**Birla Institute of Technology & Science, Pilani**
**Work-Integrated Learning Programmes Division**
**Second Semester 2018-19**
**Mid Semester Examination( Regular)**

Course No. : DSECL ZG557
Course Title : Artificial & Computational Intelligence
Nature of Exam : Closed Book
Weightage : 30%
Duration : 1.5 Hours
Date of Exam : 11 / 08 / 2019, AN

No. of Pages = 4
*No. of Questions = 4*

Time of Exam: 2:00 PM to 3:30 PM

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**Note:**

1. Please follow all the *Instructions to Candidates* given on the cover page of the answer book.
2. All parts of a question should be answered consecutively. Each answer should start from a fresh page.
3. ***Questions must be answered only in the page numbers mentioned against each question. In case you require more pages to answer a question, you can continue from page #21***
4. Assumptions made if any, should be stated clearly at the beginning of your answer.

**Answer all the questions**

**Question -1 [1+ 2+ 2 + 2 = 7 M]** **[ Page 03 - 05 ]**

**(1-a)** Define Artificial Intelligence in your own terms.

**(1-b)** Here is a list of a few noted researchers who have contributed immensely during the early days of artificial intelligence.

```
John McCarthy
Allen Newell
Alan Turing
Donald O. Hebb
```

Pick any two names from this list and write down their most significant contribution (in your view) to the field of Artificial Intelligence. Your answer must be *provided in two well articulated statements as precise as possible.*

| Chosen Name | Their most significant contribution to AI [*in two well articulated statements covering their most significant contribution precisely, and the impact.*] |
|---|---|
| [Name #1] | |
| [Name #2] | |

***To answer questions (1-c) and (1-d) consider this scenario:*** Consider a Domestic Trading Agent (DTA) which is a software agent supports in purchasing items which are necessary for a family. The members of a family interacts with this agent by specifying the following things to make a purchase

```
[name of the item to buy, date by when it is needed, price upper limit]
```

DTA takes a details of list of such items to buy and interacts with many online seller agents. DTA publishes the list of items with the associated details for the seller agents. The seller agents will place bids for each items. DTA analyses the bids and places the order with sellers such that it maximizes its utility. Meeting the expected delivery date, lower costs results in higher utility for DTA. Given this context, answer the questions (1-c) and (1-d)

**(1-c)** Write down the PEAS description of the task environment

**(1-d)** Following is the list of few possible descriptions of a task environment. Write a one line reason why / why not it applies to the given scenario.

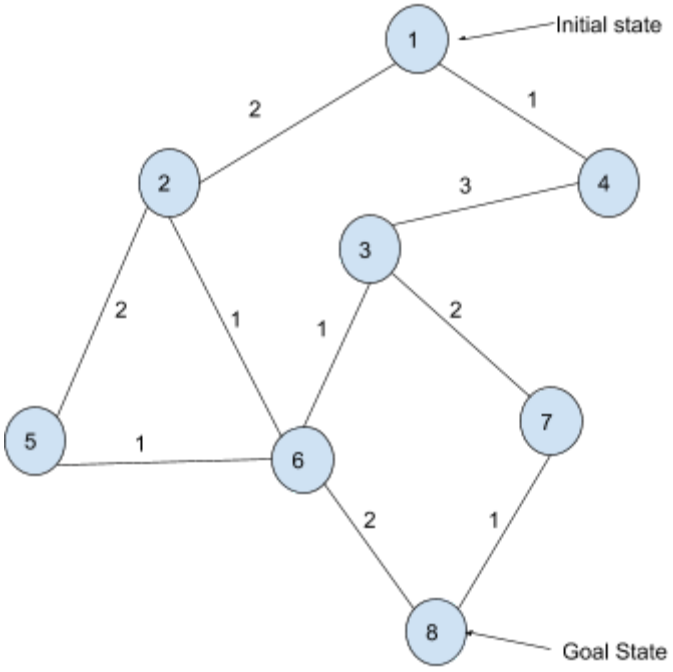
(i) fully observable
(ii) multi-agent
(iii) stochastic
(iv) episodic

**Question -2 [4+4 = 8 M]** **[ Page 06 - 11 ]**

(2-a) Comment on completeness, optimality, time & space requirement of the algorithms (column headers in the table) as seen in the table below.

| | Iterative Deepening Depth First Search | *Uniform Cost Search* | *A* Algorithm* | *MBA** |
|---|---|---|---|---|
| Completeness | | | | |
| Optimality | | | | |
| Time Complexity | | | | |
| Space Complexity | | | | |

(2-b) Consider the state space and the associated heuristic given below.



Also, consider the heuristic function h(n) as mentioned in the table

| n | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| h(n) | 7 | 3 | 3 | 6 | 3 | 1 | 1 | 0 |

Show the sequence of nodes as visited by A* algorithm. You do not need to redraw the state space every each step. For each step, show the f(.) computation for all relevant nodes. If two nodes have same f(.) value, assume A* chooses a state whose number is lesser. [ i.e. if f(1) = f(2), then the algorithm prioritize f(1) over f(2) ]

**Question -3 [3 + 4.5 = 7.5 M]** **[ Page 12 - 16 ]**

(3-a) Give the name of the algorithm that results from each of the following special cases. Provide one line explanation supporting your answer.

(i) Local beam search with k = 1.

(ii) Simulated annealing with T = ∞ at all times.

(iii) Genetic algorithm with population size N = 1.

(3-b) Consider a 4 queen problem where you are trying to place 4 queens on each column of a 4X4 board such that no two queen attacking another. Below is the current state where queens are placed in cells (1,1),(2,2),(3,3) and (4,4).

| | | | |
|---|---|---|---|
| Q | | | |
| | Q | | |
| | | Q | |
| | | | Q |

You can move each queen only along the column arrive at a goal state. Assume that the heuristic function being used here is "number of pairs of queens attacking each other".

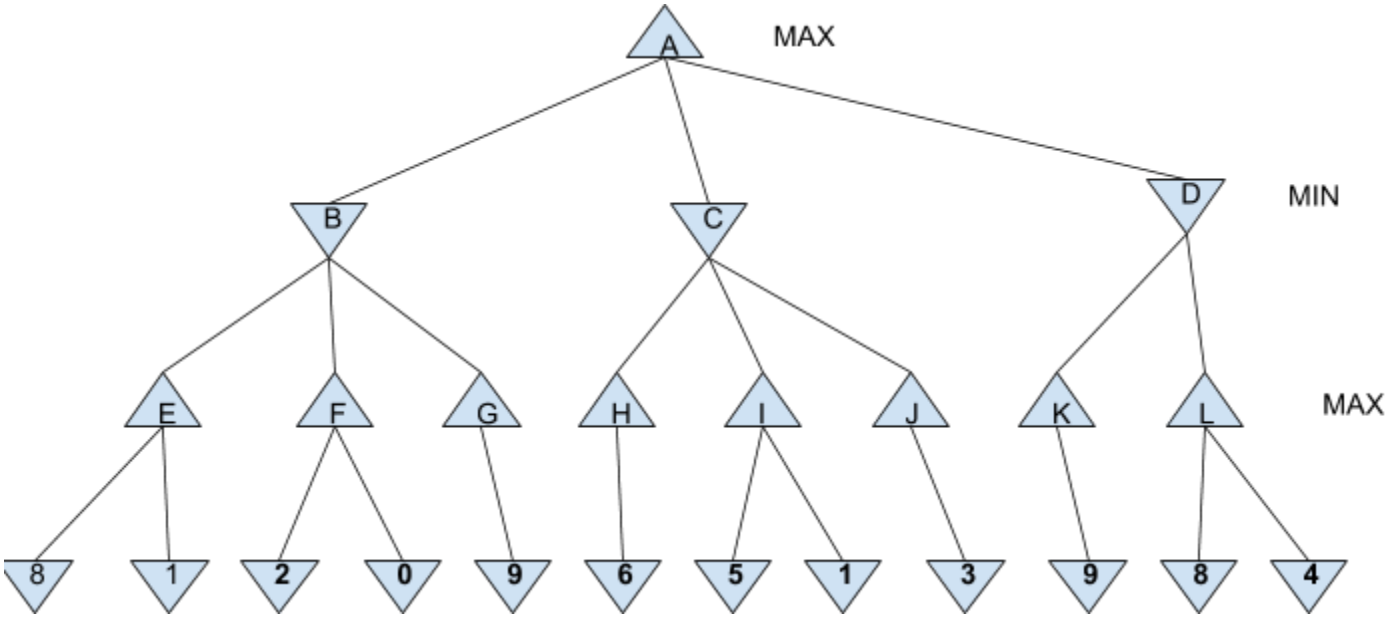
i) What is the heuristic value of the current state.

ii) You are trying to solve this problem using the ***first choice*** hill climbing algorithm (that is, generate successors and accept the first successor which improves the state). Show one step of this algorithm with all the necessary details.

iii) Consider that we decide to use simulated annealing in place of first choice hill climbing algorithm. Assume that the current temperature T is 0.2. Given this, how likely the move that you suggested in the previous (first choice hill climbing) question is accepted? Provide details.

**Question -4 [3+4.5 = 7.5 M]** **[ Page 17 - 20 ]**

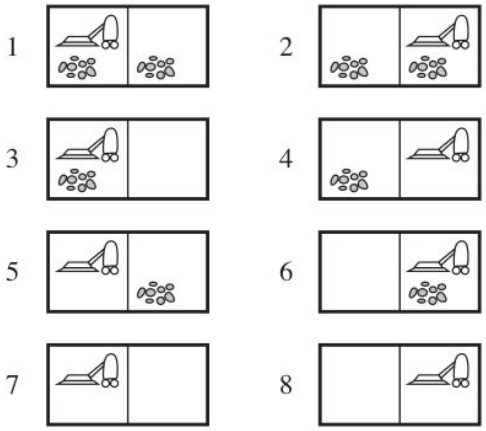
(4-a) Consider the following game tree. Terminal nodes are annotated with their utility and the remaining nodes.




Compute the minimax value of all the internal nodes and present the summary as a table as below.

| Node | A | B | C | D | E | F | G | H | I | J | K | L |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Minimax value | | | | | | | | | | | | |

(4-b) Consider a vacuum word (as discussed in the class) and the states as shown below




The available actions ***suck*** and ***left*** behaves as intended. When the agent is in the left tile, initiating the action ***right*** might leave the agent in the same state, instead taking it to the right tile. This is a non-deterministic action. The environment is fully observable. The goal is to get both tile clean, i.e states 7 and 8. Show the search tree and a possible solution to the search tree.[You need not apply any search algorithm to show the solution.]