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Q 1 What is soft computing? Compare hard and soft computing. List various soft computing techniques.

Soft Computing -

An approach to computing which parallels the remarkable ability of the human mind to reson and learn in an environment of uncertainly and precision.

It is characterised by the use of in exact solutions to computationally hard tasks such as the solution of non parametric complex problems for which an exact solution can't be derived in polynomial of time.

Mathmetical model and analysis can be done for relatively simple systems more complex system arising in biology medicine and manggement systems remains intractable to conventional mathematical and analytical methods soft computing deals with imprecisim uncertainity, partial truth and approximation to achieve tractability robustness and low solution cost it extends its application to various disiplines of engineering and science

Typically human can

1) Take decisions
2) Expertise in an area
3) Inference from previous situations experience
4) Adapt to changing environment.
5) Learn to do better.
6) Social behaviour of collective intelligence.

Soft Computing	Hard computing
1) Soft computing is liberal in exactness, uncertainity partial truth and approximation	1) Hard computing needs a exactly state analytic model
2) Soft computing relies on formal logic and probabilistic reasoning.	2) Hard computing relies on binary system and crisp system.
3) Soft computing has the features of approximation and dispositionality	3) Hard computing has the features of exactitude and categoricity
4) Soft computing is stochastic in nature	4) Hard computing is deterministic in nature
5) It works on ambiguous and noisy data.	5) It works on exact data
6) It can perform parallel computations	6) It perform sequential computations
7) It produce approximate results.	7) It produces precise result.
8) It will emerge its own programs	8) It requires programs to be written.
9) It incorporates randomness	9) It is settled
10) It will use multivalued logic	10) It uses two-valued logic.

The popular soft computing components in designing intelligence control theory are.

1) Fuzzy Logic
2) Neutral Networks
3) Evolutionary Algorithms.

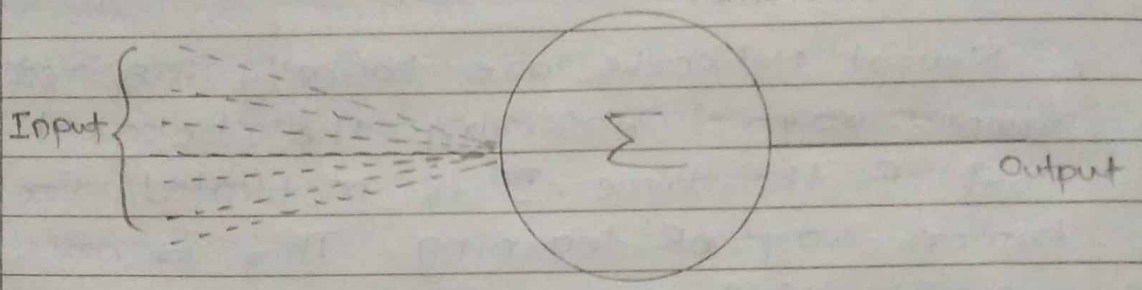
Q. 2 Draw biological NN and explain its parts? Draw neat sketch of biological equivalent NN and explain various parts

Neural Networks are basically inspired by various way of observing the biological organism. Most of the time. It is motivated from human way of learning. This is an artificial network that learns from example and because it is disturbed in nature fault tolerent parallel processing of data and distributed structure.

A neural network is a method in artificial intelligence that teches computers to process data in a way that is inspired by the human brain. It is a type of machine learning process called deep learning that uses interconnected nodes or neurons in a layered structure that resembles the human brain.

The basic elements of artificial Neural Network are input nodes, weights, activation function and output node. Input are associated with synaptic weights. They are all summed and passed through an activation function giving output y. In a way output is summation of the signal multiplied with synaptic weight over many input channels.

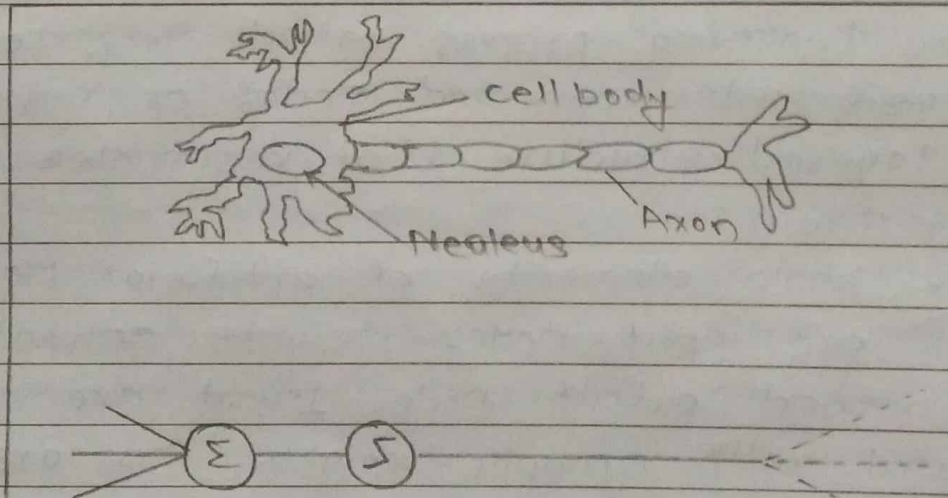
Linear Neural Networks



$W = \{w_1, w_2, \ldots, w_n\}$ weight vector

Basic element of an artificial neuron.

Analogy of Biological neurons and artificial neuron.



Through axon this neuron actuates the signal and this signal is sent out through synapes to various neurons. Similarly shown a classical artificial neuron. This is a computational unit. There are many inputs reaching this. The input excites this neuron. Similarly, there are many inputs that excite this computational unit and the output again excites many other units like here. Like that taking certain concepts in actual neural network, we develop these artificial computing models having similar structure.

There are various locations where various functions take place in the brain.

If we look at a computer and a brain, this is the central processing unit and a brain. Let us compare the connection between our high speed computers that are available in the market today and a brain. Approximately there are 10 to the power of 14 synapses in the human brain, whereas typically you will have 10 to the power of 8 transistors inside a CPU. The element size is almost comparable, both are 10 to the power minus 6 and energy use is almost like 30 watts and comparable actually; that is energy dissipated in a brain is almost same as in a computer. But you see the processing speed. Processing speed is only 100 hurtz; our brain is very slow, whereas computers nowadays, are some Giga hertz.

Q.3 Compare Biological neurons with ANN.

Artificial Neuron Network	Biological Neural Network
1) It is the mathematical model which is mainly inspired by the biological neuron system in the human brain.	1) It is also composed of several processing pieces known as neurons that are linked together via synapses.
2) Its processing was sequential and centralized.	2) It processes the informati in a parallel and distributive manner.
3) It is small in size	3) It is large in size
4) Its control unit keeps track of all computer-related operations.	4) All processing is managed centrally.
5) It control unit keeps track of all computer-related operations.	5) All processing is managed centrally.
6) It processes the information at a faster speed	6) It processes the information at a slow speed.
7) It cannot perform complex pattern recognition	7) The large quantity and complexity of the connections allows the brain to perform complicated tasks.
8) It doesn't provide any feedback.	8) It provides feedback
9) There is no fault tolerance.	9) It has fault tolerance
10) It is very valuerable.	10) It is robust.

Q.6. Explain the Basic terminology associated with NN [input, Weights, Net Input function, Activation function, List of activation functions, Error propagation].

Neural Networks are a type of machine learning algorithm that are modeled after the human brain. Here are some basic termilogies associated with neural networks:

- Input :- The input layer of a neural network is where data is fed into the network. The input can be in the form of text, images, or any other type of data.

- Weights :- Weights are the parameters that are learned by the neural network during training. They determine the strength of the connections between neurons in the network.

- Net Input Funtions :- The net input function is the weighted sum of the inputs to a neuron. It is calculated by multiplying each input by its corresponding weight and then summing the results.

- Activation Function :- The activation function is applied to net input function to determine the output of a neuron. It introduces non-linearity into the network and allows it to model complex relationships between inputs

and outputs.

- List of Activation Functions :- There are several activation functions that can be used in a neural network, including the sigmoid function, the ReLU function, and the tanh function. Each function has its own strengths and weakness, and the choice of function depends on the specific problem being solved.

- Error Propagation :- Error propagation is the weights of a neural network, including the sigmoid function, during training in order to minimize the different between the predicted output and the actual output. This is done using an optimization algorithm such as gradient descent.

Q5. What is learning? State and explain different categories of learning [parameter, structure, Unsupervised, Supervised and Reinforcement].

Learning is the process of acquiring knowledge, skills, and abilities through experience, study or instruction. Here are some different categories of learning:

- Parameter Learning :- In parameter learning, the neural network learns the values of the parameters that best fit the training data. This is typically done using an optimization algorithm such as gradient descent.

- Structure Learning :- In structure learning, the neural network learns the structure of the network itself. This can include the number of layers, the number of neurons is each layer, and the connections between neurons.

- Unsupervised Learning :- In unsupervised learning, the neural network is given a set of inputs and must find patterns or structure in the data without any explicit feedback or labels.

- Supervised Learning :- In supervised learning the neural network given a set of inputs and corresponding outputs. and must learn to map the inputs to the correct outputs.

- Reinforcement Learning :- In reinforcement learning, the neural network learns to take actions in an environment in order to maximize a reward signal. The network receives feedback in the form of rewards or punishments based on its actions, and must learn to take actions that lead to the highest reward.

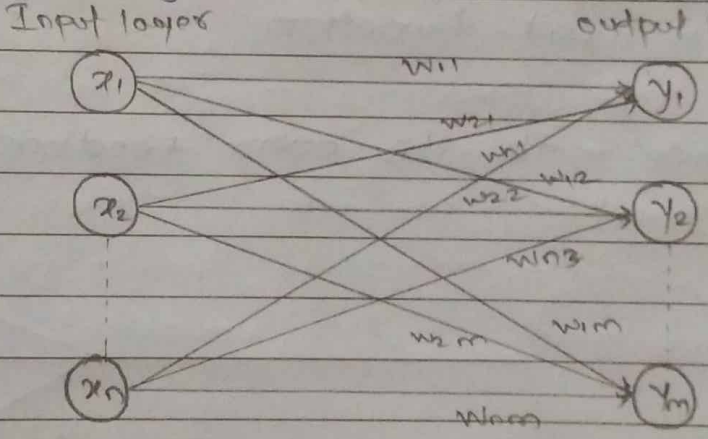
Q. 6 Explain different NNs architectures with suitable figure.

There are several different architectures for ANNs each with their own strengths and weakness, some of the most common architecture include.

- Feed forward Neural Network
- Recurrent Neural Network
- convolutional Neural Network

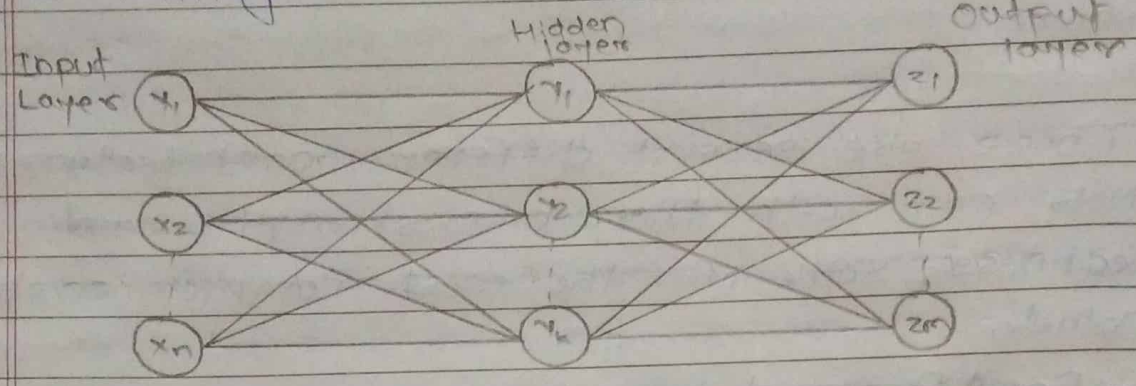
There are five basic types of neuron connection architecture :

1) Single - layer feed-forward network



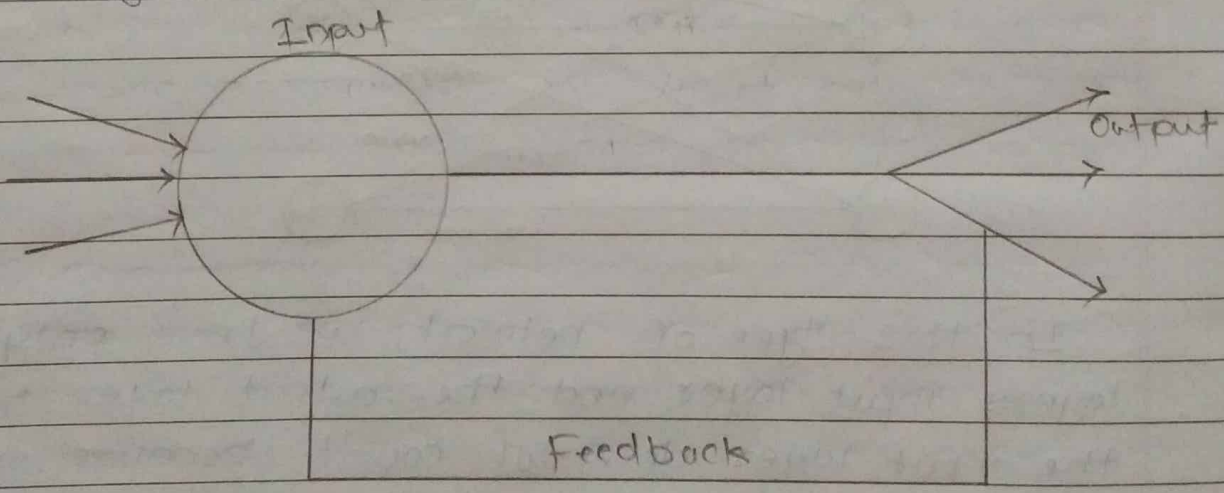
In this type of network, we have only two layers input layer and the output layer but the input layer does not count because no computation is performed in this layer, the output layer is formed when different weights are applied to input nodes and the cumulative effect per node is taken, After this the neurons collectively give the output layer to compute the output signals

2) Multilayer feed-forward network.



This layer also has a hidden layer that is internal to the network and has no direct contact with the external layer. The existence of one or more hidden layers enables the network to be computationally stronger a feed-forward network because of information flow through the input function.

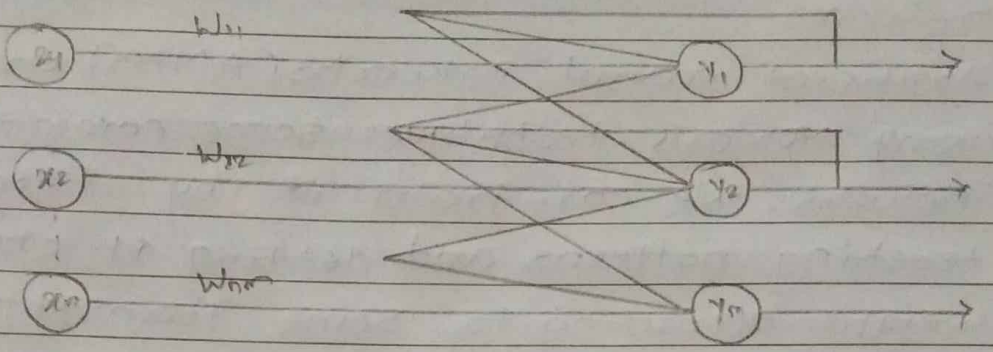
3) Single node with its own feedback.



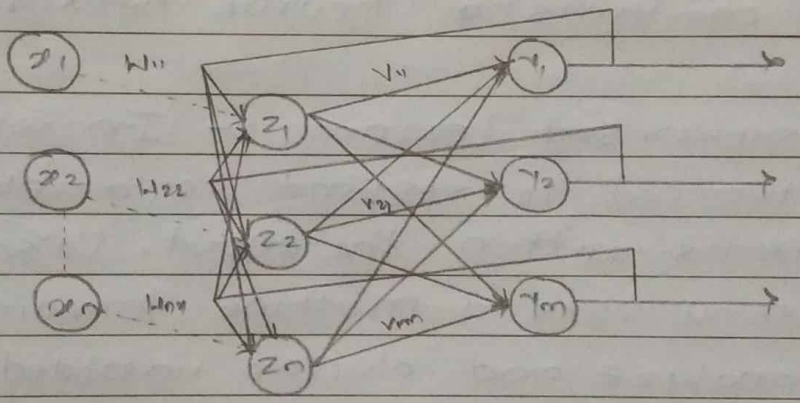
When outputs can be directed back as inputs to the same layer or preceding layer nodes.

4) Single layer recurrent network :- A signal layer network with feedback from output

can be directed to processing element itself or to other processing element / both.



5) Multilayer recurrent network :-
Processing element output can be directed back to the nodes in the preceding layer, forming a multilayer recurrent network.



Q.7. What are various training techniques used in ANN.

Artificial neural networks (ANNs) are trained using various techniques. some common methods includes, We can train it by feeding it by teaching patterns and letting it change its weight according to some learning rules.

1) Supervised Learning :- The network is trained by providing it with input and matching output patterns, and these input-output pairs can be provided by an external system that contains a neural network.

2) Unsupervised Learning :- In which output is trained to respond to a classes of patterns within the input. Unsupervised learning uses a machine learning algorithm to analyze and cluster unlabeled datasets.

3) Reinforcement Learning :- This type of learning may be considered as an intermediate form of the above two types of learning. which trains a model to return an optimum solutions for a problem by taking a sequence of decision by itself.

Steps of Back propagation Algorithm:
1) Present the training sample to the neural network.

2) Compare the ANNs output to the wanted output from the data.
3) calculate the error in each output neuron
4) For each neuron, calculate the scaling factor, output, and how much lower or higher the output showed be to match the desired output.

Q8. State and explain few applications of ANNs which are used to solve some real life problems

Applications of artificial neural Networks:

1) Social media :- Artificial neural networks are used heavily on social media.
For example - let's take the people you may know features on facebook that suggests people that you might know in real life so that, you send them friend requests. Well, this magical effect is achieved by using artificial neural networks that analyze your profile. Another application is social recognition - This is done by finding around 100 reference points on the persons face and then matching them with those already available in the database using convolutional neural networks.

2) Marketing and Sales :-
When you log into E-commerce sites like amazon and flipcart, they will recommended your products to buy based on previous browsing history. Similarly, Suppose you love pasta, then zomato, swiggy, etc will show you restaurant.

3) Healthcare :-
Artificial neural network are used in oncology to train algorithms that can

identify cancerous issue on the microscopic level at the same accuracy as trained physician. various rare disease may manifest in physical characteristic and can be identified in their premature stages by using facial analysis on the patient photos so the full skill implementation of artificial neural networks in the healthcare environment can only enhance the diagnostic abilities of medical experts and ultimately, lead to the overall improvement in the quality of medical care all over the world.

4) Personal Assistants :-

There are personal assistants and an example of speech recognition that uses Natural Language processing to interact with the uses and formulas a response accordingly. Natural Language processing to ussd to make to handle many tasks of these personal assistants such as managing the language syntax, sematics, correct speech, the conversation that is going on etc.