(B) subset sum problem
(C) fractional knapsack problem
(D) all pairs shortest path problem
(E) Matrix chain Multiplication
(F) Longest common subsequence problem
(G) Tower of Hanoi problem
(H) Fibonacci sequence
(I) Huffman coding

21. Which of the following expression represents the total number of ways of parenthesizing an expression with n pairs of parentheses?
(A) $\binom{2n}{n}$
(B) $n!$
(C) $\frac{\binom{2(n-1)}{(n-1)}}{n}$
(D) $\frac{\binom{2n}{n}}{n+1}$

22. What is the time and space complexity of dynamic programming approach to solve the boolean parenthesizing problem?
(A) $O(n^2)$, $O(n^2)$
(B) $O(n^3)$, $O(n^2)$
(C) $O(n^4)$, $O(n^2)$
(D) Exponential, $O(n^2)$

8 Greedy Approach

1. Which of the following is true about Huffman Coding.
(A) Huffman coding may not return optimum encoding in all cases
(B) No code is prefix of any other code.
(C) Huffman Codes may be lossy in some cases
(D) All of the above

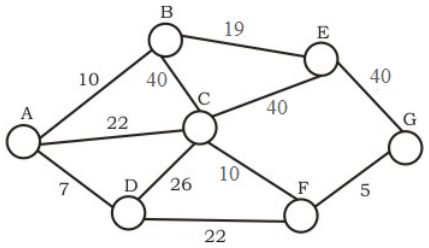
2. Suppose the letters a, b, c, d, e, f have probabilities $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$,$\frac{1}{16}$, $\frac{1}{32}$, $\frac{1}{32}$ respectively.
Which of the following is the Huffman code for the letter a, b, c, d, e, f?

(A) 0, 10, 110, 1110, 11110, 11111
(B) 11, 10, 011, 010, 001, 000
(C) 11, 10, 01, 001, 0001, 0000
(D) 110, 100, 010, 000, 001, 111

3. In the correct encoding of above question, what is the average length of huffman code for any character?

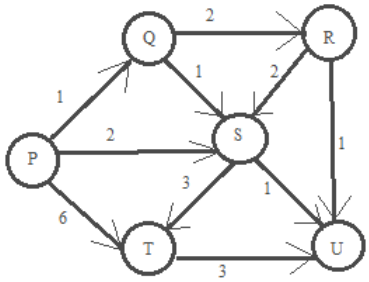
(A) 3
(B) 1.1875
(C) 2.25
(D) 1.9375

4. Consider the undirected graph shown below:



Prims algorithm is applied in order to construct minimum spanning tree starting with node A, which one of the following sequences of edges represents a possible order in which the edges would be added to construct the minimum spanning tree?
(A) (A, B), (A, D), (B, E), (B, C), (C, F), (F, G)
(B) (A, D), (A, B), (B, E), (A, C), (C, F), (F, G)
(C) (A, B), (A, D), (B, E), (E, G), (G, F), (F, C)
(D) (A, D), (A, B), (D, F), (F, G), (F, C), (G, E)
(E) (A, D), (A, B), (B, E), (E, C), (C, F), (F, G)
(F) (A, D), (A, B), (B, E), (D, F), (F, G), (F, C)

5. Suppose we run Dijkstra's single source shortest-path algorithm on the following edge weighted directed graph with vertex P as the source.



In what order do the nodes get included into the set of vertices for which the shortest path distances are finalized?
(A) P,Q,R,S,T,U
(B) P,S,Q,R,T,U
(C) P,Q,R,S,U,T
(D) P,Q,S,R,U,T

6. Which of the following best expresses the construction of Huffman coding tree given a sorted array of integer keys with array size n:
   (A) $O(\log n)$
   (B) $O(n)$
   (C) $O(n \log n)$
   (D) $O(n^{\log n})$

7. Consider a system in which there are only 6 characters in its alphabet, which form all types of words in this system. Following are shown the frequencies of these characters:
   p: 2
   t: 4
   r: 6
   s: 8
   o: 9
   u: 10
   Before sending a message, it is encoded with the help of Huffman coding scheme. For this system, which of the following bit-strings represents the encoded form of "sprouts"?
   (A) 0011001110110110100
   (B) 0011011110111101000
   (C) 00110011111110111010100
   (D) 0011001110110111010100

8. In above question, if each character takes a nibble, what percentage of data is saved using Huffman coding scheme while sending above message.
   (A) 42%
   (B) 32%
   (C) 50%
   (D) 53%
   (E) 45%

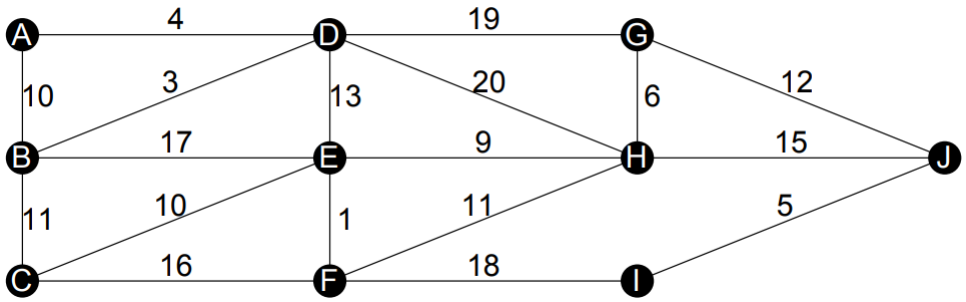
9. A traitor transmits a message to his hometown using Huffman coding scheme. The transmitted message is:
   1000 110111101011100 00110101110000
   Write down the actual message which is sent using above encoding? What percentage of bits is saved using Huffman coding scheme?

10. A text is made up of the characters a, b, c, d, e each occurring with the probability 0.11, 0.40, 0.16, 0.09 and 0.24 respectively. What is the average length of The Huffman coding technique will have the average length of:

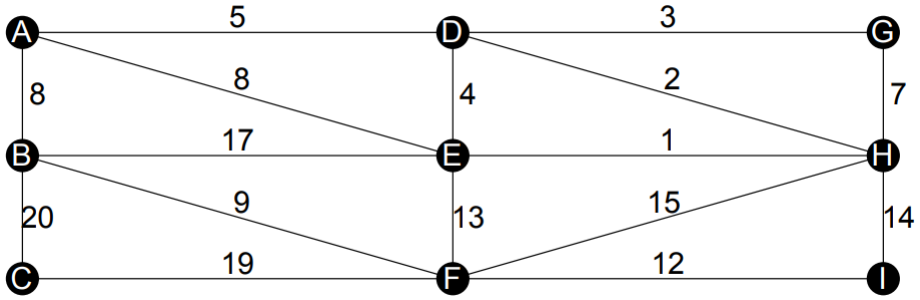
(A) 2.40
(B) 2.16
(C) 2.26
(D) 2.12

11. Prim's algorithm is a Greedy method to find a Minimum Spanning Tree abbreviated as *MST* of a given graph. Compute MST using Prim's algorithm for following graphs and compute the average weight of each of the edges in computed MSTs:

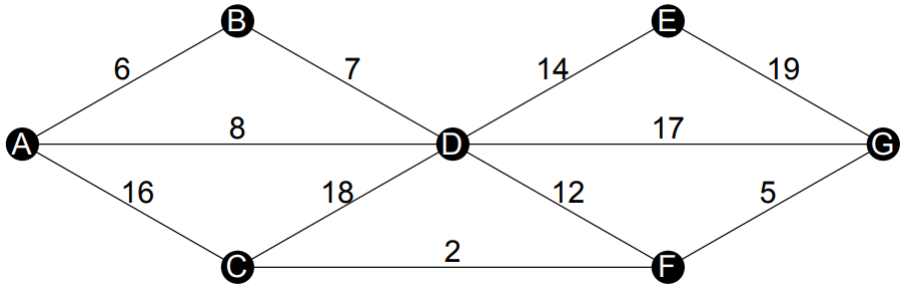
(A)



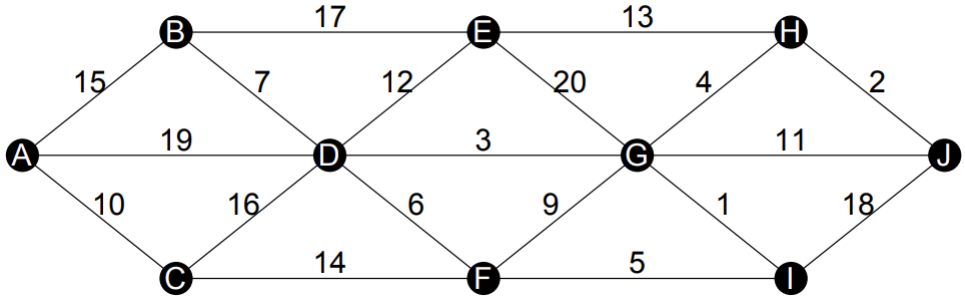
(B)



(C)

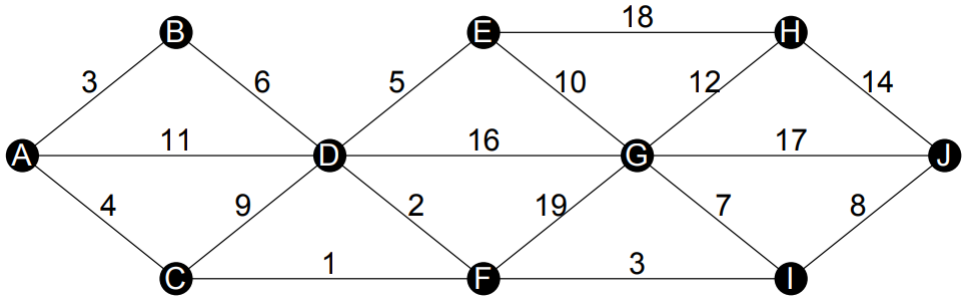


(D)

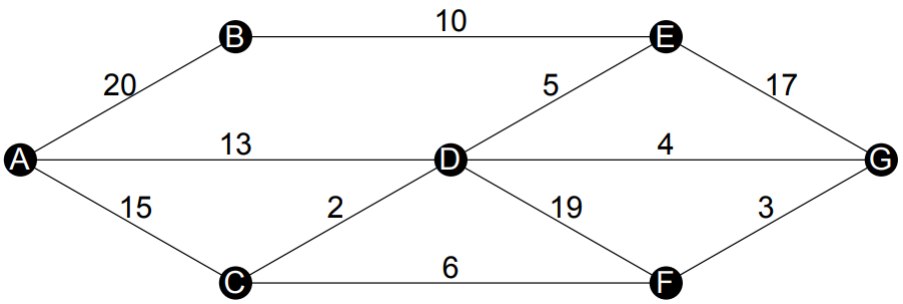


12. Kruskal's algorithm is another Greedy method to find a Minimum Spanning Tree abbreviated as *MST* of a given graph. Compute MST using Kruskal's algorithm for following graphs along with the average weight of each of the edges in computed MSTs:

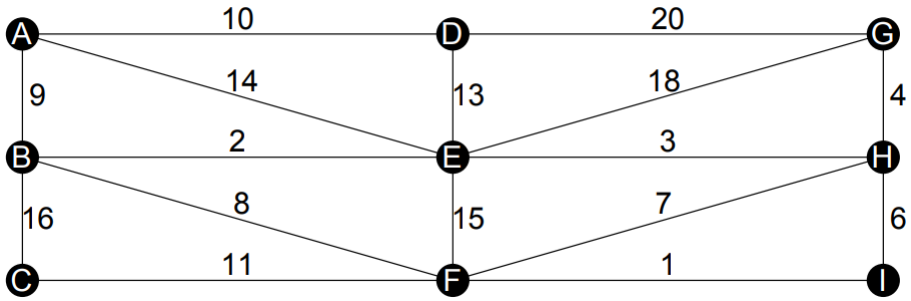
(A)



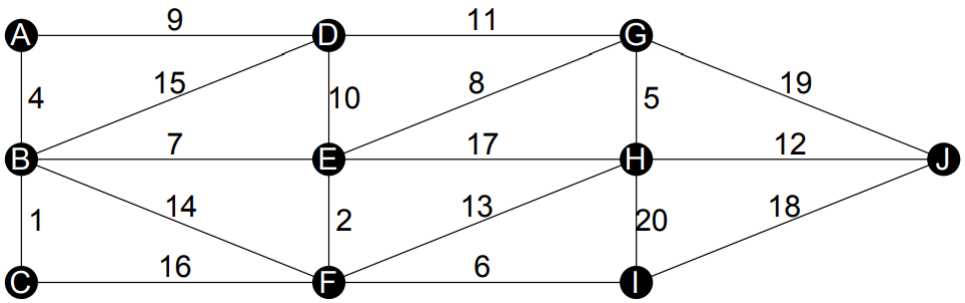
(B)



(C)



(D)



13. For each of the following tabular representation of some graph find Mini-

mum spanning tree. Along with this, if the distribution of weight on each unit length in the graph is W_{Graph} and the same for the corresponding MST is W_{MST}, find the absolute difference between the two terms.

(A)

	A	B	C	D	E
A	–	6	16	1	5
B	6	–	25	29	28
C	16	25	–	8	30
D	1	29	8	–	21
E	5	28	30	21	–

(B)

	A	B	C	D	E	F	G
A	–	23	10	20	7	13	22
B	23	–	2	4	27	9	15
C	10	2	–	18	17	11	25
D	20	4	18	–	1	12	8
E	7	27	17	1	–	29	16
F	13	9	11	12	29	–	6
G	22	15	25	8	16	6	–

(C)

	A	B	C	D	E	F
A	–	29	7	12	17	18
B	29	–	24	9	19	6
C	7	24	–	26	14	21
D	12	9	26	–	3	28
E	17	19	14	3	–	16
F	18	6	21	28	16	–

(D)

	A	B	C	D	E	F	G
A	–	5	11	30	25	27	8
B	5	–	1	15	22	13	2
C	11	1	–	10	23	20	4
D	30	15	10	–	12	26	3
E	25	22	23	12	–	24	19
F	27	13	20	26	24	–	14
G	8	2	4	3	19	14	–

14. Consider the three statements about Greedy approach:
(I) Greedy algorithm may depend on many choices but it can not depend on any choices of future.
(II) At each step first the sub-problem is solved and after that only the best possible choice is accepted which is in fact a local optimal solution but it may or may not return the globally optimal solution.
(III) The method of greedy algorithm is a top-down approach, creating greedy choices in a series and then reduce each of the given problem to even smaller ones.
Which of the following is true:
(A) (II) only
(B) (I) and (II) only
(C) (I) and (III) only
(D) (I) (II) and (III) only

(E) None of the above

15. Consider following statements about Prim's algorithm to compute an MST for a given graph.

(I) An edge is added to the tree, at every step which belongs to a cut, connecting to some node in the graph.
(II)It grows the tree until it spans all the edges in the graph.
(III) The edges in the subset of some minimum spanning tree always form a single tree.
(IV) An edge is added to the tree, if its weight is the minimum of any edge crossing the cut, connecting it to some node of the graph

Which of the following is true:
(A) (II) and (III) only
(B) (I), (II) and (III) only
(C) (III) only
(D) (I) (III) and (IV) only
(E) (III) and (IV) only
(F) None of the above.

16. Assume that there are unlimited supply of coins with denominator 60,40,15,2 and 1 are available. It is required to make a sum of 89 using minimum number of these coins. To solve this problem A uses Greedy approach while B uses Brute force.
Which one of the following represents the Difference between minimum number of coins computed by A and B?
(A) 0
(B) 1
(C) 2
(D) 3
(E) 4

17. Assume that there are unlimited supply of coins with denominator 1,10,21,34,70,100 and 350.

(I) Does Greedy approach help in making the sum= 140 with minimum number of coins? Is it optimum? By how much does it differ than Optimum number of coins?

(II) Does Greedy approach help in making the sum= 182 with minimum number of coins? Is it optimum? By how much does it differ than Opti-

mum number of coins?

18. Six Jobs with their Job_ID, Deadlines, Profits and Arrival-times respectively are represented in tuples as follows:
(a,2,200,0), (b,1,19,0), (c,2,27,1), (d,1,25,1), (e,3,15,0),(f,1,80,0)
, where Deadline is defined as number of wait-time units before the job expires while Arrival time is the time-instance when the process joined the Job-queue. Assuming that a job gets finished as soon as it is dispatched to be executed.
What should be the order of these jobs in order to maximize the overall profit of the sequence. Also write the maximum achievable profit of the sequence obtained.

9 Graphs

1. Let G be a complete undirected graph on 8 vertices. If vertices of G are labeled, then the number of distinct cycles of length 4 in G is equal to
(A) 150
(B) 90
(C) 140
(D) 210
(E) 70

2. Which of the following statements is/are TRUE for undirected graphs?
P: Number of even degree vertices is even.
Q: Sum of degrees of all odd-degree vertices is even.
R: Sum of degrees of all vertices is even.
(A) P only
(B) Q only
(C) R only
(D) Both P and Q
(E) Both Q and R
(F) All of the above
(E) None of the above

3. Consider an undirected random graph of ten vertices. The probability that there is an edge between a pair of vertices is $\frac{1}{2}$. What is the expected number of unordered cycles of length three?

(A) $\frac{1}{8}$

(B) $\frac{1}{10}$