**DEEP LEARNING**

Deep learning is a subset of machine learning in artificial intelligence (AI) that focuses on algorithms inspired by the structure and function of the human brain. It uses multi-layered neural networks to model complex patterns in large amounts of data.

**NEURAL NETWORKS AND ITS TYPES**

A **neural network** is a computational system modelled after the human brain. It consists of layers of interconnected nodes (called neurons), where each neuron receives input, processes it using weights and activation functions, and passes the result to the next layer.

It has following main types:

**1. Feedforward Neural Network (FNN)**

This is the most basic type of neural network where information moves only in one direction—from input to output. It doesn’t have any loops or memory. It’s mainly used for simple tasks like classification or regression. FNNs are the building blocks of more complex networks.

**2. Convolutional Neural Network (CNN)**

CNNs are specialized for processing grid-like data such as images. They use convolutional layers to automatically detect patterns like edges, textures, and shapes. CNNs have revolutionized computer vision tasks such as image recognition, facial detection, and object tracking.

**3. Recurrent Neural Network (RNN)**

RNNs are designed for sequential data. They have loops in their architecture, allowing them to maintain a sort of "memory" of past inputs. This makes them well-suited for time-series data, speech recognition, and natural language processing. However, they struggle with long-term dependencies.

**4. Transformer Networks**

Transformers are the most advanced and currently dominant architecture in deep learning, especially for language-related tasks. Instead of using recurrence, transformers use an attention mechanism to process input sequences in parallel. They are highly efficient and power models like BERT, GPT (like me), and others.

**CNN IN SIMPLE WORDS**

Convolutional Neural Network (CNN) is an advanced version of artificial neural networks, primarily designed to extract features from grid-like matrix datasets. This is particularly useful for visual datasets such as images or videos, where data patterns play a crucial role. CNNs are widely used in computer vision applications due to their effectiveness in processing visual data.

In simple words a Convolutional Neural Network (CNN) is a type of computer program that helps machines understand and recognize images by learning patterns—just like how we recognize objects by their shapes, colours, or edges.

**PROJECT PIPELINE**

The workflow during the project will be as follows:

1. **Data Collection and Loading**

In the initial phase of the project, a dataset consisting of forest images, both with and without fire, will be collected. These images will be sourced from publicly available datasets and online repositories to ensure diversity in environmental conditions and fire appearances. Once collected, the images will be organized, labelled, and loaded into the development environment using appropriate data-handling libraries, preparing them for further processing.

1. **Image Processing and Augmentation**

Following data collection, the images will undergo preprocessing to standardize their dimensions and normalize pixel values, ensuring consistency across the dataset. To improve model robustness and reduce overfitting, data augmentation techniques will be applied. This will effectively expand the training data, enabling the model to learn more general features.

1. **Building the CNN**

A Convolutional Neural Network (CNN) will be designed to classify the images into “fire” and “no fire” categories. The network will include multiple convolutional and pooling layers to extract relevant features from the images, followed by dense layers for final classification. Once the model is built, it will be trained on the processed dataset, and its performance will be evaluated using a separate validation set to assess generalization to unseen data.

1. **Evaluation**

After training, the model will be evaluated using performance metrics such as accuracy, precision, and recall. These metrics will provide insights into how well the model distinguishes between fire and non-fire images. A confusion matrix will also be generated to visualize prediction results and identify any common misclassifications. The evaluation results will determine whether the model requires further refinement or if it is ready for deployment.