South African Computer Olympiad
Training Camp 1, 2006
Day 1

Overview

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Problem	**bunny**	**gap**	**logic**
Source	bunny.java bunny.c bunny.cpp bunny.pas	gap.java gap.c gap.cpp gap.pas	logic.java logic.c logic.cpp logic.pas
Input file	bunny.in	gap.in	logic.in
Output file	bunny.out	gap.out	logic.out
Time limit	5 seconds	1 second	5 seconds
Number of tests	10	10	10
Points per test	10	10	10
Total points	**100**	**100**	**100**

The maximum total score is 300 points.

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Killer Rabbits

Author

Timothy Stranex

Introduction

King Arthur and his knights have to come to the entrance of the cave of Caerbannog, the last resting place of the most Holy Grail. Unfortunately, the entrance is guarded by a creature so foul, so cruel that no man has yet fought with it and lived! In its years of guarding the cave, this foul killer rabbit has spawned itself an army of little killer rabbits just as terrible as itself. Luckily, Brother Maynard carries with him the Holy Hand Grenade of Antioch which Arthur hopes will kill a sufficient number of rabbits that he won't be noticed sneaking into the cave.

Task

The N killer rabbits are swarming out the mouth of the cave in single file toward Arthur but with varying distances between them. Arthur's Holy Hand Grenade will kill all the rabbits within R metres from its point of impact; that is, if the grenade explodes x metres in front of Arthur, it will kill a rabbit d metres in front of Arthur if $|x - d| \leq R$. Arthur can only aim the hand grenade so that it lands on a rabbit; he can't throw it between two rabbits. You must choose the rabbit that Arthur should aim for so that as many rabbits are killed in the blast as possible.

Example

Suppose the hand grenade has a blast radius of $R = 3$ metres and there are $N = 5$ rabbits with distances 5, 10, 1, 7 and 14 metres respectively in front of Arthur. If Arthur aims for the fourth rabbit, the blast will kill the rabbits 1, 4 and 2. This is the greatest number of rabbits he can kill with one grenade.

Input (bunny.in)

The first line of the input contains two space-separated integers, N and R. The next N lines each contain a single integer x_i, the distance in front of Arthur of the ith rabbit.

Sample input

```
5 3
5
10
1
7
14
```

Output (bunny.out)

The first line of the output contains a single integer, the number of the rabbit that Arthur should target with the hand grenade to kill as many rabbits as possible. There may be several correct answers, you only need to output one of them.

Sample output

```
4
```

Constraints

- $1 \leq N \leq 1000000 = 10^6$
- $0 \leq R \leq 2^{30}$
- $1 \leq x_i \leq 2^{30}$

50% constraints

- $1 \leq N \leq 5000$

Time limit

5 seconds.

Scoring

A correct answer scores 100%, while an incorrect one scores 0%.

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Gap

Author

Bruce Merry

Introduction

On returning to Camelot, the Knights of the Round Table are once again forced to pass through the woods guarded by the knights who say... the knight who until recently said "Ni!". They do not want to have to find another shrubbery, so they want to try to cross the woods undetected. Help them by finding the safest route through the forest.

Task

The woods have a number of points where they can be entered by road, and other points where they can be exited on the other side. The knights have a map showing the road network inside the forest. They have also worked out a risk for using each road, based on its visibility.

Let us introduce some terminology: a junction is either an entry point, an exit point, or a road intersection within the woods. A path is a direct road connection between two junctions. A route is a connected sequence of paths that leads from an entry point to an exit point. Each path has an associated risk factor, and the risk of a route is the sum of the risks of each path along the route.

Example

Consider the conceptual diagram of the wood shown in figure 1. The double-framed junctions are entry points, the square-framed junctions are exit points and the other round-framed junctions are internal intersections. The lines indicate paths, and the numbers indicate associated risk. The safest route is to go from 2 to 4 to 6 — note that this is safer than going directly from 2 to 6.

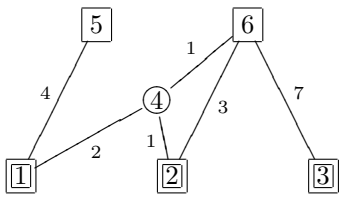

Figure 1: The conceptual layout of the woods.

Input (gap.in)

The first line of the input contains the integers N, I, O and P separated by single spaces. N is the number of junctions, I is the number of entry points, O the number of exit points and P the number of paths. The entry points are numbered from 1 to I, the interior points from $I+1$ to $N-O$ and the exit points from $N-O+1$ to N.

The following P lines each contain three integers A, B and R separated by single spaces. This indicates that there is a path between A and B (which can be travelled in either direction), with risk R. There will be no path that connects a junction to itself, but there may be multiple paths between two junctions.

Sample input

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

Output (gap.out)

The output consists of three integers X, Y and T, separated by spaces. This indicates that the knights should enter at point X and leave at point Y, and that their minimum total risk is T. If there is a more than one optimal pair of entry and exit points, you may output any one of them.

Sample output

```
2 6 2
```

Constraints

- $2 \leq I + O \leq N \leq 50000$
- $1 \leq P \leq 50000$
- $1 \leq A, B \leq N$ for each path
- $0 \leq R \leq 10000$ for each path

There is guaranteed to be a route through the woods.

50% constraints

- $1 \leq N \leq 500$

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Time limit

1 second.

Scoring

If your formatting is incorrect or any of your values are out of range, you will immediately score 0. Otherwise, 50% is awarded for the correct value of T and 50% is awarded for a correct (X, Y) pair (i.e. one for which X is an entry point, Y is an exit point and an optimal route exists between X and Y).

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Logic

Author

Shen Tian

Introduction

Fred's factory workers are all from overseas countries where English isn't widely spoken, and they get quite confused when trying to understand some of Fred's instructions. What really confuses them is the number of synonyms that there are for each word.

Task

You must write a program that will determine if given pairs of words are synonyms according to a given list of known synonyms. The following rules hold:

- Any word is a synonym of itself
- If A is a synonym of B, then B is a synonym of A
- If A is a synonym of B, and B is a synonym of C, then A is a synonym of C.

Example

Given the following list of synonyms:

- "car" is a synonym of "auto"
- "vehicle" is a synonym of "car"
- "dwelling" is a synonym of "home"

and the following queries:

- Is "auto" a synonym of "vehicle"?
- Is "home" a synonym of "car"?

then the answers would be:

- Yes
- No

Input (logic.in)

The first line of input will contain two space-separated integers, N and M. N is the number of known synonym pairs, and M is the number of queries. The next N lines will each contain two space-separated words, which are the known synonym pairs. The next M lines will each contain two space-separated words, which are the queries.

Sample input

```
3 2
car auto
vehicle car
dwelling home
auto vehicle
home car
```

Output (logic.out)

Your output should consist of M lines, each of which must contain either the word "yes" or the word "no".

Sample output

```
yes
no
```

Constraints

- $1 \leq N \leq 10000$
- $1 \leq M \leq 10$
- Each word consists of only lowercase letters, and is at most 10 letters long.

Time limit

5 seconds.

Scoring

Your score is obtained as follows: 1 point per right answer, -1 point per wrong answer. Your score is then calculated as $100\frac{\max(points,0)}{M}\%$.