浙江大学宁波理工学院 2019–2020 学年 1 学期

《数据结构(A)》课程期末考试试卷（B）

开课分院：数据与计算机工程学院，考试形式：闭 卷，允许带_____入场

考试日期：2020 年 1 月 14 日，考试所需时间：120 分钟

考生姓名_____学号_____考生所在分院：数据学院 专业班级：_____.

术语表：

binary search tree 二叉搜索树	balance factor 平衡因子	complete binary tree 完全二叉树
sorted (non-decreasing) order （非递减）有序	（worst-case） time complexity（最坏情况）时间复杂度	single source shortest path 单源最短路径
preorder traversal 先序遍历	binary tree 二叉树	topological order 拓扑排序
inorder traversal 中序遍历	dummy head node 空表头结点	weighted path length 带权路径长度
postorder traversal 后续遍历	linear list 线性表	linear probe 线性探测
Singly/ doubly linked list 单/双向链表	ascending 递增	quadratic probe 平方探测
Circular Queue 循环队列	postfix expression 后缀表达式	Open addressing 开放定址
circularly linked list 循环链表	Shell/Heap/Quick/Insertion/Merge/bubble sort 希尔/堆/快速/插入/归并/冒泡排序	collision 冲突
circular array 循环数组	average search time 平均查找时间	loading factor 负载因子
hash table 散列表	adjacency matrix 邻接矩阵	sequence 序列
hash value 散列值	DFS/BFS 深度/宽度优先搜索	connected component 连通部件
adjacency lists 邻接表	connected graph 连通图	sequential storage 顺序存储

命题（组）老师签名：_____ 年 月 日

分院主管教学院长或首席主讲教授签名：_____ 年 月 日

. 考生姓名_____学号_____考生所在分院：_____专业班级：_____.

1、Answer the following questions with True or False, and make it on your answer sheet.（15 Points）

( )1、 The Fibonacci number sequence {*FN*} is defined as: *F*0=0, *F*1=1, *FN*=*FN*−1+*FN*−2 , *N*=2, 3, ... The space complexity of the function which calculates *FN* recursively is *O*(*logN*).

( )2、 If the most commonly used operations are to visit a random position and to insert and delete the last element in a linear list, then sequential storage works the fastest.

( )3、 Run the following operations on a stack S: Push(S,1), Push(S,2), Pop(S), Push(S,3), Pop(S), Pop(S). The output sequence must be {1, 2, 3}.

( )4、 In a circular queue which is implemented by an array, the front value must always be no larger than the rear value.

( )5、 If the preorder and inorder traversal sequences of a binary tree are the same, then none of the nodes in the tree has a left child .

( )6、 In a binary search tree which contains several integer keys including 4, 5, and 6, if 4 and 6 are on the same level, then 5 must be their parent.

( )7、 The number of leaf nodes in a complete binary tree with 124 nodes is definite.

( )8、 For any node in an AVL tree, the left and right subtrees must have the same height.

( )9、 In a directed graph, the sum of the in-degrees must be equal to the sum of the out-degrees of all the vertices.

( )10、 If a graph is represented by adjacency lists, then the space taken depends only on the number of vertices, not the number of edges.

( )11、 In a min-heap, all the keys along the path from the root to any leaf node must be in sorted (non-decreasing) order.

( )12、 $N\log N^2$ and $N\log N$ have the same speed of growth.

( )13、 In a binary search tree, the keys on the same level from left to right must be in sorted (non-decreasing) order.

( )14、 In a singly linked list of N nodes, the time complexities for query and insertion are $O(1)$ and $O(N)$, respectively.

( )15、 In a graph G, if we have to do BFS twice to visit every one of its vertices, then there must be two connected components in G.

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2. Read each of the following questions carefully; choose the best answer(from among items A, B, C, or D) and make it on your answer sheet.（30 Points）

( )1、 Insert the serial 2, 1, 4, 5, 9, 3, 6, 7 sequently into an AVL tree which is initialized to be empty. Which of the following statement is wrong?

A. 4 is the root node; B. 3 and 7 are siblings

C. 2 and 6 are siblings; D. 9 is the parent node of 7;

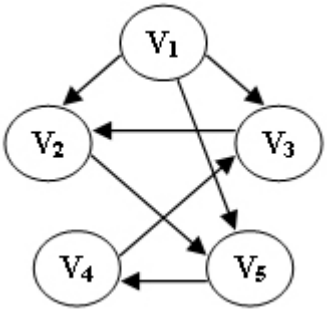
( )2、 Given the adjacency matrix of a directed graph as followed, the out-degree and in-degree of the node 2 (The number of the nodes starts with 0) are respectively:

$$\begin{bmatrix} 0 & 1 & 0 & 1 \\ 1 & 0 & 1 & 1 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 \end{bmatrix}$$

A. 3 and 1 B. 1 and 3

C. 0 and 2 D. 2 and 5

( )3、 Give the graph as followed, which option is not the DFS serial of the graph?



A. V_1, V_5, V_4, V_3, V_2 B. V_1, V_3, V_2, V_5, V_4

C. V_1, V_2, V_5, V_4, V_3 D. V_1, V_2, V_3, V_4, V_5

( )4、 Given an ordered sequence of 1000 elements. If another element is inserted by binary insertion sorting, the maximum number of comparisons is:

A. 1000 B. 999

C. 500 D. 10

( )5、 For a linear list with length n of sequential storage, the time complexity of searching and inserting nodes are respectively:

A. $O(1), O(1)$ B. $O(1), O(N)$

C. $O(N), O(1)$ D. $O(N), O(N)$

( )6、 Let *h* be a single-linked list without header node. The statement to insert a new node *t* on the head of h is:

A. h=t; t->next=h->next; B. t->next=h->next; h=t;

C. h=t; t->next=h; D. t->next=h; h=t;

( )7、 If *top* is a pointer to the top element of the stack, the condition for determining that stack *S* (containing at most *m* elements, index from 0 to *m*-1) is empty is:

A. S->top == 0 B. S->top == -1

C. S->top != m-1 D. S->top == m-1

( )8、 If the circular queue is represented by an array of size *m*, the queue head position is *front*, and the number of queue elements is *size*, then the queue tail element position *rear* is

A. front+size B. front+size-1

C. (front+size)%m D. (front+size-1)%m

( )9、 If the result of postorder traversal of a binary tree is *FDEBGCA* and the result of inorder traversal is FDBEACG, what is the result of preorder traversal of this binary tree?

A. ABCDEFG B. ABDFEGC

C. ABDFECG D. ABDEFCG

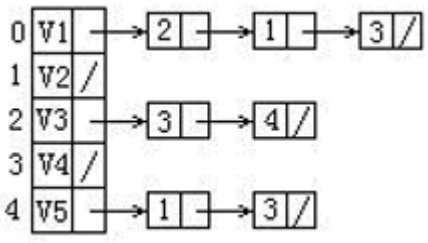
( )10、 On the 5th level of a binary tree (the root is at the 1st level), we can have at most （ ）nodes.

A. 8 B. 15 C. 16 D. 32

( )11、 Insert { 6, 4, 3、5, 8, 9 } one by one into an initially empty max-heap. The root of the resulting heap is

A. 3 B. 5 C. 6 D. 9

( )12、 Given the adjacency lists of a directed graph as followed. Then starting from V1, a possible BFS sequence is:



A. V1,V2,V3,V4,V5 B. V1,V2,V3,V5,V4

C. V1,V3,V2,V4,V5 D. V1,V4,V3,V5,V2

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( )13、 Which one of the following statements is TRUE about the consequential addresses generated by linear probing to resolve collisions?

A. They must be greater than or equal to the original has address

B. They must be smaller than or equal to the original has address

C. They can be greater than or smaller than, but never equal to the original has address

D. There is no restriction on the address

( )14、 Given a complete binary tree with 1102 nodes, the number of leaf nodes in the tree must be _____ .

A. 79 B. 551 C. 1063 D. Not sure

( )15、 The routes of airline flights can be represented by a directed graph. Which one of the following algorithms is the most suitable for finding the most economical flight path between any pair of cities?

A. Dijkstra B. Kruskal C. DFS D. Topological sort

3. Read each of the following programs (originate from the textbook) carefully, fill in the blanks and make it on your answer sheet. (2 points for each blank, 20 points total)

1. Given the following function to reverse the list L with a dummy header.

```
typedef struct Node * PtrToNode;
struct Node {
        ElementType Data;
        PtrToNode Next;
};
typedef PtrToNode List;
List Reverse(List L) {
        PtrToNode  Old_head, New_head, Temp;
        Old_head=L->next;
        New_head=NULL;
        while(Old_head) {
                Temp= Old_head->Next;
                Old_head->Next= New_head;
                 (     1     );
                Old_head=Temp;
```

```
        }
        (    2    );
        return L;
}
```

2. Given the following program to initialize a array implementation stack.

```
#define MaxSize  <储存数据元素的最大个数>
typedef int Position;
typedef struct SNode *PtrToSNode;
struct SNode{
        ElementType Data[MaxSize];
        Position Top;
        int MaxSize;
};
typedef PtrToSNode Stack;
Stack CreateStack( int N){
        Stack S = _____(3)_____;
        S-> Top =  -1;
        S-> MaxSize = _____(4)_____ ;
        return S;
}
```

3. Given the following program to implement inorder traversal sequences of a binary tree.

```
typedef struct TNode * Position;
typedef Position BinTree;
struct TNode {
        ElementType  Data;
        BinTree Left;
        BinTree Right;
};
void InorderTraversal(BinTree BT)
{
```

```
    if(BT){
        InorderTraversal (    5    );
        printf("%d", BT->Data);
        InorderTraversal (    6    );
    }
}
```

4. Given the following program for the Simple Insertion Sort to sort numbers from small to large.

```
void InsertionSort( ElementType A[], int N){
    int P, i;
    ElementType Tmp;
    for( P=1; P<N; P++){
        Tmp = A[P];  //get the first element of unsorted serial
        for( i=P; i>0 &&      (7)      ; i--)
            A[i] = A[i-1];
        A[i] =      (8)      ;
    }
}
```

5. Given the following program to implement binary search

```
typedef int KeyType;
typedef struct {
    KeyType key;
    InfoType data;
}RecType;
int BinSearch (RecType R[], int n, KeyType k)
{
    int low=0, high=n-1, mid;
    while (   9   ){
        mid = (low+high)/2;
        if (k = = R[mid].key)
        return mid;
        if(k<R.[mid].key)
```

```
                    high = mid-1;
                else
                    (   10   )
        }
        return 0;
}
```

4. Please write or draw your answers for the following problems on the answer sheet. (35 points)

1) (5 points) Give the input serial with A, B, and C, please write all possible output serials of a stack.

2) (7 points) Give the following input keys serial {70, 55, 93, 12, 50, 99 }, please draw some graphs to illustrate the construction process of a MaxHeap.

3) (7 points) Given the following program of quick sort. Let array A = {59, 12, 85, 94, 18, 22, 44}. Please draw a table to show the result in program first and second times running position 1.

```
void QSort ( ElementType A[ ],  int Left,  int Right )
{       ElementType Pivot = A[Right];
        int Low= Left, High = Right -1;
        while (1){
                        while (A[Low]) < Pivot )  Low++;
                        while (A[High]) > Pivot )  High--;
                        if ( Low < High )     Swap ( &A[Low], &A[High] ) ;
                        else  break;
        }
        Swap ( &A[Low], &A[Right] ) ;
          ; // position 1
        QSort ( A, Left, Low - 1 ) ;
        QSort ( A, Low + 1, Right ) ;
}
void QuickSort( ElementType A[ ], int N )
{     /* 快速排序 */
      QSort( A, 0, N-1 );
}
```

4) (7 points) Assume keys = {47, 29, 11, 92, 22, 8, 50, 37, 89, 94}, has table size with 11, and hash function h(key)=key%11, we use the linear probing to resolve collisions. Please try to give the final hash table and calculate the average successful search length (ASL).

5) (9 points) Given the adjacency matrix of a weighted directed graph as followed, the nodes numbered as V0, V1, …..V5.

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	V0	V1	V2	V3	V4	V5
V0	∞	2	12	∞	∞	∞
V1	∞	∞	∞	8	4	∞
V2	∞	∞	∞	∞	5	3
V3	∞	∞	∞	∞	∞	9
V4	∞	∞	∞	∞	∞	10
V5	∞	∞	∞	∞	∞	∞

a) Please draw the graph according to the matrix (2 points)
b) Please use algorithm Dijkstra to calculate the shortest path of other nodes from V0. (7 points)