Uva Wellassa University of Sri Lanka
Faculty of Science and Technology
Department of Computer Science and Technology
200 level 2nd Semester Examination – Dec.-2017/ Jan.-2018
CST226-2 Design and Analysis of Algorithms

Uva Wellassa University

Instructions to candidates
Number of questions: Four (04)
Time allocation: Two (02) hours
Mark allocation: 100
Answer all questions.

1.

a. What is an algorithm? Briefly describe the factors to be considered when analyze the complexity of an algorithm (4 mark)

b. The first few elements of the Fibonacci sequence are : 0,1,1,2,3,5,8,13,21..... and definition of Fibonacci numbers is as follows:

$$\text{fib}(n) = \begin{cases} 0 & \text{if } n = 0 \\ 1 & \text{if } n = 1 \\ \text{fib}(n-1) + \text{fib}(n-2) & \text{if } n >= 2 \end{cases}$$

Write a recursive pseudo code to print Fibonacci numbers up to 100. (6 mark)

c. Find the complexity of the following equations using big O notation.

i. $T(n) = 6\log_6 n + \log_2 \log_2 \log_2 n$
ii. $T(n) = 0.4n + 5n^{1.5} + 2.5.n^{1.8}$
iii. $T(n) = 100n \log_3 n + n^3 + 100n$
iv. $T(n) = n\log_5 n + n\log_2 n$

(8 mark)

d. Assume that the population of the world is 7 billion in 2020 and the growth rate is 3% per year.
i. Set up a recurrence relation for the population of the world in n years after 2020. (5 mark)
ii. What will be the population of the world be in 2025? (2 mark)

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2.

a. Briefly define the 'Divide-and-Conquer' approach in problem solving? (5 mark)

b. Consider the following dataset.
[38, -3, 47, 55, 1, 58, 16, 96, -84, 7]
Which sorting algorithm will give the following intermediate steps? Choose among **bubble sort, selection sort, insertion sort, merge sort** and **quick sort**

Note: if the sorting algorithm is quick sort, the algorithm chooses the last element as its pivot.

i. [-84, -3, 1, 55, 47, 58, 16, 96, 38, 7]

ii. [-3, 1, 38, 16, 47, -84, 7, 55, 58, 96]

iii. [-3, 1, 47, 55, 38, 58, 16, 96, -84, 7]

iv. [-3, 1, 38, 47, 55, -84, 7, 16, 58, 96]

v. [-3, 38, 47, 55, 1, 58, 16, 96, -84, 7] (25 mark)

3.

a. What is 'Dynamic Programming'? Name four (04) applications of dynamic programming. (5 mark)

b. Illustrate the behavior of the longest common subsequence algorithm on the following two lists. (8 mark)
{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11} and {2, 11, 3, 10, 8, 6, 7, 9, 1, 4, 5}

c. Briefly describe the main properties of 'Heap' data structure. (4 mark)

d. Sort the following array in ascending order using heap sort. All the intermediate steps should be mentioned. (8 mark)
A = {6, 5, 3, 1, 8, 7, 2, 4}

4.

a. Briefly describe a greedy algorithm using an example. Compare and contrast the greedy algorithm with dynamic programming. (4 mark)

b. Write the Dijkstra's Algorithm to solve the single-source shortest-paths problem on a weighted graph. (5 mark)

c. Find the Minimum Spanning Tree(MST) for the Figure 1 using the following algorithms.(State the steps clearly)

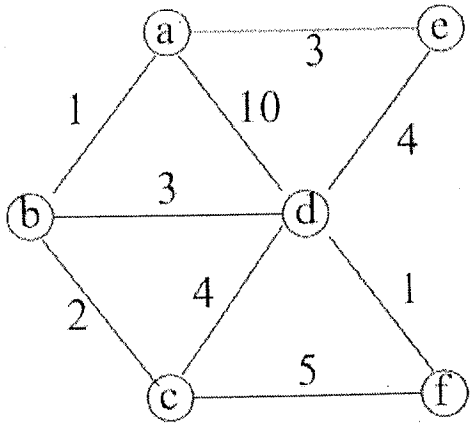

Figure 1: Graph

i. Kruskal's Algorithm
ii. Prim's Algorithm (Start at the node a)

(16 mark)