COMSATS University Islamabad, Sahiwal Campus Department of Computer Science

Artificial Intelligence – Assignment 03

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Knowledge Representation: Categories & Knowledge-Based Agents

Knowledge Representation

Knowledge representation is a field in artificial intelligence (AI) that focuses on how information and data are structured and stored to allow machines to reason, infer, and understand the world. It serves as the bridge between human knowledge and computer systems, enabling AI systems to make informed decisions, solve problems, and interact with their environment intelligently.

Categories in Knowledge Representation

Categories are used to group objects, concepts, or entities that share common characteristics. These groups help organize and simplify knowledge, allowing AI systems to reason efficiently. Categories form the basis of many knowledge representation systems and are critical for classification tasks.

Key Features of Categories:

1. Abstraction: Categories abstract details by grouping similar items, making knowledge representation less complex.
2. Generalization: They allow generalizations by applying knowledge about a category to all its members.
3. Hierarchies: Categories often form hierarchies (e.g., Animal > Mammal > Dog), enabling structured reasoning.

Types of Categories:

1. Natural Categories: Based on shared inherent properties (e.g., mammals).
2. Artificial Categories: Defined by human-made criteria (e.g., vehicles).
3. Fuzzy Categories: Allow partial membership based on degree (e.g., shades of colors).

Example:

- Category: Bird
    - Characteristics: Has feathers, can fly (exceptions like penguins exist), lays eggs.
    - Members: Sparrow, Eagle, Penguin.

Knowledge-Based Agents

Knowledge-based agents are AI systems that utilize a representation of knowledge to perceive, reason, and act. These agents are designed to make decisions based on their knowledge and goals, enabling intelligent behavior.

Components of a Knowledge-Based Agent:

1. Knowledge Base (KB): Stores facts and rules about the world.
2. Inference Engine: Derives new facts and conclusions from the knowledge base using logical reasoning.
3. Sensors and Actuators: Allow the agent to perceive the environment and take actions.

Steps in Knowledge-Based Agent Functioning:

1. Perception: Gather information about the environment.
2. Knowledge Updating: Add new facts or rules to the knowledge base.
3. Reasoning: Use the inference engine to deduce the best action.
4. Action: Perform the decided action using actuators.

Characteristics of Knowledge-Based Agents:

1. Goal-Oriented: Operates based on goals or objectives.
2. Logical Reasoning: Uses logic to make informed decisions.
3. Adaptable: Can learn or update knowledge over time.

Example:

- **Medical Diagnosis Agent:**
    - Knowledge Base: Symptoms, diseases, treatments.
    - Inference: Uses symptoms to infer possible diseases.
    - Action: Suggests appropriate treatments or further tests.

Importance in AI

1. Decision-Making: Enables reasoning and informed decisions.
2. Problem-Solving: Facilitates solving complex problems.
3. Automation: Powers intelligent systems, such as chatbots and expert systems.
4. Scalability: Allows AI to handle vast and complex knowledge bases efficiently.

By leveraging categories and knowledge-based agents, AI systems can emulate human-like reasoning and provide accurate and efficient solutions in diverse applications.