 [1]

Problem 26: Mad Vet

Source filename:	`madvet.(cpp|java)`
Input filename:	`madvet.in`
Output filename:	`madvet.out`

A mad veterinarian has developed several machines that can transform an animal into one or more animals and back again. The challenge is then to determine if it is possible to change one collection of animals into another by applying the machines in some order (forward or reverse). For example, if a description of the three machines is:

Machine A turns one ant into one beaver.
Machine B turns one beaver into one ant, one beaver and one cougar.
Machine C turns one cougar into one ant and one beaver.

Sample Question 1:
Can the mad veterinarian convert a beaver and a cougar into 3 ants?

Yes! First, use machine C to convert the cougar into one ant and one beaver, giving us one ant and two beavers. Second, use machine A in reverse to convert one of the beavers into an ant – now, we have two ants and one beaver. Third, use machine A in reverse again to convert the last beaver into an ant. We now have 3 ants.

Symbolically: Let a=ant, b=beaver, c=cougar, then

{b,c} [C] → {a,2b} [A-reversed] → {2a,b} [A-reversed] → {3a}

Sample Question 2:
Can he convert one ant into 2 ants? NO!

Notice that the machines have the following properties:

1. In forward mode, each machine converts one animal of one of the 3 given species into a finite, non-empty collection of animals from among the 3 given species.
2. Each machine can operate in reverse. For example, if machine B above is run in reverse, it takes 1 ant, 1 beaver and 1 cougar as input and spits out one beaver.
3. There is one machine for each of the 3 species: ant, beaver & cougar.

Write a program to find the shortest solution (if any) to several Mad Vet challenges.

Input File (`madvet.in`)

The first line of input contains a single integer, P ($1 \leq P \leq 100$), which is the number of data sets that follow. Each data set consists of several lines of input.

The first line of each data set consists of two integers separated by a single space. The first integer is the data set number. The second integer is the number, N ($1 \leq N < 10$), of questions in this data set.

The next three input lines contain the descriptions of machines **A**, **B** and **C**, in that order. Each machine description line contains three single digit integers separated by spaces that give the number animals of type **a**, **b** and **c** that are output for one input animal when the machine is run in the forward mode. In forward mode, machine **A** accepts one ant (**a**) as input; machine **B** accepts one beaver (**b**) and machine **C** accepts one cougar (**c**).

The next N lines give a description of a question associated with the given 3 machine descriptions. Each contains seven positive single-digit integers separated by single spaces; the question number, the three starting animal counts for animals **a**, **b** and **c** followed by the three desired ending animal counts for animals **a**, **b** and **c**.

[1] Graphic courtesy of the Mathematical Association of America

For example, the 3 machines and 2 questions described on page 1 would be represented by these lines:

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

Output File (`madvet.out`)

For each input data set, there are multiple lines of output. The first line of output for each data set contains the data set number, a space and the number of questions (*N*). For each question, there is one line of output which consists of the question number followed by a space, followed by **either** (1) the shortest number of machine steps needed to achieve the desired number of animals **or** (2) the text: "**NO SOLUTION**" (without the quotes) if there is no solution that requires fewer than 30 machine steps.

Sample Input File

```
2
1 2
0 1 0
1 1 1
1 1 0
1 0 1 1 3 0 0
2 1 0 0 2 0 0
2 2
0 3 4
0 0 5
0 0 3
1 2 0 0 0 0 5
2 2 0 0 0 0 4
```

Sample Output File

```
1 2
1 3
2 NO SOLUTION
2 2
1 NO SOLUTION
2 25
```