CHAPTER – 5

APPLICATIONS

NEURAL NETWORKS:

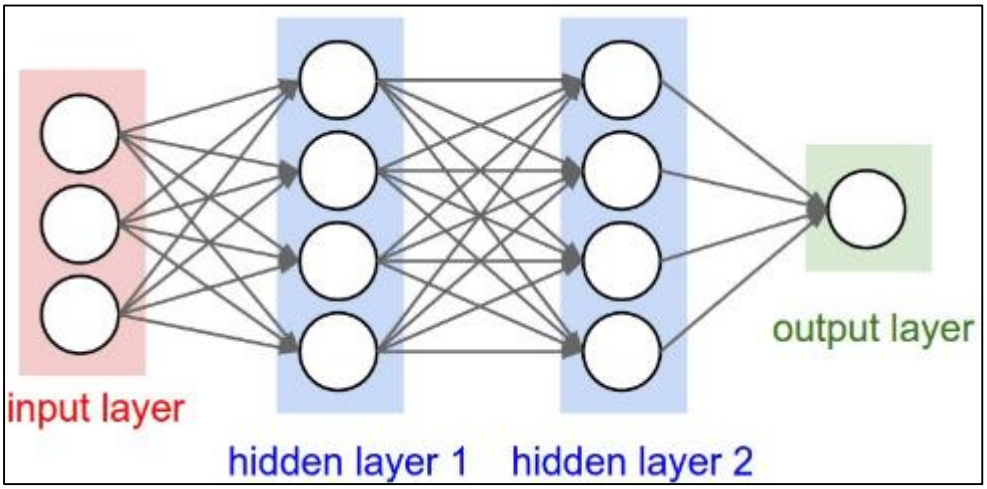
A neural network also known as Artificial Neural Network (ANN) is an artificial intelligence system that is capable of finding and differentiating patterns like a human brain. A neural network can learn by examples and can adept new concepts and knowledge. Neural networks are widely used for visual pattern and speech recognition system.

Neural network is inspired by biological neural networks that constitute animal brain. Such system learn to perform task by considering examples, generally without being programmed and with any task specific rules.

An ANN is based on a collection of connected units or nodes called artificial neurons which loosely model the neurons in a biological brain. Each connection can transmit a signal from one neuron to another. An artificial neuron that receives a signal can process it and then provide some value.

Neural networks attempt to mimic the structure and functioning of the human brain. Conceptually neural network consist of three layers of virtual nerves cells (neurons) and this three layers are:

a. Input Layer
b. Output Layer
c. Middle Layer (Hidden Layer)



The input and output layers are connected to the middle layer by connections having different weights. All the inputs and the corresponding weights are computed to calculate a value. If the final value is greater than or equal to a particular threshold value then the system takes some action accordingly. There may be multiple hidden layers in between input and output layers.

Applications of Neural Networks:

- **Character Recognition:**

The idea of character recognition has become very important as handheld devices like the Palm Pilot are becoming increasingly popular. Neural networks can be used to recognize handwritten characters.

- **Image Compression:**

Neural networks can receive and process vast amounts of information at once, making them useful in image compression. With the Internet explosion and more sites using more images on their sites, using neural networks for image compression is worth a look.

- **Stock Market Prediction:**

The day-to-day business of the stock market is extremely complicated. Many factors weigh in whether a given stock will go up or down on any given day. Since neural networks can examine a lot of information quickly and sort it all out, they can be used to predict stock prices.

- **Traveling Salesman's Problem:**

Interestingly enough, neural networks can solve the traveling salesman problem, but only to a certain degree of approximation.

- **Medicine, Electronic Nose, Security, and Loan Applications:**

These are some applications that are in their proof-of-concept stage, with the acceptation of a neural network that will decide whether or not to grant a loan, something that has already been used more successfully than many humans.

- **Face Recognition Using Artificial Neural Networks:**

Face recognition entails comparing an image with a database of saved faces to identify the person in that input picture. Face detection mechanism involves dividing images into two parts; one containing targets (faces) and one providing the background.

The associated assignment of face detection has direct relevance to the fact that images need to be analyzed and faces identified, earlier than they can be recognized.

- **Fraud Detection & Prevention Services:**

XenonStack Fraud Detection Services offers real-time fraud analysis to increase profitability. Data Mining is used to quickly detect frauds and search for spot patterns and detect fraudulent transactions. Data Mining Tools like Machine Learning, Neural Networks, and Cluster Analysis are used to generate Predictive Models to prevent fraud losses.

- **Data Modeling Services:**

XenonStack offers Data Modelling using Neural Networks, Machine Learning, and Deep Learning. Data modelling services help Enterprises to create a conceptual model based on the analysis of data objects. Deploy your Data Models on leading Cloud Service

Providers like Google Cloud, Microsoft Azure, and AWS or on container environment - Kubernetes & Docker.

Advantages of Neural Networks

- A neural network can perform tasks that a linear program cannot.
- When an element of the neural network fails, it can continue without any problem by their parallel nature.
- A neural network learns and does not need to be reprogrammed.
- It can be implemented in any application.
- It can be performed without any problem.

Limitations of Neural Networks

- The neural network needs the training to operate.
- The architecture of a neural network is different from the architecture of microprocessors, therefore, needs to be emulated.
- Requires high processing time for large neural networks.

Expert System:

An expert system also called a knowledge base system is an artificial intelligence system that applies reasoning capabilities to reach at a conclusion. Expert systems work as an expert consultant for a particular problem domain and gives suggestion accordingly. The strength of expert system is based on the knowledgebase and inference rules used by expert system. Expert systems are excellent for the diagnosis and prescriptive problems. Diagnostic problems are those requiring an answer to the question like "what is wrong?" correspond to the intelligence phase of decision making prescriptive problems are those that require an answer to the question, "what to do?" and corresponds to the choice phase of decision making.

Components of Expert System:

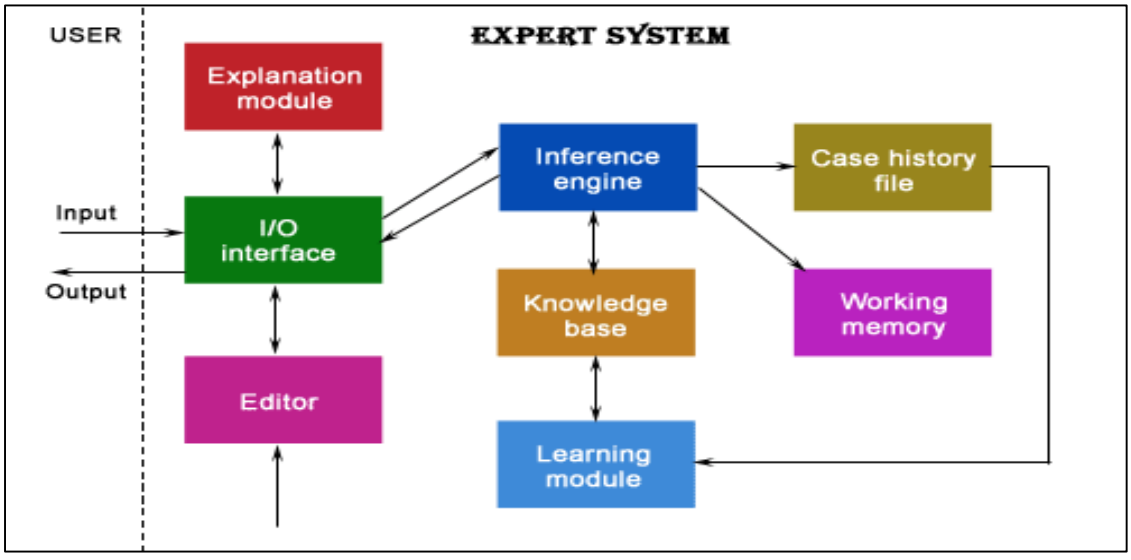


Fig: Components of Expert System

1. **Input/output User Interface:**

It enables the users to enter instructions and information into the expert system and to receive information from it. The interface permits the users to communicate with the system in a more natural way. Especially use in language which is close to the natural language. The user interface has two parts:

a. Expert System Input: A user can use method for input command, natural language and customize the interface.
b. Expert System Output: An expert systems are designed to provide output or solution for specific problem domain and also has the ability to explain the solution.

2. **Inference Engine:**

The inference engine is one of the most important component that accepts user input queries and responses to questions through the user interface and uses this dynamic information with the static knowledge base. So, the inference engine acquires and manipulate the knowledge from the knowledge base to arrive at a particular solution. In case of rule based expert system, inference engine:

- Applies rules repeatedly to the facts, which are obtained from earlier rule application.
- Adds new knowledge into the knowledge base if require.
- Resolves rules conflicts when multiple rules are applicable to a particular case.

To recommend a solution the inference system uses following strategies:

a. **Forward Chaining:**

It is a strategy of an expert system to answer the question, "what can happen next?" here, the inference engine follows the chains of conditions and derivations and finally provides the outcomes.

b. **Backward Chaining:**

With this strategy, an expert system find out the answer to the question "why this happen?" on the basis of what has already happen, the inference engine tries to find out which conditions could have happened in past for this result.

3. **Knowledge Base:**

It contains domain specific and high quality knowledge especially in the form of facts and rules. Knowledge is required to show intelligent behavior and the success of any expert system mainly depends upon the collection of highly accurate and précised knowledge.

The knowledge base of an expert system is a store of both factual and heuristic knowledge. In knowledge base knowledge acquisition and knowledge representation plays the important role knowledge are acquired from various sources and organize the knowledge using different knowledge representation methods.

Application Areas of Expert Systems:

a. Diagnosis and Troubleshooting of Devices and Systems of All Kinds

This class comprises systems that deduce faults and suggest corrective actions for a malfunctioning device or process. Medical diagnosis was one of the first knowledge areas to which ES technology was applied (for example, see Shortliffe 1976), but diagnosis of engineered systems quickly surpassed medical diagnosis. There are probably more diagnostic applications of ES than any other type. The diagnostic problem can be stated in the abstract as: given the evidence presenting itself, what is the underlying problem/reason/cause?

b. Planning and Scheduling:

Systems that fall into this class analyze a set of one or more potentially complex and interacting goals in order to determine a set of actions to achieve those goals, and/or provide a detailed temporal ordering of those actions, taking into account personnel, materiel, and other constraints. This class has great commercial potential, which has been recognized. Examples involve airline scheduling of flights, personnel, and gates; manufacturing job-shop scheduling; and manufacturing process planning.

c. Configuration of Manufactured Objects from Subassemblies:

Configuration, whereby a solution to a problem is synthesized from a given set of elements related by a set of constraints, is historically one of the most important of expert system applications. Configuration applications were pioneered by computer companies as a means of facilitating the manufacture of semi-custom minicomputers (McDermott 1981). The technique has found its way into use in many different industries, for example, modular home building, manufacturing, and other problems involving complex engineering design and manufacturing.

d. Financial Decision Making:

The financial services industry has been a vigorous user of expert system techniques. Advisory programs have been created to assist bankers in determining whether to make loans to businesses and individuals. Insurance companies have used expert systems to assess the risk presented by the customer and to determine a price for the insurance. A typical application in the financial markets is in foreign exchange trading.

e. Knowledge Publishing:

This is a relatively new, but also potentially explosive area. The primary function of the expert system is to deliver knowledge that is relevant to the user's problem, in the context of the user's problem. The two most widely distributed expert systems in the world are in this category. The first is an advisor which counsels a user on appropriate grammatical usage in a text. The second is a tax advisor that accompanies a tax preparation program and advises the user on tax strategy, tactics, and individual tax policy.

f. Process Monitoring and Control:

Systems falling in this class analyze real-time data from physical devices with the goal of noticing anomalies, predicting trends, and controlling for both optimality and failure correction. Examples of real-time systems that actively monitor processes can be found in the steel making and oil refining industries.

g. Design and Manufacturing:

These systems assist in the design of physical devices and processes, ranging from high-level conceptual design of abstract entities all the way to factory floor configuration of manufacturing processes.

Natural Language Processing (NLP):

Language is the medium for communication. Natural Language Processing means processing the natural languages commonly used by human being to communicate with each other, so that one language can be easily translated into another language. NLP is a complicated task due to different symbolic domain and difference in grammars in different languages.

Steps in Natural Language Processing:

The various steps of Natural Language Processing are as:

1. **Morphological Analysis:**

Individual words are analyzed into their components and non-word tokens such as punctuation are separated from the words.

2. **Syntactic Analysis:**

In this analysis linear sequence of words are transformed into a structural form, showing how the words relate to each other. In this phase, sentence is represented in a graphical structure known as parsed tree and this step is also known as parsing.

3. **Semantic Analysis:**

The structures created by the syntactic analyzer are assigned meanings that means a mapping is made between the syntactic structures and objects in the task domain.

4. **Discourse Integration:**

The meaning of an individual sentence may depends on the sentences that proceed it and may influence the meaning of the sentences that follow it. This kind of relationship is identified in this step.

5. **Pragmatic Analysis:**

The structure representing what was said is reinterpreted to determine what was actually meant. That means meaning of any sentence may depend on the emotion or feeling or accent while using the sentence. This impact is analyzed in pragmatic analysis.