

姓名
学号
院系
班级
课序号
任课教师

大 连 理 工 大 学

课程名称: 数据结构与算法 2 试卷: C 考试形式: 闭 卷

授课院(系) 国际信息与软件学院 考试日期: 2020 年 月 日 试卷共 7 页

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标准分	30	60	10								100
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一、单项选择题 (共 15 题, 每题 2 分, 共 30 分)

- If one directed graph has 10 vertices and 16 edges, then there are () zeros in its adjacency matrix.
A. 16 B. 32 C. 84 D. 68
- In the queue-based BFS (Breath-First Search) process for a graph with n vertices, each vertex will enter the queue at most () times.
A. 1 B. 2 C. 3 D. n
- A B+ tree can contain a maximum of 9 pointers in a node. What is the minimum number of keys in a leaf? ()
A. 6 B. 3 C. 4 D. 7
- What is the pseudo code to compute the shortest path in Dijkstra's algorithm? ()

```

if(!T[w].Known)
    if(T[v].Dist + C(v,w) < T[w].Dist) {
        Decrease(T[w].Dist to T[v].Dist +C(v,w));
        T[w].path=v; }

```

A.

```

if(T[w].Known)
    if(T[v].Dist + C(v,w) < T[w].Dist) {
        Increase (T[w].Dist to T[v].Dist +C(v,w));
        T[w].path=v; }

```

B.

```

if(!T[w].Known)
    if(T[v].Dist + C(v,w) > T[w].Dist) {
        Decrease(T[w].Dist to T[v].Dist +C(v,w);
        T[w].path=v; }

```

C.

```

if(T[w].Known)
    if(T[v].Dist + C(v,w) < T[w].Dist) {
        Increase(T[w].Dist to T[v].Dist);
        T[w].path=v; }

```

D.

5. Topological sort can be applied to which of the following graphs? ()

- A. Undirected Cyclic Graphs B. Directed Cyclic Graphs
C. Undirected Acyclic Graphs D. Directed Acyclic Graphs

6. Complete the given snippet of code for the adjacency list representation of a weighted directed graph. ()

```

class neighbor{
    int vertex, weight;
    ____ next;    }
class vertex{
    string name;
    ____ adjlist;  }
vertex adjlists[101];

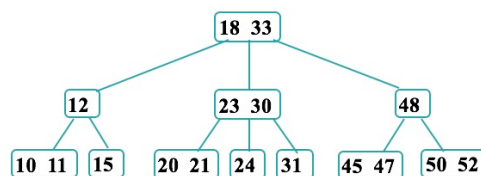
```

- A. vertex, vertex B. neighbor, vertex C. neighbor, neighbor D. vertex, neighbor

7. What is the running time of the Floyd Warshall Algorithm? ()

- A. $O(n^3)$ B. $O(n^2)$ C. $O(\log n)$ D. $O(n)$

8. What are the keys in the rightmost leaf node in the following B-tree of order 3 after inserting key 53 ()



- A. 52 53 B. 53 C. 50 52 D. 50 52 53

9. Suppose we're debugging a quicksort implementation that is supposed to sort an array in ascending order. After the first partition step has been completed, the contents of the array are in the following order:

3 9 1 14 17 24 22 20

Which of the following statements is correct about the partition step? ()

- A. The pivot could have been either 14 or 17
B. The pivot could have been 14, but could not have been 17
C. The pivot could have been 17, but could not have been 14

D. Neither 14 nor 17 could have been the pivot

10. Let P be a quick sort program to sort numbers in ascending order using the first element as the pivot. Let t_1 and t_2 be the number of comparisons made by P for the input [1 2 3 4 5] and [4 1 5 3 2] respectively. Which one of the following holds? ()

A. $t_1=5$ B. $t_1<t_2$ C. $t_1>t_2$ D. $t_1=t_2$

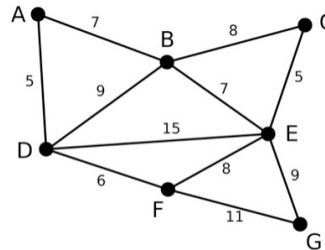
11. The height of 2-3 tree with n elements is ()

A. between $(n/2)$ and $(n/3)$ B. $(n/6)$
C. between (n) and $\log_2(n+1)$ D. between $\log_3(n+1)$ and $\log_2(n+1)$

12. For an undirected graph with n vertices and e edges, the sum of the degree of each vertex is equal to ()

A. $2n$ B. $(2n-1)/2$ C. $2e$ D. $(e^2)/2$

13. Consider the given graph



What is the weight of the minimum spanning tree using the Kruskal's algorithm? ()

A. 24 B. 53 C. 48 D. 39

14. For a given sequence of unsorted 3000 elements, which of following methods is the best for obtaining the largest 10 elements as quickly as possible? ()

A. Heap sort B. Quick sort C. Radix sort D. Bubble sort

15. For the given hash table, in what location will the element 58 be hashed using linear probing $\text{hash}(x) = x \bmod 10$? ()

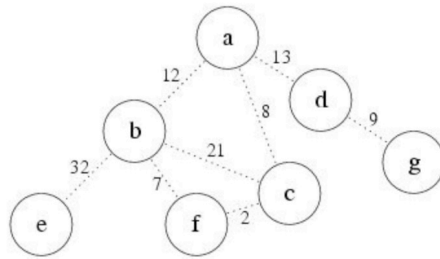
0	49
1	
2	
3	
4	
5	
6	
7	
8	18
9	89

A. 1 B. 2 C. 6 D. 7

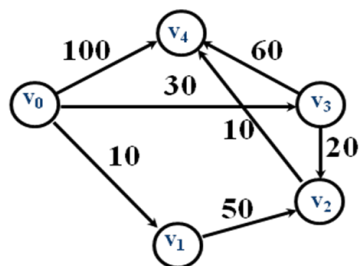
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二、简答题（共 7 题，60 分）

1. Find the minimum spanning tree of the following graph using Prim's algorithm (starting from vertex a). Please also list the edges according to the order where they are added to the MST (10 Points)



2. Given the directed graph below, produce the shortest path from vertex V_0 to all the other vertices using Dijkstra's Algorithm. (10 points)



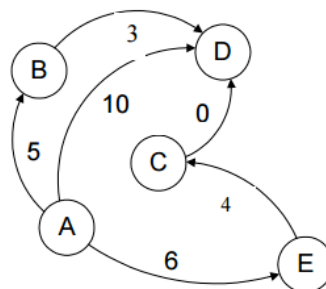
3. For a sequence of keys 66, 77, 11, 88, 99, 22, 33, 44, 55, what will be the result of sorting in ascending order using selection sort, quick sort (take the first element as the pivot), merge sort, shell sort (increment 增量 $d1=3$), and heap sort after one pass has completed, respectively. (10 points)

4. Assume a weighted directed graph G has 6 vertexes $\{v_0, v_1, v_2, v_3, v_4, v_5\}$, its Adjacency Matrix is

	v_0	v_1	v_2	v_3	v_4	v_5
v_0	0	7	∞	2	∞	60
v_1	∞	0	∞	∞	6	∞
v_2	∞	∞	0	∞	∞	∞
v_3	∞	∞	∞	0	12	15
v_4	∞	∞	25	∞	0	∞
v_5	∞	∞	10	∞	1	0

Draw the weighted directed graph G according to its adjacency matrix. (5 points)

5. Given the following graph, find a valid topological ordering of the nodes. Assume that any algorithm begins at node A. (5 Points)



6. Insert the keys 68,54,82,35,75,90,103,22 in the given order into an initially empty B-tree of order 3 (2-3 tree)

a) show the tree after insertion. (5 Points)

b) show the tree after deletion of keys 22 and 75 in turn (依次). (5 Points)

7. Suppose a hash table that has 13 positions indexed from 0 to 12, hash function $h(\text{key}) = \text{key} \% 13$. Utilize the closed hashing to solve the collisions. According to the keys to build a hash table. Keys: 19, 1, 23, 14, 55, 20, 27, 84.

a) You should show the hash table by utilizing a linear probing (6 points)

b) Calculate the ASL of **successful** searching and **unsuccessful** searching, respectively (4 Points)

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三、算法设计题（10 分）

A recursive function to traverse a graph as follow:

```
void DFS(Graph& G, int v) {    // Recursive depth first search
    G.Mark[v] = VISITED;      // Mark v as VISITED
    Visit(G, v);              // visit vertex v
    for (Edge e = G.FirstEdge(v); G.IsEdge(e); e = G.NextEdge(e))
        //each unvisited vertex adjacent to vertex v
        if (G.Mark[G.ToVertex(e)] == UNVISITED)
            DFS(G, G.ToVertex(e));
}
```

To convert an inherently recursive procedure to an iterative one,

- please describe the basic idea of your algorithm. (You may use English, Chinese or pseudo code to describe the algorithm) (3 Points)
- please write down the C or C++ codes for an iterative solution of traversing a graph using depth first search (Provide comments if necessary). (7 Points)