

Algorithm

Shuwen He

1201220707@pku.edu.cn

Written in Peking University Library

2020 年 1 月 9 日

目录

第一章	Algorithm	2
1.1	Overview	2
第二章	Logarithm	3
2.1	$\lg n$	3
第三章	divide and conquer	4
第四章	Search	5
4.1	Binary Search	5
4.2	Binary Search Tree	5
第五章	list	6
5.1	list	6
第六章	Sort	11
6.1	comparison sort	11
6.1.1	quick sort	11
6.1.2	merge sort	12
6.1.3	heap sort	12
6.2	bubble sort	12
第七章	Dynamic programming	13
7.1	调度问题	13
7.2	矩阵链乘法	13
7.3	公共子序列	13
7.4	Binary search tree	13
第八章	贪心算法	14
8.1	最小生成树	14

Chapter

Algorithm

Overview

In this book I define algorithms as a branch of mathematics

Algorithm must be designed to solve practical problems. An algorithm that cannot solve practical problems is a vase.

Divide the algorithm in a way that solves the problem

Please believe that learning algorithms have methods

Fresh and refined, immediate, don't be sloppy

I proved the algorithmic mathematical kilometers system

Chapter

Logarithm

lgn

$\lg n = \log_2 n$ (Base 2 logarithm)

$\ln n = \log_e n$ (Natural logarithm)

$\lg^k n = (\lg n)^k$ (Exponentiation)

$\lg \lg n = \lg(\lg n)$ (complex)

Chapter

divide and conquer

Chapter

Search

Binary Search

Binary Search Tree

Chapter

list

list

```
1    package main
2
3    import (
4        "fmt"
5    )
6
7    type ListNode struct{
8        Val int
9        Next *ListNode
10    }
11
12    func main1() {
13        headNode := &ListNode{}
14        listData := headNode
15
16        InsertTail(1, listData, headNode)
17        PrintList(listData)
18
19        InsertTail(2, listData, headNode)
20        PrintList(listData)
21
22        InsertTail(3, listData, headNode)
23        PrintList(listData)
24    }
25
26    func InsertTail(value int, list, position *ListNode) {
27        tempCell := new(ListNode)
28
29        if tempCell == nil{
```

```
30         fmt.Println("out of space")
31     }
32
33     tempCell.Val = value
34     tempCell.Next = position.Next
35     position.Next = tempCell
36 }
37
38 func PrintList(list *ListNode) {
39     if list.Next != nil {
40         fmt.Print(list.Val, "->")
41         PrintList(list.Next)
42     } else {
43         fmt.Println(list.Val)
44     }
45 }
46
47 // 给出两个非空的链表用来表示两个非负的整数。其中，它们
48 // 各自的位数是按照逆序的方式存储的，
49 // 并且它们的每个节点只能存储一位数字。
50 // 如果，我们将这两个数相加起来，则会返回一个新的链表来
51 // 表示它们的和。
52 // 您可以假设除了数字0之外，这两个数都不会以0开头。
53 // 示例：
54 // 输入：(2 -> 4 -> 3) + (5 -> 6 -> 4)
55 // 输出：7 -> 0 -> 8
56 // 原因：342 + 465 = 807
57
58 // type ListNode2 struct {
59 //     Val int
60 //     Next *ListNode2
61 // }
62
63 type List struct {
64     headNode2 *ListNode // head node
65 }
```



```
65     func Insert2(value int, list *ListNode, position *
        ListNode) {
66         tempCell := new(ListNode)
67         if tempCell == nil {
68             fmt.Println("out of space")
69         }
70         tempCell.Val = value
71         tempCell.Next = position.Next
72         position.Next = tempCell
73     }
74
75     func PrintList2(list *ListNode) {
76         if list.Next != nil {
77             fmt.Println(list.Val)
78             PrintList2(list.Next)
79         } else {
80             fmt.Println(list.Val)
81         }
82     }
83
84     func main() {
85         l1 := new(ListNode)
86         listDate := l1
87         // insert data to l1
88         Insert2(9, listDate, l1)
89         Insert2(7, listDate, l1)
90         Insert2(5, listDate, l1)
91         l2 := new(ListNode)
92         //
93         listDate2 := l2
94         // insert data to l1
95         Insert2(4, listDate2, l2)
96         Insert2(2, listDate2, l2)
97         Insert2(8, listDate2, l2)
98         l3 := addTwoNumbers(l1, l2)
99         PrintList(l3)
100     }
101
```

```
102     func addTwoNumbers(l1 *ListNode, l2 *ListNode) *ListNode
103     {
104         promotion := 0      // 进位值，只可能为0或1
105         var head *ListNode // 结果表的头结点
106         var rear *ListNode // 保存结果表的尾结点
107         for nil != l1 || nil != l2 {
108             sum := 0
109             if nil != l1 {
110                 sum += l1.Val
111                 l1 = l1.Next
112             }
113             if nil != l2 {
114                 sum += l2.Val
115                 l2 = l2.Next
116             }
117             sum += promotion
118             promotion = 0
119
120             if sum >= 10 {
121                 promotion = 1
122                 sum = sum % 10
123             }
124
125             node := &ListNode{
126                 sum,
127                 nil,
128             }
129
130             if nil == head {
131                 head = node
132                 rear = node
133             } else {
134                 rear.Next = node
135                 rear = node
136             }
137         }
138     }
```

```
139         if promotion > 0 {
140             rear.Next = &ListNode{
141                 promotion,
142                 nil,
143             }
144         }
145         return head
146     }
```

Chapter

Sort

comparison sort

quick sort

quick sort is better than heap sort

```
1      package main
2
3      import (
4          "math/rand"
5      )
6
7      // quick sort
8      // 分治排序
9      func main() {
10         var z []int
11
12         for i := 0; i < 3; i++{
13             z = append(z, rand.Intn(3))
14         }
15
16         quickSort(z)
17     }
18
19     func quickSort(list []int) {
20         if len(list) <= 1{
21             return
22         }
23
24         i, j := 0, len(list) - 1
25         index := 1 // 第一次比较索引位置
26         key := list[0] // 第一次比较参考值，选择第一个
```

```
27
28     if list[index] > key{
29         list[i], list[j] = list[j], list[i]
30         j—
31     } else {
32         list[i], list[index] = list[index], list[i]
33         i++
34         index++
35     }
36
37     quickSort(list[:i]) // 处理参考值前面值
38     quickSort(list[i+1:])
39 }
```

merge sort

John von Neumann¹⁹⁴⁵ Merge Sort: The linear table to be sorted is continuously divided into several subtables until each subtable contains only one element. At this time, the subtable containing only one element can be considered as an ordered list. Merge the subtables in pairs. Each time a new table is generated, a new and longer ordered list is generated. Repeat this step until there is only one subtable left. This subtable is an ordered linear table.

heap sort

$O(n\lg n)$ (heap sort run time)

bubble sort

Repeated swapping of two adjacent elements in reverse order

Chapter

Dynamic programming

调度问题

矩阵链乘法

公共子序列

Binary search tree

Chapter

贪心算法

最小生成树