

Algorithmic Trading Developer Technical Assignment – Matching Engine Instruction Manual

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[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 3.0, 4.0, 5.0, 6.0, 7.0. 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-cfad327-6081-4650-98bf-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 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 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). The simulation displays the temporary order created for this execution.

```

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*****
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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-a04abbc9f506, 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-a04abbcb9f506, 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 |
```

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 order 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 looks 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-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-cfad327-6081-4650-98bf-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. 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-cfad327-6081-4650-98bf-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 3.0 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