

CS502-Fundamentals of Algorithms

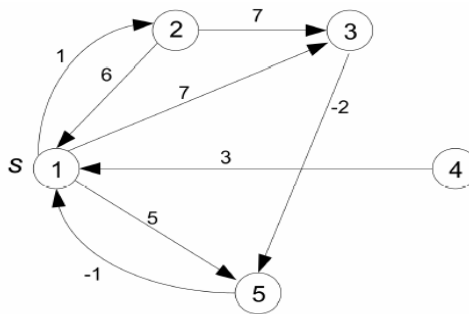
Final Term Examination – spring 2006

Time Allowed: 150 Minutes

Question No. 1

Marks : 15

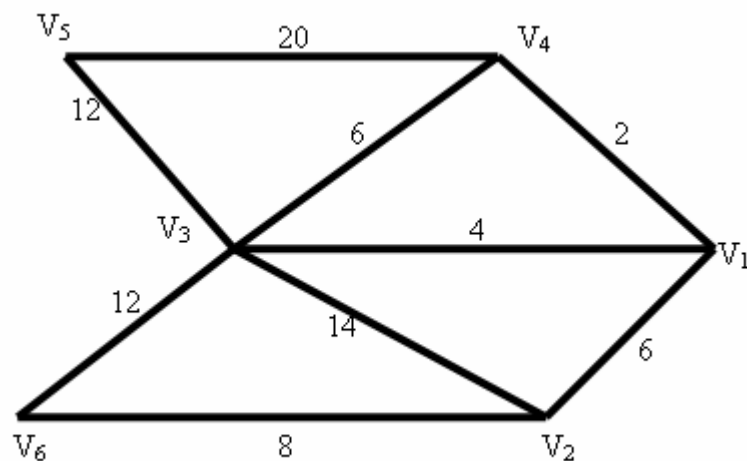
Compute all-pairs shortest paths using Floyd-Warshall algorithm on the following graph



Question No. 2

Marks : 15

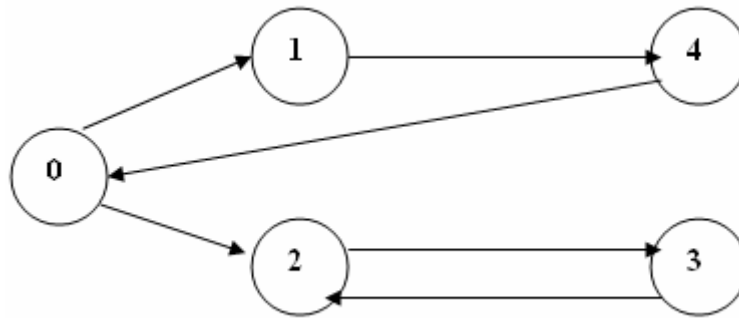
Use Prim's Algorithm starting with vertex " V_1 " to find the minimal spanning tree for the graph



Question No. 3

Marks : 10

Consider the following *digraph*



- (a) Find the adjacency matrix of this graph
 (b) List the *strongly connected components* of this digraph

Question No. 4

Marks : 1

If a graph has v vertices and e edges. Then to obtain a spanning tree we have to delete

- v edges
- $v - e + 5$ edges
- $v + e$ edges
- None of these

Question No. 5

Marks : 1

Which of the following is not true about Dijkstra's algorithm?

- I. The length of the shortest path to the start vertex is always zero
- II. It takes time polynomial to the number of vertices
- III. It will work on any weighted graph with positive weights
- IV. It can be implemented to run in $O(V)$ time

- Only II
- Only IV
- Both II and IV
- None of these

Question No. 6

Marks : 1

If a problem is not in P, it must be NP-complete

- Yes
- No
- Unknown

Question No. 7

Marks : 15

You are managing 300 million dollars. From this money you can sponsor 4 projects P_1 , P_2 , P_3 , and P_4 with total cost no more than 300 million dollars. The project P_1 has cost 60 million and generates a profit 20 millions, the, project P_2 has cost 240 million and generates a profit 500

millions, the project P_3 has cost 180 million and generates a profit 300 millions ,the project P_4 has cost 120 million and generates a profit 210 millions

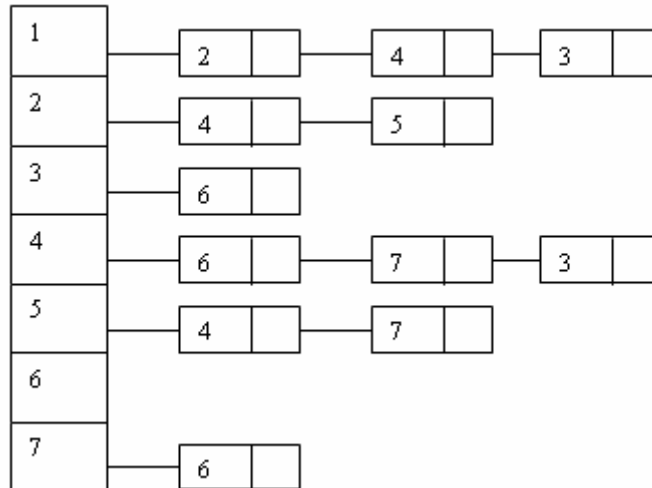
Find out which projects to sponsor so that you get the largest profit.

Hint: This is the classic 0-1 knapsack problem

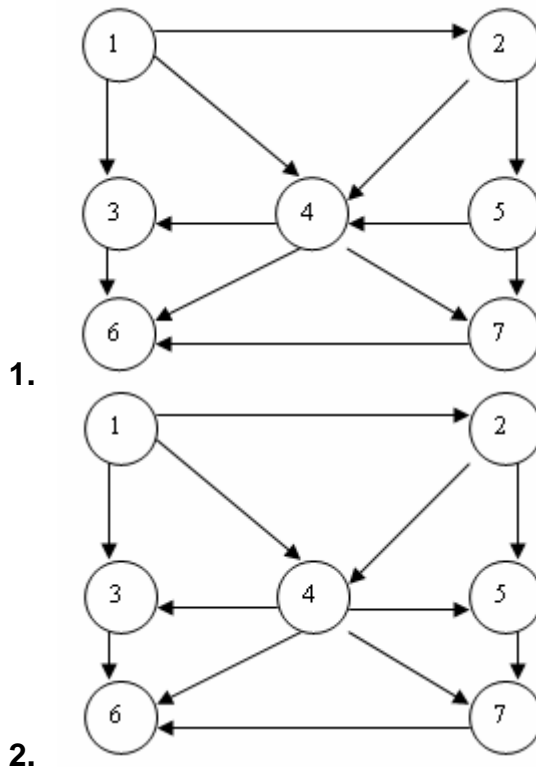
Question No. 8

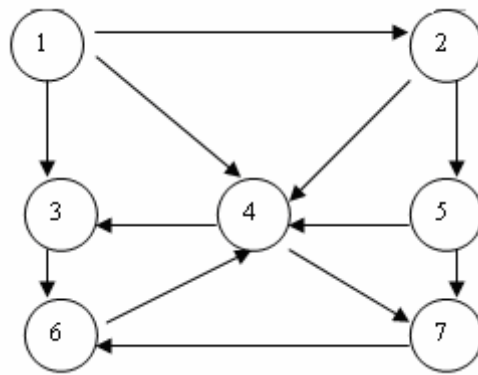
Marks : 1

Consider the following adjacency list:

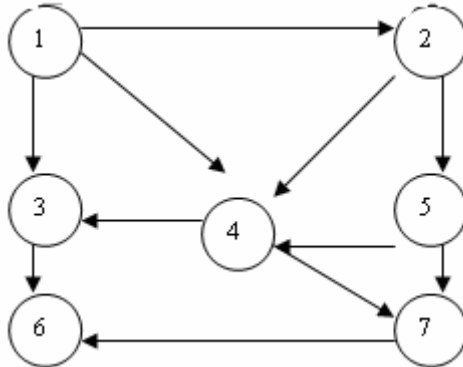


Which of the following graph(s) describe(s) the above adjacency list?

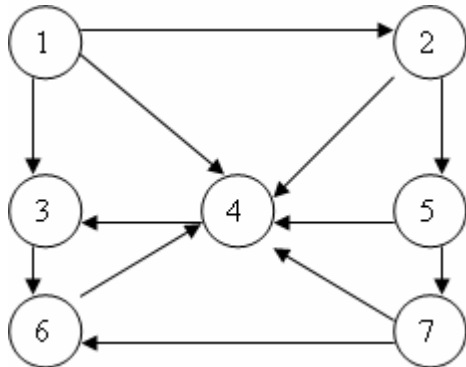




3.



4.



5.

Question No. 9

Marks : 1

Which statement is true

- (I) The running time of Bellman-Ford algorithm is $\Theta(V^2E)$
- (II) Both Dijkstra's algorithm and Bellman-Ford are based on performing repeated relaxations
- (III) The 0-1 knapsack problem is hard to solve

- Only I
- Only III
- Both I and III
- All of these

Question No. 10

Marks : 1

The recurrence relation of Tower of Hanoi is given below

$$T(n) = \begin{cases} 1 & \text{if } n=1 \\ 2T(n-1)+1 & \text{if } n>1 \end{cases}$$

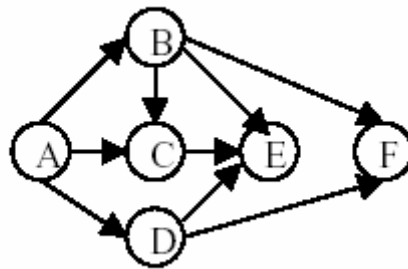
In order to move a tower of 4 rings from one peg to another, how many ring moves are required

- 15
- 7
- 12
- None of these

Question No. 11

Marks : 1

Which sequence is not a valid topological order of the directed graph shown below?



- ABDCEF
- ADBCEF
- ABCDFE
- ADBCFE
- ABDFEC

Question No. 12

Marks : 1

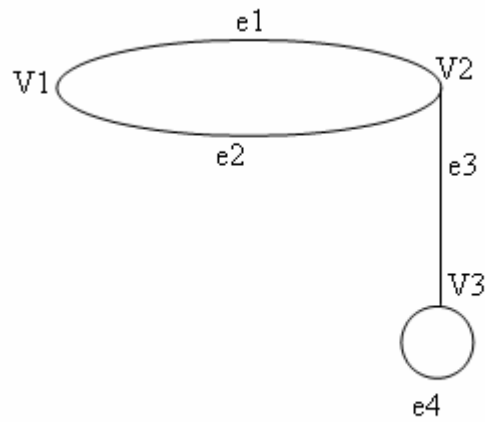
Suppose we have two problems A and B .Problem A is polynomial-time reducible and problem B is NP-complete. If we reduce problem A into B then problem A becomes NP-complete

- Yes
- No

Question No. 13

Marks : 1

The total degrees of the following graph G



are

- 4
- 5
- 7
- 8

Question No. 14

Marks : 1

Which of the following arrays represent descending (max) heaps?

- I. [10,7,7,2,4,6]
- II. [10,7,6,2,4,7]
- III. [10,6,7,2,4,6]
- IV. [6,6,7,2,4,10]

- Only II
- Only IV
- Both II and IV
- Both I and III

Question No. 15

Marks : 1

Which of the following statement(s) is/are correct?

- (a) $O(n \log n + n^2) = O(n^2)$.
- (b) $O(n \log n + n^2) = O(n^2 \log 2n)$
- (c) $O(c n^2) = O(n^2)$ where c is a constant.
- (d) $O(c n^2) = O(c)$ where c is a constant.
- (e) $O(c) = O(1)$ where c is a constant.

- Only (a)
- Only (c)
- Both (a) and (e)
- Both (c) and (e)

- (a) ,(c),(e)

Question No. 16

Marks : 1

The adjacency matrix say $A = [a_{ij}]$ is defined as

$$a_{ij} = \begin{cases} 1 & \text{if } \{v_i, v_j\} \text{ is an edge of } G \\ 0 & \text{otherwise} \end{cases}$$

•

$$a_{ij} = \begin{cases} 0 & \text{if } \{v_i, v_j\} \text{ is an edge of } G \\ 1 & \text{otherwise} \end{cases}$$

•

$$a_{ij} = \begin{cases} -1 & \text{if } \{v_i, v_j\} \text{ is an edge of } G \\ 0 & \text{otherwise} \end{cases}$$

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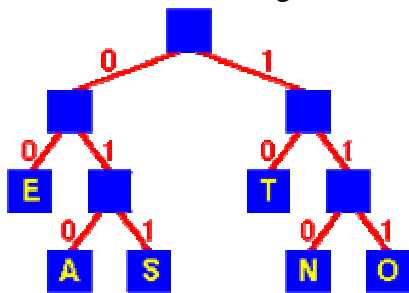
$$a_{ij} = \begin{cases} 0 & \text{if } \{v_i, v_j\} \text{ is an edge of } G \\ -1 & \text{otherwise} \end{cases}$$

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Question No. 17

Marks : 1

Consider the following Huffman Tree



The binary code for the string “TEA” is

- 10 00 010
- 011 00 010
- 10 00 110
- None of these

Question No. 18

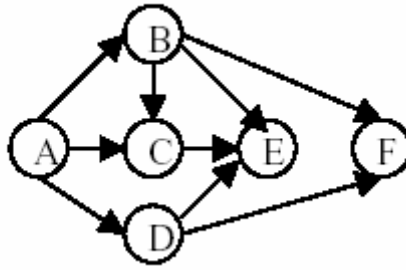
Marks : 1

Which of the shortest path algorithms would be most appropriate for finding paths in the graph with negative edge weights and cycles?

- I. Dijkstra's Algorithm
- II. Bellman-Ford Algorithm
- III. Floyd Warshall Algorithm

- Only II
- Only III
- Both II and III

Which of the following orders is not a possible order in which **Depth First Search** can visit the vertices of the directed graph shown below?



- ABCEFD
- ACEBFD
- ADFEBC
- ADFBCE
- ABFECD