考試科目	計算機概論	所別	資訊管理系 4161 商管組/科技組 4162	考試時間	2月26日(日) 第一節

I.
Answer Yes (O) / No (X) for the following descriptions: (30%)

1. 1. The idea of "Divide and Conquer" is to divide the problem into sub problems that can be solved independently, and conquer the results of sub problems.
2. The idea of "Dynamic Programming" is to define global optimum in terms of optimal sub problems. Sub problems may overlap. We can solve and store the results of sub problems bottom-up to accelerate the computation.
3. In a binary search tree, any value in the left subtree of a node is less than any value in the right subtree of the same node.
4. An inorder traversal of a binary search tree visits the keys of nodes in an increasing order.
5. In a graph, two vertices in a graph are adjacent if there exists an edge having these two vertices as its end vertices, and two edges in a graph are parallel if they have different end vertices.
6. The sum of the degree of all vertices in a graph is equal to the number of edges in the graph.
7. Removing the tail in a singly linked list (with the pointers of head and tail) takes O(1) time.
8. A skip list contains a series of lists where each list is a subsequence of the previous one.
9. In a skip list with n entries, the expected search, insertion and deletion time is O(n).
10. Checking whether an edge is incident to a vertex can be done in O(1) time in an adjacency-matrix graph.
11. Removing a vertex in an adjacency-matrix graph takes $O(n^2)$ time, where n is the number of vertices in the graph.
12. The height of a binary tree is the maximum depth of its node, where the depth of a node in a tree is the number of its descendants.
13. An AVL tree is a binary search tree where for every internal node the heights of its children are the

備註	試題隨卷繳交

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same.

14. In a splay tree, splaying a node means moving the node to a leaf.

15. A Map is an ADT where multiple entries with the same key are allowed.

16. While using an unsorted list to implement a Map, get(k) (find the entry with the key k) takes O(1) time.

17. While using an unsorted list to implement a map, remove(k) (remove the entry with the key k) takes O(n) time.

18. A hash function maps a key to integers in a fixed interval, e.g., [0,N-1] for a hash table associated with an Array of size N.

19. Hashing is more efficient when the load factor (the number of stored elements / the size of the Array) is higher.

20. Liner probing handles collisions on a hash table by letting each cell of in the table point to a linked list, while separate chaining handles collisions by finding the nearest available cell.

21. An array-based stack takes O(n) time in average for push(k) using the constant incremental strategy when it is full.

22. The basic unit in Java is an object whose type is defined by a class.

23. In Java, "Overloading" means that we redefine a method in the subclass, while "Overriding" means that we define the same method in the same class with different signatures.

24. An interface can inherit multiple interfaces; a class can inherit only a single class.

25. A class can implement many interfaces as long as it implements all the methods of each interface.

26. Using brute-force pattern matching (forward), we need 18 comparisons to find a match "aab" in "aaaaaaab".

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27. A heap storing n values has height O(n), and methods insert(k) and removeMin() take O(n) time.

28. A heap-order specifies the relations between silbling nodes, e.g., the value stored in the left child is greater than the value stored in the right child.

29. A min heap has the minimal key stored in the last node (the right most node of the bottom layer).

30. Heap-sort is a quardratic sorting algorithm, i.e., it takes O(n^2) time for sorting n elements.

Ⅱ.
Answer the following questions:

1. Evaluating an arithmetic expression:

   1.1 (10%) Represent the expression 3 * 5 + 2 > 15 – 4 * 3 + 5 using a binary tree. (An internal node stores an operator, e.g., *, +, and an external node stores a value, e.g., 3, 5.)

   1.2 (15%) Write the pseudo code to evaluate such kind of an expression.

   Algorithm: evaluateExpression (T, v)

   Input: A binary tree T and a node v in T

   Output: the value of v

2. Sorting n elements:

   2.1 (10%) Given n integers, describe a sorting algorithm that has O(n) complexity.

   2.2 (15%) Run an in-place quick sort on the following array. Show the result of each iteration by choosing the first element as a pivot.

   [15, 3, 12, 7, 35, 28, 16, 9, 19, 20, 5, 32, 18]

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3. Finding the minimal string combination in the alphabetic order:

Given a set of n strings, S= {s1, s2, …, sn}, we say that a string s is a combination of S if s is equal to a combination of all strings in S (in any order). We say that a string s is the minimal combination of S, if s has the minimal alphabetical order among all the combinations of S.

For examples:

(1) S = {bb, aa, cc}, the minimal combination is "aabbcc."

(2) S = {ab, abc}, the minimal combination is "ababc."

(3) S = {cae, abc, cd}, the minimal combination is "abccaecd."

3.1 (5%) Please describe a greedy algorithm with the aim to find the minimal combination of S.

3.2 (5%) Show an example to illustrate how it works.

3.3 (10%) Show a counter example that the algorithm fails.

備註	試題隨卷繳交