Kirinyaga University

UNIVERSITY EXAMINATION 2020/2021

YEAR 3 SEMESTER I EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE IN INFORMATION TECHNOLOGY/ COMPUTER SCIENCE

ECE 2309: ALGORITHM DESIGN AND ANALYSIS

DATE: Thursday, 20ᵗʰ May,2021   TIME: 4.00 pm – 6.00 pm

INSTRUCTION: Answer Question one (compulsory) and any other TWO questions

Question One (30 Marks)

a) When analyzing the running time or space usage of programs, we usually try to estimate the time or space as function of the input size.

   i)   Using this scenario provice the asymptotic analysis/notations algorithm that is used to estimate time and space.   (3 marks)

   ii)   With reference to the above casè explain the meaning of "space usafe of programs"   (2 marks)

   iii)   Outline three asymptotic notations that can be used   (4 marks)

b) Divide and conquer and dynamic programming algorithms are mostly used in finding an optimal solution for a problem / solving optimization problem. Using a divide and conquer algorithms, explain how to solve optimization problems   (4 marks)

c) Using the master method, solve the following recurrence relations

   i)T(n)= $2T(n^{1/2})$ + log n   (2 marks)

   ii) $T(n) = 2T + n \; n > n$ (2 marks)

d) For interval scheduling algorithm, the set of jobs (Si, fi.) are as follows: (0,2), (1,3), (3,6), (6,9), (4, 12), (5,8) and (6,7)

   i.   Explain the meaning of the above scheduling algorithm   (4 marks)

   ii) What is the running time of the greedy. algorithm   (2marks)

e) A Hamiltonian cycle is a closed loop on a graph where every node (vertex) is visited exactly once. Describe the meaning of this statement   (4 marks)

e) How does Kruskal's algorithm know when the addition of an edge will generate a cycle.   (3 marks)

Question Two (20 Marks)

a) Find an optimal paenthesization of matrix chain multiplication whose sequence of dimension are as follows:<40,45,25,10,20,30,35> (10 marks)

b) Huffman code is a particular type of optimal prefix code that is commonly used for lossless data compression.

i.   Write down the time complexity of Hoffman code algorithm (5 marks)

ii.   Explain five characteristics of Huffman code algorithm (5 Marks)

Question Three (20 Marks)

a) Write an algorithm to construct a min heap. Min heap from the following list:{16,14,10,8,7,9,3,2,4,1} (6 marks)

b) Outline the recursive algorithm of the tower of Tanoi (4 marks)

c) Briefly describe three dynamic programming algorithms design techniques (6 marks)

d) Explain whether the dynamic programing matrix chain algorithms is optimal or not (4 marks)

Question Four (20 Marks)

a) Write down the algorithm of binary search and show that the worst case time complexity of the binary search. (8 marks)

b) The knapsack problem is a problem in combinatorial optimization: Given a set of items, each with a weight and a value, determine the number of each item to include in a collection so that the total weight is less than or equal to a given limit and the total value is as large as possible.

i)   Explain the two algorithms of the knapsack problem and provide suitable examples for each. (8marks)

ii) Outline four applications of the knapsack (4 marks)

Question Five (20 Marks)

a) Algorithms are one of the foundations of our technological world, and are driven by the scientists and engineers who design and implement these algorithms.

i)   Discuss five areas where algorithms are applied in real life situations. (5 Marks)

ii) An Algorithm is a sequence of steps to solve a problem. Describe three different types of Engineering problems solved by algorithms, today (3 marks)

b) Merge sort is one of the most efficient sorting algorithms. It works on the principle of Divide and Conquer. Merge sort repeatedly breaks down a list into several sublists until each sublist consists of a single element and merging those sublists in a manner that results into a sorted list.

    i)   Using the scenario above write a algorithm for implementation of a merge sort   (5 marks)

    ii) Outline three areas where merge sort can be applied in Engineering field.

                                                   (3marks)

    iii) Using examples describe two best-case complexity of the merge sort algorithm   (4 marks)