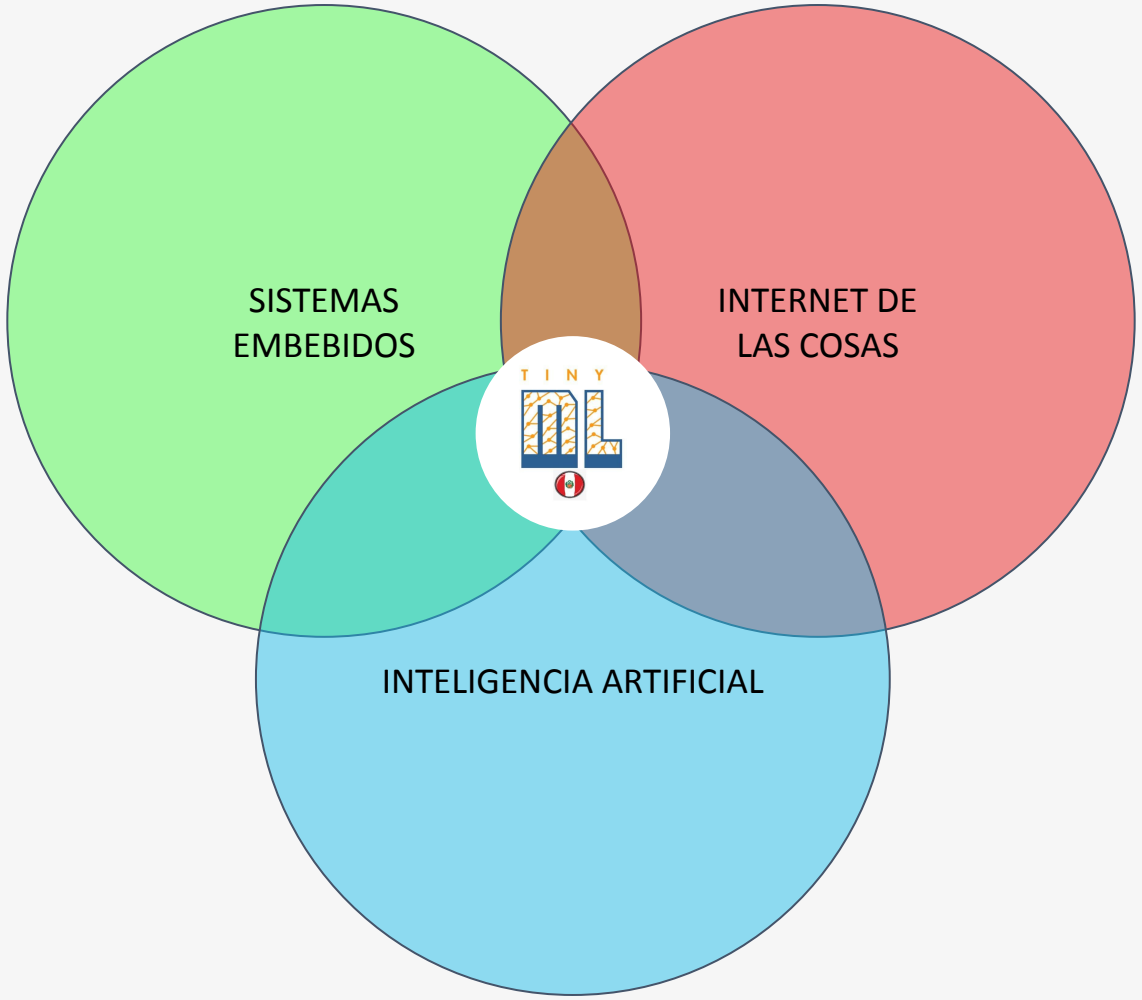
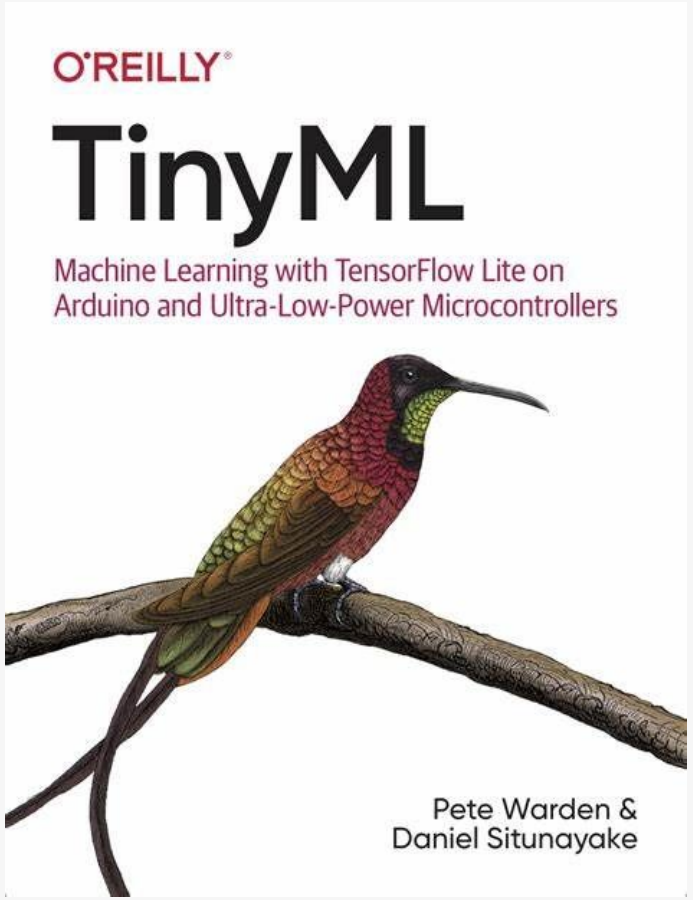
Despliega tu modelo

Mag. Ing. CIP. Moises Meza Rodriguez
Comunidad TinyML Perú

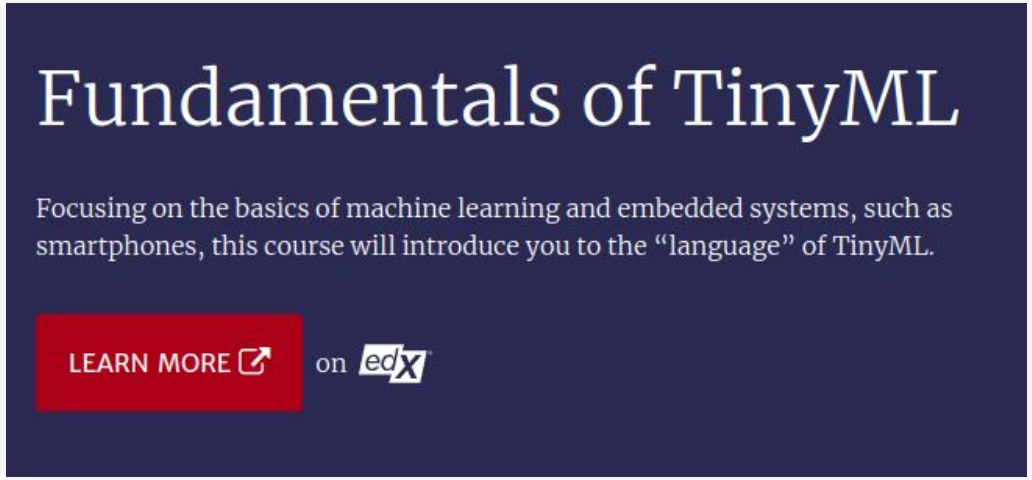

SISTEMAS
EMBEBIDOS
INTERNET DE
LAS COSAS
TINY
INTELIGENCIA ARTIFICIAL

El primer libro de TinyML



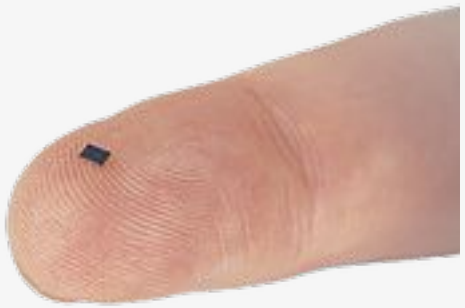
¿Qué es el TinyML?

"TinyML is at the intersection of embedded Machine Learning (ML) applications, algorithms, hardware, and software. TinyML differs from mainstream machine learning (e.g., server and cloud) in that it requires not only software expertise, but also embedded-hardware expertise."

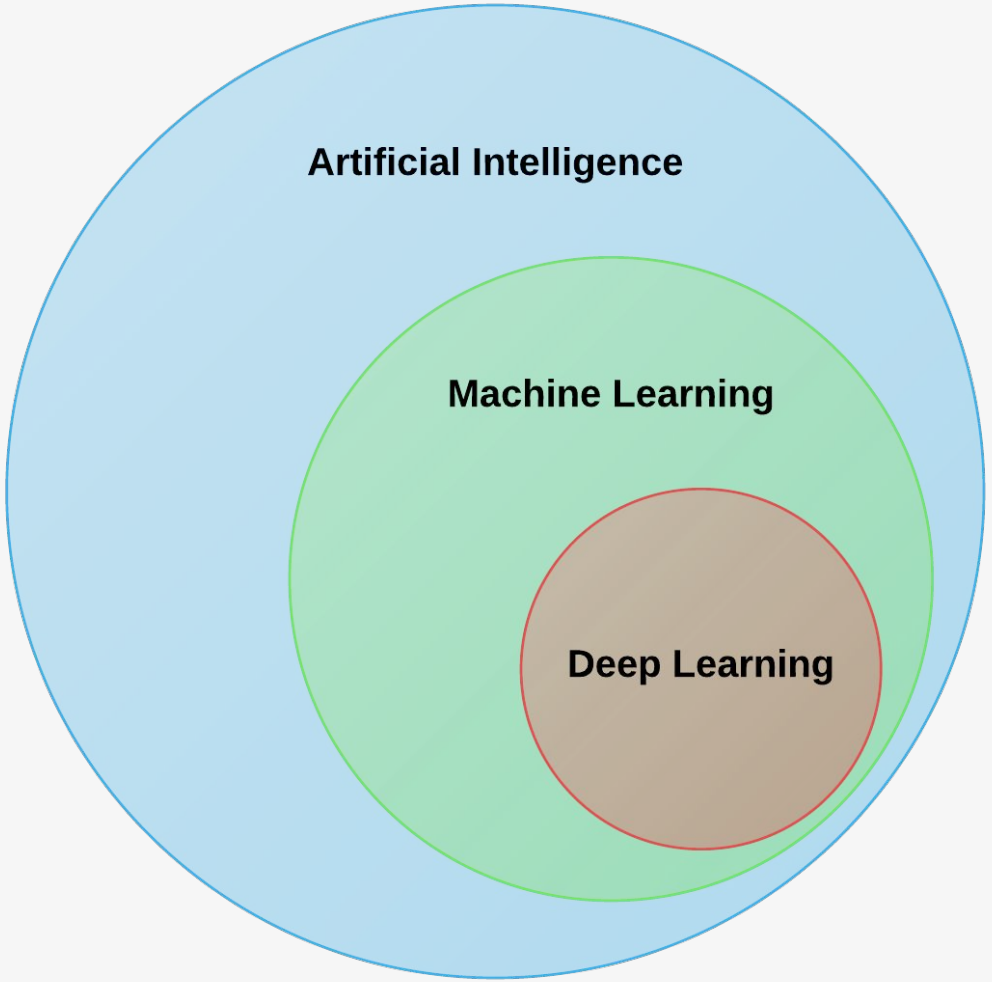


https://pll.harvard.edu/course/fundamentals-tinyml

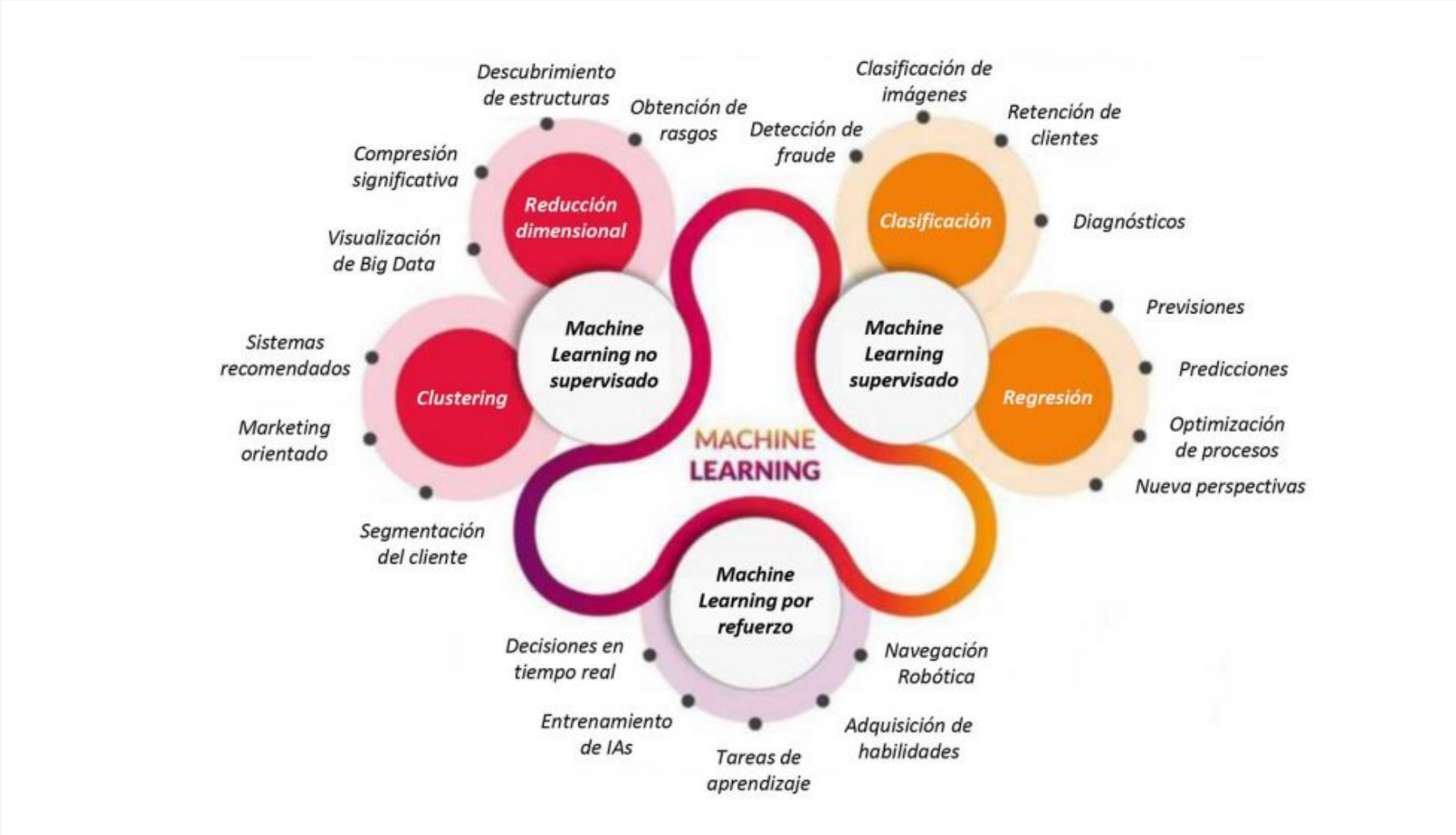
The Future of ML is Tiny and Bright



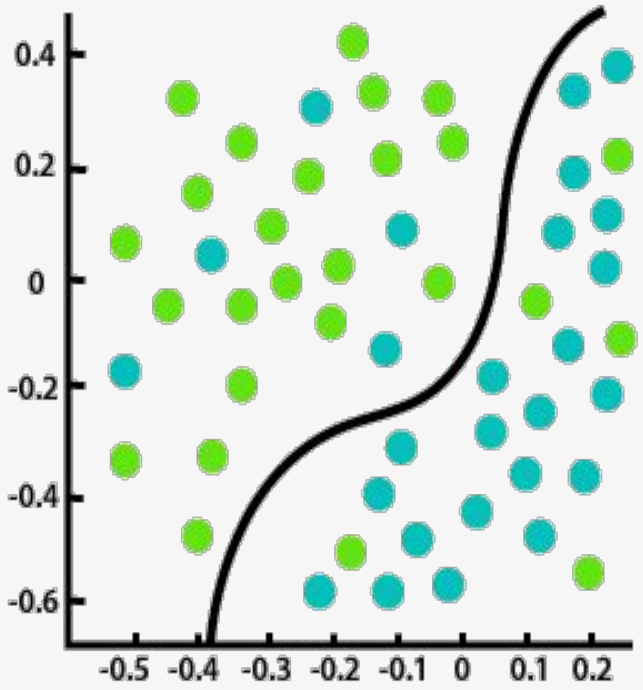
Machine Learning

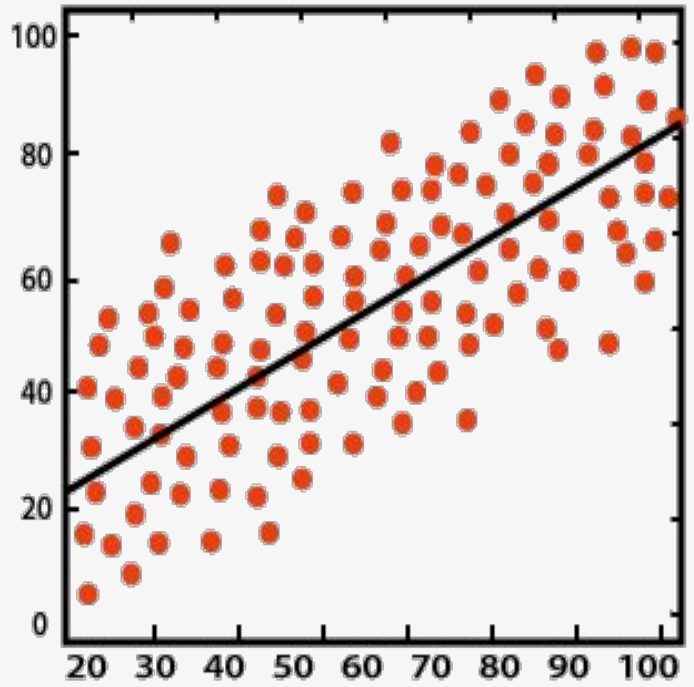


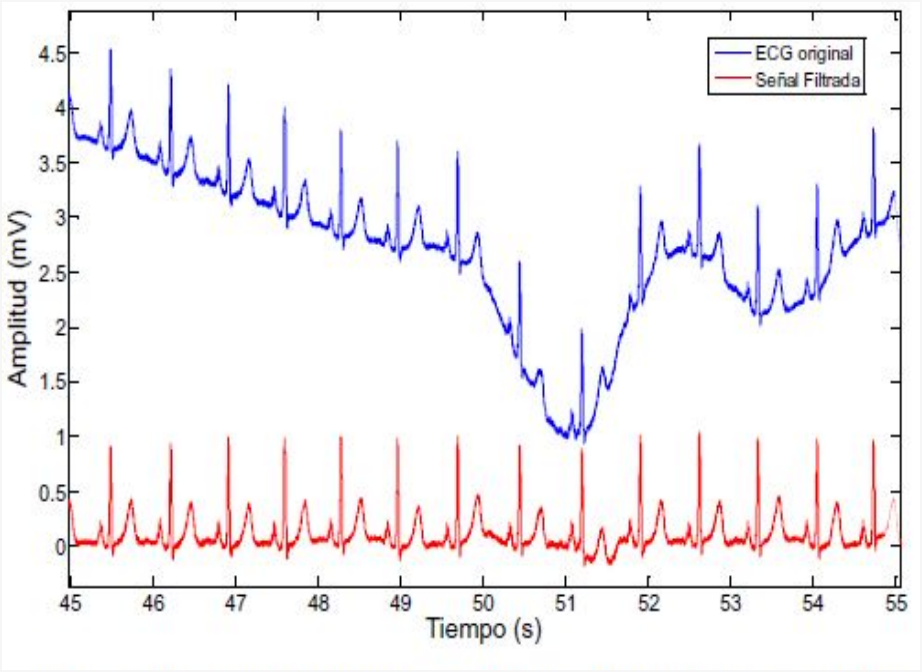
Machine Learning



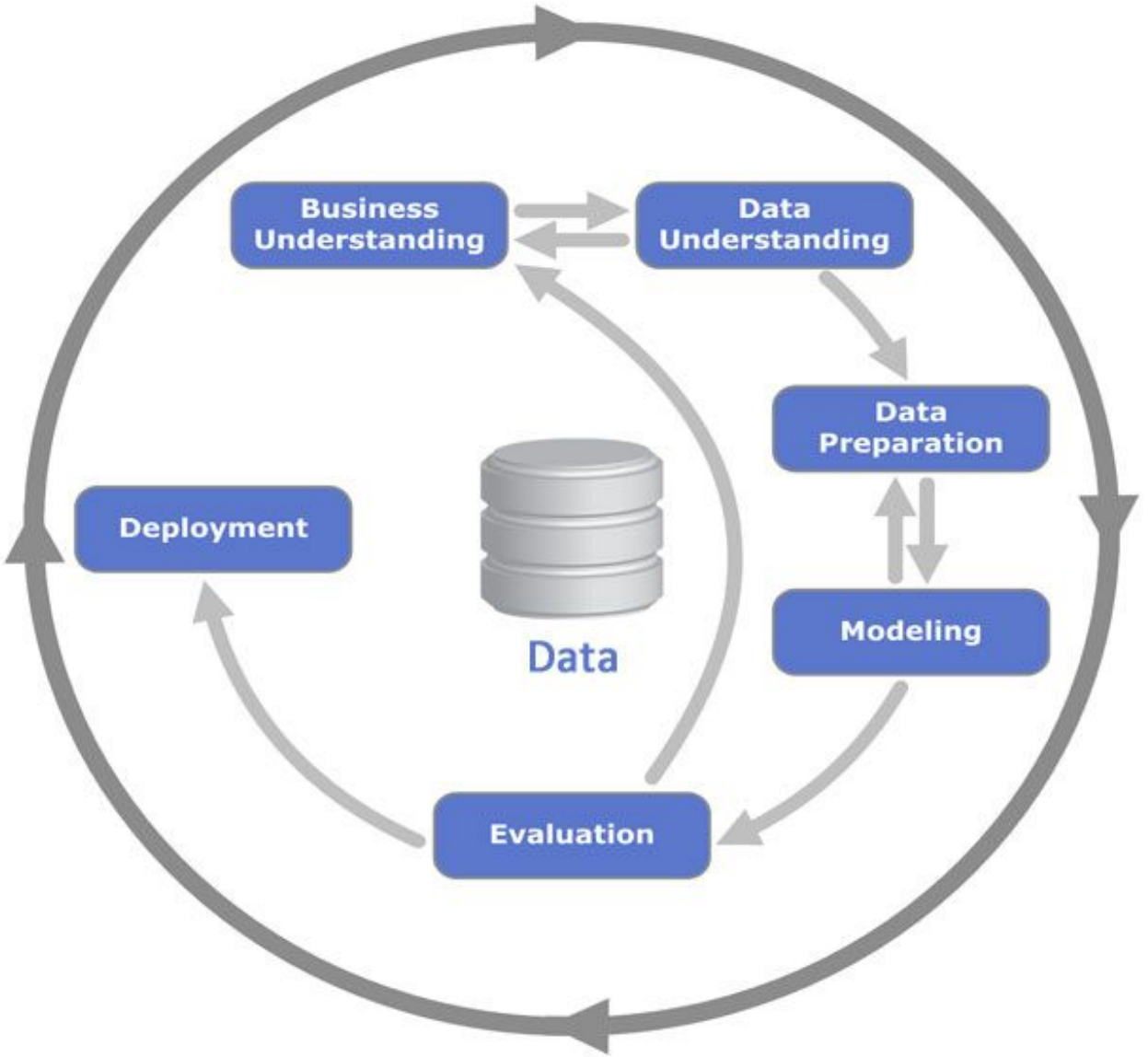
Tareas

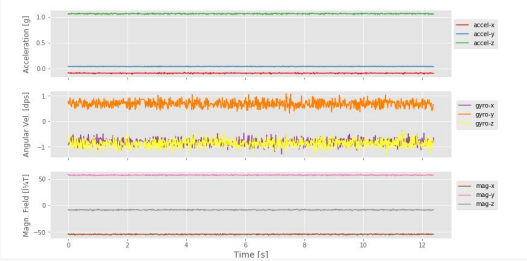

0.4
0.2
0
-0.2
-0.4
-0.6
-0.5 -0.4 -0.3 -0.2 -0.1 0 0.1 0.2

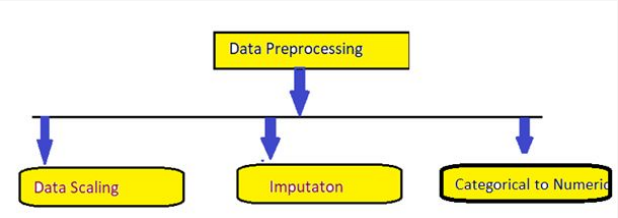

100
80
60
40
20
0
20 30 40 50 60 70 80 90 100


ECG original
Señal Filtrada
Amplitud (mV)
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
45 46 47 48 49 50 51 52 53 54 55
Tiempo (s)

CRISP-DM Process Diagram





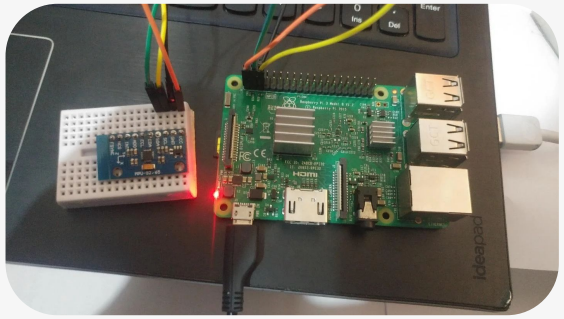


Adquisición de datos de un sensor

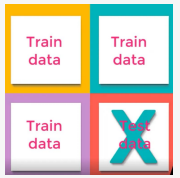
Normalización

Codificación

Dividir el conjunto de datos



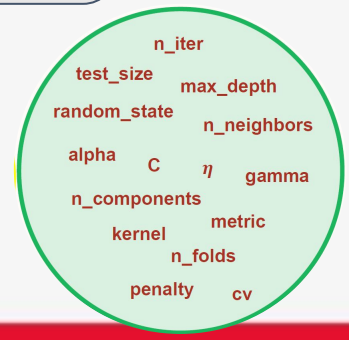
Etapas para el aprendizaje



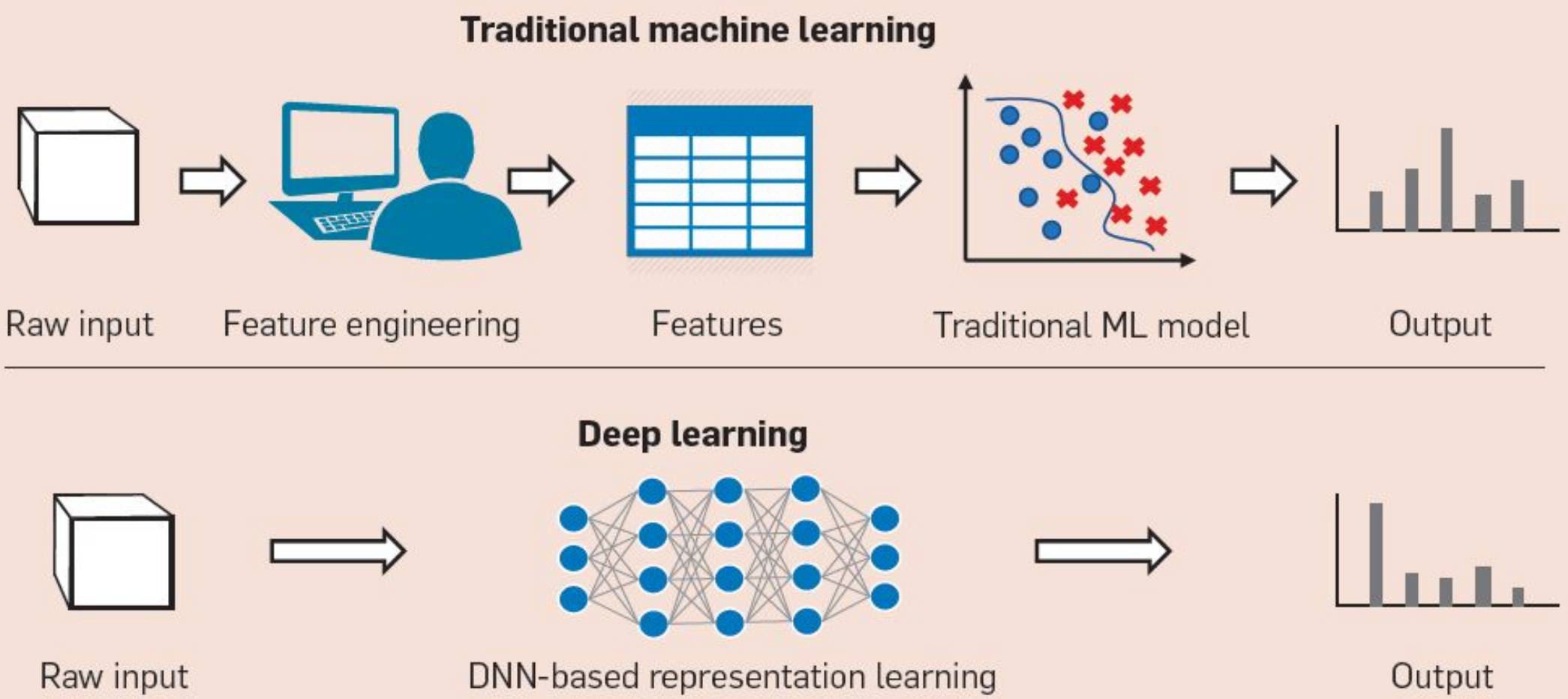
Establecer hiper-parámetros

Etapa de validación

Exportar a un microcontrolador

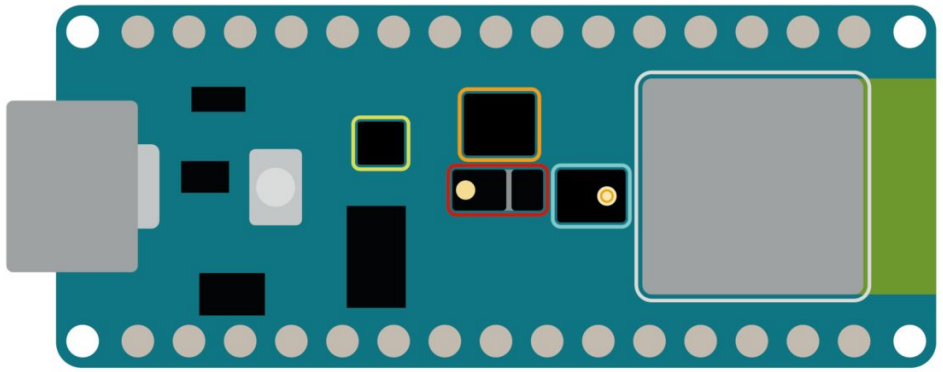


Deep Learning

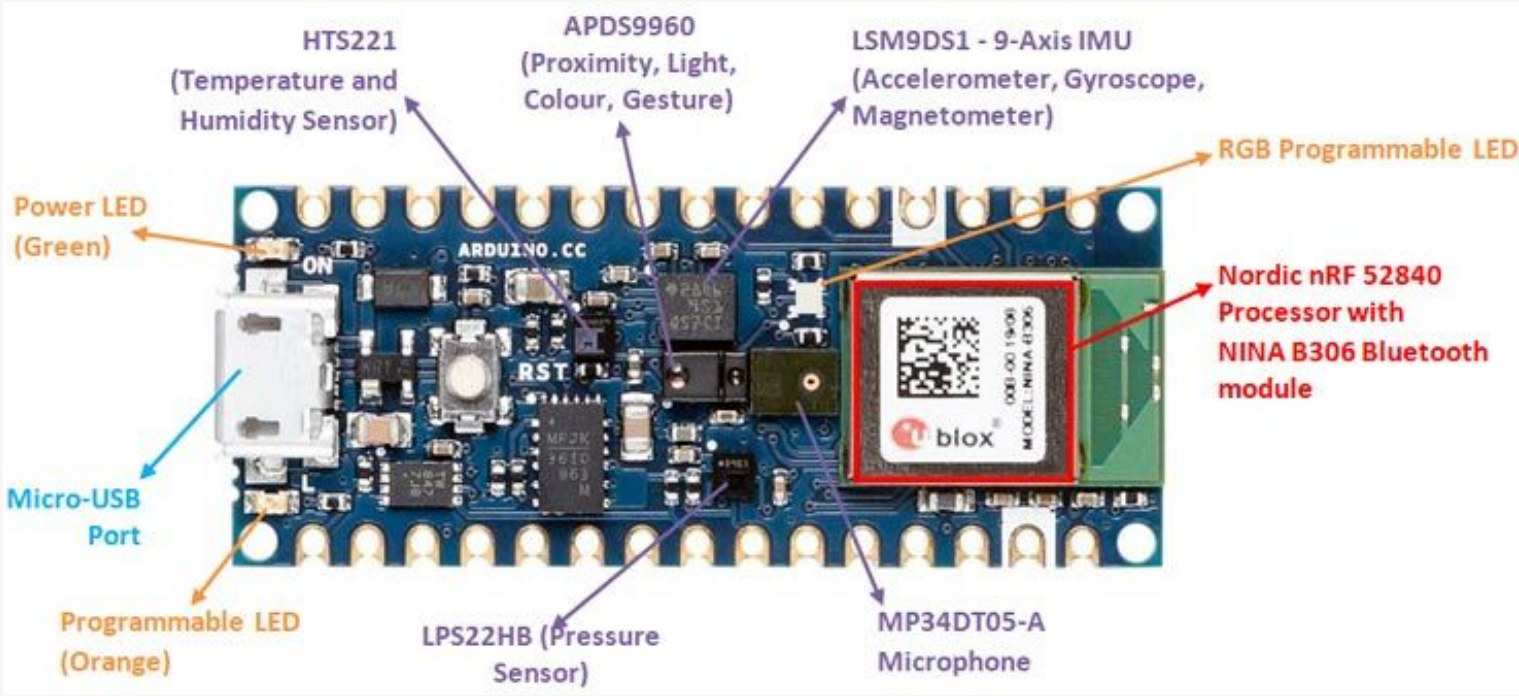


Arduino nano 33 ble

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



Raspberry Pi

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Links útiles

Libro online con ejemplos:

https://mlsysbook.ai/ (libro)

https://github.com/harvard-edge/cs249r_book (github)

Documentación de arduino nano 33 ble sense

https://docs.arduino.cc/hardware/nano-33-ble-sense/#features

Documentación de edge impulse

https://docs.edgeimpulse.com/docs/edge-ai-hardware/mcu/arduino-nano-33-ble-sense

Código en C++ para inferir la clasificación

```
// Run the classifier
ei_impulse_result_t result = { 0 };

err = run_classifier(&signal, &result, debug_nn);
if (err != EI_IMPULSE_OK) {
    ei_printf("ERR:(%d)\r\n", err);
    return;
}
```

```
/*********************************************************************************************/
// This part is the core
    message = "";
    // print the predictions
    ei_printf("Predictions (DSP: %d ms., Classification: %d ms., Anomaly: %d ms.):\r\n",
        result.timing.dsp, result.timing.classification, result.timing.anomaly);
    for (size_t ix = 0; ix < EI_CLASSIFIER_LABEL_COUNT; ix++) {
        ei_printf("%s: %.5f\r\n", result.classification[ix].label, result.classification[ix].value);
        message += String(result.classification[ix].label) + ": " + String(result.classification[ix].value, 5) + "\r\n";
    }
    snprintf (msg, MSG_BUFFER_SIZE, "%s", message.c_str());
    mqttClient.beginMessage(topic);
    //mqttClient.print("hello ");
    mqttClient.print(msg);
    mqttClient.endMessage();
  Serial.print(msg);
/*********************************************************************************************/
```

Link del proyecto a trabajar

https://docs.edgeimpulse.com/experts/audio-projects/snoring-detection-on-smartphone

Gracias

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