

GeekBand 极客班

互联网人才加油站!



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8. 高频算法面试题解析

大纲

1. 数组求和问题，2 sum, 3 sum, 3-Sum Closest
2. 子数组问题系列 Subarray Max Sum
3. 买卖股票 Best Time to Buy and Sale Stock
4. 寻找丢失数 Single Number
5. 找主元素 Majority Number
6. 排序切分问题，quick sort
7. TOP K问题，最大堆和最小堆
8. LRU Cache问题，链表 + HashMap
9. 去重问题，bitmap介绍
10. 搜索问题，倒排索引
11. 分布式求和，MapReduce算法

2 Sum

Find a pair of two elements in an array, whose sum is a given target number. Assume only one qualified pair of numbers existed in the array, return the index of these numbers (e.g. returns (i, j), smaller index in the front).

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3 Sum

Given an array S of n integers, are there elements a, b, c in S such that $a + b + c = 0$?

Find all unique triplets in the array which gives the sum of zero.

Example

For example, given array $S = \{-1, 0, 1, 2, -1, -4\}$, A solution set is:

$(-1, 0, 1)$

$(-1, -1, 2)$

Note

Elements in a triplet (a, b, c) must be in non-descending order. (ie, $a \leq b \leq c$)

3 Sum closest

Given an array S of n integers, find three integers in S such that the sum is closest to a given number, target. Return the sum of the three integers. You may assume that each input would have exactly one solution.

For example, given array $S = \{-1\ 2\ 1\ -4\}$, and target = 1. The sum that is closest to the target is 2. $(-1 + 2 + 1 = 2)$.

Subarray max sum

Find the contiguous subarray within an array (containing at least one number) which has the largest sum.

For example, given the array $[-2, 1, -3, 4, -1, 2, 1, -5, 4]$, the contiguous subarray $[4, -1, 2, 1]$ has the largest sum = 6.

$$dp[i + 1] = \max(dp[i], dp[i] + a[i + 1])$$

Subarray Sum

Given an integer array, find a subarray where the sum of numbers is zero.

Your code should return the index of the first number and the index of the last number.

Example

Given `[-3, 1, 2, -3, 4]`, return `[0, 2]` or `[1, 3]`.

Note

There is at least one subarray that its sum equals to zero.

Subarray Sum Closest

Given an integer array, find a subarray with sum closest to zero. Return the indexes of the first number and last number.

Example

Given `[-3, 1, 1, -3, 5]`, return `[0, 2]`, `[1, 3]`, `[1, 1]`, `[2, 2]` or `[0, 4]`

Challenge

$O(n \log n)$ time

Maximum Product Subarray

Find the contiguous subarray within an array (containing at least one number) which has the largest product.

For example, given the array [2,3,-2,4], the contiguous subarray [2,3] has the largest product = 6.

$$\text{maxDP}[i + 1] = \max(\text{maxDP}[i] * A[i + 1], A[i + 1], \text{minDP}[i] * A[i + 1])$$

$$\text{minDP}[i + 1] = \min(\text{minDP}[i] * A[i + 1], A[i + 1], \text{maxDP}[i] * A[i + 1])$$

$$\text{dp}[i + 1] = \max(\text{dp}[i], \text{maxDP}[i + 1])$$

Best Time to Buy and Sell Stock

Say you have an array for which the i th element is the price of a given stock on day i .

If you were only permitted to complete at most one transaction (ie, buy one and sell one share of the stock), design an algorithm to find the maximum profit.

Best Time to Buy and Sell Stock II

Say you have an array for which the i th element is the price of a given stock on day i .

Design an algorithm to find the maximum profit. You may complete as many transactions as you like (ie, buy one and sell one share of the stock multiple times). However, you may not engage in multiple transactions at the same time (ie, you must sell the stock before you buy again).

Best Time to Buy and Sell Stock III

Say you have an array for which the i th element is the price of a given stock on day i .

Design an algorithm to find the maximum profit. You may complete at most two transactions.

Note: You may not engage in multiple transactions at the same time (ie, you must sell the stock before you buy again).

Find Missing Num

Given an unsorted integer array, find the first missing positive integer.

Example

Given [1,2,0] return 3, and [3,4,-1,1] return 2.

Challenge

Your algorithm should run in $O(n)$ time and uses constant space.

Single Num

Given an array of integers, every element appears twice except for one. Please write a function to find that single one.

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Single Number II

Given $3*n + 1$ numbers, every numbers occurs triple times except one, find it.

Example

Given [1,1,2,3,3,3,2,2,4,1] return 4

Challenge

One-pass, constant extra space

Majority Number

Given an array of integers, the majority number is the number that occurs more than half of the size of the array. Find it.

Example

Given [1, 1, 1, 1, 2, 2, 2], return 1

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Majority Number II

Given an array of integers, the majority number is the number that occurs more than $1/3$ of the size of the array.

Find it.

Example

Given [1, 2, 1, 2, 1, 3, 3], return 1.

Majority Number III

Given an array of integers and a number k , the majority number is the number that occurs more than $1/k$ of the size of the array.

Find it.

Example

Given [3,1,2,3,2,3,3,4,4,4] and $k=3$, return 3.

Partition Array

Given an array "a" of integers and an int "k", Partition the array (i.e move the elements in "a") such that

- All elements $< k$ are moved to the left
- All elements $\geq k$ are moved to the right

Return the partitioning Index, i.e the first index "i" $a[i] \geq k$.

quick sort

Select K

Get the k largest elements in an array with $O(n)$ expected time, they don't need to be sorted.

There are n points on a 2D plan, find the k points that are closest to origin ($x= 0$, $y= 0$).

Top K

TopK in an array

Variation: get most frequent K words in logs

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Sort Colors

Given an array with n objects colored red, white or blue, sort them so that objects of the same color are adjacent, with the colors in the order red, white and blue. Here, we will use the integers 0, 1, and 2 to represent the color red, white, and blue respectively. Note: You are not suppose to use the library's sort function for this problem. [click to show follow up.](#)

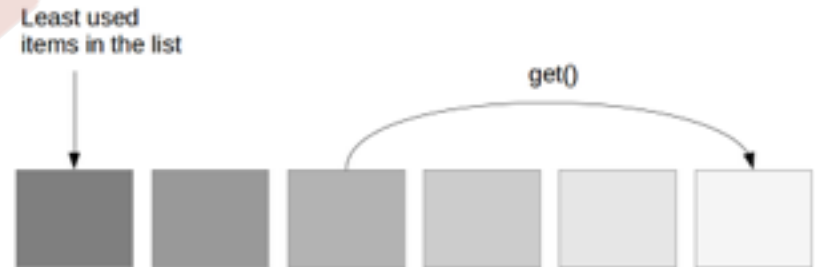
LRU Cache

接口:

T Get(K key);

void Put(K key, T data);

LRU Cache



Calling get() for an item, moves it to the top of the cache

LRU Cache

LinkedHashMap = DoublyLinkedList + HashMap

```
HashMap<key, DoublyListNode>
```

```
DoublyListNode {
```

```
    prev, next, key, value;
```

```
}
```

Newest node append to tail.

Eldest node remove from head.

<http://www.hawstein.com/posts/lru-cache-impl.html>

Hash拓展

Distributed HashTable

Distributed Cache

Consistent Hashing

- Dynamic adjust nodes to avoid rehashing whole space

Bloom Filter

space-efficient probabilistic data structure that is used to test whether an element is a member of a set. False positive matches are possible

Dedup URL

Suppose you are given an extremely large set of URLs, ~billion for example. How do you de-duplicate(remove duplicates)?

BITMap

Byte: MASK = 0X07; SHIFT = 3; Integer: MASK = 0X1F; SHIFT = 5;

// $i >> \text{SHIFT} \Rightarrow i/8$; $i \& \text{MASK} \Rightarrow i\%8$

set(i): $\text{array}[i >> \text{SHIFT}] \mid= (1 \ll (i \& \text{MASK}))$;

// return 0: not exist

isExist(i) : $\text{return array}[i >> \text{SHIFT}] \& (1 \ll (i \& \text{MASK}))$;

Query Search

A library is trying to build up a smart computer-aided look up system: user may input a list of key words, and the system shall provide all books that contain these words. How to implement such query? (A library may have millions of books)

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Distributed Sum

MapReduce

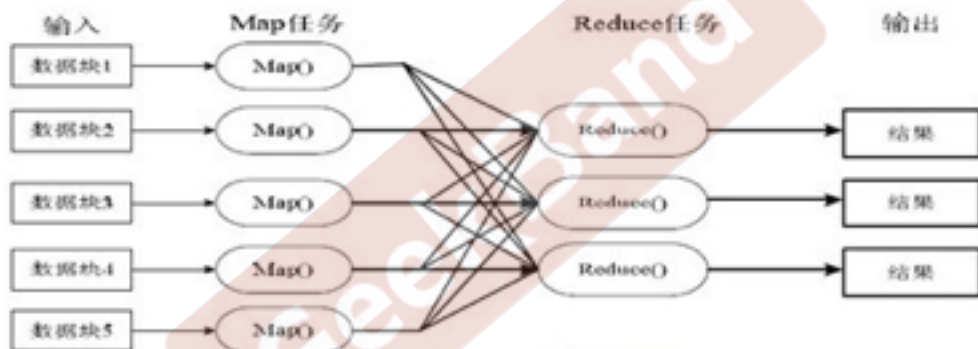


图1 MapReduce 的处理流程

Quick Questions

Power(x, n)

Sqrt(x)

Trailing Number of zeros in n!

O(1) Check Power of 2

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Homework: Subarray sum k

Given an nonnegative integer array, find a subarray where the sum of numbers is k.

Your code should return the index of the first number and the index of the last number.

Example

Given [1, 4, 20, 3, 10, 5], sum k = 33, return [2, 4].

Homework: Compose Letter

Given a newspaper and message as two strings, check if the message can be composed using letters in the newspaper.

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结束语

“每个人有每个人的算法，每个算法都有每个算法的作用，就算大家在用同样的算法，但是每个人算法中的那些变量、开关和条件都不一样，得到的结果也不一样。我们就是生活在Matrix里的一段程序，我们每个人的算法决定着我们每个人的选择，我们的选择决定了我们的人生!”