A Matching Engine for MESH-X

A matching engine is a program that accepts orders from buyers and sellers and subsequently conducts trades. You have to design the matching engine for **MESH-X**, a unique market with its own set of rules.

Introduction: Suppose Mal intends to buy 100 shares of Global Widget Corp (GWC), and the maximum price he is ready to pay *per share* is $99. This is a **Limit Order**, since he has specified the limiting criteria – the maximum quantity he needs and the maximum price he is willing to pay. A limit order to buy is called a **Bid**. Similarly, if Jayne wishes to sell 200 shares of GWC and the minimum price she is willing to accept per share is $101, she would send a limit order to sell, which is called an **Offer.** MESH-X accepts limit orders continuously and these form the **Order Book**.

If Mal & Jayne's orders from the above example are the only orders, no trade can happen, since Mal is only willing to pay up to $99, but Jayne would only accept a minimum of $101. Now, Zoe come in with a limit order to buy 100 shares for $101. Bueno! We can have a trade here - Zoe buys 100 shares from Jayne for $101. After the trade, Jayne's offer remains on the order book, but with 100 shares outstanding.

But, what if the limit price on Zoe's bid was $102 ? The trade would still be conducted at $101, even though Jayne would be happier to sell at $102. The trade price is determined at the limit price of the order that came *earlier* to the order book. A trade is immediately conducted upon receipt of a limit order whenever possible, after which the quantity on the interacting bids or offers on the order book is reduced by the quantity traded.

Priority Rules: MESH-X uses **Price** - **Size** - **Time** priority for conducting trades. Thus, when an incoming sell (buy) order can trade with multiple available bids (offers), the following hierarchy is used.

1) Price : Bids (Offers) with higher (lower) price trade first
2) Size: If there are multiple bids (offers) at the same price, they are traded in descending order of size
3) Time: If price and size are equal, bids (offers) sent earlier to the matching engine would trade earlier

Check out the examples on next page.

Inventory: When Kaylee buys 100 shares from Inara, Kaylee's inventory goes *Long* by 100 while Inara's inventory goes *Short* by 100.
Consider a sequence of Jayne's trades: Buy 30, Sell 100, Sell 60, Buy 100
Total Long positions: 30 + 100 = 130; Total Short Positions: 100 + 60 = 160; Net Position: Short 30

Dataset: orders.csv contains a list of limit orders sent to MESH-X during a trading day.
The entries have the following format: ID, party, price, quantity, timestamp, side
Example: 673, River, 100.42, 200, 100044, BUY
This means River placed an order at timestamp 100044 to buy 200 shares at price $100.42

Problem - What is Kaylee's net position at the end of the day?
You may use any programming language of your choice to answer the question, as also available standard libraries, but we are looking for a **clear**, **efficient** & **concise** code. For verifying your answer and further instructions on submitting your application, please check the following link.
www.meshcapital.com/instructions-<X><num>.html
Here <X> = L or S depending upon Kaylee being net long or short respectively;
<num> is the absolute value of net position.

Apart from the correct answer, your application should contain your resume, source code and brief answers to the following questions.
1. If orders.csv contains N entries, and the average number of bids / offers on order book is M, what is the time complexity of your solution?
2. Why do you consider your solution efficient or can you think of anything to improve performance ?

Examples

Each example independently shows the status of the order book, with bids or offers and the timestamp of entry. The trades that result from a subsequent incoming order illustrate Price-Size-Time priority logic of MESH-X.

Example 1

Incoming order : Zoe wants to buy 350 shares at $102

Order Book (offers)	Trades
Time 002: Jayne wants to sell 100 shares at price $101 Time 005: Simon wants to sell 100 shares at price $101 Time 003: River wants to sell 400 shares at price $102	Jayne sells 100 shares to Zoe at $101 Simon sells 100 shares to Zoe at $101 River sells 150 shares to Zoe at $102

Matching Logic : Lower offer prices have higher priority. Note the sell order trades with 2 different bid prices. After the 3 trades, River's offer remains on the book but with 250 shares outstanding.

Example 2

Incoming order : River wants to sell 50 shares at $99

Order Book (bids)	Trades
Time 004: Kaylee wants to buy 100 shares at price $100 Time 007: Inara wants to buy 100 shares at price $100 Time 003: Zoe wants to buy 400 shares at price $99	River sells 50 shares to Kaylee at $100

Matching Logic: Both Kaylee and Inara have same price and quantity, but Kaylee's order came earlier. Higher bid prices have higher priority.

Example 3

Incoming order : Zoe wants to buy 550 shares at $102

Order Book (offers)	Trades
Time 008: Jayne wants to sell 200 shares at price $101 Time 010: Inara wants to sell 300 shares at price $101 Time 012: Simon wants to sell 400 shares at price $101 Time 004: River wants to sell 600 shares at price $102	Simon sells 400 shares to Zoe at $101 Inara sells 150 shares to Zoe at $101

Matching Logic: With 3 offers at the lowest price, Simon's order gets first priority followed by Inara's on the basis of available size. Note that after this trade, Inara's offer would have 150 shares outstanding and for subsequent trades, Jayne's offer with 200 shares would have highest priority.

Example 4

Incoming order : Mal wants to buy 300 shares at price $102

Order Book	Trades
Bid side: Time 006: Shephard wants to buy 200 shares at $98 Offer side: Time 007: Inara wants to sell 100 shares at price $101 Time 004: Mal wants to sell 100 shares at price $102 Time 002: Simon wants to sell 200 shares at price $105	Inara sells 100 shares to Mal at $101 Mal sells 100 shares to Mal at $102

Matching Logic: Inara's and Mal's offers partially fill the buy order from Mal. The remaining 100 shares from the incoming buy order stays on the book as a new bid at $102. Also note that Mal actually traded with himself for 100 shares.

Good Luck !