DEEP LEARNING AND TIME SERIES ANALYSIS

Introduction to Neural Networks

- Definition:- Deep Learning is a subset of machine learning that uses neural networks with multiple layers to to get output

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Purpose

- **Automate Feature Extraction**
- **Process Unstructured Data**
- **Achieve Higher Accuracy**
- **Power Advanced AI Applications**

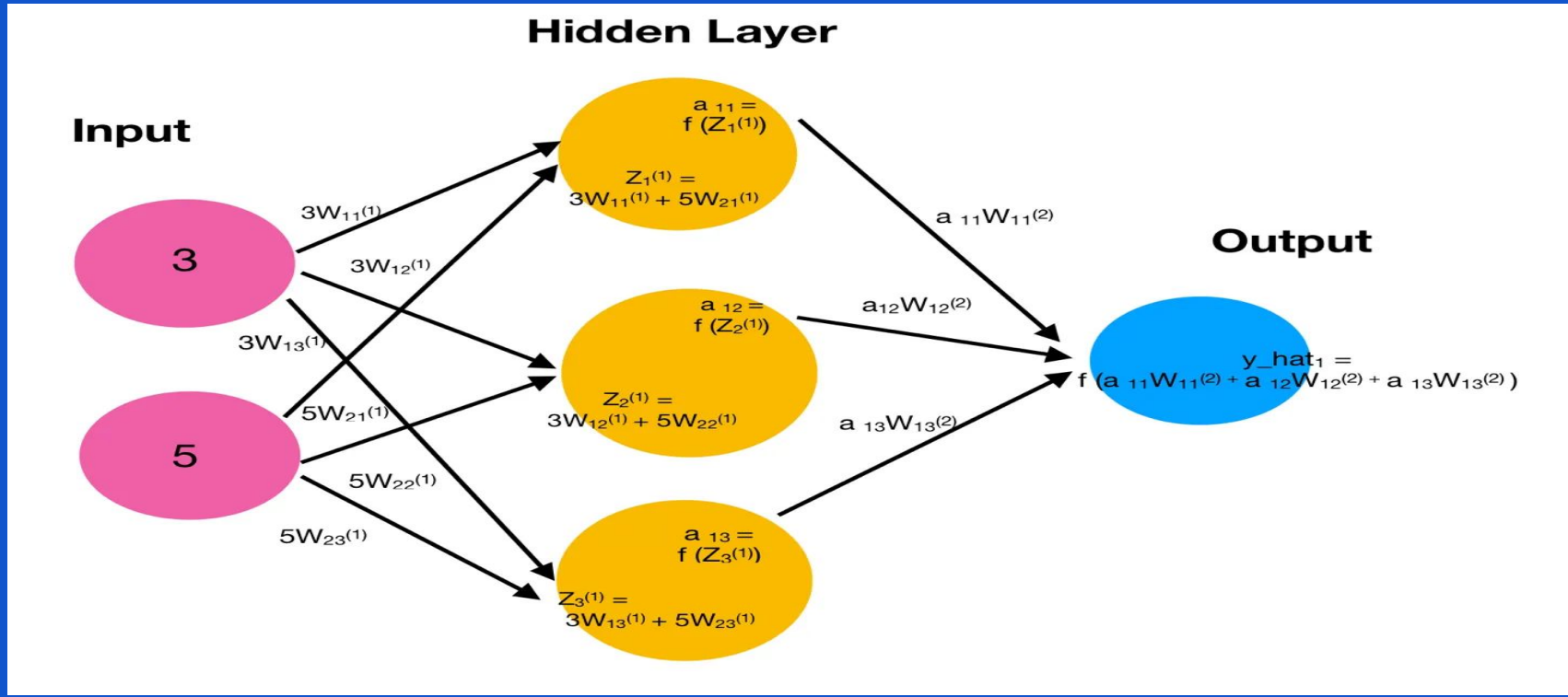
Applications

- Image and Speech Recognition
- Natural Language Processing (NLP)
- Autonomous Vehicles
- Fraud Detection
- Recommendation Systems

Biological vs Artificial Neural Networks

- Biological:- A biological neural network is a system of neurons found in the brain and nervous system of living organisms
- Artificial Neural Networks:-An artificial neural network is a computational model inspired by the structure and function of biological neural networks

Basic Structure of a Neural Network



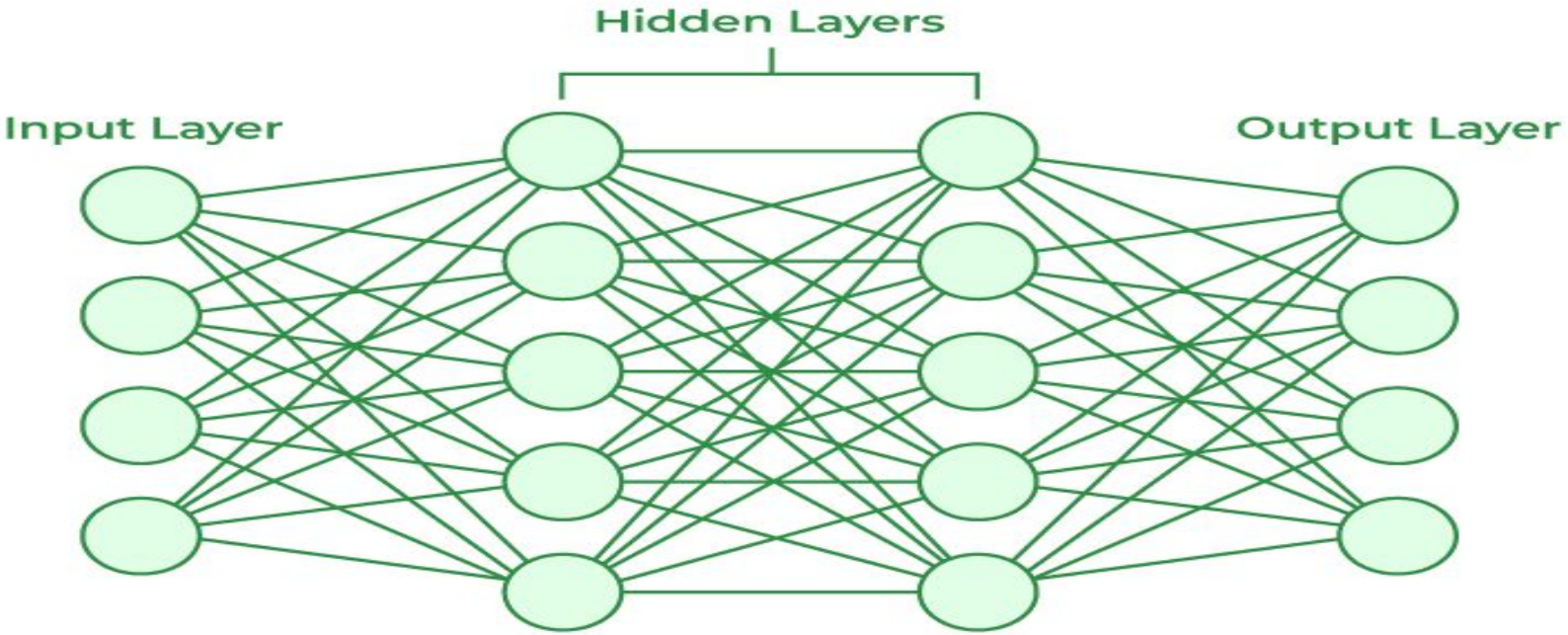
Types of Neural Networks Overview

- ANN (Artificial Neural Network)
- CNN (Convolutional Neural Network)
- RRN (Recurrent Neural Network)
- GAN (Generative Adversarial Networks)

Artificial Neural Networks (ANN)

Def:-An Artificial Neural Network (ANN) is a computational model inspired by the structure and functionality of the human brain. ANNs are used to solve problems on classification, regression

Structure and Working of ANN



Applications of ANN

- Image and Video Processing
- Natural Language Processing
- Healthcare and Medical Diagnosis
- Finance and Banking
- E-Commerce and Retail
- Gaming

Limitations and Challenges of ANN

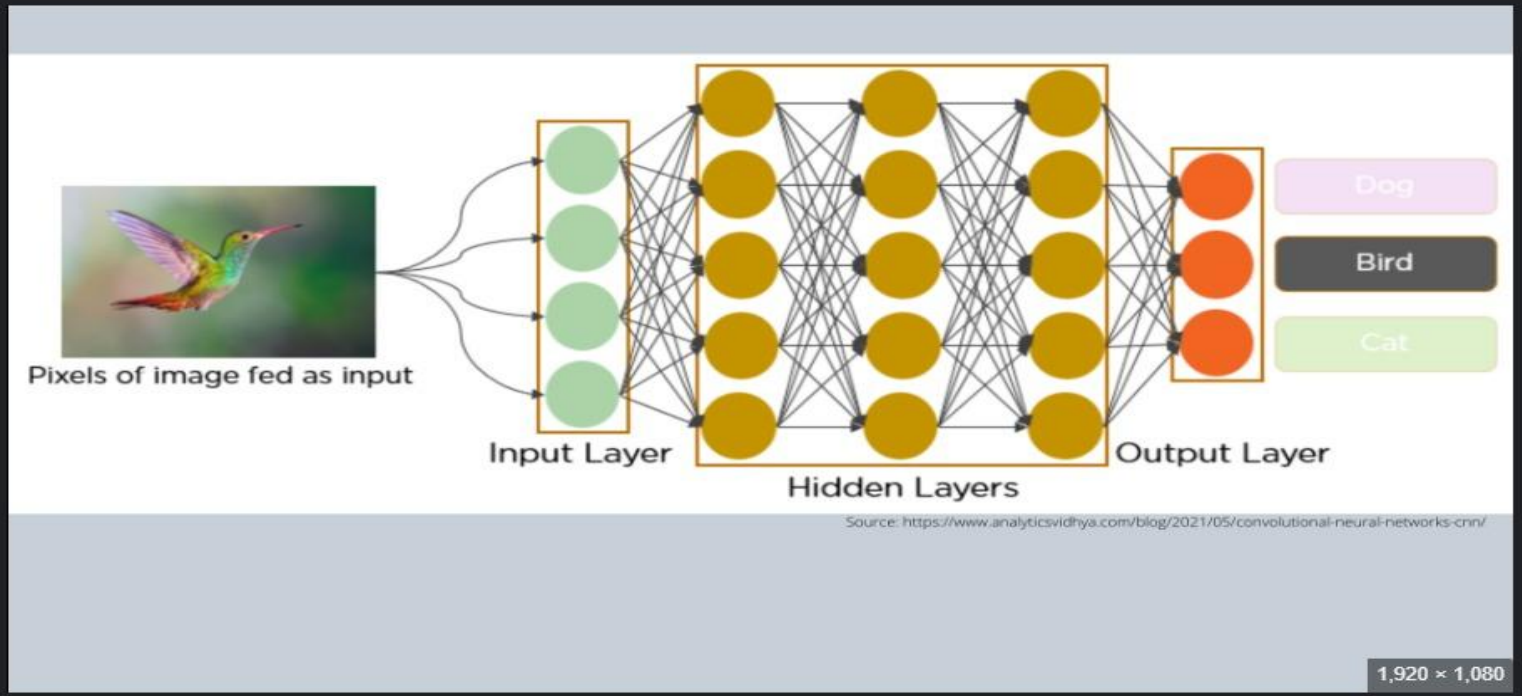
- **High Computational Requirements** – Requires powerful hardware (GPUs/TPUs) and large memory.
- **Long Training Time** – Time-consuming for large datasets and complex models.
- **Overfitting and Underfitting** – Prone to overfitting with small datasets or underfitting with simple models.
- **Difficulty in Generalization** – Poor performance on unseen or different datasets.
- **Memory and Storage Requirements** – Large models demand extensive storage.
- **Ethical and Privacy Concerns** – data privacy risks.

Convolutional Neural Networks (CNN)

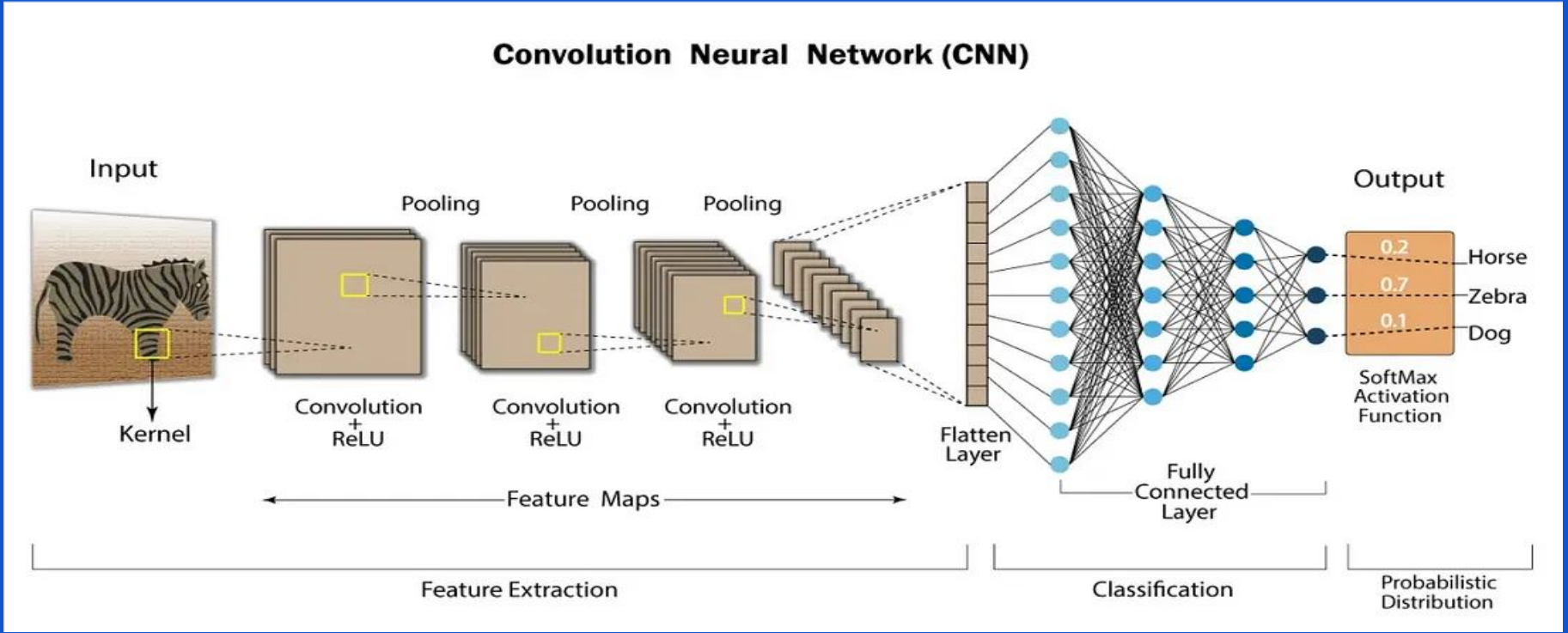
Introduction to CNN

Def:-A Convolutional Neural Network (CNN) is a type of deep learning algorithm specifically designed to process and analyze data, such as images,video as well as audio data

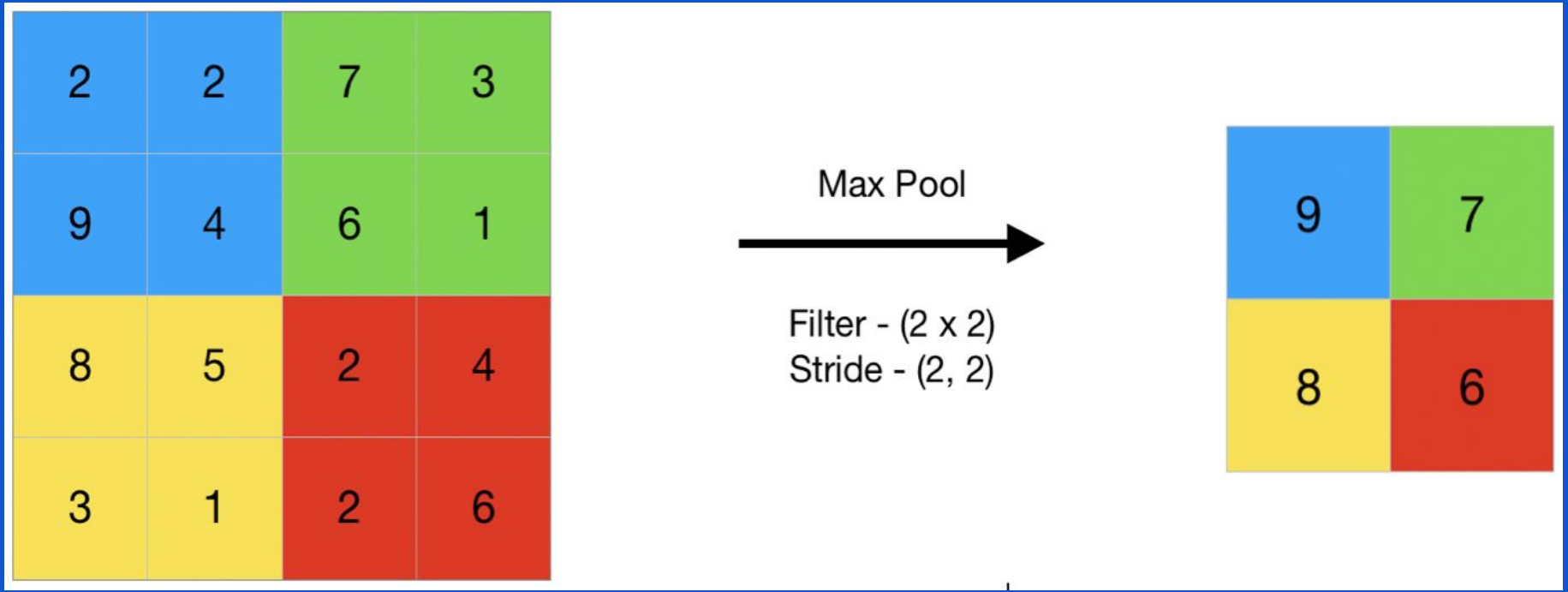
Structure of CNN



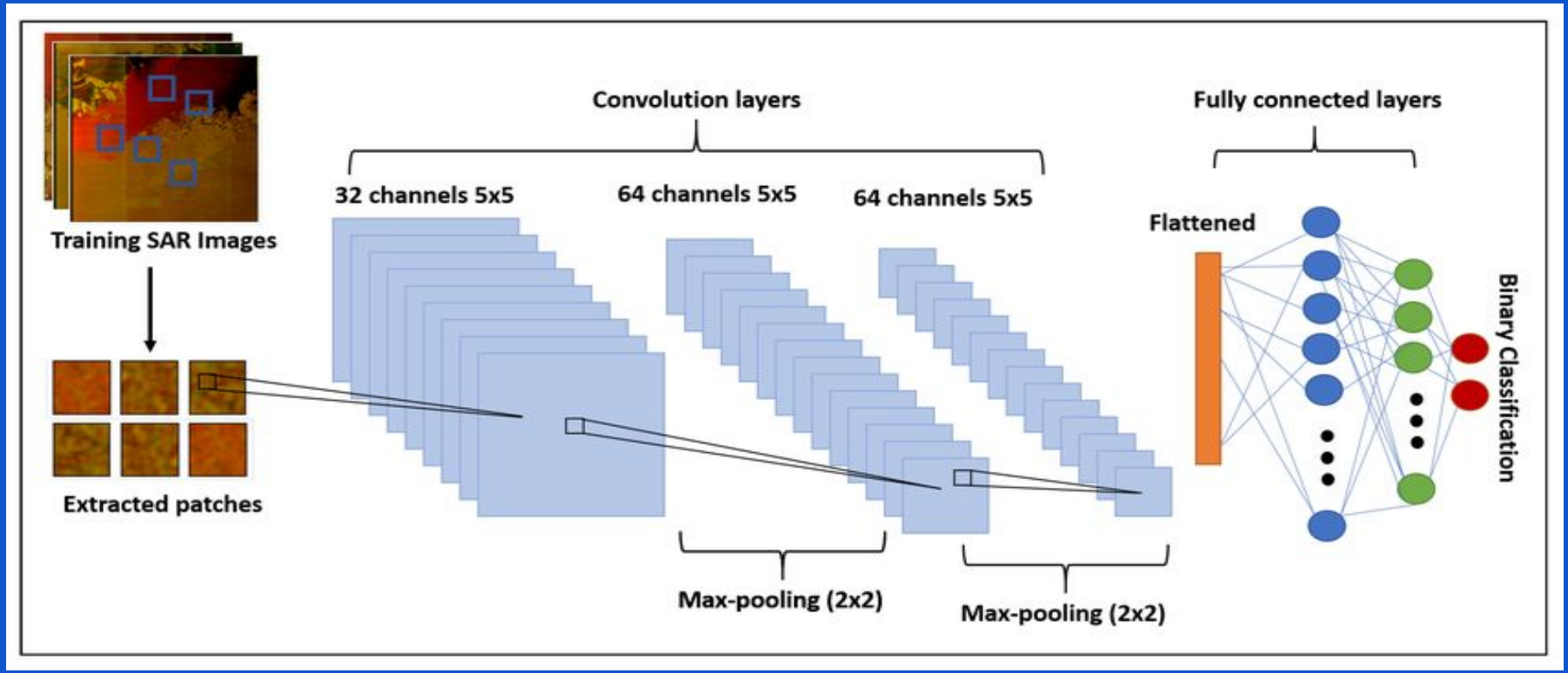
Convolution Operation



Pooling Layers in CNN



CNN Architecture for Multi-Class Image Classification



Recurrent Neural Networks (RNN)

Introduction to RNN

- Def:-A Recurrent Neural Network (RNN) is a type of artificial neural network designed to recognize patterns in sequences of data such as time series data as well as NLP

Applications of RNN

1. Natural Language Processing (NLP)
2. Speech Recognition
3. Time Series Forecasting
4 .Video Analysis and Action Recognition
5. Handwriting and Character Recognition

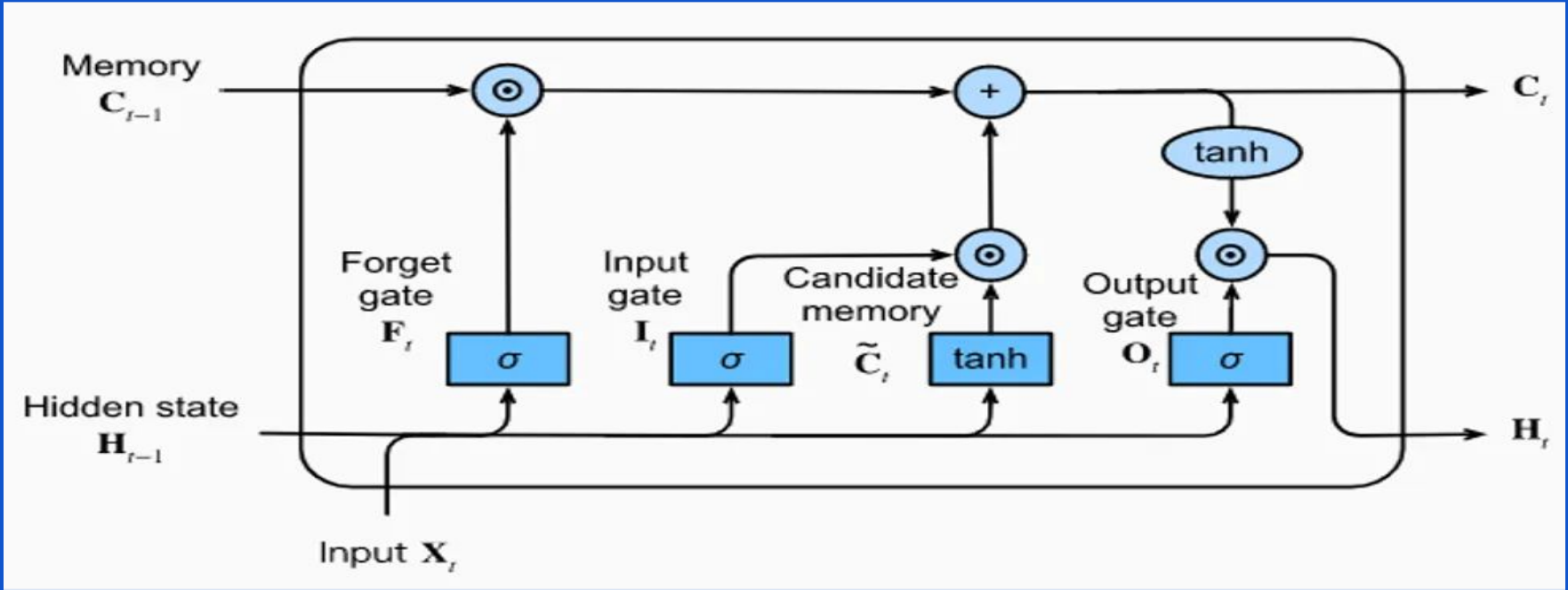
Challenges with RNN

- Slow and Inefficient Training
- Memory Constraints
- Difficulty in Handling Long Sequences

Variants of RNNs

- Vanilla RNN
- Long Short-Term Memory (LSTM)
- Gated Recurrent Unit (GRU)
- Bidirectional RNN
- Bidirectional LSTM
- Bidirectional GRU

LSTM: Architecture and Working



GRUs vs LSTMs: Key Differences

LSTM

- **Number of Gates:** 3 Gates
  - **Forget Gate:** Decides what to discard
  - **Input Gate:** Decides what information to add
  - **Output Gate:** Outputs relevant information

GRU

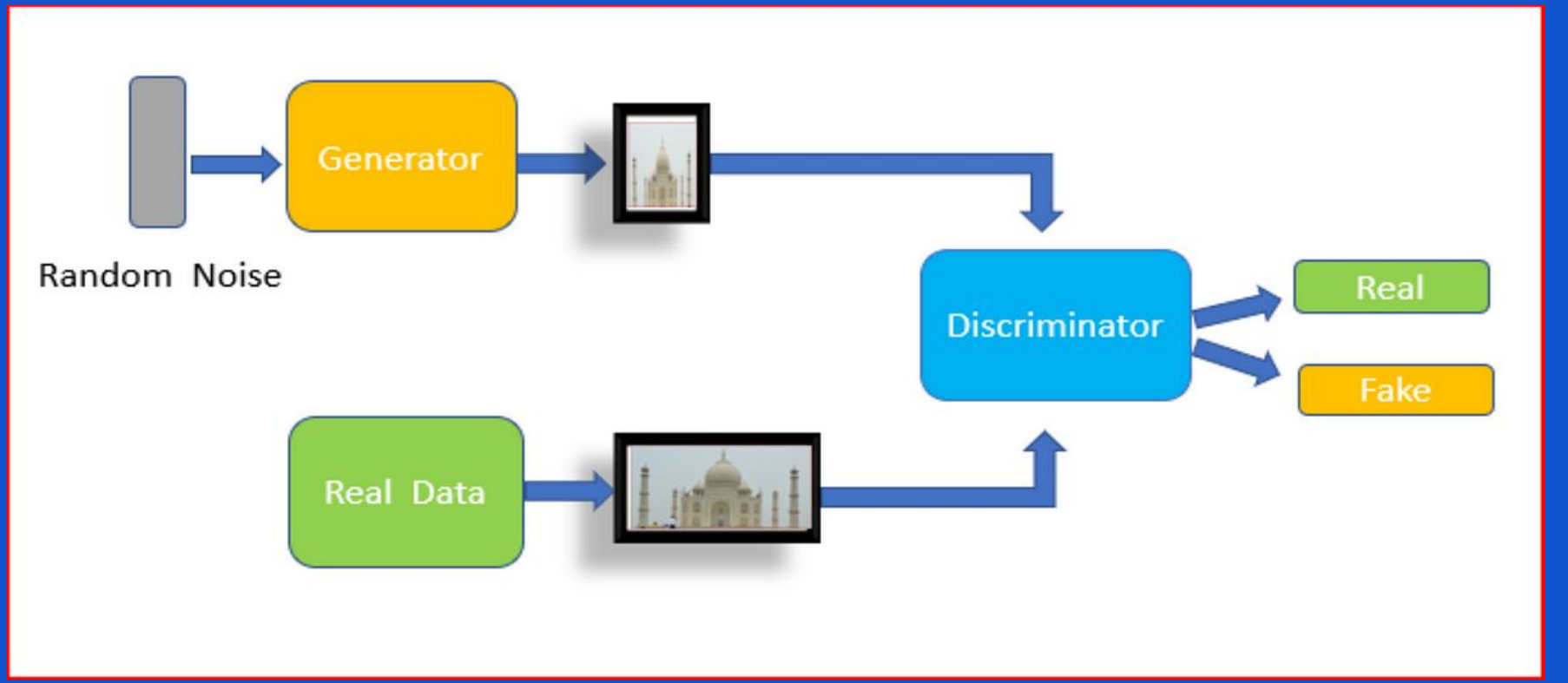
- **Number of Gates:** 2 Gates
  - **Update Gate:** Controls what information to keep or discard.
  - **Reset Gate:** Decides how much past information to forget.

Generative Adversarial Networks (GAN)

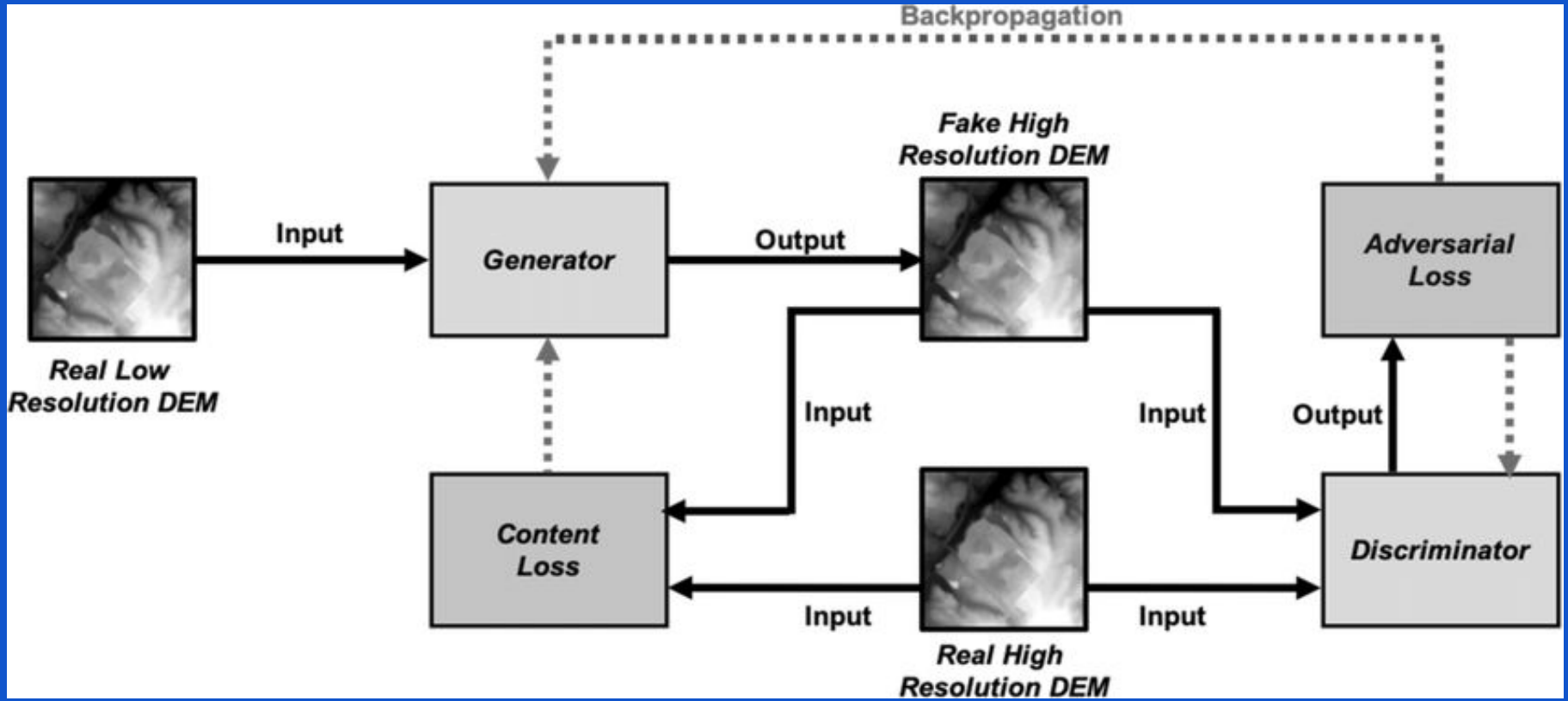
Introduction to GAN

Def:-A GAN is a type of machine learning model that used to create Audio,Video and Images

Structure of GANs: Generator and Discriminator



Training Process of GAN



Applications of GAN

- Image Generation and Enhancement
- Art Generation
- Video Generation and Editing
- Gaming and Virtual Reality (VR)
- Medical Imaging and Diagnosis
- Text-to-Image Generation
- Audio and Speech Generation
- Architecture and Design

Challenges of GAN

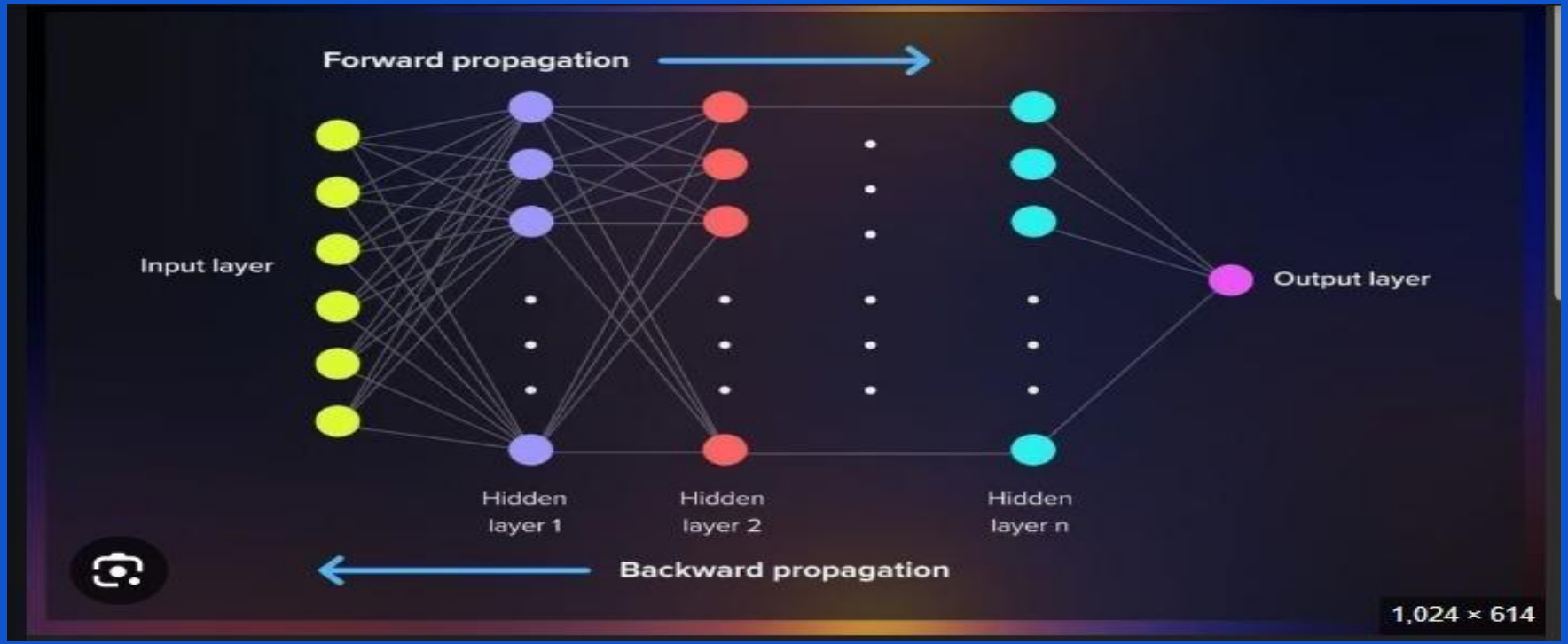
- High Computational Cost
- Ethical Concerns and Misuse

Building Shallow and Deep Neural Networks

- Introduction to Network Building

Def:-A Neural Network (NN) is a machine learning model inspired by the structure and functioning of the human brain.

Forward Propagation and Backward Propagation



Object Detection Overview

- Face Detection
- Object Detection