**Statistical Models**

1. **Linear Regression**

**Definition:** A method used to model the relationship between a dependent variable and one or more independent variables by fitting a straight line (linear equation) through the data. The goal is to predict a continuous output.

**Use case**

**Sales Forecasting**: Sales forecasting with linear regression helps predict how much a business might sell in the future by looking at past sales trends and seasonal patterns. For example, if sales usually go up during the holidays, the model can learn that and factor it in. It’s a useful way for businesses to plan ahead whether that’s stocking inventory or setting sales targets.

1. **Logistic Regression**

**Definition:** A classification algorithm used to predict the probability of a binary outcome (0 or 1) using a logistic (sigmoid) function. The goal is to predict classify outcomes as true/false, yes/no, or positive/negative

**Use case**

**Disease prediction:** Logistic regression is often used to predict whether a patient has a certain disease, such as diabetes or heart disease, based on their medical data like age, blood pressure, cholesterol levels, and lifestyle factors. The model looks for patterns in past cases to estimate the likelihood of a diagnosis. It doesn't give a definite yes or no but provides a probability that helps doctors make more informed decisions.

**Machine Learning Models**

1. **Decision Tree**

**Definition:** Decision trees are like flowcharts that help make decisions by asking a series of questions based on the data’s features. Each question splits the data into branches until it reaches a final decision or prediction.

**Use case**

**Loan Approval:** When banks use decision trees for loan approval, the model looks at different pieces of information from users like credit score, income, and job stability. It asks simple yes-or-no questions, such as “Is the credit score above a certain level?” or “Is the income high enough?” Based on the users’ answers, it follows different paths to decide if they’re likely to repay the loan. This helps banks make faster and more consistent decisions.

1. **Random Forest**

**Definition:** Random Forest is like a team of decision trees working together. Instead of relying on a single tree, it builds many trees and combines their votes to make a more accurate and stable prediction.

**Use case**

**Fraud detection:** Random forests look at lots of past transaction data from users to learn what normal behaviour looks like. By examining patterns like spending amounts, locations, and frequency, the model can spot when something doesn’t fit the usual pattern like a sudden large purchase in a different country. This helps banks and companies catch potential fraud quickly and protect users’ accounts.

1. **Support Vector Machines (SVM)**

**Definition:** SVM is a classification method that finds the best boundary (or hyperplane) to separate different classes in the data. It’s great when data points are clearly divided but can work well even in complex, high-dimensional spaces.

**Use case**

**Text classification:** Support Vector Machines (SVMs) analyse the words and phrases in documents to figure out what the text is about or how it feels. For example, they can sort customer reviews into positive or negative categories by looking at the language used. This helps businesses quickly understand customer feedback or organize large amounts of text without reading every single document.

**Deep Learning Models**

1. **Convolutional Neural Networks (CNNs)**

**Definition:** CNNs are deep learning models that use layers of filters to automatically detect patterns in images, such as edges, textures, or shapes. By stacking these layers, CNNs can recognize complex features and objects, making them especially powerful for image-related tasks.

**Use case**

**Medical Imaging:** In medical imaging, CNNs help doctors by analysing X-rays or MRI scans to spot things that might be hard to see with the naked eye. For instance, they can highlight suspicious areas like tumours or lesions, making it easier and faster for doctors to diagnose diseases and plan treatments. This technology improves accuracy and helps catch problems earlier.

**2. Recurrent Neural Networks (RNNs)**  
**Definition:** RNNs are a type of deep learning model designed to process sequences of data by maintaining a “memory” of previous inputs. This lets them understand context and patterns over time, which is especially useful for tasks involving language, speech, or time series.

**Use case**

**Speech Recognition:** When you use voice assistants like Siri or Alexa, RNNs help convert your spoken words into text by remembering the flow of your speech. They can understand how one word relates to the next, which helps them accurately transcribe sentences even if the speech is fast or unclear. This makes talking to devices feel more natural and responsive.

**3. Transformers**  
**Definition:** Transformers are deep learning models that use a self-attention mechanism to figure out how words in a sentence relate to each other, no matter how far apart they are. They process all parts of the input simultaneously, which makes them very efficient and powerful for understanding language and sequences.

**Use case**

**Virtual Assistants:** Transformers are the backbone of advanced chatbots like ChatGPT and Gemini. They help these bots understand the context of your questions and provide detailed, relevant answers even if the conversation jumps between different topics. This makes interactions feel much more natural and human-like.

**Generative Models**

**1. Generative Adversarial Networks (GANs)**  
**Definition:** GANs consist of two neural networks a generator and a discriminator that compete with each other. The generator tries to create realistic fake data (like images), while the discriminator learns to tell real data apart from the fakes. Through this competition, the generator gets better at producing convincing outputs.

**Use case**

**Deepfake Creation**: GANs are often used to create deepfake videos, where the face of one person is realistically swapped onto another’s body. This technology can generate highly convincing visuals that look almost real, which has both exciting creative uses and serious ethical concerns. It’s also used in entertainment and special effects to create lifelike digital characters.

**2. Diffusion Models**  
**Definition:** Diffusion models are a type of generative model that start with random noise and gradually transform it into meaningful data by learning to reverse a noising process. Essentially, they learn how to create realistic images or data by slowly “denoising” random patterns step by step.

**Use case**

**Image Generation:** Diffusion models power tools like Stable Diffusion, which can create detailed, photorealistic images from simple text descriptions. For example, you can type “a sunset over a mountain lake,” and the model gradually shapes random noise into a beautiful, realistic picture. This approach is helping artists and designers bring their ideas to life in amazing new ways.

**3. Large Language Models (LLMs)**  
**Definition:** LLMs are massive neural networks trained on vast amounts of text data to understand language patterns, context, and meaning. This allows them to generate fluent, meaningful text and perform complex language tasks like translation, summarization, or answering questions.

**Use case**  
**Customer Support Automation**: Many companies use Large Language Models to power their customer support chatbots. These chatbots can understand what users are asking whether it’s about billing, product features, or troubleshooting and provide clear, helpful answers right away. This means customers don’t have to wait on hold or send emails to get basic questions answered. It makes support faster and easier for everyone, freeing up human agents to handle more complex issues.