

BRAC UNIVERSITY

Department of Computer Science and Engineering

Examination: Semester Final

Duration: 1 Hour 30 Minutes

Set B

Semester: Summer 2022

Full Marks: 40

CSE 422/EEE472: Artificial Intelligence

Answer 4 out of 5 from the following questions.

Figures in the right margin indicate marks.

Name:	ID:	Section:
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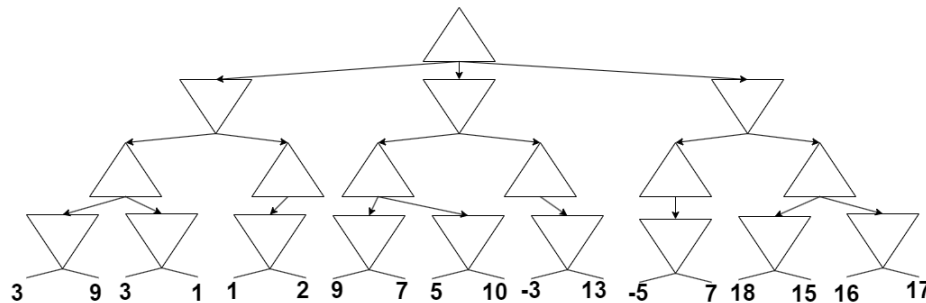
1. CO5

Answer the following questions based on the given Joint probability matrix.

	Male	Female	Total
Football	0.24	0.15	0.39
Rugby	0.2	0.05	0.25
Other	0.1	0.26	0.36
	0.54	0.46	1

- Estimate** the probability of someone playing Rugby if they are male. 2
- Estimate** the probability of being female if someone plays Football. 2
- If you pick a person randomly, **estimate** the probability of that person playing one of Football or other games. 2
- Infer** whether playing rugby depends on females. 4

2. CO4



- Apply** Minimax algorithm in the following tree and calculate the values of nodes. 3
- Apply** alpha-beta pruning algorithm in the same tree, mark the pruned branches and calculate the values of nodes. 7

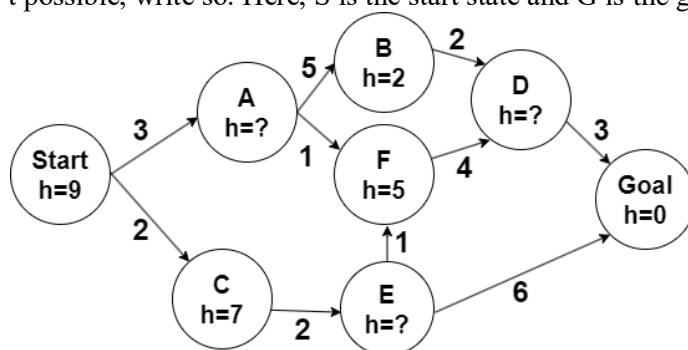
3. CO6

Sl	X1	X2	X3	Y
1	Group 1	Positive	Confirm	Yes
2	Group 1	Positive	Confirm	Yes
3	Group 2	Positive	Confirm	No
4	Group 2	Negative	Deny	No
5	Group 2	Negative	Deny	No
6	Group 1	Negative	Confirm	Yes
7	Group 1	Positive	Confirm	Yes
8	Group 1	Positive	Deny	No
9	Group 2	Negative	Deny	No
10	Group 2	Negative	Confirm	No

- Assume “Y” is the output whose value depends on the input features “X1”, “X2”, and “X3”. **Find** out the root node using ID3 decision tree algorithm. 6
- Suppose two other continuous input features “X4” and “X5” were added to this dataset. In this scenario, would ID3 still be suitable for this classification task? Briefly **explain** your views. 2
- A study was conducted among 15 participants (10 Male, 5 Female) to assess the chances of being a smoker based on gender. It was seen that among males, the smoker to non-smoker ratio was 70:30, and it was 20:80 for females. **Find** Entropy(Smoking/Gender = male). 2

4. CO2

Consider the state space tree shown below in which some of the states are missing a heuristic value. Determine the possible range for each missing heuristic value so that the heuristic is admissible and consistent. If this isn't possible, write so. Here, S is the start state and G is the goal state.



- a.

State	Lowest Possible Value for the State's Admissible and Consistent Heuristic	Highest Possible Value for the State's Admissible and Consistent Heuristic
A		
D		
E		

 4
- b. Assume the heuristics of A, D, and E are 6, 2, and 6 respectively. If you were to run the A* algorithm to find the shortest path from Start to Goal in this search space, **find** the length of the shortest path between them. Also, find what nodes will be explored in sequence. 6

5. CO5

Throughout the whole semester, you've been trying to get hold of your CSE422 instructor. But you never seem to find him in his office. To take matters into your own hands, you decide to install a pressure sensor under his chair and a motion sensor inside his room. These sensors will give you information of the following form.

- The pressure sensor tells you if someone is sitting on the chair ($C = 1$) or not ($C = 0$).
- The motion sensor tells you if someone is moving inside the room ($M = 1$) or not ($M = 0$).

You want to use these sensor readings to predict whether your instructor is in the room ($Y = 1$) or not ($Y = 0$).

You've also done some detective work to obtain the following logs over ten days.

Day	1	2	3	4	5	6	7	8	9	10
C	1	0	0	1	0	1	0	1	0	1
M	0	1	0	0	0	0	0	0	1	1
Y	0	0	0	1	1	1	1	1	1	1

You have used these logs to train a Naive Bayes classifier that predicts Y . The parameters of the model are shown in the following conditional probability tables. Some parameters are missing but can be calculated using the existing parameters.

Y	$P(Y)$
0	q
1	$1 - q$

C	Y	$P(C Y)$
0	0	p_1
0	1	
1	0	
1	1	p_2

M	Y	$P(M Y)$
0	0	
0	1	
1	0	p_3
1	1	p_4

Now solve the following problems.

- a. Using the conditional probability tables above, **find** $P(C = 1, M = 0, Y = 1)$ in terms of q , p_2 , and p_4 . 1
Consider that M and C are conditionally independent given Y .
- b. Using the conditional probability tables above, **find** $P(C = 1, M = 0, Y = 0)$ in terms of q , p_1 , and p_3 . 1
Consider that M and C are conditionally independent given Y .
- c. Using the conditional probability tables above, **find** $P(Y = 1 | C = 1, M = 0)$ in terms of q , p_1 , p_2 , p_3 , and p_4 . Your answers to (a) and (b) should help. 2
- d. **Solve** the values of q , p_1 , p_2 , p_3 , and p_4 . 5
- e. Using your classifier, **predict** whether or not your instructor is in his office if $C = 1$ and $M = 0$ on day 11. Again, your answers to the previous questions should help 1