Reg. No. _____

Indian Institute of Information Technology Ranchi

Department of Computer Science & Engineering

B. Tech End Semester Examination – Autumn Semester 2022-23

Semester: 6th | **Course Instructor:** Dr. Nidhi Kushwaha

Course Code: CS3002 | **Course Name:** Artificial Intelligence

QUESTION PAPER

Duration: 3 Hrs. | **Max Marks:** 100

Instructions:
(1). Number in [ ] indicates marks.
(2). Any missing data can be assumed suitably.
(3). Symbols have their usual meaning.
(4). Non-Programmable Scientific Calculator are allowed

Section A: Answer all the questions.

1 (a) What are the phases involved in designing a problem-solving agent? [5]

(b) What do you mean by PEAS? Determine the PEAS values for following AI Problems: [5]
   i. Chess Player
   ii. Autonomous Taxi

(c) List various types of Intelligent Agents in AI. Explain the concepts of Utility based agent with an example. [5]

(d) Show that $(p \rightarrow (q \rightarrow r)) \rightarrow ((p \rightarrow q) \rightarrow (p \rightarrow r))$ is a tautology [5]

2 (a) 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: [10]
$f(x) = (a + b) - (c + d) + (e + f) - (g + h)$, 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
x4 = 4 1 8 5 2 0 9 4
a) Evaluate the fitness of each individual, showing all your workings, and arrange them in order with the fittest first and the least fit last.
b) Perform the following crossover operations:
i) Cross the fittest two individuals using one–point crossover at the middle point.
ii) Cross the second and third fittest individuals using a two–point crossover (points b and f).

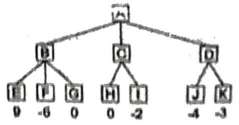
(b) Elaborate on the following search techniques- [10]
   i. Greedy best-first search
   ii. Hill-climbing

3 (a) Write the AC-3 algorithm for arc consistency. What is the complexity of AC-3 algorithm [4]

(b) What is the various way to improve the backtracking method of a CSP Problem? Discuss with example. [8]

(c) Answer whether **True or False** with one-line justification: [4]
   i. Depth-first search will always expand more nodes than breath-first search
   ii. The heuristic h(n) =C(n), where c(n) is the true cheapest cost to get from the node n to a goal state, is admissible for every problem.
   iii. The amount of memory required to run minimax with alpha-beta pruning is $O(b^d)$ for branching factor b and depth limit d.
   iv. The most-constraint variable heuristic provides a way to select the next variable to assign in a backtracking search for solving a CSP.

(d) Consider a two-player game in which the minimax search procedure id used to compute the best moves for the first player. Assume a static evaluation function that returns values ranging from -10 to 10 indicating a win for the first player and -10 a win for the second player. Assume the following game tree in which the static scores are from the first player's point of view. Suppose the first player is maximizing player and need to make the next move. What moves should be chosen at this point? Can the search be optimized? [4]



Section B: Answer any **two** questions

4 (a) What is the limitation of propositional logic to represent the knowledge base? [5]

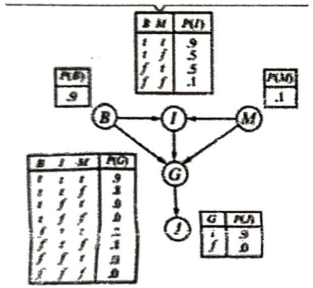
(b) Define (i) Prior Probability (ii) Conditional Probability (iii) Posterior Probability [5]

(c) NASA wants to be able to discriminate between Martians (M) and Humans (H) based on the following characteristics: Green ∈{N, Y} , Legs ∈{2,3} , Height ∈{S, T}, Smelly ∈{N, Y} Our available training data is as follows: [10]

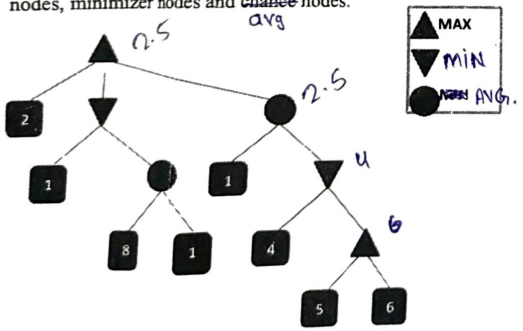
	Smoke	Green	Legs	Height	Smelly
1	M	N	3	S	Y
2	M	Y	2	T	N
3	M	Y	3	T	N
4	M	N	2	S	Y
5	M	Y	3	T	N
6	H	N	2	T	Y
7	H	N	2	S	N
8	H	N	2	T	N
9	H	Y	2	S	N
10	H	N	2	T	Y

learn a decision tree using the ID3 algorithm and draw the tree up to level 1.

5 (a) Discuss the need and structure of Bayesian Network. Calculate the value of P (B, I, ~M, ~G, J) for the Bayes net given below [10]



(b) (a) Consider the game tree below, which contains maximiser nodes, minimizer nodes and chance nodes. [10]



(i) Assume that for the chance nodes the probability of each outcome is equally likely. Is pruning possible if the nodes are evaluated in left-to-write order? If No, provide brief justification. If Yes, cross out the branches that can be pruned.

(ii) What is the propagated value at the root node under the condition as in (a)?

6 (a) Consider the following sentences: [10]

- John likes all kind of food
- Apples are food
- Chicken is food
- Anything anyone eats and is not killed by is a food
- Bill eats peanuts and still alive
- Sue eats everything bill eats

i. Translate these sentences into formulas in predicate logic.
ii. Convert the formulas into clause form

(b) Given a confusion matrix below, with respect to Class C2 calculate the accuracy, Error rate, Precision, F1-Score and the Sensitivity of the model along with the discussion about them in brief. [10]

		Predicted class			
		C1	C2	C3	Total
Correct class	C1	15	2	3	20
	C2	7	15	8	30
	C3	2	3	45	50
	Total	24	20	56	100

End