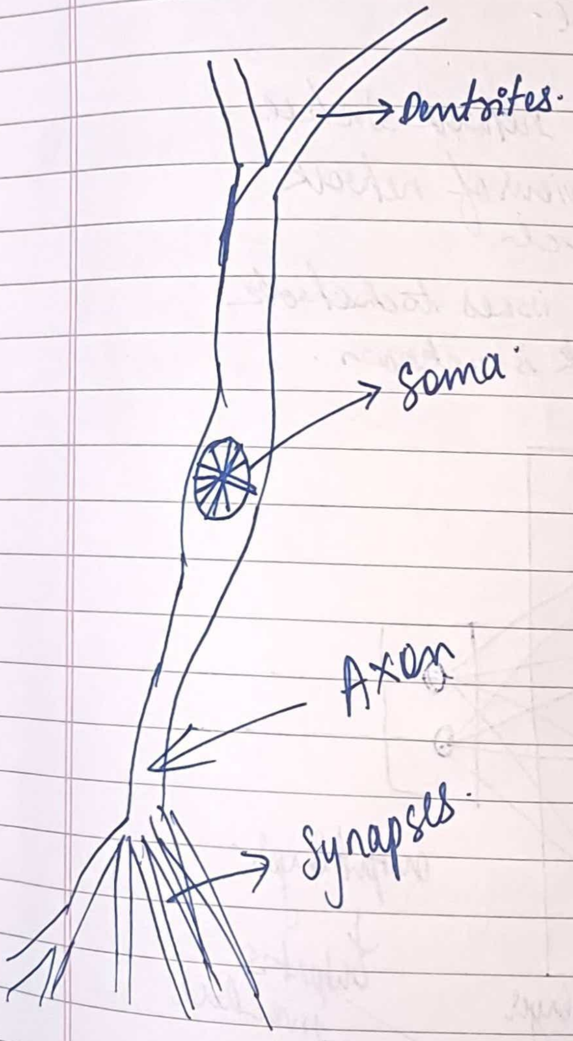
U-6
(ML)

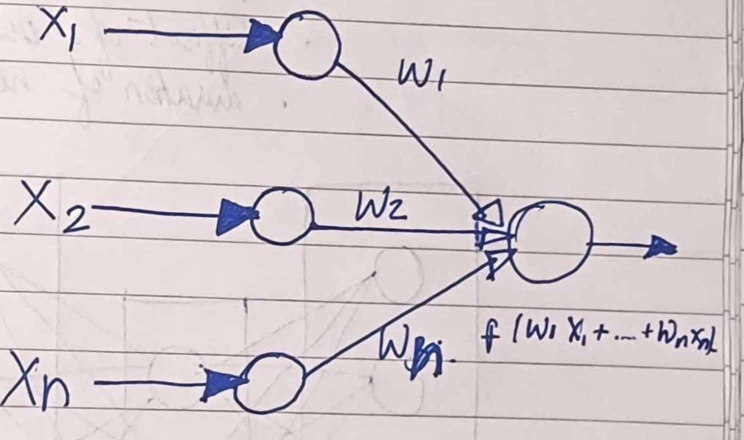
* Biological Neuron Model

- Dendarites → accepts inputs.
- soma → process input
- Axon → Turns processed inputs into output
- Synapses → electrochemical contact between neurons



* Artifical Neuron Model.

- ANN
- Edge or connection or link.
- Weight or connection strg

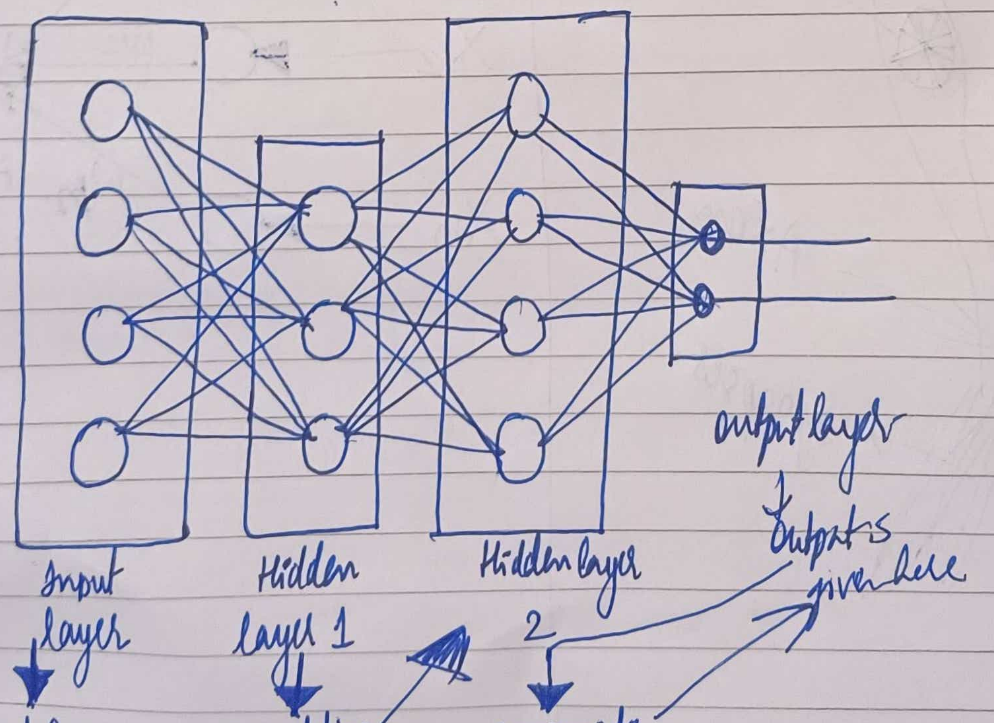


- Artifical Neural network

- inspired by biological neural network.
- mimic network of neurons like human beings so computers can be made decision in human like manner.

Adv → • parallel processing capability
- sotering data on entire network.
- capability to work with incompleted knowledge.
- Having memory distribution.
- Having fault tolerance.

Disadv → • assurance of proper network structure
- unrecognizable behaviour of network
- Hardware dependance.
- diffirent of showing issues to the network
- duration of network is unknown.



accepts input from programmer in variety of diff formats.

computation necessary to uncover patterns & buried features

communicate output after input has undergone no. of alternation in hidden layer

✱ Types of ANN → 1) Feed Forward ANN

- → atleastone layer of neurons
- → network intensity → output & input layer connected neurons
- → output → network's output in context of its input.
- → benefit → learns to assess & indentify input patterns.

↓ 2) Feedback ANN

- → output loops back into network to acheive best internally involved results
- → addressing optimization problems.
- → feed info into themselves.
- → Internalsystemselves repairs.

✱ Appl^n of ANN

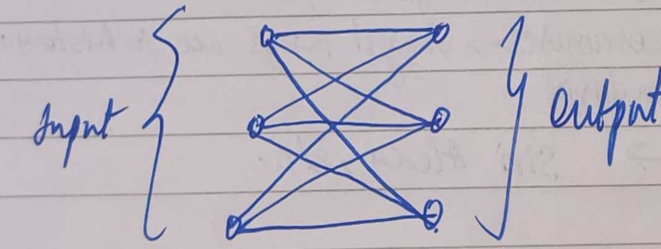
1) Social Media → Insta → People you may know.
2) Sales & marketing → ecommerce → suggest things acc to historyo
3) Healthcare → facial analysis
4) Personal Assistants → Siri Alexa, etc.

Single layer Neural Network

- Precepton is most basic form of neural network.
- consists of set of inputs nodes connected to output nodes using weighted connections.
- Neuron in procyptoon are independt of each other.
- No. of input may net be same as number of neurons (output)

Mathematically -

1) Perception → 'm' inputs 'n' neurons.
2) ~~each~~ weights are labelled wi & where $1 \leq i \leq m$.
3) each neuron has its own specific weight denoted on Wij, where i is input node no &
   j is output node number.

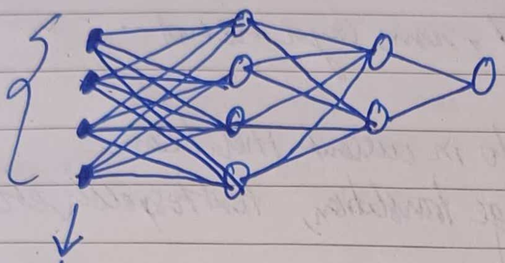


Limitations -

- uses just binary activation function
- only applicable to linear network
- provides an optimal soln due to supervised learning.
  more training time.
- unable to tackle linear in sepelabl problems

* Multilayer Preceptron-

- If neural network requires complex decision making we can create mutiple layers of perceptron netwok.



Layer 1 process input its output is input for layer2. along with output, weights are also given.

- atleast one layer b/w input & output layer.
- hidden layer b/w i/o layers.
- offers best sol^n to every categorization issue
- input → non linear multilayer network with linear discriminants use

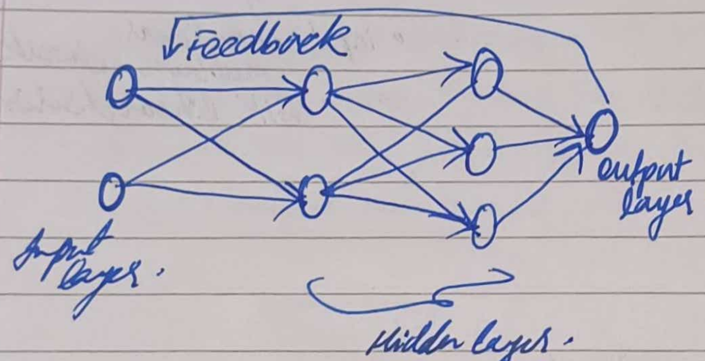
* need for Multilayer networks-

- to solve complex probles
- forhuge input output data
- intricate info is too complex for single layer tohandle
- multilayer go beyond limitation of single layer.

Recurrent Neural Network (RNN)-

- Feed Forward Neural Network.
  - Perceptors are alleged in layers, hidden layers are not connected with outside world.
  - All nodes fully connected & some layer are not.

- need to access previous info in current iteration
- commonly used in language translation, text to speech, etc



Adv → • remember each info through time
- useful in time series prediction → feature to remember input. LSTM
- extend effective pixel neighbourhood.

Disadv → • gradient vanishing & exploding problems.
- Training is an difficult task.
- can't process very long sequence if using tanh or relu as activation funct

Types of RNN → one to one
one to many
many to one
many to many.

FLANN →

- Functional Link Artifical Neural Network.
- high order neural network with low computational complexity
- No hidden layers.
- generate additional synthetic inputs for a feed forward NN. by appl^n func^n to original, raw input

Two choices for input data –

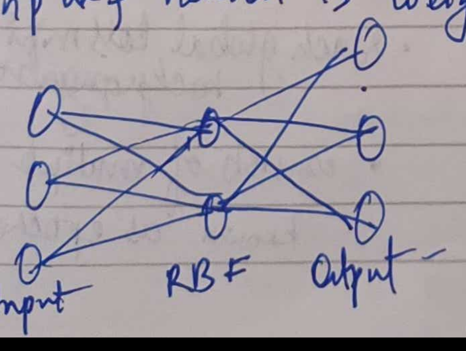
1) Outerproduct or Tensor model –
   - product of input with each other
   - inputs = {x_0, x_1, x_2} · after tensor model input will be
     inputs = {x_0, x_1, x_2, x_0x_1, x_1x_2, x_2x_3}.

2) Functional expansion model –
   - apply one or more univariant func^n to each input.
     eg → Input → x
     extra inputs → x^2, x^3, x^n ———

RBF →

- Radial Basis Functions.
  → kernal trick used to classify non linear data using SVM.
  given as $K(x,y) = \exp\left[-\frac{(x-y)^2}{2\sigma^2}\right]$.

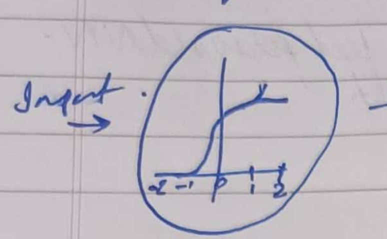
RBFN → consists of input nodes connected by weights to set. RBF neurons which fine ~~proportional~~ proportional · to distance b/w input & neuron is weight space



– They never have >1 layer of non-lineal neurons.

Activation Fuction -

decides wheather artificial neural would fire for a given set of inputs.



It's crucible in determining accuracy & computational effcien of model.

Types of activation fucn -

1) Identify fucn $= g(x) = x$.

2) Binary step fuction $= g(x) = 1$ when $x > 0$ otherwise 0.

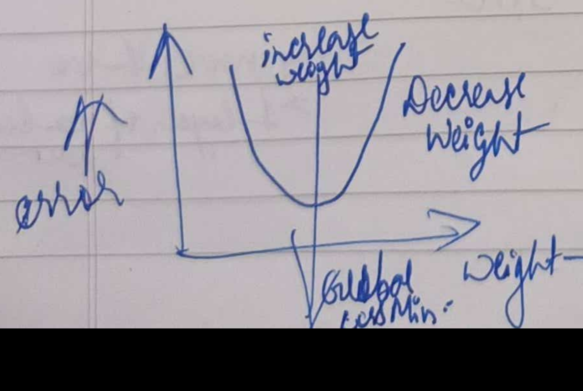
3) Logistic / Sigmoid $= s(x) = \frac{1}{1+e^{-x}}$

4) TanH $= TanH(x) = \frac{e^{x} - e^{-x}}{e^{x} + e^{-x}}$.

5) Rectified Linear Unit (ReLU):
$R(x) = max(0, x)$

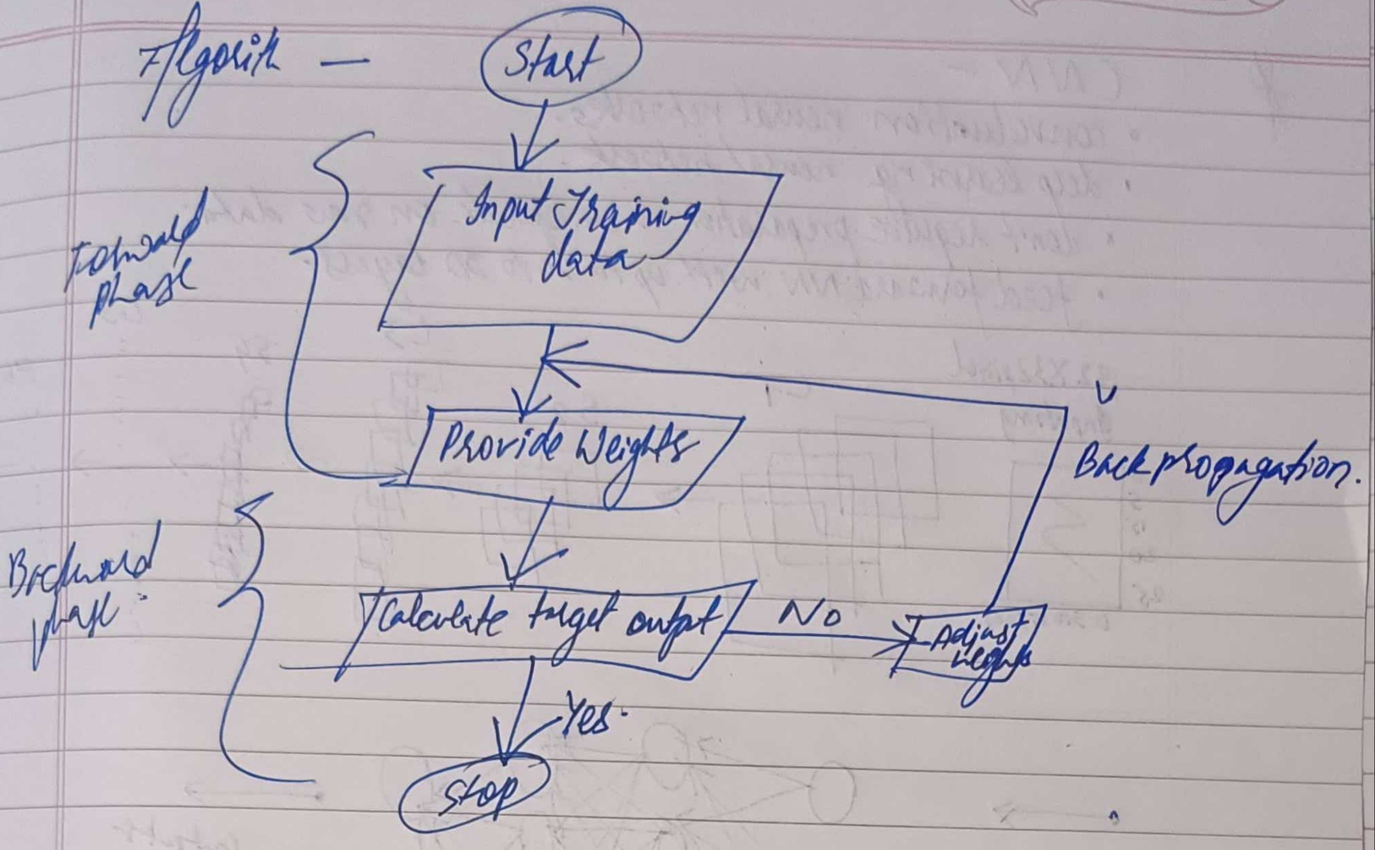
Back propagation -

- algo for supervised learning for ANN
- keeps adjusting weights of connected neurons with an output to reduce deviation of output signal with target output.



- reach global loss mini using backpropagation
- consists of mutiple iterations known as epochs

Algorith —



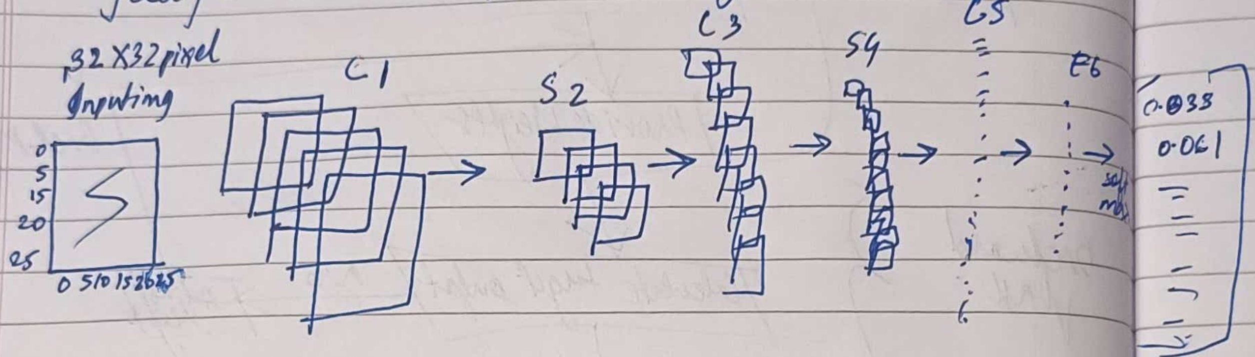
Features → gradient descent method → case of simple perceptron network with diff unit
→ weights are calculate in learning period of network
→ • feed forward of input training pattern
• calculation & backpropagation of error
• updation of weight.

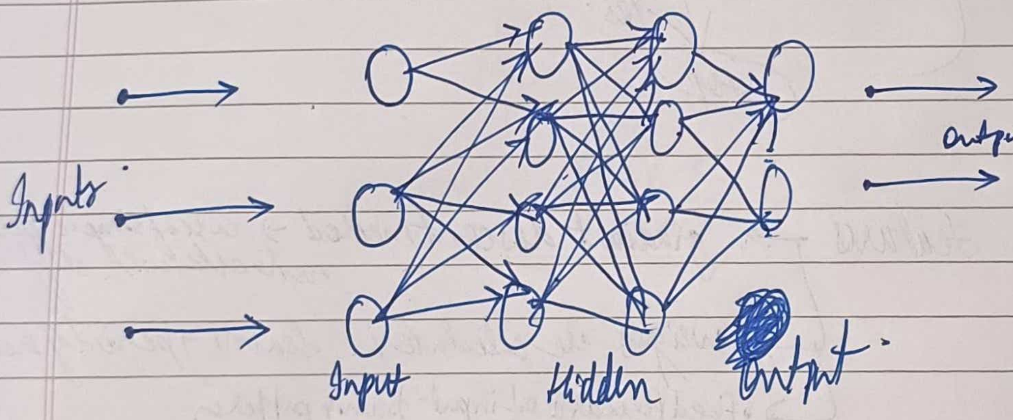
Adv → • simple, fast & easy
• only no. of input are tuned, not any other parameter
• flexible & efficient
• No need for user to learn any special function.

Disadv → • sensitive to noisy data & irregularities.
• performance → dependent → data
• too much time training
• matrix based approach preffered over mini batch

✱ CNN -

- convelution neural networks.
- deep learning neural network.
- don't require preparation → can operate on raw data.
- feed forward NN with up to 20 to 30 layers.





Adv → • detecting patterns & feature in img, video & audio signals
- Robust to translation, rotation, & scaling invariance
- end-to end training, no need for manual feature extraction
- can handle large amt of data & high accuracy

Dis → • computationally expensive & need lot of memory
- prone to overfitting
- large amount of labeled data
- Interpretability is limited, hard to understand what network has learned.