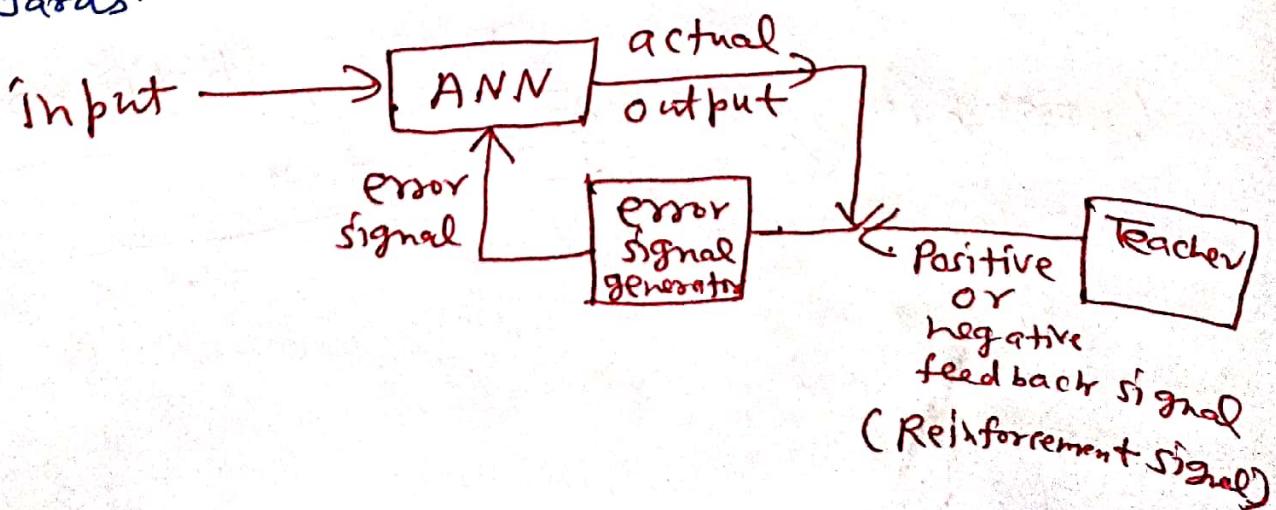


Some Additional Topics

Reinforcement Learning (~~Reinforcement~~)

- * In this type of learning, the ANN learns itself automatically using either positive feedback or negative feedback.
- * If the Computed output is correct, then it gets a positive feedback (Reward) or if the Computed output is incorrect, then a negative feedback (Penalty) is received.
- * So we can say that it is like supervised learning that a teacher is present, but does not present the expected output / desired output, but only indicates that whether the Computed output is correct or incorrect.
- * Since there is no expected output, so the ANN is bound to learn by its experiment only.
- * Reinforcement Learning solves a specific type of problem where decision making is sequential and the goal is long term. e.g. Game Playing.
- * The primary goal of ANN is to improve the performance by getting the maximum positive rewards.



key features of Reinforcement Learning

- ① It is based on the hit and trial Process.
 - ② Artificial Neural Network (ANN) takes the next action and changes parameters (weights etc.) according to the feedback of the previous action.
 - ③ In this, there is no instruction about the environment and what actions needs to be taken.
 - ④ Time plays a crucial role in Reinforcement problem.
 - ⑤ Feedback is always delayed, not instantaneous.
 - ⑥ It is a part of deep learning method.
- ### Application of Reinforcement Learning:

- ① Robotics for Industrial automation.
- ② Machine learning & data processing.
- ③ Aircraft Control & robot motion control.

Gradient Descent Learning algorithm

- ① It is the most used algorithm to train neural network.
- ② It is an optimization algorithm whose goal is to find model parameters (coefficient weights) that minimize the error of the model.
- ③ It does so by making changes to the model that move it along a gradient/slope of errors down toward a minimum error value.
- ④ Gradient descent can vary in terms of no. of training patterns used to calculate error that is in turn used to update the model.
- ⑤ Real life example: Suppose we have a ball  and if we place it on an inclined plane, then it will start rolling until it reaches a gentle plane where it will be stationary (reached the minima.)

Types of Gradient descent algorithm:

- ① Batch
- ② Stochastic
- ③ Mini batch

- ① Batch gradient descent It is a variation of the gradient descent algorithm that calculates the error for each example in the training data set, but only updates its model after all training examples have been evaluated.
* model updates and in term training speed

may become very slow and expensive for large dataset.

* Decreased update frequency means more stable error gradient as well as more computationally efficient

② Stochastic Gradient Descent:

Stochastic means "Random probability". In this algorithm gradient, error for random example in the training dataset is calculated instead of each example. It is faster than batch gradient.

③ Mini Batch Gradient Descent:

This variant of gradient descent algorithm splits the training datasets into small batches that are used to calculate model error and update model parameters. The model update frequency is higher than batch gradient descent. It is the most common implementation of gradient descent used in the field of deep learning.

Types of Supervised Learning

① Classification

② Regression

Classification

① Classification is a technique with which we can affiliate data under certain labels. We can train algorithms and models to classify data under different classes.

② E.g. 1: Will it be hot or cold tomorrow?

E.g. 2: Will you pass or fail in exam?

③ So Classification is the task of predicting a discrete class label.

④ A classification problem with more than two classes is called multi-class classification.

Regression

① Regression helps us to understand the relationship between continuous data points and help us to find hidden patterns among the data. The model's main objective is predict some values.

② E.g. 1: What will be the temperature going to be tomorrow?

E.g. 2: What will be your percentage in exam?

③ So Regression is the task of predicting a continuous quantity.

④ A regression problem with multiple input variable is called a multivariate regression problem.

Fuzzy Propositions

Definition: A proposition is a declarative statement that can either be true or false. A fuzzy proposition is a proposition in which truth value or false value is also depend on additional factor called "degree of truth" or "degree of false", ~~where~~ having value between 0 and 1:

for example: p : Speed is slow

where p = fuzzy proposition

fuzzy truth value $\leftarrow \begin{cases} T(p) = 0-8, & \text{if } p \text{ is partly true.} \\ T(p) = 1, & \text{if } p \text{ is absolutely true.} \\ T(p) = 0, & \text{if } p \text{ is completely false.} \end{cases}$

Types of fuzzy Propositions

- ① Unconditional & Unqualified Proposition.
- ② Unconditional & Qualified Proposition.
- ③ Conditional and Unqualified proposition.
- ④ Conditional and Qualified Proposition.

① Unconditional & Unqualified Proposition

This type of proposition can be represented as

p : V is F .

Where V is a variable and F is a fuzzy set

Example p : Speed(V) is high(F)

$T(p) = 0-8$, if p is partly true

$T(p) = 1$, if p is absolutely true

$T(p) = 0$, if p is totally false.

Where $T(v) = \mu_F(v)$ membership grade function
which indicates the degree of truth of
 v in F .

② Unconditional and Qualifed Propositions

The representation of this proposition is

$$p: v \text{ is } F \text{ is } S.$$

↓ ↓ ↓
Variable Fuzzy set Fuzzy truth Qualifier.

Example: Speed is high is very tall

↓ ↓ ↓
v F S

③ Conditional and Unqualified Propositions

The representation of this proposition is

$$p: \text{if } X \text{ is } A, \text{ then } Y \text{ is } B,$$

↓ ↓ ↓
Variable Fuzzy set Variable Fuzzy set

Example: If speed is high, then risk is low.

④ Conditional and Qualified Propositions

④ The representation of this proposition is

$$p: (\text{if } x \text{ is } A, \text{ then } y \text{ is } B) \text{ is } S$$

Example: If speed is high, then risk is low is true

Short Question in Soft Computing

①

Mutation Rate / Mutation Probability

Mutation rate decides how often parts of chromosomes will be mutated. If there is no mutation, offspring are generated immediately after crossover without any change. So if mutation rate is 0%, nothing will change and if mutation rate is 100%, whole chromosome will change.

②

Linguistic Variable in fuzzy Logic:

Linguistic variable is a variable whose values are words or sentences in a natural language.

OR

Linguistic variable is a variable of higher order than fuzzy variable and it takes fuzzy variable as its values.

example: $T(\text{Age}) = \{\text{young}, \text{not young}, \text{very young}, \text{old}\}$

\downarrow \downarrow \downarrow \downarrow
 Linguistic fuzzy values

③

Fuzzy Inference: Fuzzy inference is the process

of formulating the mapping from a given input to an output using fuzzy logic. It is a method that interprets the values in the input vector and based on some set of rules, assign value to the output vector. It provides a basis from which decision can be made.

(4) Advantages of Genetic Algorithm (GA)

- (a) Concept is easy to understand
- (b) GA is easily parallelized.
- (c) GA is robust.
- (d) GA is good for noisy environment.
- (e) GA can operate on various representation
- (f) GA work well on mixed discrete/continuous problem.

(5) Predicate logic: is an extension of propositional logic.

It adds the concept of Predicates and quantifiers to better capture the meaning of statements that cannot be adequately expressed by propositional logic.

e.g. $P(x)$: x is greater than 3
↓ ↓
Subject Predicate

(6) What is genetic programming

Genetic Programming: Genetic programming is a domain independent method that genetically breeds a population of computer programs to solve a problem. It iteratively transforms a population of computer programs into a new generation of programs by applying analogs of naturally occurring genetic operations (such as Crossover, mutation, reproduction etc.).

Role of AI (Artificial Intelligence) in Neural Networks

Ans

The Role of AI made it possible for machines to learn from experience to perform faster more efficiently. The neural network is one of its advancements which is inspired by the structure of the human brain that helps to computers and machine more like a human. Neural networks uses various technologies like deep learning and machine learning as a part of Artificial Intelligence.

What do you mean by Fuzzification

Fuzzification is the process of transforming crisp input values into linguistic values.

Steps for fuzzification

- ① Input values are translated into linguistic concepts, which are represented by fuzzy set.
- ② Membership functions are applied to the measurements and the degree of membership is determined.

Limitation of fuzzy Systems

Ans

- ① Fuzzy System can
- ② Determining fuzzy rules and membership function is a complex task.
- ③ One cannot predict how many membership functions are required.
- ④ Verification & validation of a fuzzy