

Problem 11: The Fault in Our Bricks 2: Forever in Code

12 Points

Problem ID: `cylinder`

Rank: 4

Introduction

After his first week of [ASTRON C10](#), Big Ben realizes his hypothesis was [wrong](#)! It turns out that he fundamentally misunderstood how stars in the sky work—they're actually scattered in 3D space, not 2D! Determined to refine his hypothesis, he scribbles down a bunch of floating coordinates on a napkin and ran straight to you, panting and yelling something about "rectangular prisms in the [firmament](#)."

Problem Statement

This is a harder version of [circle](#)! Key changes in `cylinder` are highlighted.

There is a **rectangular prism** located somewhere in **3D space**. You are given a set of N points by their decimal (not necessarily integer) coordinates $(X_1, Y_1, Z_1), (X_2, Y_2, Z_2), \dots, (X_N, Y_N, Z_N)$ sampled uniformly at random from the **surface** of the **rectangular prism**.

Furthermore, the following information is guaranteed:

- The sampled points uniquely describe a single **rectangular prism**. In other words, there does not exist a different **rectangular prism** from which these exact points could have been sampled.
- The sampled points have coordinate values between -10^3 and 10^3 .
- The edges of the **rectangular prism** have a length between 1 and 10^3 .

Using this information, find the **volume** of the **rectangular prism**.

Input Format

The first line of the input contains a single integer T denoting the number of test cases that follow.
For each test case:

- The first line contains a single integer N denoting the total number of points sampled.
- The next N lines each contain 3 space-separated decimals X_i Y_i Z_i denoting the given points of the rectangular prism.

Output Format

For each test case, output a single decimal denoting the volume of the rectangular prism.

Your answer will be considered correct if it has an [absolute or relative error](#) less than 10^{-5} from the actual answer.

Constraints

$$1 \leq T \leq 100$$

$$15 \leq N \leq 1000$$

$$-10^3 \leq X_i \leq 10^3$$

$$-10^3 \leq Y_i \leq 10^3$$

$$-10^3 \leq Z_i \leq 10^3$$

Sample Test Cases

Note: There are no download links for the sample input/output for this problem.

Sample Input

```
2
15
-10.220000 11.500000 16.070000
-16.840000 -2.580000 -17.000000
20.500000 1.970000 0.840000
-15.160000 -11.500000 7.870000
-5.250000 -7.590000 -17.000000
14.080000 8.220000 17.000000
-20.500000 11.200000 -13.230000
17.970000 -11.500000 16.350000
-15.570000 -11.500000 13.880000
-7.700000 6.470000 -17.000000
20.500000 8.480000 0.690000
20.500000 1.470000 13.350000
0.210000 11.500000 7.630000
0.410000 11.500000 5.010000
9.680000 -3.200000 -17.000000
15
-3.028172 -24.480620 9.789910
4.176684 24.181432 -32.099666
13.482567 1.540450 -32.121978
11.443827 12.858622 -12.509643
-4.622740 6.638379 14.274379
-13.173013 16.648120 19.895405
-26.352370 5.326689 27.037033
-10.796030 8.520057 21.797129
12.143485 26.221863 -22.161315
-5.815366 20.433307 -11.744593
-1.978139 -3.588701 -6.903093
1.098876 -15.531449 -3.520380
23.497727 -12.340841 -29.460849
-10.978229 -22.928202 28.463432
-10.365286 -13.651728 31.300019
```

Sample Output

```
32062.00
37674.00
```