Assignment #9: 密集期中考试周

Updated 1918 GMT+8 Nov 6, 2023

2023 fall, Complied by Xinjie Song, Phy

说明：

1）请把每个题目解题思路（可选），源码Python, 或者C++（已经在Codeforces/Openjudge上AC），截图（包含Accepted, 学号），填写到下面作业模版中（推荐使用 typora https://typoraio.cn ，或者用word）。AC 或者没有AC，都请标上每个题目大致花费时间。

2）提交时候先提交pdf文件，再把md或者doc文件上传到右侧“作业评论”。Canvas需要有同学清晰头像、提交文件有pdf、作业评论有md或者doc。

3）如果不能在截止前提交作业，请写明原因。

编程环境

操作系统：Windows 11 22H2

Python编程环境：PyCharm 2023.2 (Community Edition)

C/C++编程环境：g++ (x86_64-win32-seh-rev0, Built by MinGW-W64 project) 8.1.0

1. 必做题目

OJ19943：图的拉普拉斯矩阵

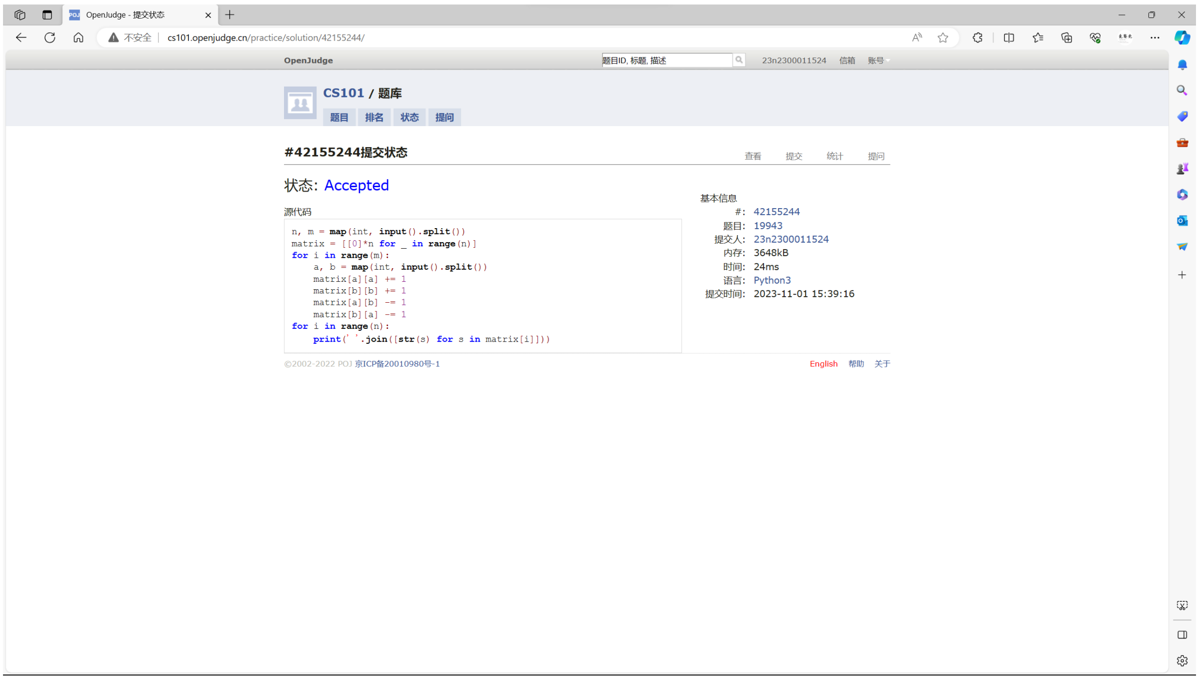
matrix, http://cs101.openjudge.cn/practice/19943/

思路：边读取数据边进行操作

代码

```
n, m = map(int, input().split())
matrix = [[0]*n for _ in range(n)]
for i in range(m):
    a, b = map(int, input().split())
    matrix[a][a] += 1
    matrix[b][b] += 1
    matrix[a][b] -= 1
    matrix[b][a] -= 1
for i in range(n):
    print(' '.join([str(s) for s in matrix[i]]))
```

代码运行截图



#42155244提交状态

状态: Accepted

源代码

```
n, m = map(int, input().split())
matrix = [[0]*n for _ in range(n)]
for i in range(m):
    a, b = map(int, input().split())
    matrix[a][a] += 1
    matrix[b][b] += 1
    matrix[a][b] -= 1
    matrix[b][a] -= 1
for i in range(n):
    print(' '.join([str(s) for s in matrix[i]]))
```

基本信息

#:	42155244
题目:	19943
提交人:	23n2300011524
内存:	3648kB
时间:	24ms
语言:	Python3
提交时间:	2023-11-01 15:39:16

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OJ19942：二维矩阵上的卷积运算v0.2

matrix, http://cs101.openjudge.cn/practice/19942/

思路：依次将卷积核中的元素一次乘到矩阵的元素中，存储到输出矩阵的对应位置

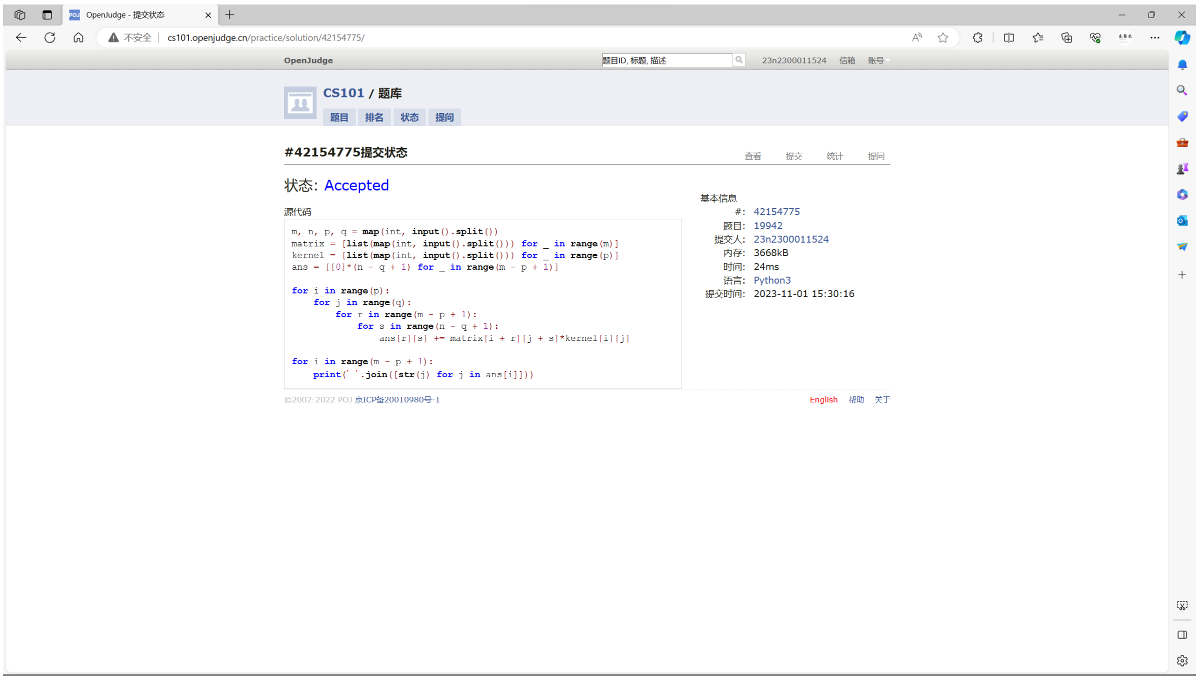
代码

```
m, n, p, q = map(int, input().split())
matrix = [list(map(int, input().split())) for _ in range(m)]
kernel = [list(map(int, input().split())) for _ in range(p)]
ans = [[0]*(n - q + 1) for _ in range(m - p + 1)]

for i in range(p):
    for j in range(q):
        for r in range(m - p + 1):
            for s in range(n - q + 1):
                ans[r][s] += matrix[i + r][j + s]*kernel[i][j]

for i in range(m - p + 1):
    print(' '.join([str(j) for j in ans[i]]))
```

代码运行截图



#42154775提交状态

状态: Accepted

源代码

```
m, n, p, q = map(int, input().split())
matrix = [list(map(int, input().split())) for _ in range(m)]
kernel = [list(map(int, input().split())) for _ in range(p)]
ans = [[0]*(n - q + 1) for _ in range(m - p + 1)]

for i in range(p):
    for j in range(q):
        for r in range(m - p + 1):
            for s in range(n - q + 1):
                ans[r][s] += matrix[i + r][j + s]*kernel[i][j]

for i in range(m - p + 1):
    print(' '.join([str(j) for j in ans[i]]))
```

基本信息

#:	42154775
题目:	19942
提交人:	23n2300011524
内存:	3668kB
时间:	24ms
语言:	Python3
提交时间:	2023-11-01 15:30:16

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English 帮助 关于

CF313B: Ilya and Queries

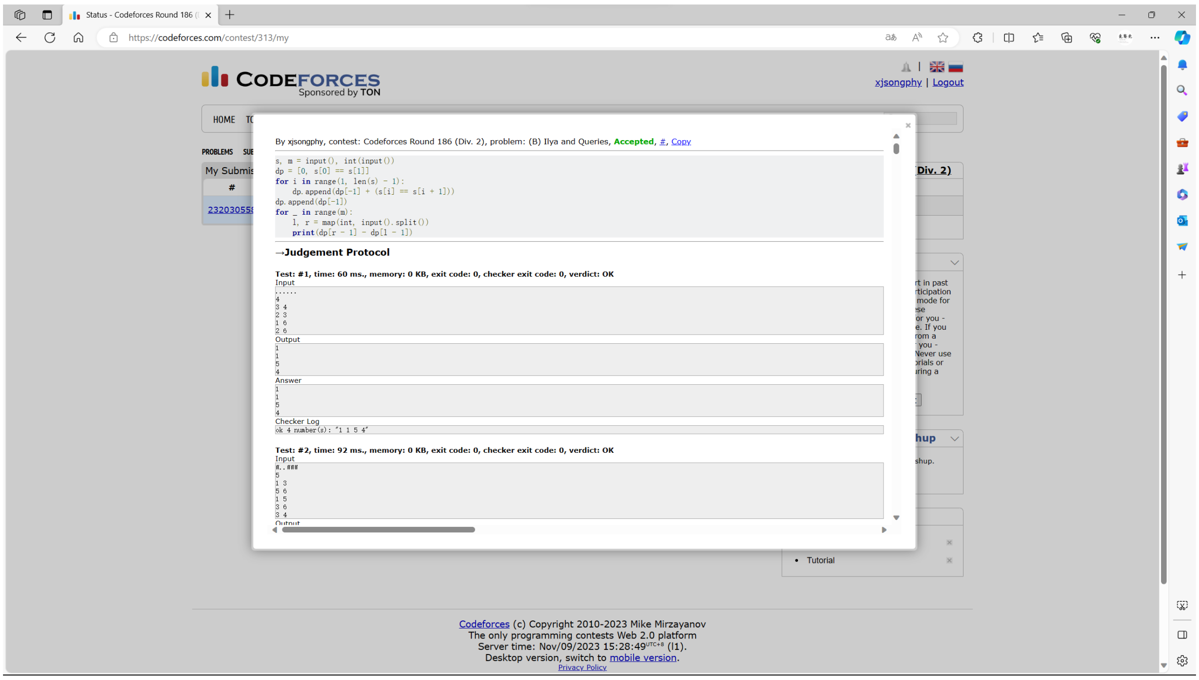
dp/implementation, 1100, https://codeforces.com/contest/313/problem/B

思路：类似前缀和的动态规划

代码

```
s, m = input(), int(input())
dp = [0, s[0] == s[1]]
for i in range(1, len(s) - 1):
    dp.append(dp[-1] + (s[i] == s[i + 1]))
dp.append(dp[-1])
for _ in range(m):
    l, r = map(int, input().split())
    print(dp[r - 1] - dp[l - 1])
```

代码运行截图



By xjsongphy, contest: Codeforces Round 186 (Div. 2), problem: (B) Ilya and Queries, Accepted, #, Copy

```
s, m = input(), int(input())
dp = [0, s[0] == s[1]]
for i in range(1, len(s) - 1):
    dp.append(dp[-1] + (s[i] == s[i + 1]))
dp.append(dp[-1])
for _ in range(m):
    l, r = map(int, input().split())
    print(dp[r - 1] - dp[l - 1])
```

→Judgement Protocol

Test: #1, time: 60 ms., memory: 0 KB, exit code: 0, checker exit code: 0, verdict: OK

Input

```
......
4
3 4
2 3
1 6
2 6
```

Output

```
1
1
5
4
```

Answer

```
1
1
5
4
```

Checker Log

```
ok 4 number(s): "1 1 5 4"
```

Test: #2, time: 92 ms., memory: 0 KB, exit code: 0, checker exit code: 0, verdict: OK

Input

```
#..###
5
1 3
5 6
1 5
3 6
3 4
```

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The only programming contests Web 2.0 platform
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Desktop version, switch to mobile version.
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CF706B: Interesting drink

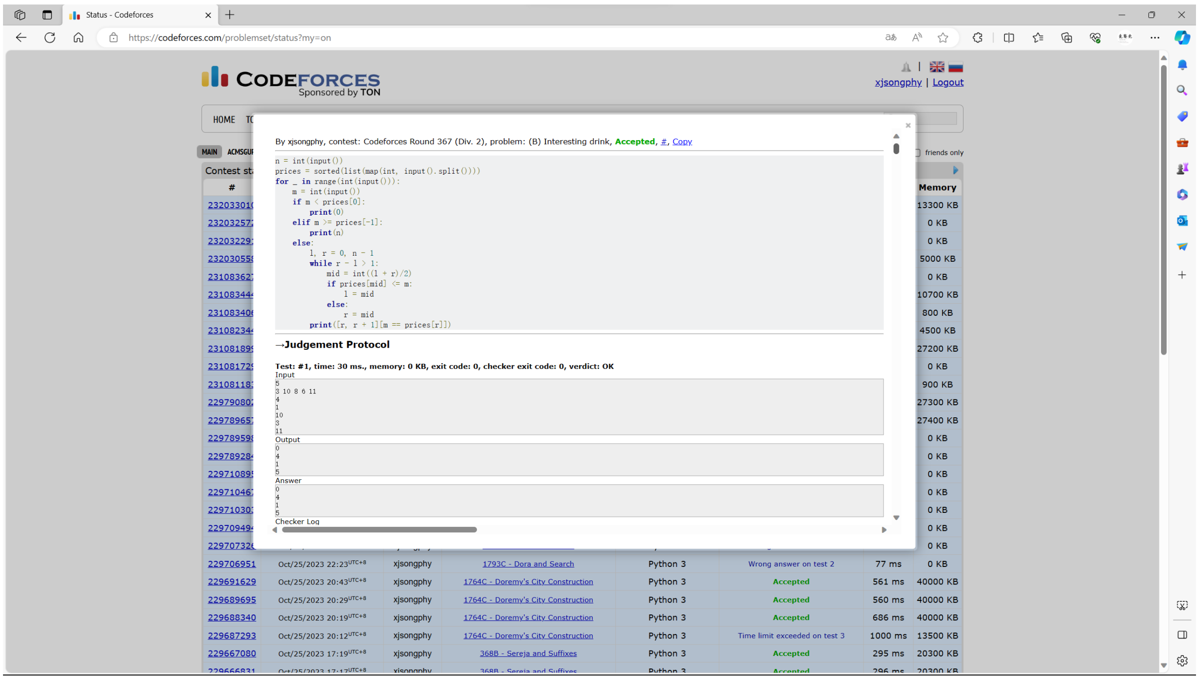
binary search/dp/implementation, 1100, https://codeforces.com/problemset/problem/706/B

思路：二分查找，注意数据在列表外的情况

代码

```python
n = int(input())
prices = sorted(list(map(int, input().split())))
for _ in range(int(input())):
    m = int(input())
    if m < prices[0]:
        print(0)
    elif m >= prices[-1]:
        print(n)
    else:
        l, r = 0, n - 1
        while r - l > 1:
            mid = int((l + r)/2)
            if prices[mid] <= m:
                l = mid
            else:
                r = mid
        print([r, r + 1][m == prices[r]])
```

代码运行截图



By xjsongphy, contest: Codeforces Round 367 (Div. 2), problem: (B) Interesting drink, Accepted, #, Copy

```
n = int(input())
prices = sorted(list(map(int, input().split())))
for _ in range(int(input())):
    m = int(input())
    if m < prices[0]:
        print(0)
    elif m >= prices[-1]:
        print(n)
    else:
        l, r = 0, n - 1
        while r - l > 1:
            mid = int((l + r)/2)
            if prices[mid] <= m:
                l = mid
            else:
                r = mid
        print([r, r + 1][m == prices[r]])
```

→Judgement Protocol

Test: #1, time: 30 ms., memory: 0 KB, exit code: 0, checker exit code: 0, verdict: OK

Input

```
5
3 10 8 6 11
4
1
10
3
11
```

Output

```
0
4
1
5
```

Answer

```
0
4
1
5
```

Checker Log

229706951	Oct/25/2023 22:23^{UTC+8}	xjsongphy	1793C - Dora and Search	Python 3	Wrong answer on test 2	77 ms	0 KB
229691629	Oct/25/2023 20:43^{UTC+8}	xjsongphy	1764C - Doremy's City Construction	Python 3	Accepted	561 ms	40000 KB
229689695	Oct/25/2023 20:29^{UTC+8}	xjsongphy	1764C - Doremy's City Construction	Python 3	Accepted	560 ms	40000 KB
229688340	Oct/25/2023 20:19^{UTC+8}	xjsongphy	1764C - Doremy's City Construction	Python 3	Accepted	686 ms	40000 KB
229687293	Oct/25/2023 20:12^{UTC+8}	xjsongphy	1764C - Doremy's City Construction	Python 3	Time limit exceeded on test 3	1000 ms	13500 KB
229667080	Oct/25/2023 17:19^{UTC+8}	xjsongphy	368B - Sereja and Suffixes	Python 3	Accepted	295 ms	20300 KB
229666831	Oct/25/2023 17:17^{UTC+8}	xjsongphy	368B - Sereja and Suffixes	Python 3	Accepted	296 ms	20300 KB

2. 选做题目

如果耗时太长，直接看解题思路，或者源码

CF466C: Number of Ways

binary search/brute force/data structures/dp/two pointers, 1700

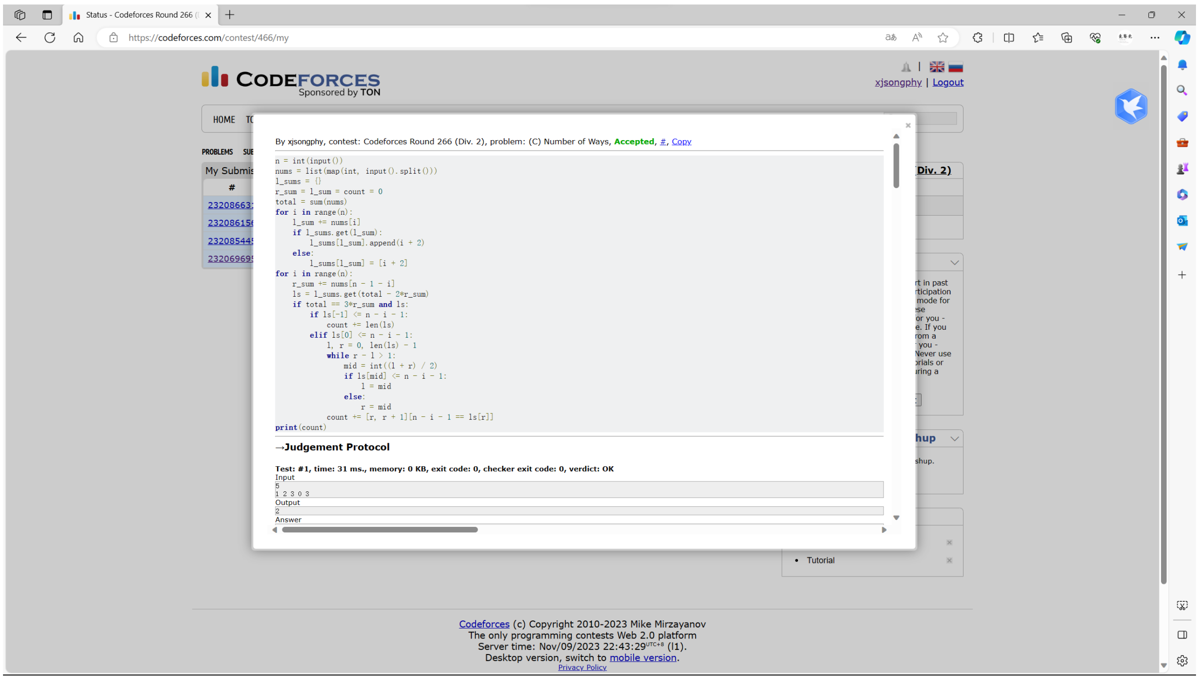
https://codeforces.com/problemset/problem/466/C

思路：将前缀和和对应的索引存储为字典方便查找，计算后缀和的同时检验所有数字的和是否等于后缀和的3倍，若等于在已经存储的字典中取出前缀和等于后缀和的索引，二分查找定位到满足要求的索引

代码

```
n = int(input())
nums = list(map(int, input().split()))
l_sums = {}
r_sum = l_sum = count = 0
total = sum(nums)
for i in range(n):
    l_sum += nums[i]
    if l_sums.get(l_sum):
        l_sums[l_sum].append(i + 2)
    else:
        l_sums[l_sum] = [i + 2]
for i in range(n):
    r_sum += nums[n - 1 - i]
    ls = l_sums.get(total - 2*r_sum)
    if total == 3*r_sum and ls:
        if ls[-1] <= n - i - 1:
            count += len(ls)
        elif ls[0] <= n - i - 1:
            l, r = 0, len(ls) - 1
            while r - l > 1:
                mid = int((l + r) / 2)
                if ls[mid] <= n - i - 1:
                    l = mid
                else:
                    r = mid
            count += [r, r + 1][n - i - 1 == ls[r]]
print(count)
```

代码运行截图



By xjsongphy, contest: Codeforces Round 266 (Div. 2), problem: (C) Number of Ways, Accepted, #, Copy

```
n = int(input())
nums = list(map(int, input().split()))
l_sums = {}
r_sum = l_sum = count = 0
total = sum(nums)
for i in range(n):
    l_sum += nums[i]
    if l_sums.get(l_sum):
        l_sums[l_sum].append(i + 2)
    else:
        l_sums[l_sum] = [i + 2]
for i in range(n):
    r_sum += nums[n - 1 - i]
    ls = l_sums.get(total - 2*r_sum)
    if total == 3*r_sum and ls:
        if ls[-1] <= n - i - 1:
            count += len(ls)
        elif ls[0] <= n - i - 1:
            l, r = 0, len(ls) - 1
            while r - l > 1:
                mid = int((l + r) / 2)
                if ls[mid] <= n - i - 1:
                    l = mid
                else:
                    r = mid
            count += [r, r + 1][n - i - 1 == ls[r]]
print(count)
```

→Judgement Protocol

Test: #1, time: 31 ms., memory: 0 KB, exit code: 0, checker exit code: 0, verdict: OK

Input

```
5
1 2 3 0 3
```

Output

```
2
```

Answer

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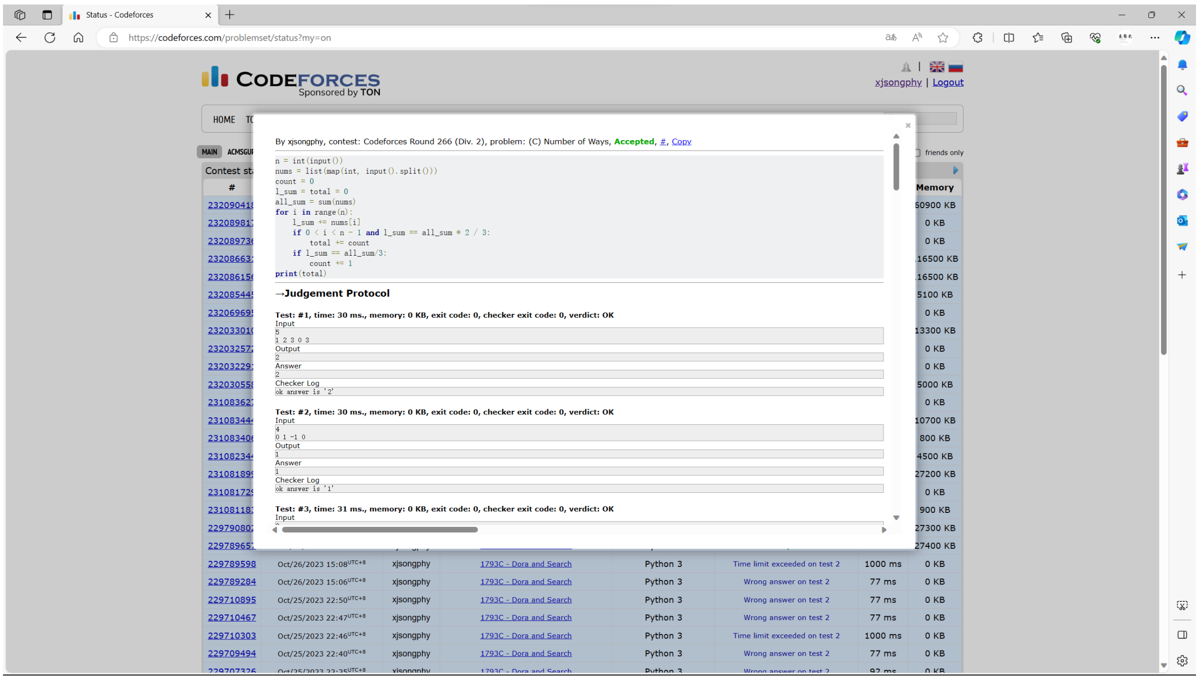
经过提示优化了算法（运行时间为三分之一）：

```
n = int(input())
nums = list(map(int, input().split()))
count = 0
l_sum = total = 0
all_sum = sum(nums)
for i in range(n):
    l_sum += nums[i]
    if 0 < i < n - 1 and l_sum == all_sum * 2 / 3:
        total += count
    if l_sum == all_sum/3:
        count += 1
print(total)
```

代码运行截图



By xjsongphy, contest: Codeforces Round 266 (Div. 2), problem: (C) Number of Ways, Accepted, #, Copy

```
n = int(input())
nums = list(map(int, input().split()))
count = 0
l_sum = total = 0
all_sum = sum(nums)
for i in range(n):
    l_sum += nums[i]
    if 0 < i < n - 1 and l_sum == all_sum * 2 / 3:
        total += count
    if l_sum == all_sum/3:
        count += 1
print(total)
```

→Judgement Protocol

Test: #1, time: 30 ms., memory: 0 KB, exit code: 0, checker exit code: 0, verdict: OK

Input

```
5
1 2 3 0 3
```

Output

```
2
```

Answer

```
2
```

Checker Log

```
ok answer is '2'
```

Test: #2, time: 30 ms., memory: 0 KB, exit code: 0, checker exit code: 0, verdict: OK

Input

```
4
0 1 -1 0
```

Output

```
1
```

Answer

```
1
```

Checker Log

```
ok answer is '1'
```

Test: #3, time: 31 ms., memory: 0 KB, exit code: 0, checker exit code: 0, verdict: OK

Input

#							Memory
229789598	Oct/26/2023 15:08^{UTC+8}	xjsongphy	1793C - Dora and Search	Python 3	Time limit exceeded on test 2	1000 ms	0 KB
229789284	Oct/26/2023 15:06^{UTC+8}	xjsongphy	1793C - Dora and Search	Python 3	Wrong answer on test 2	77 ms	0 KB
229710895	Oct/25/2023 22:50^{UTC+8}	xjsongphy	1793C - Dora and Search	Python 3	Wrong answer on test 2	77 ms	0 KB
229710467	Oct/25/2023 22:47^{UTC+8}	xjsongphy	1793C - Dora and Search	Python 3	Wrong answer on test 2	77 ms	0 KB
229710303	Oct/25/2023 22:46^{UTC+8}	xjsongphy	1793C - Dora and Search	Python 3	Time limit exceeded on test 2	1000 ms	0 KB
229709494	Oct/25/2023 22:40^{UTC+8}	xjsongphy	1793C - Dora and Search	Python 3	Wrong answer on test 2	77 ms	0 KB
229707326	Oct/25/2023 22:25^{UTC+8}	xjsongphy	1793C - Dora and Search	Python 3	Wrong answer on test 2	92 ms	0 KB

CF1443C: The Delivery Dilemma

binary search/greedy/sortings, 1400,

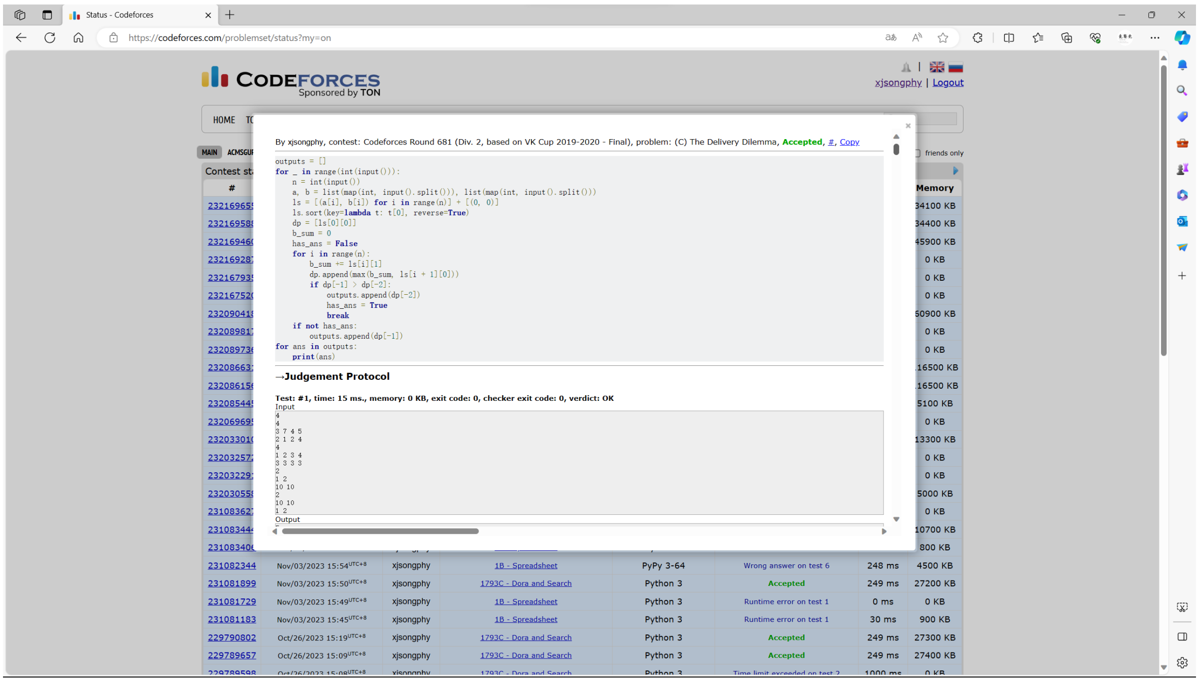
https://codeforces.com/problemset/problem/1443/C
提示： 1）结果要一起输出，不要分次print，会超时。2）用zip函数。

思路：排序后找到分界点并存储结果，最后统一输出

代码

```
outputs = []
for _ in range(int(input())):
    n = int(input())
    a, b = list(map(int, input().split())), list(map(int, input().split()))
    ls = [(a[i], b[i]) for i in range(n)] + [(0, 0)]
    ls.sort(key=lambda t: t[0], reverse=True)
    dp = [ls[0][0]]
    b_sum = 0
    has_ans = False
    for i in range(n):
        b_sum += ls[i][1]
        dp.append(max(b_sum, ls[i + 1][0]))
        if dp[-1] > dp[-2]:
            outputs.append(dp[-2])
            has_ans = True
            break
    if not has_ans:
        outputs.append(dp[-1])
for ans in outputs:
    print(ans)
```

代码运行截图



By xjsongphy, contest: Codeforces Round 681 (Div. 2, based on VK Cup 2019-2020 - Final), problem: (C) The Delivery Dilemma, Accepted, #, Copy

```python
outputs = []
for _ in range(int(input())):
    n = int(input())
    a, b = list(map(int, input().split())), list(map(int, input().split()))
    ls = [(a[i], b[i]) for i in range(n)] + [(0, 0)]
    ls.sort(key=lambda t: t[0], reverse=True)
    dp = [ls[0][0]]
    b_sum = 0
    has_ans = False
    for i in range(n):
        b_sum += ls[i][1]
        dp.append(max(b_sum, ls[i + 1][0]))
        if dp[-1] > dp[-2]:
            outputs.append(dp[-2])
            has_ans = True
            break
    if not has_ans:
        outputs.append(dp[-1])
for ans in outputs:
    print(ans)
```

→Judgement Protocol

Test: #1, time: 15 ms., memory: 0 KB, exit code: 0, checker exit code: 0, verdict: OK

Input

```
4
4
3 7 4 5
2 1 2 4
4
1 2 3 4
3 3 3 3
2
1 2
10 10
2
10 10
1 2
```

Output

231082344	Nov/03/2023 15:54^{UTC+8}	xjsongphy	1B - Spreadsheet	PyPy 3-64	Wrong answer on test 6	248 ms	4500 KB
231081899	Nov/03/2023 15:50^{UTC+8}	xjsongphy	1793C - Dora and Search	Python 3	Accepted	249 ms	27200 KB
231081729	Nov/03/2023 15:49^{UTC+8}	xjsongphy	1B - Spreadsheet	Python 3	Runtime error on test 1	0 ms	0 KB
231081183	Nov/03/2023 15:45^{UTC+8}	xjsongphy	1B - Spreadsheet	Python 3	Runtime error on test 1	30 ms	900 KB
229790802	Oct/26/2023 15:19^{UTC+8}	xjsongphy	1793C - Dora and Search	Python 3	Accepted	249 ms	27300 KB
229789657	Oct/26/2023 15:09^{UTC+8}	xjsongphy	1793C - Dora and Search	Python 3	Accepted	249 ms	27400 KB
229789598	Oct/26/2023 15:08^{UTC+8}	xjsongphy	1793C - Dora and Search	Python 3	Time limit exceeded on test 2	1000 ms	0 KB

3. 学习总结和收获

深刻体会了python中输出耗时较大。

截至2023年11月10日，OJ完成题目102道，CF完成题目44道。