Lu Chang & Zhang Mengjiao

LeetCode Solutions

First Edition

Preface

This project is aimed to accompany my girlfriend @MengjiaoZhang to learn git, programming skills and algorithms.

Here, I want to thank LeetCode providing these problems. It will be better if all problems can be accessed without subscribing. (ಡωಡ)hiahiahia

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Chapter 1

Solutions for Algorithms

"*Perhaps the most important principle for the good algorithm designer is to refuse to be content.*"

— Alfred V. Aho

535. Encode and Decode TinyURL

Difficulty

Medium

Tags

Cryptology

Description

TinyURL is a URL shortening service where you enter a URL such as `https://leetcode.com/problems/design-tinyurl` and it returns a short URL such as `http://tinyurl.com/4e9iAk`.

Design the `encode` and `decode` methods for the TinyURL service. There is no restriction on how your encode/decode algorithm should work. You just need to ensure that a URL can be encoded to a tiny URL and the tiny URL can be decoded to the original URL.

Analysis

This is an open problem where numerous solutions can be applied. We can even keep the original url as encode and decode, although it is meaningless.

We should to pay attention to these limitations:

- Correctness: We must make sure that the decoded url is the same as the original url.
- Uniqueness: Each url must have an unique encoded url, and an encoded url must be decoded to a single url.
- Simplicity: The aim to encode a url is to make it easy to share or write, so we need to make the encoded url as simple as possible.

We can use current popular encode/decode algorithms such as `AES`, `DES`, but in this problem, we just design a simpler algorithm to encode and decode a url.

```
function encode(url)
    return hex(current number of urls in hash table)
end

function decode(encoded_url)
    return (hash table).find(encoded_url)
end
```

Solution

C++

```cpp
typedef unordered_map<string, string> Urlmap;

class Solution {
public:

    Urlmap urlmap;

    // Encodes a URL to a shortened URL.
    string encode(string longUrl) {
        size_t size = urlmap.size();
        stringstream encoded;
        encoded << hex << size;
        string encoded_url = encoded.str();
        urlmap.insert(make_pair(encoded_url, longUrl));
        return encoded_url;
    }

    // Decodes a shortened URL to its original URL.
    string decode(string shortUrl) {
    Urlmap::iterator it = urlmap.find(shortUrl);
    if (it == urlmap.end()) return NULL;
        return it->second;
    }
};
```

654. Maximum Binary Tree

Difficulty

Medium

Tags

Binary Tree

Description

Given an integer array with no duplicates. A maximum tree building on this array is defined as follow:

1. The root is the maximum number in the array.
2. The left subtree is the maximum tree constructed from left part sub-array divided by the maximum number.
3. The right subtree is the maximum tree constructed from right part sub-array divided by the maximum number.

Construct the maximum tree by the given array and output the root node of this tree.

Example 1

```
Input: [3, 2, 1, 6, 0, 5]
Output: return the tree root node representing the following tree
↪ :

      6
    /   \
   3     5
    \    /
     2  0
       \
        1
```

Note

- The size of the given array will be in the range [1, 1000].

Analysis

At first sight, we can easily know that we can design a recursive algorithm to find the maximum value, take it as root, and do the same step on the left and right array. The worst time complexity is $\mathcal{O}(n^2)$ when array is in order, assuming that the number of array is n.

We can directly build this maximum binary tree in the following steps:

1. Choose the first value as the root;
2. For each successive value, if it is larger that the root, take it as root, and the previous root and its subtree as the left subtree of root (because previous root is the left array). Otherwise go to step 3;
3. If the successive value is less than the root, then compare it with the right node of root (because this value is at the right array). If right node is null, take this value as right node. Otherwise go to step 2.

- Time Complexity: Average is $\mathcal{O}(n\log n)$ because we need to insert each value to a tree. Worst case is $\mathcal{O}(n^2)$, when original array is only descending but not ascending, which has less worst cases than recursive way. In this case, this algorithm degenerates to the insertion sort.
- Space Complexity: $\mathcal{O}(1)$ (We don't need extra space).

Solution

C

```c
struct TreeNode* constructMaximumBinaryTree(int* nums, int numsSize) {
    typedef struct TreeNode TreeNode;
    // we need a root pointer to the real root
    TreeNode *root = (TreeNode *)malloc(sizeof(TreeNode));
    root->right = NULL;
    for (int i = 0; i < numsSize; ++i) {
```

```
        int v = nums[i];
        TreeNode *p = root;
        // move to right and find a node's right child less than current value
        while (p->right != NULL && v < p->right->val) {
            p = p->right;
        }
        TreeNode *node = (TreeNode *)malloc(sizeof(TreeNode));
        node->val = v;
        node->left = p->right;  // null or less than current value should be node's left child
        node->right = NULL;
        p->right = node;  // replace previous right child
    }
    return root->right;  // return real root
}
```

771. Jewels and Stones

Difficulty

Easy

Tags

Hash Table

Description

You're given strings `J` representing the types of stones that are jewels, and `S` representing the stones you have. Each character in `S` is a type of stone you have. You want to know how many of the stones you have are also jewels.

The letters in `J` are guaranteed distinct, and all characters in `J` and `S` are letters. Letters are case sensitive, so `"a"` is considered a different type of stone from `"A"`.

Example 1

```
Input: J = "aA", S = "aAAbbbb"
Output: 3
```

Example 2

```
Input: J = "z", S = "ZZ"
Output: 0
```

Note

- `S` and `J` will consist of letters and have length at most 50.
- The characters in `J` are distinct.

Analysis

This is an easy problem. All we need to do is to verify wether each letter in `S` exists in `J`.

Therefore, we can use a hash set to store `J`. Specifically, `J` is composed of letters (lower or upper) only, so we can use an array of `char` to store each letter in . After that, we only need to iterate `S` to calculate the number of jewels.

We assume the length of is m, the length of `S` is n, then

- Time complexity: $\mathcal{O}(m+n)$
- Space complexity: $\mathcal{O}(1)$ (256 ASCII chars)

Solution

C

```c
int numJewelsInStones(char* J, char* S) {
    char j_letters[256] = { 0 };  // initialize an array to store letters in J
    char c;
    for (int i = 0; (c = J[i]) != '\0'; ++i) {
        j_letters[c] = 1;  // set j_letters[c] = 1 means c appears in J
    }
    int jewel_number = 0;  // number of jewels
    for (int i = 0; (c = S[i]) != '\0'; ++i) {
        jewel_number += j_letters[c];  // if c appears in J, then we add a
        ↪ number
    }
    return jewel_number;
}
```

804. Unique Morse Code Words

Difficulty

Easy

Tags

Hash Table

Description

International Morse Code defines a standard encoding where each letter is mapped to a series of dots and dashes, as follows: `"a"` maps to `".-"`, `"b"` maps to `"-..."`, `"c"` maps to `"-.-."`, and so on.

For convenience, the full table for the 26 letters of the English alphabet is given below:

```
[".-", "-...", "-.-.", "-..", ".", "..-.", "--.", "....", "..",
↪ ".---", "-.-", ".-..", "--", "-.", "---", ".--.", "--.-",
↪ ".-.", "...", "-", "..-", "...-", ".--", "-..-", "-.--",
↪ "--.."]
```

Now, given a list of words, each word can be written as a concatenation of the Morse code of each letter. For example, `"cab"` can be written as `"-.-.-....-"`, (which is the concatenation `"-.-."` + `"-..."` + `".-"`). We'll call such a concatenation, the transformation of a word.

Return the number of different transformations among all words we have.

Example 1

```
Input: words = ["gin", "zen", "gig", "msg"]
Output: 2
Explanation:
The transformation of each word is:
"gin" -> "--...-."
```

```
"zen" —> "——...—."
"gig" —> "——...——."
"msg" —> "——...——."

There are 2 different transformations, "——...—." and "——...——.".
```

Note

- The length of `words` will be at most `100`.
- Each `words[i]` will have length in range `[1, 12]`.
- `words[i]` will only consist of lowercase letters.

Analysis

This problem is the combination of Morse Code and a hash store. In this problem, we need to check repetition count of the Morse Code for each word in `words`. Therefore we can simply use a hash set to store appeared Morse Codes and check the existence of next.

We assume the size of `words` is m, and we have already known that each `words[i]` will have length in range `[1, 12]`, we assume the max length of a word is n, then

- Time complexity: $\mathcal{O}(mn)$ (We need to iterate all m word in `words` and calculate the hash of this word, while checking the existence is $\mathcal{O}(1)$)

Solution

C++

```cpp
int uniqueMorseRepresentations(vector<string>& words) {
    string morse_table[] = { ".-", "-...", "-.-.", "-..", ".", "..-.", "--.",
    ↪  "....", "..", ".---", "-.-", ".-..", "--", "-.", "---", ".--.", "--.-",
    ↪  ".-.", "...", "-",  "..-", "...-", ".--", "-..-", "-.--", "--.." };
    unordered_set<string> morse_codes(100);  // the max size of words is 100
    for (vector<string>::iterator iter = words.begin(); iter != words.end();
    ↪  ++iter) {
```

```
        string word = *iter;
        string code;
        code.reserve(50);
        for (string::iterator ch_iter = word.begin(); ch_iter != word.end(); ++ch_iter) {
            code += morse_table[*ch_iter - 'a'];  // calculate the morse code of each letter
        }
        morse_codes.insert(code);
    }
    return morse_codes.size();
}
```

814. Binary Tree Pruning

Difficulty

Medium

Tags

Binary Tree, Recursive Algorithm

Description

We are given the head node `root` of a binary tree, where additionally every node's value is either a 0 or a 1.

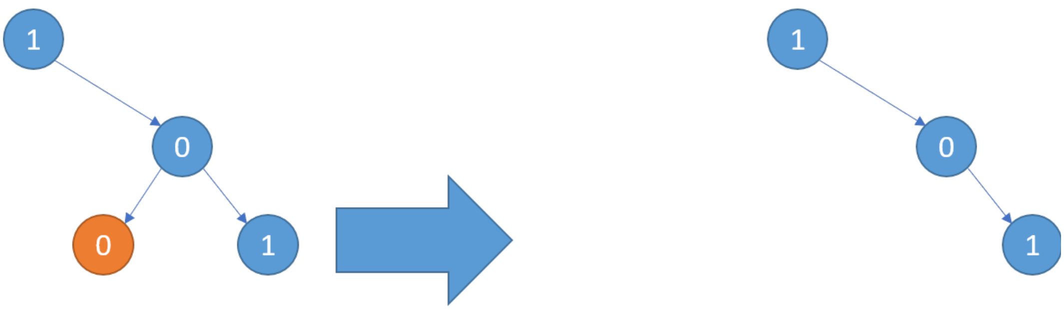
Return the same tree where every subtree (of the given tree) not containing a 1 has been removed.

(Recall that the subtree of a node X is X, plus every node that is a descendant of X.)

Example 1

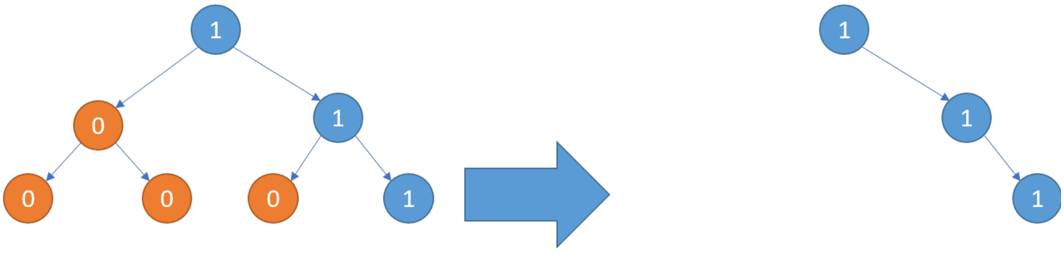
```
Input: [1, null, 0, 0, 1]
Output: [1, null, 0, null, 1]

Explanation:
Only the red nodes satisfy the property "every subtree not
↪ containing a 1".
The diagram on the right represents the answer.
```



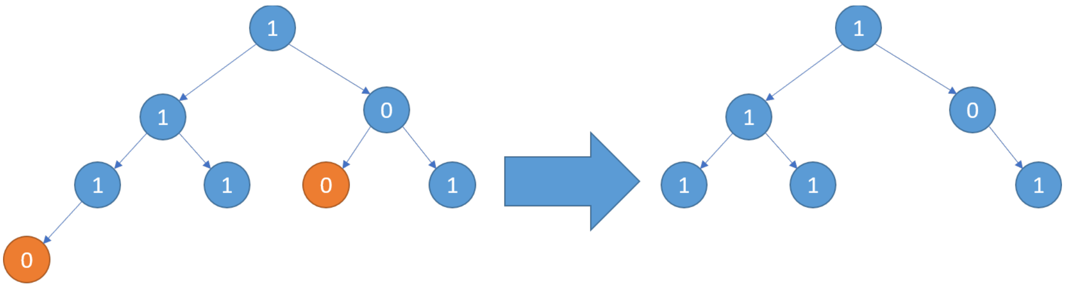
Example 2

```
Input: [1, 0, 1, 0, 0, 0, 1]
Output: [1, null, 1, null, 1]
```



Example 3

```
Example 3:
Input: [1, 1, 0, 1, 1, 0, 1, 0]
Output: [1, 1, 0, 1, 1, null, 1]
```



Note

- The binary tree will have at most `100 nodes`.
- The value of each node will only be `0` or `1`.

Analysis

This is a problem about the binary tree. However, it is not a complicated problem because we only need a preorder traversal and count the number of 1 in the subtree of a node. Then if the count is `0` of the subtree for a node, we just need to make the pointer to `null`.

We assume that the nodes number is n, then

- Time Complexity: $\mathcal{O}(n)$
- Space Complexity: $\mathcal{O}(n)$ (We need to maintain a count for each node)

Solution

C

```c
int count_one(struct TreeNode* r) {
    if (r == NULL) return 0;  // leaf node
    int left_count = count_one(r->left);
    int right_count = count_one(r->right);
    /**
    * I write this comment just to say I remember to free the memory,
    * but in this test, forget it.
    */
    if (left_count == 0) r->left = NULL;
    if (right_count == 0) r->right = NULL;
    return r->val + left_count + right_count;  // consider the value for this
    ↪  node itself.
}

struct TreeNode* pruneTree(struct TreeNode* root) {
    count_one(root);  // only need call this function
    return root;
}
```

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Chapter 2

Solutions for Databases

"*Inconsistency of your mind can damage your memory. Remove the inconsistent data and keep the original one only.*"

— Anonym

595. Big Countries

Difficulty

Easy

Tags

Where Condition

Description

There is a table `World`

```
+-----------------+------------+------------+--------------+---------------+
| name            | continent  | area       | population   | gdp           |
+-----------------+------------+------------+--------------+---------------+
| Afghanistan     | Asia       | 652230     | 25500100     | 20343000      |
| Albania         | Europe     | 28748      | 2831741      | 12960000      |
| Algeria         | Africa     | 2381741    | 37100000     | 188681000     |
| Andorra         | Europe     | 468        | 78115        | 3712000       |
| Angola          | Africa     | 1246700    | 20609294     | 100990000     |
+-----------------+------------+------------+--------------+---------------+
```

A country is big if it has an area of bigger than 3 million square km or a population of more than 25 million.

Write a SQL solution to output big countries' name, population and area.

For example, according to the above table, we should output:

```
+--------------+-------------+--------------+
| name         | population  | area         |
+--------------+-------------+--------------+
| Afghanistan  | 25500100    | 652230       |
| Algeria      | 37100000    | 2381741      |
+--------------+-------------+--------------+
```

Analysis

Most basic SQL knowledge on select and where.

Solution

```sql
select name, population, area from World
    where population > 25000000
    or area > 3000000;
```

Indexes of Solutions for Databases

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Where Condition

595. Big Countries