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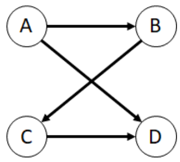
Internal Assessment Test 3 – Aug 2022

Sub:	Design and Analysis of Algorithms			Sub Code:	18CS42	Branch:	CSE
Date:	26/08/2022	Duration:	90 mins	Max Marks:	50	Sem/Sec:	IV/A,B&C

<u>Answer any FIVE FULL Questions</u>

		MARKS	OBE CO	OBE RBT
1	Define transitive closure. Apply Warshall's algorithm on the following graph to compute its transitive closure	[10]	CO3	L3



Ans: The transitive closure of a directed graph with n vertices can be defined as the n×n boolean matrix T = { t_{ij} }, in which the element in the i th row and the j th column is 1 if there exists a nontrivial path (i.e., directed path of a positive length) from the i^{th} vertex to the j^{th} vertex; otherwise, t_{ij} is 0.

Build the adjacency matrix to get R0. Use the Warshals algorithm to create R1 to R4.

R0

0	1	0	1
0	0	1	0
0	0	0	1
0	0	0	0

R1

0	1	0	1
0	0	1	0
0	0	0	1
0	0	0	0

R2

0	1	1	1
0	0	1	0
0	0	0	1
0	0	0	0

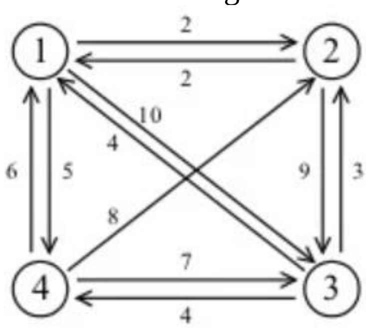
R3

0	1	1	1
0	0	1	1
0	0	0	1
0	0	0	0

R4

0	1	1	1
0	0	1	1
0	0	0	1
0	0	0	0

		MARKS	CO	RBT
2	Solve the travelling sales man problem using dynamic programming.	[10]	CO3	L3



Ans:

Adjacency matrix for the graph is

0	2	10	5
2	0	9	∞
4	3	0	4
6	8	7	0

The recurrence equation for DP is

$$g(i, S) = \min_{j \in S} \{ c_{ij} + g(j, S-\{j\}) \}$$

0	2	10	5
2	0	9	∞
4	3	0	4
6	8	7	0

Assuming that tour starts at 1,

g(2,Φ) = c_{21} = 2
g(3,Φ) = c_{31} =*4*
g(4,Φ) = c_{41} =*6*

g(2,{3}) = c23 + *g(3,Φ) = 9 + 4 = 13*
g(2,{4}) = No edge from 2 to 4 = ∞
g(3,{2}) = c32 + *g(2,Φ) = 3 + 2 = 5*
g(3,{4}) = c34 + *g(4,Φ) = 4 + 6 = 10*
g(4,{2}) = c42 + *g(2,Φ) = 8 + 2 = 10*
g(4,{3}) = c43 + *g(3,Φ) = 7 + 4 = 11*

g(2,{3,4}) = min{ ***c23 + g(3,{4})****, c24 + g(4,{3}) } = min{19, ∞} = 19*
g(3,{2,4}) = min{ c32 + g(2,{4}), ***c34 + g(4,{2})*** *} = min{∞, 14} = 14*
g(4,{2,3}) = min{ c42 + g(2,{3}), ***c43 + g(3,{2})*** *} = min{21, 12} = 12*
g(1, {2,3,4}) = min { c12+g(2,{3,4}), c13+g(3,{2,4}), ***c14+g(4,{2,3})}***
= min { ***21****, 24, 17} = 17*

Hence the path is 1-> 4 -> 3 -> 2 -> 1

3 Explain multistage graph with example. Write the forward approach algorithm to solve multistage algorithm. [10] CO3 L2

Ans:

- A multistage graph *G=(V,E)* is a directed graph in which vertices are partitioned into *k*>= 2 disjoint sets V_i, 1 <= *i* <= *k*
- If <*u,v*> is a edge, then *u* ϵ V_i and *v* ϵ V_{i+1} for some *i*. Let *c(u,v)* be the cost (or weight) of the edge <*u,v*>
- Sets V_1 and V_k have just one vertex each. The vertex ***s*** in V_1 is called source vertex and the vertex ***t*** in V_k is called the sink vertex.
- The multistage graph problem is to find a minimum cost path from ***s*** to ***t.***

Forward Algorithm

```
Fgraph (G, K, n, P)
 {
     Cost[n]:= 0.0;
     for j:= n-1 to 1 step -1 do
     {
            Let r be a vertex such that <j, r>  is an edge of G and C[j, r] + cost[r]
            is minimum;       //r is the vertex in v_{i+1} and j be the vertex in v_i
            Cost[j] := C[j, r] + Cost[r];   //taking the value of min. cost edge
            d[j] := r;
     }
     P[1]:= 1 ,  P[k]:= n
     for j:= 2 to k-1
     P[j] = d[P[j-1]];
 }
```

4 Obtain an optimal binary search tree for the following set of four keys with probabilities given below. [10] CO3 L2

Key	A	B	C	D
Probability	0.1	0.2	0.4	0.3

Ans:

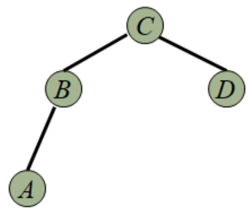
The tables below are filled diagonal by diagonal: the left one is filled using the recurrence

$$C[i,j] = \min \{C[i,k-1] + C[k+1,j]\} + \sum p_s, \quad C[i,i] = p_i;$$

the right one, for trees' roots, records *k*'s values giving the minima

i \ j	0	1	2	3	4
1	0	.1	.4	1.1	1.7
2		0	.2	.8	1.4
3			0	.4	1.0
4				0	.3
5					0

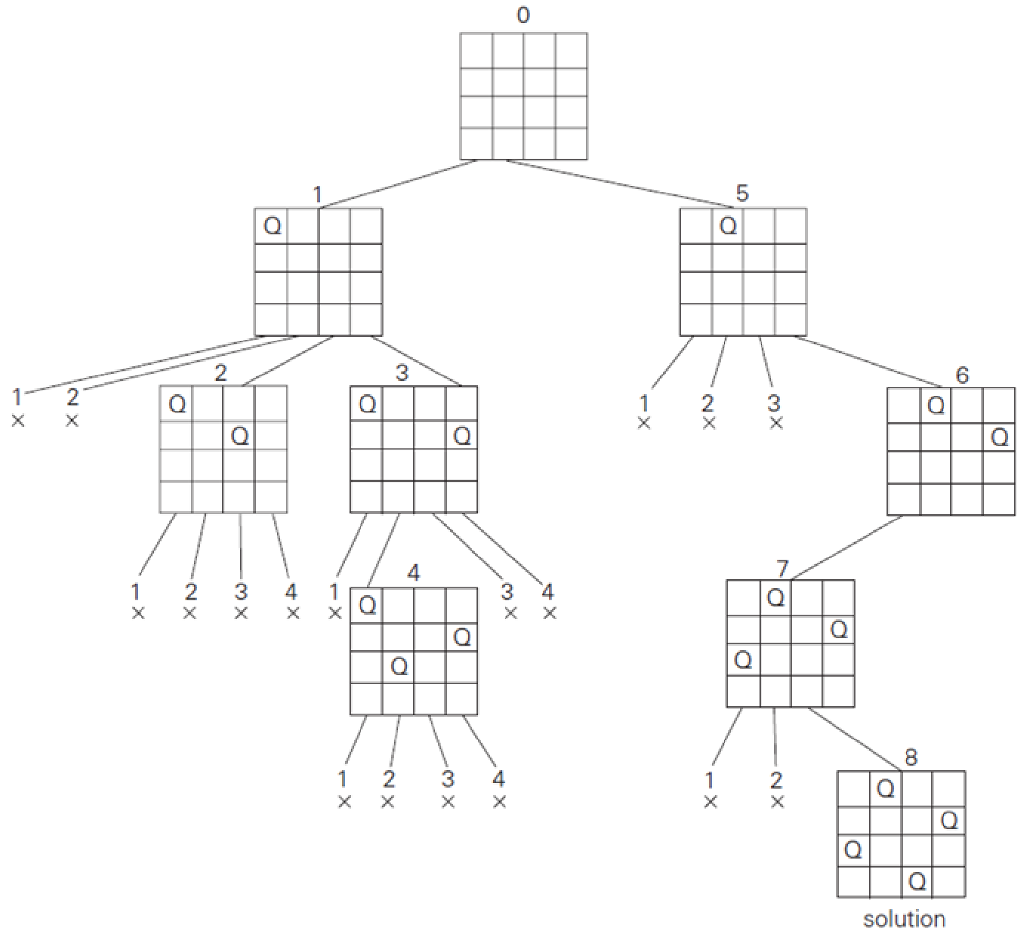
i \ j	0	1	2	3	4
1		1	2	3	3
2			2	3	3
3				3	3
4					4
5					



optimal BST

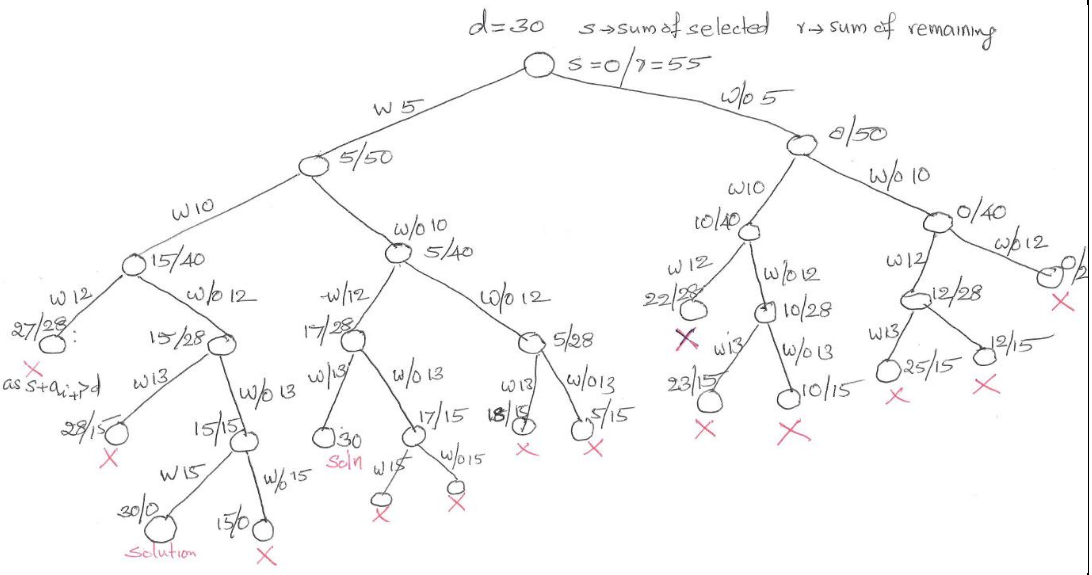
5	Use Backtracking to solve 4-queens problem. Show the state space tree.	[10]	CO3	L2

Ans:



6	.What is the central principle of back tracking? Apply backtracking to solve the below instance of the subset sum problem. Draw the state space tree. S={5,10,12,13,15}, d=30.	[10]	CO3	L3

Ans: Backtracking is a more intelligent variation of exhaustive search. The principal idea is to construct solutions one component at a time and evaluate such partially constructed candidates as follows. If a partially constructed solution can be developed further without violating the problem's constraints, it is done by taking the first remaining legitimate option for the next component. If there is no legitimate option for the next component, no alternatives for any remaining component need to be considered. In this case, the algorithm backtracks to replace the last component of the partially constructed solution with its next option.



The subsets that have a sum of 30 are {5,10,15} and {5,12,13}

BEST OF LUCK

CO-PO and CO-PSO Mapping																				
Course Outcomes		**Blooms Level**	**Modules covered**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	Describe the computational solution to well-known	**L1**	1,2	2	3	2	2	-	2	-	-	2	-	-	-	2	-	-	2

	problems like searching and sorting																		
CO2	Estimate computational complexity of various algorithms.	**L2**	1,2,3,4,5	3	3	2	2	-	2	-	-	2	-	-	-	2	-	-	2
CO3	Devise an algorithm using appropriate design strategies for computation problems.	**L3**	2,3,4,5	3	3	2	2	-	2	-	-	2	-	-	-	2	-	-	2

COGNITIVE LEVEL	REVISED BLOOMS TAXONOMY KEYWORDS
L1	List, define, tell, describe, identify, show, label, collect, examine, tabulate, quote, name, who, when, where, etc.
L2	summarize, describe, interpret, contrast, predict, associate, distinguish, estimate, differentiate, discuss, extend
L3	Apply, demonstrate, calculate, complete, illustrate, show, solve, examine, modify, relate, change, classify, experiment, discover.
L4	Analyze, separate, order, explain, connect, classify, arrange, divide, compare, select, explain, infer.
L5	Assess, decide, rank, grade, test, measure, recommend, convince, select, judge, explain, discriminate, support, conclude, compare, summarize.

PROGRAM OUTCOMES (PO), PROGRAM SPECIFIC OUTCOMES (PSO)				CORRELATION LEVELS	
PO1	Engineering knowledge	PO7	Environment and sustainability	0	No Correlation
PO2	Problem analysis	PO8	Ethics	1	Slight/Low
PO3	Design/development of solutions	PO9	Individual and team work	2	Moderate/ Medium
PO4	Conduct investigations of complex problems	PO10	Communication	3	Substantial/ High
PO5	Modern tool usage	PO11	Project management and finance		
PO6	The Engineer and society	PO12	Life-long learning		