

浙江大学2015-16春夏《高级数据结构与算法分析》期中模拟 练习

开始时间 2016/01/01 08:00:00 结束时间 2038/01/18 08:00:00 答题时长 60分钟
考生 得分 97 总分 100

判断题 得分：33 总分：36

R1-1 When measuring the relevancy of the answer set, if the precision is high but the recall is low, it means (3分) that most of the relevant documents are retrieved, but too many irrelevant documents are returned as well.

T F

评测结果 答案正确 (3 分)

R1-2 For any node in an AVL tree, the height of the left subtree must be greater than that of the right (3分) subtree.

T F

评测结果 答案正确 (3 分)

R1-3 If a problem can be solved by dynamic programming, it must be solved in polynomial time. (3分)

T F

评测结果 答案正确 (3 分)

R1-4 All the languages can be decided by a non-deterministic machine. (3分)

T F

评测结果 答案正确 (3 分)

R1-5 For one operation, if its amortized time bound is $O(\log N)$, then its worst-case time bound must be (3分) $O(\log N)$.

T F

评测结果 答案正确 (3 分)

R1-6 Word stemming is to eliminate the commonly used words from the original documents. (3分)

T F

评测结果 答案正确 (3 分)

R1-7 In a red-black tree, the number of internal nodes in the subtree rooted at x is no more than $2^{bh(x)} - 1$ where $bh(x)$ is the black-height of x . (3分)

T F

评测结果 答案正确 (3 分)

R1-8 The right path of a skew heap can be arbitrarily long. (3分)

T F

评测结果 答案正确 (3 分)

R1-9 For any node in an AVL tree, the left and right subtrees must have the same height.

(3分)

- T F

评测结果 答案正确 (3分)

R1-10 For one operation, if its average time bound is $O(\log N)$, then its amortized time bound must be $O(\log N)$.

- T F

评测结果 答案正确 (3分)

R1-11 In a B+ tree, leaves and nonleaf nodes have some key values in common.

(3分)

- T F

评测结果 答案正确 (3分)

R1-12 Given that problem A is NP-complete. If problem B is in NP and can be polynomially reduced to problem A, then problem B is NP-complete.

F

- T F

评测结果 答案错误 (0分)

单选题

得分：52 总分：52

R2-1 Which one of the following statements is TRUE?

(4分)

- A. With the same operations, the resulting skew heap is always more balanced than the leftist heap
- B. For leftist heaps and skew heaps, the worst-case running time of a single insertion are both $O(N)$
- C. None of the above is true
- D. The relationship of skew heaps to leftist heaps is analogous to the relation between splay trees and AVL trees

评测结果 答案正确 (4分)

R2-2 Insert $\{3, 9, 6, 7, 1, 4, 8, 10\}$ into an initially empty 2-3 tree (with splitting), and then delete 7. Which one of the following statements is FALSE about the resulting tree?

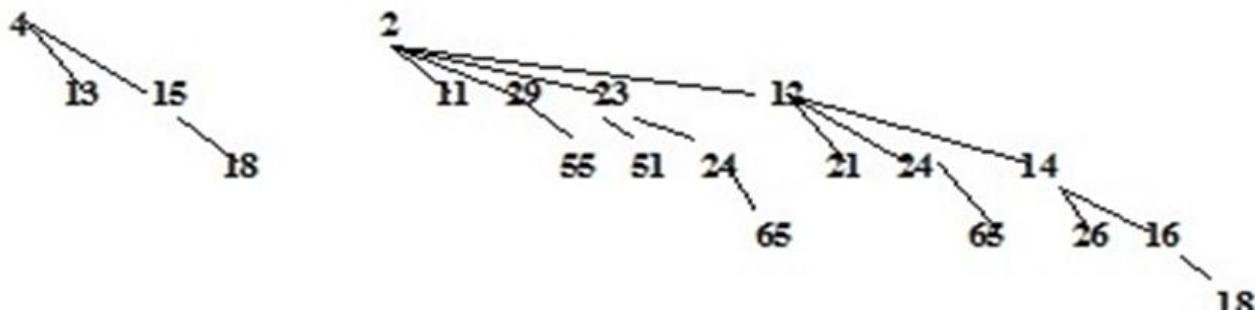
(5分)

- A. there are 4 leaf nodes
- B. the first key stored in the root is 4
- C. 9 and 8 are in the same node
- D. the parent of the node containing 6 has 3 children

评测结果 答案正确 (5分)

R2-3 Delete the minimum number from the given binomial queue in the following figure. Which one of the following statements is FALSE?

(5分)



- A. 11 is the root of a binomial tree
- B. 23 is not the root of any resulting binomial tree
- C. there are three binomial trees after deletion, which are B_0 , B_1 and B_4
- D. 29 and 23 are both children of 4

评测结果 答案正确 (5分)

R2-4 If the depth of an AVL tree is 5 (the depth of an empty tree is defined to be 0), then the minimum possible number of nodes in this tree is: (5分)

- A. 64
- B. 12
- C. 20
- D. 33

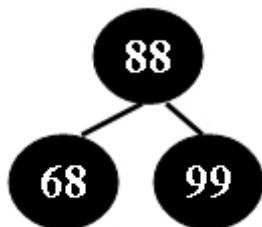
评测结果 答案正确 (5分)

R2-5 When solving a problem with input size N by divide and conquer, if at each stage the problem is divided into 4 sub-problems of equal size $N/5$, and the conquer step takes $O(\log N)$ to form the solution from the sub-solutions, then the overall time complexity is: (5分)

- A. $O(\log N)$
- B. $O(\log^2 N)$
- C. $O(N)$
- D. $O(N^{\log 4 / \log 5})$

评测结果 答案正确 (5分)

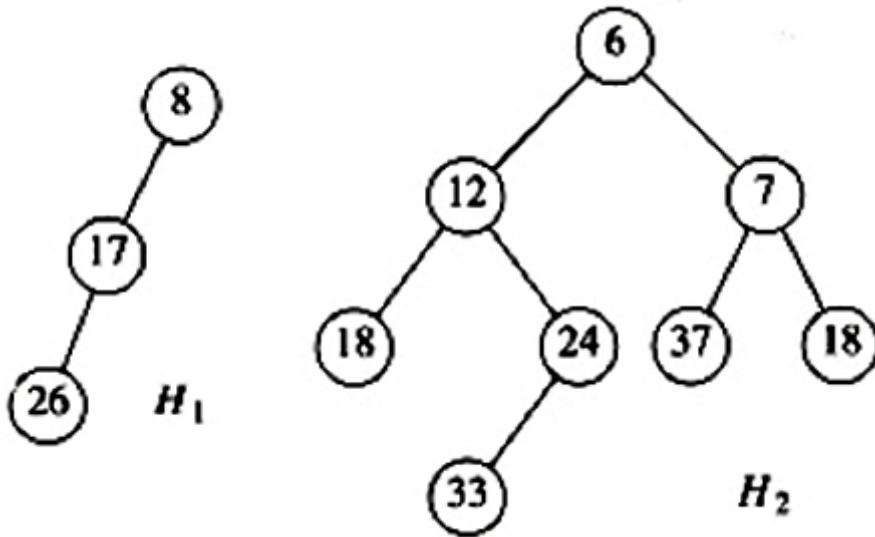
R2-6 Starting from the red-black tree given in the figure, after successively inserting the keys {83, 75, 19}, which one of the following statements is FALSE? (4分)



- A. 75 and 99 are siblings, and they are both black
- B. 19 is the deepest red node
- C. there are two red nodes
- D. 75 is the parent of 83

评测结果 答案正确 (4分)

R2-7 Merge the two leftist heaps in the following figure. Which one of the following statements is FALSE? (4分)



- A. the null path length of 7 is the same as that of 12
- B. 37 is the left child of 7
- C. the depths of 24 and 8 are the same
- D. 6 is the root with 7 being its right child

评测结果 答案正确 (4分)

R2-8 We can perform BuildHeap for leftist heaps by considering each element as a one-node leftist heap, (5分) placing all these heaps on a queue, and performing the following step: Until only one heap is on the queue, dequeue two heaps, merge them, and enqueue the result. Which one of the following statements is FALSE?

-
- A. the time complexity $T(N) = O(\frac{N}{2} \log 2^0 + \frac{N}{2^2} \log 2^1 + \frac{N}{2^3} \log 2^2 + \dots + \frac{N}{2^K} \log 2^{K-1})$ for some integer K so that $N = 2^K$
- B. the worst case is when $N = 2^K$ for some integer K
- C. the worst case time complexity of this algorithm is $\Theta(N \log N)$
- D. in the k -th run, $\lceil N/2^k \rceil$ leftist heaps are formed, each contains 2^k nodes

评测结果 答案正确 (5分)

R2-9 A queue can be implemented by using two stacks S_A and S_B as follows: (6分)

- To enqueue x , we push x onto S_A .
- To dequeue from the queue, we pop and return the top item from S_B . However, if S_B is empty, we first fill it (and empty S_A) by popping the top item from S_A , pushing this item onto S_B , and repeat until S_A is empty.

Assuming that push and pop operations take $O(1)$ worst-case time, please select a potential function ϕ which can help us prove that enqueue and dequeue operations take $O(1)$ amortized time (when starting from an empty queue).

- A. $\phi = 2|S_A|$
- B. $\phi = 2|S_B|$
- C. $\phi = |S_A|$
- D. $\phi = |S_B|$

评测结果 答案正确 (6分)

R2-10 Rod-cutting Problem: Given a rod of total length N inches and a table of selling prices P_L for lengths $L = 1, 2, \dots, M$. You are asked to find the maximum revenue R_N obtainable by cutting up the rod and selling the pieces. For example, based on the following table of prices, if we are to sell an 8-inch rod, the optimal solution is to cut it into two pieces of lengths 2 and 6, which produces revenue $R_8 = P_2 + P_6 = 5 + 17 = 22$. And if we are to sell a 3-inch rod, the best way is not to cut it at all.

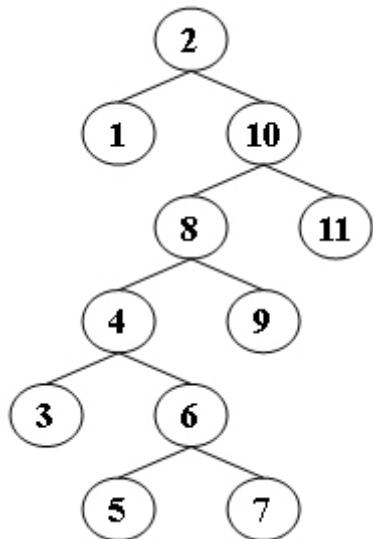
Length L	1	2	3	4	5	6	7	8	9	10
Price P_L	1	5	8	9	10	17	17	20	23	28

Which one of the following statements is FALSE?

- A. If $N \leq M$, we have $R_N = \max\{P_N, \max_{1 \leq i < N} \{R_i + R_{N-i}\}\}$
- B. This problem can be solved by dynamic programming
- C. If $N > M$, we have $R_N = \max_{1 \leq i < N} \{R_i + R_{N-M}\}$
- D. The time complexity of this algorithm is $O(N^2)$

评测结果 答案正确 (5分)

R2-11 For the result of accessing 5 in the splay tree in the following figure, besides saying that 5 must be the root, which one of the following statements is also TRUE?



- A. 6 and 10 are siblings
- B. 6 is a leaf node
- C. 2 and 10 are siblings
- D. 4 and 10 are siblings

评测结果 答案正确 (4分)

程序填空题

得分: 12 总分: 12

R5-1 The function `RL_Rotation` is to do right-left rotation to the trouble-finder tree node `T` in an AVL tree.

```

typedef struct TNode *Tree;
struct TNode {
    int key, h;
    Tree left, right;
};

Tree RL_Rotation( Tree T )
{

```

```

Tree K1, K2;

K1 = T->right;
K2 = K1->left;
K1->left = K2->right      (4分);
T->right = K2->left       (4分);
K2->right = K1;
K2->left = T              (4分);
/* Update the heights */
K1->h = maxh(Height(K1->left), Height(K1->right)) + 1;
T->h = maxh(Height(T->left), Height(T->right)) + 1;
K2->h = maxh(K1->h, T->h) + 1;

return K2;
}

```

评测结果 答案正确 (12 分)

测试点得分

序号	结果	得分
0	答案正确	4
1	答案正确	4
2	答案正确	4

浙江大学2017-18春夏《高级数据结构与算法分析》期中模拟练习

开始时间	2016/01/01 08:00:00	结束时间	2038/01/18 08:00:00	答题时长	45分钟
考生		得分	86	总分	100

判断题 得分：36 总分：39

R1-1 To solve a problem by dynamic programming instead of recursions, the key approach is to store the results of computations for the subproblems so that we only have to compute each different subproblem once. Those solutions can be stored in an array or a hash table. (3分)

- T F

评测结果 答案正确 (3分)

R1-2 Word stemming is to eliminate the commonly used words from the original documents. (3分)

- T F

评测结果 答案正确 (3分)

R1-3 For the recurrence equation $T(N) = aT(N/b) + f(N)$, if $af(N/b) = Kf(N)$ for some constant $K > 1$, then $T(N) = \Theta(f(N))$. (5分)

- T F

评测结果 答案正确 (5分)

R1-4 While accessing a term, hashing is faster than search trees. (3分)

- T F

评测结果 答案正确 (3分)

R1-5 All of the Zig, Zig-zig, and Zig-zag rotations not only move the accessed node to the root, but also roughly half the depth of most nodes on the path. (3分)

- T F

评测结果 答案错误 (0分)

R1-6 In the 4-queens problem, (x_1, x_2, x_3, x_4) correspond to the 4 queens' column indices. During backtracking, $(1, 4, 2, ?)$ will be checked before $(1, 3, 4, ?)$, and none of them has any solution in their branches. (4分)

- T F

评测结果 答案正确 (4分)

R1-7 In a B+ tree, leaves and nonleaf nodes have some key values in common. (3分)

- T F

评测结果 答案正确 (3分)

R1-8 In a red-black tree, an internal red node cannot be a node of degree 1. (4分)

- T F

评测结果 答案正确 (4分)

R1-9 With the same operations, the resulting skew heap is always more balanced than the leftist heap. (3分)

- T F

评测结果 答案正确 (3分)

R1-10 Insert { 1, 2, 5, 3, 8, 4, -1, 10, 128, 34, 15, 63, 18, -24, 186 } into an initially empty binomial queue, the resulting roots are 186, -24, 15 and -1. (5分)

- T F

评测结果 答案正确 (5分)

R1-11 For one operation, if its amortized time bound is $O(\log N)$, then its worst-case time bound must be (3分) $O(\log N)$.

- T F

评测结果 答案正确 (3分)

单选题

得分：30 总分：36

R2-1 Among the following groups of concepts, which group is not totally relevant to a search engine? (6分)

- A. word stemming, hashing, compression
- B. inverted file index, stop words, precision
- C. distributed index, backtracking, query
- D. posting list, thresholding, recall

评测结果 答案正确 (6分)

R2-2 When solving a problem with input size N by divide and conquer, if at each step, the problem is divided into 9 sub-problems and each size of these sub-problems is $N/3$, and they are conquered in $O(N^2 \log N)$. Which one of the following is the closest to the overall time complexity? (6分)

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

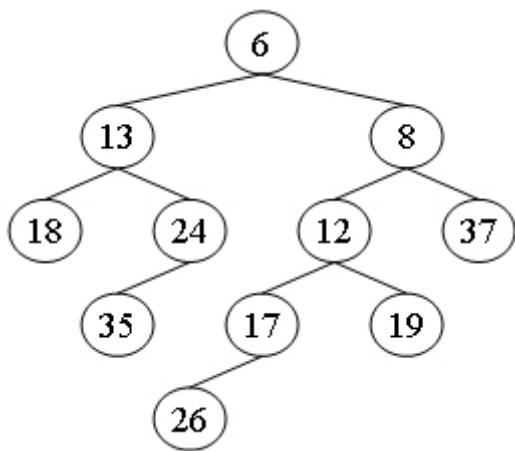
评测结果 答案正确 (6分)

R2-3 A B+ tree of order 3 with 21 numbers has at least ___ nodes of degree 2. (6分)

- C
- A. 3
 - B. 2
 - C. 0
 - D. 1

评测结果 答案错误 (0分)

R2-4 Delete the minimum number from the given leftist heap. Which one of the following statements is TRUE? (6分)



- A. 24 is the left child of 13
- B. 12 is the right child of 8
- C. 35 is the right child of 24
- D. 8 is NOT the root

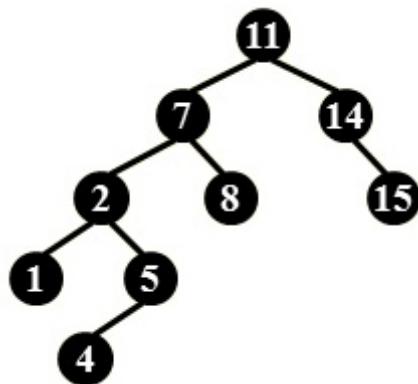
评测结果 答案正确 (6分)

R2-5 Insert { 9, 8, 7, 2, 3, 5, 6, 4} into an initially empty AVL tree. Which one of the following statements is FALSE? (6分)

- A. there are 2 nodes with their balance factors being -1
- B. 2 and 5 are siblings
- C. the height of the resulting AVL tree is 3
- D. 5 is the root

评测结果 答案正确 (6分)

R2-6 For the result of accessing the keys 4 and 8 in order in the splay tree given in the figure, which one of the following statements is FALSE? (6分)



- A. 8 is the root
- B. 7 and 14 are siblings
- C. 4 and 11 are siblings
- D. 4 is the parent of 7

评测结果 答案正确 (6分)

程序填空题

得分： 20 总分： 25

R5-1 The function `BinQueue_Merge` is to merge two binomial queues `H1` and `H2`, and return `H1` as the resulting queue.

```

BinQueue BinQueue_Merge( BinQueue H1, BinQueue H2 )
{
    BinTree T1, T2, Carry = NULL;
    int i, j;
    H1->CurrentSize += H2-> CurrentSize;
    for ( i=0, j=1; j<= H1->CurrentSize; i++, j*=2 ) {
        T1 = H1->TheTrees[i]; T2 = H2->TheTrees[i];
        switch( 4*!Carry + 2*!T2 + !T1 ) {
            case 0:
            case 1: break;
            case 2: H1->TheTrees[i]=T2;H2->TheTrees[i]=NULL;Carry=NULL (5分); break;
            case 4: H1->TheTrees[i] = Carry; Carry = NULL; break;
            case 3: Carry = CombineTrees( T1, T2 );
                H1->TheTrees[i] = H2->TheTrees[i] = NULL; break;
            case 5: Carry = CombineTrees( T1, Carry );
                H1->TheTrees[i] = NULL; break;
            case 6: Carry = CombineTrees( T2, Carry );
                H2->TheTrees[i] = NULL; break;
            case 7: H1->TheTrees[i] = Carry;
                Carry = CombineTrees( T1, T2 ); (5分);
                H2->TheTrees[i] = NULL; break;
        } /* end switch */
    } /* end for-loop */
    return H1;
}

```



评测结果 答案正确 (10 分)

测试点得分

序号	结果	得分
0	答案正确	5
1	答案正确	5

R5-2 The function `LR_Rotation` is to do left-right rotation to the trouble-finder tree node `T` in an AVL tree.

```

typedef struct TNode *Tree;
struct TNode {
    int key, h;
    Tree left, right;
};

Tree LR_Rotation( Tree T )
{
    Tree K1, K2;

    K1 = T->left;
    K2 = K1->right;
    K1->right = K2->left (5分);
    T->left = K2->right (5分);
    K2->right = T;
    K2->left=K1 (5分); K2->left=K1
    /* Update the heights */
    K1->h = maxh(Height(K1->left), Height(K1->right)) + 1;
    T->h = maxh(Height(T->left), Height(T->right)) + 1;
    K2->h = maxh(K1->h, T->h) + 1;
}

```

```
    return K2;  
}
```

评测结果 部分正确 (10 分)

测试点得分

序号	结果	得分
0	答案正确	5
1	答案正确	5
2	编译错误	0

浙江大学2018-19春夏《高级数据结构与算法分析》期中模拟

练习-陈越

开始时间 2016/01/01 08:00:00

结束时间 2038/01/18 08:00:00

答题时长 45分钟

考生

得分 97

总分 100

判断题

得分：32 总分：35

R1-1 When measuring the relevancy of the answer set, if the precision is low but the recall is high, it means (4分)

F that most of the relevant documents are missing, but most of the retrieved documents are relevant.

- T F

R1-2 A perfectly balanced tree forms if keys 1 to $2^k - 1$ are inserted in order into an initially empty leftist heap. (4分)

- T T F

R1-3 In a red-black tree, the number of rotations in the DELETE operation is $O(1)$. (3分)

- T T F

R1-4 For the recurrence equation $T(N) = aT(N/b) + f(N)$, if $a f(N/b) = f(N)$, then $T(N) =$ (4分)

F $\Theta(N \log N)$.

- T F

R1-5 Making N insertions into an initially empty binomial queue takes $O(N)$ time in the worst case. (3分)

- T T F

R1-6 In amortized analysis, a good potential function should always assume its maximum at the start of the sequence. (3分)

- F T F

R1-7 Finding the minimum key from a splay tree will result in a tree with its root having no left subtree. (4分)

- T T F

R1-8 In an AVL tree, it is possible to have this situation that the balance factors of a node and both of its children are all -1. (4分)

- T T F

R1-9 In backtracking, if different solution spaces have different sizes, start testing from the partial solution with the smallest space size would have a better chance to reduce the time cost. (3分)

- T T F

R1-10 The time bound of the FIND operation in a B+ tree containing N numbers is $O(\log N)$, no matter what the degree of the tree is. (3分)

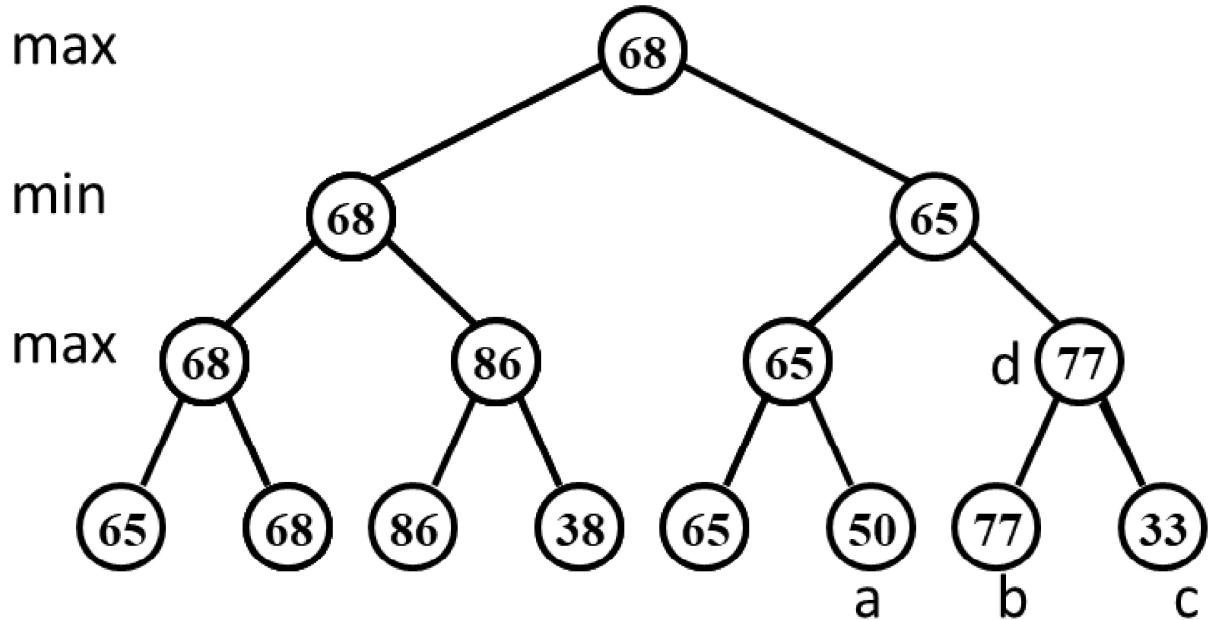
- T T F

单选题

得分：40 总分：40

R2-1 Given the following game tree, which node in the right subtree is the first node to be pruned with α - β pruning algorithm? (5分)

A



- A. d
- B. b
- C. c
- D. a

R2-2 Insert { 5, 1, 7, 8, 21, 2, 12, 19, 13, 0 } into an initially empty 2-3 tree (with splitting). Which one of the following statements is FALSE? (5分)

A

- A. 13 and 19 are in the same node
- B. the first key stored in the root is 12
- C. the parent of the node containing 8 has 3 children
- D. there are 5 leaf nodes

R2-3 There are 8000 documents in the database. The statistic data for one query are shown in the following table. The precision is: _____ (5分)

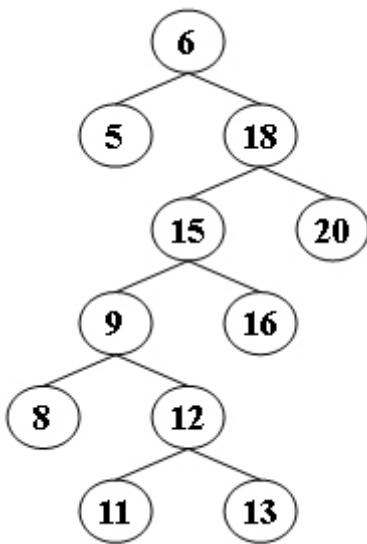
A

	Relevant	Irrelevant
Retrieved	1000	1000
Not Retrieved	2000	4000

- A. 50%
- B. 33%
- C. 12.5%
- D. 20%

R2-4 For the result of accessing 11 in the splay tree in the following figure, besides saying that 11 must be the root, which one of the following statements is also TRUE? (5分)

D



- A. 6 and 18 are siblings
- B. 12 is a leaf node
- C. 9 and 18 are siblings
- D. 12 and 18 are siblings

R2-5 A queue can be implemented by using two stacks S_A and S_B as follows:

(5分) ▲

- A
- To enqueue x , we push x onto S_A .
 - To dequeue from the queue, we pop and return the top item from S_B . However, if S_B is empty, we first fill it (and empty S_A) by popping the top item from S_A , pushing this item onto S_B , and repeat until S_A is empty.

Assuming that push and pop operations take $O(1)$ worst-case time, please select a potential function ϕ which can help us prove that enqueue and dequeue operations take $O(1)$ amortized time (when starting from an empty queue).

- A. $\phi = 2|S_A|$
- B. $\phi = |S_B|$
- C. $\phi = 2|S_B|$
- D. $\phi = |S_A|$

R2-6 3-way-mergesort : Suppose instead of dividing in two halves at each step of the mergesort, we divide (5分)

B into three one thirds, sort each part, and finally combine all of them using a three-way-merge. What is the overall time complexity of this algorithm ?

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

R2-7 Delete a node v from an AVL tree T_1 , we can obtain another AVL tree T_2 . Then insert v into T_2 , we can obtain another AVL tree T_3 . Which one(s) of the following statements about T_1 and T_3 is(are) true? (5分)

D

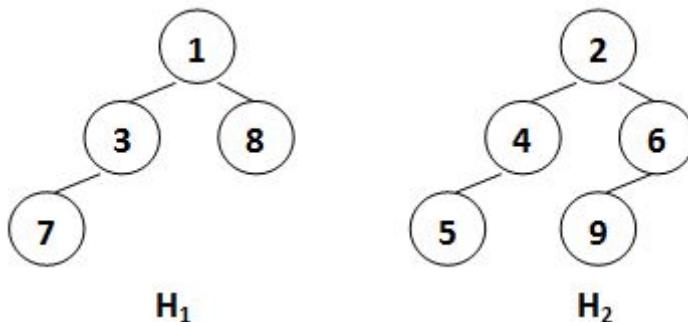
- I. If v is a leaf node in T_1 , then T_1 and T_3 might be different.
- II. If v is not a leaf node in T_1 , then T_1 and T_3 must be different.
- III. If v is not a leaf node in T_1 , then T_1 and T_3 must be the same.

- A. II only

- B. I and II only
- C. I and III only
- D. I only

R2-8 Merge the two leftist heaps in the following figure. Which one of the following statements is FALSE? (5分)

D



- A. 6 is the left child of 2
- B. the null path length of 6 is the same as that of 2
- C. 1 is the root with 3 being its right child
- D. Along the left most path from top down, we have 1, 2, 4, and 5

程序填空题

得分：25 总分：25

R5-1 The functions `BinQueue_Find` and `Recur_Find` are to find `X` in a binomial queue `H`. Return the node pointer if found, otherwise return `NULL`.

```

BinTree BinQueue_Find( BinQueue H, ElementType X )
{
    BinTree T, result = NULL;
    int i, j;

    for( i=0, j=1; j<=H->CurrentSize; i++, j*=2) { /* for each tree in H */
        T= H->TheTrees[i];
        if ( X == T->Element ) { /* if need to search inside this tree */
            result = Recur_Find(T, X);
            if ( result != NULL ) return result;
        }
    }
    return result;
}

BinTree Recur_Find( BinTree T, ElementType X )
{
    BinTree result = NULL;
    if ( X==T->Element ) return T;
    if ( T->LeftChild != NULL ) {
        result = Recur_Find(T->LeftChild, X);
        if ( result!=NULL ) return result;
    }
    if ( T->NextSibling!=NULL )
        result = Recur_Find(T->NextSibling, X);
    return result;
}

```

R5-2 The functions `IsRBT` is to check if a given binary search tree `T` is a red-black tree. Return `true` if `T` is, or `false` if not.

The red-black tree structure is defined as the following:

```
typedef enum { red, black } colors;
typedef struct RBNode *PtrToRBNode;
struct RBNode{
    int Data;
    PtrToRBNode Left, Right, Parent;
    int BlackHeight;
    colors Color;
};
typedef PtrToRBNode RBTree;
```

Please fill in the blanks.

```
bool IsRBT( RBTree T )
{
    int LeftBH, RightBH;
    if ( !T ) return true;
    if ( T->Color == black ) T->BlackHeight = 1;
    else {
        if ( T->Left && (T->Left->Color==red) (5分)) return false;
        if ( T->Right && (T->Right->Color == red) ) return false;
    }
    if ( !T->Left && !T->Right ) return true;
    if ( IsRBT(T->Left)&&IsRBT(T->Right) (5分) {
        if ( T->Left ) LeftBH = T->Left->BlackHeight;
        else LeftBH = 0;
        if ( T->Right ) RightBH = T->Right->BlackHeight;
        else RightBH = 0;
        if ( LeftBH == RightBH ) {
            T->BlackHeight+=LeftBH (5分);
            return true;
        }
        else return false;
    }
    else return false;
}
```



▶ 1-1 分数 2

The maximum/minimum height for an AVL tree of 30 nodes is 6/4.
(The height of an empty tree is defined to be -1)

T F

答案正确: 2 分

1-2 分数 2

While accessing a term by hashing in an inverted file index, range searches are expensive.

T F

答案正确: 2 分 创建提问

1-3 分数 2

The asymptotic upper bound for the recurrence $T(n) = 2T(\lfloor n/2 \rfloor + 17) + n$ is $T(n) = O(n \log n)$.

T F

答案正确: 2 分

1-4 分数 2

A perfectly balanced tree forms if keys 1 to $2^k - 1$ are inserted in order into an initially empty skew heap.

T F

答案正确: 2 分 创建提问

1-5 分数 2

To implement a binomial queue, the subtrees of a binomial tree are linked in increasing sizes.

T F

答案正确: 2 分 创建提问

1-6 分数 2

The worst-case running time of *Insert* operation is $O(\log N)$ for skew heaps.

T F

答案正确: 2 分



< 上一题

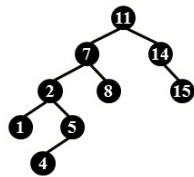
单题作答

下一题 >

▶ 2-2 分数 3

作者 徐镜春 单位 浙江大学

For the result of accessing the keys 4 and 8 in order in the splay tree given in the figure, which one of the following statements is FALSE?



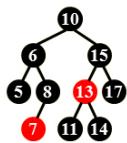
- A. 8 is the root
- B. 4 and 11 are siblings
- C. 7 and 14 are siblings
- D. 4 is the parent of 7

答案正确: 3 分

2-3 分数 3

作者 徐镜春 单位 浙江大学

After deleting 10 from the red-black tree given in the figure, which one of the following statements must be FALSE?



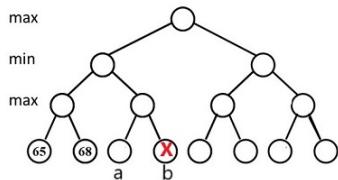
- A. 11 is the parent of 6, and 14 is red
- B. 8 is the parent of 15, and 7 is black
- C. 11 is the parent of 15, and there are 2 red nodes in the tree
- D. 8 is the parent of 15, and there are 2 red nodes in the tree

答案正确: 3 分

2-5 分数 3

作者 何钦铭 单位 浙江大学

Given the following game tree, if node b is pruned with $\alpha\text{-}\beta$ pruning algorithm, which of the following statements about the value of node a is correct?



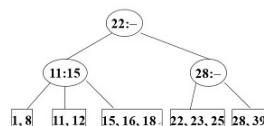
- A. greater than 65
- B. less than 65
- C. greater than 68
- D. less than 68

答案正确: 3 分

2-4 分数 3

作者 何钦铭 单位 浙江大学

Given a 2-3 tree as shown in the following figure. Which of the following pairs of insertions will result in a 2-3 tree with different structures?



- A. Inserting 9 vs. Inserting 13
- B. Inserting 13 vs. inserting 30
- C. Inserting 17 vs. inserting 19
- D. Inserting 19 vs. inserting 24

答案正确: 3 分



< 上一题

□ 单题作答

下一题 >



▶ 5-1 B+ Tree - Find Key 分数 4

The function `FindKey` is to check if a given `key` is in a B+ Tree with its root pointed by `root`.
 Return `true` if `key` is in the tree, or `false` if not. The B+ tree structure is defined as following:

```
static int order = DEFAULT_ORDER;
typedef struct BpTreeNode BpTreeNode;
struct BpTreeNode {
    BpTreeNode** childrens; /* Pointers to childrens. This field is not used by leaf nodes. */
    ElementType* keys;
    BpTreeNode* parent;
    bool isLeaf; /* 1 if this node is a leaf, or 0 if not */
    int numKeys; /* This field is used to keep track of the number of valid keys.
    In an internal node, the number of valid pointers is always numKeys + 1. */
};

bool FindKey(BpTreeNode * const root, ElementType key){
    if (root == NULL) {
        return false;
    }
    int i = 0;
    BpTreeNode * node = root;
    while ( !(node->isLeaf) [2 分] {
        i = 0;
        while (i < node->numKeys) {
            if (key >= node->keys[i] [2 分]) i++;
            else break;
        }
        node = node->childrens[i];
    }
    for(i = 0; i < node->numKeys; i++){
        if(node->keys[i] == key)
            return true;
    }
    return false;
}
```

答案正确: 4 分

创建提问

5-2 Decode Count 分数 6

Suppose that a string of English letters is encoded into a string of numbers. To be more specific, A - Z are encoded into 0 - 25. Since it is not a prefix code, the decoded result may not be unique. For example, 1213407 can be decoded as BCBDEAH, MBDEAH, BCNEAH, BVDEAH or MNEAH. Note that 07 is not 7, hence cannot be decoded as H.

The function `DecodeCount` is supposed to return the number of different ways (modulo `BASE` to avoid overflow) we can decode `NumStr`, where `NumStr` is a string consisting of only the numbers 0 - 9. Please complete the following program.

```
int DecodeCount( char NumStr[] )
{
    int L, i;
    int dp[MAXN];//dp[i] is the solution from NumStr[i] to the end

    L = strlen(NumStr);
    if (L==0) return 1;
    if (L==1) return 1;
    dp[L-1] = 1;
    if (NumStr[L-2]!='1' && (NumStr[L-2]!='2' || NumStr[L-1]>'5'))
        dp[L-2] = 1;
    else dp[L-2] = 2;
    for (i=L-3; i>=0; i--) {
        if (NumStr[i]!='1' && (NumStr[i]!='2' || NumStr[i+1]>'5'))
            dp[i] = [dp[i+1]-dp[i+2]] [2 分];
        else dp[i] = [dp[i+1]] [2 分];
        dp[i] %= BASE; //to avoid overflow
    }
    return [dp[0]] [2 分];
}
```

部分正确: 2 分

创建提问



< 上一题

单题作答

下一题 >

浙江大学2018-19春夏《高级数据结构与算法分析》期中模拟练习-陈越

开始时间 1/1/2016, 08:00:00

考生 德布丁丁

结束时间 1/18/2038, 08:00:00

得分 92

答题时长 45分钟

总分 100

判断题

总分：35 得分：32

1-1 In backtracking, if different solution spaces have different sizes, start testing from the partial solution with the smallest space size would have a better chance to reduce the time cost. (3分)

T F

评测结果：答案正确 (3 分)

1-2 In a red-black tree, the number of rotations in the DELETE operation is O(1). (3分)

T F

评测结果：答案错误 (0 分)

1-3 Finding the maximum key from a splay tree will result in a tree with its root having no right subtree. (4分)

T F

评测结果：答案正确 (4 分)

1-4 The time bound of the FIND operation in a B+ tree containing N numbers is $O(\log N)$, no matter what the degree of the tree is. (3分)

T F

评测结果：答案正确 (3 分)

1-5 In an AVL tree, it is impossible to have this situation that the balance factors of a node and both of its children are all +1. (4分)

T F

评测结果: 答案正确 (4 分)

1-6 Making N insertions into an initially empty binomial queue takes $\Theta(N \log N)$ time in the worst case.
(3分)

T F

评测结果: 答案正确 (3 分)

1-7 When measuring the relevancy of the answer set, if the precision is low but the recall is high, it means that most of the relevant documents are retrieved, but too many irrelevant documents are returned as well. (4分)

T F

评测结果: 答案正确 (4 分)

1-8 A perfectly balanced tree forms if keys 1 to $2^k - 1$ are inserted in order into an initially empty leftist heap. (4分)

T F

评测结果: 答案正确 (4 分)

1-9 In amortized analysis, a good potential function should always assume its maximum at the start of the sequence. (3分)

T F

评测结果: 答案正确 (3 分)

1-10 For the recurrence equation $T(N) = aT(N/b) + f(N)$, if $af(N/b) = f(N)$, then
 $T(N) = \Theta(f(N) \log_b N)$. (4分)

T F

评测结果: 答案正确 (4 分)

单选题

总分: 40 得分: 35

2-1 Insert { 3, 1, 4, 5, 0, 9, 2, 6, 8, 7 } into an initially empty 2-3 tree (with splitting). Which one of the following statements is FALSE? (5分)

C

- A. 6 and 7 are in the same node
- B. the parent of the node containing 5 has 3 children
- C. the first key stored in the root is 6
- D. there are 5 leaf nodes

评测结果: 答案错误 (0 分)

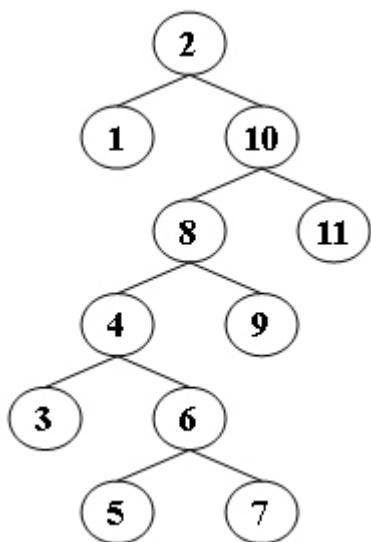
2-2 There are 28000 documents in the database. The statistic data for one query are shown in the following table. The recall is: __ (5分)

	Relevant	Irrelevant
Retrieved	4000	12000
Not Retrieved	8000	4000

- A. 14%
- B. 25%
- C. 33%
- D. 50%

评测结果: 答案正确 (5 分)

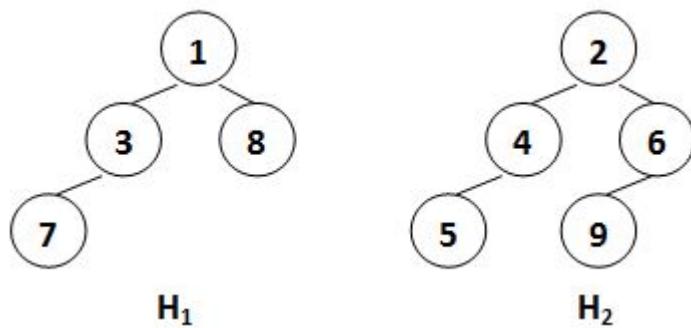
2-3 For the result of accessing 5 in the splay tree in the following figure, besides saying that 5 must be the root, which one of the following statements is also TRUE? (5分)



- A. 2 and 10 are siblings
- B. 4 and 10 are siblings
- C. 6 and 10 are siblings
- D. 6 is a leaf node

评测结果: 答案正确 (5 分)

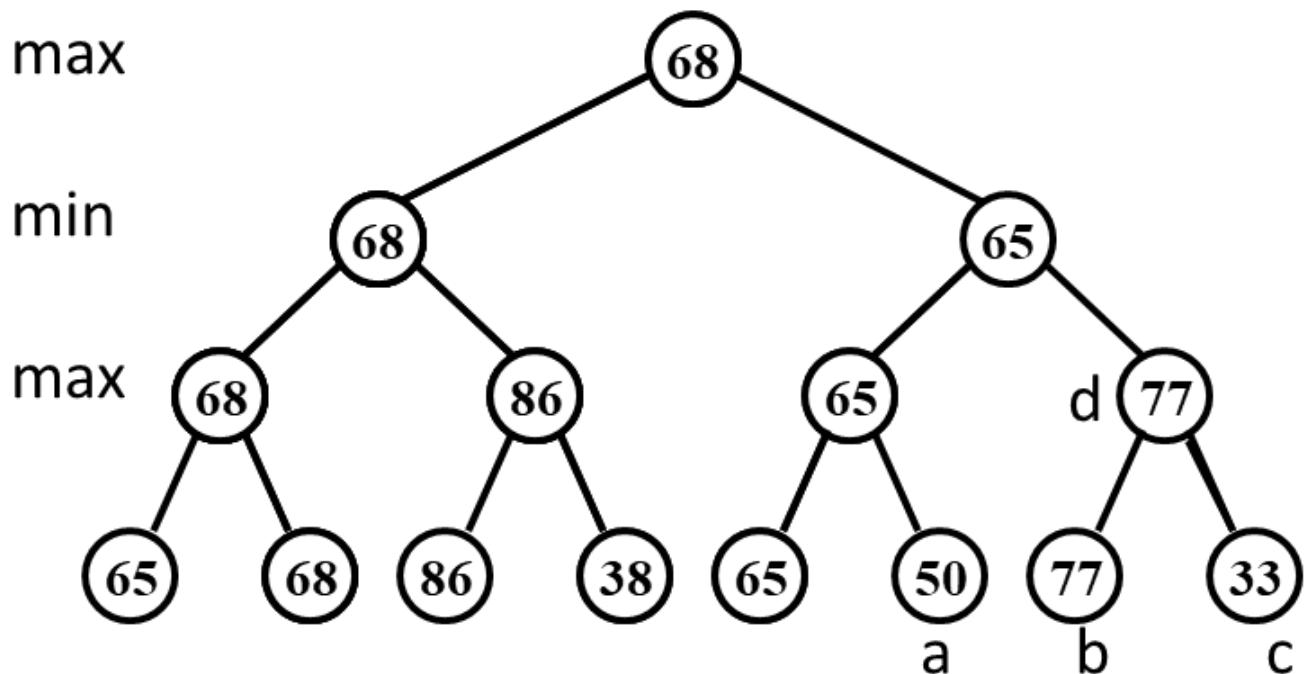
2-4 Merge the two leftist heaps in the following figure. Which one of the following statements is FALSE?
(5分)



- A. the null path length of 6 is the same as that of 2
- B. 1 is the root with 3 being its right child
- C. Along the left most path from top down, we have 1, 2, 4, and 5
- D. 6 is the left child of 2

评测结果: 答案正确 (5 分)

2-5 Given the following game tree, which node in the right subtree is the first node to be pruned with $\alpha\text{-}\beta$ pruning algorithm? (5分)



- A. a
- B. b
- C. c
- D. d

评测结果: 答案正确 (5 分)

2-6 3-way-mergesort : Suppose instead of dividing in two halves at each step of the mergesort, we divide into three one thirds, sort each part, and finally combine all of them using a three-way-merge. What is the overall time complexity of this algorithm ? (5分)

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

评测结果: 答案正确 (5 分)

2-7 A queue can be implemented by using two stacks S_A and S_B as follows:

- To enqueue x , we push x onto S_A .
- To dequeue from the queue, we pop and return the top item from S_B . However, if S_B is empty, we first fill it (and empty S_A) by popping the top item from S_A , pushing this item onto S_B , and repeat until S_A is empty.

Assuming that push and pop operations take $O(1)$ worst-case time, please select a potential function ϕ which can help us prove that enqueue and dequeue operations take $O(1)$ amortized time (when starting from an empty queue). (5分)

- A. $\phi = |S_B|$
- B. $\phi = 2|S_B|$
- C. $\phi = |S_A|$
- D. $\phi = 2|S_A|$

评测结果: 答案正确 (5 分)

2-8 Delete a node v from an AVL tree T_1 , we can obtain another AVL tree T_2 . Then insert v into T_2 , we can obtain another AVL tree T_3 . Which one(s) of the following statements about T_1 and T_3 is(are) true? (5分)

- I. If v is a leaf node in T_1 , then T_1 and T_3 might be different.
- II. If v is not a leaf node in T_1 , then T_1 and T_3 must be different.
- III. If v is not a leaf node in T_1 , then T_1 and T_3 must be the same.

- A. I only
- B. II only
- C. I and II only
- D. I and III only

评测结果: 答案正确 (5 分)

- 5-1 The functions `IsRBT` is to check if a given binary search tree `T` is a red-black tree. Return `true` if `T` is, or `false` if not.

The red-black tree structure is defined as the following:

```
typedef enum { red, black } colors;
typedef struct RBNode *PtrToRBNode;
struct RBNode{
    int Data;
    PtrToRBNode Left, Right, Parent;
    int BlackHeight;
    colors Color;
};
typedef PtrToRBNode RBTree;
```

Please fill in the blanks.

```
bool IsRBT( RBTree T )
{
    int LeftBH, RightBH;
    if ( !T ) return true;
    if ( T->Color == black ) T->BlackHeight = 1;
    else {
        if ( T->Left && (T->Left->Color == red) ) (5分)) return false;
        if ( T->Right && (T->Right->Color == red) ) return false;
    }
    if ( !T->Left && !T->Right ) return true;
    if ( IsRBT(T->Left)&&IsRBT(T->Right) ) (5分)) {
        if ( T->Left ) LeftBH = T->Left->BlackHeight;
        else LeftBH = 0;
        if ( T->Right ) RightBH = T->Right->BlackHeight;
        else RightBH = 0;
        if ( LeftBH == RightBH ) {
            T->BlackHeight = LeftBH+1 (5分);
            return true;
        }
        else return false;
    }
    else return false;
}
```

我感觉这整道题本身就有问题，BH的定义是不包含结点 T 本身的，但这份代码看上去默认包含了，所以上面会写 T->BlackHeight=1。不过即便如此，这一空也不可能写 LeftBH+1，因为点 T 未必是黑点，因此得写 T->BlackHeight+=LeftBH。

评测结果：答案正确 (15 分)

序号	结果	得分
0	答案正确	5
1	答案正确	5

序号	结果	得分
2	答案正确	5

5-2 The functions `BinQueue_Find` and `Recur_Find` are to find `X` in a binomial queue `H`. Return the node pointer if found, otherwise return NULL.

```

BinTree BinQueue_Find( BinQueue H, ElementType X )
{
    BinTree T, result = NULL;
    int i, j;

    for( i=0, j=1; j<=H->CurrentSize; i++, j*=2) { /* for each tree in H */
        T= H->TheTrees[i];
        if ( X >= T->Element (5分) ){ /* if need to search inside this tree */
            result = Recur_Find(T, X);
            if ( result != NULL ) return result;
        }
    }
    return result;
}

BinTree Recur_Find( BinTree T, ElementType X )
{
    BinTree result = NULL;
    if ( X==T->Element ) return T;
    if ( T->LeftChild (5分) ){
        result = Recur_Find(T->LeftChild, X);
        if ( result!=NULL ) return result;
    }
    if ( T->NextSibling!=NULL )
        result = Recur_Find(T->NextSibling, X);
    return result;
}

```

评测结果: 答案正确 (10 分)

序号	结果	得分
0	答案正确	5
1	答案正确	5



ZJUADS_cy2020_MidTermExam

判断题 10 A. 单选题 11 程序填空题 2

1-1 Making N insertions into an initially empty binomial queue takes $O(N)$ time in the worst case. (3分) T F作者 陈越
单位 浙江大学

1-1 答案正确 (3分)

1-2 In amortized analysis, a good potential function should always assume its minimum at the start of the sequence. (3分)

 T F作者 陈越
单位 浙江大学

1-2 答案正确 (3分)

1-3 In an AVL tree, it is possible to have this situation that the balance factors of a node and both of its children are all -1. (3分)

 T F作者 陈越
单位 浙江大学

1-3 答案正确 (3分)

1-4 In a B+ tree, leaves and nonleaf nodes have some key values in common. (3分)

 T F作者 陈越
单位 浙江大学

1-4 答案正确 (3分)

1-5 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. (3分) T F作者 徐镜春
单位 浙江大学

1-5 答案正确 (3分)

1-6 To solve a problem by dynamic programming instead of recursions, the key approach is to store the results of computations for the subproblems so that we only have to compute each different subproblem once. Those solutions can be stored in an array or a hash table. (3分)

 T F作者 叶德仕
单位 浙江大学

1-6 答案正确 (3分)

1-7 In a Red-Black tree, the path from the root to the nearest leaf is no more than half as long as the path from the root to the farthest leaf. (3分)

 T F作者 陈越
单位 浙江大学

1-7 答案正确 (3分)

1-8 When measuring the relevancy of the answer set, if the precision is low but the recall is high, it means that most of the relevant documents are retrieved, but too many irrelevant documents are returned as well. (3分)

 T F作者 陈越
单位 浙江大学

1-8 答案正确 (3分)

1-9 Finding the maximum key from a splay tree will result in a tree with its root having no left subtree. (3分)

 T F作者 陈越
单位 浙江大学

1-9 答案正确 (3分)

1-10 For the recurrence equation $T(N) = aT(N/b) + f(N)$, if $a f(N/b) = f(N)$, then $T(N) = \Theta(f(N)\log_b N)$. (3分) T F作者 陈越
单位 浙江大学

1-10 答案正确 (3分)





ZJUADS_cy2020_MidTermExam

判断题 10

A. 单选题 11

B. 程序填空题 2

- 2-1 Insert { 5, 1, 7, 8, 21, 2, 12, 19, 13, 0 } into an initially empty 2-3 tree (with splitting). Which one of the following statements is FALSE? (5分)

A

- A. 13 and 19 are in the same node
- B. the parent of the node containing 8 has 3 children
- C. the first key stored in the root is 12
- D. there are 5 leaf nodes

2-1 答案错误 ① (0 分) 创建提问

- 2-2 To solve the optimal binary search tree problem, we have the recursive equation

C $c_{ij} = \min_{l \leq l \leq j} \{w_{ij} + c_{i,l-1} + c_{l+1,j}\}$. To solve this equation in an iterative way, we must fill up a table as follows: (5分)

A.

```
for i= 1 to n-1 do;
    for j= i to n do;
        for l= i to j do
```

B.

```
for j= 1 to n-1 do;
    for i= 1 to j do;
        for l= i to j do
```

C.

```
for k= 1 to n-1 do;
    for i= 1 to n-k do;
        set j = i+k;
        for l= i to j do
```

D.

```
for k= 1 to n-1 do;
    for i= 1 to n do;
        set j = i+k;
        for l= i to j do
```

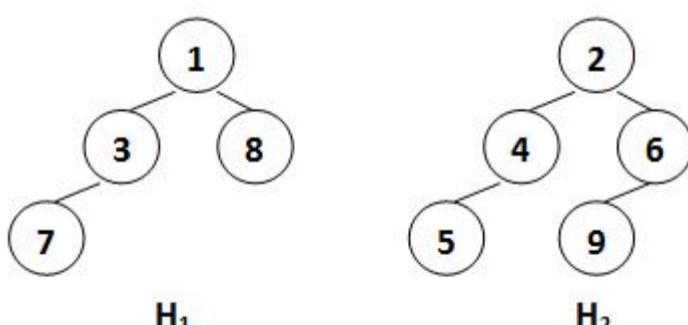
2-2 答案错误 ① (0 分) 创建提问

- 2-3 When solving a problem with input size N by divide and conquer, if at each step, the problem is divided into 4 sub-problems and each size of these sub-problems is $N/2$, and they are conquered in $O(N^2 \log N)$. Which one of the following is the closest to the overall time complexity? (5分)

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

2-3 答案正确 (5 分) 创建提问

- 2-4 Merge the two leftist heaps in the following figure. Which one of the following statements is FALSE? (5分)



- A. the null path length of 6 is the same as that of 2
- B. 1 is the root with 3 being its right child
- C. Along the left most path from top down, we have 1, 2, 4, and 5
- D. 6 is the left child of 2

2-4 答案正确 (5 分) 创建提问

- 2-5 Given 4 cases of frequencies of four characters. In which case(s) that the total bits taken by Huffman codes are the same as that of the ordinary equal length codes? (5分)

- (1) 1 2 2 3
- (2) 1 1 1 2
- (3) 2 2 3 5
- (4) 1 2 3 4

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作者
沈鑫
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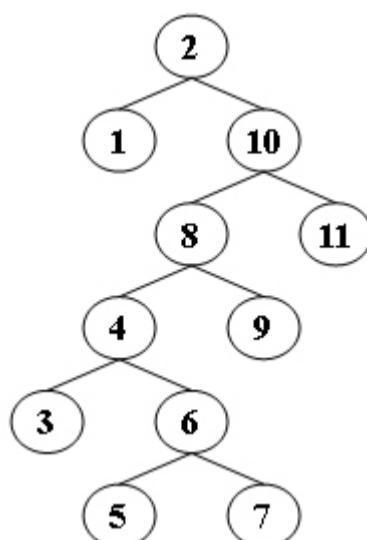
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- A. (1) and (2)
- B. (3) only
- C. (1), (2) and (4)
- D. (2) only

2-5 答案错误 ① (0分) 创建提问

2-6 For the result of accessing 5 in the splay tree in the following figure, besides saying that 5 must be the root, which one of the following statements is also TRUE? (5分)

作者
单位
陈越
浙江大学
C

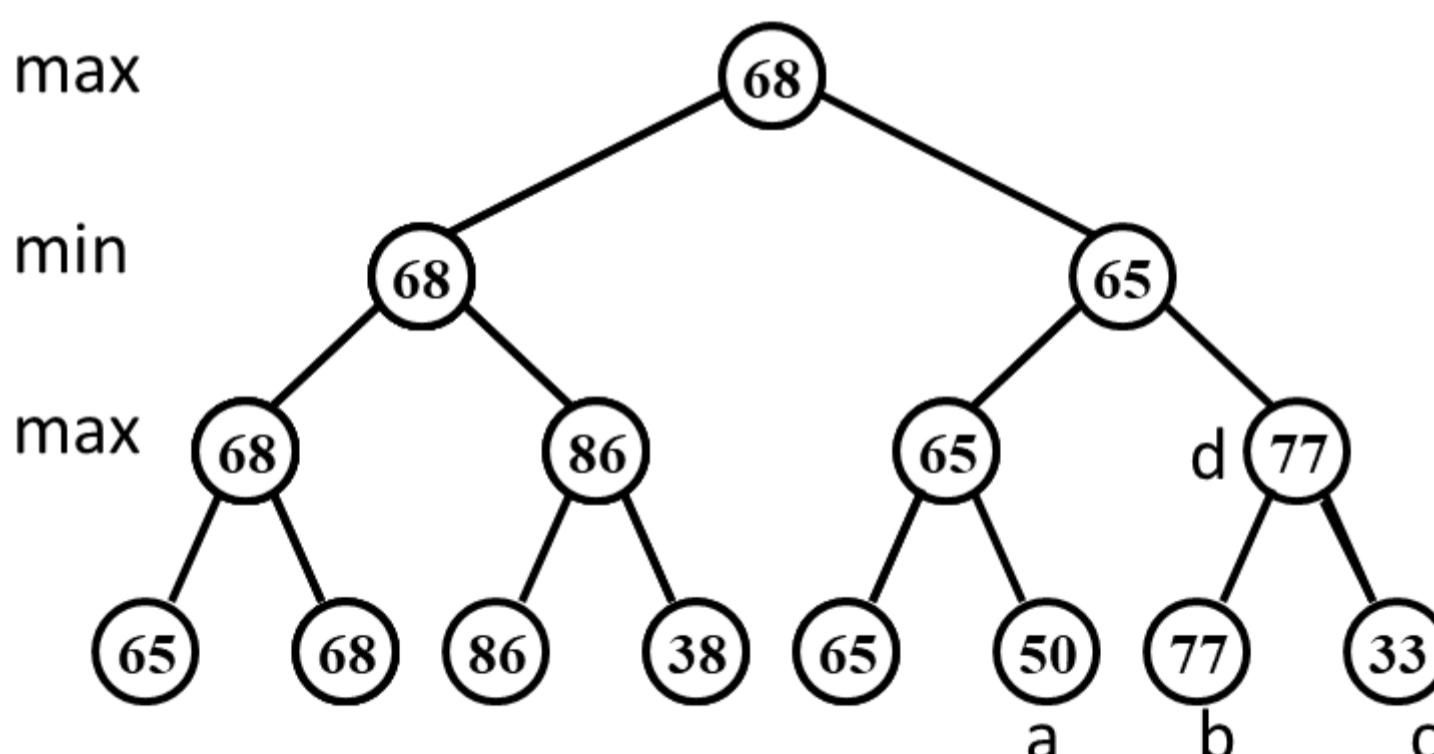
- A. 2 and 10 are siblings
- B. 4 and 10 are siblings
- C. 6 and 10 are siblings
- D. 6 is a leaf node

2-6 答案错误 ① (0分) 创建提问

2-7 When doing amortized analysis, which one of the following statements is FALSE? (2分)

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单位
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- A. For potential method, a good potential function should always assume its maximum at the start of the sequence
- B. For accounting method, when an operation's amortized cost exceeds its actual cost, we save the difference as credit to pay for later operations whose amortized cost is less than their actual cost
- C. Aggregate analysis shows that for all n , a sequence of n operations takes worst-case time $T(n)$ in total. Then the amortized cost per operation is therefore $T(n)/n$
- D. The difference between aggregate analysis and accounting method is that the later one assumes that the amortized costs of the operations may differ from each other

2-7 答案正确 (2分) 创建提问2-8 Given the following game tree, which node in the right subtree is the first node to be pruned with $\alpha\beta$ pruning algorithm? (5分)
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D

- A. a
- B. b
- C. c
- D. d

2-8 答案错误 ① (0分) 创建提问

2-9 There are 8000 documents in the database. The statistic data for one query are shown in the following table. The precision is: _ (5分)

作者
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杨欣豫
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	Relevant	Irrelevant
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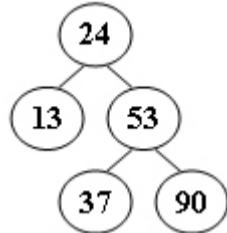


	Relevant	Irrelevant
Retrieved	1000	1000
Not Retrieved	2000	4000

- A. 12.5%
- B. 20%
- C. 33%
- D. 50%

2-9 答案正确 (5分) 创建提问

2-10 Insert key 48 into the balanced binary tree shown by the figure. Then in the resulting balanced tree, the left- and right-child of key 37 are: (5分)

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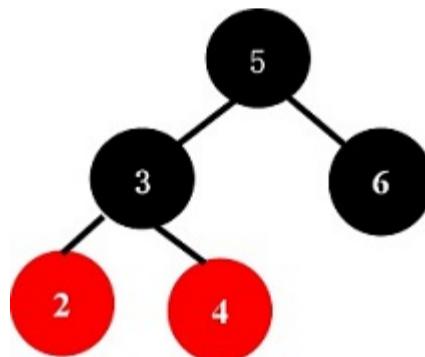
- A. 13 and 48
- B. 24 and 48
- C. 24 and 53
- D. 24 and 90

2-10 答案正确 (5分) 创建提问

2-11 After inserting 1 into the red-black tree given in the figure, which node(s) will keep its/their color(s) unchanged? (3分)

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- A. both 3 and 6
- B. both 5 and 6
- C. 3, 5, and 6
- D. 3, 4, 5, and 6



2-11 答案正确 (3分) 创建提问





ZJUADS_cy2020_MidTermExam

判断题 10

A. 单选题 11

程序填空题 2

5-1 A binary tree is said to be "height balanced" if both its left and right subtrees are height balanced, and the heights of its left and right subtrees can differ by at most 1. That is, $|H_L - H_R| \leq 1$ where H_L and H_R are the heights of the left and right subtrees, respectively. An empty binary tree is defined to be height balanced.

The function `IsBalanced` is to judge if a given binary tree `T` is height balanced. If the answer is yes then return `true` and store the tree height in the parameter `pHeight`, else simply return `false`. The height of an empty tree is defined to be 0.

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时间限制 400 ms
内存限制 64 MB

```
typedef struct TNode *BinTree;
struct TNode{
    int Key;
    BinTree Left;
    BinTree Right;
};

bool IsBalanced ( BinTree T, int *pHeight )
{
    int LHeight, RHeight, diff;

    if( T == NULL) {
        *pHeight = 0;
        return true;
    }
    else if ( IsBalanced(T->Left, &LHeight) && IsBalanced(T->Right, &RHeight) ) {
        diff = LHeight - RHeight;
        if ( diff <= 1 && diff >= -1 ) (5分) {
            *pHeight = 1 + ( diff<0 ? RHeight : LHeight ) (5分);
            return true;
        }
        else return false;
    }
    return false;
}
```

5-1 答案正确 (10 分)

5-2 The function `DeleteRt` is to delete the root of a subtree with index `Pos` from a binomial queue `H`. The rest of the subtree is then stored as a new binomial queue and returned.

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时间限制 400 ms
内存限制 64 MB

```
BinQ DeleteRt( BinQ H, int Pos )
{
    BinTree OldRoot, SubTree;
    BinQ NewBinQ;
    int p;

    OldRoot = H->TheTrees[Pos];
    SubTree = OldRoot->LeftChild;
    free(OldRoot);
    NewBinQ = Initialize();
    NewBinQ->CurrentSize = 2 (5分);
    for ( p = 0; p < 2; p++ ) (5分) {
        p=Pos-1; p>=0; p--
        NewBinQ->TheTrees[p] = SubTree;
        SubTree = SubTree->NextSibling;
        NewBinQ->TheTrees[p]->NextSibling = NULL;
    }
    return NewBinQ;
}
```

5-2 答案错误 ① (0 分)