【华工包打听说明】

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 》A 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: (B)
(A) Partially correct (B) Infinite (C) No Ambiguous (D) Concrete steps

(2) Pick the growth rate that corresponds to the slowest growing algorithm as n gets larger: (D)
(A) $4n^3$ (B) 2^n (C) 3n! (D) $50n^2\log n$

(3) If a data element requires 8 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: (B)
(A) 1/4 (B) 2/3 (C) 3/5 (D) 3/4

(4) Which is the realization of a data type as a software component: (A)
(A) An abstract data type (B) A real data type
(C) A type (D)A data structure

(5) We use the parent pointer representation for general trees to solve (C) problem?
(A) Shortest paths (B) General tree traversal
(C) Equivalence classes (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 I/O 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 key value.
(B) Different keys are mapped to the same position of hash table.
(C) Two records have the same requiring number.
(D) Data elements are too much.

(8) Given an array as A[m][n]. Supposed that $A[0][0]$is located at $644_{(10)}$ and $A[4][4]$is

stored at $676_{(10)}$, 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:

(B)

(A) 692 (B) 668 (C) 650 (D) 708

(9) Which statement is not correct among the following four: (A)

(A) The number of empty sub-trees in a non-empty binary tree is one less than the number of nodes in the tree.

(B) The Mergesort is a stable sorting algorithm.

(C) The root of a binary tree transferred from a general tree has only left child.

(D) A sector is the smallest unit of allocation for a record, so all records occupy a multiple of the sector size.

(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 transpose heuristic, then the final list will be (B).

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

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

2. Fill the blank with correct C++ codes: (18 scores)

(1) Given an array storing integers ordered by value, modify the binary search routines to return the position of the first 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: (14 scores)

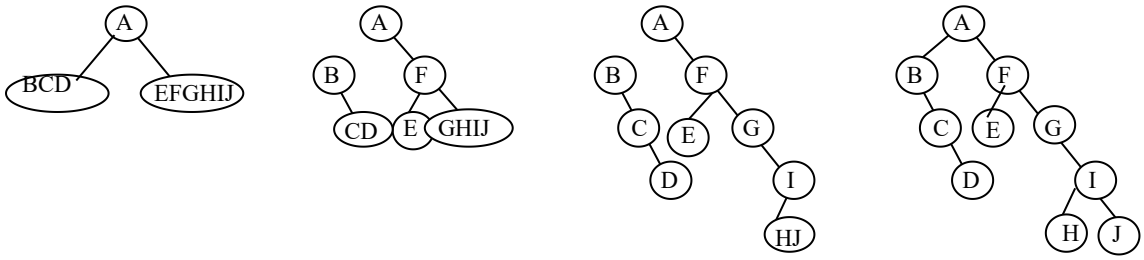
```
// Return position of lest element >= K
int newbinary(int array[], int n, int K) {
  int l = -1;
  int r = n;                    // l and r beyond array bounds
  while (l+1 != r) {            // Stop when l and r meet
    ___int i=（l+r）/2_____;        // Check middle of remaining subarray
    if (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] or r!=n
          then    return  r;     // the first 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)

The height of the shortest tree and the tallest tree with both n nodes is respectively _2_or n(n<2) and __n_ , suppose that the height of the one-node tree is 1 (4 scores)

3. Please calculate the number of binary trees in different shape with 5 nodes in total, and 6 nodes? (4 scores)
5:42, 6:132, $C_{2n}^{n}/n+1$

4. A certain binary tree has the preorder enumeration as ABCDFEGIHJ and the inorder enumeration as BCDAEFGHIJ. Try to draw the binary tree and give the postorder enumeration. (The process of your solution is required!!!) (6 scores)



Postorder enumeration: DCBEHJIGFA

5. Trace by hand the execution of Radix-sort algorithm on the array: int a[] = {265 301 751 129 937 863 742 694 076 438}. (6 scores)
initial: 265 301 751 129 937 863 742 694 076 438
pass 1: [] [301 751] [742] [863] [694] [265] [076] [937] [438] [129]
pass 2: [301] [] [129] [937 438] [742] [751] [863 265] [076] [] [694]
pass 3: [075] [129] [265] [301] [438] [] [694] [742 751] [863] [937]
final sorted array: 075 129 265 301 438 694 742 751 863 937

6. (a) Describe simply the main tasks of the two phases of external sorting. (4 scores)The task of first phase is to break the files into large initial runs by replacement selection; the second phase is to merge the runs together to form a single sorted run file.(b)Assume that working memory is 256KB broken into blocks of 8192 bytes (there is also additional space available for I/O buffers, program variables, etc.) What is the expected size for the largest file that can be merged using replacement selection followed by two passes of multi-way merge? Explain how you got your answer. (4 scores)

Since working memory is 256KB and the blocksize is 8KB, the working memory holds 32 blocks. The expected runlength is 512KB, so a single pass of multiway merge forms runs of length 512KB*32=16MB. The second pass then forms a run as large as 16MB*32=512MB.

7. Assume a disk drive is configured as follows. The total storage is approximately

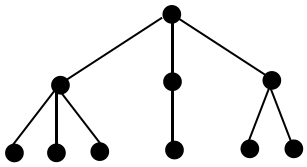
675M divided among 15 surfaces. Each surface has 612 tracks; there are 144 sectors/track, 512 byte/sector, and 16 sectors/cluster. The interleaving factor is 3. The disk turns at 7200rmp (8.3ms/r). The track-to-track seek time is 20 ms, and the average seek time is 80 ms. Now how long does it take to 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)

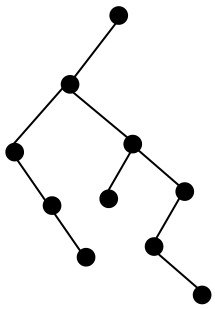
A cluster holds 16*0.5K = 8K. Thus, the file requires 360/8=45clusters.
The time to read a cluster is seek time to the cluster+ latency time + (interleaf factor × rotation time).Average seek time is defined to be 80 ms. Latency time is 0.5 *8.3, and cluster rotation time is 3 * (16/144)*8.3.Seek time for the total file read time is
45* (80 + 0.5 * 8.3+ 3 * (16/144)*8.3) = 3911.25

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, 31, 19, 35, 41, 13, 1, 67. (8 scores)

Answer:
$H_1(22)=0$, $H_1(31)=5$, $H_1(19)=2$, $H_1(35)=6$, no conflict
When $H_1(41)=2$, $H_2(41)=8$ （2+8*1）%11=10，so 41 enters the 10^{rd} slot;
$H_1(13)=6$, $H_2(13)=2$ (6+1*2)%11=8, so 13 enters the 8^{th} slot;
$H_1(1)=3$, so 1 enters 3 ;
$H_1(67)=3$, $H_2(67)=10$ (3+2*10)%11= 1 so 67 enters 1(pass by 2)

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





10.

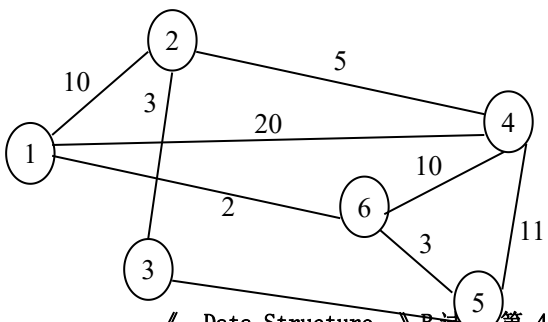


Figure 1 Example graph

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

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

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

(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)