

The Open University of Sri Lanka
Faculty of Engineering Technology
Department of Electrical and Computer Engineering

064



Study Programmes	: Bachelor of Science Honours in Engineering Bachelor of Software Engineering Honours
Name of the Examination	: Final Examination
Course Code and Title	: EEX7340- AI Techniques and Agent Technology : EEX6340 -AI Techniques and Agent Technology
Academic Year	: 2023/24
Date	: 18, February 2025
Time	: 0930-1230hrs
Duration	: 3 hours

General Instructions

1. Read all instructions carefully before answering the questions.
 2. This question paper consists of **Five (5) questions** in **Four (4) pages**.
 3. Answer ALL questions. All questions carry equal marks.
 5. Answer for each question should commence from a new page.
 6. This is a Closed Book Test (**CBT**).
 7. Answers should be in clear hand writing.
 8. Do not use Red colour pen.
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Q1

Consider three blocks A, B and C which can be stacked on top of each other, for example as shown below.



It is assumed that blocks cannot be moved but rather consider a fixed configuration. In such a configuration, let $S_{A,B}$ represent the fact that A is stacked above B, and similarly the rest of the combinations too can be defined. For instance, the figure on the right side can be represented as $S_{A,B}$, $S_{B,C}$ and $S_{A,C}$.

Answer parts (a)-(c) below, based on the above explanation and you need to clearly derive/explain how you obtained the answer using propositional logic.

- Represent the fact that if one block is stacked above another, then the second cannot be above the first using propositional logic, for example, if A is above B, then B cannot be above A. (3 marks)
- Represent that if one block is stacked above a second block, which is stacked above a third block, then the first block must be stacked above the third block. For example, if A is above B, and B is above C, then A must be above C. (4 marks)
- Show how to represent the proposition that at least one block must have no blocks stacked above it. (4marks)
- Write the following predicate logic sentences in simple English.

- $\forall x \neg S(x, x)$
- $\forall x (\exists y S(y, x) \rightarrow \exists z S(x, z))$
- $\exists x \forall y \neg S(y, x)$ (3×3=9 marks)

Q2

Tic-tac-toe is a game played between two players on a board of 9 squares, divided into 3 rows and 3 columns. Starting with an empty board, the player in alternating turns places a single piece in an empty square. The first player to line up 3 of their pieces in a line (horizontal, vertical, or diagonal), wins the game. If no more moves are possible the game ends in a draw. The below figure shows an instance on the board.

X	O	O
O	X	
X		

- Give the PEAS description for the starting player in tic-tac-toe. (4 marks)
- Classify the tic-tac-toe task environment according to the properties, e.g. observability, decision-making process, etc., You need to give justification/s for your choice. (4 marks)

- (c) Give the formal problem definition of tic-tac-toe in terms of, state, initial states, successor function, goal test, and path cost. (5 marks)
- (d) Assume that a tic-tac-toe agent is one player in the game and answer the below questions.
- Write a pseudo code algorithm for the tic-tac-toe agent for possible moves based on the Breadth-First Search (BFS) algorithm. (3 marks)
 - Define a heuristic function that can be used in A* algorithm for implementing tic-tac-toe game. (2 marks)
 - Compare and contrast the use of A* algorithm with BFS for the tic-tac-toe game. (2 marks)

Q3

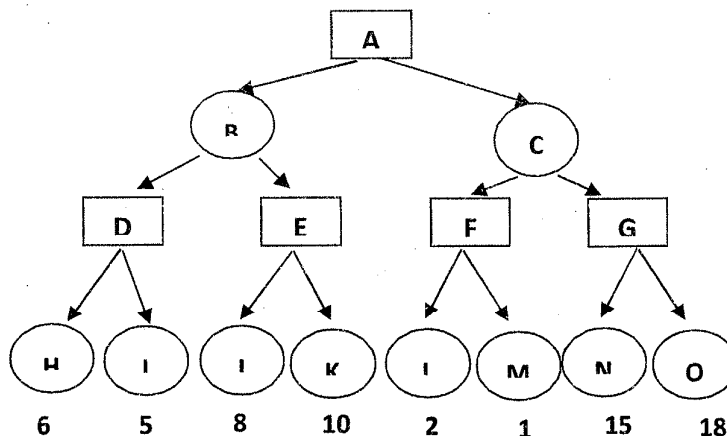
Consider the below given sentences.

- Every boy or girl is a child.
- Every child gets a doll or a train or a lump of coal.
- No boy gets any doll.
- No child who is good gets any lump of coal.

- Write the above given sentences in predicate logic, using appropriate predicates. (8 marks)
- Convert each of the sentences written above to Conjunctive Normal Form. (6 marks)
- Use resolution with refutation to prove that if no child gets a train, then no boy is good. (6 marks)

Q4

- (a) Consider the game tree given below in which the static scores are from first player's point of view. Suppose the first player is a maximizing player.

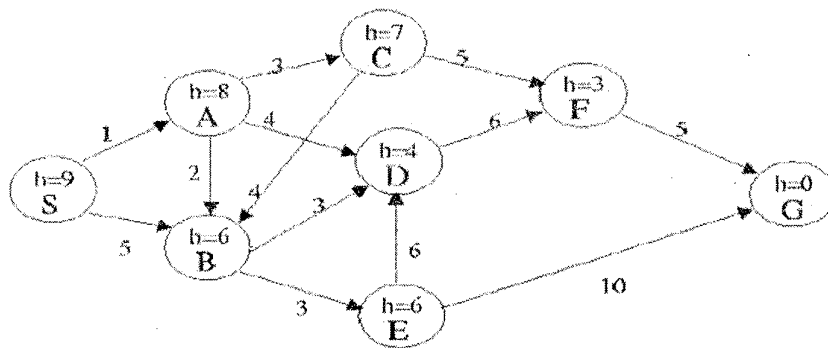


- Apply the min-max algorithm and clearly indicate the backed-up values in the tree. (5 marks)
- Apply the alpha-beta pruning algorithm to the search tree created in part(i). Clearly indicate where the alpha and beta cuts are applied, and which parts of the search tree are pruned as a result. (7 marks)

- (b) Write a prolog predicate to find whether a given item x appears in a given list L . For example $\text{member}(X, L)$ is true if X appears in the list L otherwise false. (3 marks)
- (c) Distinguish between a fact and a rule in Prolog with an example. (2 marks)
- (d) Write a Prolog program to find the summation of elements in an integer list. For example $\text{sum}([7,12,6,4], S)$ should give $S=29$ (3 marks)

Q5

Consider the following search space where S is the initial state and G is the goal state. The transition costs are next to the edges, and the heuristic estimate, h , of the distance from the state to the goal is given inside the node. In case of ties pick the state, which comes first alphabetically.



- (a) Give the sequence of states that depth-first search visits. (4 marks)
- (b) Give the sequence of states that iterative deepening visits. (4 marks)
- (c) Give the sequence of states that hill climbing with $f(s) = g(s) + h(s)$ visits. (4 marks)
- (d) A company named **MedicoVBot**, is developing an AI-powered virtual doctor that can diagnose common illnesses based on a patient's symptoms. The system uses a knowledge base consisting of rules and facts to infer diagnoses. The AI system must be capable of explaining its reasoning process to human users. The system is empowered with logical reasoning with knowledge representation in the forms of rule base and semantic networks.
- Draw a semantic network to represent relationships between diseases, symptoms, and treatments? Illustrate with an example. (4 marks)
 - What are the advantages and disadvantages of using rule-based reasoning (forward and backward chaining) in MedicoVBot's diagnostic system? Provide an example of how each approach works. (4 marks)

End of the Paper