

1-1 Let  $S$  be the set of activities in Activity Selection Problem. Then the latest start activity  $a_i$  must be included in some maximum-size subset of mutually compatible activities of  $S$ . (1分)

☒ T ☐ F

1-1 答案正确 (1 分)

1-2 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  $x$ . (1分)

☒ T ☐ F

1-2 答案错误 ① (0 分) [创建提问](#)

1-3 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}. (1分)

☐ T ☒ F

1-3 答案错误 ① (0 分) [创建提问](#)

1-4 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. (1分)

☒ T ☐ F

1-4 答案正确 (1 分) [创建提问](#)

1-4 答案正确 (1 分) [创建提问](#)

1-5 When measuring the relevancy of the answer set of a search engine, the precision is low means that most of the relevant documents are not retrieved. (1分)

☐ T ☒ F

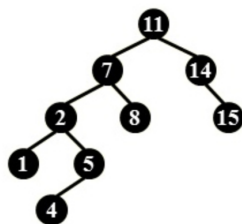
1-5 答案正确 (1 分) [创建提问](#)

1-6 In a B+ tree, leaves and nonleaf nodes have some key values in common. (1分)

☒ T ☐ F

1-6 答案正确 (1 分) [创建提问](#)

2-1 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? (1分)



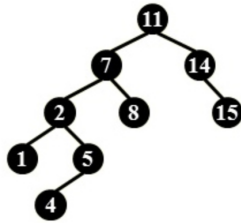
- ☒ A. 7 and 14 are siblings
- ☐ B. 4 and 11 are siblings
- ☐ C. 4 is the parent of 7
- ☐ D. 8 is the root

2-1 答案正确 (1 分) [创建提问](#)

作者  
单位

徐镜春  
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2-1 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? (1分)



- ☒ A. 7 and 14 are siblings
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2-1 答案正确 (1 分) 创建提问

2-2 In a binomial queue with 150 nodes, how many nodes have depth 1 (the root has depth 0)? (1分)

- ☒ A. 4
- ☐ B. 8
- ☐ C. 14
- ☐ D. Cannot be determined

2-2 答案错误 (0 分) 创建提问

2-3 Given 4 characters ( $u, v, w, x$ ) with some frequencies ( $f_u, f_v, f_w, f_x$ ) in a text. If the corresponding Huffman codes are  $u: 00, v: 010, w: 011$  and  $x: 1$ . Which of the following sets of frequencies is a possible one for ( $f_u, f_v, f_w, f_x$ )? (1分)

- ☐ A. 15, 23, 16, 45
- ☒ B. 30, 21, 12, 33
- ☐ C. 41, 12, 20, 32
- ☐ D. 55, 22, 18, 46

2-3 答案正确 (1 分) 创建提问

2-4 A B+ tree of order 3 with 21 numbers has at most \_\_ nodes of degree 3. (1分)

- ☐ A. 1
- ☐ B. 2
- ☐ C. 3
- ☒ D. 4

2-4 答案正确 (1 分) 创建提问

2-5 In proving the amortized bound of a Merge operation in skew heaps, the potential of a skew heap is defined to be

2-5 In proving the amortized bound of a Merge operation in skew heaps, the potential of a skew heap is defined to be the total number of right heavy nodes. Then we can prove that, in an  $N$ -node skew heap, the amortized cost for a Merge operation is exactly \_\_ .

**Hint:**

Define the weight of a node,  $w(x)$ , to be the number of descendants of  $x$  (including  $x$ ). A non-root node is said to be *heavy* if its weight is greater than half the weight of its parent.

- **Lemma 1:** At most one child is heavy, of all children of any node.
- **Lemma 2:** On any path from node  $x$  down to a descendant  $y$ , there are at most  $\lfloor \log_2 \frac{w(x)}{w(y)} \rfloor$  light nodes, excluding  $x$ .

(1分)

- ☐ A.  $\lfloor \log_2 N \rfloor + 1$
- ☒ B.  $2 \lfloor \log_2 N \rfloor + 1$
- ☐ C.  $3 \lfloor \log_2 N \rfloor + 1$
- ☐ D.  $4 \lfloor \log_2 N \rfloor + 1$

2-5 答案错误 (0 分) 创建提问

2-6 Given the distance set  $D=\{1,1,2,2,2,2,3,3,3,4,5,5,6,6,8\}$  in a Turnpike Reconstruction problem, first it can be sure that  $x_1=0$  and  $x_6=8$ . Which of the following possible solutions will be checked next? (1分)

- ☐ A.  $x_2=1, x_5=6$
- ☒ B.  $x_2=2, x_5=6$
- ☐ C.  $x_3=3, x_5=6$
- ☐ D.  $x_2=1, x_5=5$

2-6 答案正确 (1 分) 创建提问

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作者 徐镜春  
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作者 徐镜春  
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2-7 In the Red Black tree that results after successively inserting the keys 20, 22, 18, 12, 15, 8, into an initially empty Red Black tree, which nodes will be black? (1分)

作者 何勃  
单位 浙江

- ☒ A. 20,12,22,18
- ☐ B. 20,15,22
- ☐ C. 20,12,15
- ☐ D. 20,8,15

2-7 答案正确 (1 分) 创建提问

2-8 To solve the optimal binary search tree problem, we have the recursive equation

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

作者 叶健  
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- ☐ A. 

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

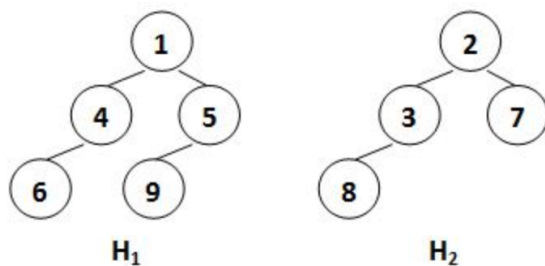
```
for j= 1 to n-1 do;
  for i= 1 to j do;
    for l= i to j do
```
- ☒ C. 

```
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
```

2-8 答案正确 (1 分) 创建提问

2-9 Merge the two leftist heaps in the following figure. Which one of the following statements is FALSE? (1

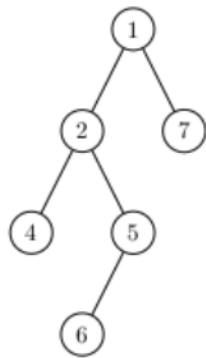


- ☐ A. the null path length of 5 is the same as that of 2
- ☐ B. 1 is the root with 4 being its right child
- ☒ C. Along the left most path from top down, we have 1, 2, 5, and 7
- ☐ D. 8 is the left child of 3

2-9 答案正确 (1 分) 创建提问

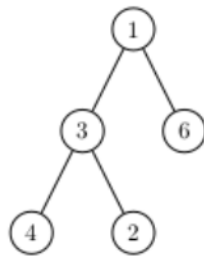
2-10 Which one of the following statements is **TRUE**? (1分)

☒ A.



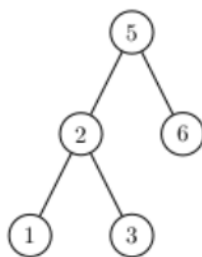
may be a leftist heap

☐ B.



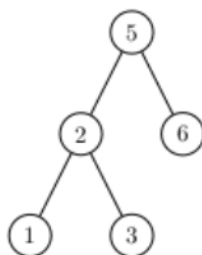
may be a leftist heap

☐ C.



may be a leftist heap

☐ D.



may be a skew heap

2-10 答案正确 (1分) 创建提问

2-11 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? (1分)

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

2-11 答案正确 (1分) 创建提问

作答  
单位

5-1 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 (1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) (1分);
                    H2->TheTrees[i] = NULL; break;
        } /* end switch */
    } /* end for-loop */
    return H1;
}
```

5-1 答案正确 (2分) 创建提问

5-2 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 RBTTree;
```

Please fill in the blanks.

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

截图(Alt + A)

5-2 答案正确 (3分) 创建提问

5-2 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.

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    if ( T->Color == black ) T->BlackHeight = 1;
    else {
        if ( T->Left && (T->Left->Color==red) (1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) (1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分);
            return true;
        }
        else return false;
    }
    else return false;
}
```

截图(Alt + A)

5-2 答案正确 (3分) 创建提问

作者	陈越
单位	浙江大学
时间限制	400 ms
内存限制	64 MB

作者	陈越
单位	浙江大学
时间限制	400 ms
内存限制	64 MB

