

Compute the following quantities:

- (i) $P(\neg B, C|A)$
(ii) $P(A|\neg B, C)$.

$$(2 + 4) + 6 = 12$$

9. (a) What is Goal Stack Planning?
(b) Explain 'Sussman anomaly' with suitable diagram.
(c) Consider the following

Premise: x is little.

Implication: x and y are approximately equal.

Then conclude "y is more or less little" by using fuzzy modus ponens where

$$x = y = \{1, 2, 3, 4\}$$

$A = \{\text{little}\} = \{(1/1), (2/0.6), (3/0.2), (4/0)\}$ is a fuzzy set and

$R =$ approximately equal, a fuzzy relation defined as

$x \backslash y$	1	2	3	4
1	1	0.5	0	0
2	0.5	1	0.5	0
3	0	0.5	1	0.5
4	0	0	0.5	1

$$3 + 4 + 5 = 12$$

INTELLIGENT SYSTEMS (MCAP 2204)

Time Allotted : 3 hrs

Full Marks : 70

Figures out of the right margin indicate full marks.

*Candidates are required to answer Group A and
any 5 (five) from Group B to E, taking at least one from each group.*

*Candidates are required to give answer in their own words as far as
practicable.*

Group - A (Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**
- (i) Inheritable knowledge is best represented by
(a) semantic net (b) FOPL
(c) frame (d) none of these.
- (ii) Which of the following algorithm face local maximum ?
(a) Hill Climbing (b) Breadth-first search
(c) Best-first search (d) All of these.
- (iii) Max no. of neighbouring node (child) of any node in 15-puzzle is
(a) 4 (b) 5 (c) 15 (d) 16.
- (iv) Skolem constant is used in
(a) unification algorithm (b) natural deduction
(c) conversion to clausal form (d) none of these.
- (v) Simulated annealing is a variation of
(a) BFS (b) hill climbing
(c) genetic algorithm (d) means end analysis.
- (vi) According to binary resolution if $\neg P(x, a) \vee Q(x)$ and $\neg Q(b) \vee R(x)$
then the binary resolvent is
(a) $\neg P(x, a) \vee R(x)$ (b) $\neg P(b, a) \vee R(b)$
(c) $\neg P(b, a) \vee R(x)$ (d) None of these.
- (vii) Which of the following is the heuristic search?
(a) Depth-first search (b) Breadth-first search
(c) Best-first search (d) None of these.

(viii) Which of the following is a limitation of the semantic networks?

- (a) Intractability
- (b) Lack in expressing some of the properties
- (c) Incomplete
- (d) Ambiguity

(ix) The resolution is called as refutation-complete when

- (a) sentence is satisfiable
- (b) sentence is unsatisfiable
- (c) sentence remains the same
- (d) none of the mentioned.

(x) The process of adding new knowledge to a knowledge-base and refining or improving knowledge that was previously stored is called

- (a) knowledge acquisition
- (b) knowledge representation
- (c) knowledge inference
- (d) none of these.

Group - B

2. (a) When a heuristic function will be called consistent? Prove that in A* algorithm, if $h(n)$ is consistent, then the values of $f(n)$ along any path are non-decreasing.

(b) Define a heuristic function to solve the 8 puzzle problem using hill climbing. What is meant by 'Best-First' heuristics?

$$(3 + 4) + (3 + 2) = 12$$

3. (a) What are the different approaches in defining artificial intelligence? Define Learning Agent.

(b) Considering Mars Rover as an Intelligent Agent answer the following questions:

- (i) What are the percepts for this agent?
- (ii) Characterize the operating environment.
- (iii) What are the actions the agent can take?

$$(4 + 2) + 6 = 12$$

Group - C

4. (a) What is meant by adversarial search? How does α - β Pruning improve adversarial search procedure? Explain with suitable examples.

(b) Solve the Crypt-arithmetic Problem :

$$\begin{array}{r} \text{E A T} \\ + \text{T H A T} \\ \hline \text{A P P L E} \end{array}$$

$$(2 + 5) + 5 = 12$$

5. (a) Show that the following pair of propositions are logically equivalent.

$$\neg p \vee q \rightarrow r, (p \wedge \neg q) \vee r$$

(b) Verify that the proposition $(p \wedge q) \wedge \neg (p \vee q)$ is a contradiction.

(c) Verify the following theorem by Wang's algorithm.

$$p \rightarrow (q \rightarrow r) \Leftrightarrow (p \wedge q) \rightarrow r$$

$$3 + 3 + 6 = 12$$

Group - D

6. (a) Give predicate logic statements to describe the following:

- (i) The boy is either mad or a fool.
- (ii) Computers can never be intelligent.

(b) Consider the following knowledge base:

- (i) Anyone whom Mary loves is a football star.
- (ii) Any student who does not pass does not play.
- (iii) John is a student.
- (iv) Any student who does not study does not pass.
- (v) Anyone who does not play is not a football star.
- (vi) (**Conclusion**) If John does not study, then Mary does not love John.

Prove by resolution theorem that the **conclusion** is derivable from the knowledge base.

$$4 + 8 = 12$$

7. (a) Explain the strategies of forward chaining with an example.

(b) You are given two jugs having capacity of 8 gallon and 6 gallon. Neither has any measuring marker on it. You may fill the jugs with water. How can you get exactly 4 gallons of water into the 8-gallon jug? Write down the production rule and solve by forward chaining strategy.

$$3 + 9 = 12$$

Group - E

8. (a) What is meant by 'conditional independence' between two events? State Bayes' Theorem with suitable example.

(b) Consider the following Bayesian Network containing 3 Boolean random variables:

