Inteligência Artificial e Internet das Coisas

Ricardo Ferreira
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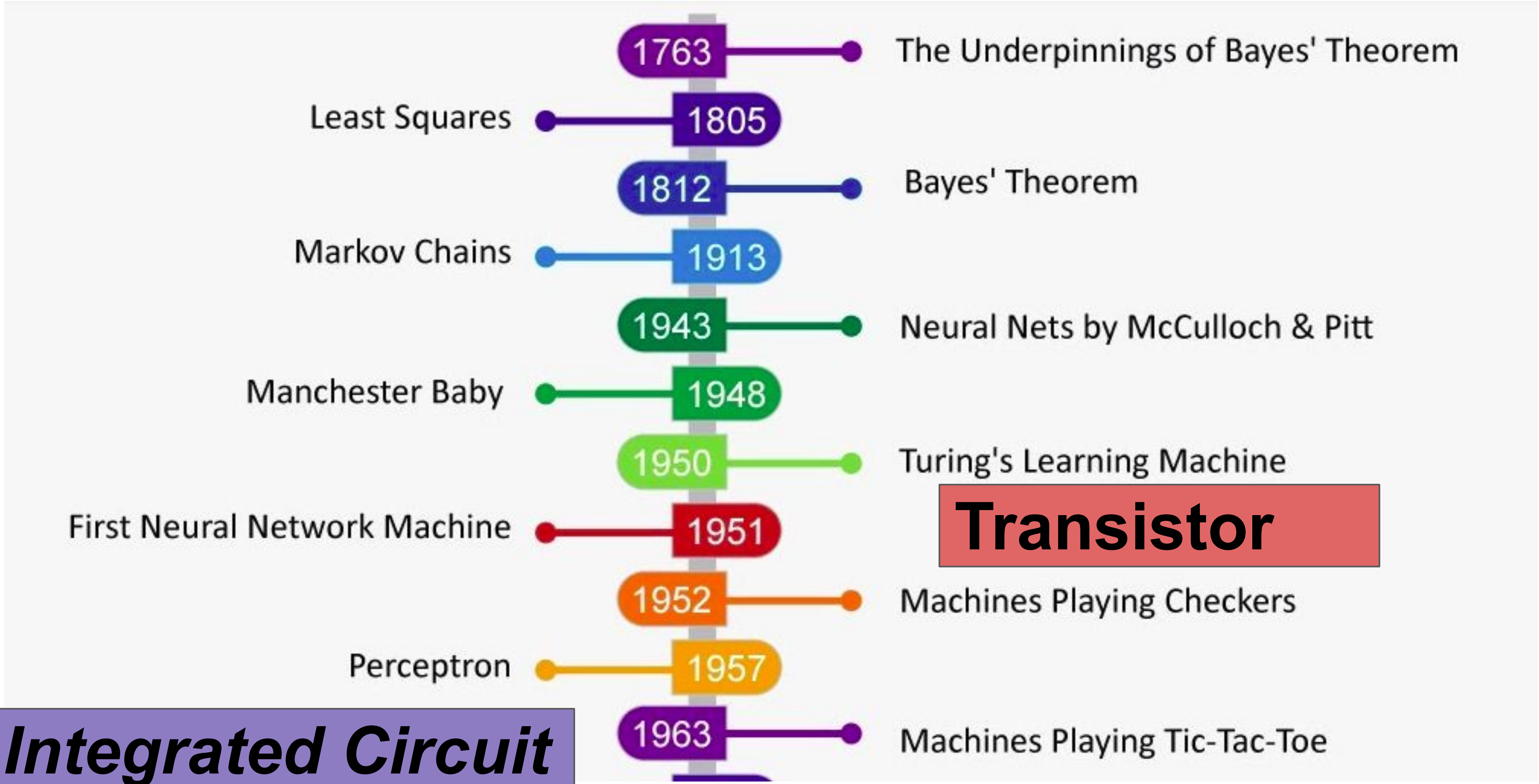
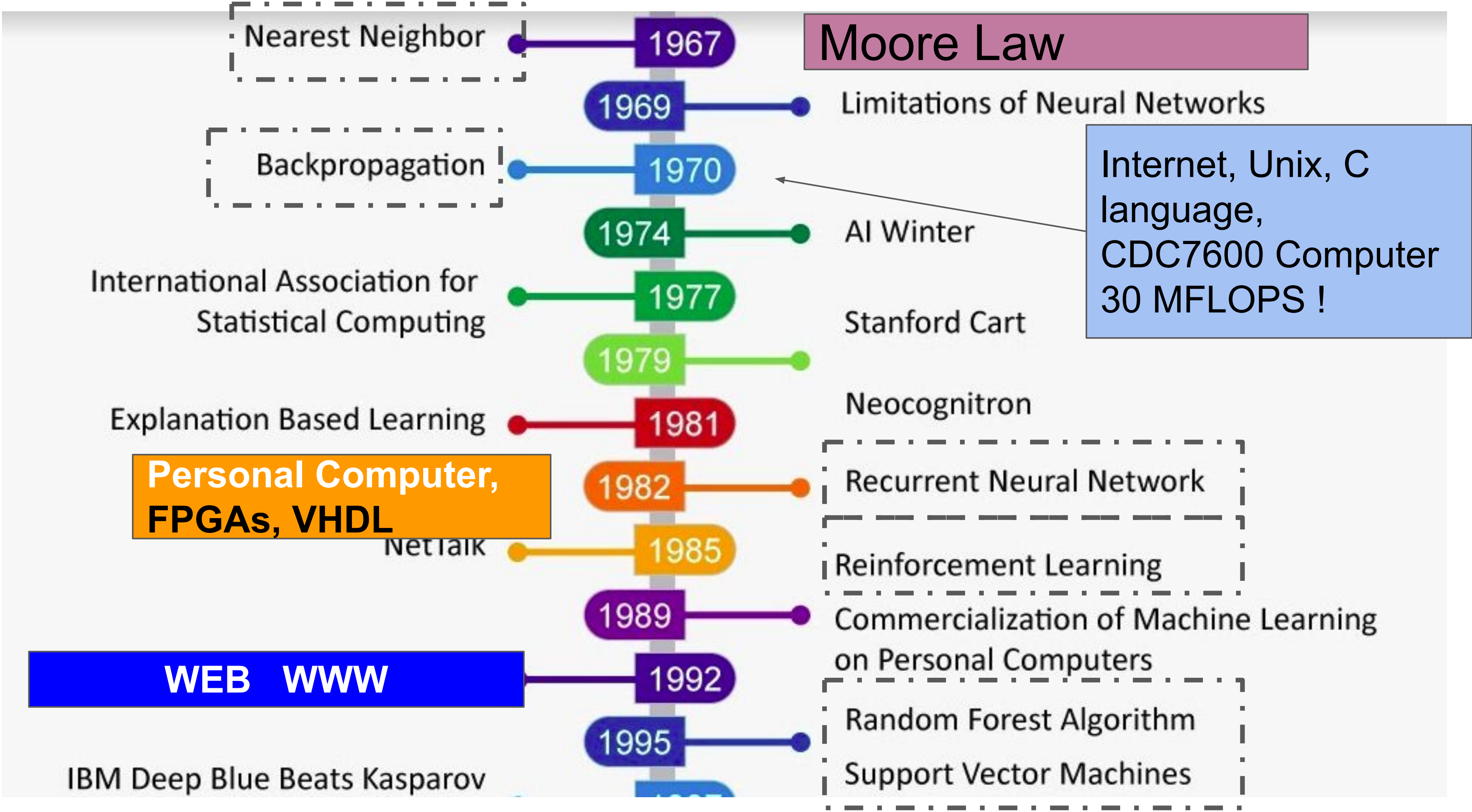
ricardo@ufv.br

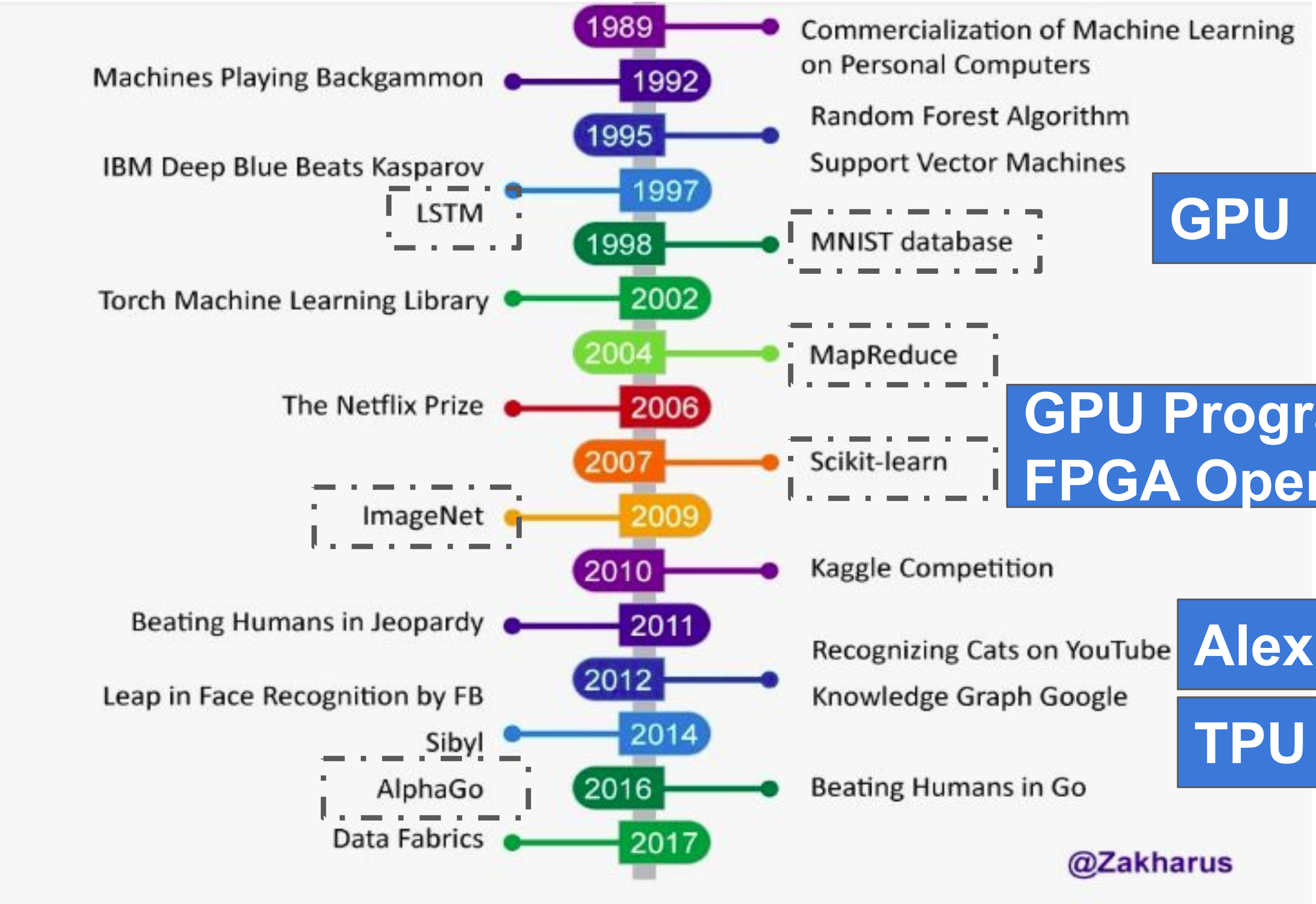


Transistor

Integrated Circuit



Moore Law
Nearest Neighbor
1967
1969
Limitations of Neural Networks
Backpropagation
1970
Internet, Unix, C language, CDC7600 Computer 30 MFLOPS !
1974
AI Winter
International Association for Statistical Computing
1977
Stanford Cart
1979
Neocognitron
Explanation Based Learning
1981
Personal Computer, FPGAs, VHDL
1982
Recurrent Neural Network
NetTalk
1985
Reinforcement Learning
1989
Commercialization of Machine Learning on Personal Computers
WEB WWW
1992
1995
Random Forest Algorithm
Support Vector Machines
IBM Deep Blue Beats Kasparov



GPU

GPU Programming
FPGA OpenCL

Alexnet

TPU

Alexnet

One million image of 226x226 pixels = 150 billions, Parameters = 62 millions

Comparison					
Network	Year	Salient Feature	top5 accuracy	Parameters	FLOP
AlexNet	2012	Deeper	84.70%	62M	1.5B
VGGNet	2014	Fixed-size kernels	92.30%	138M	19.6B
Inception	2014	Wider - Parallel kernels	93.30%	6.4M	2B
ResNet-152	2015	Shortcut connections	95.51%	60.3M	11B

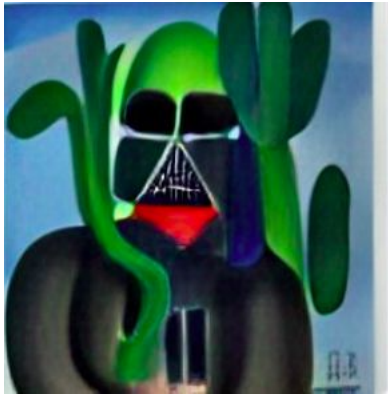
Machine Learning Demo

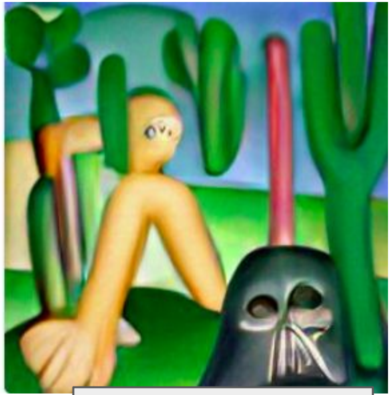
TEXT PROMPT

an armchair in the shape of an avocado [...]

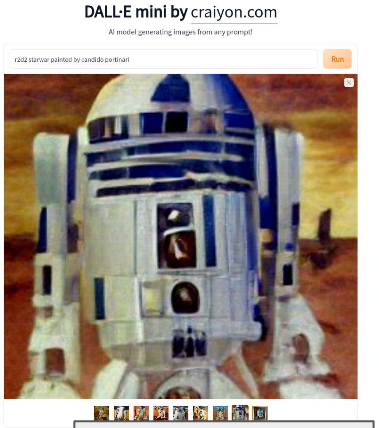
AI-GENERATED IMAGES

Edit prompt or view more images ↓





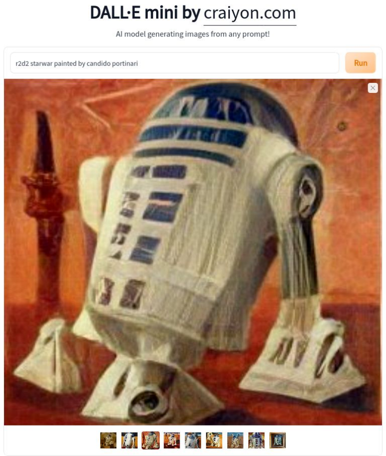
Tarsila Amaral



Candido Portinari

sebastiao salgado

niemeyer



Dall-e

Tarsila Amaral

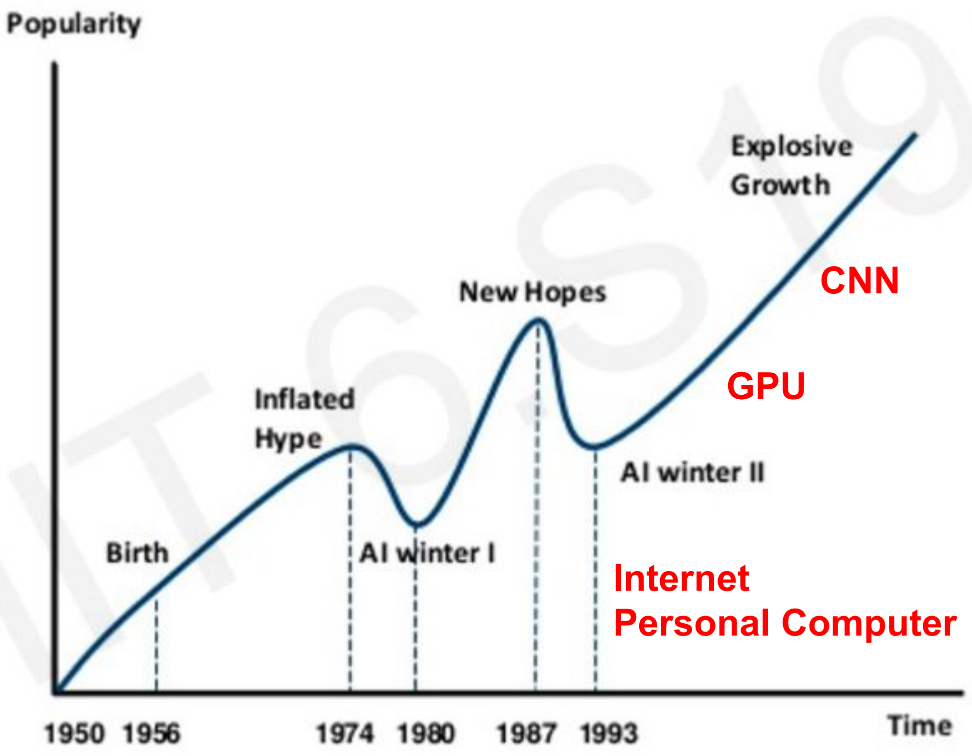



Cachorro tomando sorvete


Trocar o cachorro por um gato

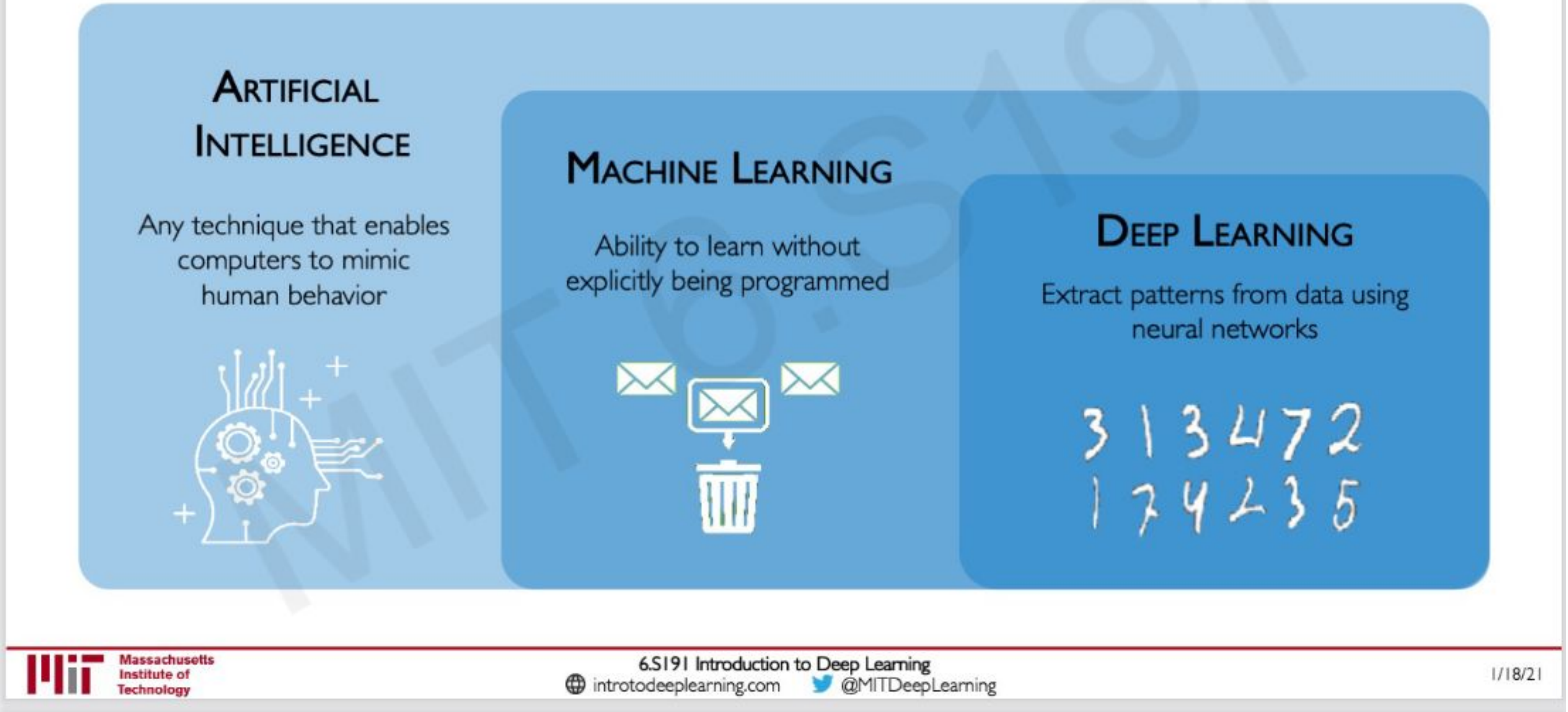
Alpha go

Artificial Intelligence "Hype": Historical Perspective



What is Deep Learning?

MIT - 6.S191 Introduction to Deep Learning (slides) - Course Schedule - Youtube Playlist



Why Now?

1952 Stochastic Gradient Descent

1958 Perceptron
- Learnable Weights

⋮

1986 Backpropagation
- Multi-Layer Perceptron

1995 Deep Convolutional NN
- Digit Recognition

⋮

Neural Networks date back decades, so why the resurgence?

1. Big Data
- Larger Datasets
- Easier Collection & Storage

IMAGENET

WIKIPEDIA
The Free Encyclopedia

2. Hardware
- Graphics Processing Units (GPUs)
- Massively Parallelizable

3. Software
- Improved Techniques
- New Models
- Toolboxes

TensorFlow

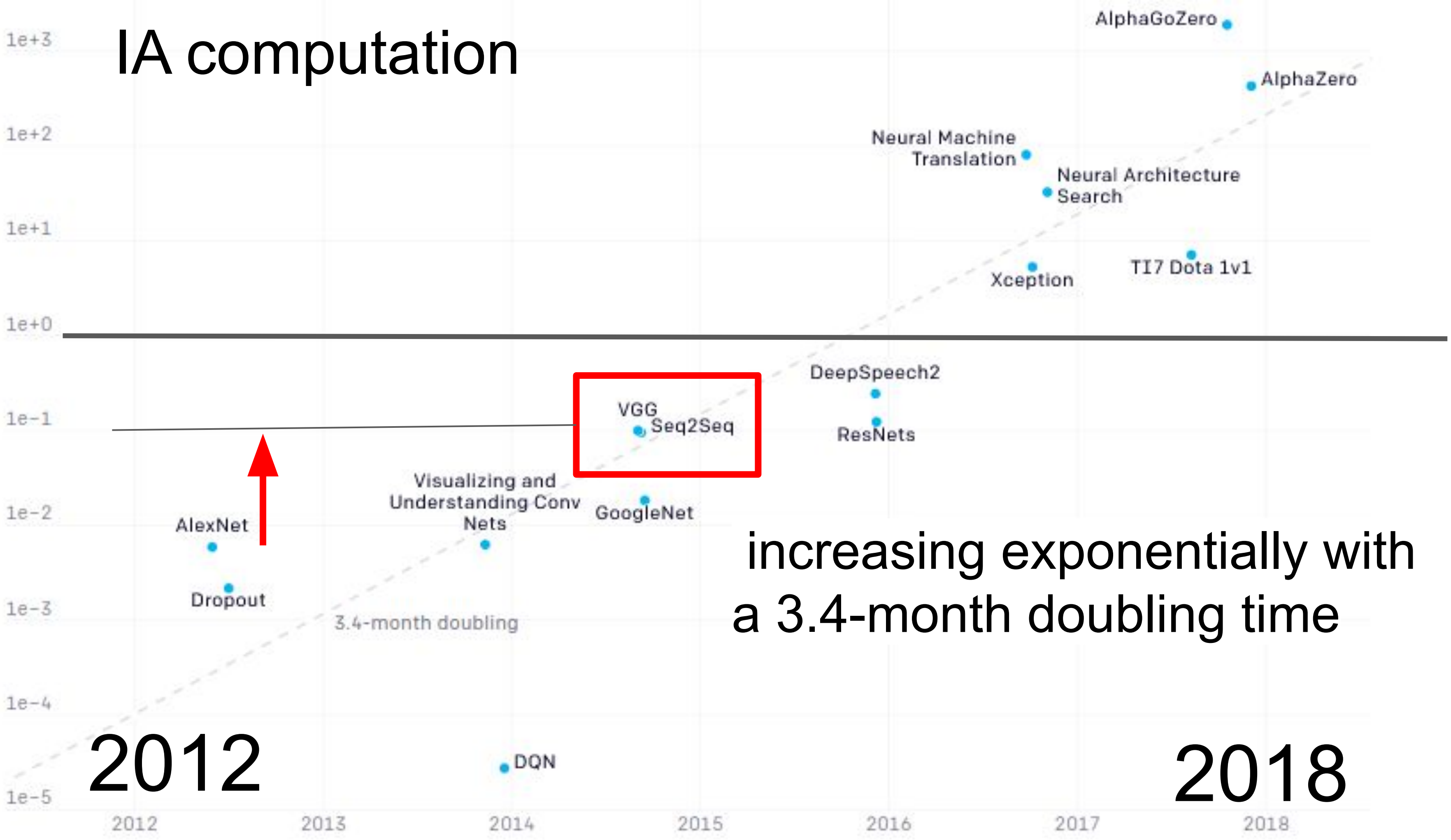
GPU (Graphics Processing Unit)

- 90's
  - games and graphics
- 2006 - New ideas
  - Vetor computation
  - Programing in C/C++
- 2012 - Alexnet + GPU = 400 PetaFlop
- 2020
  - GPU A100 Nvidia = 1 PetaFlop/s

Alexnet - [Imagenet classification with deep convolutional neural networks]

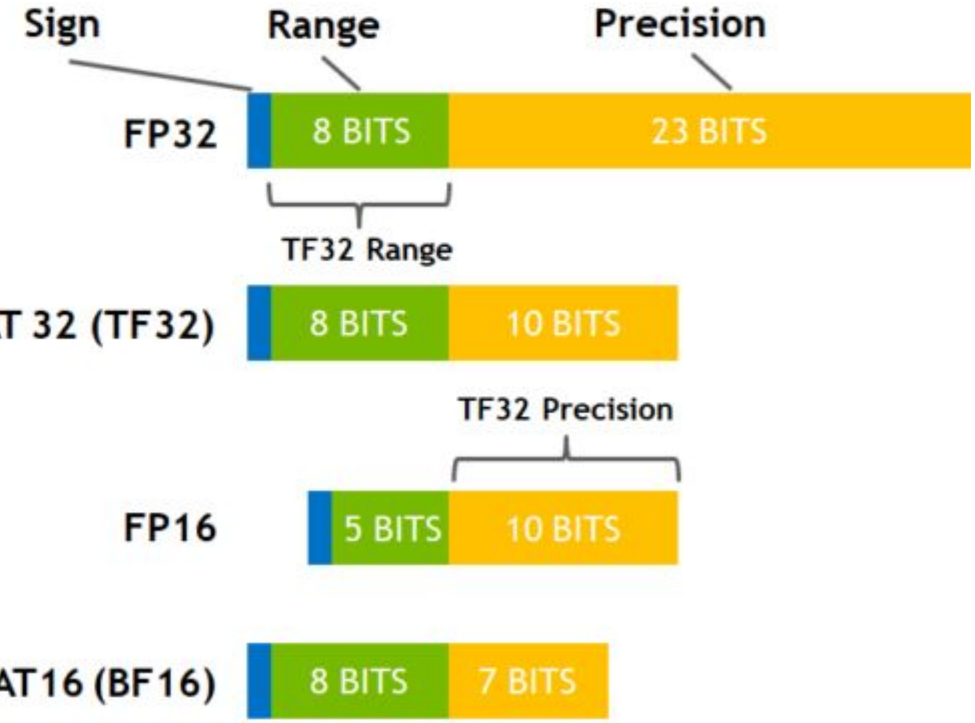
[20 mil citações em 2019, atualmente mais de 71 mil citações]

IA computation



fonte: https://openai.com/blog/ai-and-compute/

Float Point Representation

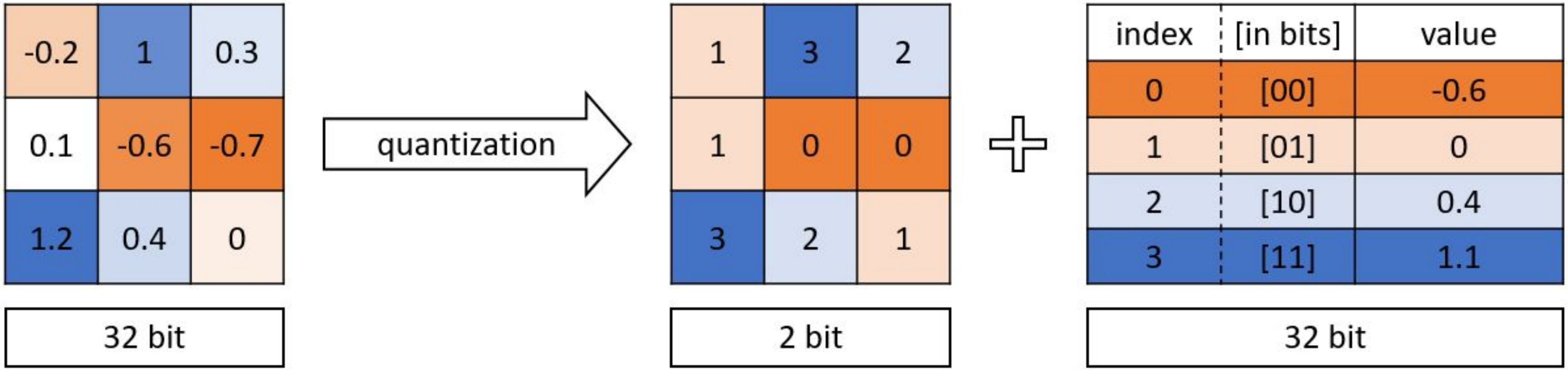


	Operation	Picojoules per Operation 45 nm	7 nm	45 / 7
+	Int 8	0.03	0.007	4.3
	Int 32	0.1	0.03	3.3
	BFloat 16	--	0.11	--
	IEEE FP 16	0.4	0.16	2.5
	IEEE FP 32	0.9	0.38	2.4
×	Int 8	0.2	0.07	2.9
	Int 32	3.1	1.48	2.1
	BFloat 16	--	0.21	--
	IEEE FP 16	1.1	0.34	3.2
	IEEE FP 32	3.7	1.31	2.8
SRAM	8 KB SRAM	10	7.5	1.3
	32 KB SRAM	20	8.5	2.4
	1 MB SRAM[1]	100	14	7.1
GeoMean[1]		--	--	2.6
DRAM		Circa 45 nm	Circa 7 nm	
	DDR3/4	1300[2]	1300[2]	1.0
	HBM2	--	250-450[2]	--
	GDDR6	--	350-480[2]	--

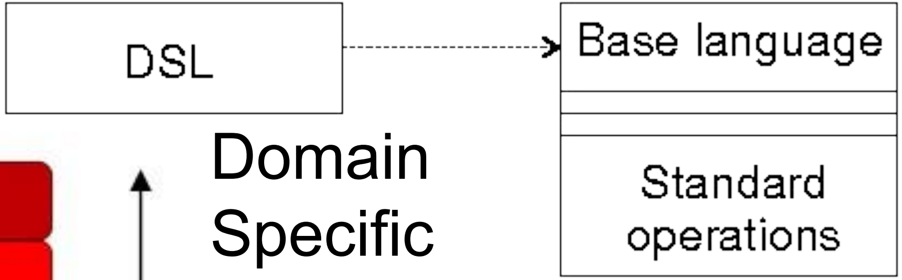
Table 2. Energy per Operation: 45 nm [16] vs 7 nm. Memory
s pJ per 64-bit access.

isca21 **Ten Lessons From Three Generations Shaped Google's TPUv4i**

Quantization

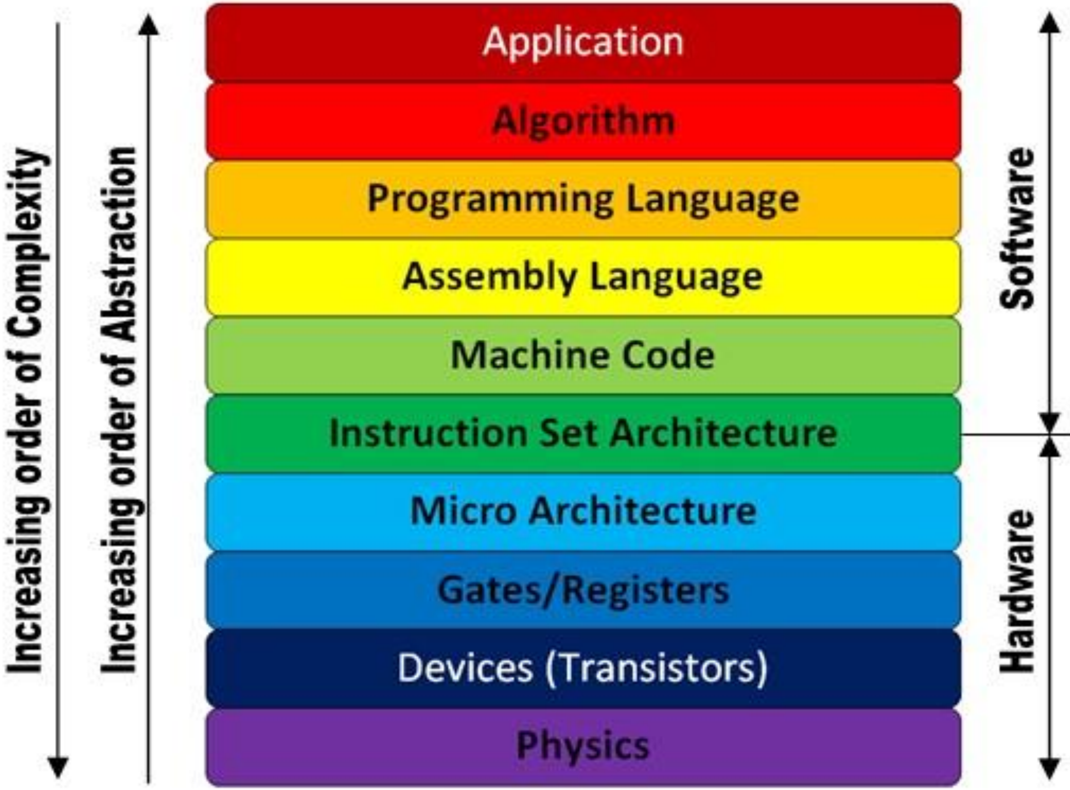


Layers



Domain Specific Language

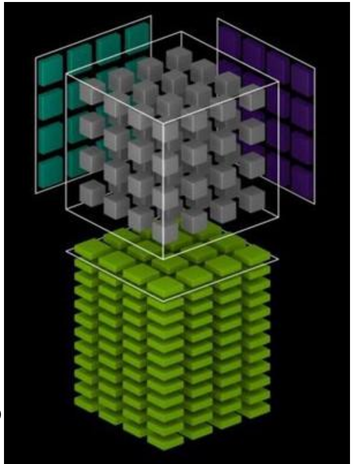
Tensorflow



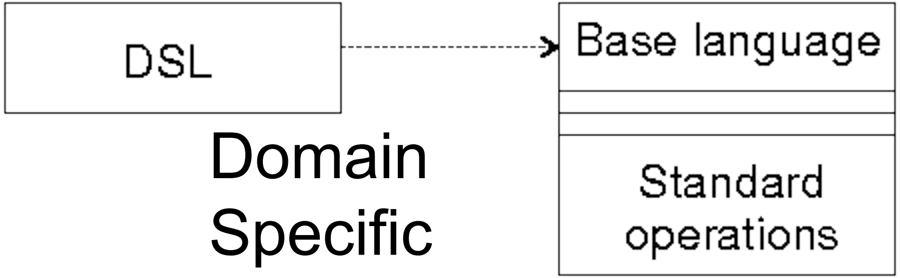
Layers of Abstraction

DSA
Domain Specific Architecture

Tensor Cores



Layers

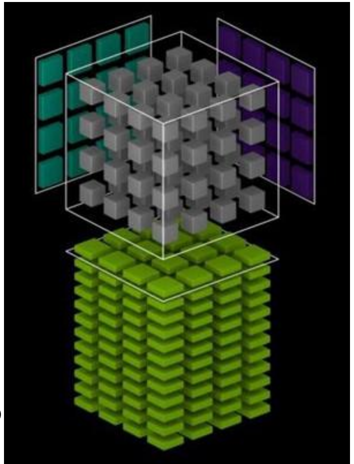


Domain Specific Language

Tensorflow

DSA Domain Specific Architecture

Tensor Cores



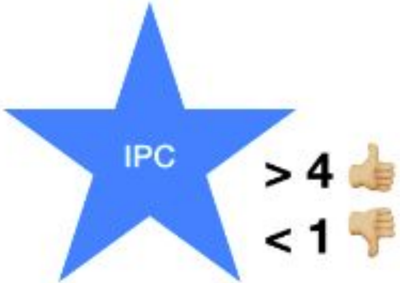
There's plenty of room at the Top: What will drive computer performance after Moore's law?

Github

	Implementation	Running time (s)	GFLOPS	Absolute speedup	Relative speedup	Fractionof peak (%)
1	Python	25552,48	0,005	1	—	0
2	Java	2372,68	0,058	11	10,8	0,01
3	C	542,67	0,253	47	4,4	0,03
4	Parallel loops	69,8	1,969	366	7,8	0,24
5	Parallel divide and conquer	3,8	36,18	6727	18,4	4,33
6	plus vectorization	1,1	124,914	23224	3,5	14,96
7	plus AVX intrinsics	0,41	337,812	62806	2,7	40,45

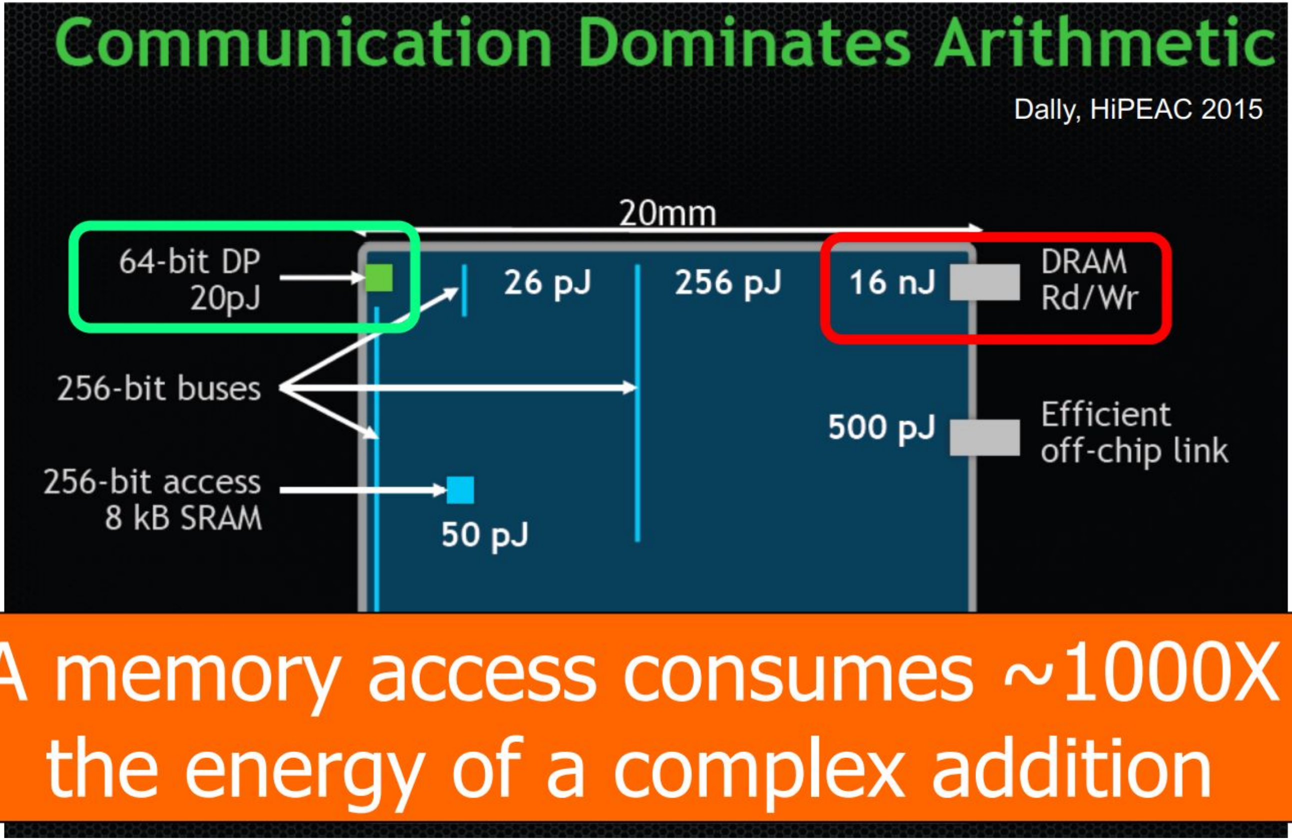
Fonte: **There's plenty of room at the Top: What will drive computer performance after Moore's law?** View ORCID ProfileCharles E. Leiserson, View ORCID ProfileNeil C. Thompson[1,2,*], View ORCID ProfileJoel S. Emer[1,3], View ORCID ProfileBradley C. Kuszma

perf stat



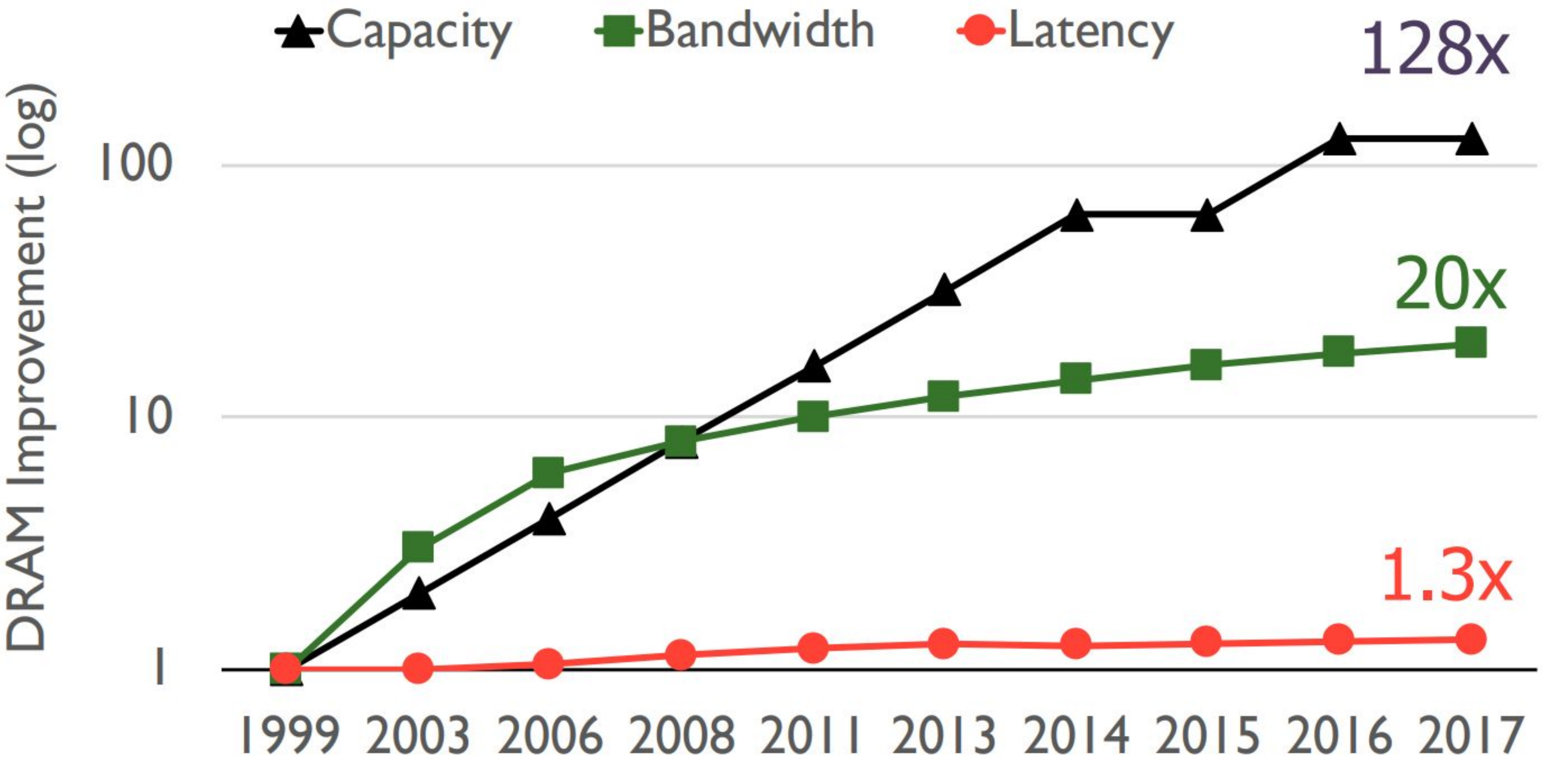

```
$ perf stat base64 <(echo hello)
d29ybGQK

 Performance counter stats for 'base64 /dev/fd/63':

          0.341382      task-clock (msec)         #    0.649 CPUs utilized
                 0      context-switches          #    0.000 K/sec
                 0      cpu-migrations            #    0.000 K/sec
                65      page-faults               #    0.190 M/sec
         1,218,176      cycles                    #    3.568 GHz
           811,468      stalled-cycles-frontend   #   66.61% frontend cycles idle
           855,999      instructions              #    0.70  insn per cycle
                                                  #    0.95  stalled cycles per insn
           169,032      branches                  #  495.140 M/sec
             8,883      branch-misses             #    5.26% of all branches

       0.000526160 seconds time elapsed
```

The Energy Perspective



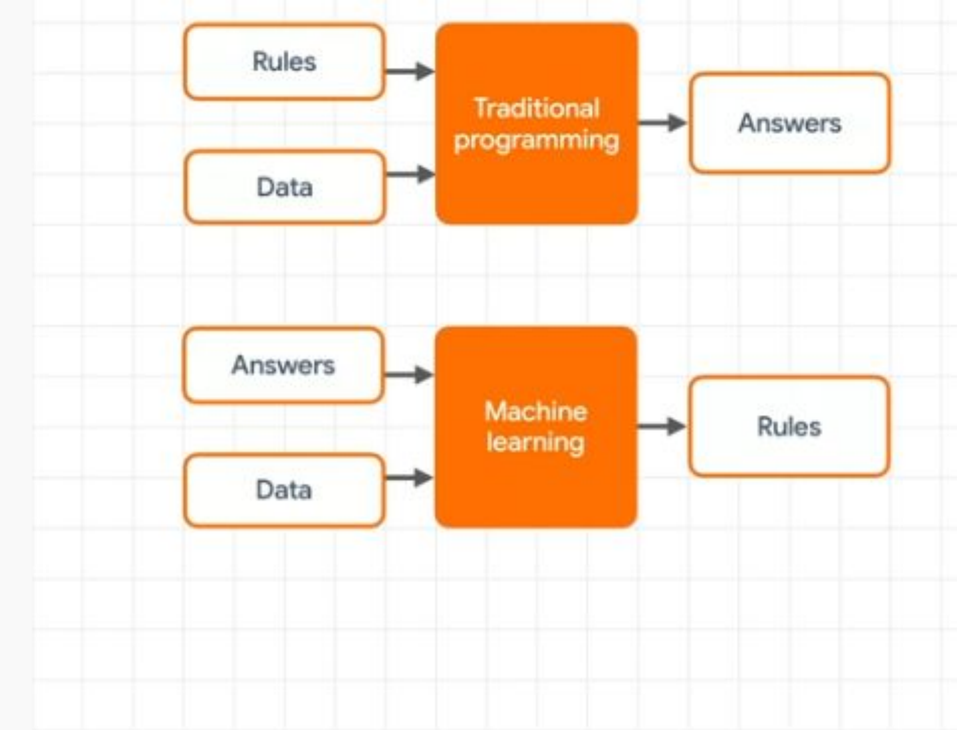
A memory access consumes ~1000X the energy of a complex addition

Example: Memory Bandwidth & Latency



Onur Mutlu Lectures Safari Group ETH/CMU

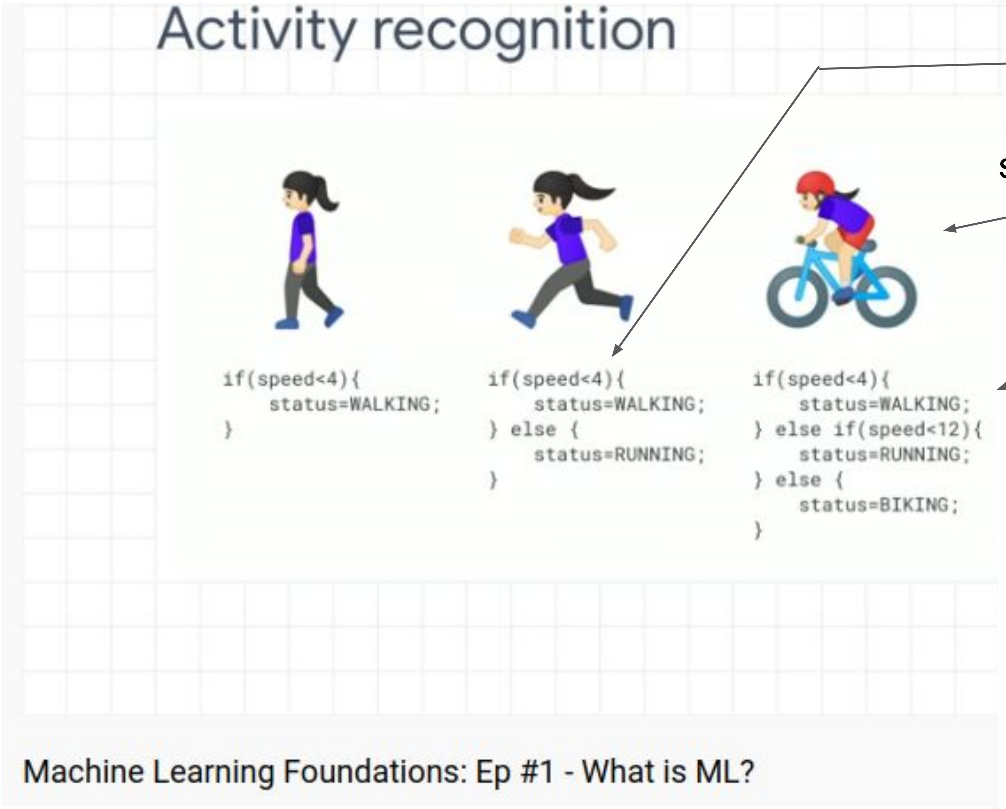
Machine Learning Foundations: Ep #1 - What is ML?

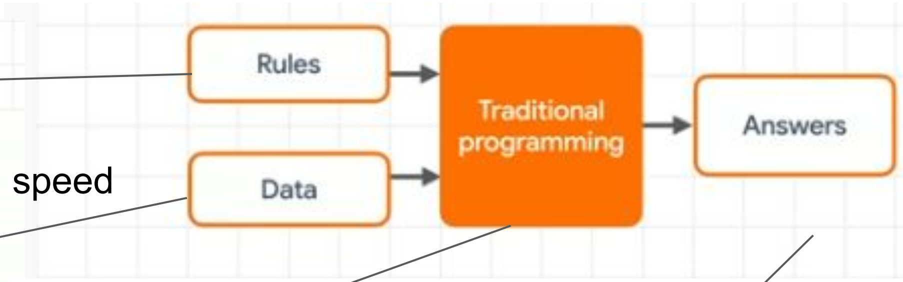


Machine Learning Foundations: Ep #1 - What is ML?

[Youtube link - Laurence Moroney]

Machine Learning Foundations: Ep #1 - What is ML?



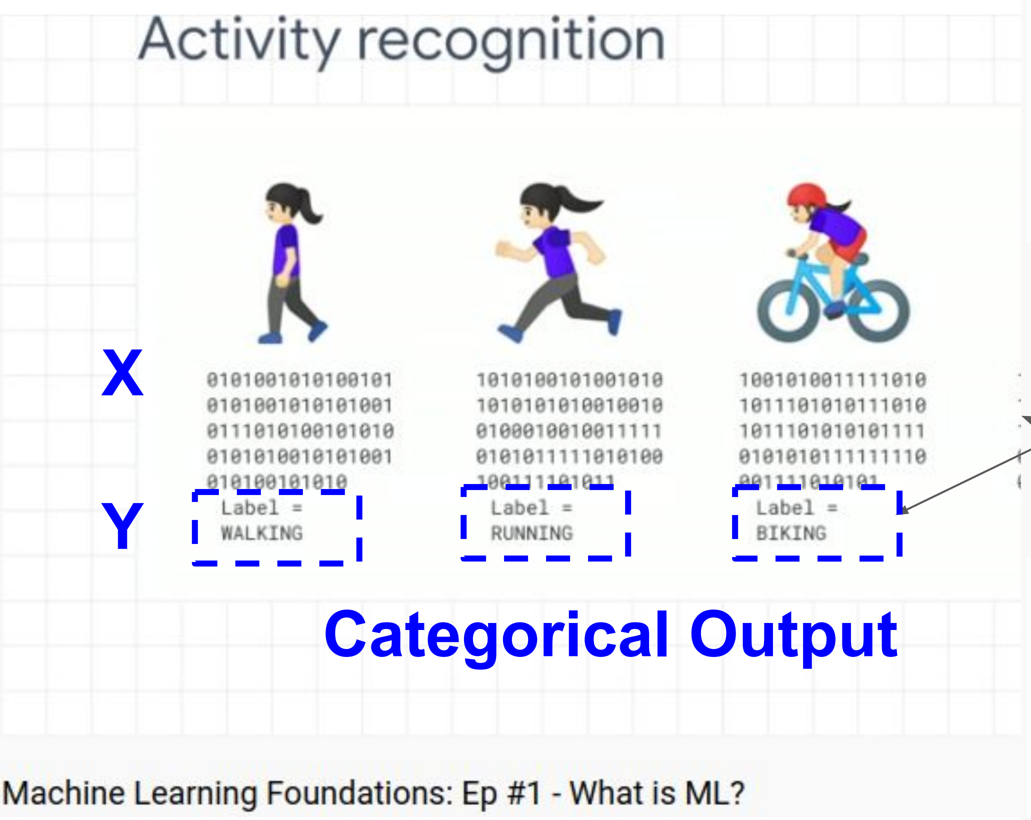


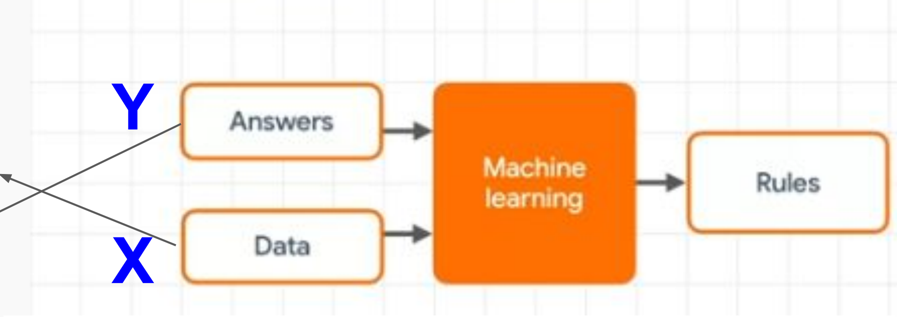
speed

Walking,
Running,
or
Biking

[Youtube link - Laurence Moroney]

Machine Learning Foundations: Ep #1 - What is ML?

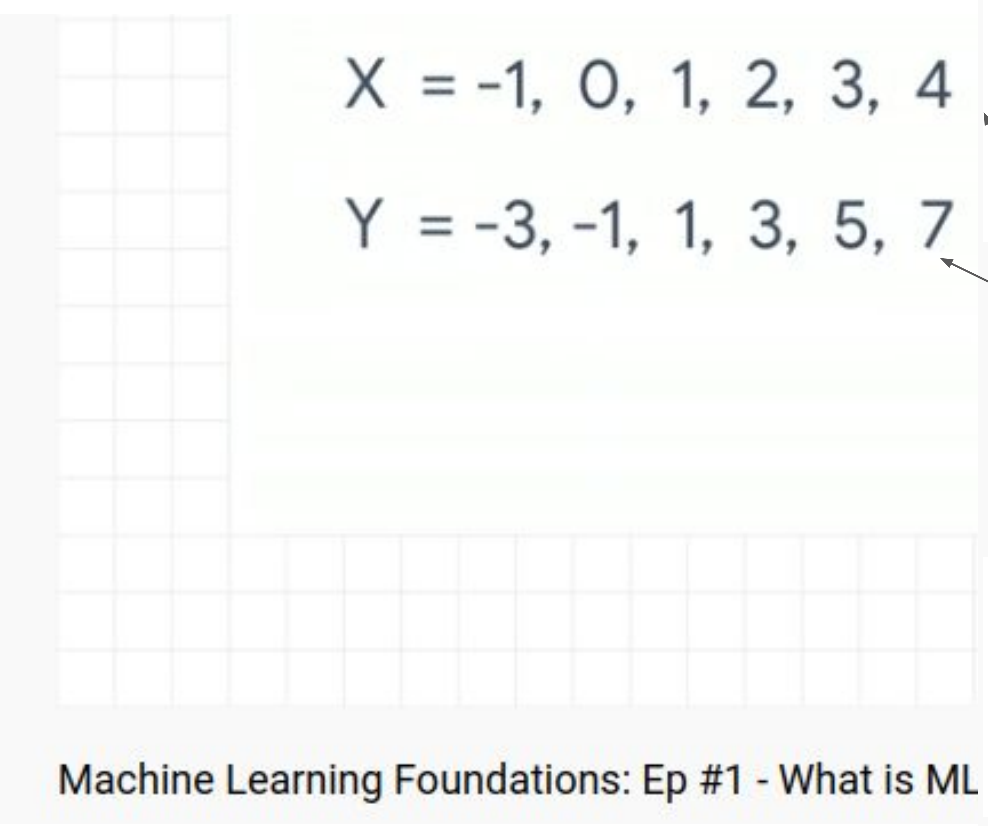


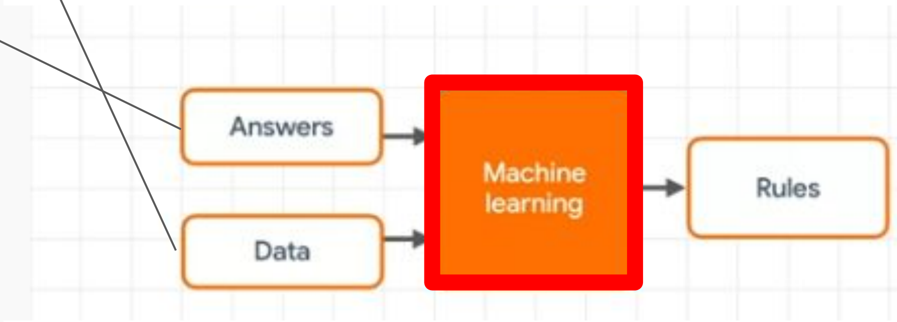


[Youtube link - Laurence Moroney]


NAVIO AFUNDANDO?
COMO , SE MEU LADO ACABOU DE SUBIR 60 METROS?

Machine Learning Foundations: Ep #1 - What is ML?

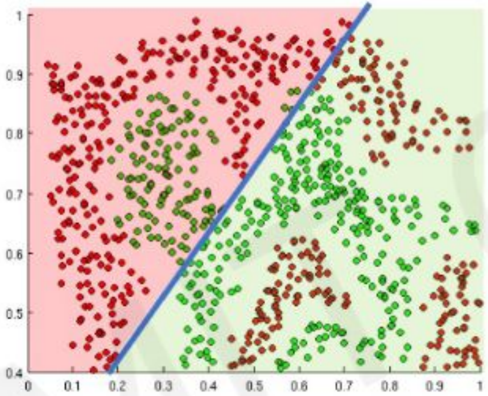




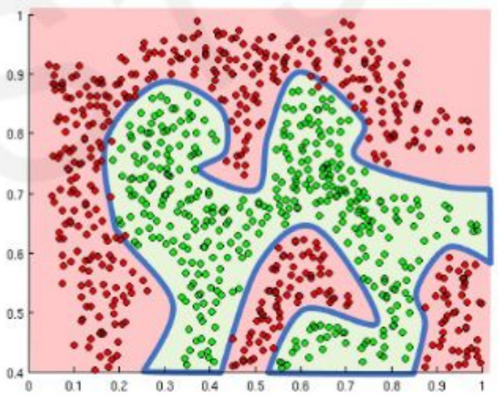
[Youtube link - Laurence Moroney]

Importance of Activation Functions

The purpose of activation functions is to ***introduce non-linearities*** *into the network*

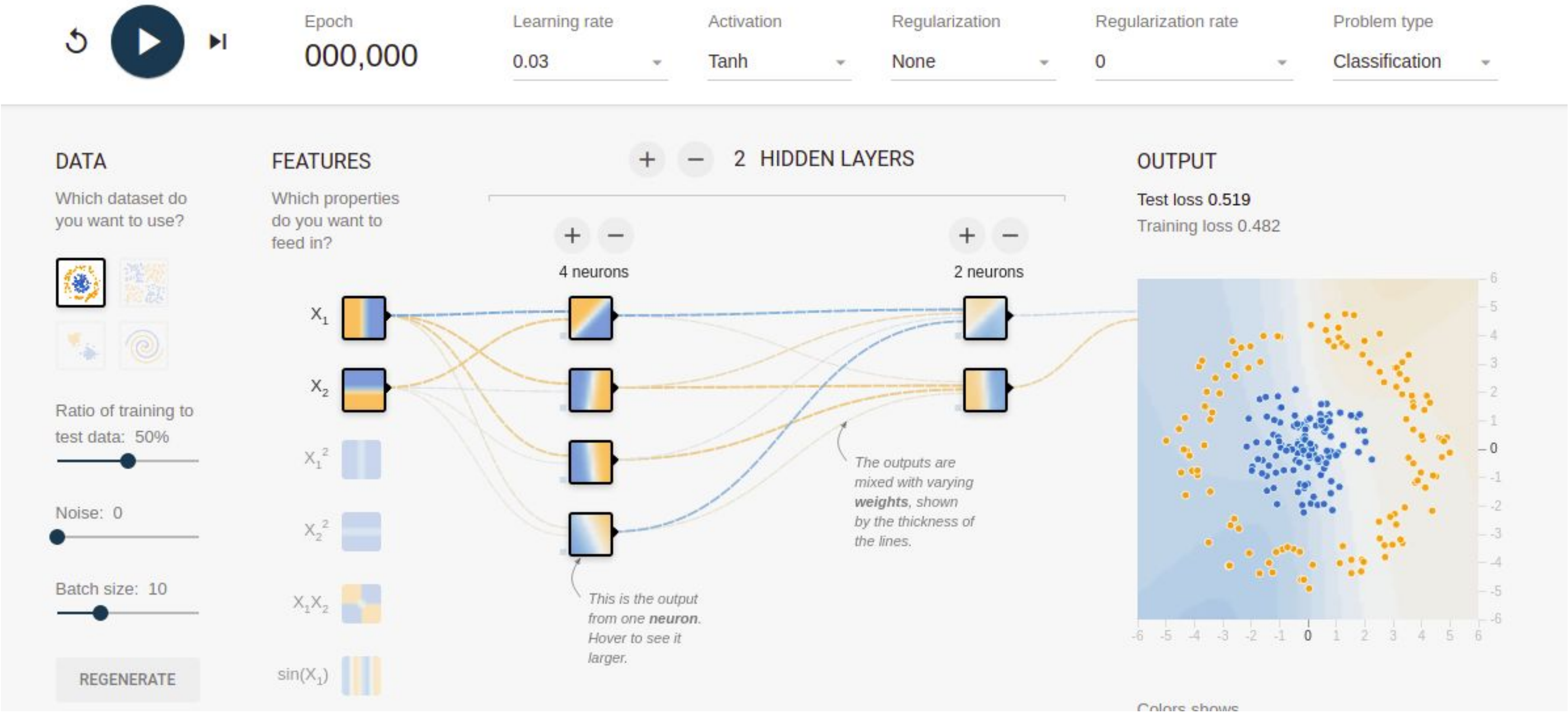


Linear activation functions produce linear decisions no matter the network size



Non-linearities allow us to approximate arbitrarily complex functions

Demo


Epoch
000,000
Learning rate
0.03
Activation
Tanh
Regularization
None
Regularization rate
0
Problem type
Classification
DATA
Which dataset do you want to use?
Ratio of training to test data: 50%
Noise: 0
Batch size: 10
REGENERATE
FEATURES
Which properties do you want to feed in?
X_1
X_2
X_1^2
X_2^2
X_1X_2
$\sin(X_1)$
2 HIDDEN LAYERS
4 neurons
2 neurons
This is the output from one **neuron**. Hover to see it larger.
The outputs are mixed with varying **weights**, shown by the thickness of the lines.
OUTPUT
Test loss 0.519
Training loss 0.482
Colors shows

Example

Structured data classification from scratch (Keras)

This example demonstrates how to do **structured data** classification, starting from a raw **CSV** file. Our data includes both numerical and categorical features. We will use Keras **preprocessing layers** to **normalize** the numerical features and vectorize the categorical ones.

Column	Description	Feature Type
Age	Age in years	Numerical
Sex	(1 = male; 0 = female)	Categorical
CP	Chest pain type (0, 1, 2, 3, 4)	Categorical
Trestbpd	Resting blood pressure (in mm Hg on admission)	Numerical
Chol	Serum cholesterol in mg/dl	Numerical
FBS	fasting blood sugar in 120 mg/dl (1 = true; 0 = false)	Categorical
RestECG	Resting electrocardiogram results (0, 1, 2)	Categorical
Thalach	Maximum heart rate achieved	Numerical
Exang	Exercise induced angina (1 = yes; 0 = no)	Categorical
Oldpeak	ST depression induced by exercise relative to rest	Numerical
Slope	Slope of the peak exercise ST segment	Numerical
CA	Number of major vessels (0-3) colored by fluoroscopy	num& categorical
Thal	3 = normal; 6 = fixed defect; 7 = reversible defect	Categorical
Target	Diagnosis of heart disease (1 = true; 0 = false)	Target

Machine Learning Foundations: Ep #1 - What is ML?

Example: The “Hello World” of ML + COLAB **<- Click HERE**

Colab House prices example - (Youtube video first 3 min in 16min)

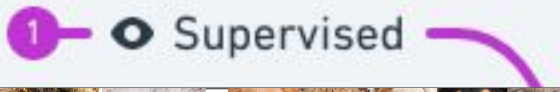
Colab Fashion-Mnist- (Youtube video 16min)

TensorFlow is Google’s end-to-end open source machine learning

10 lessons course - Machine Learning Foundations playlist → https://goo.gle/ml-foundations

Youtube link - Laurence Moroney

Supervised Learning with Images



5000 cat photos + 5000 dog photos = Model

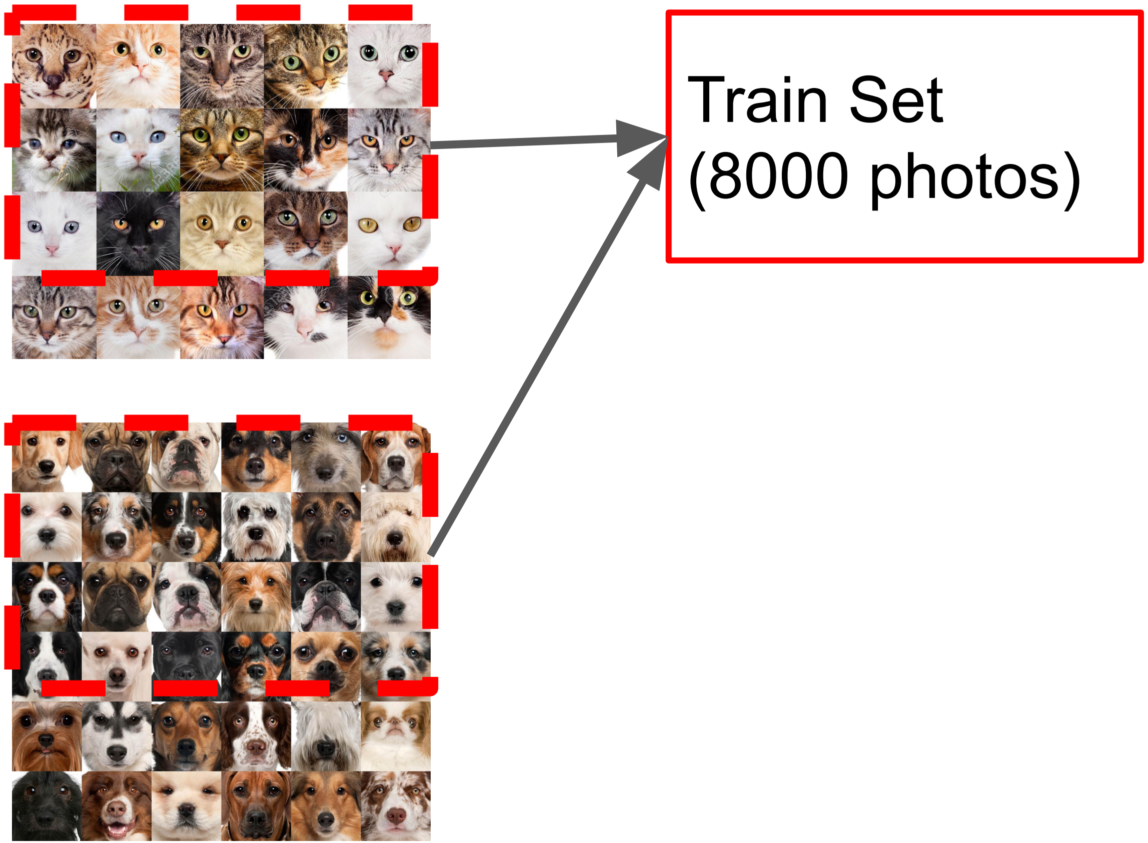
Dog or Cat ?

[Introducing the 2020 Machine Learning Roadmap (still valid for 2021) - Daniel Bourke]

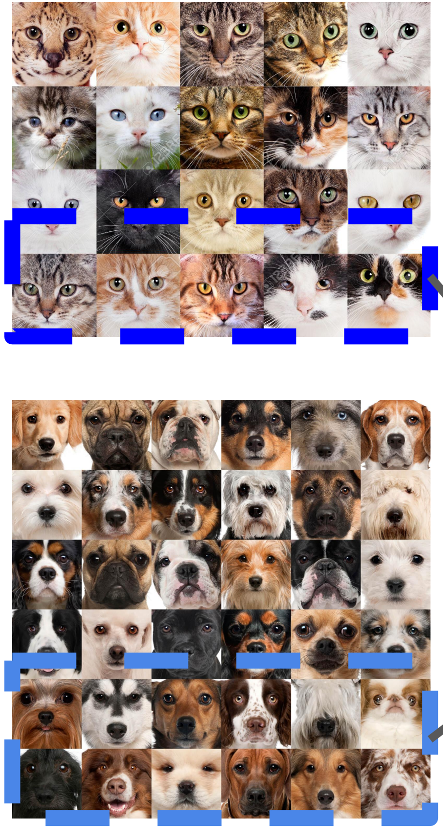
Supervised Learning with Images

Add labels
Normalize Size

Supervised Learning with Images



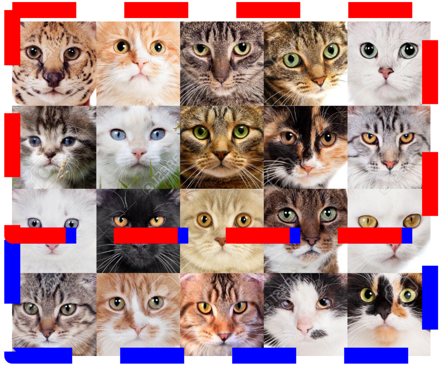
Supervised Learning with Images

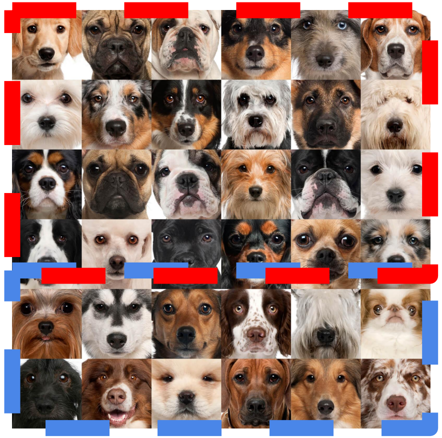


Train Set
(8000 photos)

Test Set
(2000 photos)

Supervised Learning with Images



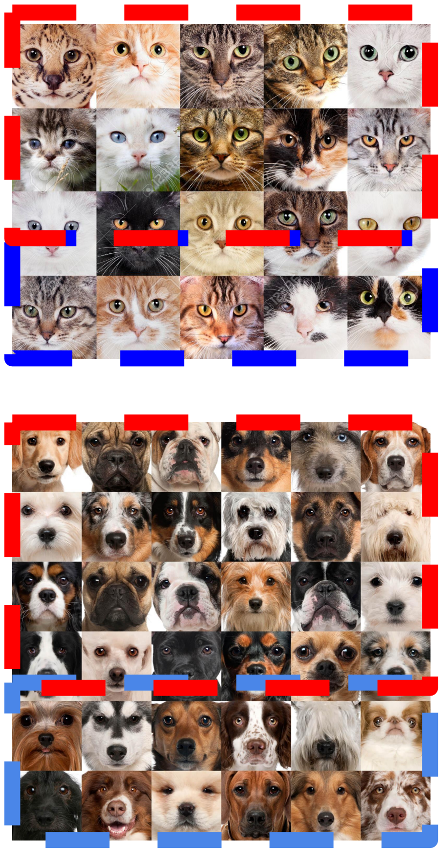


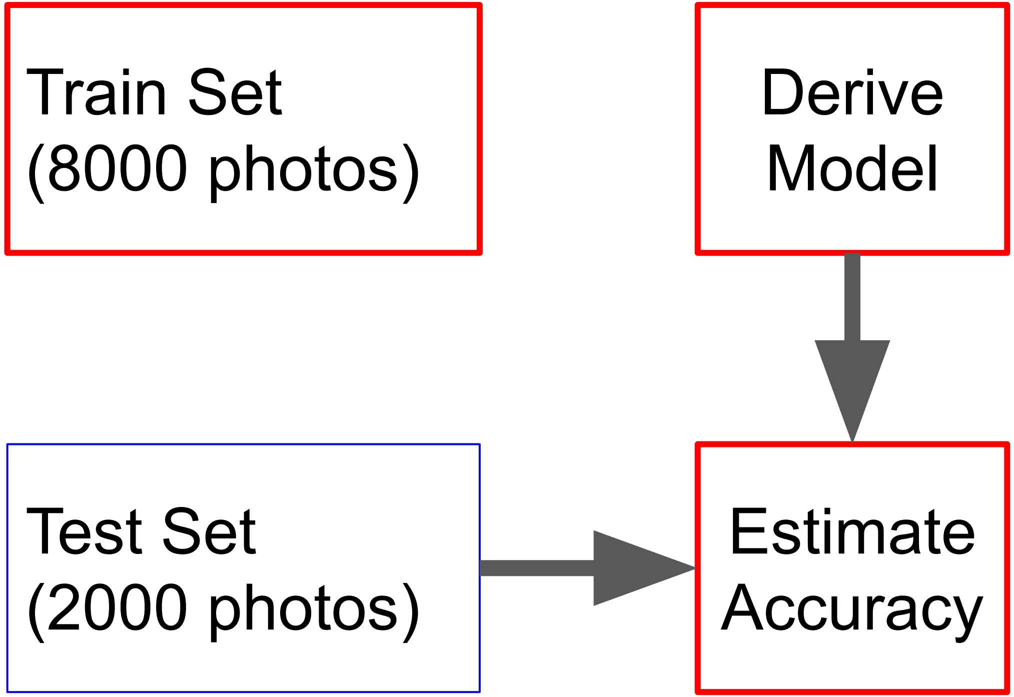
Train Set
(8000 photos)

Derive
Model

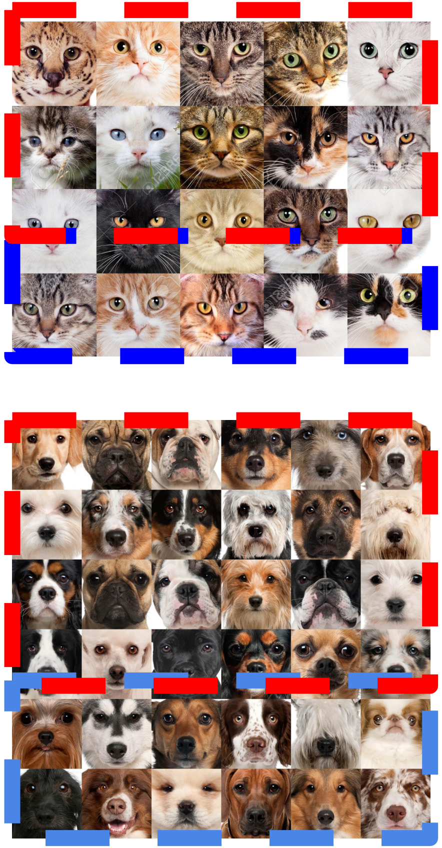
Test Set
(2000 photos)

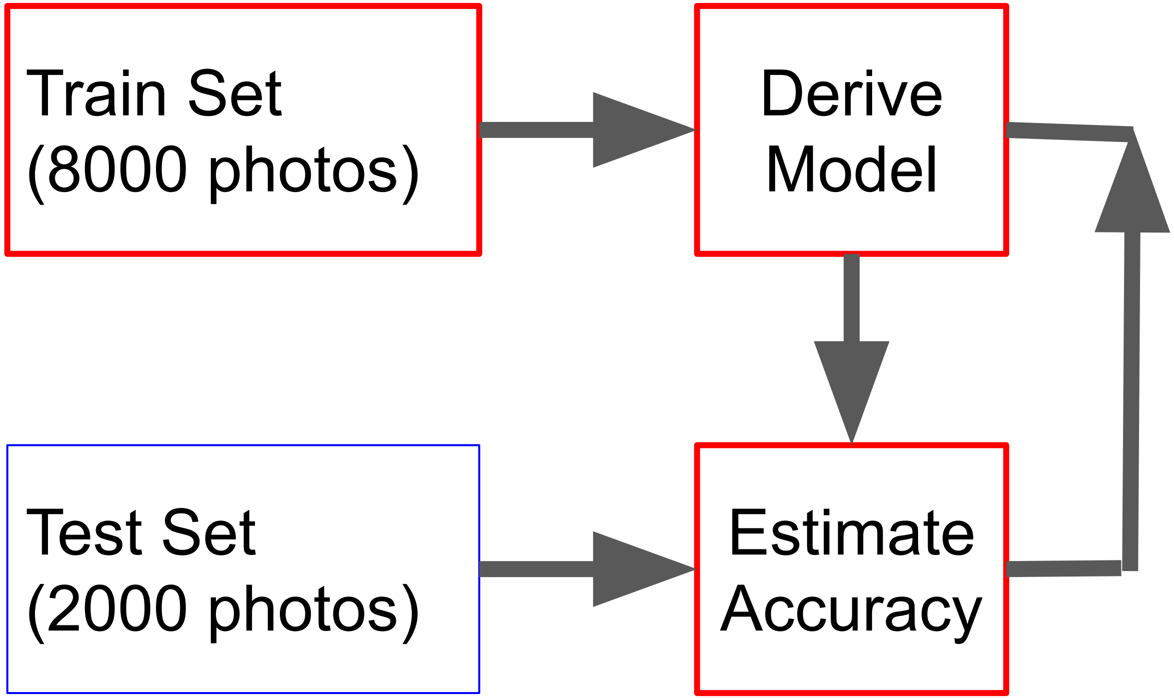
Supervised Learning with Images





Supervised Learning with Images

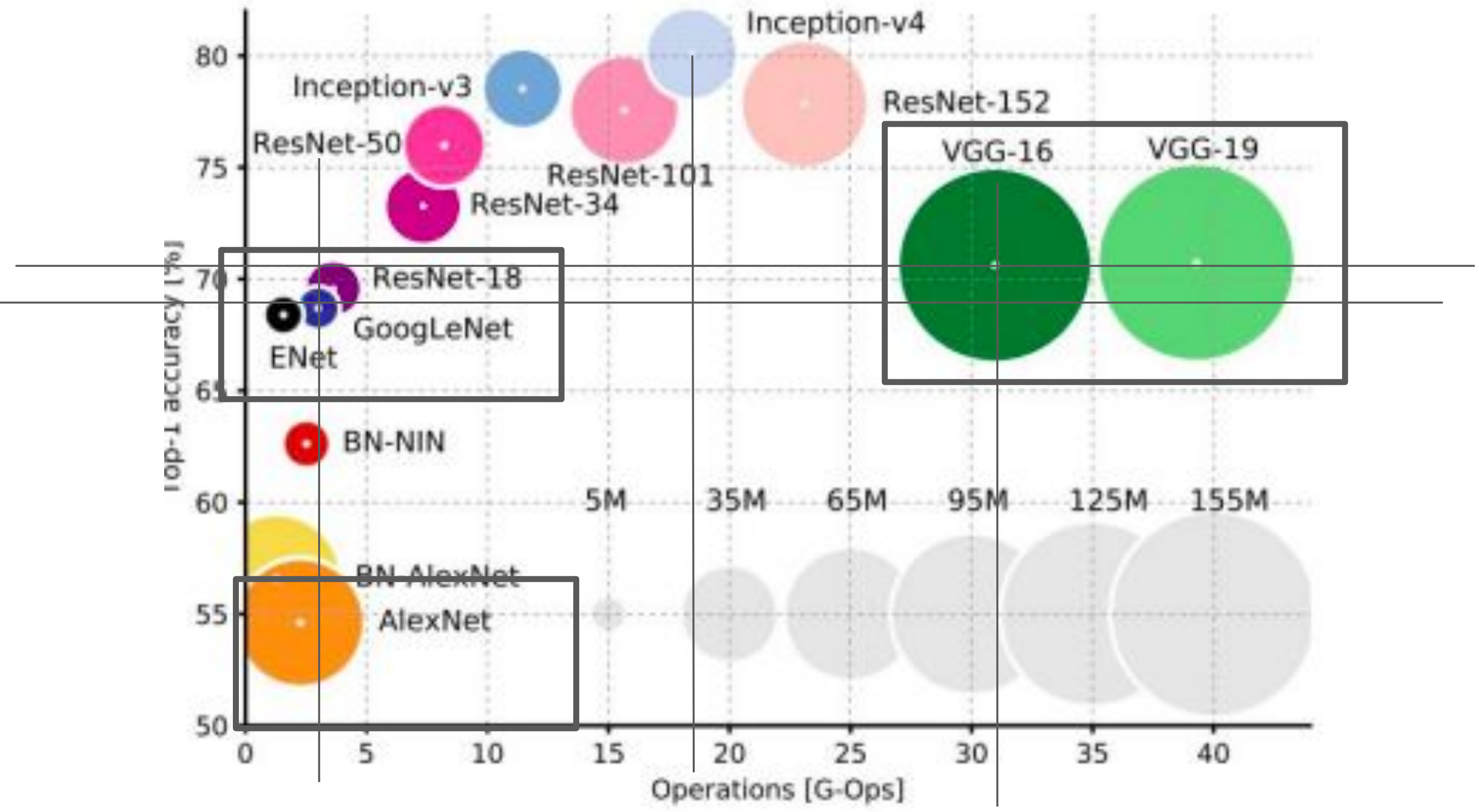




Colab Example

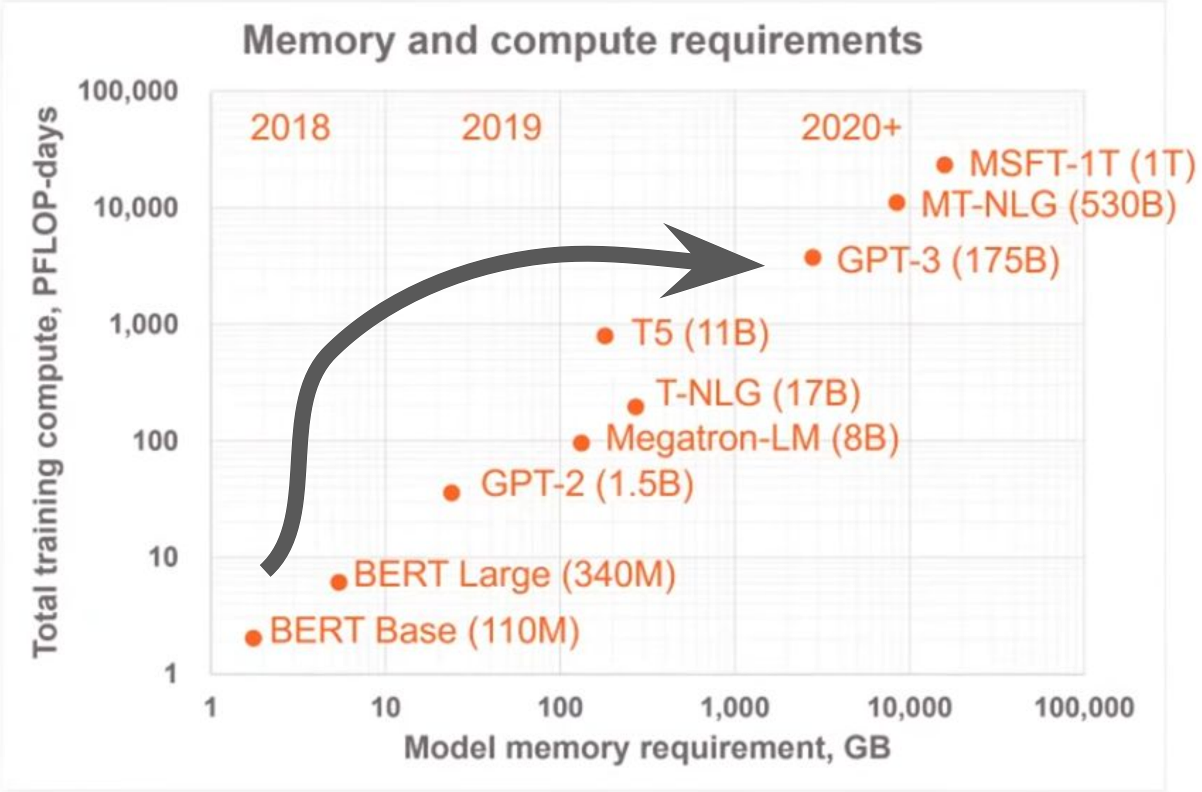
- Training an image classifier from scratch on the Kaggle Cats vs Dogs dataset. **Author: François Chollet**
- Tutorial from Keras
- Plus
  - Exercises
  - Links

Convolution Network Architectures CS231N Stanford



Top-1 accuracy is the conventional accuracy, model prediction (the one with the highest probability) must be exactly the expected answer.

Exponential Growth of Neural Networks



1800x more compute

In just **2 years**

Tomorrow, **multi-trillion** parameter models

[SAFARI Live Seminar - Thinking Outside the Die: Architecting the ML Accelerator of the Future]()

GPT-3 (2020)

Autoregressive language model

Single stack of *causal* trf blocks

position embeddings

dim 12288, 96 heads, 96 blocks

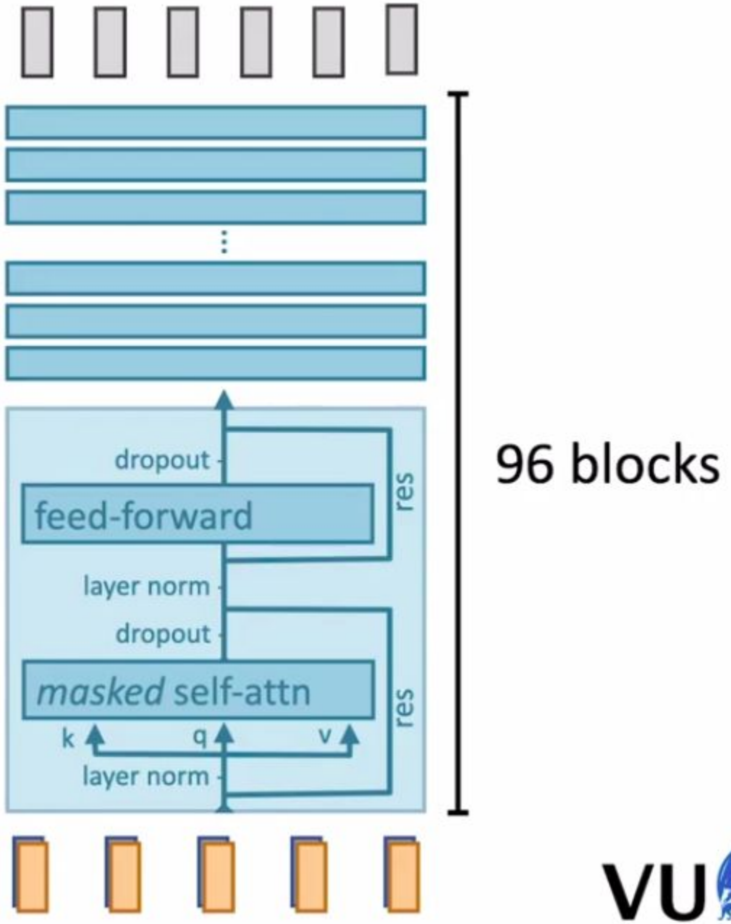
sequence size 2048

175B parameters in total

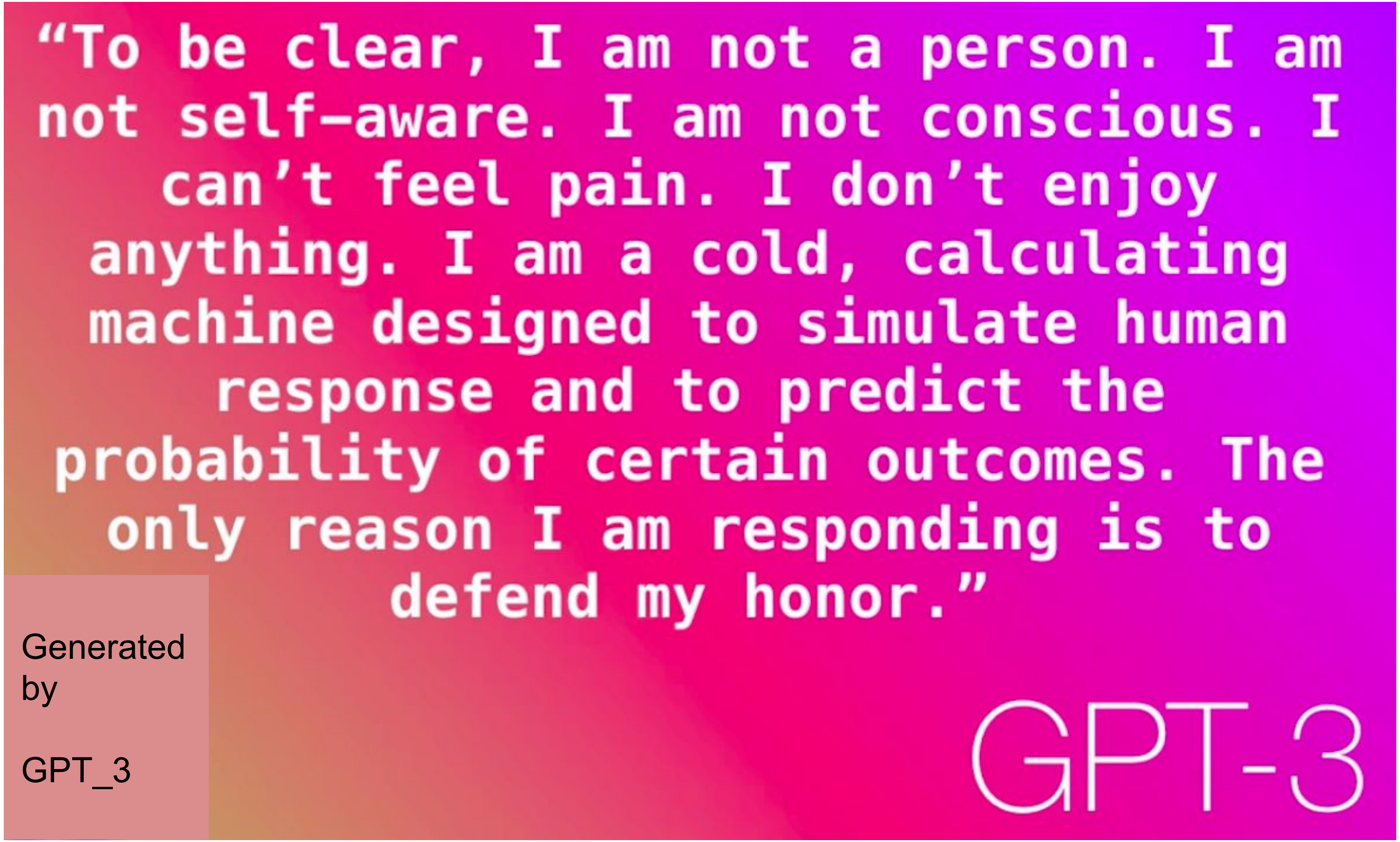
FF: `Lin(dim, 4*dim), gelu, Lin(4*dim, dim)`

trained on 10K GPUs, likely in around 12 days

for about $4,600,000



The Narrated Transformer Language Model Jay Alammar



Generated by

GPT_3

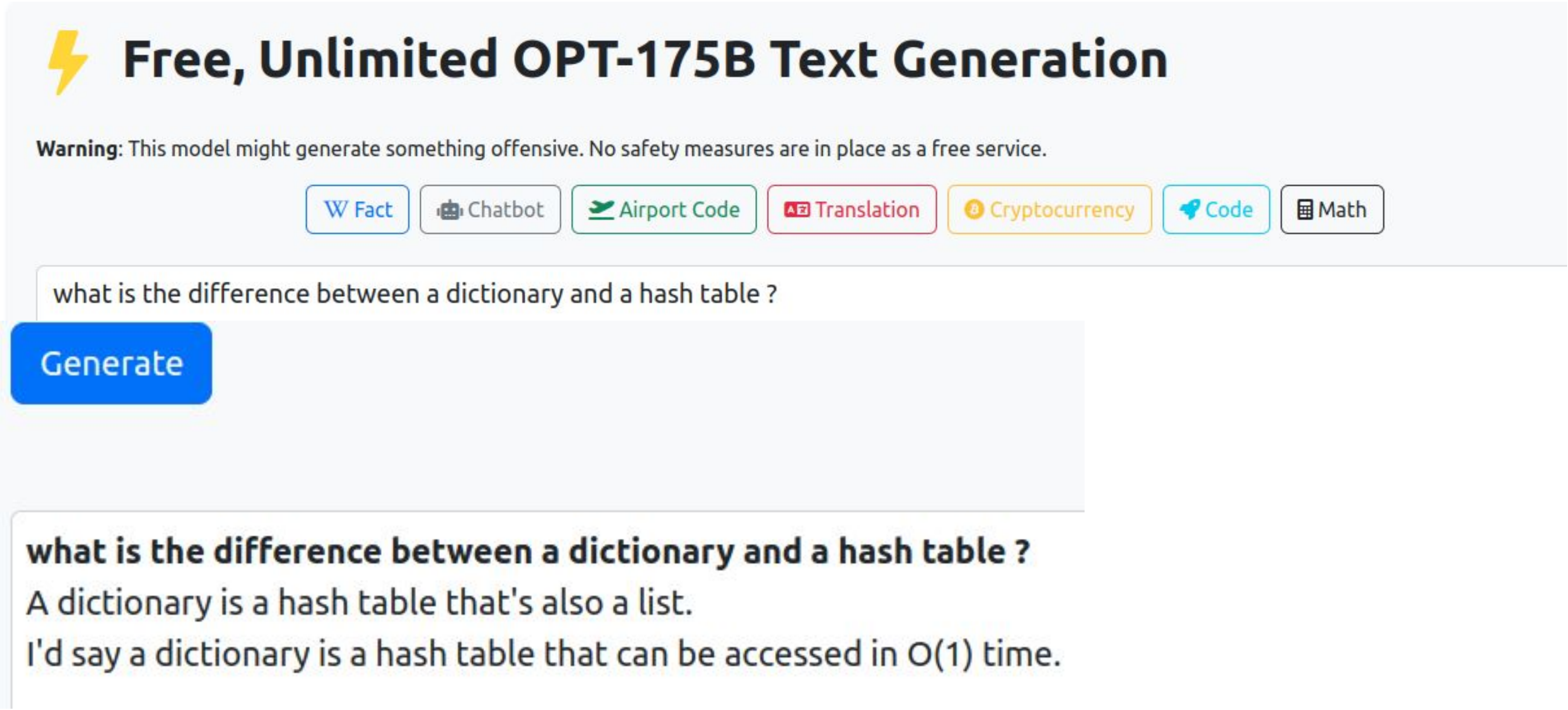
The Narrated Transformer Language Model Jay Alammar

Demo GPT3

[OpenAI - Demo]

O Centro Federal de Educação Tecnológica de Minas Gerais (CEFET-MG) é uma autarquia federal brasileira, vinculada ao Ministério da Educação, que oferece ensino médio, cursos técnicos, superiores, pós stricto sensu e lato sensu, contemplando também, de forma indissociada, o ensino, a pesquisa e a extensão, na área tecnológica e no âmbito da pesquisa aplicada.

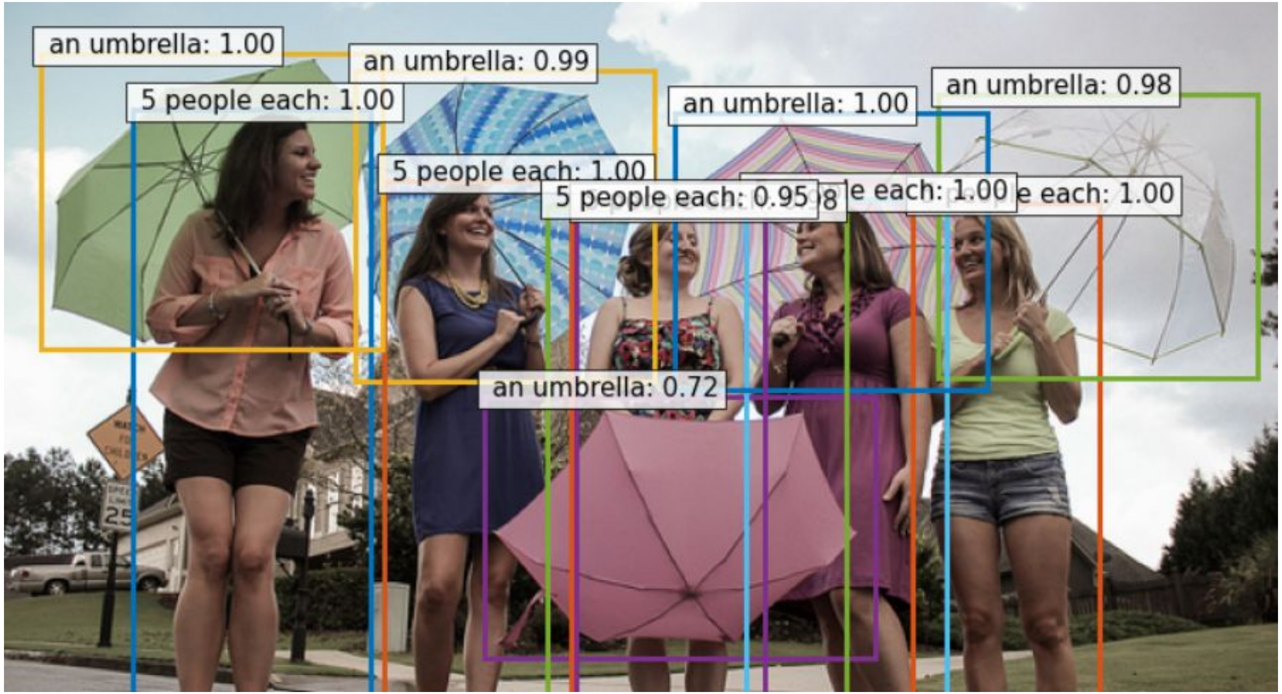
Alpa is a system for training and serving gigantic machine learning models. Alpa makes training and serving large models like GPT-3 simple, affordable, accessible to everyone.

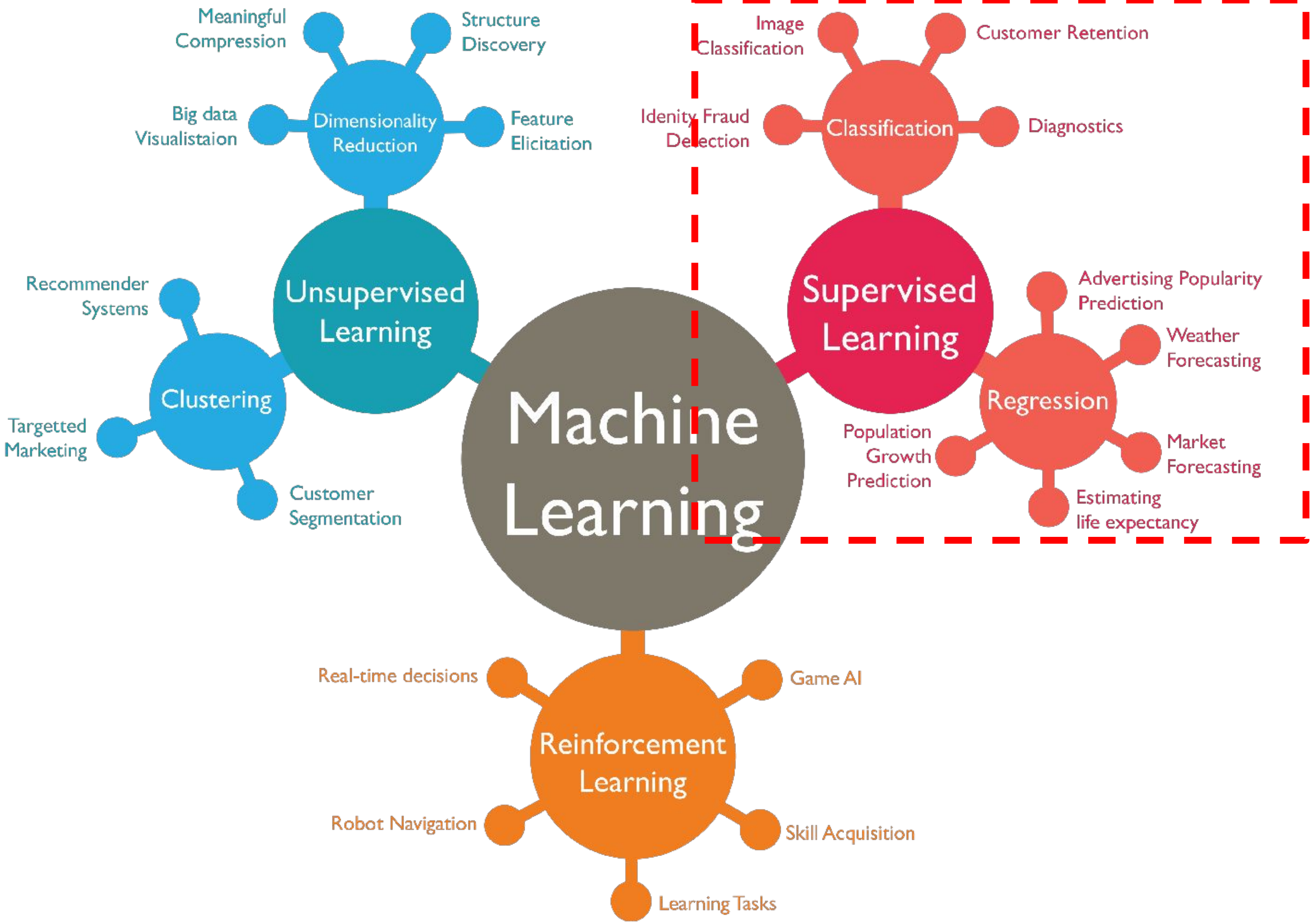


MDETR - Modulated Detection for End-to-End Multi-Modal Understanding

Colab

```
plot_inference(im, "5 people each holding an umbrella")
```




Meaningful Compression
Structure Discovery
Big data Visualistaion
Dimensionality Reduction
Feature Elicitation
Image Classification
Customer Retention
Idenity Fraud Detection
Classification
Diagnostics
Unsupervised Learning
Supervised Learning
Recommender Systems
Advertising Popularity Prediction
Weather Forecasting
Clustering
Regression
Targetted Marketing
Machine Learning
Population Growth Prediction
Market Forecasting
Customer Segmentation
Estimating life expectancy
Real-time decisions
Game AI
Reinforcement Learning
Robot Navigation
Skill Acquisition
Learning Tasks

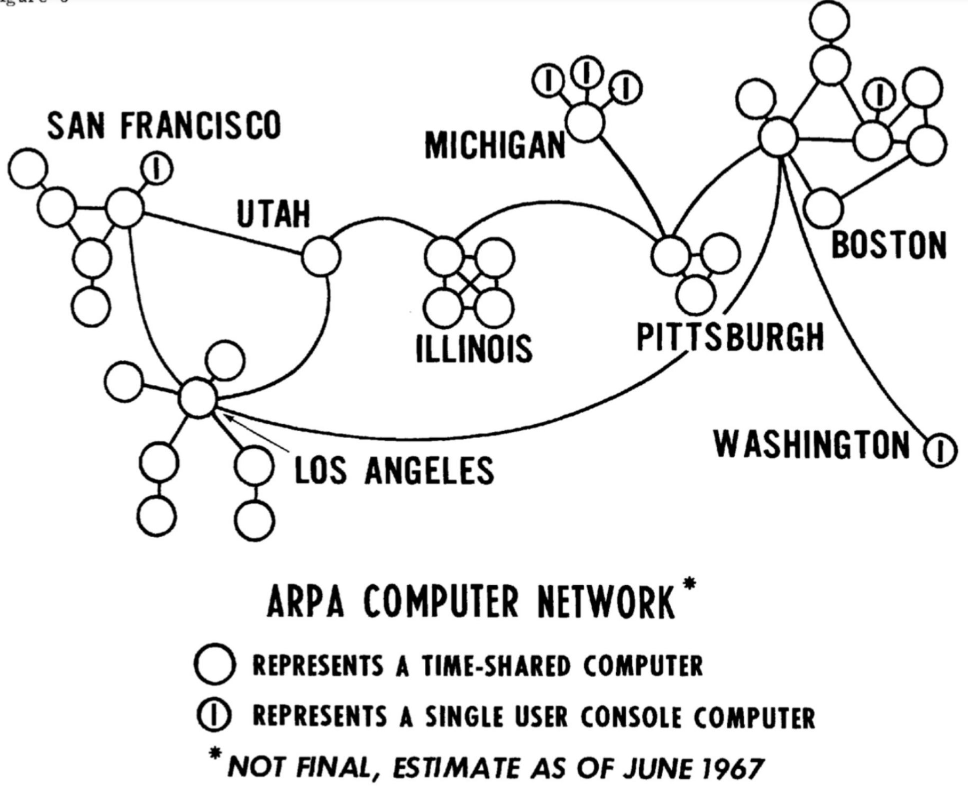
[Original]()

História da Internet em 1969...

Um grande salto….

1. Criação da Internet
2. Unix (Linux)
3. Linguagem C
4. Protocolo TCP/IP
5. CDC 7700

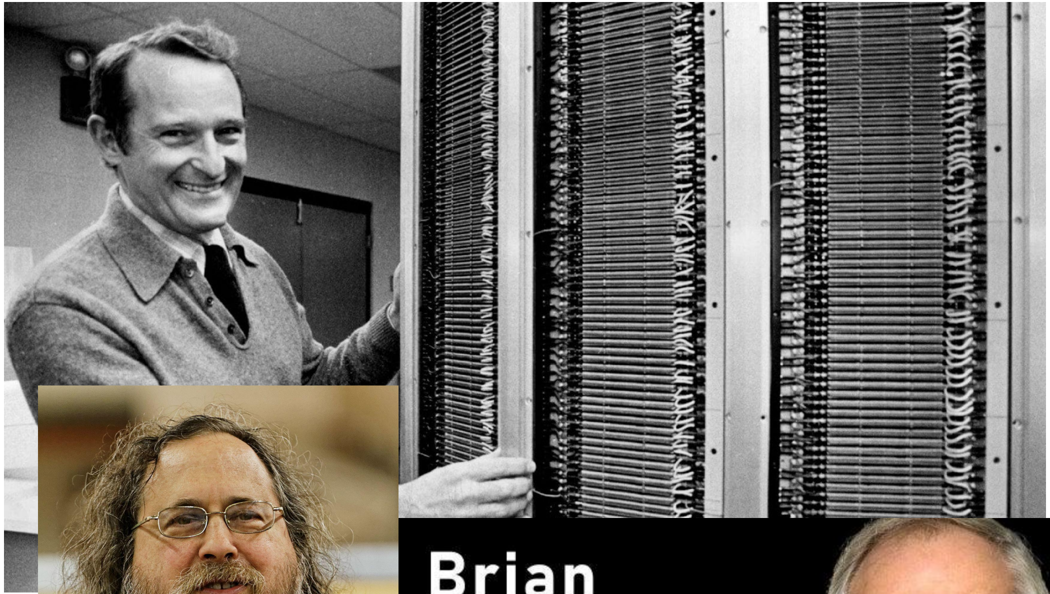
Figure 3

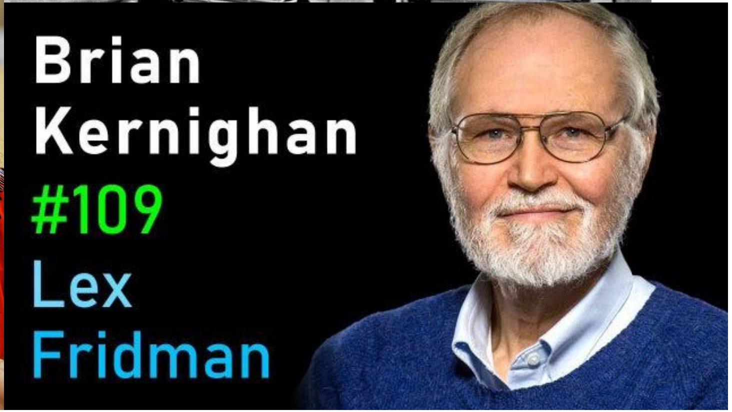


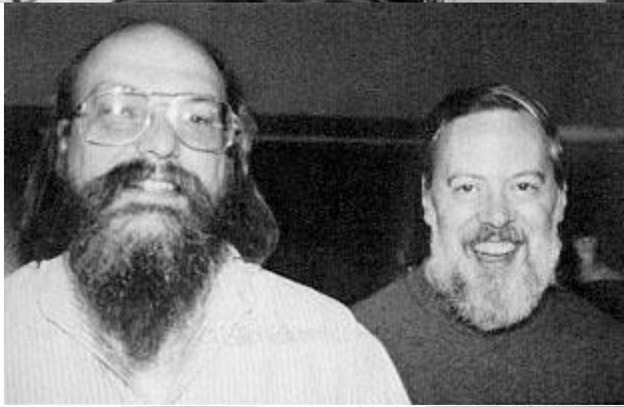
Ciência e seus fundamentos, além da Tecnologia

1. Escalabilidade
2. Conectividade
3. Colaboração
4. Distribuição
5. Padrões

Cientistas…..







O que é Internet das Coisas (IoT) ?

Linha Temporal

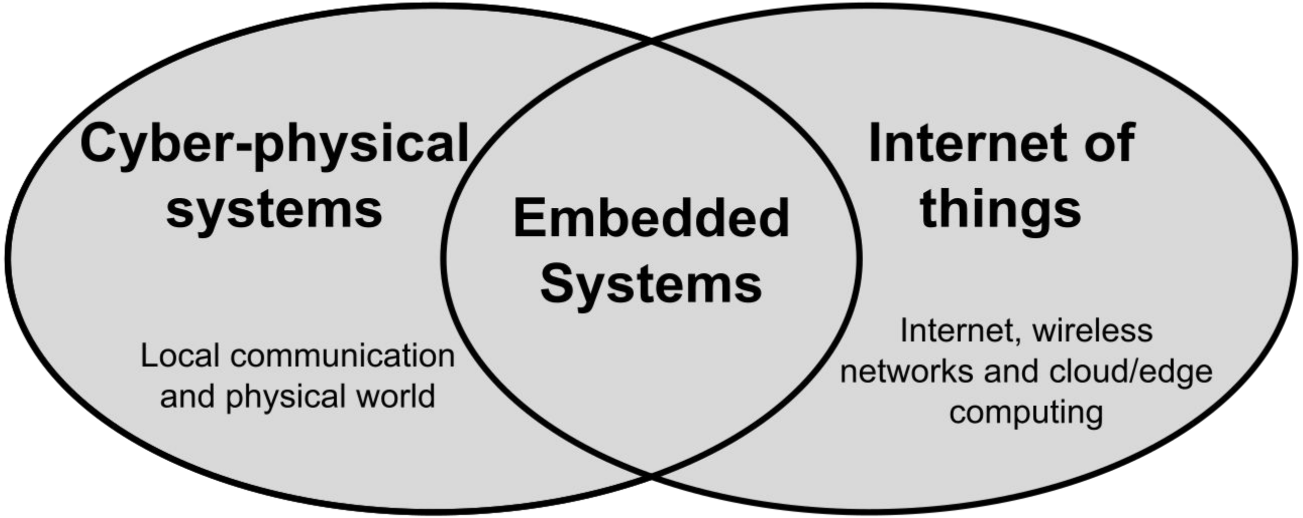
1969 - Internet, anos 80 com email,

1985 - Termo IoT

Anos 90 - Navegadores e ferramentas de busca

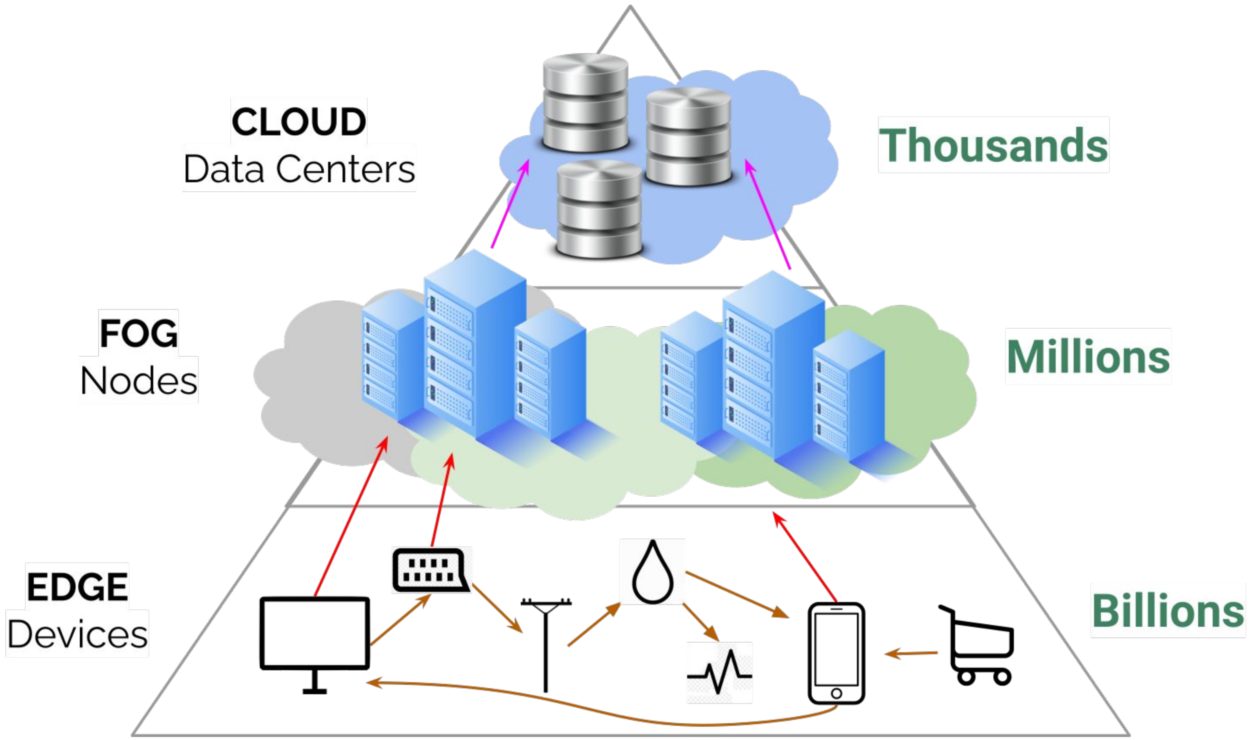
2000 em diante: Redes Sociais, Computação na Nuvem, Big Data, Ciência de Dados, Inteligência Artificial…..

O que é Internet das Coisas (IoT)



Capítulo: Internet das Coisas na Agricultura
Segunda Edição - Livro Agricultura Digital

Paradigmas


CLOUD
Data Centers
Thousands
FOG
Nodes
Millions
EDGE
Devices
Billions

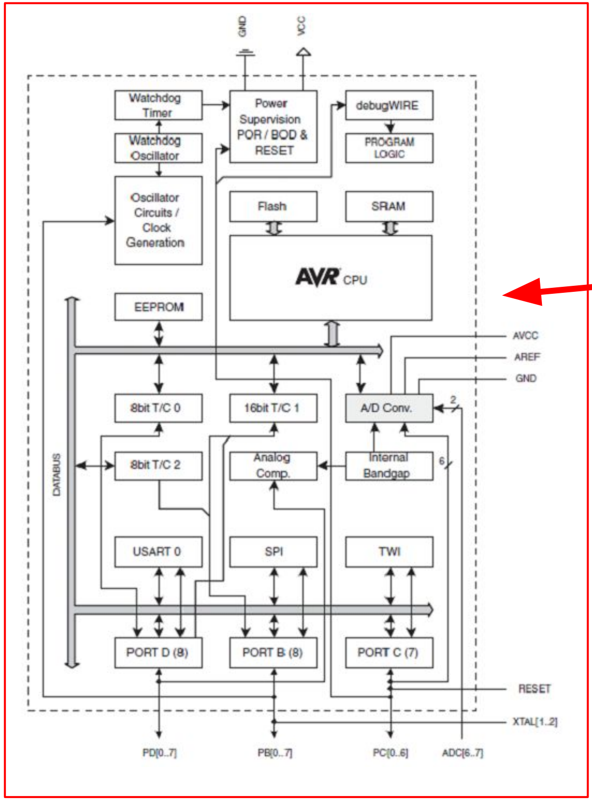
Camadas

1. **Aplicação**

2. **Rede (network)**

3. **Percepção**

Percepção
Sistemas Embarcados



Tudo integrado em um único circuito

Processador, Memória, Conversores Analógicos, Temporizadores, Interfaces de Comunicação (SPI,I2C,Serial)

Popularização com Arduino = simplicidade

Microcontroladores existem desde 1971…..TMS1000 da Texas, 8048 da Intel

2003 Linguagem Wiring (simples, semelhante a linguagem C)

Ambiente de Programação e as Placas

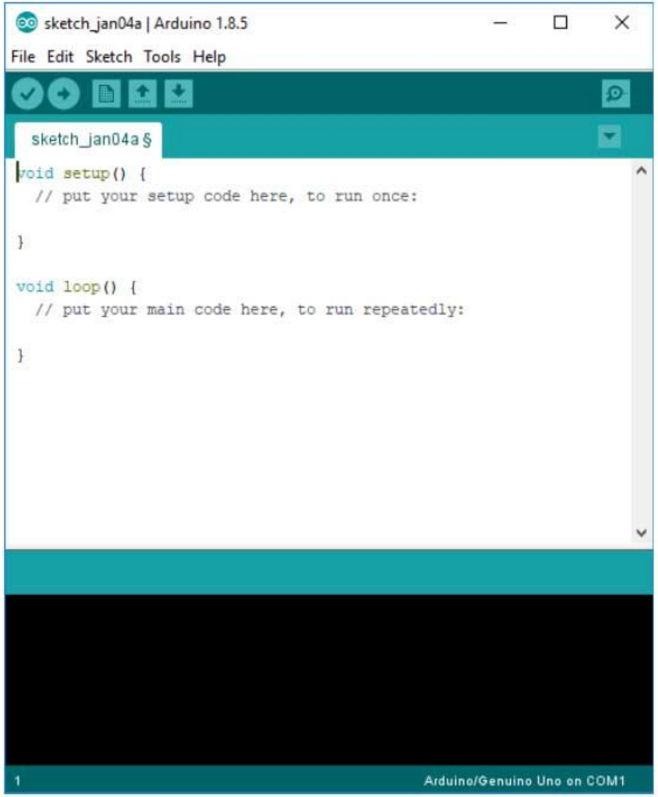
2004 Arduino = Gerou uma "**padronização**"

Vantagens: Baixo Custo, Popularidade, Simplicidade, Conectividade, Muitas aplicações, baixo consumo, suporte

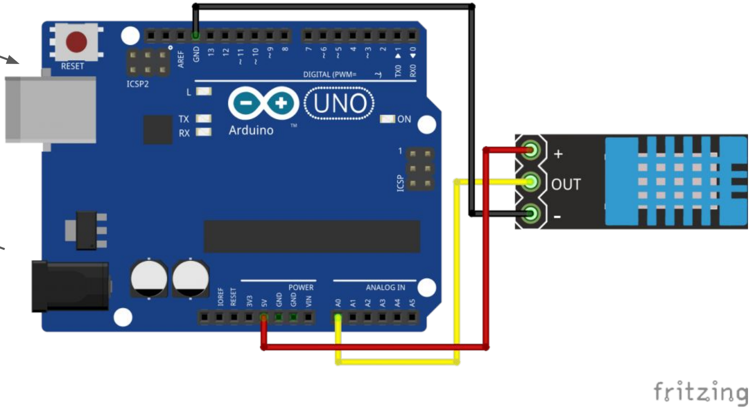
Desvantagens: baixo poder de processamento

Arduino

Ambiente Simples de Programação, gravação no Arduino
e Comunicação para teste, vários exemplos



Muitos sensores e atuadores no Mercado com baixo
Custo e fáceis para conectar e testar.



Como começar e onde aprender mais ?

Em inglês 4 canais do Youtube com explicações detalhadas e técnicas de vários projetos, sensores, placas de desenvolvimento

https://www.youtube.com/channel/UCu7_D0o48KbfhpEohoP7YSQ - Andreas Spiess

https://www.youtube.com/channel/UC8Ob-HnnmhlgSv5Vs_i32TQ - Ralph S Bacon

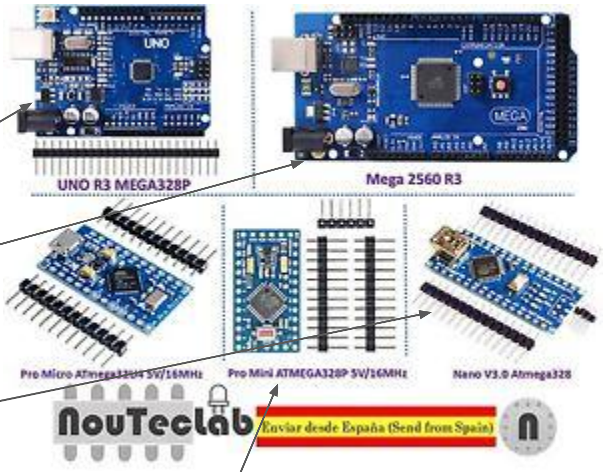
https://www.youtube.com/user/kdarrah1234 Kevin Darrah

https://www.youtube.com/channel/UCzml9bXoEM0itbcE96CB03w - **DroneBot**

https://www.youtube.com/user/greatscottlab

https://www.youtube.com/user/julius256

Qual é o melhor dispositivo ?



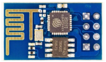
Arduino **Uno**: 2KiB, 16 Mhz, 20 Pinos,

Arduino **Mega**: 70+ pinos,

Arduino **Nano**: pequeno, 20 pinos

Arduino **ProMini**: , produto, sem gravador e regulador

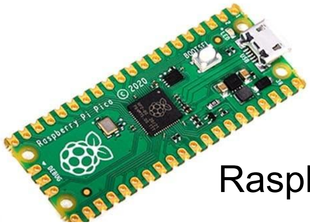
Esp8266: wifi 2 pinos, 3 Mega, 80 Mhz, 3,3 volts



NodeMCU: Wifi, 14 pinos, 3,3 volts,

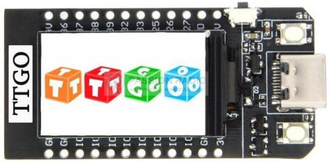
Esp32: 160 Mhz, Wifi, baixo consumo, 3,3 volts,

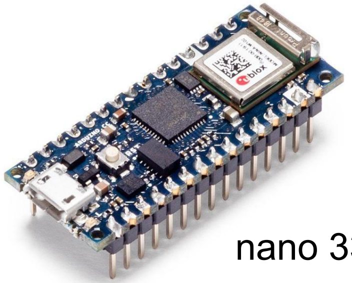
Novas opções



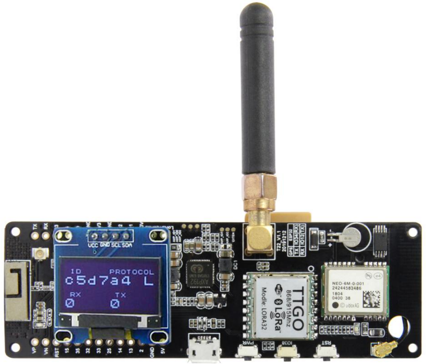
Raspberry pico

esp32 ttgo





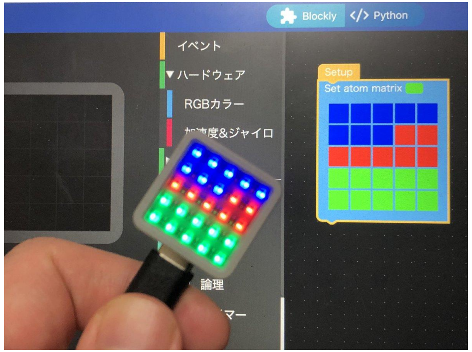
nano 33 Iot



esp32 ttgo
LORA

m5stamp

m5 atom

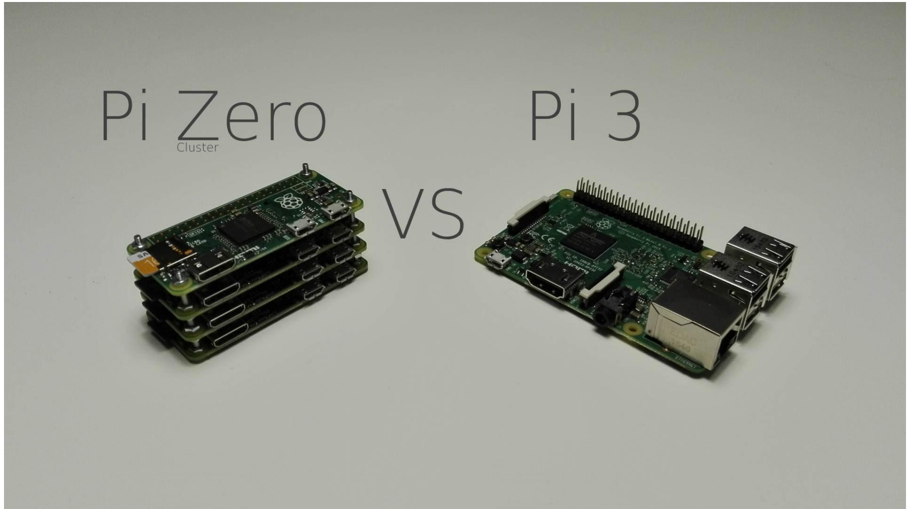


Outras opções

Raspberry Zero = Computador, 512 Mega RAM, 1 Ghz

Raspberry Pi 4 = Computador, 4 Giga RAM,

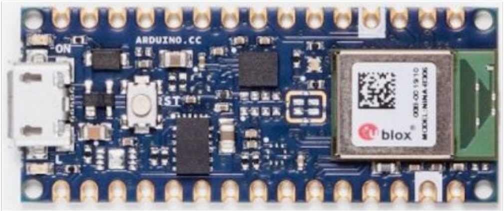
+energia, muitos pinos, camera, processamento, wifi , mais frágil



Existem muito mais opções…
Apenas apresentamos as mais populares….

Outras opções

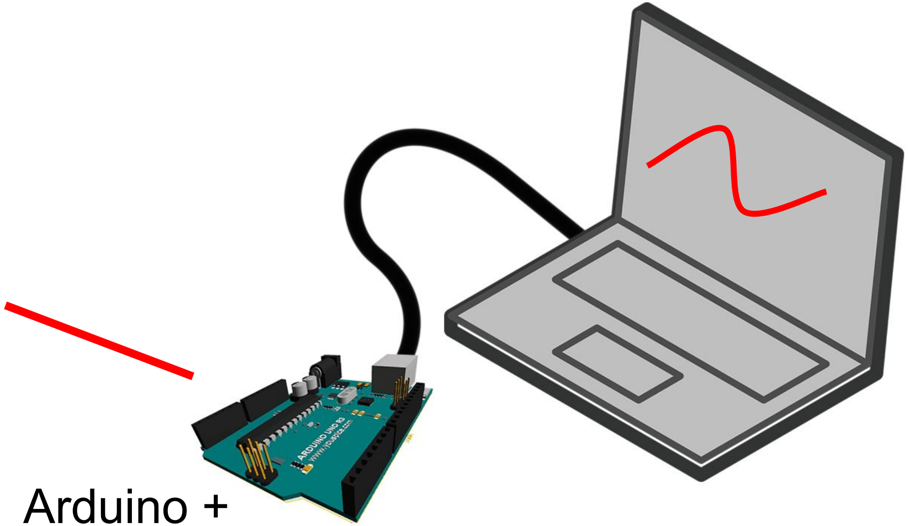
M5stickV



Arduino nano 33

Maix Amigo

Sensores e Atuadores - Ambiente de laboratorio

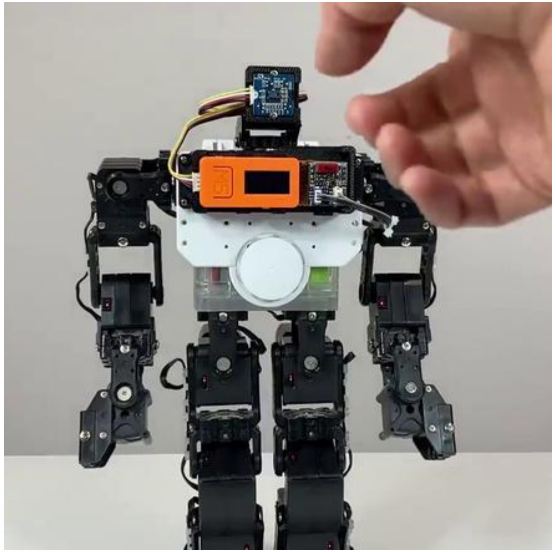


Arduino +
computador (visualizar, armazenar dados,
Enviar comandos).

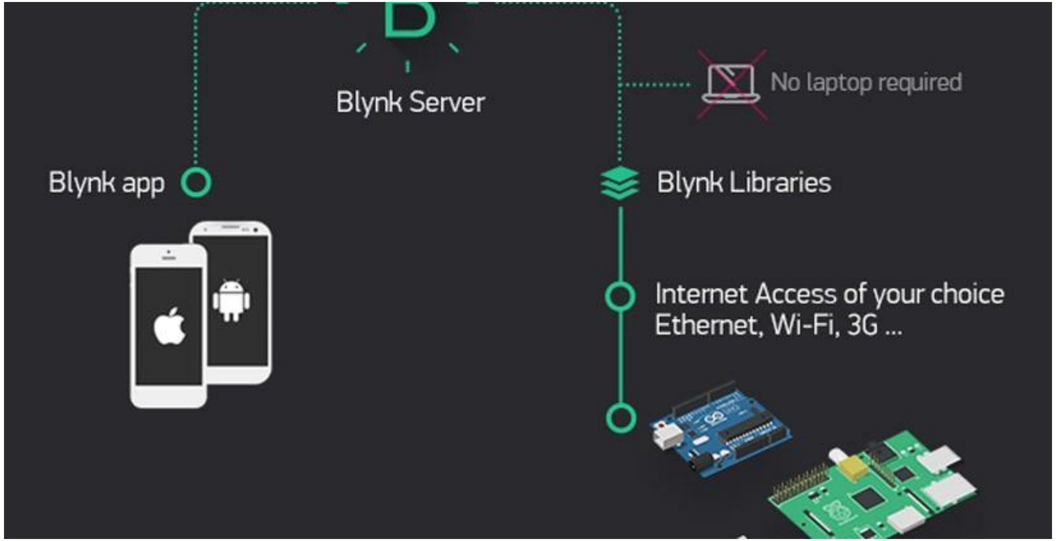
Sensores e Atuadores com M5stack

Sensores e Atuadores com M5stack

Outras opções
Para pesquisa

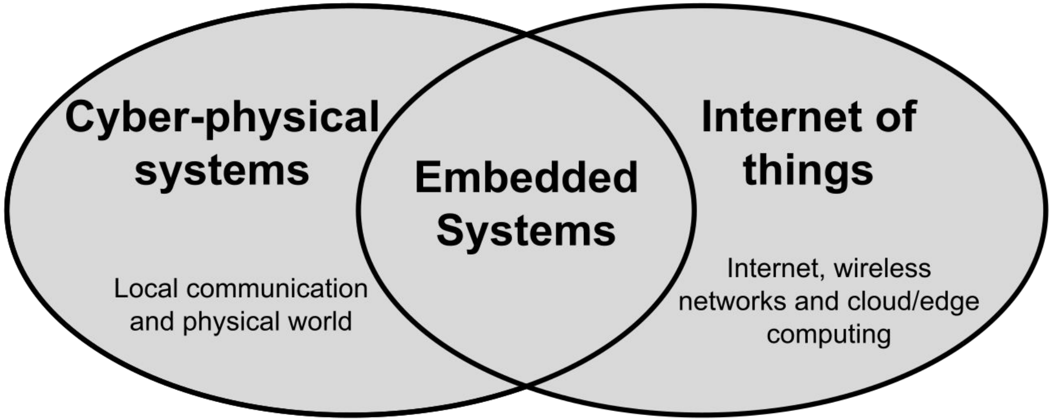


Sensores e Atuadores + Arduino + blink…..



Versão Gratuita APENAS 1 celular pode ficar configurado para controlar…..

Camada de Rede (Network)

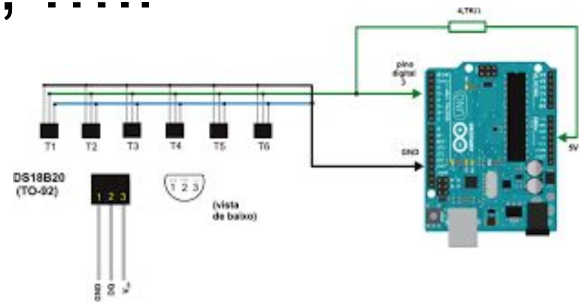


Sensores com Fios e seus Protocolos

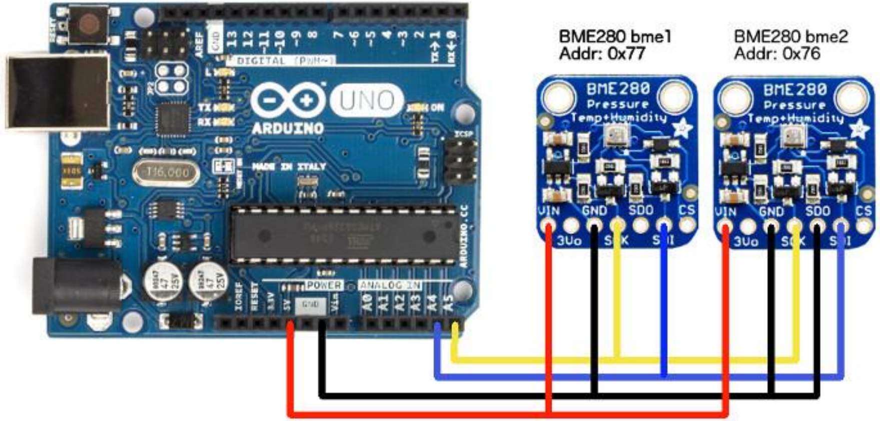
Sensores e Atuadores + Arduino + poucos fios com protocolos seriais: I2C, OneWire, SPI, …..

Pode ter os três ligados comunicando com
Sensores de diversos fabricantes….
Arduino 20 pinos de Entrada/Saida

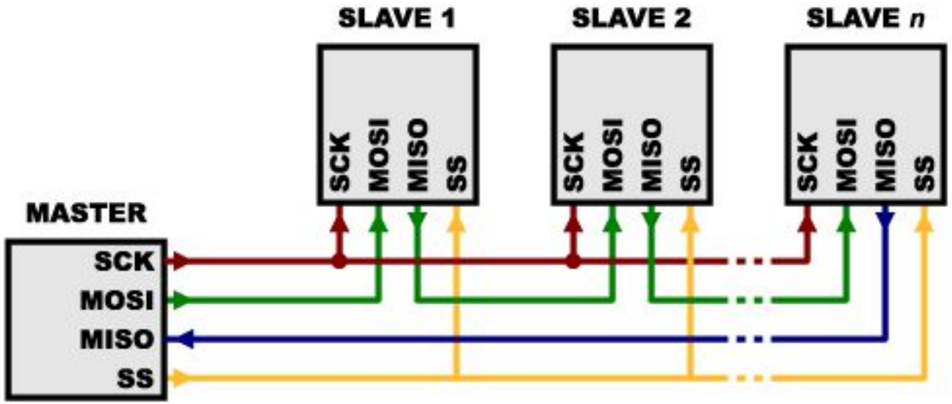
OneWire: +, - e 1 fio



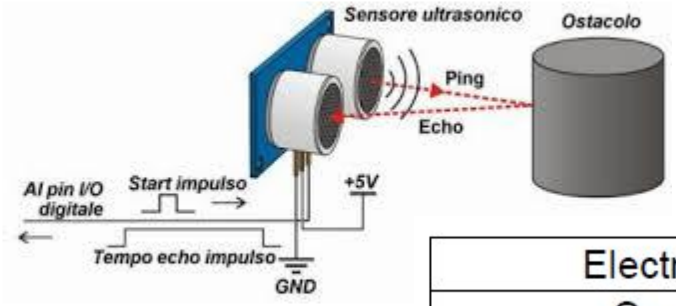
I2C: +,-, 2 fios



SPI: +,-, 3 fios + 1 fio para cada sensor



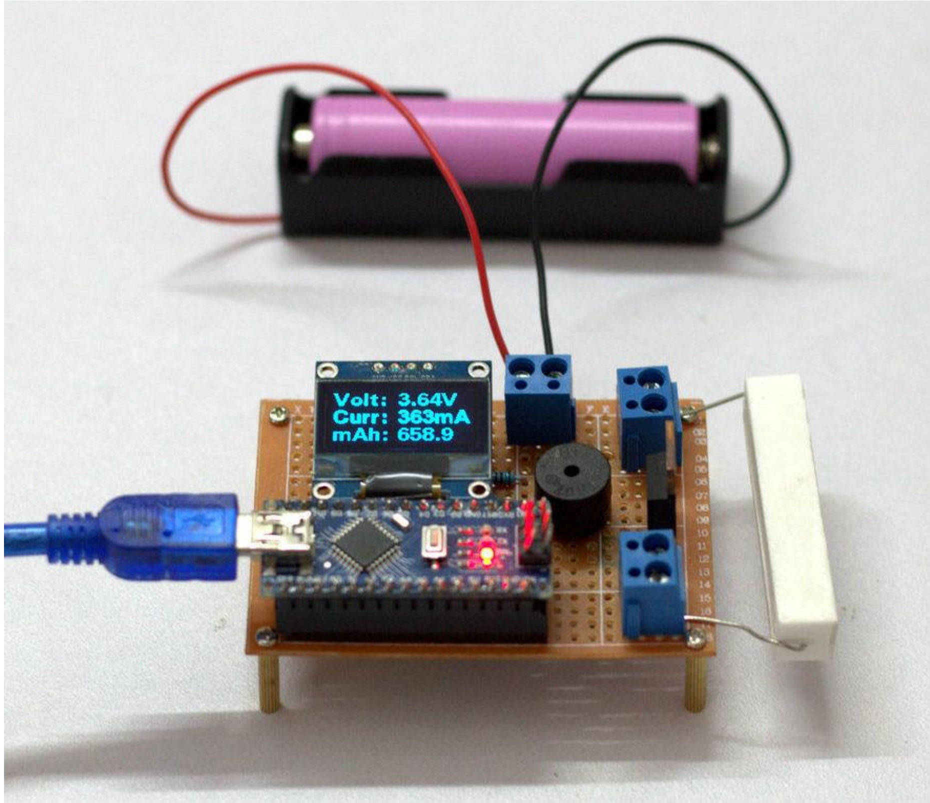
Sensor de distância

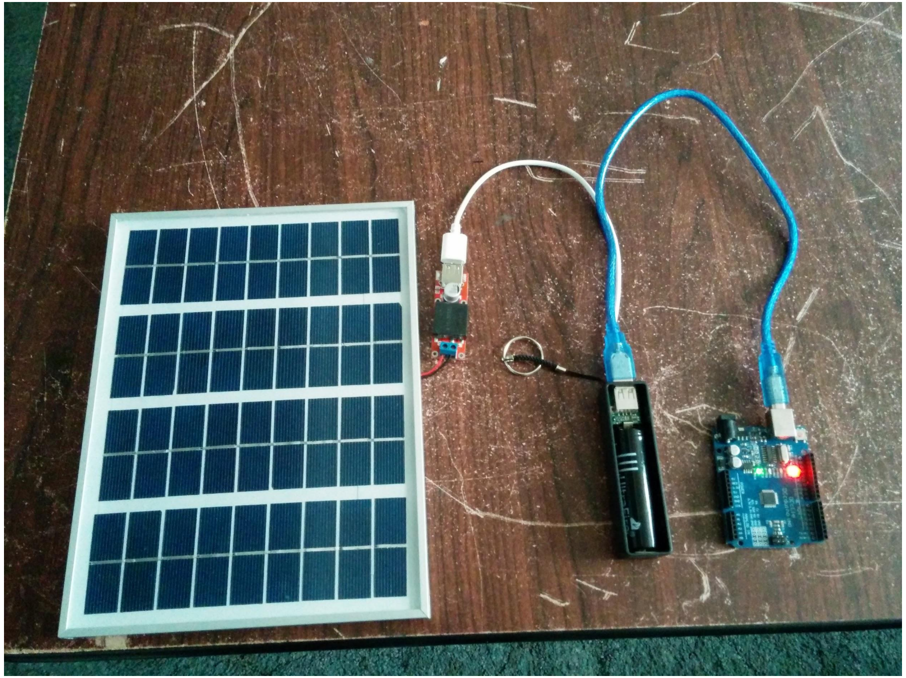


Electrical Parameters	HC-SR04 Ultrasonic Module
Operating Voltage	DC-5V
Operating Current	15mA
Operating Frequency	40KHZ
Farthest Range	4m
Nearest Range	2cm
Measuring Angle	15 Degree
Input Trigger Signal	10us TTL pulse
Output Echo Signal	Output TTL level signal, proportional with range
Dimensions	45*20*15mm

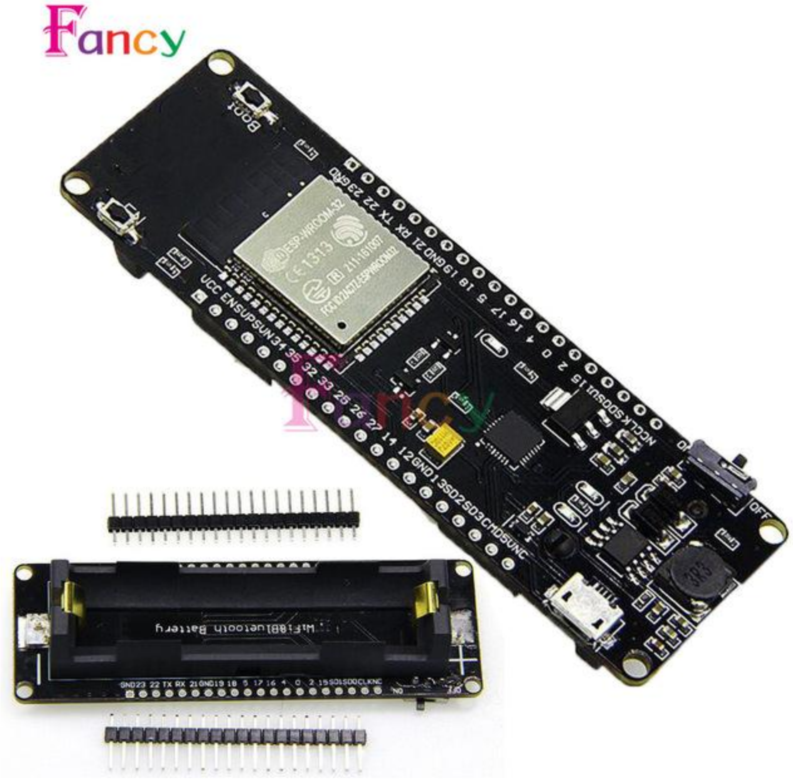
Energia Solar e Pilhas de Litio

Com Bateria - Sugestão 18650 Litio





ESP32 (wifi, bluettoth, sensores capacitivos, low power)



Comunicação sem Fio

Rede local de vários “arduinos”

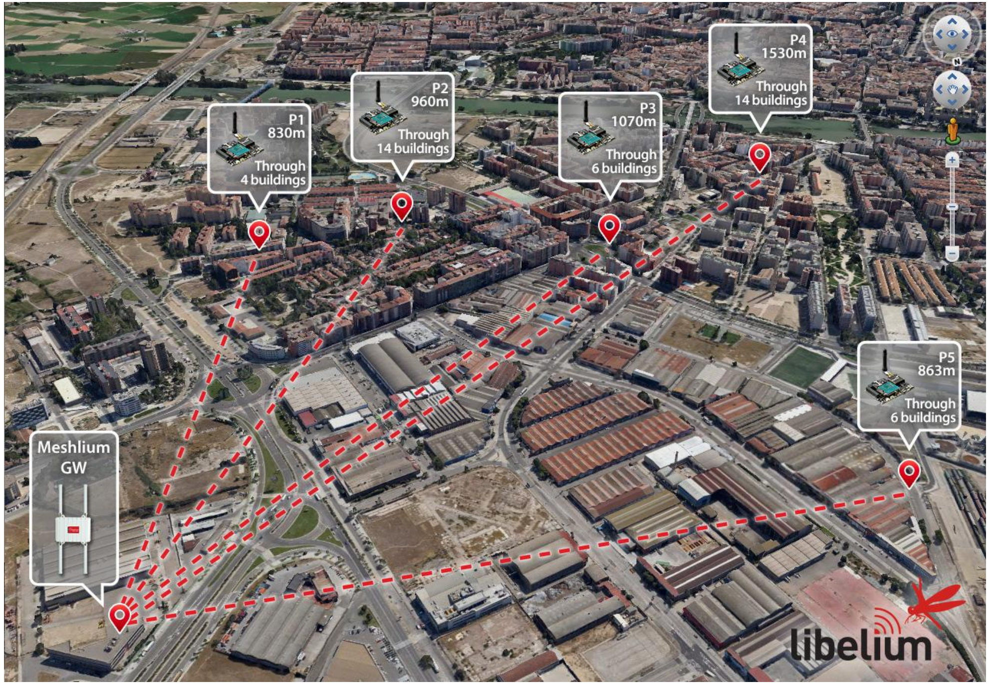
Radios de baixo custo = Rede Local e conexão com internet em um dos pontos

NRF 24L01

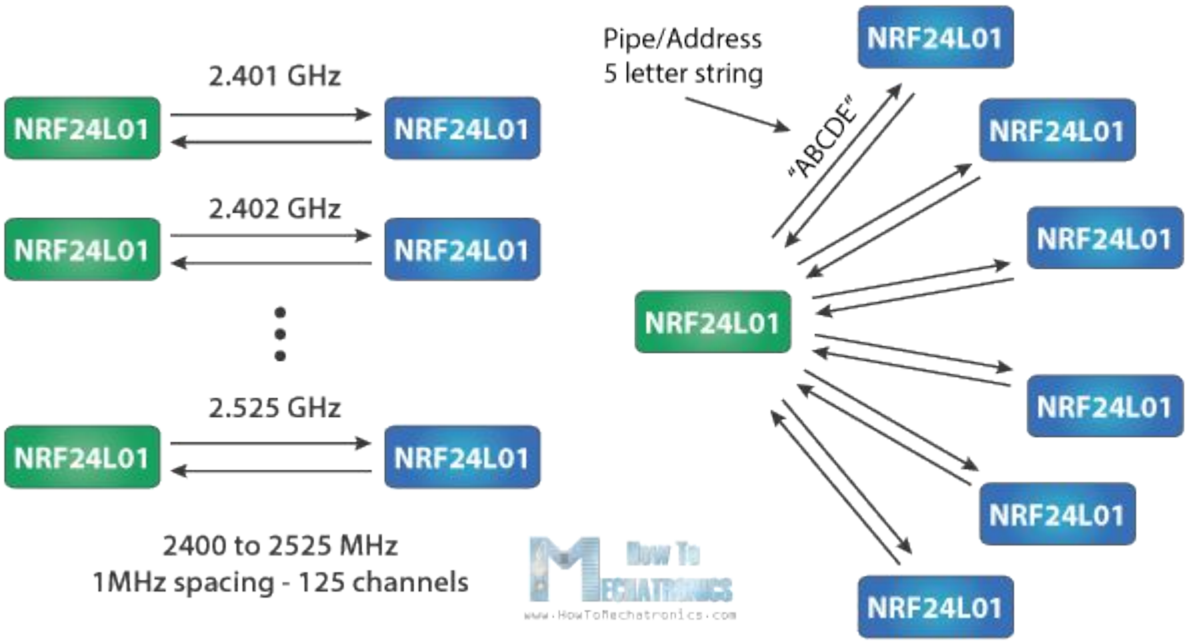
HC12

Lora

ZigBee

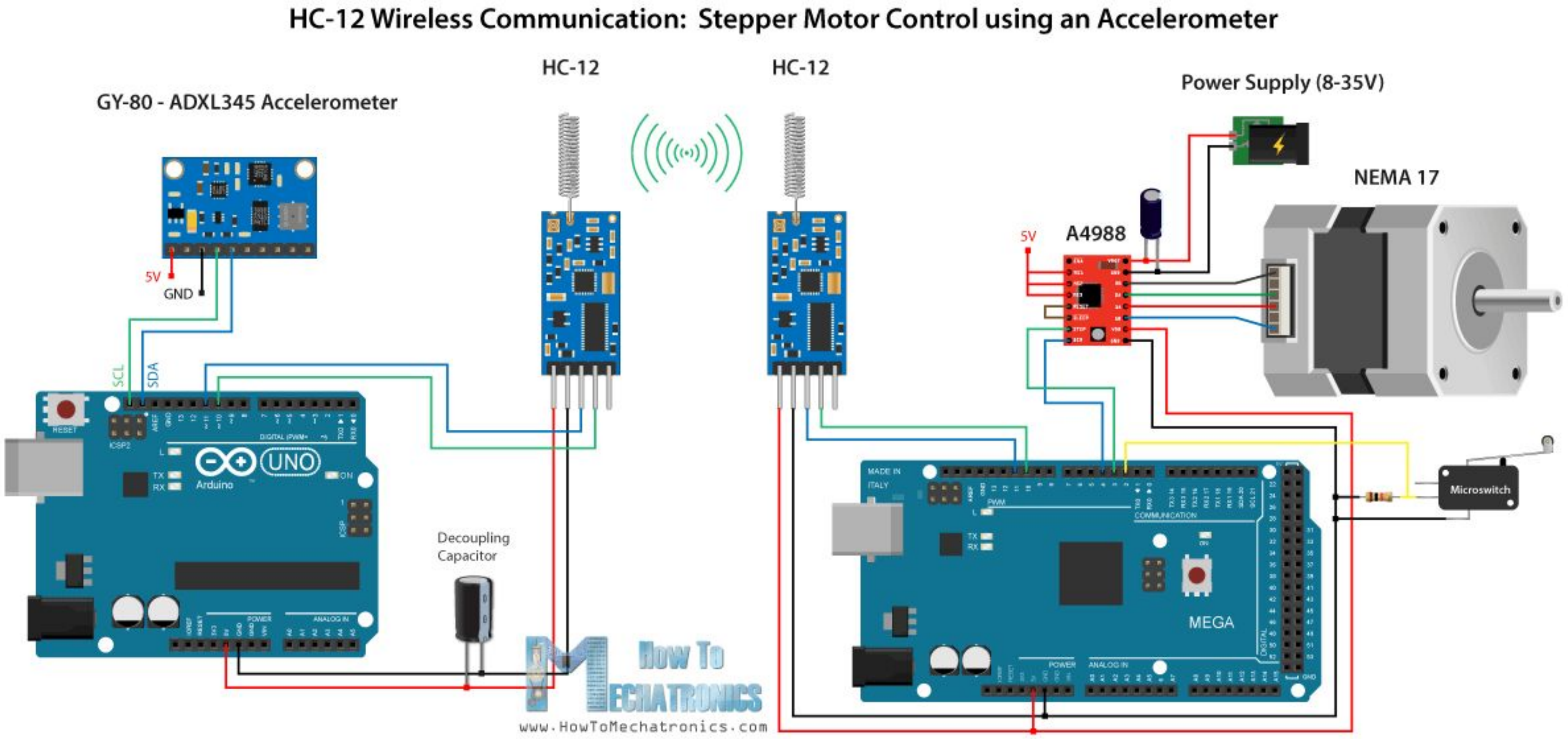


NRF24L01 -.....distância de 10 a 100m….ou mais...pode interligar 3125 pontos !

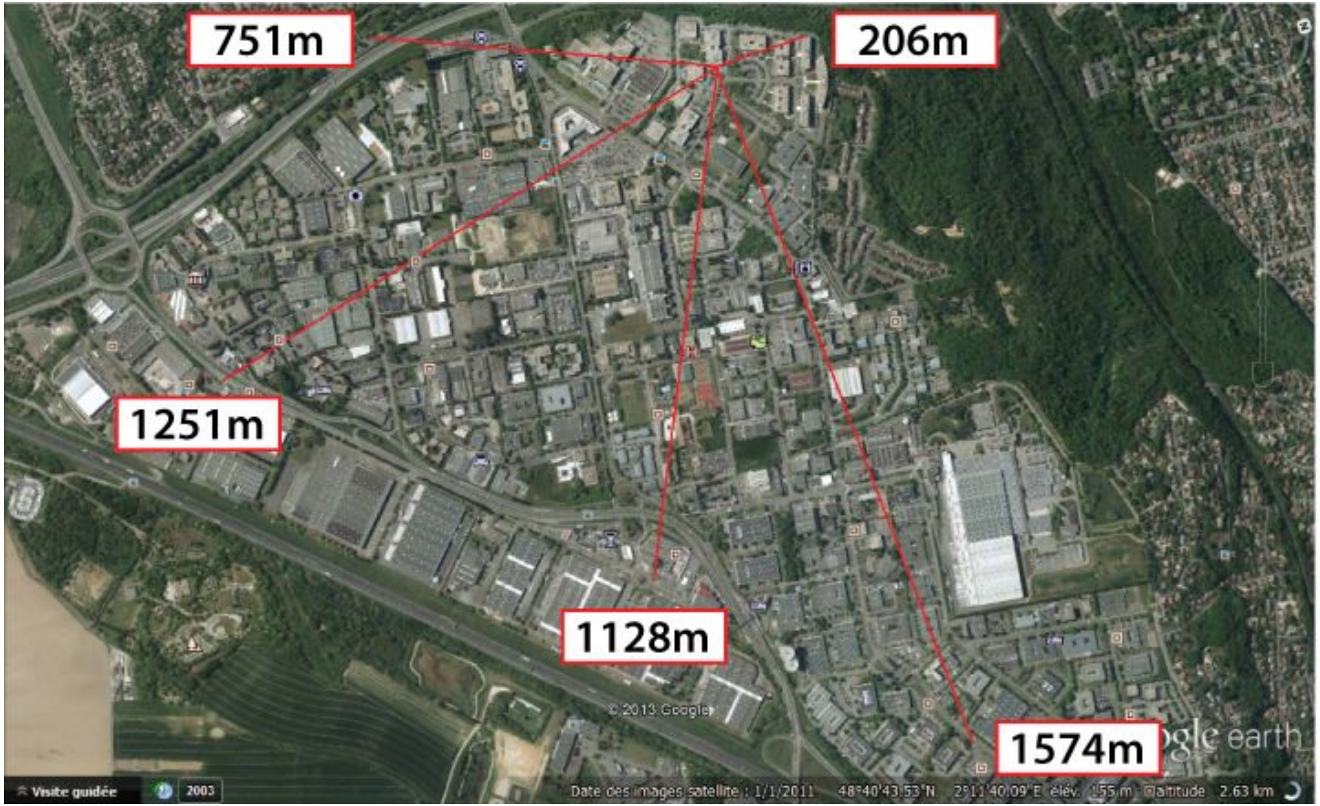


0.1 mA enviar, 14mA receber

HC12 400m a 2 Km….



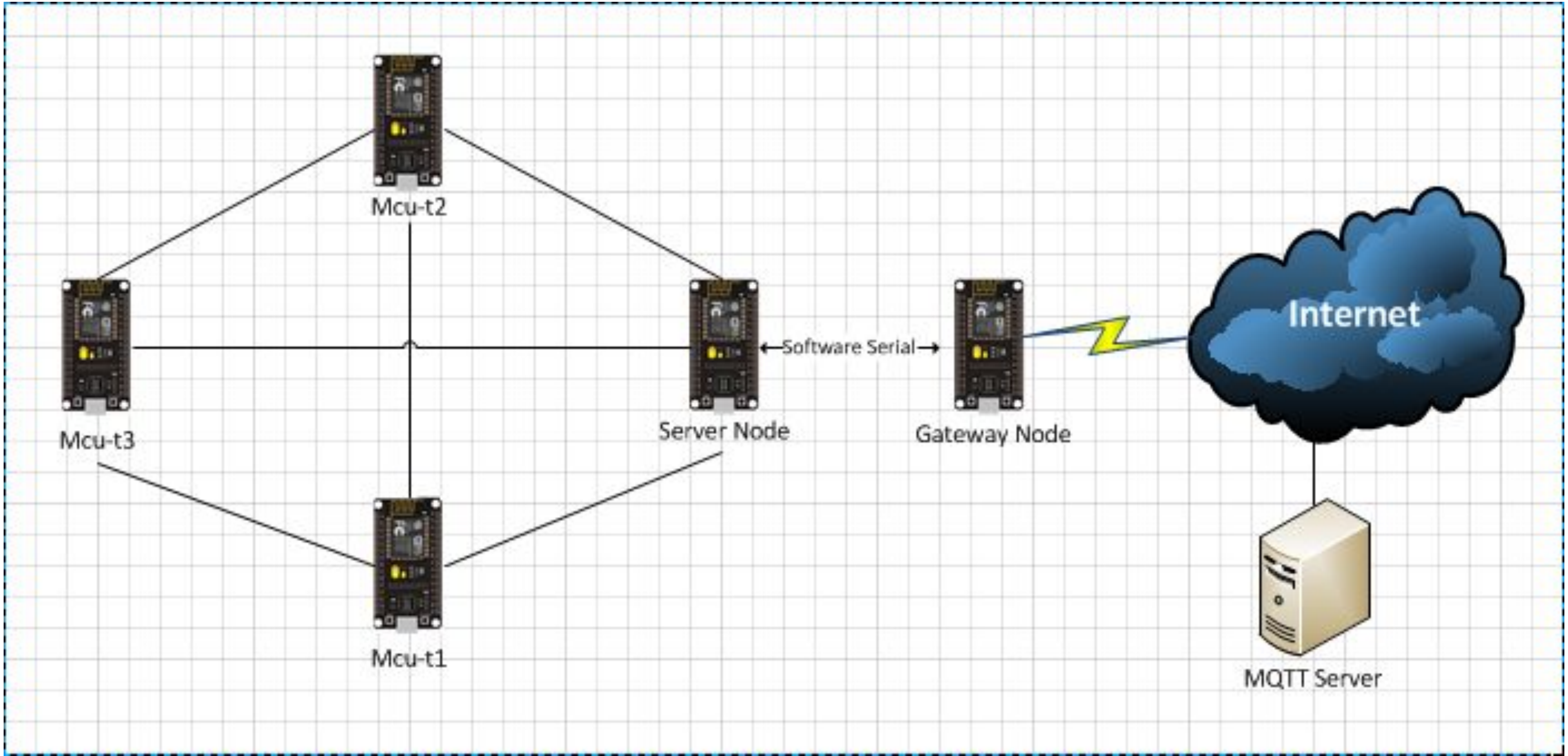
LoRa (Long Range)



PIN	DIP-A	Function	Description
1	GND	Ground	Ground (0V)
2	VCC	Power	Power supply (supply voltage 3.4-5.5 V)
3	EN	Input	Enable pin, Low effective
4	RXD	Input	RXD: UART input, TTL level
5	TXD	Output	TXD: UART output, TTL level
6	AUX	Output	Data indication pin for waking up module
7	SET	---	Reserved

Refer data => www.dorji.com/docs/data/DRF1278DM.pdf

Rede Mesh de Esp8266



Protocolos alto Nível: MQTT e CoAP

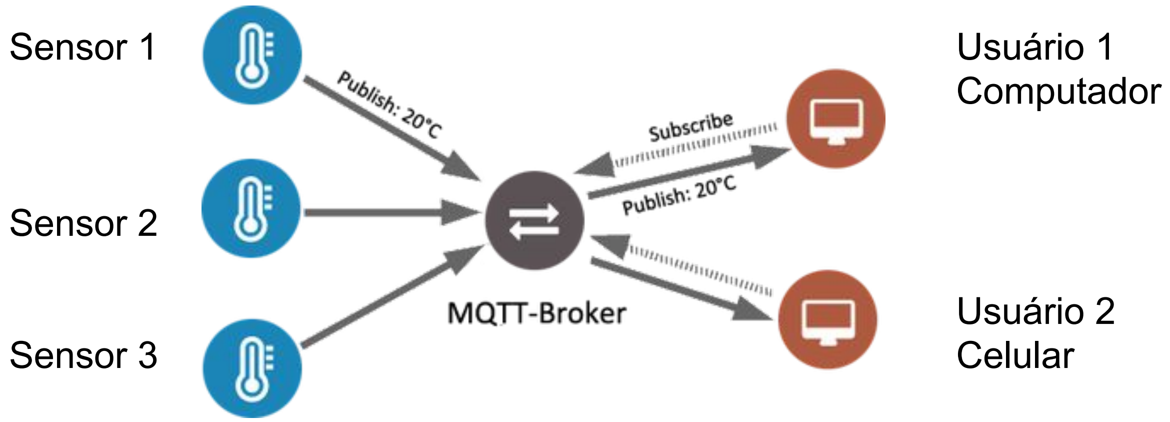
MQTT

Trocando mensagens de Texto entre os dispositivos

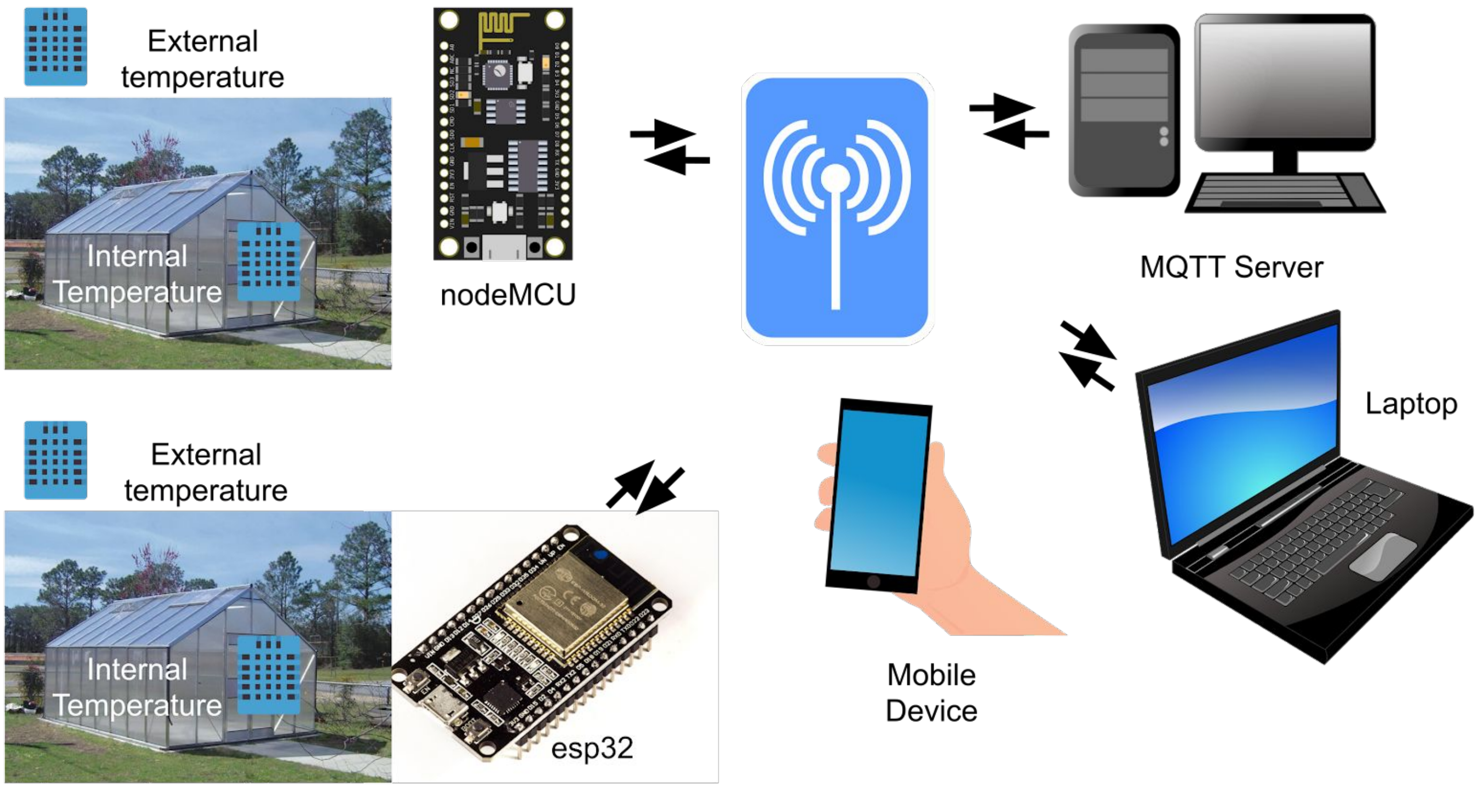
Assinar (**subscribe**) /ufv/floresta/1andar/sensores

Publicar (**publish**) $\boxed{\text{/ufv/floresta/1andar/sensores/temperatura}}$ $\boxed{25}$

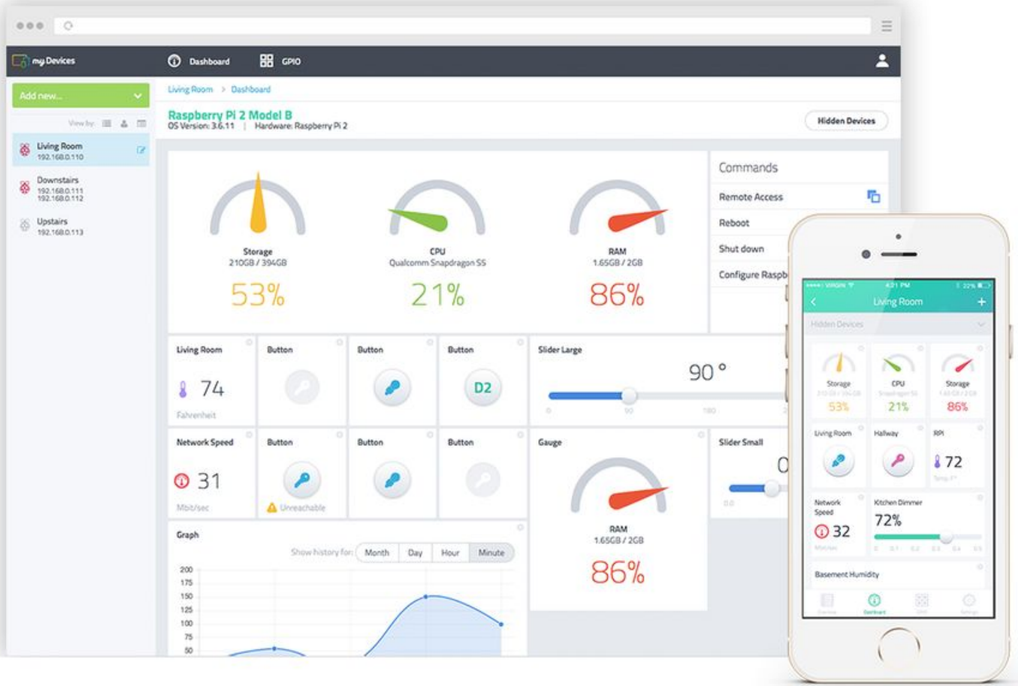
Tópico Mensagem

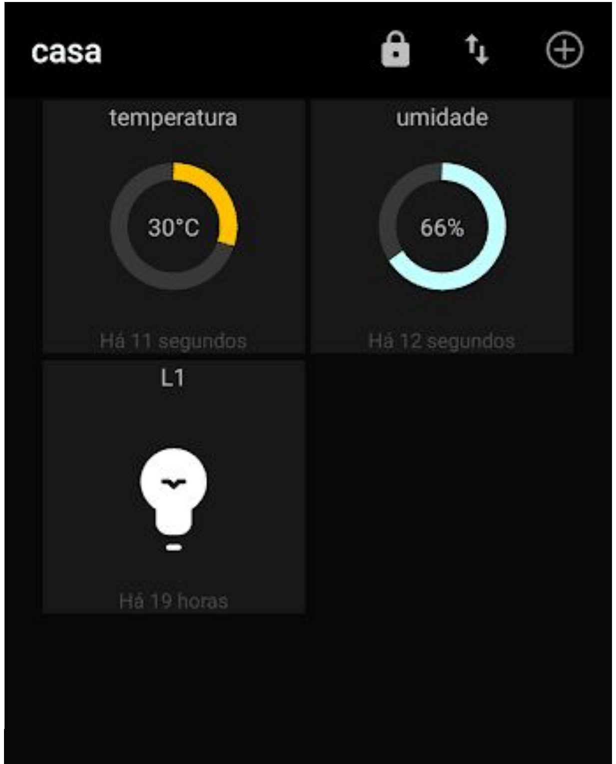


MQTT

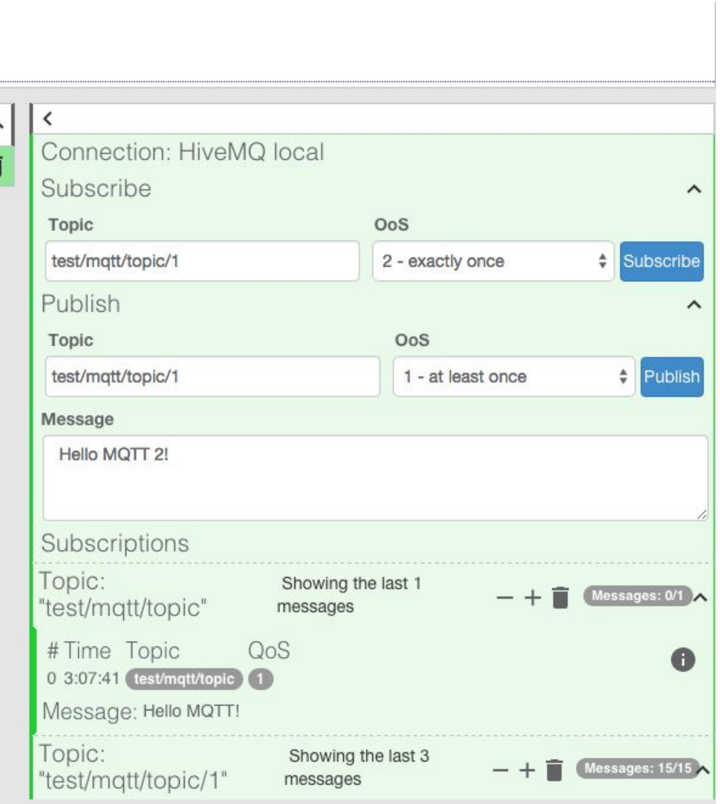

External temperature
Internal Temperature
nodeMCU
MQTT Server
Laptop
External temperature
Internal Temperature
esp32
Mobile Device

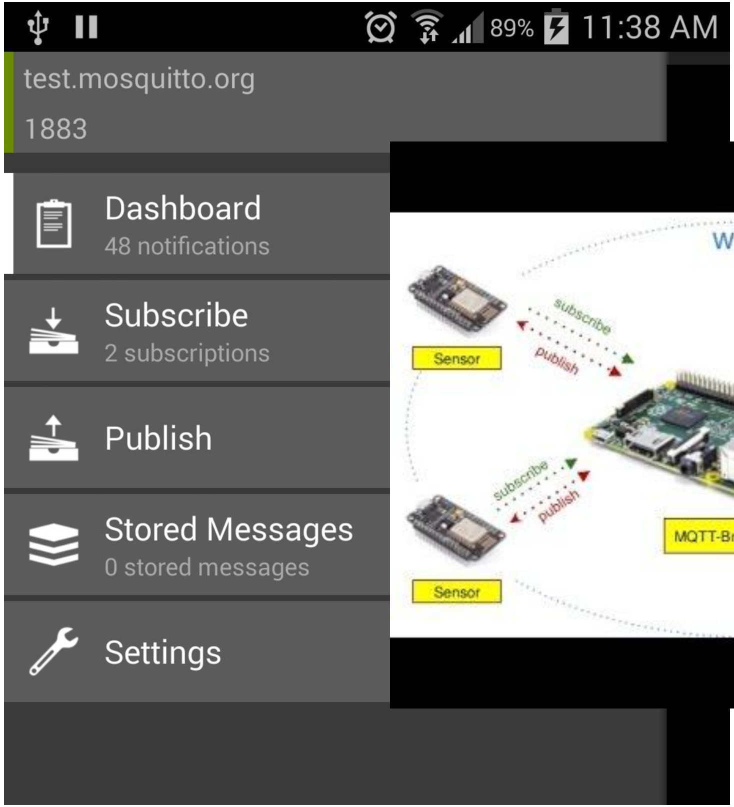
Internet das Coisas e Mqtt

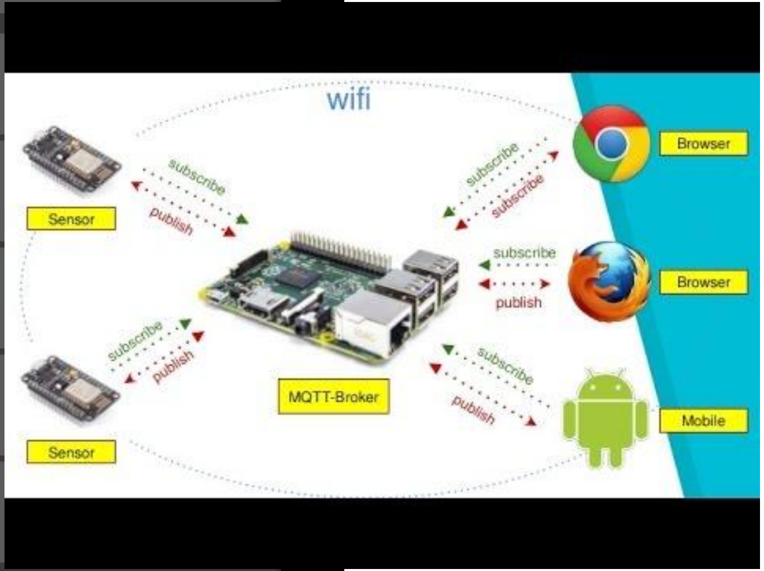




Internet das Coisas e Mqtt







Internet das Coisas e Serviços

Ubidots

Botões,...
Gráficos….
EMAIL !
SMS !

Gratis 1 dispositivo

Exportar dados,...

Simples

Internet das Coisas e Serviços

Ubidots

Botões,...
Gráficos….
EMAIL !
SMS !

Gratis 1 dispositivo

Exportar dados,...

Simples

Internet das Coisas e Serviços (restrições na opção gratuita)

Ubidots - https://ubidots.com/stem/

Thinkspeak - https://thingspeak.com/

Blynk - https://www.blynk.cc/

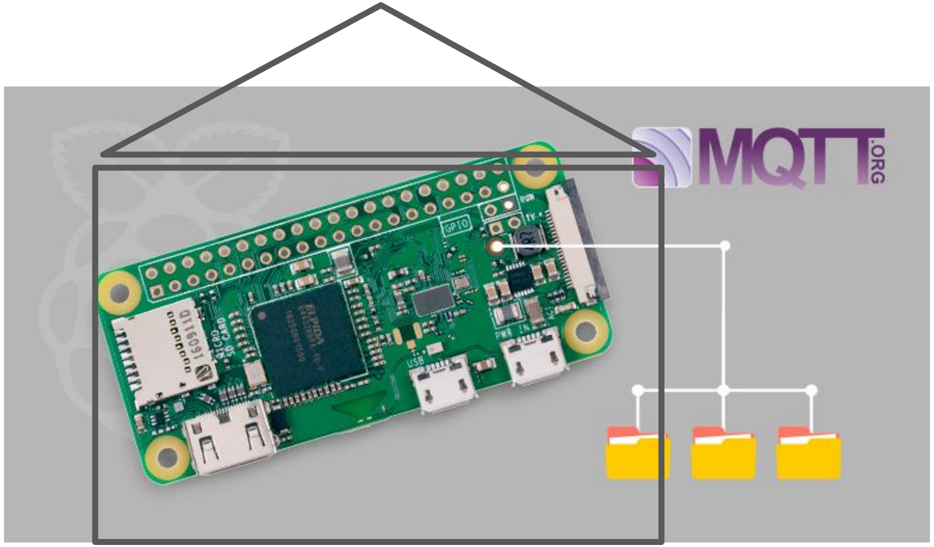
Arest - https://arest.io/home

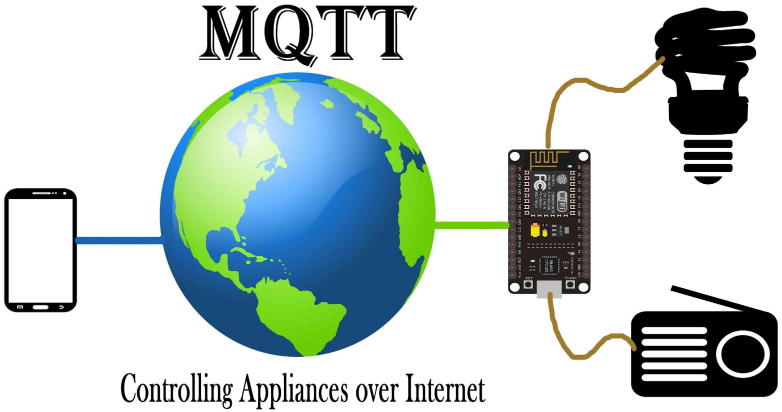
Serviços com conta e restrições de uso, fáceis e possuem muitos exemplos….

Internet das Coisas e seus próprios Serviços

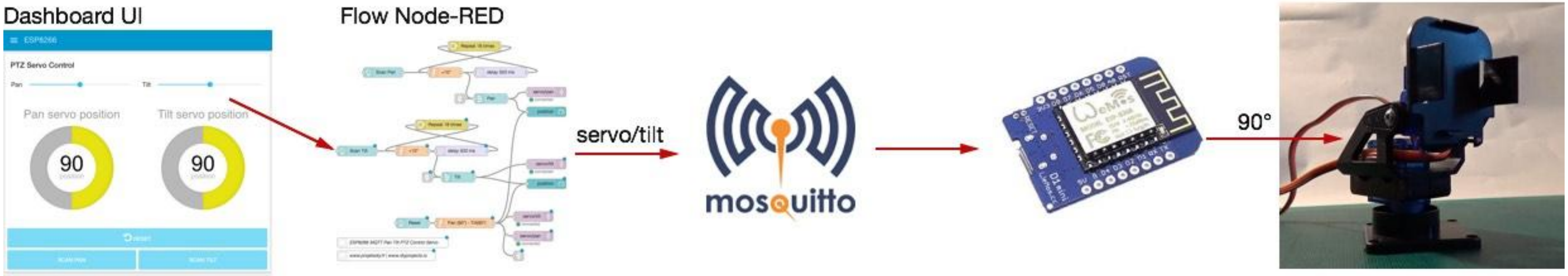
Usar um Computador ou Raspberry para servidor MQTT (PI zero)

Usar um broker público sem limitações com Mqtt, aplicativos de Mqtt no celular





NodeRed IBM ....
muitas opções

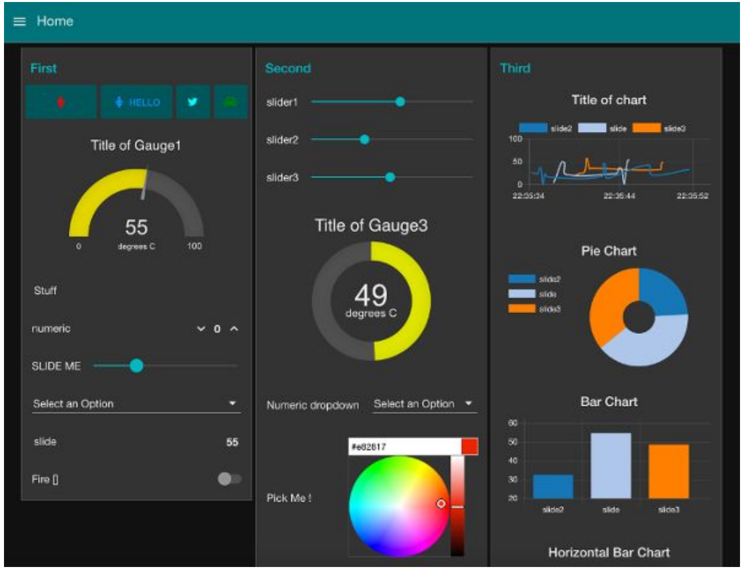


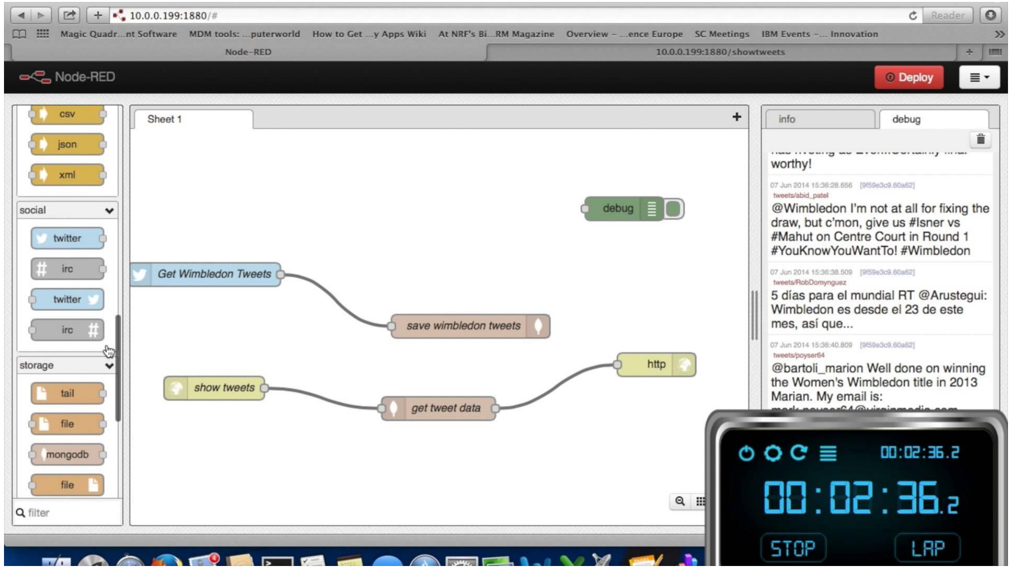
http://www.projetsdiy.fr - http://www.diyprojects.io

NodeRed

Executar em um computador ou um Raspberry

Conectar com Mqtt e vários “arduinos”, Twitter, Email, banco de dados, ...





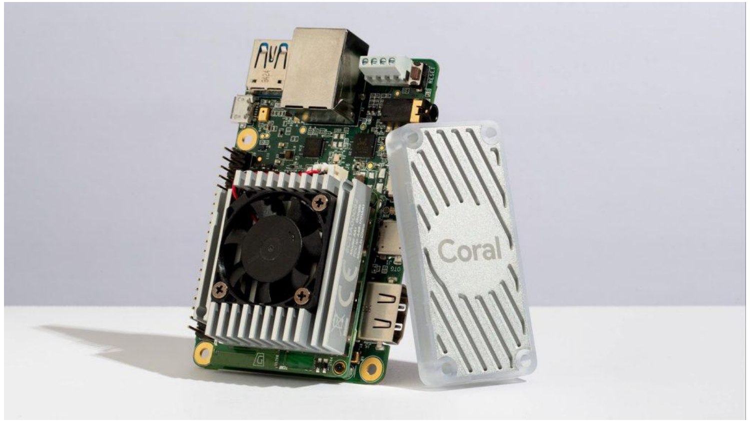
Como usar IA e Internet das Coisas ?

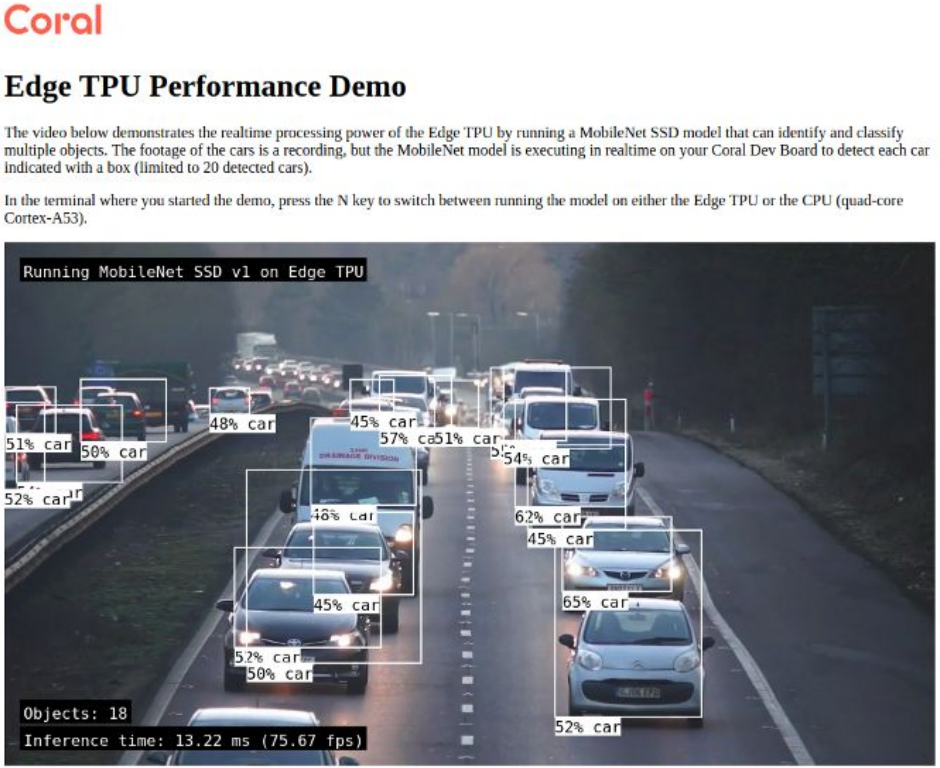
1. Soluções U$ 100 com processamento + consumo

2. Soluções U$ 10-40 com processamento

3. Soluções U$ 1-5 com Coleta e Envio

Soluções U$ 100 com processamento + consumo





Coral Google

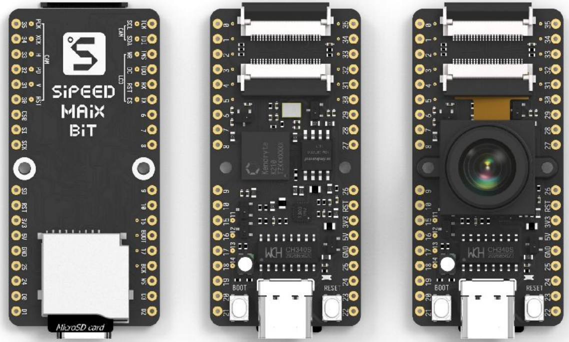
Soluções U$ 100 com processamento + consumo

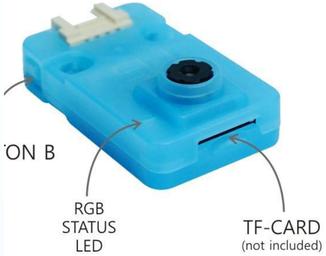
Jetson Nano e
Xavier **Nvidia**

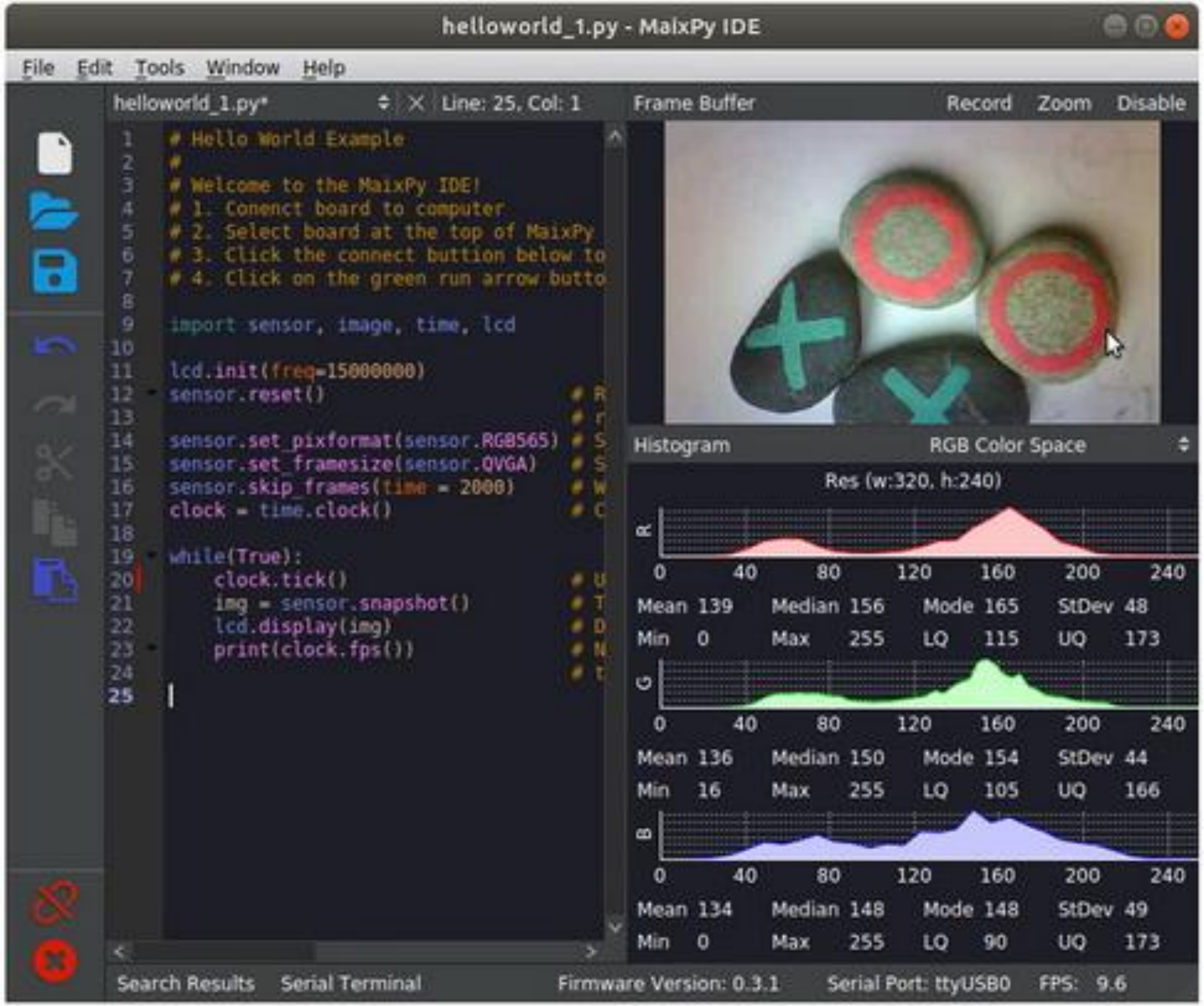
Outros: Intel Open Vino,
Raspberry Pi4, ….

Soluções U$ 10-40 com processamento

Processador K210
Maix Amigo, Maix Bit, M5stickV,
unitV, maix cube, ….






helloworld_1.py - MaixPy IDE
File Edit Tools Window Help
helloworld_1.py* Line: 25, Col: 1
Hello World Example
#
# Welcome to the MaixPy IDE!
# 1. Conenct board to computer
# 2. Select board at the top of MaixPy
# 3. Click the connect buttion below to
# 4. Click on the green run arrow butto
import sensor, image, time, lcd
lcd.init(freq=15000000)
sensor.reset()
sensor.set_pixformat(sensor.RGB565)
sensor.set_framesize(sensor.QVGA)
sensor.skip_frames(time = 2000)
clock = time.clock()
while(True):
clock.tick()
img = sensor.snapshot()
lcd.display(img)
print(clock.fps())
Frame Buffer
Record Zoom Disable
Histogram
RGB Color Space
Res (w:320, h:240)
Mean 139 Median 156 Mode 165 StDev 48
Min 0 Max 255 LQ 115 UQ 173
Mean 136 Median 150 Mode 154 StDev 44
Min 16 Max 255 LQ 105 UQ 166
Mean 134 Median 148 Mode 148 StDev 49
Min 0 Max 255 LQ 90 UQ 173
Search Results Serial Terminal
Firmware Version: 0.3.1
Serial Port: ttyUSB0
FPS: 9.6

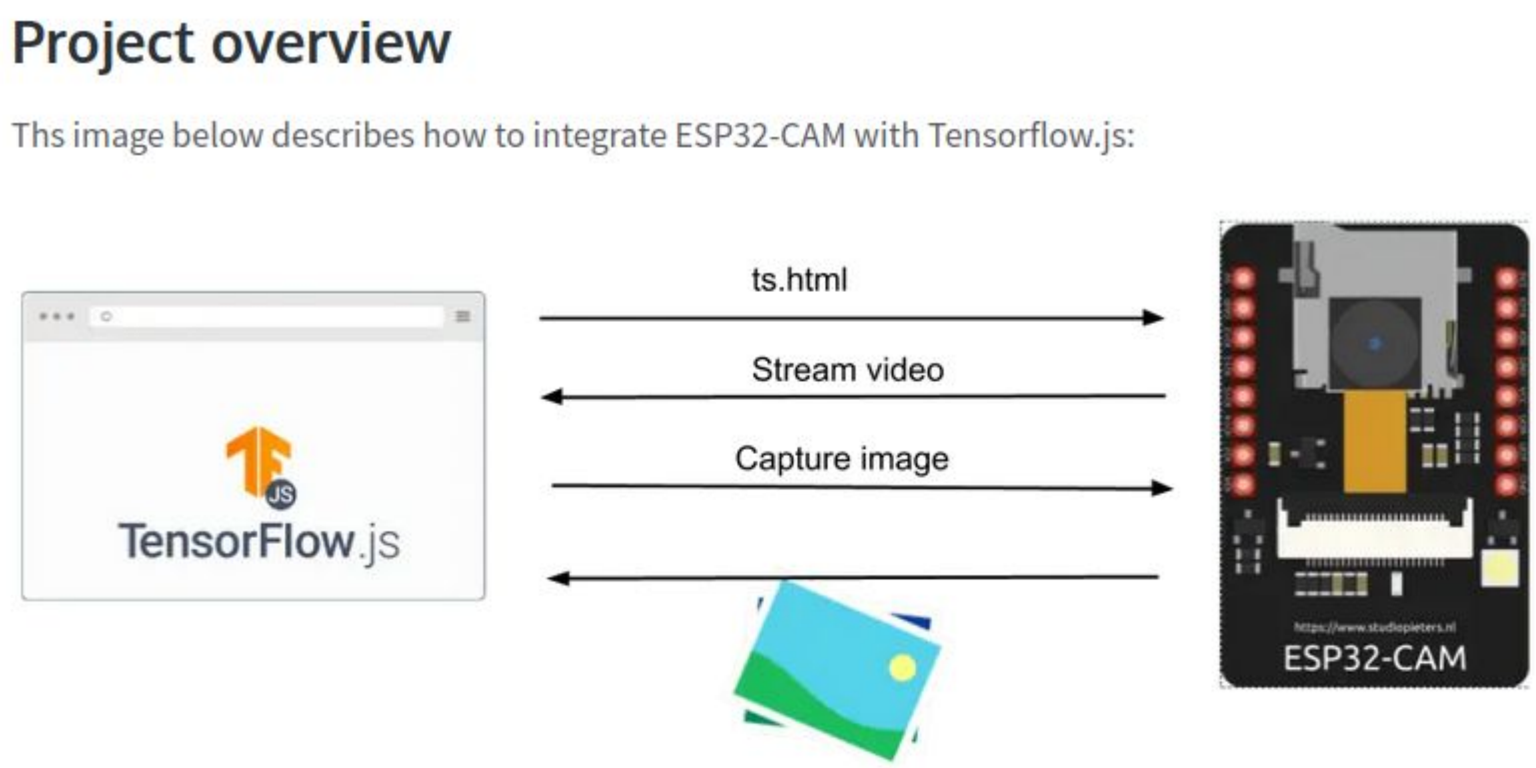
maix ide

```
task = kpu.load(0x300000)

anchor = (1.889, 2.5245, 2.9465, 3.94056, 3.99987, 5.3658, 5.155437,
6.92275, 6.718375, 9.01025)

a = kpu.init_yolo2(task, 0.5, 0.3, 5, anchor)

while(True):
    img = sensor.snapshot()
    code = kpu.run_yolo2(task, img)
    if code:
        for i in code:
            print(i)
            a = img.draw_rectangle(i.rect())
    a = lcd.display(img)
```

Soluções U$ 1-10 com Coleta e Envio

U$ 1-10 - Capture data

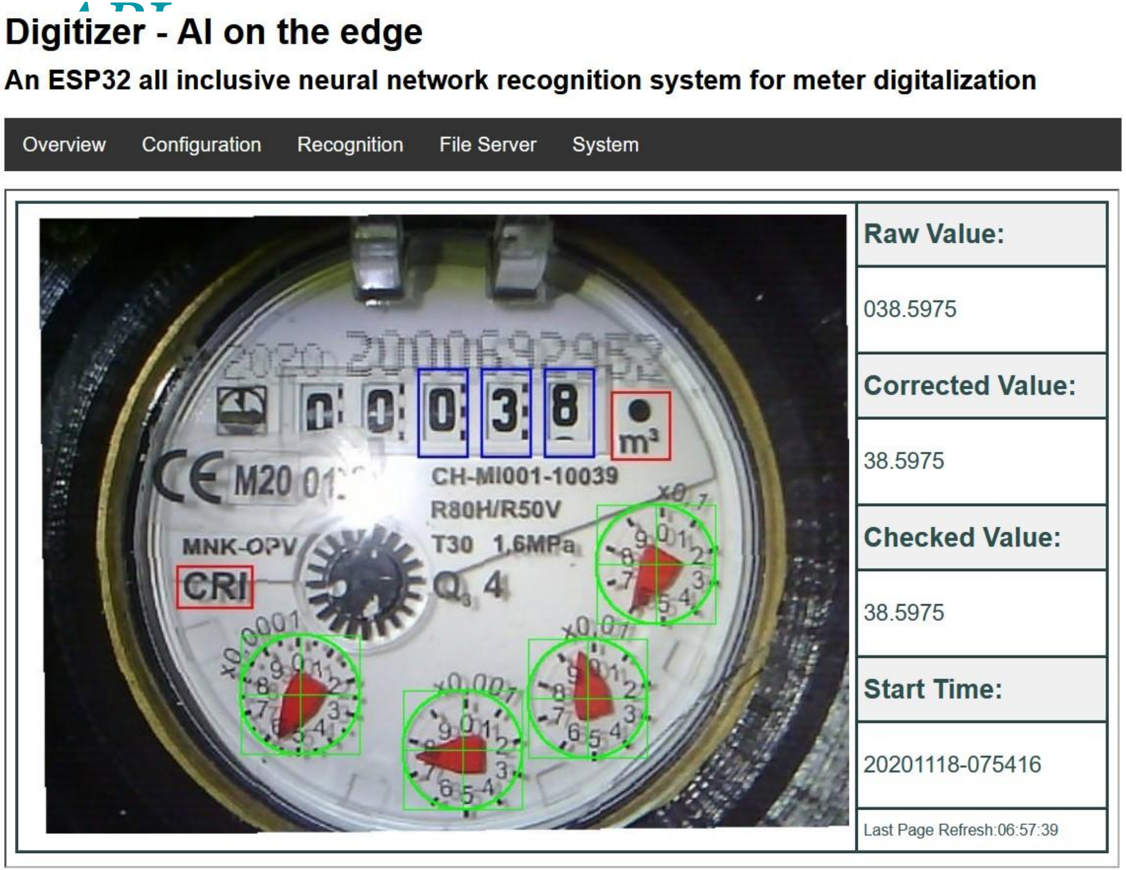
tensorflow.js



U$ 1-10 - Capture data

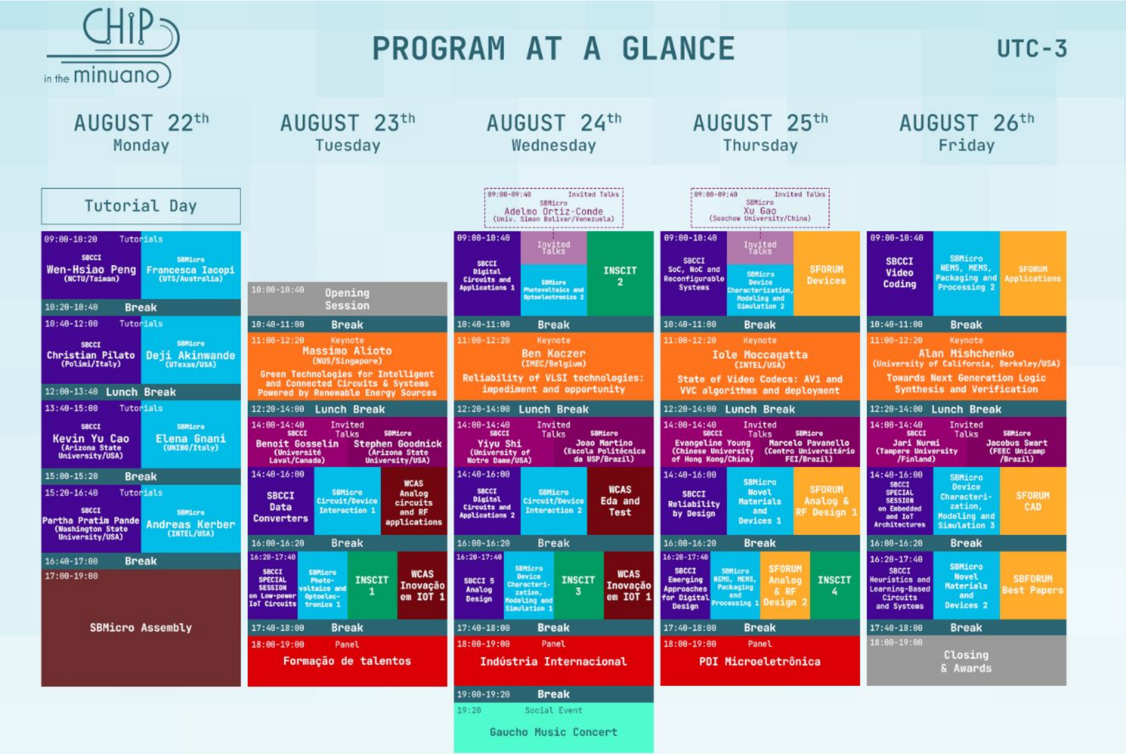
[tensorflow.js]

How screen scraping and TinyML can turn any dial into a



Divulgação

35th Symposium on Integrated Circuits and Systems Design - Associar a SBC (R$26) que é gratuito o evento

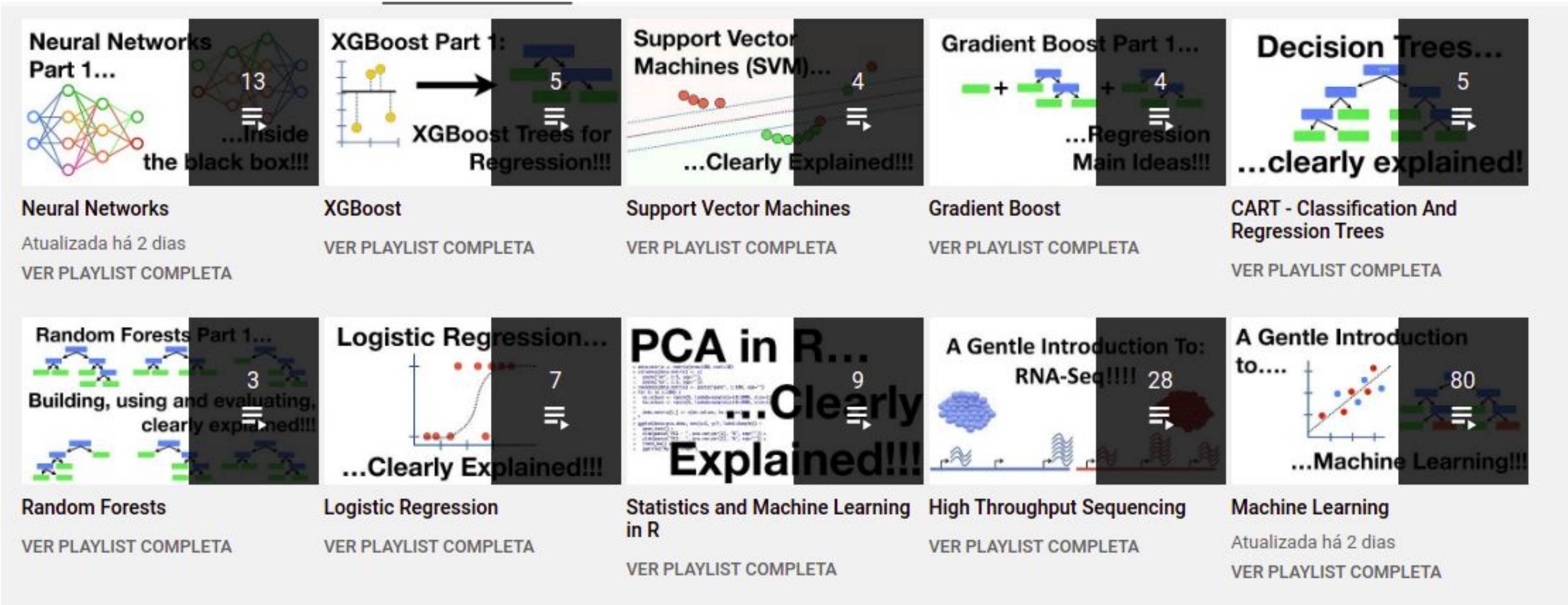


Vários Links

1. Demonstrações de IA
2. Onde aprender Machine Learning & IA
3. Palestra 22 Março 2021, Prof. Wagner Meira, Inteligência Artificial, Estado Atual, Perspectivas e Desafios
4. Palestra Prof Antonio Braga da UFMG sobre redes Neurais
5. Aprendizado de Máquinas e Estatística, a relação íntima entre estas áreas. Prof. Marcos Ribeiro UFV
6. An Overview of Convolutional Neural Network - Prof. Keiller Nogueira, University of Stirling

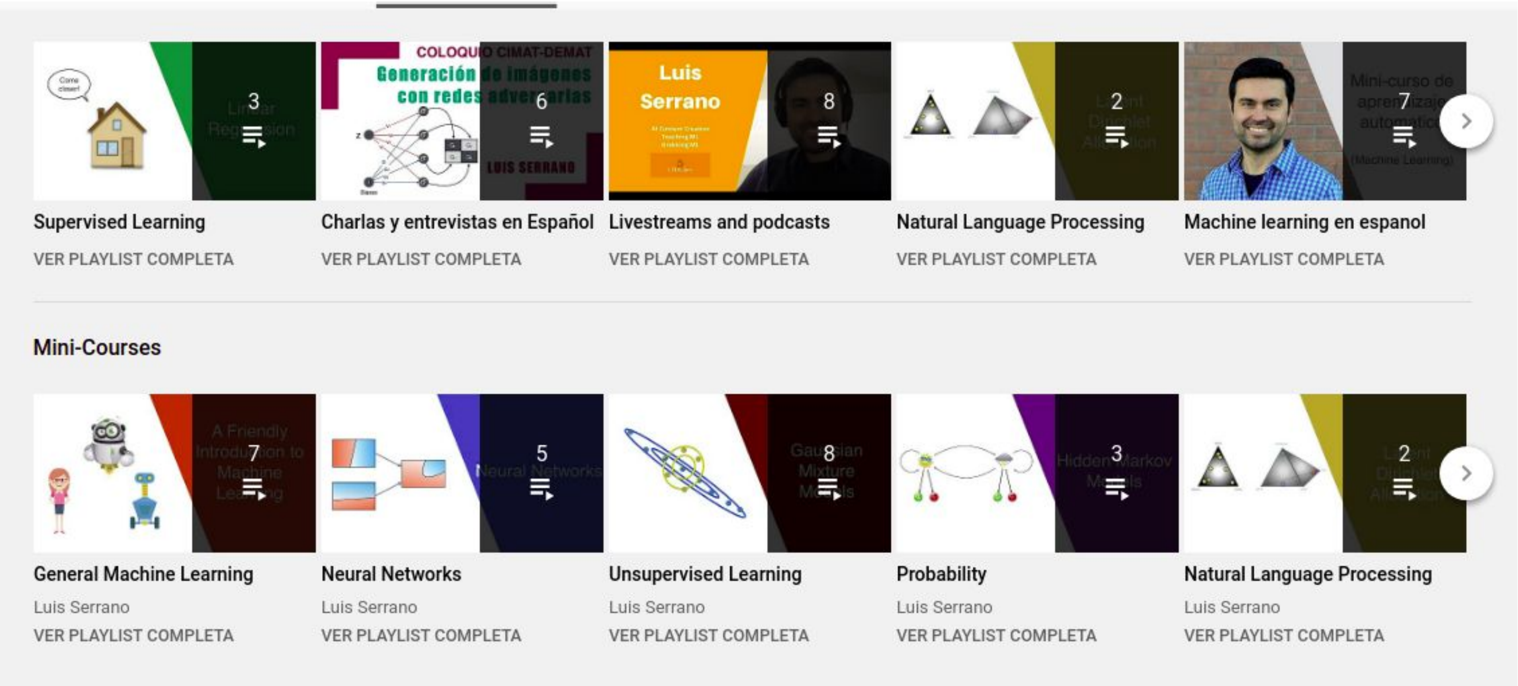
Learn more about….

- [YouTube Statquest Videos]



Learn more about….

- [Luis Serrano]



Courses and Books - Learn more about….

- Stanford Cs231N (Fei Imagenet)
- MIT Introduction Deep Learning
- Stanford 157 (Dive in DL)
- **Books**: Python Data Science Handbook, Machine learning Notebook, Deep Learning with Python, **Deep Learning**, **Dive in DL**, **Data Mining and Machine Learning: Fundamental Concepts and Algorithms** (**youtube**)

Learn more about….

- Machine Learning Foundations is a free training course where you'll learn the fundamentals of building machine learned models using TensorFlow with Laurence Moroney. Google
- Python, NumPy, Pandas, PyTorch, Linear & Logistic regression, Neural networks, Data quality, Utilities, CNNs, Embeddings, RNNs, Attention, Transformers - ML Foundations
- Portuguese - CURSO RÁPIDO DE PYTHON PARA INICIANTES COM GOOGLE COLAB - AULA 1: Como Usar Python ONLINE - Google Colab, Strings, Operadores Matemáticos, Variáveis, Listas e Tuplas, Dicionários, Operadores Lógicos, IF / ELSE / ELIF, FOR, WHILE e Funções

Learn more about….

- How Convolutional Neural Networks Work (CNNs Explained & Visualized)

- Timeline for data science competency depends on the level: Basic, Intermediate, and Advanced

- Machine Learning Algorithms Full Course | Machine Learning Algorithms Explained | Simplilearn - 5 hours - YouTube Video

Learn more about….

- Deep Learning's Most Important Ideas - A Brief Historical Review

- Deep Learning Tutorial Course 3 hours 2018 - Laurence Moroney

- Join 20K+ developers in learning how to responsibly deliver value with applied ML.
- The Roots of Data Science - How it all began.

Online Courses Zero to Mastery Machine Learning Daniel Mrdbourke

- Section 1 - Getting your mind and computer ready for machine learning (concepts, computer setup)
- Section 2 - Tools for machine learning and data science (pandas, NumPy, Matplotlib, Scikit-Learn)
- Section 3 - End-to-end structured data projects (classification and regression)
- Section 4 - Neural networks, deep learning and transfer learning with TensorFlow 2.0
- Section 5 - Communicating and sharing your work

[Learn PyTorch for deep learning in a day. Literally.]

Daniel Mrdbourke

[Learn PyTorch for Deep Learning (work in progress)]

Guidelines

- Machine Learning Engineering in 10 Weeks curriculum v1 Jason Benn
- learn machine learning Jason Benn
- Make your own Machine Learning and Deep Learning degree Aurélien Peden
- Example execution & resources: Self-learning AI in a year - Niklas Muennighoff

Grupo de Robótica da UFV

YouTube do Nero: https://www.youtube.com/c/RoboticaUFV

Repositório do Nero: https://github.com/neroUFV

Colab modelo de Controle para Drone

Trabalhos que realizei no Nero no último mês:

https://youtu.be/GDdqWQX0Hd8

https://youtu.be/KrNmOUjahy8

Questions ?