CS3334 Midterm Sample

Data Structures (City University of Hong Kong)

CITY UNIVERSITY OF HONG KONG
Sample

Course code & title :

Session :

Time allowed :

This paper has THREE pages (including this cover page).

1. This paper consists of 16 questions.

2. Answer <u>ALL</u> questions.

3. Use the **<u>answer book</u>** to answer questions.

*This is a **closed-book** examination.*

*Candidates are allowed to use the following materials/aids:*

Approved Calculator

Materials/aids other than those stated above are not permitted. Candidates will be subject to disciplinary action if any unauthorized materials or aids are found on them.

You cannot refer to any materials, either softcopy or hardcopy or internet.

Please conform to Academic Honest rules.

1. Answer whether the following states are correct or not.

    i)   Queue is First-in-first-out (FIFO).

    ii)   The time complexity of insertion operation in a linked list is O(n).

    iii)   Maximum number of nodes in a binary tree is $2^{height\_of\_tree}$.

    iv)   The degree of a node means the number of subtrees of a node .

    v)   Stack is a list with the restriction that insertions and deletions (usually all the accesses) can only be performed at one end of the list.

2. Write down one advantage and one disadvantage of using the array-based implementation for linked list.

3. The number of nodes in a full binary tree with height 3 is _____?

4. Create a binary search tree according to the input sequence:
   <3, 5, 0, 2, 7, 9, 6, 8>

5. Order the following functions by growth rate:
   N, N^2, N logN, N loglogN, N log (N^2), 2/N, $2^{N/2}$, 37, N^2 logN.
   Indicate which functions grow at the same rate (it they are).

6. When using array representation for a binary tree and a node is at slot 7, then which slot does the left child of this node locates?

7. Given the following traversal sequences, write down the **postorder** traversal of the corresponding binary tree:
   inorder : DCEBAUZTXY
   preorder : ABCDEXZUTY

8. The inorder traversal output for the following tree is _____?
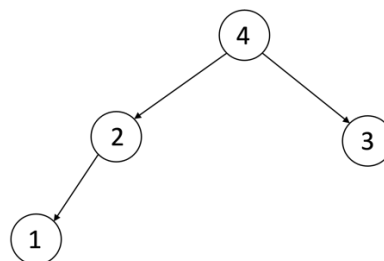
9. After deleting the root of the following min-heap, what's the new heap?
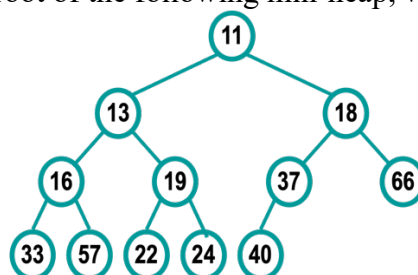
10. What is the running time of the following code? (i.e., O(?))

```
Sum = 0;
for (i=0; i<n; i++){
     for (j=0; j < i; j++)
         ++sum;
}
```

11. After inserting the following numbers one by one into a hash table of size 10 (initially empty; using **separate chaining to resolve collisions**), what are the numbers in each slot in the array (array index starts from 0)?
If a slot does not store any number, please fill in 0.
11, 22, 33, 44, 55, 66, 77, 88, 99, 21

12. Assume that we have the processing time $T(n) = n + nlog_2n$ spent by an algorithm for solving a problem of size *n*. Specify the Big-Oh complexity of this algorithm.

13. Please decide the Big-Oh complexity for recursive relations below.
T(n)=T(n-1)+A; T(1)=1

14. Suppose the variable *sk* references a stack of integers objects. What will be printed when running the following codes?

```
for (int i = 0; i < 6; i++)
   sk.push(i);

while (sk.IsEmpty() != true) {
   cout << sk.pop() << " ";
}
```

15. Given a pointer to the head node of a linked list, the task is to reverse the linked list. Please provide an implementation to reverse the list by changing the links between nodes.
E.g.,
Input: the following linked list 1->2->3->4->NULL
Output: Linked list should be changed to 4->3->2->1->NULL

16. Implement the codes for swapping two adjacent elements by adjusting only the links (and not the data) using singly linked lists.

```
struct ListNode {
   int data;
   ListNode * next;
};

void swapAdjacentSingly(ListNode * first) {
   ...
}
```