**UCS1504 - Artificial Intelligence Lab**

**Department of CSE, SSN College of Engineering**

**Evaluation Test**

**Date of Test: ?**

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| **No** | **Question** | **CO/KL** |
| 1 | Use a suitable data structure to keep track of the parent of every state and show the structure as a state space representation for the given graph (Figure 1)    Fig.1 Graph | **CO1/K3** |
| 2 | Write a function to print the sequence of states and actions from the initial state to the goal state using BFS with suitable data structure for the given graph (Figure 1).  Also find the time and space complexity.  Hint: Time: *1+b+b2+b3*+… +*bd* + *b(bd-1*) = O(bd+1)  Space: *O(bd+1)* (keeps every node in memory)  Output: Start, d, e, p, b, c, h, r, q, a, f, Goal | **CO1/K4** |
| 3 | Write a function to print the sequence of states and actions from the initial state to the goal state using DFS with suitable data structure for the given graph (Figure 1)  Also find the time and space complexity.  Hint: Time: *O(bm)*  Space: *O(bm)*  Output: Start, d, e, r, f, Goal | **CO1/K4** |
| 4 | Write a function to print the sequence of states and actions from the initial state to the goal state using Uniform Search Cost with suitable data structure for the given graph (Figure 1)  Output: {START, d, e, h, q, r, f, GOAL} | **CO1/K3** |
| 5 | Write a function to print the sequence of states and actions from the initial state to the goal state using DLS with suitable data structure for the given graph (Figure 1)  Hint: Time: *O(bl) where b is the branching factor and l is depth of the search tree or number of levels in search tree*  Space: *O(bl)*  **Hint**: Read limit value and goal state | **CO1/K4** |
| 6 | Write a function to print the sequence of states and actions from the initial state to the goal state for every level using IDS with suitable data structure for the given graph (Figure 1)  Hint: Time: *O(bl) where b is the branching factor and l is depth of the search tree or number of levels in search tree*  Space: *O(bl)*  **Hint**: Read limit value and goal state | **CO1/K4** |
| 7 | Consider the following graph-  https://www.gatevidyalay.com/wp-content/uploads/2020/01/A-Algorithm-Problem-02.png  The numbers written on edges represent the distance between the nodes.  The numbers written on nodes represent the heuristic value.  Write a function to find the most cost-effective path to reach from start state A to final state J using A\* Algorithm.  Soultion: **Path- A → F → G → I → J** | **CO1/K3** |
| 8 | Given an initial state of a 8-puzzle problem and final state to be reached-  https://www.gatevidyalay.com/wp-content/uploads/2020/01/A-Algorithm-Problem-01.png    Write a function to find the most cost-effective path to reach the final state from initial state using A\* Algorithm.  Consider g(n) = Depth of node and h(n) = Number of misplaced tiles.  **Solution:**  https://www.gatevidyalay.com/wp-content/uploads/2020/01/A-Algorithm-Problem-01-Solution-A-on-8-Puzzle.png | **CO1/K3** |
| 9 | Consider the following knowledge base:  1. The humidity-is-high or the-sky-is-cloudy.  2. If the-sky-is-cloudy then it-will-rain.  3. If the-humidity-is-high then it-is-hot.  4. It-is-not-hot.  **Goal**: It-will-rain   1. Translate the statements into propositional logic 2. Write a function to prove by resolution theorem that the goal is derivable from the knowledge base   **Solution**  p = the-humidity-is high, q = the-sky-is-cloudy, r = it-will-rain, s = it-is-hot.  The CNF form of the above clause thus become-  1. p **∨** q  2. ¬ q **∨** r (after applying theorem 10)  3. ¬ p **∨** s (after applying theorem 10)  4. ¬ s  5. ¬ r | **CO2/K3** |
| 10 | Consider the following knowledge base:  1. The humidity-is-high or the-sky-is-cloudy.  2. If the-sky-is-cloudy then it-will-rain.  3. If the-humidity-is-high then it-is-hot.  4. It-is-not-hot.  **Goal**: It-will-rain   1. Translate the statements into propositional logic 2. Write a function to prove by applying appropriate inference rules that the goal is derivable from the knowledge base   **Solution**  p = the-humidity-is high, q = the-sky-is-cloudy, r = it-will-rain, s = it-is-hot.  The CNF form of the above clause thus become-  1. p **∨** q  2. ¬ q **∨** r (after applying theorem 10)  3. ¬ p **∨** s (after applying theorem 10)  4. ¬ s  5. ¬ r | **CO2/K3** |
| 11 | The distribution of 2 independent variables Sky (S), Wind(W) are as follows: [ **Hint**: P(A | B) = P(A&B)/P(B) i.e. Given are Independent events: P(A&B) = P(A) P(B) ]   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | |  |  |  |  | | --- | --- | --- | --- | | **S** | **Sunny** | **Cloudy** | **Rain** | | **f(S)** | 0.6 | 0.2 | 0.4 | | |  |  |  | | --- | --- | --- | | **Wind** | **True** | **False** | | **g(W)** | 0.3 | 0.7 | |      1. Write necessary function to draw/determine Full Joint Probability Distribution Table   **Joint Probability Distribution Table**   |  |  |  |  | | --- | --- | --- | --- | | **S/W** | **W=T** | **W=F** | **Sum** | | **S=Sunny** |  |  |  | | **S=Cloudy** |  |  |  | | **S=Rain** |  |  |  | | **Sum** |  |  |  |  1. Write necessary functions to determine the following inferences from the table:    1. P(S=rain ∧ W)    2. P(S=rain)    3. P(W)    4. P(S=rain|W) | **CO3/K3** |
| 12 | A patient goes to the doctor for a medical condition, the doctor suspects three diseases as the cause of the condition. The three diseases are D1, D2, D3, which are marginally independent from each other. There are four symptoms S1, S2, S3, S4 which the doctor wants to check for presence in order to find the most probable cause of the condition. The symptoms are conditionally dependent to the three diseases as follows: S1 depends only on D1, S2 depends on D1 and D2. S3 is depends on D1 and D3, whereas S4 depends only on D3. Assume all random variables are Boolean, they are either ‘true’ or ‘false’.   1. Construct the Bayesian network according to the above symptoms   (**Hint**: Use a suitable data structure to keep track of the parent of every state)   1. Write a function to provide the expression for the joint probability distribution as a product of conditional probabilities. 2. Write a function to find the number of independent parameters that is required to describe this joint distribution. 3. Write a function to find the number of independent parameters required if we assume there were no conditional independence between the variables. 4. Write a function to find the Markov Blanket of variable S2? | **CO3/K4** |

**Content to be written in Answer Booklet for output verification:**

i. Date

ii. Quest. No

iii. Title

iv. Aim v. Data structure used (with justification)

v. **Solve the problem manually - 50 marks**

vi. Logic applied or Algorithm (short description) – **5** marks

vii. Sample input and output – **5** marks

viii. Program :

* Reading Input & Displaying the same Correctly – **20** marks
* Modularity – Necessary Functions for Logic (with correct datastructure) - **10** marks

viii. Viva – **10** marks