Assignment #2: 编程练习

Updated 0953 GMT+8 Feb 24, 2024

2024 spring, Complied by 赵语涵 生命科学学院

说明：

1）The complete process to learn DSA from scratch can be broken into 4 parts:

- Learn about Time and Space complexities
- Learn the basics of individual Data Structures
- Learn the basics of Algorithms
- Practice Problems on DSA

2）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），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。

3）课程网站是Canvas平台, https://pku.instructure.com, 学校通知3月1日导入选课名单后启用。**作业写好后，保留在自己手中，待3月1日提交。**

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"区有上传的md或者doc附件。

4）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

Python编程环境：Spyder IDE 5.2.2

1. 题目

27653: Fraction类

http://cs101.openjudge.cn/2024sp_routine/27653/

思路：建立对象Fraction，将2个分数进行处理，并改写加法函数使之符合分数运算结果。注意其中需要用下划线的函数处为前后分别2个下划线

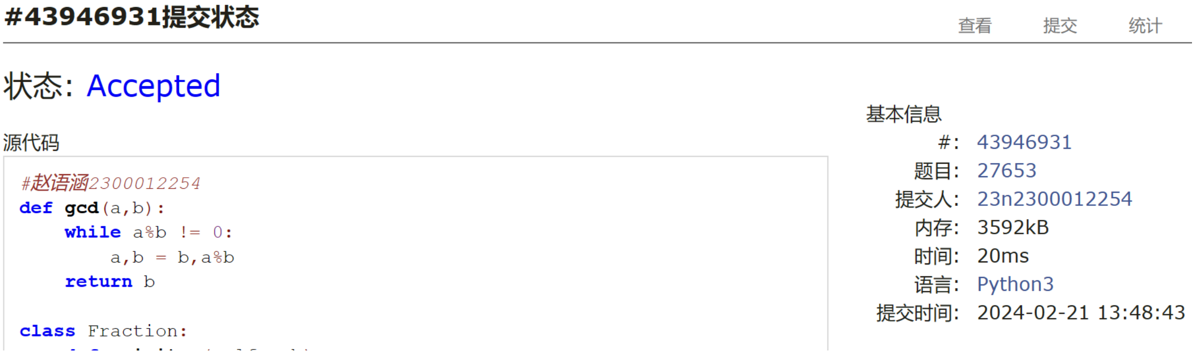
代码

```python
#赵语涵2300012254
def gcd(a,b):
    while a%b != 0:
        a,b = b,a%b
    return b

class Fraction:
    def __init__(self,a,b):
        self.up = a
        self.down = b
    def __add__(self,another):
        up = self.up*another.down+self.down*another.up
        down = self.down*another.down
        g = gcd(up,down)
        return str(up//g)+'/'+str(down//g)

a,b,c,d = map(int,input().split())
print(Fraction(a,b)+Fraction(c,d))
```

代码运行截图



#43946931提交状态

状态: Accepted

源代码

```python
#赵语涵2300012254
def gcd(a,b):
    while a%b != 0:
        a,b = b,a%b
    return b

class Fraction:
```

基本信息

#:	43946931
题目:	27653
提交人:	23n2300012254
内存:	3592kB
时间:	20ms
语言:	Python3
提交时间:	2024-02-21 13:48:43

04110: 圣诞老人的礼物-Santa Clau’s Gifts

greedy/dp, http://cs101.openjudge.cn/practice/04110

思路：由于糖果每箱是可以拆分的，直接找到单位价值最高的糖果优先带走即可

代码

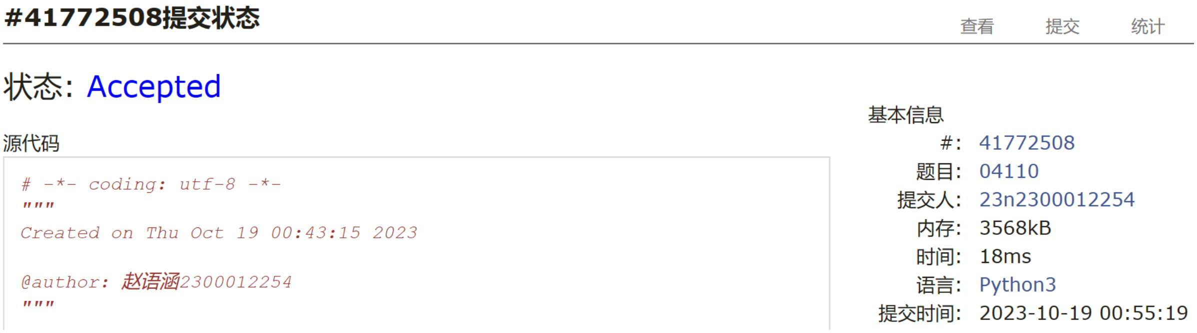
```python
# -*- coding: utf-8 -*-
"""
Created on Thu Oct 19 00:43:15 2023

@author: 赵语涵2300012254
"""

n,w = map(int,input().split())
gifts = []
total = 0
for _ in range(n):
    gifts.append(list(map(int,input().split())))

gifts.sort(key=lambda x:x[0]/x[1],reverse=True)
for i in gifts:
    if w > 0:
        total += min(i[0],i[0]/i[1]*w)
        w -= min(i[1],w)
print('%.1f'%total)
```

代码运行截图



#41772508提交状态

查看 提交 统计

状态: Accepted

源代码

```python
# -*- coding: utf-8 -*-
"""
Created on Thu Oct 19 00:43:15 2023

@author: 赵语涵2300012254
"""
```

基本信息

#:	41772508
题目:	04110
提交人:	23n2300012254
内存:	3568kB
时间:	18ms
语言:	Python3
提交时间:	2023-10-19 00:55:19

18182: 打怪兽

implementation/sortings/data structures, http://cs101.openjudge.cn/practice/18182/

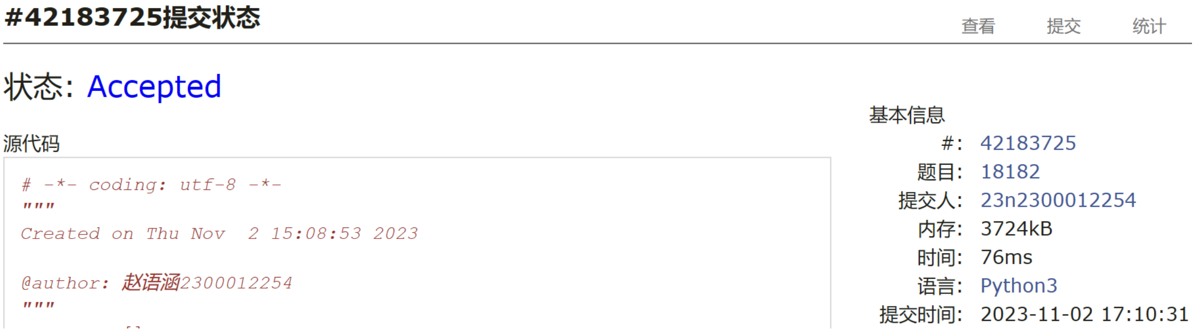
思路：建立{时刻：[技能]}的字典，然后对于每个时刻依序遍历并使血量b减去所有技能或者要求技能最大数条件下取最大的技能之和。即可得到答案。

代码

```python
# -*- coding: utf-8 -*-
"""
Created on Thu Nov  2 15:08:53 2023

@author: 赵语涵2300012254
"""
answer = []
for _ in range(int(input())):
    n,m,b = map(int,input().split())
    skill = {}
    time = set()
    for i in range(n):
        t,x = map(int,input().split())
        time.add(t)
        try:
            skill[t].append(x)
        except:
            skill[t] = [x]
    for j in sorted(list(time)):
        num = len(skill[j])
        if num<=m:
            b -= sum(skill[j])
        else:
            b -= sum(sorted(skill[j],reverse=True)[:m])
        if b <= 0:
            answer.append(j)
            break
    else:
        answer.append('alive')
for a in answer:
    print(a)
```

代码运行截图



#42183725提交状态

状态: Accepted

源代码

```
# -*- coding: utf-8 -*-
"""
Created on Thu Nov  2 15:08:53 2023

@author: 赵语涵2300012254
"""
```

基本信息

#:	42183725
题目:	18182
提交人:	23n2300012254
内存:	3724kB
时间:	76ms
语言:	Python3
提交时间:	2023-11-02 17:10:31

230B. T-primes

binary search/implementation/math/number theory, 1300, http://codeforces.com/problemset/problem/230/B

思路：有3个因子的数，其因子应分别为1，其本身，一个质数。所以只要满足为质数的平方数即可

代码

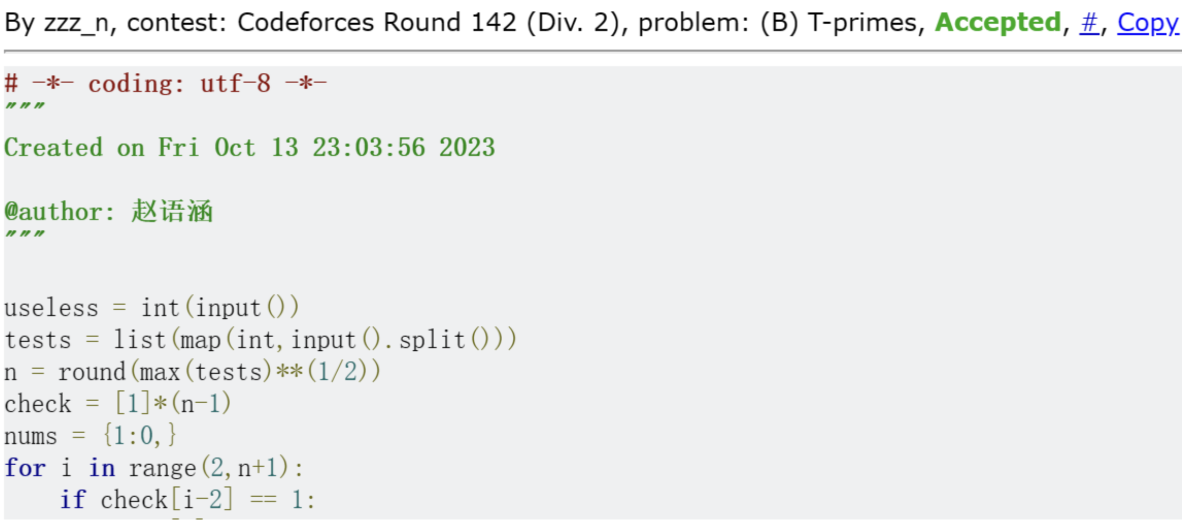
```
# -*- coding: utf-8 -*-
"""
Created on Fri Oct 13 23:03:56 2023

@author: 赵语涵
"""

useless = int(input())
tests = list(map(int,input().split()))
n = round(max(tests)**(1/2))
check = [1]*(n-1)
nums = {1:0,}
for i in range(2,n+1):
    if check[i-2] == 1:
        nums[i] = 1
        for j in range(2,n//i+1):
            check[i*j-2] = 0
```

```python
    else:
        nums[i] = 0
answers = []
for x in tests:
    y = round(x**(1/2))
    if y**2 == x:
        if nums[y]==1:
            answers.append('YES')
        else:
            answers.append('NO')
    else:
        answers.append('NO')
for answer in answers:
    print(answer)
```

代码运行截图



By zzz_n, contest: Codeforces Round 142 (Div. 2), problem: (B) T-primes, **Accepted**, #, Copy

```python
# -*- coding: utf-8 -*-
"""
Created on Fri Oct 13 23:03:56 2023

@author: 赵语涵
"""

useless = int(input())
tests = list(map(int,input().split()))
n = round(max(tests)**(1/2))
check = [1]*(n-1)
nums = {1:0,}
for i in range(2,n+1):
    if check[i-2] == 1:
```

1364A. XXXXX

brute force/data structures/number theory/two pointers, 1200, https://codeforces.com/problemset/problem/1364/A

思路：为选取最长子序列，首先选全部数字，若不是x倍数即为所求；若为x倍数，只需减去一个非x倍数数字即所得。为使子序列最长，寻找离序列两端最近的非x倍数数字。

代码

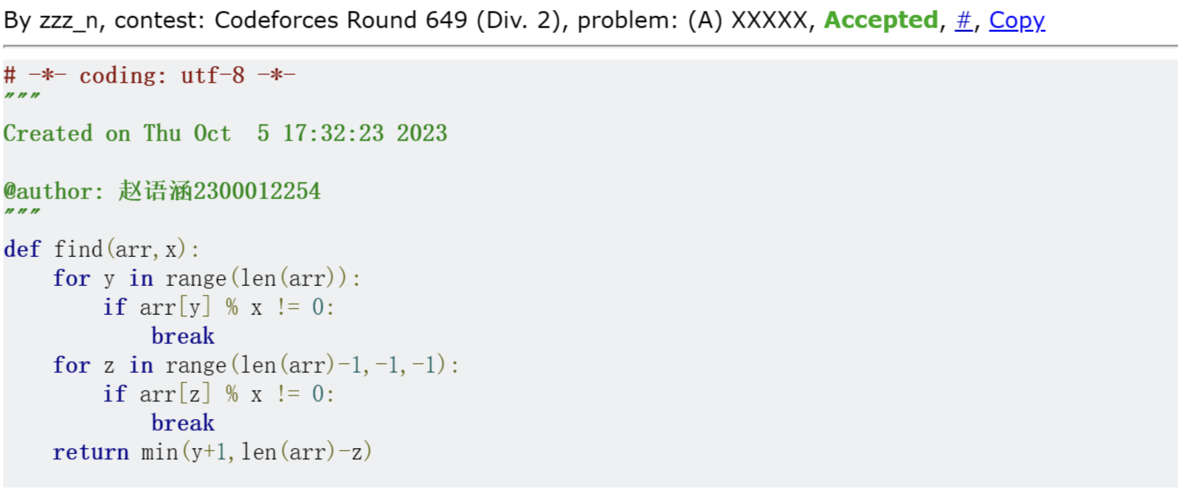
```python
# -*- coding: utf-8 -*-
"""
Created on Thu Oct  5 17:32:23 2023

@author: 赵语涵2300012254
"""
```

```python
def find(arr,x):
    for y in range(len(arr)):
        if arr[y] % x != 0:
            break
    for z in range(len(arr)-1,-1,-1):
        if arr[z] % x != 0:
            break
    return min(y+1,len(arr)-z)

g = int(input())
answers = []
for i in range(g):
    n,x = map(int,input().split())
    arr = list(map(int,input().split()))
    sum = 0
    count = 0
    for j in arr:
        sum += j
        count += 1
    if sum%x == 0:
        count -= find(arr, x)
    if count == 0:
        count = -1
    answers.append(count)
for a in answers:
    print(a)
```

代码运行截图



By zzz_n, contest: Codeforces Round 649 (Div. 2), problem: (A) XXXXX, **Accepted**, #, Copy

```python
# -*- coding: utf-8 -*-
"""
Created on Thu Oct  5 17:32:23 2023

@author: 赵语涵2300012254
"""
def find(arr,x):
    for y in range(len(arr)):
        if arr[y] % x != 0:
            break
    for z in range(len(arr)-1,-1,-1):
        if arr[z] % x != 0:
            break
    return min(y+1,len(arr)-z)
```

18176: 2050年成绩计算

http://cs101.openjudge.cn/practice/18176/

思路：用埃氏筛打质数表，关键在于优化时间。用math中开方换掉了手动n**(1/2)才AC

代码

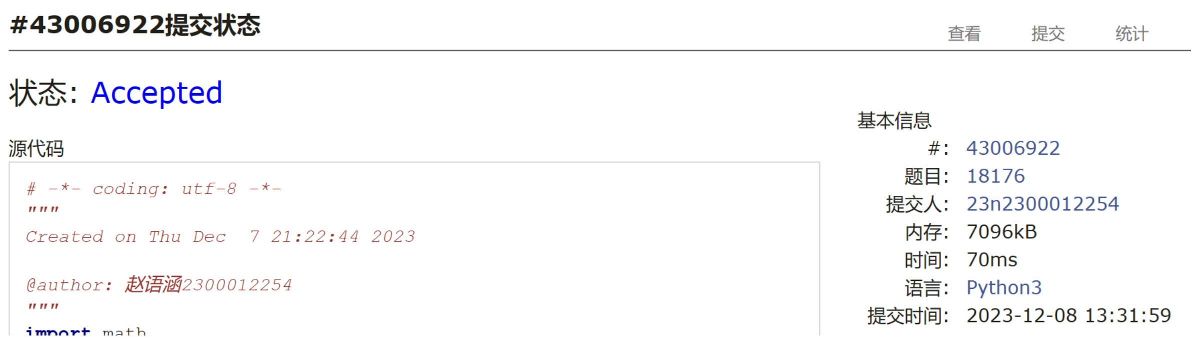
```python
# -*- coding: utf-8 -*-
"""
Created on Thu Dec  7 21:22:44 2023

@author: 赵语涵2300012254
"""
import math
m,n = map(int,input().split())
score,big = {},0
for i in range(m):
    score[i]= list(map(int,input().split()))
    big = max(max(score[i]),big)
big = int(big**(1/2))

prime = {i:True for i in range(0,big+1)}
prime[0],prime[1] = False,False
primes = []
for i in range(2,big+1):
    if prime[i]:
        primes.append(i)
    for j in primes:
        if i*j <= big:
            prime[i*j] = False
        else:
            break

for i in range(m):
    num,per_sc = 0,0
    for s in score[i]:
        num += 1
        if (a:=math.sqrt(s)) == int(a):
            if prime[int(a)]:
                per_sc += s
    if per_sc == 0:
        print(0)
    else:
        a = per_sc/num
        print('%.2f'%a)
```

代码运行截图



#43006922提交状态

状态: Accepted

源代码

```python
# -*- coding: utf-8 -*-
"""
Created on Thu Dec  7 21:22:44 2023

@author: 赵语涵2300012254
"""
import math
```

基本信息

#: 43006922
题目: 18176
提交人: 23n2300012254
内存: 7096kB
时间: 70ms
语言: Python3
提交时间: 2023-12-08 13:31:59

2. 学习总结和收获

由于大部分是关于上学期的作业题，基本都没有在这部分作业上花太多时间。这段时间在读闫老师发在群里数算的教参书一边在数算2024pre里面选相关的题目做，但是目前进度太慢还在学习树相关和做题...另外感觉笔试部分最后得花时间背一下前面建类的代码之类的...

3.课外补充

看数算书时做了一些前后序表达式转换计算，以及树相关的问题

OJ02255.重建二叉树

OpenJudge - 02255:重建二叉树

思路：要构建后序表达式，感觉先根据前序中序建树再想办法用后序导出会比较麻烦，便通过各种繁琐的转换进行直接转后序...首先前序pre转为deque以方便popleft弹出每一个父节点，其在中序mid中的位置决定了左右枝的长度，而在后序post直接将父节点放在最后。子树分为左、右子树，左树祖先节点位置是左枝的最右端，右树的祖先节点位置在右树的最右边。依次用递推解决问题。

代码

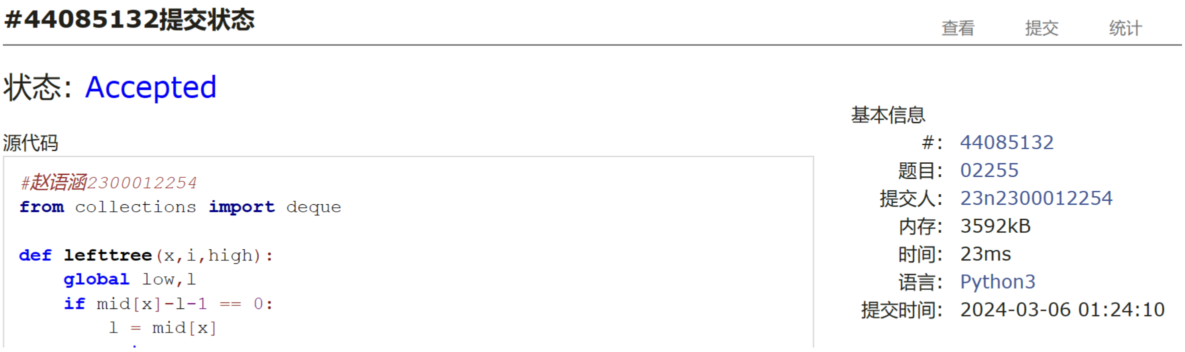
```python
#赵语涵2300012254
from collections import deque

def lefttree(x,i,high):
    global low,l
    if mid[x]-l-1 == 0:
        l = mid[x]
        return
    fill(low+mid[x]-l-1,i)

def righttree(x,i,high):
    global low,l
    if i-low <= 1:
        low = i
        l += 1
        return
    fill(i-1,i)

def fill(i,high):
    global pre,mid,post,low,l
    x = pre.popleft()
    post[i] = x
    lefttree(x, i, high)
    righttree(x, i, high)
    low = i

while True:
    try:
        pre,mid = input().split()
        pre = deque(list(pre))
        long = len(mid)
        mid = dict(zip(list(mid),range(1,long+1)))
        post = dict(zip(range(1,long+1),['0']*long))
        low,l = 0,0
        fill(long,long)
        print(''.join(post.values()))
    except EOFError:
        break
```



#44085132提交状态

状态: Accepted

源代码

```
#赵语涵2300012254
from collections import deque

def lefttree(x,i,high):
    global low,l
    if mid[x]-l-1 == 0:
        l = mid[x]
```

基本信息

#: 44085132
题目: 02255
提交人: 23n2300012254
内存: 3592kB
时间: 23ms
语言: Python3
提交时间: 2024-03-06 01:24:10