4531 - Movie Promotion

Asia - Hsinchu - 2009/2010

All Cool Movie (ACM) is a company that runs a website with many movie DVDs for online rental service. A user who subscribes to the service not only can rent DVDs by a few online clicks, but also can rate the movies that she has seen using ranks of `one-star`, `two-star`, `three-star`, `four-star`, or `five-star`. `One-star` means that the user absolutely hates the movie, and `five-star` means that the user likes it very much. ACM's success is based on a simple but robust model that predicts the users' preferences on unseen movies. In particular, the company uses the ratings that were gathered to predict the users' preferences on unseen movies.

ACM's model is as follows. Assume that there are U users and M movies in the system, and user i rates movie j as rank $r_{i,j}$. ACM tries to decompose the rank into two factors: the user factor u_i and the movie factor m_j. In other words, it seeks to find a real value u_i and a real value m_j such that $\hat{r}_{i,j} = u_i + m_j \approx r_{i,j}$. For calibration, there is assumed to be a pseudo user 0 with $u_0 = 0$ that rates every movie as rank 3 (i.e., $r_{0,j} = 3$ for all $1 \le j \le M$). There is also a pseudo movie 0 with $m_0 = 0$ that gets rank 3 from every user (i.e., $r_{i,0} = 3$ for all $1 \le i \le U$).

After gathering N tuples of $(i, j, r_{i,j})$ pairs from the users, ACM then determines the optimal values of $(u_1, \cdots, u_i, \cdots, u_U)$ and $(m_1, \cdots, m_j, \cdots, m_M)$ by minimizing the sum of squared error $(r_{i,j} - \hat{r}_{i,j})^2$ over all the N tuples, the ranks from pseudo user 0 and the ranks for pseudo movie 0.

Because of the success in business, ACM decides to run a promotion as a thank-you gesture to its users. During the promotion period, each user would be freely awarded with one movie--no more, no less--that she/he has not rated (which is taken to mean that she/he has not seen the movie). Of course, ACM doesn't have many DVDs for each movie, and thus can only give the same movie to at most two different users. Assume that user k gets movie $g(k)$ during the promotion, her satisfaction is assumed to be $(\lfloor \hat{r}_{k,g(k)} \rfloor)^2$, where $\lfloor \hat{r}_{k,g(k)} \rfloor$ is the largest integer smaller than or equal to $\hat{r}_{k,g(k)}$. ACM's goal during the promotion is then maximizing the sum of the satisfaction from all the users under the constraints above. Given the N tuples that were gathered on ACM's website, please determine whether ACM's promotion plan is feasible. If so, please compute the maximum overall satisfaction $\sum_{k=1}^{U} (\lfloor \hat{r}_{k,g(k)} \rfloor)^2$ that can be achieved.

Technical Specification

1. The number of users U is a positive integer no more than 256.
2. The number of movies M is a positive integer no more than 256.
3. The actual users are indexed by $i \in \{1, 2, \cdots, U\}$.
4. The actual movies are indexed by $j \in \{1, 2, \cdots, M\}$.
5. The ratings $r_{i,j}$ are integers in $\{1, 2, 3, 4, 5\}$.
6. Each actual user would rate at least one actual movie; each actual movie would be rated by at least one actual user.

7. For any given actual movie, each actual user would rate it no more than once.

Input

The first line of the input file contains an integer indicating the number of test cases to follow. The first line of each test case contains three integers N U M separated by spaces. Each of the following N lines would contain three integers i j $r_{i,j}$ separated by spaces.

Output

For each test case, if there is a feasible plan, output the maximum overall satisfaction that can be achieved by the promotion in a line. Otherwise, output `` `no solution' ``.

Sample Input

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

Sample Output

```
32
no solution
```

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