Tehran Site Qualifications 2018 - Round 2

Isfahan University of Technology

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Organizers:

Sponsors:

A. The Lonely Planet

In a far far galaxy, there is a planet called IUT. The living creatures of IUT have decided to explore the life outside their beloved planet; "Are we alone?", they asked! So they decided to send ships throughout the galaxy. Due to the age and current maintenance of the ships, each ship travels at a different top speed and has a different fuel consumption rate. Also each ship has some amount of fuel stored in it. Each ship reaches its top speed instantaneously.

Input

Input begins with a line with one integer T ($1 \leq T \leq 50$) denoting the number of test cases. Each test case begins with a line with two space-separated integers N and D, where N ($1 \leq N \leq 100$) denotes the number of ships available in IUT and D ($1 \leq D \leq 10^6$) denotes the distance in light-years to the expedition site. Next follow N lines with three space-separated integers v_i, f_i, and c_i, where v_i ($1 \leq v_i \leq 1000$) denotes the top speed of ship i in light-years per hour, f_i ($1 \leq f_i \leq 1000$) denotes the fuel on ship i in gallons of gas, and c_i ($1 \leq c_i \leq 1000$) denotes the fuel consumption of ship i in gallons of gas per hour.

Output

For each test case, print a single integer on its own line denoting the number of ships capable of reaching the expedition site. Be careful with integer division!

Sample Input

```
2
3 100
52 75 10
88 13 44
56 9 5
2 920368
950 950 1
943 976 1
```

Sample Output

```
2
1
```

B. Marco Polo

Leily (Hamoon Marco polo) is investigating what battery is appropriate for her electric car. She wants to travel the world with that car. Each country has a charging station. It is important that a trip from one country to any other be completed with no more than K rechargings. The car is initially at zero battery and must always be recharged at the start of each trip; this counts as one of the K rechargings. There is at most one road between each pair of countries, and there is at least one path of roads connecting each pair of countries. Given the layout of these roads and K, compute the necessary range required of the electric shuttle. The range is the maximum distance that Leily's car can go with fully charged battery.

Input

Input begins with a line with one integer T $(1 \leq T \leq 50)$ denoting the number of test cases. Each test case begins with a line containing three integers N, K, and M $(2 \leq N \leq 100, 1 \leq K \leq 100)$, where N denotes the number of countries, K denotes the maximum number of rechargings permitted per trip, and M denotes the number of roads. Next follow M lines each with three integers u_i, v_i, and d_i $(0 \leq u_i, v_i < N, u_i \neq v_i, 1 \leq d_i \leq 10^9)$ indicating that road i connects countries u_i and v_i (0-indexed) bidirectionally with distance d_i.

Output

For each test case, output one line containing the minimum range required.

Sample Input

```
2
4 2 4
0 1 100
1 2 200
2 3 300
3 0 400
10 2 15
0 1 113
1 2 314
2 3 271
3 4 141
4 0 173
5 7 235
7 9 979
9 6 402
6 8 431
8 5 462
0 5 411
1 6 855
2 7 921
3 8 355
4 9 113
```

Sample Output

```
300
688
```

C. Sort it Randomly

Soroush is the teaching assistant for Introduction to Algorithms. During his first class, the cadets were asked to come up with their own sorting algorithms. Monty came up with the following code:

```
while (!sorted(a)) {
  int i = random(n);
  int j = random(n);
  if (a[min(i,j)] > a[max(i,j)])
    swap(a[i], a[j]);
}
```

Carlos, inspired, came up with the following code:

```
while (!sorted(a)) {
  int i = random(n-1);
  int j = i + 1;
  if (a[i] > a[j])
    swap(a[i], a[j]);
}
```

Soroush needs to determine which algorithm is better.

For a given input array of up to 8 values, calculate and print the expected number of iterations for each algorithm. That is, on average, how many iterations should each algorithm take for the given input?

Input

The first line contains T, the number of test cases: $2 \leq T \leq 100$.

Each test case is given on a single line. The first value is N, the number of array elements; $2 \leq N \leq 8$. This is followed on the same line by N integer array elements. The array elements will have values between 0 and 100 inclusive. The array elements may not be distinct.

Output

For each test case, print out the expected number of iterations for Monty's algorithm and for Carlos's algorithm, as shown in the sample output section. There should be exactly one space between words and no spaces at the start of each line or at the end of each line. There should be exactly six digits after the decimal point. Rounding should be to nearest representable value.

Sample Input

```
12
2 1 2
2 2 1
3 1 2 3
3 3 2 1
4 1 2 3 4
4 4 3 2 1
4 2 1 4 3
5 1 1 1 1 1
5 5 4 3 2 1
8 8 7 6 5 4 3 2 1
8 3 1 4 1 5 9 2 6
8 2 7 1 8 2 8 1 8
```

Sample Output

```
Monty 0.000000 Carlos 0.000000
Monty 2.000000 Carlos 1.000000
Monty 0.000000 Carlos 0.000000
Monty 6.000000 Carlos 5.000000
Monty 0.000000 Carlos 0.000000
Monty 14.666667 Carlos 12.500000
Monty 12.000000 Carlos 4.500000
Monty 0.000000 Carlos 0.000000
Monty 26.382275 Carlos 23.641975
Monty 89.576273 Carlos 79.496510
Monty 79.161905 Carlos 33.422840
Monty 63.815873 Carlos 38.910494
```

D. Dabir & His Nayeb

Aseyed (The Dabir) is responsible for the latest event of Anjoman they call BBBB (Bezan Berim Badkonak Beterekoonim!). But there is a big problem: They do not have enough money to hold the event (as always!). As Aseyed does not ever give up, he wants to find some money. He called Alireza (The Nayeb Dabir) to bring his car.

They know that the university will help them with k Bitcoins only if they find $N - k$ Bitcoins themselves. As they (and we) know, Bitcoins come from mines. So they decided to start a trip throughout the country finding mines and mine them. Each mine will bring them one Bitcoin. They also have brought their diamond axes!

They must find the fastest way, using their car leaving from any one of the mines and returning to that same mine, to visit all but a given number of mines.

There are N mines and $N - 1$ paths connecting them. Each path has a known time duration required for traversal. Find the shortest time required, starting from an arbitrary mine, to visit $N - k$ mines, and return.

Input

The first line contains T, the number of test cases; $1 \leq T \leq 50$. Each test case instance starts with a line with two integers, N, the number of mines, and k, the count of mines that need not be visited; $2 \leq N \leq 10^4$ and $0 \leq k \leq \min(N-1, 20)$. Following that are $N-1$ lines, each containing three integers, which are, in order, the source and destination mine numbers (from 0 to $N - 1$) and then the time required to traverse that path. The time is between 0 and 10^6, inclusive. The input graph will be connected.

Output

For each problem instance, print a single integer representing the final distance of travel required.

Sample Input

```
3
2 0
0 1 3000
4 1
0 1 81
1 2 41
2 3 59
9 2
0 1 1000
1 2 1200
0 3 1000
3 4 1200
0 5 1000
5 6 1200
0 7 1800
7 8 600
```

Sample Output

```
6000
200
13200
```

E. Mahdi Run

Mahdi has stuck in IUT and is trying to escape. He is surrounded by professors in the rectangle grid of IUT. Help him escape after years!

Input is a rectangular grid; each grid square either has Mahdi or some professor. Associated with each professor is a time that it takes for Mahdi to defeat that professor. To escape, Mahdi must defeat each professor on some path to the perimeter. Squares are connected by their edges, not by corners (thus, four neighbors).

Input

The first line will contain T, the number of cases; $2 \leq T \leq 100$. Each case will start with line containing three numbers k, w, and h. The value for k is the number of different professors will be between 1 and 25, inclusive. The value for w is the width of the grid and will be between 1 and 1000, inclusive. The value for h is the height of the grid and will be between 1 and 1000, inclusive.

Following that will be k lines. Each will consist of a capital letter used to label the professor followed by the duration required to defeat that professor. The label will not be "M". The duration is in minutes and will be between 0 and 10^5, inclusive. Each label will be distinct.

Following that will be h lines. Each will consist of w capital letters (with no spaces between them). There will be exactly one "M" across all h lines, denoting the location of Mahdi; all other capital letters will be one of the k labels given above, denoting the professor in the square.

Output

Your output should be a single integer value indicating the minimum time required for Mahdi to escape.

Sample Input

```
2
6 3 3
A 1
B 2
C 3
D 4
F 5
G 6
ABC
FMC
DBG
2 6 3
A 100
B 1000
BBBBBB
AAAAMB
BBBBBB
```

Sample Output

```
2
400
```

F. Crowded University

A university has limited infrastructures and facilities so it can have limited number of students, Obvious huh?! But the MASOOLINs do have another idea. They say that we should increase the number of students we have no matter the university is capable or not. Well... it is a very brilliant idea! isn't it?

Unfortunately, MASOOLINs do love fibonacci numbers. So they have defined a formula based on fibonacci's for the number of students in each year ($s(y)$ is the number of students in year y):

$$\begin{array}{ll} y < 2: & 1 \\ y = 2: & 2 \\ y = 3: & 4 \\ y \geq 4: & s(y-4) + s(y-3) + s(y-2) + s(y-1) \end{array}$$

Input

The first line of input will be an integer T ($0 < T < 69$) representing the number of test cases. Following this will be T integer values, one per line. Each of these will represent a year number y ($0 \leq y \leq 67$) to calculate.

Output

For each year number read, display the corresponding number of students in a line.

Sample Input

```
7
0
1
2
3
4
5
30
```

Sample Output

```
1
1
2
4
8
15
201061985
```

G. Mirror

Someone put a physical mirror on the numbers. The mirror had the effect of superimposing reversed number on top of the original number. You need to figure out how scramble the number is. Given a positive number Y, calculate the number of distinct positive values of X such that $Y = X + rev(X)$. The rev operator reverses the digits of a number. The values for X must be in their normal decimal form, without leading zeros. For example, $rev(350) = 53$ and $rev(53) = 35$.

Input

Input begins with a line with one integer T $(1 \leq T \leq 500)$ denoting the number of test cases. Each test case consists of a single line with a single integer Y $(1 \leq Y < 10^{18})$.

Output

For each test case, print out a line containing the count of positive integers that, when summed with their reverse, equals the input value.

Sample Input

```
8
10
11
121
2999999999999999981
109
7087
59284
10201
```

Sample Output

```
1
1
9
1
0
0
0
1
```

H. Interstellar

> We've always defined ourselves by the ability to overcome the impossible. And we count these moments. These moments when we dare to aim higher, to break barriers, to reach for the stars, to make the unknown known. We count these moments as our proudest achievements. But we lost all that. Or perhaps we've just forgotten that we are still pioneers. And we've barely begun. And that our greatest accomplishments cannot be behind us, that our destiny lies above us.
>
> – Cooper in Interstellar Movie

After Cooper came back from the black hole, he went for a journey to find two places in the universe to put his wormhole endpoints there. He wants to minimize the maximum distance between any pair of planets so it takes less time for the people to travel.

Conveniently, all of the planets of interest lie on a straight line, and in the absence of the wormhole, the distance between any pair of them is simply the straight-line distance. Once the wormhole has been added, a traveler has the additional option of going from one planet straight to one end of the wormhole, and then straight from the other end of the wormhole to the other planet. The distance traveled in this case is then the sum of those two distances (travel between the two ends of the wormhole is instantaneous). Note that a traveler always has the option of not using the wormhole, even if an endpoint of the wormhole lies directly between the two planets of interest. Finally, you may place a wormhole endpoint arbitrarily close to any planet, such that the distance from the planet to the wormhole is effectively zero.

Input

Input begins with a line with one integer T ($1 \leq T \leq 50$) denoting the number of test cases. Each test case begins with a line with a single integer N ($2 \leq N \leq 4000$) denoting the number of planets. This is followed by N lines with a single integer x_i each ($-10^9 \leq x_i \leq 10^9$) denoting the location of planet i (all planets are points on the x-axis). No two planets will be at the same location.

Output

For each test case, print on a single line the maximum distance between any pair of planets after the wormhole has been placed in such a manner as to minimize this value. If this distance is fractional, round it up to the next integer. Note that although all planet locations are given as integers, the wormhole location may not have integer coordinates.

Sample Input

```
3
3
-1
1
10
2
1000000000
-1000000000
5
1
2
6
7
8
```

Sample Output

```
2
0
2
```

I. Go Captain, Go!

Captain Mehran was not successful divide his army last week in the contest. He does not want to be ashamed of himself so now he wants to take the Voyager through an asteroid field, but there are too many asteroids for such a trip to be safe. To help blaze a path, you have been asked to take a shuttle into the asteroid field. Your plan is to fly through the field and note its layout, then position the shuttle in such a manner to take out as many asteroids as possible with a single, straight-line phaser blast.

For simplicity we will model this problem in the plane, with circular asteroids, an infinitely thin phaser, and the ability to position your shuttle wherever and however you like, in or around the asteroid field.

Input

Input begins with a line with one integer T ($1 \leq T \leq 25$) denoting the number of test cases. Each test case begins with a line with a single integer N denoting the number of asteroids; $1 \leq N \leq 2000$. Furthermore, there will be at most 5 test cases for which $N > 500$. This line is followed by N line each with 3 space-separated real numbers x_i, y_i, r_i, which specify that asteroid i is centered at (x_i, y_i) and has radius r_i. $-10^6 \leq x_i, y_i \leq 10^6, 1 \leq r_i \leq 100$. All of these numbers will be given to two decimal places. No asteroids will overlap or intersect each other. The input will be such that the answer will not change even if the radii of the asteroids vary by 10^{-6} in either direction.

Output

For each test case, print a single integer on its own line denoting the maximum number of asteroids that may be destroyed.

Sample Input

```
1
3
0.00 0.00 1.00
3.00 0.00 1.00
3.00 3.00 1.00
```

Sample Output

```
2
```

J. Modern Warfare

War has broken out between Isfahan and Sedeh. But war between these clans is not just any war; it must be both honorable and glorious. For honor, the two sides must be exactly matched. For glory, there must be as many participants as possible.

Each clan obeys a strict hierarchy: there is one leader of the entire clan. This leader may have zero or more direct subordinates who are ordered from eldest to youngest. Each subordinate in turn may have zero or more direct subordinates of his or her own, also ordered from eldest to youngest (and so on and so forth). By tradition, every clan warrior is younger than his or her superior. Furthermore, each individual clan warrior specializes in one of several distinct fighting styles.

The subclan commanded by a clan warrior consists of the warrior himself and all direct or indirect reports (i.e., subordinates, subordinates of subordinates, etc.). A pair of subclans are said to match exactly if two conditions are met. First, the leaders of each subclan must have the same fighting style and number of subordinates. Second, assuming that the direct subordinates of each leader are ordered by decreasing age, then the subclans commanded by the first direct subordinates must match exactly, the subclans commanded by the second direct subordinates must match exactly, and so on.

Each clan will select its participants in the war, consisting of a single warrior and his or her subclan. The two subclans chosen must match exactly, and must be as large as possible. How many warriors fight for each clan?

Input

Input begins with a line with one integer T ($1 \leq T \leq 50$) denoting the number of test cases. Each test case begins with a line with two integers M and N ($1 \leq M, N \leq$ 10 000) denoting the size of the two clans. Next follow M lines with an uppercase letter f_i and an integer s_i ($s_0 = -1, 0 \leq s_i < i$, zero-indexed) denoting the fighting style and the superior respectively of warrior i of the first clan. Warrior 0 is always the clan leader (and has a "superior" of -1 to indicate this). Warriors are ordered from eldest to youngest. Next follow N lines with an uppercase letter f_j and an integer s_j (same bounds) denoting the fighting style and the superior respectively of warrior j of the second clan.

Output

For each test case, print out a line with a single integer equal to the maximum number of warriors that each clan may send to fight.

Sample Input

```
1
3 4
A -1
B 0
C 0
Z -1
A 0
B 1
C 1
```

Sample Output

```
3
```

K. Squadron

IUT ACM Student Chapter needs to deploy a squadron of ships at the edge of space. There is a nearby planet where the ships can be built, but the planet doesn't have the infrastructure to support the construction of ships from scratch. It is, however, possible to assemble the ships using prefabricated kits containing an assortment of base parts. Each kit is designed to be turned into a ship by converting the base parts into the necessary ship components. To ensure consistent construction, parts from different kits should not be mixed and matched; each kit must be used in its entirety to construct exactly one ship. This squadron consists of two distinct classes of ships, Class A ships and Class B ships. Both classes consist of the same total number of components, though their individual makeup is different. Each base part is capable of being turned into any type of ship component, though the cost to turn a base part into a ship component varies depending on the base part type and the ship component type. You are responsible for creating these prefabricated kits, which must all be identical to each other. You have access to Sheikhbahaei, the greatest super-computer of all time. What should the composition of the kit be to minimize the total cost of constructing the squadron?

Input

Input begins with a line with one integer T ($1 \leq T \leq 50$) denoting the number of test cases. Each test case begins with a line with four integers M, N, A, and B ($1 \leq M, N \leq 10$; $1 \leq A, B \leq 100$), where M denotes the number of types of base parts, N denotes the number of types of ship components, A denotes the number of Class A ships required, and B denotes the number of Class B ships required. Next is a line with N integers a_i denoting the quantity of ship component i needed for each Class A ship ($0 \leq a_i \leq 100$). Next is a line with N integers b_i denoting the quantity of ship component i needed for each Class B ship ($0 \leq b_i \leq 100$; $\sum_i a_i = \sum_i b_i$). Next follow M lines with N integers c_{ij} ($0 \leq c_{ij} \leq 100$) denoting the cost of converting a single base part i into a single ship component j.

Output

For each test case, output a line with a single integer equal to the minimum total conversion cost of assembling all the ships from the factory kits.

Sample Input

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

Sample Output

```
14
```

Note: In the sample given, the optimal factory kit has one of each base part; such a kit costs 1 to convert into the components for a Class A ship and 2 to convert into the components for a Class B ship.