Sichuan University Final Examination

(Closed Book)

(2016-2017 Academic Year 1st Semester)

课程号 Course Number: 311116030　　课程名称: Data Structure and Algorithm
任课教师 Lecturer: Yingke Chen　　考试时间 Time Period:
学生姓名 Name:　　学号 Student ID:　　成绩 Total Mark:

考 生 承 诺

Student Commitment

我已认真阅读并知晓《四川大学考场规则》和《四川大学本科学生考试违纪作弊处分规定（修订）》，郑重承诺：

I have read and comprehended the "Regulations of Sichuan University on Examinations". I give my commitments as follows:

1、已按要求将考试禁止携带的文具用品或与考试有关的物品放置在指定地点；

1. I have put prohibited stationary and exam-related items at designated area as required.

2、不带手机进入考场；

2. I have not brought cell phone to the examination room.

3、考试期间遵守以上两项规定，若有违规行为，同意按照有关条款接受处理。

3. During the examination, I will comply with the above two provisions. If there is any violation, I agree to accept the punishments in accordance with the relevant provisions.

考生签名：
Signature:

I. Multiply choice (20 points)

1	2	3	4	5	6	7	8	9	10

1. What is the minimum number of nodes in a complete binary tree with depth 3?

( )

A. 3； B. 4； C. 8； D. 11；

2. The correct operation of inserting a node ‘s’ after node ‘p’ in a single linked list is:

A. p. next=p B. s. next=p. next, p. next=s

C. p. next=s；s. next=p. next D. p. next=s

3. A recursive function can cause an infinite sequence of function calls if ( )

A．the problem size is halved at each step.

B．the termination condition (base case) is missing.

C．no useful incremental computation is done in each step.

D．the general case reduces the size of the problem.

4. The addresses which store Linked List.

A. must be sequential B. must be partly sequential

C. must be no sequential D. can be sequential or discontiguous

5. Given a stack, by the operation ( ), input ABC can be transform to CBA

A．push，pop，push，pop，push，pop

B．push，push，push，pop，pop，pop

C．push，push，pop，pop，push，pop

D．push，pop，push，push，pop，pop

6. Assume the preorder of binary tree T is ABEGFCDH, the inorder is EGBFADHC, then the postorder will be:

A. GEFBHDCA B. EGFBDHCA

C. GEFBDHCA D. GEBFDHCA

7. What is the **worst-case** time for binary search finding a single item in an array?

( )

A. O(1) B. O(log(N)) C. O(N) D. O(N^2)

8. The best case for an algorithm refers to ( )

A. The smallest possible input size.

B. The specific input instance of a given size that gives the lowest cost.

C. The largest possible input size that meets the required growth rate.

D. The specific input instance of a given size that gives the greatest cost.

9. Consider the node of a complete binary tree whose value is stored in data[i] for an

array implementation. If this node has a right child, where will the left child's value be stored? ( )

A. data[i+1] B. data[i+2] C. data[2*i + 1] D. data[2*i + 2]

10. Which sorting algorithm is of efficiency O(nlogn) ? ( )

A. bubble sort; B. mergesort;

C. insertion sort; D. selection sort

II. Fill blanks and True or False

1	2	3	4		5

1. Given an array with n elements, the average time complexity for reading the i-th element is ( ).

2. Given a binary search tree with n nodes, we can always find an element with time complexity O($log \quad n$). ( ) (True or False)

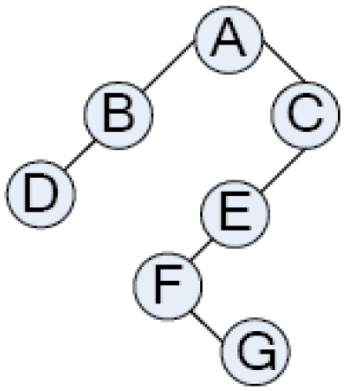
3. The big-O notation of arithmetic expression $5n^3 + 20nlog_2 n + 10nlog_2(n^4)$ is (_____)

4. Every complete binary tree is full. ( ) (True or False), and every full binary tree is complete. ( ) (True or False).

5. For binary trees, every node has at most two children. ( ) (True or False).

III. Analysis. Provide details as much as you can.

1. Write down the pre-order, post-order and in-order traversal of the tree below.



2. Convert A + B * (C – D) - E * F + G into a postfix expression, and convert AB+C/DE-* into an infix expression. Provide detailed steps.

3. Give a sequence of numbers: 77, 22, 9, 68, 16, 34, 13, please sort it with two different sorting algorithms: insertion sort and merge sort. Draw the result after each iteration/pass for each algorithm.

4. Draw the binary **max** heap that results from inserting: 77, 22, 9, 68, 16, 34, 13, and 8 in that order into an initially empty binary max heap. Draw the binary **max** heap that results from doing 2 deletions on the heap you created.

5. You are given a series of records whose keys are numbers. The records arrive in the following order: 23, 77, 27, 71, 12, 66, 55, and 46. Draw a BST and an AVL tree for storing these records, and intermediate steps are appreciated.

IV. Program. Provide details as much as you can.

1. Given a class of binary search tree node as follows:

```
public class BinaryNode {
   public int data;   // data stored in this node
   public BinaryNode leftChild;
   public BinaryNode rightChild;
   public BinaryNode(int data) {
      this.data = data;
      this.leftChild = null;
      this.rightChild = null;
    }
}
```

Write a function that prints out the node values for a BST in sorted order **from lowest to highest**.

2. Complete the following quick sort algorithm.

```
/**
 * Return median of left, center, and right.
 * Order these and hide the pivot.
 */
 private int median3( int [ ] a, int left, int right )
 {
   int center =  _____(1)_____;
   if( a[ center ] < a[ left ] )
        swapReferences( a, left, center );
   if( a[ right ] > a[ left ] )
        _____(2)_____;
   if(_____(3)_____ )
        swapReferences( a, center, right );
  // Place pivot at position right - 1
   swapReferences( a, center, right - 1 );
   return  _____(4)_____;
 }
```

```
private void quicksort( int [ ] a, int left, int right )
{
 int pivot = median3( a, left, right );
 // Begin partitioning
 int i = left,    j = right - 1;
 for( ; ; )
 {
       while( a[ ++i ] <  ___(5)___ ) { }
       while( a[ j- - ]  __(6)__  pivot )    { }
       if( i < j )
            _____(7)_____;
       else
            break;
 }
 // Restore pivot
 swapReferences( a, i, right - 1 );
 quicksort( a, left, i - 1 ); // Sort small elements
 _____(8)_____; // Sort large elements
}
```