CS 577: Introduction to Algorithms	Program 6 - Arbitrage
Out: 16 March 2021	Due: 23 March 2021

Coding Question:

Reminders:

- Must be coded individually in your choice of either Python, Java, C, C++, or C#
- There are hidden testcases
- Submitted through Gradescope
- There is a class-wide runtime leaderboard on Gradescope
- We encourage the use of Piazza for debugging help
- Please do not cheat

Problem:

Arbitrage is the simultaneous buying and selling of an asset in different markets to make profit off of the difference in the asset's price. For example, with currency arbitrage, say 1 USD buys 0.83 Euro, 1 Euro buys 12.934 Japanese Yen, 1 Japanese Yen buys 0.096 USD. By converting currencies through theses exchanges (USD $\rightarrow$ Euro $\rightarrow$ Yen $\rightarrow$ USD), a trader on every 1 USD would earn $1 \cdot 0.83 \cdot 12.934 \cdot 0.096 \approx 1.03$ or about a 3% profit.

You're given a list of values of an asset across different exchanges and must calculate the minimum transaction cost (as an integer percent) so as to eliminate any possible arbitrage if starting and ending in the same exchange. You may assume the asset is infinitely divisible. In the above example, a transaction cost of 1% would remove the arbitrage opportunity.

Input should be read in from stdin. The first line will contain the number of exchanges (n) and the number of possible trades (m) and all subsequent lines will contain 3 inputs, separated by spaces, where the first input is the buying location, the second input is the selling location, and the last input is the integer price (p), in the sell market, of \$100 of the asset in the buy market.

Constraints:

- $1 \leq n \leq 100$
- $1 \leq m \leq 10000$
- $1 \leq p \leq 500$

Sample Test Case 1:

Input:

```
2 2
NYSE JPX 110
JPX NYSE 110
```

Output:

```
10
```

Explanation:

Trading the asset from NYSE to JPX and back results in $110\% * 110\% = 121\%$ profit. The minimum cost solves $110 * (1 - x) * 110 * (1 - x) \leq 100$. Thus, the minimum cost per trade is $\lceil 9.\overline{09}\% \rceil = 10\%$.

Sample Test Case 2:

Input:

```
5 6
NYSE JPX 110
JPX LSE 90
LSE SSE 110
SSE NYSE 111
SSE AMS 90
AMS NYSE 90
```

Output:

```
5
```

Explanation:

Optimal trade is NYSE $\rightarrow$ JPX $\rightarrow$ LSE $\rightarrow$ SSE $\rightarrow$ NYSE for profit of 120.879%. This is the highest possible profit if starting and ending in the same exchange. Thus, the minimum cost per trade solves $120.879(1-x)^4 \leq 100$ for an integer x and is thus $\lceil 4.6\% \rceil = 5\%$