WOBURN CHALLENGE

2018-19 Online Round 3

Friday, February 1st, 2019

Intermediate Division Problems

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Problem I1: R

14 Points / Time Limit: 2.00s / Memory Limit: 16M *Submit online: http://wcipeg.com/problem/wc183j3*

Jessie, James, and Meowth, members of the honourable Team Rocket, are big fans of the letter `R`. It's just such an awe-inspiring letter! It only makes sense that it should feature prominently on all of their uniforms and equipment.

James is generally tasked with painting the letter `R` onto Team Rocket's various belongings. Sometimes he needs to paint small `R`'s, and other times enormous ones. As such, he'd like to get in some extra practice with painting the most beautifully perfect `R`'s that he can.

Today, James would like to paint an `R` of size S ($3 \le S \le 30$) onto a grid with $2S - 1$ rows and S columns. The required state of each cell in the grid may be represented with a character, either "`#`" if that cell should be painted, or "`.`" if it should be left unpainted.

The top portion of an `R` of size S consists of the painted outline of a square of cells with side-length S, with its top-right and bottom-right corners left unpainted. Below that, a vertical line of $S - 1$ cells should be painted, running up from the grid's bottom-left corner to just below the square. Finally, to the right of that, a diagonal line of $S - 1$ cells should be painted, running up-left from the grid's bottom-right corner to just below the square. Please see the sample cases for a demonstration.

Help James visualize what a perfect `R` of size S should look like!

Input Format

The first and only line of input consists of a single integer, S.

Output Format

Output a grid with $2S - 1$ rows and S columns of characters, representing an `R` of size S.

Sample Input 1

```
5
```

Sample Output 1

```
####.
#...#
#...#
#...#
####.
##...
#.#..
#..#.
#...#
```

Sample Input 2

```
3
```

Sample Output 2

```
##.
#.#
##.
##.
#.#
```

Problem I2: Leveling Up

18 Points / Time Limit: 2.00s / Memory Limit: 64M *Submit online: http://wcipeg.com/problem/wc183j4*

Jessie loves her Arbok, but the poor snake seems to not have much luck winning any battles. Jessie's decided to turn things around by helping Arbok level up! There's no better way to train than going around and defeating wild Pokémon who are just minding their own business, so that's exactly what Jessie intends on doing.

Jessie and her Arbok, as well as N ($1 \le N \le 1000$) wild Pokémon, are all standing at various points along a trail, which can be represented as a number line. Jessie's initial position along the trail is S ($1 \le S \le 100,000$), while the i-th wild Pokémon's position is P_i ($1 \le P_i \le 100,000$). All $N + 1$ of these positions are distinct.

Jessie can walk in either the positive or negative direction along the trail. However, whenever she arrives at the same location as a wild Pokémon, sneaking by is out of the question — she must have Arbok battle it.

Arbok's initial level is L ($1 \le L \le 100,000$), while the i-th wild Pokémon's level is M_i ($1 \le M_i \le 100,000$). Arbok can defeat a Pokémon if Arbok's current level is greater than or equal to that Pokémon's level. If Arbok defeats the i-th wild Pokémon, Arbok's current level will increase by G_i ($1 \le G_i \le 100,000$), and that Pokémon will faint and no longer occupy a point on the trail. Jessie will never make Arbok battle against a Pokémon whose level is strictly greater than Arbok's level, as Arbok would faint instead and would not be able to gain any more levels.

What's the maximum possible level which Jessie can help Arbok achieve, by optimally choosing how to walk around on the trail?

Input Format

The first line of input consists of a single integer, N.
The next line consists of two space-separated integers, S and L.
N lines follow, the i-th of which consists of three space-separated integers, P_i, M_i, and G_i, for $i = 1..N$.

Output Format

Output a single integer, the maximum possible level which Arbok can achieve.

Sample Input

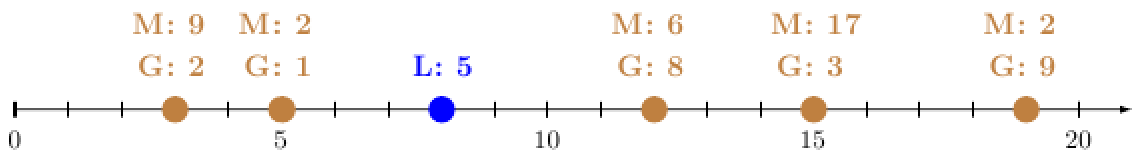
```
5
8 5
3 9 2
19 2 9
12 6 8
5 2 1
15 17 3
```

Sample Output

```
16
```

Sample Explanation

The following diagram illustrates Jessie's starting location (indicated in blue) as well as the wild Pokémon (indicated in brown):



Jessie can move left to position 5, and defeat the Pokémon there to increase Arbok's level to 6. She can then move right to position 12, defeating the Pokémon there and raising Arbok's level to 14. Finally, she can defeat the Pokémon at position 3 to increase Arbok's level to 16. This is the highest level which Arbok would ever be able to reach.

Problem I3: The Perfect Team

28 Points / Time Limit: 4.00s / Memory Limit: 64M *Submit online: http://wcipeg.com/problem/wc183s1*

Jessie, James, and Meowth, members of the honourable Team Rocket, have finally hit the jackpot! They've managed to steal a group of N ($1 \le N \le 300{,}000$) Pokémon. There are K ($1 \le K \le N$) different Pokémon types, numbered from 1 to K. The i-th Pokémon has type T_i ($1 \le T_i \le K$), and level L_i ($1 \le L_i \le 10^9$). There's at least one Pokémon of each type 1..K.

What remains is for Team Rocket to make the best use of their haul. They can't necessarily afford to carry around that many Pokémon with them, so they'd like to choose exactly M ($K \le M \le N$) of the N Pokémon to form an unstoppable battling team. Putting all of the highest-level Pokémon to use would be nice, but Team Rocket's top priority is putting together a team which has no glaring weaknesses. To make sure they're covered against anything they might face, they insist that their M-Pokémon team must include at least one Pokémon of each type 1..K.

Subject to those conditions, help Team Rocket determine the maximum sum of Pokémon levels which such a team could possibly have! Please note that the answer may not fit within a 32-bit signed integer.

Subtasks

In test cases worth 14/28 of the points, $M = K$.

Input Format

The first line of input consists of three space-separated integers, N, M, and K.
N lines follow, the i-th of which consists of two space-separated integers, T_i and L_i, for i = 1..N.

Output Format

Output a single integer, the maximum sum of Pokémon levels which a valid team of M Pokémon can have.

Sample Input 1

```
5 3 3
1 8
2 5
1 13
3 5
2 4
```

Sample Output 1

```
23
```

Sample Input 2

```
7 5 2
1 11
2 10
1 16
2 11
1 19
1 7
2 15
```

Sample Output 2

```
72
```

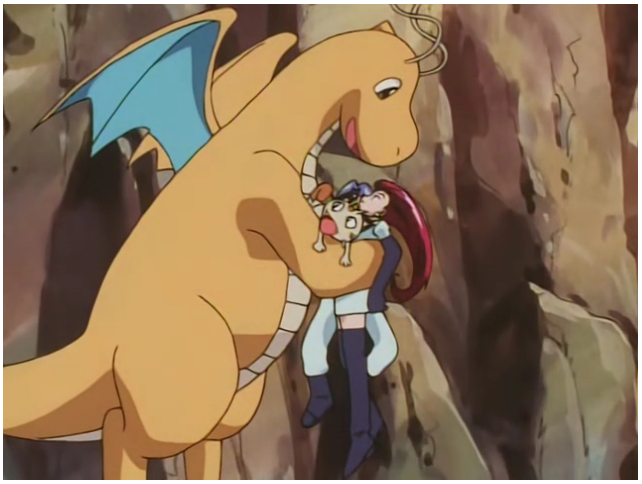
Sample Explanation

In the first case, the 2nd, 3rd, and 4th Pokémon should be chosen. All Pokémon types 1..3 are represented, and the sum of these Pokémon's levels is 5 + 13 + 5 = 23, which is the largest achievable sum.

In the second case, the 1st, 3rd, 4th, 5th, and 7th Pokémon should be chosen.

Problem I4: Gym Tour

40 Points / Time Limit: 3.00s / Memory Limit: 64M *Submit online: http://wcipeg.com/problem/wc183s2*



It's every Pokémon trainer's dream to visit all of the Pokémon gyms in their region, defeating each of their gym leaders and claiming gym badges proving their worth! The members of Team Rocket also dream of visiting all of the gyms, though that's mostly because they're sure to be filled with powerful Pokémon worth stealing…

A certain region has N ($2 \le N \le 100{,}000$) towns, numbered from 1 to N. There are $N - 1$ routes running amongst the towns, each of which allows travelers to walk in either direction between a pair of towns, such that each town may be reached from any other town by following a sequence of one or more routes. The i-th route runs between towns A_i and B_i ($1 \le A_i, B_i \le N$, $A_i \ne B_i$).

There are K ($1 \le K < N$) Pokémon gyms in the region, the i-th of which is located in town G_i ($2 \le G_i \le N$). No two gyms are in the same town, and none of the gyms are in town 1.

Team Rocket would like to pay a friendly visit to each gym's town at least once. They currently find themselves in town 1, and it takes them one whole day to walk along a route from their current town to another town. It takes them no time to conduct any business in the gyms, but all of this walking looks to be very time-consuming by itself!

Fortunately, another potential method of travel is also available to them. A winged Pokémon named Dragonite can be found in town F ($1 \le F \le N$), and Team Rocket may be able to enlist its transportation services. If they're ever in town F, they may choose to catch Dragonite. Anytime after they've caught Dragonite, they may choose to Fly back to any town they've previously visited. Catching Dragonite and Flying to a previous town each take no time at all. It's guaranteed that Dragonite is not at a town which has a Pokémon gym.

What's the minimum number of days required for Team Rocket to visit all K gyms after beginning in town 1?

Subtasks

In test cases worth 18/40 of the points, $F = 1$.

Input Format

The first line of input consists of three space-separated integers, N, K, and F.
The next line consists of integers, $G_{1..K}$.
$N - 1$ lines follow, the i-th of which consists of two integers, A_i and B_i, for $i = 1..(N - 1)$.

Output Format

Output a single integer, the minimum number of days required for Team Rocket to visit all K gyms.

Sample Input 1

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

Sample Output 1

```
3
```

Sample Input 2

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

Sample Output 2

```
3
```

Sample Input 3

```
7 3 2
7 6 3
5 6
4 7
2 4
1 4
6 1
4 3
```

Sample Output 3

```
5
```

Sample Explanation

In the first case, Team Rocket can immediately catch Dragonite in town 1. They can then walk to town 2 followed by town 3, visiting both of their gyms. They can then Fly back to town 2, and finally walk from there to town 4 to visit its gym. In total, they will have walked from town to town 3 times, resulting in the whole tour taking 3 days.

In the second case, Team Rocket can begin by walking to town 2 and visiting its gym. They can then walk back to town 1 and then to town 5, visiting its gym as well.