Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

V SEMESTER B.TECH. (INFORMATION TECHNOLOGY / COMPUTER AND COMMUNICATION ENGINEERING)

END SEMESTER EXAMINATIONS, NOVEMBER 2017

SUBJECT: PROGRAM ELECTIVE-I

ARTIFICIAL INTELLIGENCE [ICT 4009]

REVISED CREDIT SYSTEM
(27/11/2017)

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data, if any, may be suitably assumed.

1A. Use the tree depicted in Fig. Q.1A to indicate the order that nodes are expanded for different types of search. Assume that A is the start node and G is the only goal node. Here path costs are shown to the right of each path, g = cost of path so far, h = estimate of remaining cost to goal, f = estimate of total path cost.

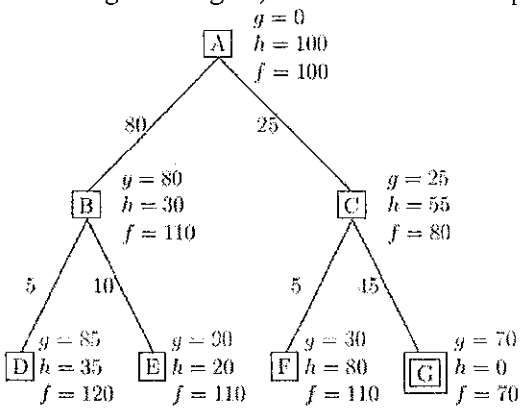

Fig. Q.1A

For each search strategy, write down the order in which nodes are expanded. Stop at G.

i) Depth first search
ii) Iterative deepening search
iii) Uniform-cost search
iv) Greedy best-first search
v) A* search

5

1B. Formulate erratic vacuum cleaner world problem by specifying state description, initial state, actions, goal state and path cost. Which type of agent the vacuum

3

cleaner world belongs to? Write an agent program (pseudo code) for a simple reflex agent in the two states vacuum environment.

1C. For each of the following assertions, say whether it is true or false and support your answer with examples or counter examples where appropriate.

i) An agent that senses only partial information about the state cannot be perfectly rational.

ii) A perfectly playing poker-playing agent never loses. 2

2A. Suppose a genetic algorithm uses chromosomes of the form x = abcdefgh with a fixed length of eight genes. Each gene can be any digit between 0 and 9. Let the fitness of individual x be calculated as: f(x) = (a + b) − (c + d) + (e + f) − (g + h) and let the initial population consist of four individuals with the following chromosomes: x1 = 6 5 4 1 3 5 3 2, x2 = 8 7 1 2 6 6 0 1, x3 = 2 3 9 2 1 2 8 5 and x4 = 4 1 8 5 2 0 9 4.

i) Evaluate the fitness of each individual, showing all your workings and arrange them in order with the fittest first and the least fit last.

ii) Perform the one–point crossover at the middle point. Take chromosomes in the order of fitness for crossover operations.

iii) Evaluate the fitness of the new population, showing all your workings. Has the overall fitness improved?

iv) By looking at the fitness function and considering that genes can only be digits between 0 and 9 find the chromosome representing the optimal solution (i.e. with the maximum fitness). Find the value of the maximum fitness. 5

2B. Apply uniform cost search for finding the shortest path in a weighted graph given in Fig. Q.2B from S to G. Clearly distinguish visited and not visited nodes using data structures.

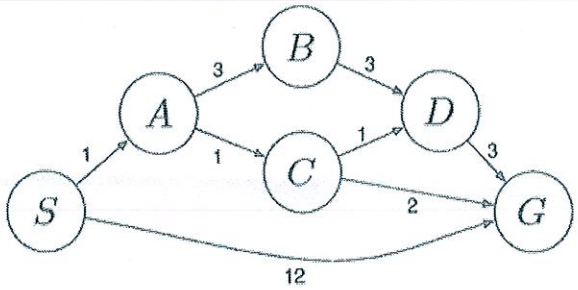

Fig. Q.2B 3

2C. Define alpha bound and beta bound for an arbitrary node J. Write the pruning criteria for alpha and beta bounds. 2

3A. Consider a full binary search tree - 4 ply deep. The evaluation/utility values for the terminal nodes (from Left to Right) are 31, 27, -7, -37, 11, -53, 60, -57, 38, 25, -89, -51, 56, 7, 54, -72. Show which are the terminal nodes pruned by Alpha – Beta pruning and what is the value returned by the algorithm. Draw the tree again and apply minimax procedure for the given problem and show the value returned by minimax algorithm. 5

3B. Give precise formulation for each of the following as constraint satisfaction problems.

i) Class Scheduling: There is a fixed number of professors, students and classrooms, a list of courses to be offered, and a list of possible timeslots for the courses. Each professor has a list of courses that he or she can teach. 3

ii) Hamiltonian Tour: Given a network of cities connected by roads, choose an order to visit all cities without repeating any.

3C. Explain why it is a good heuristic to choose the variable that is most constrained but the value that is least constrained in a CSP search. 2

4A. Consider the following sentence:
[(Food ⇒ Party) V (Drinks ⇒ Party)] ⇒ [(Food ∧ Drinks) ⇒ Party]

i) Determine, whether the sentence is valid, satisfiable (but not valid), or unsatisfiable.
ii) Convert the sentence into CNF, showing each step and explain how the results confirm your answer to (i).
iii) Prove your answer to (i) using resolution. 5

4B. Express the following statements in first-order logic.

i) Emily has a boss who is a lawyer.
ii) There exists a lawyer all of whose customers are doctors.
iii) Every surgeon has a lawyer. 3

4C. Use resolution to prove the sentence ~A ∧ ~B from the following clauses:
S1: A ⇔ (B V E)
S2: E ⇒ D
S3: C ∧ F ⇒ ~B
S4: E ⇒ B
S5: B ⇒ F
S6: B ⇒ C 2

5A. The monkey-and-bananas problem is faced by a monkey in a laboratory with some bananas hanging out of reach from the ceiling. A box is available that will enable the monkey to reach the bananas if he climbs on it. Initially, the monkey is at A, the bananas at B, and the box at C. The monkey and box have height Low, but if the monkey climbs onto the box he will have height High, the same as the bananas. The actions available to the monkey include Go from one place to another, Push an object from one place to another, ClimbUp onto or CimbDown from an object, and Grasp or Ungrasp an object. Grasping results in holding the object if the monkey and object are in the same place, at the same height. Using PDDL represent initial state, goal state and set of action schemas. 5

5B. Obtain the planning graph for the "Birthday Dinner" problem up to level S1. Also show the mutex relations at each levels.
Init: garbage ∧ clean ∧ quiet
Goal: ¬ garbage ∧ dinner ∧ present
Actions :

- Cook
  - Pre: clean
  - Effect: dinner
- Wrap
  - Pre: quiet
  - Effect: present
- Carry
  - Pre: garbage

Effect: ¬ garbage ∧ ¬ clean 3

5C. How knowledge can be represented in terms of categories and objects. Illustrate with examples. 2