School of Computer Science and Engineering

Winter Semester 2023-24

Continuous Assessment Test – 2- ANSWER KEY

SLOT: B1+TB1

Programme Name &Branch : B.Tech Computer Science and Engineering

Course Name & code: ARTIFICIAL INTELLIGENCE - BCSE306L

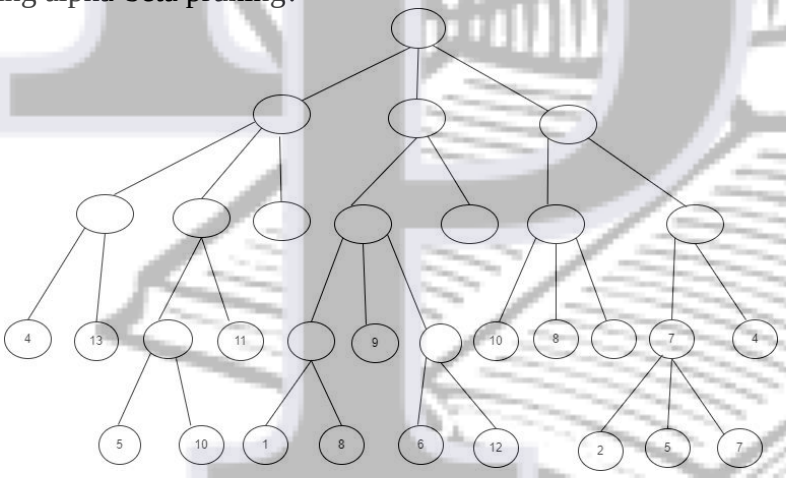
Class Number (s): Common to all batches

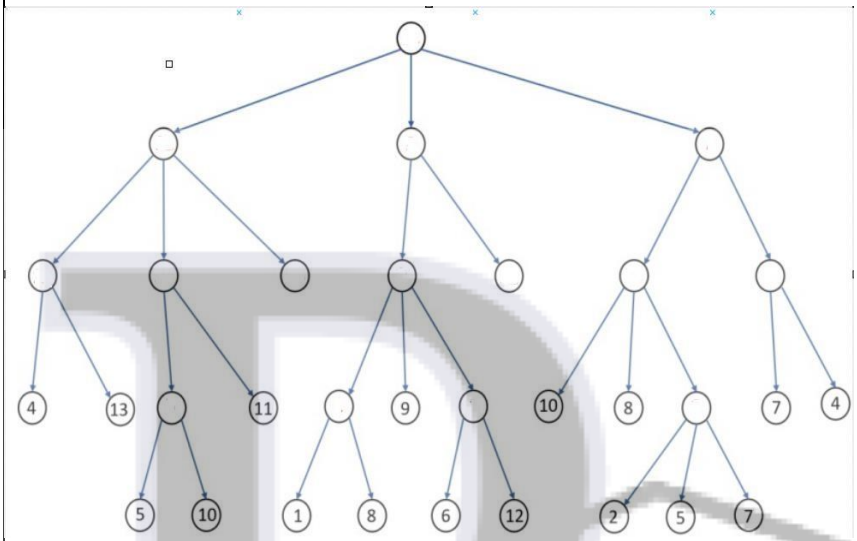
Exam Duration: 90 Min. **Maximum Marks: 50**

General instruction(s):

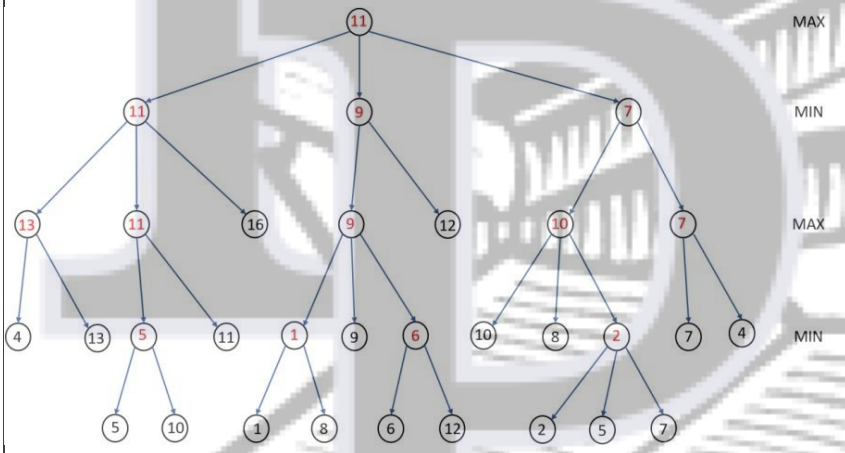
Open Text Book/Note Book Examination

Answer All Questions

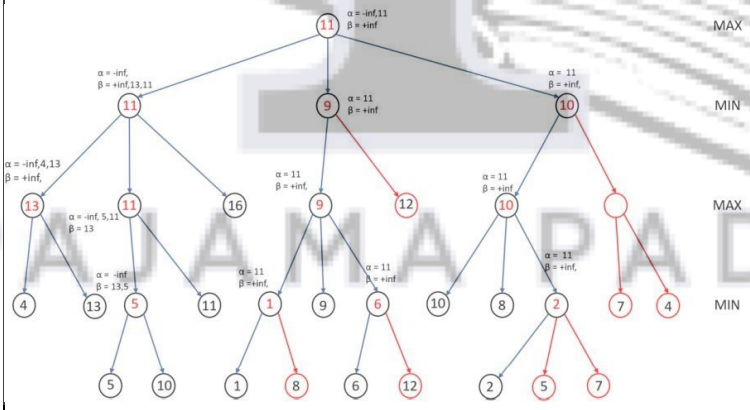
Q.No.	Questions	Max Marks	CO	BL
1.	Consider the game tree given below. By Applying mini-max search, show the backed-up values in the tree. If the nodes are expanded from left to right, what nodes would not be visited using alpha-beta pruning?  **ANSWER :** This question we have **two solutions .** First with the below corrected tree – correct solution	10	CO 4	BL 3



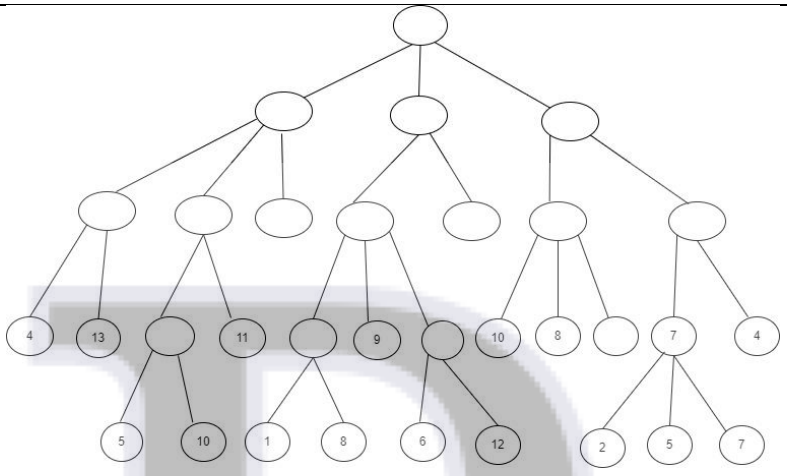
Applying Min-Max



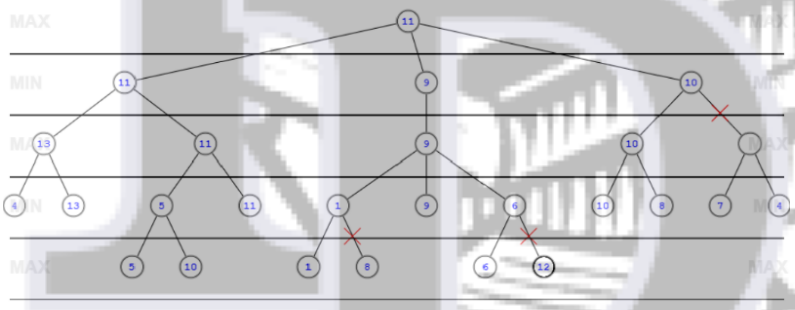
Applying Alpha-beta pruning



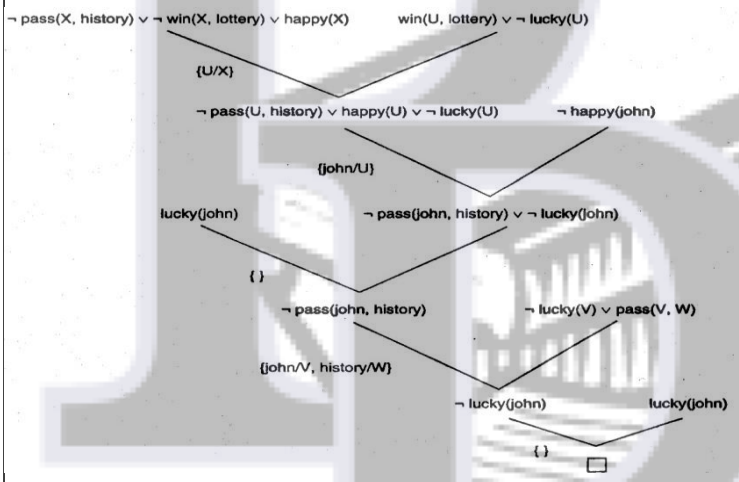
Second Solution is with the below diagram given in the question paper



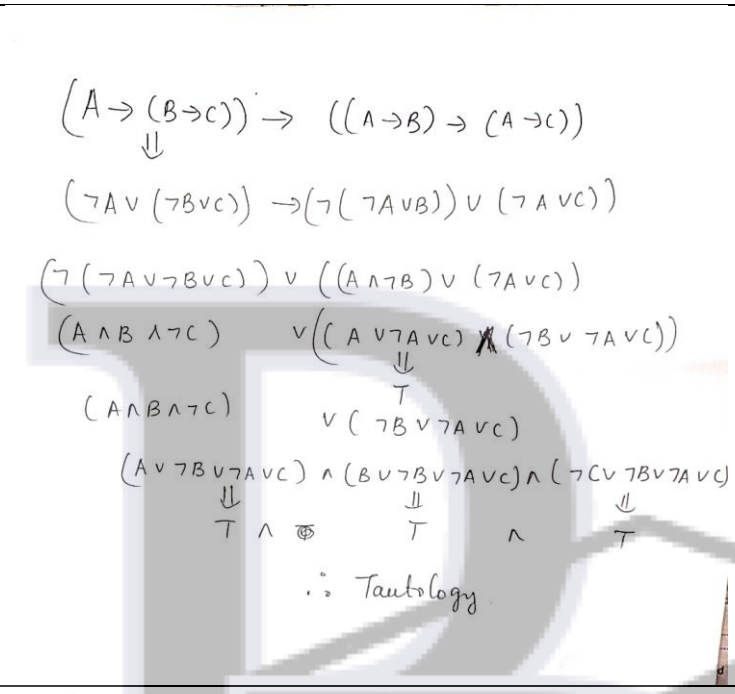
For the above tree the student can apply mini-max and alpha-beta pruning as per their understandingand can generate a solution for both Mini-Max and Alpha-Beta Pruning

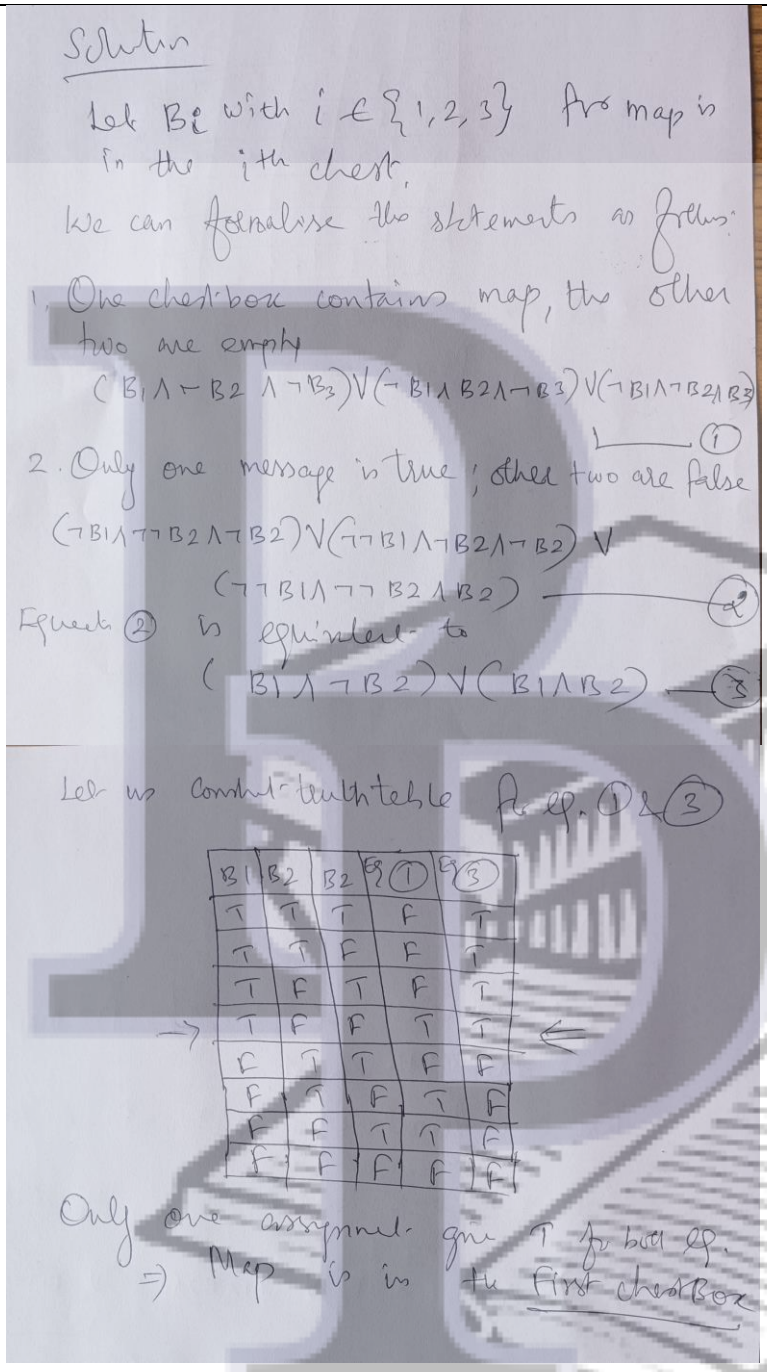


2.	Consider the following story of the "lucky student": "Anyone passing his history exams and winning the lottery is happy. But anyone who studies or is lucky can pass all his exams. John did not study but he is lucky. Anyone who is lucky wins the lottery. Prove using resolution that"John Is happy" **ANSWER:** First change the sentences to predicate form: 1- Anyone passing his history exams and winning the lottery is happy. $\forall X$ (pass(X, history) Λ win(X, lottery) $\Rightarrow$ happy(X)) 2- Anyone who studies or is lucky can pass all his exams. $\forall X \forall Y$ (study(X) v lucky(X) $\Rightarrow$ pass(X,Y)) 3- John did not study but he is lucky. $\neg$ study(john) Λ lucky(john) 4- Anyone who is lucky wins the lottery. $\forall X$ (lucky(X) $\Rightarrow$ win(X, lottery))	10	CO 2	BL 3

	Next, These four predicate statements are now changed to clause form: 1- ¬ pass(X, history) ν ¬ win(X, lottery) ν happy(X) 2- ¬ study(Y) ν pass(Y,Z) 3- ¬ lucky(W) ν pass(W,V) 4- ¬ study(john) 5- lucky(john) 6- ¬ lucky(U) ν win(U, lottery) Into these clauses is entered, in clause form, the negation of the conclusion: 7- ¬ happy(john) The resolution refutation graph of Figure shows a derivation of the contradiction and, consequently, proves that John is happy. 			
3.	a) Convert the following English Statements into FOL i) Any house in Parson costs less than any apartment in Chennai. ii) Any small apartment costs less than any big house. iii) There is exactly one house in Parson whose cost is Rs 20,00,000. iv) There is a house in Parson which costs more than any other house. **Solution:** i) Any house in Parson costs less than any apartment in Chennai. ∀x,y house(x) A in(x, Parson) A apartment(y) A in(y, Chennai) ⇒ cost(x) ii) Any small apartment costs less than any big house. ∀x, y[Apartment(x) A House(y) A Small(x) A Big(y)] ⇒ Cost(x) < Cost(y) iii) There is exactly one house in Parson whose cost is Rs 20,00,000.	4	CO 2	BL 4

	∃x house(x) A in(x, Parson) A cost(x)=20,00,000. A ∀y [house(y) A in(y, Parson) A cost(y)=20,00,000.) ⇒ x=y] iv) There is a house in Parson which costs more than any other house. ∃y house(y) A in(y, Parson) A [∀x house(x) A in(x, Parson) x≠y ⇒ cost(y)>cost(x)] b) Which of the following are entailed by the given sentence *(A ∨B) ∧ (¬C ∨¬D ∨E)*? Justify with suitable rules/laws *i.) (A ∨B ∨C) ∧ (B ∧ C ∧ D ⇒ E)* *ii.) (A ∨B) ∧ (¬D ∨E)* **Solution :** *i.) (A ∨ B ∨ C)* A *(B* A *C* A *D ⇒ E)* ENTAILED: (B A C A D ⇒ E) is equivalent to (¬B ∨ ¬C ∨ ¬D ∨ E), so this simply weakens the clauseby introducing another disjunct. *ii.) (A ∨ B)* A *(¬D ∨ E)* NOT ENTAILED: this removes the ¬C literal, which strengthens the clause. (c) Prove that the following statement is valid using laws of inference (A → (B → C)) → ((A →B) → (A →C)) **Solution :** Students can apply any set of laws and prove this implication (tautology). One such proof is given below	2 4		

				
4.	**(a)** Three chests are presented to you. One contains treasure map, the other two are empty. Each box has imprinted on it a clue as to its contents; the clues are: Chest 1 "The treasure map is not here" Chest 2 "The treasure map is not here" Chest 3 "The treasure map is in Chest 2" Only one message is true; the other two are false. Which box has the treasure map? Formalize the puzzle in Propositional Logic and find the solution using a truth table**. (5 marks)** **SOLUTION:**	10	CO 3	BL 4



Solution

Let B_i with $i \in \{1,2,3\}$ be map is in the i^{th} check.

We can formalise the statements as follows:

1. One checkbox contains map, the other two are empty

$$(B_1 \wedge \neg B_2 \wedge \neg B_3) \vee (\neg B_1 \wedge B_2 \wedge \neg B_3) \vee (\neg B_1 \wedge \neg B_2 \wedge B_3) \quad \text{---- (1)}$$

2. Only one message is true; other two are false

$$(\neg B_1 \wedge \neg B_2 \wedge \neg B_3) \vee (\neg \neg B_1 \wedge \neg B_2 \wedge \neg B_3) \vee (\neg \neg B_1 \wedge \neg \neg B_2 \wedge B_3) \quad \text{---- (2)}$$

Equation (2) is equivalent to

$$(B_1 \wedge \neg B_2) \vee (B_1 \wedge B_2) \quad \text{---- (3)}$$

Let us construct truth table for eq. (1) & (3)

B_1	B_2	B_3	eq (1)	eq (3)
T	T	T	F	T
T	T	F	F	T
T	F	T	F	T
T	F	F	T	T
F	T	T	F	F
F	T	F	T	F
F	F	T	T	F
F	F	F	F	F

Only one assignment gives T for both eq.

⇒ Map is in the first checkBox

(b) Using the probability values given in the table answer the following statements with proper justifications **(5 Marks)**

1. Does the probability of wind increase given the probability of rain?
2. What is the dependency between wind and Headache? Does the probability of wind remain unchanged given headache?
3. Is rain conditionally independent of Headache, given

wind?

P(rain∧wind∧Headache)	rain		¬rain	
	wind	¬wind	wind	¬wind
Headache	0.432	0.16	0.084	0.008
¬Headache	0.048	0.16	0.036	0.072

ANS: (Solve by applying Conditional Probability)

1. The dependence between *wind* and *rain :*
   The probability is 0.6 for both so both are Independent
2. The dependence between *wind* and *Headache:*
   The probability is **0.754 & 0.6 so they are Dependent**
3. Is *rain* conditionally independent of *Headache*, given *wind*? - **NOT**

5. Apply Naïve Bayes Classification for the given dataset of animals along with their attributes. — 10 — CO 3 — BL 3

Give Birth	Can Fly	Live in Water	Have Legs	Class
yes	no	no	yes	mammals
no	no	no	no	non-mammals
no	no	yes	no	non-mammals
yes	no	yes	no	mammals
no	no	sometimes	yes	non-mammals
no	no	no	yes	non-mammals
yes	yes	no	yes	mammals
no	yes	no	yes	non-mammals
yes	no	no	yes	mammals
yes	no	yes	no	non-mammals
no	no	sometimes	yes	non-mammals
no	no	sometimes	yes	non-mammals
yes	no	no	yes	mammals
no	no	yes	no	non-mammals
no	no	sometimes	yes	non-mammals
no	no	no	yes	non-mammals
no	no	no	yes	mammals
no	yes	no	yes	non-mammals
yes	no	yes	no	mammals
no	yes	no	yes	non-mammals

Execute the following query to predict the class

Give Birth	Can Fly	Live in Water	Have Legs	Class
yes	no	yes	no	?

SOLUTION :

A: attributes

M: mammals

N: non-mammals

$$P(A|M) = \frac{6}{7} \times \frac{6}{7} \times \frac{2}{7} \times \frac{2}{7} = 0.06$$

$$P(A|N) = \frac{1}{13} \times \frac{10}{13} \times \frac{3}{13} \times \frac{4}{13} = 0.0042$$

$$P(A|M)P(M) = 0.06 \times \frac{7}{20} = 0.021$$

$$P(A|N)P(N) = 0.004 \times \frac{13}{20} = 0.0027$$

P(A|M)P(M) > P(A|N)P(N)

=> Mammals