Angels in Space

Let's talk about ~~angels~~ angles in space!

Given three non-collinear points, A, B, and C, let $\operatorname{angle}(A,B,C)$ be the *measure* of the angle formed by the rays $\overrightarrow{BA}$ and $\overrightarrow{BC}$.

Note that $0 < \operatorname{angle}(A,B,C) < \pi $ always holds.

Given N points, $P_0, \ldots, P_{N - 1}$, three points, (P_i,P_j,P_k) with $i < j < k$, are randomly and uniformly selected. Compute the expected value of $\operatorname{angle}(P_i,P_j,P_k)$. Give your answer in radians.

Note: The points are 3D!

Resources

Dot Product
Cross Product

Input Format

The first line contains a single integer, N, denoting the number of points. The next N lines describe the points.

The ith subsequent line describes a point in the form of three space-separated integers: x_i, y_i, and z_i, respectively.

Constraints

- $3 \le N \le 100$
- $-10^4 \le x_i, y_i, z_i \le 10^4$
- *No three points are collinear.*

Output Format

Print a single real number: the expected value of $\operatorname{angle}(P_i,P_j,P_k)$ in radians. Your answer is considered to be correct if the absolute error from the correct answer is at most 10^{-8}.

Sample Input

```
4
0 0 0
2 0 0
2 2 1
0 2 1
```

Sample Output

```
1.20593249868
```

Explanation

The sample input contains $N = 4$ points which are vertices of a rectangle in space.

There are four choices for (P_i,P_j,P_k), each equally likely:

- $(P_1,P_2,P_3): \operatorname{angle} = \pi/2$
- $(P_1,P_2,P_4): \operatorname{angle} \approx 0.841068670568$
- $(P_1,P_3,P_4): \operatorname{angle} \approx 0.841068670568$
- $(P_2,P_3,P_4): \operatorname{angle} = \pi/2$

Thus, the expected value is:
$\approx \frac{1}{4}\left(\pi/2 + 0.841068670568 + 0.841068670568 + \pi/2 \right)$
≈ 1.20593249868