UNIT-3 AI

✡ Neural Network :

→ A neural n/w is a machine learning model design to mimic the function and structure of the human brain.

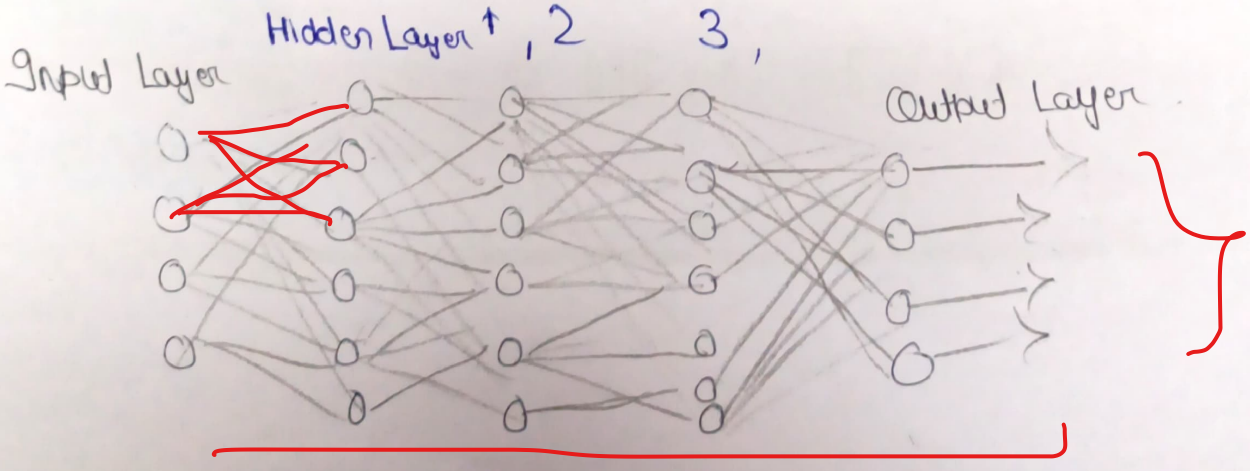
→ Neural Network are intricate n/w of interconnected nodes or neurons, that collaborate to tackle complicated problem.

→ Also referred as artificial neural network or deep neural network.

How N.N Works.

- An Ann usually involve many processors operating in parallel and arranged in tiers or layers.
- The first tier -- analogous to optic nerve in human visual processing receive the raw input information.
- Each successive tier receives the output from the tier preceding it rather than the raw input.
- The last tier produce the output of the system.

Each processing node has its own small sphere of knowledge including what it has seen and any rule it was originally programmed with or developed for itself.



Deep Neural Network Artificial Neural Network

✡ Application of N.N

- → Image Recognition ✓
- → Chatbots ✓
- → NLP translation ✓
- → Stock Market Prediction
- → Drug Discovery
- → Delivery Driver route Planning ✓

2) Convolutional Neural Network (CNN)

A convolutional Neural Network is a subset of Machine learning & is one of the various types of ANN which are used for different Applications and data types.

A CNN is a kind of network architecture of deep learning algorithm and is specifically used for Image recognition and tasks that involve the processing of pixel data.

CNN are the network architecture of choice for identifying and recognising objects.

Inside CNN

The CNN is another type of neural network that can uncover key information in both time series and image data.

For this reason it is highly valueable for tasks such as image recognition, object classification and pattern recognition.

To identify patterns within an Image, a CNN Leverage principal from linear Algebra, such as matrix multiplication

✡ CNN Layers

A deep learning CNN consist of 3 Layers.

1. A convolutional layer 2. A Pooling layer 3. A Fully Connected layer.

1. Convolutional Layer: It is the core building block of CNN.
   - The majority of computation happen in the convolution layer.
   - A second convolutional layer may can follow the initial Convolutional Layer.
   - The process of convolution involves a kernal or filter inside this layer moving across the receptive field of the image, checking if the feature is present in the image.

2. Pooling Layer: Like convolutional Layer, the pooling Layer also sweep a kernal across the input image.
   But the pooling Layer reduce the no. of parameter in input and also result in some information Loss.
   On Positive side this Layer reduce complexity and improve the efficiency of CNN.

3. Fully Connected Layer: The FC layer is where image classification happens in the CNN based on the features extracted in the previous Layer.

→ Here fully connected means that all the input or nodes from one layer are connected to every activation unit or node of the next Layer.

How CNN Works

A CNN can have multiple layers each of which learn to detect the different feature of an input image.

A filter or kernal is applied to each image to produce an output that gets progressively better, and more detailed after each layer.

Application of CNN.

Health Care: Examine visual reports to detect any anomalous condition in patient

Automative: CNN technology is powering research into autonomous vehicle & self driving cars.

Facial Recognition for Law Enforcement: Generative adversarial n/w are used to produce new images that can be used to train deep learning model for facial recognition.

Audio processing for Virtual Assitans: CNN in virtual assistant learn and detect user spoken keywords and process the input to guide their action and respond to user.

Text Classification

CNN can also be applied to text classification task [12].
In this case the input is typically represented as a matrix where each row corresponds to a word vector.
The convolutional filter slider over these words vectors, capturing patterns and relationships b/w words.

Image Classification and Hyper-Parameter tuning

Image Classification with CNN involves training a model to recognise and categorize images into predefined classes.
The process typically involves data (preprocessing, model architecture design, training and evaluation)

Hyper parameter Tuning

Hyperparameter tuning is the process of determining the right combination of hyper parameter that maximize the model performance.

a. It works by running multiple trials in a single training process.

b. Each trial is a complete execution of your training application with value for your chosen hyperparameters, set within the limit you specify.

c. The process once finished will give you the set of hyper parameter value that best suited for model to give optimal result.

Emerging Neural Network

Residual Network (ResNet)

1. Background:

ResNet was introduced → Kaiming Heet al (2015).

It address the challange of training very deep Neural Network by introducing the concept of residual learning

2. Key Concept:

ResNet introduced the concept of residual learning which involves shortcut connections that skip one or more layers. This architecture helps address the vanishing gradient problem, enabling the training of very deep N.N.

→ Widely used in Image Classification & Object detection.

Advantage of ResNet

- Addressing Vanishing Gradient
- Ease of training

AlexNet

1. Background

AlexNet, named after its creator Alex Krizhevsky, Ilya Sutskever and Geoffrey Hinton.

It played a pivotal role in popularizing deep learning and Convolutional neural network.

2. Architecture

1. The architecture consist of eight Layers : 5 Convolutional Layer and 3 Fully connected layer.
2. It employs a large no. of filters in the early convolutional layer to capture complex feature.
3. The final layer is a softmax Layer for classification.

→ Primary used for image classification.

3. Advantages

- Deep Learning Breakthrough
- GPU Utilization.

Application of AlexNet & ResNet

- Image Classification
- Image Generation: They can be used for image generation tasks such as generating new image that resemble a given dataset.
- Transfer Learning: Pre trained version of these model are often used for transfer learning.

Object detection.

UNIT-4 (Recurrence Neural N/W)

- A recurrence Neural Network is a type of ANN commonly used in speech recognition and natural Language processing.
- Recurrent neural network recognise data's sequential characteristics and use pattern to predict the next likely scenario.
- RNN are used in Deep Learning and in the development of model that simulate neuron activity in the human brain. ~~They are e~~

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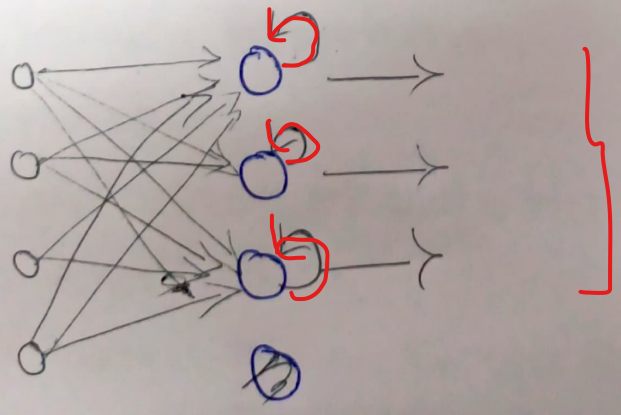
- RNN is a type of N.N where the output from the previous step is fed as input to the current step.
- In traditional N.N, all the input and output are independent of each other. Still in case when it is required to predict the next word of a sentence, the previous words are required and hence there is a need to remember the previous word.
- The RNN came into existance which solve the issue with the help of a Hidden Layer.
- The main and most important feature of RNN is its Hidden State, which remember some information about a sequence.



Recurrence Neural N/W

RNN Architecture

The basic architecture of an RNN have 3 main components.

1. Input Layer: This Layer take input sequence where each element correspond to an input at a specific time step. The input is usually represented as a vector.

2. Recurrent Layer: This Layer contains recurrent connection that allow information to be passed from one step of the sequence to the next.

3. Output Layer: This Layer produce the output based on the information captured in the hidden state. The output can be a prediction, classification or any other relevant task.

Other Architecture

Bidirectional RNN

In BRNN inputs from future time steps are used to improve the accuracy of the nw. It is like knowing the first and last word of a sentence to predict the middle word.

Long Short term Memory (LSTM)

LSTM were designed to address the vanishing gradient problem in RNNs. LSTMs use three gates called input, output and forget gate. These gates determine which information to retain.

Time Series forecasting

Time Series forecasting involves predicting future value based on past observation. RNN and LSTMs are commonly used for this task, given their ability to capture temporal Dependencies.