

7. Lightnings (valgud)

100 points

Juta decided to take up amateur photography during the summer, capturing various natural phenomena. She was particularly captivated by the frequent thunderstorms, during which she saw numerous lightning strikes in an extremely flat and vast field from her window. After some experimentation, she managed to capture the lightning strikes, sometimes with several different lightning bolts in the same picture.

However, upon reviewing her photo collection, Juta noticed that the lightning bolts followed rather boring paths. In her mind's eye, she imagined that lightnings should create more interesting patterns. Help Juta create the most interesting pictures possible to replace some of the actually captured ones.

To maintain credibility, the following properties must be the same between the new and the original picture: (1) the number and locations of starting points of the lightning bolts in the cloud, (2) the number and locations of endpoints of the lightning bolts on the ground, and (3) the number of endpoints of the lightning bolts in the air.

For simplicity, let the ground and the cloud be horizontal planes, with the ground at height 0 and the cloud at height H . A single lightning bolt is defined by a set of points on the image plane, constructed according to the following conditions:

1. Exactly one point is located at one of the given starting points of a lightning strike in the cloud.
2. Every other point is located one unit lower and one unit to either the left or the right of *exactly* one other point.
3. Every point on the ground is located at one of the given impact points.
4. No two points of a lightning bolt are in the same location.
5. At least one of the lightning bolt's points is on the ground.

In addition, all points of different lightning bolts must be at least 2 units apart.

Each lightning bolt can be viewed as a set of (diagonal) line segments connecting the starting point, turning points, branching points, and endpoints of the lightning bolt. We call the corresponding line segments the segments of the lightning bolt.

To compare different pictures, Juta has several metrics, each with a numerical value:

- a. The segments of the lightning bolts should be predominantly short. Numerically, the value of this metric is the sum of the squares of the lengths (ℓ) of all segments of all lightning bolts.
- b. A lightning bolt should have few segments of the same length. Let there be $c_{i,\ell}$ segments of length ℓ in the i -th lightning bolt. The value of this metric is the sum of the squares of the numbers $c_{i,\ell}$ over all lightning bolts and all values of ℓ .
- c. The branches of a lightning bolt should be far from each other. For the lower endpoint of each segment of a lightning bolt, we find the closest point of any lightning bolt *at the same height*; let this be at a distance d (if there are no other lightning bolt points at that height, then let $d = 10^9$). The value of this metric is the sum of the inverse squares ($\frac{1}{d^2}$) over all lightning bolts and segments.
- d. The endpoints of the lightning bolts in the air should be high above the ground. The value of this metric is the sum of the reciprocal values of the heights of the endpoints of the lightning bolt in the air over all lightning bolts and all endpoints in the air.

- e. The endpoints of the lightning bolts in the air should appear in groups. Let the distance between two different endpoints in the air be D . The value of this metric is the sum of the values of the expression

$$\frac{(D - 10)^2}{D^4}$$

over all unordered pairs of endpoints in the air (we only consider pairs whose elements are different points).

To get the total score, the value of each metric is multiplied by a separate coefficient that expresses its relative importance. *The coefficients are given in each test, may differ between tests, and may be equal to zero.* Let the numerical values of the above metrics be h_a , h_b , h_c , h_d , and h_e , respectively; then the total score h is found by the formula

$$h = k_a \cdot h_a + k_b \cdot h_b + k_c \cdot h_c + k_d \cdot h_d + k_e \cdot h_e ,$$

where the values of k_* are the given coefficients. *The smallest possible value of h is considered the best.*

Input. The first line of the input contains four non-negative integers: the number of lightning start points N ($N \geq 1$), the number of lightning end points on the ground M ($M \geq N$) and in the air K , and the height of the cloud from the ground H .

The second line of the input contains N different integers A_1, \dots, A_N in ascending order ($0 < A_1 < \dots < A_N$), where A_i is the x -coordinate of the starting point of the i -th lightning bolt in the cloud (the x -axis is parallel to the ground).

The third line of the input contains M different integers B_1, \dots, B_M in ascending order ($0 < B_1 < \dots < B_M$), where B_i is the x -coordinate of the i -th impact point on the ground.

The fourth line of the input contains the non-negative real coefficients k_a , k_b , k_c , k_d , and k_e .

It is guaranteed that for each given input there exists at least one set of lightning bolts that meets the conditions of the problem.

Output. Output the descriptions of N lightning bolts in the same order as their starting points are listed in the input. On the first line of the description of each lightning bolt, output an integer S_i , which denotes the total number of points the lightning bolt passes through or hits. On the following S_i lines, output two integers X_i and Y_i ($|X_i| \leq 10^6$, $0 \leq Y_i \leq H$), the x - and y -coordinates of one point. The order of the points of a single lightning bolt is not important.

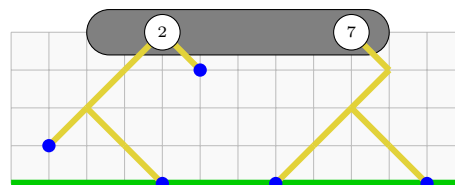
The sum of all S_i must not exceed $2 \cdot 10^6$.

Grading. In this task, the testing environment provides ten input files from `input_001.txt` to `input_010.txt`, and the solution requires submitting the corresponding output files from `output_001.txt` to `output_010.txt`. It is not necessary to submit all output files at once. Submitting the program is not necessary and will not be graded.

Each correct solution to a test receives $10 \cdot \frac{p}{h}$ points, where h is the total score of the submitted solution and p is the best (lowest) total score over all correct solutions submitted by all contestants. The best score may change during the competition, and the final score for each solution will be determined only at the end of the competition.

A solution that does not meet the conditions of the problem, for example, a solution that does not follow the output format or describes incorrect lightning bolts, always receives 0 points and is not taken into account when determining p .

Example.	Input	Output
	2 3 2 4	7
	2 7	2 4
	2 5 9	1 3
	1.0 2.0 4.0 0.0 0.0	3 3
		0 2
		-1 1
		1 1
		2 0
		7
		7 4
		8 3
		7 2
		6 1
		5 0
		8 1
		9 0



The figure visualizes the sample input and output. The first lightning bolt described in the output consists of four segments and has one endpoint on the ground and two in the air. The second lightning bolt consists of four segments and has two endpoints on the ground. The numerical values of the metrics for the given solution are $h_a = 40$; $h_b = 16$; $h_c \approx 0.87$; $h_d \approx 1.33$ and $h_e \approx 0.08$, and the total score is $h \approx 75.46$.