Oriental Institute of Science and Technology, Bhopal

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Assignment - 03

Q. Define probabilistic

Probabilistic reasoning is a method of knowledge reasoning representation in AI used to handle uncertainty and make decisions when information is incomplete, noisy or ambiguous. Unlike traditional logic-based AI, which requires absolute true or false values, probabilistic reasoning assigns a degree of belief to propositions. It combines probability theory with logical reasoning to manage real-world complexities effectively.

Importance in AI

Handling Uncertainty: Manages noisy, incomplete, and unpredictable data.

Decision-Making: Weighs risks and outcomes for smarter choices.

Learning: Updates prediction with new evidence (Bayesian updating).

Applications: Powers autonomous devices, NLP, spam filtering, finance and robot

Behaviour: Loyal, Playful.

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Q Explain of Bayes' theorem with an example

Bayes theorem is a fundamental formula of probability theory that describes how to update the probability of a hypothesis (or event) based on the availability of new evidence or information. It allows for the calculation of posterior probability using prior and likelihood

The formula is

$$P(A|B) = \frac{P(B|A) \cdot P(A)}{P(B)}$$

Ex Medical diagnosis

Consider a scenario involving a medical test for a rare disease:

- The general population prevalence for the disease is 1% ($P(D) = 0.01$). This is the prior probability.
- The test is 98% accurate at detecting the disease if it's present (true positive rate: $P(T|D) = 0.95$). This is the likelihood
- The test has a 5% false positive rate

If a person tests positive (T), one can calculate the probability that person

4. Acquisitional Efficiency
- Adding, updating or removing knowledge should be easy and should not disrupt the system's structure or logic.

5. Support for Uncertainty
- The system should handle incomplete, vague, or probabilistic information using methods like fuzzy logic or probabilistic reasoning.

6. Explain frames with example also describes its utility in current scenario
One A Frame is a data structure that holds knowledge about a particular object or situation. Think of it like a template or a record - each frame contains slot and fillers.
- Frame = Concept
- slot = Property or Attribute
- Fillers = value of the Attribute

Example: Frame For a "Dog".
Frame: Dog
- Type: Animal
- Sound: Bark
- Legs: 4
- Color: varies
- Behaviour: loyal, playful.

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Utility in current scenarios

Frames are still highly relevant in modern AI systems, especially in:

1. Expert systems
- Frames are still highly relevant in modern AI systems, especially in:
- used in medical diagnosis, legal reasoning and troubleshooting systems

Ex: A "patient" frame might include symptoms, history, and test results.

2. Natural language Processing (NLP)
- Helps in understanding context and meaning in sentences.
- Example: Understanding "John gave Ma a book" involves frame "person", "object", and "action".

3. Semantic web and Ontologies
Frames form the basis for owl used in knowledge graphs and embed data.

4. Cognitive Architectures
systems like SOAR and ACT-R use fra like structures to simulate human cognition.

Q Derivation of the Formula for Bayes' Theorem

Ans Q. For two events A and B with $P(B) > 0$

$$P(A|B) = \frac{P(A \cap B)}{P(B)}$$

Similarly,

$$P(B|A) = \frac{P(A \cap B)}{P(A)} \quad (\text{if } P(A) > 0)$$

2. Express the joint probability two ways

From the second eqn

$$P(A \cap B) = P(B|A)\,P(A)$$

3. Substitude eq to the first eqn

Plug that into $P(A|B) = \frac{P(A \cap B)}{P(B)}$

$$P(A|B) = \frac{P(B|A)\,P(A)}{P(B)}$$

This is Bayes' Theorem.