Problem 1: Wormholes

Farmer John's hobby of conducting high-energy physics experiments on weekends has backfired, causing N wormholes (2 <= N <= 12, N even) to materialize on his farm, each located at a distinct point on the 2D map of his farm.

According to his calculations, Farmer John knows that his wormholes will form N/2 connected pairs. For example, if wormholes A and B are connected as a pair, then any object entering wormhole A will exit wormhole B moving in the same direction, and any object entering wormhole B will similarly exit from wormhole A moving in the same direction. This can have rather unpleasant consequences. For example, suppose there are two paired wormholes A at (0,0) and B at (1,0), and that Bessie the cow starts from position (1/2,0) moving in the +x direction. Bessie will enter wormhole B, exit from A, then enter B again, and so on, getting trapped in an infinite cycle!

Farmer John knows the exact location of each wormhole on his farm. He knows that Bessie the cow always walks in the +x direction, although he does not remember where Bessie is currently located. Please help Farmer John count the number of distinct pairings of the wormholes such that Bessie could possibly get trapped in an infinite cycle if she starts from an unlucky position.

INPUT FORMAT:

* Line 1: The number of wormholes, N.

* Lines 2..1+N: Each line contains two space-separated integers describing the (x,y) coordinates of a single wormhole. Each coordinate is in the range 0..1,000,000,000.

SAMPLE INPUT:

```
4
0 0
1 0
1 1
0 1
```

INPUT DETAILS:

There are 4 wormholes, forming the corners of a square.

OUTPUT FORMAT:

* Line 1: The number of distinct pairings of wormholes such that
        Bessie could conceivably get stuck in a cycle walking from
        some starting point in the +x direction.

SAMPLE OUTPUT:

2

OUTPUT DETAILS:

If we number the wormholes 1..4, then by pairing 1 with 2 and 3 with 4, Bessie can get stuck if she starts anywhere between (0,0) and (1,0) or between (0,1) and (1,1). Similarly, with the same starting points, Bessie can get stuck in a cycle if the pairings are 1-3 and 2-4. Only the pairings 1-4 and 2-3 allow Bessie to walk in the +x direction from any point in the 2D plane with no danger of cycling.

Problem 2: Ski Course Design

Farmer John has N hills on his farm (1 <= N <= 1,000), each with an integer elevation in the range 0 .. 100. In the winter, since there is abundant snow on these hills, FJ routinely operates a ski training camp.

Unfortunately, FJ has just found out about a new tax that will be assessed next year on farms used as ski training camps. Upon careful reading of the law, however, he discovers that the official definition of a ski camp requires the difference between the highest and lowest hill on his property to be strictly larger than 17. Therefore, if he shortens his tallest hills and adds mass to increase the height of his shorter hills, FJ can avoid paying the tax as long as the new difference between the highest and lowest hill is at most 17.

If it costs x^2 units of money to change the height of a hill by x units, what is the minimum amount of money FJ will need to pay? FJ is only willing to change the height of each hill by an integer amount.

INPUT FORMAT:

* Line 1: The integer N.

* Lines 2..1+N: Each line contains the elevation of a single hill.

SAMPLE INPUT:

```
5
20
4
1
24
21
```

INPUT DETAILS:

FJ's farm has 5 hills, with elevations 1, 4, 20, 21, and 24.

OUTPUT FORMAT:

* Line 1: The minimum amount FJ needs to pay to modify the elevations

of his hills so the difference between largest and smallest is
at most 17 units.

SAMPLE OUTPUT:

```
18
```

OUTPUT DETAILS:

FJ keeps the hills of heights 4, 20, and 21 as they are. He adds mass to the hill of height 1, bringing it to height 4 (cost = 3^2 = 9). He shortens the hill of height 24 to height 21, also at a cost of 3^2 = 9.

Cross Country Skiing

The cross-country skiing course at the winter Moolympics is described by an M x N grid of elevations (1 <= M, N <= 500), each elevation being in the range 0 .. 1,000,000,000.

Some of the cells in this grid are designated as waypoints for the course. The organizers of the Moolympics want to assign a difficulty rating D to the entire course so that a cow can reach any waypoint from any other waypoint by repeatedly skiing from a cell to an adjacent cell with absolute elevation difference at most D. Two cells are adjacent if one is directly north, south, east, or west of the other. The difficulty rating of the course is the minimum value of D such that all waypoints are mutually reachable in this fashion.

INPUT FORMAT:

* Line 1: The integers M and N.

* Lines 2..1+M: Each of these M lines contains N integer elevations.

* Lines 2+M..1+2M: Each of these M lines contains N values that are either 0 or 1, with 1 indicating a cell that is a waypoint.

SAMPLE INPUT:

```
3 5
20 21 18 99 5
19 22 20 16 26
18 17 40 60 80
1 0 0 0 1
0 0 0 0 0
0 0 0 0 1
```

INPUT DETAILS:

The ski course is described by a 3 x 5 grid of elevations. The upper-left, upper-right, and lower-right cells are designated as waypoints.

OUTPUT FORMAT:

* Line 1: The difficulty rating for the course (the minimum value of D
        such that all waypoints are still reachable from each-other).

SAMPLE OUTPUT:

21

OUTPUT DETAILS:

If D = 21, the three waypoints are reachable from each-other. If D < 21, then the upper-right waypoint cannot be reached from the other two.

Problem 4: Optimal Milking

Farmer John has recently purchased a new barn containing N milking machines (1 <= N <= 40,000), conveniently numbered 1..N and arranged in a row.

Milking machine i is capable of extracting M(i) units of milk per day (1 <= M(i) <= 100,000). Unfortunately, the machines were installed so close together that if a machine i is in use on a particular day, its two neighboring machines cannot be used that day (endpoint machines have only one neighbor, of course). Farmer John is free to select different subsets of machines to operate on different days.

Farmer John is interested in computing the maximum amount of milk he can extract over a series of D days (1 <= D <= 50,000). At the beginning of each day, he has enough time to perform maintenance on one selected milking machine i, thereby changing its daily milk output M(i) from that day forward. Given a list of these daily modifications, please tell Farmer John how much milk he can produce over D days (note that this number might not fit into a 32-bit integer).

INPUT FORMAT:

* Line 1: The values of N and D.

* Lines 2..1+N: Line i+1 contains the initial value of M(i).

* Lines 2+N..1+N+D: Line 1+N+d contains two integers i and m, indicating that Farmer John updates the value of M(i) to m at the beginning of day d.

SAMPLE INPUT:

```
5 3
1
2
3
4
5
5 2
2 7
1 10
```

INPUT DETAILS:

There are 5 machines, with initial milk outputs 1,2,3,4,5. On day 1, machine 5 is updated to output 2 unit of milk, and so on.

OUTPUT FORMAT:

* Line 1: The maximum total amount of milk FJ can produce over D days.

SAMPLE OUTPUT:

32

OUTPUT DETAILS:

On day one, the optimal amount of milk is 2+4 = 6 (also achievable as 1+3+2). On day two, the optimal amount is 7+4 = 11. On day three, the optimal amount is 10+3+2=15.

Problem 5: Cow Curling

Cow curling is a popular cold-weather sport played in the Moolympics.

Like regular curling, the sport involves two teams, each of which slides N heavy stones (3 <= N <= 50,000) across a sheet of ice. At the end of the game, there are 2N stones on the ice, each located at a distinct 2D point.

Scoring in the cow version of curling is a bit curious, however. A stone is said to be "captured" if it is contained inside a triangle whose corners are stones owned by the opponent (a stone on the boundary of such a triangle also counts as being captured). The score for a team is the number of opponent stones that are captured.

Please help compute the final score of a cow curling match, given the locations of all 2N stones.

INPUT FORMAT:

* Line 1: The integer N.

* Lines 2..1+N: Each line contains 2 integers specifying the x and y coordinates of a stone for team A (each coordinate lies in the range -40,000 .. +40,000).

* Lines 2+N..1+2N: Each line contains 2 integers specifying the x and y coordinates of a stone for team B (each coordinate lies in the range -40,000 .. +40,000).

SAMPLE INPUT:

```
4
0 0
0 2
2 0
2 2
1 1
1 10
-10 3
10 3
```

INPUT DETAILS:

Each team owns 4 stones. Team A has stones at (0,0), (0,2), (2,0), and (2,2), and team B has stones at (1,1), (1,10), (-10,3), and (10,3).

OUTPUT FORMAT:

* Line 1: Two space-separated integers, giving the scores for teams A and B.

SAMPLE OUTPUT:

1 2

OUTPUT DETAILS:

Team A captures their opponent's stone at (1,1). Team B captures their opponent's stones at (0,2) and (2,2).