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WRITTEN ASSIGNMENT NO. 1

Q1. Give one definition on AI for each of the following approaches: i) Acting humanly ii) Thinking humanly iii) Acting Rationally iv) Thinking Rationally

Ans: i) Acting Humanly: On this approach AI aims to emulate human behaviour, responses, and actions. This involves programming systems to understand and replicate human like interactions such as natural language processing, facial recognition and other behavioural traits.

ii) Thinking Humanly: This approach is to make developing AI system that mimic cognitive process and mental strategies to humans for thinking. It involves understanding human thought patterns waining mechanism and decision making process to replicate them in artifical system.

iii) Acting Rationally: It involves making decisions and taking actions that are logically derived to achieve specific goals. This approach does not necessarily mimic human behaviour but touches on finding optimal solutions based on predefined objectives using methods like logical reasoning & problem solving algorithm.

iv) Thinking Rationally: Thinking Rationally in AI reflects to developing systems that employ logical reasoning & problem solving method. This approach aims to achieve efficient decision-making by following logical principle & rule often without directly imitating human thought conclusions through logical deduction & sound reasoning.

Q2. Explain component of AI system in details.

Ans: Components of AI include:

a) Perception: It involves the ability of a system to interpret & understand information from its environment. It includes gathering data from various sources such as sensors & processing that data to comprehend the surrounding context.

b) Knowledge representation: It involves structuring information to make it accessible & usable for the AI system. It provides a way for the system to store & manipulate knowledge, facilating reasoning & decision making.

c) Learning: Learning in AI refers to ability of a system to improve its performance over time by acquisition new knowledge or adapting to changing environment machine learning in a prominent way, whose algorithm learns pattern from data.

d) Reasoning: It involves the logical thinking & inference capabilities of an AI system. It allows the system to draw conclusion make a decision, or solve problems based on the acquired knowledge & available information.

e) Problem solving: This in AI involves the ability to find solutions to complex issues. It often integrates reasoning & learning to devise optimal or near optimal solutions to a given problem.

f) Natural language processing :- NLP enables an AI system to understand, interact, & generate human language. It involves tasks such that it understands sentiment analysis.

Q3. Write a short note on: categorization of AI.

Ans Primary AI is divided into two categories:

I) Based on capabilities:

a. Weak AI (narrow AI): Specialized system design for specific tasks within limited domains, lacking general cognitive abilities.

b. General AI: Machines with human like cognitive versatility & adaptability across various tasks.

c. Strong AI: Machines with cognitive abilities equal to or surpassing human intelligence, including self awareness & consciousness.

II) Based on functionalities:

a) Reactive AI: Operates based on predefined rules & programmed responses lacking the ability to learn from past experience.

b) Limited Memory AI: Integrate memory to learn from past experiences & make better decision in dynamic environment.

c) Theory of mind machines: Hypothetical AI category understanding human emotions & beliefs & intentions with "theory of mind".

d) Self aware AI: Theoretical AI processing consciousness, awareness of its own existence & the ability to reflect on its identical stats.

Q4. Explain problem formulation with help of example.

Ans. Problem formulation is the step in problem definition that is used to understand & decide order of action that needs to be considered to acheive goal. If there is more than one way an agent can reach its goal, then it causes complexity in terms of actually acheiving the goal as there were too many steps & path that AI entity takes to reach the goal. as there would be too many steps such that the definition of the initial stage as the definition of the initial stage creation of transition models to describe the actions of agent. problem formulation in AI organizes several steps to formulate a target / goal which require a specific action to acheive the goal. Problem formulation in AI is used in probable different domains to formulate the goal based on AI agents.

Different methods can be used in problem formulation are tree structure, graphical model, implementation of graph.

Problem solving components are:

1] problem statement
   a] definition
   b] limitation or constraints or restriction
2] problem solution
3] solution space
4] operation.

- state formulation: states representation of different situations or configurations that the system can be in.
- Initial state - the starting point or initial configuration of the problem.
- Goal test - the condition to meet if a solution has been reached
- Action sequence - the set of possible actions that the agent can take to transition between states
- Path cost - the numerical cost associated with taking action.

Example:

8 side puzzle:

- state: A state description specifies the location of each of the eight tiles + the blank in one of the nine squares

- Initial state: Any random shuffled state can be designated as initial state.
- Action: slide left or slide right or slide up or slide down.
- Transaction model: Given a state & action, this returns the resulting state.
- Goal test: this checks whether the state matches the goal.
- Path cost: Each step costs 1.

Q5) Explain PEAS properties in detail.

Ans. PEAS is the representation of system for AI. agent which caters to measuring performance with respect to environment, sensors & activators. To design an agent we must know our task environment. PEAS system helps specify the task environment. PEAS is the short form of performance, environment, activators & sensors. Identify PEAS it can help to develop an optimal algorithm for AI.

1] Performance measure: It is the unit to define the success of an agent. performance varies with agents based on different precepts.

2] Environment: The surrounding of the agent at a particular instant in which the agent works is called environment. It can be static or dynamic based on motion of agent.

3] Actuators: Actuators helps agent operate in one environment includes display boards, object picking name track changing mechanisms, etc. Actions performed by agents can bring change.

4] Sensors: They help agents, perceive their environment by giving them a complete set of inputs. The action of agent depends on the past history & current input set.

Example:
Hospital Management system.

- Performance measure: Patient's health, admission process, payment
- Environment: Hospital, Doctor, Patient
- Actuators: Prescription, Diagnosis, scan report
- Sensors: Symptoms, patient's response.

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Q6. Describe different types of environment with suitable examples.

Ans: a) fully observable vs partially observable.
In a fully observable environment, the agent can access the complete state of environment at a given time.
Eg: Chess is an example of a fully observable environment as the player can see the entire board. In a partially observable environment the agent has limited or incomplete information. In a cards game, the player can only see their cards

b) Deterministic vs stochastic
When a uniqueness in the agent's current state complete determines the next state of the agent, the environment is said to be deterministic. The stochastic environment is random in nature which is not unique & cannot be completely determined by the agent.
Example: Chess - there would be only few possible move for a coin at the current state & these moves can be determined self-driving car. These are not unique, it varies time to time.

c) Dynamic vls static
An environment that keeps constantly changes it self when the agent is up with same action is said to be dynamic. An roller coaster is dynamic as it is set in motion & the environment keeps changing constantly. An idle environment with no change is called static.
Eg: An empty house is called statics as there is no change.

d) Episodic vls sequential
In an episodic task environment, each of the agents action is divided, into atomic incidents or episodes.
Eg: Consider an example of pick & drop robot which is used to detect defective part from conveyer belts.
In a sequential manner, the previous decision can affect all future decision.
Eg: chectes.

e) Discretes vls continuous.
In discrete environment, there is a finite or countable set of distinct states & actions.
Eg: Tic tac toes. , where board has finite no. of discrete states.
In continuous, states & actions can take on a continuous range of value.

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Assignment NO. 2.

Assignment on.

a) Forward chaining, Backward chaining & Resolution.
b) AI in NLP & Robotics.

Q1. Discuss the forward chaining & backward chaining algorithms. Illustrate the working of forward chaining & backward chaining for the following problem.

The law says that it is crime for an American to sell weapons to hostile nations. The country Nono, an enemy of America, has some missiles, & all of its missiles were sold to it by Colonel West, who is American.

→ Forward chaining & backward chaining are two common inference algorithms for reasoning in rule-based systems.

Forward chaining: In forward chaining, also known as data driven reasoning, the system starts with the available data & applies rules to derive conclusions. It iteratively matches facts against rules, & applies the consequent of the rules to generate new facts. It continues this process until no new facts can be inferred. It's useful when the goal is to reach a specific conclusion based on known data.

Backward chaining: In backward chaining, also known as goal-driven reasoning, the system starts with the goal or conclusion & works backward to find the supporting facts. It begins by selecting a goal & then looks for rules whose consequents match the goal. It recursively applies rules & checks if all the antecedents of a rule are satisfied. It continues this process until it reaches the known facts or until it cannot find any more rules to apply. It's useful when the objective is to determine the facts necessary to satisfy a given goal.

Problem:
The law says that it is a crime for an American to sell weapons to hostile nations. The country Nono, an enemy of America, has some missiles, & all of its missiles were sold to it by Colonel West who is American.

Forward chaining:
Start with known facts:
Nono is an enemy of America, Colonel West is American.
Applying the rule:
"It is a crime for an American to sell weapons to hostile nations."

Since Colonel West is American, check if he sold weapons to a hostile nation. Since Nono is an enemy of America & has missiles, & Colonel West is American, concluding that Colonel West sold missiles to a hostile nation.
Conclusion: Colonel West committed a crime by selling missiles to Nono.

Backward chaining:
Start with the goal: Did colonel west commit a crime?
Look for rules that lead to this goal.
Use the rule: "It is a crime for an American to sell weapons to hostile nations."
Determine if Colonel West sold weapons to a hostile nation. Check if Nono is a hostile nation & if Colonel West sold weapons to Nono. Since Nono is an enemy of America & has missiles, & Colonel West is American, conclude that Colonel West sold missiles to a hostile nation.
Conclusion: Yes, Colonel West committed a crime by selling missiles to Nono.

Q2. Consider following example & prove using resolution curiosity killed cat.

- Everyone who loves all animals is loved by someone.
- Anyone who kills an animal is loved by no one.
- Jack loves all animals.
- Either Jack or curiosity killed the cat, who is name Tuna.
- Did curiosity kill the cat?

→ "Everyone who loves all animals is loved by someone"

: $\forall x [[\forall y \text{ Animal}(y) \Rightarrow \text{loves}(x,y)] \Rightarrow \exists y \text{ loves}(y,x)]$

→ "Anyone who kills an animal is loved by no one".

$\forall x [\exists z (\text{Animal}(z) \wedge \text{kills}(x,z)] \Rightarrow \forall y \neg \text{loves}(y,x)$

→ "Jack loves all animals."

$\forall x \text{ Animal}(x) \Rightarrow \text{loves}(\text{jack}, x)$.

→ Either Jack or curiosity killed the chat

kills (jack, tuna) ∨ kills (curiosity, tuna)

→ The cat is named tuna.

cat (tuna)

→ "Cats are animals".

$\forall x \; cat(x) \Rightarrow Animal(x)$

→ "Did curiosity kill the cat?".

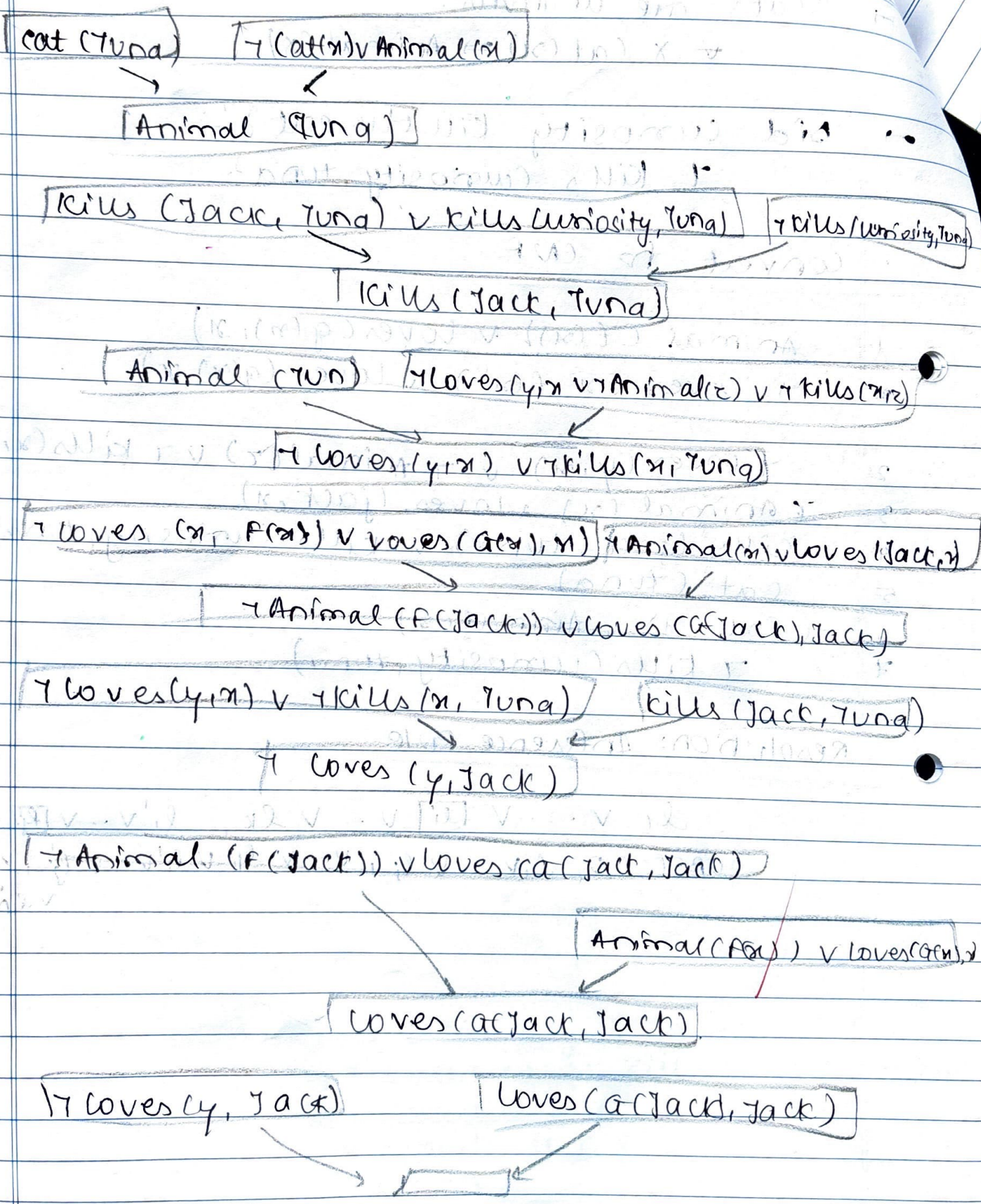
$\neg$ kills (curiosity, tuna).

• Convert to CNF

1. $Animal(f(x)) \vee loves(g(x), x)$
2. $\neg loves(x, f(x)) \vee loves(g(x), x)$.
2. $\neg loves(y, x) \vee \neg Animal(z) \vee \neg kills(x, z)$
3. $\neg Animal(x) \vee loves(jack, x)$
4. $kills(jack, tuna) \vee kills(curiosity, tuna)$
5. $cat(tuna)$
6. $\neg cat(x) \vee Animal(x)$
7. $\neg kills(curiosity, tuna)$

• Resolution: Inference Rule

$$\frac{l_1 \vee \ldots \vee \boxed{l_i} \vee \ldots \vee l_k, \quad l'_1 \vee \ldots \vee \boxed{l'_j} \vee \ldots \vee l'_n}{SUBST(\theta, l_1 \vee \ldots \vee l_{i-1} \vee l_{i+1} \vee \ldots \vee l_k \vee l'_1 \vee \ldots \vee l'_{j-1} \vee l'_{j+1} \vee \ldots \vee l'_n)}$$



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¬K(x) ∨ Kills(curiosity, Tuna)

Use of the factoring rule to infer
loves(G(Jack), Jack)

∴ Curiosity killed the cat cannot be concluded as resolution does not lead to the empty clause

Q3. Discuss in detail NLP, elaboration:

1. What is NLP?

→ Natural language processing (NLP) is a subfield of artificial intelligence (AI) & computational linguistics concerned with the interaction between computers & human languages. NLP enables computers to understand, interpret, & generate human language in way that is both meaningful & useful

2. Components of NLP:

NLP involves several components, including:

1. Tokenization: Breaking text into smaller units such as words, phrases or sentences.
2. Part of speech tagging: Assigning grammatical categories like noun, verb, adjective to each word in a sentence.
3. Parsing: Analyzing the syntactic structure of sentences to determine their grammatical structure.

4. Named Entity Recognition: Identifying & classifying named entities in a text.
5. Semantic Analysis: Understanding the meaning of text beyond its literal interpretation.
6. Machine translation: Translating text from one language to another automatically.
7. Text Generation: Creating text based on a given input or context.
8. Question Answering: Generating answers to questions posed in natural language.
9. Summarization: Generating concise summaries of long texts.

3. Difficulties in NLP:

NLP faces several challenges due to the inherent complexity & ambiguity of human language.

1. Ambiguity: words & phrases can have multiple meanings depending on context.
2. Syntax variability: Natural language exhibits variations in grammar, syntax & structure.
3. Semantic Ambiguity: Understanding the intended meaning of words or phrases based on context
4. Named Entity Recognition: Identifying & categorizing named entities accurately, especially in unstructured text.

5. Domain Specificity: Language usage & terminology can vary significantly across different domains.

4. Steps involved in NLP:

1) Data Collection: Gathering text data from various sources
2) Preprocessing: Cleaning & formatting the text data, including tasks like tokenization, lowercasing, removing punctuation, & handling special characters
3) Feature extraction: Extracting relevant features.
4) Model Building: Training a machine learning or deep learning model on the annotated data to perform specific NLP tasks
5) Evaluation: Assessing the performance of model using evaluation metrics appropriate for the task.
6) Deployment: Integrating the trained model into applications or systems for real-world use.

5. Role of NLP in AI:

NLP plays a crucial role in AI, by enabling machines to understand & interact with human language.

1. Virtual Assistants: NLP powers virtual assistants like Siri, Alexa & Google Assistant, allowing users to interact with devices.
2. Information Retrieval: NLP techniques are used in search engines to understand user queries & retrieve relevant information from vast amounts of textual data.
3. Healthcare: NLP is used in healthcare for tasks such as extracting information from medical records, analyzing clinical notes, etc.

Q4. What is robotics? Discuss the role of AI in robotics. Brief the application of robotics in healthcare & agriculture.

→ Robotics is a field that involves the design, construction, operation, & use of robots to perform various tasks autonomously. Robots are programmable machines capable of carrying out complex actions.

Role of AI in robotics:

AI plays a crucial role in enhancing the capabilities of robots, enabling them to perceive, reason, learn & interact with their environment more intelligently.

Applications of Robotics.

1. Healthcare:

- Surgical Robotics: Robots are used in minimally invasive surgery to assist surgeons with precision & dexterity, leading to improved patient outcomes & faster recovery times.
- Assistive Robotics: Robots assist individuals with disabilities or limited mobility in performing daily tasks, such as feeding, dressing & assistance.

2. Agriculture:

- weeding Robots: Robots equipped with vision systems & AI algorithms are used for automated weed detection & removal reducing the need for herbicides & manual labor
- Harvesting Robots: Autonomous robots are developed for harvesting fruits, vegetables, & other crops, reducing labor waste & increasing efficiency in agricultural operations

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