SPRING RE-MID SEMESTER EXAMINATION-2018

Design & Analysis of Algorithms

[CS-2008]

Full Marks: 25 **Time: 1.5 Hours**

Answer any five questions including question No.1 which is compulsory.
The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable and all parts of a question should be answered at one place only.

Q1 Answer the following questions: (1 x 5)

a) What is the time complexity of the following C function is (assume n > 0)

```
int FUN(int n)
{
  if (n==1)
     return 1;
else
     return  ( FUN(n-1)+ FUN(n-1));
}
```

b) In the following C function, let n ≤ m.

```
int GCD (n, m)
{
  if(n & m==0} return m;
  n= n & m;
  return GCD(m, n);
}
```

How many recursive calls are made by this function?
(A) $\Theta(\log_2 n)$ (B) □ (n) (C) $\Theta(\log_2\log_2 n)$ (D) $\Theta(\sqrt{n})$

c) Given two Algorithms for a task, Describe how do we find out which one is better?

d) A priority-Queue is implemented as a Max-Heap, Initially, it has 5 elements. The level-order traversal of the heap is < 10, 8, 5, 3, 2 >. Two new elements '1' and '7' are inserted into the heap in that order. Find out the level-order traversal of the heap after the insertion of the elements.

e) Find the optimal storage for 13 programs on three magnetic tapes, where the lengths of the programs are 10, 5, 8, 9, 7, 5, 18, 26, 4, 3, 11, 10, 6 respectively.

Q2 A numeric array of length n contains positive and negative numbers. Design a function that sorts the array in ascending order such that it finds all positive numbers in the array that have their opposites in it as well consecutively. (5)

For Example: Array: -7 4 -3 2 2 -8 -2 3 3 7 -2 3 -2
Sorted: -2 -2 -2 2 2 -3 3 3 3 4 -7 7 -8

N.B. In this type of special sorting method, we have [-2, 2], [-3, 3] and [-7, 7] combinations appearing consecutively exactly once.

Q3 Solve the following recurrences (5)

a) $T(n) = 2T(n/3)+\log^2 n$

b) $T(n) =2T(\sqrt{n}) + \log_2 n$

Q4 Write MAX-HEAPIFY(A, i) Algorithm. Illustrate step by step, the operation of MAX-HEAPIFY(A, 3) on the array A ={27, 17, 3, 16, 13, 10, 1, 5, 7, 12, 4, 8, 9, 0} (5)

Q5 Write Merge-Sort Algorithm and describe in a step by step process how the Merge-Sort Algorithm is applied on the following to sort the data in ascending order. (5)

5, 4, 3, 6, 2, 5, 9, 8, 7, 3, 6, 1

Q6 A variable-length code can do considerably better than a fixed-length code. Justify this statement with the help of the following information. (5)

The contains of a file is as follows:

Character	a	b	c	d	e
frequency	2	4	3	6	5

Find out the variable length but prefix free code for each character and compare with the fixed length code for this problem.

Q7 Write an Algorithm for fractional Knapsack problem. Find an optimal solution to the knapsack instance where n=10, W=15. (v1, v2, v3, v4, v5, v6, v7) = (10, 5, 15, 7, 6, 18, 3, 5, 4, 20) and (w1, w2, w3, w4, w5, w6, w7, w8, w9, w10) = (2, 3, 5, 7, 1, 4, 1, 4, 3, 2).

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