Artificial Intelligence

A.I. is a branch of computer science by which we can create intelligent machines which can behave like human, think like human & is able to make decisions.

Main goals of A.I. :-

* To replicate human intelligence
* To solve knowledge intensive task.
* Intelligent connection of perception and action.
* Building machine which can create or perform task which require human intelligence.
  eg → proving a theorem, playing games like chess, planning a surgical operation, driving a car, prediction & analysis, recommendations creation
* Creating system which exhibits intelligent behaviour, learns new things by itself, demonstrate, explain & can advince its user.

AI is not just of computer science, it is so vast and requires lots of other factors for creating A.I.

Intelligence is combination of logic, reasoning, learning, problem solving, perception, language understanding and decision making.

Advantages of A.I.

i) High accuracy with less errors.
ii) High speed, fast process
iii) High reliability.
iv) Useful for risky areas. (remote areas, space travel etc)
v) Digital assitance
vi) Useful for public utility.
vii) Available 24/7 (viii) Easily handles repititive tasks.

Disadvantages of A.I.

i) High cost
ii) Increases dependency ~~of~~ on machine.
iii) Can't think out of box.
iv) No feelings / emotions
v) Unemployment, maintainance

Production system:

Production rule system is a computer program, typically used to provide some form of A.I. which consists primary set of rules about behaviour. It also includes mechanism necessary to follow those rules as the system

These rules are basic representation helpful in expert system, automated planning & action selection

⇒ Major components of production system in A.I. are:-

i) Global database

The global database is the central datastructure used by the production system in A.I.

ii) Set of production rules

* The production rules operate on the global database
* Each rule has a pre condition that is either satisfied or not by the global database.
* If the precondition is satisfied, the rule is usually applied.
* The application of rule changes the database.

iii) The control system

* The control system then chooses which applicable rule should be applied and stops computation when a termination condition on the database is satisfied.
* If multiple rules are applied at the same time, the control system resolves the conflict.

⇒ Main features of production system:-

i) Simplicity

The structure of each sentence in production

system is unique as they use 'if-then' structure

This structure provides simplicity in knowledge representation & improves the readibility

ii) Modularity: This means the production rule code the knowledge available in discrete pieces. So information can be added & deleted from the system without any side effect to whole system.

iii) Modifiability.
This means the facility for modifying rules. This allows the development of production in a skeletal form and then it is modified to suit a specific application

iv) Knowledge intensive
* The knowledge based of production system stores pure knowledge.
* This part does not contain any type of control or programming information.

Classes of production system:-

i) Monotonic Production System: In this type of production system the rules can be applied simultaneously as the use of

one production system does not prevent the involvment of another rule that is selected at the same time.

ii) Non-monotonic production system: This type of production system increases efficiency in solving problems. The implementation of these system does not require backtracking to the correct previous incorrect moves. The non-monotonic production system are necessary for the implementation to find an efficient solution. This production system increases efficiency since it is not necessary to keep track of the changes made in the search process.

iii) Partially commutative production system: This class of production system helps to create a production system (PS) that can give result even by interchanging the state of rules. If using a set of rules transforms state A to state B, then multiple combinations of those rules will be capable to convert state B to state B.

iv) Commutative system: They are helpful, where order of operation is not important. Also problems where changes are reversible use commutative system.

In comparison to partially commutative changes are irreversible. Also, order of operation is important to get correct result.

Advantages of production system in AI:

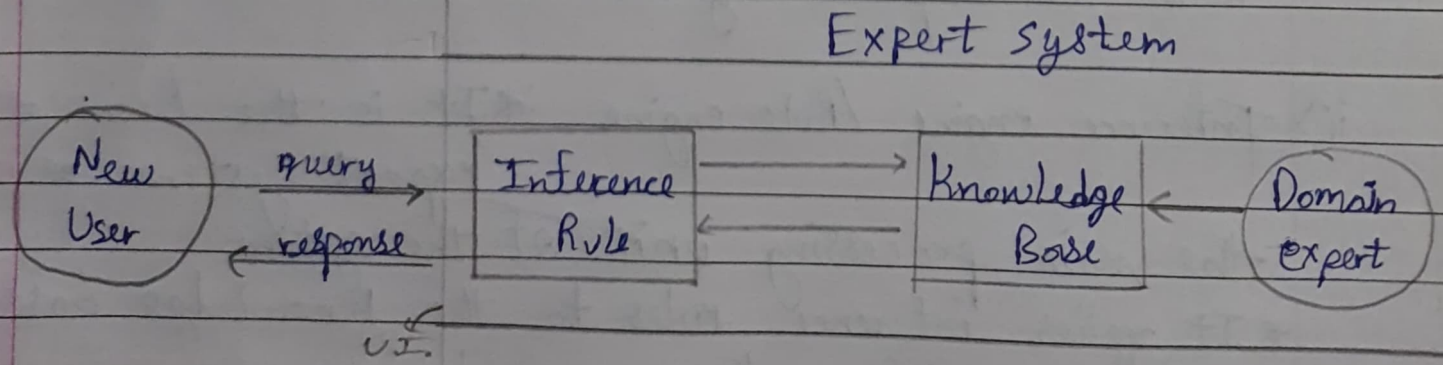
i) Offers modularity: Rules can be deleted, added & modified
ii) Separate knowledge system and

iii) Accurate & Feasible models that ~~imitates~~ imitates human problem solving skill.
iv) Beneficial in real time application.

Disadvantages

i) It is very difficult to analyze the flow of control within a production system.
ii) It describes the operation that can be performed in a search of a problem.
iii) There is a absence of learning due to rule based production system that does not store the result of the problem for future.

Architecture of Expert System:-



* example of expert system:-

i) DENDRAL - * It is an A.I. project that was made as a chemical analyst expert system.
* It is used in organic chemistry to detect unknown organic molecules with the help of their mass spectra and knowledge base of chemistry.

ii) MYCIN - * It was designed to find bacteria causing infections like bacteremia, menegits.
* It is used for recommendation of antibiotics & diagonisis of blood clotting disease.

iii) PXDES - * It is an expert system used to determine type and level of lung cancer.

iv) Cadet - The cadet expert system is a diagonistic support system that can detect early stages of cancer.

* The expert system mainly consist of three components :-

i) User Interface : It is an interface that helps a non-expert user to communicate with the expert system to find a solution.

ii) Inference engine / Rule engine : * It is the brain of an expert system as it is the main processing unit of the system.
* It applies inference rules to the knowledge base to derive new information or conclusion.

* There are ~~are~~ two types of inference engine:

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

2) Probabilistic inference engine: This type of inference engine contains uncertainity i.e it's based on probability.

iii) Knowledge base: * It contains domain specific information.
* Knowledge is required to gain intelligence of expertise.

* The success of any expert system depends upon collection of accurate & precise knowledge.
* A knowledge base contains factual & Heuristic knowledge.
factual → books, facts
Heuristic knowledge → experiment based

* heuristic knowledge is more about practice, accurate judgement once ability of evaluation and guessing.

* Knowledge representation - it is a method to organize & formalize knowledge in knowledge base. It is in form of IF-THEN-ELSE rule.
Expert systems whose knowledge is represented in rule form are called rule-based systems.

* Knowledge engineer - A person who creates knowledge base, they acquires information from domain expert by recording, interviewing & observing his work. They then categorize & organize information in meaningful way in form of IF-THEN-ELSE.
The knowledge engineer also monitors development of knowledge base

Use of inference engine :-

- Use of efficient procedure & uses ~~f~~ of the inference engine is essential is for getting a correct solution.

- To recommend a solution, inference engine uses following strategies :-
  * Forward chaining
  * Backward chaining

Development of expert system :-

Example of MYCIN :-

* In case of MYCIN doctors, experts specialised in medical field of bacteria infection.

* Provide information about the causes, symptoms and other information in that domain.

* The knowledge base of the MYCIN is updated successfully in order to test it doctors provide a new problem to it.

* The problem is to identify the presence of bacteria in the input details of the ~~status~~ patient (symptoms, history, current)

* The expert system will need a questionaire to be filled by a patient to ~~know~~ know general information about the patient.

* Now, the system has collected all the information so it

will find output for the problem, by applying if-then-else rule. Using inference engine and the facts /data stored in the knowledge base.

* In the end user will get response by using the use interface.

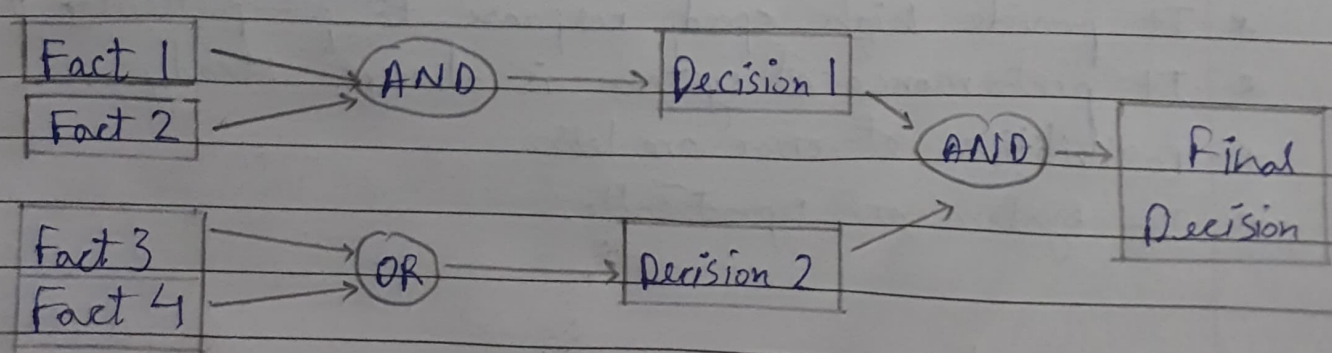
⇒ Participants in ~~OES~~ development of expert system :-

* Domain Expert * Knowledge Engineer * User

⇒ Advantage of Expert system :-
→ It is not affected by emotions.
→ It has constant performance.
→ It has high security.
→ Considers all the facts /data.
→ Regular update in the system improves the performance.

Inference Engine :-

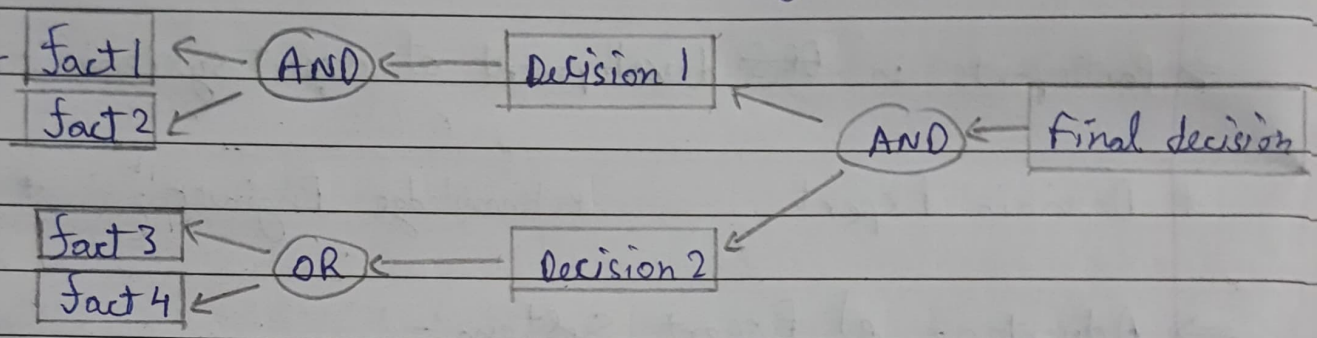
Forward chaining - Here the inference engine follows the chain of variation & considers all the facts rules before concluding to the sol^n. The strategy followed for working on it conclusion, result or effect.
eg → Prediction of share market status, as an effect of change in interest rate.



Backward-chaining - This expert system answers to the system why it happens on the basis of what has already happened, the inference engine tries to find out which condition could have happened for this result.

* The strategy is followed for finding out cause or region.

eg-



(H.W) Q> Differentiate b/w forward & backward Reasoning.

⇒ To create a new expert system :-

* Identify the problem domain / statement.
* Design the system.
* Develop the prototype.
* Test and refine the prototype
* Develop and complete the expert system.
* Maintain the expert system.

⇒ Advantages / Benefits of expert system :-

* It can be used in risky places.
* It provide high speed response to a particular query.
* It performance of system is always steady.
* Possibilities of error are less.
* The system are reproducable.

⇒ Limitations of expert system :-

* Response of expert system may got wrong, if knowledge base has wrong information.
* ~~Maintaino~~ Maintenance & development cost is high.
* knowledge accession is a very difficult task.
* for each domain we need a specific expert system.

Natural Language Processing (NLP)

⇒ There are five phases to NLP :-

1> Lexical Analysis

* This is the first phase of NLP.
* It converts the whole stream of data into meaningful characters or words (leximes)
* It divides the whole text into paragraphs sentences and words.

2> Syntactic Analysis

* It is used to check grammar of the syntax sentence, word arrangements and relationship between the words.
* Dependency grammar and part of speech by are important attributes of text syntax.

3> Semantic Analysis

* We try to determine meaning of a sentence based on the literal meaning of words phrases and sentences.

4> Discourse integration

* In this analysis our main focus is on the properties of a text as a whole that convey meaning by making connections between different components of the sentences, it means sense of the context.

5> Pragmatic Analysis eg → close the door → could be request or order

* This is the fifth & the last phase of analysis.
* In this analysis we explain how extra meaning is read into text without actually being encoded in depth.
* This analysis require :-
  i> World knowledge
  ii> Understanding the intention, plan & goal

⇒ Applications of NLP :- (Natural language Processing)
* Alexa, siri * chat bot * Text summarization
* Information retrieval * grammar & spelling correction
* speech recognition * spam detection * sentiment analysis