AI QUESTION BANK

Define the importance of using Bayes theorem? Explain the conditional probability,posterior probability and prior probability.

Bayes' theorem allows updating the probability prediction of an event by observing new information of the real world.

Example: If cancer corresponds to one's age then by using Bayes' theorem, we can determine the probability of cancer more accurately with the help of age.

Bayes' theorem can be derived using product rule and conditional probability of event A with known event B:

As from product rule we can write:

1. $P(A \wedge B) = P(A|B)\ P(B)$ or

Similarly, the probability of event B with known event A:

1. $P(A \wedge B) = P(B|A)\ P(A)$

Equating right hand side of both the equations, we will get:

$$P(A|B) = \frac{P(B|A)\ P(A)}{P(B)} \quad \text{....(a)}$$

The above equation (a) is called as **Bayes' rule** or **Bayes' theorem**.

- It is used to calculate the next step of the robot when the already executed step is given.
- Bayes' theorem is helpful in weather forecasting.
- It can solve the Monty Hall problem.

Conditional probability is known as the possibility of an event or outcome happening, based on the existence of a previous event or outcome. It is calculated by multiplying the probability of the preceding event by the renewed probability of the succeeding, or conditional, event.

The probability of occurrence of any event A when another event B in relation to A has already occurred is known as conditional probability. It is depicted by P(A|B).

When the intersection of two events happen, then the formula for conditional probability for the occurrence of two events is given by;

$P(A|B) = N(A \cap B)/N(B)$

Or

P(B|A) = N(A∩B)/N(A)

A posterior probability, in Bayesian statistics, is the revised or updated probability of an event occurring after taking into consideration new information. The posterior probability is calculated by updating the prior probability using Bayes' theorem.

$$P(A \mid B) = \frac{P(A \cap B)}{P(B)} = \frac{P(A) \times P(B \mid A)}{P(B)}$$

Prior probability, in Bayesian statistics, is the probability of an event before new data is collected. This is the best rational assessment of the probability of an outcome based on the current knowledge before an experiment is performed.

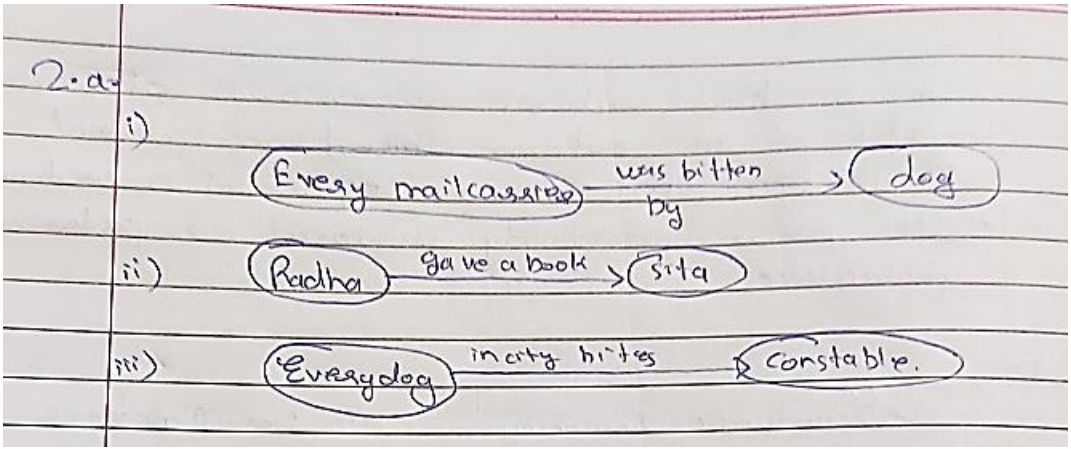
Prior probability can be compared with posterior probability.

Differentiate between monotonic and non-monotonic reasoning systems.

	Monotonic Reasoning	Non-Monotonic Reasoning
1	Monotonic Reasoning is the process which does not change its direction or can say that it moves in the one direction.	Non-monotonic Reasoning is the process which changes its direction or values as the knowledge base increases.
2	Monotonic Reasoning deals with very specific type of models, which has valid proofs.	Non-monotonic reasoning deals with incomplete or not known facts.
3	The addition in knowledge won't change the result.	The addition in knowledge will invalidate the previous conclusions and change the result.
4	In monotonic reasoning, results are always true, therefore, set of prepositions will only increase.	In non-monotonic reasoning, results and set of prepositions will increase and decrease based on condition of added knowledge.
5	Monotonic Reasoning is based on true facts.	Non-monotonic Reasoning is based on assumptions.
6	Deductive Reasoning is the type of monotonic reasoning.	Abductive Reasoning and Human Reasoning is a non-monotonic type of reasoning.

1. The size of the KB always increases monotonically.	1. The size of the KB always increases non-monotonically.
2. All new knowledge that is added to the KB must be consistent with the previous knowledge.	2. In uncertain situations addition of new axioms may contradict with earlier and might be required to be removed from the KB.
3. No retractions of rules (removals) are allowed.	3. Allow retractions also removal of contradictory facts.
4. Inference methods available are insufficient.	4. Inference methods are complete and justified.
5. Traditional KR technologies like PL, FOPL, Propositional can't accommodate the real world's changing situations.	5. These system like TMS allows the revision in belief and accommodate the real world changing situations.

Q2 a | Construct the semantic network for following sentence.
i)"Every mail carrier was bitten by a dog".
ii) Radha gave a book to Sita.
iii) Every dog in the city bites the constable.



Describe a script for restaurant.

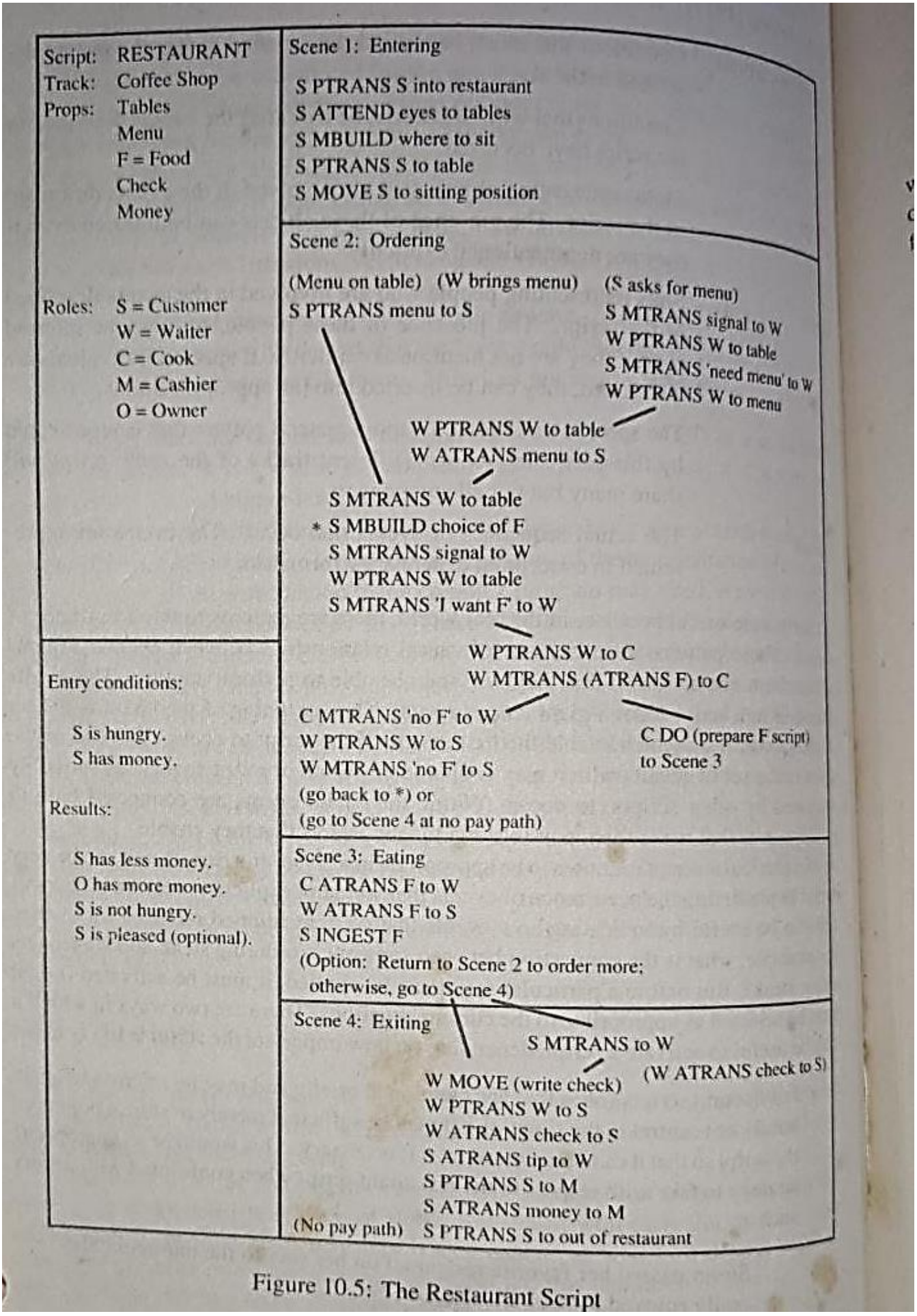


Figure 10.5: The Restaurant Script

03	a	Explain the types of grammar in detail

1. Type 0 known as Unrestricted Grammar.
2. Type 1 known as Context Sensitive Grammar.
3. Type 2 known as Context Free Grammar.
4. Type 3 Regular Grammar.

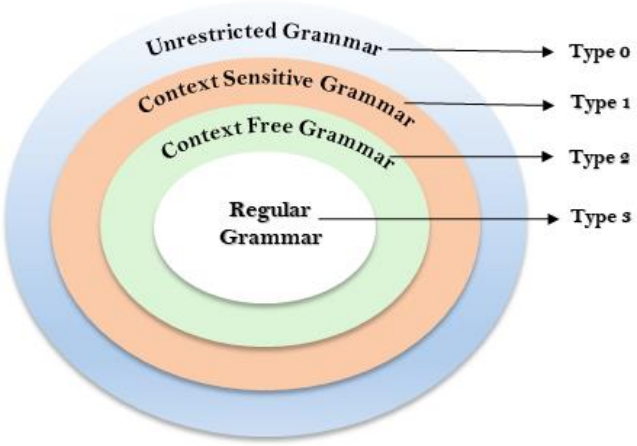


Fig: Chomsky Hierarchy

This is a hierarchy. Therefore every language of type 3 is also of type 2, 1 and 0. Similarly, every language of type 2 is also of type 1 and type 0, etc.

Type 0 Grammar:

Type 0 grammar is known as Unrestricted grammar. There is no restriction on the grammar rules of these types of languages. These languages can be efficiently modeled by Turing machines.

For example:

1. S → s

Type 1 Grammar:

Type 1 grammar is known as Context Sensitive Grammar. The context sensitive grammar is used to represent context sensitive language. The context sensitive grammar follows the following rules:

- The context sensitive grammar may have more than one symbol on the left hand side of their production rules.
- The number of symbols on the left-hand side must not exceed the number of symbols on the right-hand side.
- The rule of the form A → ε is not allowed unless A is a start symbol. It does not occur on the right-hand side of any rule.
- The Type 1 grammar should be Type 0. In type 1, Production is in the form of V → T

Where the count of symbol in V is less than or equal to T.

For example:

1. S → AT
2. T → xy
3. A → a

Type 2 Grammar:

Type 2 Grammar is known as Context Free Grammar. Context free languages are the languages which can be represented by the context free grammar (CFG). Type 2 should be type 1. The production rule is of the form

1. A → α

Where A is any single non-terminal and is any combination of terminals and non-terminals.

For example:

1. A → aBb
2. A → b
3. B → a

Type 3 Grammar:

Type 3 Grammar is known as Regular Grammar. Regular languages are those languages which can be described using regular expressions. These languages can be modeled by NFA or DFA.

Type 3 is most restricted form of grammar. The Type 3 grammar should be Type 2 and Type 1. Type 3 should be in the form of

1. V → T*V / T*

For example:

1. A → xy

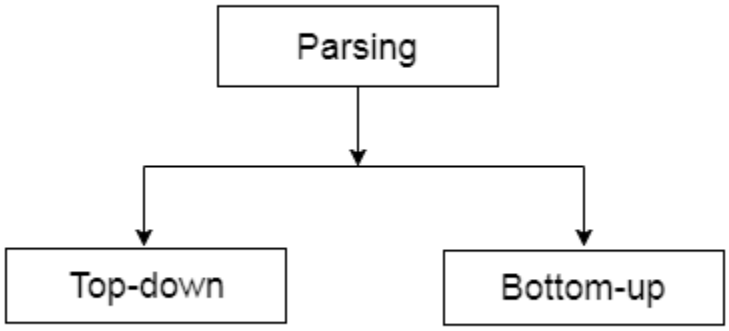
Compare knowledge based expert system with rule based expert system.

A knowledge-based system (KBS) is a computer program that reasons and uses a knowledge base to solve complex problems. The term is broad and is used to refer to many different kinds of systems. The one common theme that unites all knowledge based systems is an attempt to represent knowledge explicitly via tools such as ontologies and rules rather than implicitly via code the way a conventional computer program does. A knowledge based system has two types of sub-systems: a knowledge base and an inference engine. The knowledge base represents facts about the world, often in some form of subsumption ontology. The inference engine represents logical assertions and conditions about the world, usually represented via IF-THEN rules.

an expert system is a computer system that emulates the decision-making ability of a human expert. Expert systems are designed to solve complex problems by reasoning about knowledge, represented primarily as if–then rules rather than through conventional procedural code.
. . .
An expert system is divided into two sub-systems: the inference engine and the knowledge base. The knowledge base represents facts and rules. The inference engine applies the rules to the known facts to deduce new facts. Inference engines can also include explanation and debugging capabilities.

Explain the two basic parsing techniques and differentiate between them.

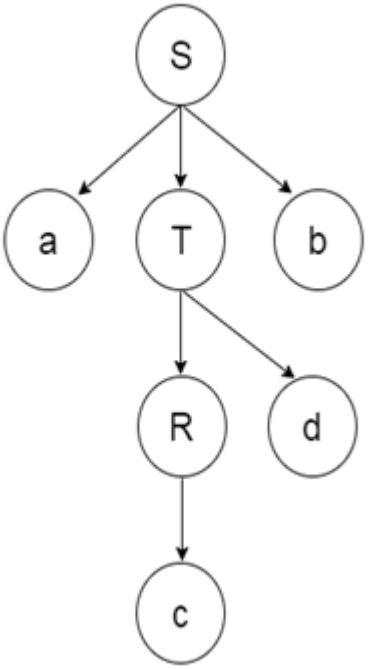
Parsing is of two types: top down parsing and bottom up parsing.



Top down paring

- The top down parsing is known as recursive parsing or predictive parsing.
- Bottom up parsing is used to construct a parse tree for an input string.
- In the top down parsing, the parsing starts from the start symbol and transform it into the input symbol.

Parse Tree representation of input string "acdb" is as follows:



Bottom up parsing

- Bottom up parsing is also known as shift-reduce parsing.
- Bottom up parsing is used to construct a parse tree for an input string.

- In the bottom up parsing, the parsing starts with the input symbol and construct the parse tree up to the start symbol by tracing out the rightmost derivations of string in reverse.

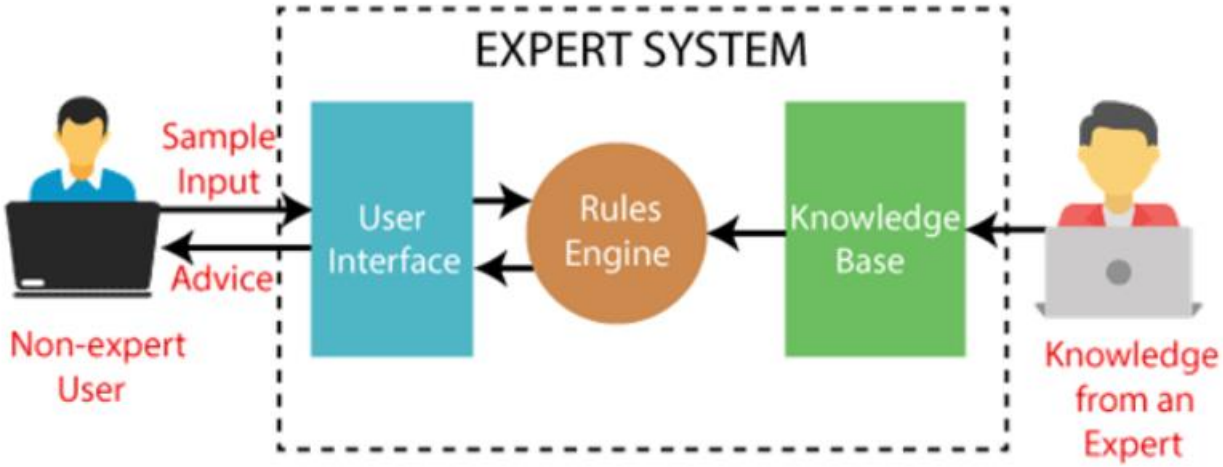
Sr. No.	Key	Top Down Parsing	Bottom Up Parsing
1	Strategy	Top down approach starts evaluating the parse tree from the top and move downwards for parsing other nodes.	Bottom up approach starts evaluating the parse tree from the lowest level of the tree and move upwards for parsing the node.
2	Attempt	Top down parsing attempts to find the left most derivation for a given string.	Bottom up parsing attempts to reduce the input string to first symbol of the grammer.
3	Derivation Type	Top down parsing uses leftmost derivation.	Bottom up parsing uses the rightmost derivation.
4	Objective	Top down parsing searches for a production rule to be used to construct a string.	Bottom up parsing searches for a production rule to be used to reduce a string to get a starting symbol of grammer.

BASIS FOR COMPARISON	TOP-DOWN PARSING	BOTTOM-UP PARSING
Initiates from	Root	Leaves
Working	Production is used to derive and check the similarity in the string.	Starts from the token and then go to the start symbol.
Uses	Backtracking (sometimes)	Handling
Strength	Moderate	More powerful
Producing a parser	Simple	Hard
Type of derivation	Leftmost derivation	Rightmost derivation

Define expert system shell? Explain architecture of 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 performance of an expert system is based on the expert's knowledge stored in its knowledge base.



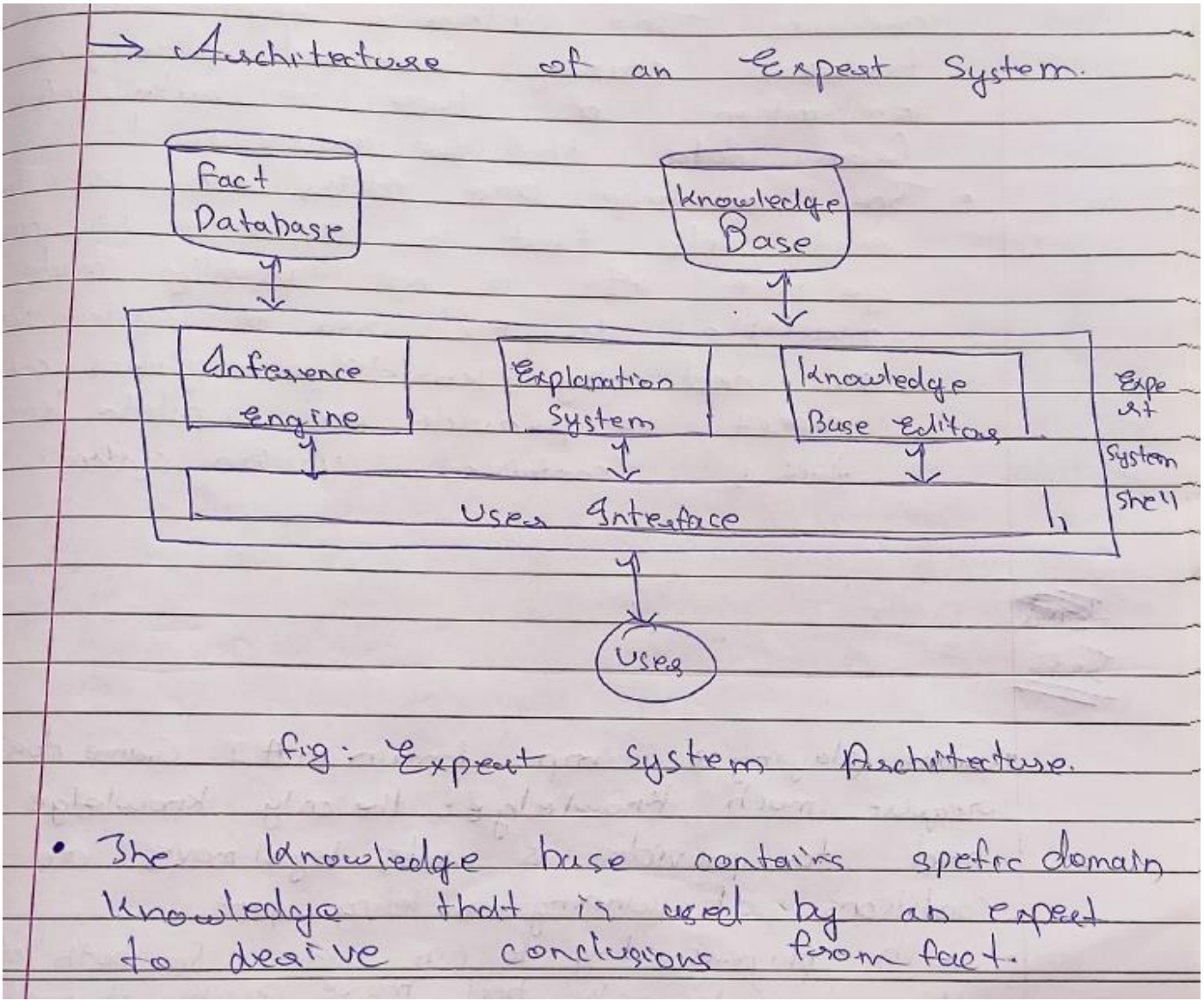
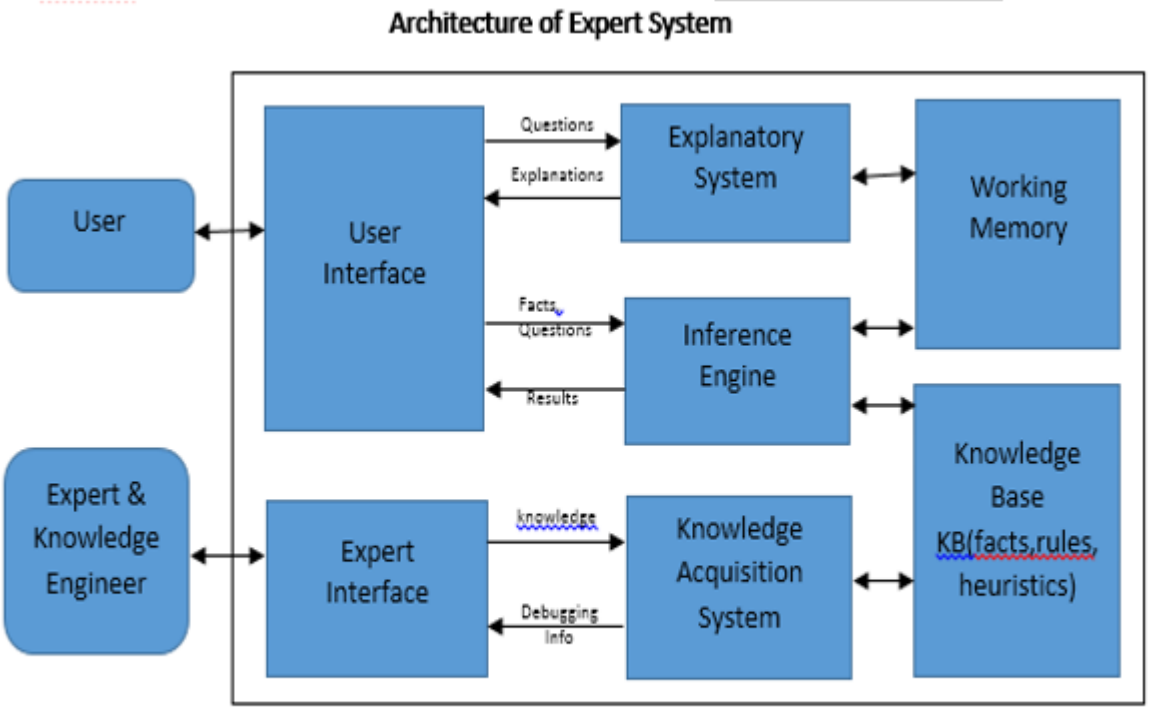


fig: Expert system Architecture.

- The knowledge base contains specific domain knowledge that is used by an expert to derive conclusions from fact.

- The explanation system provide info to user about how inference engine arrived at its conclusion. This can often be essential, particularly if advice being given is of critical nature, such as medical diagnosis system.
- The inference engine is part of system that uses rules and facts to derive conclusions. The inference engine will use forward chaining, backward chaining or combination of two to make inferences from data that are available to it.
- The knowledge base editor allows user to edit info that is contained in knowledge base. It is not usually made available to end user of system but is used by knowledge engineer as expect to provide and update knowledge that is contained within system.

OR



The Architecture of an Expert System (ES) consists of the following major components:

- **Knowledge Base (KB):** repository of special heuristics or rules that direct the use of knowledge, facts (productions). It contains the knowledge necessary for understanding, formulating, & problem solving.
- **Working Memory(Blackboard):** if forward chaining used

  It describes the current problem & record intermediate results

  Records Intermediate Hypothesis & Decisions: 1. Plan, 2. Agenda, 3. Solution
- **Inference Engine:** the deduction system used to infer results from user input & KB

  It is the brain of the ES, the control structure(rule interpreter)

  It provides methodology for reasoning
- **Explanation Subsystem (Justifier):** Traces responsibility & explains the ES behaviour by interactively answering question: Why?, How?, What?, Where?, When?, Who?
- **User Interface:** interfaces with user through Natural Language Processing (NLP), or menus & graphics. Acts as Language Processor for friendly, problem-oriented communication

Shell = Inference Engine + User Interface

The Human Elements in ESs

- Expert: Has the special knowledge, judgement, experience and methods to give advice and solve problems.

Provides knowledge about task performance

- Knowledge Engineer: Usually also the System Builder

Helps the expert(s) structure the problem area by interpreting and integrating human answers to questions, drawing analogies, posing counter examples, and bringing to light conceptual difficulties.

The Expert & the knowledge Engineer should Anticipate Users' needs & Limitations when designing Expert Systems

- **User: Possible Classes of Users can be**
    - A non-expert client seeking direct advice (ES acts as a Consultant or Advisor)
    - A student who wants to learn (ES acts as an Instructor)
    - An ES builder improving or increasing the knowledge base(ES acts as a Partner)
    - An Expert (ES acts as a Colleague or an Assistant)

Describe the importance of Game playing concept in AI.

Game Playing is an important domain of artificial intelligence. Games don't require much knowledge; the only knowledge we need to provide is the rules, legal moves and the conditions of winning or losing the game.

Both players try to win the game. So, both of them try to make the best move possible at each turn. Searching techniques like BFS(Breadth First Search) are not accurate for this as the branching factor is very high, so searching will take a lot of time. So, we need another search procedures that improve –

- **Generate procedure** so that only good moves are generated.
- **Test procedure** so that the best move can be explored first.

The most common search technique in game playing is Minimax search procedure. It is depth-first depth-limited search procedure. It is used for games like chess and tic-tac-toe.

Minimax algorithm uses two functions –

MOVEGEN : It generates all the possible moves that can be generated from the current position.

STATICEVALUATION : It returns a value depending upon the goodness from the viewpoint of two-player

This algorithm is a two player game, so we call the first player as PLAYER1 and second player as PLAYER2. The value of each node is backed-up from its children. For PLAYER1 the backed-up value is the maximum value of its children and for PLAYER2 the backed-up value is the minimum value of its children. It provides most promising move to PLAYER1, assuming that the PLAYER2 has make the best move. It is a recursive algorithm, as same procedure occurs at each level.

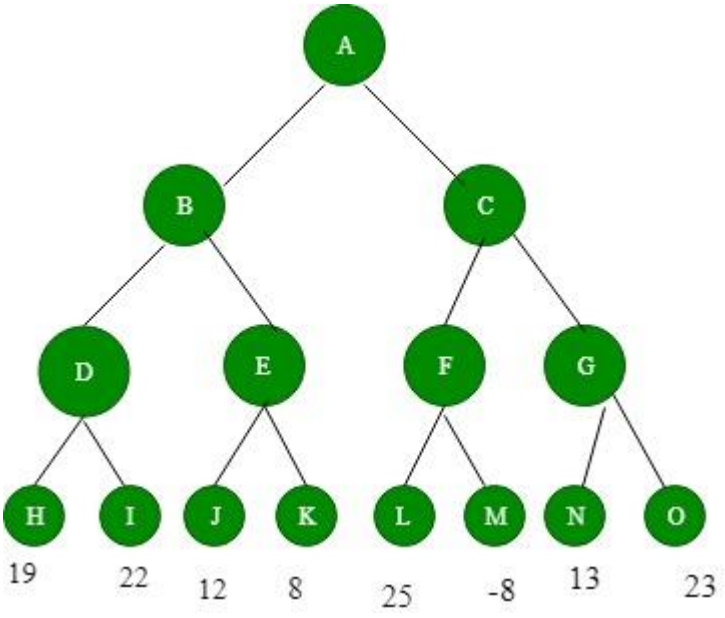


Figure 1: Before backing-up of values

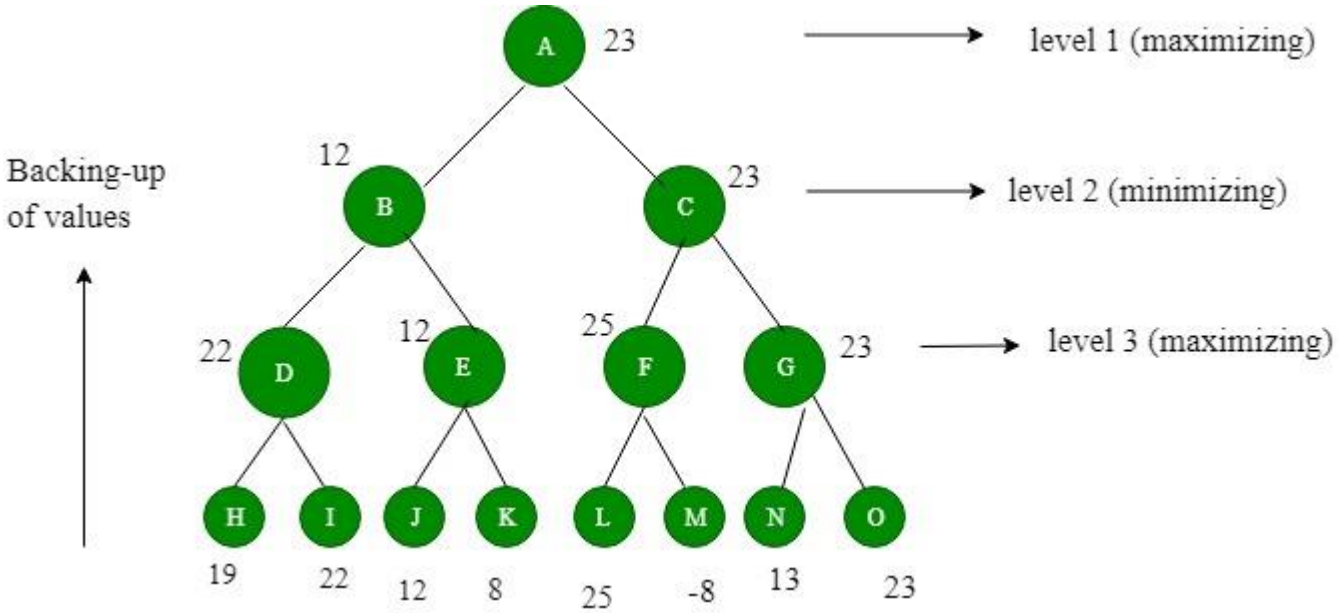


Figure 2: After backing-up of values

We assume that PLAYER1 will start the game. 4 levels are generated. The value to nodes H, I, J, K, L, M, N, O is provided by STATICEVALUATION function. Level 3 is maximizing level, so all nodes of level 3 will take maximum values of their children. Level 2 is minimizing level, so all its nodes will take minimum values of their children. This process continues. The value of A is 23. That means A should choose C move to win.

Explain the following (any one)
i) Mini Max search procedure ii) Alpha - beta pruning

- Mini-max algorithm is a recursive or backtracking algorithm which is used in decision-making and game theory. It provides an optimal move for the player assuming that opponent is also playing optimally.
- Mini-Max algorithm uses recursion to search through the game-tree.
- Min-Max algorithm is mostly used for game playing in AI. Such as Chess, Checkers, tic-tac-toe, go, and various tow-players game. This Algorithm computes the minimax decision for the current state.
- In this algorithm two players play the game, one is called MAX and other is called MIN.
- Both the players fight it as the opponent player gets the minimum benefit while they get the maximum benefit.
- Both Players of the game are opponent of each other, where MAX will select the maximized value and MIN will select the minimized value.
- The minimax algorithm performs a depth-first search algorithm for the exploration of the complete game tree.
- The minimax algorithm proceeds all the way down to the terminal node of the tree, then backtrack the tree as the recursion

- Alpha-beta pruning is a modified version of the minimax algorithm. It is an optimization technique for the minimax algorithm.
- As we have seen in the minimax search algorithm that the number of game states it has to examine are exponential in depth of the tree. Since we cannot eliminate the exponent, but we can cut it to half. Hence there is a technique by which without checking each node of the game tree we can compute the correct minimax decision, and this technique is called **pruning**. This involves two threshold parameter Alpha and beta for future expansion, so it is called **alpha-beta pruning**. It is also called as **Alpha-Beta Algorithm**.
- Alpha-beta pruning can be applied at any depth of a tree, and sometimes it not only prune the tree leaves but also entire sub-tree.
- The two-parameter can be defined as:
    a. **Alpha:** The best (highest-value) choice we have found so far at any point along the path of Maximizer. The initial value of alpha is **-∞**.
    b. **Beta:** The best (lowest-value) choice we have found so far at any point along the path of Minimizer. The initial value of beta is **+∞**.
- The Alpha-beta pruning to a standard minimax algorithm returns the same move as the standard algorithm does, but it removes all the nodes which are not really affecting the final decision but making algorithm slow. Hence by pruning these nodes, it makes the algorithm fast.

Condition for Alpha-beta pruning:

The main condition which required for alpha-beta pruning is:

1. $\alpha >= \beta$

Key points about alpha-beta pruning:

- The Max player will only update the value of alpha.
- The Min player will only update the value of beta.
- While backtracking the tree, the node values will be passed to upper nodes instead of values of alpha and beta.
- We will only pass the alpha, beta values to the child nodes.

a)Define NLP. Explain the following components of NLP.
i) NLU (Natural Language Understanding)
ii)NLG (Natural Language Generation)

Ans: NLP: 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, when you want to hear decision from a dialogue based clinical expert system, etc.
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 NLU :

- NLU
- NLG

NLG: NLG is a method of creating meaningful phrases and sentences (natural language) from data. It comprises three stages: text planning, sentence planning, and text realization.

- Text planning: Retrieving applicable content.
- Sentence planning: Forming meaningful phrases and setting the sentence tone.
- Text realization: Mapping sentence plans to sentence structures.
  Chatbots, machine translation tools, analytics platforms, voice assistants, sentiment analysis platforms, and AI-powered transcription tools are some applications of NLG.

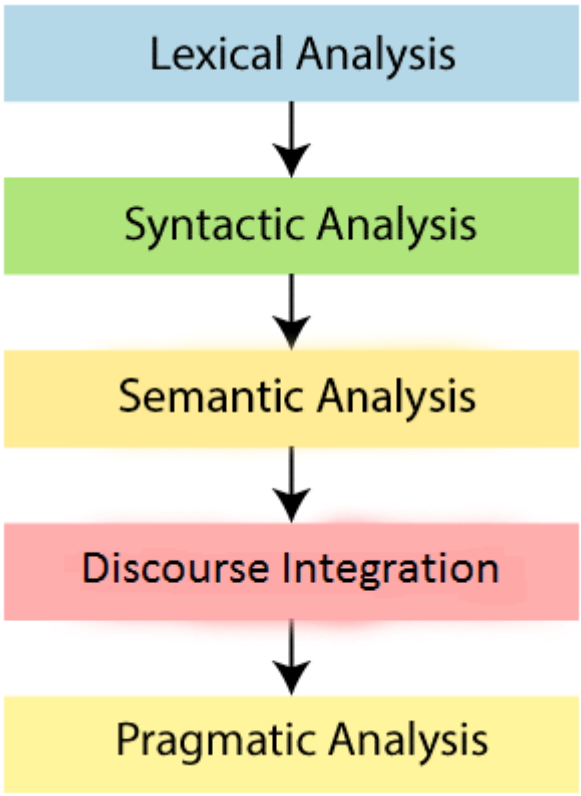
NLU: NLU enables machines to understand and interpret human language by extracting metadata from content. It performs the following tasks:

- Helps analyze different aspects of language.
- Helps map the input in natural language into valid representations.

NLU is more difficult than NLG tasks owing to referential, lexical, and syntactic ambiguity.

- Lexical ambiguity: This means that one word holds several meanings. For example, "The man is looking for the match." The sentence is ambiguous as 'match' could mean different things such as a partner or a competition.
- Syntactic ambiguity: This refers to a sequence of words with more than one meaning. For example, "The fish is ready to eat." The ambiguity here is whether the fish is ready to eat its food or whether the fish is ready for someone else to eat. This ambiguity can be resolved with the help of the part-of-speech tagging technique.
- Referential ambiguity: This involves a word or a phrase that could refer to two or more properties. For example, Tom met Jerry and John. They went to the movies. Here, the pronoun 'they' causes ambiguity as it isn't clear who it refers to.

List the levels of NLP and explain each with suitable example.



1. Lexical Analysis and Morphological

The first phase of NLP is the Lexical Analysis. This phase scans the source code as a stream of characters and converts it into meaningful lexemes. It divides the whole text into paragraphs, sentences, and words.

2. Syntactic Analysis (Parsing)

Syntactic Analysis is used to check grammar, word arrangements, and shows the relationship among the words.

Example: Agra goes to the Poonam

In the real world, Agra goes to the Poonam, does not make any sense, so this sentence is rejected by the Syntactic analyzer.

3. Semantic Analysis

Semantic analysis is concerned with the meaning representation. It mainly focuses on the literal meaning of words, phrases, and sentences.

4. Discourse Integration

Discourse Integration depends upon the sentences that proceeds it and also invokes the meaning of the sentences that follow it.

5. Pragmatic Analysis

Pragmatic is the fifth and last phase of NLP. It helps you to discover the intended effect by applying a set of rules that characterize cooperative dialogues.

For Example: "Open the door" is interpreted as a request instead of an order.

Explain the knowledge representation in artificial neural networks.

Knowledge Representation in AI describes the representation of knowledge. Basically, it is a study of how the **beliefs, intentions**, and **judgments** of an **intelligent agent** can be expressed suitably for automated reasoning. One of the primary purposes of Knowledge Representation includes modeling intelligent behavior for an agent.

Knowledge Representation and Reasoning (**KR, KRR**) represents information from the real world for a computer to understand and then utilize this knowledge to solve **complex real-life problems** like communicating with human beings in natural language. Knowledge representation in AI is not just about storing data in a database, it allows a machine to learn from that knowledge and behave intelligently like a human being.

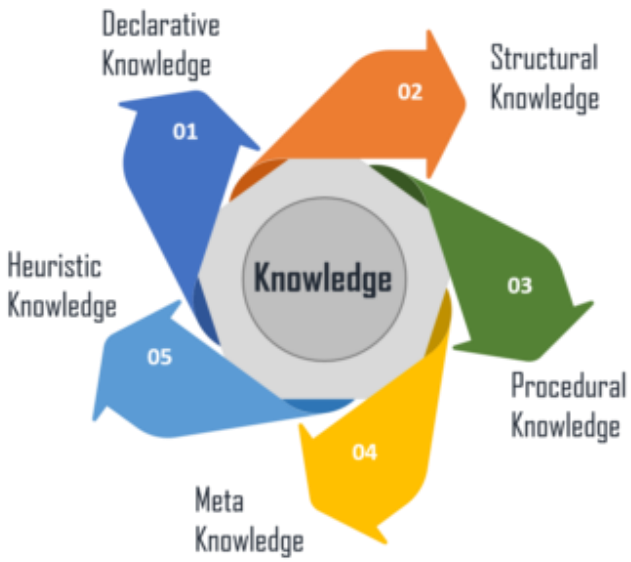
The different kinds of knowledge that need to be represented in AI include:

- **Objects**
- **Events**
- **Performance**
- **Facts**
- **Meta-Knowledge**
- **Knowledge-base**

Now that you know about Knowledge representation in AI, let's move on and know about the different types of Knowledge.

Different Types of Knowledge

There are 5 types of Knowledge such as:



- **Declarative Knowledge** – It includes concepts, facts, and objects and expressed in a declarative sentence.
- **Structural Knowledge** – It is a basic problem-solving knowledge that describes the relationship between concepts and objects.
- **Procedural Knowledge** – This is responsible for knowing how to do something and includes rules, strategies, procedures, etc.
- **Meta Knowledge** – Meta Knowledge defines knowledge about other types of Knowledge.
- **Heuristic Knowledge** – This represents some expert knowledge in the field or subject.

Explain the life cycle of genetic algorithm.

ANS: A genetic algorithm is used to solve complicated problems with a greater number of variables & possible outcomes/solutions. The combinations of different solutions are passed through the Darwinian based algorithm to find the best solutions. The poorer solutions are then replaced with the offspring of good solutions.

- The components of the population, i.e., elements, are termed as genes in genetic algorithms in AI. These genes form an individual in the population (also termed as a chromosome).
- A search space is created in which all the individuals are accumulated. All the individuals are coded within a finite length in the search space.
- Each individual in the search space (population) is given a fitness score, which tells its ability to compete with other individuals.

- All the individuals with their respective fitness scores are sought & maintained by the genetic algorithm & the individuals with high fitness scores are given a chance to reproduce.
- The new offspring are having better 'partial solutions' as compared to their parents. Genetic algorithms also keep the space of the search space dynamic for accumulating the new solutions (offspring).
- This process is repeated until the offsprings do not have any new attributes/features than their parents (convergence). The population converges at the end, and only the fittest solutions remain along with their offspring (better solutions). The fitness score of new individuals in the population (offspring) are also calculated.

The general lifecycle of a genetic algorithm is as follows:

- **Creation of a population**: This involves creating a random population of potential solutions.
- **Measuring fitness of individuals in the population**: This involves determining the efficacy of a specific solution. This is accomplished by using a fitness function which scores solutions to determine their worth.
- **Selecting parents based on their fitness**: This involves selecting a number of pairs of parents who will reproduce offspring.
- **Reproducing individuals from parents**: This involves creating offspring from their respective parents by mixing genetic information and applying slight mutations to the offspring.
- **Populating the next generation**: This involves selecting individuals and offspring from the population who will survive to the next generation.

List the genetic operators and explain each of them with suitable example.

Explain the following terms:-
i) Genes ii) Chromosomes

In genetic algorithms, a **chromosome** (also sometimes called a **genotype**) is a set of parameters which define a proposed solution to the problem that the genetic algorithm is trying to solve. The set of all solutions is known as the *population*.

- **Gene** – A gene is one element position of a chromosome.

Describe different applications of neural networks.

- **Speech Recognition:** Speech recognition relies heavily on artificial neural networks (ANNs). Earlier speech recognition models used statistical models such as Hidden Markov Models. With the introduction of deep learning, several forms of neural networks have become the only way to acquire a precise classification.
- **Handwritten Character Recognition:** ANNs are used to recognize handwritten characters. Handwritten characters can be in the form of letters or digits, and neural networks have been trained to recognize them.
- **Signature Classification:** We employ artificial neural networks to recognize signatures and categorize them according to the person's class when developing these authentication systems. Furthermore, neural networks can determine whether or not a signature is genuine.
- **Medical:** It can be used to detect cancer cells and analyze MRI pictures in order to provide detailed results.

Facial Recognition

Facial Recognition Systems are serving as robust systems of surveillance. Recognition Systems matches the human face and compares it with the digital images. They are used in offices for selective entries. The systems thus authenticate a human face and match it up with the list of IDs that are present in its database.

Convolutional Neural Networks (CNN) are used for **facial recognition and image processing.** Large number of pictures are fed into the database for training a neural network. The collected images are further processed for training.

Sampling layers in CNN are used for proper evaluations. Models are optimized for accurate recognition results.

2. Stock Market Prediction

Investments are subject to market risks. It is nearly impossible to predict the upcoming changes in the highly volatile stock market. The forever changing bullish and bearish phases were unpredictable before the advent of neural networks. But well what changed it all? Neural Networks of course…

To make a successful stock prediction in real time a **Multilayer Perceptron MLP** *(class of feedforward artificial intelligence algorithm)* is employed. MLP comprises multiple layers of nodes, each of these layers is fully connected to the succeeding nodes. Stock's past performances, annual returns, and non profit ratios are considered for building the MLP model.

Check out this video to know how the LTSM model is built for making predictions in the stock market.

3. Social Media

No matter how cliche it may sound, social media has altered the normal boring course of life. Artificial Neural Networks are used to study the behaviours of social media users. Data shared everyday via virtual conversations is tacked up and analyzed for competitive analysis.

Neural networks duplicate the behaviours of social media users. Post analysis of individuals' behaviours via social media networks the data can be linked to people's spending habits. **Multilayer Perceptron ANN** is used to mine data from social media applications.

MLP forecasts social media trends, it uses different training methods like **Mean Absolute Error (MAE), Root Mean Squared Error (RMSE), and Mean Squared Error (MSE).** MLP takes into consideration several factors like user's favourite instagram pages, bookmarked choices etc. These factors are considered as inputs for training the MLP model.

In the ever changing dynamics of social media applications, artificial neural networks can definitely work as the best fit model for user data analysis.

4. Aerospace

Aerospace Engineering is an expansive term that covers developments in spacecraft and aircraft. Fault diagnosis, high performance auto piloting, securing the aircraft control systems, and modeling key dynamic simulations are some of the key areas that neural networks have taken over. Time delay Neural networks can be employed for modelling non linear time dynamic systems.

Time Delay Neural Networks are used for **position independent feature recognition.** The algorithm thus built based on time delay neural networks can recognize patterns. *(Recognizing patterns are automatically built by neural networks by copying the original data from feature units).*

Other than this TNN are also used to provide stronger dynamics to the NN models. As passenger safety is of utmost importance inside an aircraft, algorithms built using the neural network systems ensures the accuracy in the autopilot system. As most of the autopilot functions are automated, it is important to ensure a way that maximizes the security.

5. Defence

Defence is the backbone of every country. Every country's state in the international domain is assessed by its military operations. Neural Networks also shape the defence operations of technologically advanced countries. The United States of America, Britain, and Japan are some countries that use artificial neural networks for developing an active defence strategy.

Neural networks are used in logistics, armed attack analysis, and for object location. They are also used in air patrols, maritime patrol, and for controlling automated drones. The defence sector is getting the much needed kick of artificial intelligence to scale up its technologies.

Convolutional Neural Networks(CNN), are employed for determining the presence of underwater mines. Underwater mines are the underpass that serve as an illegal commute route between two countries. **Unmanned Airborne Vehicle (UAV),** and **Unmanned Undersea Vehicle (UUV)** these autonomous sea vehicles use convolutional neural networks for the image processing.

Convolutional layers form the basis of Convolutional Neural Networks. These layers use different filters for differentiating between images. Layers also have bigger filters that filter channels for image extraction.

6. Healthcare

The age old saying goes like "Health is Wealth". Modern day individuals are leveraging the advantages of technology in the healthcare sector. **Convolutional Neural Networks** are actively employed in the healthcare industry for **X ray detection, CT Scan** and **ultrasound.**

As CNN is used in image processing, the medical imaging data retrieved from aforementioned tests is analyzed and assessed based on neural network models. **Recurrent Neural Network (RNN)** is also being employed for the development of voice recognition systems.

Voice recognition systems are used these days to keep track of the patient's data. Researchers are also employing **Generative Neural Networks** for drug discovery. Matching different categories of drugs is a hefty task, but generative neural networks have broken down the hefty task of drug discovery. They can be used for combining different elements which forms the basis of drug discovery.

7. Signature Verification and Handwriting Analysis

Signature Verification , as the self explanatory term goes, is used for verifying an individual's signature. Banks, and other financial institutions use signature verification to cross check the identity of an individual.

Usually a signature verification software is used to examine the signatures. As cases of forgery are pretty common in financial institutions, signature verification is an important factor that seeks to closely examine the authenticity of signed documents.

Artificial Neural Networks are used for **verifying the signatures.** ANN are trained to recognize the difference between real and forged signatures. ANNs can be used for the verification of both offline and online signatures.

For training an ANN model, varied datasets are fed in the database. The data thus fed help the ANN model to differentiate. **ANN model employs image processing** for extraction of features.
The analysis is further used to evaluate the variations in two handwritten documents. The process of spilling words on a blank sheet is also used for behavioural analysis. **Convolutional Neural Networks (CNN)** are used for handwriting analysis and handwriting verification.

8. Weather Forecasting

The forecasts done by the meteorological department were never accurate before artificial intelligence came into force. Weather Forecasting is primarily undertaken to anticipate the upcoming weather conditions beforehand. In the modern era, weather forecasts are even used to predict the possibilities of natural disasters.

Define :
i) Artificial Neural Network ii Genetic Algorithm.

Ans: i) Artificial Neural Network

Artificial Neural Networks contain artificial neurons which are called **units**. These units are arranged in a series of layers that together constitute the whole Artificial Neural Networks in a system. A layer can have only a dozen units or millions of units as this depends on the complexity of the system. Commonly, Artificial Neural Network has an input layer, output layer as well as hidden layers. The input layer receives data from the outside world which the neural network needs to analyze or learn about. Then this data passes through one or multiple hidden layers that transform the input into data that is valuable for the output layer. Finally, the output layer provides an output in the form of a response of the Artificial Neural Networks to input data provided.

In the majority of neural networks, units are interconnected from one layer to another. Each of these connections has weights that determine the influence of one unit on another unit. As the data transfers from one unit to another, the neural network learns more and more about the data which eventually results in an output from the output layer.

ii Genetic Algorithm.

A genetic algorithm is used to solve complicated problems with a greater number of variables & possible outcomes/solutions. The combinations of different solutions are passed through the Darwinian based algorithm to find the best solutions. The poorer solutions are then replaced with the offspring of good solutions.

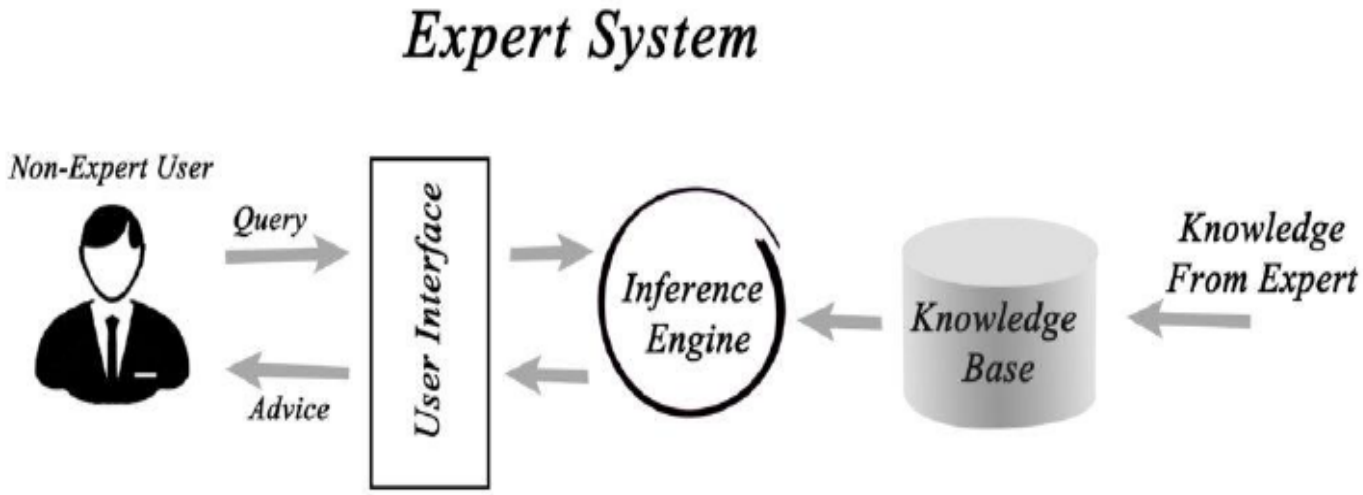
Genetic Algorithms(GAs) are adaptive heuristic search algorithms that belong to the larger part of evolutionary algorithms. Genetic algorithms are based on the ideas of natural selection and genetics. These are intelligent exploitation of random search provided with historical data to direct the search into the region of better performance in solution space. They are commonly used to generate high-quality solutions for optimization problems and search problems.

Genetic algorithms simulate the process of natural selection which means those species who can adapt to changes in their environment are able to survive and reproduce and go to next generation. In simple words, they simulate "survival of the fittest" among individual of consecutive generation for solving a problem. Each generation consist of a population of individuals and each individual represents a point in search space and possible solution. Each individual is represented as a string of character/integer/float/bits. This string is analogous to the Chromosome.

Explain with neat diagram various components of a typical expert system.

Ans: There are 5 Components of expert systems:

1. Knowledge Base
2. Inference Engine
3. Knowledge acquisition and learning module
4. User Interface
5. Explanation module



- **Knowledge base:** The knowledge base in an expert system represents facts and rules. It contains knowledge in specific domains along with rules in order to solve problems and form procedures that are relevant to the domain.
- **Inference engine:** The most basic function of the inference engine is to acquire relevant data from the knowledge base, interpret it, and find a solution to the user's problem. Inference engines also have explanatory and debugging abilities.
- **Knowledge acquisition and learning module:** This component functions to allow the expert systems to acquire more data from various sources and store it in the knowledge base.
- **User interface:** This component is essential for a non-expert user to interact with the expert system and find solutions.
- **Explanation module:** As the name suggests, this module helps in providing the user with an explanation of the achieved conclusion.

Explain GA based machine learning.

Ans: A genetic algorithm is used to solve complicated problems with a greater number of variables & possible outcomes/solutions. The combinations of different solutions are passed through the Darwinian based algorithm to find the best solutions. The poorer solutions are then replaced with the offspring of good solutions.

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How Genetic Algorithm Work?

The genetic algorithm works on the evolutionary generational cycle to generate high-quality solutions. These algorithms use different operations that either enhance or replace the population to give an improved fit solution.

It basically involves five phases to solve the complex optimization problems, which are given as below:

- **Initialization**
- **Fitness Assignment**
- **Selection**
- **Reproduction**
- **Termination**

Advantages of Genetic Algorithm

- The parallel capabilities of genetic algorithms are best.
- It helps in optimizing various problems such as discrete functions, multi-objective problems, and continuous functions.
- It provides a solution for a problem that improves over time.
- A genetic algorithm does not need derivative information.

Limitations of Genetic Algorithms

- Genetic algorithms are not efficient algorithms for solving simple problems.
- It does not guarantee the quality of the final solution to a problem.
- Repetitive calculation of fitness values may generate some computational challenges.