

# Algorithmic Trading Developer Technical Assignment – Matching Engine Instruction Manual

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## Contents

Limit Order Book Matching Engine Instruction Manual. ....	3
Startup: .....	3
Running Matching Tests: .....	5
1. Executing Sell Order, price = 7.5, quantity = 100 .....	5
2. Executing Sell order, price = 6.0, quantity = 200 .....	6
3. Execute Sell order, price = 7.0, quantity = 32 .....	7
4. Executing Sell Order, price = 4.9, quantity = 6+46+85+76+50 = 263 .....	7
5. Executing a Sell Order, price = 4.9, quantity = 3.....	8
6. Executing a Buy Order, price = 3.2, quantity = 30+32+62+86+99+50 = 359 .....	9
Reloading Test Data:.....	11
Delete Order.....	12
Modify Order.....	12
BID Price – Quantity view: .....	14
ASK Price – Quantity view: .....	14
Add Order:.....	15

## Limit Order Book Matching Engine Instruction Manual.

### Startup:

When you click start in your IDE to run the application, you will be greeted with a menu with the following options:

- 0 - Exit Application!
- 1 - Load Test Data
- 2 - Display All Orders
- 3 - Add Order
- 4 - Generate Orders (bulk)
- 5 - Modify Order
- 6 - Delete Order
- 7 - Search Price Level
- 8 - BID Price - Quantity
- 9 - ASK Price - Quantity
- 10 - Execute An Order

```
|
Simulation Menu
Please choose from the menu below
Enter the content number and hit enter:
*****
0 - Exit Application!
1 - Load Test Data
2 - Display All Orders
3 - Add Order
4 - Generate Orders (bulk)
5 - Modify Order
6 - Delete Order
7 - Search Price Level
8 - BID Price - Quantity
9 - ASK Price - Quantity
10 - Execute An Order
*****
```

You are to then enter the number corresponding to the function available on the menu, e.g. 0 to Exit Application, 1 to Load Test Data etc.

To display the workings of the matching engine, we first need to load orders into our application. The quickest way to accomplish this would be to load the pre-defined test data.

The other option would be to use the add order function to manually add orders 1 by 1. The pre-defined test data has a range of orders and contains multiple orders at the same prices, this is designed so that we can test and display all scenarios of the Limit Order Book.

For this instruction manual we will use the pre-loaded test data, pressing 1 and enter, and we would have generated our test data. Then from the menu pressing 2 will give us a view of all the orders loaded into the limit order book. You will notice that on the BID side there are 4 orders each of prices 7.0, 6.0, 5.0, 4.0, 3.0. On the ASK side there 5 orders each of prices 3.0, 4.0, 5.0, 6.0, 7.0. There are also 5 random prices with 1 order each on both sides. This is how the test data is generated.

## BIDS:

2 BID	
Price	Orders
79.01	OrderId: BID-238d1e61-0478-4cba-94d4-b2c5f1f03c33, Price= 79.01, Quantity= 42, Side= true
67.34	OrderId: BID-4389dc7d-f79e-40bb-a28d-cbb0ced12a98, Price= 67.34, Quantity= 69, Side= true
57.12	OrderId: BID-a47795b1-9c4a-489e-af28-93f4849a6550, Price= 57.12, Quantity= 98, Side= true
50.72	OrderId: BID-36b3c798-d0da-4e1d-ac0f-bf5c40a230e8, Price= 50.72, Quantity= 98, Side= true
50.19	OrderId: BID-69ec5ba4-0c18-4840-922c-052475f4588a, Price= 50.19, Quantity= 62, Side= true
17.62	OrderId: BID-0add4268-09ff-4c73-892f-202fc074c060, Price= 17.62, Quantity= 32, Side= true
7.0	OrderId: BID-62e3ab87-b3ff-44e2-ab59-e4d29d541deb, Price= 7.0, Quantity= 19, Side= true
7.0	OrderId: BID-2a506581-c6b8-498b-b475-1852d37eebb2, Price= 7.0, Quantity= 26, Side= true
7.0	OrderId: BID-d9bb9120-05ae-4a7f-b050-9109796f4183, Price= 7.0, Quantity= 59, Side= true
7.0	OrderId: BID-416b45c5-1844-49e6-848b-6d7d85f10d5a, Price= 7.0, Quantity= 59, Side= true
6.0	OrderId: BID-d8e8071e-92e6-424c-8160-f4a4a125d45c, Price= 6.0, Quantity= 40, Side= true
6.0	OrderId: BID-08169125-550a-40af-ae14-3beb31419067, Price= 6.0, Quantity= 46, Side= true
6.0	OrderId: BID-2e63d981-d9ef-48a0-a5e8-3285892c3e4d, Price= 6.0, Quantity= 85, Side= true
6.0	OrderId: BID-6193382c-2ad2-4937-bda9-a04abbc9f506, Price= 6.0, Quantity= 76, Side= true
5.0	OrderId: BID-b0f97d01-7fd5-402e-be58-aa70a1d71b12, Price= 5.0, Quantity= 85, Side= true
5.0	OrderId: BID-b52da0ab-f28b-4129-8e6e-4dbeaf44bac6, Price= 5.0, Quantity= 77, Side= true
5.0	OrderId: BID-f3bde8d6-424e-42f3-9f7f-6c66e958bcfb, Price= 5.0, Quantity= 100, Side= true
5.0	OrderId: BID-cfadb327-6081-4650-98bf-022d9c660177, Price= 5.0, Quantity= 5, Side= true
4.0	OrderId: BID-d2c7468a-4347-44e8-ac19-3c3cbbf7071f, Price= 4.0, Quantity= 10, Side= true
4.0	OrderId: BID-f078d42b-6051-4021-9cb8-3bfd6dae0b77, Price= 4.0, Quantity= 65, Side= true
4.0	OrderId: BID-0ca2108b-9d07-41fd-9528-8eaa99966c34, Price= 4.0, Quantity= 79, Side= true
4.0	OrderId: BID-a7925bd7-1703-4611-9458-fb4b014ffb92, Price= 4.0, Quantity= 38, Side= true
3.0	OrderId: BID-420943df-0cfe-45a0-b671-df63149bf3e0, Price= 3.0, Quantity= 100, Side= true
3.0	OrderId: BID-5852bc7e-fb06-4cad-a530-1551d4cbf2c6, Price= 3.0, Quantity= 21, Side= true
3.0	OrderId: BID-35c6d56b-6897-47a4-9730-48f8bbe3155b, Price= 3.0, Quantity= 36, Side= true
3.0	OrderId: BID-174c1762-310a-412d-ac6c-d4726b7b2139, Price= 3.0, Quantity= 46, Side= true

## ASKS:

ASK	
Price	Orders
3.0	OrderId: ASK-4fd527d6-467d-40cd-8964-e45b4a583aa6, Price= 3.0, Quantity= 30, Side= false
3.0	OrderId: ASK-70314fbd-4870-41c4-85f7-d1f63ace68d6, Price= 3.0, Quantity= 32, Side= false
3.0	OrderId: ASK-f751cce1-a214-483a-b133-e9b468431324, Price= 3.0, Quantity= 62, Side= false
3.0	OrderId: ASK-18be9aa1-a2db-449f-9cd0-b5e978ab0dfc, Price= 3.0, Quantity= 86, Side= false
3.0	OrderId: ASK-40374dab-a78a-4d25-b86f-e58c1de550a3, Price= 3.0, Quantity= 99, Side= false
4.0	OrderId: ASK-de04f932-088b-496a-a7ce-857f61ffe657, Price= 4.0, Quantity= 54, Side= false
4.0	OrderId: ASK-668adf6f-fe4f-48ec-9cb4-f7c4679d6948, Price= 4.0, Quantity= 76, Side= false
4.0	OrderId: ASK-9b16d346-c176-4faa-b5d0-bf7af260c954, Price= 4.0, Quantity= 42, Side= false
4.0	OrderId: ASK-9d9859df-60de-4aa0-97b7-8415262239a7, Price= 4.0, Quantity= 79, Side= false
4.0	OrderId: ASK-e2ed88ae-0a3b-4856-81fe-de9b66d15e00, Price= 4.0, Quantity= 15, Side= false
5.0	OrderId: ASK-5888f9bf-ccb3-47d6-a488-1a2569a57ffb, Price= 5.0, Quantity= 60, Side= false
5.0	OrderId: ASK-d43c9027-9b64-4093-8fcd-22b275b247b2, Price= 5.0, Quantity= 32, Side= false
5.0	OrderId: ASK-2b42d68d-2673-4bf5-bbc7-3f76dafa6d62, Price= 5.0, Quantity= 86, Side= false
5.0	OrderId: ASK-fad8ee39-6dcc-4bcd-84cf-4629dc998880, Price= 5.0, Quantity= 83, Side= false
5.0	OrderId: ASK-9980eee7-753f-4c60-8fe0-dc279293a81c, Price= 5.0, Quantity= 47, Side= false
6.0	OrderId: ASK-56264ad7-902b-41dc-84f7-0f1df3ea34c3, Price= 6.0, Quantity= 94, Side= false
6.0	OrderId: ASK-3f6186dc-927b-4817-9076-6ac152c3f483, Price= 6.0, Quantity= 20, Side= false
6.0	OrderId: ASK-e678d45a-ca92-4c58-b950-020eeb810cb4, Price= 6.0, Quantity= 19, Side= false
6.0	OrderId: ASK-884d8b83-4a53-44a8-9477-bce7ae4629ec, Price= 6.0, Quantity= 39, Side= false
6.0	OrderId: ASK-b8d9bea4-130d-46e5-9e7f-d7f590bfd98b, Price= 6.0, Quantity= 57, Side= false
7.0	OrderId: ASK-bc2604fa-5807-40b7-9620-ec25917e5a26, Price= 7.0, Quantity= 7, Side= false
7.0	OrderId: ASK-1342fa83-e0e1-4185-a95b-5da6bd828d56, Price= 7.0, Quantity= 5, Side= false
7.0	OrderId: ASK-2679bddf-1d50-4b6b-ade1-560010739dc4, Price= 7.0, Quantity= 91, Side= false
7.0	OrderId: ASK-5c6aaa0e-9d7f-4e89-b8c0-4da6f65f072c, Price= 7.0, Quantity= 99, Side= false
7.0	OrderId: ASK-3ace9963-beff-48db-bd0f-59c66cf0c412, Price= 7.0, Quantity= 3, Side= false
15.59	OrderId: ASK-949e4129-51cb-4e76-a976-94c4d884a110, Price= 15.59, Quantity= 6, Side= false
26.91	OrderId: ASK-dc23b953-fea5-48fb-9411-4218b97b73ab, Price= 26.91, Quantity= 80, Side= false
49.69	OrderId: ASK-f12bd9d1-9303-42a8-aa7c-6857e742f679, Price= 49.69, Quantity= 39, Side= false
78.95	OrderId: ASK-867d8664-dffe-4ff2-b2ce-83737a57b2b6, Price= 78.95, Quantity= 32, Side= false
87.54	OrderId: ASK-c03bb165-40ba-42fc-84dd-7f973c55f198, Price= 87.54, Quantity= 81, Side= false

## Running Matching Tests:

Now that we have our test data loaded into our Limit Order Book, we can begin running through the test cases of a matching limit order.

### 1. Executing Sell Order, price = 7.5, quantity = 100

When executing a sell order the limit order book will be matching the orders on the bid side. With a limit price of 7.5, we should subtract quantity= 100 from the first order on the bid side. Let's run this execution and see what happens. The Bid orders are ordered from highest price to lowest price. The order book will always execute the sell at a specific price or better (higher), thus it will start executing from the highest order going down until the limit order price is reached.

We will press 10 from the menu to execute an order, then enter the limit price and the quantity of the order to execute, then we are asked if it is a buy order, and we will choose false (as it is a sell order in this case).

```
Simulation Menu
Please choose from the menu below
Enter the content number and hit enter:
*****
0 - Exit Application!
1 - Load Test Data
2 - Display All Orders
3 - Add Order
4 - Generate Orders (bulk)
5 - Modify Order
6 - Delete Order
7 - Search Price Level
8 - BID Price - Quantity
9 - ASK Price - Quantity
10 - Execute An Order
*****
10
Enter the limit order price:
7.5
Enter order quantity:
100
Is this a buy order?
Enter True or False
false
Execution of order OrderId: ASK-20edd77d-9b42-4262-a644-12065e45c532, Price= 7.5, Quantity= 7, Side= false
was successfully.
```

We then display all orders, to see our results:

We see on the BID side that the total quantity that was executed was 100. The first order priced at 79.01 with quantity=42 was removed and the balance  $100 - 42 = 58$  was subtracted from the next order priced at 67.34 with a new quantity =  $69 - 58 = 11$ .

```
*****
```

2  
BID

Price	Orders
67.34	OrderId: BID-4389dc7d-f79e-40bb-a28d-cbb0ced12a98, Price= 67.34, Quantity= 11, Side= true
57.12	OrderId: BID-a47795b1-9c4a-489e-af28-93f4849a6550, Price= 57.12, Quantity= 40, Side= true
50.72	OrderId: BID-36b3c798-d0da-4e1d-ac0f-bf5c40a230e8, Price= 50.72, Quantity= 40, Side= true
50.19	OrderId: BID-69ec5ba4-0c18-4840-922c-052475f4588a, Price= 50.19, Quantity= 4, Side= true
7.0	OrderId: BID-2a506581-c6b8-498b-b475-1852d37eebb2, Price= 7.0, Quantity= 19, Side= true
7.0	OrderId: BID-d9bb9120-05ae-4a7f-b050-9109796f4183, Price= 7.0, Quantity= 59, Side= true
7.0	OrderId: BID-416b45c5-1844-49e6-848b-6d7d85f10d5a, Price= 7.0, Quantity= 59, Side= true
6.0	OrderId: BID-d8e8071e-92e6-424c-8160-f4a4a125d45c, Price= 6.0, Quantity= 33, Side= true
6.0	OrderId: BID-08169125-550a-40af-ae14-3beb31419067, Price= 6.0, Quantity= 46, Side= true
6.0	OrderId: BID-2e63d981-d9ef-48a0-a5e8-3285892c3e4d, Price= 6.0, Quantity= 85, Side= true
6.0	OrderId: BID-6193382c-2ad2-4937-bda9-a04abb9f506, Price= 6.0, Quantity= 76, Side= true
5.0	OrderId: BID-b0f97d01-7fd5-402e-be58-aa70a1d71b12, Price= 5.0, Quantity= 78, Side= true
5.0	OrderId: BID-b52da0ab-f28b-4129-8e6e-4dbeaf44bac6, Price= 5.0, Quantity= 77, Side= true
5.0	OrderId: BID-f3bde8d6-424e-42f3-9f7f-6c66e958bcfb, Price= 5.0, Quantity= 100, Side= true
5.0	OrderId: BID-cfadb327-6081-4650-98bf-022d9c660177, Price= 5.0, Quantity= 5, Side= true
4.0	OrderId: BID-d2c7468a-4347-44e8-ac19-3c3cbbf7071f, Price= 4.0, Quantity= 3, Side= true
4.0	OrderId: BID-f078d42b-6051-4021-9cb8-3bfd6dae0b77, Price= 4.0, Quantity= 65, Side= true
4.0	OrderId: BID-0ca2108b-9d07-41fd-9528-8eaa99966c34, Price= 4.0, Quantity= 79, Side= true
4.0	OrderId: BID-a7925bd7-1703-4611-9458-fb4b014ffb92, Price= 4.0, Quantity= 38, Side= true
3.0	OrderId: BID-420943df-0cfe-45a0-b671-df63149bf3e0, Price= 3.0, Quantity= 93, Side= true
3.0	OrderId: BID-5852bc7e-fb06-4cad-a530-1551d4cbf2c6, Price= 3.0, Quantity= 21, Side= true
3.0	OrderId: BID-35c6d56b-6897-47a4-9730-48f8bbe3155b, Price= 3.0, Quantity= 36, Side= true
3.0	OrderId: BID-174c1762-310a-412d-ac6c-d4726b7b2139, Price= 3.0, Quantity= 46, Side= true

## 2. Executing Sell order, price = 6.0, quantity = 200

We will look at the bid orders and count the quantities in order going down till we get to 200. Because the order book is ordered by priority going down, we find that we will be on the last 7.0 order (OrderId= BID-416b45c5-1844-49e6-848b-6d7d85f10d5a) with updated quantity = 32.

```
*****
10
Enter the limit order price:
6.0
Enter order quantity:
200
Is this a buy order?
Enter True or False
false
Execution of order OrderId: ASK-d4bc7c28-25dc-442a-aa63-944210eaada0, Price= 6.0, Quantity= 24, Side= false
was successfully.
```

We can see from the BID orders that this is indeed the situation that occurred after executing the order:

```
*****
```

2  
BID

Price	Orders
7.0	OrderId: BID-416b45c5-1844-49e6-848b-6d7d85f10d5a, Price= 7.0, Quantity= 32, Side= true
6.0	OrderId: BID-d8e8071e-92e6-424c-8160-f4a4a125d45c, Price= 6.0, Quantity= 6, Side= true
6.0	OrderId: BID-08169125-550a-40af-ae14-3beb31419067, Price= 6.0, Quantity= 46, Side= true
6.0	OrderId: BID-2e63d981-d9ef-48a0-a5e8-3285892c3e4d, Price= 6.0, Quantity= 85, Side= true
6.0	OrderId: BID-6193382c-2ad2-4937-bda9-a04abb9f506, Price= 6.0, Quantity= 76, Side= true
5.0	OrderId: BID-b0f97d01-7fd5-402e-be58-aa70a1d71b12, Price= 5.0, Quantity= 51, Side= true
5.0	OrderId: BID-b52da0ab-f28b-4129-8e6e-4dbeaf44bac6, Price= 5.0, Quantity= 77, Side= true
5.0	OrderId: BID-f3bde8d6-424e-42f3-9f7f-6c66e958bcfb, Price= 5.0, Quantity= 100, Side= true
5.0	OrderId: BID-cfadb327-6081-4650-98bf-022d9c660177, Price= 5.0, Quantity= 5, Side= true
4.0	OrderId: BID-f078d42b-6051-4021-9cb8-3bfd6dae0b77, Price= 4.0, Quantity= 1, Side= true
4.0	OrderId: BID-0ca2108b-9d07-41fd-9528-8eaa99966c34, Price= 4.0, Quantity= 79, Side= true
4.0	OrderId: BID-a7925bd7-1703-4611-9458-fb4b014ffb92, Price= 4.0, Quantity= 38, Side= true
3.0	OrderId: BID-420943df-0cfe-45a0-b671-df63149bf3e0, Price= 3.0, Quantity= 69, Side= true
3.0	OrderId: BID-5852bc7e-fb06-4cad-a530-1551d4cbf2c6, Price= 3.0, Quantity= 21, Side= true
3.0	OrderId: BID-35c6d56b-6897-47a4-9730-48f8bbe3155b, Price= 3.0, Quantity= 36, Side= true
3.0	OrderId: BID-174c1762-310a-412d-ac6c-d4726b7b2139, Price= 3.0, Quantity= 46, Side= true



### 3. Execute Sell order, price = 7.0, quantity = 32

For this sell order we have chose a price = 7.0 and quantity = 32. This will sell the last orders at price 7.0. the new first element will be at price 6.0 and quantity 6.

Lets execute the order:

```
*****
10
Enter the limit order price:
7.0
Enter order quantity:
32
Is this a buy order?
Enter True or False
false
Execution of order OrderId: ASK-b8cd64e6-003d-48ee-981c-f4bbba90bf9, Price= 7.0, Quantity= 32, Side= false
was successfully.
Now the BID orders look like this:
```

```
*****
2
BID
+-----+-----+-----+-----+-----+-----+
| Price | Orders |
+-----+-----+-----+-----+-----+-----+
| 6.0   | OrderId: BID-d8e8071e-92e6-424c-8160-f4a4a125d45c, Price= 6.0, Quantity= 6, Side= true |
| 6.0   | OrderId: BID-08169125-550a-40af-ae14-3beb31419067, Price= 6.0, Quantity= 46, Side= true |
| 6.0   | OrderId: BID-2e63d981-d9ef-48a0-a5e8-3285892c3e4d, Price= 6.0, Quantity= 85, Side= true |
| 6.0   | OrderId: BID-6193382c-2ad2-4937-bda9-a04abbc9f506, Price= 6.0, Quantity= 76, Side= true |
| 5.0   | OrderId: BID-b0f97d01-7fd5-402e-be58-aa70a1d71b12, Price= 5.0, Quantity= 51, Side= true |
| 5.0   | OrderId: BID-b52da0ab-f28b-4129-8e6e-4dbeaf44bac6, Price= 5.0, Quantity= 77, Side= true |
| 5.0   | OrderId: BID-f3bde8d6-424e-42f3-9f7f-6c66e958bcfb, Price= 5.0, Quantity= 100, Side= true |
| 5.0   | OrderId: BID-cfadb327-6081-4650-98bf-022d9c660177, Price= 5.0, Quantity= 5, Side= true |
| 4.0   | OrderId: BID-f078d42b-6051-4021-9cb8-3bfd6dae0b77, Price= 4.0, Quantity= 41, Side= true |
| 4.0   | OrderId: BID-0ca2108b-9d07-41fd-9528-8eaa99966c34, Price= 4.0, Quantity= 79, Side= true |
| 4.0   | OrderId: BID-a7925bd7-1703-4611-9458-fb4b014ffb92, Price= 4.0, Quantity= 38, Side= true |
| 3.0   | OrderId: BID-420943df-0cfe-45a0-b671-df63149bf3e0, Price= 3.0, Quantity= 69, Side= true |
| 3.0   | OrderId: BID-5852bc7e-fb06-4cad-a530-1551d4cbf2c6, Price= 3.0, Quantity= 21, Side= true |
| 3.0   | OrderId: BID-35c6d56b-6897-47a4-9730-48f8bbe3155b, Price= 3.0, Quantity= 36, Side= true |
| 3.0   | OrderId: BID-174c1762-310a-412d-ac6c-d4726b7b2139, Price= 3.0, Quantity= 46, Side= true |
```

It is as expected.

### 4. Executing Sell Order, price = 4.9, quantity = 6+46+85+76+50 = 263

With this test we are selling the rest of the orders priced at 6.0 and 50 of the orders priced at 5.0. Our limit order price =4.9 it will sell orders until the price is less than 4.9 or the quantity sold has been reached, in this case we have reached the quantity sold at price 5.0. This will result in orderId = BID-b0f97d01-7fd5-402e-be58-aa70a1d71b12 being the first order with price 1.

```
*****
10
Enter the limit order price:
4.9
Enter order quantity:
263
Is this a buy order?
Enter True or False
false
Execution of order OrderId: ASK-73e462af-1f1e-462c-a532-31ce9d9b1965, Price= 4.9, Quantity= 9, Side= false
was successfully.
```

Displaying our BID orders, we can see that the result is as expected:

```
*****
```

2  
BID

Price	Orders
5.0	OrderId: BID-b0f97d01-7fd5-402e-be58-aa70a1d71b12, Price= 5.0, Quantity= 1, Side= true
5.0	OrderId: BID-b52da0ab-f28b-4129-8e6e-4dbeaf44bac6, Price= 5.0, Quantity= 77, Side= true
5.0	OrderId: BID-f3bde8d6-424e-42f3-9f7f-6c66e958bcfb, Price= 5.0, Quantity= 100, Side= true
5.0	OrderId: BID-cfadb327-6081-4650-98bf-022d9c660177, Price= 5.0, Quantity= 5, Side= true
4.0	OrderId: BID-0ca2108b-9d07-41fd-9528-8eaa99966c34, Price= 4.0, Quantity= 70, Side= true
4.0	OrderId: BID-a7925bd7-1703-4611-9458-fb4b014ffb92, Price= 4.0, Quantity= 38, Side= true
3.0	OrderId: BID-420943df-0cfe-45a0-b671-df63149bf3e0, Price= 3.0, Quantity= 60, Side= true
3.0	OrderId: BID-5852bc7e-fb06-4cad-a530-1551d4cbf2c6, Price= 3.0, Quantity= 21, Side= true
3.0	OrderId: BID-35c6d56b-6897-47a4-9730-48f8bbe3155b, Price= 3.0, Quantity= 36, Side= true
3.0	OrderId: BID-174c1762-310a-412d-ac6c-d4726b7b2139, Price= 3.0, Quantity= 46, Side= true

##### 5. Executing a Sell Order, price = 4.9, quantity = 3

Here we will demonstrate priority at the same price. The orders will sell with the highest priority going at price 5.0 with quantity =1 and continue with the next order in the priority. Because the linkedList was used for orders at the same price, the priority (FIFO) is set, with new orders coming in at the lowest priority(added at the bottom of the list). The result from this execution will be orderId=BID-b52da0ab-f28b-4129-8e6e-4dbeaf44bac6 with price 5.0 and a new quantity of 77-2 = 75.

```
*****
10
Enter the limit order price:
4.9
Enter order quantity:
3
Is this a buy order?
Enter True or False
false
Execution of order OrderId: ASK-b1690e0b-4dd3-44bf-aa56-46f1d53d6418, Price= 4.9, Quantity= 2, Side= false
was successfully.
```

We can see that the result is as expected:

```
*****
```

2  
BID

Price	Orders
5.0	OrderId: BID-b52da0ab-f28b-4129-8e6e-4dbeaf44bac6, Price= 5.0, Quantity= 75, Side= true
5.0	OrderId: BID-f3bde8d6-424e-42f3-9f7f-6c66e958bcfb, Price= 5.0, Quantity= 100, Side= true
5.0	OrderId: BID-cfadb327-6081-4650-98bf-022d9c660177, Price= 5.0, Quantity= 5, Side= true
4.0	OrderId: BID-0ca2108b-9d07-41fd-9528-8eaa99966c34, Price= 4.0, Quantity= 68, Side= true
4.0	OrderId: BID-a7925bd7-1703-4611-9458-fb4b014ffb92, Price= 4.0, Quantity= 38, Side= true
3.0	OrderId: BID-420943df-0cfe-45a0-b671-df63149bf3e0, Price= 3.0, Quantity= 58, Side= true
3.0	OrderId: BID-5852bc7e-fb06-4cad-a530-1551d4cbf2c6, Price= 3.0, Quantity= 21, Side= true
3.0	OrderId: BID-35c6d56b-6897-47a4-9730-48f8bbe3155b, Price= 3.0, Quantity= 36, Side= true
3.0	OrderId: BID-174c1762-310a-412d-ac6c-d4726b7b2139, Price= 3.0, Quantity= 46, Side= true

ASK



6. Executing a Buy Order, price = 3.2, quantity = 30+32+62+86+99+50 = 359  
Just to remind you of the ASK orders with the highlighted quantities being used.

ASK	
Price	Orders
3.0	OrderId: ASK-4fd527d6-467d-40cd-8964-e45b4a583aa6, Price= 3.0, Quantity= 30, Side= false
3.0	OrderId: ASK-70314fbd-4870-41c4-85f7-d1f63ace68d6, Price= 3.0, Quantity= 32, Side= false
3.0	OrderId: ASK-f751cce1-a214-483a-b133-e9b468431324, Price= 3.0, Quantity= 62, Side= false
3.0	OrderId: ASK-18be9aa1-a2db-449f-9cd0-b5e978ab0dfc, Price= 3.0, Quantity= 86, Side= false
3.0	OrderId: ASK-40374dab-a78a-4d25-b86f-e58c1de550a3, Price= 3.0, Quantity= 99, Side= false
4.0	OrderId: ASK-de04f932-088b-496a-a7ce-857f61ffe657, Price= 4.0, Quantity= 54, Side= false
4.0	OrderId: ASK-668adf6f-fe4f-48ec-9cb4-f7c4679d6948, Price= 4.0, Quantity= 76, Side= false
4.0	OrderId: ASK-9b16d346-c176-4faa-b5d0-bf7af260c954, Price= 4.0, Quantity= 42, Side= false
4.0	OrderId: ASK-9d9859df-60de-4aa0-97b7-8415262239a7, Price= 4.0, Quantity= 79, Side= false
4.0	OrderId: ASK-e2ed88ae-0a3b-4856-81fe-de9b66d15e00, Price= 4.0, Quantity= 15, Side= false
5.0	OrderId: ASK-5888f9bf-ccb3-47d6-a488-1a2569a57ffb, Price= 5.0, Quantity= 60, Side= false
5.0	OrderId: ASK-d43c9027-9b64-4093-8fcd-22b275b247b2, Price= 5.0, Quantity= 32, Side= false
5.0	OrderId: ASK-2b42d68d-2673-4bf5-bbcb-3f76dafa6d62, Price= 5.0, Quantity= 86, Side= false
5.0	OrderId: ASK-fad8ee39-6dcc-4bcd-84cf-4629dc998880, Price= 5.0, Quantity= 83, Side= false
5.0	OrderId: ASK-9980eee7-753f-4c60-8fe0-dc279293a81c, Price= 5.0, Quantity= 47, Side= false
6.0	OrderId: ASK-56264ad7-902b-41dc-84f7-0f1df3ea34c3, Price= 6.0, Quantity= 94, Side= false
6.0	OrderId: ASK-3f6186dc-927b-4817-9076-6ac152c3f483, Price= 6.0, Quantity= 20, Side= false
6.0	OrderId: ASK-e678d45a-ca92-4c58-b950-020eeb810cb4, Price= 6.0, Quantity= 19, Side= false
6.0	OrderId: ASK-884d8b83-4a53-44a8-9477-bce7ae4629ec, Price= 6.0, Quantity= 39, Side= false
6.0	OrderId: ASK-b8d9bea4-130d-46e5-9e7f-d7f590bfd98b, Price= 6.0, Quantity= 57, Side= false
7.0	OrderId: ASK-bc2604fa-5807-40b7-9620-ec25917e5a26, Price= 7.0, Quantity= 7, Side= false
7.0	OrderId: ASK-1342fa83-e0e1-4185-a95b-5da6bd828d56, Price= 7.0, Quantity= 5, Side= false
7.0	OrderId: ASK-2679bddf-1d50-4b6b-ade1-560010739dc4, Price= 7.0, Quantity= 91, Side= false
7.0	OrderId: ASK-5c6aaa0e-9d7f-4e89-b8c0-4da6f65f072c, Price= 7.0, Quantity= 99, Side= false
7.0	OrderId: ASK-3ace9963-beff-48db-bd0f-59c66cf0c412, Price= 7.0, Quantity= 3, Side= false
15.59	OrderId: ASK-949e4129-51cb-4e76-a976-94c4d884a110, Price= 15.59, Quantity= 6, Side= false
26.91	OrderId: ASK-dc23b953-fea5-48fb-9411-4218b97b73ab, Price= 26.91, Quantity= 80, Side= false
49.69	OrderId: ASK-f12bd9d1-9303-42a8-aa7c-6857e742f679, Price= 49.69, Quantity= 39, Side= false
78.95	OrderId: ASK-867d8664-dffe-4ff2-b2ce-83737a57b2b6, Price= 78.95, Quantity= 32, Side= false
87.54	OrderId: ASK-c03bb165-40ba-42fc-84dd-7f973c55f198, Price= 87.54, Quantity= 81, Side= false

Although, this test case has a limit order price of 3.2. Thus, it should only buy all the orders at prices 3.2 or less, even though the quantity is more. Let's see what happens:

```

10
Enter the limit order price:
3.2
Enter order quantity:
359
Is this a buy order?
Enter True or False
true
Execution of order OrderId: BID-831269ce-faad-4bd1-a116-77b99bc72447, Price= 3.2, Quantity= 50, Side= true
was successfully.

```

We can see below that the ASK orders are reflecting as expected, even though the quantity was larger the limit order price prevented buying higher than the limit 3.2 price.

ASK	
Price	Orders
4.0	OrderId: ASK-de04f932-088b-496a-a7ce-857f61ffe657, Price= 4.0, Quantity= 54, Side= false
4.0	OrderId: ASK-668adf6f-fe4f-48ec-9cb4-f7c4679d6948, Price= 4.0, Quantity= 76, Side= false
4.0	OrderId: ASK-9b16d346-c176-4faa-b5d0-bf7af260c954, Price= 4.0, Quantity= 42, Side= false
4.0	OrderId: ASK-9d9859df-60de-4aa0-97b7-8415262239a7, Price= 4.0, Quantity= 79, Side= false
4.0	OrderId: ASK-e2ed88ae-0a3b-4856-81fe-de9b66d15e00, Price= 4.0, Quantity= 15, Side= false
5.0	OrderId: ASK-5888f9bf-ccb3-47d6-a488-1a2569a57ffb, Price= 5.0, Quantity= 60, Side= false
5.0	OrderId: ASK-d43c9027-9b64-4093-8fcd-22b275b247b2, Price= 5.0, Quantity= 32, Side= false
5.0	OrderId: ASK-2b42d68d-2673-4bf5-bbc7-3f76dafa6d62, Price= 5.0, Quantity= 86, Side= false
5.0	OrderId: ASK-fad8ee39-6dcc-4bcd-84cf-4629dc998880, Price= 5.0, Quantity= 83, Side= false
5.0	OrderId: ASK-9980eee7-753f-4c60-8fe0-dc279293a81c, Price= 5.0, Quantity= 47, Side= false
6.0	OrderId: ASK-56264ad7-902b-41dc-84f7-0f1df3ea34c3, Price= 6.0, Quantity= 94, Side= false
6.0	OrderId: ASK-3f6186dc-927b-4817-9076-6ac152c3f483, Price= 6.0, Quantity= 20, Side= false
6.0	OrderId: ASK-e678d45a-ca92-4c58-b950-020eeb810cb4, Price= 6.0, Quantity= 19, Side= false
6.0	OrderId: ASK-884d8b83-4a53-44a8-9477-bce7ae4629ec, Price= 6.0, Quantity= 39, Side= false
6.0	OrderId: ASK-b8d9bea4-130d-46e5-9e7f-d7f590bfd98b, Price= 6.0, Quantity= 57, Side= false
7.0	OrderId: ASK-bc2604fa-5807-40b7-9620-ec25917e5a26, Price= 7.0, Quantity= 7, Side= false
7.0	OrderId: ASK-1342fa83-e0e1-4185-a95b-5da6bd828d56, Price= 7.0, Quantity= 5, Side= false
7.0	OrderId: ASK-2679bddf-1d50-4b6b-ade1-560010739dc4, Price= 7.0, Quantity= 91, Side= false
7.0	OrderId: ASK-5c6aaa0e-9d7f-4e89-b8c0-4da6f65f072c, Price= 7.0, Quantity= 99, Side= false
7.0	OrderId: ASK-3ace9963-beff-48db-bd0f-59c66cf0c412, Price= 7.0, Quantity= 3, Side= false
15.59	OrderId: ASK-949e4129-51cb-4e76-a976-94c4d884a110, Price= 15.59, Quantity= 6, Side= false
26.91	OrderId: ASK-dc23b953-fea5-48fb-9411-4218b97b73ab, Price= 26.91, Quantity= 80, Side= false
49.69	OrderId: ASK-f12bd9d1-9303-42a8-aa7c-6857e742f679, Price= 49.69, Quantity= 39, Side= false
78.95	OrderId: ASK-867d8664-dffe-4ff2-b2ce-83737a57b2b6, Price= 78.95, Quantity= 32, Side= false
87.54	OrderId: ASK-c03bb165-40ba-42fc-84dd-7f973c55f198, Price= 87.54, Quantity= 81, Side= false

## Reloading Test Data:

I have reloaded test data to be used for the rest of this manual. Please see below the BID and ASK orders, for each test case I will paste the screenshots of the instructions and the resultant order list.

### BID

*****			
2			
BID			
Price	Orders		
74.36	OrderId: BID-ad42d4ea-5228-4b75-9016-fc0d308adfb6,	Price= 74.36,	Quantity= 91, Side= true
73.22	OrderId: BID-86ede548-5559-46cd-912c-15cef44940b8,	Price= 73.22,	Quantity= 94, Side= true
59.17	OrderId: BID-e6176419-2e1b-4335-a056-d39962ee312d,	Price= 59.17,	Quantity= 42, Side= true
30.19	OrderId: BID-0cb132fa-91d6-46e5-a24a-cf3cba93a35a,	Price= 30.19,	Quantity= 71, Side= true
23.69	OrderId: BID-7663181f-2848-4c85-9ab9-49b9abc9243a,	Price= 23.69,	Quantity= 15, Side= true
18.76	OrderId: BID-07d7109d-9b52-4a12-8620-5f2b13fafba2,	Price= 18.76,	Quantity= 5, Side= true
8.37	OrderId: BID-41dcf0a2-d46c-43df-99d6-5c606e84aba0,	Price= 8.37,	Quantity= 21, Side= true
7.0	OrderId: BID-36489466-0dac-4cbc-bdd7-bb92116359c9,	Price= 7.0,	Quantity= 44, Side= true
7.0	OrderId: BID-1c2dec2e-6325-4d3a-9303-62ce0f46bdeb,	Price= 7.0,	Quantity= 95, Side= true
7.0	OrderId: BID-2af6ab3d-d2f3-41f5-b59a-76e62eb55c1b,	Price= 7.0,	Quantity= 67, Side= true
7.0	OrderId: BID-bef01b20-3a52-4de5-b9ad-e588999d0834,	Price= 7.0,	Quantity= 22, Side= true
6.0	OrderId: BID-bf77689d-7f06-45ec-8244-c7a6f8ad64d0,	Price= 6.0,	Quantity= 11, Side= true
6.0	OrderId: BID-14307cb6-3128-4d87-84ad-2757ae745ed8,	Price= 6.0,	Quantity= 83, Side= true
6.0	OrderId: BID-475eb4d2-ac05-4153-8fbd-5f08769bb43f,	Price= 6.0,	Quantity= 26, Side= true
6.0	OrderId: BID-1e5cbdb6-36b2-40ac-9891-0b82d10934e3,	Price= 6.0,	Quantity= 55, Side= true
5.0	OrderId: BID-6d664921-10ad-437b-b8e8-186cfc784cc4,	Price= 5.0,	Quantity= 4, Side= true
5.0	OrderId: BID-4e59a022-cc30-4ce2-8089-d5cfb20de783,	Price= 5.0,	Quantity= 60, Side= true
5.0	OrderId: BID-55a40fc0-bd95-466b-a204-5dee950bd0af,	Price= 5.0,	Quantity= 30, Side= true
5.0	OrderId: BID-17bdf83a-fb35-4632-b61c-06c9579cb683,	Price= 5.0,	Quantity= 92, Side= true
4.0	OrderId: BID-69c79475-afee-4767-9d91-d3a6e3192b04,	Price= 4.0,	Quantity= 83, Side= true
4.0	OrderId: BID-983a580d-8611-48a6-9c52-2e399f30c8f1,	Price= 4.0,	Quantity= 21, Side= true
4.0	OrderId: BID-318b52c6-cccb-423e-9540-624f75501572,	Price= 4.0,	Quantity= 12, Side= true
4.0	OrderId: BID-0a6caa22-286c-4fae-aea6-b9e158e12ff7,	Price= 4.0,	Quantity= 44, Side= true
3.0	OrderId: BID-81a4c62b-34ea-4dc4-b16a-02d409d66ebd,	Price= 3.0,	Quantity= 41, Side= true
3.0	OrderId: BID-7cfb2e35-fece-47b7-805f-290128f61fdd,	Price= 3.0,	Quantity= 85, Side= true
3.0	OrderId: BID-01dd822f-a386-4df3-8801-730b5454b680,	Price= 3.0,	Quantity= 95, Side= true
3.0	OrderId: BID-7d297306-e3f6-4480-a142-02d0d1f5fd37,	Price= 3.0,	Quantity= 53, Side= true

### ASK

ASK			
Price	Orders		
3.0	OrderId: ASK-a1af9516-429e-4a5a-aeed-411adda00645,	Price= 3.0,	Quantity= 91, Side= false
3.0	OrderId: ASK-3555a091-ed6c-4f84-a7c7-5d9529c97cf7,	Price= 3.0,	Quantity= 69, Side= false
3.0	OrderId: ASK-bfb203cf-f292-4132-8a19-69d73c44264b,	Price= 3.0,	Quantity= 56, Side= false
3.0	OrderId: ASK-a1616e88-e98a-452c-9cd7-8a1ebdafa05a,	Price= 3.0,	Quantity= 50, Side= false
3.0	OrderId: ASK-f4f0b7d3-07c2-4ae3-8373-78bc098e1768,	Price= 3.0,	Quantity= 96, Side= false
4.0	OrderId: ASK-4803aed3-6677-4fd4-9f0e-5f676791800c,	Price= 4.0,	Quantity= 26, Side= false
4.0	OrderId: ASK-57e10abe-bd1b-4406-8650-29940d1b179a,	Price= 4.0,	Quantity= 97, Side= false
4.0	OrderId: ASK-3d1bbf08-1516-4d5c-9eb5-1c0e38b205a1,	Price= 4.0,	Quantity= 78, Side= false
4.0	OrderId: ASK-2aff8385-99af-4ebf-b632-f98e1a4a4cd0,	Price= 4.0,	Quantity= 24, Side= false
4.0	OrderId: ASK-0f1aa6fa-043d-4edb-9c2b-24bccca01410,	Price= 4.0,	Quantity= 78, Side= false
5.0	OrderId: ASK-418e3a27-a191-4d00-9f7a-2979264b7e27,	Price= 5.0,	Quantity= 83, Side= false
5.0	OrderId: ASK-91c0f314-dc07-42f1-81ef-f4162685fff6,	Price= 5.0,	Quantity= 35, Side= false
5.0	OrderId: ASK-e48aabab-ccad-4588-b7a4-5d47cf344be7,	Price= 5.0,	Quantity= 80, Side= false
5.0	OrderId: ASK-cb0db2ea-2b6b-4d5d-8fc4-53a70269d204,	Price= 5.0,	Quantity= 4, Side= false
5.0	OrderId: ASK-5a1c5349-7d51-4905-9de1-9bcd8dcaae4a,	Price= 5.0,	Quantity= 20, Side= false
6.0	OrderId: ASK-6f714912-0fdd-4252-bb04-2cdc181f2839,	Price= 6.0,	Quantity= 45, Side= false
6.0	OrderId: ASK-fdfc6d2f-4067-40e2-a65e-d8efe23c89fd,	Price= 6.0,	Quantity= 60, Side= false
6.0	OrderId: ASK-5121d299-3801-44cf-bd28-14cc645c5af7,	Price= 6.0,	Quantity= 84, Side= false
6.0	OrderId: ASK-d9052563-d114-4339-9f77-167f56d043d9,	Price= 6.0,	Quantity= 45, Side= false
6.0	OrderId: ASK-46b4898b-e85d-4e32-ac05-17daf4424ab2,	Price= 6.0,	Quantity= 96, Side= false
7.0	OrderId: ASK-3265e236-21ff-48a9-8a24-06fc15b75135,	Price= 7.0,	Quantity= 82, Side= false
7.0	OrderId: ASK-55430411-f6ca-4d38-b438-a729a32bf0e,	Price= 7.0,	Quantity= 19, Side= false
7.0	OrderId: ASK-eb836feb-87c4-4a36-ae9f-514e47ee791f,	Price= 7.0,	Quantity= 9, Side= false
7.0	OrderId: ASK-eda8d65d-61cf-43d8-8eea-cd2b43e7a9f4,	Price= 7.0,	Quantity= 53, Side= false
7.0	OrderId: ASK-8ef65c75-116a-4ee0-bdd2-daccf3837920,	Price= 7.0,	Quantity= 92, Side= false
42.44	OrderId: ASK-5fe5f0d4-524f-437a-a524-08b80fb34c22,	Price= 42.44,	Quantity= 51, Side= false
54.37	OrderId: ASK-8e875a7d-6ee8-4de8-95b7bb2e02ff,	Price= 54.37,	Quantity= 29, Side= false
68.95	OrderId: ASK-cbdb4e8a-7a93-482f-bde9-a2f370768967,	Price= 68.95,	Quantity= 22, Side= false

## Delete Order

We used OrderId: BID-36489466-0dac-4cbc-bdd7-bb92116359c9 to delete. Full order:

OrderId: BID-36489466-0dac-4cbc-bdd7-bb92116359c9, Price= 7.0, Quantity= 44, Side= true

```
*****
6
Enter the order Id:
BID-36489466-0dac-4cbc-bdd7-bb92116359c9
Order BID-36489466-0dac-4cbc-bdd7-bb92116359c9 was successfully deleted.
```

We can see that this order is missing from the BID orders list:

```
*****
2
BID
+-----+-----+
| Price | Orders |
+-----+-----+
| 74.36 | OrderId: BID-ad42d4ea-5228-4b75-9016-fc0d308adfb6, Price= 74.36, Quantity= 91, Side= true |
| 73.22 | OrderId: BID-86ede548-5559-46cd-912c-15cef44940b8, Price= 73.22, Quantity= 94, Side= true |
| 59.17 | OrderId: BID-e6176419-2e1b-4335-a056-d39962ee312d, Price= 59.17, Quantity= 42, Side= true |
| 30.19 | OrderId: BID-0cb132fa-91d6-46e5-a24a-cf3cba93a35a, Price= 30.19, Quantity= 71, Side= true |
| 23.69 | OrderId: BID-7663181f-2848-4c85-9ab9-49b9abc9243a, Price= 23.69, Quantity= 15, Side= true |
| 18.76 | OrderId: BID-07d7109d-9b52-4a12-8620-5f2b13fafba2, Price= 18.76, Quantity= 5, Side= true |
| 8.37  | OrderId: BID-41dcf0a2-d46c-43df-99d6-5c606e84aba0, Price= 8.37, Quantity= 21, Side= true |
| 7.0   | OrderId: BID-1c2dec2e-6325-4d3a-9303-62ce0f46bdeb, Price= 7.0, Quantity= 95, Side= true |
| 7.0   | OrderId: BID-2af6ab3d-d2f3-41f5-b59a-76e62eb55c1b, Price= 7.0, Quantity= 67, Side= true |
| 7.0   | OrderId: BID-bef01b20-3a52-4de5-b9ad-e588999d0834, Price= 7.0, Quantity= 22, Side= true |
| 6.0   | OrderId: BID-bf77689d-7f06-45ec-8244-c7abf8adb4d0, Price= 6.0, Quantity= 11, Side= true |
| 6.0   | OrderId: BID-14307cb6-3128-4d87-84ad-2757ae745ed8, Price= 6.0, Quantity= 83, Side= true |
| 6.0   | OrderId: BID-475eb4d2-ac05-4153-8fbd-5f08769bb43f, Price= 6.0, Quantity= 26, Side= true |
| 6.0   | OrderId: BID-1e5cbdb6-36b2-40ac-9891-0b82d10934e3, Price= 6.0, Quantity= 55, Side= true |
| 5.0   | OrderId: BID-6d664921-10ad-437b-b8e8-186cfc784cc4, Price= 5.0, Quantity= 4, Side= true |
| 5.0   | OrderId: BID-4e59a022-cc30-4ce2-8089-d5cfb20de783, Price= 5.0, Quantity= 60, Side= true |
| 5.0   | OrderId: BID-55a40fc0-bd95-466b-a204-5dee950bd0af, Price= 5.0, Quantity= 30, Side= true |
| 5.0   | OrderId: BID-17bdf83a-fb35-4632-b61c-06c9579cb683, Price= 5.0, Quantity= 92, Side= true |
| 4.0   | OrderId: BID-69c79475-afee-4767-9d91-d3a6e3192b04, Price= 4.0, Quantity= 83, Side= true |
| 4.0   | OrderId: BID-983a580d-8611-48a6-9c52-2e399f30c8f1, Price= 4.0, Quantity= 21, Side= true |
| 4.0   | OrderId: BID-318b52c6-cccb-423e-9540-624f75501572, Price= 4.0, Quantity= 12, Side= true |
| 4.0   | OrderId: BID-0a6caa22-286c-4fae-aea6-b9e158e12ff7, Price= 4.0, Quantity= 44, Side= true |
| 3.0   | OrderId: BID-81a4c62b-34ea-4dc4-b16a-02d409d66ebd, Price= 3.0, Quantity= 41, Side= true |
| 3.0   | OrderId: BID-7cfb2e35-fece-47b7-805f-290128f61fdd, Price= 3.0, Quantity= 85, Side= true |
| 3.0   | OrderId: BID-01dd822f-a386-4df3-8801-730b5454b680, Price= 3.0, Quantity= 95, Side= true |
| 3.0   | OrderId: BID-7d297306-e3f6-4480-a142-02d0d1f5fd37, Price= 3.0, Quantity= 53, Side= true |
```

## Modify Order

We used OrderId: BID-1c2dec2e-6325-4d3a-9303-62ce0f46bdeb to modify. We modify this order with a quantity = 1. Full order:

OrderId: BID-1c2dec2e-6325-4d3a-9303-62ce0f46bdeb, Price= 7.0, Quantity= 95, Side= true

```
*****
5
Enter the order Id:
BID-1c2dec2e-6325-4d3a-9303-62ce0f46bdeb
Enter the new quantity for this order:
1
Order BID-1c2dec2e-6325-4d3a-9303-62ce0f46bdeb was successfully updated.
```



From the resultant view of all orders below, we can see that order BID-1c2dec2e-6325-4d3a-9303-62ce0f46bdeb has been modified to have a quantity=1 and has dropped to the bottom priority of all the 7.0 priced orders.

```
*****
```

2	BID	
Price	Orders	
74.36	OrderId: BID-ad42d4ea-5228-4b75-9016-fc0d308adfb6, Price= 74.36, Quantity= 91, Side= true	
73.22	OrderId: BID-86ede548-5559-46cd-912c-15cef44940b8, Price= 73.22, Quantity= 94, Side= true	
59.17	OrderId: BID-e6176419-2e1b-4335-a056-d39962ee312d, Price= 59.17, Quantity= 42, Side= true	
30.19	OrderId: BID-0cb132fa-91d6-46e5-a24a-cf3c9a93a35a, Price= 30.19, Quantity= 71, Side= true	
23.69	OrderId: BID-7663181f-2848-4c85-9ab9-49b9abc9243a, Price= 23.69, Quantity= 15, Side= true	
18.76	OrderId: BID-07d7109d-9b52-4a12-8620-5f2b13fafba2, Price= 18.76, Quantity= 5, Side= true	
8.37	OrderId: BID-41dcf0a2-d46c-43df-99d6-5c606e84aba0, Price= 8.37, Quantity= 21, Side= true	
7.0	OrderId: BID-2af6ab3d-d2f3-41f5-b59a-76e62eb55c1b, Price= 7.0, Quantity= 67, Side= true	
7.0	OrderId: BID-bef01b20-3a52-4de5-b9ad-e588999d0834, Price= 7.0, Quantity= 22, Side= true	
7.0	OrderId: BID-1c2dec2e-6325-4d3a-9303-62ce0f46bdeb, Price= 7.0, Quantity= 1, Side= true	
6.0	OrderId: BID-bf77689d-7f06-45ec-8244-c7a6f8ad64d0, Price= 6.0, Quantity= 11, Side= true	
6.0	OrderId: BID-14307cb6-3128-4d87-84ad-2757ae745ed8, Price= 6.0, Quantity= 83, Side= true	
6.0	OrderId: BID-475eb4d2-ac05-4153-8fbd-5f08769bb43f, Price= 6.0, Quantity= 26, Side= true	
6.0	OrderId: BID-1e5cbbd6-36b2-40ac-9891-0b82d10934e3, Price= 6.0, Quantity= 55, Side= true	
5.0	OrderId: BID-6d664921-10ad-437b-b8e8-186cfc784cc4, Price= 5.0, Quantity= 4, Side= true	
5.0	OrderId: BID-4e59a022-cc30-4ce2-8089-d5cfb20de783, Price= 5.0, Quantity= 60, Side= true	
5.0	OrderId: BID-55a40fc0-bd95-466b-a204-5dee950bd0af, Price= 5.0, Quantity= 30, Side= true	
5.0	OrderId: BID-17bdf83a-fb35-4632-b61c-06c9579cb683, Price= 5.0, Quantity= 92, Side= true	
4.0	OrderId: BID-69c79475-afee-4767-9d91-d3a6e3192b04, Price= 4.0, Quantity= 83, Side= true	
4.0	OrderId: BID-983a580d-8611-48a6-9c52-2e399f30c8f1, Price= 4.0, Quantity= 21, Side= true	
4.0	OrderId: BID-318b52c6-cccb-423e-9540-624f75501572, Price= 4.0, Quantity= 12, Side= true	
4.0	OrderId: BID-0a6caa22-286c-4fae-aea6-b9e158e12ff7, Price= 4.0, Quantity= 44, Side= true	
3.0	OrderId: BID-81a4c62b-34ea-4dc4-b16a-02d409d66ebd, Price= 3.0, Quantity= 41, Side= true	
3.0	OrderId: BID-7cfb2e35-fece-47b7-805f-290128f61fdd, Price= 3.0, Quantity= 85, Side= true	
3.0	OrderId: BID-01dd822f-a386-4df3-8801-730b5454b680, Price= 3.0, Quantity= 95, Side= true	
3.0	OrderId: BID-7d297306-e3f6-4480-a142-02d0d1f5fd37, Price= 3.0, Quantity= 53, Side= true	

Modifying an ASK order with new quantity=1:

OrderId: ASK-bfb203cf-f292-4132-8a19-69d73c44264b, Price= 3.0, Quantity= 56, Side= false

```
*****
5
Enter the order Id:
ASK-bfb203cf-f292-4132-8a19-69d73c44264b
Enter the new quantity for this order:
1
Order ASK-bfb203cf-f292-4132-8a19-69d73c44264b was successfully updated.
```

We can see from the list below that the order was updated with the new quantity =1 and the order has moved down to the bottom of the priority list for all orders priced at 3.0. Point to remember that for each price level the priority drops going down on the list.

ASK	
Price	Orders
3.0	OrderId: ASK-a1af9516-429e-4a5a-aeed-411adda00645, Price= 3.0, Quantity= 91, Side= false
3.0	OrderId: ASK-a1616e88-e98a-452c-9cd7-8a1ebdafa05a, Price= 3.0, Quantity= 50, Side= false
3.0	OrderId: ASK-f4f0b7d3-07c2-4ae3-8373-78bc098e1768, Price= 3.0, Quantity= 96, Side= false
3.0	OrderId: ASK-bfb203cf-f292-4132-8a19-69d73c44264b, Price= 3.0, Quantity= 1, Side= false
4.0	OrderId: ASK-4803aed3-6677-4fd4-9f0e-5fdf6791800c, Price= 4.0, Quantity= 26, Side= false
4.0	OrderId: ASK-57e10abe-bd1b-4406-8650-29940d1b179a, Price= 4.0, Quantity= 97, Side= false
4.0	OrderId: ASK-3d1bbf08-1516-4d5c-9eb5-1c0e38b205a1, Price= 4.0, Quantity= 78, Side= false
4.0	OrderId: ASK-2aff8385-99af-4ebf-b632-f98e1a4a4cd0, Price= 4.0, Quantity= 24, Side= false
4.0	OrderId: ASK-0f1aa6fa-043d-4edb-9c2b-24bccca01410, Price= 4.0, Quantity= 78, Side= false
5.0	OrderId: ASK-418e3a27-a191-4d00-9f7a-2979264b7e27, Price= 5.0, Quantity= 83, Side= false
5.0	OrderId: ASK-91c0f314-dc07-42f1-81ef-f4162685fff6, Price= 5.0, Quantity= 35, Side= false
5.0	OrderId: ASK-e48aabad-ccad-4588-b7a4-5d47cf344be7, Price= 5.0, Quantity= 80, Side= false
5.0	OrderId: ASK-cb0db2ea-2b6b-4d5d-8fc4-53a70269d204, Price= 5.0, Quantity= 4, Side= false
5.0	OrderId: ASK-5a1c5349-7d51-4905-9de1-9bcd8dcaae4a, Price= 5.0, Quantity= 20, Side= false
6.0	OrderId: ASK-6f714912-0fdf-4252-bb04-2cdc181f2839, Price= 6.0, Quantity= 45, Side= false
6.0	OrderId: ASK-fdfc6d2f-4067-40e2-a65e-d8efe23c89fd, Price= 6.0, Quantity= 60, Side= false
6.0	OrderId: ASK-5121d299-3801-44cf-bd28-14cc645c5af7, Price= 6.0, Quantity= 84, Side= false
6.0	OrderId: ASK-d9052563-d114-4339-9f77-167f56d043d9, Price= 6.0, Quantity= 45, Side= false
6.0	OrderId: ASK-46b4898b-e85d-4e32-ac05-17daf4424ab2, Price= 6.0, Quantity= 96, Side= false
7.0	OrderId: ASK-3265e236-21ff-48a9-8a24-06fc15b75135, Price= 7.0, Quantity= 82, Side= false
7.0	OrderId: ASK-55430411-f6ca-4d38-b438-a729aa32bf0e, Price= 7.0, Quantity= 19, Side= false
7.0	OrderId: ASK-eb836feb-87c4-4a36-ae9f-514e47ee791f, Price= 7.0, Quantity= 9, Side= false
7.0	OrderId: ASK-eda8d65d-61cf-43d8-8eea-cd2b43e7a9f4, Price= 7.0, Quantity= 53, Side= false
7.0	OrderId: ASK-8ef65c75-116a-4ee0-bdd2-daccf3837920, Price= 7.0, Quantity= 92, Side= false
42.44	OrderId: ASK-5fe5f0d4-524f-437a-a524-08b80fb34c22, Price= 42.44, Quantity= 51, Side= false
54.37	OrderId: ASK-8e875a7d-6ee8-4de8-a578-95b7bb2e02ff, Price= 54.37, Quantity= 29, Side= false
68.95	OrderId: ASK-cbdb4e8a-7a93-482f-bde9-a2f370768967, Price= 68.95, Quantity= 22, Side= false

### BID Price – Quantity view:

BID Price -Quantity view is to display the BID orders according to their prices and all the quantity of orders for each price with priority of these orders going down towards the right.

8				
Price	Quantity	HighestPriority	-----> LowestPriority	
74.36	91			
73.22	94			
59.17	42			
30.19	71			
23.69	15			
18.76	5			
8.37	21			
7.00	67	22	1	
6.00	11	83	26	55
5.00	4	60	30	92
4.00	83	21	12	44
3.00	41	85	95	53

### ASK Price – Quantity view:

ASK Price -Quantity view is to display the ASK orders according to their prices and all the quantity of orders for each price with priority of these orders going down towards the right.

9				
Price	Quantity	HighestPriority	-----> LowestPriority	
3.00	91	50	96	1
4.00	26	97	78	24 78
5.00	83	35	80	4 20
6.00	45	60	84	45 96
7.00	82	19	9	53 92
42.44	51			
54.37	29			
68.95	22			



## Add Order:

This functionality is to add a new order to either the BID or ASK maps. If the price exists on the map the function will add the new order to the list for that price. If the price does not exist, the function will add a new price and create a new order list with this order for that new price. We are using TreeMap, so the new price will be added in order of the collection. For BID orders the collection order is reversed(descending), while the ASK orders run in natural order (ascending).

I have added an ASK(sell) order.

OrderId: ASK-72d36ab5-aca5-4b9a-b700-4b24f52aed62, Price= 6.5, Quantity= 10, Side= false

```
3
Enter order price:
6.5
Enter order quantity:
10
Is this a buy order?
Enter True or False
False
Order OrderId: ASK-72d36ab5-aca5-4b9a-b700-4b24f52aed62, Price= 6.5, Quantity= 10, Side= false added successfully.
```

We can see below that the order was added with the new price to the ASK orders:

```
ASK
+-----+-----+
| Price | Orders |
+-----+-----+
| 3.0    | OrderId: ASK-a1af9516-429e-4a5a-aeed-411adda00645, Price= 3.0, Quantity= 91, Side= false |
| 3.0    | OrderId: ASK-a1616e88-e98a-452c-9cd7-8a1ebdafa05a, Price= 3.0, Quantity= 50, Side= false |
| 3.0    | OrderId: ASK-f4f0b7d3-07c2-4ae3-8373-78bc098e1768, Price= 3.0, Quantity= 96, Side= false |
| 3.0    | OrderId: ASK-bfb203cf-f292-4132-8a19-69d73c44264b, Price= 3.0, Quantity= 1, Side= false |
| 4.0    | OrderId: ASK-4803aed3-6677-4fd4-9f0e-5fdf6791800c, Price= 4.0, Quantity= 26, Side= false |
| 4.0    | OrderId: ASK-57e10abe-bd1b-4406-8650-29940d1b179a, Price= 4.0, Quantity= 97, Side= false |
| 4.0    | OrderId: ASK-3d1bbf08-1516-4d5c-9eb5-1c0e38b205a1, Price= 4.0, Quantity= 78, Side= false |
| 4.0    | OrderId: ASK-2aff8385-99af-4ebf-b632-f98e1a4a4cd0, Price= 4.0, Quantity= 24, Side= false |
| 4.0    | OrderId: ASK-0f1aa6fa-043d-4edb-9c2b-24bccca01410, Price= 4.0, Quantity= 78, Side= false |
| 5.0    | OrderId: ASK-418e3a27-a191-4d00-9f7a-2979264b7e27, Price= 5.0, Quantity= 83, Side= false |
| 5.0    | OrderId: ASK-91c0f314-dc07-42f1-81ef-f4162685fff6, Price= 5.0, Quantity= 35, Side= false |
| 5.0    | OrderId: ASK-e48aabab-ccad-4588-b7a4-5d47cf344be7, Price= 5.0, Quantity= 80, Side= false |
| 5.0    | OrderId: ASK-cb0db2ea-2b6b-4d5d-8fc4-53a70269d204, Price= 5.0, Quantity= 4, Side= false |
| 5.0    | OrderId: ASK-5a1c5349-7d51-4905-9de1-9bcd8dcaae4a, Price= 5.0, Quantity= 20, Side= false |
| 6.0    | OrderId: ASK-6f714912-0fdf-4252-bb04-2cdc181f2839, Price= 6.0, Quantity= 45, Side= false |
| 6.0    | OrderId: ASK-fdfc6d2f-4067-40e2-a65e-d8efe23c89fd, Price= 6.0, Quantity= 60, Side= false |
| 6.0    | OrderId: ASK-5121d299-3801-44cf-bd28-14cc645c5af7, Price= 6.0, Quantity= 84, Side= false |
| 6.0    | OrderId: ASK-d9052563-d114-4339-9f77-167f56d043d9, Price= 6.0, Quantity= 45, Side= false |
| 6.0    | OrderId: ASK-46b4898b-e85d-4e32-ac05-17daf4424ab2, Price= 6.0, Quantity= 96, Side= false |
| 6.5    | OrderId: ASK-72d36ab5-aca5-4b9a-b700-4b24f52aed62, Price= 6.5, Quantity= 10, Side= false |
| 7.0    | OrderId: ASK-3265e236-21ff-48a9-8a24-06fc15b75135, Price= 7.0, Quantity= 82, Side= false |
| 7.0    | OrderId: ASK-55430411-f6ca-4d38-b438-a729aa32bf0e, Price= 7.0, Quantity= 19, Side= false |
| 7.0    | OrderId: ASK-eb836feb-87c4-4a36-ae9f-514e47ee791f, Price= 7.0, Quantity= 9, Side= false |
| 7.0    | OrderId: ASK-eda8d65d-61cf-43d8-8eea-cd2b43e7a9f4, Price= 7.0, Quantity= 53, Side= false |
| 7.0    | OrderId: ASK-8ef65c75-116a-4ee0-bdd2-daccf3837920, Price= 7.0, Quantity= 92, Side= false |
| 42.44 | OrderId: ASK-5fe5f0d4-524f-437a-a524-08b80fb34c22, Price= 42.44, Quantity= 51, Side= false |
| 54.37 | OrderId: ASK-8e875a7d-6ee8-4de8-a578-95b7bb2e02ff, Price= 54.37, Quantity= 29, Side= false |
| 68.95 | OrderId: ASK-cbdb4e8a-7a93-482f-bde9-a2f370768967, Price= 68.95, Quantity= 22, Side= false |
```

Adding a second ASK order with the same price will add the new order below this order as it will come in with least priority. OrderId: ASK-4f04535c-02e2-4ebf-a6f7-70b777355fa0, Price= 6.5, Quantity= 15, Side= false.

```
3
Enter order price: |
6.5
Enter order quantity:
15
Is this a buy order?
Enter True or False
false
Order OrderId: ASK-4f04535c-02e2-4ebf-a6f7-70b777355fa0, Price= 6.5, Quantity= 15, Side= false added successfully.
```

Viewing the ASK order list, we can see below:

ASK	
Price	Orders
3.0	OrderId: ASK-a1af9516-429e-4a5a-aeed-411adda00645, Price= 3.0, Quantity= 91, Side= false
3.0	OrderId: ASK-a1616e88-e98a-452c-9cd7-8a1ebdafa05a, Price= 3.0, Quantity= 50, Side= false
3.0	OrderId: ASK-f4f0b7d3-07c2-4ae3-8373-78bc098e1768, Price= 3.0, Quantity= 96, Side= false
3.0	OrderId: ASK-bfb203cf-f292-4132-8a19-69d73c44264b, Price= 3.0, Quantity= 1, Side= false
4.0	OrderId: ASK-4803aed3-6677-4fd4-9f0e-5fdf6791800c, Price= 4.0, Quantity= 26, Side= false
4.0	OrderId: ASK-57e10abe-bd1b-4406-8650-29940d1b179a, Price= 4.0, Quantity= 97, Side= false
4.0	OrderId: ASK-3d1bbf08-1516-4d5c-9eb5-1c0e38b205a1, Price= 4.0, Quantity= 78, Side= false
4.0	OrderId: ASK-2aff8385-99af-4ebf-b632-f98e1a4a4cd0, Price= 4.0, Quantity= 24, Side= false
4.0	OrderId: ASK-0f1aa6fa-043d-4edb-9c2b-24bcccc01410, Price= 4.0, Quantity= 78, Side= false
5.0	OrderId: ASK-418e3a27-a191-4d00-9f7a-2979264b7e27, Price= 5.0, Quantity= 83, Side= false
5.0	OrderId: ASK-91c0f314-dc07-42f1-81ef-f4162685fff6, Price= 5.0, Quantity= 35, Side= false
5.0	OrderId: ASK-e48aabad-ccad-4588-b7a4-5d47cf344be7, Price= 5.0, Quantity= 80, Side= false
5.0	OrderId: ASK-cb0db2ea-2b6b-4d5d-8fc4-53a70269d204, Price= 5.0, Quantity= 4, Side= false
5.0	OrderId: ASK-5a1c5349-7d51-4905-9de1-9bcd8dcaae4a, Price= 5.0, Quantity= 20, Side= false
6.0	OrderId: ASK-6f714912-0fdf-4252-bb04-2cdc181f2839, Price= 6.0, Quantity= 45, Side= false
6.0	OrderId: ASK-fdfc6d2f-4067-40e2-a65e-d8efe23c89fd, Price= 6.0, Quantity= 60, Side= false
6.0	OrderId: ASK-5121d299-3801-44cf-bd28-14cc645c5af7, Price= 6.0, Quantity= 84, Side= false
6.0	OrderId: ASK-d9052563-d114-4339-9f77-167f56d043d9, Price= 6.0, Quantity= 45, Side= false
6.0	OrderId: ASK-46b4898b-e85d-4e32-ac05-17daf4424ab2, Price= 6.0, Quantity= 96, Side= false
6.5	OrderId: ASK-72d36ab5-aca5-4b9a-b700-4b24f52aed62, Price= 6.5, Quantity= 10, Side= false
6.5	OrderId: ASK-4f04535c-02e2-4ebf-a6f7-70b777355fa0, Price= 6.5, Quantity= 15, Side= false
7.0	OrderId: ASK-3265e236-21ff-48a9-8a24-06fc15b75135, Price= 7.0, Quantity= 82, Side= false
7.0	OrderId: ASK-55430411-f6ca-4d38-b438-a729aa32bf0e, Price= 7.0, Quantity= 19, Side= false
7.0	OrderId: ASK-eb836feb-87c4-4a36-ae9f-514e47ee791f, Price= 7.0, Quantity= 9, Side= false
7.0	OrderId: ASK-eda8d65d-61cf-43d8-8eea-cd2b43e7a9f4, Price= 7.0, Quantity= 53, Side= false
7.0	OrderId: ASK-8ef65c75-116a-4ee0-bdd2-daccf3837920, Price= 7.0, Quantity= 92, Side= false
42.44	OrderId: ASK-5fe5f0d4-524f-437a-a524-08b80fb34c22, Price= 42.44, Quantity= 51, Side= false
54.37	OrderId: ASK-8e875a7d-6ee8-4de8-a578-95b7bb2e02ff, Price= 54.37, Quantity= 29, Side= false
68.95	OrderId: ASK-cbdb4e8a-7a93-482f-bde9-a2f370768967, Price= 68.95, Quantity= 22, Side= false

Adding a third order at price 6.5 will push the order to the bottom of the price 6.5 list, as this order will come in with the lowest priority.

```

3
Enter order price:
6.5
Enter order quantity:
8
Is this a buy order?
Enter True or False
false
Order OrderId: ASK-f076f8df-1899-4ac2-a091-d15483ea4672, Price= 6.5, Quantity= 8, Side= false added successfully.

```

Viewing the ASK orders we can see that this is reflecting:

ASK	
Price	Orders
3.0	OrderId: ASK-a1af9516-429e-4a5a-aeed-411adda00645, Price= 3.0, Quantity= 91, Side= false
3.0	OrderId: ASK-a1616e88-e98a-452c-9cd7-8a1ebdafa05a, Price= 3.0, Quantity= 50, Side= false
3.0	OrderId: ASK-f4f0b7d3-07c2-4ae3-8373-78bc098e1768, Price= 3.0, Quantity= 96, Side= false
3.0	OrderId: ASK-bfb203cf-f292-4132-8a19-69d73c44264b, Price= 3.0, Quantity= 1, Side= false
4.0	OrderId: ASK-4803aed3-6677-4fd4-9f0e-5fdf6791800c, Price= 4.0, Quantity= 26, Side= false
4.0	OrderId: ASK-57e10abe-bd1b-4406-8650-29940d1b179a, Price= 4.0, Quantity= 97, Side= false
4.0	OrderId: ASK-3d1bbf08-1516-4d5c-9eb5-1c0e38b205a1, Price= 4.0, Quantity= 78, Side= false
4.0	OrderId: ASK-2aff8385-99af-4ebf-b632-f98e1a4a4cd0, Price= 4.0, Quantity= 24, Side= false
4.0	OrderId: ASK-0f1aa6fa-043d-4edb-9c2b-24bccca01410, Price= 4.0, Quantity= 78, Side= false
5.0	OrderId: ASK-418e3a27-a191-4d00-9f7a-2979264b7e27, Price= 5.0, Quantity= 83, Side= false
5.0	OrderId: ASK-91c0f314-dc07-42f1-81ef-f4162685fff6, Price= 5.0, Quantity= 35, Side= false
5.0	OrderId: ASK-e48aabad-ccad-4588-b7a4-5d47cf344be7, Price= 5.0, Quantity= 80, Side= false
5.0	OrderId: ASK-cb0db2ea-2b6b-4d5d-8fc4-53a70269d204, Price= 5.0, Quantity= 4, Side= false
5.0	OrderId: ASK-5a1c5349-7d51-4905-9de1-9bcd8dcaae4a, Price= 5.0, Quantity= 20, Side= false
6.0	OrderId: ASK-6f714912-0fdf-4252-bb04-2cdc181f2839, Price= 6.0, Quantity= 45, Side= false
6.0	OrderId: ASK-fdfc6d2f-4067-40e2-a65e-d8efe23c89fd, Price= 6.0, Quantity= 60, Side= false
6.0	OrderId: ASK-5121d299-3801-44cf-bd28-14cc645c5af7, Price= 6.0, Quantity= 84, Side= false
6.0	OrderId: ASK-d9052563-d114-4339-9f77-167f56d043d9, Price= 6.0, Quantity= 45, Side= false
6.0	OrderId: ASK-46b4898b-e85d-4e32-ac05-17daf4424ab2, Price= 6.0, Quantity= 96, Side= false
6.5	OrderId: ASK-72d36ab5-aca5-4b9a-b700-4b24f52aed62, Price= 6.5, Quantity= 10, Side= false
6.5	OrderId: ASK-4f04535c-02e2-4ebf-a6f7-70b777355fa0, Price= 6.5, Quantity= 15, Side= false
6.5	OrderId: ASK-f076f8df-1899-4ac2-a091-d15483ea4672, Price= 6.5, Quantity= 8, Side= false
7.0	OrderId: ASK-3265e236-21ff-48a9-8a24-06fc15b75135, Price= 7.0, Quantity= 82, Side= false
7.0	OrderId: ASK-55430411-f6ca-4d38-b438-a729aa32bf0e, Price= 7.0, Quantity= 19, Side= false
7.0	OrderId: ASK-eb836feb-87c4-4a36-ae9f-514e47ee791f, Price= 7.0, Quantity= 9, Side= false
7.0	OrderId: ASK-eda8d65d-61cf-43d8-8eea-cd2b43e7a9f4, Price= 7.0, Quantity= 53, Side= false
7.0	OrderId: ASK-8ef65c75-116a-4ee0-bdd2-daccf3837920, Price= 7.0, Quantity= 92, Side= false
42.44	OrderId: ASK-5fe5f0d4-524f-437a-a524-08b80fb34c22, Price= 42.44, Quantity= 51, Side= false
54.37	OrderId: ASK-8e875a7d-6ee8-4de8-a578-95b7bb2e02ff, Price= 54.37, Quantity= 29, Side= false
68.95	OrderId: ASK-cbdb4e8a-7a93-482f-bde9-a2f370768967, Price= 68.95, Quantity= 22, Side= false

Viewing the ASK Price- Quantity view we can see the orders and priority:

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9					
Price	Quantity	HighestPriority	-----> LowestPriority		
3.00	91	50	96	1	
4.00	26	97	78	24	78
5.00	83	35	80	4	20
6.00	45	60	84	45	96
6.50	10	15	8		
7.00	82	19	9	53	92
42.44	51				
54.37	29				
68.95	22				