

## Glossary of Machine Learning and AI Terms

### **Area under curve (AUC)**

The area underneath the ROC (Receiver Operating Characteristics) curve; a measure of the performance of the binary classification model that lies between the value 0 and 1, with greater value denoting better model performance.

### **Artificial neural network (ANN)**

A deep learning algorithm composed of multiple layers of interconnecting nodes, called artificial neurons, that mimic biological neurons by receiving, processing, and transmitting signals to other nodes to increase the speed of computational tasks.

### **Classification**

A type of supervised learning technique where an algorithm is trained on a labelled dataset to predict the class or category of new, unseen data.

### **Convolutional neural network (CNN)**

A type of deep neural network designed specifically for processing grid-like data, such as images or sequential data like time-series. CNNs employ convolutional layers to systematically learn hierarchical representations by detecting spatial and temporal patterns in the input data.

### **Decision tree**

A supervised machine learning algorithm with a flowchart-like tree structure where decisions are made by iteratively asking questions to partition data and reach a solution.

### **Deep learning**

A branch of machine learning that involves the use of neural networks to model and solve complex problems.

### **DenseNet169**

A variant of Dense Convolutional Network (DenseNet), which is a type of deep learning architecture renowned for its densely connected layers. DenseNet169 specifically comprises 169 layers and fosters feature reuse, promotes gradient flow, and addresses the vanishing gradient issue, leading to highly efficient and parameter-efficient models.

### **Elastic net regression**

A statistical linear regression technique that is a hybrid of Ridge regression and LASSO regularised regression.

### **Inertial measurement units (IMUs)**

IMUs are electronic devices that consist of sensors used for measuring specific movements, orientation, and forces acting upon an object in three-dimensional space. Typically integrated into devices such as smartphones, wearables, or robotics, an IMU combines multiple sensors like accelerometers, gyroscopes, and magnetometers to capture information about linear and angular motion, including acceleration, rotation, and sometimes magnetic field orientation. **Least**

### **Absolute shrinkage and selection operator (LASSO)**

A type of 'regularised' linear regression that adds a penalty term to linear regression, which encourages sparse solutions where some coefficients are forced to shrink towards a central point such as the mean.

### **Light Gradient Boosting Models**

A series of supervised machine learning approaches that are efficient, fast and scalable. These are types of ensemble algorithms that iteratively combine the outputs of multiple machine learning models to formulate a more accurate result.

### **Gradient-weighted Class Activation Mapping (Grad-CAM)**

A technique used in the field of computer vision and deep learning to visualize and understand the decision-making process of convolutional neural networks (CNNs). Grad-CAM generates heatmaps highlighting the important regions in an input image that contribute the most to the CNN's prediction for a particular class. **Multi-modal feature integration method (MMLM)**

### **Multi-modal Feature Integration Method (MMLM)**

Multi-modal Feature Integration Method (MMLM) is an approach in machine learning that combines diverse types of data or features from multiple modalities (such as text, images, audio, etc.) to create a unified representation for analysis or prediction, aiming to enhance model performance by capturing complementary information and relationships across the varied data.

#### **Out of Distribution Error**

An error in a model's output due to the input data deviating beyond the range of values in the training data.

#### **Quantum machine learning**

The integration of quantum computing within machine learning programs. Quantum computers follow principles of quantum mechanics, which allows them to perform calculations in parallel.

#### **Random forest**

A supervised machine learning model which combines the outputs of multiple decision trees to formulate a single result. Each of the decision trees are trained on a subset of the training dataset, with the final result of the random forest collating the outputs of each decision tree to formulate a single, accurate and stable prediction. **Regularisation**

An important concept used to avoid overfitting of data, especially when the trained and test data vary. It is implemented by adding a penalty term to the best fit derived from the trained data, to achieve a lesser variance with the tested data.

#### **Ridge regression**

A regularised linear regression model used to eliminate multicollinearity (highly correlated independent variables) that can lead to large variance and unreliable estimates.

#### **ROC (Receiver Operating Characteristics) Curve**

The graphical representation of the effectiveness of the binary classification model. It plots the true positive rate (TPR) versus the false positive rate (FPR) at different classification thresholds.

#### **Supervised machine learning**

A machine learning approach that uses labelled datasets to train algorithms into classifying data or predicting outcomes accurately. The algorithm learns from labelled training data to help you predict outcomes for unforeseen data.

#### **Supported vector machine (SVM)**

A supervised machine learning algorithm used for classification and statistical regression. It works by finding a division that separates data into two categories with the largest margin possible between the category data points.

#### **Ten-fold cross-validation**

A method of estimating the performance of a machine learning model on unseen test data. It involves splitting the data into 10 subsets and using each subset as a test set while training the model on the remaining 9 subsets. The process is repeated 10 times, and the average performance is calculated.

#### **U-Net**

A supervised machine learning model (a type of convolutional neural network) primarily designed to identify and outline specific parts or objects within an image. It's particularly utilised in radiological analysis, helping to distinguish anatomical structures or pathological features in scans like MRIs or X-rays.

#### **Unsupervised machine learning**

A process of inferring underlying hidden patterns from data using machine learning algorithms to analyse and cluster unlabelled datasets. The algorithms discover patterns or data groupings without the need for human intervention or prior training.

#### **XGBoost**

XGBoost stands for eXtreme Gradient Boosting; an machine learning approach that is part of the 'gradient boosting' family of algorithms. As with light gradient boosting, this supervised ensemble-based approach is highly efficient, fast and flexible.

#### **YOLOv3**

A CNN model for tiny-based object identification approach to automatically detect and categorise knee osteoarthritis according to the Kellgren-Lawrence (KL) classification scheme.