Ornithology

In a research project, you have been studying the flying behavior of a flock of brent geese[1]. Your team has equipped s geese with little sensors that give you their position at discrete points in time (a series of three-dimensional points). The sensors are not completely reliable. You see that some paths have much less points than others, but what you know for sure is that for each goose, you receive at most n points and that those points are in the correct order. We call such an ordered series $P_i = p_{i1}, \ldots, p_{im_i}$ of $m_i \leq n$ points a *goose path*. The points are from $\mathbb{R}^3$, but have integer coordinates.

Now you want to compute a representative flight path of the flock, i.e., you want to compute a goose path $R = r_1, \ldots, r_n$ that roughly summarizes the paths of all geese in the flock. R does not have to be one of the actually observed goose paths (but it can be).

Now it is not obvious how to even judge how well $R = r_1, \ldots, r_n$ fits a different goose path $P = p_1, \ldots, p_m$. In order to define this, you match R and P, more precisely, you match their vertices. Indeed you compute an *optimal* matching $M = (i_1, j_1), \ldots, (i_t, j_t)$ under the following conditions:

1. $i_1, j_1 = 1$, $i_t = n$, $j_t = m$.
2. $\forall (i_u, j_u) \in M : i_{u+1} - i_u \in \{0, 1\}$ and $j_{u+1} - j_u \in \{0, 1\}$.
3. $\forall (i_u, j_u) \in M : (i_{u+1} - i_u) + (j_{u+1} - j_u) \geq 1$.

You claim that $d(R, P) := \min_{\text{all legal} M} \max_{(i_u, j_u) \in M} ||r_{i_u} - p_{j_u}||$ is a nice distance measure for goose paths: One can imagine $d(R, P)$ as the maximum distance of two birds that (discretizedly) fly along R and P, following an optimal matching of the two paths. This measure looks quite complicated, but at least you have shown that it actually defines a metric on the space of all goose paths[2].

Your task is to compute a 2-approximation to the optimal representative R. The optimal representative R is a goose path for which the maximum of $d(R, P)$ is minimized, where $d(R, P)$ itself stems from an optimal matching between R and P. We call the optimum distance d^*:

$$d^* = \min_{R = r_1, \ldots, r_n} \max_{j \in \{1, \ldots, s\}} d(R, P_j)$$

Input: The first line contains s, the second line contains n. The following s lines define the goose paths. Each starts with an integer $m_i \leq n$, the number of points for the ith goose path. This number is followed by the $3 \cdot m_i$ integers which are the ordered m_i points of the ith goose path.

Output: Compute a number that is at least d^* and at most $2d^*$. To avoid rounding problems, **output the square of the number**, i.e., output X^2 with $d^* \leq X \leq 2d^*$.

Sample Input:

```
2
4
3 0 0 8 2 0 8 6 0 8
3 0 2 8 4 2 8 6 2 8
```

[1] That's birds.

[2] This is not completely true because two paths can have distance 0 even though their vertices are not identical (if they repeat different points). However, this is unimportant for the exercise.

Sample Output:

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2
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In this example, $\sqrt{2}$ *is the optimum value. Thus, outputting* 2 *is allowed and optimal. However, solutions up to* $2 \cdot \sqrt{2}$ *would be permitted, i.e., outputs up to* $(2\sqrt{2})^2 = 8$ *are accepted. Here is a picture illustrating the optimum representative path and the two matchings with the two input paths (the picture ignores the third coordinate):*