Compile and Run

Compile:

gcc -o client client.c

gcc -o server server.c

Run:

./server <port_num>

./client <server_ip> <server_port>

Login:

1. Run the client as directed above

2. User will be prompted to choose login from two options

3. Choose option 1

4. Enter a valid user name and password to authenticate

5. If login is successful, further options to make a trade are visible.

Buy item:

After successful login, four options are displayed:

1: Send Buy Request

2: Send Sell Request

3: View Order Status

4: View Trade Status

Enter option 1 to make a buy. Then user is prompted to enter item number, quantity and the buy price . On entering all values correctly, trade is placed on the server and executed.

Sell item:

After successful login, four options are displayed:

1: Send Buy Request

2: Send Sell Request

3: View Order Status

4: View Trade Status

Enter option 2 to make a buy. Then user is prompted to enter item number, quantity and the sell price . On entering all values correctly, trade is placed on the server and executed.

View Order Status:

Using the option 3 displays max buy price and least sell price for each item .

```
Item: 0
   Sell for this item:
        No sell available for this item
   Buy for this item:
        No buy available for this item
Item: 1
   Sell for this item:
        No sell available for this item
   Buy for this item:
        No buy available for this item
Item: 2
   Sell for this item:
 Minimum Selling price Item::quantity- 1, price- 60
        quantity- 10, price- 100
   Buy for this item:
        No buy available for this item
Item: 3
   Sell for this item:
        No sell available for this item
   Buy for this item:
        No buy available for this item
Item: 4
   Sell for this item:
        No sell available for this item
   Buy for this item:
        No buy available for this item
Item: 5
   Sell for this item:
        No sell available for this item
   Buy for this item:
        No buy available for this item
Item: 6
   Sell for this item:
        No sell available for this item
   Buy for this item:
        No buy available for this item
Item: 7
   Sell for this item:
        No sell available for this item
   Buy for this item:
        No buy available for this item
Item: 8
   Sell for this item:
        No sell available for this item
   Buy for this item:
        No buy available for this item
Item: 9
   Sell for this item:
```

View Trade Status:

Using the option 4 from the displayed options displays the completed trades in the form as shown

```
Please Select below options :
1: Send Buy Request
2: Send Sell Request
3: View Order Status
4: View Trade Status

Please Select any number(except 1 to 4) to exit from the menu
4

ITEM_NO        BUYER_NAME     SELLER_NAME    QUANTITY        PRICE   BUYER_ID        SELLER_ID

7              neelabh        himanshu              5                20             1
```

Use cases

1. User with Id 2 creates Create two sell requests for Item 2

       2 2 Sell 5 60

       2 2 Sell 10 100

       User with Id 4 creates a buy request for item 2 at price 120

       4 2 Buy 4 120

       As shown in the o/p below using **"View Orders"**, 4 quantities of item 2 for BUY are matched against lowest SP 60, remaining is 1 quantity is available, and one with 100 is entirely available.

```
Item: 0
   Sell for this item:
        No sell available for this item
   Buy for this item:
        No buy available for this item
Item: 1
   Sell for this item:
        No sell available for this item
   Buy for this item:
        No buy available for this item
Item: 2
   Sell for this item:
 Minimum Selling price Item::quantity- 1, price- 60
        quantity- 10, price- 100
   Buy for this item:
        No buy available for this item
Item: 3
   Sell for this item:
        No sell available for this item
   Buy for this item:
        No buy available for this item
Item: 4
   Sell for this item:
        No sell available for this item
   Buy for this item:
        No buy available for this item
Item: 5
   Sell for this item:
        No sell available for this item
   Buy for this item:
        No buy available for this item
Item: 6
   Sell for this item:
        No sell available for this item
   Buy for this item:
        No buy available for this item
Item: 7
   Sell for this item:
        No sell available for this item
   Buy for this item:
        No buy available for this item
Item: 8
   Sell for this item:
        No sell available for this item
   Buy for this item:
        No buy available for this item
Item: 9
   Sell for this item:
```

2. User with Id 2 creates Create two buy requests for Item 4

2 4 Buy 5 10

2 4 Buy 5 15

User with Id 4 creates a sell request for item 2 at price 120

4 4 sell 4 12

As shown in the o/p below using **"View Orders"**, 4 quantities of item 2 for SELL are matched against highest BP 15, remaining is 1 quantity is available, and one with BP as 10 is entirely available.

```
Item: 0
   Sell for this item:
       No sell available for this item
   Buy for this item:
       No buy available for this item
Item: 1
   Sell for this item:
       No sell available for this item
   Buy for this item:
       No buy available for this item
Item: 2
   Sell for this item:
       No sell available for this item
   Buy for this item:
       No buy available for this item
Item: 3
   Sell for this item:
       No sell available for this item
   Buy for this item:
       No buy available for this item
Item: 4
   Sell for this item:
       No sell available for this item
   Buy for this item:
 Maximum buying price for Item::quantity- 1 price- 15
       quantity- 5 price- 10

Item: 5
   Sell for this item:
       No sell available for this item
   Buy for this item:
       No buy available for this item
Item: 6
   Sell for this item:
       No sell available for this item
   Buy for this item:
       No buy available for this item
Item: 7
   Sell for this item:
       No sell available for this item
   Buy for this item:
       No buy available for this item
```

3. B 7 5 20

B 7 10 10

S 7 12 18

5 units of SELL are matched against highest BP of 20 , then remaining 7 units cannot be matched as BP of 10<18. Hence Buy queue has one trade items and sell queue has remaining 5 units at SP 18.

```
Item: 0
   Sell for this item:
        No sell available for this item
   Buy for this item:
        No buy available for this item
Item: 1
   Sell for this item:
        No sell available for this item
   Buy for this item:
        No buy available for this item
Item: 2
   Sell for this item:
        No sell available for this item
   Buy for this item:
        No buy available for this item
Item: 3
   Sell for this item:
        No sell available for this item
   Buy for this item:
        No buy available for this item
Item: 4
   Sell for this item:
        No sell available for this item
   Buy for this item:
        No buy available for this item
Item: 5
   Sell for this item:
        No sell available for this item
   Buy for this item:
        No buy available for this item
Item: 6
   Sell for this item:
        No sell available for this item
   Buy for this item:
        No buy available for this item
Item: 7
   Sell for this item:
 Minimum Selling price Item::quantity- 7, price- 18
   Buy for this item:
 Maximum buying price for Item::quantity- 10 price- 10

Item: 8
   Sell for this item:
        No sell available for this item
```

4. B 6 5 20

 B 6 10 15

 S 6 15 10

5 units of sell are matched against highest BP, then 10 against against second largest , leaving 5 units of buy and none of the sell.

```
Item: 2
   Sell for this item:
       No sell available for this item
   Buy for this item:
       No buy available for this item
Item: 3
   Sell for this item:
       No sell available for this item
   Buy for this item:
       No buy available for this item
Item: 4
   Sell for this item:
       No sell available for this item
   Buy for this item:
       No buy available for this item
Item: 5
   Sell for this item:
       No sell available for this item
   Buy for this item:
       No buy available for this item
Item: 6
   Sell for this item:
       No sell available for this item
   Buy for this item:
       No buy available for this item
Item: 7
   Sell for this item:
       No sell available for this item
   Buy for this item:
       No buy available for this item
Item: 8
   Sell for this item:
       No sell available for this item
   Buy for this item:
       No buy available for this item
Item: 9
   Sell for this item:
       No sell available for this item
   Buy for this item:
 Maximum buying price for Item::quantity- 5 price- 7
```

Implementation details:

Connection creation:

1. Server:
   a. Creates a TCP socket and binds to given port number
   b. Listens for connection request from client.

2. Client:

   a. Creates a TCP socket
   b. Sends connection request to server at given IP and port number.

3. Server:

   Accepts connection and waits for data.

4. Client : sends data over created connection and waits for response.

Login:

Valid user names and passwords are maintained in a file which is read by server on startup. When a login request arrives, entered id and password are compared against that in the file and if it matches, then login is successful else client needs to re-login.

Buy and sell items:

Data structures

Per item buy queue(BQ): Contains buy items sorted in descending order by price

Per item sell queue(SQ): Contains sell items sorted in ascending order by price

Buy request:

1. Sell queue is empty or BP<min(SP): Nothing to match, buy request is placed in BQ and max heap sort performed to place max item at top of the queue
2. Match is found in sell queue: Minimum SP< BP is matched. If buy quantity remains, it is matched again in the same queue, either till no buy quantity remains or no match is found. If no match found, remaining buy quantity is placed in BQ and queue is max-heap sorted again.

Sell Request:

1. Buy queue is empty or SP>max(BP): Nothing to match, sell request is placed in SQ and min heap sort performed to place min sell item at top of the queue
2. Match is found in buy queue: max BP< SP is matched. If sell quantity remains, it is matched again in the same queue, either till no sell quantity remains or no match is found. If no match found, remaining sell quantity is placed in SQ and queue is min-heap sorted again.