诚信应考,考试作弊将带来严重后果!

华南理工大学期末考试

《 Data Structure 》B 试卷

注意事项：1. 考前请将密封线内填写清楚；
2. 所有答案请直接答在试卷上；
3. 考试形式：闭卷；
4. 本试卷共十大题，满分 100 分，考试时间 120 分钟。

题 号	一	二	三	四	五	六	七	八	九	十	总分
得 分											
评卷人											

1. Select the correct choice. (20 scores, each 2 scores)

(1) An algorithm must be or do all of the following EXCEPT: (C)
(A) Correct (B) No Ambiguous (C) Infinite number of steps (D) terminate

(2) Pick the growth rate that corresponds to the most efficient algorithm as n gets large: (D)
(A) n^3 (B) 2^n (C) n! (D) $50n^2\log n$

(3) If a data element requires 6 bytes and a pointer requires 4 bytes, then a linked list representation will be more space efficient than a standard array representation when the fraction of non-null elements is less than about: (C)
(A) 1/4 (B) 2/3 (C) 3/5 (D) 3/4

(4) Which statement is not correct among the following four: (A)
(A) A general tree can be transferred to a binary tree with the root having both left child and right child.
(B) The number of empty sub-trees in a non-empty binary tree is one more than the number of nodes in the tree.
(C) A cluster is the smallest unit of allocation for a file, so all files occupy a multiple of the cluster size.
(D) The Heap-sort is an unstable sorting algorithm.

(5) We use the parent pointer representation for general trees to solve (C) problem?
(A) Shortest paths (B) General tree traversal
(C) Merging two tree together (D) Exact-match query

(6) The most effective way to reduce the time required by a disk-based program is to: (D)
(A) Improve the basic operations. (B) Reduce main memory use.
(C) Eliminate the recursive calls. (D) Minimize the number of disk accesses.

(7) In the hash function, collision refers to (B).
(A) Two elements have the same sequence number.
(B) Different keys are mapped to the same address of hash table.

(C) Two records have the same key. (D) Data elements are too much.

(8) Given an array as A[m][n]. Supposed that $A[0][0]$is located at $544_{(10)}$ and $A[2][2]$is stored at $576_{(10)}$, and every element occupies one space. "$_{(10)}$" means that the number is presented in decimals. Then the element $A[3][3]_{(10)}$ is at position:

(A)

(A) 592 (B) 595 (C) 550 (D) 608

(9) Tree indexing methods are meant to overcome what deficiency in hashing? (D)

(A) Inability to handle range queries. (B) Inability to maximum queries

(C) Inability to handle queries in key order (D) All of above.

(10) Assume that we have eight records, with key values A to H, and that they are initially placed in alphabetical order. Now, consider the result of applying the following access pattern: F D F G E G F A D F G E if the list is organized by the count heuristic, then the final list will be (B).

(A) F E G C A B H D (B) F G D E A B C H

(C) F G A D B E C H (D) F E G H A D B C

2. Fill the blank with correct C++ codes: (20 scores)

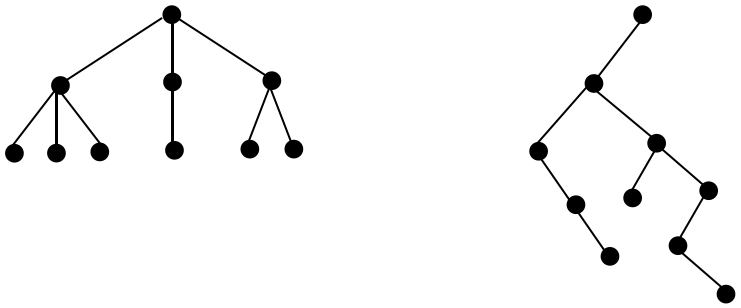
(1) Given an array storing integers ordered by value, modify the binary search routines to return the position of the integer with the least value greater than K when K itself does not appear in the array. Return ERROR if the greatest value in the array is less than K: (12 scores)

```
// Return position of lest element >= K
int newbinary(int array[], int n, int K) {
  int l = -1;
  int r = n;                    // l and r beyond array bounds
  while (l+1 != r) {            // Stop when l and r meet
    __int i=（l+r）/2__;        // Check middle of remaining subarray
    if (K < array[i])    __r=i__;          // In left half
    if (K == array[i])   __return i__;     // Found it
    if (K > array[i])    __l=i__           // In right half
  }
  // K is not in array or the greatest value is less than K
  if  K< array[n-1]
        then   return  r;   // the integer with the least value greater than K //
                            when K itself does not appear in the array
  else       return  ERROR;  // the greatest value in the array is less than K
                          }
```

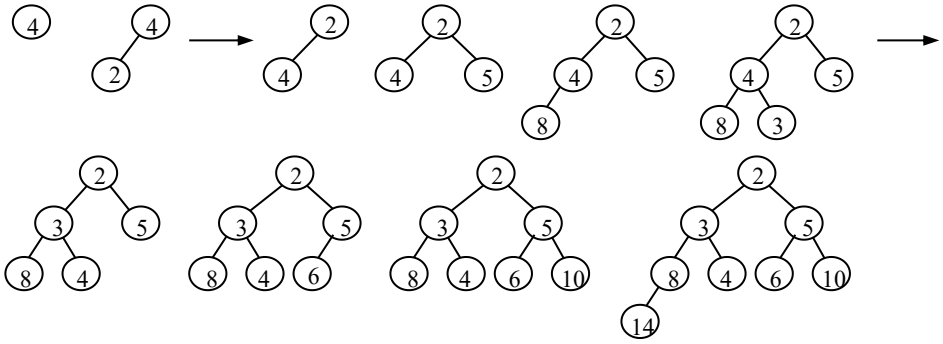
(2) A full 6-ary tree with 100 internal vertices has _601_ vertices. (4 scores)

(3) The number of different shapes of binary trees with 5 nodes is _42_. (4 scores)

3. Converting from a general tree to a binary tree. (4 scores)



4. Show the min-heap that results from running buildheap on the following values stored in an array: 4, 2, 5, 8, 3, 6, 10, 14. (6 scores)



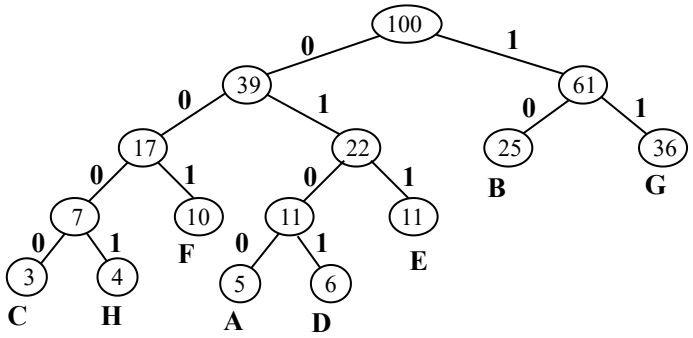
5. Trace by hand the execution of Quicksort algorithm on the array: int a[] = {27，34，78，13，20，44，09，34*} The pivot is 27 in the first pass, the following pivots are selected by the same method (at the first position of the input array). (8 scores)

initial: 27 34 78 13 20 44 09 34*
pass 1: [09 20 13] 27 [34 44 34* 78]
pass 2: 09 [20 13] 27 [34*] 34 [78 44]
pass 3: 09 [13] 20 27 34* 34 [44] 78
pass 4: 09 13 20 27 34* 34 44 78
final sorted array:
09 13 20 27 34* 34 44 78

6. 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
5	25	3	6	11	10	36	4

Draw the Huffman coding tree and give the Huffman code for each letters. What is the expected length in bits of a message containing n characters for this frequency distribution? (The process of your solution is required!!!) (8 scores)



Huffman code

A	B	C	D	E	F	G	H
0100	10	0000	0101	011	001	11	0001

Total length: 4 * 5 + 2 * 25 + 4 * 3 + 4 * 6 + 3 * 10 + 3 * 11 + 2 * 36 + 4 * 4 = 257

Expected length: 257/100=2.57

7. Assume a disk drive is configured as follows. The total storage is approximately 675M divided among 15 surfaces. Each surface has 612 tracks; there are 144 sectors/track, 512 byte/sector, and 16 sectors/cluster. The interleaving factor is 3. The disk turns at 5400rmp (11.1 ms/r). The track-to-track seek time is 20 ms, and the average seek time is 80 ms. Now how long does it take to read all of the data in a 360 KB file on the disk? Assume that the file's clusters are spread randomly across the disk. A seek must be performed each time the I/O reader moves to a new track. Show your calculations. (The process of your solution is required!!!) (8cores)

Answer:

The first question is how many clusters the file requires?

A cluster holds 16*0.5K = 8K. Thus, the file requires 360/8=45clusters.

The time to read a cluster is seek time to the

cluster+ latency time + (interleaf factor × rotation time).

Average seek time is defined to be 80 ms. Latency time is 0.5 *11.1 ms,

and cluster rotation time is 3 * (16/144)*11.1.

Seek time for the total file read time is

45* (80 + 0.5 * 11.1+ 3 * (16/144)*11.1) = 4016.25

8. Using closed hashing, with double hashing to resolve collisions, insert the following keys into a hash table of eleven slots (the slots are numbered 0 through 10). The hash functions to be used are H1 and H2, defined below. You should show the hash table after all eight keys have been inserted. Be sure to indicate how you are using H1 and H2 to do the hashing. (The process of your solution is required!!!)

H1(k) = 3k mod 11 H2(k) = 7k mod 10+1

Keys: 22, 41, 53, 46, 30, 13, 1, 67. (10 scores)

Answer:

$H_1(22)=0$, $H_1(41)=2$, $H_1(53)=5$, $H_1(46)=6$, no conflict

When $H_1(30)=2$, $H_2(30)=1$ （2+1*1）%11=3，so 30 enters the 3rd slot;
$H_1(13)=6$, $H_2(13)=2$ (6+1*2)%11=8, so 13 enters the 8th slot;
$H_1(1)=3$, $H_2(1)=8$ (3+5*8)%11= 10 so 1 enters 10 (pass by 0, 8, 5, 2);
$H_1(67)=3$, $H_2(67)=10$ (3+2*10)%11= 1 so 67 enters 1(pass by 2)

9. (16 scores)

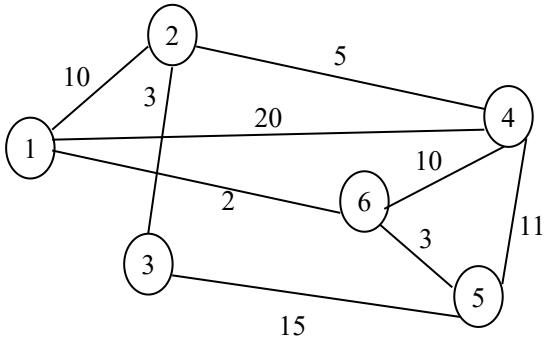


Figure 1 Example graph

(a) Draw the adjacency matrix representation and adjacency list representation for the graph of the figure-1. (6 scores)

(b) Use Dijkstra's Algorithm to find the shortest paths from Vertex1 to all the other vertices. (6 scores)

(c) Use Kruskal's algorithm to find the minimum-cost spanning tree. (4 scores)

(a) adjacency matrix

```
     1  2  3  4  5  6
-------------------------
1 |    10    20    2    |
2 | 10     3  5         |
3 |    3         15      |
4 | 20 5        11 10    |
5 |       15 11     3    |
6 | 2        10  3       |
-------------------------
```

adjacency list:

1 -> 2(10) -> 4(20) -> 6(2) -> \
2 -> 1(10) -> 3(3) -> 4(5) -> \
3 -> 2(3) -> 5(15) -> \
4 -> 1(20) -> 2(5) -> 5(11) -> 6(10) -> \
5 -> 3(15) -> 4(11) -> 6(3) -> \
6 -> 1(2) -> 4(10) -> 5(3) -> \

(b) 1 to 2: 10 (1,2);
1 to 3: 13(1,2,3);

1 to 4: 12 (1,6,4);
1 to 5: 5 (1,6,5);
1 to 6: 2 (1,6,);

(C)