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（A）

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	quick sort 快速排序
linear probing 线性探测法	binary tree 二叉树
preorder traversal 先序遍历	postorder traversal 后序遍历
inorder traversal 中序遍历	linear list 线性表
the minimum spanning tree 最小生成树	the shortest path 最短路径
time complexity 时间复杂度	linked list 链表
Circular Queue 循环队列	postfix expression 后缀表达式
quadratic probing 平方探测	complete binary tree 完全二叉树
singly linked list 单向链表	average search time 平均查找时间
hash table 散列表	adjacency matrix 邻接矩阵
hash value 散列值	BFS 宽度优先搜索
adjacency lists 邻接表	Huffman code 哈夫曼编码
AVL tree 平衡二叉树	Heap sort 堆排序
loading density 装填密度	collision 冲突

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

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

( ) 1. $O(N^2)$ is the same as $O(1+2+3+\cdots+N)$.

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

( ) 3. If keys are pushed onto a stack in the order ***abcde***, then it's impossible to obtain the output sequence ***cedab*** .

( ) 4. There exists a binary tree with 2020 nodes in total, and with 14 nodes having only one child.

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

( ) 6. Given a binary search tree with 20 integer keys which include 10, 11, and 12, if 10 and 12 are on the same level, then 11 must be their common ancestor.

( ) 7. Insert 1, 2, 3, 4, 5, and 6 one by one into an initially empty AVL tree. Then the preorder traversal sequence of the resulting tree must be {4, 2, 1, 3, 5, 6}.

( ) 8. The preorder traversal sequence of any min-heap must be in sorted (non-decreasing) order.

( ) 9. In a directed graph, the sum of the in-degrees and out-degrees of all the vertices is twice the total number of edges.

( ) 10. Let M be the minimum spanning tree of a weighted graph G. Then the path in M between V1 and V2 must be the shortest path between them in G.

( ) 11. After the first run of Insertion Sort, it is possible that no element is placed in its final position.

( ) 12. Store M elements in a hash table which is represented by an array of size S, the loading density is then M/S.

( ) 13. If quadratic probing is used to resolve collisions, then a new insertion must be successful if the size of the hash table is a prime.

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

( ) 15. The Huffman code is one kind of optimal prefix codes. For a given alphabet and its characters' frequencies， the Huffman codes may not be unique, but the Huffman code length of each character is unique.

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. For the following piece of code

```
x=90;
y=100;
while(y>0)
   if(x>100)
      { x=x-10; y--; }
   else x++;
```

the time complexity is:

A. O(1) B. O(N) C. $O(N^2)$ D. $O(\log_2 N)$

( ) 2. For a singly linked list with N nodes, which of the following operations has the time complexity O(N)?

A. insert a node after the node at address p

B. delete the first node

C. traverse the list and find the i-th node

D. delete the node right after the node at address p

( ) 3. Let h be the head of a singly linked list without a dummy head node. To insert a new node t as the first node, we must do:

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;

( ) 4. In order to convert the infix expression 4 * 3 + (6 * 3 - 12) to postfix expression using a stack S, then the minimum size of S must be:

A. 2 B. 3 C. 4 D. 5

( ) 5. What is the major difference among lists, stacks, and queues?

A. Lists use pointers, and stacks and queues use arrays

B. Stacks and queues are lists with insertion/deletion constraints

C. Lists and queues can be implemented using circularly linked lists, but stacks cannot

D. Lists are linear structures while stacks and queues are not

( ) 6. Insert {5, 6, 7, 2, 4, 3} one by one into an initially empty binary search tree. The postorder traversal sequence of the resulting tree is _?

A. 2, 3, 4, 7, 6, 5　　B. 2, 3, 4, 5, 6, 7

C. 5, 2, 4, 3, 6, 7　　D. 3, 4, 2, 7, 6, 5

(　　) 7. If a binary search tree of N nodes is also a complete binary tree, then among the following, which one is FALSE?

A. The average search time is O(logN)

B. The largest key must be on the last level

C. The smallest key must be at a leaf node

D. The median key must be at either the root or in the left subtree of the root

(　　) 8. Insert {10, 12, 1, 14, 6, 5, 8, 15, 3, 9, 7} one by one into an initially empty min-heap, and then run DeleteMin twice. The root of the resulting heap is:

A. 5　　B. 6　　C. 7　　D. 9

(　　) 9. Given a piece of text which consists of characters {a, b, c, d, e}, with the frequencies of occurrence being {3, 2, 5, 1, 1}, respectively. How many bytes will this piece of text occupy after Huffman coding?

A. 40　　B. 36　　C. 25　　D. 12

(　　) 10. Insert 26, 13, 44, 51, 98, 37, 66, 73 into an initially empty AVL tree. Which one of the following statements is FALSE?

A. 44 is the root

B. 37 and 73 are siblings

C. 26 and 66 are siblings

D. 26 is the parent of 13

(　　) 11. Given the adjacency matrix of a directed graph as the following:

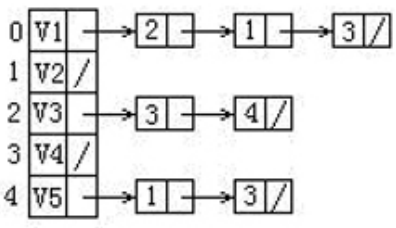
$$\begin{bmatrix} 0 & 1 & 0 & 1 \\ 1 & 0 & 1 & 1 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 \end{bmatrix}$$

The out-degree and the in-degree of the vertex 2 (the index starts from 0) are __, respectively.

A. 3 and 1　　B. 1 and 3

C. 0 and 2　　D. 2 and 0

(　　) 12. Given the adjacency lists of a directed graph as shown by the figure. 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

( ) 13. Given the adjacency matrix of a weighted graph as shown by the figure. The total weight of its minimum spanning tree is:

$$\begin{bmatrix} \infty & \infty & 3 & 2 & 4 & 6 \\ \infty & \infty & 10 & \infty & \infty & \infty \\ 3 & 10 & \infty & 1 & 5 & 7 \\ 2 & \infty & 1 & \infty & 4 & 8 \\ 4 & \infty & 5 & 4 & \infty & 6 \\ 6 & \infty & 7 & 8 & 6 & \infty \end{bmatrix}$$

A. 24 B. 23 C. 18 D. 17

( ) 14. To sort { 8, 3, 9, 11, 2, 1, 4, 7, 5, 10, 6 } by Shell Sort, if we obtain (1, 3, 7, 5, 2, 6, 4, 9, 11, 10, 8) after the first run, and (1, 2, 6, 4, 3, 7, 5, 8, 11, 10, 9) after the second run, then the increments of these two runs must be __ , respectively.

A. 3 and 1 B. 3 and 2

C. 5 and 2 D. 5 and 3

( ) 15. The average search time of searching a hash table with N elements is:

A. O(1) B. O(logN)

C. O(N) $O(N)$ D. cannot be determined

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.

```
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;
        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 function to create circle queue and insert element X into queue.

```
typedef int Position;
typedef struct QNode * PtrToQNode;
struct QNode {
        ElementType * Data;             /*存储元素的数组*/
        Position Front, Rear;           /*队列的头、尾*/
        int MaxSize;                    /*队列最大容量*/
};
typedef PtrToQNode Queue;
Queue CreateQueue(int MaxSize)
{
        Queue Q=(Queue)malloc(sizeof(struct QNode));
        Q->Data=(ElementType*)malloc(MaxSize*sizeof(ElementType));
        Q->Front=Q->Rear=0;
        Q->MaxSize=MaxSize;
        return Q;
}
bool IsFull(Queue Q)
{
        return ((Q->Rear+1)%Q->MaxSize ==      ③      );
}
bool Add(Queue Q,  ElementType X)
{
        if(IsFull(Q)){
                printf("Queue is full!");
                return false;
        }else{
```

```
            Q->Rear=_____④_____;
            Q->Data[Q->Rear] = X;
            return true;
        }
}
```

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

```
typedef struct TNode * Position;
typedef Position BinTree;
struct TNode {
        ElementType  Data;
        BinTree Left;
        BinTree Right;
};
void PreorderTraversal(BinTree BT)
{
        if(BT){
            printf("%d", BT->Data);
            PreorderTraversal (_____⑤_____);
            PreorderTraversal (_____⑥_____);
        }
}
```

4. Given the following program to implement levelorder traversal sequences of a binary tree.

```
typedef struct TNode * Position;
typedef Position BinTree;
struct TNode {
        ElementType  Data;
        BinTree Left;
        BinTree Right;
};
void LevelorderTraversal (BinTree BT){
        Queue Q;
        BinTree T;
        if(!BT) return;
        Q=CreatQueue();         /*创建空队列Q, 队列操作的相关方法代码省略*/
        AddQ(Q, BT);
        While(!IsEmpty(Q)){
```

```
            T=DeleteQ(Q);
            print("%d", T->Data);
            if(T->Left)     AddQ(Q,_____⑦_____);
            if(T->Right)    AddQ(Q,_____⑧_____);
        }
}
```

5. Given the following program to implement Shell Sort using the Sedgewick incremental sequence.

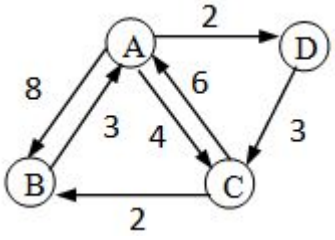
```
void ShellSort(ElementType A[], int N){
        int Si, D, P, i;
        ElementType Tmp;
        int Sedgewick[]={929, 505, 209, 109, 41, 19, 5, 1, 0};
        for(Si=0; Sedgewick[Si]>=N; Si++);
        for(D= Sedgewick[Si]; D<0;D= Sedgewick[++Si])
            for(P=D; P<N; P++){
                Tmp=A[P];
                for(i=P; i>=D&&_____⑨_____; i-=D)
                    A[i]=A[i-D];
                _____⑩_____;
        }
}
```

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

1. (7 points) Use the stack to calculate the value of post-expression: ***562/+34*-***, please draw the content of the Stack ***while*** reading **+** and **-**.

2. (7 points) The inorder and the postorder traversal sequences of a binary tree are ***a b c d e f g*** and ***a c b g f e d***, respectively. (1) please draw this binary tree; (2) please write the preorder traversal sequences.

3. (7 points) For the following weighted graph:



Use Floyed algorithm to calculate the shortest paths between pairs of vertices, please write the construction process step by step for shortest paths length matrix D and shortest path matrix P.

4. (7 points) Insert {18, 23, 11, 20, 2, 7, 27, 33, 42, 15} one by one into an initially empty hash table of size 11 with the hash function H(Key)=Key%11, and linear probing is used to resolve collisions. ⑴ Please try to give the final hash table; ⑵ Please try to calculate the average successful search length (ASL); ⑶ What is the loading factor α when the first collision occurs?

5. (7 points) For the following sequence {48, 62, 6, 25, 90, 17, 84, 96, 49, 72, 27}, please sort it into ascending sequence by Quick Sort algorithm. Write the sequence after first and second sorting operations (Selecting the ***last element*** as the pivot for each sorting).