Problem A: Painting, ***(K Narayan Kumar, CMI)***

A new university campus is coming up at Siruseri. At the centre of this campus is a piece of sculpture designed by a well known modern artist of Siruseri. The sculpture is made up of a set of concrete pillars of square cross-section of varying heights, placed next to each other.

The sculpture occupies a rectangular area of length M feet and width N feet. $M \times N$ pillars, each of cross section 1 foot by 1 foot, are placed in this area. These pillars of varying height. A description of such an sculpture can be given as an $M \times N$ array of numbers. The number at position *(i,j)* indicates the height of the pillar placed at position *(i,j)*. For example, here is a description of a sculpture where M=2 and N=3.

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

The artist wants the entire sculpture to be painted in canary yellow. Notice that when two pillars are placed next to each other, a part of the surface of each of these pillars is no longer exposed to the outside and need not be painted. In the example above, only 9 square feet of the pillar at position (1,1) need to be painted. As a standalone pillar it has 13 square feet of paintable area (1 square foot on the top, and 3 square foot on each of its four faces). But, in the current arrangement, it is placed adjacent to two pillars which hide 2 square feet each of its exposed area. So, only 9 square feet need to be painted. If you add up the paintable areas for all the 6 pillars, you can see that a total of 34 square feet need to be painted.

Your task is to determine the total area that is to be painted given a description of the sculpture.

Input format

The first line of the input contains two integers, M and N, indicating the length and width of the sculpture in feet. This is followed by M rows of N positive numbers each. The jth number on line $i+1$ denotes height of the pillar at position *(i,j)*.

Output format

A single positive integer indicating the total area to be painted.

Test data

You may assume $1 \leq M,N \leq 1000$.

Example

We now illustrate the input and output formats using the example described above.

Sample input

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

Sample output

```
34
```

Problem B: Renting Equipment, *(K Narayan Kumar, CMI)*

The Chennai Mathematical Institute (CMI) organises a number of seminars throughout the year. These seminars require audio-visual equipment like projectors, microphones, speakers and so on. CMI rents this equipment from S.W.Indler and Co.

The cost of renting such equipment consists of three parts: a initial flat charge (to cover the transport and setting up of the equipment), a daily rental and finally a winding down charge (for dismantling and transporting the equipment back).

CMI is a very organised institute and the office secretary knows the schedule of seminars for the next N days. He would like to place orders for the equipment from S.W.Indler and Co. so that the total cost to the institute is minimized.

Notice that it might make sense to keep rented equipment even on days without seminars as this expenditure might be less that the cost incurred in returning and then re-renting the equipment. Suppose seminars are to be held on days 1, 3, 5 and 12. If the initial cost is 500, the daily rental is 200 and the winding up cost is 250, then it makes sense to rent the equipment on the 1st day, return it on the 5th day, rent it again on the 12th day and return it on the same day. The total cost works out to (500+200*5+250) + (500+200+250) = 2700. You can verify that this is the minimum possible cost.

Your task is to help the secretary determine the minimum possible cost for any schedule of seminars.

Input format

The first line of the input contains 3 integers I, R and W denoting the initial charge, the daily rental and the winding up charge, respectively. The second line contains a single integer N indicating the number of days for which the secretary knows the schedule. The third line has N entries giving information about the schedule of lectures. Each entry on this line is either 0 or 1. If the ith entry on the line is 0 then there are no seminars scheduled for the ith day. If the ith entry on the line is 1 then there is a seminar scheduled for the ith day.

Output format

A single line containing the minimum cost of hiring the equipment.

Test data

You may assume that $N \leq 100000$. You may further assume that in 50% of the inputs $N \leq 5000$.

Example

We now illustrate the input and output formats using the above example.

Sample input

```
500 200 250
12
1 0 1 0 1 0 0 0 0 0 0 1
```

Sample output

```
2700
```

Problem C: Railway Catering Contracts, *(K Narayan Kumar, CMI)*

The government of Siruseri has just commissioned one of the longest and most modern railway routes in the world. This route runs the entire length of Siruseri and passes through many of the big cities and a large number of small towns and villages in Siruseri.

The railway stations along this route have all been constructed keeping in mind the comfort of the travellers. Every station has big parking lots, comfortable waiting rooms and plenty of space for eateries. The railway authorities would like to contract out the catering services of these eateries.

Unfortunately, catering contractors are not philanthropists and would like to maximise their profits. The Siruseri Economic Survey has done a through feasibility study of the different stations and documented the expected profits (or losses) for the eateries in all the railway stations on this route. Every contractor would like to run the catering service only in the profitable stations and stay away from the loss making ones.

On the other hand the authorities would like to ensure that every station was catered to. Towards this end, authorities offered to contract out stations in groups. They would fix a minimum size K and a contractor was only allowed to bid for any **contiguous** sequence of K or more stations.

For example suppose there are 8 stations along the line and their profitability is as follows:

```
Station              1    2    3    4    5    6    7    8
Expected Profits   -20   90  -30  -20   80  -70  -60  125
```

If K was fixed to be 3, a contractor could pick stations 3, 4, 5 and 6. This would give him a total profit of -40 (i.e. a loss of 40). He could have picked 3, 4 and 5 giving him a profit of 30. On the other hand if he picked stations 2, 3, 4 and 5, he would make a profit of 120. You can check that this is the best possible choice when K = 3.

If K = 1, then the best choice would be to bid for just station 8 and make a profit of 125.

You have been hired by a contractor. Your task is to help him identify the segment of stations to bid for so at to maximize his expected profit.

Input format

The first line of the input contains two integers N and K, where N is the number of stations and K is the minimum number of contiguous stations that must form part or the bid. The next N+1 lines (lines 2,...,N+1) describe the profitability of the N stations. Line i+1 contains a single integer denoting the expected profit at station i.

Output format

A single integer P, indicating the maximum possible profit.

Test Data:

You may assume that $1 \leq N \leq 1000000$ and $1 \leq K \leq$ N. You may further assume that in 50% of the inputs $N \leq$ 5000.

Example:

We illustrate the input and output format using the above example:

Sample Input 1:

```
8 3
-20
90
-30
-20
80
-70
-60
125
```

Sample Output 1:

```
120
```

Sample Input 2:

```
8 1
-20
90
-30
-20
80
-70
-60
125
```

Sample Output 2:

```
125
```

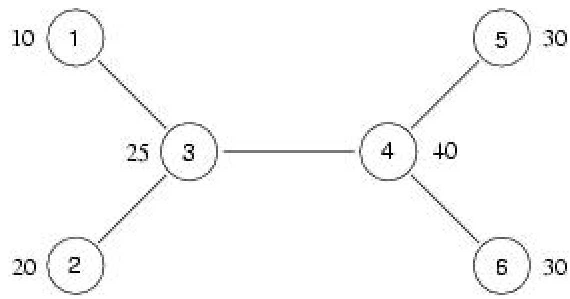
Problem D: The Three-Way Split, *(Indraneel Mukherjee, CMI)*

A key feature of the Siruseri railway network is that it has exactly one route between any pair of stations.

The government has chosen three contractors to run the canteens at the stations on the railway network. To ensure that there are no disputes between the contractors it has been decided that if two stations, say *A* and *B*, are assigned to a particular contractor then all the stations that lie on the route from *A* to *B* will also be awarded to the same contractor.

The government would like the assignment of stations to the contractors to be as equitable as possible. The government has data on the number of passengers who pass through each station each year. They would like to assign stations so that the maximum number of passengers passing through any contractor's collection of stations is minimized.

For instance, suppose the railway network is as follows, where the volume of passenger traffic is indicated by the side of each station.



One possible assignment would to award stations 1 and 3 to one contractor (there by giving him a traffic of 35 passengers), station 2 to the second contractor (traffic of 20) and stations 4, 5 and 6 to the third contractor (traffic of 100). In this assignment, the maximum traffic for any one contractor is 100. On the other hand if we assigned stations 1, 2 and 3 to one contractor, station 4 and 6 to the second contractor and station 5 to the third contractor the maximum traffic for any one contractor is 70. You can check that you cannot do better. (The assignment 1, 2 and 3 to one contractor, 4 to the second contractor, and 5 and 6 to the third contractor has a lower value for the maximum traffic (55) but it is not a valid assignment as the route from 5 to 6 passes through 4.)

Input format

The first line of the input contains one integer *N* indicating the number of railways stations in the network. The stations are numbered 1,2,..., *N*. This is followed by *N* lines of input, lines 2,3,...,*N*+1, indicating the volume of traffic at each station. The volume of traffic at station *i*, $1 \leq i \leq N$, is given by a single integer in line *i*+1. The next *N*-1 lines of input, lines *N*+2, *N*+3, ..., 2*N*, describe the railway network. Each of these lines contains two integers, denoting a pair of stations that are neighbours.

Output format

The output should be a single integer, corresponding to the minimum possible value of the maximum traffic of any contractor among all valid assignment of the stations to the three contractors.

Test Data:

You may assume that $N \leq 3000$.

Example:

Here is the sample input and output corresponding to the example discussed above.

Sample Input

```
6
10
20
25
40
30
30
4 5
1 3
3 4
2 3
6 4
```

Sample Output

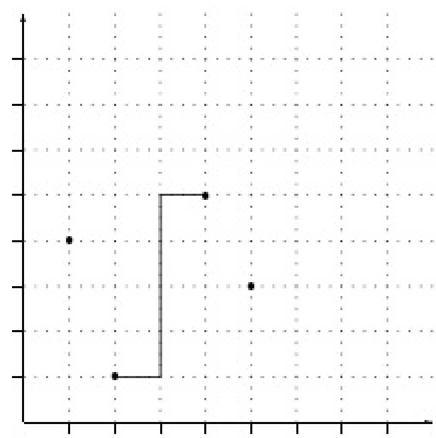
```
70
```

Problem E: Cellular Jail, ***(Indraneel Mukherjee / R Shreevatsa, CMI)***

On the planet of Zorg, scientists have conquered the limitations of space-time and designed a cellular jail in which the cells are organized as an *n*-dimensional hypercube with upto 10^8 prison cells along each dimension. A clever system of connected corridors makes it possible to walk from any cell in the jail to any other cell. Each corridor runs parallel to one of the axes, so all paths from one cell to another are grid paths.

Two desperate criminals have just been sentenced to life imprisonment in this jail. The jail authorities have a list of the cells in the jail that are currently empty. To prevent any possibility of the new prisoners colluding to create trouble, the authorities want to place them in two empty cells that are as far apart as possible with respect to the distance to be travelled along the jail corridors.

For instance, suppose we have a simple two dimensional jail with empty cells at positions (2,1), (1,4), (4,5) and (5,3). Then, the pair of empty cells that are furthest apart are (2,1) and (4,5), which are separated by a corridor path of length 6.



Input format

The first line of input contains two integers, *N* and *D*, where *N* is the number of empty cells in the jail and *D* is the number of dimensions of the cellular jail. This is followed by *N* lines of input describing the locations of the empty cells. Each line consists of *D* integers, giving the *D* coordinates of the cell.

Output format

Two lines, each containing *D* integers. Each line gives the *D* coordinates of one of the two empty cells to be used for the new prisoners. The two cells can be listed in any order. If there is more than one valid solution, print any one.

Test Data:

You may assume that $N \leq 10^6$ and $D \leq 5$. In 60% of the test cases, $D = 2$.

Example:

Here is the sample input and output corresponding to the example discussed above.

Sample Input

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

Sample Output

```
2 1
4 5
```

Problem F: Chess Festival, ***(K Narayan Kumar, CMI)***

The Siruseri Chess Club has decided to hold a Festival of Chess to attract youngsters to take up the game. There are N chess players in Siruseri and the Club knows the ELO rating of each player. You may assume that no two players have the same ELO rating. The Club has decided to organize K matches, where $K < N$, satisfying the following rules:

1. No player may play more than two games.
2. No player can play more than one game with the same colour.
3. In all games, the player with the higher ELO rating will play with black.

In order to the make the matches as close as possible, it has been decided to organize the K games so that the sum of the (absolute values of the) differences in ELO ratings between the players is as small as possible.

Your task is to help the Siruseri Chess Club to choose the pairings for the matches based on the ELO ratings of the N players and the number of games, K, to be played.

For example, suppose there are 7 players with ratings 30, 17, 26, 41, 19, 38 and 18, and $K = 3$. Then, the best pairings would be: Player 2 vs Player 7, Player 7 vs Player 5 and finally Player 6 vs Player 4, for a total sum of (18-17) + (19-18) + (41-38) = 5.

Input format

The first line contains two integers N and K. This is followed by N lines containing the ELO ratings of the N players.

Output format

A single integer giving the minimum sum of differences possible for the K games, meeting the requirements listed above.

Test data

You may assume that $N \leq 100000$ and $K < N$. In 90% of the inputs, $N \leq 3000$.

Example

Here is a sample input and output corresponding to the example discussed above.

Sample input

```
7 3
30
17
26
41
19
38
18
```

Sample output

```
5
```