BACHELOR OF SCIENCE IN INFORMATION TECHNOLOGY

INFORMATION TECHNOLOGY TRENDS GROUP WORK

YEAR 4 SEMESTER 2

PRESENTETION ON ARTIFICIAL INTELLIGENCE

GROUP TWO

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1. Introduction to Artificial Intelligence

Since the invention of computers or machines, their capability to perform various tasks went on growing exponentially. Humans have developed the power of computer systems in terms of their diverse working domains, their increasing speed, and reducing size with respect to time. A branch of Computer Science named Artificial Intelligence pursues creating the computers or machines as intelligent as human beings. According to the father of Artificial Intelligence John McCarthy, it is "The science and engineering of making intelligent machines, especially intelligent computer programs". Artificial Intelligence is a way of making a computer, a computer-controlled robot, or a software think intelligently, in the similar manner the intelligent humans think. AI is accomplished by studying how human brain thinks, and how humans learn, decide, and work while trying to solve a problem, and then using the outcomes of this study as a basis of developing intelligent software and systems. While exploiting the power of the computer systems, the curiosity of human, lead him to wonder, "Can a machine think and behave like humans do?" Thus, the development of AI started with the intention of creating similar intelligence in machines that we find and regard high in humans.

Goals of AI

- To Create Expert Systems: The systems which exhibit intelligent behavior, learn, demonstrate, explain, and advice its users.

- To Implement Human Intelligence in Machines: Creating systems that understand, think, learn, and behave like humans

What Contributes to AI?

Artificial intelligence is a science and technology based on disciplines such as Computer Science, Biology, Psychology, Linguistics, Mathematics, and Engineering. A major thrust of AI is in the development of computer functions associated with human intelligence, such as reasoning, learning, and problem solving.

Applications of AI

AI has been dominant in various fields such as:

- Gaming AI plays crucial role in strategic games such as chess, poker, tic-tac-toe, etc., where machine can think of large number of possible positions based on heuristic knowledge. ⎪ Natural Language Processing It is possible to interact with the computer that understands natural language spoken by humans.
- Expert Systems There are some applications which integrate machine, software, and special information to impart reasoning and advising. They provide explanation and advice to the users. ⎪ Vision Systems These systems understand, interpret, and comprehend visual input on the computer. For example,
- A spying aeroplane takes photographs which are used to figure out spatial information or map of the areas.
- Doctors use clinical expert system to diagnose the patient.
- Police use computer software that can recognize the face of criminal with the stored portrait made by forensic artist ⎪ Speech Recognition. Some intelligent systems are capable of hearing and comprehending the language in terms of sentences and their meanings while a human talks to it. It can handle different accents, slang words, noise in the background, change in human's noise due to cold, etc.
- Handwriting Recognition The handwriting recognition software reads the text written on paper by a pen or on screen by a stylus. It can recognize the shapes of the letters and convert it into editable text.
- Intelligent Robots Robots are able to perform the tasks given by a human. They have sensors to detect physical data from the real world such as light, heat, temperature, movement, sound, bump, and pressure. They have efficient processors, multiple sensors and huge memory, to exhibit intelligence. In addition, they are capable of learning from their mistakes and they can adapt to the new environment

A Brief History of AI

The concept of Artificial Intelligence is not as modern as we think it is. This traces back to as early as 1950 when Alan Turing invented the Turing test. Then the first chatbot computer program, ELIZA, was created in the 1960s. IBM deep blue was a chess computer made in 1977 beat a world chess champion in two out of six games, one won by the champion and the

other three games were draw. In 2011, Siri was announced as a digital assistant by Apple. Elon Musk and some others founded OpenAI in 2015.

Artificial Intelligence vs Machine Learning vs Deep Learning

AI is a vast and growing field which also includes a lot more subfields like machine learning and deep learning and so on. Machine learning is in a nutshell the concept of computers learning to improve their predictions and creativity to resemble a humanlike thinking process using algorithms. Machine learning involves a number of learning processes such as:

Supervised learning: Supervised learning is a process where our machines are designed to learn with the feeding of labelled data. In this process our machine is being trained by giving it access to a huge amount of data and training the machine to analyze it. For instance, the machine is given a number of images of dogs taken from many different angles with colour variations, breeds and many more diversity. So that, the machine learns to analyze data from these diverse images of dogs and the "insight" of machines keep increasing and soon the machine can predict if it's a dog from a whole different picture which was not even a part of the labelled data set of dog images the machine was fed earlier.

Unsupervised learning: Contrary to the supervised learning, the unsupervised learning algorithms comprises analyzing unlabelled data i.e., in this case we are training the machine to analyze and learn from a series of data, the meaning of which is not apparently comprehendible by the human eyes. The machine looks for patterns and draws conclusions on its own from the patterns of the data. Important thing to remember that the dataset used in this instance is not labelled and the conclusions are drawn by the machines.

Reinforcement learning: Reinforcement learning is a feedback dependent machine learning model. In this process the machine is given a data and made to predict what the data was. If the machine generates an inaccurate conclusion about the input data, the machine is given feedback about its incorrectness. For example, if you give the machine an image of a basketball and it identifies the basketball as a tennis ball or something else, you give a negative feedback to the machine and eventually the machine learns to identify an image of a basketball on its own when it comes across a completely different picture of a basketball.

Deep Learning, on the other hand is the concept of computers simulating the process a human brain takes to analyze, think and learn. The deep learning process involves something called a neural network as a part of the thinking process for an AI. It takes an enormous amount of data to train deep learning and a considerably powerful computing device for such computation methods.

AI at Work Today

The most common examples of uses of Artificial Intelligence can be found today in smart personal assistants like Apple's Siri and Amazon's Alexa. People interact with these devices to command them on a daily basis and these devices use the commands as a part of their dataset to learn from. Another known example of Artificial Intelligence is the use of algorithms in Netflix. Netflix provides very much accurate and relevant suggestions of movies, tv series from our data which is created every time we stream or click on something in Netflix. As the dataset for these systems grows, their accuracy and precision increase as

well. Artificial Intelligence is also viewed as a great tool for better cybersecurity. Many banks are using AI as a means to identify unauthorized credit cards uses. From analyzing complex genetic data to perform the most delicate surgeries at the highest precision is also being worked on to integrate with AI. We all know about companies like Tesla and Apple working to make flawless self-driving cars which is going to have game changing impacts on the future of transportation.

Concerns about AI

One of the most immediate concerns about Artificial Intelligence is the fear of losing jobs. Artificial Intelligence enhancing automation is also causing huge job losses around the world. According to a Forbes article, it is predicted that by 2025 automation will cause a loss of 85 million jobs. Bigger fears regarding AI includes the scenario whereas machines become smarter and smarter they going to end up being as opinionated and biased like some of the people training it. Automatization of weapons is also a big reason people worry about the future of Artificial Intelligence. The idea that weapons can be used to search and target someone with pre-programmed instructions and the misuse of this by governments or mafias or rogue AI can be something very deadly and devastating. However, there are many myths in disguise of concerns surrounding AI that spreads panic and misinformation. AI today is nowhere near to become a super-intelligent entity and turn into our overlords like in sci-fi movies. However, heavy regulations and cautions are being advised by Big Tech giants like Elon Musk while developing this industry.

Artificial Intelligence and The Future

It is said that AI is the greatest thing humankind has ever worked on. AI is being used in image and speech recognition and analysis which will be far better than human recognition of image and speech and its application stretches wide and far. There are research and works being conducted using AI that is going to play a very important role in our future healthcare. AI is being worked on to cure Alzheimer's disease and someday even blindness. Someone with dyslexia is being helped to read better with the help of AI. Genetic data is being analyzed by bioinformatics; data science integrated with AI for way better data analysis in healthcare that has not been possible for us in the past. Fields like cancer research and other such diseases are being impacted greatly by advanced applications of AI. AI can be a great tool in the future of education. AI can be used to analyze data from an individual's personal and intellectual needs, capabilities, choices and limitations to develop customized curriculum, strategies and schedules that will be more well suited, appealling and inclusive of most, if not all, children and adults. The uses of AI are also going to change the way we are going to commute in the future. In addition to self-driving cars, work is being done to manufacture "self-flying" planes and drones that conveniently deliver your food faster and better. One of the biggest concerns about AI is that jobs are being replaced due to automation. However, AI might be creating more jobs than it replaces. This will change the way humans work by creating new types of jobs.

AI is still in a fairly preliminary (but rapidly growing) stage today and it requires more and more training to develop. Trainers, engineers, system designers and software developer jobs in machine learning, data science and many such related fields are being created in

abundance. New business and investment opportunities are also on the rise due to endless AI applications in agriculture, education, transportation, finance, biotechnology, cybersecurity, gaming etc. As new businesses are being created so are new jobs. Many existing jobs are becoming redefined and more specialised which is really important for the new world to prosper and advance.

2. Artificial Intelligence - Neural Networks

a computing system made up of a number of simple, highly interconnected processing elements, which process information by their dynamic state response to external inputs.

Structure of ANN's

The idea of ANNs is based on the belief that working of human brain by making the right connections, can be imitated using silicon and wires as living **neurons** and **dendrites**.

The human brain is composed of 86 billion nerve cells called **neurons.** They are connected to other thousand cells by **Axons.** Stimuli from external environment or inputs from sensory organs are accepted by dendrites. These inputs create electric impulses, which quickly travel through the neural network. A neuron can then send the message to other neuron to handle the issue or does not send it forward.

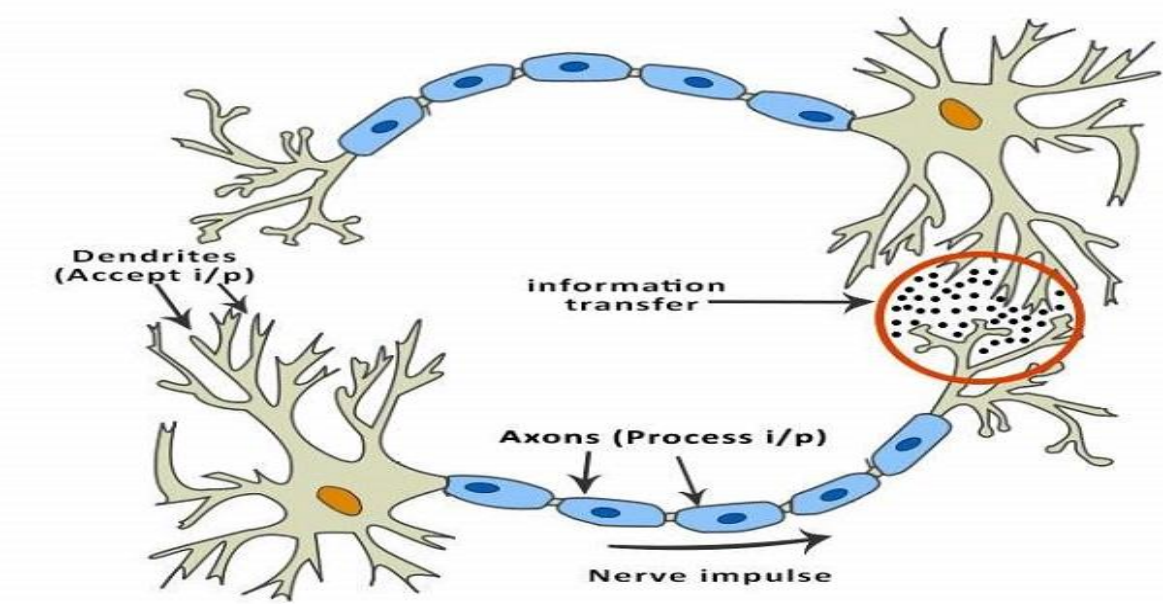


Fig 1: Structure of ANN's

ANNs are composed of multiple **nodes**, which imitate biological **neurons** of human brain. The neurons are connected by links and they interact with each other. The nodes can take input data and perform simple operations on the data. The result of these operations is passed to other neurons. The output at each node is called its **activation** or **node value.**

Each link is associated with **weight.** ANNs are capable of learning, which takes place by altering weight values. The following illustration shows a simple ANN −

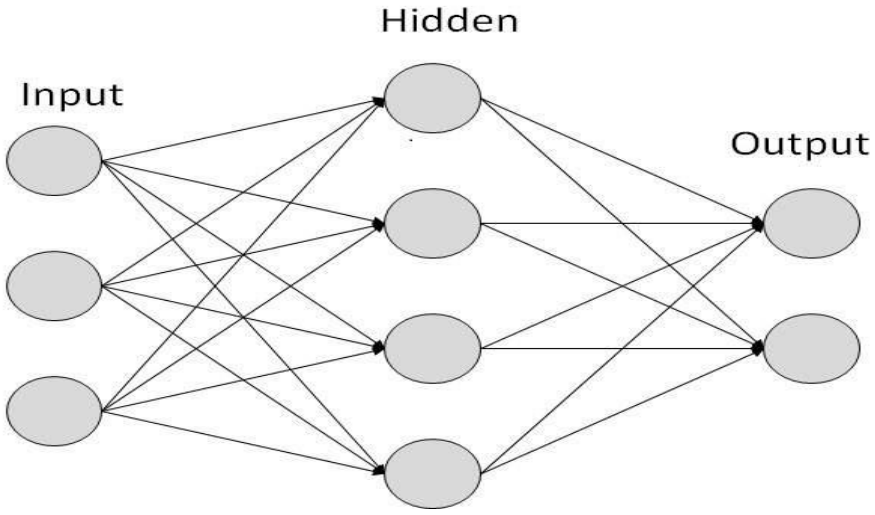


Fig 2: simple ANN's

Types of Artificial Neural Networks

There are two Artificial Neural Network topologies − **FeedForward** and **Feedback.**

- **FeedForward ANN**

In this ANN, the information flow is unidirectional. A unit sends information to other unit from which it does not receive any information. There are no feedback loops. They are used in pattern generation/recognition/classification. They have fixed inputs and outputs.

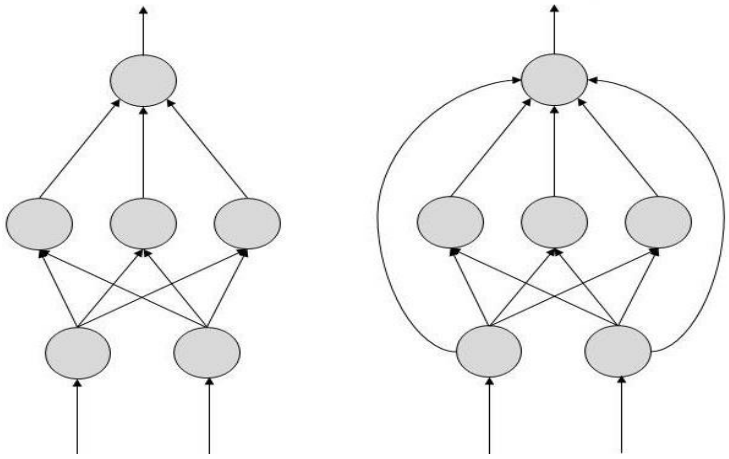


Fig 3: FeedForward

- **FeedBack ANN**

Here, feedback loops are allowed. They are used in content addressable memories.

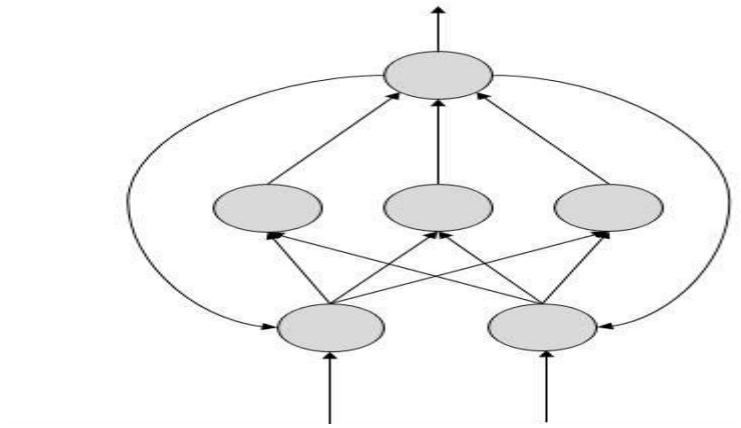


Fig 4: FeedBack

Working of ANNs

In the topology diagrams shown, each arrow represents a connection between two neurons and indicates the pathway for the flow of information. Each connection has a weight, an integer number that controls the signal between the two neurons.

If the network generates a "good or desired" output, there is no need to adjust the weights. However, if the network generates a "poor or undesired" output or an error, then the system alters the weights in order to improve subsequent results.

Machine Learning in ANNs

ANNs are capable of learning and they need to be trained. There are several learning strategies

- **Supervised Learning** − It involves a teacher that is scholar than the ANN itself. For example, the teacher feeds some example data about which the teacher already knows the answers.
  For example, pattern recognizing. The ANN comes up with guesses while recognizing. Then the teacher provides the ANN with the answers. The network then compares it guesses with the teacher's "correct" answers and makes adjustments according to errors.
- **Unsupervised Learning** − It is required when there is no example data set with known answers. For example, searching for a hidden pattern. In this case, clustering i.e. dividing a set of elements into groups according to some unknown pattern is carried out based on the existing data sets present.
- **Reinforcement Learning** − This strategy built on observation. The ANN makes a decision by observing its environment. If the observation is negative, the network adjusts its weights to be able to make a different required decision the next time.

Back Propagation Algorithm

It is the training or learning algorithm. It learns by example. If you submit to the algorithm the example of what you want the network to do, it changes the network's weights so that it can produce desired output for a particular input on finishing the training.

Back Propagation networks are ideal for simple Pattern Recognition and Mapping Tasks.

Bayesian Networks (BN)

These are the graphical structures used to represent the probabilistic relationship among a set of random variables. Bayesian networks are also called **Belief Networks** or **Bayes Nets.** BNs reason about uncertain domain.

In these networks, each node represents a random variable with specific propositions. For example, in a medical diagnosis domain, the node Cancer represents the proposition that a patient has cancer.

The edges connecting the nodes represent probabilistic dependencies among those random variables. If out of two nodes, one is affecting the other then they must be directly connected in the directions of the effect. The strength of the relationship between variables is quantified by the probability associated with each node.

There is an only constraint on the arcs in a BN that you cannot return to a node simply by following directed arcs. Hence the BNs are called Directed Acyclic Graphs (DAGs).

BNs are capable of handling multivalued variables simultaneously. The BN variables are composed of two dimensions −

- Range of prepositions
- Probability assigned to each of the prepositions.

Consider a finite set $X = \{X_1, X_2, \ldots, X_n\}$ of discrete random variables, where each variable X_i may take values from a finite set, denoted by $Val(X_i)$. If there is a directed link from variable X_i to variable, X_j, then variable X_i will be a parent of variable X_j showing direct dependencies between the variables.

The structure of BN is ideal for combining prior knowledge and observed data. BN can be used to learn the causal relationships and understand various problem domains and to predict future events, even in case of missing data.

Building a Bayesian Network

A knowledge engineer can build a Bayesian network. There are a number of steps the knowledge engineer needs to take while building it.

Example problem − *Lung cancer.* A patient has been suffering from breathlessness. He visits the doctor, suspecting he has lung cancer. The doctor knows that barring lung cancer, there are various other possible diseases the patient might have such as tuberculosis and bronchitis.

Gather Relevant Information of Problem

- Is the patient a smoker? If yes, then high chances of cancer and bronchitis.
- Is the patient exposed to air pollution? If yes, what sort of air pollution?
- Take an X-Ray positive X-ray would indicate either TB or lung cancer.

Identify Interesting Variables

The knowledge engineer tries to answer the questions −

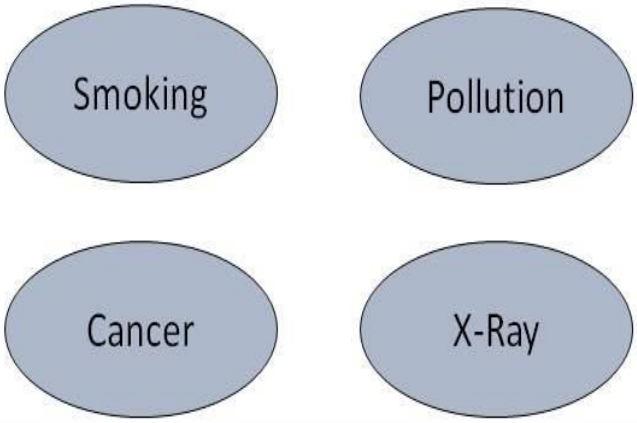
- Which nodes to represent?
- What values can they take? In which state can they be?

For now let us consider nodes, with only discrete values. The variable must take on exactly one of these values at a time.

Common types of discrete nodes are −

- **Boolean nodes** − They represent propositions, taking binary values TRUE (T) and FALSE (F).
- **Ordered values** − A node *Pollution* might represent and take values from {low, medium, high} describing degree of a patient's exposure to pollution.
- **Integral values** − A node called *Age* might represent patient's age with possible values from 1 to 120. Even at this early stage, modeling choices are being made.

Possible nodes and values for the lung cancer example −

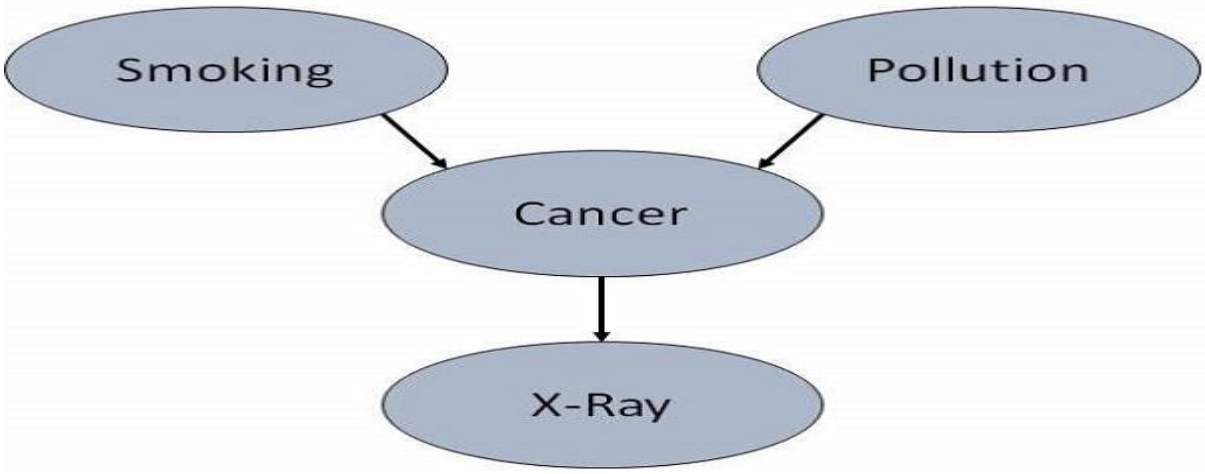
Node Name	Type	Value	Nodes Creation
Polution	Binary	{LOW, HIGH, MEDIUM}	
Smoker	Boolean	{TRUE, FASLE}	
Lung-Cancer	Boolean	{TRUE, FASLE}	
X-Ray	Binary	{Positive, Negative}	

Create Arcs between Nodes

Topology of the network should capture qualitative relationships between variables.

For example, what causes a patient to have lung cancer? - Pollution and smoking. Then add arcs from node *Pollution* and node *Smoker* to node *Lung-Cancer*.

Similarly if patient has lung cancer, then X-ray result will be positive. Then add arcs from node *Lung-Cancer* to node *X-Ray*.



Specify Topology

Conventionally, BNs are laid out so that the arcs point from top to bottom. The set of parent nodes of a node X is given by Parents(X).

The *Lung-Cancer* node has two parents (reasons or causes): *Pollution* and *Smoker*, while node *Smoker* is an **ancestor** of node *X-Ray*. Similarly, *X-Ray* is a child (consequence or effects) of node *Lung-Cancer* and **successor** of nodes *Smoker* and *Pollution.*

Conditional Probabilities

Now quantify the relationships between connected nodes: this is done by specifying a conditional probability distribution for each node. As only discrete variables are considered here, this takes the form of a **Conditional Probability Table (CPT).**

First, for each node we need to look at all the possible combinations of values of those parent nodes. Each such combination is called an **instantiation** of the parent set. For each distinct instantiation of parent node values, we need to specify the probability that the child will take.

For example, the *Lung-Cancer* node's parents are *Pollution* and *Smoking.* They take the possible values = { (H,T), (H,F), (L,T), (L,F)}. The CPT specifies the probability of cancer for each of these cases as <0.05, 0.02, 0.03, 0.001> respectively.

Each node will have conditional probability associated as follows −

Smoking
P(S = T)
0.30

Pollution
P(P = L)
0.90

Lung-Cancer		
P	S	P (C = T|P, S)
H	T	0.05
H	F	0.02
L	T	0.03
L	F	0.001

X-Ray	
C	X = (Pos | C)
T	0.90
F	0.20

Applications of Neural Networks

They can perform tasks that are easy for a human but difficult for a machine −

- **Aerospace** − Autopilot aircrafts, aircraft fault detection.
- **Automotive** − Automobile guidance systems.
- **Military** − Weapon orientation and steering, target tracking, object discrimination, facial recognition, signal/image identification.
- **Electronics** − Code sequence prediction, IC chip layout, chip failure analysis, machine vision, voice synthesis.
- **Financial** − Real estate appraisal, loan advisor, mortgage screening, corporate bond rating, portfolio trading program, corporate financial analysis, currency value prediction, document readers, credit application evaluators.

- **Industrial** − Manufacturing process control, product design and analysis, quality inspection systems, welding quality analysis, paper quality prediction, chemical product design analysis, dynamic modeling of chemical process systems, machine maintenance analysis, project bidding, planning, and management.
- **Medical** − Cancer cell analysis, EEG and ECG analysis, prosthetic design, transplant time optimizer.
- **Speech** − Speech recognition, speech classification, text to speech conversion.
- **Telecommunications** − Image and data compression, automated information services, real-time spoken language translation.
- **Transportation** − Truck Brake system diagnosis, vehicle scheduling, routing systems.
- **Software** − Pattern Recognition in facial recognition, optical character recognition, etc.
- **Time Series Prediction** − ANNs are used to make predictions on stocks and natural calamities.
- **Signal Processing** − Neural networks can be trained to process an audio signal and filter it appropriately in the hearing aids.
- **Control** − ANNs are often used to make steering decisions of physical vehicles.
- **Anomaly Detection** − As ANNs are expert at recognizing patterns, they can also be trained to generate an output when something unusual occurs that misfits the pattern.

3. ROBOTICS

Robotics is a domain in artificial intelligence that deals with the study of creating intelligent and efficient robots.

What are Robots?

Robots are the artificial agents acting in real world environment.

Objective

Robots are aimed at manipulating the objects by perceiving, picking, moving, modifying the physical properties of object, destroying it, or to have an effect thereby freeing manpower from doing repetitive functions without getting bored, distracted, or exhausted.

What is Robotics?

Robotics is a branch of AI, which is composed of Electrical Engineering, Mechanical Engineering, and Computer Science for designing, construction, and application of robots.

Aspects of Robotics

- The robots have mechanical construction, form, or shape designed to accomplish a particular task.
- They have electrical components which power and control the machinery.
- They contain some level of computer program that determines what, when and how a robot does something.

Difference in Robot System and Other AI Program

Here is the difference between the two –

AI Programs	Robots
They usually operate in computer-stimulated worlds.	They operate in real physical world
The input to an AI program is in symbols and rules.	Inputs to robots is analog signal in the form of speech waveform or images
They need general purpose computers to operate on.	They need special hardware with sensors and effectors.

Robot Locomotion

Locomotion is the mechanism that makes a robot capable of moving in its environment. There are various types of locomotion −

- Legged
- Wheeled
- Combination of Legged and Wheeled Locomotion
- Tracked slip/skid

Legged Locomotion

- This type of locomotion consumes more power while demonstrating walk, jump, trot, hop, climb up or down, etc.
- It requires a greater number of motors to accomplish a movement. It is suited for rough as well as smooth terrain where irregular or too smooth surface makes it consume more power for a wheeled locomotion. It is little difficult to implement because of stability issues.
- It comes with the variety of one, two, four, and six legs. If a robot has multiple legs, then leg coordination is necessary for locomotion.

The total number of possible **gaits** (a periodic sequence of lift and release events for each of the total legs) a robot can travel depends upon the number of its legs.

If a robot has k legs, then the number of possible events N = (2k-1)!

In case of a two-legged robot (k=2), the number of possible events is N = (2k-1)! = (2*2-1)! = 3! = 6.

Hence there are six possible different events −

- Lifting the Left leg
- Releasing the Left leg
- Lifting the Right leg
- Releasing the Right leg
- Lifting both the legs together

- Releasing both the legs together

In case of k=6 legs, there are 39916800 possible events. Hence the complexity of robots is directly proportional to the number of legs.

Wheeled Locomotion

It requires fewer number of motors to accomplish a movement. It is little easy to implement as there are less stability issues in case of more number of wheels. It is power efficient as compared to legged locomotion.

- **Standard wheel** − Rotates around the wheel axle and around the contact
- **Castor wheel** − Rotates around the wheel axle and the offset steering joint.
- **Swedish 45º and Swedish 90º wheels** − Omni-wheel, rotates around the contact point, around the wheel axle, and around the rollers.
- **Ball or spherical wheel** − Omnidirectional wheel, technically difficult to implement.

Slip/Skid Locomotion

In this type, the vehicles use tracks as in a tank. The robot is steered by moving the tracks with different speeds in the same or opposite direction. It offers stability because of large contact area of track and ground.

Components of a Robot

Robots are constructed with the following −

- **Power Supply** − The robots are powered by batteries, solar power, hydraulic, or pneumatic power sources.
- **Actuators** − They convert energy into movement.
- **Electric motors (AC/DC)** − They are required for rotational movement.
- **Pneumatic Air Muscles** − They contract almost 40% when air is sucked in them.
- **Muscle Wires** − They contract by 5% when electric current is passed through them.
- **Piezo Motors and Ultrasonic Motors** − Best for industrial robots.
- **Sensors** − They provide knowledge of real time information on the task environment. Robots are equipped with vision sensors to be to compute the depth in the environment. A tactile sensor imitates the mechanical properties of touch receptors of human fingertips.

Computer Vision

This is a technology of AI with which the robots can see. The computer vision plays vital role in the domains of safety, security, health, access, and entertainment.

Computer vision automatically extracts, analyzes, and comprehends useful information from a single image or an array of images. This process involves development of algorithms to accomplish automatic visual comprehension.

Hardware of Computer Vision System

This involves −

- Power supply

- Image acquisition device such as camera
- A processor
- A software
- A display device for monitoring the system
- Accessories such as camera stands, cables, and connectors

Tasks of Computer Vision

- **OCR** − In the domain of computers, Optical Character Reader, a software to convert scanned documents into editable text, which accompanies a scanner.
- **Face Detection** − Many state-of-the-art cameras come with this feature, which enables to read the face and take the picture of that perfect expression. It is used to let a user access the software on correct match.
- **Object Recognition** − They are installed in supermarkets, cameras, high-end cars such as BMW, GM, and Volvo.
- **Estimating Position** − It is estimating position of an object with respect to camera as in position of tumor in human's body.

Application Domains of Computer Vision

- Agriculture
- Autonomous vehicles
- Biometrics
- Character recognition
- Forensics, security, and surveillance
- Industrial quality inspection
- Face recognition
- Gesture analysis
- Geoscience
- Medical imagery
- Pollution monitoring
- Process control
- Remote sensing
- Robotics
- Transport

Applications of Robotics

The robotics has been instrumental in the various domains such as −

- **Industries** − Robots are used for handling material, cutting, welding, color coating, drilling, polishing, etc.
- **Military** − Autonomous robots can reach inaccessible and hazardous zones during war. A robot named *Daksh*, developed by Defense Research and Development Organization (DRDO), is in function to destroy life-threatening objects safely.
- **Medicine** − The robots are capable of carrying out hundreds of clinical tests simultaneously, rehabilitating permanently disabled people, and performing complex surgeries such as brain tumors.
- **Exploration** − The robot rock climbers used for space exploration; underwater drones used for ocean exploration are to name a few.
- **Entertainment** − Disney's engineers have created hundreds of robots for movie making.

4. Machine Learning

Machine learning (ML) is a part of Artificial intelligence devoted to understanding and building methods that 'learn', that is, methods that leverage data to improve performance on some set of tasks.

Approaches

Machine learning approaches are traditionally divided into three broad categories, depending on the nature of the "signal" or "feedback" available to the learning system:

- **Supervised learning:** The computer is presented with example inputs and their desired outputs, given by a "teacher", and the goal is to learn a general rule that maps inputs to outputs. Supervised learning algorithms build a mathematical model of a set of data that contains both the inputs and the desired outputs. The data is known as training data, and consists of a set of training examples. In the mathematical model, each training example is represented by an array or vector, sometimes called a feature vector, and the training data is represented by a matrix. Through iterative optimization of an objective function, supervised learning algorithms learn a function that can be used to predict the output associated with new inputs. An optimal function will allow the algorithm to correctly determine the output for inputs that were not a part of the training data. An algorithm that improves the accuracy of its outputs or predictions over time is said to have learned to perform that task.
  Types of supervised-learning algorithms include active learning, classification and regression.
- **Unsupervised learning:** No labels are given to the learning algorithm, leaving it on its own to find structure in its input. Unsupervised learning algorithms take a set of data that contains only inputs, and find structure in the data, like grouping or clustering of data points. The algorithms, therefore, learn from test data that has not been labelled, classified or categorized. Instead of responding to feedback, unsupervised learning algorithms identify commonalities in the data and react based on the presence or absence of such commonalities in each new piece of data

- **Reinforcement learning:** Reinforcement learning is an area of machine learning concerned with how software agents ought to take actions in an environment so as to maximize some notion of cumulative reward. Due to its generality, the field is studied in many other disciplines, such as game theory, genetic algorithms or swarm intelligence. Reinforcement learning algorithms are used in autonomous vehicles or in learning to play a game against a human opponent.

Models

Performing machine learning involves creating a model, which is trained on some training data and then can process additional data to make predictions. The Various types of models that have been used and researched for machine learning systems include:

i. Decision Trees

Decision tree learning uses a decision tree as a predictive model to go from observations about an item (represented in the branches) to conclusions about the item's target value (represented in the leaves). It is one of the predictive modelling approaches used in statistics, data mining, and machine learning. There are two types of decision trees;

- Classification trees-the target variable can take a discrete set of values. In this structure, leaves represent class labels and branches represent conjunctions of features that lead to those class labels
- Regression trees- the target variable can take continuous values (typically real numbers).

ii. Support-vector machine

Support-vector machines (SVMs) are a set of related supervised learning methods used for classification and regression. Given a set of training examples, each marked as belonging to one of two categories, an SVM training algorithm builds a model that predicts whether a new example falls into one category or the other.

iii. Regression analysis

Regression analysis encompasses a large variety of statistical methods to estimate the relationship between input variables and their associated features. Its most common form is linear regression, where a single line is drawn to best fit the given data according to a mathematical criterion such as ordinary least squares.

iv. Bayesian networks

A Bayesian is a belief network. It represents a set of random variables and their conditional independence. For example, a Bayesian network could represent the probabilistic relationships between diseases and symptoms. Given symptoms, the network can be used to compute the probabilities of the presence of various diseases.

Applications of Machine Learning

i. Renewable Energy production

Siemens Gamesa Renewable Energy is working with NVIDIA to create physics-informed digital doubles of wind farms - groups of wind turbines used to produce electricity.

They are using machine learning to boost renewable energy generation and reduce costs of wind farms. Adding a turbine next to another on a farm can change the wind flow and create wake effects that is, decreases in downstream wind speed which lead to a reduction in the farm's production of electricity.

Using NVIDIA Modulus and physics-Machine Learning models running on Graphical Processing Units (GPUs), researchers can now run computational fluid dynamics simulations orders of magnitude faster than before and determine early on the most effective way to build their wind farms to maximize wind power.

ii. **Natural-language generation (NLG):**
Convert information from computer databases or semantic intents into readable human language.

iii. **Commute estimation from Google maps**
Using the location data from smartphones, Google Maps can inspect the agility of shifting traffic at any time. Moreover Google map can organize user-reported traffic like construction, traffic, and accidents.

v. **Pinterest:**
It employs computer vision to automatically recognize objects in the images or "pin" and then recommend similar pins.

5. Fuzzy Logic

Fuzzy logic is an approach to computing based on "degrees of truth" rather than the usual "true or false" (1 or 0) Boolean logic on which the modern computer is based.

Fuzzy Logic (FL) is an extension of Boolean logic based on the mathematical theory of fuzzy sets, which is a generalization of the classical set theory. By introducing the notion of degree in the verification of a condition, thus enabling a condition to be in a state other than true or false, fuzzy logic provides a very valuable flexibility for reasoning, which makes it possible to take into account inaccuracies and uncertainties.

The fuzzy Logic is a method of reasoning that resembles human reasoning. The approach of FL imitates the way of decision making in humans that involves all intermediate possibilities between digital values YES and NO. The conventional logic block that a computer can understand takes precise input and produces a definite output as TRUE or FALSE, which is equivalent to human's YES or NO. The inventor of fuzzy logic, Lotfi Zadeh, observed that unlike computers, the human decision making includes a range of possibilities between YES and NO in natural language, such as − CERTAINLY YES, POSSIBLY YES, CANNOT SAY, POSSIBLY NO, CERTAINLY NO.

For example, to solve the problem: is it hot outside?

The Boolean logic solution will take a definite input and produce a precise result Yes (1) or No (0).

- Yes (1)
- No (0)

The fuzzy logic solution will have a wider range of output such as very hot, moderately hot and not hot. Values displaying the range of possibilities will range between 0 and 1.

- Very hot (0.9)
- Moderately hot (0.4)
- Little hot (0.2)
- Not hot (0.1)

The Fuzzy logic works on the levels of possibilities of input to achieve a definite output in cases where accurate reasoning cannot be provided. Now, talking about the implementation of this logic:

- It can be implemented in systems with different sizes and capabilities such as micro-controllers, large networked or workstation-based systems.
- Also, it can be implemented in hardware, software or a combination of both.

Generally, the fuzzy logic system is used for both commercial and practical purposes such as:

- It controls machines and consumer products
- If not accurate reasoning, it at least provides acceptable reasoning
- This helps in dealing with the uncertainty in engineering

In artificial intelligence (AI) systems, fuzzy logic is used to imitate human reasoning and cognition. Rather than strictly binary cases of truth, fuzzy logic includes 0 and 1 as extreme cases of truth but with various intermediate degrees of truth.

Fuzzy Logic Architecture

The fuzzy logic architecture consists of four main parts:

- **Rule base**– It contains all the rules and the if-then conditions offered by the experts to control the decision-making system. The recent update in the fuzzy theory provides different effective methods for the design and tuning of fuzzy controllers. Usually, these developments reduce the number of fuzzy rules. These set of rules are also known as a knowledge base.
- **Fuzzification** – This step converts inputs or the crisp numbers into fuzzy sets. You can measure the crisp inputs by sensors and pass them into the control system for further processing. It splits the input signal into five steps such as-

Large Positive	LP
Medium Positive	MP
Small	S
Medium Negative	MN
Large Negative	LN

- **Inference Engine** – It determines the degree of match between fuzzy input and the rules. According to the input field, it will decide the rules that are to be fired. Combining the fired rules, form the control actions.
- **Defuzzification** – The Defuzzification process converts the fuzzy sets into a crisp value. There are different types of techniques available, and you need to select the best-suited one with an expert system.

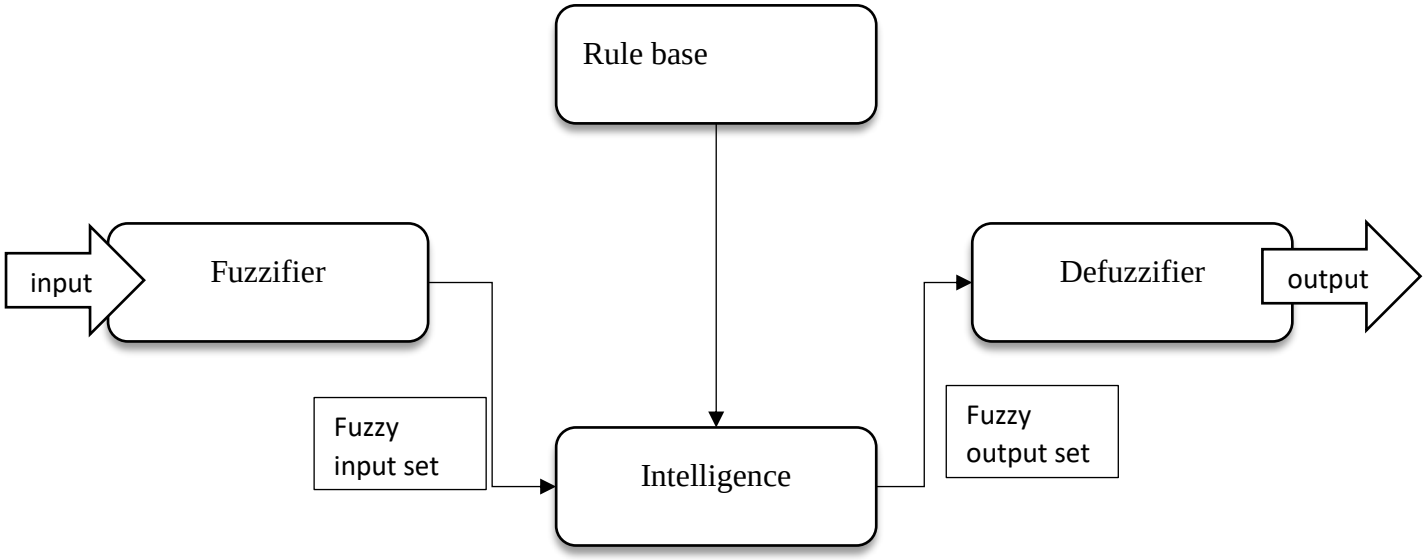


Figure:The fuzzy logic architecture main parts:

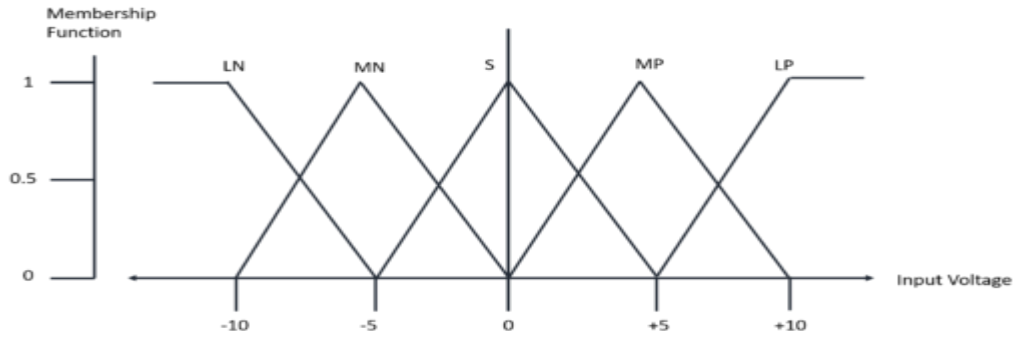
Membership Function

The membership function is a graph that defines how each point in the input space is mapped to membership value between 0 and 1. It allows you to quantify linguistic terms and represent a fuzzy set graphically. A membership function for a fuzzy set A on the universe of discourse X is defined as $\mu A: X \rightarrow [0,1$

It quantifies the degree of membership of the element in X to the fuzzy set A.

- x-axis represents the universe of discourse.
- y-axis represents the degrees of membership in the [0, 1] interval.

There can be multiple membership functions applicable to fuzzify a numerical value. Simple membership functions are used as the complex functions do not add precision in the output. The membership functions for LP, MP, S, MN, and LN are:



Applications of Fuzzy Logic

The Fuzzy logic is used in various fields such as automotive systems, domestic goods, environment control, etc. Some of the common applications in various fields are:

- In Medicine - Controlling arterial pressure when providing anesthesia to patients, used in diagnostic radiology and diagnostic support systems, diagnosis of prostate cancer and diabetes
- In Transportation systems - Handling underground train operations, controlling train schedules, braking and stopping vehicles based on parameters, such as car speed, acceleration and wheel speed.
- In Defense - Locating and recognizing targets underwater, supports naval decision making, using thermal infrared images for target recognition, used for controlling hypervelocity interceptors.
- In industries - Controlling water purification plants, handling problems in constraint satisfaction in structural design, pattern analysis for quality assurance, Fuzzy Logic is used for tackling sludge wastewater treatment.
- In naval control it is used to, steer ships properly, selecting the optimal or best possible routes for reaching a destination, autopilot is based on Fuzzy Logic, autonomous underwater vehicles are controlled using Fuzzy Logic
- It is used in the aerospace field for altitude control of spacecraft and satellite.
- It is used for decision making support systems and personal evaluation in the large company business.
- It also controls the pH, drying, chemical distillation process in the chemical industry.
- Fuzzy logic is used in Natural language processing and various intensive applications in Artificial Intelligence.
- It is extensively used in modern control systems such as expert systems.
- Fuzzy Logic mimics how a person would make decisions, only much faster. Thus, you can use it with Neural Networks.

Advantages of Fuzzy Logic

Fuzzy logic provides simple reasoning similar to human reasoning. There are more such advantages of using this logic, such as:

- The structure of Fuzzy Logic Systems is **easy and understandable**
- It helps you to deal with the uncertainty in engineering
- Mostly robust as no precise inputs required

- If the feedback sensor stops working, you can program it into the situation
- You can easily modify it to improve or alter system performance
- Inexpensive sensors can be used which helps you to keep the overall system cost and complexity low
- Fuzzy logic is widely used for commercial and practical purposes
- It helps you to control machines and consumer products

Disadvantages of Fuzzy Logic

- Fuzzy logic is not always accurate. So, the results are perceived based on assumptions and may not be widely accepted
- It cannot recognize machine learning as-well-as neural network type patterns
- Validation and Verification of a fuzzy knowledge-based system needs extensive testing with hardware
- Setting exact, fuzzy rules and, membership functions is a difficult task
- At times, the fuzzy logic is confused with probability theory.

6.0 Expert System

An expert system is a computer program that is designed to solve complex problems and to provide decision-making ability like a human expert. It performs this by extracting knowledge from its knowledge base using the reasoning and inference rules according to the user queries.

The expert system is a part of AI, and the first Expert System was developed in the year 1970, which was the first successful approach of artificial intelligence. It solves the most complex issue as an expert by extracting the knowledge stored in its knowledge base. The system helps in decision making for complex problems using both facts and heuristics like a human expert. It is called so because it contains the expert knowledge of a specific domain and can solve any complex problem of that particular domain. These systems are designed for a specific domain, such as medicine, science**,** etc.

The performance of an expert system is based on the expert's knowledge stored in its knowledge base. The more knowledge stored in the Knowledge Base, the more that system improves its performance. One of the common examples of an Expert System is a suggestion of spelling errors while typing in the Google search box.

Below are some popular examples of the Expert System:

- **DENDRAL:** It was an artificial intelligence project that was made as a chemical analysis expert system. It was used in organic chemistry to detect unknown organic molecules with the help of their mass spectra and knowledge base of chemistry.
- **MYCIN:** It was one of the earliest backward chaining expert systems that was designed to find the bacteria causing infections like bacteraemia and meningitis. It was also used for the recommendation of antibiotics and the diagnosis of blood clotting diseases.

- **PXDES:** It is an expert system that is used to determine the type and level of lung cancer. To determine the disease, it takes a picture from the upper body, which looks like the shadow. This shadow identifies the type and degree of harm.
- **CaDeT:** The CaDet expert system is a diagnostic support system that can detect cancer at early stages.

Characteristics of Expert System

- **High Performance:** The expert system provides high performance for solving any type of complex problem of a specific domain with high efficiency and accuracy.
- **Understandable:** It responds in a way that can be easily understandable by the user. It can take input in human language and provides the output in the same way.
- **Reliable:** It is much reliable for generating an efficient and accurate output.
- **Highly responsive:** Expert System provides the result for any complex query within a very short period of time.

Components of Expert System

An expert system mainly consists of three components:

1. User Interface

With the help of a user interface, the expert system interacts with the user, takes queries as an input in a readable format, and passes it to the inference engine. After getting the response from the inference engine, it displays the output to the user. In other words, it is an interface that helps a non-expert user to communicate with the expert system to find a solution.

2. Inference Engine (Rules of Engine)

The inference engine is known as the brain of the expert system as it is the main processing unit of the system. It applies inference rules to the knowledge base to derive a conclusion or deduce new information. It helps in deriving an error-free solution of queries asked by the user.

With the help of an inference engine, the system extracts the knowledge from the knowledge base.

There are two types of inference engine:

Deterministic Inference engine: The conclusions drawn from this type of inference engine are assumed to be true. It is based on facts and rules.

Probabilistic Inference engine: This type of inference engine contains uncertainty in conclusions, and based on the probability.

Inference engine uses the below modes to derive the solutions:

Forward Chaining: It starts from the known facts and rules, and applies the inference rules to add their conclusion to the known facts.

Backward Chaining: It is a backward reasoning method that starts from the goal and works backward to prove the known facts.

3. Knowledge Base

The knowledgebase is a type of storage that stores knowledge acquired from the different experts of the particular domain. It is considered as big storage of knowledge. The more the knowledge base, the more precise will be the Expert System.

It is similar to a database that contains information and rules of a particular domain or subject.

One can also view the knowledge base as collections of objects and their attributes. Such as a Lion is an object and its attributes are it is a mammal, it is not a domestic animal, etc.

Components of Knowledge Base

Factual Knowledge: The knowledge which is based on facts and accepted by knowledge engineers comes under factual knowledge.

Heuristic Knowledge: This knowledge is based on practice, the ability to guess, evaluation, and experiences.

Knowledge Representation: It is used to formalize the knowledge stored in the knowledge base using the If-else rules.

Knowledge Acquisitions: It is the process of extracting, organizing, and structuring the domain knowledge, specifying the rules to acquire the knowledge from various experts, and store that knowledge into the knowledge base.

Development of Expert System

Here, we will explain the working of an expert system by taking an example of MYCIN ES. Below are some steps to build an MYCIN:

- Firstly, Expert System should be fed with expert knowledge. In the case of MYCIN, human experts specialized in the medical field of bacterial infection, provide information about the causes, symptoms, and other knowledge in that domain.
- The KB of the MYCIN is updated successfully. In order to test it, the doctor provides a new problem to it. The problem is to identify the presence of the bacteria by inputting the details of a patient, including the symptoms, current condition, and medical history.
- The Expert System will need a questionnaire to be filled by the patient to know the general information about the patient, such as gender, age, etc.
- Now the system has collected all the information, so it will find the solution for the problem by applying if-then rules using the inference engine and using the facts stored within the KB.
- In the end, it will provide a response to the patient by using the user interface.

Participants in the development of Expert System

There are three primary participants in the building of Expert System:

1. **Expert:** The success of an Expert System much depends on the knowledge provided by human experts. These experts are those persons who are specialized in that specific domain.
2. **Knowledge Engineer:** Knowledge engineer is the person who gathers the knowledge from the domain experts and then codifies that knowledge to the system according to the formalism.
3. **End-User:** This is a particular person or a group of people who may not be experts, and working on the expert system needs the solution or advice for his queries, which are complex.

Why Expert System?

Below are the points that are describing the need of the Expert System:

1. **No memory Limitations:** It can store as much data as required and can memorize it at the time of its application. But for human experts, there are some limitations to memorize all things at every time.
2. **High Efficiency:** If the knowledge base is updated with the correct knowledge, then it provides a highly efficient output, which may not be possible for a human.
3. **Expertise in a domain:** There are lots of human experts in each domain, and they all have different skills, different experiences, and different skills, so it is not easy to get a final output for the query. But if we put the knowledge gained from human experts into the expert system, then it provides an efficient output by mixing all the facts and knowledge
4. **Not affected by emotions:** These systems are not affected by human emotions such as fatigue, anger, depression, anxiety, etc.. Hence the performance remains constant.
5. **High security:** These systems provide high security to resolve any query.
6. **Considers all the facts:** To respond to any query, it checks and considers all the available facts and provides the result accordingly. But it is possible that a human expert may not consider some facts due to any reason.
7. **Regular updates improve the performance:** If there is an issue in the result provided by the expert systems, we can improve the performance of the system by updating the knowledge base.

Capabilities of the Expert System

Below are some capabilities of an Expert System:

Advising: It is capable of advising the human being for the query of any domain from the particular Expert System.

Provide decision-making capabilities: It provides the capability of decision making in any domain, such as for making any financial decision, decisions in medical science, etc.

Demonstrate a device: It is capable of demonstrating any new products such as its features, specifications, how to use that product, etc.

Problem-solving: It has problem-solving capabilities.

Explaining a problem: It is also capable of providing a detailed description of an input problem.

Interpreting the input: It is capable of interpreting the input given by the user.

Predicting results: It can be used for the prediction of a result.

Diagnosis: An Expert System designed for the medical field is capable of diagnosing a disease without using multiple components as it already contains various inbuilt medical tools.

Advantages of Expert System

- These systems are highly reproducible.
- They can be used for risky places where the human presence is not safe.
- Error possibilities are less if the KB contains correct knowledge.
- The performance of these systems remains steady as it is not affected by emotions, tension, or fatigue.
- They provide a very high speed to respond to a particular query.

Limitations of Expert System

- The response of the expert system may get wrong if the knowledge base contains the wrong information.
- Like a human being, it cannot produce a creative output for different scenarios.
- Its maintenance and development costs are very high.
- Knowledge acquisition for designing is much difficult.
- For each domain, we require a specific Expert System, which is one of the big limitations.
- It cannot learn from itself and hence requires manual updates.

Applications of Expert System

In designing and manufacturing domain
It can be broadly used for designing and manufacturing physical devices such as camera lenses and automobiles.

In the knowledge domain
These systems are primarily used for publishing the relevant knowledge to the users. The two popular Expert System used for this domain is an advisor and a tax advisor.

In the finance domain
In the finance industries, it is used to detect any type of possible fraud, suspicious activity, and advise bankers that if they should provide loans for business or not.

In the diagnosis and troubleshooting of devices
In medical diagnosis, the Expert System is used, and it was the first area where these systems were used.

Planning and Scheduling
The expert systems can also be used for planning and scheduling some particular tasks for achieving the goal of that task.

7.0 Natural Language Processing Presentation

Natural Language Processing (NLP) refers to AI method of communicating with an intelligent-systems using a natural language such as English. Processing of Natural Language is required when you want an intelligent system like robot to perform as per your instructions (Tutorialspoint, 2022). The field of NLP involves making computers to perform useful tasks with the natural languages' humans use. The input and output of an NLP system can be −

- Speech
- Written Text

Components of NLP

There are two components of NLP given as:

- Natural Language Understanding
- Natural Language Generation

Natural Language Understanding (NLU)

When we talk about Natural Language Understanding, it involves the following tasks:

i. Mapping the given input in natural language into meaningful representations
ii. Analyzing different aspects of the language

Natural Language Generation (NLG)

Natural Language generation is the process of producing meaningful phrases and sentences in the form of natural language from some internal representation.

It involves the following:

- Text planning: It involves retrieving the relevant content from the knowledge base
- Sentence planning: It includes choosing required words, forming meaningful phrases, setting tone of sentence.
- Text realization: It is mapping sentence plan into sentence structure

NLU is harder than NLG

Difficulties in NLU

NLU is very ambiguous and there can be different level of ambiguity.

- **Lexical ambiguity** – It is a word level ambiguity for example whether to treat the word board as a noun or a verb?
- **Syntax level ambiguity** – a sentence can be parsed in various ways for example "He lifted the beetle with the red cap." The ambiguity would be whether he used the cap to lift the beetle or he lifted a beetle with a red cap
- **Referential ambiguity** – Referring to something using pronouns. For example. It was taken to the house. What exactly was taken to the house?
- One input can have different meaning
- Many inputs can mean the same thing

NLP Terminology

There are several NLP terminologies as listed below:

- **Phonology –** It is the study and organizing sound systematically
- **Morphology –** It is a study of construction of words from primitive meaningful units

- **Morpheme –** It is primitive unit of meaning in a language
- **Syntax –** It is organizing word to make a sentence. It also involves determining the role of words and phrases in a sentence.
- **Semantics –** It is concerned with the meaning of words in sentences and how to combine words to form a sentence.
- **Pragmatics –** It deals with using and understanding sentences in different situations and how the interpretation of sentences is affected.
- **Discourse –** It involves determining how the interpretation of a preceding sentence can affect the interpretation of the next sentence.
- **World Knowledge –** It includes general knowledge of the world.

Steps in NLP

Nlp involves five steps:

i. Lexical Analysis - It entails figuring out how words are put together and then examining that structure. A language's lexicon refers to the collection of words and phrases that make up that language (Tutorialspoint, 2022). Lexical analysis is the process of breaking down a large body of text into smaller units, such as paragraphs, phrases, and individual words.
ii. Syntatic Analysis (Parsing) - Words in the phrase are examined for their grammar and their link to one another is shown by arranging them in a certain way.
iii. Semantic analysis - It deduces the text's meaning by comparing it to the definition found in a dictionary. The content of the text is examined for relevance.
iv. Discourse Integration - The meaning of any sentence depends upon the meaning of the sentence just before it.
v. Pragmatic Analysis - What was spoken is re-examined in light of the intended meaning. Deriving those features of language that are based on real-world knowledge is part of this process.

Implementation Aspect of Syntatic Analysis

There are several algorithms that have been developed for syntactic analysis but the two are the most-simple methods.

- Context Free grammar

- Top-Down parser

Context Free Grammar

The grammar consists of rules with a single symbol on the left side of the rewrite rules. The parse tree simplifies the computer's understanding of a sentence by separating it into smaller, more manageable chunks. These rewrite rules are necessary for the parsing algorithm to build this parse tree, as they explain what tree structures are allowed. Symbols can be enlarged in the tree in this way, according to these rules. When a noun phrase (NP) and a verb phrase (VP) are present in a string, a sentence is formed using the first order logic rule.

Merit - simplest form of grammar therefore widely used

Demerits

There are not highly precise. It may take some sentences to be correct even if they make no sense.

Multiple sets of grammar are needed to achieve high levels of precision.

Top-Down Parser

The parser begins with the S symbol and tries to rewrite it into a succession of terminal symbols that match the classes of the words in the input phrase until it is totally terminal symbols. Afterwards, the output is compared with the input to see if the two agree. A new set of rules must be devised in order for the process to continue. The process is repeated until a specific rule for the construction of the sentence is discovered.

Merits – It is simple to implement

Demerits

The search procedure has to be repeated if a mistake occurs, it is therefore inefficient

Slow working pace.

NLP Applications

Machine Translation

One of the most important uses of NLP is machine translation (MT), which is the process of converting one source language or text into another (IBM, 2020). One of the significant applications of machine translation is language translator.

Social Media Monitoring

Increasing numbers of people are turning to social media to share their thoughts about a specific product, policy, or other topic. These may provide valuable insight into an individual's preferences and dislikes (Abhishek, 2020). As a result, examining this unstructured data can yield useful information. Here, Natural Language Processing steps in to help.

Chatbots

Chatbots are increasingly being used in apps and websites to answer simple questions from customers. It saves both companies and customers from the aggravation of having to wait on hold for customer service representatives.

Voice Assistant

Using speech recognition, natural language comprehension, and natural language processing (NLP), a voice assistant can recognize and respond to a user's spoken requests.

8.0 Advantages of AI

1. Automates the processes - Artificial Intelligence allows robots to automatically develop repetitive, routine, and process optimization tasks without human intervention.

2. Enhance creative tasks - AI frees people from routine and repetitive tasks and allows them to spend more time on creative functions.

3. Provides precision - The application of AI is capable of providing greater precision than humans, for example in industrial environments, machines can make decisions that were previously made manually or monitored without AI.

4. Reduces human error. AI reduces failures caused by human limitations. In some production lines, AI is used to detect, using infrared sensors, small cracks or defects in parts that are undetectable by the human eye.

5. Reduces time spent on data analysis - It allows the analysis and exploitation of the data derived from production to be carried out in real-time.

6. Predictive maintenance - It allows to carry out maintenance of the industrial equipment based on the times and conditions of operation of the same, allowing to increase its performance and life cycle.

7. Improvement in decision making at both production and business levels - Having more information in a structured way, allows each of the people in charge to make decisions in a faster and more efficient way.

8. Control and optimization of production processes and production lines - Through AI, more efficient, error-free processes are achieved, obtaining greater control over production lines in the company.

9. Increase in productivity and quality in production - AI not only increases productivity at the machine level but also makes workers more productive and increases the quality of the work they do. Having more information allows them to have a more focused view of their work and make better decisions.

Others include

- AI drives down the time taken to perform a task. It enables multi-tasking and eases the workload for existing resources.
- AI enables the execution of hitherto complex tasks without significant cost outlays.
- AI operates 24x7 without interruption or breaks and has no downtime
- AI augments the capabilities of differently-abled individuals
- AI has mass-market potential, it can be deployed across industries.
- AI facilitates decision-making by making the process faster and smarter.

Disadvantages

1. High Costs of Creation - As AI is updating every day the hardware and software need to get updated with time to meet the latest requirements. Machines need repairing and maintenance which need plenty of costs. Its creation requires huge costs as they are very complex machines.

2. Making Humans Lazy - AI is making humans lazy with its applications automating the majority of the work. Humans tend to get **addicted** to these inventions which can cause a problem for future generations.

3. Unemployment - As AI is replacing the majority of the repetitive tasks and other work with robots, human interference is becoming less which will cause a major problem in the employment standards. Every organization is looking to replace the minimum qualified individuals with AI robots which can do similar work with more efficiency.

4. No Emotions - There is no doubt that machines are much better when it comes to working efficiently but they cannot replace the human connection that makes the team. Machines cannot develop a bond with humans which is an essential attribute when comes to Team Management.

5. Lacking Out of Box Thinking - Machines can perform only those tasks which they are designed or programmed to do, anything out of that they tend to crash or give irrelevant outputs which could be a major backdrop.

6. Data availability - Often, data is presented in isolation across companies or is inconsistent and of low quality, presenting a significant challenge for companies seeking to create value from AI at scale. To overcome this barrier, it will be vital to draw up a clear strategy from the outset so that AI data can be extracted in an organized and consistent manner.

7. Lack of qualified professionals - Another obstacle that often occurs at the business level for the adoption of AI is the scarcity of profiles with skills and experience in this type of implementation. It is crucial in these cases to have professionals who have already worked on projects of the same magnitude.

8. The cost and implementation time of AI projects - The cost of implementation, both at the time and the economic level is a very important factor in choosing to execute this type of project. Companies that lack internal skills or are not familiar with AI systems, must value the outsourcing of both implementation and maintenance to obtain successful results in their project.

Conclusion

The growth of Artificial Intelligence in recent times has been exponential. We cannot even imagine how big and impactful AI is going to be in the near future and how drastically it is going to change and upgrade the world we live in today. There are a lot more to learn about AI and its rapidly growing applications in our life. I believe it would be wise to adapt to this changing world and acquire skills related to Artificial Intelligence and technology. Just like AI learns and develops, we should too - to make this world a better place.

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