

## Problem 3

### Ghost Encounters

**Input File:** ghostin.txt  
**Output File:** ghostout.txt

**Time and Memory Limits:** 1 second, 1 GB

You are a paranormal investigator who studies the behavioural patterns of ghosts. Ghosts are mysterious creatures, appearing in certain locations for the briefest of moments before suddenly disappearing. Years of meticulous research has allowed you to learn exactly when and where ghosts appear.

But your friend Tulpa is doubtful about the existence of ghosts. You will convince her by organising a walk along the local haunted trail. The trail is dark and dilapidated, taking  $\mathbf{K}$  seconds to travel each metre. There are  $\mathbf{N}$  ghosts which you know will appear at certain locations along the trail. Ghost  $\mathbf{i}$  will appear  $\mathbf{X}_i$  metres into the walk,  $\mathbf{T}_i$  seconds after sunset. If Tulpa is exactly  $\mathbf{X}_i$  metres into her walk when the ghost appears, she will encounter the ghost.

You'd like to pick a time to start the walk that maximises the number of ghosts Tulpa will encounter. You will pick an integer  $\mathbf{s}$ , and she will begin her walk  $\mathbf{s}$  seconds after sunset. You can also choose  $\mathbf{s}$  to be negative, indicating that she should begin her walk before sunset. If you pick the best possible  $\mathbf{s}$ , what is the maximum number of ghosts you can make Tulpa encounter?

Two ghosts appearing at the same location at the same time are considered to be two encounters.

#### Input

- The first line contains integers  $\mathbf{N}$  and  $\mathbf{K}$ .
- The next  $\mathbf{N}$  lines each describe one ghost. The  $\mathbf{i}$ th such line contains two integers  $\mathbf{X}_i$  and  $\mathbf{T}_i$ , describing the  $\mathbf{i}$ th ghost. Ghosts are given in ascending order of their  $\mathbf{X}_i$  values. Ghosts with the same  $\mathbf{X}_i$  value are given in ascending order of their  $\mathbf{T}_i$  values.

#### Output

Your program should output a single integer, the maximum number of encounters Tulpa can have.

##### Sample Input 1

```
3 4
1 2
2 6
2 9
```

##### Sample Input 2

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

##### Sample Input 3

```
5 2
1 5
1 5
1 5
2 5
2 5
```

##### Sample Output 1

```
2
```

##### Sample Output 2

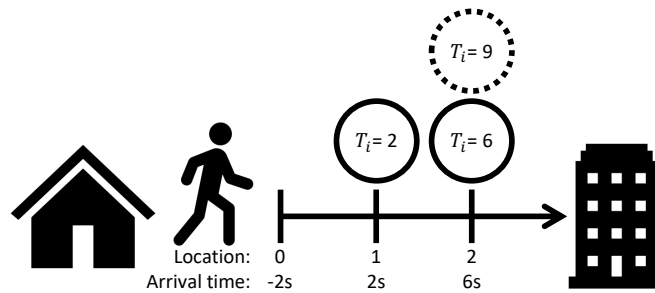
```
2
```

##### Sample Output 3

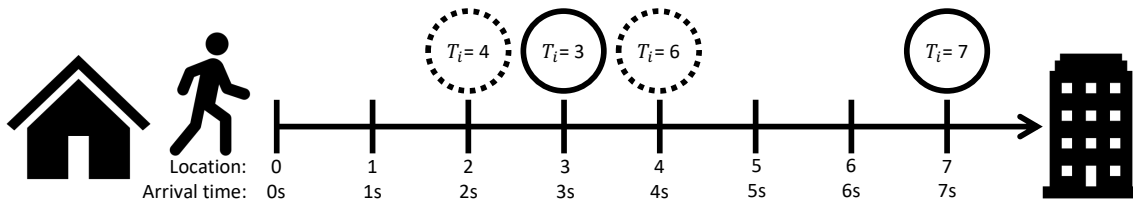
```
3
```

### Explanation

In the first sample input, there are  $N = 3$  ghosts and it takes Tulpa  $K = 4$  seconds to walk one metre. If you choose  $s = -2$  (that is, you ask her to leave 2 seconds **before** sunset), she will encounter two ghosts as shown in the diagram below. Solid circles represent the ghosts that she will encounter, dotted circles represent the ghosts that she will not encounter. Two encounters is the maximum possible.



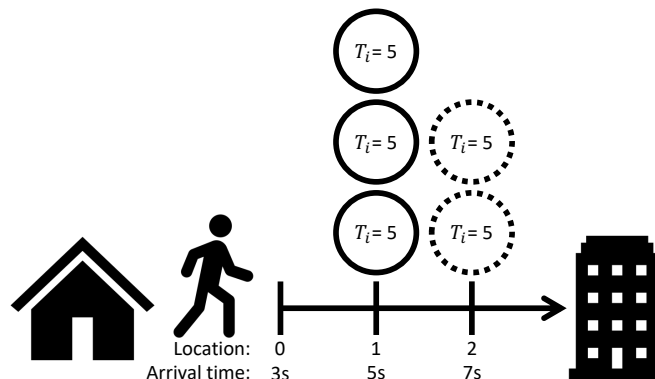
In the second sample input, there are  $N = 4$  ghosts and it takes Tulpa  $K = 1$  second to walk one metre. If you choose  $s = 0$  (that is, you ask her to leave at sunset), she will encounter the second and fourth ghost, as shown in the diagram below. Note that choosing  $s = 2$  also leads to two encounters. Two encounters is the maximum possible.



In the third sample input, there are  $N = 5$  ghosts and it takes Tulpa  $K = 2$  seconds to walk one metre.

- If you choose  $s = 3$ , she will encounter the first, second and third ghosts.
- If you choose  $s = 1$ , she will encounter the fourth and fifth ghosts.

Choosing  $s = 3$  leads to the most encounters. This is shown in the diagram below. Three encounters is the maximum possible.



## Subtasks & Constraints

For all test cases:

- $1 \leq N \leq 100\,000$ .
- $1 \leq K \leq 30\,000$ .
- $1 \leq X_i \leq 30\,000$ , for all  $i$ .
- $1 \leq T_i \leq 1\,000\,000\,000$ , for all  $i$ .
- $X_i \leq X_{i+1}$  for all  $i$ .
- If  $X_i = X_{i+1}$ , then  $T_i \leq T_{i+1}$ .

Additionally:

- For Subtask 1 (25 marks),  $T_i = T_j$  for all  $i$  and  $j$ . That is, all ghosts will appear at the same time. Sample input 3 is an example of this.

*Hint:* Since all the ghosts appear at the same time, the only thing you have to think about is which location has the most ghosts. You can instruct Tulpa to leave as late or as early as necessary to encounter those ghosts.

- For Subtask 2 (35 marks), the best choice for  $s$  is between 1 and 10, inclusive. That is, Tulpa will encounter the most ghosts if she leaves between 1 and 10 seconds after sunset.

*Hint:* Try simulating Tulpa's walk for each value of  $s$  and checking how many ghosts she would encounter on that walk.

- For Subtask 3 (30 marks),  $N \leq 1000$ .

*Hint:* Try working out for each ghost, what value of  $s$  you would need to choose so that Tulpa encounters that ghost.

- For Subtask 4 (10 marks), there are no special constraints.

*There are no hints available for this subtask.*