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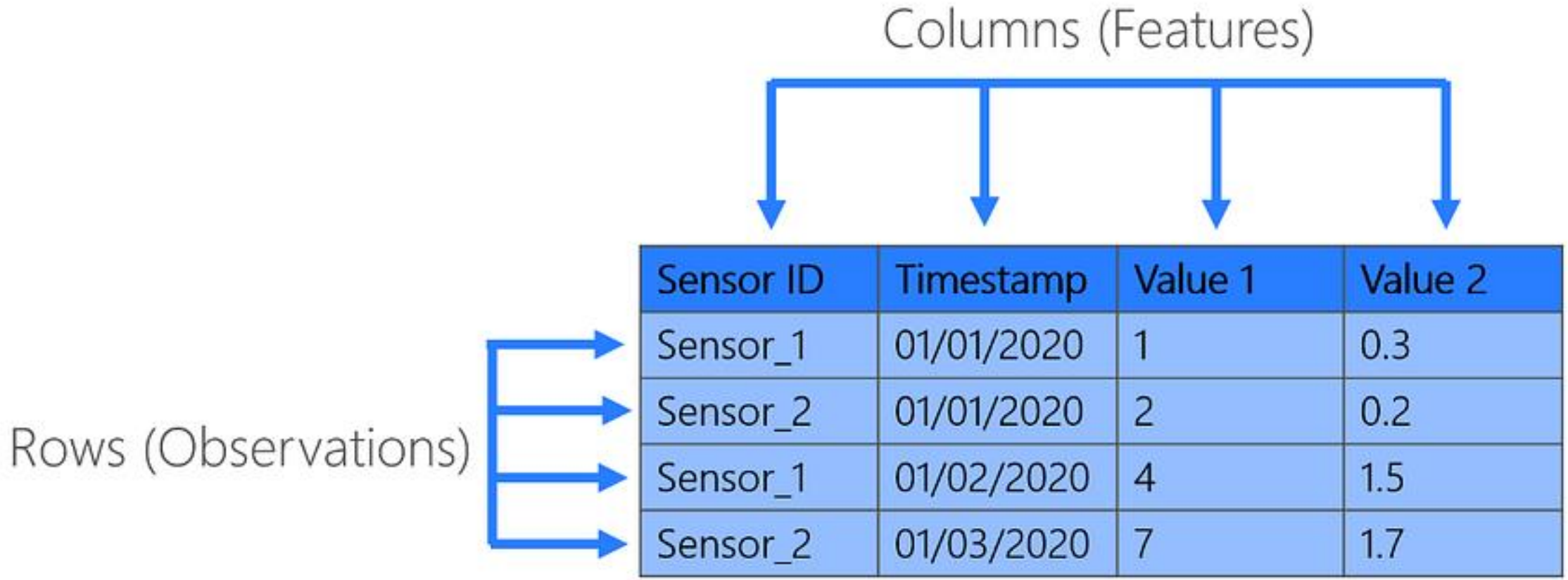
Feature Extraction

Ingeniería en Electronica

Somos Innovación Tecnológica con Sentido Humano

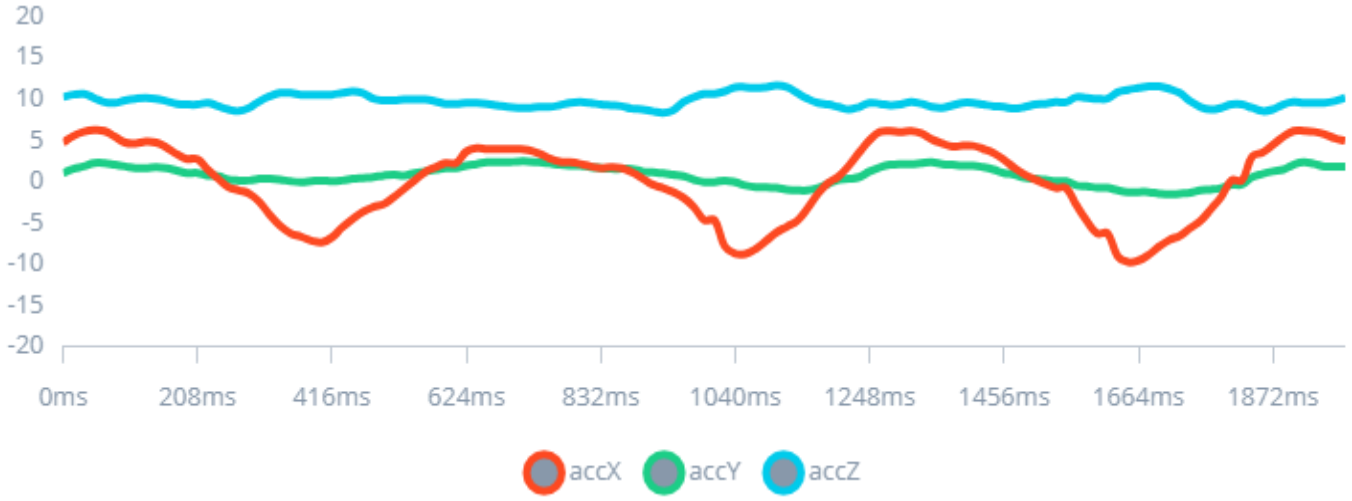
Alcaldía de Medellín

Features Table

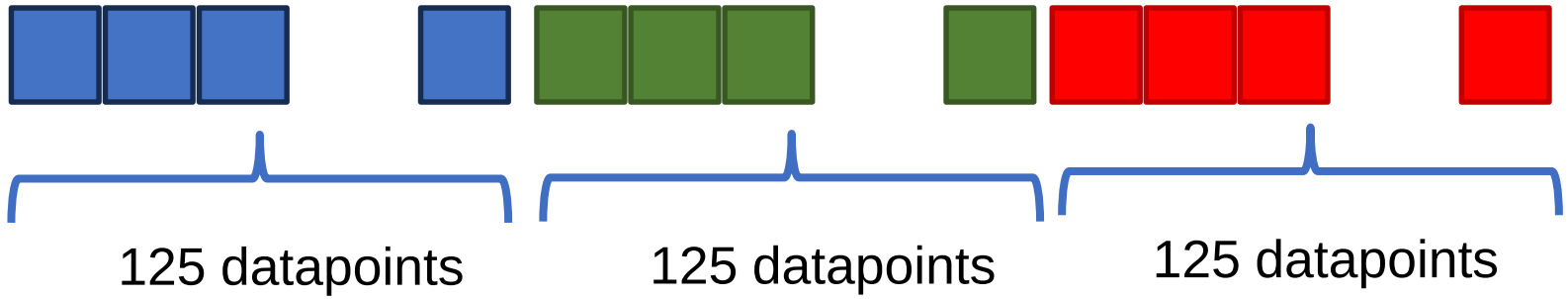


Sensor ID	Timestamp	Value 1	Value 2
Sensor_1	01/01/2020	1	0.3
Sensor_2	01/01/2020	2	0.2
Sensor_1	01/02/2020	4	1.5
Sensor_2	01/03/2020	7	1.7

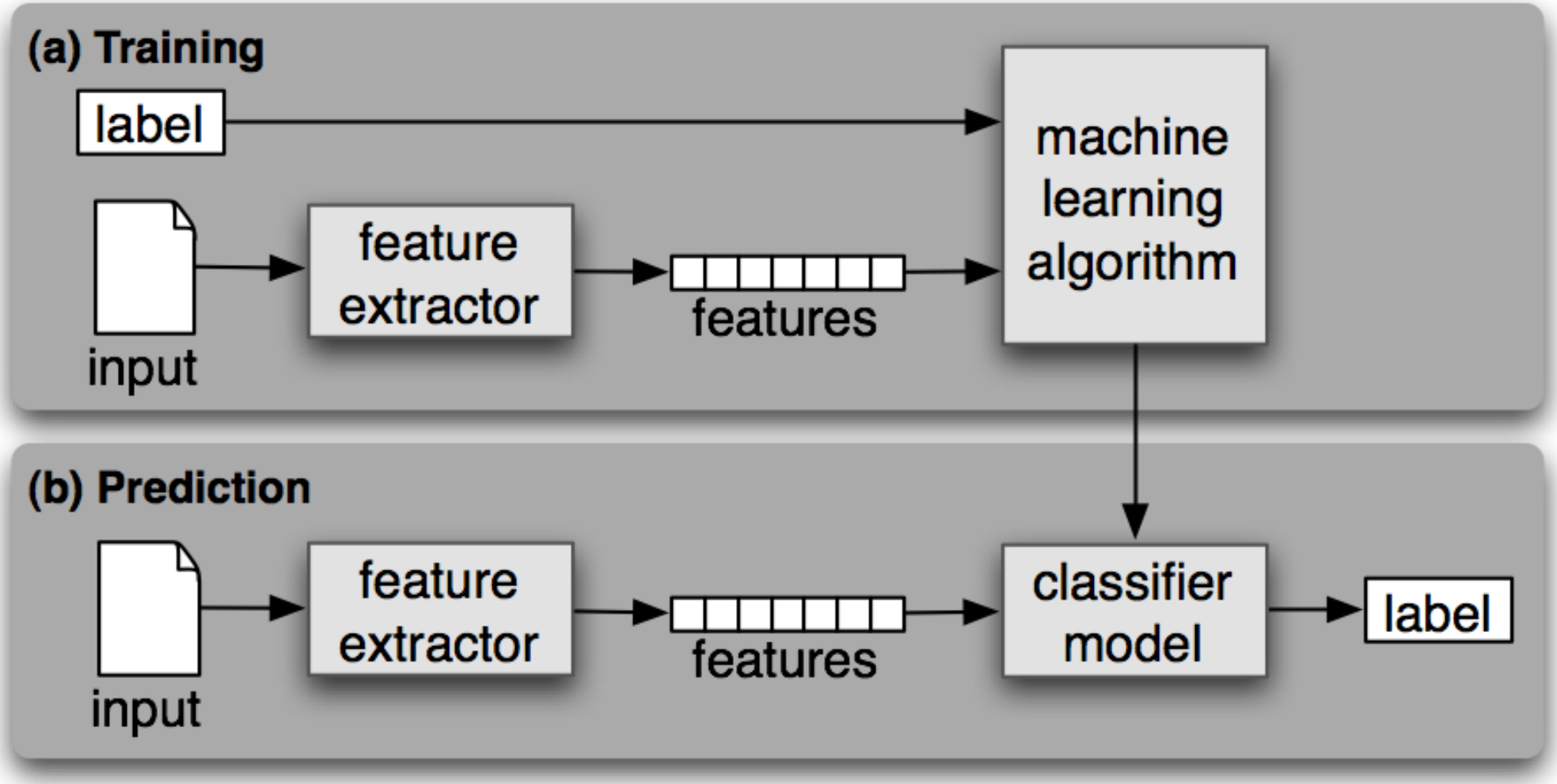
Accelerometer Signal



2s at 62.5Hz => 125 datapoints



Feature Extraction - Idea



Introduction

Extracting features from a dataset captured with accelerometers involves processing and analyzing the raw data. Accelerometers measure the acceleration of an object along one or more axes (typically three, denoted as X, Y, and Z). These measurements can be used to understand various aspects of the object's motion, such as movement patterns and vibrations.

Feature: Individual measurable property or characteristic of a phenomenon being observed.

https://studio.edgeimpulse.com/public/124439/latest

Data Collection

we need to gather data from the accelerometers. Depending on the application, data may be collected at different sampling rates. It's essential to ensure that the sampling rate is high enough to capture the relevant dynamics of the studied motion (The sampling rate should be at least double the maximum relevant frequency present in the signal).

Data preprocessing

Raw accelerometer data can be noisy and contain errors or irrelevant information. Preprocessing steps, such as filtering and normalization, can help clean and standardize the data, making it more suitable for feature extraction. The Studio does not perform standardization, so sometimes, when working with Sensor Fusion, it could be necessary to perform this step before uploading data to the Studio. See the excellent Shawn Hymel's tutorial Data Curation and Feature Scaling with Edge Impulse to learn more about it.

Segmentation

Depending on the nature of the data and the application, dividing the data into smaller segments or **windows** may be necessary. This can help focus on specific events or activities within the dataset, making feature extraction more manageable and meaningful. The **window size** and overlap (**window increase**) choice depend on the application and the frequency of the events of interest. As a thumb rule, we should try to capture a couple of "cycles of data".

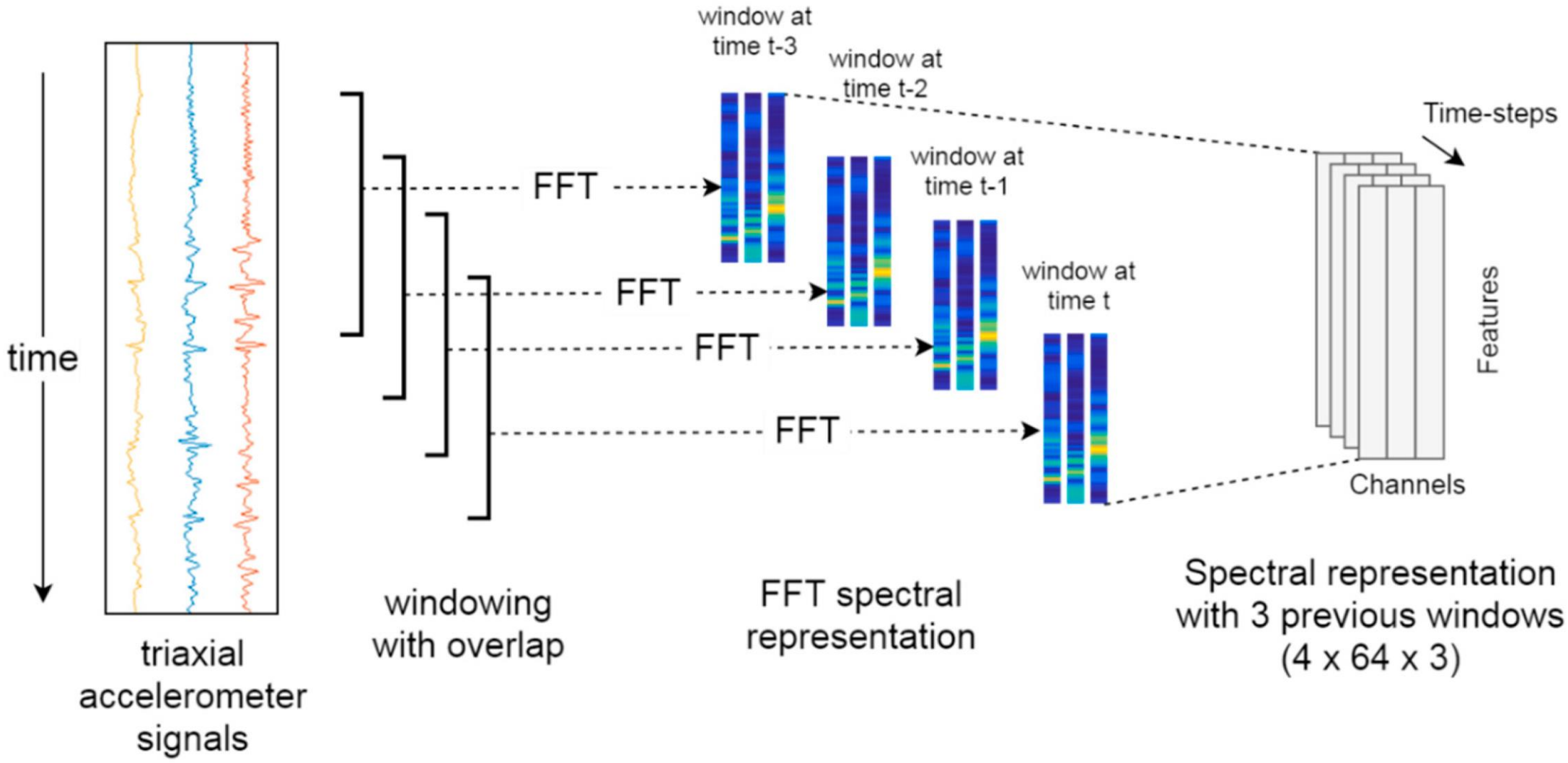
Feature Extraction

Time-domain features describe the data's statistical properties within each segment, such as mean, median, standard deviation, skewness, kurtosis, and zero-crossing rate.

Frequency-domain features are obtained by transforming the data into the frequency domain using techniques like the Fast Fourier Transform (FFT). Some typical frequency-domain features include the power spectrum, spectral energy, dominant frequencies (amplitude and frequency), and spectral entropy.

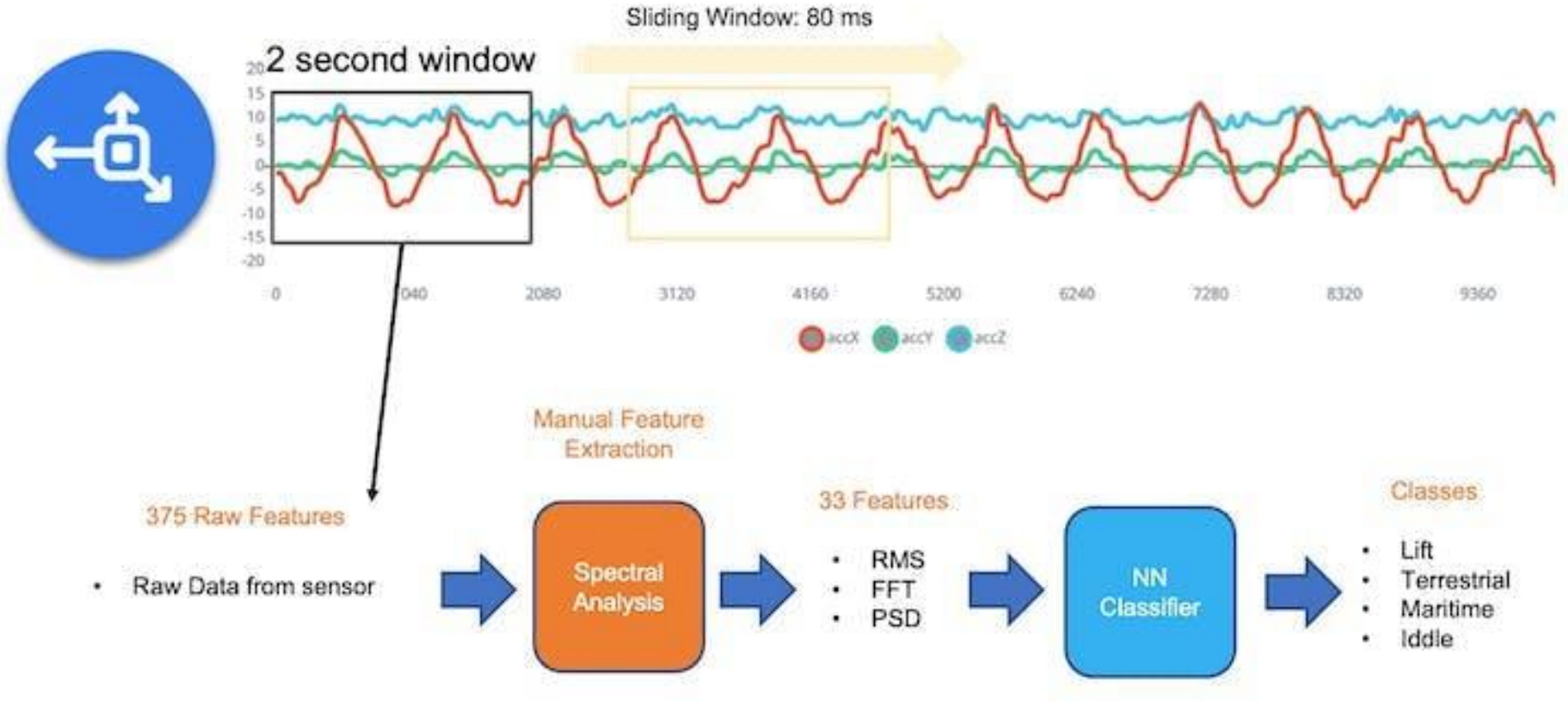
Time-frequency domain features combine the time and frequency domain information, such as the Short-Time Fourier Transform (STFT) or the Discrete Wavelet Transform (DWT). They can provide a more detailed understanding of how the signal's frequency content changes over time.

Feature Extraction-Example

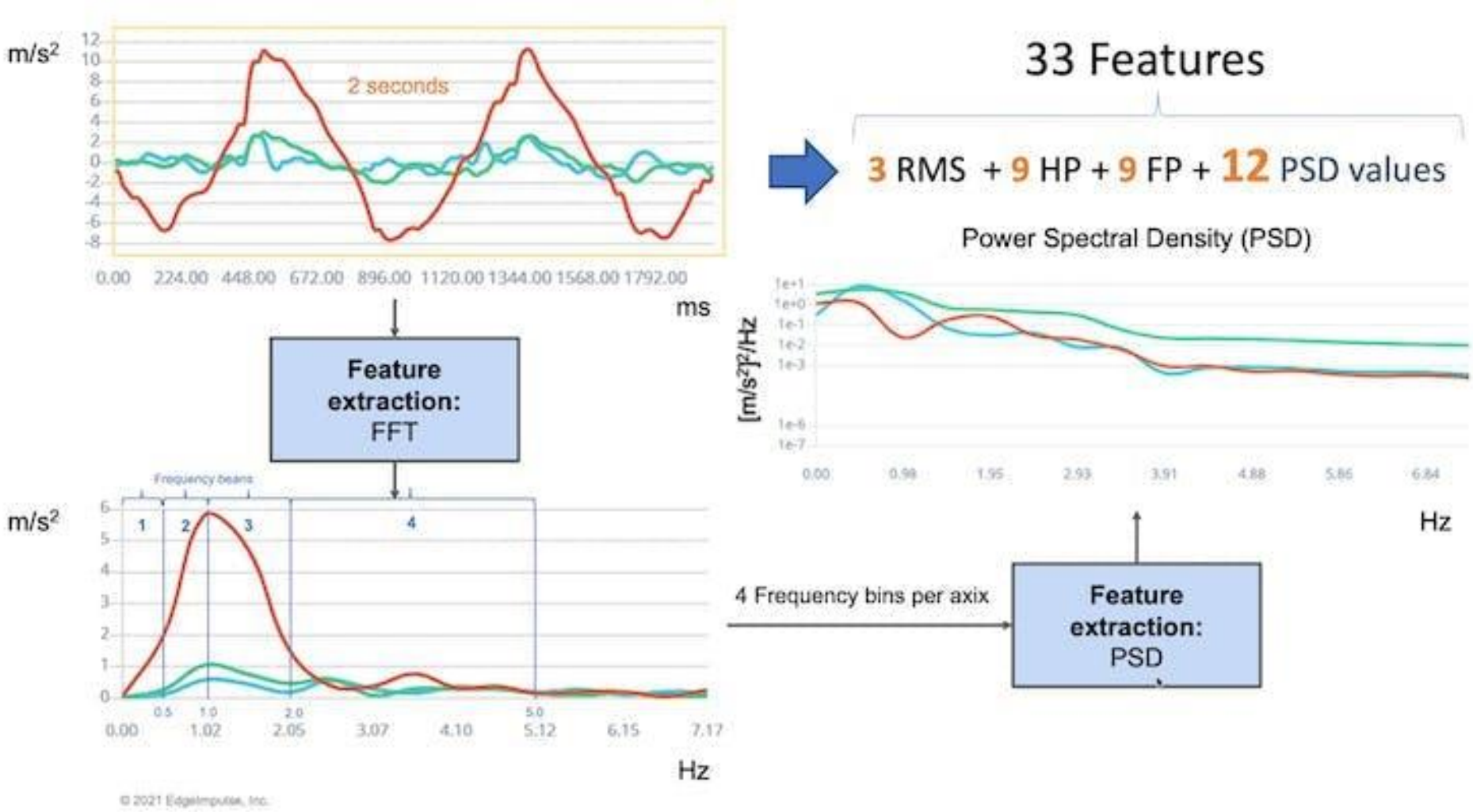


https://studio.edgeimpulse.com/public/124439/latest

Feature Extraction



Feature Extraction



Edge Impelse

In Version 2, Time Domain Statistical features per axis/channel are:

RMS

Skewness

Kurtosis

And the Frequency Domain Spectral features per axis/channel are:

Spectral Power

Skewness (in the next version)

Kurtosis (in the next version)

https://docs.edgeimpulse.com/docs/edge-impulse-studio/processing-blocks/spectral-features

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¡Gracias!

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