UNITED INTERNATIONAL UNIVERSITY
Department of Computer Science and Engineering (CSE)

Course Title: Data Structure & Algorithm Lab II **Course Code: CSE2218**

Trimester & Year: Summer 2022 **Section: E** **Credit Hours: 1.0** **AZ**

ASSIGNMENT 03: SP and Dynamic Programming

Q1: Maximize Marks

An exam consists of **N** questions. The marks of the N questions are $\mathbf{m_1, m_2, m_3, .. m_N}$ respectively. Jam is giving the exam and he wants to maximize his number of marks. However he takes some time to solve each question. The time taken by him to solve the questions are $\mathbf{t_1, t_2, t_3, .. t_N}$ respectively. The exams last for a total of time **T**.

But Jam's teacher is very smart and she knows that Jam will find out a way to get maximum marks. So, to confuse Jam, she also puts up a bonus offer for him - The offer is that Jam can select a question for which he can double the marks awarded for that question. Now, Jam is indeed confused. Help him find out the maximum number of marks he can gain.

Input

- The first line contains a single integer **N** that represents the number of questions.
- Second line contains a single integer **T**, the total time for which the exam takes place.
- Third line contains N space-separated integers $\mathbf{m_1, m_2, m_3, ... m_N}$, where $\mathbf{m_i}$ represents marks assigned to the $\mathbf{i^{th}}$ question.
- Fourth line contains N space-separated integers $\mathbf{t_1, t_2, t_3, ... t_N}$, where $\mathbf{t_i}$ represents time taken to solve the $\mathbf{i^{th}}$ question.

Output

Output a single integer, that is the maximum number of marks Jam can achieve.

Example

Input	Output
3 10 1 2 3 4 3 4	8

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Q2: The Secret Magic Trip

Marvel is a land with N cities (numbered 1 through N) connected by M bidirectional roads. Dr. Strange is on a mission to spread a secret Magic. He has a sequence $A_1,A_2,\ldots,A_K$ and he must visit cities in the following way: he starts in the city A_1, travels to the city A_2, then travels from there to the city A_3 and so on until he reaches the city A_K. Note that a city may appear in the sequence **A** for multiple times, but $A_i \neq A_{i+1}$ for each valid i. When travelling between two cities, Dr. Strange always follows one of the shortest paths between them (but not necessarily the same one if he travels between them again).

The government is trying to track which cities are targeted by Dr. Strange. However, they do not know the sequence A. Instead, they have tracked Dr. Strange's movement as a sequence B1, B2…,BL of cities visited by him during his mission. Formally, B1=A1 is the city where Dr. Strange starts, then for each valid i, he moves from the city Bi to the city Bi+1 using the direct road between them and finally, he ends his mission in the city BL=AK; Dr. Strange's sequence A is a subsequence of B, since the sequence B also contains all shortest paths which Dr. Strange followed. It is guaranteed that there is a direct road between cities Bi and Bi+1 for each valid i.

Help the government of Marvel find the minimum possible number of targeted cities, i.e. the minimum possible value of K for a sequence A that corresponds to the given sequence B, or determine that no such sequence A exists.

Input: The first line of the input contains a single integer T denoting the number of test cases. The description of T test cases follows.

- The first line of each test case contains three space-separated integers N, M and L.
- The second line contains L space-separated integers $B_1, B_2\ldots,B_L$
- Each of the following M lines contains three space-separated integers u, v and w describing a road between cities u and v with length w.

Output: For each test case, print a single line containing one integer — the minimum possible K, or −1 if a valid sequence A does not exist.

Input:	**Output:**
3 3 3 6 1 2 3 1 2 3 1 2 1 2 3 1 3 1 1 4 4 9 1 2 3 4 1 2 3 4 1 1 2 1 2 3 1 3 4 1 4 1 1 3 3 2 1 2 1 2 3 2 3 1 3 1 1	6 5 -1

Q3: TASFIA NEEDS TO BAKE A CAKE!!

Tasfia is very happy as tomorrow is her best friend's birthday. She wants to gift her a delicious cake. But Tasfia has spent most of her money in buying chocolate for herself and so she wants to get the best out of her remaining money. Now she has only **M** rupees remaining. She decides to make a delicious cake for her best friend with as much ingredients as possible.

So Tasfia went to the super-market and found out that **I** ingredients are sold in each bag for a price of **P** rupee. There were **N** types of bags in the super-market and she can buy any number of bags of each type. She has to buy at least **K** number of ingredients to make her cake delicious, otherwise she will not be able to make a delicious cake. Your task is to help Tasfia make the most delicious cake for her friend.

Input Format:

- The first line of input contains three space-separated integers **N**, **M** and **K** denoting the no types of bags, the amount of money Tasfia has and minimum number of ingredients Tasfia needs to buy to make a delicious cake respectively.
- **N** lines follow. The $\mathbf{i^{th}}$ line contains two space-separated integers $\mathbf{I_i}$ and $\mathbf{P_i}$ denoting the number of ingredients in the $\mathbf{i^{th}}$ bag and price of the $\mathbf{i^{th}}$ bag. ($\mathbf{1 \leq i \leq N}$)

Output Format: For each test case print "**YES**" without quotes along with the maximum number of ingredients Tasfia can buy if she can make a delicious cake else print "**NO**" without quotes.

Sample Input	**Sample Output**	**Explanation**
3 6 1 6 4 5 3 1 1	Yes 7	Tasfia can buy 7 ingredients by taking the 1st and 3rd type of bag.
3 10 12 8 10 7 11 11 12	No	There is no possible way that Tasfia can make a delicious cake with her money.

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Q4: Home Delivery

Mr. Chandler has started Home Delivery scheme in one of his restaurants. As the scheme is new, he appoints only one employee to deliver food to various locations. However, He is facing trouble with that delivery boy as he is an absent-minded chap!

The delivery boy always forgets to fill fuel in his delivery scooter. So, what he does is that whenever Mr. Chandler sends him for delivery, he goes to the gas station from the restaurant first. He gets his tank filled and then he heads towards his destination. He will do this every single time *irrespective of the destination*. The delivery boy tries his best to be on time. And to do this, he will choose those paths **(from restaurant to gas station AND gas station to destination)** which cost him the ***least* amount of time**.

Your task is to tell Mr. Chandler how much time can the delivery boy save if he had enough fuel in his scooter i.e. if he went to the destination directly without stopping for fuel (taking the path which costs him least amount of time). The city has **N** streets numbered from **0** to **N-1**. The restaurant is on street number **S**, the gas station is on street number **G** and the food has to be delivered to street **D**. Note that **S, G** and **D** need **not** be distinct.

Input:

- First line of the input contains a single integer **N**.
- Then follows an **N x N** matrix **T** which is represented in **N** lines with **N** space separated integers on each line. **T[i][j]** denotes the time taken to move from the i^{th} street to j^{th} street. Obviously, **T[i][i]** = 0.
- Next line contains a single integer **M**, the number of scenarios. The following **M** lines contain 3 space separated integers **S**, **G** and **D**.

Output:

For each of the **M** scenarios, output the time taken by the delivery boy to deliver the food and the time he could have saved if he went directly from **S** to **D**. Both these values must be on the same line separated by a single space.

Sample Input	Sample Output	Explanation
4 0 2 1 3 1 0 4 5 3 1 0 3 1 1 1 0 4 0 2 1 0 2 2 3 1 2 3 0 1	2 0 1 0 3 2 3 2	Look, in the first scenario: The Delivery Boy has travelled 0 (S) to 2(G) and then 2 (G) to 1 (D). ➢ Least time from 0->2 = 1 ➢ Least time from 2->1 = 1 ➢ Total Time taken is 2. If He would have the fuel and travelled from 0 to 1 directly: ➢ Least time from 0->1 = 2 Thus, He could have saved (2-2) = 0 That's why frist line of output 2 0. The rest follows the same theory.