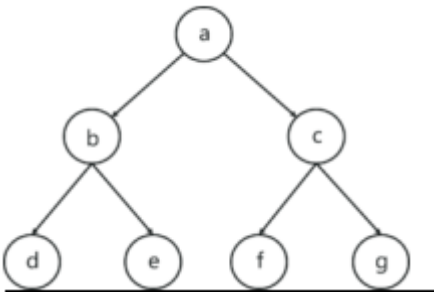
Principles of AI Question Bank

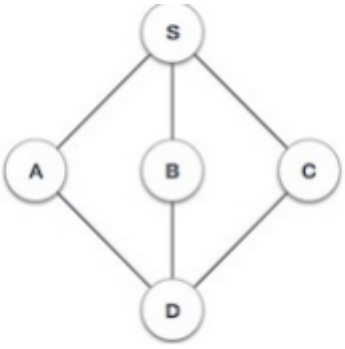
Module 1:

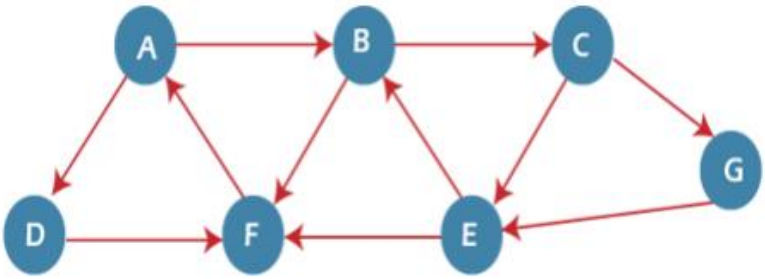
1. Define the following:
    a. Artificial Intelligence
    b. Agent
2. Explain Artificial Intelligence by considering the following Characteristics:
    a. Human like (Thinking/Acting)
    b. Rationally (Thinking/Acting)
3. Explain how **Turing** test can be used for checking the Intelligence of Machines. /Discuss the significance of **Turing Test** in evaluating AI capabilities.
4. Illustrate the Foundations and History of AI through a timeline.
5. Mention and describe the different **types** of agents.
6. Describe the Key characteristics of Intelligent Agents.
7. Explain the difference between **Agent function** and **Agent Program.**
8. Write a Function for the following:
    a. Reflex Vacuum agent
    b. Table Driven Agent
9. Describe the Concept of Rationality (Good behavior)
10. What are Rational Agents? Explain **PEAS**. Give Examples for different Agents and their PEAS performances.
11. Explain nature of environment/Task environments. Give the **PEAS** description for the taxi's task environment.
12. Discuss the different properties of Task Environments. Give 5 examples for task environment and their properties.
13. Define the structure of Agent. With a neat diagram explain the following five basic types of agent programs:
    1. Simple reflex agents
    2. Model-based reflex agents
    3. Goal-based agents
    4. Utility-based agents
    5. Learning Agents
14. Discuss how the components of agent programs work.

Module 2:

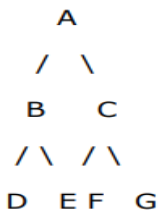
1. Discuss the steps followed by Problem Solving agents.
2. Formulate the following Toy problems using five components of **well-defined** problems:
    a. Vacuum world Problem
    b. Eight Puzzle Game
    c. Eight Queens Problem
    d. Math's Sequences
3. Formulate the **Realtime Route Finding problem** using five components of well-defined problem.
4. Define a function for the following
    a. **TREE** Search
    b. **GRAPH** Search
5. Discuss how to measure performance of problem-solving agents.
6. Compare Uniformed and informed search strategies.
7. Design and explain the Breadth First Search Algorithm with example.
8. Apply Breadth First search for the following using FIFO Queue:

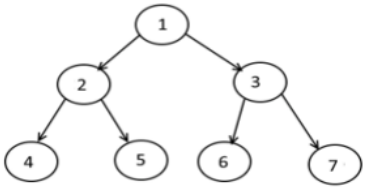






15. Design and explain the **Depth First Search** Algorithm with example.
16. Apply **Depth First search** for the following using LIFO Queue (Stack):



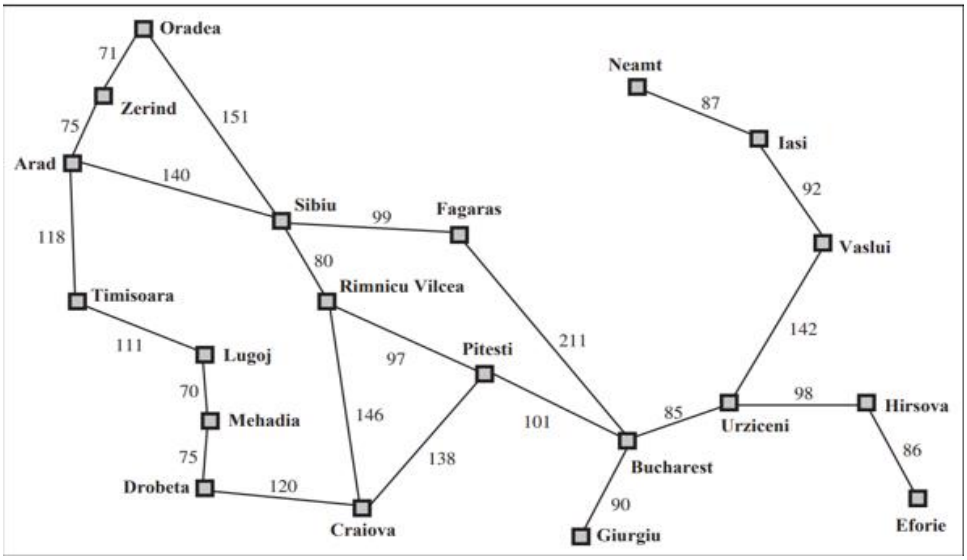


17. Write a pseudo code for **Depth First Search**
18. Compare Time and Space Complexity of BFS and DFS for Graph and Binary Tree.
19. With examples design, explain and compare the following algorithms:

a. Breadth First search,
b. Depth First Search,
c. Iterative deepening depth first search;

Module 3.

1. Design and explain the **Greedy Best First Search Algorithm** to find the best path from **ARAD** to **BUCHAREST** in the map given below:

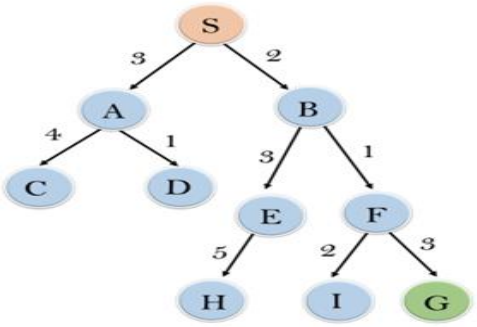


Make use of the **heuristic value** given below:

Arad	366	Mehadia	241
Bucharest	0	Neamt	234
Craiova	160	Oradea	380
Drobeta	242	Pitesti	100
Eforie	161	Rimnicu Vilcea	193
Fagaras	176	Sibiu	253
Giurgiu	77	Timisoara	329
Hirsova	151	Urziceni	80
Iasi	226	Vaslui	199
Lugoj	244	Zerind	374

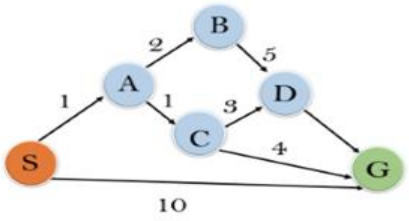
Figure 3.22 Values of h_{SLD}—straight-line distances to Bucharest.

2. Design and explain the **A* Best First Search Algorithm** to find the best path from **ARAD** to **BUCHAREST.** Consider the map and heuristic value of question no **5**.
3. Apply Greedy Best First Search for the following with **S** as a Start node and **G** as goal. Find the Optimal path by applying Greedy Best First Search Algorithm using Closed list and Open list.



node	H (n)
A	12
B	4
C	7
D	3
E	8
F	2
H	4
I	9
S	13
G	0

4. Apply **A* Best** First Search for the following with **S** as a Start node and G as goal. Find the Optimal path by applying Greedy Best First Search Algorithm using Closed list and Open list



State	h(n)
S	5
A	3
B	4
C	2
D	6
G	0

5. Discuss how heuristic functions can be selected making use of the following four approaches for 8 puzzles:
   - The effect of heuristic accuracy on performance
   - Generating admissible heuristics from relaxed problems:
   - Generating admissible heuristics from subproblems: Pattern databases
   - Learning heuristics from experience

6. Define Logical agents and explain how the knowledge can be represented using sematic networks and Propositional Logic.
7. Define Logical Reasoning and explain Syllogism with example. Discuss Key Components of Knowledge based agents.
8. Write and explain the function for Knowledge based agents.
9. Describe Wumpus World and its PEAS description
10. Discuss the following with suitable examples:
    a. Logical Entailment

b. Logical Inference
c. Model Checking
d. Sound or Truth Preserving

11. Discuss the following with suitable examples:

a. Key elements and components of Propositional logic
b. Syntax and BNF Grammar of Propositional logic
c. Semantics and Rules for Atomic and complex sentences in Propositional logic

12. Express the simple Knowledge base of Wumpus World using syntax and semantics of Propositional logic

13. Differentiate between Unit Resolution and Complete Resolution with examples.

14. Convert the following sentences to conjunctive normal form.

a. $(A \rightarrow B) \rightarrow C$

Answer:

$\neg(\neg A \vee B) \vee C$ $(A \wedge \neg B) \vee C$ $(A \vee C) \wedge (\neg B \vee C)$

b. $A \rightarrow (B \rightarrow C)$

Answer:

$\neg A \vee \neg B \vee C$

c. $(A \rightarrow B) \vee (B \rightarrow A)$

Answer:

$(\neg A \vee B) \vee (\neg B \vee A)$

d. 4. $(\neg P \rightarrow (P \rightarrow Q))$

Answer:

$\neg\neg P \vee (\neg P \vee Q)$ $P \vee \neg P \vee Q$

e. $(P \rightarrow (Q \rightarrow R)) \rightarrow (P \rightarrow (R \rightarrow Q))$

Answer:

$\neg(\neg P \vee \neg Q \vee R) \vee (\neg P \vee \neg R \vee Q)$

$(P \wedge Q \wedge \neg R) \vee (\neg P \vee \neg R \vee Q)$

$(P \vee \neg P \vee \neg R \vee Q) \wedge (Q \vee \neg P \vee \neg R \vee Q) \wedge (\neg R \vee \neg P \vee \neg R \vee Q)$

$\neg P \vee Q \vee \neg R$

15. Explain the following with examples

a. Algorithm To convert a given formula to CNF
b. Algorithm/Steps To prove by resolution
c. Horn Clauses and Definite Clauses
d. Forward and Back Ward Chaining

Module 4:

1. Explain the following with examples:
   a. The syntax of first-order logic with equality, specified in Backus–Naur form
   b. Syntax and Semantics of FOL
2. For each of the following English sentences, write a corresponding sentence in FOL.
   a. The only good extraterrestrial is a drunk extraterrestrial.
   b. The Barber of Seville shaves all men who do not shave themselves.
   c. There are at least two mountains in England.
   d. There is exactly one coin in the box.
   e. There are exactly two coins in the box.
   f. The largest coin in the box is a quarter.
   g. No mountain is higher than itself.
   h. All students get good grades if they study.

Ans:

First Order Logic Sentences

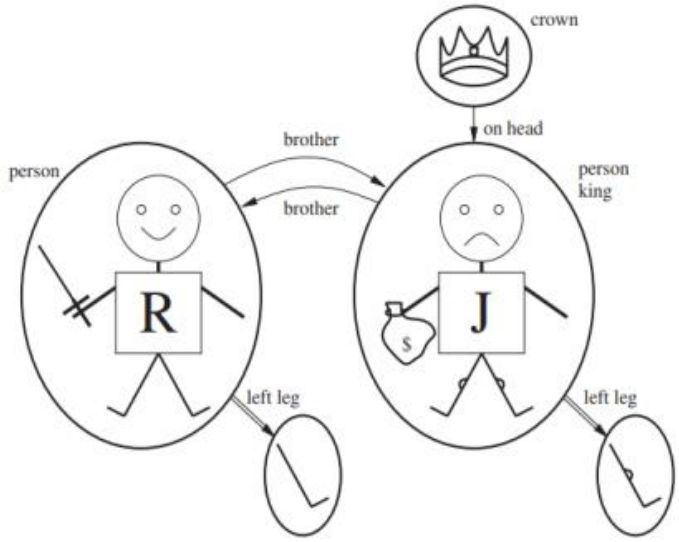
For each of the following English sentences, write a corresponding sentence in FOL.

1. The only good extraterrestrial is a drunk extraterrestrial.
   $\forall x. ET(x) \land Good(x) \rightarrow Drunk(x)$
2. The Barber of Seville shaves all men who do not shave themselves.
   $\forall x. \neg Shaves(x, x) \rightarrow Shaves(BarberOfSeville, x)$
3. There are at least two mountains in England.
   $\exists x, y. Mountain(x) \land Mountain(y) \land InEngland(x) \land InEngland(y) \land x \neq y$
4. There is exactly one coin in the box.
   $\exists x. Coin(x) \land InBox(x) \land \forall y. (Coin(y) \land InBox(y) \rightarrow x = y)$
5. There are exactly two coins in the box.
   $\exists x, y. Coin(x) \land InBox(x) \land Coin(y) \land InBox(y) \land x \neq y \land \forall z. (Coin(z) \land InBox(z) \rightarrow (x = z \lor y = z))$
6. The largest coin in the box is a quarter.
   $\exists x. Coin(x) \land InBox(x) \land Quarter(x) \land \forall y. (Coin(y) \land InBox(y) \land \neg Quarter(y) \rightarrow Smaller(y, x))$
7. No mountain is higher than itself.
   $\forall x. Mountain(x) \rightarrow \neg Higher(x, x)$
8. All students get good grades if they study.
   $\forall x. Student(x) \land Study(x) \rightarrow GetGoodGrade(x)$

3. List the properties and draw backs of Propositional Language
4. With example explain the following components of FOL
   a. Objects
   b. Relations

c. Functions

5. Compare different types of languages
6. List the Basic Elements of FOL and give examples for each/
7. Discuss the following components of Syntax and Semantics of FOL
   a. Models for FOL
   b. Symbols and Interpretations
   c. Terms
   d. Atomic Sentences
   e. Complex Sentence
   f. Quantifiers
   g. Equality
   h. Data base Semantics
8. List all Objects, Tuples, Relations and Functions in the following Model:



9. Write the syntax of FOL with equality specified in Backus Naur form.
10. Give examples for Nested Quantifiers
11. Write DeMorgans Rules for quantified and unquantified sentences.
12. Write a FOL statements for the following :
   a. One's mother is one's female parent: ∀ m,c Mother (c)= m ⇔ Female(m) ∧ Parent(m,c) .
   b. One's husband is one's male spouse: ∀ w,h Husband(h,w) ⇔ Male(h) ∧ Spouse(h,w)
   c. Male and female are disjoint categories: ∀ x Male(x) ⇔ ¬Female(x) .
   d. Parent and child are inverse relations: ∀ p,c Parent(p,c) ⇔ Child(c,p)
   e. A grandparent is a parent of one's parent: ∀ g,c Grandparent(g,c) ⇔ ∃ p Parent(g,p) ∧ Parent(p,c) .
   f. A sibling is another child of one's parents: ∀ x,y Sibling(x,y) ⇔ x 6= y ∧ ∃ p Parent(p,x) ∧ Parent(p,y)
   g.
13. Discuss the Following with examples
   a. Assertions and queries in first-order logic
   b. Representing Numbers and List in FOL
   c. Representing Sets in FOL
   d. Representing Wumpus World using FOL

14. Compare Propositional Logic with First Order logic with examples
15. Discuss the following of FOL
    a. The rule of Universal Instantiation
    b. The rule of Existential Instantiation
    c. Unification
    d. Forward Chaining
    e. Backward Chaining
    f. Resolution
    g. Equality
16. Unify the following two predicates using Unification Algorithm
    a. Predicate P(x,y)
    b. Predicate Q(f(z),a)
17. Consider the following 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, and all of its missiles were sold to it by Colonel West, who is American. Using FOL Forward Chaining prove that West is Criminal/
18. Explain the Steps involved in Resolution of FOL statements with examples.
19. Write an Algorithm for the following of FOL
    a. Unification in FOL
    b. Forward Chaining in FOL
    c. Backward Chaining in FOL
    d. Resolution in FOL
20. Explain the following
    a. Herbrands Theorem
    b.

Module 5:

1. Write a Agent function that uses decision theory to select actions'
2. Explain the following with examples
    a. Probability Model
    b. Unconditional Probability
    c. Conditional or Posterior probability
    d. Product Rule
    e. Probability Distribution
    f. Probability density Function
    g. Joint Probability Distribution
3. Explain the following axioms with examples
    a. Probability of Negation
    b. Inclusion – Exclusion Principle
    c. Kolmogorov's axioms
4. Discuss with example the following:
    a. Inference using Full Joint Distribution
    b. Conditioning
    c. Normalization

    d. Independence
5. Discuss the following
    a. Bayes Rule
    b. Applying ayes Rule to simple case
    c. Combining Evidence using Bayes rule
6. Discuss Wumpus World using Probability Theory.