LEARNING PROCESS

LEARNING WITHOUT A TEACHER

- Reinforcement learning
  - Uses a feedback signal to know how good or but the current configuation of the network parameters is.
- Unsupervised learning
  - The input data is unlabeled.
  - The parameters of the network are optimized with respect of the task independent measure.

LEARNING WITH A TEACHER

- Concept
  - Known as Supervised Learning
  - Update the parameters of the network based on the influence of the training vector and the error signal, which is calculated from the difference of the desired response and the actual response of the network.
  - The input data is labeled

BOLTZMANN LEARNING

- Concept
  - Stochastic learning algorithm
  - When implemented in a neural network is get called Boltzmann Machine
  - The neurons constitute a recurrent structure and they operate in a binary manner as they are either on or off.
  - It uses an energy function to update the weights of the network using a T with a probability.

COMPETITIVE LEARNING

- Concept
  - Output neurons of a NN compete among themselves to become active (fired).
  - Only a single output neuron is active.
- Components
  - Set of neurons with randomly distributed synaptic weights.
  - A limit on the strength of each neuron
  - A mechanism that permits the neurons to compete for the right to respond to a given subset of inputs.

HEBBIAN LEARNING

- Process:
  - 1. If two neurons on either side of a synapse are activated simultaneously, then the strength of that synapse is selectively increased.
  - 2. If two neurons on either side of a synapse are activated asynchronously, then that synapse is selectively weakened or eliminated.
- Properites of a Hebbian Synapse
  - Time dependent mechanism
  - Local mechanism
  - Interactive mechanism
  - Conjunctional or correlational mechanism
  - Several output neuron can be active simultaneously.

LEARNING TASKS

- Pattern association
  - Autoassociation
    - A NN is required to store a set of patterns by repeatedly presenting them to the network
    - Input data is noisy or partial
  - Heteroassociation
    - The set of input patterns are paired with another arbitrary set of output patterns.
- Pattern recognition
  - Process where a category is assigned to a pattern or signal perceived
  - Forms:
    - Machine is split into two parts: Unsupervised network for feature extraction and supervised network for classification
    - Machine is designed as a single multilayer feedforwards network using supervised learning algorithm.
- Function approximation
  - Uses a NN to approximate an unknown function
- Control
- Filtering
- Beamforming
  - Spatial form of filtering used to distinguish between properties of a target signal and background noise.

DEFINITION

- [Haykin, 1994] Learning is a process by which the free parameters of a neural network are adapted through a process of stimulation by the environment in which the network is embedded. The type of learning is determined by the manner in which the parameter changes take place.

SEQUENCES OF EVENTS

- 1. Neural network is stimulated by an enviroment
- 2. Neural network undergoes changes in its free parameters as a result of the stimulation
- 3. Neural network responds in a new way to the environment because of the changes in its internal structure.

ERROR-CORRECTION LEARNING

- Process of updating the weights of a network by comparing the output signal of the network to a desired response or target output.
- Designed to make the output signal come closer to the desired output
- e_k(n) = d_k(n) - y_k(n)
- Also known as delta-rule or Widrow-Hoff Rule

MEMORY-BASED LEARNING

- Past experiences are explicitly stored in a large memory of correctly classified input-output examples.
- Types
  - Nearest neighbor rule
    - Components
      - Local neighbor
        - Training example that lies in the immediate neighborhood of the test vector.
      - Euclidean distance
        - Measure the distance between two vectors
  - K-Nearest Neighor
    - Procedure
      - 1. Identify the K classified patterns that lie nearest to the test vector for some integer k.
      - 2. Assign x to the class hypothesis most frequently represented in the k nearest neighbors to x.
- Require