

University of Rajshahi
Department of Computer Science and Engineering
B.Sc. (Engg.) Part-2 Even Semester Examination -2017
Course: CSE2221 (Design and Analysis of Algorithms)

Time: 3:00 Hours

Full Marks: 52.5

SECTION-A

ANSWER ANY THREE OF THE FOLLOWINGS

- 1.(a) Define algorithm. [1.5]
(b) Explain why we use O-notation. [03]
(c) Show the worst-case running time of insertion sort algorithm in terms of cost and times. [4.25]
- 2.(a) Show how a recursion tree can provide a good guess for the recurrence $T(n)=3T(n/4)+cn^2$. [3]
(b) Write the Heap sort algorithm for sorting N integer values in descending order. [4]
(c) Compare between divide-and-conquer method and dynamic programming. [1.75]
- 3.(a) What is optimization? Why optimization of the binary search tree is required? [1.75]
(b) What is meant by the term *optimum solution*? How is it related to dynamic programming approach? [2]
(c) State the dynamic programming approach for computing the multiplication order for multiplying series of matrix. [5]
- 4.(a) What is Greedy Algorithm? What kind of problems can be solved using greedy algorithm? [3]
(b) Why Huffman coding algorithm is used? [1]
(c) Assume that the following table states the character and its frequency in a text document, [4.75]
respectively:

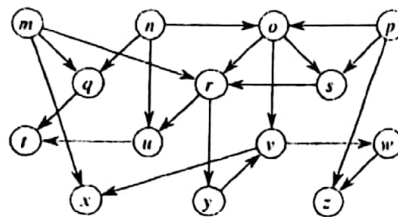
character	a	b	c	d	e	f
frequency	16	12	13	45	9	5

Can you generate the Huffman tree (with step by step explanation) for this given symbolic data?

SECTION-B

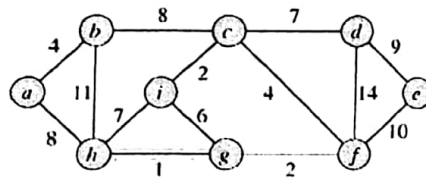
ANSWER ANY THREE OF THE FOLLOWINGS

- 5.(a) Given an input string "ABCA". Determine all the permutations of the given string such that no permutation is repeated. Show all the steps of generating the permutations. [4.25]
- (b) Given an input string "AABC". Determine all the possible subsets of the characters in the string. Show all the steps of generating the subsets. [4.5]
- 6.(a) What is topological sorting? How is it performed? [2]
- (b) Assume that the following graph is given: [3]



Find the Topological ordering of the given graph.

- (c) Assume that the following graph is given: [3.75]



Find the minimum spanning tree using the Kruskal Algorithm.

- 7.(a) What is Convex Hull? Explain the Graham's scan algorithm for finding convex hull with suitable example. [4]
- (b) How can we detect whether or not two line-segments are intersecting? Explain with example. [4.75]
- 8.(a) What is Backtracking? [2]
- (b) Assume that you are given a 4×4 chess board. You have to place 4 Queens on that board in such way that they do not attack each other. How can you solve the problem? [5]
- (c) What's the purpose of the following algorithms: BFS, DFS, Bellman-Ford, Dijkstra and Floyd-Warshall. [1.75]

University of Rajshahi
Department of Computer Science & Engineering
B.Sc. (Engg.) Part-2 (Even Semester) Examination 2016
Course: CSE2221 (Design and Analysis of Algorithms)
Full Marks: 52.5 Duration: 3(Three) Hours
Answer 06(Six) questions taking any 03(Three) questions from each part

Part-A

1. a) Define algorithm. Write down the properties of algorithm. 1+2
 b) What is meant by best case, worst case and average case complexity? 3
 c) If f is a function of data size n then what is meant by $O(f(n))$, $\Omega(f(n))$ and $\Theta(f(n))$ for analyzing algorithm? 2.75

2. a) Consider an array A that contains the following values 4.75
 $A = \{75, 176, 89, 24, 33, 5, 98, 55, 12, 91, 134, 29\}$
 If the above array A contains the frequency of character $a, b, c, d, e, f, g, h, i, j, k, l$ in a text file. What will be the minimum file size if we apply fixed length coding for each character? Compute the Huffman code for each character and also compute the file size after applying Huffman code for the characters.
 b) Write the quick sort algorithm for sorting N integer values in descending order. 4

3. a) What kind of problem can be solved using dynamic programming algorithm? 2
 b) Write an algorithm to compute and print the longest common subsequence of two strings. Show the computational data and the longest common subsequence of two strings 'extemporized' and 'maximization'. 6.75

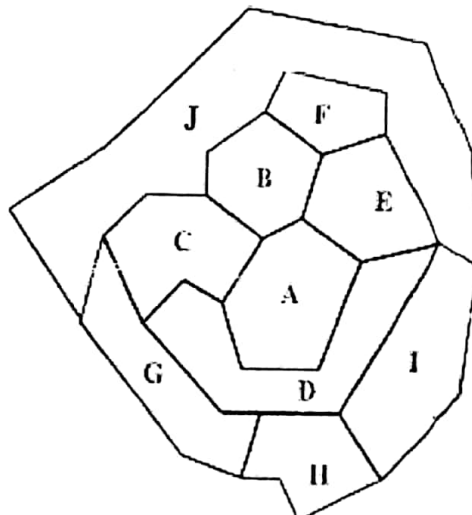
4. a) How does greedy algorithm work? 2
 b) Describe the worst-case, best-case and balanced partitioning of quick sort algorithm. 3
 c) Given a set of 10 activities along with their start time s_i and finish time f_i . 3.75

i	1	2	3	4	5	6	7	8	9	10
s_i	1	2	0	5	3	5	6	8	8	12
f_i	4	5	3	7	5	9	10	11	12	16

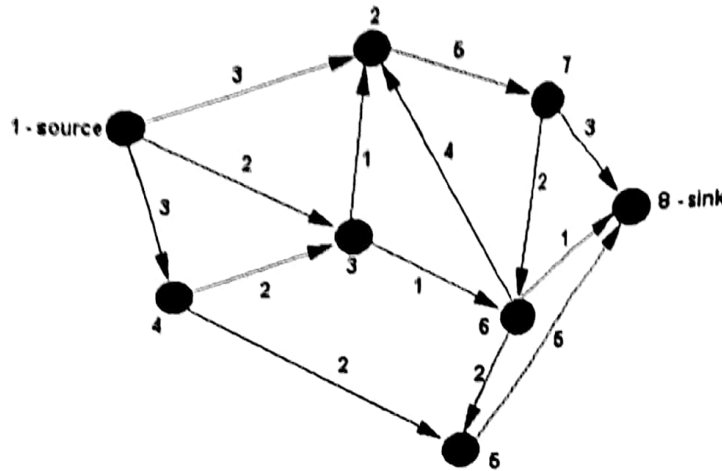
Choose the maximum number of activities from the above list, so that no two activities overlap each other.

Part-B

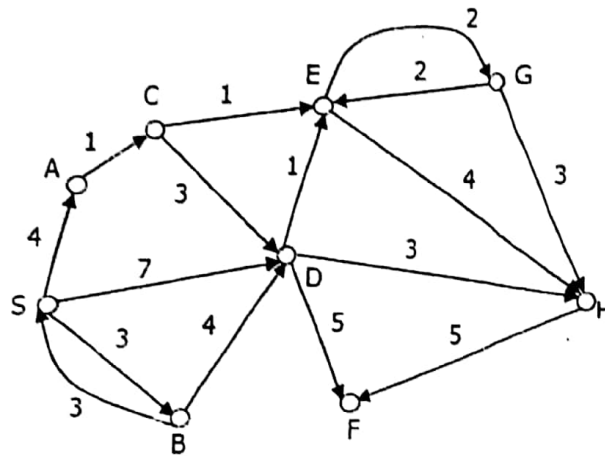
5. a) What is the typical input and output of a computational geometry problem? 2
 b) Write the algorithm to determine whether two line segments intersect. 4
 c) Compute the minimum number of distinct color required to fill the following map, so that no two adjacent regions are the same color? List the color for each region, if you assign distinct integer value as color identifier. 2.75



6. a) State the Ford-Fulkerson algorithm for computing maximum flow in a flow network.
 b) Compute the maximum flow from source to sink for the following flow network, where each edge weight W_{ij} defines maximum flow capacity from node i to node j . Also show the final residual network and residual capacity of each edge.



7. a) State the optimal substructure property of graph. 1
 b) Write down the algorithm to decompose a directed graph into its strongly connected components. 2.5
 c) Write the Prim's algorithm to determine minimum spanning tree for a given graph. 2.75
 d) Show the shortest path and distance from node S to all other nodes for the following directed graph, where each edge weight W_{ij} defines distance from node i to node j . 2.5



8. a) Given a set of non-negative integers 2, 3, 7, 8, 10 and a value 11. Determine if there is a subset of the given set with sum is equal to to given value 11. Show all steps of your algorithm. 3.75
 b) A businessman wants to import some goods in order to sell them in local market so that he could gain some profit after selling the items. The problem is he could buy maximum one unit of each items. Moreover, he had only 1,20,000 Taka. Formulate a 0-1 Knapsack problem for the given problem and compute the items that could be chosen for selling to maximize the profit. Also show the searching tree for selecting the items using the algorithm. The item name, item buying price and sell profit is given as follow. 5

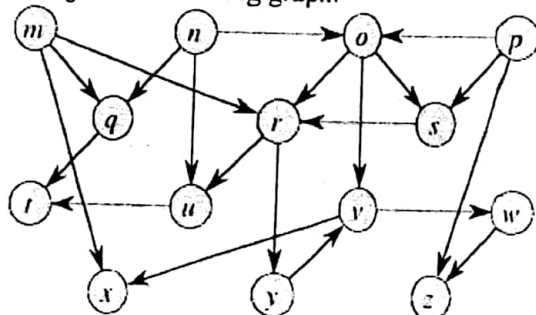
Product name	Unit price	Sell profit
Laptop	40,000	4,400
Tablet PC	17,500	2,100
Music Player	9,000	900
Gaming Console	21,600	2,700
Projector	35,000	4,550
Home Theatre	30,000	2,700

University of Rajshahi
Department of Computer Science & Engineering
 2nd Year Even Semester Examination 2015
 Course: CSE2221 (Design and Analysis of Algorithms)
 Full Marks: 52.5 Duration: 3(Three) Hours
 Answer 06(Six) questions taking any 03(Three) questions from each part

Part-A

1. a) Define algorithm. What are the steps required for algorithm design? 2+2
 b) Explain why we use O-notation. 3
 c) Write down the complexity of bubble sort, quick sort, selection sort, heap sort and binary search algorithm for n number of data. 1.75

2. a) Write down the algorithm to maintain the heap property. 3.75
 b) Consider an array X that contains the following values.
 $X = \{182, 11, 121, 75, 98, 33, 215, 43\}$ 5
 Lets consider the above array X contains the frequency of character a, b, c, d, e, f, g, h in a text file. What will be file size if we apply fixed length coding for each character? Compute the Huffman code for each character and also compute the file size after applying Huffman code for the characters.

3. a) Show the topological sorting of the following graph. 3

 b) State the dynamic programming approach for computing the multiplication order for multiplying series of matrix. 4
 c) What is meant by time and space analysis of algorithm? 1.75

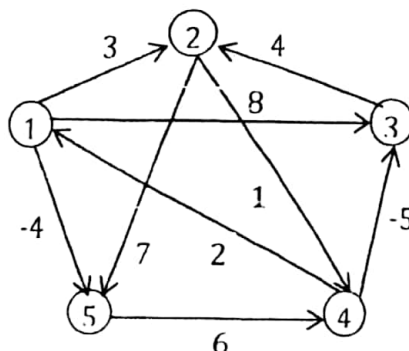
4. a) Explain why we cannot apply $\Omega(n \log n)$ lower bound for some sorting algorithms that run in linear time. 2.75
 b) Show the steps for sorting the following array using counting sort algorithm. 4

2	5	3	0	2	3	0	3
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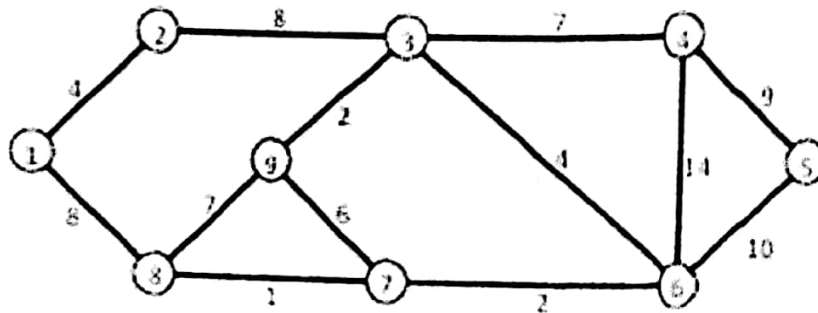
 c) Show the worst-case running time for Bucket-sort algorithm. 1

Part-B

5. a) Show the solution to all pairs shortest-paths problem using Floyd-Warshall algorithm. 4.25
 b) Show all the matrices for the following graph using Floyd-Warshall algorithm. 4.5



6. a) What is minimum spanning tree? Write down the Kruskal's algorithm to find minimum spanning tree. 4.75



- b) Discover the adjacency-matrix and adjacency-list representation of the above graph. Also compute its minimum spanning tree using Prim's algorithm. 2+2
7. a) Write the algorithm for placing n chess queens on a $n \times n$ chessboard so that no queens can attack each other. 3.5
- b) Write an algorithm for solving 0-1 Knapsack problem. 4
- c) What does mean by polynomial time? 1.25
8. a) Write an algorithm for determining whether any pair of line segments intersects. 4.25
- b) Write an algorithm for finding the convex hull of n points in a two dimensional plane. 4.5

University of Rajshahi
Department of Computer Science & Engineering
 B. Sc. (Engg.) Part-II Even Semester Examination 2014
 Course: CSE-2221 (Design and Analysis of Algorithms)
 Full Marks: 52.5 Duration: 3(Three) Hours
Answer 06(Six) questions taking any 03(Three) questions from each part

Part-A

1. a) Define algorithm. Write down the properties of algorithm. 2+2
 b) If f is a function of data size n then what is meant by $O(f(n))$, $\Omega(f(n))$ and $\Theta(f(n))$ for analyzing algorithm? 3
 c) What does best, worst, and average-case complexity mean? 1.75

2. a) Consider the algorithms for two procedures as follow: 3.75
 $A = \{45, 11, 21, 55, 9, 13, 33, 27, 15, 42, 35, 36\}$
 ARRANGE (A, n)
 1. $l \leftarrow 2 * n$
 2. $r \leftarrow 2 * n + 1$
 3. if $l \leq A.size$ and $A[l] < A[n]$
 4. $h = l$
 5. else
 6. $h = n$
 7. if $r \leq A.size$ and $A[r] < A[h]$
 8. $h = r$
 9. if $h \neq n$
 10. exchange $A[n] \leftrightarrow A[h]$
 11. ARRANGE (A, h)
 CONSTRUCT (A)
 1. $A.size = A.length$
 2. for $n = [A.length/2]$ downto 1
 3. ARRANGE (A, n)
 If the array A initially contains the values $\{45, 11, 21, 55, 9, 13, 33, 27, 15, 42, 35, 36\}$, then find the order of values on the array A after calling the procedure CONSTRUCT (A).
 b) Write down the quick-sort algorithm for sorting an array of string. 5

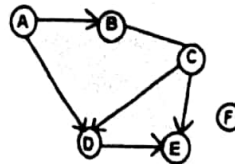
3. a) What does dynamic programming mean? When we can apply dynamic programming algorithm to solve a problem. 2
 b) Write two algorithms for solving matrix chain multiplication problem with recursive procedure approach and dynamic programming approach. Also compare between two algorithms for solving matrix chain multiplication problem. 6.75

4. a) What do you understand by 'binary tree', 'binary search tree' and 'optimal binary search tree'? Give proper examples. 2.25
 b) What are the disadvantages of using a binary search tree? 2
 c) Write an algorithm to delete an element from a binary search tree. 4.5

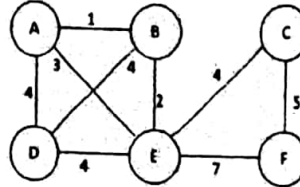
Part-B

5. a) Define backtracking. 1.75
 b) Show the position of 6 chess queens on a 6x6 chessboard so that no queens can attack each other. 3
 c) Write down Bellman-Ford routing algorithm. 4

6. a) Show the steps of topological sort for the following directed graph.



- b) Find ST (Spanning Tree) and MST (Minimum Spanning Tree) from the following graph.



- c) Show that, if a graph's edges all have distinct weights, the MST is unique. 1.75
7. a) Write some applications of DFS and BFS algorithms. 3
- b) Distinguish between backtracking and branch & bound algorithm. 1.75
- c) Write down the algorithm for coloring a graph so that no two adjacent vertices have same color. 4
8. a) Compare the Bellman-Ford algorithm and Dijkstra's algorithm for computing single source shortest path. 2
- b) Write an algorithm for solving 0-1 Knapsack problem. A businessman wants to import some goods in order to sell them in local market so that he could gain some profit after selling the items. The problem is he could buy maximum 2(two) units of each items. Moreover he had only 1,50,000 taka. Formulate a 0-1 Knapsack problem for the given problem and compute the items with quantity that could be chosen for selling to maximize the profit. Also show the searching tree for selecting the items using the algorithm. The item name, item buying price and sell profit is given as follow. 6.75

Product name	Unit price	Sell profit
Laptop	41,000	4,000
Tablet PC	20,500	2,100
Music Player	9,000	850
Gaming Console	25,000	2,600
Projector	46,000	4,900

Department of Computer Science and Engineering

B.Sc. Engg. Part II Even Semester Examination 2013 (Session 2011-12)

Course: CSE 2221: Design and Analysis of Algorithms

Marks: 52%

Time: 3 Hours

Answer any six (06) questions taking three questions from each part.

Part A

- 1.a) Define algorithm. Write down the properties of algorithm. 2+2
- b) If f is a function of data size n then what is meant by $O(f(n))$, $\Omega(f(n))$ and $\Theta(f(n))$ for analyzing algorithm. 3
- c) Write down the complexity of bubble sort, quick sort, selection sort, heap sort and binary search algorithm for m number of data. 1%
2. Consider an array A that contains the following values: 3%
 $A = \{42, 11, 21, 55, 9, 13, 33, 27, 15, 43, 35, 36\}$
 - a) Given an algorithm of a procedure as follow:
BRANCH (A, p, r)
 1. $x \leftarrow A[p]$
 2. $i \leftarrow p - 1$
 3. $j \leftarrow r + 1$
 4. **while** **TRUE**
 5. **do repeat** $j \leftarrow j - 1$
 6. **until** $A[j] < x$
 7. **do repeat** $i \leftarrow i + 1$
 8. **until** $A[i] > x$
 9. **if** $i < j$
 10. **then exchange** $A[i] \leftrightarrow A[j]$
 11. **else return** j

If the procedure was called with $p=1$ & $r=10$, then what will be the sequence of values in array A after calling the procedure? What will be the return value of the procedure?
 - b) Let's consider the above array A contains the frequency of character $a, b, c, d, e, f, g, h, i, j, k, l$ in a text file. What will be the minimum file size if we apply fixed length coding for each character? Compute the Huffman code for each character and also compute the file size after applying Huffman code for the characters. 5%
- 3.a) Compare between divide-and-conquer method and dynamic programming. 2
- b) Write an algorithm to compute and print the longest common subsequence of two strings. Show the computational data and the longest common subsequence of two strings 'information' and 'communication'. 6%
- 4.a) Show that the average complexity of Merge-sort algorithm is $O(n \log n)$. 4
- b) Write down the HEAPSORT algorithm. 4%

Part B

- 5.a) Define binary search tree with example. Write down the main properties of binary search tree. 4%
- b) What are Huffman trees? Explain how to construct Huffman trees. Construct Huffman Tree for the following data set $f: 5, e: 9, c: 12, b: 13, d: 16, a: 45$ where alphabets represent the data and numbers represent their corresponding frequencies. 4
- 6.a) Define graph with example. 1%
- b) Draw a directed graph with the following adjacency list 2%
 $*A: F, C, B; *B: G, C; *C: F; *D: C; *E: D, C, J; *F: D; *G: C, E; *J: D, K; *K: E, G;$
- c) Write the Dijkstra's algorithm to find the shortest path in weighted graph. 4%
- 7.a) Write the algorithm for determining whether two line segments intersect. 4
- b) Write the algorithm for finding the closest pair of points in a set of n points. 4%
- 8.a) Describe how to determine whether consecutive line segments turn left or right. 4
- b) Define P, NP and NPC problem? How can you prove that a problem is NP-complete? 4%

University of Rajshahi
Department of Computer Science and Engineering
2nd Year 2nd Semester Examination 2012
Course: CSE2211-Design and Analysis of Algorithms

Full Marks: 52.5

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 Dept. of Computer Science &
 Engineering
 University of Rajshahi.

Time: 04 hours

(Answer SIX questions taking any **THREE** from each groups)

Part-A

1.
 - a) What is an Algorithm? What is the need to study Algorithms? 2
 - b) Define: i) Time Efficiency ii) Space Efficiency 2
 - c) What are different ways of measuring the running time of an algorithm? 2
 - d) What is Order of Growth? Define Worst case, Average case and Best case efficiencies. $2\frac{3}{4}$

2.
 - a) Explain the Quick Sort algorithm. Analyze the efficiency of Quick sort algorithm. 4
 - b) Apply Quick sort algorithm to sort the list E,X,A,M,P,L,E in alphabetical order. $2\frac{3}{4}$
 - c) How much time does the following "algorithm" require as a function of n: 2

$m \leftarrow 0$
 for i \leftarrow 1 to n do
 for j \leftarrow 1 to n^2 do
 for k \leftarrow 1 to n^3 do
 $m \leftarrow m + 1$

3.
 - a) What is Heap? What are the different types of heaps? Explain how do you construct heap? Explain the Heap Sort algorithm with an example. 4
 - b) Explain the Merge Sort algorithm with an example and also draw the tree structure of the recursive calls made. Analyze the efficiency of Merge sort algorithm. 3
 - c) What are Huffman trees? Explain how to construct Huffman trees with an example. $1\frac{3}{4}$

4.
 - a) What is P, NP and NPC problem? How can you prove that a problem is NP-complete? 3
 - b) Describe the recursive solution of Matrix-Chain multiplication problem. 4
 - c) What kind of problem can be solved using dynamic programming algorithm? $1\frac{3}{4}$

Part-B

5. a) Write a pseudo code for a divide and conquer algorithm for finding values of both the largest and the smallest elements in any array of n numbers. $4\frac{3}{4}$
b) Explain Divide and Conquer technique and give the general divide and conquer recurrence. 4
6. a) Describe how to determine whether consecutive segments turn left to right. 3
b) What is convex hull? $1\frac{3}{4}$
c) Write down the algorithm to determine whether any pair of segments intersects. 4
7. a) Explain the concept of Backtracking with an example. How is it implemented in knapsack problem? 4
b) A thief with a knapsack, can steal ' n '. Each item I_i has a certain weight w_i and value v_i . The maximum capacity of the knapsack is W . Devise an algorithm which fills the knapsack with the maximum possible value. Perform your algorithm over the given set of values. $4\frac{3}{4}$
- | | | | |
|--------|-------|-------|-------|
| Item | I_1 | I_2 | I_3 |
| Weight | 80 | 30 | 40 |
| Value | 20 | 15 | 14 |
8. a) Describe two standard ways to represent a graph. 3
b) Explain Dijkstra's graph algorithm. 4
c) What is the difference between Kruskal's algorithm and Prim's algorithm? $1\frac{3}{4}$