

# TRANSLATORS

## Introduction

Management of the Beetle Military Intelligence Unit is a demanding task. Usually the Command places purposeful and direct operations – in particular the ones including the use of force – above any covert operations. The Colonel knew his superiors were only looking for the slightest excuse to disband the Intelligence Unit and transfer the whole personnel to the front-line. The only thing he could do in this difficult situation was not providing such an excuse to anybody.

The Beetle Intelligence Unit's lack of popularity impacts its budget in a significant way. The Unit does not have permanent funding and they receive any funds only in the event of providing important information intercepted from hostile countries.

The Colonel's squad are all real champions, true professionals, so obtaining confidential documents or useful recordings is not a problem at all. The obstacles arise when interesting bits must be extracted from the gathered information. In such a case it becomes necessary to translate the contents into one of the native beetlejumper dialects. Command of foreign languages is undesirable and downright resented in the Beetle Army – any recruit having a knack for languages is immediately suspected of being a spy – therefore the Intelligence Unit must avail themselves of the professional translation services. And that's a considerable financial burden...

## Problem

The Colonel knows exactly when to expect new documents for analysis to arrive and how voluminous they are going to be (i.e., how much time is needed to translate them from one language to another). He is also aware of the relevance of such materials – which translates directly into the squad's profit – and knows until when they are going to be usable from the Command's point of view.

The Colonel has a full range of translation services at his disposal: he knows which languages are on offer at any individual translation agency and what the costs are for hiring its services for a specified time.

In order to translate a text from one language into another one can first translate it into bridge language. For example, wanting to translate the data from language 1 into language 3, one can first have the data translated at one agency into language 2 within time  $t$  and then – again within time  $t$  – have it translated from language 2 into language 3. The whole process will take at least  $2 \cdot t$  (at least, because one does not have to start the next translation right after the preceding one).

The hired translation agency can translate any number of materials at the same time. Each agency can be hired more than once. In order to translate a given document an agency must be hired for the whole period needed for its translation. In order to complete a single step of a translation an agency must be hired without any breaks in its availability.

Help the Colonel decide which materials he should take notice of in order to boost the budget of his unit.

## Input data

Test sets are given in `trans*.in` files.

The first line of the test set includes one integer  $T$  denoting the number of tests. The following lines include descriptions of tests.

The first line of the description of each test includes two natural numbers  $N$  and  $M$  denoting respectively: the number of available translation agency services and the number of materials that (to the Colonel's knowledge) will soon be obtained by the Intelligence Unit.

The following  $2 \cdot N$  lines include descriptions of translation services on offer. Each offer comprises two lines. The first one includes four integers  $A^{id}$ ,  $P$ ,  $T_c$ ,  $L$ , denoting respectively: the agency number (identification), the price of hiring the agency, the hiring period and the number of languages on offer at the agency. The second line of the translation services description includes  $L$  various natural numbers  $l_i$  that constitute identifiers of languages on offer at the agency. The offer of any agency should be understood in such a way that the Colonel, spending  $P$  money obtains the service of translation from language  $l_i$  into any other language from the list of languages offered by the agency for the period  $T_c$ .

The following  $M$  lines include descriptions of materials that will fall into the hands of the Intelligence Unit. A single batch of materials is described by seven numbers in one line:  $D^{id}$ ,  $t_b$ ,  $t_e$ ,  $l_b$ ,  $l_e$ ,  $t$ ,  $V$ . They mean that at the moment  $t_b$  the Intelligence Unit will obtain data in language  $l_b$  which, in order to be useful, must be translated into language  $l_e$ . The material was given an identifier  $D^{id}$ , and for an effective translation of this batch of documents the Intelligence Unit will receive an award in the amount of  $V$ . However, translation cannot take any length of time – the documents become obsolete at the moment  $t_e$ . Direct translation of the material from one language into another takes always  $t$  time units.

The appearing materials are given in chronological order, i.e., according to non-decreasing  $t_b$  values.

$$\begin{aligned} 1 &\leq T \leq 10 \\ 1 &\leq N \leq 1000 \\ 1 &\leq M \leq 10^4 \\ 1 &\leq P \leq 10^6 \\ 1 &\leq T_c \leq 10^9 \\ 1 &\leq L \leq 1000 \\ 1 &\leq l_i \leq 1000 \\ 1 &\leq t_b < t_e \leq 10^9 \\ 1 &\leq l_b, l_e \leq 1000 \\ l_b &\neq l_e \\ 1 &\leq t \leq 10^9 \\ 1 &\leq V \leq 10^6 \\ 1 &\leq A^{id} \leq N \\ 1 &\leq D^{id} \leq M \end{aligned}$$

## Output data

The first line of the output file should include one integer  $N_r$  ( $1 \leq N_r \leq 10^5$ ), denoting the number of cases translations agencies are hired by the Intelligence Unit.

Each of the following  $N_r$  lines should consist of two numbers:  $A^{id}$ ,  $t_{start}$ . They mean that an agency with identifier  $A^{id}$  is hired at the moment  $t_{start}$ .

The following line should include one integer  $M_r$  ( $1 \leq M_r \leq M$ ) denoting the number of translations the Intelligence Unit receives on time. Then provide descriptions of those translations.

Description of a received translation consists of two lines. The first line should include two numbers  $D^{id}$  and  $K$  ( $1 \leq K \leq 100$ ) that denote respectively: the identifier of translated materials and the number of consecutive translations leading to the target language. The second line of the description should include  $3 \cdot K$  numbers. The numbers should mean successively in threes ( $t_i^{tmp}$ ,  $A_i^{id}$ ,  $l_i^{tmp}$ ) that at the moment  $t_i^{tmp}$  the agency  $A_i^{id}$  starts translating the material already available in language  $l_{i-1}^{tmp}$  into language  $l_i^{tmp}$  (where  $i \in \{1, 2 \dots K\}$  and  $l_0^{tmp} = l_b$ ).

The last output line for each test should include the sum of money earned by the Intelligence Unit ( $S_u$ ) calculated as a sum of awards received for providing the desired translations on time decreased by the amount spent on hiring the services of translation agencies.

## Example

For input data:

```
1
4 7
1 100 10 3
33 31 42
2 200 15 5
31 18 42 77 92
3 40 19 2
77 15
4 18000 5000 2
15 24
```

```
1 21 71 33 77 25 1000
2 48 60 31 92 10 300
3 50 99 77 29 40 10000
4 50 1120 92 24 17 12000
5 1050 1100 33 42 60 7000
6 1100 2000 15 24 200 6550
7 1200 1250 18 77 15 500
```

One of possible solutions is:

```
8
1 21
1 31
1 41
2 46
2 58
3 70
4 1100
2 1200
5
1 2
21 1 42 46 2 77
2 1
48 2 92
4 3
50 2 77 70 3 15 1100 4 24
6 1
1100 4 24
7 1
1200 2 77
1410
```

## Example clarification

The first translation agency was hired three times within the following intervals:  $\langle 21, 30 \rangle$ ,  $\langle 31, 40 \rangle$  and  $\langle 41, 50 \rangle$  (according to the input file each hire of the translation agency number 1 allows to use its services for 10 time units). For the Colonel its summary availability will therefore apply to the interval  $\langle 21, 50 \rangle$ . By the same token, hiring the agency number 2 pertains to the intervals:  $\langle 46, 60 \rangle$ ,  $\langle 58, 72 \rangle$  and  $\langle 1200, 1214 \rangle$ . Agencies number 3 and 4 were hired only once. Total costs incurred for hiring all the agencies amount to:  $3 \cdot 100 + 3 \cdot 200 + 40 + 18000 = 18940$ .

Spending this sum of money allowed to obtain the following periods of availability of each agency hired in the example:

- Agency number 1:  $\langle 21, 50 \rangle$ ,
- Agency number 2:  $\langle 46, 72 \rangle \cup \langle 1200, 1214 \rangle$ ,
- Agency number 3:  $\langle 70, 88 \rangle$ ,
- Agency number 4:  $\langle 1100, 6099 \rangle$ .

The agencies will translate documents with identifiers: 1, 2, 4, 6 and 7. The first of the documents will be prepared in two steps. Agency number 1 will prepare translation from language 33 to language 42 within the interval  $\langle 21, 45 \rangle$ . Further work on the text will be possible from the subsequent point of time (46). And thus translation from language 42 into language 77 (target language) will be prepared by agency number 2 within the interval  $\langle 46, 70 \rangle$ . The finished translation will be delivered to the Colonel at the moment 70, namely at exactly last possible moment (the document becomes obsolete at the moment 71).

The remaining documents will be prepared in a similar manner. It's worth noting that consecutive steps of translation of documents with identifier 4 will be prepared within intervals:  $\langle 50, 66 \rangle$ ,  $\langle 70, 86 \rangle$  i  $\langle 1100, 1116 \rangle$ , meaning that there will be breaks in translating the material between those steps.

The document with identifier 3 cannot be translated, because none of the agencies employs a person speaking language 29. Translation of materials with identifier 5 is also impossible – time needed for their preparation, even in just one step, would exceed their usability deadline for the Command.

The prepared set of five translations will generate the revenue for the Intelligence Unit in the amount:  $1000 + 300 + 12000 + 6550 + 500 = 20350$ . In the end the Colonel's Unit will earn:  $20350 - 18940 = 1410$ .

## Score

If the following conditions are satisfied for each test:

- output data is in the correct format,
- each of the selected batches of materials was correctly translated into the target language,
- translation of each selected batch had been finished before its usability deadline expired,
- only translation agencies hired for the specified time were used for the translations,
- the profit from the delivery of translations to the Command was correctly calculated ( $S_u$ ),

the score for the set is the value  $\max(1, \sum_{u=1}^T S_u)$ . Otherwise the score is 0.