REG.NO.:

SLOT:D1+TD1

Vellore Institute of Technology

(Deemed to be University under section 3 of UGC Act, 1956)

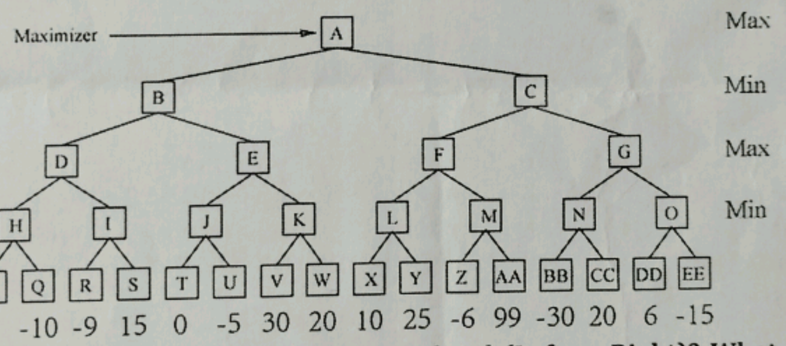
SCHOOL OF COMPUTER SCIENCE AND ENGINEERING
CONTINUOUS ASSESSMENT TEST - II
FALL SEMESTER 2025-2026

Programme Name & Branch	: B.Tech. & Computer Science & Engineering / SCOPE
Course Code and Course Name	: BCSE306L & Artificial Intelligence
Faculty Name(s)	: ALL
Class Number(s)	: ALL
Date of Examination	: 08-10-2025 (AN)
Exam Duration	: 90 minutes

Maximum Marks: 50

General instruction(s):

- Answer All Questions
- M - Max mark; CO – Course Outcome; BL – Blooms Taxonomy Level (1 – Remember, 2 – Understand, 3 – Apply, 4 – Analyse, 5 – Evaluate, 6 – Create)
- Course Outcomes:
  CO4 - Apply basic principles of AI in solutions that require problem-solving, inference, perception, knowledge representation and learning.

Q. No	Question	M	CO	BL
1.	**Consider the min-max tree below, A to EE are numbers on the leaf, and the numbers for leaf are shown in the last row.**  **i) Which move should be made at the top level (Left or Right)? What is its value? Show the steps of applying the Minimax algorithm by giving the specific value for each node.(4).** **ii) Which nodes get pruned if you use alpha-beta pruning when you explore successors of states going left-to-right? (3).** **iii) Which nodes get pruned if you use alpha-beta pruning when you explore successors of states going right-to-left? (3).**	10	4	3
2.	**a) For the following sentences write the predicate and convert the sentence to first order logic** **i) "You can fool some of the people all of the time and all of the people some of the time, but not all of the people all of the time." (2)** **ii)"There's a lady who's sure all that glitters is gold, and she's buying a Stairway to Heaven. (2)** **b) Classify the following formulas as valid, satisfiable, or not satisfiable, and prove using the semantic method (truth tables, ¬ Negation). (6)** i) $(p \land q) \rightarrow (p \lor q)$, ii) $(p \land \neg q) \lor q$, iii) $(\neg q \rightarrow \neg p) \rightarrow (p \rightarrow q)$, iv) $\neg q \rightarrow q$ v) $(\neg q \rightarrow q) \land (q \rightarrow \neg q)$	10	4	3

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3. Suppose you are given the following axioms:

1. $0 \le 3$.
2. $7 \le 9$.
3. $\forall x \quad x \le x$.
4. $\forall x \quad x \le x + 0$.
5. $\forall x \quad x + 0 \le x$.
6. $\forall x, y \quad x + y \le y + x$.
7. $\forall w, x, y, z \quad w \le y \land x \le z \Rightarrow w + x \le y + z$.
8. $\forall x, y, z \quad x \le y \land y \le z \Rightarrow x \le z$

i) Give a backward-chaining and forward chaining proof of the sentence $7 \le 3+9$. (Use only the axioms given here, not anything else) Show only the steps that leads to success, not the irrelevant steps.

10 | 4 | 3

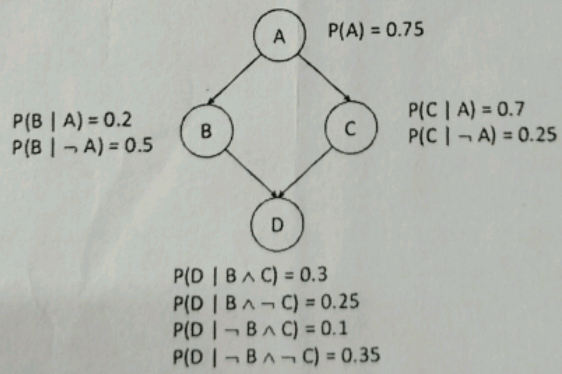
4. Consider the following hypothetical data concerning student characteristics and whether or not each student should be hired.

Name	GPA	Effort	Hirable
Sarah	poor	lots	No
Dana	average	some	No
Alex	average	some	No
Annie	average	lots	Yes
Emily	excellent	lots	Yes
Pete	excellent	some	Yes
John	excellent	lots	No
Kathy	poor	some	No

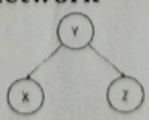
Use a Naive Bayes classifier to determine whether or not someone with excellent attendance, poor GPA, and lots of effort should be hired.

10 | 3 | 3

5. a) Consider the following Bayesian network. A, B, C, and D are Boolean random variables. If we know that A is true, what is the probability of D being true?



b) For the following Bayesian network



we know that X and Z are not guaranteed to be independent if the value of Y is unknown. This means that, depending on the probabilities, X and Z can be independent or dependent if the value of Y is unknown. Construct probabilities where X and Z are independent if the value of Y is unknown, and show that they are indeed independent.

10 | 3 | 3

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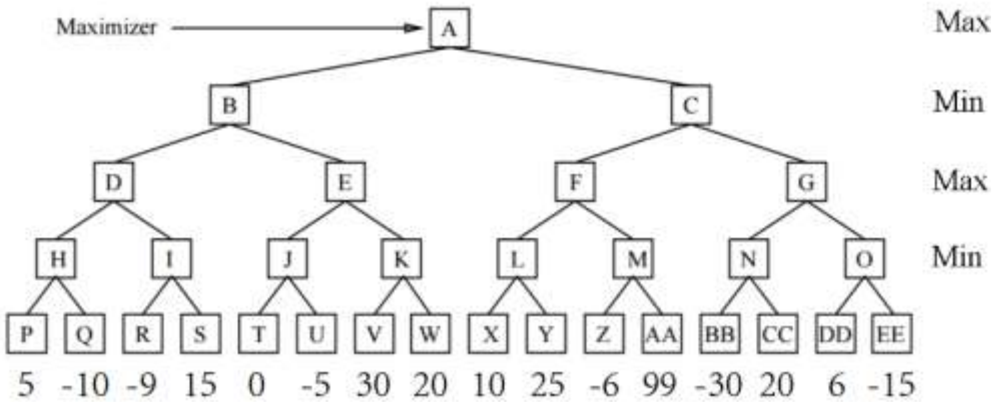
FALL SEMESTER 2025-2026

Programme Name & Branch	**: B.Tech. & Computer Science & Engineering / SCOPE**
Course Code and Course Name	**: BCSE306L & Artificial Intelligence**
Faculty Name(s)	**: ALL**
Class Number(s)	**: ALL**
Date of Examination	**: 08-10-2025 (AN)**
Exam Duration	**: 90 minutes** **Maximum Marks: 50**

<u>General instruction(s):</u>

- Answer All Questions
- M - Max mark; CO – Course Outcome; BL – Blooms Taxonomy Level (1 – Remember, 2 – Understand, 3 – Apply, 4 – Analyse, 5 – Evaluate, 6 – Create)
- Course Outcomes: (2 and 3)

Q. No	**Question**	M	CO	BL
1.	Consider the min-max tree in Figure 1, A to EE are numbers on the leaf, and the numbers for leaf are shown in the last row.  Figure1: Min-Max Tree i) Which move should be made at the top level (Left or Right)? What is its value? Show the steps of applying the Minimax algorithm below by giving the specific value for each node. (6) Left, and the value is -9.	10	2	3

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	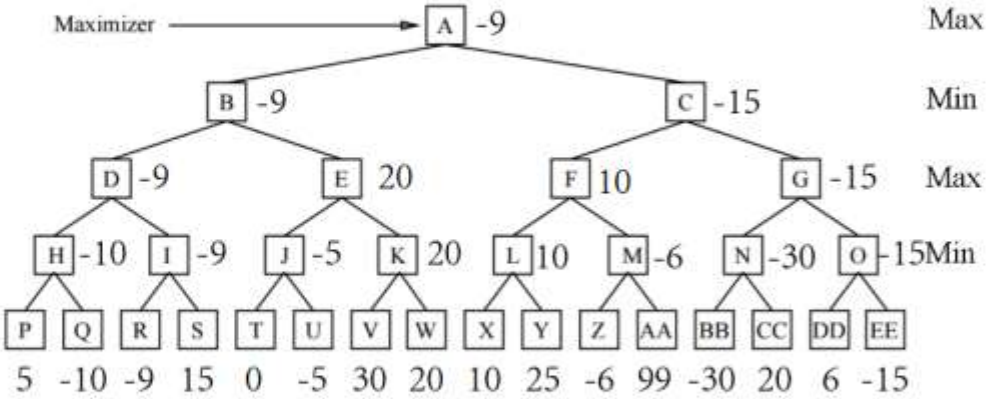 ii) Which nodes get pruned if you use alpha-beta pruning when you explore successors of states going left-to-right? (2) Solution: **Node:** K, V, W, AA, CC • The value of α and β are −∞ and −9 for the pruning of E–K. • The value of α and β are 10 and +∞ for the pruning of M–AA. • The value of α and β are −9 and 10 for the pruning of N–CC. iii) Which nodes get pruned if you use alpha-beta pruning when you explore successors of states going right-to-left? (2) Solution: Node: L, P, T, X, Y The value of α and β are -9 and 20 for the pruning of H-P. The value of α and β are 20 and +∞ for the pruning of J-T. The value of α and β are −∞ and -15 for the pruning of F-L.			
2.	a) predicate *Fools(x, y, t)*, which states that *x* fools *y* at time *t*, *Person(x)*, which states that *x* is a person, and *Time(t)*, which states that *t* is a time, Solution: ∃person_i ∀person_j ∃time_k (Fools(you, person_i, time_k)) ∧ ∃time_m ∀person_n (Fools(you, person_n, time_m)) ∧ ¬∀person_p ∃time_q (Fools(you, person_p, time_q)) 1. **"you can fool some of the people all of the time"** ○ ∃person_i ∀person_j ∃time_k (Fools(you, person_i, time_k)) 2. **"and all of the people some of the time"**	10	2	3

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	○ ∃time_m ∀person_n (Fools(you, person_n, time_m)) 3. **"but not all of the people all of the time."** ○ ¬∀person_p ∃time_q (Fools(you, person_p, time_q)) b) Given the predicates *Lady(x)*, which states that *x* is a lady, *Glitters(x)*, which states that *x* glitters, *IsSureIsGold(x, y)*, which states that *x* is sure that *y* is gold, *Buying(x, y)*, which states that *x* buys *y*, *StairwayToHeaven(x)*, which states that *x* is a Stairway to Heaven, "There's a lady who's sure all that glitters is gold, and she's buying a Stairway to Heaven. `∃x (Lady(x) ∧ IsSureIsGold(x, ∀y (Glitters(y) → IsGold(y))) ∧ ∃z (Buying(x, z) ∧ StairwayToHeaven(z)))` b) Classify the following formulas as valid, satisfiable, or not satisfiable, and prove using the semantic method (truth tables, ¬ Negation). (p ∧ q) → (p ∨ q) Ans: satisfiable, valid (p ∧ ¬q) ∨ q Satisfiable, not valid (¬q → ¬p) → (p → q) Satisfiable valid logical equivalence ¬q → q Satisfiable, not valid (¬q → q) ∧ (q → ¬q) not satisfiable, not valid			
3.	**a**. (Note: At each resolution, we rename the variables in the rule). Goal G0: $7 \leq 3+9$ — Resolve with (8) $\{x1/7, z1/3+9\}$. Goal G1: $7 \leq y1$ — Resolve with (4) $\{x2/7, y1/7+0\}$. Succeeds. Goal G2: $7+0 \leq 3+9$. — Resolve with (8) $\{x3/7+0, z3/3+9\}$ Goal G3: $7+0 \leq y3$ — Resolve with (6) $\{x4/7, y4/0, y3/0+7\}$ Succeeds. Goal G4: $0+7 \leq 3+9$ — Resolve with (7) $\{w5/0, x5/7, y5/3, z5/9\}$. Goal G5: $0 \leq 3$. — Resolve with (1). Succeeds. Goal G6: $7 \leq 9$. — Resolve with (2). Succeeds.	5	2	3

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b. From (1),(2), (7) $\{w/0, x/7, y/3, z/9\}$ infer
(9) $0 + 7 \leq 3 + 9$.
From (9), (6), (8) $\{x1/0, y1/7, x2/0 + 7, y2/7 + 0, z2/3 + 9\}$ infer
(10) $7 + 0 \leq 3 + 9$.
($x1, y1$ are renamed variables in (6). $x2, y2, z2$ are renamed variables in (8).)
From (4), (10), (8) $\{x3/7, x4/7, y4/7 + 0, z4/3 + 9\}$ infer
(11) $7 \leq 3 + 9$.
($x3$ is a renamed variable in (4). $x4, y4, z4$ are renamed variables in (8).)

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4. Consider the following hypothetical data concerning student characteristics and whether or not each student should be hired. (Marks: 5) 3 3

Name	GPA	Effort	Hirable
Sarah	poor	lots	No
Dana	average	some	No
Alex	average	some	No
Annie	average	lots	Yes
Emily	excellent	lots	Yes
Pete	excellent	some	Yes
John	excellent	lots	No
Kathy	poor	some	No

Task:
Use a Naive Bayes classifier to determine whether or not someone with **excellent attendance**, **poor GPA**, and **lots of effort** should be hired.

Solutions:

Hirable Yes - 0.0833, No - 0.05, **0.0833** > **0.05**, the classifier predicts:

Hirable = Yes

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5. a) Consider the following Bayesian network. A, B, C, and D are Boolean random
variables. If we know that A is true, what is the probability of D being true? (Marks: 10) 3 3

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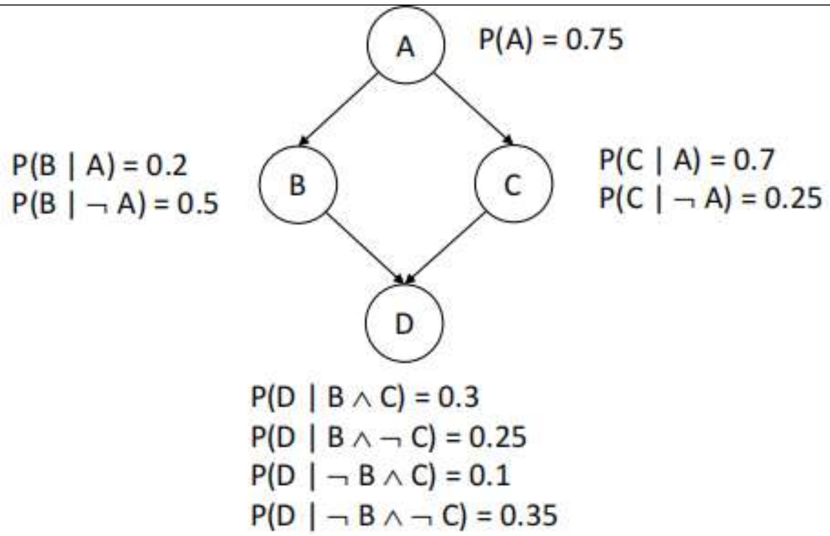


Answer

$P(D|A) = P(A, D) / P(A)$

$= (P(A, B, C, D) + P(A, B, \neg C, D) + P(A, \neg B, C, D) + P(A, \neg B, \neg C, D)) / P(A)$

$= P(B \mid A)\, P(C \mid A)\, P(D \mid B, C) + P(B \mid A)\, P(\neg C \mid A)\, P(D \mid B, \neg C) +$

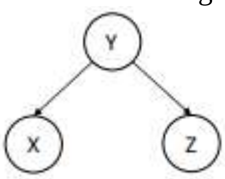
$P(\neg B \mid A)\, P(C \mid A)\, P(D \mid \neg B, C) + P(\neg B \mid A)\, P(\neg C \mid A)\, P(D \mid \neg B, \neg C)$

$= (0.2 \times 0.7 \times 0.3) + (0.2 \times 0.3 \times 0.25) + (0.8 \times 0.7 \times 0.1) + (0.8 \times 0.3 \times 0.35)$

$= 0.042 + 0.015 + 0.056 + 0.084$

$= 0.197$

b) For the following Bayesian network



we know that X and Z are not guaranteed to be independent if the value of Y is unknown. This means that, depending on the probabilities, X and Z can be independent or dependent if the value of Y is unknown. Construct probabilities
where X and Z are independent if the value of Y is unknown, and show that they are indeed independent.

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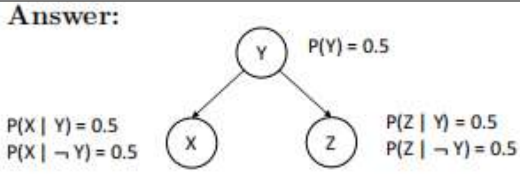
Answer:



$P(X) = P(Y)\ P(X \mid Y) + P(\neg\ Y)\ P(X \mid \neg\ Y) = 0.5 \times 0.5 + 0.5 \times 0.5 = 0.5$

$P(Z) = P(Y)\ P(Z \mid Y) + P(\neg\ Y)\ P(Z \mid \neg\ Y) = 0.5 \times 0.5 + 0.5 \times 0.5 = 0.5$

$P(X, Z) = P(X, Y, Z) + P(X, \neg\ Y, Z)$

$= P(Y)\ P(X \mid Y)\ P(Z \mid Y) + P(\neg\ Y)\ P(X \mid \neg\ Y)\ P(Z \mid \neg Z)$

$= 0.5 \times 0.5 \times 0.5 + 0.5 \times 0.5 \times 0.5 = 0.25$

Therefore, P(X) P(Z) = P(X,Z). We can similarly show that P(X) P(¬ Z) = P(X, ¬ Z), P(¬ X) P(Z) = P(¬ X, Z) and P(¬ X) P(¬ Z) = P(¬ X, ¬ Z) to prove that X and Z are independent if the value of Y is unknown.

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