Artificial Intelligence for Healthcare

Glossary - Applying AI to Wearable Device Data

Lesson 1: Introduction to Wearable Data

Classification Accuracy

A metric for evaluating the performance of a classifier -- the fraction of classifications that are correct.

Exclusion Criteria

Characteristics that disqualify potential study subjects from participating in a clinical study. e.g., some common ones are being under 18 or pregnant.

Inclusion Criteria

Characteristics that potential study subjects must have for them to be included in the study.

Precision

The fraction of positive classifications that are correct.

Primary Endpoint

The metric being used to answer the question that the study seeks to ask. e.g., # of heart attacks in the test group vs. control group for a study on the effectiveness of a new statin in preventing heart attacks.

Recall

The fraction of positive elements that are classified correctly as positive.

Lesson 2: Intro to Digital Sampling & Signal Processing

Aliasing

The effect that causes frequency components greater than the Nyquist frequency to become indistinguishable from frequencies below the Nyquist frequency.

Analog-to-Digital Converter (ADC)

A device (usually embedded in the sensor) that converts an analog voltage into an array of bits.

Bandpass Filter

A function that preserves frequency components of a signal within a band and suppresses the frequency components outside that band.

Bandwidth

A range of frequencies within a band.

Bit Depth

The number of bits an ADC uses to create a sample. A 16-bit ADC produces a 16-bit number for each sample.

Dynamic Range

The physical range of the sensor. Values outside of this range will show up as clipping in the digital signal.

Frequency Component

The Fourier transform explains a signal as a sum of sinusoids. Each of these sinusoids is a frequency component of the signal.

Frequency Domain

A representation of a signal over frequency instead of time. Instead of representing the signal as a series of numbers in time, the signal is represented by the frequency components that make it up.

Hz

The units of the sampling rate. 1Hz means 1 sample per second.

Interpolation

A method for estimating new data points within a range of discrete known data points.

Noise Floor

The total amount of noise in the sensor, including electrical interference from the environment and other parts of the device, thermal noise, and quantization noise.

Nyquist Frequency

Half of the sampling frequency. Signal components above this frequency will get aliased in the sampled signal.

Passband

The band of a bandpass filter where frequency components will be preserved.

Resampling

The process of changing the sampling rate of a discrete signal to obtain a new discrete representation of the underlying continuous signal.

Sampling Rate

The frequency at which a sensor measures a signal.

Stationarity

A property of a signal where the statistics of a process generating a signal do not change in time. Generally, if the frequency components in a signal change in time, this signal is not stationary.

Time-domain

The typical representation we are used to for signals where the signal is represented by values in time.

Transducer

Part of a sensor that converts a physical phenomenon into an electrical one (e.g., voltage)

Lesson 3: Introduction to Sensors

Accelerometer

A sensor that measures linear acceleration.

Diastole

The phase of the cardiac cycle where the heart relaxes and fills with blood.

Electrocardiogram (ECG)

A sensor that measures the electrical activity of the heart.

Electrode

Part of an ECG circuit. Conductive pads that make contact with the skin.

g-force

The amount of acceleration on a body due to gravity.

Gyroscope

A sensor that measures angular velocity.

Holter monitor

A mobile ECG device that can measure continuously for typically 24 - 72 hours.

Inertial Measurement Unit (IMU)

A collection of sensors that measure motion.

Lead

An electrical potential difference measured across two electrodes of an ECG circuit.

Magnetometer

A sensor that measures magnetic forces.

Photodetector

A sensor that measures light.

Photoplethysmogram (PPG)

An optical sensor used to measure pulse rate on a wearable device.

Systole

The phase of the cardiac cycle where the ventricles contract and pump blood through the arteries.

Lesson 4: Activity Classification

Classification Accuracy

The percent of correct classifications made by a model.

Cross-validation

A technique for estimating model performance where multiple models are trained and tested each on a separate partition of the entire dataset.

Hyperparameter

A parameter of the model that dictates how the model learns. This is not trained during the training process of the model itself.

Nested cross-validation

A technique to determine model performance when hyperparameters are also optimized.

Regularization

Regularization is a technique to reduce overfitting of a model by discouraging complexity in the model.

Lesson 5: ECG Signal Processing

Arrhythmia

An irregular heart rhythm.

Atria

The upper chambers of the heart that pass blood to the ventricles.

Atrial fibrillation

An irregular rhythm caused by multiple, haphazard depolarizations across the atria.

AV node

Part of the cardiac conduction system that propagates the impulse from the atria to the ventricles after a delay.

Cardiac conduction system

A group of specialized cardiac cells that send signals to the heart, causing it to contract. e.g., the sinoatrial (SA) node, atrioventricular (AV) node, bundle of His, left and right bundle branches, and the Purkinje fibers.

Depolarization

The movement of charges across a cell membrane that causes the inside of the cell to become less negatively charged.

inter-beat-interval

The time between successive heartbeats. Also called the RR interval.

Refractory Period

The period after depolarization where a cell cannot depolarize again.

Repolarization

The movement of charges across the cell membrane that restore the negative resting charge inside the cell.

Sinus node

The natural pacemaker of the heart. Responsible for generating the impulse that causes the heart to beat.

Sinus Rhythm

The normal, regular heart rhythm, paced by the sinus node.

Ventricles

The main chambers of the heart that pump blood throughout the body