浙江大学 2012 - 2013 学年秋学期

《数据结构基础》课程期末考试试卷(A)

课程号： 211C0020 ，开课学院： 计算机科学与技术

考试试卷： √A 卷、B 卷（请在选定项上打 √）

考试形式： √闭、开卷（请在选定项上打 √），允许带____无___入场

考试日期： 2012 年 11 月 15 日,考试时间： 120 分钟

诚信考试，沉着应考，杜绝违纪。

考生姓名：_____学号：_____所属院系：_____

题序	一	二	三	四	总 分
得分					
评卷人					

Answer Sheet

Part I (20)				
1. d	2. a	3. d	4. b	5. d
6. c	7. d	8. a	9. b	10. b

Part II (21)

1.

① p->next->value > p->next->next->value

② p->next = q->next; (or p->next->next) .

③ q->next = p->next->next;

④ p->next->next = q;

2. ① root = S[root]; ② trail = lead;

③ S[trail] = root;

Part III (44)

1.
(a) No. Example: 2, 1, 2

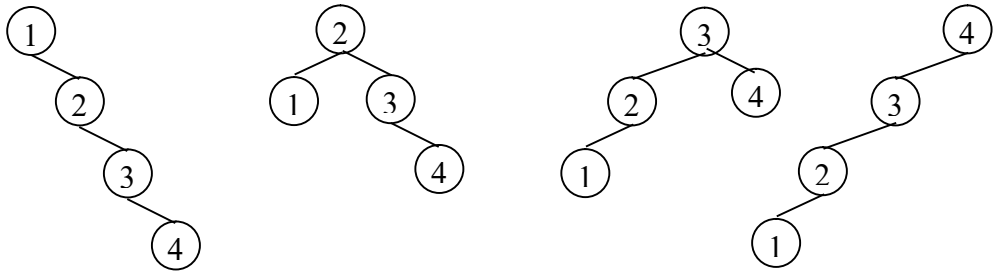
(b) No. Example: 1, 1, 1, …, 1

2.
(a) V1, V3, V4, V5, V2

(b) V1, V3, V2, V4, V5

(c) {V1, V3, V5}; {V2}; {V4}

3.
(a)



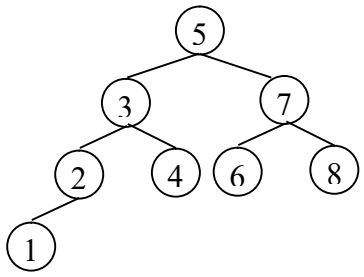
(b) N. Can only consist of two skewed subtrees.

4.

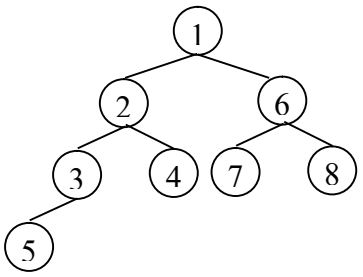
i	0	1	2	3	4	5	6	7	8	9	10	11	12
H[i]			2	15	3	28	6	16				24	29

5.

(a)



(b)



(c) In increasing order. Yes it's always true since it's from a BST.

Part IV (15)

```
typedef  struct  TreeNode  *Tree;
struct TreeNode {
Tree Child;
int key;
Tree Sibling;
};
int Counter[MAX_LEVEL] ;
/* Counter[i] stores the number of leaves on the i-th level.*/
/* The root is on the level 0. */

void Count_Leaves( Tree T )
{
    Level = 0 ;
    Visit( T, &level ) ;
}

Visit( Tree T, int *level )
{
if ( !T->Child ) Counter[*level]++ ;
    else {
    (*level)++ ;
    Visit(T->Child, level) ;
    (*level)-- ;
    }
    If (T->Sibling)
    Visit(T->Sibling, level) ;
}
```

NOTE: Please write your answers on the answer sheet.
注意：请将答案填写在答题纸上。

I. Please select the answer for the following problems. (20 points)

(1) Which one of the following statements is true as N grows?

a. For any x, x^N grows faster than $N!$

b. $(\log N)^2$ grows faster than $\sqrt{N}$

c. $\log N^2$ grows faster than $(\log N)^2$

d. N grows faster than $\sqrt{N}(\log N)^2$

(2) What is the time complexity of the following function that computes X^N?

```
long int  Pow (long int X, unsigned int N) {
  if (N == 0) return 1;
  if (N == 1) return X;
  if (IsEven(N)) /* IsEven(N) returns 1 if N is even, or 0 otherwise */
     return Pow(X, N / 2) * Pow (X,  N / 2);
  else return Pow(X * X, N / 2) * X;
}
```

a. O(N) b. O($\log N$) c. O($N \log N$) d. O($\sqrt{N}$)

(3) Suppose that N integers are pushed into and popped out of a stack. The input sequence is 1, 2, …, N and the output sequence is p_1, p_2, …, p_N. If $p_2 = 2$, then p_i (i>2) must be _____.

a. i b. i+2 c. N - i d. cannot be determined

(4) What is the major difference among lists, stacks, and queues?

a. Lists use pointers, and stacks and queues use arrays
b. Stacks and queues are lists with insertion/deletion constraints
c. Lists and queues can be implemented using circularly linked lists, but stacks cannot
d. Stacks and queues are linear structures while lists are not

(5) For an in-order threaded binary tree, if the pre-order and in-order traversal sequences are ABCDEF and CBAEDF respectively, which pair nodes' right links are both threads?

a. A and B b. B and D c. C and D d. B and E

(6) If N keys are hashed into the same slot, then to find these N keys, the minimum number of probes with linear probing is _____.

a. N-1 b. N c. N(N+1)/2 d. N+1

(7) If an undirected graph with N vertices and E edges is represented by an adjacency matrix. How many zero elements are there in the matrix?

a. E b. 2E c. N^2-E d. N^2-2E

(8) If a directed graph is stored by an upper-triangular adjacency matrix -- that is, all the elements below the main diagonal are zero. Then its topological order _____.

a. exists and must be unique b. exists but may not be unique
c. does not exist d. cannot be determined

(9) Sort a sequence of nine integers {4, 8, 3, 7, 9, 2, 10, 6, 5} by insertion sort. When 2 is moved to the first position, the number 8 must be at position (start from 1) _____.

a. 4 b. 5 c. 6 d. 7

(10) Let T be a tree of N nodes created by union-by-height without path compression, then the depth of the tree is

a. N/2 b. O(logN) c. $O(N^2)$ d. O(1)

II. Given the function descriptions of the following two (pseudo-code) programs, please fill in the blank lines. (21 points)

(1) Bubble sort is a simple sorting algorithm. Suppose we have a list of integers and want to sort them in ascending order. Bubble sort repeatedly scans the list from the head to the tail, and swaps two adjacent numbers if they are in the wrong order. Please complete the following program to implement bubble sort. (12 points)

```
struct node{
  int value;
  struct node *next;
  /* some other fields */
}

struct node BubbleSort (struct node *h)
{/* h is the head pointer of the list with a dummy head node */
  struct node *p, *q;
  int flag_swap;

  if (!h->next)  return h;
  do{
      flag_swap = 0;
      p = h;
      while (p->next->next){
        if (①_____________________){
            flag_swap++;
            q = p->next;
            ②_____________________;
            ③_____________________;
            ④_____________________;
        }
        else p = p->next;
      }
  } while (flag_swap > 0);
  return h;
}
```

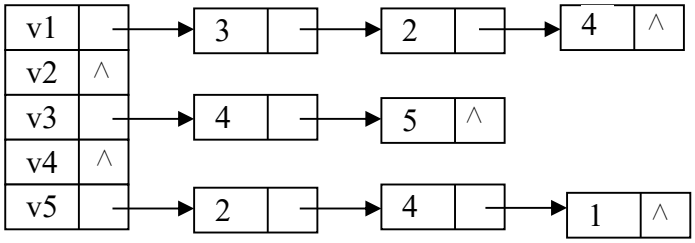
(2) The function is to perform Find as a Union/Find operation with path compression. (9 points)

```
SetType  Find ( ElementType  X, DisjSet  S )
{
    ElementType  root,  trail,  lead;
    for ( root = X; S[ root ] > 0; ①_____________)
        ;
    for ( trail = X; trail != root; ②_____________) {
        lead = S[ trail ] ;
        ③_____________ ;
    }
    return  root ;
}
```

III. Please write or draw your answers for the following problems on the answer sheet. (44 points)

(1) A sorting algorithm is **stable** if for any keys $K_i = K_j$ for $i < j$, the corresponding records R_i precedes R_j in the sorted list.
   (a) Is Heap Sort stable? Please give a proof if your answer is "YES", else please provide a counter example. (4 points)
   (b) Is Quick Sort stable? Please give a proof if your answer is "YES", else please provide a counter example. (4 points)

(2) Given the adjacency list representation of a directed graph. Suppose V1 is always the first vertex being visited. Please list
   (a) the depth-first search sequence; (5 points)
   (b) the breath-first search sequence; (5 points) and
   (c) the strongly connected components. (3 points)



(3) A binary search tree is said to be of "type A" if all the keys along the path from the root to any leaf node are in sorted order (either ascending or descending).
   (a) Given four keys {1, 2, 3, 4}, please draw all the possible binary search trees of type A. (4 points)
   (b) In general, given N keys {1, 2, …, N}, how many different binary search trees of type A can be constructed? (3 points)

(4) Given a hash table of size 13 and the hash function *H(key) = key mod 13*. Assume that quadratic probing is used to solve collisions. Please fill in the hash table with input numbers {2, 15, 3, 16, 6, 29, 24, 28}. (4 points)

(5) Given eight keys {1, 2, …, 8}. Please do the following:
   (a) construct a complete binary tree which is also a binary search tree; (5 points) and
   (b) construct a min-heap out of the array which stores the complete binary tree obtained from (a). Use BuildHeap with a sequence of percolate-down's. (4 points)
   (c) Observe the keys on each level of the min-heap obtained from (b). Is there a pattern of ordering? Is this true for more general cases? (3 points)

IV. Given a tree represented by left-child-right-sibling structure, please describe an algorithm that counts the number of leaf nodes on every level. (15 points)