CS3201Algorithm Design Project Report

Problem: 1726 Visits

Submitted to:

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By:

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Introduction:

1726. Visits

Time limit: 1.0 second
Memory limit: 64 MB
Difficulty: 241
The program committee of the school programming contests, which are often held at the Ural State University, is a big, joyful, and united team. In fact, they are so united that the time spent together at the university is not enough for them, so they often visit each other at their homes. In addition, they are quite athletic and like walking.
Once the guardian of the traditions of the sports programming at the Ural State University decided that the members of the program committee spent too much time walking from home to home. They could have spent that time inventing and preparing new problems instead. To prove that, he wanted to calculate the average distance that the members of the program committee walked when they visited each other. The guardian took a map of Yekaterinburg, marked the houses of all the members of the program committee there, and wrote down their coordinates. However, there were so many coordinates that he wasn't able to solve that problem and asked for your help.
The city of Yekaterinburg is a rectangle with the sides parallel to the coordinate axes. All the streets stretch from east to west or from north to south through the whole city, from one end to the other. The house of each member of the program committee is located strictly at the intersection of two orthogonal streets. It is known that all the members of the program committee walk only along the streets, because it is more pleasant to walk on sidewalks than on small courtyard paths. Of course, when walking from one house to another, they always choose the shortest way. All the members of the program committee visit each other equally often.

Input

The first line contains the number n of members of the program committee ($2 \le n \le 10^5$). The i-th of the following n lines contains space-separated coordinates x_i, y_i of the house of the i-th member of the program committee ($1 \le x_i, y_i \le 10^6$). All coordinates are integers.

Output

Output the average distance, rounded down to an integer, that a member of the program committee walks from his house to the house of his colleague.

Sample

input	output
3 10 10 20 20 10 20	13

Problem Author: Denis Dublennykh
Implementation

```python
N = int(input())
x = []
y = []
ans = 0
for i in range(N):
    temp = input().split()
    x.append(int(temp[0]))
    y.append(int(temp[1]))
x.sort()
y.sort()
for i in range(1,N):
    temp = (x[i] - x[i-1] + y[i] - y[i-1])
    temp *= ((i * (N - i)) * 2)
    ans += temp
ans /= (N*(N-1))
print(int(ans))
```

Explanation

Line1: Take in input of the number of points

Line2 and Line3: Create empty array for storing coordinates X and Y respectively

Line4: Initialize the ans to be zero

Line5: Make a loop from 0 to N-1

{Start for loop}

Line6: Spilt user input of coordinates X and Y

Line7 and Line8: Append the X and Y coordinates into the corresponding arrays

{End for loop}

Line9 and Line 10: Sort the array X and Y in ascending order

Line11: Loop from 1 to N-1

{Start for loop}

Line12: calculate the distance between x[i] – x[i-1] + y[i] – y[i-1] and store it in temp

Line13: Multiply the temp by the number of times we will have to pass through the distance of temp (i * (N – i) * 2),where i is the current position in the index, and where N is the total number of points
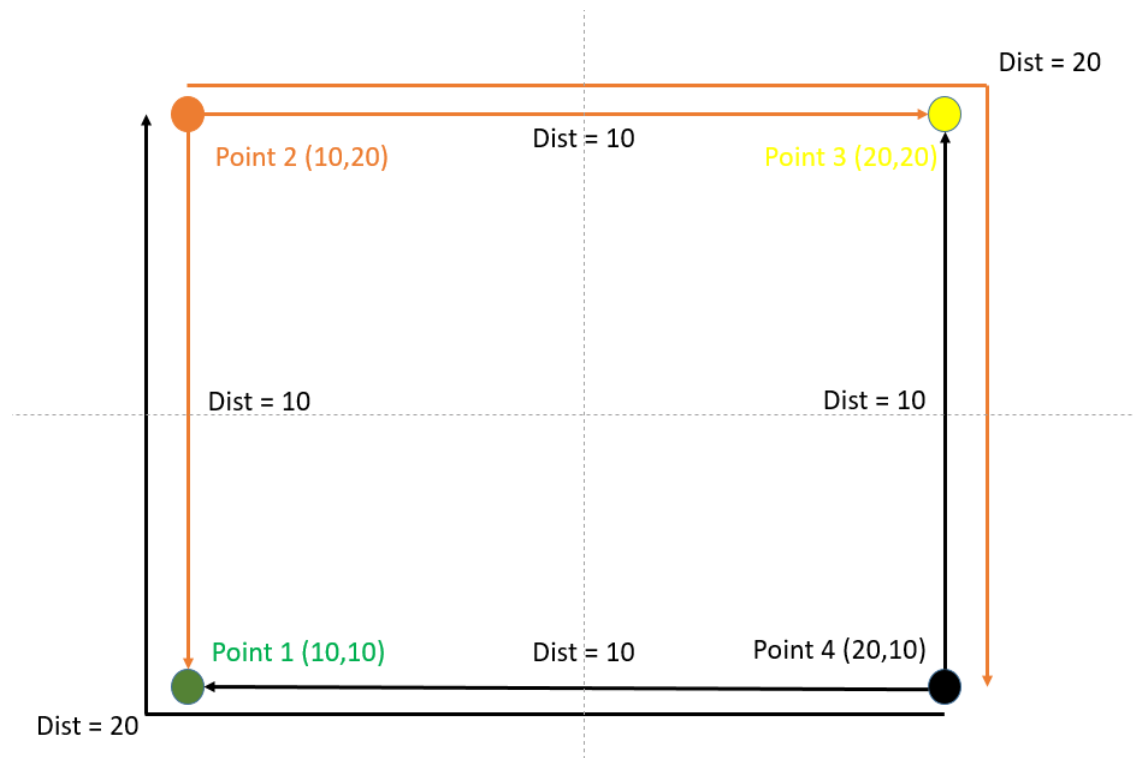
Line14: add the temp to the ans variable

{End for loop}

Line15: We divide the ans by N(N-1), where N is the total number of points to get the average distance between all points

Line1: Print the ans in integer to show the result.

Explanation:

$(40 \times 4)/(4(4-1)) \approx 13$

In order to reach from one point to all the other points, we need to walk a distance of 10 + 10 + 20, which the total would be 40. We have four points in this example therefore the total distance between all point would be 40 x 4 = 160.

In our case of the solution we sort the coordinates X and Y in ascending order, then we find the distance between point i with the next point in the array, then we use this distance to multiply it with the number of time we have to cross this path which is 2(i (N - i)), where i would be the number of points that are already visited before and (N - i) would be the number of remaining points to be visited. The whole result i(N - i) is then multiplied by 2 because we have to again go back through the same path.

Once we have the total distance from each point to the others we find the average distance between all points. We can achieve this by dividing the total distance with the total number of path from each point to the others by using (N (N-1)) formulas, where N is the total number of points, because we have 4 points in this example our total number of path would be (4(4-1)) paths = 12 paths. We then divide the total distance between all points with the total number of paths (160/12) to get the answer 13.

Submission

ID	Date	Author	Problem	Language	Judgement result	Test #	Execution time	Memory used
8655975	12:53:31 27 Nov 2019	Sorasit	1726. Visits	Python 3.6	Accepted		0.78	4 896 KB
8655267	20:58:58 26 Nov 2019	Sorasit	1726. Visits	Python 3.6	Wrong answer	2	0.062	268 KB
8655265	20:57:44 26 Nov 2019	Sorasit	1726. Visits	Python 3.6	Wrong answer	1	0.062	280 KB

Running Time Analysis

```
C:\Users\Poom\Documents\Visual Code\AD>python Project.py
4
10 10
10 20
20 10
20 20
13
input size:  4
Count of loops 3
```

Time complexity = O(n-1) ≈ O(n), where n is the total number of points

References

Timus Discussion

- **https://acm.timus.ru/forum/thread.aspx?id=23318&upd=635888511458343789**
- **https://acm.timus.ru/forum/thread.aspx?id=36132&upd=636297043575929093**