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Artificial Intelligence

UNIT - 1

(One - shot)

Topics to be covered :-

1. AI
2. Intelligent agents
3. Problem solving approach to typical AI problem.
4. Turing test

(#) Artificial Intelligence :

- It refers to the development of computer systems that can perform tasks like human does.
- It is the area of computer science that emphsizes the creation of intelligent machines that can work and behave like humans.
- The term artificial intelligence was coined by John McCarthy during Dartmouth conference in 1956.
- AI involves techniques like ML, ANN, NLP to enable the system mimic human cognitive functions.

* Goals of AI:

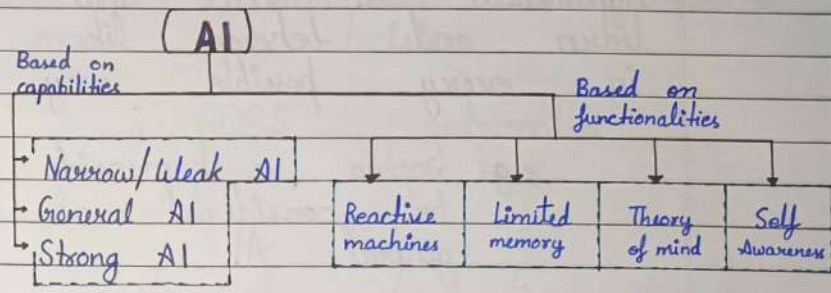
1. Mastery in ML
2. Enhanced decision - making
3. Natural language understanding
4. Computer vision advancement
5. Autonomous systems
6. Ethical AI development
7. Human - Robot Collaboration
8. Advance personalized user experience
9. Healthcare innovations
10. Sustainability solutions.

* Roles of AI:

1. Automation
2. Personalization
3. Healthcare
4. Forecasting
5. NLP
6. Computer vision
7. Cyber - Security
8. Research and innovation
9. Education
10. Space exploration.

ARFAT Date Page

* Types of AI:



Capability based:

i) Narrow/Weak AI:

- Designed for specific tasks and lacks general cognitive abilities.
- AI that is designed for a specific purpose.

e.g: Virtual Assistants like siri and alexa are voice recognition models, they can't process broad intelligence.

ii) General AI:

- Designing of AI with human - like cognative abilities, capable of understand -ing, learning and performing any intellectual task.

- Hypothetical AI model that can think, learn and behave like humans in every possible way.

e.g: Sophia, a humanoid robot can be considered as 1% of general AI.

iii) Strong AI:

- Similar to general AI but with a high level of cognative abilities.
- It is a smarter AI that can do alot more than human can do, but its approximately impossible.

Functionality based:

i) Reactive machines:

- They don't perceive any past experience or memories, they just react on the actions.

e.g: AI in chess.

ii) Limited memory:

- They store experiences and learnings to make new decisions

e.g: ADAS in automobiles

iii) Theory of mind:

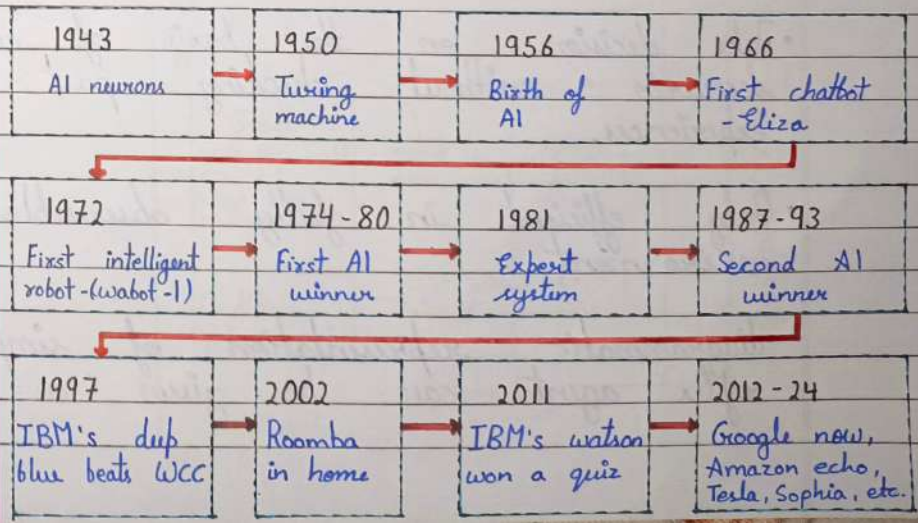
- They capable of understanding human emotions.

e.g: Sophia

iv) Self awareness:

- They depict the human equivalence and have ability to predict emotions.

★ Evolution of AI:



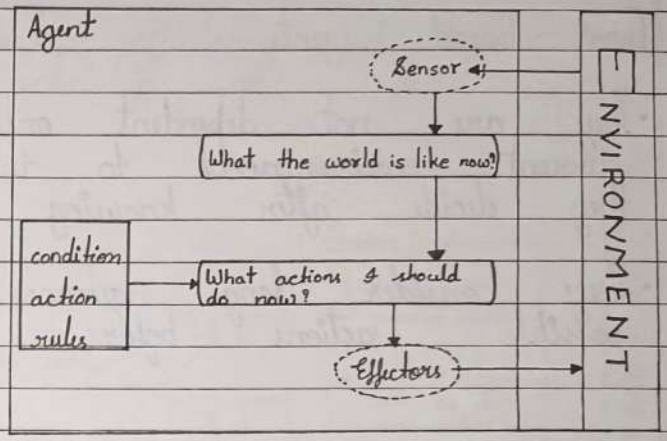
Intelligent agents:

- An intelligent agent is a software or hardware system that observes its environment and take actions to acheive goals.
- It uses sensors to gather information and make decisions based on its programming or learnings from data.
- These are fundamental concept in AI and can range from simple rule-based system to complex learning agents.

Types of agents:

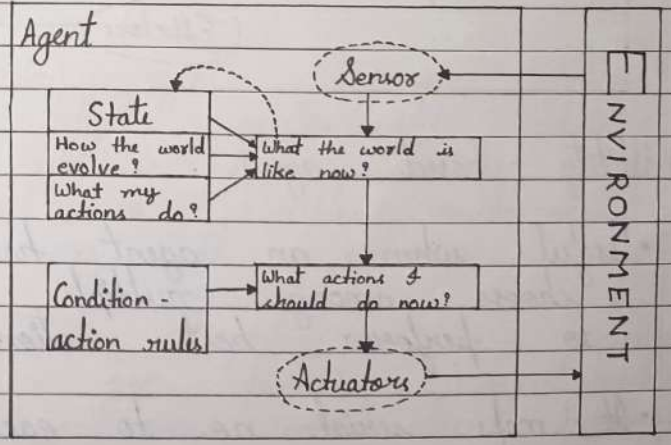
i) Simple reflex agent:

- Take decision on the basis of current scenario without chucking past experiences.
- Only efficient in fully observable enviironment.
- diagrammatic representation of simple reflex agent can be given as:



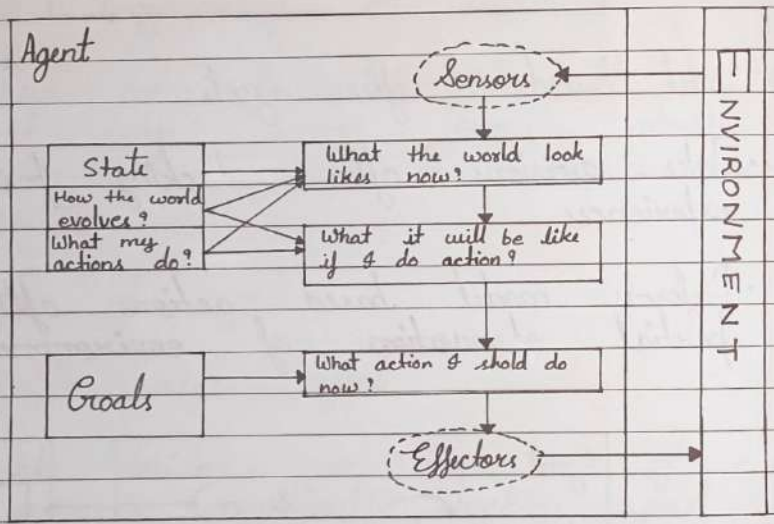
ii) Model - based reflex agents:

- Take decisions after checking past experiences.
- Performs model based actions after partial observation of environment.



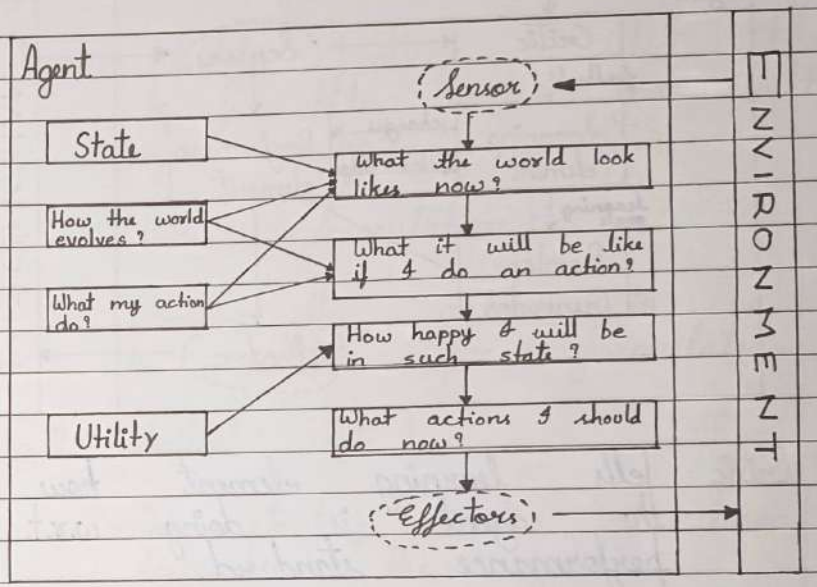
iii) Goal - based agents:

- They are not dependent only on current environment to take decision, they decide after knowing the goal.
- They consider long sequence of possible actions before deciding.



iv) Utility - based agents:

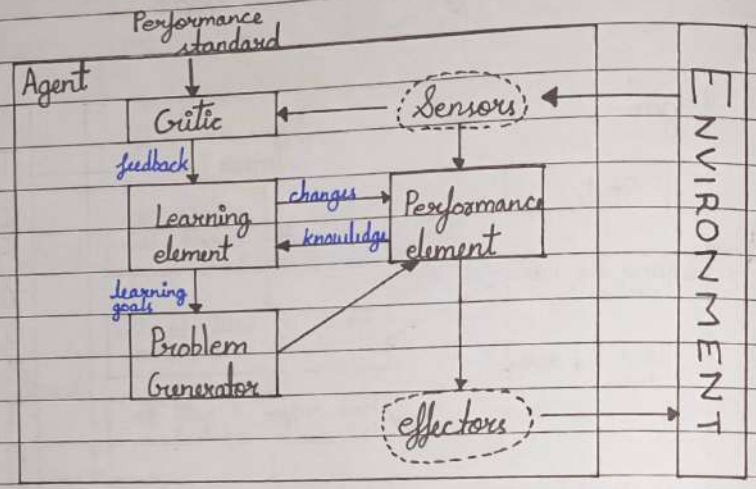
- Useful when an agent have to choose among multiple alternatives to perform best action.
- It maps serial no. to each state to check efficiency of each action for acheiving the goal.



(#) Learning agent:

- A learning agent is an intelligent system that continuously enhance its abilities and make informed decisions in complex environment based on its experiences.
- Reinforcement learning is a common approach for learning agent because they work on less information.

Architecture of learning agents:



- **Critic:** Tells learning element how well the agent is doing w.r.t. fixed performance standard.
- **Learning element:**
  - responsible for making improvement.
  - uses feedback from critic on working of agent.
- **Problem generator:** Responsible for suggesting actions that will lead to new and informative experience.
- **Performance element:** Responsible to select external actions through actuators.

Approach to solve typical AI prob

Step 1: (Goal formulation)

- Identify problem → select steps to formulate perfect goal out of multiple goals.

Step 2: (Problem formulation)

- Choose the actions to be t to acheive the formulated

Step 3: (Initial state)

- The starting state of agent towards the goal.

Step 4: (Actions)

- List of possible actions avail to the agent.

Step 5: (Transition model)

- Description of each action.

Step 6: (Goal test)

- Testing the resulted state to

whether it is goal state or not.

Step 7 : (Path cost)

- A numeric cost of path assigned to find goal state.
- Solution with lowest cost is considered as optimal solution.

AKTU PYQ

Q. Give 6-discipline needed by Intelligent Agent to pass turing test.

⇒ 6-disciplines or features that an agent must follow to pass turing test are:

i) NLP: Machine must understand the human language in which iterrogator is communicating.

ii) Knowledge representation: Machine must be able to store and retreive information in real-time for effective communication with interrogator.

iii) Automated reasoning: Machine should b able to draw log reasons based on previously stored i to make interrogator beleive that it is conversing with a hu

iv) Machine learning: Machine should learn from its past mistakes and should have the ability to recognize pat in the conversation t respond in a human - like manner.

v) Vision: Machine should have the abi to recognize interrogators actions and its surrounding

vi) Motor Control: Machine should be able to move its parts to perform the requested action.

⊛ Turing Test:

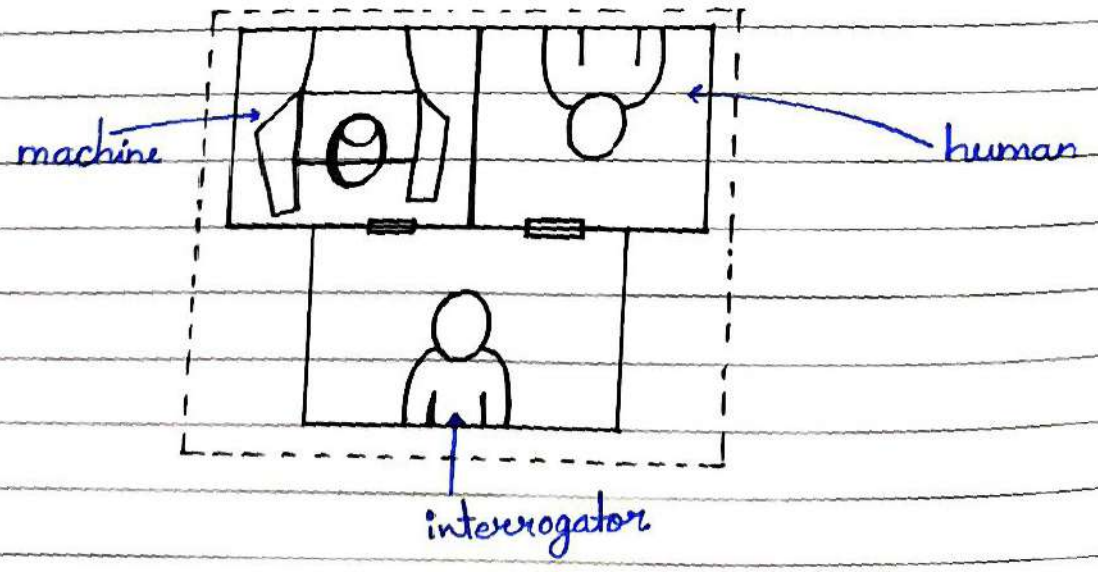
- It was proposed by Alan Turing in year 1950.
- It was performed to prove that a machine can exhibit intelligent behaviour indistinguishable from human.
- In this test, a human judge interacts with both the machine and human without knowing which is machine and which is human.

↓

if judge can't be able to distinguish between two of them on the basis of their responses.

↓

The machine is considered to have passed the turing test.



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Artificial Intelligence

Unit - 2 (One - Shot)

Topics to be covered:

1. Steps involved in problem solving.
2. Searching
3. Types of search
4. Alpha - Beta Pruning
5. Constraint satisfaction problem.

Steps involved in problem solving:

Step 1: (Define the problem)

Step 2: (Analyze the problem)

Step 3: (Develop potential solutions)

Step 4: (Evaluate the options)

Step 5: (Select the best option)

Step 6: (Implement the solution)

Step 7: (Measure the results.)

Searching:

- It is a fundamental concept in AI, used in various applications such as route planning, puzzle-solving, optimization problems and decision making systems.
- It refers to the process of systematically exploring a problem space to find a solution.

Key components of searching:

i) State space

ii) Initial state

iii) Goal state

iv) Operators or actions

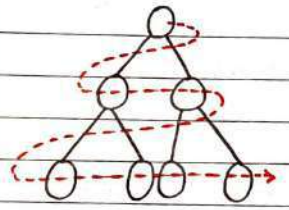
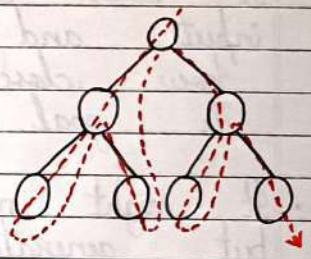
v) Path

Types of search:

- Informed vs Uninformed search
- DFS vs BFS
- Heuristic search
- Hill climb search and A* search.

* Informed search	Uninformed search
• Uses knowledge to find steps to solution.	• No use of knowledge.
• Quick solution	• Slow solution
• Low cost	• high cost
• More efficient	• less efficient
• Low time & space complexity	• more time and space complexity
• e.g: Best First Search, A* search.	• e.g: BFS, DFS, etc.

* BFS	DFS
• Breadth first search performs breadth wise searching.	• Depth first search performs depth wise searching.
• Uninformed approaches to traverse tree.	• Uninformed approaches to traverse tree.
• No backtracking is allowed.	• Backtracking is allowed.

• Provides solution in min-steps, if there exist more than one solution.	• Reoccurence of nodes result solution in max-steps.
• More optimal	• Less optimal
• More time consuming	• Faster but can stuck in (∞) loop.
• 	• 

* Best first search:

- Best First Search is combination of Breadth first search and Depth first search.
- It allows switching b/w BFS and DFS, and choose most promising node to go to the goal node.
- If a node is less promising, it jumps over next node in same level.

Heuristic search:

- Works on heuristic function that ranks alternatives in search algorithm.
- Heuristic function rank the branches based on available information to decide which branch to follow.
- It takes current state of agent as input and compute estimation of how close an agent is from its goal.
- It might not give best solution everytime, but generate guarantee for optimal solution.
- It finally calculates the cost of path with most optimal solution.

> #note: Value of HF is always (+ve)

Hill climbing:

- It is based on loop that moves in direction of goal.
- The loop is terminated when it reaches peak.
- It don't maintain search tree, it only record states and functions.

Algorithm:

Step - 1: Evaluate initial state.

Step - 2: if (goal found)
return success;
else
continue;

Step - 3: Step 2 is repeated in a loop until either of these conditions are satisfied.

i) Found the solution
ii) All operations are performed

Step - 4: If (solution not found)
go to step-1;

ch :

based on informed search technique
heuristic function to reach the
possible solution.

optimal and complete algorithm
ind the solution.

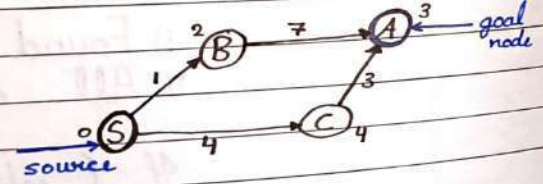
is comparitively faster than any
searching algorithms to
complex problem.

for total cost to reach a
node is given as:

$$f(n) = g(n) + h(n)$$

$h(n)$ → heuristic value (child)

$g(n)$ → cost to reach child node.



given: S → 0
A → 3
B → 2
C → 4

S → B 3 ✓
S → C 8

S → B → A 11 4

ARFAT Data Page

Alpha - Beta pruning:

- It is an optimization technique for min-max algorithm, commonly used in game-playing scenarios like chess.
- The goal is to minimize the no. of nodes evaluated in the game tree by eliminating the branches that cannot affect the final decision.
- Min-max algorithm: This is a decision making algorithm used in two-player games. It explores all possible moves, creating a tree of possible game states.
- Alpha (α): • represent the best/maximum value that the maximizing player can acheive.
  • initial value : $(-\infty)$
- Beta (β): • represents the best/minimum value that the minimizing player can acheive.
  • initial value : (∞)

- Pruning mechanism:
  - If maximizing player discovers a move of (value ≥ beta), it prunes the remaining branches.
  - If minimizing player finds a move of (value ≤ alpha), it prunes the remaining branches.

Constraint Satisfaction problem:

- Constraint satisfaction problem is a logical approach used to represent a problem in terms of a set of variables, domains and constraints.
- The goal is to assign values to the variables that satisfies all constraints.

key components of CSP:

i) Variables:
- They represent unknown decision variables in the problem.
- Each variable has a domain, which is set of values it can take.

ii) Domains:
- Define the possible values that a variable can take.
- They are usually determined based on the nature of the problem.

iii) Constraints: Defines the relationship or condition that must be satisfied for a solution to be valid.

e.g: Sudoku is best example of CSP;
- ↳ variables are cells on board,
- ↳ domain are digits {1-9} to be filled in variables.
- ↳ constraints are rules of Sudoku.

(such as each row, column and 3X3 subgrid must contain distinct values)

Artificial Intelligence

UNIT - 2

Topics to be covered

1. Best First Search
2. Numerical on Constraint Satisfaction Problem

⊛ Best First Search:

- It is a graph search algorithm that selects the most promising node for expansion based on heuristic function.
- It priortizes nodes based on heuristic evaluation, also the effectiveness of this algorithm is dependent on the choice and accuracy of heuristic function.

Step 1: Initialization

- Start with an initial node as the current state.

Step 2: Heuristic Function

- Define a heuristic function 'h(n)' to estimate the cost or distance from current node to the goal node.

#note: most promising node has minimum value of heuristic function.

Step 3: Validation / Selection

- Select the node with lowest heuristic value and chick whether it is goal node or not.
- If not, expand selected node by generating its successor.

Step 4: Repetition

- For successors in expansion, repeat step 2 and 3 for each successor.

Step 5: Termination

- Terminate after finding goal node or after completing no. of iterations.

Numerical

1. Evaluate constraint satisfaction problem within crypt arithematic problem:

CROSS + ROADS = DANGER

⇒

i) C = ~~8~~
R = ~~4~~
O =
S = ~~0~~ ~~2~~
A = ~~6~~
D = ~~1~~
N =
G =
E = ~~3~~

0 – 9

e.g:

```
  ONE
+ ONE
  TWO
```

O	N	E	T	W
2	3	1	4	6

```
  2 3 1
  2 3 1
-------
  4 6 2
```

=> {O:2, N:3, E:1, T:4, W:6}


```
  TO
+ NO
-----
 OUT
```

T = 2
O = 1
N = 8
U = 0

```
  2 1
  8 1
-------
1 0 2
```

=> {T:2, O:1, N:8, U:0}

	C	R	O	S	S
+	R	O	A	D	S
D	A	N	G	E	R

	~~8~~	4		2	2
+	4		0	1	2
1	0			3	4

	9	6	2	3	3
+	6	2	5	1	3
1	5	8	7	4	6

C: 9
R: 6
O: 2
S: 3
A: 5
D: 1
N: 8
G: 7
E: 4

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Artificial Intelligence

UNIT - 3

(One - Shot)

Topics to be covered:

1. First order predicate logic
2. Concept of prolog programming
3. Unification and Resolution
4. Forward chaining vs Backward chaining
5. Knowledge representation
6. Reasoning systems
7. Mental events and Mental objects.

First order predicate logic:

- It is a powerful mathematical tool used to express relationship or compute the relationship and facts about any object or logic.
- It is the foundation for representing and reasoning about knowledge in various fields including AI.

Key aspects of First order predicate logic:

i) **Syntax:** It involves terms (objects or individuals) and predicates (relations or properties).

ii) **Quantifiers:** They are of two types:

a) **Universal quantifiers** ($\forall$) denotes 'for all' and is used to state about every element in a set.

b) **Existential quantifier** ($\exists$) denotes 'there exists' and is used to define the existence of at-least one element in the set.

iii) **Connectives:** FOL are connected using these connectives, namely:

- conjunction ($\wedge$) (and)
- disjunction ($\vee$) (or)
- implication ($\rightarrow$) (if then)
- negation ($\neg$) (not)

iv) **Variables:** - They are denoted by symbols such as x, y, and z.

- Used to represent elements within a given domain.

v) **Inference rules:**

Responsible for manipulation and derivatio of statements in the logic.

e.g: i) A: Gorilla is black
B: Gorilla is old

=> Gorilla(X) → black(X) ∧ old(X).

ii) All boys like to play.

=> ∀ boys(X) → like(X, play).
∀ X : boys(X) → like(X, play). ✓

iii) Some boys like chess.

=> ∃ X : boys(X) → like(X, chess).
who

iv) Every boy, buys car is smart.

=> ∀x ∀y : boy(x), car(y) → buys(x, y, smart).

Concept of Prolog programming:

- Prolog (Programming in Logic) is a declarative programming language designed for symbolic reasoning and manipulation.
- It is particularly well-suited for tasks involving artificial intelligence, knowledge representation, and rule-based systems.

key aspects of Prolog programming:

★ Declarative nature:

- Prolog is a declaritive language. focuses on what needs to be acheived rather than how to acheive it.
- Programs in prolog consist of a set of rules and facts that define relationships and conditions.

★ Rules and Facts:

- Rules: Logical conditions expressed as 'if-then' statements.

e.g: ancestor(X, Y) :- parent(X, Y).

- Facts: Basic statements about relationships in the form of rules.

e.g: parent(X, Y).

★ Predicates and Queries:

- Predicate define relationships between entities. Each rule or fact in Prolog is a predicate.

- Queries are used to ask questions or retrieve information.

★ Backtracking :

- Prolog uses a backtracking mechanism to explore alternative solutions. If a query fails, Prolog can backtrack and explore other possibilities.

★ Lists and Pattern Matching :

- Prolog has built-in support for working with lists and pattern matching, making it convenient for tasks involving structured data.

Unification and Resolution in knowledge representation :

★ Unification :

- It is a fundamental concept in knowledge representation, especially in a logic based system like prolog.
- It is the process of making two different logical atomic expression identical by finding substitution.
- Take two literals as i/p and make them identical using substitution.
- Variables : These are placeholders for unknown values and can be unified with constants or other variables.
- Substitution : Unification results in a substitution of variables with values or other variables, creating a more specific expression.

  e.g: if we have X = Y and Y = 3, unifying these statements leads to the substitution X = 3.

★ Resolution :

- It is a fundamental inference rule used in prepositional and predicate logic to derive new logical statements from existing ones.

- It is commonly employed in automated reasoning systems, including those used in AI.

Key aspects of resolution:

- Goal: The main goal of resolution is to prove the validity of a logical formula or to derive new statements based on existing ones.
- Formulation: Resolution is used in the context of clauses (either variables or their negations).
- Resolution rule: It states that if two clauses share complementary literals (one positive, one negated), then a resolvent can be obtained by eliminating these literals.

e.g: Clauses:
C1: (P ∨ Q)
C2: (¬P ∨ R)
C3: (¬Q ∨ R)

Resolution:
Resolve C1 and C2 on P: (Q ∨ R)
Resolve (Q ∨ R) and C3 on Q: R
Result: R

#	Forward chaining	Backward chaining
•	It starts with facts.	• Starts with goal.
•	Increment from facts to reach goal.	• decrement from goals to prove facts.
•	Data-driven (down to up) approach.	• Goal-driven (top to bottom) approach.
•	Conclusion is derived on behalf of facts.	• Goal is breaked into sub-goals to prove facts true.
•	Efficient with large data and unknown goals.	• Efficient when the goal is known.
•	Relies on data availability.	• Performs strategic reasoning.
•	It may explore unnecessary branches.	• Comparitively more directed.
•	Used in rule-based systems with incremental data.	• Used in expert systems and query-driven tasks.
•	It discovers conclusions during the process.	• It focuses on a specific known goals.

(*) Knowledge representation:

- This concept in AI focuses on how knowledge about the world can be structured, stored and manipulated in computational systems.

key aspects of knowledge representation:

i) Logical / Declarative representation:

Utilizes formal logic to represent knowledge through symbols, predicates and logical relationships.

ii) Semantic networks:

Represent knowledge as interconnected nodes and edges, providing a hierarchical organization.

iii) Rule - based systems:

Represent knowledge using rules that define conditions and actions, facilitating reasoning and decision making.

iv) Probabilistic representations:

Deals with uncertainty and probability to model relationships between variables and events.

v) Neural network representation:

Represents knowledge using neurons and distributed patterns of activation, enabling learning and pattern recognition.

(#) Reasoning systems:

It plays a vital role in AI, enabling machines to draw logical inferences, make decisions and solve problems.

key aspects of reasoning systems:

- Deductive reasoning: (Top-down approach)

Starts with general principles or rules and derive specific conclusions based on them.

- Inductive reasoning: (bottom-up approach)

- It makes generalization based on specific observations.
- ML uses inductive reasoning to learn patterns and make predictions.

- Meta reasoning:

It refers to the ability to reason about the strategies and approaches used in the reasoning process.

In a reasoning system, choice of reasoning method is dependent on the nature of the problem, the available information, and the desired outcomes in any AI application.

Mental events and Mental objects:

- Mental event operates on Mental objects.
- In ML, training of dataset involves a dynamic manipulation of data (MO) to learn patterns and make predictions (ME).

* Mental events:

- These events involve the dynamic processing of information, such

  - reasoning
  - learning
  - decision making
  - problem solving

- AI mental events are the computational activities that d the system's functionality.

* Mental objects:

- They represent knowledge, patterns data that the system man during its computational proces
- These objects are responsible to form the basis for AI decision making and intelligen behaviour.

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Artificial Intelligence

UNIT - 4

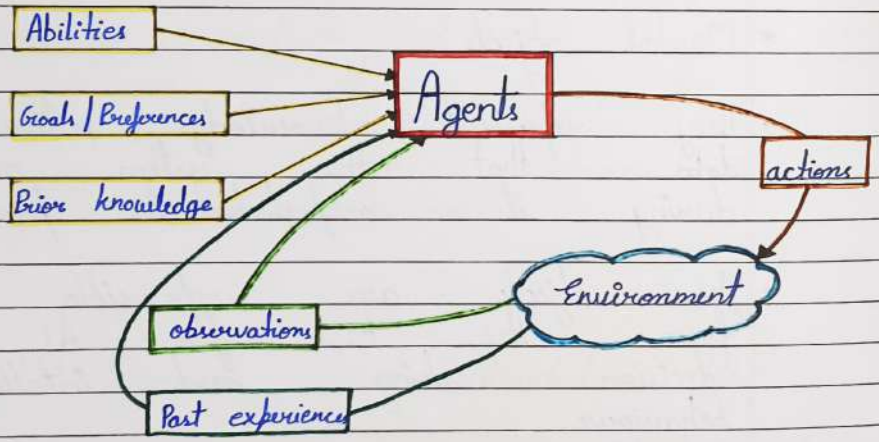
(One - Shot)

Topics to be covered:

1. Architecture of Intelligent Agents
2. Agent communication
3. Negotiation and Bargaining
4. Trust and Reputation

@brevilearning

Architecture of Intelligent Agents:



- **Agents:** It is a program or system that uses artificial intelligence techniques to perform tasks autonomously.
- **Abilities:**
  - It refer to the skills or functionality of an intelligent agent.
  - It includes:
    - → perception (sense sensing and interpreting data)
    - → reasoning (making decisions based on logical reasoning)
- **Goals / Preferences:** Goal defines the aim to be accomplished by agent and preference guides it to take correct and required decisions to reach goal.
- **Prior knowledge:** It includes pre-existing knowledge about the environment that is utilized in the process of decision-making.
- **Actions:** These are operations or decisions performed by agent to influence the environment.
- **Observation:** Information received by the agent from environment.
- **Past experiences:** Agent's history of

of interactions and outcomes with environment.

- Environment: It refers to the external system or surroundings in which the AI agent operates.

Agent communication:

- In multi-agent systems, communication between agents refers to exchange of information between autonomous entities (agents) to achieve specific goals or tasks.
- Agent communication involves following key aspects:

i) Message passing: Agents communicate by sending messages to each other, these messages contains information about the agents current state, intentions, requests or other relevant data.

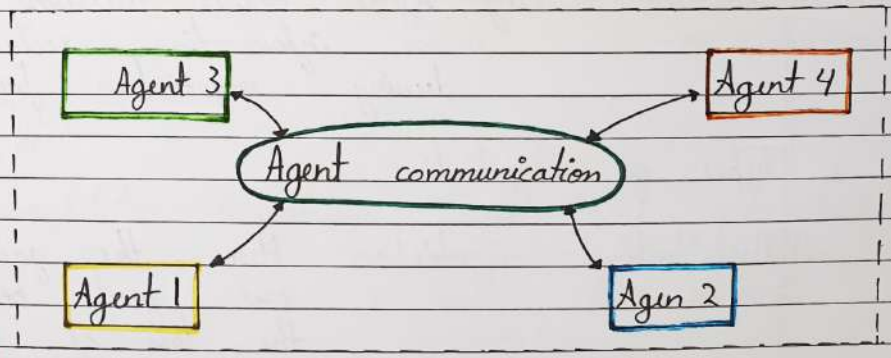
ii) Co-ordination: Agent co-ordinate with each other to achieve shared objectives.

Communication helps agents in synchronization of activities and help them to work togather efficiently.

iii) Information sharing: Agents share relevant information to enhance their individual or collective knowledge.

iv) Adaptability: Agent can inform each other about alterations in their environment, leading to adjustment in their strategies or behaviours.

v) Challenges: Agent communication helps in reducing challenges by addressing conflicting objectives, and ensures efficient and secure message transmission.



Negotiation and Bargaining:

* **Negotiation:** It is the process by which AI agents communicate, exchange information and make concessions to reach a mutual agreement or resolve conflicts.

key components:

- **Communication:** Agent exchange messages to convey their intentions or proposals.
- **Compromise:** Negotiation allows agents to adjust their positions to find a satisfactory outcome.
- **Decision-making:** Agent makes decisions based on information retrieve during negotiation process.

Types of negotiation:

i) **Distributive negotiation:** Here, the gain of one agent becomes the loss of another agent.
(case: hangging over a fixed resource)

ii) **Integrative negotiation:** Focuses on finding mutually beneficial solution, creating gain for all agents involved.

* **Bargaining:** It refers to the act of making compromises during the negotiation process to agreement on specific terms.

key components:

- **Concessions:** Agent adjust their positions, making trade-offs to reach middle ground.
- **Terms of agreement:** It determines the specific criterias of agreement such as price or conditions.

Types:

i) **Competative Bargaining:** Each agent seeks to maximize its gain, leading to a better negotiation.

ii) **Co-operative Bargaining:** Agent works togather to find solutions that benefit all agents involved

Trust and Reputation:

★ Trust:

- Agents establish trust by evaluating the reliability and competance of other agent.
- This evaluation is based on past interactions, observed behaviour, and positive reccommendations from other agents.
- These models include factors such as consistency in delivering promises, and overall performance.
- Agents update their trust assesments over time, adapting to changes in their environment.
- e.g: imagine a group of delivery agents (robots) in a warehouse. If one of them consistently deliver packages on time, other agents can trust it to collaborate.

★ Reputation:

- It refers to the overall opinion of an agents behaviour by all other agents within the system.
- It is the collective assesment by other agents based on their direct interactions or information obtained from third parties.
- It involves the fedback from multiple sources to create a comprehensive view of an agents realiability and trustworthyness.
- Agents with positive reputations are more likely to ~~attract~~ attract co-operation from other agents, while those with negative reputation are more likely to face challenges in forming co-operation.
- e.g: consider a buyer and seller in market, if seller consistently sell good products only, then reputation of seller will be possitive for buyer to trust seller.

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Artificial Intelligence

UNIT - 5

(One - Shot)

Topics to be covered:

1. Language models
2. NLP
3. Information retrieval vs. Information extraction
4. Machine Translation
5. Speech recognition

Language models:

- These are designed to understand, generate and manipulate human language.
- These are very powerful tools in AI, with broad applications accross various domains.
- These are the algorithms that learns the structure and patterns of natural language from large dataset.
- They can understand, generate and predict text based on patterns they have learned.
- e.g: ChatGPT, Google Bard, etc.

Applications of Language models:

- Text generation: Language models can generate human like text, including articles, stories, poems, etc.
- Language translation: Models like google translate uses language models to translate text between different languages.
- Text summarization: Language models can summarize long texts into shorter summaries.
- Question answering: Models like GPT can answer questions based on context and knowledge learned from large dataset.
- Chatbots and conversational agents: Language model empowers chatbots and virtual assistants to interact with users in natural language.

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NLP (Natural Language Processing):

- It is the sub-field of Artificial intelligence that focus on enabling computers to understand, interpret, and generate human language in most relevant and meaningful context.

- It plays a crucial role in enhancing human-computer interactions and making information accessible and understandable accross different languages and contexts.

Key aspects of NLP:

* Text-understanding:

- NLP aims to enable machines to comprehend and extract information from human-readable text.

- It involves tasks such as named entity recognition, part-of-speech tagging and syntactic parsing.

* Machine Translation:

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- NLP facilitates translation from one language to other in the form of text.

- Google translate uses NLP techniques to understand and generate translation.

* Sentiment analysis:

- NLP is used to analyze and determine the sentiments expressed in a piece of text.

- This is valueable for understanding public opinion, customer feedback and social media sentiments.

* Speech recognition:

- Although speech recognition is a separate field, but at some point it also uses N.L.P techniques.

- NLP techniques are applied to convert spoken languages into text in speech recognition.

* NER (named entity recognition):

NLP involves identifying and classifying entities (such as names of peoples, locations and organisations) within a text.

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# Information retreival	Information extraction
• Retrieve relevant document.	• Extract structured data.
• Don't retrieve details but complete document.	• Focuses on the extraction of specific details.
• Indexing and ranking techniques are used for information retreival.	• NER and relation extraction are used for information extraction.
• Deals with document relevance and their rankings.	• Deals with handling ambiguity and accurately extracting information.
• e.g: Search engine (like google)	• e.g: extracting dates, locations from news articles.

* Machine translation:

- It refers to the use of computational algorithms and models to automatically translate text or spoken words from one language to another.
- It utilizes the neural network architecture to witness advancement in the feild of AI.

key aspects:

- Rule-based translation: This translation approach uses linguistic rules and dictionaries to translate text.
- Statistical Machine translation: It utilized the statistical model to learn patterns. Phrase-based translation models are the most popular technique based on SMT.
- Neural machine translation: NMT models are particularly

based on transformer architectures, captures contextual information and dependencies leading to more fluent and accurate translation.

- Encoder-decoder architecture:

Encoder processes the source language and produces a fixed-size representation, while the decoder generates the target language based on this representation.

- Application:
  - online language translation services
  - multilingual chatbot systems.
  - global content localization.

Speech recognition:

- Also known as Automatic speech recognition (ASR) is a technique that is used to convert spoken language into written texts.

- It became an integral part of many technologies, enabling hands-free operations, accessibility features and enhanced user experiences in a wide

Key aspects:

- Audio input: It takes audio signals as input, this audio can be a recorded speech or real-time spoken language.

- Feature extraction: Input is processed to extract relevant features. It uses (MFCC) Mel Frequency Cepstral Co-efficients to represent the characteristics of speech.

- Acoustic modelling: These are use to capture the relation between the extracte features and phonemes

- Language modelling: They help predict likelihood of word sequence in a gi language.

- Decoding: It determines the most l word sequence based on acoustic and language m

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