Marathon of Parallel Programming - 2022
Problem: k-Nearest Neighbors Classifier

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Problem definition

Given a set of two-dimensional points S divided intro n groups, an integer k and a two-dimensional point P to be classified, the k-Nearest Neighbors (KNN) algorithm can be used to solve the classification problem of the point P, i.e., classifying the point P into one of the n existing groups based on some criteria.

The KNN algorithm works by comparing the distances from each point $s \in S$ to the point P, then selecting the k points with the smallest distance values and counting the frequency of each group in these k points, the point P is then classified to belong to the group with the highest frequency among the k nearest points.

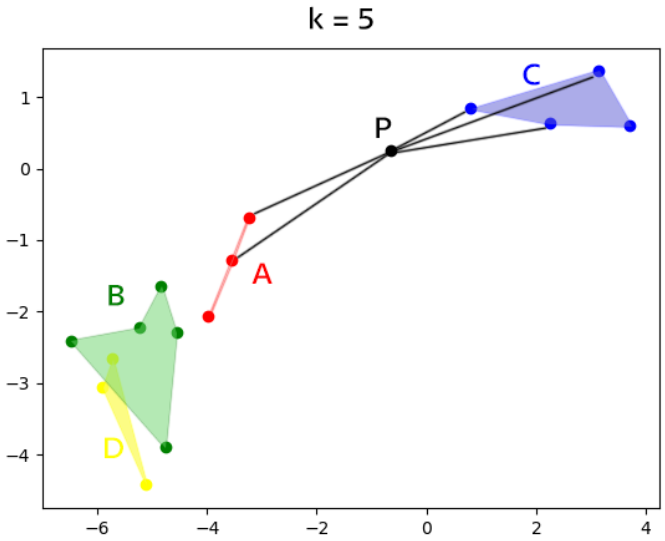

Figure 1: Simple example of the KNN classification.

The Figure 1 illustrates an example of the KNN classification algorithm being applied. The points have been segregated between 4 different groups (*i.e.*, A, B, C and D) and a point P with no group is provided to be classified, the KNN algorithm then searches for the k points closest to the point P and, after that, the groups have their frequencies counted, with the highest frequency being chosen as the classification of P, in the case of this example, the point P is classified to belong to the group C.

Input

An input represents the classification of a single point. The first line contains the pattern "n_groups=n", where n is the total number of groups in this input. Then, for each of the n groups the following lines will be provided, the first line has the pattern "label=c" where c is a single character that represents the label (*i.e.*, identification) of the group, then the second line follows the pattern "length=L", where L is the number of two-dimensional points in this group and then, the next L lines contain the pattern "(x,y)" that represents each point that belongs to the aforementioned group. After all groups have been represented there's a single line with the pattern "k=k", where k is the parameter previously discussed. Lastly, the final line also contains the pattern "(x,y)", representing the coordinates to the two-dimensional point to be classified.

The input must be read form the standard input.

Output

The output contains a single character, it being the label of the group chosen as the classification of the provided point.

The output must be written to the standard output.

Example

Input example	Output example
n_groups=4 label=A length=3 (-3.55,-1.28) (-3.99,-2.06) (-3.23,-0.70) label=B length=5 (-4.85,-1.65) (-5.23,-2.22) (-4.75,-3.89) (-6.48,-2.41) (-4.56,-2.29) label=C length=4 (2.25,0.64) (0.80,0.85) (3.13,1.37) (3.71,0.59) label=D length=3 (-5.73,-2.65) (-5.11,-4.41) (-5.92,-3.06) k=5 (-0.65,0.25)	C