▶ 1-6-1 分数 2 作者 陈翔 单位

A graph with $|V|$ nodes ($|V| \geq 2$) has at most $|V| - 2$ articulation points.

◉ T ○ F

评测结果 答案正确

得分 2 分

1-2-2 分数 2 作者 干红华 单位

When sorting the array `{5, 8, 0, 3, 7, 17, 11, 9, 6, 16, 12, 4, 2, 13, 20}` in ascending order by iterative Merge Sort, the sorting result after the first run is `{5, 8, 0, 3, 7, 17, 9, 11, 6, 16, 4, 12, 2, 13, 20}` and that after the second run is `{0, 3, 5, 8, 7, 9, 11, 17, 4, 6, 12, 16, 2, 13, 20}` .

◉ T ○ F

评测结果 答案正确

得分 2 分

1-5-2 分数 2 作者 陈翔 单位

Suppose we have a doubly linked circular list with N regular nodes and a dummy head. Now given `p` pointing to an arbitrary node (see `Node` definition below) in the list, we could get back to the original position by executing the statement "`p = p->prev;`" $N+1$ times.

```
struct Node {
    Node * prev;
    Node * next;
    int element;
};
```

◉ T ○ F

评测结果 答案正确

得分 2 分

1-1-2 分数 2 作者 干红华 单位

When sorting the array `{1, 13, 19, 10, 2, 5, 7, 4, 8, 20, 0, 15, 3, 11, 17}` in ascending order by Shell Sort using Hibbard's increments ($h_k = 2^k - 1$), the sorting result after the first run is `{1, 8, 19, 0, 2, 3, 7, 4, 13, 20, 10, 15, 5, 11, 17}` and that after the second run is `{0, 2, 3, 1, 4, 13, 5, 8, 15, 7, 10, 17, 20, 11, 19}` .

◉ T ○ F

评测结果 答案正确

得分 2 分

1-8-1 分数 2 作者 陈超超 单位

Every node in the tree is the root of some subtree.

◉ T ○ F

评测结果 答案正确

得分 2 分

1-7-2 分数 2 作者 陈翔 单位

Given a graph with $|V|$ nodes and $|E|$ edges, the total edge weight of its minimum spanning tree is W. If the weight of each edge in the graph is increased by 1, then W is increased by $|E| - 1$.

○ T ◉ F

评测结果 答案正确

得分 2 分

1-3-1 分数 2 作者 朱建科 单位

For a binary search tree (BST), its in-order traversal gives nodes in non-decreasing order.

◉ T ○ F

评测结果 答案正确

得分 2 分

1-10-2 分数 2 作者 朱建科 单位

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

◉ T ○ F

评测结果 答案正确

得分 2 分

1-4-2 分数 2 作者 陈翔 单位

$\log(N!) = \Omega(N \cdot \log(N))$.

◉ T ○ F

评测结果 答案正确

得分 2 分

1-9-2 分数 2 作者 何钦铭 单位

In hashing with quadratic probing to solve collisions, it is possible that a new element **can not** be inserted if the table size is 8 and 3 cells are occupied.

◉ T ○ F

评测结果 答案正确

得分 2 分

2-17-1 分数 3 作者 何钦铭 单位

The array representation of the disjoint sets is given by S = { -4, 0, 0, 2, -3, 4, 4, -1 }, the elements are numbered from 0 to 7. Which operations will turn the array into S = { -5, 0, 0, 0, -3, 4, 4, 0 }?

- A. Union(0,7); Find(6)
- B. Find(5); Union(0,7)
- C. Union(Find(3),7)
- D. Find(3); Union(4,7)

评测结果 答案正确

得分 3 分

2-5-1 分数 3 作者 朱建科 单位

Given a binary search tree with its preorder traversal sequence { 9, 5, 1, 7, 15, 20}. If 10 is inserted into the tree, which one of the following statements is TRUE?

- A. 10 is the right child of 9
- B. 10 is the left child of 20
- C. 1 and 10 are at the same level
- D. 10 and 5 are at the same level

评测结果 答案正确

得分 3 分

2-16-1 分数 3 作者 陈超超 单位

Which of the following statements about d-heaps is True?

- A. In a d-heap, the parent of a given node can be found using integer division.
- B. In a complete d-heap, the number of leaf nodes is less than the number of internal nodes.
- C. D-heaps are used for sorting data in ascending order.
- D. The height of a d-heap with n elements is directly proportional to n.

评测结果 答案正确

得分 3 分

2-2-1 分数 3 作者 干红华 单位

When sorting the array {80, 58, 88, 11, 7, 25, 64} in ascending order by Quick Sort, the pivot is selected by Median-of-Three Partitioning. After the first run, the number of inversions will decrease by ____.

A. 9 B. 3 C. 2 D. 5

评测结果 答案正确

得分 3 分

2-15-2 分数 3 作者 陈超超 单位

Suppose that the level-order traversal sequence of a min-heap is { 3, 12, 7, 53, 32, 8, 19 }. Use the linear algorithm to adjust this min-heap into a max-heap, and then call DeleteMax. The inorder traversal sequence of the resulting tree is:

- A. 32, 12, 7, 3, 19, 8
- B. 7, 3, 12, 8, 19, 32
- C. 3, 8, 12, 7, 19, 32
- D. 7, 12, 3, 32, 8, 19

评测结果 答案正确

得分 3 分

2-12-1 分数 3 作者 陈越 单位

We represent a directed graph as an adjacency list:

```
v0: -> null
v1: -> v0 -> v3 -> null
v2: -> v1 -> null
v3: -> null
v4: -> v1 -> v6 -> null
v5: -> v2 -> v4 -> null
v6: -> null
v7: -> v1 -> v2 -> null
```

Which one below is a topological order of the given graph?

A. 7 5 2 4 6 1 3 0 B. 7 5 2 1 0 3 4 6 C. 6 0 3 1 4 2 7 5 D. 5 7 4 1 3 0 2 5

评测结果 答案正确

得分 3 分

2-14-2 分数 3 作者 陈超超 单位

The post-fix expression of `a+(b-c)*d/e` is

A. `abc-*de/+` B. `abc-d*e/+` C. `abc-de/*+` D. `abc-de*/+`

评测结果 答案正确

得分 3 分

2-6-1 分数 3 作者 朱建科 单位

Given a binary search tree with its level order traversal sequence {7, 4, 12, 3, 6, 8, 1, 5, 10}. If 4 is deleted from the tree, which one of the following statements is FALSE?

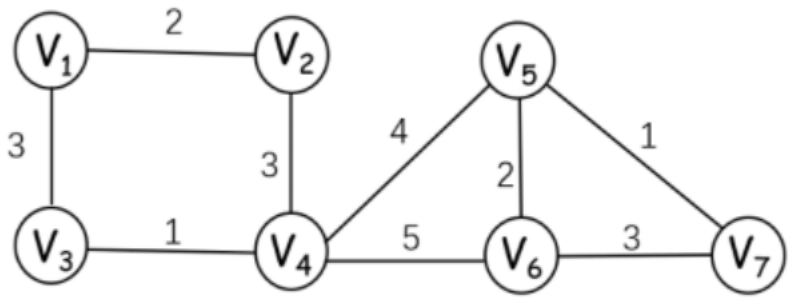
- A. 3 and 12 may be at the same level
- B. 5 and 12 may be at the same level
- C. 6 and 12 may be at the same level
- D. The in-order traversal is {1, 3, 5, 6, 7, 8, 10, 12}

评测结果 答案正确

得分 3 分

2-18-1 分数 3 作者 何钦铭 单位

Given an undirected weighted graph as shown below, its minimum spanning tree is to grow by Kruskal's algorithm with greedy strategies. Which of the following statement is **correct**?



A. (v5,v7) must be an edge of the minimum spanning tree, but (v2,v4) must not be.

B. (v5,v6) must be an edge of the minimum spanning tree, but (v4,v6) must not be.

C. (v3,v4) must be an edge of the minimum spanning tree, but (v5,v4) must be not.

D. (v1,v3) must be an edge of the minimum spanning tree, but (v4,v6) must not be.

评测结果 答案正确

得分 3 分

2-10-1 分数 3 作者 陈翔 单位

Suppose we have a circular queue implemented on an array `a[20]`. We store the position of the first queue element in `front`, and the next position of the last queue element in `rear`. What is the size of the circular queue when `front==7` and `rear==3`?

○ A. 16 ○ B. 4 ○ C. 5 ◉ D. 17

评测结果 答案错误

得分 0 分

2-8-1 分数 3 作者 李松 单位

Given a hash table of size 13 with the hash function $H(Key) = Key\%13$. Quadratic probing $(h_i(k) = (H(k) \pm i^2)\%13)$ is used to resolve collisions. Then after inserting {20, 6, 2, 16, 27, 15 } one by one into the hash table, the address of 15 is__.

◉ A. 11 ○ B. 6 ○ C. 4 ○ D. 2

评测结果 答案正确

得分 3 分

2-11-2 分数 3 作者 陈越 单位

Which of the following algorithms can be used to solve the single source shortest path problem for an unweighted DAG? I.Kruskal; II. Breadth-first search; III. Topological Sort; IV. Dijkstra

- A. II and IV only
- B. I and IV only
- C. All of them
- D. II, III and IV only

评测结果 答案错误

得分 0 分

2-3-1 分数 3 作者 干红华 单位

After indirectly sorting the array `list[10] = {10, 8, 1, 13, 19, 7, 14, 16, 6, 9}` by Table Sort, the resulting index permutation array `table[10]` is made up of ___ disjoint cycles.

- A. 2
- B. 3
- C. 5
- D. 8

评测结果 答案错误

得分 0 分

2-1-2 分数 3 作者 干红华 单位

When sorting the array `{76971, 19927, 31681, 98978, 19537, 40134, 65401, 60983, 92952, 83584}` in ascending order by Radix Sort, which of the following sorting results is IMPOSSIBLE?

- A. `{65401, 76971, 31681, 92952, 60983, 40134, 83584, 19927, 19537, 98978}`, after the second run of LSD Sort
- B. `{76971, 31681, 65401, 92952, 60983, 40134, 83584, 19927, 19537, 98978}`, after the first run of LSD Sort
- C. `{19927, 19537, 31681, 40134, 60983, 65401, 76971, 83584, 92952, 98978}`, after the second run of MSD Sort
- D. `{19927, 19537, 31681, 40134, 65401, 60983, 76971, 83584, 98978, 92952}`, after the first run of MSD Sort

评测结果 答案正确

得分 3 分

2-7-1 分数 3 作者 李松 单位

Given a set of keys {92, 81, 58, 21, 57, 45, 161, 38, 117}, the hash function is defined as $h(key) = key\%13$. To resolve the i^{th} collision, we use the following double hashing probing method: $h(key) = (h(key) + i \times h_2(key))\%13$, where $h_2(key) = (key\%11) + 1$. Assume we have a hash table with the hash address space from 0 to 12 for this sequence of keys, the average search length for successful searches is ___.

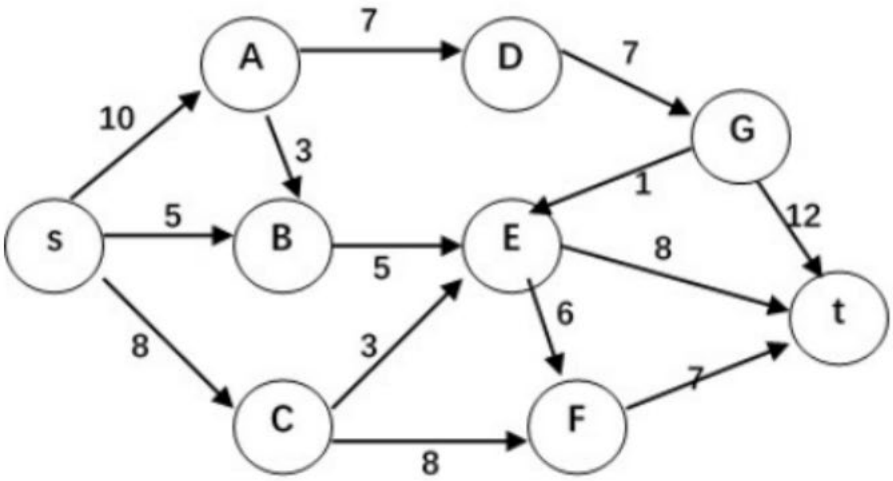
A. 1.33 B. 1.56 C. 1.44 D. 1.67

评测结果 答案错误

得分 0 分

2-20-1 分数 3 作者 何钦铭 单位

When solving the maximum flow problem for graph G, which statement is **wrong**?



A. Edge (S,B) with flow 5 is a possible edge in the maximum flow.

B. Edge (S,C) with flow 8 is a possible edge in the maximum flow.

C. Edge (S,A) with flow 10 is a possible edge in the maximum flow.

D. Edge (G,t) with flow 12 is a possible edge in the maximum flow.

评测结果 答案正确

得分 3 分

2-9-2 分数 3 作者 陈翔 单位

Suppose that we are using a stack to convert the infix expression `((A + B) - C * (D / E)) + F` to the postfix expression. What is the maximum number of operators in the stack during conversion?

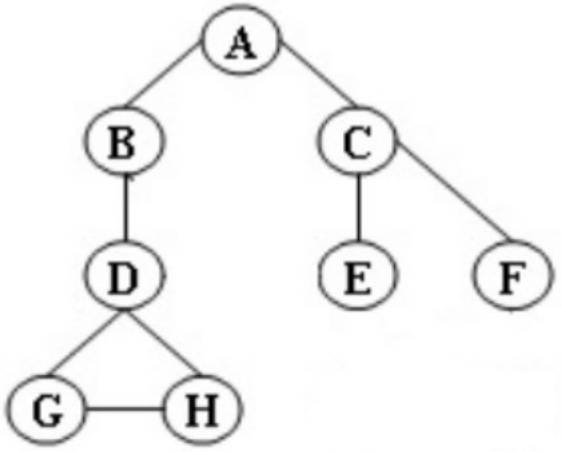
A. 2 B. 4 C. 3 D. 5

评测结果 答案正确

得分 3 分

2-19-1 分数 3 作者 何钦铭 单位

To find the articulation points for following graph by depth-first search tree start from node D, Which of the following statement is **correct**?



- A. D has 3 children in depth-first search tree.
- B. Low(A) < Num(A)
- C. Num(A) > Num(B)
- D. There are 2 back edges.

评测结果 答案正确

得分 3 分

2-4-1 分数 3 作者 朱建科 单位

If a binary search tree of N nodes is complete, which one of the following statements is FALSE?

- A. the median node must either be the root or in the left subtree
- B. the minimum key must be at a leaf node
- C. the average search time for all nodes is $O(\log N)$
- D. the maximum key must be at a leaf node

评测结果 答案正确

得分 3 分

2-13-1 分数 3 作者 陈超超 单位

Given a binary tree with in-order traversal sequence { 4, 1, 3, 8, 7, 12, 11, 9 } and post-order traversal sequence { 4, 1, 8, 12, 7, 9, 11, 3 }. What is the index of 8 if we number the nodes in level-order? (Obviously, the index of the root is 1.)

A. 5 B. 2 C. 3 D. 7

评测结果 答案正确

得分 3 分

5-2-2 分数 6 Eulerian 作者 陈越 单位

An Euler tour in an undirected graph is a tour that traverses each edge of the graph exactly once. An Euler curcuit is an Euler tour that starts and ends at the same vertex.
Function `Eulerian` is to test if there exists an Euler tour or an Euler curcuit in a given connected `Graph`. The array `Graph->G` stores the adjacency matrix of the undirected graph, and `MGraph` is defined as the following:

```
typedef struct GNode *PtrToGNode;
struct GNode{
     int Nv;  /* number of vertices */
     int Ne;  /* number of edges */
     int G[MaxVertexNum][MaxVertexNum]; /* adjacency matrix
*/
};
typedef PtrToGNode MGraph;
```

Please fill in the blanks.

```
Type Eulerian( MGraph Graph )
{
    int count_odd, degree;
    Vertex i, j;
    Type ret;

    count_odd = 0;
    for (i=0; i<Graph->Nv; i++) {
        degree = 0;
        for (j=0; j<Graph->Nv; j++) {
```

`if ((Graph -> G)[i][j] != 0) degree ++` 3 分

```
;
        }
        if (degree%2 == 1) {
            count_odd++;
        }
        if (count_odd > 2) break;
    }
    if (count_odd == 0) {
        ret = EulerCurcuit;
    }
    else if (
```

`count__odd == 2` 3 分

```
) {
        ret = EulerTour;
    }
    else {
        ret = NotEulerian;
    }
    return ret;
}
```

评测结果 部分正确

得分 3 分

5-1-1 分数 6 Hashing and rehashing 作者 李松 单位

Let's consider creating a basic hashing program for a list of **nonnegative** numbers with rehashing. We'll use **linear probing** (f(i) = i) to handle collisions. Moreover, rehashing will occur when the table reaches half capacity (capacity > 0.5).

```
typedef struct {
    int *table;
    int size;
    int count;
} HashTable;
void init(HashTable *ht, int size) {
    ht->size = size;
    ht->table = (int*)malloc(sizeof(int) * size);
    ht->count = 0;
    for (int i = 0; i < size; i++) {
        ht->table[i] = -1;
    }
}
void rehash(HashTable *ht);
void insert(HashTable *ht, int key) {
    if (
ht -> count > (ht -> size) / 2   3 分 ) {
        rehash(ht);
    }
    int index = hash_function(key, ht->size);
    while (ht->table[index] != -1) {
        index =  index + 1   3 分 ; }
    ht->table[index] = key;
    ht->count++;
}
```

评测结果 答案正确

得分 6 分

6-1-1 Height of Binary Search Tree 分数 8

作者 杨子祺 单位 浙江大学

You are supposed to write two functions to calculate the height of a binary search tree and find all the longest paths, respectively.

Format of struct:

The binary search tree is defined as follows:

```
typedef struct TreeNode *PtrTreeNode;
typedef struct TreeNode {
int key;
struct TreeNode *left;
struct TreeNode *right;
} TreeNode;
typedef PtrTreeNode BinarySearchTree;
```

Format of functions:

The definitions of the two functions you need to write are as follows:

```
int GetHeight(BinarySearchTree root);
void GetPath(BinarySearchTree root, int path[MAXN][MAXN], int height);
```

`root` is the root of a binary search tree. `height` is the height of the binary search tree. `path` is a two-dimensional array that stores all the longest paths, where the first dimension represents the paths and the second dimension represents the node keys in the paths.
For each test case, the function `GetHeight` returns the height of the binary search tree, and the function `GetPath` finds all the longest paths and stores them in the two-dimensional array `path`.
Note:

1. Each path is stored in order from the root node to the leaf node.
2. The storage order of different paths is not limited.
3. The key of each node is a positive integer.
4. The program will take the preorder sequence of the binary search tree as the input.
5. The height of the binary search tree is the number of edges in the longest path.

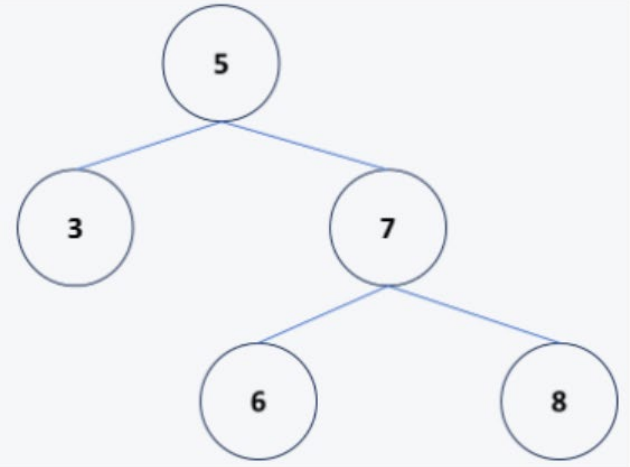
Sample program of judge:

```c
#include <stdio.h>
#include <stdlib.h>
#define MAXN 150

typedef struct TreeNode *PtrTreeNode;
typedef struct TreeNode {
  int key;
  struct TreeNode *left;
  struct TreeNode *right;
} TreeNode;
typedef PtrTreeNode BinarySearchTree;

int GetHeight(BinarySearchTree root);
void GetPath(BinarySearchTree root, int path[MAXN][MAXN], int height);
void PrintPath(int path[MAXN][MAXN]);
BinarySearchTree BuildBST(int tree[], int size);

int main() {
  int treeArray[MAXN], N, i;
  scanf("%d", &N);
  for (i = 0; i < N; i++) scanf("%d", &treeArray[i]);
  int path[MAXN][MAXN] = {0};
  BinarySearchTree root = BuildBST(treeArray, N);
  int height = GetHeight(root);
  GetPath(root, path, height);
  printf("%d\n", height);
  PrintPath(path);
  return 0;
}
/* Your function will be put here */
```



Sample Input:

```
5
5 3 7 6 8
```

Sample Output:

```
2
5 7 6
5 7 8
```

The storage in the two-dimension array can be visualized as follows.

5	7	6	0	.....	0
5	7	8	0	.....	0
.....					
0	0	0	0	.....	0