DMOPC '20 Contest 7 P2 - Alice and Tiles

Alice is feeling bored in math class. So she gets an infinitely large sheet of graph paper and starts tiling it with squares and octagons, as shown below. The squares are 1 unit high, the octagons are 3 units high and 3 units wide, and all the tiles' vertices are at integer lattice points. The origin point, $(0, 0)$, is at the bottom-left corner of a square tile.

When Alice finally finishes tiling the infinitely large sheet of paper, math class is still not over. So she decides to colour in N tiles to make a single polygon with no holes. What are the polygon's vertices, in clockwise order?
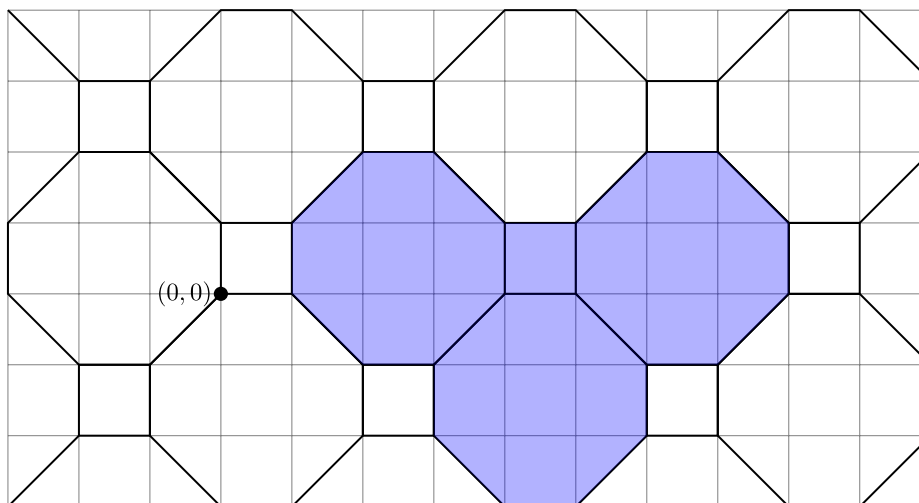
Constraints

$1 \le N \le 2 \times 10^5$

$-10^9 \le x_i, y_i \le 10^9$

Subtask 1 [70%]

$1 \le N \le 5 \times 10^4$

Subtask 2 [30%]

No additional constraints.

Input Specification

The first line contains an integer N, the number of coloured tiles.

The next N lines each contain 2 integers x_i and y_i, the coordinates of the i-th coloured tile. If the tile is a square, these coordinates indicate its bottom-left corner. If it is an octagon, they indicate the bottom-left corner of its central square.
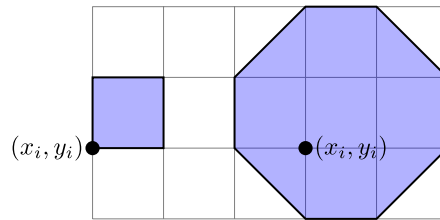
All tile coordinates are guaranteed to be valid, and the coloured tiles are guaranteed to form a single polygon with no holes.

Output Specification

On the first line, output K, the number of vertices of the coloured polygon.

On the j-th of the next K lines, output the x and y coordinates of the j-th vertex. The vertices should be outputted in clockwise order (in other words, if you imagine walking from one vertex to the next, the polygon should always be to your right). You must start with the vertex with the least x coordinate, breaking ties by choosing the vertex with the least y coordinate.

Sample Input 1

```
1
2 0
```

Sample Output 1

```
8
1 0
1 1
2 2
3 2
4 1
4 0
3 -1
2 -1
```

Sample Input 2

```
4
2 0
4 0
6 0
4 -2
```

Sample Output 2

```
18
1 0
1 1
2 2
3 2
4 1
5 1
6 2
7 2
8 1
8 0
7 -1
6 -1
6 -2
5 -3
4 -3
3 -2
3 -1
2 -1
```

Explanation for Sample 2

This case corresponds to the diagram provided in the problem statement.