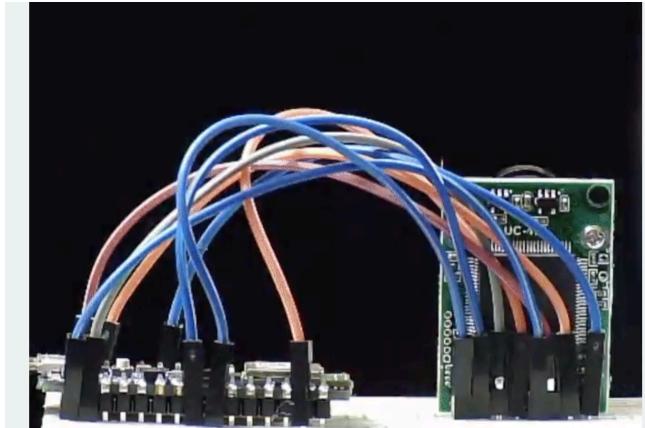


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Edge Computing

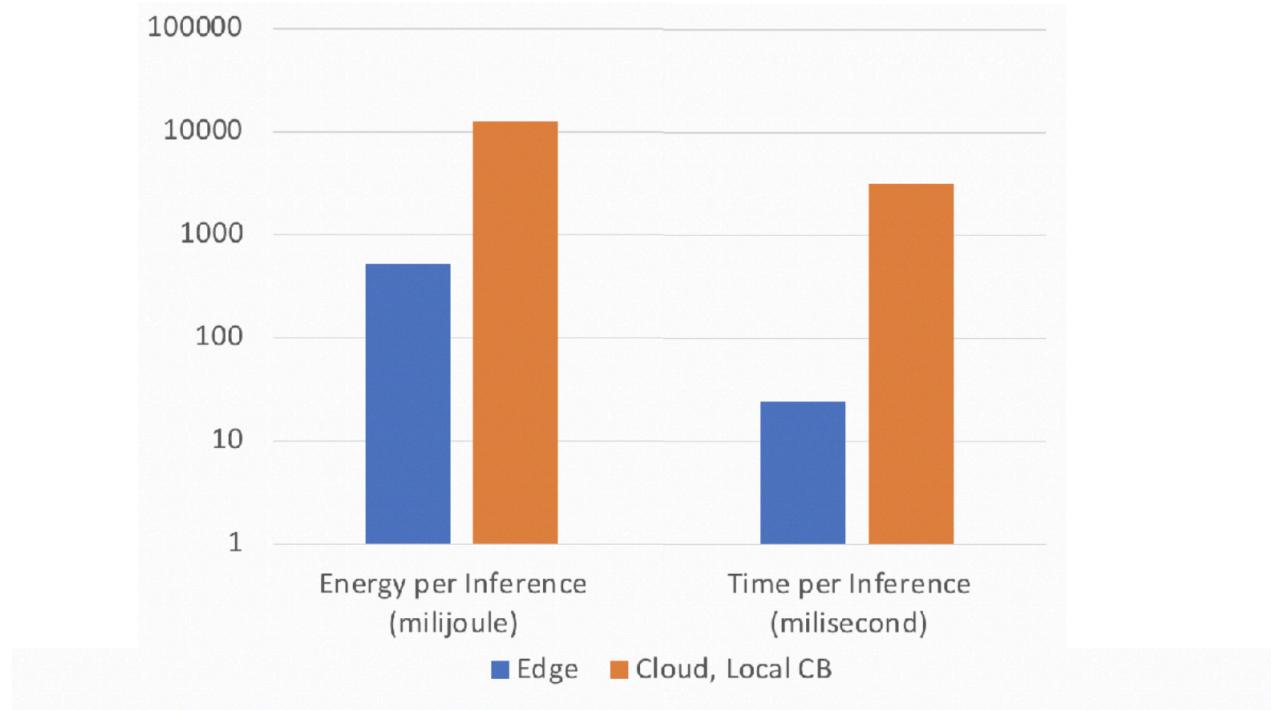
Offline self-contained systems



Person Detection with TensorFlow and
Arduino © GPL3+

<https://os.mbed.com/blog/entry/streaming-data-cows-dsa2017/>

Edge vs Cloud



http://tiny.cc/iot_s6

uTensor

Machine learning for microcontrollers

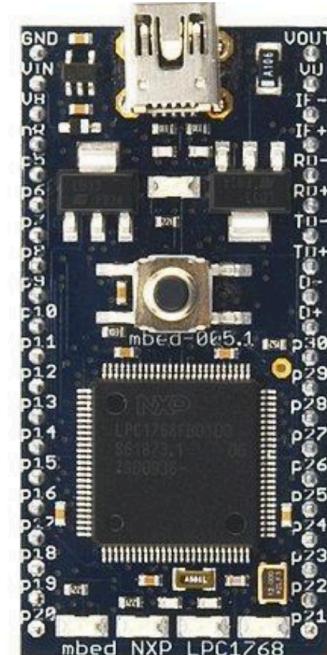
Runs in <256K RAM

TensorFlow compatible

Built on top of Mbed OS 5

(file systems, drivers, 150 boards compatible)

Open source, Apache 2.0 license



<https://github.com/uTensor/uTensor>

uTensor



A 4x8 grid of handwritten digits, likely from the MNIST dataset. The digits are drawn in black on a white background. The grid contains the following digits:

0	0	0	0	0	0	0	0
1	1	1	1	1	1	1	1
2	2	2	2	2	2	2	2
3	3	3	3	3	3	3	3

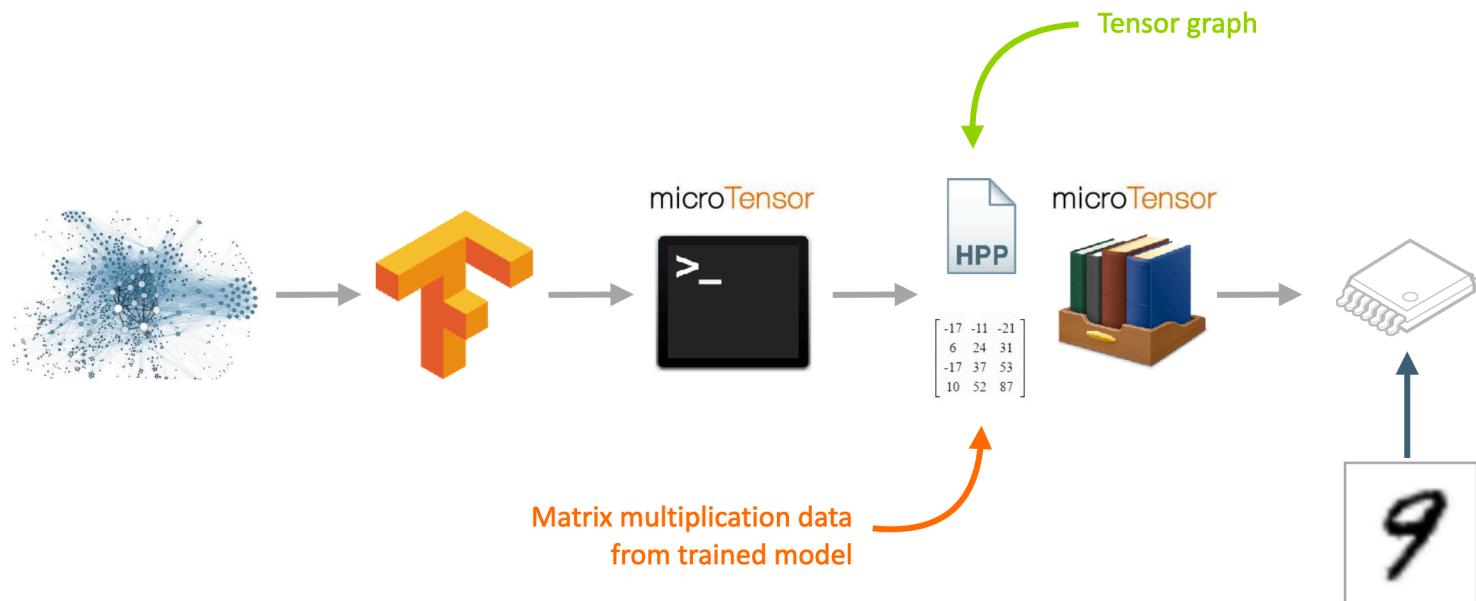
MNIST data set

Training set: 60,000 images

Every drawing is downsampled to 28x28 pixels

Supervised learning through backpropagation

uTensor



IoT+AI



NVIDIA Jetson Nano



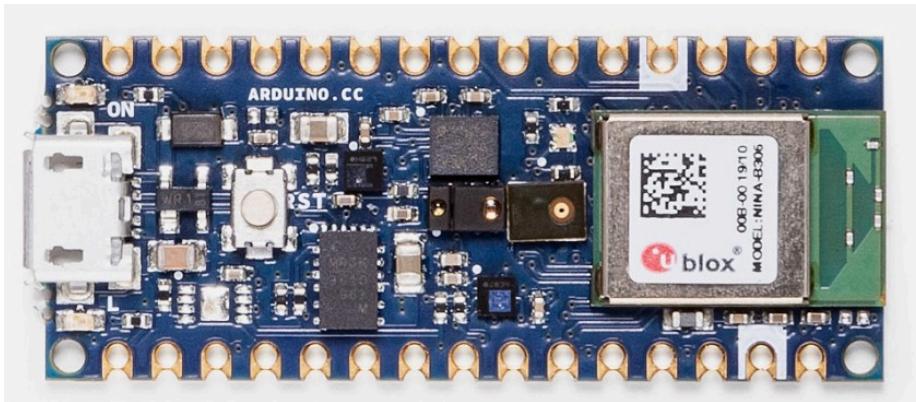
Google Coral Edge TPU



Raspberry Pi 3B +
Intel Neural Compute Stick 2

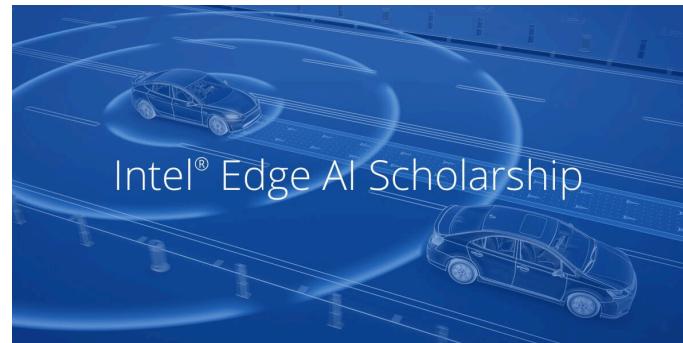
IoT+AI

Arduino Nano 33 BLE Sense



http://tiny.cc/iot_s1

Intel Edge AI Scholarship



http://tiny.cc/iot_s4

Seguridad



Smart Toy Bear



Programa de recompensas Tesla

OWASP

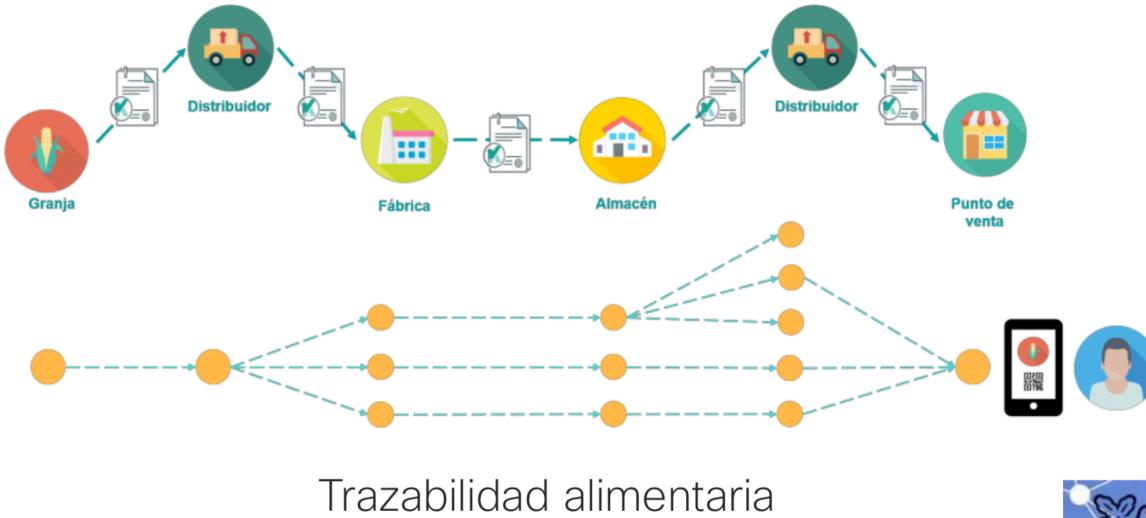


OWASP TOP 10 INTERNET OF THINGS 2018

1	Weak, Guessable, or Hardcoded Passwords Use of easily bruteforced, publicly available, or unchangeable credentials, including backdoors in firmware or client software that grants unauthorized access to deployed systems.	
2	Insecure Network Services Unneeded or insecure network services running on the device itself, especially those exposed to the internet, that compromise the confidentiality, integrity/authenticity, or availability of information or allow unauthorized remote control...	
3	Insecure Ecosystem Interfaces Insecure web, backend API, cloud, or mobile interfaces in the ecosystem outside of the device that allows compromise of the device or its related components. Common issues include a lack of authentication/authorization, lacking or weak encryption, and a lack of input and output filtering.	
4	Lack of Secure Update Mechanism Lack of ability to securely update the device. This includes lack of firmware validation on device, lack of secure delivery (un-encrypted in transit), lack of anti-rollback mechanisms, and lack of notifications of security changes due to updates.	
5	Use of Insecure or Outdated Components Use of deprecated or insecure software components/libraries that could allow the device to be compromised. This includes insecure customization of operating system platforms, and the use of third-party software or hardware components from a compromised supply chain.	

6	Insufficient Privacy Protection User's personal information stored on the device or in the ecosystem that is used insecurely, improperly, or without permission.	
7	Insecure Data Transfer and Storage Lack of encryption or access control of sensitive data anywhere within the ecosystem, including at rest, in transit, or during processing.	
8	Lack of Device Management Lack of security support on devices deployed in production, including asset management, update management, secure decommissioning, systems monitoring, and response capabilities.	
9	Insecure Default Settings Devices or systems shipped with insecure default settings or lack the ability to make the system more secure by restricting operators from modifying configurations.	
10	Lack of Physical Hardening Lack of physical hardening measures, allowing potential attackers to gain sensitive information that can help in a future remote attack or take local control of the device.	

Blockchain



Blockchain



Elk



Arquitectura actual centralizada



Arquitectura actual descentralizada

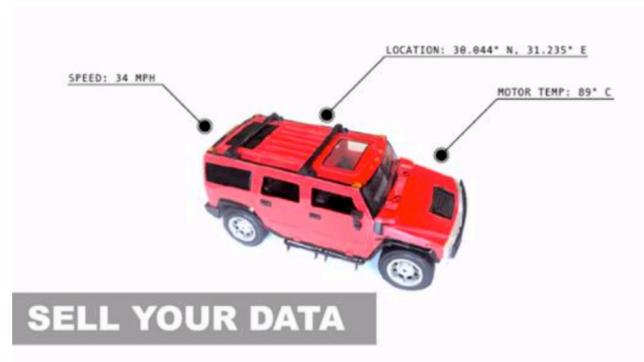
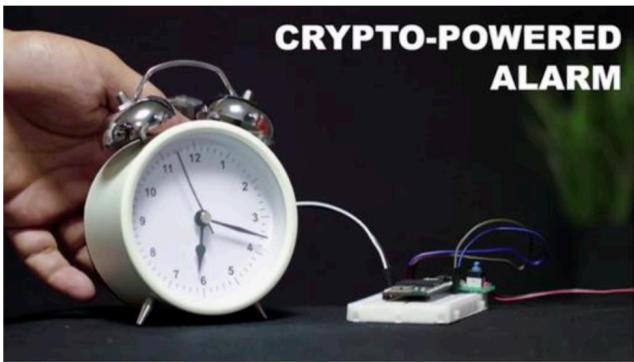


ARDUINO & RASPBERRY PI

DECENTRALIZED NETWORKS

ELK

Elk



Free Starter kits



http://tiny.cc/iot_s3

<https://www.element14.com>

<https://www.hackster.io/contests>

Avnet BCM4343W IoT Starter Kit



http://tiny.cc/iot_s2

Feedback?

Email us

Marco Zennaro mzennaro@ictp.it

Ermanno Pietrosemoli ermanno@ictp.it

Ronald Criollo rrcrioll@espol.edu.ec



thank you
danke 謝謝
спасибо Баярлалаа
спасибо faafelai lava
спасибо vinaka
спасибо blagodaram
спасибо dankie
спасибо kiiłos
спасибо dhanyavad
спасибо бэзэнтэн
спасибо nami
спасибо hvala
спасибо mauryuu
спасибо keszöntöm
спасибо bayatalaa
спасибо gracie
спасибо akun
спасибо dankon ačiu
спасибо chnorakaloutioun
спасибо gratias ago
спасибо gracies
спасибо sulpay
спасибо go
спасибо raibh
спасибо maith agat
спасибо arigatō
спасибо dakujem
спасибо талк
спасибо trugarez
спасибо shukriya
спасибо merce
спасибо мерси
спасибо chokräfte muratze
спасибо xvala
спасибо asante
спасибо manana
спасибо obrigada
спасибо lenki
спасибо mochchakkeram
спасибо djiere dieuf
спасибо dýakou
спасибо mammun
спасибо chokrane muratze
спасибо sukriya
спасибо kop khun krap
спасибо ありがとう
спасибо tanemirrt
спасибо grazie
спасибо arigatō
спасибо dakujem
спасибо талк
спасибо diolch
спасибо dhanyavadagalu
спасибо xièxie
спасибо ευχαριστώ
спасибо 감사합니다
спасибо merci
спасибо wal