计算机学院 2021 级

《算法实践》指导手册

（2022 年 11 月）

一、时间

2022 年 11 月 12 日~2022 年 12 月 23 日

进度计划：

1) 2022.11.12~2022.12.2：理论学习与上机实验
2) 2020.12.2~2022.12.23：撰写报告
3) 2022.12.2~2022.12.23：课堂报告
4) 2022.12.23：提交材料

二、内容

指定专题：6 个专题，并查集、树状数组、后缀数组、线段树、LCA/RMQ 问题、差分约束系统。

自选专题：相关要求见本手册“十、关于自选专题的说明”。

三、形式

理论学习、上机练习、分组课堂报告、撰写课程报告

四、理论学习

针对 6 个训练专题，查阅相关书籍和资料学习，通过学习回答以下问题：

（1）并查集的概念；基于并查集的操作；并查集的应用；

（2）树状数组的概念；树状数据的相关性质和应用；

（3）后缀树的概念；后缀数组的概念；倍增算法；DC3 算法；倍增算法和 DC3 算法比较分析；

（4）LCA 和 RMQ 问题的概念；LCA 和 RMQ 的相互转换；ST 算法；Tarjan 算法；DFS、并查集、DP 在 LCA/RMQ 问题中的应用；

（5）线段树的概念；线段树的性质；单点更新；区间更新；离散化；Lazy 思想；

（6）差分约束系统的概念、性质；Bellman-Ford 算法；SPFA 算法等。

五、上机练习

每人每专题必须完成 1 道以上的题目，不得有遗漏专题。

本手册附有 12 道参考题目，但不限于该 12 道题目，学生可根据情况选择其它有代表性的题目。

2022 年 12 月 2 日统计各人完成情况，根据情况给上机分数。

六、分组课堂报告

1）课堂报告分组进行，一组负责一个专题，每组 4 人，并原则上不超过 4 人，汇报前决定分组情况。

2）每组根据自己的专题，书写汇报 PPT，不少于 30 页。组内成员分工完成 PPT，一般可由：

- 1 人负责总体，把控 PPt 制作水平，除文字外，应配以图片、动画等展示成果；
- 1 人负责整理理论相关的文字材料，要求内容详实、表述完整，引用的概念、定理、算法及公式、图表等要正确、规范；
- 2 人负责书写题目相关的材料，题目描述要准确、解题思路要清晰、算法设计要完整，并有详实的计算过程描述和丰富、正确的测试数据和结果分析，要做到文字描述流畅、语言表达准确。

3）最后 2-3 周，每组推选代表现场报告。

- 报告时必须明确小组成员对汇报材料的贡献；
- 根据报告情况打分，包括总体分、每人负责的各部分评分等。

七、《算法实践课程报告》

在六个专题中选择一个撰写课程设计报告。原则上以本人学号尾数模 6+1 的方式决定所选专题，不得随意更改。如要更换，必须找人互换并报备。

报告的基本框架如下：

（1）封面 （2）目录 （3）正文

关于报告的具体要求见“关于《算法实践课程设计报告》的说明”。

八、成绩评定

总成绩由上机题完成情况分、PPT 和课堂分组报告分、课程报告分三部分组成。

其中，

（1）**上机题完成情况分（0~100）**：完成的题目数以 OJ 上 AC 的题目为准，完成 8 道题得 80 分，每多完成 1 道加 5 分，最多加 40 分；少于 8 道的，每少 1 道扣 10 分，扣至 0 分为止。

- ✧ **上机题完成情况分低于 50 分者，本课程总评成绩不及格。**
- ✧ **题目必须独立完成，如发现拷贝现有代码或抄袭别人代码的一律视为作弊，将根据情节严重进行纪律处分。**

（2）**PPT 和课堂分组报告分（0~100）**：根据 PPt 的完成质量给出 PPt 分数（0~70），包括总体质量（0~20）、每人负责部分得分（0~50）。根据课堂汇报情况给出报告分（0~30，总体分）。各人的 PPt 和课堂分组报告分=PPt 总体质量分+每人负责部分得分+课堂汇报情况分。

（3）**课程报告分（0~100）**：根据报告的书写质量评定等级，A：90 分，B：80 分，C：70 分，D：60 分，E：综合成绩直接不及格（55 分以下），另对 A、B、C、D 评带”+”等级，A+：≥95 分，B+：85 分，C+：75 分，D+：65 分。

（4）综合成绩评定：

综合成绩=上机题完成情况分*20% + PPt 和课堂报告分*30% +课程报告分*50%

九、关于自选专题的说明

（1）如自选专题内容，必须事先与老师沟通，提交关于所选内容的文字说明，得到同意后才能选择。

（2）所选专题，必须内容充实，工作量饱满，并有明确的目标和可检查成果。

（3）多人同组做一个自选专题时，小组成员的工作不能重叠，每人必须要有独立的工作内容。

（4）参加课堂报告，并在评定成绩时作为重点对象予以审核。

十、未尽事宜，另行解释

备注：自己在 POJ 上注册账号

专题一：并查集

POJ1182 食物链

Time Limit: 1000MS Memory Limit: 10000K

Total Submissions: 56363 Accepted: 16522

Description

动物王国中有三类动物 A,B,C，这三类动物的食物链构成了有趣的环形。A 吃 B， B 吃 C，C 吃 A。现有 N 个动物，以 1－N 编号。每个动物都是 A,B,C 中的一种，但是我们并不知道它到底是哪一种。有人用两种说法对这 N 个动物所构成的食物链关系进行描述：

第一种说法是"1 X Y"，表示 X 和 Y 是同类。

第二种说法是"2 X Y"，表示 X 吃 Y。

此人对 N 个动物，用上述两种说法，一句接一句地说出 K 句话，这 K 句话有的是真的，有的是假的。当一句话满足下列三条之一时，这句话就是假话，否则就是真话。

1） 当前的话与前面的某些真的话冲突，就是假话；

2） 当前的话中 X 或 Y 比 N 大，就是假话；

3） 当前的话表示 X 吃 X，就是假话。

你的任务是根据给定的 N（1 <= N <= 50,000）和 K 句话（0 <= K <= 100,000），输出假话的总数。

Input

第一行是两个整数 N 和 K，以一个空格分隔。

以下 K 行每行是三个正整数 D，X，Y，两数之间用一个空格隔开，其中 D 表示说法的种类。

若 D=1，则表示 X 和 Y 是同类。

若 D=2，则表示 X 吃 Y。

Output

只有一个整数，表示假话的数目。

Sample Input

```
100 7
1 101 1
2 1 2
2 2 3
2 3 3
1 1 3
2 3 1
1 5 5
```

Sample Output

```
3
```

POJ1417 True Liars

Time Limit: 1000MS Memory Limit: 10000K
Total Submissions: 2532 Accepted: 793

Description

After having drifted about in a small boat for a couple of days, Akira Crusoe Maeda was finally cast ashore on a foggy island. Though he was exhausted and despaired, he was still fortunate to remember a legend of the foggy island, which he had heard from patriarchs in his childhood. This must be the island in the legend. In the legend, two tribes have inhabited the island, one is divine and the other is devilish, once members of the divine tribe bless you, your future is bright and promising, and your soul will eventually go to Heaven, in contrast, once members of the devilish tribe curse you, your future is bleak and hopeless, and your soul will eventually fall down to Hell.

In order to prevent the worst-case scenario, Akira should distinguish the devilish from the divine. But how? They looked exactly alike and he could not distinguish one from the other solely by their appearances. He still had his last hope, however. The members of the divine tribe are truth-tellers, that is, they always tell the truth and those of the devilish tribe are liars, that is, they always tell a lie.

He asked some of them whether or not some are divine. They knew one another very much and always responded to him "faithfully" according to their individual natures (i.e., they always tell the truth or always a lie). He did not dare to ask any other forms of questions, since the legend says that a devilish member would curse a person forever when he did not like the question. He had another piece of useful informationf the legend tells the populations of both tribes. These numbers in the legend are trustworthy since everyone living on this island is immortal and none have ever been born at least these millennia.

You are a good computer programmer and so requested to help Akira by writing a program that classifies the inhabitants according to their answers to his inquiries.

Input

The input consists of multiple data sets, each in the following format :

n p1 p2
xl yl a1
x2 y2 a2
...
xi yi ai
...
xn yn an

The first line has three non-negative integers n, p1, and p2. n is the number of questions Akira asked. pl and p2 are the populations of the divine and devilish tribes, respectively, in the legend. Each of the following n lines has two integers xi, yi and one word ai. xi and yi are the identification numbers of inhabitants, each of which is between 1 and p1 + p2, inclusive. ai is either yes, if the inhabitant xi said that the inhabitant yi was a member of the divine tribe, or no, otherwise. Note that xi and yi can be the same number since "are you a member of the divine

tribe?" is a valid question. Note also that two lines may have the same x's and y's since Akira was very upset and might have asked the same question to the same one more than once.

You may assume that n is less than 1000 and that p1 and p2 are less than 300. A line with three zeros, i.e., 0 0 0, represents the end of the input. You can assume that each data set is consistent and no contradictory answers are included.

Output

For each data set, if it includes sufficient information to classify all the inhabitants, print the identification numbers of all the divine ones in ascending order, one in a line. In addition, following the output numbers, print end in a line. Otherwise, i.e., if a given data set does not include sufficient information to identify all the divine members, print no in a line.

Sample Input

```
2 1 1
1 2 no
2 1 no
3 2 1
1 1 yes
2 2 yes
3 3 yes
2 2 1
1 2 yes
2 3 no
5 4 3
1 2 yes
1 3 no
4 5 yes
5 6 yes
6 7 no
0 0 0
```

Sample Output

```
no
no
1
2
end
3
4
5
6
end
```

专题二：树状数组

POJ3321 Apple Tree

Time Limit: 2000MS Memory Limit: 65536K

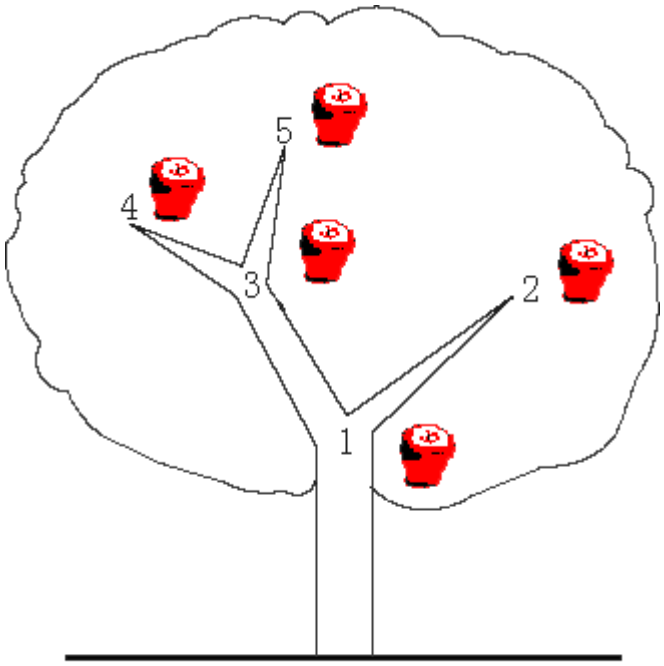
Total Submissions: 22482 Accepted: 6840

Description

There is an apple tree outside of kaka's house. Every autumn, a lot of apples will grow in the tree. Kaka likes apple very much, so he has been carefully nurturing the big apple tree.

The tree has *N* forks which are connected by branches. Kaka numbers the forks by 1 to *N* and the root is always numbered by 1. Apples will grow on the forks and two apple won't grow on the same fork. kaka wants to know how many apples are there in a sub-tree, for his study of the produce ability of the apple tree.

The trouble is that a new apple may grow on an empty fork some time and kaka may pick an apple from the tree for his dessert. Can you help kaka?



-

Input

The first line contains an integer *N* ($N \leq 100,000$) , which is the number of the forks in the tree.

The following *N* - 1 lines each contain two integers *u* and *v*, which means fork *u* and fork *v* are connected by a branch.

The next line contains an integer *M* ($M \leq 100,000$).

The following *M* lines each contain a message which is either

"**C *x***" which means the existence of the apple on fork *x* has been changed. i.e. if there is an apple on the fork, then Kaka pick it; otherwise a new apple has grown on the empty fork.

Or

"**Q *x***" which means an inquiry for the number of apples in the sub-tree above the fork *x*, including the apple (if exists) on the fork x

Note the tree is full of apples at the beginning

Output

For every inquiry, output the correspond answer per line.

Sample Input

```
3
1 2
1 3
3
Q 1
C 2
Q 1
```

Sample Output

```
3
2
```

POJ1990 MooFest

Time Limit: 1000MS **Memory Limit:** 30000K

Total Submissions: 6087 **Accepted:** 2688

Description

Every year, Farmer John's N (1 <= N <= 20,000) cows attend "MooFest",a social gathering of cows from around the world. MooFest involves a variety of events including haybale stacking, fence jumping, pin the tail on the farmer, and of course, mooing. When the cows all stand in line for a particular event, they moo so loudly that the roar is practically deafening. After participating in this event year after year, some of the cows have in fact lost a bit of their hearing.

Each cow i has an associated "hearing" threshold v(i) (in the range 1..20,000). If a cow moos to cow i, she must use a volume of at least v(i) times the distance between the two cows in order to be heard by cow i. If two cows i and j wish to converse, they must speak at a volume level equal to the distance between them times max(v(i),v(j)).

Suppose each of the N cows is standing in a straight line (each cow at some unique x coordinate in the range 1..20,000), and every pair of cows is carrying on a conversation using the smallest possible volume.

Compute the sum of all the volumes produced by all N(N-1)/2 pairs of mooing cows.

Input

* Line 1: A single integer, N

* Lines 2..N+1: Two integers: the volume threshold and x coordinate for a cow. Line 2 represents the first cow; line 3 represents the second cow; and so on. No two cows will stand at the same location.

Output

* Line 1: A single line with a single integer that is the sum of all the volumes of the conversing cows.

Sample Input

```
4
3 1
2 5
2 6
4 3
```

Sample Output

```
57
```

专题三：后缀数组

POJ3294 Life Forms

Time Limit: 5000MS Memory Limit: 65536K

Total Submissions: 11969 Accepted: 3327

Description

You may have wondered why most extraterrestrial life forms resemble humans, differing by superficial traits such as height, colour, wrinkles, ears, eyebrows and the like. A few bear no human resemblance; these typically have geometric or amorphous shapes like cubes, oil slicks or clouds of dust.

The answer is given in the 146th episode of *Star Trek - The Next Generation*, titled *The Chase*. It turns out that in the vast majority of the quadrant's life forms ended up with a large fragment of common DNA.

Given the DNA sequences of several life forms represented as strings of letters, you are to find the longest substring that is shared by more than half of them.

Input

Standard input contains several test cases. Each test case begins with $1 \le n \le 100$, the number of life forms. n lines follow; each contains a string of lower case letters representing the DNA sequence of a life form. Each DNA sequence contains at least one and not more than 1000 letters. A line containing 0 follows the last test case.

Output

For each test case, output the longest string or strings shared by more than half of the life forms. If there are many, output all of them in alphabetical order. If there is no solution with at least one letter, output "?". Leave an empty line between test cases.

Sample Input

```
3
abcdefg
bcdefgh
cdefghi
3
xxx
yyy
zzz
0
```

Sample Output

```
bcdefg
cdefgh

?
```

POJ3415 Common Substrings

Time Limit: 5000MS **Memory Limit:** 65536K

Total Submissions: 8818 **Accepted:** 2926

Description

A substring of a string T is defined as:

$$T(i, k)=T_iT_{i+1}...T_{i+k-1}, 1\leq i\leq i+k-1\leq |T|.$$

Given two strings A, B and one integer K, we define S, a set of triples (i, j, k):

$$S = \{(i, j, k) \mid k\geq K, A(i, k)=B(j, k)\}.$$

You are to give the value of $|S|$ for specific A, B and K.

Input

The input file contains several blocks of data. For each block, the first line contains one integer K, followed by two lines containing strings A and B, respectively. The input file is ended by K=0.

$1 \leq |A|, |B| \leq 10^5$

$1 \leq K \leq min\{|A|, |B|\}$

Characters of A and B are all Latin letters.

Output

For each case, output an integer $|S|$.

Sample Input

```
2
aababaa
abaabaa
1
xx
xx
0
```

Sample Output

```
22
5
```

专题四：LCA/RMQ

POJ1470 Closest Common Ancestors

Time Limit: 2000MS Memory Limit: 10000K

Total Submissions: 17803 Accepted: 5704

Description

Write a program that takes as input a rooted tree and a list of pairs of vertices. For each pair (u,v) the program determines the closest common ancestor of u and v in the tree. The closest common ancestor of two nodes u and v is the node w that is an ancestor of both u and v and has the greatest depth in the tree. A node can be its own ancestor (for example in Figure 1 the ancestors of node 2 are 2 and 5)

Input

The data set, which is read from a the std input, starts with the tree description, in the form:
nr_of_vertices

vertex:(nr_of_successors) successor1 successor2 ... successorn

...

where vertices are represented as integers from 1 to n (n <= 900). The tree description is followed by a list of pairs of vertices, in the form:

nr_of_pairs

(u v) (x y) ...

The input file contents several data sets (at least one).

Note that white-spaces (tabs, spaces and line breaks) can be used freely in the input.

Output

For each common ancestor the program prints the ancestor and the number of pair for which it is an ancestor. The results are printed on the standard output on separate lines, in to the ascending order of the vertices, in the format: ancestor:times

For example, for the following tree:

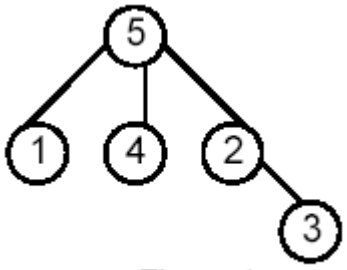


Figure 1

Sample Input

```
5
5:(3) 1 4 2
1:(0)
4:(0)
2:(1) 3
3:(0)
6
(1 5) (1 4) (4 2)
      (2 3)
(1 3) (4 3)
```

Sample Output

```
2:1
5:5
```

Hint

Huge input, scanf is recommende

POJ1986 Distance Queries

Time Limit: 2000MS Memory Limit: 30000K

Total Submissions: 11218 Accepted: 3931

Case Time Limit: 1000MS

Description

Farmer John's cows refused to run in his marathon since he chose a path much too long for their leisurely lifestyle. He therefore wants to find a path of a more reasonable length. The input to this problem consists of the same input as in "Navigation Nightmare",followed by a line containing a single integer K, followed by K "distance queries". Each distance query is a line of input containing two integers, giving the numbers of two farms between which FJ is interested in computing distance (measured in the length of the roads along the path between the two farms). Please answer FJ's distance queries as quickly as possible!

Input

* Lines 1..1+M: Same format as "Navigation Nightmare"

* Line 2+M: A single integer, K. 1 <= K <= 10,000

* Lines 3+M..2+M+K: Each line corresponds to a distance query and contains the indices of two farms.

Output

* Lines 1..K: For each distance query, output on a single line an integer giving the appropriate distance.

Sample Input

```
7 6
1 6 13 E
6 3 9 E
3 5 7 S
4 1 3 N
2 4 20 W
4 7 2 S
3
1 6
1 4
2 6
```

Sample Output

```
13
3
36
```

Hint

Farms 2 and 6 are 20+3+13=36 apart.

专题五：线段树

Count Color

Time Limit: 1000MS Memory Limit: 65536K

Total Submissions: 40416 Accepted: 12193

Description

Chosen Problem Solving and Program design as an optional course, you are required to solve all kinds of problems. Here, we get a new problem.

There is a very long board with length L centimeter, L is a positive integer, so we can evenly divide the board into L segments, and they are labeled by 1, 2, ... L from left to right, each is 1 centimeter long. Now we have to color the board - one segment with only one color. We can do following two operations on the board:

1. "C A B C" Color the board from segment A to segment B with color C.

2. "P A B" Output the number of different colors painted between segment A and segment B (including).

In our daily life, we have very few words to describe a color (red, green, blue, yellow…), so you may assume that the total number of different colors T is very small. To make it simple, we express the names of colors as color 1, color 2, ... color T. At the beginning, the board was painted in color 1. Now the rest of problem is left to your.

Input

First line of input contains L (1 <= L <= 100000), T (1 <= T <= 30) and O (1 <= O <= 100000). Here O denotes the number of operations. Following O lines, each contains "C A B C" or "P A B" (here A, B, C are integers, and A may be larger than B) as an operation defined previously.

Output

Ouput results of the output operation in order, each line contains a number.

Sample Input

```
2 2 4
C 1 1 2
P 1 2
C 2 2 2
P 1 2
```

Sample Output

```
2
1
```

City Horizon

Time Limit: 2000MS **Memory Limit:** 65536K

Total Submissions: 17413 **Accepted:** 4760

Description

Farmer John has taken his cows on a trip to the city! As the sun sets, the cows gaze at the city horizon and observe the beautiful silhouettes formed by the rectangular buildings.

The entire horizon is represented by a number line with N ($1 \le N \le 40{,}000$) buildings. Building i's silhouette has a base that spans locations A_i through B_i along the horizon ($1 \le A_i < B_i \le 1{,}000{,}000{,}000$) and has height H_i ($1 \le H_i \le 1{,}000{,}000{,}000$). Determine the area, in square units, of the aggregate silhouette formed by all N buildings.

Input

Line 1: A single integer: N

Lines 2..N+1: Input line i+1 describes building i with three space-separated integers: A_i, B_i, and H_i

Output

Line 1: The total area, in square units, of the silhouettes formed by all N buildings

Sample Input

```
4

2 5 1

9 10 4

6 8 2

4 6 3
```

Sample Output

```
16
```

Hint

The first building overlaps with the fourth building for an area of 1 square unit, so the total area is just 3*1 + 1*4 + 2*2 + 2*3 - 1 = 16.

专题 6：差分约束系统

Candies

Time Limit: 1500MS Memory Limit: 131072K

Total Submissions: 26812 Accepted: 7355

Description

During the kindergarten days, flymouse was the monitor of his class. Occasionally the head-teacher brought the kids of flymouse's class a large bag of candies and had flymouse distribute them. All the kids loved candies very much and often compared the numbers of candies they got with others. A kid A could had the idea that though it might be the case that another kid B was better than him in some aspect and therefore had a reason for deserving more candies than he did, he should never get a certain number of candies fewer than B did no matter how many candies he actually got, otherwise he would feel dissatisfied and go to the head-teacher to complain about flymouse's biased distribution.

Snoopy shared class with flymouse at that time. flymouse always compared the number of his candies with that of snoopy's. He wanted to make the difference between the numbers as large as possible while keeping every kid satisfied. Now he had just got another bag of candies from the head-teacher, what was the largest difference he could make out of it?

Input

The input contains a single test cases. The test cases starts with a line with two integers N and M not exceeding 30 000 and 150 000 respectively. N is the number of kids in the class and the kids were numbered 1 through N. snoopy and flymouse were always numbered 1 and N. Then follow M lines each holding three integers A, B and c in order, meaning that kid A believed that kid B should never get over c candies more than he did.

Output

Output one line with only the largest difference desired. The difference is guaranteed to be finite.

Sample Input

```
2 2
1 2 5
2 1 4
```

Sample Output

```
5
```

Hint

32-bit signed integer type is capable of doing all arithmetic.

Cashier Employment

Time Limit: 1000MS **Memory Limit:** 10000K

Total Submissions: 7472 **Accepted:** 2812

Description

A supermarket in Tehran is open 24 hours a day every day and needs a number of cashiers to fit its need. The supermarket manager has hired you to help him, solve his problem. The problem is that the supermarket needs different number of cashiers at different times of each day (for example, a few cashiers after midnight, and many in the afternoon) to provide good service to its customers, and he wants to hire the least number of cashiers for this job.

The manager has provided you with the least number of cashiers needed for every one-hour slot of the day. This data is given as R(0), R(1), ..., R(23): R(0) represents the least number of cashiers needed from midnight to 1:00 A.M., R(1) shows this number for duration of 1:00 A.M. to 2:00 A.M., and so on. Note that these numbers are the same every day. There are N qualified applicants for this job. Each applicant i works non-stop once each 24 hours in a shift of exactly 8 hours starting from a specified hour, say ti (0 <= ti <= 23), exactly from the start of the hour mentioned. That is, if the ith applicant is hired, he/she will work starting from ti o'clock sharp for 8 hours. Cashiers do not replace one another and work exactly as scheduled, and there are enough cash registers and counters for those who are hired.

You are to write a program to read the R(i) 's for i=0..23 and ti 's for i=1..N that are all, non-negative integer numbers and compute the least number of cashiers needed to be employed to meet the mentioned constraints. Note that there can be more cashiers than the least number needed for a specific slot.

Input

The first line of input is the number of test cases for this problem (at most 20). Each test case starts with 24 integer numbers representing the R(0), R(1), ..., R(23) in one line (R(i) can be at most 1000). Then there is N, number of applicants in another line (0 <= N <= 1000), after which come N lines each containing one ti (0 <= ti <= 23). There are no blank lines between test cases.

Output

For each test case, the output should be written in one line, which is the least number of cashiers needed.

If there is no solution for the test case, you should write No Solution for that case.

Sample Input

```
1
1 0 1 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1
5
```

```
0
23
22
1
10
```

Sample Output

```
1
```

关于《算法实践课程设计报告》的说明

《算法实践课程设计报告》为本课程结业和成绩评定的重要依据，必须认真撰写并按时提交纸质报告。

一、报告内容

除封面、目录外，报告正文至少包含以下 4 大部分：

1.课程设计任务的完成情况

所做题目总数、通过题目总数，附以 OJ 上本人提交的题目情况列表截图。

可以以时间序介绍一下这两周以来你的学习、做题进度和成效等。

2.课堂报告小组的工作情况

（1）说明你在小组中的角色和分工；

（2）汇报你在组内的工作情况，可以是收集材料、编写伪代码、制作 ppt 等，都可以介绍，不一定都有，主要介绍你负责的工作即可，技术的、非技术的都可以。

（3）**本部分的字数不得少于 400 字。**

3.专题报告

必须按照指导手册的要求确定你要写的专题。本部分描写的内容一般应包括：

（1）本专题的一般性描述，包括基本概念、相关原理、常用算法的介绍等。

（2）1~2 道题目的解题报告，应包括完整的问题描述、解题分析、算法设计、测试分析等，尤其是算法设计部分，应给出伪代码描述、算法的时间空间复杂度分析，最好能展示一下算法优化的方法和过程；测试分析部分可以以截图方式展示。

注：**本部分应以文字描述为主，辅以图表说明，不得粘贴程序源码（正文中可以包含少量关键代码+注释说明，完整的源程序可以作为附录附在报告最后，但不是必需的）。**

报告中必须要有关于实现过程中使用到的编程技术、技巧的描述，否则会被酌情扣分。

4. 总结：

（1）总结自己已完成的工作，做的好的、还没有保质保量完成的都可以写；

（2）心得体会；

（3）建议和意见。

二、纪律要求

报告要独立完成，严禁抄袭，尤其是解题报告部分要写出自己的东西，而不是网上随便抄抄。如果被发现只是复制网上现成的或抄别人的，将视为作弊处理，记 0 分。

三、页数要求

除封面、目录、附件之外，**正文部分不少于 8 页**，总体不超过 20 页。

四、提交的材料

（1）电子档材料：课程设计报告和打包的源程序

报告命名：**学号_姓名.doc**

源程序压缩包命名：**学号_姓名.zip**（只要源程序）

（2）**纸质材料**：课程设计报告（不需要源程序清单），单面打印、必须有封面、目录，装订成册

五、提交时间

最晚 12 月 25 日之前交。班上统一收齐后交东校区创新研究院 905.

（算法实践课设报告模板）

华中科技大学

2022

算法实践　课程设计报告

专　　业：　计算机科学与技术

班　　级：

学　　号：

姓　　名：

电　　话：

邮　　件：

完成日期：

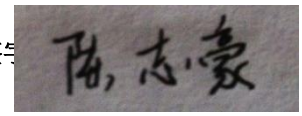
目　录

华 中 科 技 大 学 课 程 设 计 报 告

一、原创性声明

本人郑重声明本报告内容，是由作者本人独立完成的。有关观点、方法、数据和文献等的引用已在文中指出。除文中已注明引用的内容外，本报告不包含任何其他个人或集体已经公开发表的作品成果，不存在剽窃、抄袭行为。

特此声明！

作者签字： 

二、对课程设计的学术评语（教师填写）

三、对课程设计的评分（教师填写）

评分项目 （分值）	报告撰写 （50 分）	课设过程 （50 分）	最终评定 （100 分）
得分			

指导教师签字: _____