计算机学院 2015 级创新实验班

《算法实践》指导手册

（2017 年 11 月）

一、时间

2018 年 1 月 2 日~2018 年 1 月 13 日

进度计划：

1) 2017.11.15~2017.12.31：布置任务、学习与上机
2) 2018.1.2~2018.1.6：程序验收
3) 2018.1.7~2018.1.13：课堂报告、考核
4) 2018.1.14~：撰写报告、提交材料

二、内容

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

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；差分约束系统的性质；Bellman-Ford 算法；SPFA 算法。

五、上机练习

每专题完成基础题 4 道，课外扩展题可根据个人情况补充。题目见附件。

基础题共 24 题，统计各人完成情况，根据情况给上机分数。

七、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 4~5 人，上课前决定分组情况。

2）每组根据自己的专题，书写汇报 PPt，不少于 30 页。每组 5（4）人分工完成汇报 PPt， PPt 中要指出每一部分是由谁负责完成的：

- 1 人负责总体。要求 PPt 有较高的质量，配以图片、动画等效果展示所负责专题算法和例题的内容。PPt 整体质量影响小组得分。
- 1 人负责相关概念、性质、讨论等文字材料的整理。要求描述详细、准确、完整，用书面语表达，概念、定理、公式、图表书写规范。
- 1 人负责基本伪代码算法、算法框架等材料的整理。要求用规范的方式书写伪代码，有必要的文字、流程图、注释等说明，结构完整，清晰易懂。
- 2 人各负责一题实例材料的整理。要求给出：题目描述、解题分析、算法设计、计算流程说明、测试数据、程序代码等，有完整、准确的描述。

3）2018 年 1 月 7-13 日，每组推选代表报告，每组 1 小时。根据 PPt 制作质量和现场报告情况打分。

八、《算法实践课程报告》

书面报告分为 7 章，1~6 章每章一个专题。每章至少需包含以下内容：

1）对本专题所涉及问题的详细描述，包括相关概念、性质、方法等；

2）解决本专题所涉及问题的各种算法介绍，给出各算法的分析、设计和相关讨论，算法的伪代码描述等。

3）解题报告，就你本专题所完成的题目，给出详细、完整、准确的解题说明，包括：

① 问题描述

② 算法设计：设计分析、建模和算法描述（伪代码、流程图等）

③ 程序代码：源代码，加必要注释

④ 性能分析：时间空间复杂度分析，性质讨论等

⑤ 编程技术技巧：在实现过程中学习和使用到的编程技术、技巧等。**编程技术、技巧必须要有，否则酌情扣分**。

第 7 章为总结。总结工作，谈谈收获和建议。

九、成绩评定

总成绩由上机题完成情况分、课堂分组报告情况分、课程书面报告分三部分组成。其中，

上机题完成情况分（0~100）：基础题完成 20 道以上得 100 分，每少完成 1 道扣 10 分（并影响书面报告的得分）；课外题每完成一道加 5 分（最高加 20 分）。完成题目以 OJ 上 AC 为准，截屏展示。

注：**题目必须独立完成，发现拷贝现有代码或抄袭别人代码的一律视为没有通过，并根据情节严重进行纪律处分和罚分**。

课堂分组报告情况分（0~100）：包括 PPt 制作质量得分（50 分）和现场报告得分（50 分），先给小组总分，然后根据小组成员的贡献（每人负责部分完成的好坏）做适当调整。

书面报告分（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。

综合成绩评定：

综合成绩=上机题完成情况分***20% +** 课堂分组报告情况分***30% +**书面报告分***50%**

十、未尽事宜，另行解释

备注：自己在 poj.org 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
```

POJ1733 Parity game

Time Limit: 1000MS **Memory Limit:** 65536K

Total Submissions: 9860 **Accepted:** 3815

Description

Now and then you play the following game with your friend. Your friend writes down a sequence consisting of zeroes and ones. You choose a continuous subsequence (for example the subsequence from the third to the fifth digit inclusively) and ask him, whether this subsequence contains even or odd number of ones. Your friend answers your question and you can ask him about another subsequence and so on. Your task is to guess the entire sequence of numbers.

You suspect some of your friend's answers may not be correct and you want to convict him of falsehood. Thus you have decided to write a program to help you in this matter. The program will receive a series of your questions together with the answers you have received from your friend. The aim of this program is to find the first answer which is provably wrong, i.e. that there exists a sequence satisfying answers to all the previous questions, but no such sequence satisfies this answer.

Input

The first line of input contains one number, which is the length of the sequence of zeroes and ones. This length is less or equal to 1000000000. In the second line, there is one positive integer which is the number of questions asked and answers to them. The number of questions and answers is less or equal to 5000. The remaining lines specify questions and answers. Each line contains one question and the answer to this question: two integers (the position of the first and last digit in the chosen subsequence) and one word which is either `even' or `odd' (the answer, i.e. the parity of the number of ones in the chosen subsequence, where `even' means an even number of ones and `odd' means an odd number).

Output

There is only one line in output containing one integer X. Number X says that there exists a sequence of zeroes and ones satisfying first X parity conditions, but there exists none satisfying X+1 conditions. If there exists a sequence of zeroes and ones satisfying all the given conditions, then number X should be the number of all the questions asked.

Sample Input

```
10
5
1 2 even
3 4 odd
5 6 even
1 6 even
7 10 odd
```

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
```

POJ2912 Rochambeau

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

Total Submissions: 3693 **Accepted:** 1293

Description

N children are playing Rochambeau (scissors-rock-cloth) game with you. One of them is the judge. The rest children are divided into three groups (it is possible that some group is empty). You don't know who is the judge, or how the children are grouped. Then the children start playing Rochambeau game for *M* rounds. Each round two children are arbitrarily selected to play Rochambeau for one once, and you will be told the outcome while not knowing which gesture the children presented. It is known that the children in the same group would present the same gesture (hence, two children in the same group always get draw when playing) and different groups for different gestures. The judge would present gesture randomly each time, hence no one knows what gesture the judge would present. Can you guess who is the judge after after the game ends? If you can, after how many rounds can you find out the judge at the earliest?

Input

Input contains multiple test cases. Each test case starts with two integers *N* and *M* ($1 \le N \le 500$, $0 \le M \le 2{,}000$) in one line, which are the number of children and the number of rounds. Following are *M* lines, each line contains two integers in [0, *N*) separated by one symbol. The two integers are the IDs of the two children selected to play Rochambeau for this round. The symbol may be "=", ">" or "<", referring to a draw, that first child wins and that second child wins respectively.

Output

There is only one line for each test case. If the judge can be found, print the ID of the judge, and the least number of rounds after which the judge can be uniquely determined. If the judge can not be found, or the outcomes of the *M* rounds of game are inconsistent, print the corresponding message.

Sample Input

```
3 3
0<1
1<2
2<0
```

```
3 5
0<1
0>1
1<2
1>2
0<2
4 4
0<1
0>1
2<3
2>3
1 0
```

Sample Output

```
Can not determine
Player 1 can be determined to be the judge after 4 lines
Impossible
Player 0 can be determined to be the judge after 0 lines
```

专题二：树状数组

POJ3321 Apple Tree

Time Limit: 2000MS Memory Limit: 65536K

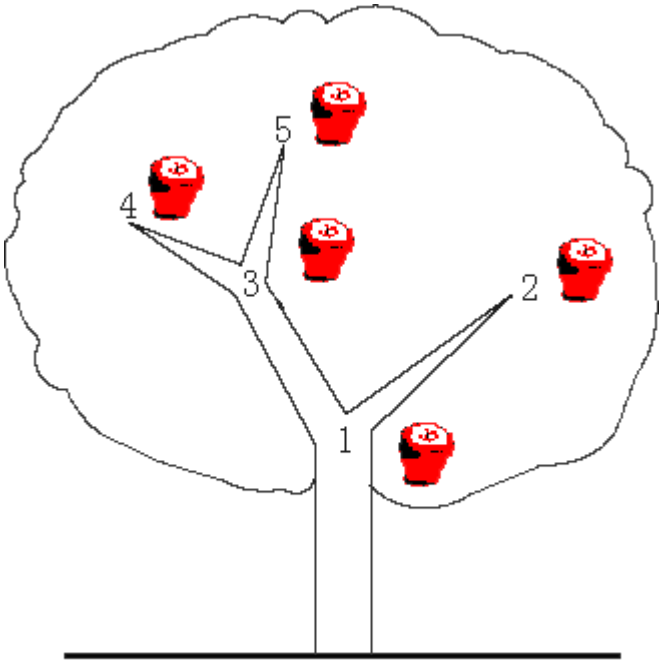
Total Submissions: 22482 Accepted: 6840

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
```

POJ 2892 Tunnel Warfare

Time Limit: 1000MS **Memory Limit:** 131072K

Total Submissions: 8712 **Accepted:** 3604

Description

During the War of Resistance Against Japan, tunnel warfare was carried out extensively in the vast areas of north China Plain. Generally speaking, villages connected by tunnels lay in a line. Except the two at the ends, every village was directly connected with two neighboring ones.

Frequently the invaders launched attack on some of the villages and destroyed the parts of tunnels in them. The Eighth Route Army commanders requested the latest connection state of the tunnels and villages. If some villages are severely isolated, restoration of connection must be done immediately!

Input

The first line of the input contains two positive integers n and m (n, $m \leq 50{,}000$) indicating the number of villages and events. Each of the next m lines describes an event.

There are three different events described in different format shown below:

1. `D x`: The x-th village was destroyed.
2. `Q x`: The Army commands requested the number of villages that x-th village was directly or indirectly connected with including itself.
3. `R`: The village destroyed last was rebuilt.

Output

Output the answer to each of the Army commanders' request in order on a separate line.

Sample Input

```
7 9
D 3
D 6
D 5
Q 4
Q 5
```

```
R
Q 4
R
Q 4
```

Sample Output

```
1
0
2
4
```

Hint

An illustration of the sample input:

```
       0000000

D 3    00X0000

D 6    00X00X0

D 5    00X0XX0

R      00X00X0

R      00X0000
```

poj2481 Cows

Time Limit: 3000MS **Memory Limit:** 65536K

Total Submissions: 20257 **Accepted:** 6902

Description

Farmer John's cows have discovered that the clover growing along the ridge of the hill (which we can think of as a one-dimensional number line) in his field is particularly good.

Farmer John has N cows (we number the cows from 1 to N). Each of Farmer John's N cows has a range of clover that she particularly likes (these ranges might overlap). The ranges are defined by a closed interval [S,E].

But some cows are strong and some are weak. Given two cows: cow_i and cow_j, their favourite clover range is [Si, Ei] and [Sj, Ej]. If Si <= Sj and Ej <= Ei and Ei - Si > Ej - Sj, we say that cow_i is stronger than cow_j.

For each cow, how many cows are stronger than her? Farmer John needs your help!

Input

The input contains multiple test cases.
For each test case, the first line is an integer N ($1 <= N <= 10^5$), which is the number of cows. Then come N lines, the i-th of which contains two integers: S and E($0 <= S < E <= 10^5$) specifying the start end location respectively of a range preferred by some cow. Locations are given as distance from the start of the ridge.

The end of the input contains a single 0.

Output

For each test case, output one line containing n space-separated integers, the i-th of which specifying the number of cows that are stronger than cow_i.

Sample Input

```
3
1 2
0 3
3 4
```

```
0
```

Sample Output

```
1 0 0
```

Hint

Huge input and output,scanf and printf is recommended.

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:

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

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

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

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.

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

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

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
```

POJ2406 Power Strings

Time Limit: 3000MS **Memory Limit:** 65536K

Total Submissions: 52580 **Accepted:** 21895

Description

Given two strings a and b we define a*b to be their concatenation. For example, if a = "abc" and b = "def" then a*b = "abcdef". If we think of concatenation as multiplication, exponentiation by a non-negative integer is defined in the normal way: a^0 = "" (the empty string) and a^(n+1) = a*(a^n).

Input

Each test case is a line of input representing s, a string of printable characters. The length of s will be at least 1 and will not exceed 1 million characters. A line containing a period follows the last test case.

Output

For each s you should print the largest n such that s = a^n for some string a.

Sample Input

```
abcd
aaaa
ababab
.
```

Sample Output

```
1
4
3
```

Hint

This problem has huge input, use scanf instead of cin to avoid time limit exceed.

POJ 3693 Maximum repetition substring

Time Limit:	1000MS	Memory Limit:	65536K
Total Submissions:	10842	Accepted:	3341

Description

The repetition number of a string is defined as the maximum number *R* such that the string can be partitioned into *R* same consecutive substrings. For example, the repetition number of "ababab" is 3 and "ababa" is 1.

Given a string containing lowercase letters, you are to find a substring of it with maximum repetition number.

Input

The input consists of multiple test cases. Each test case contains exactly one line, which gives a non-empty string consisting of lowercase letters. The length of the string will not be greater than 100,000.

The last test case is followed by a line containing a '#'.

Output

For each test case, print a line containing the test case number(beginning with 1) followed by the substring of maximum repetition number. If there are multiple substrings of maximum repetition number, print the lexicographically smallest one.

Sample Input

```
ccababababc
daabbccaa
#
```

Sample Output

```
Case 1: ababab
Case 2: aa
```

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:

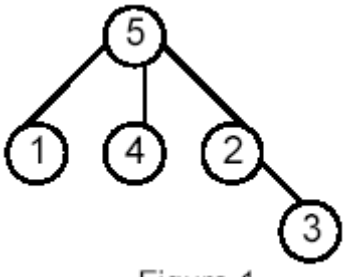


Figure 1

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.

POJ2763 Housewife Wind

Time Limit: 4000MS **Memory Limit:** 65536K

Total Submissions: 12743 **Accepted:** 3529

Description

After their royal wedding, Jiajia and Wind hid away in XX Village, to enjoy their ordinary happy life. People in XX Village lived in beautiful huts. There are some pairs of huts connected by bidirectional roads. We say that huts in the same pair directly connected. XX Village is so special that we can reach any other huts starting from an arbitrary hut. If each road cannot be walked along twice, then the route between every pair is unique.

Since Jiajia earned enough money, Wind became a housewife. Their children loved to go to other kids, then make a simple call to Wind: 'Mummy, take me home!'

At different times, the time needed to walk along a road may be different. For example, Wind takes 5 minutes on a road normally, but may take 10 minutes if there is a lovely little dog to play with, or take 3 minutes if there is some unknown strange smell surrounding the road.

Wind loves her children, so she would like to tell her children the exact time she will spend on the roads. Can you help her?

Input

The first line contains three integers n, q, s. There are n huts in XX Village, q messages to process, and Wind is currently in hut s. n < 100001 , q < 100001.

The following n-1 lines each contains three integers a, b and w. That means there is a road directly connecting hut a and b, time required is w. 1<=w<= 10000.

The following q lines each is one of the following two types:

Message A: 0 u
A kid in hut u calls Wind. She should go to hut u from her current position.
Message B: 1 i w
The time required for i-th road is changed to w. Note that the time change will not happen when Wind is on her way. The changed can only happen when Wind is staying somewhere, waiting to take the next kid.

Output

For each message A, print an integer X, the time required to take the next child.

Sample Input

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

Sample Output

```
1
3
```

POJ3728 The merchant

Time Limit: 3000MS **Memory Limit:** 65536K
Total Submissions: 5274 **Accepted:** 1815

Description

There are *N* cities in a country, and there is one and only one simple path between each pair of cities. A merchant has chosen some paths and wants to earn as much money as possible in each path. When he move along a path, he can choose one city to buy some goods and sell them in a city after it. The goods in all cities are the same but the prices are different. Now your task is to calculate the maximum possible profit on each path.

Input

The first line contains *N*, the number of cities.
Each of the next *N* lines contains w_i the goods' price in each city.
Each of the next *N-1* lines contains labels of two cities, describing a road between the two cities.
The next line contains *Q*, the number of paths.
Each of the next *Q* lines contains labels of two cities, describing a path. The cities are numbered from 1 to *N*.

$1 \le N, w_i, Q \le 50000$

Output

The output contains *Q* lines, each contains the maximum profit of the corresponding path. If no positive profit can be earned, output 0 instead.

Sample Input

```
4
1
5
3
2
1 3
3 2
3 4
9
```

```
1 2
1 3
1 4
2 3
2 1
2 4
3 1
3 2
3 4
```

Sample Output

```
4
2
2
0
0
0
0
2
0
```

专题五：线段树

POJ2777 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
```

POJ3277 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.

POJ2761 Feed the dogs

Time Limit: 6000MS **Memory Limit:** 65536K

Total Submissions: 21495 **Accepted:** 6817

Description

Wind loves pretty dogs very much, and she has n pet dogs. So Jiajia has to feed the dogs every day for Wind. Jiajia loves Wind, but not the dogs, so Jiajia use a special way to feed the dogs. At lunchtime, the dogs will stand on one line, numbered from 1 to n, the leftmost one is 1, the second one is 2, and so on. In each feeding, Jiajia choose an inteval[i,j], select the k-th pretty dog to feed. Of course Jiajia has his own way of deciding the pretty value of each dog. It should be noted that Jiajia do not want to feed any position too much, because it may cause some death of dogs. If so, Wind will be angry and the aftereffect will be serious. Hence any feeding inteval will not contain another completely, though the intervals may intersect with each other.

Your task is to help Jiajia calculate which dog ate the food after each feeding.

Input

The first line contains n and m, indicates the number of dogs and the number of feedings.

The second line contains n integers, describe the pretty value of each dog from left to right. You should notice that the dog with lower pretty value is prettier.

Each of following m lines contain three integer i,j,k, it means that Jiajia feed the k-th pretty dog in this feeding.

You can assume that n<100001 and m<50001.

Output

Output file has m lines. The i-th line should contain the pretty value of the dog who got the food in the i-th feeding.

Sample Input

```
7 2
1 5 2 6 3 7 4
1 5 3
```

```
2 7 1
```

Sample Output

```
3
2
```

POJ3667 Hotel

Time Limit: 3000MS **Memory Limit:** 65536K

Total Submissions: 18491 **Accepted:** 8049

Description

The cows are journeying north to Thunder Bay in Canada to gain cultural enrichment and enjoy a vacation on the sunny shores of Lake Superior. Bessie, ever the competent travel agent, has named the Bullmoose Hotel on famed Cumberland Street as their vacation residence. This immense hotel has N ($1 \le N \le 50{,}000$) rooms all located on the same side of an extremely long hallway (all the better to see the lake, of course).

The cows and other visitors arrive in groups of size D_i ($1 \le D_i \le$ N) and approach the front desk to check in. Each group i requests a set of D_i contiguous rooms from Canmuu, the moose staffing the counter. He assigns them some set of consecutive room numbers $r..r+D_i-1$ if they are available or, if no contiguous set of rooms is available, politely suggests alternate lodging. Canmuu always chooses the value of r to be the smallest possible.

Visitors also depart the hotel from groups of contiguous rooms. Checkout i has the parameters X_i and D_i which specify the vacating of rooms X_i ..X_i +D_i-1 ($1 \le X_i \le N-D_i+1$). Some (or all) of those rooms might be empty before the checkout.

Your job is to assist Canmuu by processing M ($1 \le M < 50{,}000$) checkin/checkout requests. The hotel is initially unoccupied.

Input

* Line 1: Two space-separated integers: N and M
* Lines 2..M+1: Line i+1 contains request expressed as one of two possible formats: (a) Two space separated integers representing a check-in request: 1 and D_i (b) Three space-separated integers representing a check-out: 2, X_i, and D_i

Output

* Lines 1.....: For each check-in request, output a single line with a single integer r, the first room in the contiguous sequence of rooms to be occupied. If the request cannot be satisfied, output 0.

Sample Input

```
10 6
1 3
1 3
1 3
1 3
2 5 5
1 6
```

Sample Output

```
1
4
7
0
5
```

专题 6：差分约束系统

POJ3158 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.

POJ1275 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 0 1
5
0
23
22
1
10
```

Sample Output

```
1
```

POJ1201 Intervals

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

Total Submissions: 27963 **Accepted:** 10773

Description

You are given n closed, integer intervals [ai, bi] and n integers c1, ..., cn.
Write a program that:
reads the number of intervals, their end points and integers c1, ..., cn from the standard input,
computes the minimal size of a set Z of integers which has at least ci common elements with interval [ai, bi], for each i=1,2,...,n,
writes the answer to the standard output.

Input

The first line of the input contains an integer n (1 <= n <= 50000) -- the number of intervals. The following n lines describe the intervals. The (i+1)-th line of the input contains three integers ai, bi and ci separated by single spaces and such that 0 <= ai <= bi <= 50000 and 1 <= ci <= bi - ai+1.

Output

The output contains exactly one integer equal to the minimal size of set Z sharing at least ci elements with interval [ai, bi], for each i=1,2,...,n.

Sample Input

```
5
3 7 3
8 10 3
6 8 1
1 3 1
10 11 1
```

Sample Output

```
6
```

POJ3169 Layout

Time Limit: 1000MS **Memory Limit:** 65536K

Total Submissions: 12625 **Accepted:** 6069

Description

Like everyone else, cows like to stand close to their friends when queuing for feed. FJ has N (2 <= N <= 1,000) cows numbered 1..N standing along a straight line waiting for feed. The cows are standing in the same order as they are numbered, and since they can be rather pushy, it is possible that two or more cows can line up at exactly the same location (that is, if we think of each cow as being located at some coordinate on a number line, then it is possible for two or more cows to share the same coordinate).

Some cows like each other and want to be within a certain distance of each other in line. Some really dislike each other and want to be separated by at least a certain distance. A list of ML (1 <= ML <= 10,000) constraints describes which cows like each other and the maximum distance by which they may be separated; a subsequent list of MD constraints (1 <= MD <= 10,000) tells which cows dislike each other and the minimum distance by which they must be separated.

Your job is to compute, if possible, the maximum possible distance between cow 1 and cow N that satisfies the distance constraints.

Input

Line 1: Three space-separated integers: N, ML, and MD.

Lines 2..ML+1: Each line contains three space-separated positive integers: A, B, and D, with 1 <= A < B <= N. Cows A and B must be at most D (1 <= D <= 1,000,000) apart.

Lines ML+2..ML+MD+1: Each line contains three space-separated positive integers: A, B, and D, with 1 <= A < B <= N. Cows A and B must be at least D (1 <= D <= 1,000,000) apart.

Output

Line 1: A single integer. If no line-up is possible, output -1. If cows 1 and N can be arbitrarily far apart, output -2. Otherwise output the greatest possible distance between cows 1 and N.

Sample Input

```
4 2 1
1 3 10
2 4 20
2 3 3
```

Sample Output

```
27
```