ALLAMA IQBAL OPEN UNIVERSITY, ISLAMABAD

(Department of Computer Science)

WARNING

1. **PLAGIARISM OR HIRING OF GHOST WRITER(S) FOR SOLVING THE ASSIGNMENT(S) WILL DEBAR THE STUDENT FROM AWARD OF DEGREE/CERTIFICATE, IF FOUND AT ANY STAGE.**
2. **SUBMITTING ASSIGNMENTS BORROWED OR STOLEN FROM OTHER(S) AS ONE'S OWN WILL BE PENALIZED AS DEFINED IN "AIOU PLAGIARISM POLICY".**

Course: Analysis & Design of Algorithms (3466) **Semester: Autumn, 2013**
Level: BS (CS) **Total Marks: 100**

ASSIGNMENT No. 1

Units: (1 – 4)

Note: All questions are compulsory. Each question carries equal marks.

Q. 1 a) Let f(n) and g(n) be asymptotically positive functions. Prove or disprove each of the following conjectures;

a. $f(n) = \theta(f(n/2))$
b. $f(n) = O((f(n))^2)$
c. $f(n) = O(g(n))$ implies $g(n) = \Omega(f(n))$

b) Prove that $Pr\{A \mid B\} + Pr\{\overline{A} \mid B\} = 1$.

Q. 2 a) Give examples of relations that are:

a. Reflexive and symmetric but not transitive
b. Reflexive and transitive but not symmetric
c. Symmetric and transitive but not reflexive

b) Illustrate the operation of counting sort on the array A = [6, 0, 2, 0, 1, 3, 4, 6, 1, 3, 2].

Q. 3 a) Let A and B be finite sets, and f : A −> B be a function. Show that:

a. If f is injective, then $|A| \leq |B|$
b. If f is surjective, then $|A| \geq |B|$

b) Show that any connected, undirected graph G = (V, E) satisfies $|E| \geq |V| - 1$.

Q. 4 a) Illustrate the operation of Heap sort on the array A = [5, 13, 2, 25, 7, 17, 20, 8, 4].

b) What is the running time of heap sort on an array A of length n that is already sorted in increasing order? What about decreasing order?

Q. 5 Write notes on the following topics:

- Graph and trees
- Radix and Bucket Sort
- Counting and Probability
- Lower bounds for sorting

ASSIGNMENT No. 2

Units: (5 – 8)

Total Marks: 100

Note: All questions are compulsory. Each question carries equal marks.

Q. 1 Give and explain each step with graph example for the trace of following graph traversal algorithms.

a) Breadth first search
b) Depth first search

Q. 2 a) Demonstrate the insertion of the keys 5, 28, 19, 15, 20, 33, 12, 17, 10 into a hash table with collisions resolved by chaining. Let the table have 9 slots, and let the hash function be h(k) = k mod 9.

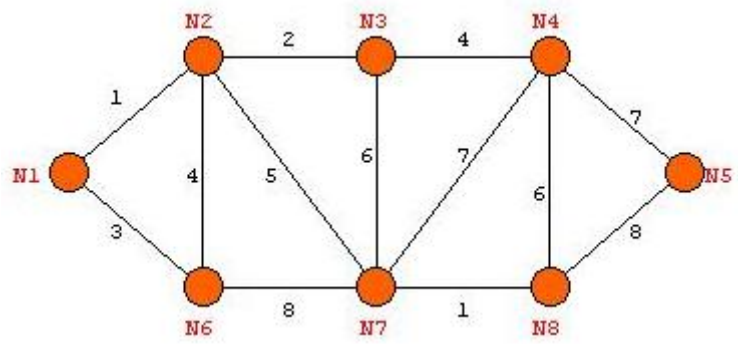
b) For the set of keys {1, 4, 5, 10, 16, 17, 21}, draw binary search trees of height 2, 3, 4, 5, and 6.

Q. 3 a) Prove that the fractional knapsack problem has the greedy-choice property.

b) What is an optimal Huffman code for the following set of frequencies, based on the first 8 Fibonacci numbers?
a : 1 b : 1 c : 2 d : 3 e : 5 f : 8 g : 13 h : 21

Q. 4 Execute the following algorithms for the given graph. Analyze the difference between the order of nodes or edges visited for the two algorithms.

a) Prim's algorithm
b) Kruskal's algorithm



Q. 5 Write notes on the following topics:

- Huffman Codes
- Breadth first search
- Binary Search Trees
- Optimal Polygon Triangulation

Analysis and Design of Algorithm (3466/3503) Credit Hours: 3(3+0)

Recommended Book:

Introduction to Algorithms by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest

Course Outlines:

Unit No.1: Introduction

Introduction to Algorithm Analysis and Design
Growth of Functions, Summations Formulas and Properties

Unit No.2: Recurrences and Sets

Substitution, Iteration and Master Methods
Sets, Relations, Functions, Graph and Trees, Counting and Probability

Unit No.3: Sorting Algorithms

Heaps, Maintaining the Heap Property, Heap Sort algorithm,
Quick Sort, Performance and Analysis of Quick Sort

Unit No.4: Sorting in Linear Time and Order Statistics

Lower bounds for sorting, Counting sort, Radix and Bucket Sort, Medians and order Statistics

Unit No.5: Elementary Data Structures

Analysis of Stack, Queues and Linked List Algorithms, Hash Table and Functions, Binary Search Trees

Unit No.6: Dynamic Programming

Matrix Chain Multiplication, Longest Common Subsequence, Optimal Polygon Triangulation

Unit No.7: Greedy Algorithms

An activity selection problem, Huffman Codes, A Task Scheduling Problem, Amortized Analysis

Unit No.8: **Graph Algorithms**

Elementary Graph Algorithms, Breadth first search, Depth first search, Minimum Spanning Trees

Unit No.9: **Single Source Shortest Paths**

Shortest Paths and Relaxation, Dijkstra's Algorithm, The Bellman-Ford Algorithm, Introduction to NP-Completeness

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