2023

M.Sc.

4th Semester Examination

COMPUTER SCIENCE

PAPER : COS-401

(Artificial Intelligence)

Full Marks : 50

Time : 2 hours

The figures in the right-hand margin indicate marks.

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

Illustrate the answers wherever necessary.

Answer from **all** the Groups as directed.

GROUP—A

1. Answer *any* **four** questions from the following : 2×4=8

(a) State the advantages of Breadth-first search.

(b) Differentiate between weak AI and strong AI.

(c) What is a chatbot? Give one example.

(d) What do you mean by adversarial search?

(e) Show the truth table of implication connective.

(f) Why is uninformed search known as blind search technique?

GROUP—B

2. Answer *any* **four** questions from the following : 4×4=16

(a) Consider the following problem : A water jug problem : You are given two jugs, a four-gallon, and a three-gallon, a pump on which has unlimited water which you can use to fill the jugs, and the ground on which water may be poured. Neither jar has any measuring marking on it. How can you get exactly two gallons of water in the four-gallon jug? Formulate the problem as state space search problem. 4

(b) How simulated annealing algorithm works? What are the advantages of simulated annealing method? 3+1=4

(c) Translate the following English sentence into predicate logic :

"All computer science students are smart". 4

(d) What are quantifiers? Define each type of quantifier with example. 2+2=4

(e) Why is crossover important in genetic algorithm? What is crossover rate? 2+2=4

(f) What are the criteria by which we can compare the performances of different search algorithms? Explain each of them. 4

GROUP—C

3. Answer *any* **two** questions from the following : 8×2=16

(a) Consider the following game tree (Fig.1) in which the static scores at the tip nodes are from the first player's perspective. Assume that the first player is the maximizing (MAX) player.

(i) What is the minimax value for the root? Indicate which action of the first player would choose assuming a fully rational opponent.

(ii) Show which branches (if any) would be pruned by alpha-beta pruning algorithm. Assuming that the nodes are evaluated in left-to-right order.

(3+1)+4=8

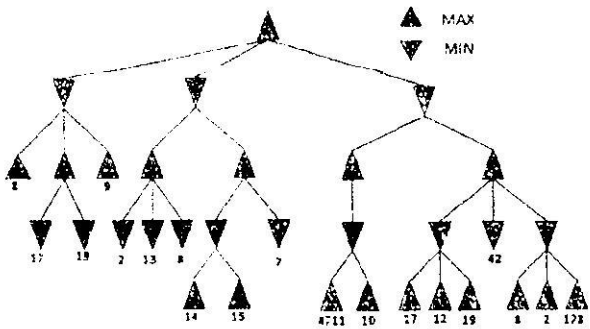

Fig. 1

(b) Consider the following maze (Fig.2) in which the successors of a cell include any adjacent cell in the directions North, South, East and West of the current cell, except at the boundary of the maze or when a barrier (thick line) exists. For example, successors (M)={D, N, G}. Assume each move has cost 1.

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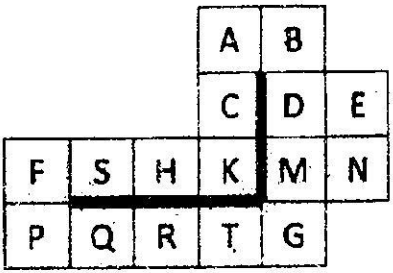

Fig. 2

The problem is to find a path from cell S to cell G. A search method breaks ties, if needed, using the alphabetical order of the labels in the cells. So, Breadth-first search (without duplicates) would visit cells in the order S F H P K C Q A R B T D G. For Greedy Best First Search, what is the order of nodes expanded? Use as the heuristic function h (state) = Manhattan distance from state to G assuming there were no barriers. For example, h(K)=2 and h(S)=4. 8

(c) Consider a nxn chess board (Fig 3). n pawns numbered 1,2,...,n are initially placed in the bottom row such that pawn i is at position (i,1). The goal is to move the pawns to the top row but in reverse order, so that pawn i ends up in position (n-i +1, n). On each time step, each of the n pawns can

move one square left, right up or stay put. But if a pawn stays put, an adjacent pawn may hop over it. Two pawns cannot occupy the same square. An example with n=3 is illustrated below.

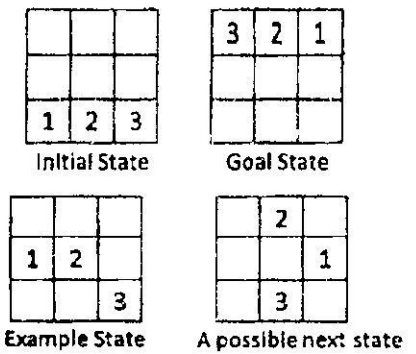

Fig. 3

(i) Suppose that pawn i is at (x_i, y_i). Write an admissible heuristic h(i) for the number of moves it will require to get to its goal location (n-i+1,n), assuming there are no other pawns on the board.

(ii) Draw the state space search graph up to level 1. 4+4=8

(d) Let $P(x)$ be the predicate "x is a car".

Let $Q(x)$ be the predicate "x is in the garage".

Let $R(x)$ be the predicate "x has a broken window".

Let $S(x,y)$ be the predicate "x and y are the same object".

Translate the following symbolic notation into English :

j) $\forall x(R(x) \Rightarrow Q(x))$

k) $\forall x(Q(x) \wedge R(x))$

l) $\exists x(P(x) \wedge Q(x))$

m) $\exists x\ P(x) \wedge \exists x\ R(x)$ 2+2+2+2=8

[Internal Assessment : 10 Marks]

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