Roll No											

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF INFORMATION SCIENCE
MID TERM EXAMINATION - APR 2023

Semester : Semester IV - 2021
Course Code : CSA3020
Course Name : Sem IV - CSA3020 - Artificial Intelligence for Game Development
Program : BCG

Date : 13-APR-202
Time : 2PM - 3:30P
Max Marks : 50
Weightage : 25%

Instructions:
(i) Read all questions carefully and answer accordingly.
(ii) Question paper consists of 3 parts.
(iii) Scientific and non-programmable calculator are permitted.
(iv) Do not write any information on the question paper other than Roll Number.

PART A

ANSWER ALL THE QUESTIONS **(5 X 2 = 10M)**

1. Mention two games which have **perfect information**, such that one of them is deterministic and the other is stochastic. Also mention which is deterministic and which is stochastic.

(CO1) [Knowledge]

2. Consider 3 points in a grid A, B, and C. If A and C are connected, and B and C are connected, prove or disprove that A and B are also connected!

(CO2) [Knowledge]

3. Consider a **modification** of Dijkstra's algorithm for single-source shortest path. Here, each node stores the following information – d(n) is the minimum distance of a given node from the source node and p(n) is the parent of the given node. Let c(u,v) is the edge length of the edge connecting the vertices u and v. Initially, d(S) = 0, d(every other node) = +Infinity, and p(all nodes) = NULL. Fill in the blanks in the pseudocode, which updates the values of d and p for each node:

IF (d(v) < c(u,v) + d(u)) THEN:
d(v) = _____
p(v) = u

(CO2) [Knowledge]

4. Mention the data structure(s) used by the Breadth-First Search Algorithm.

(CO2) [Knowledge]

5. Select **ALL the FALSE statements** about Alpha-Beta Pruning from the following:

1. In alpha-beta pruning, we change the beta values for the max nodes and the alpha values for the min nodes.
2. In alpha-beta pruning, we change the alpha values for the max nodes and the beta values for the min nodes.
3. In alpha-beta pruning, we prune all other subtrees once alpha <= beta.
4. In alpha-beta pruning, we prune all other subtrees once alpha >= beta.

(CO1) [Knowledge]

PART B

ANSWER ALL THE QUESTIONS **(4 X 5 = 20M)**

6. Consider the following Minesweeper grid. There are **SEVEN mines** which you can locate from the cells numbered from (A) to (O). For each of those cells, either write **X** (denoting that there is no mine and you can explore it) or **F** meaning that there ***should be a mine***.at that cell.

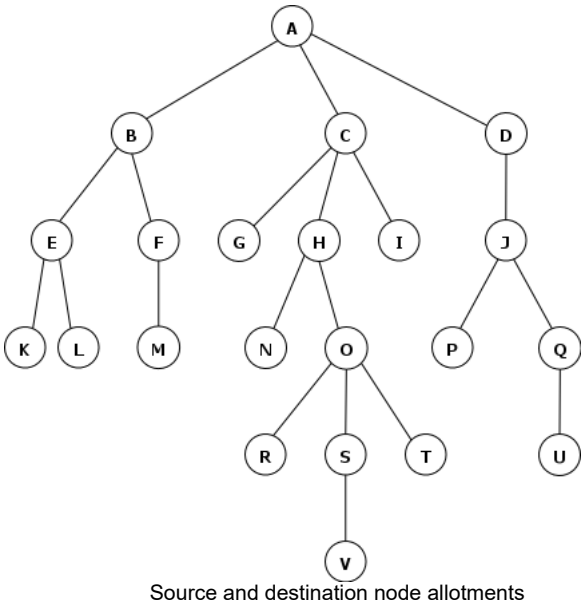
After you solve from (A) to (O), based on the **last digit of your roll number**, write the values for the cells numbered from (a) to (e) in the grid below.

Last digit of Roll No.	0	1	2	3	4	5	6	7	8	9
(a)	A	F	K	A	F	K	A	F	K	A
(b)	B	G	L	B	G	L	B	G	L	B
(c)	C	H	M	C	H	M	C	H	M	C
(d)	D	I	N	D	I	N	D	I	N	D
(e)	E	J	O	E	J	O	E	J	O	E

NOTE: You need not write the value for the other 10 cells - only the 5 cells (numbered from (a) to (e)) which you have been allotted.

(CO1) [Comprehension]

7. Consider the following graph. Use **BFS** to find out a path from the source vertex to the destination vertex. The source and destination are based on the **last digit of your roll number**.

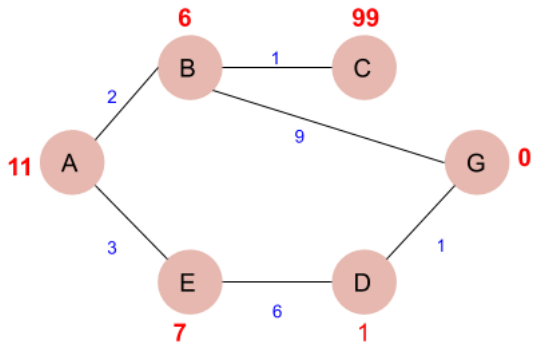


Source and destination node allotments

Last digit of your roll number	0	1	2	3	4	5	6	7	8	9
Starting node	K	L	M	N	R	S	V	T	P	U
Ending node	V	Q	D	K	U	L	A	B	M	B

(CO2) [Comprehension]

8. Consider the following graph:



Find the lowest cost path from the source node to the destination node using **BOTH**, the **Greedy Best-first Search** and the **A* Search** algorithms. The heuristic values are in the numbers next to the nodes. The starting nodes are alloted as follows, based on the **last digit of your roll number**.

Allotment of starting vertices

Last digit of your roll number	0	1	2	3	4	5	6	7	8	9
Starting node	A	C	E	A	C	E	A	C	E	A

(CO2) [Comprehension]

9. Prof. SAM wanted to go on a trip to North America to visit a number of relatives. So, he plans to visit the following cities in the United States – San Francisco (SFO), Seattle (SEA), Los Angeles (LAX), Dallas (DFW), Miami (MIA), Chicago (CHI), Toronto (YYZ), Honolulu (HNL), Washington D.C. (WAS) and New Orleans (MSY). The following are the costs to visit each of the cities:

Rows denote the starting city and columns denote the intermediate destination. X means that there is no edge between the 2 cities.

	SFO	SEA	LAX	DFW	MIA	CHI	YYZ	HNL	WAS	MSY
SFO	0	X	48	93	X	X	X	128	139	134
SEA	69	0	79	X	X	104	X	178	X	X
LAX	49	79	0	108	X	X	X	119	X	X
DFW	83	X	X	0	X	89	X	X	X	79
MIA	X	X	X	X	0	69	105	X	99	80
CHI	X	114	X	89	69	0	105	X	104	100
YYZ	X	X	X	X	123	137	0	X	129	X
HNL	200	188	169	X	X	X	X	0	X	X
WAS	X	X	X	X	64	104	106	X	0	X
MSY	X	X	X	79	80	99	X	X	X	0

Based on the **LAST DIGIT** of your **ROLL NUMBER,** start from the given city, and find the **shortest path to every other city**.

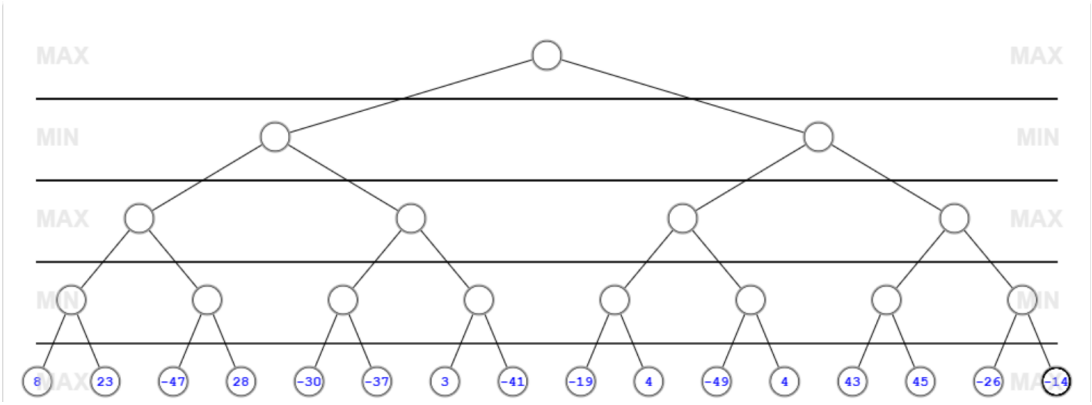
	Allotments of starting city									
Last Digit of Roll Number	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Starting City	CHI	DFW	HNL	LAX	MIA	MSY	SEA	SFO	WAS	YYZ

(CO2) [Comprehension]

PART C

ANSWER ALL THE QUESTIONS **(2 X 10 = 20M)**

10. Consider the following game tree:



- Find out the expected utility of the player.
- Perform alpha-beta pruning and draw the pruned tree.
- Perform ideal ordering to **maximize** the amount of pruning, and **minimize** the number of nodes that are explored.
- Perform alpha-beta pruning on the ideal-ordered tree.

(CO1) [Application]

11. Odysseus (O) needs to return home to Ithaca (I) after winning the Trojan War, while on his way home, he needs to pass through a narrow strait, that is guarded by 2 monsters. The first monster is Scylla (S) who throws massive boulders from a high mountain that sink ships that come in its range (s). The second monster is Charybdis (C), who has a giant mouth that sucks in massive amounts of water, causing a whirlpool that destroys ships that approach it (c)! Construct the **vector field** for the problem and **find a path** for Odysseus to return home to Ithaca, as well as **its cost**. Use the following influence requirements:

- Moves are only 4 directional – top, right, left, bottom.
- Influence of Scylla's and Charybdis's cells are +3
- Influence of Scylla's and Charybdis's ***neighbouring cells*** (i.e. those marked with a small s and small c) are +2 (if it is top, left, bottom, or right) and +1 (if it is diagonally adjacent), or adjacent to a cell which is +2.

Use the following map:

Map of the world. Destination is Ithaca (I9) and source is the location of Odysseus (A1)

	1	2	3	4	5	6	7	8	9
A	**O**						s		
B						s	s	s	
C					s	s	**S**	s	s
D			c			s	s	s	
E		c	c	c			s		
F	c	c	**C**	c	c				
G		c	c	c					
H			c						
I									**I**

(CO2) [Application]