

Rabia Syed
BSCS-24103

Stock Market Matching Engine

Main Features

- Users (Create Users)
- Place Orders
- View Portfolio
- Automatic Trade
- Full Order Book
- View Trade History
- Cancel Order

Data Structures I am Using And Why

- Hash Map – For Quick Lookup
 - OrderID – Orders
 - UserID – Users
 - Symbol- OrderBook
- BTree – To maintain Order Book
 - Sell Tree
 - Buy Tree
- OrderQueue – If there are multiple orders of same prices

Completed

- All the functionalities
- Create user, portfolio , automatic trade
- Slight Issue in Cancel order.

What is Left to Implement

- Socket Programming To connect Backend and Frontend
- Frontend

Demo

```
== MATCHING ENGINE TEST SUITE ==
Created user alice with $100000
Created user bob with $100000
Created user charlie with $50000

Test users created

--- TEST 1: Basic Order Matching ---
Placed BUY order: 1
Trade executed: TradeID: 1 , Symbol: AAPL , Qty: 100 , Price: $150.00 , BuyOrder: 1 (alice) , SellOrder: 2 (bob) , Timestamp: 1765266703
Placed SELL order: 2
Trades executed: 1
    TradeID: 1 , Symbol: AAPL , Qty: 100 , Price: $150.00 , BuyOrder: 1 (alice) , SellOrder: 2 (bob) , Timestamp: 1765266703

--- TEST 2: Partial Fills ---
Placed BUY 200 @ $151
Trade executed: TradeID: 2 , Symbol: AAPL , Qty: 80 , Price: $151.00 , BuyOrder: 3 (alice) , SellOrder: 4 (bob) , Timestamp: 1765266703
Placed SELL 80 @ $151 (partial match)
Trade executed: TradeID: 3 , Symbol: AAPL , Qty: 120 , Price: $151.00 , BuyOrder: 3 (alice) , SellOrder: 5 (bob) , Timestamp: 1765266703
Placed SELL 120 @ $151 (complete match)
    Buy order remaining: 0
    Buy order status: FILLED

--- TEST 3: Order Cancellation ---
Placed BUY order: 6
Cancelled OrderID 6 from BUY side
Cancelled order
    Cash before: $100000
    Cash after: $107450
    Order status: CANCELLED
```

Demo

```
--- TEST 4: Balance Validation ---
Error: Insufficient funds. Need $1e+06, have $50000
  Correctly rejected order (insufficient funds)
Error: Insufficient shares of AAPL
  Correctly rejected order (insufficient shares)

--- TEST 5: Multiple Stocks ---
  Placed GOOGL order
Error: Insufficient shares of TSLA
  Placed TSLA order
  Placed MSFT order
    AAPL best bid: none
    GOOGL best bid: exists
```

Demo

```
--- TEST 6: Concurrent Orders (Thread Safety) ---
Created user user1 with $100000
Created user user2 with $100000
Created user user3 with $100000
```

PORTFOLIO: user1
Cash Balance: \$100000.00
Holdings:
AAPL: 1000 shares
Active Orders: 0
Total Trades: 0

```
Trade executed: TradeID: 4 , Symbol: AAPL , Qty: 70 , Price: $150.00 , BuyOrder: 14 (user2) , SellOrder: 13 (user1) , Timestamp: 1765267215
Trade executed: TradeID: 5 , Symbol: AAPL , Qty: 19 , Price: $150.00 , BuyOrder: 17 (user2) , SellOrder: 13 (user1) , Timestamp: 1765267215
Trade executed: TradeID: 6 , Symbol: AAPL , Qty: 69 , Price: $159.00 , BuyOrder: 19 (user3) , SellOrder: 20 (user2) , Timestamp: 1765267215
Trade executed: TradeID: 8 , Symbol: AAPL , Qty: 71 , Price: $152.00 , BuyOrder: 17 (user2) , SellOrder: 22 (user3) , Timestamp: 1765267215
Trade executed: TradeID: 7 , Symbol: AAPL , Qty: 13 , Price: $159.00 , BuyOrder: 19 (user3) , SellOrder: 21 (user1) , Timestamp: 1765267215
Completed 15 concurrent orders without crashes
    Total trades: 8
```

PORTFOLIO: user1
Cash Balance: \$115417.00
Holdings:
AAPL: 898 shares
Active Orders: 0
Total Trades: 3

```
==== ALL TESTS COMPLETE ===
```