銘傳大學九十二學年度轉學生招生考試

七月二十六日 第三節

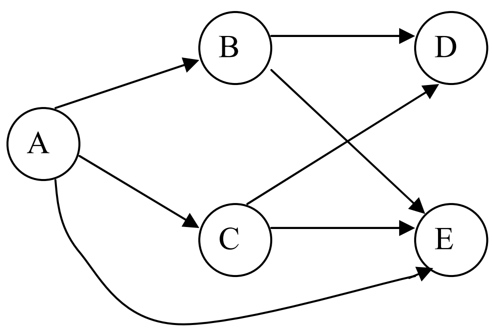
資料結構 試題

一(60%) Multiple choice, For each question, choose the best answer.

1. Let T be an extended binary search tree. Assume that the internal path length I of T is 25, and that T has 13 external nodes. What is the last digit of the external path length E of T?
   (A) 0 or 5 (B) 1 or 6 (C) 2 or 7 (D) 3 or 8 (E) 4 or 9.

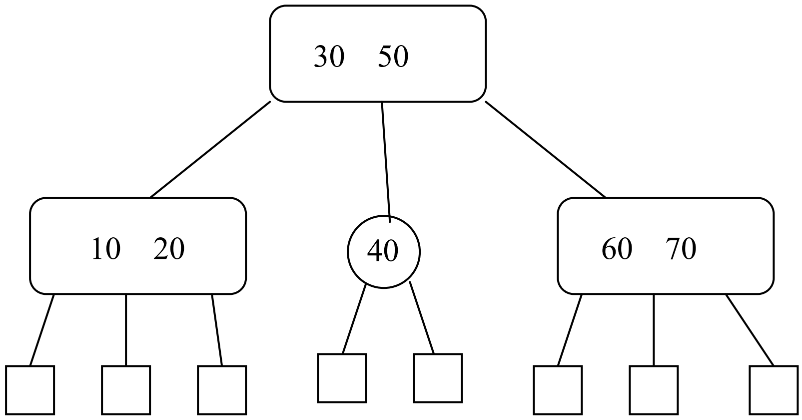
2. Suppose that the first node in the preorder traversal of some binary tree T is the same as the first node in the postorder traversal of T. Let r be the root of the tree. What can we conclude?
   (A) r may have left and right children, but the number of nodes in the left subtree of r is equal to the number of nodes in the fight subtree of r.
   (B) r is the only node in the tree.
   (C) R has no left child, but it may have a right child.
   (D) R may have a left child, but it has no right child.
   (E) None of the above.

3. Which of these orders is not a possible order in which Breadth First Search could visit the vertices of the directed graph shown bellows.



   (A) ABCDE (B) ABCED (C)ACBED (D) AEBCD (E) AECBD

4. Suppose that we start with the 2-3 tree shown and insert just one key K. For which of the following values of K would the insertion cause any node splits?



(A) 15 (B)25 (C)35 (D)A and B (E) B and C

5. Let n_k be the smallest possible number of keys in an AVL tree of height k. (when measuring height, assume that the tree is extended. Thus $n_0 = 0$ and $n_1 = 1$.) What is the last digit of n_8?
   (A) 0 or 5 (B) 1 or 6 (C) 2 or 7 (D) 3 or 8 (E) 4 or 9.

6. Which of the following choices for c and n_0 work in the definition of O-notation to show that $2n^2+3n-4 = O(n^2)$?
   (A) $n_0 = 1, c = 1$ (B) $n_0=3, c = 3$ (C) $n_0 = 1, c = 4$ (D) B and C (E) None of the above.

7. Heapsort runs in two phases. In the first phase it forms the elements in the array to be sorted into a heap. In the second phase it removes them from the heap one at a time, in order from largest to smallest. Suppose that we apply Heapsort to the array shown below. How many swaps of keys will take place during the first phase? (Remember that the heap used during Heapsort has the key in each node greater than or equal to keys in its children.)

i:	1	2	3	4	5	6	7	8	9
A[i]	50	70	40	80	90	30	60	10	20

   (A)3 (B)4 (C)5 (D)6 (E)7

8. One general strategy for designing efficient algorithms is called divide-and conquer. In this strategy we solve a large problem by a) dividing it into smaller subproblems, b) solving the subproblems recursively, and then c) combining the solutions to the subproblems to get a solution to the original problem. Which of the following sorting algorighms is an example of the divide-and-conquer approach, with the comparisons between the keys taking place during the process of combining the solutions to the subproblems?

(A) Insertion Sort (B)Quicksort (C) Mergesort (D) Heapsort (E)Bucketsort

9. Suppose that we are using a linked representation of lists which is circular, has double links, and has a sentinel node (also known as a list header). Assume that L points to the sentinel node for a list that has at least 5 elements. What effect would executing the following code have on the list being represented?

```
x = L. prev.prev;
x.next.prev = x.prev;
x.prev.next = x.next;
```

(A) It would delete the first element.
(B) It would delete the last element.
(C) It would delete the second-to-last element (i.e. the element just before the last element)
(D) It would delete all elements in the list.
(E) It would not change the list at all.

10. which of the choices below correctly describes the amount of time used by the following code:

```
for(i=n=2; i<n; i++)
for(j=1; j<n; j+=n/2)
    for(k=1; k<n; k=2*k)
        x = x +1;
```

(A) $\Theta(n^3)$ (B) $\Theta(n^2\log n)$ (C) $\Theta(n(\log n)^2)$ (D) $\Theta(n \log n)$ (E) $\Theta((\log n)^2)$

11. Suppose that we insert the keys below, in the order given, into an initially empty binary search tree. What will be the preorder traversal of the resulting tree?

25, 20, 40, 60, 50, 30

(A) 25, 20, 40, 30, 60, 50
(B) 25, 20, 40, 30, 50, 60
(C) 25, 20, 30, 40, 60, 50
(D) 25, 20, 30, 40, 50, 60

12. Suppose that we have a set of records with one field giving the ID number of students, and another field giving the number of a course they are taking. (Thus each record specifies one student in one class.) We wish to sort these records so that all records for a given student are consecutive, and the records for a given student are in order by course number. Which of the strategies below will achieve this?

(A) Sort the file by student ID using a stable sorting algorithm, and then sort the file by course number using a sorting algorithm which isn't necessarily stable.
(B) Sort the file by student ID using a sorting algorithm which isn't necessarily stable, and then sort the file by course number using a stable sorting algorithm.
(C) Sort the file by course number using a stable sorting algorithm, and then the file by student ID using a sorting algorithm which isn't necessarily stable.
(D) Sort the file by course number using a sorting algorithm which isn't necessarily stable, and then sort the file by student ID using a stable sorting algorithm.

13. The nodes of a binary tree T are labeled by capital letters. The inorder traversal of the tree is A B C D E F G H I J, and the preorder traversal is G D B A C E F I H J. How many nodes are in the left subtree of T?
(A) 4 or 9
(B) 3 or 8
(C) 2 or 7
(D) 1 or 6
(E) 0 or 5

14. Suppose that we are using double hashing as our collision resolution method, and that our table has 13 hash locations, numbered from 0 to 12 as shown below. The entries marked with an × have elements sorted in them already, and then we insert a new key K for which h(K) = 4 and δ(K) = 2. (The function δ(K) specifies by how many steps we are to back up each time we find an occupied location.) Into which location would key K be inserted?

0	1	2	3	4	5	6	7	8	9	10	11	12
×		×		×			×	×		×	×	×

(A) 1 (B) 3 (C) 5 (D) 6 (E) 9

15. A chained hash table has an array size of 512. What is the maximum number of entries that can be placed in the table?
(A) 265 (B) 511 (C) 512 (D) 1024 (E) There is no maximum.

二(15%) Suppose that graph G has the following adjacency lists:

1 – (2;3;4)
2 – (1;3;4)
3 – (1;2;4)
4 – (1;2;3;64)
5 – (6;7;8)
6 – (4;5;7)
7 – (5;6;8)
1 – (5;7)

1. Draw G.
2. Give the sequence of vertices visited using depth-first search starting at vertex 1.
3. Give the sequence of vertices visited using breadth-first search starting at vertex 1.

三(10%) Given an arbitrary binary tree T with integer keys stored at the nodes, design an efficient algorithm which determines whether or not T is a binary search tree. What is the time complexity of your algorithm?

四(5%) Below is an uncommented function, where tree is the type definition of a binary tree. Fine out its functionality.

```
typedef struct tree_type{
        int key;
        struct tree_type *llink, *rlink;
}tree;

foo(tree *root)
{
        tree *temp;
        if(root==NULL) return;
                temp = root -> llink;
                root-> llink = root-> rlink;
                root-> rlink = temp;
                foo(root->llink);
                foo(root->rlink);
        }/*foo*/
```

五(10%) Study the code below and answer the questions.

```
    template<class T>
void mystery(T c[],T d[], int a, int m, int b)
{ int i =a, j = m+1, k =a;
   while((i<=m)&&(j<=b))
    if(c[i]<=c[j] d[k++] = c[i++];
    else d[k++] = c[j++];
   if(i>m) for (int q = j; q<=b; q++)
                d[k++] = c[q];
   else for (int q=i; q<=m; q++)
                  d[k++]=c[q];
}
```

1. Describe the overall purpose of the code. (Do not give a line by line explanation of what each statement does.)
2. Are there any errors? If so, what?
3. What restrictions exist on the type of T that this function can be used with?

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