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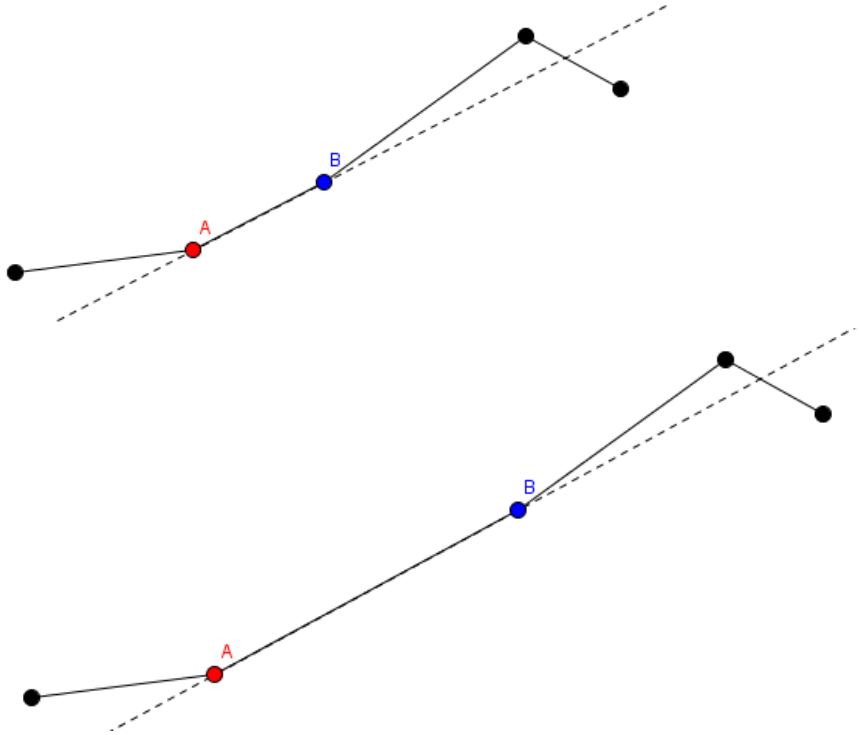
E. Robot Arm

time limit per test: 8 seconds
memory limit per test: 256 megabytes
input: standard input
output: standard output

Roger is a robot. He has an arm that is a series of n segments connected to each other. The endpoints of the i-th segment are initially located at points $(i - 1, 0)$ and $(i, 0)$. The endpoint at $(i - 1, 0)$ is colored red and the endpoint at $(i, 0)$ is colored blue for all segments. Thus, the blue endpoint of the i-th segment is touching the red endpoint of the $(i + 1)$-th segment for all valid i.

Roger can move his arm in two different ways:

1. He can choose some segment and some value. This is denoted as choosing the segment number i and picking some positive l. This change happens as follows: the red endpoint of segment number i and segments from 1 to $i - 1$ are all fixed in place. Imagine a ray from the red endpoint to the blue endpoint. The blue endpoint and segments $i + 1$ through n are translated l units in the direction of this ray.



In this picture, the red point labeled A and segments before A stay in place, while the blue point labeled B and segments after B gets translated.

2. He can choose a segment and rotate it. This is denoted as choosing the segment number i, and an angle a. The red endpoint of the i-th segment will stay fixed in place. The blue endpoint of that segment and segments $i + 1$ to n will rotate clockwise by an angle of a degrees around the red endpoint.

Wunder Fund Round 2016 (Div. 1 + Div. 2 combined)

Finished

Practice

→ Virtual participation

Virtual contest is a way to take part in past contest, as close as possible to participation on time. It is supported only ACM-ICPC mode for virtual contests. If you've seen these problems, a virtual contest is not for you - solve these problems in the archive. If you just want to solve some problem from a contest, a virtual contest is not for you - solve this problem in the archive. Never use someone else's code, read the tutorials or communicate this other person during a virtual contest.

Start virtual contest

→ Submit?

Language: GNU G++ 5.1.0

Choose file: 选择文件 未选择任何文件

Be careful: there is 50 points penalty for submission which fails the pretests or resubmission (except failure on the first test, denial of judgement or similar verdicts). "Passed pretests" submission verdict doesn't guarantee that the solution is absolutely correct and it will pass system tests.

Submit

→ Problem tags

data structures

No tag edit access

→ Contest materials

- Announcement
- Tutorial

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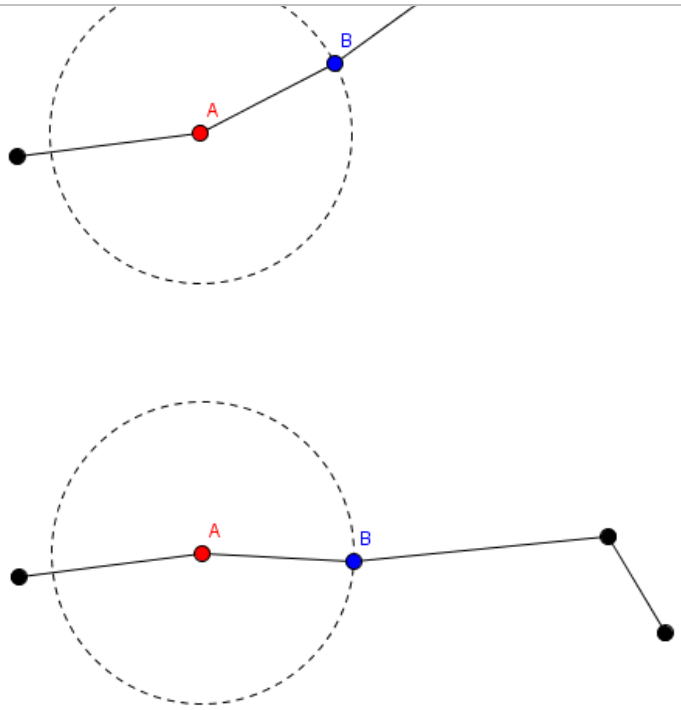

In this picture, the red point labeled A and segments before A stay in place, while the blue point labeled B and segments after B get rotated around point A.

Roger will move his arm m times. These transformations are a bit complicated, and Roger easily loses track of where the blue endpoint of the last segment is. Help him compute the coordinates of the blue endpoint of the last segment after applying each operation. Note that these operations are cumulative, and Roger's arm may intersect itself arbitrarily during the moves.

Input

The first line of the input will contain two integers n and m ($1 \le n, m \le 300\,000$) — the number of segments and the number of operations to perform.

Each of the next m lines contains three integers x_i, y_i and z_i describing a move. If $x_i = 1$, this line describes a move of type 1, where y_i denotes the segment number and z_i denotes the increase in the length. If $x_i = 2$, this describes a move of type 2, where y_i denotes the segment number, and z_i denotes the angle in degrees. ($1 \le x_i \le 2$, $1 \le y_i \le n$, $1 \le z_i \le 359$)

Output

Print m lines. The i-th line should contain two real values, denoting the coordinates of the blue endpoint of the last segment after applying operations 1, ..., i. Your answer will be considered correct if its absolute or relative error does not exceed 10^{-4}.

Namely, let's assume that your answer for a particular value of a coordinate is a and the answer of the jury is b. The checker program will consider your answer correct if $\frac{|a-b|}{\max(1,b)} \le 10^{-4}$ for all coordinates.

Sample test(s)

input
5 4 1 1 3 2 3 90 2 5 48 1 4 1
output
8.0000000000 0.0000000000 5.0000000000 -3.0000000000 4.2568551745 -2.6691306064 4.2568551745 -3.6691306064

Note

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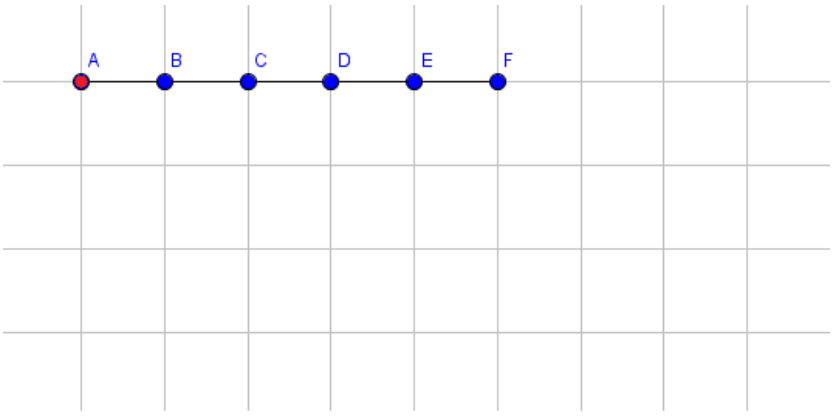
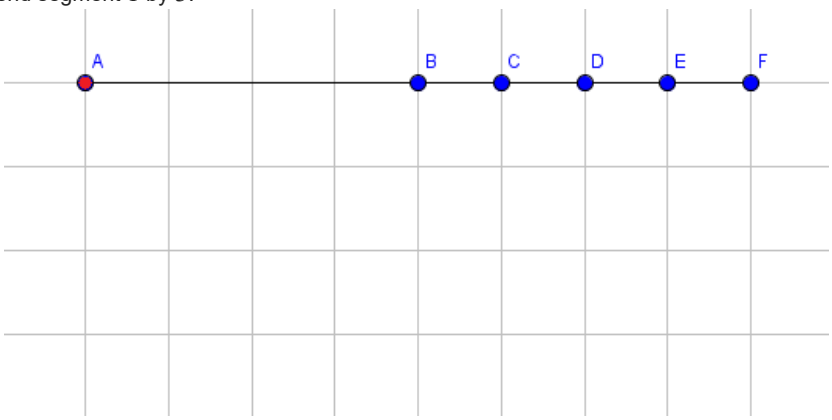
The following pictures shows the state of the arm after each operation. The coordinates of point F are printed after applying each operation. For simplicity, we only show the blue segment 2.

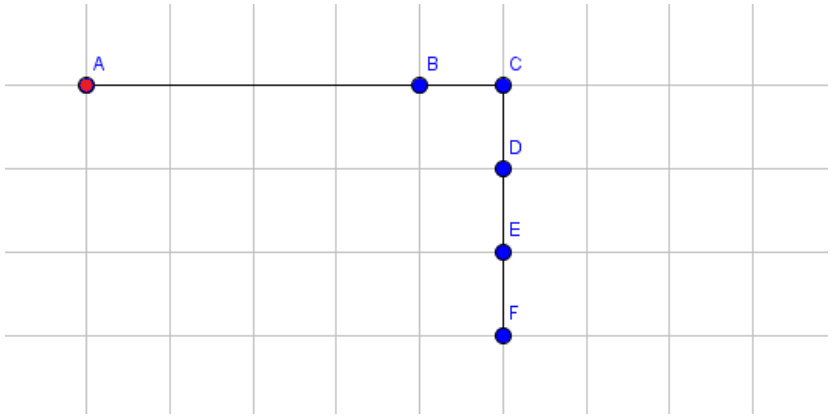
Initial state:



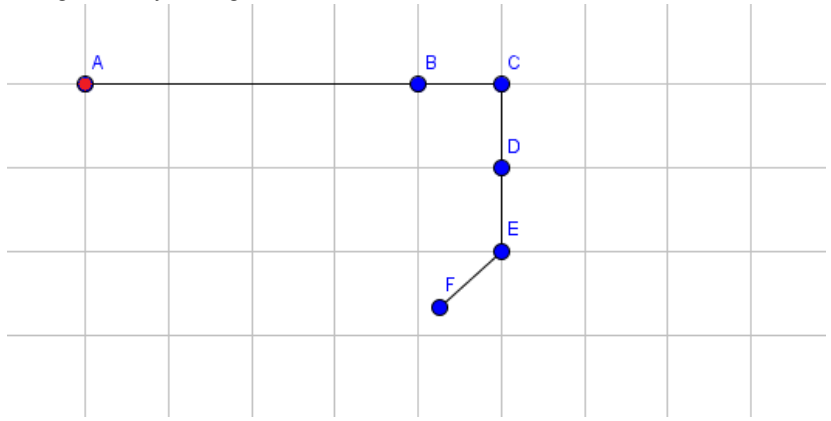
Extend segment 1 by 3.



Rotate segment 3 by 90 degrees clockwise.



Rotate segment 5 by 48 degrees clockwise.



Extend segment 4 by 1.

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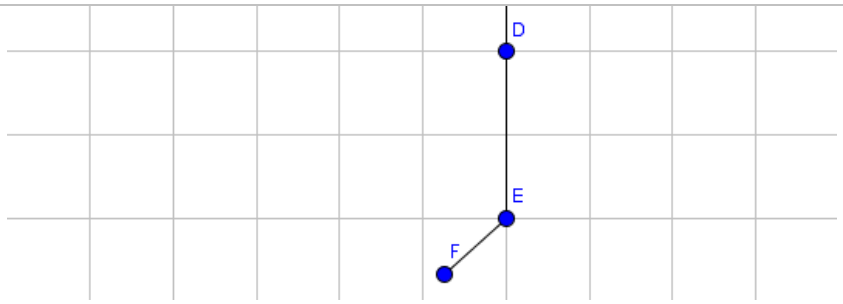

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