



ASANSOL ENGINEERING COLLEGE

INFORMATION TECHNOLOGY

TOPIC:- KNOWLEDGE REPRESENTATION AND REASONING

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SEM:- 5th

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INTRODUCTION

Definition:

- KR is the field of AI focused on representing information in a form understandable by computers.
- Used to solve complex tasks like diagnosing medical conditions or conversing in natural language.

Importance:

- Provides a framework for structuring data.
- Makes data understandable and useful for reasoning.

Reasoning in AI:

- Involves drawing inferences from stored knowledge.
- Vital for decision-making in AI applications.

TYPES OF KNOWLEDGE

Symbolic Representation:

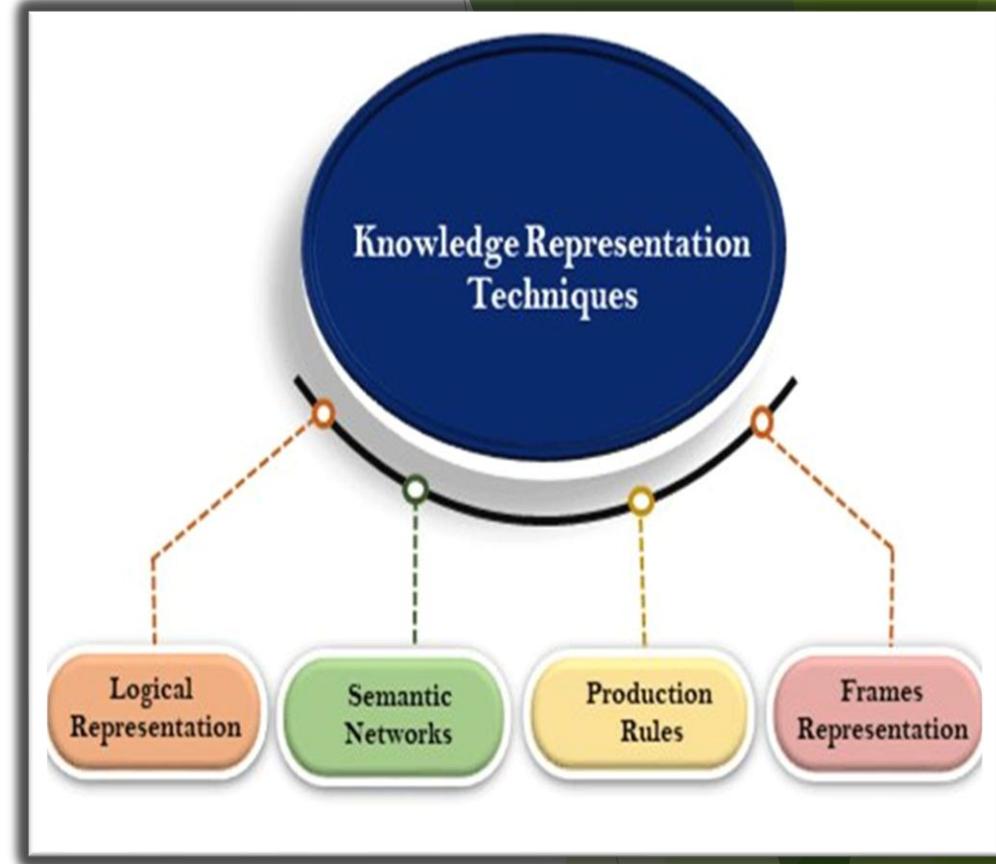
- Uses symbols and relations.
- Examples:
 - Logic (Predicate and Propositional Logic).
 - Semantic Networks (Graphs of nodes and links).

Sub-symbolic Representation:

- Uses numerical methods.

Examples:

- Neural Networks (Modeled after the human brain's network).
- Vector Spaces (Used in machine learning for data representation).



LOGICAL REPRESENTATION

Propositional Logic:

- Deals with statements that are either true or false.
- Simplest form of logic used in KR.

Predicate Logic:

- Extends propositional logic.
- Expresses properties or relationships between objects.
- Includes quantifiers like "for all" (\forall) and "exists" (\exists).

SEMANTIC NETWORKS

Components:

- Nodes (concepts).
- Edges (relationships).

Applications:

- Used in natural language processing.
- Example: WordNet, a lexical database.

Example:

- Semantic network representing the animal kingdom.
- Nodes for "Animal," "Mammal," "Bird," etc.
- Edges representing "is a type of" relationships.

FRAMES

Definition:

- Data structures for representing stereotyped situations.

Components:

- Slots (attributes of the frame).
- Fillers (values that fill these slots).

Example:

- Frame for a "dog."
- Slots for "species," "breed," "color."

PRODUCTION RULES

Definition:

- Rules describing actions to be taken when conditions are met.

Structure:

- IF (condition) THEN (action).

Application:

- Common in expert systems like Mycin (diagnosing bacterial infections).

ONTOLOGIES

Definition:

- Formal representation of a set of concepts and relationships.

Components:

- Classes (categories of objects).
- Relations (ways classes and objects relate to each other).

Benefits:

- Facilitates knowledge sharing and reuse.

Example: Medical ontologies like SNOMED CT.

REASONING TECHNIQUES

Deductive Reasoning:

- General rule to specific instances.
- Example: "All humans are mortal" and "Socrates is human," therefore "Socrates is mortal."

Inductive Reasoning:

- Generalizing from specific observations.
- Example: Observing that "all swans we've seen are white" might lead to "all swans are white."

DESCRIPTION LOGICS

Definition:

- Family of formal knowledge representation languages.

Purpose:

- Describe and reason about relevant concepts of an application domain.

Applications:

- Used in semantic web and ontologies for managing structured information.

PROBABILISTIC REASONING

Handling Uncertainty:

- Uses probabilistic models.

Examples:

- Bayesian Networks (Graphical models representing probabilistic relationships).
- Markov Models (Systems that transition from one state to another probabilistically).

APPLICATIONS

Natural Language Processing (NLP):

- Understanding and generating human languages.

Robotics:

- Enabling robots to make informed decisions.

Expert Systems:

- Providing specialized advice in fields like medicine and engineering.

CONCLUSION

Summary:

- Recap key points discussed.

Future Trends:

- Integration with machine learning.
- Advancements in natural language understanding.
- Improved reasoning algorithms.

Challenges:

- Dealing with incomplete or inconsistent knowledge.
- Ensuring computational efficiency.

REFERENCES

- ▶ Artificial Intelligence: A Modern Approach by Stuart Russell and Peter Norvig: A comprehensive AI textbook with a dedicated chapter on knowledge representation and reasoning.
- ▶ Knowledge Representation and Reasoning by Ronald J. Brachman and Hector J. Levesque: A classic textbook covering the fundamentals of KR&R.
- ▶ Online Courses: Many universities offer online courses on AI and KR&R through platforms like Coursera, edX, and Udacity.

THANK YOU