# Types of Models

## Statistical Models

**A mathematical representation of the relationships within data, used to identify patterns, make predictions, and draw inferences about a population from a sample.**

**These models capture probabilistic relationships between variables, often using established mathematical frameworks like regression, to provide a framework for understanding and interpreting data. They help uncover insights and guide decision-making by creating approximations of reality that can be tested and refined.**

### Linear Regression :

**Definition:  Predicts a continuous (quantitative) outcome variable that can have any value within a range.**

**Example: Estimating the price of a house based on its size, location, and number of bedrooms.**

### Logistic Regression :

**Definition: Predicts a categorical (qualitative) outcome variable, often used for classification problems with two or more categories.**

**Example: Determining whether a loan applicant will be approved or rejected based on their financial profile.**

### Statistical Models vs Machine Learning Models :

**Statistical modelling is traditionally more concerned with inference and interpretation. It aims to explain the relationships between variables, test hypotheses, and understand the "why" behind the data.**

**Machine learning, while relying heavily on statistical principles, prioritizes predictive accuracy. Its focus is often on building powerful models that make accurate predictions on new, unseen data, even if the inner workings are less interpretable.**

# Machine Learning Models

**A machine learning (ML) model is a computer program, built by training an algorithm on data, that can find patterns, make predictions, or classify information from new, unseen data.**

**It acts as a mathematical representation of relationships learned from a dataset, allowing it to generalize and perform tasks like identifying objects in images or translating languages without explicit human programming for every scenario.**

## Decision Tree :

**Definition: A decision tree is a flowchart-like, hierarchical model that maps out a series of decisions and their possible outcomes**

**Example: A diagnostic tool can use a decision tree to help a doctor determine the likelihood of a patient having a specific illness based on their symptoms.**

## Random Forest:

**Definition: A Random Forest is a machine learning technique that creates an "ensemble" of many individual decision trees to make predictions.**

**Example: Companies use random forests to analyze customer behaviour and recommend products a person is most likely to purchase.**

## Support Vector Machine (SVM) :

**Definition: A Support Vector Machine (SVM) is a supervised machine learning algorithm that finds the best decision boundary, or hyperplane, to separate data into different classes.**

**Example: SVMs are used in natural language processing (NLP) to classify text, such as product reviews or social media posts, as having a positive, negative, or neutral sentiment.**

# Deep Learning Models

**Deep learning models are artificial neural networks with multiple "deep" layers designed to learn patterns from large datasets without extensive human intervention, enabling complex tasks like image recognition, natural language processing, and autonomous driving.**

**They are capable of understanding and managing complex tasks and patterns in various forms of data, including images, text, and sound. Through continued exposure to new data, the models refine their skills and accuracy, similar to how humans learn from experience.**

## Convolutional Neural Network (CNN) :

**Definition: Type of deep learning model designed for visual data analysis, excelling at tasks like image recognition and object detection**

**Example: Facial Recognition - Powering the facial detection features on smartphones and other devices.**

## Recurrent Neural Network (RNN) :

**Definition: Type of artificial neural network designed to process sequential data, like text or time-series, by having internal "memory" that allows information from previous inputs to influence current outputs.**

**Example: RNN is used in mobile keyboards to predict the next word in a sentence because it remembers the words it has already processed.**

## Transformers :

**Definition: A neural network architecture that excels at processing sequential data simultaneously, like text, by using a mechanism called "attention" to understand relationships between different parts of the input, even if they are far apart.**

**Example: Services like Google Translate and Microsoft Translator use Transformers to provide fast, highly accurate, and fluent translations.**

# Generative Models

**A type of artificial intelligence (AI) and machine learning model that learns the patterns and distributions of its training data to generate new, realistic data instances that resemble the original data.**

**Unlike discriminative models, which classify or distinguish between existing data points, generative models create new instances from scratch.**

## Generative Adversarial Networks (GANs) :

**Definition: GANs are a machine learning framework with two neural networks a generator and a discriminator that compete to create new, realistic data that resembles a training dataset.**

**Example: Converting real scenery into paintings or changing the style of images.**

## Diffusion Models :

**Definition: Diffusion models are a class of generative AI that creates new data, such as images, audio, and video, by learning to reverse a gradual process of adding noise**

**Example: DALL-E is a powerful text-to-image model that can generate creative and photorealistic images from textual descriptions.**

## Large Language Models (LLMs) :

**Definition: Large Language Models (LLMs) are advanced AI models trained on massive text datasets to understand, generate, and process human language, performing tasks like translation, summarization, and question-answering.**

**Example: Models like GPT-4 and GPT-5 are well-known for their advanced text generation capabilities and form the core of many generative AI applications.**