Course Outcomes

CO1: Evaluate AI Methods and Describe their Foundations

CO2: Apply Basic Principles of AI in solutions that require problem solving, inference, perception, knowledge representation and learning.

CO3: Demonstrate knowledge of reasoning, uncertainty and knowledge representation for solving real world problems

CO4: Analyze and illustrate how search algorithms play a vital role in problem solving

Section - I
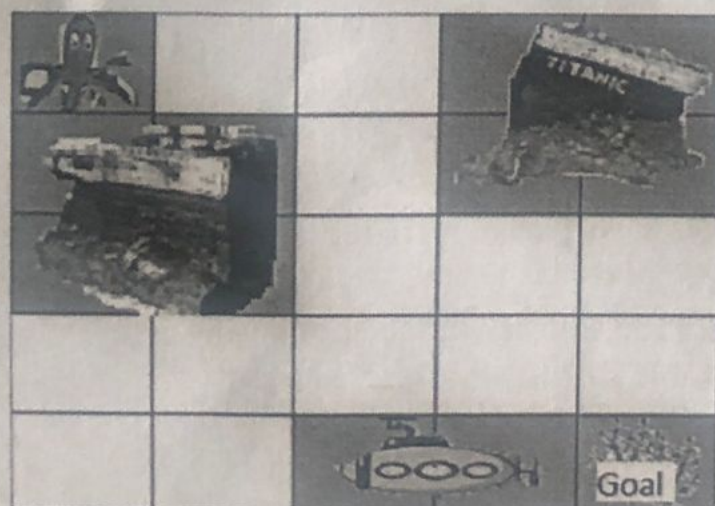### Answer all Questions (4 × 10 Marks)

*M - Marks

Q.No	Question	*M	CO	BL

01. An octopus in the sea is in search of greeneries for food and shelter. Unfortunately, its view is hidden by the obstacles sunken ship titanic and a submarine analyzing the titanic.

                                                  10 4 3

a) Represent the problem with a neat sketch of the state search tree with all nodes labeled appropriately in (row, col) format. (Note: Cells with obstacles can be ignored in search tree). (5 Marks)

b) Apply Backtracking search and lowest path cost uninformed search approaches for the given scenario and compare them based on performance parameters. (5 Marks)

02. VIT conducts a novel treasure hunt for its students during the cultural festival VIBRANCE to improve communication among the students. The treasure mobile is hidden inside the campus. The mobile phone transmits ultra-sonic sound waves with good power intensity for a radius of about 400 meters which fades with distance. The   10 4 2

hunters use UV sensors to search for UV signals. They walk randomly around the campus. Every time they find a UV signal they try to move in the direction of increasing signal strength. Unfortunately the UV sensors are sensitive to the UV cameras fixed in some of the trees in the campus. Though the vibrations produced by the camera are low, they still affect the teams who start about 600 meters away from the treasure mobile. So they end up reaching wrong places very often.

600m
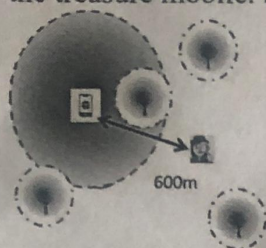
a) Sheeba plans to move towards the direction where the UV signal is highest around her. Unfortunately, there is no UV signal around her. Kiran is lucky to get a non-zero signal in his sensor, but the signal is from the UV camera in the nearest tree. Analyse the situations faced by Sheeba and Kiran. (4 Marks)

b) Design a search strategy and define the associated parameters. Choose appropriate values for the parameters that give Sheeba and Kiran directions and number of steps to walk before checking the UV signal using their sensor. Examine how your choice affects the performance of Sheeba and Kiran. (6 Marks)

03. Consider the set of sentences given below   10 2 2
    - D1: The sun is on the sky .
    - D2: The moon and sun are on the sky.
    - D3: The sun is bright.
    - D4: The locals are playing.

    a) Represent the sentences using a suitable term vector, and find a suitable way to select terms, that will make the search faster for the query "Sky is bright" using Inverse Document Frequency Method. (5 Marks)

    b) For the query "The moon is closest to the earth", explain the problems faced by the above discussed approach in the new situation. Also, suggest alternatives to overcome those problems. (5 Marks)

04. A mini max game tree has been built for a 2 player board game. Squares represent   10 2 3
    max player and circle represents min player.

| -10 | -17 | -16 | -18 | -8 | -12 | -17 | -8 | 3 | -7 | -5 | -12 | -10 | -8 | -18 |
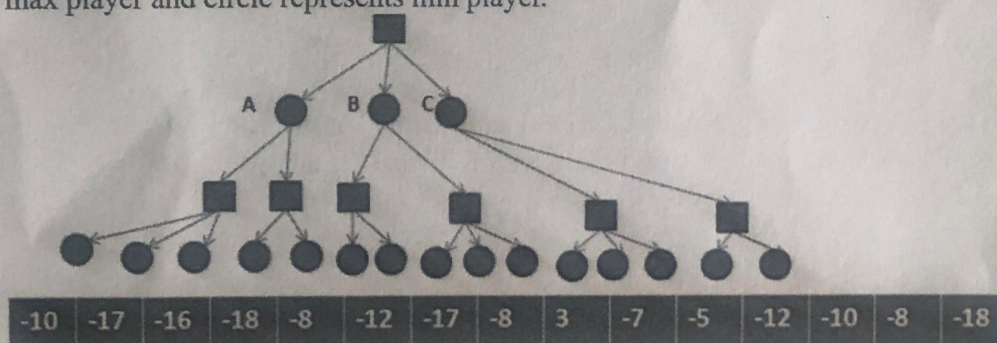
a) Discuss if the final decision made by the max Player will change if the tree is recreated by changing the orders of A, B and C. (5 Marks)

b) Illustrate whether alpha beta pruning approach prunes the same number of nodes if the order of the nodes A, B and C are changed with suitable justifications. (5 Marks)

Section - II
Answer all Questions (4 × 15 Marks)

*M - Marks

| Q.No	Question	*M CO BL

05. A medical team surveys the prevalence of Arthritis among men and women. They   15 3 3
    could get a sufficient number of men for the survey, but could not get enough number
    of females.

Sample	Gender	Player	Arthritis	Sample	Gender	Player	Arthritis
1	Female	Yes	No	11	Male	Yes	Yes
2	Male	Yes	Yes	12	Male	No	Yes
3	Male	No	Yes	13	Male	Yes	Yes
4	Male	No	Yes	14	Male	No	No
5	Male	Yes	No	15	Male	Yes	Yes
6	Male	Yes	Yes	16	Male	No	No
7	Female	Yes	Yes	17	Female	Yes	Yes
8	Male	Yes	Yes	18	Male	No	Yes
9	Male	No	No	19	Male	Yes	No
10	Female	No	Yes	20	Male	No	Yes

Dependency Graph

Gender → Player → Arthritis
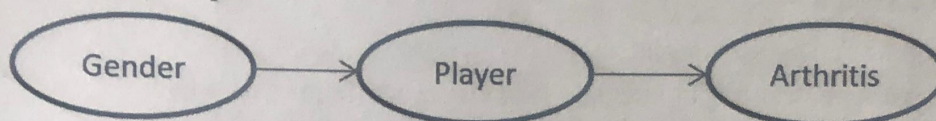
Consider the survey data and the dependency graph given above , and answer the following questions.

a) If we use rejection sampling to answer the query "Probability of a man getting Arthritis", identify the rows which will be rejected in the above random sampling done. Also answer the query. (5 Marks)

b) Given the prior probability distribution of gender G=Male = 0.4 and G=Female =0.6, identify a suitable way to obtain the right probability values for the query "Probability of a Female not getting Arthritis" by weighing the samples appropriately. (5 Marks)

c) Assume that most females do not like playing. Hence the probability of a Female being a Player is given to be 0.2. Use the likelihood weighing method to find out the Probability of a Female Player getting Arthritis in the random sample given above. (5 Marks)

06. An university is hosting a election to select a leader. Detailed instructions for conducting the election is given below with eligibility, process and winner determination.

15 3 3

1.Voter Eligibility:
- A person is eligible to vote if he/she is the student of the university, are at least 18 years old, are registered in the platform of university and have completed a mandatory sociology course.
- Voting rights are suspended if the person has committed an offense within the course of study, even if they meet other eligibility criteria.

2.Candidate Eligibility:
- A person can stand as a candidate if he/she is the student of the university, are at least 19 years old, have no suspension, and have experience in conducting events.
- A candidate must have endorsements from at least three recognized professors of the university are eligible to appear on the ballot.

3.Voting Behavior:
- A registered voter can vote for up to three candidates if they are standing for election, but not for the same candidate more than once.
- If a student has received a vote from over 70% of registered voters, they can be declared the winner without further vote count comparisons.

4.Winner Determination:
- If no student obtains more than 70% of vote, the winner is determined by the candidate with the highest number of votes. However, if multiple candidates have the highest vote count, a runoff election is held between the top candidates.

- If no clear winner is declared after the runoff (if the votes are tied), the student who conducted highest number of events is declared as the winner.

a) Represent the sentences in FOL logic and convert to Conjunctive Normal Form. (10 Marks)

b) Prove that a student, who is at least 19 years old, has no suspension, experience in conducting events, with endorsements from three professors, is eligible to be a candidate in the election. (5 Marks)

07. **PureVision** and **SortRobot** are new startups producing bots (Figures 1a. and 1b.). **PureVision** provides vacuum based dust cleaning navigating across the room. **PureVision** will stop cleaning if it hits on an object. **SortRobot** sorts the objects which are passed in front of it in a conveyor belt.
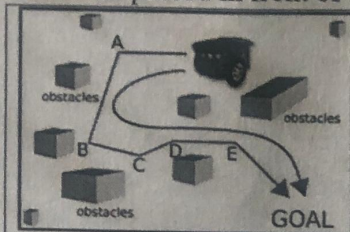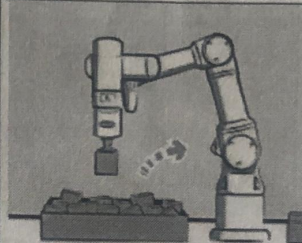
15 1 1

Fig. 1a - PureVision

Fig. 1b – SortRobot

a) Imagine an AI developer who has to integrate PureVision and Sortbot as a new product ClearVision, which integrates the advantage of both the products for hassle free house cleaning. Both models have their own limitations while used for home cleaning. Specify the task environment of the new product **ClearVision** . Provide the PEAS specification for the task environment of **ClearVision**. (7 Marks)

b) Assume that Clear Vision is to be integrated with the home automation system. The Home automation system acts as a master agent and gives comments for clear vision. There are multiple cameras to monitor the home for safety purpose. The heating and ventilating system has room temperature and air quality monitors. Explain the agent architecture of the Home Automation System as it interacts with Clear vision. (8 Marks)

08. A hungry monkey sees a jar full of peanuts and puts its hands inside to fetch a handful. The monkey's hands won't come out of the jar after picking up the peanuts. The only way is for the monkey to use the spoon which is near the jar. After fetching a spoon full of peanuts the monkey can pick the peanuts from the spoon using hand and eat it. The Monkey remains hungry till it eats the peanuts.

15 2 4

Propositions Describing States	Possible Actions
Monkey Hungry	Eat Peanuts
Monkey Holds Spoon	Pick Peanuts From Jar
Jar Empty	Pick Peanuts From Spoon
Spoon Empty	Hold Spoon
Monkey Hand outside Jar	Use Spoon to Fetch Peanuts
Monkey Hand Empty	Drop Spoon
	Drop Peanuts
	Drop Peanuts From Spoon

a) Represent the above domain as a planning problem and define the suitable Action Schema for the possible actions listed above. (5 Marks)

b) Given that the Jar is full of peanuts, the monkey is hungry, the spoon is empty, the monkey's hands do not hold the spoon, hands are empty and outside the jar, use Forward State Space Planning approach to derive the sequence of actions so that the monkey can eat all the peanuts in the jars and is not hungry. (5 Marks)

c) Explain the Sussman anomaly faced by the monkey in the given situation using the actions designed by you. (5 Marks)

BL-Bloom's Taxonomy Levels - (1.Remembering, 2.Understanding, 3.Applying, 4.Analysing, 5.Evaluating, 6.Creating)

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