Assignment #F: 十全十美

Updated 2330 GMT+8 Dec 20, 2023

2023 fall, Complied by 钟明衡 物理学院

说明：

本周作业对零基础同学偏难，如果耗时太长，直接找答案看。两个题解，经常更新。所以最好从这个链接下载最新的，https://github.com/GMyhf/2020fall-cs101 。

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_NT x64 10.0.19045

Python编程环境：Visual Studio Code 1.76.1

C/C++编程环境：Visual Studio Code 1.76.1

1. 题目

如果耗时太长，直接看解题思路，或者源码

18155: 组合乘积

dfs, brute force, http://cs101.openjudge.cn/practice/18155

思路：

首先算出所有数的乘积m，如果能组合，则m必定能整除t，否则直接输出'NO'

要排除$t=1$但是数字中没有1的情况，然后直接枚举就可以。同一次枚举，检查是否为t或者$m//t$，可以快一些

代码

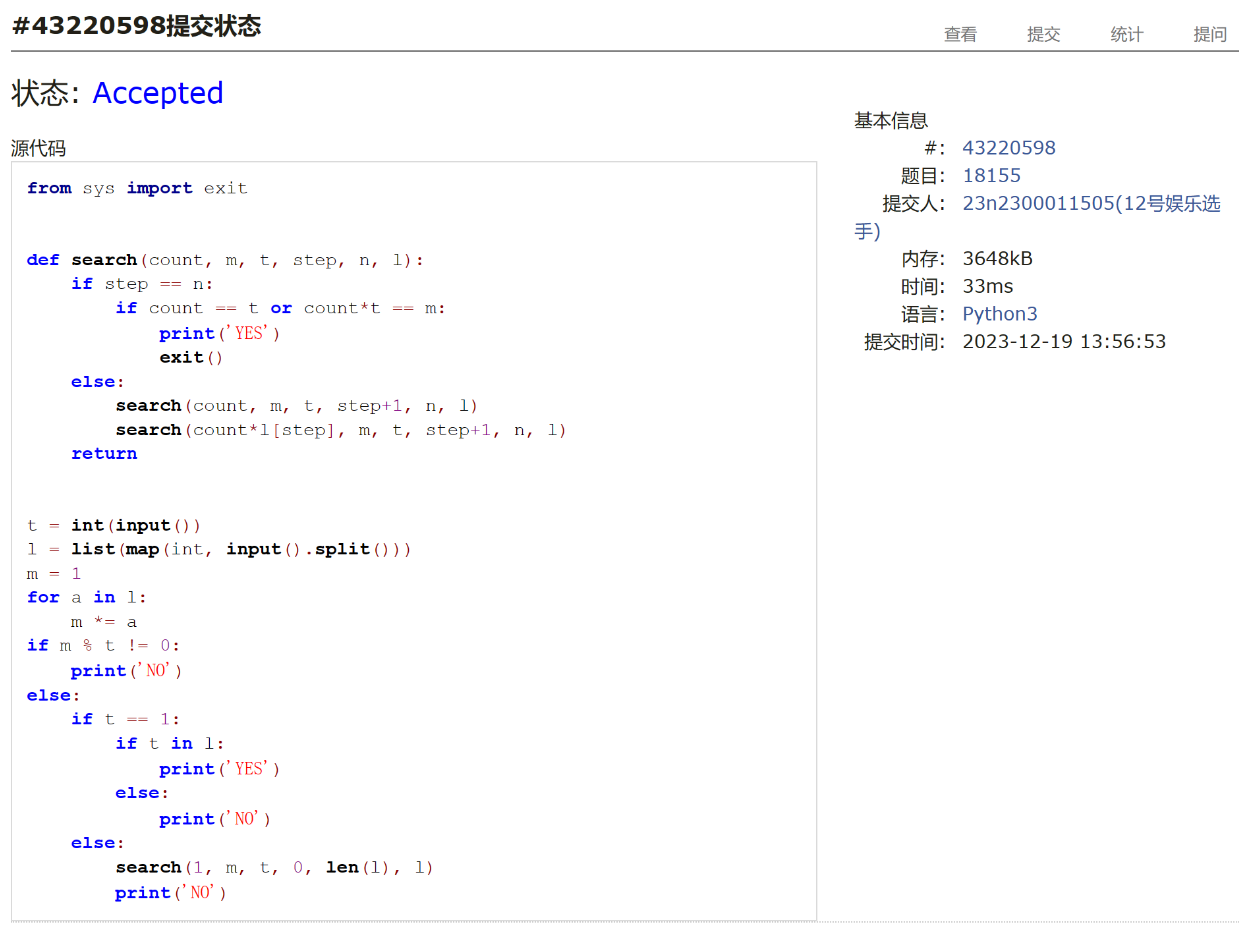
```python
from sys import exit


def search(count, m, t, step, n, l):
    if step == n:
        if count == t or count*t == m:
            print('YES')
            exit()
    else:
        search(count, m, t, step+1, n, l)
        search(count*l[step], m, t, step+1, n, l)
    return


t = int(input())
l = list(map(int, input().split()))
m = 1
for a in l:
    m *= a
if m % t != 0:
    print('NO')
else:
    if t == 1:
        if t in l:
            print('YES')
        else:
            print('NO')
    else:
        search(1, m, t, 0, len(l), l)
        print('NO')

```

代码运行截图



#43220598提交状态

查看 提交 统计 提问

状态: Accepted

源代码

```
from sys import exit


def search(count, m, t, step, n, l):
    if step == n:
        if count == t or count*t == m:
            print('YES')
            exit()
    else:
        search(count, m, t, step+1, n, l)
        search(count*l[step], m, t, step+1, n, l)
    return


t = int(input())
l = list(map(int, input().split()))
m = 1
for a in l:
    m *= a
if m % t != 0:
    print('NO')
else:
    if t == 1:
        if t in l:
            print('YES')
        else:
            print('NO')
    else:
        search(1, m, t, 0, len(l), l)
        print('NO')
```

基本信息

#:	43220598
题目:	18155
提交人:	23n2300011505(12号娱乐选手)
内存:	3648kB
时间:	33ms
语言:	Python3
提交时间:	2023-12-19 13:56:53

20106: 走山路

bfs, http://cs101.openjudge.cn/practice/20106/

思路:

最开始想了一个bfs和dfs都用上的方法，把相邻相同高度的记为同一个区域，并且记录相邻的区域，然后寻找最佳的从区域到区域的路径，结果超时了

然后写了个单独的dfs，不出意料超时了

改用bfs，记录到达每个位置上的最少体力，先写了一个每个位置只走一次的，WA了，然后就把不再走某个位置的判定改为不再能使这个位置体力最小，然后终于AC了

代码

```
dx, dy = [1, 0, -1, 0], [0, 1, 0, -1]


def bfs(x, y, a, b):
    global M, ans
    lx, ly = [x], [y]
    start, end = 0, 0
    while end != len(lx):
```

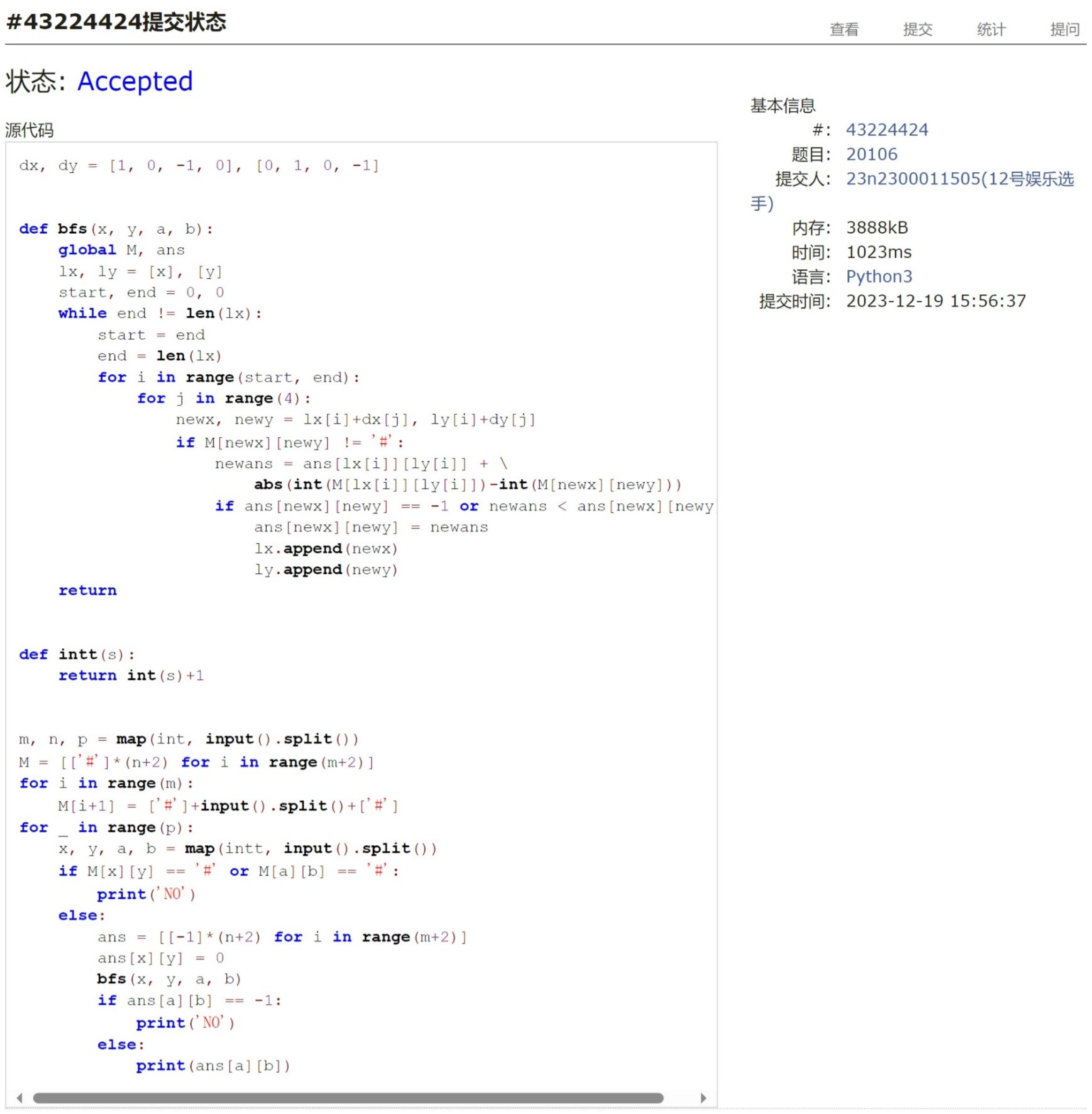
```python
        start = end
        end = len(lx)
        for i in range(start, end):
            for j in range(4):
                newx, newy = lx[i]+dx[j], ly[i]+dy[j]
                if M[newx][newy] != '#':
                    newans = ans[lx[i]][ly[i]] + \
                        abs(int(M[lx[i]][ly[i]])-int(M[newx][newy]))
                    if ans[newx][newy] == -1 or newans < ans[newx][newy]:
                        ans[newx][newy] = newans
                        lx.append(newx)
                        ly.append(newy)
    return


def intt(s):
    return int(s)+1


m, n, p = map(int, input().split())
M = [['#']*(n+2) for i in range(m+2)]
for i in range(m):
    M[i+1] = ['#']+input().split()+['#']
for _ in range(p):
    x, y, a, b = map(intt, input().split())
    if M[x][y] == '#' or M[a][b] == '#':
        print('NO')
    else:
        ans = [[-1]*(n+2) for i in range(m+2)]
        ans[x][y] = 0
        bfs(x, y, a, b)
        if ans[a][b] == -1:
            print('NO')
        else:
            print(ans[a][b])

```

代码运行截图


#43224424提交状态 查看 提交 统计 提问

状态: Accepted

源代码

```python
dx, dy = [1, 0, -1, 0], [0, 1, 0, -1]


def bfs(x, y, a, b):
    global M, ans
    lx, ly = [x], [y]
    start, end = 0, 0
    while end != len(lx):
        start = end
        end = len(lx)
        for i in range(start, end):
            for j in range(4):
                newx, newy = lx[i]+dx[j], ly[i]+dy[j]
                if M[newx][newy] != '#':
                    newans = ans[lx[i]][ly[i]] + \
                        abs(int(M[lx[i]][ly[i]])-int(M[newx][newy]))
                    if ans[newx][newy] == -1 or newans < ans[newx][newy
                        ans[newx][newy] = newans
                        lx.append(newx)
                        ly.append(newy)
    return


def intt(s):
    return int(s)+1


m, n, p = map(int, input().split())
M = [['#']*(n+2) for i in range(m+2)]
for i in range(m):
    M[i+1] = ['#']+input().split()+['#']
for _ in range(p):
    x, y, a, b = map(intt, input().split())
    if M[x][y] == '#' or M[a][b] == '#':
        print('NO')
    else:
        ans = [[-1]*(n+2) for i in range(m+2)]
        ans[x][y] = 0
        bfs(x, y, a, b)
        if ans[a][b] == -1:
            print('NO')
        else:
            print(ans[a][b])
```

基本信息

#:	43224424
题目:	20106
提交人:	23n2300011505(12号娱乐选手)
内存:	3888kB
时间:	1023ms
语言:	Python3
提交时间:	2023-12-19 15:56:37

27314: 一键换词

implementation, string, http://cs101.openjudge.cn/practice/27314/

思路：

把输入的句子按空格拆开，然后逐个词判断：

如果最后一位是句号或者逗号，就记录，在最后输出，且如果是句号就打开下一位的首字母大写

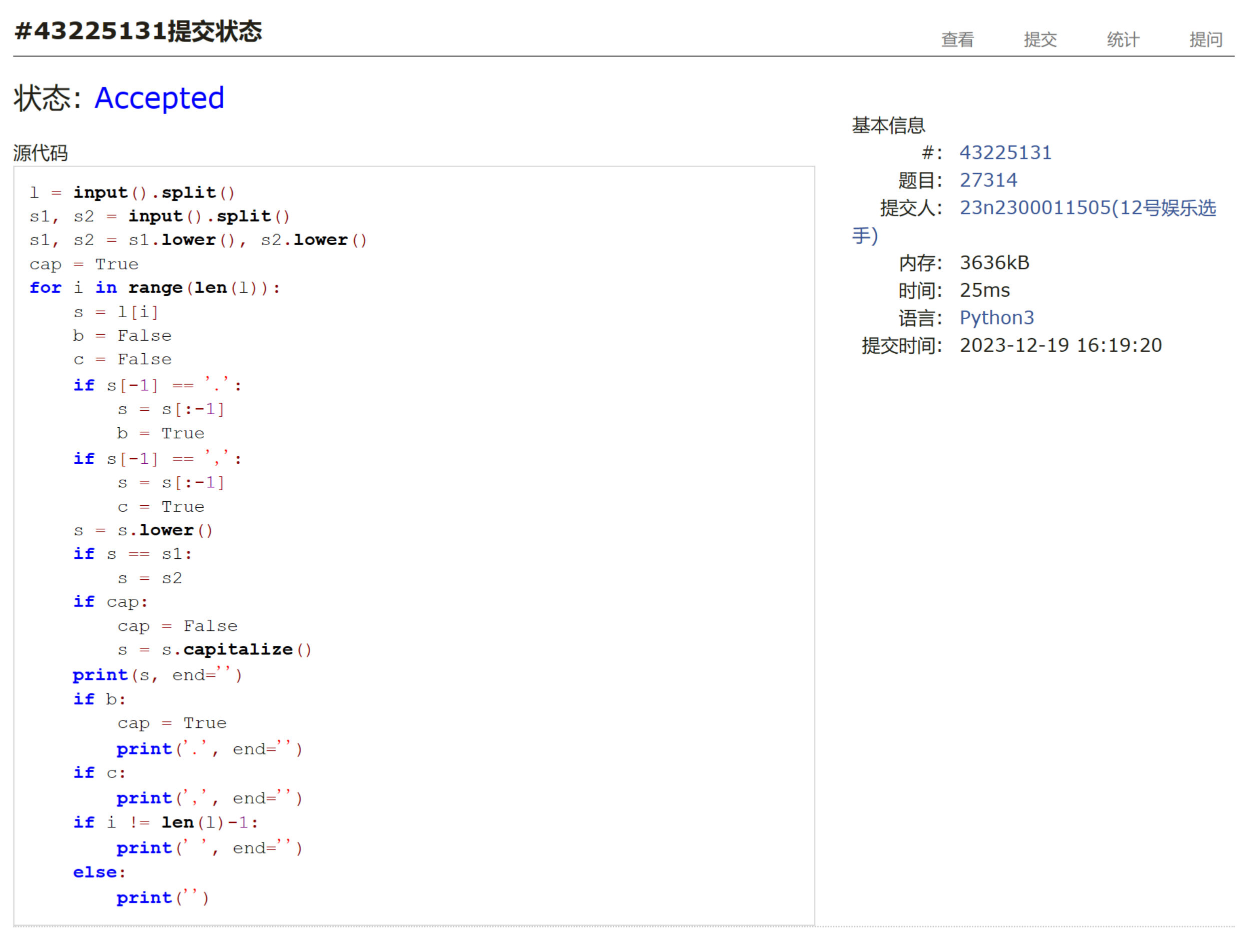
然后把分离出来的单词变成小写，比较是否要替换，然后按照大写要求输出，再输出符号，如果不是最后一个单词就额外输出一个空格

代码

```python
l = input().split()
s1, s2 = input().split()
s1, s2 = s1.lower(), s2.lower()
cap = True
for i in range(len(l)):
    s = l[i]
    b = False
    c = False
    if s[-1] == '.':
        s = s[:-1]
        b = True
    if s[-1] == ',':
        s = s[:-1]
        c = True
    s = s.lower()
    if s == s1:
        s = s2
    if cap:
        cap = False
        s = s.capitalize()
    print(s, end='')
    if b:
        cap = True
        print('.', end='')
    if c:
        print(',', end='')
    if i != len(l)-1:
        print(' ', end='')
    else:
        print('')

```

代码运行截图



#43225131提交状态

查看 提交 统计 提问

状态: Accepted

源代码

```
l = input().split()
s1, s2 = input().split()
s1, s2 = s1.lower(), s2.lower()
cap = True
for i in range(len(l)):
    s = l[i]
    b = False
    c = False
    if s[-1] == '.':
        s = s[:-1]
        b = True
    if s[-1] == ',':
        s = s[:-1]
        c = True
    s = s.lower()
    if s == s1:
        s = s2
    if cap:
        cap = False
        s = s.capitalize()
    print(s, end='')
    if b:
        cap = True
        print('.', end='')
    if c:
        print(',', end='')
    if i != len(l)-1:
        print(' ', end='')
    else:
        print('')
```

基本信息

#: 43225131
题目: 27314
提交人: 23n2300011505(12号娱乐选手)
内存: 3636kB
时间: 25ms
语言: Python3
提交时间: 2023-12-19 16:19:20

19961: 最大点数(外太空2048)

matrices, http://cs101.openjudge.cn/practice/19961/

思路:

巨大的模拟题，直接写出四个方向移动后的结果，然后枚举即可

代码

```
from copy import deepcopy


def right(M):
    global m, n
    changed = False
    while True:
        c = False
        for i in range(m):
            for j in range(n-1):
                if M[i][j] > 0 and M[i][j+1] == 0:
                    M[i][j], M[i][j+1] = 0, M[i][j]
                    c = True
        changed = c
        if not c:
            break
    for i in range(m):
        for j in range(n-1):
            if M[i][j] == M[i][j+1]:
                M[i][j+1] *= 2
                M[i][j] = 0
                changed = True
    while True:
        c = False
        for i in range(m):
            for j in range(n-1):
                if M[i][j] > 0 and M[i][j+1] == 0:
                    M[i][j], M[i][j+1] = 0, M[i][j]
                    c = True
        if not c:
            break
    return changed


def left(M):
    global m, n
    changed = False
    while True:
        c = False
        for i in range(m):
            for j in range(n-1, 0, -1):
                if M[i][j] > 0 and M[i][j-1] == 0:
                    M[i][j], M[i][j-1] = 0, M[i][j]
                    c = True
        changed = c
        if not c:
            break
    for i in range(m):
        for j in range(n-1, 0, -1):
            if M[i][j] == M[i][j-1]:
                M[i][j-1] *= 2
                M[i][j] = 0
                changed = True
    while True:
        c = False
        for i in range(m):
            for j in range(n-1, 0, -1):
                if M[i][j] > 0 and M[i][j-1] == 0:
                    M[i][j], M[i][j-1] = 0, M[i][j]
                    c = True
        if not c:
            break
    return changed


def down(M):
```

```python
    global m, n
    changed = False
    while True:
        c = False
        for j in range(n):
            for i in range(m-1):
                if M[i][j] > 0 and M[i+1][j] == 0:
                    M[i][j], M[i+1][j] = 0, M[i][j]
                    c = True
        changed = c
        if not c:
            break
    for j in range(n):
        for i in range(m-1):
            if M[i][j] == M[i+1][j]:
                M[i+1][j] *= 2
                M[i][j] = 0
                changed = True
    while True:
        c = False
        for j in range(n):
            for i in range(m-1):
                if M[i][j] > 0 and M[i+1][j] == 0:
                    M[i][j], M[i+1][j] = 0, M[i][j]
                    c = True
        if not c:
            break
    return changed


def up(M):
    global m, n
    changed = False
    while True:
        c = False
        for j in range(n):
            for i in range(m-1, 0, -1):
                if M[i][j] > 0 and M[i-1][j] == 0:
                    M[i][j], M[i-1][j] = 0, M[i][j]
                    c = True
        changed = c
        if not c:
            break
    for j in range(n):
        for i in range(m-1, 0, -1):
            if M[i][j] == M[i-1][j]:
                M[i-1][j] *= 2
                M[i][j] = 0
                changed = True
    while True:
        c = False
        for j in range(n):
            for i in range(m-1, 0, -1):
                if M[i][j] > 0 and M[i-1][j] == 0:
                    M[i][j], M[i-1][j] = 0, M[i][j]
                    c = True
        if not c:
            break
    return changed


def move(M, step):
    global ans
    ans.append(max(max(l) for l in M))
    if step == 0:
        return
    newM = deepcopy(M)
    if right(newM):
        move(newM, step-1)
    newM = deepcopy(M)
    if left(newM):
        move(newM, step-1)
    newM = deepcopy(M)
    if down(newM):
        move(newM, step-1)
    newM = deepcopy(M)
    if up(newM):
        move(newM, step-1)
    return


m, n, p = map(int, input().split())
M, ans = [], []
for _ in range(m):
    M.append(list(map(int, input().split())))
move(M, p)
print(max(ans))

```

代码运行截图

#43228478提交状态

查看 提交 统计 提问

状态: Accepted

源代码

```
from copy import deepcopy


def right(M):
    global m, n
    changed = False
    while True:
        c = False
        for i in range(m):
            for j in range(n-1):
                if M[i][j] > 0 and M[i][j+1] == 0:
                    M[i][j], M[i][j+1] = 0, M[i][j]
                    c = True
        changed = c
        if not c:
            break
    for i in range(m):
        for j in range(n-1):
            if M[i][j] == M[i][j+1]:
                M[i][j+1] *= 2
                M[i][j] = 0
                changed = True
    while True:
        c = False
        for i in range(m):
            for j in range(n-1):
                if M[i][j] > 0 and M[i][j+1] == 0:
                    M[i][j], M[i][j+1] = 0, M[i][j]
                    c = True
        if not c:
            break
    return changed


def left(M):
    global m, n
    changed = False
    while True:
        c = False
        for i in range(m):
            for j in range(n-1, 0, -1):
                if M[i][j] > 0 and M[i][j-1] == 0:
                    M[i][j], M[i][j-1] = 0, M[i][j]
                    c = True
        changed = c
        if not c:
            break
    for i in range(m):
        for j in range(n-1, 0, -1):
            if M[i][j] == M[i][j-1]:
                M[i][j-1] *= 2
                M[i][j] = 0
                changed = True
    while True:
        c = False
        for i in range(m):
            for j in range(n-1, 0, -1):
                if M[i][j] > 0 and M[i][j-1] == 0:
                    M[i][j], M[i][j-1] = 0, M[i][j]
                    c = True
        if not c:
            break
    return changed


def down(M):
    global m, n
    changed = False
    while True:
        c = False
        for j in range(n):
            for i in range(m-1):
                if M[i][j] > 0 and M[i+1][j] == 0:
                    M[i][j], M[i+1][j] = 0, M[i][j]
                    c = True
        changed = c
```

基本信息

#:	43228478
题目:	19961
提交人:	23n2300011505(12号娱乐选手)
内存:	4100kB
时间:	981ms
语言:	Python3
提交时间:	2023-12-19 17:59:27

```
        if not c:
            break
    for j in range(n):
        for i in range(m-1):
            if M[i][j] == M[i+1][j]:
                M[i+1][j] *= 2
                M[i][j] = 0
                changed = True
    while True:
        c = False
        for j in range(n):
            for i in range(m-1):
                if M[i][j] > 0 and M[i+1][j] == 0:
                    M[i][j], M[i+1][j] = 0, M[i][j]
                    c = True
        if not c:
            break
    return changed


def up(M):
    global m, n
    changed = False
    while True:
        c = False
        for j in range(n):
            for i in range(m-1, 0, -1):
                if M[i][j] > 0 and M[i-1][j] == 0:
                    M[i][j], M[i-1][j] = 0, M[i][j]
                    c = True
        changed = c
        if not c:
            break
    for j in range(n):
        for i in range(m-1, 0, -1):
            if M[i][j] == M[i-1][j]:
                M[i-1][j] *= 2
                M[i][j] = 0
                changed = True
    while True:
        c = False
        for j in range(n):
            for i in range(m-1, 0, -1):
                if M[i][j] > 0 and M[i-1][j] == 0:
                    M[i][j], M[i-1][j] = 0, M[i][j]
                    c = True
        if not c:
            break
    return changed


def move(M, step):
    global ans
    ans.append(max(max(l) for l in M))
    if step == 0:
        return
    newM = deepcopy(M)
    if right(newM):
        move(newM, step-1)
    newM = deepcopy(M)
    if left(newM):
        move(newM, step-1)
    newM = deepcopy(M)
    if down(newM):
        move(newM, step-1)
    newM = deepcopy(M)
    if up(newM):
        move(newM, step-1)
    return


m, n, p = map(int, input().split())
M, ans = [], []
for _ in range(m):
    M.append(list(map(int, input().split())))
move(M, p)
print(max(ans))
```

27401: 最佳凑单

dp, sparse bucket, http://cs101.openjudge.cn/practice/27401/

思路：

反过来看这个问题，把所有东西都放进购物车，再看删掉哪些可以让溢价最小

如果全都买，价格还不够，就无法凑单，输出0

如果可以凑单，按照从大到小排序，在另一个列表里面记录如果删了第i个东西，还溢出多少价格（从第一个可以删掉的位置$start$开始）

这个新的溢出价格$ans[i]$，在前面所有的溢出价格$ans[j](j<i)$中，寻找大于物品价格$l[i]$的最小的那个

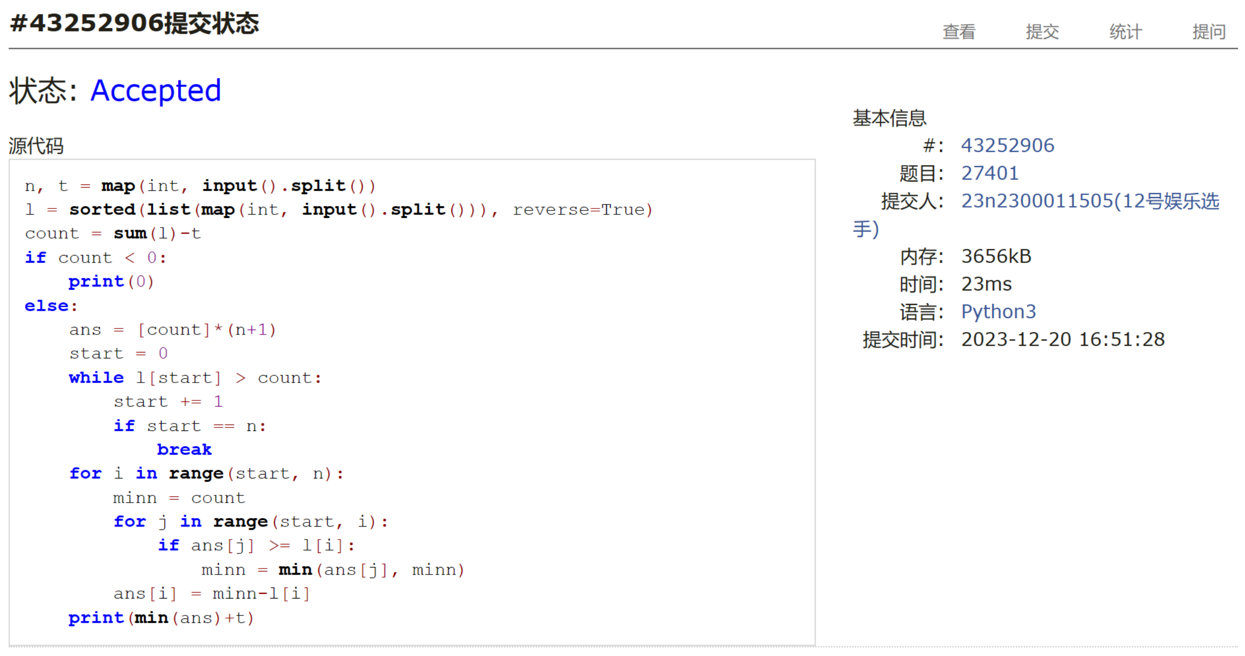
即：$ans[i]=min(ans[j])-l[i]$，要求$j<i$，$ans[j]>=l[i]$（找不到的话，就取最开始的溢出值）

代码

```python
n, t = map(int, input().split())
l = sorted(list(map(int, input().split())), reverse=True)
count = sum(l)-t
if count < 0:
    print(0)
else:
    ans = [count]*(n+1)
    start = 0
    while l[start] > count:
        start += 1
        if start == n:
            break
    for i in range(start, n):
        minn = count
        for j in range(start, i):
            if ans[j] >= l[i]:
                minn = min(ans[j], minn)
        ans[i] = minn-l[i]
    print(min(ans)+t)

```

代码运行截图



#43252906提交状态

查看 提交 统计 提问

状态: Accepted

源代码

```
n, t = map(int, input().split())
l = sorted(list(map(int, input().split())), reverse=True)
count = sum(l)-t
if count < 0:
    print(0)
else:
    ans = [count]*(n+1)
    start = 0
    while l[start] > count:
        start += 1
        if start == n:
            break
    for i in range(start, n):
        minn = count
        for j in range(start, i):
            if ans[j] >= l[i]:
                minn = min(ans[j], minn)
        ans[i] = minn-l[i]
    print(min(ans)+t)
```

基本信息

#:	43252906
题目:	27401
提交人:	23n2300011505(12号娱乐选手)
内存:	3656kB
时间:	23ms
语言:	Python3
提交时间:	2023-12-20 16:51:28

27384: 候选人追踪

heap, http://cs101.openjudge.cn/practice/27384/

熊江凯，这题应该不超纲的，感觉还是挺好的

思路:

判断方法很简单，只要候选人的最低票数 > 非候选人的最高票数即可

非候选人最高票数很好统计，但是候选人的最低票数不太好统计，不超时的方法如下：沿用之前一次作业里的想法，记录每个候选人的票数，同时记录票数为某个值的候选人的个数，如果票数最少的候选人的个数为1且此时该候选人得了一票，那么就把最低票数加一

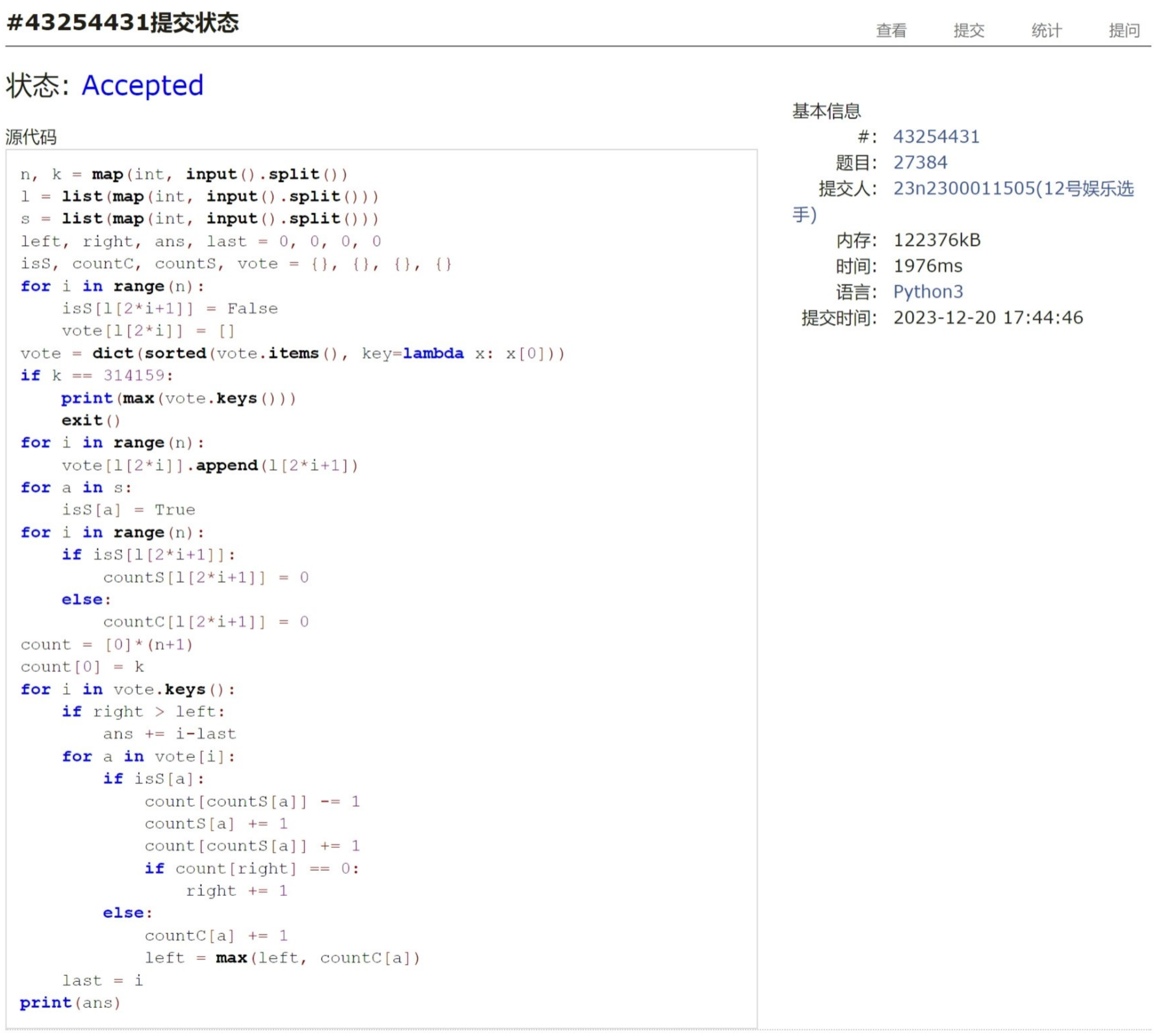
有一个巨大的坑，就是如果所有人都是候选人（即$k = 314159$），那么要直接输出最大时间，而不是正常计算

代码

```python
n, k = map(int, input().split())
l = list(map(int, input().split()))
s = list(map(int, input().split()))
left, right, ans, last = 0, 0, 0, 0
isS, countC, countS, vote = {}, {}, {}, {}
for i in range(n):
    isS[l[2*i+1]] = False
    vote[l[2*i]] = []
vote = dict(sorted(vote.items(), key=lambda x: x[0]))
if k == 314159:
    print(max(vote.keys()))
    exit()
for i in range(n):
    vote[l[2*i]].append(l[2*i+1])
for a in s:
    isS[a] = True
for i in range(n):
    if isS[l[2*i+1]]:
        countS[l[2*i+1]] = 0
    else:
        countC[l[2*i+1]] = 0
count = [0]*(n+1)
count[0] = k
for i in vote.keys():
    if right > left:
        ans += i-last
    for a in vote[i]:
        if isS[a]:
            count[countS[a]] -= 1
            countS[a] += 1
            count[countS[a]] += 1
            if count[right] == 0:
                right += 1
        else:
            countC[a] += 1
            left = max(left, countC[a])
    last = i
print(ans)

```

代码运行截图


#43254431提交状态

查看 提交 统计 提问

状态: Accepted

源代码

```
n, k = map(int, input().split())
l = list(map(int, input().split()))
s = list(map(int, input().split()))
left, right, ans, last = 0, 0, 0, 0
isS, countC, countS, vote = {}, {}, {}, {}
for i in range(n):
    isS[l[2*i+1]] = False
    vote[l[2*i]] = []
vote = dict(sorted(vote.items(), key=lambda x: x[0]))
if k == 314159:
    print(max(vote.keys()))
    exit()
for i in range(n):
    vote[l[2*i]].append(l[2*i+1])
for a in s:
    isS[a] = True
for i in range(n):
    if isS[l[2*i+1]]:
        countS[l[2*i+1]] = 0
    else:
        countC[l[2*i+1]] = 0
count = [0]*(n+1)
count[0] = k
for i in vote.keys():
    if right > left:
        ans += i-last
    for a in vote[i]:
        if isS[a]:
            count[countS[a]] -= 1
            countS[a] += 1
            count[countS[a]] += 1
            if count[right] == 0:
                right += 1
        else:
            countC[a] += 1
            left = max(left, countC[a])
    last = i
print(ans)
```

基本信息
#: 43254431
题目: 27384
提交人: 23n2300011505(12号娱乐选手)
内存: 122376kB
时间: 1976ms
语言: Python3
提交时间: 2023-12-20 17:44:46

CF1883D. In Love

data structure, greedy, 1500, https://codeforces.com/problemset/problem/1883/D

黄源森、查达闻推荐

思路:

对于(l_1, r_1)和(l_2, r_2)，如果$r_1 < l_2$，则它们不相交

因此，每次输出只需要判断r中的最小值是否小于l中的最大值

直接对列表操作会超时，因此使用heap，不断弹出不符合要求的最小值（最大值加个负号就是最小值了）

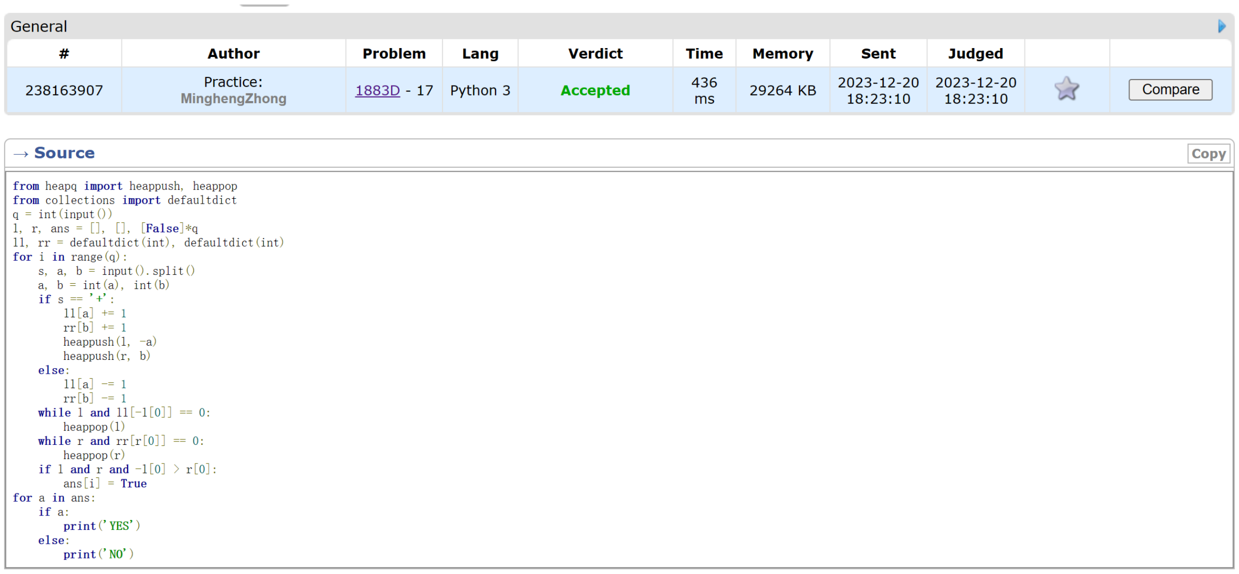
代码

```
from heapq import heappush, heappop
from collections import defaultdict
q = int(input())
l, r, ans = [], [], [False]*q
ll, rr = defaultdict(int), defaultdict(int)
for i in range(q):
```

```python
    s, a, b = input().split()
    a, b = int(a), int(b)
    if s == '+':
        ll[a] += 1
        rr[b] += 1
        heappush(l, -a)
        heappush(r, b)
    else:
        ll[a] -= 1
        rr[b] -= 1
    while l and ll[-l[0]] == 0:
        heappop(l)
    while r and rr[r[0]] == 0:
        heappop(r)
    if l and r and -l[0] > r[0]:
        ans[i] = True
for a in ans:
    if a:
        print('YES')
    else:
        print('NO')

```

代码运行截图



General

#	Author	Problem	Lang	Verdict	Time	Memory	Sent	Judged		
238163907	Practice: MinghengZhong	1883D - 17	Python 3	Accepted	436 ms	29264 KB	2023-12-20 18:23:10	2023-12-20 18:23:10	☆	Compare

→ Source

```python
from heapq import heappush, heappop
from collections import defaultdict
q = int(input())
l, r, ans = [], [], [False]*q
ll, rr = defaultdict(int), defaultdict(int)
for i in range(q):
    s, a, b = input().split()
    a, b = int(a), int(b)
    if s == '+':
        ll[a] += 1
        rr[b] += 1
        heappush(l, -a)
        heappush(r, b)
    else:
        ll[a] -= 1
        rr[b] -= 1
    while l and ll[-l[0]] == 0:
        heappop(l)
    while r and rr[r[0]] == 0:
        heappop(r)
    if l and r and -l[0] > r[0]:
        ans[i] = True
for a in ans:
    if a:
        print('YES')
    else:
        print('NO')
```

2. 学习总结和收获

感觉这次作业特别难，七道题分别为：枚举剪枝、特殊bfs、字符串处理、暴力模拟、dp、桶、heap

第一次使用了heap，确实很快