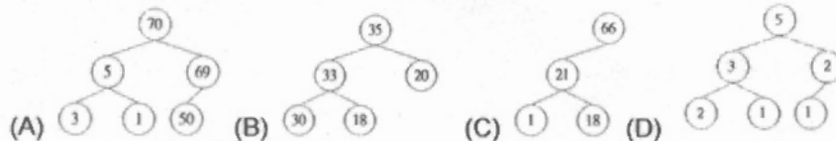


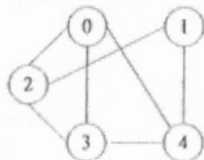
### 本考科禁用計算機

1. (3pts) Which is the postfix representation of the infix expression  $a+(b-c)*d*e/(f+g)$ , assuming normal operator priority?  
(A)  $ab+c-d*e*fg+/-$  (B)  $abc-*d+e*fg+/-$  (C)  $abc-d*e*fg+/-$  (D)  $abcdefg+-**/+$
2. (3pts) If  $f(n) = O(g(n))$ , which statement is true?  
(A)  $f(n) = o(g(n))$  (B)  $f(n) = \Omega(g(n))$  (C)  $g(n) = \Omega(f(n))$  (D)  $g(n) = \omega(f(n))$
3. (3pts) Which of the following statements about binary trees are(is) false?  
(A) If you use an array to implement a binary tree, the children of a node  $i$  is  $2i$  and  $2i+1$ .  
(B) In the worst case, a search on a binary tree takes  $O(N)$  time, where  $N$  is the number of nodes in the binary tree.  
(C) In the worst case, a search on a binary search tree takes  $O(\log_2 N)$  time, where  $N$  is the number of nodes in the binary search tree.  
(D) The root is biggest one of a binary search tree.
4. (3pts) Which of the following statements about heaps are(is) true?  
(A) Heaps are frequently used to implement priority queues.  
(B) In the worst case, removing the largest key from a binary Max-heap takes  $O(\log_2 n)$  time.  
(C) A binary Max-heap is a complex data structure that cannot be implemented with an array.  
(D) A binary Max-heap is a binary search tree.

5. (3pts) Which of the following trees is not a max heap?



6. (3pts) Consider the following graph, which is the adjacency matrix representation of this graph?



# 本考科禁用計算機

(A)  $\begin{bmatrix} 0 & 1 & 1 & 1 & 0 \\ 1 & 0 & 1 & 0 & 1 \\ 1 & 1 & 0 & 1 & 0 \\ 1 & 0 & 1 & 0 & 1 \\ 0 & 1 & 0 & 1 & 0 \end{bmatrix}$  (B)  $\begin{bmatrix} 1 & 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 1 & 0 \\ 0 & 0 & 1 & 0 & 1 \\ 1 & 1 & 0 & 1 & 1 \\ 0 & 0 & 1 & 1 & 1 \end{bmatrix}$  (C)  $\begin{bmatrix} 0 & 0 & 1 & 1 & 1 \\ 0 & 0 & 1 & 0 & 1 \\ 1 & 1 & 0 & 1 & 0 \\ 1 & 0 & 1 & 0 & 1 \\ 1 & 1 & 0 & 1 & 0 \end{bmatrix}$  (D)  $\begin{bmatrix} 0 & 0 & 1 & 1 & 1 \\ 0 & 0 & 1 & 0 & 1 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 & 0 \end{bmatrix}$

7. (3pts) Which of the following arrays is invalid representation for a binary tree?

(A) 

|   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|
| A | B | - | C | - | - | - | D |
|---|---|---|---|---|---|---|---|

 (B) 

|   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|
| A | B | C | D | E | F | G | H |
|---|---|---|---|---|---|---|---|

(C) 

|   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|
| A | - | C | - | - | F | G | - |
|---|---|---|---|---|---|---|---|

 (D) 

|   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|
| A | B | C | - | - | F | G | H |
|---|---|---|---|---|---|---|---|

8. (3pts) Which of the following statements is incorrect?

(A)  $5n^2 - 6n = O(n^2)$  (B)  $10n^{100} + 2^n = O(n^{100})$  (C)  $99n + 1 = O(n)$  (D)  $100 + 5 = O(1)$ .

9. (3pts) A complete binary tree has 21 nodes. What is the height of this tree?

(A) 3 (B) 4 (C) 5 (D) 6.

10. (3pts) Which code segment below implements the insert operation correctly for singly linked lists?

(A) 

```
void insert(ListItem pre, ListItem new) {
    ListItem next = pre.next;
    new.next = null;
    pre.next = new;
}
```

(B) 

```
void insert(ListItem pre, ListItem new) {
    new.next = pre.next.next;
    pre.next = new;
}
```

(C) 

```
void insert(ListItem pre, ListItem new) {
    if (pre.next == null) new.next = null;
    pre.next = new;
}
```

(D) 

```
void insert(ListItem pre, ListItem new) {
    new.next = pre.next;
    pre.next = new;
}
```

## 本考科禁用計算機

11. (15pts) The following function  $f$  is a recursive function that calculates  $x$ 's factorial. Please write a non-recursive function calculating exactly the same as what  $f$  calculates.
- ```
int f(int x) {  
    if (x == 0) return (1);  
    if (x == 1) return (1);  
    return (f(x-1)+f(x-2));  
}
```
12. (15pts) Which of the following sorting algorithms are stable: insertion sort, merge sort, heap sort, and quick sort? Give a simple scheme that makes any sorting algorithm stable. How much additional time and space does your scheme entail?
13. (10pts) Argue that the solution to the recurrence  $T(n) = T(n/3) + T(2n/3) + n$  is  $\Omega(n \log_2 n)$  by appealing to a recursion tree.
14. (15pts) Describe an efficient algorithm that, given an undirected graph  $G$ , determines a spanning tree of  $G$  whose largest edge weight is minimum over all spanning trees of  $G$ .
15. (15pts) Demonstrate the insertion of the keys 5, 28, 19, 15, 20, 33, 12, 17, 10 into a hash table which collisions resolved by chaining. Let the table have 9 slots, and let the hash function be  $h(k) = k \bmod 9$ .