2023-24

B.TECH. (AUTUMN SEMESTER) EXAMINATION

ARTIFICIAL INTELLIGENCE

INTRODUCTION TO ARTIFICIAL INTELLIGENCE

AIC-2020

Maximum Marks: 60 **Credits: 04** **Duration: Two Hours**

Note:

(i) Attempt all questions. Assume any suitable data, if needed.

(ii) Symbols have their usual meanings.

(iii) Marks allotted to each question and course outcome (CO) covered are indicated against each question.

Q. No.	Question	CO	M.M.
1(a)	Explain the difference between a reflex agent and a goal-based agent with a suitable diagram. Provide examples of tasks for which each type of agent would be suitable.	CO1	5
1(b)	For each of the following activities, give a PEAS (Performance, Environment, Actuators, Sensors) description of the task and characterise it in terms of the environment properties. i. Medical diagnosis system ii. Refinery controller iii. Taxi driver	CO1	5
1(c)	Evaluate and prove each of the following statements. i. If one search heuristic h1(n) is admissible and another one h2(n) is inadmissible, then h3(n) = min(h1(n), h2(n)) will be admissible. ii. If h1 and h2 are both admissible heuristics, it is always better to use the heuristic h3(n) = max(h1(n), h2(n)) rather than the heuristic h4(n) = min(h1(n), h2(n)).	CO2	5
2(a)	Consider the 8-puzzle problem as shown in Fig. 1, the initial state and the goal state, apply the heuristic A* algorithm. Take the heuristic score (h-score) as a number of misplaced tiles by comparing the goal state and current state. The actual cost between the start state to next current state (g-score) is the number of state traversal from the start state to next state. Show all the intermediate steps with updated h-score and f-score (f-score = g-score + h-score) value and find the optimal traversal path to get the goal state.	CO2	8

1	2	3
	4	6
7	5	8

Initial state

1	2	3
4	5	6
7	8	

Goal state

Fig. 1

contd....2.

6533

2(b) Consider two players, MAX and MIN, are playing a game. The game tree is shown in Fig. 2. Upward-pointing triangles denote decisions by MAX; downward-pointing triangles denote decisions by MIN. Numbers on the terminal nodes show the final score: MAX seeks to maximize the final score, and MIN seeks to minimize the final score. CO2 7

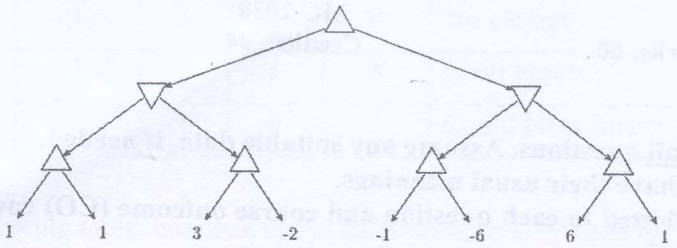


Fig. 2

Write the minimax value of each nonterminal node (each upward-pointing or downward-pointing triangle). Suppose that the minimax values of the nodes at each level are computed in order, from left to right. Put an 'X' on the game tree (Fig. 2) through any edge that would be pruned using alpha-beta pruning.

OR

2(b') How arc consistency method in the constraint satisfaction problem work? Take the following Fig. 3, and evaluate the graph-coloring problem using the arc consistency method. Consider three color domains as {R, G, B}. CO2 7

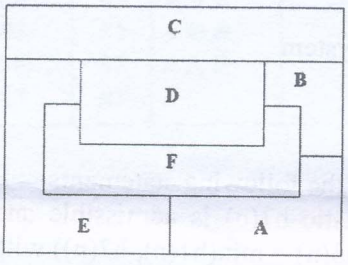


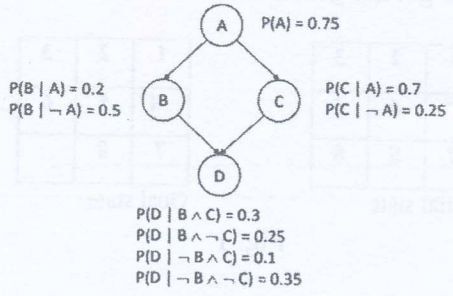
Fig. 3

3(a) What are the inference rules in Propositional logic? Use the model checking inference method, to solve the following. CO3 7

i. Suppose that the statement $p \rightarrow \neg q$ is false. Find all combinations of truth values of r and s for which $(\neg q \rightarrow r) \wedge (\neg p \vee s)$ is true.

ii. If the statement $q \wedge r$ is true, determine all combinations of truth values for p and s such that the statement $(q \rightarrow [\neg p \vee s]) \wedge [\neg s \rightarrow r]$ is true.

3(b) Consider the following Bayesian network. A, B, C, and D are Boolean random variables. CO4 8



Contd....3.

i. Write down the joint probability table of each random variable specified by the Bayesian network.
ii. If A is true, what is the probability of D being true?

OR

3'(a)	Prove the conclusion using the resolution inference method by taking the following axioms: i. Every child loves Santa. ii. Everyone who loves Santa loves any reindeer. iii. Rudolph is a reindeer, and Rudolph has a red nose. iv. Anything which has a red nose is weird or is a clown. v. No reindeer is a clown. vi. Scrooge does not love anything which is weird. vii. (Conclusion) Scrooge is not a child. Represent these axioms in predicate calculus, skolemize as necessary and convert each formula to clause form. (Note: `has a red nose' can be a single predicate. Remember to negate the conclusion.)	CO3	7
3'(b)	State utility principle and maximum expected utility principle? What are the six constraints that form the axioms of utility theory? Explain in detail.	CO4	8
4(a)	Consider a set of five training examples given as $((xi, yi), ci)$ values, where xi and yi are the two attribute values (positive integers) and ci is the binary class label: $\{((1, 1), -1), ((1, 7), +1), ((3, 3), +1), ((5, 4), -1), ((2, 5), -1)\}$. Classify a test example at coordinates (3, 6) using a *k-NN classifier* with $k = 3$ and Manhattan distance defined by $d((u, v), (p, q)) = \|u - p\| + \|v - q\|$. The answer should be either +1 or -1.	CO3	7
4(b)	What are the major applications of Artificial Intelligence (AI) in natural language processing, and computer vision? Discuss in brief.	CO4	8

OR

4(b')	State some advantages and disadvantages of AI. What are the ethical responsibilities of AI in the case of autonomous vehicle?	CO4	8

2023-24
B.TECH. (AUTUMN SEMESTER) EXAMINATION
ARTIFICIAL INTELLIGENCE
PRINCIPLES OF MACHINE LEARNING
AIC-2040

Maximum Marks: 60 **Credits: 04** **Duration: Two Hours**

Answer all the questions.
Assume suitable data if missing.
Notations used have their usual meaning.

Q.No.	Question	CO	M.M.
1(a)	Address about how AI and machine learning are related and differ from each other.	(CO1)	[03]
1(b)	How to measure the performance of a machine learning model? Write three limitations of machine learning algorithms.	(CO3)	[06]
1(c)	Briefly describe the evolution of different types of machine learning algorithms.	(CO2)	[06]
	OR		
1(c')	Write a detailed note on recent developments in the area of machine learning.	(CO2)	[06]
2(a)	Provide the benefits and drawbacks of ANN use.	(CO3)	[03]
2(b)	Construct the decision tree for the given data set. Also calculate the entropy and information gain.	(CO4)	[06]

DAY	Outlook	Temperature	Humidity	Sun light	Play cricket
D1	Rainy	Hot	High	Weak	No
D2	Rainy	Hot	High	strong	No
D3	Overcast	Hot	High	Weak	Yes
D4	Sunny	Mild	High	Weak	Yes
D5	Sunny	Cool	Normal	Weak	Yes

2(c)	What role does ensemble methods play inmachine learning? Differentiate between 'bagging' and 'boosting'.	(CO2)	[06]
	OR		
2(c')	How does Support vector machine (SVM) work? Explain with the help of a	(CO2)	[06]

contd....2.

proper diagram.

3(a)	What are the strengths and weaknesses of K-Means algorithm?	(CO1)	[03]
3(b)	Cluster the following 8-points with (x, y) representing locations into 3-clusters:A1(2, 10), A2(2, 5), A3(8, 4), A4(5, 8), A5(7, 5), A6(6, 4), A7(1, 2), A8(4, 9). Initial cluster centroids are: A1(2, 10), A4(5, 8) and A7(1, 2). The distance function between two points a = (x1, y1) and b = (x2, y2) is defined as: P(a, b) = |x2 – x1| + |y2 – y1|. Use K-Means Algorithm to find the three cluster centroids after the second iteration.	(CO3)	[06]
3(c)	Explain Factor Analysis (FA) process with the help of a suitable example.	(CO4)	[06]
	OR		
3(c')	Describe in detail the methodology and applications of Gaussian Mixture Model (GMM).	(CO4)	[06]
4(a)	How does Reinforcement Learning Work? What do you mean by policy of reinforcement learning? What are the types of reinforcement algorithms?	(CO1)	[06]
4(b)	Write short notes on **any three** of the following topics: (i) Bellman Equation (ii) Coward Policy (iii)Q Learning (iv)Deep Learning	(CO2)	[3*3]

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2023-24

B. TECH. (ODD SEMESTER) EXAMINATION
COMPUTER ENGINEERING & ARTIFICIAL INTELLIGENCE
HIGHER MATHEMATICS
AMS2610

Maximum Marks: 60 **Credits: 04** **Duration: Two Hours**

Answer all questions.
Assume suitable data if missing.
Notations and symbols used have their usual meaning.

Q.No	Question	CO	M.M.
1(a)	Show that the function $f(z) = \frac{x^3(1+i)-y^3(1-i)}{x^2+y^2}, z \neq 0$ and $f(0) = 0$ satisfies the Cauchy-Riemann equations at $z = 0$ but $f'(0)$ does not exist.	(CO1)	[05]
	OR		
1(a')	If ϕ and ψ are functions of x and y satisfying Laplace's equation, show that $s + it$ is analytic, where $s = \frac{\partial \phi}{\partial y} - \frac{\partial \psi}{\partial x}$ and $t = \frac{\partial \phi}{\partial x} + \frac{\partial \psi}{\partial y}$		
1(b)	Evaluate the integral $I = \oint_C \frac{e^z}{z^2(z+1)^3} dz$, where C is the circle $\|z\| = 2$.	(CO1)	[05]
1(c)	If $f(z) = u + iv$ is an analytic function of z and $u - v = \frac{\cos x + \sin x - e^{-y}}{2\cos x - 2\cosh y}$, prove that $f(z) = \frac{1}{2}\left[1 - \cot\frac{z}{2}\right]$, when $f\left(\frac{\pi}{2}\right) = 0$.	(CO1)	[05]
2(a)	If C is a closed contour around origin, prove that $\left(\frac{a^n}{n!}\right)^2 = \frac{1}{2\pi i}\int_C \frac{a^n e^{az}}{n!\, z^{n+1}} dz$. Hence evaluate $\sum_{n=0}^{\infty}\left(\frac{a^n}{n!}\right)^2 = \frac{1}{2\pi}\int_0^{2\pi} e^{2a\cos\theta}\, d\theta$.	(CO2)	[05]
2(b)	Using Residue theorem, evaluate $I = \oint_C \frac{e^z - 1}{z(z-1)(z-i)^2} dz$, where C is the circle $\|z\|=2$.	(CO2)	[05]
2(c)	Using contour integration, evaluate $\int_0^{\pi} \frac{\cos 2\theta}{1 - 2a\cos\theta + a^2} d\theta$, $\|a\| < 1$.	(CO2)	[05]

contd...2.

OR

2(c') Using contour integration, evaluate $\int_0^\infty \frac{cos3x}{(x^2+1)(x^2+4)}dx$ (CO2) [05]

3(a)

(i) Prove that $div(gradr^n) = \nabla^2(r^n)=n(n+1)r^{n-2}$, where $\vec{r}=x\hat{\imath}+y\hat{\jmath}+z\hat{k}$. Hence show that $\nabla^2(\frac{1}{r})=0$. (CO3) [07]

(ii) Find the value of n for which the vector $r^n\vec{r}$ is solenoidal, where $\vec{r}=x\hat{\imath}+y\hat{\jmath}+z\hat{k}$

OR

3(a')

(i) If r is the distance of a point from the origin, prove that

$$curl\left(\hat{k}\times grad\,\frac{1}{r}\right)+grad\left(\hat{k}\cdot grad\,\frac{1}{r}\right)=\vec{0}$$

where $\hat{k}$ is the unit vector in the direction of OZ.

(ii) If f and g are two scalar point functions prove that

$$div(f\nabla g) = f\nabla^2 g + \nabla f.\nabla g$$

3(b) Prove that $\vec{F}=(y^2\cos x+z^3)\hat{\imath}+(2ysinx-4)\hat{\jmath}+(3xz^2+2)\hat{k}$ is a conservative field. Find (i) scalar potential for $\vec{F}$ (ii) work done in moving an object in this field from $(0,1,-1)$ to $(\frac{\pi}{2},-1,2)$. (CO3) [08]

4(a) Using Gauss Divergence theorem to evaluate $\iint_S (\vec{V}.\hat{n})dS$, where $\vec{V}=x^2z\hat{\imath}\,y\hat{\jmath}-xz^2\hat{k}$ and S is the boundary of the region bounded by the paraboloid $z=x^2+y^2$ and the plane $z=4y$. (CO4) [07]

4(b) Apply Stoke's theorem to evaluate $\int_C[(x+2y)dx+(x-z)dy+(y-z)dz]$, where C is the boundary of the triangle with vertices (2,0,0), (0,3,0) and (0,0,6) oriented in the anti-clockwise direction. (CO4) [08]

2023-24

B.TECH. (AUTUMN SEMESTER) EXAMINATION

COMPUTER ENGINEERING/ARTIFICIAL INTELLIGENCE

DATA STRUCTURE AND ALGORITHM

COC2060/AIC2060

Maximum Marks: 60 **Duration: Two Hours**

Answer all the questions.
Make suitable assumptions wherever required. Assume suitable data if missing.
Notations used have their usual meaning.

Q.No.	Question	CO	M.M.
1(a)	Differentiate between 'little' and 'Big' notations used for asymptotic complexity with a suitable example. Explain why the following is true or false? (i) $n\log n = o(n\log n + n^2)$ (ii) $\log n = \Omega(\log\log n)$ (iii) $n^2 = O(n^2 + n^2\log n)$	CO5	[7]
1(b)	What are the advantages and disadvantages of Doubly Linked List? Write algorithms for insertion and deletion operations in doubly linked list.	CO1	[8]
	OR		
1(b')	What are the advantages of Linked list over the arrays? Write an algorithm to multiply two integers, which are stored in linked lists. Each digit of integer is stored in a separate linked list node from right to left.	CO1	[8]
2(a)	Differentiate between primary and secondary clustering in Hashing. What are the solutions to these clustering problems? What is the expected number of probes required for successful and unsuccessful search in Chaining and Linear Probing.	CO3	[7]
2(b)	Sort the following list using Merge sort algorithm: 12,11,10,15,20,30,25,27,35,9,34,17 Show all the intermediate steps. Design an algorithm that finds the surpasser count for each element of an array in O(nlogn) complexity. Surpasser count of an element is the total number of elements to its right, which are greater than it.	CO4	[8]
	OR		
2(b')	Sort the following list using Quick sort and Radix sort. 245, 163, 207, 309, 243, 341, 273 Show all the intermediate steps in both algorithms. Also compare both algorithms with respect to number of comparisons and interchange operations.	CO4	[8]
3(a)	What is a double ended queue? Write the algorithms for the insertion and deletion operations for double ended queue.	CO2	[7]
3(b)	Explain how a heap is used for the implementation for the Queue. Build a maxheap for the following numbers:	CO3	[8]

Contd.....2.

23, 47, 21, 12, 89, 56, 33, 67, 43, 88, 65, 27, 55

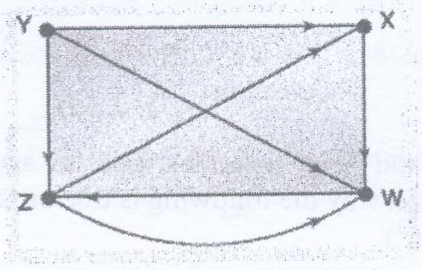
OR

3(b') Consider the following algebraic expression in prefix notations: CO3 [8]

* + a – b c / - d e + f – g h

Convert the above expression into equivalent postfix expression. Show the content of stack used for this conversion.

4(a) Find the number of paths of length 3 from node y to node w using Warshall's algorithm in the following graph. Also traverse the following graph using DFS and BFS starting with node z. CO5 [7]



4(b) Insert the following numbers in an empty balanced binary search tree. CO4 [8]

20, 25, 33, 15, 10, 7, 3

Show the tree after each insertion. Identify the type of rotations at each step if required.

OR

4(b') Consider the following list of 07 numbers: CO4 [8]

15, 10, 13, 19, 17, 23, 20

i. Build an in-threaded binary search tree T using the above numbers. Show the tree after every insertion.

ii. What will be the modified tree after 17 is deleted from the tree.

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2023-24

B.TECH. (AUTUMN SEMESTER) EXAMINATION

COMPUTER ENGINEERING/ARTIFICAL INTELLIGENCE

DIGITAL LOGIC AND SYSTEM DESIGN

COC2070/AIC2070

Maximum Marks: 60 **Credits: 04** **Duration: Two Hours**

Answer all the questions.
Assume suitable data if missing.
Notations used have their usual meaning.

Q.No.	Question	CO	M.M.
1(a)	State and Explain with the help of suitable examples the Duality Principle.	CO1	[5]
1(b)	Realize in NAND-AND form the function $F(w,x,y,z) = \Sigma(1,2,4,7,8,9,11,14)$	CO1	[10]
	OR		
1'(a)	Discuss the differences between the Boolean Algebra and the Ordinary Algebra.	CO1	[5]
1'(b)	Subtract $(63405.502)_7$ from $(9207.43)_A$ using r's complement method, where $r = 9$.	CO1	[10]
2(a)	Explain how a decoder may be converted to a demultiplexer.	CO2	[5]
2(b)	Realize the function $F(w,x,y,z) = \pi(0,3,5,6,9,10,12,14,15)$ using a Multiplexer.	CO2	[10]
	OR		
2'(a)	Design a 4 × 16 decoder using 3 × 8 decoders.	CO2	[5]
2'(b)	Design a BCD to Excess-3 Code Converter using PLA.	CO2	[10]
3(a)	Design and explain the Clocked Master-Slave J-K Flip Flop using NAND gates.	CO3	[5]
3(b)	Design and explain the sequential circuit with the following functionality:	CO3	[10]

contd ....2.

Clear	CP	Load	Count	Function
0	X	X	X	Clear to Zero
1	X	0	0	No change
1	↑	1	X	Load inputs
1	↑	0	1	Count Next Binary State

4(a) In the following table, how one of the transfers does C←0 and the other one does C←1: CO4 [7]

Binary code	Function of selection variables					
	A	B	D	F with $C_{in} = 0$	F with $C_{in} = 1$	H
0 0 0	Input data	Input data	None	$A, C \leftarrow 0$	$A + 1$	No shift
0 0 1	$R1$	$R1$	$R1$	$A + B$	$A + B + 1$	Shift-right, $I_R = 0$
0 1 0	$R2$	$R2$	$R2$	$A - B - 1$	$A - B$	Shift-left, $I_L = 0$
0 1 1	$R3$	$R3$	$R3$	$A - 1$	$A, C \leftarrow 1$	0's to output bus
1 0 0	$R4$	$R4$	$R4$	$A \vee B$	—	—
1 0 1	$R5$	$R5$	$R5$	$A \oplus B$	—	Circulate-right with C
1 1 0	$R6$	$R6$	$R6$	$A \wedge B$	—	Circulate-left with C
1 1 1	$R7$	$R7$	$R7$	$\overline{A}$	—	—

4(b) For the table given in Question 4(a) above, find out the control words for the following Operations. Also, specify the functions being carried out by each of these Operations. CO4 [8]

(i) R4←clc(R5+R4+1)

(ii) R2-Input

(iii) Output← shr(R1-(R5+1))

(iv) R3←Input

(v) R6← $\overline{R4}+1$

(vi) R3←R3+ $\overline{R4}+1$

(vii) R7←0

(viii) R5←R5, C←0
