Assignment #E: 算法基础

Updated 1419 GMT+8 Dec 12, 2023

2023 fall, Complied by ==苏王捷 工学院==

说明：

本周作业涉及到枚举、贪心、bfs、矩阵，建议提前开始作业，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

==（请改为同学的操作系统、编程环境等）==

操作系统：Windows 11 22H2

Python编程环境：Spyder IDE 5.4.5

1. 题目

如果耗时太长，直接看解题思路，或者源码

02692: 假币问题

brute force, http://cs101.openjudge.cn/practice/02692

思路：对每个硬币的条件讨论，是否满足重币或者轻币条件

代码

```
# # -*- coding: utf-8 -*-
"""
Created on Tue Dec 12 14:53:41 2023

@author: Lenovo
"""
```

```
for _ in range(int(input())):
    cases=[list(input().split())for i in range(3)]
    for coin in "ABCDEFGHIJKL":
        if all((coin in c[0] and c[2]=="up")or(coin in c[1] and
c[2]=="down")or(coin not in c[1] and coin not in c[0] and c[2]=="even")for c in
cases):
            print(f"{coin} is the counterfeit coin and it is heavy.")
            break
        elif all((coin in c[0] and c[2]=="down")or(coin in c[1] and
c[2]=="up")or(coin not in c[0] and coin not in c[1] and c[2]=="even")for c in
cases):
            print(f"{coin} is the counterfeit coin and it is light.")
            break
```

代码运行截图 ==（至少包含有"Accepted"）==

状态: Accepted

源代码

```
# -*- coding: utf-8 -*-
"""
Created on Tue Dec 12 14:53:41 2023

@author: Lenovo
"""

for _ in range(int(input())):
    cases=[list(input().split())for i in range(3)]
    for coin in "ABCDEFGHIJKL":
        if all((coin in c[0] and c[2]=="up")or(coin in c[1] and c[2]=="do
            print(f"{coin} is the counterfeit coin and it is heavy.")
            break
        elif all((coin in c[0] and c[2]=="down")or(coin in c[1] and c[2]=
            print(f"{coin} is the counterfeit coin and it is light.")
            break
```

基本信息

#:	43087749
题目:	02692
提交人:	23n2300011075(才疏学浅)
内存:	3548kB
时间:	22ms
语言:	Python3
提交时间:	2023-12-12 15:14:44

18164: 剪绳子

greedy/huffman, http://cs101.openjudge.cn/practice/18164/

思路：heapq结构解决huffman Tree 问题

代码

```
# # -*- coding: utf-8 -*-
"""
Created on Tue Dec 12 00:42:06 2023

@author: Lenovo
"""

import heapq
```

```
n=int(input())
l,ans=list(map(int,input().split())),0
heapq.heapify(l)
while n>=2:
    a=heapq.heappop(l)
    b=heapq.heappop(l)
    ans+=a+b
    n-=1
    heapq.heappush(l,a+b)
print(ans)
```

代码运行截图 ==（AC代码截图，至少包含有"Accepted"）==

#43080261提交状态

查看 提交 统计 提问

状态: Accepted

源代码

```
# -*- coding: utf-8 -*-
"""
Created on Tue Dec 12 00:42:06 2023

@author: Lenovo
"""

import heapq

n=int(input())
l,ans=list(map(int,input().split())),0
heapq.heapify(l)
while n>=2:
    a=heapq.heappop(l)
    b=heapq.heappop(l)
    ans+=a+b
    n-=1
    heapq.heappush(l,a+b)
print(ans)
```

基本信息

#: 43080261
题目: 18164
提交人: 23n2300011075(才疏学浅)
内存: 5456kB
时间: 42ms
语言: Python3
提交时间: 2023-12-12 00:44:38

01328: Radar Installation

greedy, http://cs101.openjudge.cn/practice/01328/

思路：将点转化为数轴上的线段，即求线段的覆盖区间有几个

代码

```
# class island:
    def __init__(self,left,right):
        self.left=left
        self.right=right
from math import sqrt
NO,p=1,[]
while True:
    n,d=map(int,input().split())
    if n==0 and d==0:
        break
```

```
    l,num,flag,i=[],1,True,0
    while i<n and flag:
        x,y=map(float,input().split())
        if y>d:
            flag=False
        else:
            left=x-sqrt(d**2-y**2)
            right=x+sqrt(d**2-y**2)
            l.append(island(left,right))
        i+=1
    for j in range(n-i+1):
        input()
    if not flag:
        p.append(f"Case {NO}: -1")
    else:
        l.sort(key=lambda x:x.left)
        left=l[0].left
        right=l[0].right
        for i in range(1,n):
            if l[i].left<=right:
                right=min(right,l[i].right)
            else:
                num+=1
                right=l[i].right
        p.append(f"Case {NO}: {num}")
    NO+=1
for i in p:
    print(i)
```

代码运行截图 ==（AC代码截图，至少包含有"Accepted"）==

#43072235提交状态

查看 提交 统计 提问

状态: Accepted

源代码

```
class island:
    def __init__(self,left,right):
        self.left=left
        self.right=right
from math import sqrt
NO,p=1,[]
while True:
    n,d=map(int,input().split())
    if n==0 and d==0:
        break
    l,num,flag,i=[],1,True,0
    while i<n and flag:
        x,y=map(float,input().split())
        if y>d:
            flag=False
        else:
            left=x-sqrt(d**2-y**2)
            right=x+sqrt(d**2-y**2)
            l.append(island(left,right))
        i+=1
    for j in range(n-i+1):
        input()
    if not flag:
        p.append(f"Case {NO}: -1")
    else:
        l.sort(key=lambda x:x.left)
        left=l[0].left
        right=l[0].right
        for i in range(1,n):
            if l[i].left<=right:
                right=min(right,l[i].right)
            else:
                num+=1
                right=l[i].right
        p.append(f"Case {NO}: {num}")
    NO+=1
for i in p:
    print(i)
```

基本信息

#: 43072235
题目: 01328
提交人: 23n2300011075(才疏学浅)
内存: 3812kB
时间: 55ms
语言: Python3
提交时间: 2023-12-11 16:43:27

19930: 寻宝

bfs, http://cs101.openjudge.cn/practice/19930

思路：加保护圈用heapq存步数，找到最小步数

代码

```
# # -*- coding: utf-8 -*-
"""
Created on Thu Dec  7 08:56:22 2023

@author: Lenovo
"""

import heapq
def bfs(x,y):
    d=[[-1,0],[1,0],[0,1],[0,-1]]
    queue=[]
    heapq.heappush(queue,[0,x,y])
    check=set()
    check.add((x,y))
```

```
    while queue:
        step,x,y=map(int,heapq.heappop(queue))
        if martix[x][y]==1:
            return step
        for i in range(4):
            dx,dy=x+d[i][0],y+d[i][1]
            if martix[dx][dy]!=2 and (dx,dy) not in check:
                heapq.heappush(queue,[step+1,dx,dy])
                check.add((dx,dy))
    return "NO"

m,n=map(int,input().split())
martix=[[2]*(n+2)]+[[2]+list(map(int,input().split()))+[2] for i in range(m)]+
[[2]*(n+2)]
print(bfs(1,1))
```

代码运行截图 ==（AC代码截图，至少包含有"Accepted"）==

#43080157提交状态

查看 提交 统计 提问

状态: Accepted

源代码

```
# -*- coding: utf-8 -*-
"""
Created on Thu Dec  7 08:56:22 2023

@author: Lenovo
"""

import heapq
def bfs(x,y):
    d=[[-1,0],[1,0],[0,1],[0,-1]]
    queue=[]
    heapq.heappush(queue,[0,x,y])
    check=set()
    check.add((x,y))
    while queue:
        step,x,y=map(int,heapq.heappop(queue))
        if martix[x][y]==1:
            return step
        for i in range(4):
            dx,dy=x+d[i][0],y+d[i][1]
            if martix[dx][dy]!=2 and (dx,dy) not in check:
                heapq.heappush(queue,[step+1,dx,dy])
                check.add((dx,dy))
    return "NO"

m,n=map(int,input().split())
martix=[[2]*(n+2)]+[[2]+list(map(int,input().split()))+[2] for i in rang
print(bfs(1,1))
```

基本信息

#: 43080157
题目: 19930
提交人: 23n2300011075(才疏学浅)
内存: 3696kB
时间: 24ms
语言: Python3
提交时间: 2023-12-12 00:24:05

1163B2. Cat Party (Hard Edition)

https://codeforces.com/contest/1163/problem/B2
好题。通过维护双层（三层？）数据结构可以O(n)。

确实好题，而且感觉难度适合作业没有复杂的东西。多维护了几个数就做到O(n)了。

思路：打两个表，一个存数字出现了多少次，一个存次数出现了多少次，判断条件

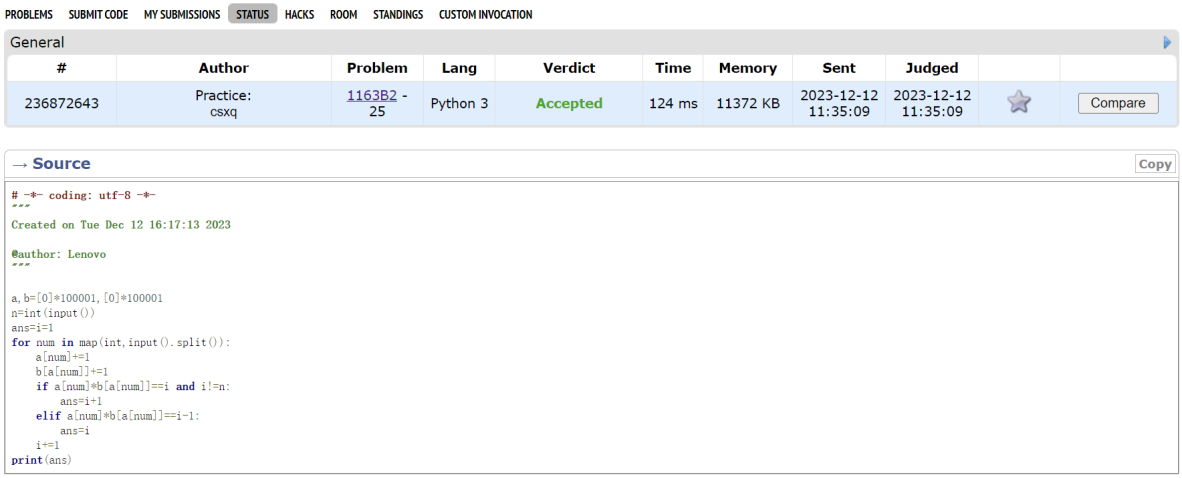
代码

```
# # -*- coding: utf-8 -*-
"""
Created on Tue Dec 12 16:17:13 2023

@author: Lenovo
"""

a,b=[0]*100001,[0]*100001
n=int(input())
ans=i=1
for num in map(int,input().split()):
    a[num]+=1
    b[a[num]]+=1
    if a[num]*b[a[num]]==i and i!=n:
        ans=i+1
    elif a[num]*b[a[num]]==i-1:
        ans=i
    i+=1
print(ans)
```

代码运行截图 ==（AC代码截图，至少包含有"Accepted"）==



02811: 熄灯问题

brute force, http://cs101.openjudge.cn/practice/02811

思路：枚举对第一列的操作，每个下一列即为上一列变化后的结果，才能使上一列灯完全熄灭；最找到能使第五列灯全熄灭的方案

代码

```
# # -*- coding: utf-8 -*-
"""
Created on Tue Dec 12 15:53:03 2023

@author: Lenovo
"""

from itertools import product
import copy
martix=[[0]*8]+[[0]+list(map(int,input().split()))+[0] for i in range(5)]+[[0]*8]
for cases in product([0,1],repeat=6):
    martixcopy=copy.deepcopy(martix)
    ans=[list(cases)]
    for i in range(1,6):
        for j in range(1,7):
            if ans[i-1][j-1]:
                martixcopy[i][j]=(martixcopy[i][j]+1)%2
                martixcopy[i][j-1]=(martixcopy[i][j-1]+1)%2
                martixcopy[i][j+1]=(martixcopy[i][j+1]+1)%2
                martixcopy[i+1][j]=(martixcopy[i+1][j]+1)%2
        ans.append(martixcopy[i][1:7])
    if martixcopy[5][1:7]==[0,0,0,0,0,0]:
        for line in ans[0:-1]:
            print(*line)
```

代码运行截图 ==（AC代码截图，至少包含有"Accepted"）==

#43088694提交状态

查看　提交　统计　提问

状态: Accepted

源代码

```
# -*- coding: utf-8 -*-
"""
Created on Tue Dec 12 15:53:03 2023

@author: Lenovo
"""

from itertools import product
import copy
martix=[[0]*8]+[[0]+list(map(int,input().split()))+[0] for i in range(5)
for cases in product([0,1],repeat=6):
    martixcopy=copy.deepcopy(martix)
    ans=[list(cases)]
    for i in range(1,6):
        for j in range(1,7):
            if ans[i-1][j-1]:
                martixcopy[i][j]=(martixcopy[i][j]+1)%2
                martixcopy[i][j-1]=(martixcopy[i][j-1]+1)%2
                martixcopy[i][j+1]=(martixcopy[i][j+1]+1)%2
                martixcopy[i+1][j]=(martixcopy[i+1][j]+1)%2
        ans.append(martixcopy[i][1:7])
    if martixcopy[5][1:7]==[0,0,0,0,0,0]:
        for line in ans[0:-1]:
            print(*line)
```

基本信息

#:	43088694
题目:	02811
提交人:	23n2300011075(才疏学浅)
内存:	3712kB
时间:	26ms
语言:	Python3
提交时间:	2023-12-12 16:01:55

02802: 小游戏

dfs, bfs, http://cs101.openjudge.cn/practice/02802/

思路：加保护圈用heapq存线段数，找到最小的线段数

代码

```
# # -*- coding: utf-8 -*-
"""
Created on Wed Dec  6 10:35:07 2023

@author: Lenovo
"""

import heapq
num1=1
while True:
    w,h=map(int,input().split())
    if w==0 and h==0:
        break
    print(f"Board #{num1}:")
    martix=[[" "]*(w+2)]+[[" "]+list(input())+[" "] for _ in range(h)]+[[" "]*
(w+2)]
    dir=[(0,1),(0,-1),(1,0),(-1,0)]
    num2=1
    while True:
        x1,y1,x2,y2=map(int,input().split())
        if x1==0 and x2==0 and y1==0 and y2==0:
            break
        queue,flag=[],False
        vis=set()
        heapq.heappush(queue,(0,x1,y1,-1))
        martix[y2][x2]=" "
        vis.add((-1,x1,y1))
        while queue:
            step,x,y,dirs=heapq.heappop(queue)
            if x==x2 and y==y2:
                flag=True
                break
            for i,(dx,dy) in enumerate(dir):
                px,py=x+dx,y+dy
                if 0<=px<=w+1 and 0<=py<=h+1 and (i,px,py) not in vis and
martix[py][px]!="X":
                    vis.add((i,px,py))
                    heapq.heappush(queue,(step+(dirs!=i),px,py,i))
        if flag:
            print(f"Pair {num2}: {step} segments.")
        else:
            print(f"Pair {num2}: impossible.")
        martix[y2][x2]="X"
        num2+=1
```

```
    print()
    num1+=1
```

代码运行截图 ==（至少包含有"Accepted"）==

#43079981提交状态 查看 提交 统计 提问

状态: Accepted

源代码

```
# -*- coding: utf-8 -*-
"""
Created on Wed Dec  6 10:35:07 2023

@author: Lenovo
"""

import heapq
num1=1
while True:
    w,h=map(int,input().split())
    if w==0 and h==0:
        break
    print(f"Board #{num1}:")
    martix=[[" "]*(w+2)]+[[" "]+list(input())+[" "] for _ in range(h)]+[[
    dir=[(0,1),(0,-1),(1,0),(-1,0)]
    num2=1
    while True:
        x1,y1,x2,y2=map(int,input().split())
        if x1==0 and x2==0 and y1==0 and y2==0:
            break
        queue,flag=[],False
        vis=set()
        heapq.heappush(queue,(0,x1,y1,-1))
        martix[y2][x2]=" "
        vis.add((-1,x1,y1))
        while queue:
            step,x,y,dirs=heapq.heappop(queue)
            if x==x2 and y==y2:
                flag=True
                break
            for i,(dx,dy) in enumerate(dir):
                px,py=x+dx,y+dy
                if 0<=px<=w+1 and 0<=py<=h+1 and (i,px,py) not in vis a
                    vis.add((i,px,py))
                    heapq.heappush(queue,(step+(dirs!=i),px,py,i))
        if flag:
            print(f"Pair {num2}: {step} segments.")
        else:
            print(f"Pair {num2}: impossible.")
```

基本信息

#:	43079981
题目:	02802
提交人:	23n2300011075(才疏学浅)
内存:	4688kB
时间:	64ms
语言:	Python3
提交时间:	2023-12-12 00:00:39

2. 学习总结和收获

==如果作业题目简单，有否额外练习题目，比如：OJ“每日选做”中每天推出的2题目、CF、LeetCode、洛谷等网站题目。==

这期作业大量使用heapq堆结构就能迅速解决，其实所有求最短、最长的问题都能用heapq实现，在图搜索中搭配bfs尤其好用。

这次卡的最久的竟然是两道brute Force。。。优化想了挺久，感觉不如少点难优化的brute froce问题多来点算法 :)