202-3

UVA WELLASSA UNIVERSITY

DEPARTMENT OF COMPUTER SCIENCE & TECHNOLOGY

END SEMESTER EXAMINATION – SEMESTER I – 2007/2008

CST202-3 DATA STRUCTURES AND ALGORITHMS

Time Allowed: 2 HOURS **No. of Questions: 6** **Answer ANY FOUR (4) Questions**

1.

a. Describe the terms static and dynamic memory allocations. (9 marks)

b. Discuss the difference between an array and a linked-list. (8 marks)

c. Compare and contrast stacks and queues. (8 marks)

2.

a. Discuss the need of pointers in creating dynamic data structures. (5 marks)

b. What is binary tree? (5 marks)

c. Prepare a binary tree for the numbers 8, 2, 10, 1, 4, 9, 12, and 3. (5 marks)

d. Identify three standard traversal orders used to traverse a binary tree and describe them. (5 marks)

e. Using the binary tree developed in the section c) and the three standard traversal methods identified in the section d), determine the order of the nodes to be processed in successive iterations. (5 marks)

3.

a. Describe what an expression tree is. (7 marks)

b. Prepare expressions trees for the following mathematical equations:

i. $u = v + ft$ (4 marks)

ii. $v^2 = u^2 - 2fs + \log(t)$ (4 marks)

iii. $s = ut + \frac{1}{2} ft^2$ (4 marks)

iv. $x = -b + (b^2 - 4ac)^3 / 2a$ (6 marks)

4.

a. A pseudocode of a sorting algorithm is given below:

```
Accept the array to be sorted with n elements
Set i to 0
Repeat
        Set current to i
        Set k to i+1
        Repeat
          If element of index current > element of index k
            Set current to k
          Replace k with k+1
        Until k less than n
        Swap element of index current with element of index i
        Replace i with i+1
Until i less than n-1
```

Discuss the output of this pseudocode, if the initial array to be sorted contain following numbers:

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

(5 Marks)

b. Rewrite the above pseudocode (or as C function) to sort reverse order.

(10 Marks)

c. What is the stability of a sorting function? Discuss the stability of the above sorting pseudo code.

(10 Marks)

5.

a. What is the purpose of the big-O notation?

(3 Marks)

b. Give an analysis of the running time of the following program fragments:

i.

```
Sum = 0;
for ( i = 0; i < N; i++)
        for ( j = 0; j < i * i;  j++)
                for ( k = 0; k < j; k++ )
                        Sum++;
```

ii.

```
Sum = 0;
for ( i = 0; i < N; i++)
        for ( j = 1; j < i *i;  j++)
                if( j % I == 0 )
                        for ( k = 0; k < j; k++ )
                                Sum++;
```

(5 X 2 Marks)

c. For each of the following pairs of functions, find the smallest integer value of n> 1 for which the first becomes larger than the second.

i. n^2 and $15n + 5$
ii. 2^n and $8n^4$
iii. $0.1n^2$ and $100n \lg n$

(4 x 3 Marks)

6.

a. Consider the searching problem below:

Input: A sequence of n numbers $A = < a_1, a_2 \ldots\ldots a_n >$ and a value v.

Output: An index i such that $v = A[i]$ or the special value ***NIL*** if v does not appear in A

Write pseudocode (or C function) for ***liner search***, which scans through the sequence, looking for v. (7 Marks)

b. If the above sequence A is sorted, the midpoint of the sequence can be checked against v and eliminate half of the sequence from further consideration. Binary Search is an algorithm that repeats this procedure, halving the size of the remaining portion of the sequence each time. Write pseudocode (or C function) for binary search.

(10 Marks)

c. Compare and contrast linear search and binary search for following situations:

i. Unsuccessful search
ii. Best successful search
iii. Worst successful search
iv. Average successful search

(2 x 4 Marks)

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