

National University of Computer and Emerging Sciences, Lahore Campus



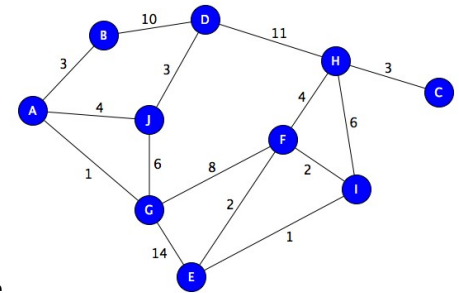
Course: Artificial Intelligence
Program: BS(Computer Science)
Duration: 60 Min
Paper Date: 21-2-2017
Section: D and E
Exam: Mid 1

Course Code: CS401
Semester: Spring 2017
Total Marks: 30
Weight: 15%
Page(s): 4
Reg. No(Sec): -----()

Instruction/Notes: You can use rough sheet, but final working and answers should be on paper.
 You can use back side of paper as well.

Question 1: (10)

- a) Consider the state space given in figure. Traverse a graph using uniform cost (graph) search to reach from start state A to goal state C. At each step show which node is explored and changes in frontier and explored list. Also maintain parent and $g(n)$ for



each node.

step 1

Frontier	Node	A
	Cost g(n)	0
	Parent	null
Explored	Node	
	Cost g(n)	
	Parent	

Step 2
A is explored

Frontier	Node	B	J	G
	Cost g(n)	3	4	1
	Parent	A	A	A
Explored	Node	A		
	Cost g(n)	0		
	Parent	null		

Step 3
G is explored

Frontier	Node	B	J	F	E
	Cost g(n)	3	4	9	15
	Parent	A	A	G	G
Explored	Node	A	G		
	Cost g(n)	0	1		
	Parent	null	A		

Step 4
B is explored

Frontier	Node	J	F	E	D
	Cost g(n)	4	9	15	13
	Parent	A	G	G	B
Explored	Node	A	G	B	
	Cost g(n)	0	1	3	
	Parent	null	A	A	

Step 5
J is explored, cost and parent of D is updated

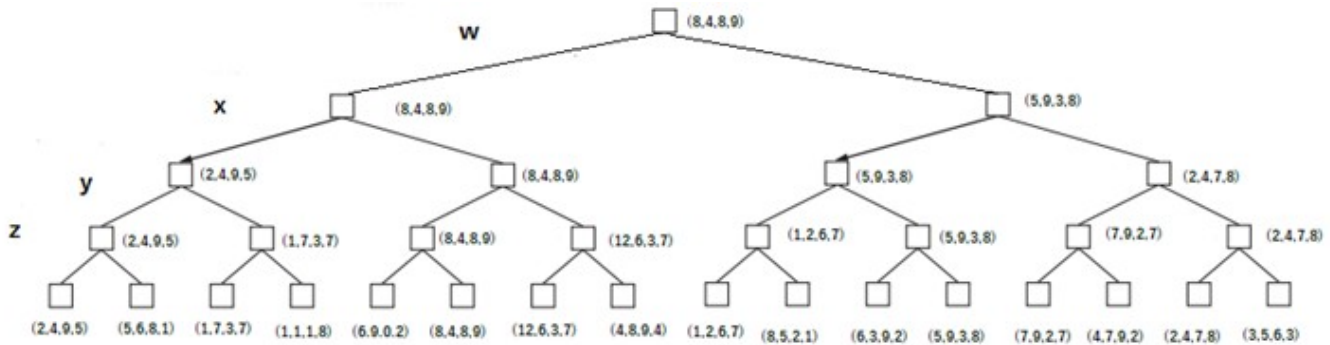
Frontier	Node	F	E	D	
	Cost g(n)	9	15	7	
	Parent	G	G	J	
Explored	Node	A	G	B	J
	Cost g(n)	0	1	3	4
	Parent	null	A	A	A

Step 6	D is explored													
Frontier	Node	F	E	H										
	Cost g(n)	9	15	18										
	Parent	G	G	D										
Explored	Node	A	G	B	J	D								
	Cost g(n)	0	1	3	4	7								
	Parent	null	A	A	A	J								
Step 7	F is explored, parent and cost of E and H is updated													
Frontier	Node	E	H	I										
	Cost g(n)	11	13	11										
	Parent	G	D	F										
Explored	Node	A	G	B	J	D	F							
	Cost g(n)	0	1	3	4	7	9							
	Parent	null	A	A	A	J	G							
Step 8	E is explored													
Frontier	Node	H	I											
	Cost g(n)	13	11											
	Parent	D	F											
Explored	Node	A	G	B	J	D	F	E						
	Cost g(n)	0	1	3	4	7	9	11						
	Parent	null	A	A	A	J	G	G						
Step 9	I is explored													
Frontier	Node	H												
	Cost g(n)	13												
	Parent	D												
Explored	Node	A	G	B	J	D	F	E	I					
	Cost g(n)	0	1	3	4	7	9	11	11					
	Parent	null	A	A	A	J	G	G	F					
Step 10	H is explored													
Frontier	Node	C												
	Cost g(n)	16												
	Parent	H												
Explored	Node	A	G	B	J	D	F	E	I	H				
	Cost g(n)	0	1	3	4	7	9	11	11	13				
	Parent	null	A	A	A	A	J	G	G	F	D			
Step 11	C is explored													
Frontier	Node													
	Cost g(n)													
	Parent													
Explored	Node	A	G	B	J	D	F	E	I	H	C			
	Cost g(n)	0	1	3	4	7	9	11	11	13	16			
	Parent	null	A	A	A	A	J	G	G	F	D	H		
Step 12	As C has been explored we can stop and back tracking will give us the following shortest path with path cost 16													
	C ← H ← F ← G ← A													

Figure 1 State Space

Question 3: (6 + 4)

- a) Consider game tree of 4 player game (W, X, Y, Z). Terminal states show the Score of each player W, X, Y, Z. The game is played in partnership W and Y are partners, and X and Z partners. Each player is playing optimality and tries to maximize sum of its own and its partner's score. Partnership with highest score wins at the end of game. Find the node value of each node given in the tree. Which partners will win in the end of game if everyone plays optimally?



W and Y will win as scoreW+ScoreY is 16 and ScoreX+ ScoreZ is 13

- b) Write a recursive function to get node value for part (a).

NodeValue (s) =

Utility if s is terminal node

$$\operatorname{argmax}_x \text{NodeValue}(\text{Result}(s, a)) \text{ for all } a \in \text{actions}(S) (x.\text{score}(s.\text{player}) + x.\text{score}(s.\text{partner}))$$

Question 4: (10)

Consider the following Genetic Algorithm setup for some hypothetical problem

Population size= 6

Chromosome: array of 8 bits

Fitness function is given as $f(n)$ = number of 1's in chromosomes

Goal: Fitness ≥ 6

Selection: Rank selection

Cross over method: One point, from random point.

Mutation Rate: 0%

Update method= population \rightarrow 6 best from (population union population)

We have generated 6 random chromosomes in initial population given in table 2.

1. Find the fitness of chromosomes in initial population and their selection probability.
2. Perform first iteration using the selection, cross over and mutation method given above and generated new population.
3. Which chromosomes will go as population in 2nd iteration?

****NOTE:** You can use suppose a random number if you need one, just mention its value where you use it. Show all steps and working clearly.

Table 1: Initial Population

		Fitness	Rank	Selection Probability%
Chromosome 1	00001101	3	6	22.2
Chromosome 2	11000000	2	2	7.4
Chromosome 3	00000000	0	1	3.7
Chromosome 4	10101000	3	6	22.2
Chromosome 5	00111000	3	6	22.2
Chromosome 6	01000011	3	6	22.2

Generating new population

C1: 00001101

C4: 10101000

Cross over point 4

New C1: 00001000

New C2: 10101101

C1: 00001101

C2: 11000000

Cross over point 1

New C3: 01000000

New C4: 10001101

C5: 00111000

C6: 01000011

Cross over point 4

New C5: 00110011

New C6: 01001000

<i>New Chromosomes</i>	Fitness
00001000	1
10101101	5
01000000	1
10001101	4
00110011	4
01001000	2

<i>Chromosomes for second iteration</i>	Fitness
01000011	3
10101101	5
01000011	3
10001101	4
00110011	4
00001101	3