Report on Deep Learning

Introduction:

Neural Networks are computer systems inspire by the human brain. They are a series of algos recognizing data patterns for deep and machine learning. Also referred to as simulated neural networks(SNNs) or artificial neural networks(ANNs).

Application : classification, recommendation engines, and language-to-language translation.

History:

History shows how the idea developed over time. It started in the 1940s with the idea of how neurons might work. In 1958, first “perceptron” was created for pattern recognition. Researchers kept improving the idea over the years but our computers weren’t powerful enouh to make them useful.. Finally in 2000s, with faster machines and more data, deep learning really took off. Breakthoughs were seen since then, like Google’s deep learning algorithm [discovers cats](https://googleblog.blogspot.com/2012/06/using-large-scale-brain-simulations-for.html),

[Facebook](https://www.forbes.com/companies/facebook/)’s learning technology called DeepFace etc.

Deep Learning:

It is a form of machine learning with many layers of neurons. Also known as Artificial Neural Networks. A Deep Learning model is trained by first defining its learning objective and then fine-tuning its parameters to maximize its output.

Basic Neural Network:

Perceptron – Algorithm where neurons learn from the given info

-Several Binary inputs, x1,x2,.. and single binary output

Two types –

Single layered Perceptron – No hidden layer (has only 2 layers)

Multi layer Perceptron – One or more hidden layers

Working:

Input layer receives input signal. Calculations are performed by hidden layers with weights, activation functions. Output is predicted but he output layer. Some output signals are sent deeper into the neural net through a synapse.

Teriminology:

Neuron/Node – Computational units for processing information. Includes receiving input signals, processing and output.

Weights -  Significance or importance of the input values flowing between neurons. Adjusting weights helps the network to recognise patterns and make accurate predictions.

Bias – Gives neurons freedom to adjust outputs and adds flexibility so the network can fit data better.

Activation Function - Activation functions introduce non-linearity, enabling the network to learn complex patterns and relationships within data. These functions determine whether a neuron should be activated or not based on the input it receives.

There are four main types of activation functions:

1. Threshold Functions

These function compute output based on whether the input exceeds the threshold value or not.

For Neural networks, input is the weighted sum of input values from the preceding layer. If this sum exceeds the threshold, the neuron is activated and produces a specific output; otherwise, it remains inactive.

Challenges – It isn’t differenciable, so gradient descent and backpropagation don’t work

1. Sigmoid Functions

The sigmoid function produces values between 0 and 1, ideal for estimating probabilities.

Since it produces values between 0 and 1 the sigmoid curve smoothly transitions. This is a major advantage over threshold function with sharp discontinuous transition. Gradient descent is possible which is important for training neural networks.

Prominently featured in Logistic regression.

1. Rectifier Functions(RELU’s)

RELU has a piecewise linear nature unlike the smooth sigmoid graph

If input<0, output is 0

If input>0, output is input value

1. The Hyperbolic Tangent Function

It is often denoted as tanh and produces output values between -1 and 1.

Similar to sigmoid function in appearance but output values are shifted downwards