Describe the structure and working of a knowledge-based agent in AI.

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    - A knowledge-based agent uses stored knowledge to make smart decisions.
    - It has two parts:

1. Knowledge Base**:** Keeps facts and rules.
2. Inference Engine**:** Uses those facts to find answers.
    - It learns from input and decides actions based on knowledge.

Outline the key components of propositional logic and their role in representing knowledge in AI systems.

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    - **Propositions:** Simple statements that are either true or false.
    - **Connectives:** Join statements (AND, OR, NOT, IF-THEN).
    - **Rules:** Help combine facts to form new knowledge.
    - **Role:** Used to represent and reason about facts in AI systems.

Explain the key issues in knowledge representation.

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    - **Representation:** How to store knowledge in a useful form.
    - **Reasoning:** How to use knowledge to make decisions.
    - **Completeness:** Making sure all needed facts are included.
    - **Consistency:** Avoiding conflicting information.
    - **Efficiency:** Using less time and memory for processing.

Interpret the concept of semantic mapping in knowledge representation and explain its significance in understanding meaning in AI systems.

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    - Semantic mapping connects words or symbols with their real meanings.
    - It helps AI systems understand relationships between concepts.
    - **Significance:** It improves language understanding, reasoning, and accurate decision- making in AI systems.

Describe the concept of a Bayesian network and its purpose.

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    - A Bayesian network is a graphical model that shows relationships between variables using probabilities.
    - It helps in reasoning under uncertainty and predicting outcomes based on given data.

Illustrate the concept of Bayes' Rule and demonstrate how it is applied in AI for probabilistic reasoning.

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  - **Bayes' Rule** is used to find the probability of an event based on prior knowledge.
- Formula:

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

- **Use in AI:** Helps in probabilistic reasoning, like predicting diseases, spam detection, or decision making under uncertainty.

Explain the concept of conditional independence and how it simplifies computations in Bayesian inference.

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  - Conditional independence means two events are independent when a third event is known.
  - It helps in reducing complex probability calculations by breaking them into simpler parts.
  - This makes Bayesian inference faster and easier.

Explain the Dempster-Shafer theory in the context of reasoning under uncertainty.

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  - Dempster-Shafer theory is a method to handle uncertain or incomplete information.
  - It gives belief values instead of exact probabilities.
  - Used in AI to combine evidence from different sources and make better decisions under uncertainty.

Contrast fuzzy sets with classical sets, highlighting their differences in terms of membership and application in AI.

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  - In classical sets, an element either belongs or does not belong to a set (membership is 0 or 1).
  - In fuzzy sets, membership can be partial, between 0 and 1.
  - Fuzzy sets are used in AI for handling uncertain or vague data, like speech or image recognition.

Describe the concept of fuzzy logic and its applications in various AI systems.

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  - Fuzzy logic is a method that deals with uncertain or imprecise information.
  - It allows values between 0 and 1 instead of only true or false.
  - It is used in AI for control systems, decision-making, pattern recognition, and robotics.

Let P(A)=0.4, P(B)=0, and A∩B=∅. Find P(A∪B).

Solution:

Since A and B are disjoint:

$P(A \cup B) = P(A) + P(B)$

$=0.4+0.3$

$=0.7$

Analyze how fuzzy logic differs from probability theory in handling uncertainty.

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    - Fuzzy logic deals with vagueness or imprecision (how true something is).
    - Probability theory deals with uncertainty (how likely something is).
    - Fuzzy logic uses degrees of truth, while probability uses chances of events.

1. **A die is rolled once. Find the probability of:**
2. **Getting a number less than 5**
3. **Getting a prime number**

Solution:

Sample space = {1, 2, 3, 4, 5, 6}

1. Numbers less than 5 = {1, 2, 3, 4} → 4 outcomes P = 4/6

= 2/3

1. Prime numbers = {2, 3, 5} → 3 outcomes P = 3/6

= 1/2

Compare propositional logic and semantic networks for knowledge representation in AI.

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    - Propositional logic shows facts using true or false statements.
    - Semantic networks show ideas using connected nodes and links.
    - Propositional logic is used for reasoning, while semantic networks show relations clearly.

Assess the role of Bayes' Rule in enabling reasoning under uncertainty within knowledge-based systems.

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    - Bayes' Rule helps to find the chance of an event using past information.
    - It allows systems to update beliefs when new data comes.
    - It is used for making decisions when information is uncertain.

Evaluate the advantages of using Bayesian Networks in knowledge representation.

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  - They show relationships between variables clearly.
  - Help in reasoning and decision-making under uncertainty.
  - Allow updating of beliefs when new data is added.
  - Reduce complex problems into simple parts for easy analysis.

Distinguish between syntactic processing and semantic analysis in Natural Language Processing by examining their roles and contributions to language understanding.

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  - Syntactic processing checks the grammar and structure of sentences.
  - Semantic analysis focuses on the meaning of words and sentences.
  - Syntax helps understand sentence form, while semantics helps understand sentence meaning.

Analyze how decision trees and explanation-based learning differ in their approach to machine learning.

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  - Decision trees learn by dividing data into parts based on features.
  - Explanation-based learning learns from one example by understanding its logic or reason.
  - Decision trees use data patterns, while explanation-based learning uses reasoning.

Evaluate the importance of semantic and pragmatic processing in Natural Language Understanding.

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  - Semantic processing helps find the meaning of words and sentences.
  - Pragmatic processing understands the context and real intention behind words.
  - Both help AI systems understand human language more naturally and correctly.

Evaluate the strengths of genetic algorithms in learning and problem-solving.

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  - They can find good solutions for complex problems.
  - Work well even when problem data is large or unclear.
  - Can explore many possible solutions at once.
  - Useful for optimization and machine learning tasks.

Question	**Option 1**	**Option 2**	**Option 3**	**Option 4**
Identify the purpose of a knowledge-	**To act randomly**	**To execute fixed**	**To make decisions**	**To store large data**

based agent in AI.		programs	based on logical	
Select the type of logic that uses statements which are either true or false.	Predicate Logic	Modal Logic	Fuzzy Logic	Propositional Logic
Identify a key issue in knowledge representation.	Cost of hardware	Speed of networking	Handling incomplete or uncertain information	Using deep learning
Explain what mapping refers to in knowledge representation.	Connecting software with hardware	Translating high-level goals to low level	Mapping syntactic expressions to semantic	Formatting datasets
Select a common approach used in knowledge representation.	Linear regression	Neural embeddings	Semantic networks	XML schema
Express the meaning of conditional independence in Bayesian networks.	Events are always dependent	Events are unrelated	Events are independent given a third	Variables are deterministic
Indicate what Bayes' Rule allows us to compute.	Causal inference	Prior knowledge from data	Posterior probability from prior and	Deterministic outcomes
Identify the correct statement about Dempster-Shafer theory.	It replaces probability theory	It assigns belief values to subsets of	It avoids reasoning under	It does not support evidence combination
Express how truth values are represented in fuzzy logic.	As binary (0 or 1)	Only using probability	On a scale between 0 and 1	Using logic gates
Identify the technique that allows inference with incomplete information in probabilistic systems.	Exact resolution only	Bayesian networks	Backpropagatio n	Rule-based systems
Select the component that enables a knowledge-based agent to infer new facts.	Percept module	Inference engine	Action executor	Memory manager
Identify the option that is not a valid use of propositional logic.	Representing uncertainty	Representing simple facts	Modeling logical operations	Performing truth table evaluations
Indicate a limitation of propositional logic in AI.	It is too complex	It cannot handle mathematica l operations	It lacks the ability to represent relationships among objects	It works only with dynamic environments
Identify the logical connective used in the expression "if A then B".	AND	OR	IMPLIES	NOT
Express what knowledge representation aims to achieve in AI.	Storing user data	Mapping user input to a database	Structuring information for reasoning	Designing user interfaces
Identify a feature of semantic networks.	Use of deep learning	Represent knowledge through graphs of concepts and relationships	Only applicable in neural systems	Inability to handle hierarchy
Indicate what a prior probability represents in Bayesian reasoning.	Probability after evidence	Random guess	Initial belief before seeing evidence	The likelihood of an unrelated event

Select the correct statement about exact inference in Bayesian networks.	It always uses fuzzy logic	It gives guaranteed results but can be computation ally expensive	It never uses conditional independence	It is used only for deep learning
Express the primary purpose of approximate inference in Bayesian networks.	To give exact answers faster	To simplify networks into	To provide near-accurate results	To replace statistical models
Indicate what a belief function represents in Dempster-Shafer theory.	Probability of a single outcome	The strength of belief in a subset of	Binary truth value	Uncertainty in logic only
Compare fuzzy logic with traditional binary logic.	It deals only with randomness	It uses statistical inference	It handles degrees of truth rather than	It requires neural networks
Identify what the membership function maps elements to in fuzzy sets.	Probabilities	Integers	Binary values	Values between 0 and 1
Select an application of fuzzy logic.	Arithmetic operations	Weather prediction systems	Text encoding	Syntax parsing
Identify the main advantage of using Bayesian networks in uncertain environments.	They eliminate uncertainty	They provide deterministic answers	They use graphical models to manage dependencies	They are only used for logic gates
Indicate what nodes represent in a Bayesian network.	Logic rules	Random variables	Agents	Algorithms
Differentiate the situations where Dempster-Shafer theory is more appropriate than Bayesian inference.	When all probabilities are known	When data is complete and certain	When evidence is incomplete or conflicting	When the logic is binary
Identify and Categorize the knowledge representation approach best suited for encoding hierarchies and relationships.	Propositional Logic	Semantic Networks	Production Rules	Dempster-Shafer Theory
Infer the effect of conditional independence between two variables given a third in a Bayesian Network.	The network becomes cyclic	It reduces the need for probability tables	It eliminates the need for inference	It increases uncertainty
Infer how a fuzzy controller in an air conditioner responds to temperature changes.	Setting fixed temperatures	Ignoring small changes	Applying crisp logic rules	Adjusting output gradually using membership
Compare the analytical advantages of fuzzy logic over traditional logic in control systems.	Faster computation	Complete certainty in reasoning	Ability to handle partial truths and vague inputs	Precise symbolic reasoning
Investigate why exact inference in Bayesian networks becomes computationally expensive in large networks.	It requires retraining the model	It depends on loop detection	It involves enumerating all variable combinations	It ignores probabilistic reasoning
Identify and Outline the component of a knowledge-based agent that aids decision-making through inference.	Sensor array	Knowledge base	Inference engine	Mapping module
Identify fuzzy logic with probability theory	Fuzzy logic	Probability	Probability measures	Fuzzy logic is

in terms of interpretation.	models randomness	measures degree of truth	likelihood; fuzzy logic measures vagueness	used only in robotics
Relate the role of structure (edges and nodes) in reasoning within Bayesian networks.	It shows which variables can be ignored	It defines data types of variables	It specifies conditional dependencies among variables	It prevents circular logic
Infer the limitation of propositional logic in representing complex, real-world knowledge.	It uses too much memory	It cannot handle uncertainty or relationships between	It is too slow to evaluate	It requires probabilistic models
Identify and Outline the main focus of syntactic processing in Natural Language Processing (NLP).	Understandin g the context of words	Analyzing grammatical structure of sentences	Translating text from one language to another	Identifying sentiment in a sentence
Differentiate the level of language analysis in NLP that deals with the actual meaning of words and sentences.	Pragmatic processing	Syntactic processing	Semantic analysis	Discourse analysis
Investigate what is primarily analyzed during discourse processing in NLP.	Word morphology	Inter-sentenc e relationships	Syntax rules	Parsing efficiency
Categorize the form of learning that generalizes from specific examples to form rules or models.	Deductive learning	Reinforceme nt learning	Inductive learning	Supervised tuning
Identify and Illustrate the primary structure used in decision tree learning.	Graph-based network	Conditional matrix	Tree of decision nodes and outcomes	Rule-based table
Distinguish the learning technique that uses explanations to form generalizations for improved performance.	Reinforceme nt learning	Explanation-based learning	Genetic algorithm	Inductive logic programming
Relate neural net learning to the biological process it primarily mimics.	Genetic inheritance patterns	Rule-based expert systems	Human brain structure and processing	Boolean logic gates
Illustrate how genetic algorithms use the process of combining two parent solutions to generate new ones.	Mutation	Fitness scaling	Selection	Crossover
Outline the main role of expert system shells in the development of expert systems.	To define learning rules	To optimize neural networks	To provide a framework for building expert systems	To preprocess raw data
Investigate a major challenge encountered in the knowledge acquisition process for expert systems.	Coding algorithms	Building user interfaces	Extracting tacit knowledge from domain	Allocating memory
Assess which option best describes a Knowledge-Based Agent.	An agent that learns from raw data	An agent that stores percepts as-is	An agent that uses a knowledge base	An agent that randomly selects actions
Determine and Justify the primary purpose of propositional logic in AI.	Represent uncertainty	Perform image classification	Represent facts and perform inference	Train neural networks
Select the option that is NOT a problem in knowledge representation.	Representing incomplete knowledge	Representing facts	Representing hidden layers in neural	Representing default values
Verify which statement is true regarding Bayesian Networks.	Used only in deterministic domains	Represent conditional independenc	Cannot model probabilistic relationships	Require complete data

Deside the rule that allows updating the probability of a hypothesis based on new evidence.	Chain rule	Bayes' Rule	DeMorgan's Law	Dempster's Rule
Assess the purpose of Exact Inference in Bayesian Networks.	Estimate probabilities randomly	Determine precise probability values	Simplify logic expressions	Eliminate dependency between nodes
Select the feature that accurately describes fuzzy logic.	Only binary values	Crisp decision making	Degree of truth	Always deterministic
Decide what Dempster-Shafer theory primarily deals with.	Genetic algorithms	Heuristic functions	Combining evidence to compute belief	Fuzzy rules in control systems
Verify how conditional independence between two variables is determined in Bayesian networks.	Their distance in the network	Direct observation	The structure of the network	Random trials
Choose the option that best represents a many-to-one mapping in knowledge representation.	Symbol grounding	Semantic networks	Frame-based systems	Logical implication