一、单项选择题（本大题共 15 小题，每小题 2 分，共 30 分）

提示：在每小题列出的四个备选项中只有一个是符合题目要求的，请将其代码填写在下表中。错选、多选或未选均无分。

1. The Linked List is designed for conveniently _____ data item.

A. getting B. inserting C. finding D. locating

2. There is an algorithm with inserting an item to an ordered Array-based List and still keeping the Array-based List ordered. The computational efficiency of this inserting algorithm is_____ .

A. $O(\log_2 n)$ B. O(1) C. O(n) D.(n^2)

3. A Binary Tree will have _____ nodes on its level i at most.

A. 2^i B. 2i C. 2^{i+1} D. 2^i-1

4. The result from scanning a Binary Search Tree in inorder traversal is in _____order.

A. descending or ascending B. descending C. ascending D. out of order

5. The priority queue is a structure implementing_____.

A. inserting item only at the rear of the priority queue.

B. inserting item only at the front of the priority queue.

C. deleting item according to the priority of the item.

D. first in/first out

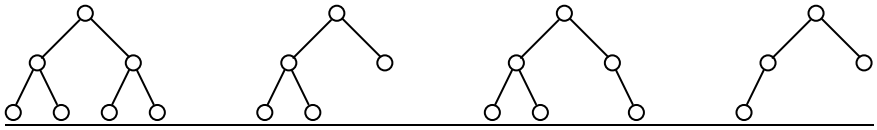
6. Suppose that a linear ordered list contains n=31 nodes, the binary search is applied to the list, the maximum times in searching is _____

A. 4 B. 5 C. 2^5-1 D. 2^4-1

7. How many binary trees in different forms can at most be built by three nodes?_____

A. 4 B. 5 C. 6 D. 7

8. In the following 4 Binary Trees, _____ is not the complete Binary Tree.



A B C D

9. On the following data structures, _____ is non-linear data structure.

A. array B. stack C. queue D. graph

10. Which linear list is better to get the elements for a given index and insert or delete in the last location? __

A. doubly circularly linked list B. doubly linked list C. array D. singly circularly linked list

11. A recursive function can cause an infinite sequence of function calls if _____

A. the problem size is halved at each step.

B. the termination condition(base case) is missing.

C. no useful incremental computation is done in each step.

D. the general case reduces the size of the problem.

12. Which one is stable in the following sorting algorithm? _____

A. shell sort B. quick sort C. heap sort D. bubble sort

13. Which one is quite right? Stacks and queues are both _____

① linear structure with array

② linear structure with linked list

③ linear structure with array or linked list

④ linear structure whose insertion and deletions are restricted to the end

A. ① B. ①④

C. ②④ D. ③④

14. An arithmetic expression (a+b)/c-d*e can be changed to the postfix expression_____

A. abc+/de*- B. ab+c/-de* C. ab+c/de*- D. ab+c/de-*

15. Which one is right about binary tree? _____

A. A binary tree has two degrees

B. The degree of a binary tree can be less than two

C. There is at least one node whose degree is two in a binary tree

D. Each node of a binary tree has two degrees

二、判断题（本大题共 5 小题，每小题 1 分，共 5 分）

提示：正确打✓，错误打×，将其结果填写在下表中。

1. The abstract data type (ADT) class code depends on the application programs. ( )
2. The big-O notation of arithmetic expression $5n^4+10n\log_2 n+100\log_2 n$ is $O(n^4)$. ( )
3. Trees can be implemented by array structure, linked list structure with two link pointers and linked list structure with three pointers. ( )
4. An undirected graph with n nodes is not necessarily connected though the number of edges is greater than n-1. ( )
5. The adjacency matrix of undirected graph must be symmetry, but symmetry matrix is not necessarily representing undirected graph. ( )

三、名词解释题（本大题共 2 小题，每小题 4 分，共 8 分）提示：对题目名词进行解释，英文缩写的需要给出全称并解释。

1. topological sort

2. DAG

四、应用题（本大题共 4 小题，每小题 8 分，共 32 分）。

提示：有求解过程的要尽量给出解题步骤，只有最终答案会酌情扣分。

1. Use mathematical induction to prove that the number of leaves in a non-empty full K-ary tree is

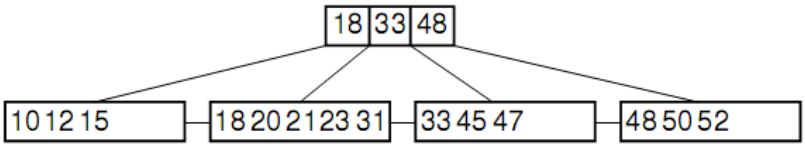
(K − 1)n + 1, where n is the number of internal nodes.

2. Build the Huffman coding tree and determine the codes for the following set of letters and weights:

a	b	c	d	e	f	g	h
2	3	5	11	13	19	31	45

3. Given an array containing the elements 52, 49, 80, 36, 14, 58, 61, 97, 23, 75. Show how the order of the elements changes during the first pass of quicksort (choosing the first element of the array to be the pivot). Show the array after each swap.

4. Insert 30 to the B+ tree of order four.



五、编程、设计及分析题（本大题共 2 小题，第 1 小题 10 分，第 2 小题 15 分，共 25 分）。

提示：题目给出了一个程序设计要求，请按照要求写出源程序代码，如果源程序代码中出现语法错误或逻辑错误，则酌情扣分。

1. Write a function that prints out the node values for a BST in sorted order from highest to lowest.

2. Use singly linked lists to implement integers of unlimited size. Each node of the list should store one digit of the integer. Write a function to implement subtraction operation. Limit exponents to be positive integers. What is the asymptotic running time for your operation, expressed in terms of the number of digits for the two operands?