

# Extracción de Caracteristicas

# INTEGRACIÓN DE ML EN EMBEBIDOS Y **EDGE COMPUTING**

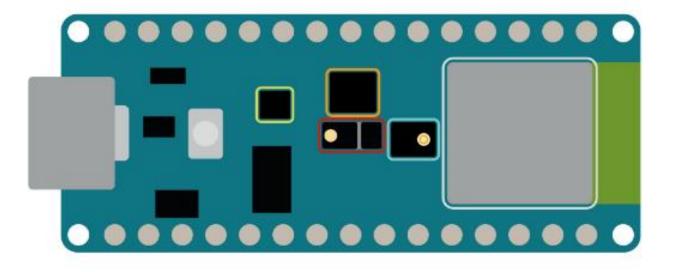






#### **Arduino nano 33 BLE sense**





- 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

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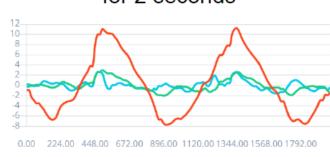
## Contenido

- 1. Acelerómetros
- 2. Audio
- 3. Imágenes



# Medidas por ventana

Sample accelerometer for 2 seconds



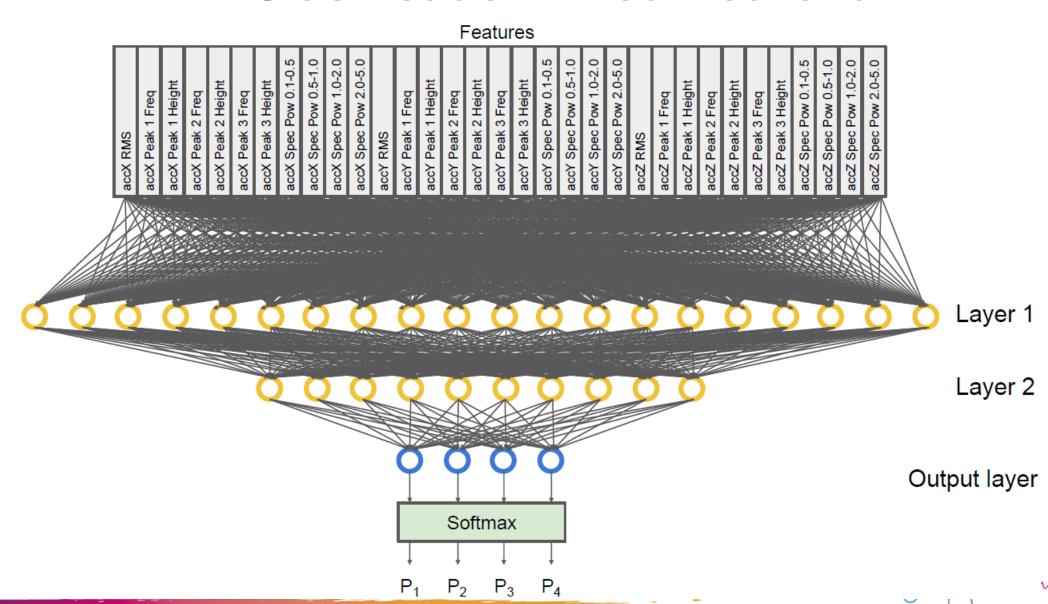
62.5 Hz sampling for 2 seconds with 3 axes = 375 values

Feature extraction:
RMS and Power
Spectral Density
(PSD)

375 raw values



#### Clasificador – Red Neuronal MLP





# Matriz de confusión

#### **Predicted Label**

**Confusion Matrix** 

Actual Label

		Circle	Idle	Left-Right	Up-Down		
_	Circle	205	10	1	46		
ממ   מ	Idle	6	199	0	32		
	Left-Right	9	17	223	34		
(	Up-Down	21	8	3	186		

Per-class accuracy

0.907

0.927

0.936

0.856

F1 scores

0.845

0.815

0.892

0.721

Total accuracy: 0.813

F1 average: 0.818

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ntido Humano

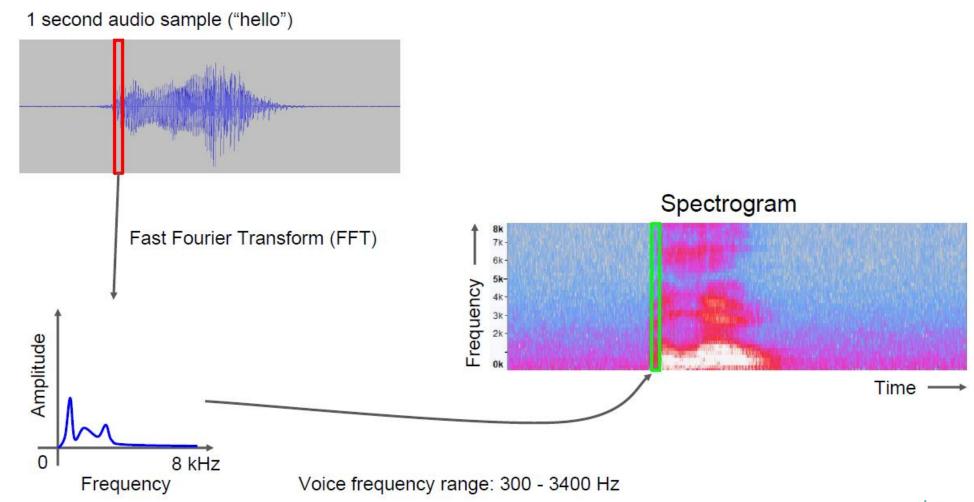


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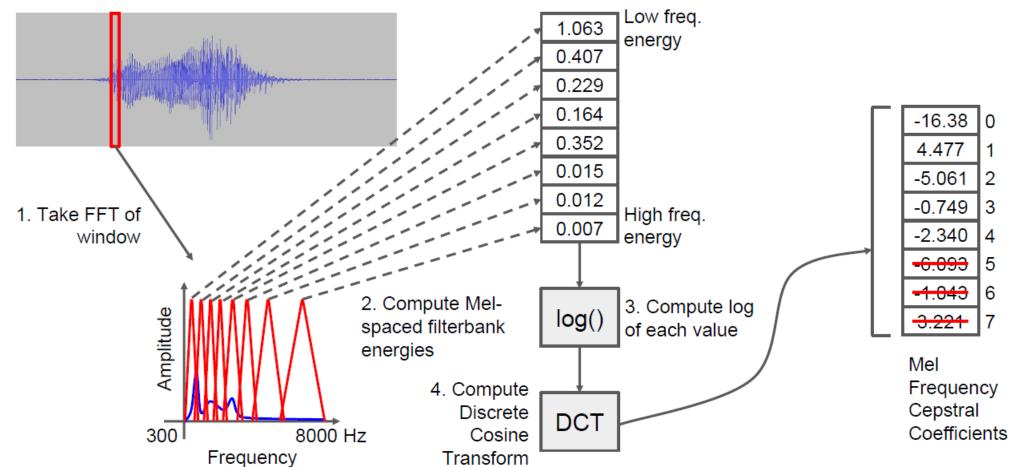


#### Transformada de Fourier





# Coeficiente Ceptrales de Mel



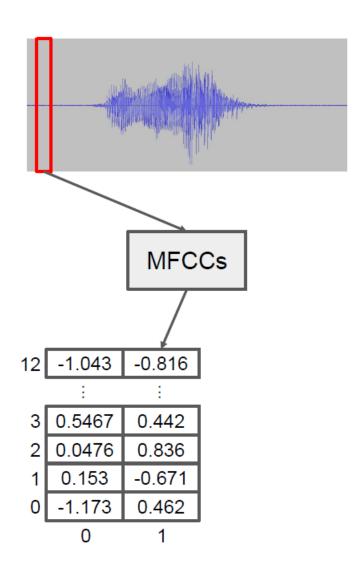
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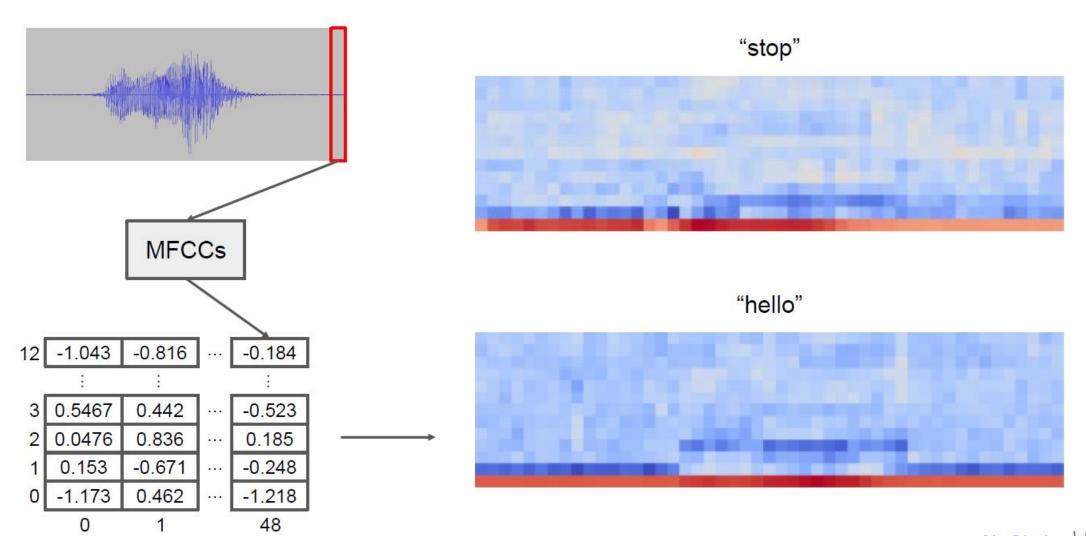


# Analisis por secuencia



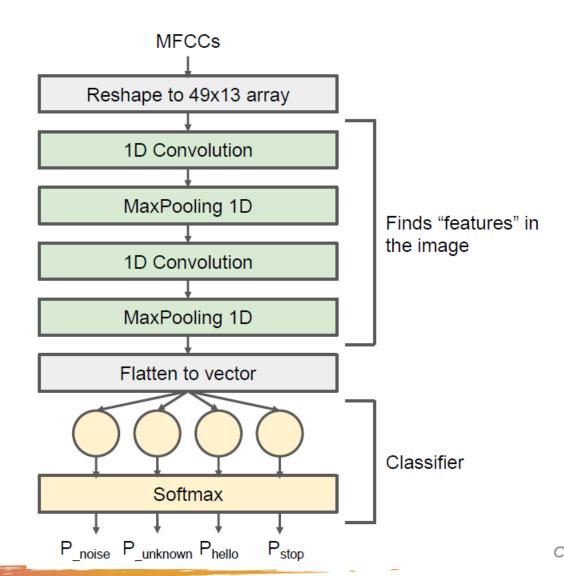


# Analisis por secuencia





## Modelo ML





# Espectrograma como una imagen

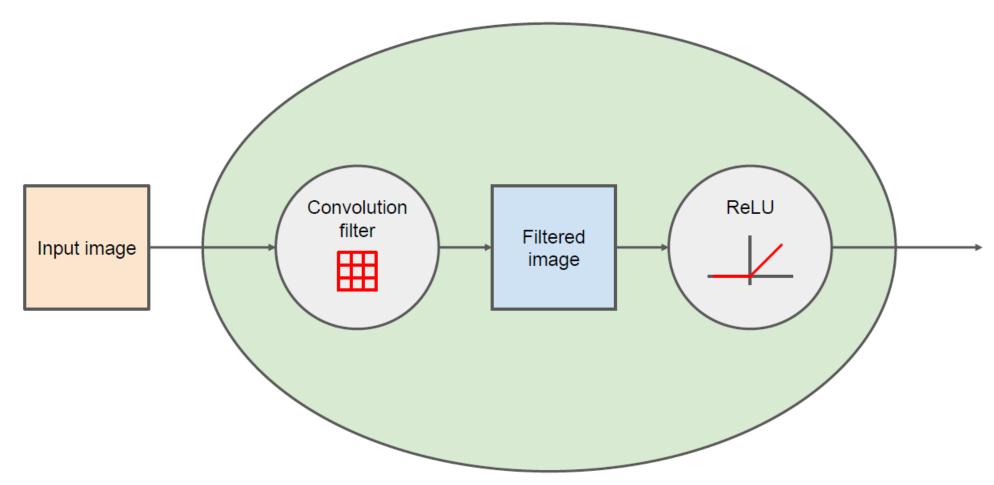
"hello"



	0.32	0.31 * 1.3	0.27 * 0.0	0.38 * -2.5	0.32	0.30	0.27	0.32	0.32	0.35	0.35	0.36	0.36	0.35	0.33	0.30	0.29
ı	0.23	0.38 * 0.0	0.30 * -0.23	0.38 * -1.1	0.32	0.95	0.97	0.92	0.32	0.95	0.35	0.33	0.36	0.95	0.33	0.30	0.29
	0.36	0.41 * 0.0	0.22 * 4.7	0.41 * -0.8	0.34	0.36	0.37	0.32	0.32	0.35	0.35	0.35	0.36	0.35	0.33	0.30	0.29
ı	0.21	0.25	0.22	0.35	0.32	0.35	0.37	0.37	0.38	0.38	0.35	0.35	0.36	0.35	0.33	0.31	0.30
ı	0.20	0.19	0.32	0.29	0.29	0.32	0.36	0.38	0.41	0.41	0.36	0.35	0.36	0.34	0.33	0.38	0.35
ı	0.32	0.19	0.18	0.20	0.22	0.30	0.35	0.36	0.38	0.40	0.34	0.35	0.35	0.34	0.35	0.35	0.35
ı	0.20	0.19	0.18	0.19	0.20	0.23	0.32	0.33	0.35	0.38	0.34	0.35	0.35	0.34	0.34	0.35	0.35
	0.18	0.19	0.20	0.18	0.19	0.25	0.32	<del>0.93</del>	0.35	0.37	0.34	0.35	0.35	0.34	0.34	0.35	0.35
	0.20	0.22	0.15	0.19	0.21	0.23	0.35	0.36	0.36	0.37	0.33	0.33	0.34	0.34	0.34	0.35	<del>0.35</del>
	0.18	0.18	0.19	0.20	0.22	0.35	0.40	0.36	0.40	0.38	0.33	0.33	0.34	0.34	0.34	0.34	0.35
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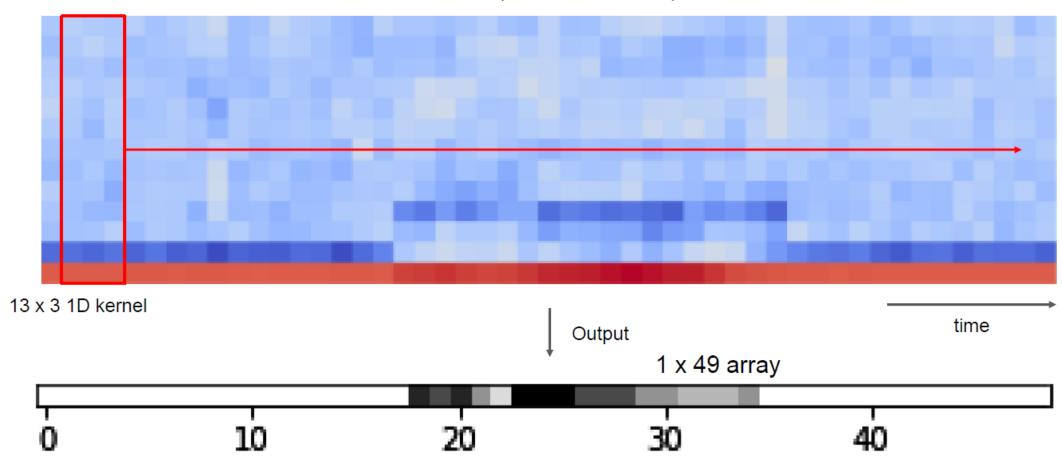


Single node in convolution layer



# Single CNN

"Hello" (13 x 49 MFCCs)



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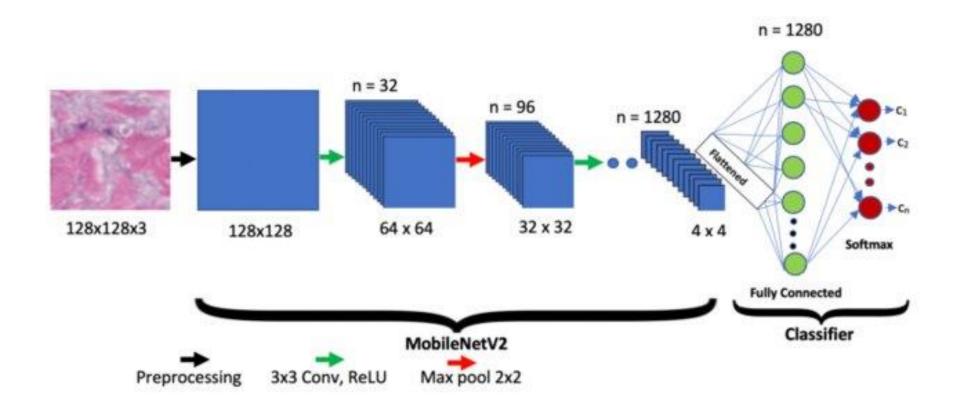


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## **Mobile Net V2**



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# 1 Gracias!



