SOFE 4790U: Distributed Systems (Fall 2021)
Instructor: Dr. Q. Mahmoud/H. Singh

Individual Programming Assignment #1
[Monday, Oct 11 -- Wednesday, Oct. 20]

Client-Server Application:
Book Store Register System

Name: Esam Uddin

Student Number: 100711116

Date: 10/20/2021

GitHub Repo Link: https://github.com/esam191/ClientServerApplication

Assignment GitHub Repo:

https://github.com/UOITEngineering2/assignment1fall2020-esam191/tree/master

Application Idea

I designed and developed a book store register system that works as a client/server application. Clients can order books by simply typing in the name and quantity of the book they would like to purchase. Clients can also ask the server to recommend a top selling book if they can't choose on their own.

The client connects to the server with an IP address and port number. Once connected, menu options are displayed for the bookstore by the server. The client has 5 options to choose from, the first option is to order a book, the second option displays the current total cost, the third option recommends a best selling book from the server, the fourth option displays a receipt including the total cost plus tax (HST) and a date stamp, and finally the last option lets the client exit from the server by manually terminating the request.

This client/server application was created using socket (TCP) programming in Java and consists of a multi-threaded server that handles multiple client requests. The application accomplishes something useful and has several novel/interesting features.

Services/Functionalities

The two significant services that the server provides for the client to use are the following:

- Take New Order + Calculate Cost
- Display Total Cost

Novel Features

The two main novel/interesting features that the server provides for the client to use are:

- Recommends Best Seller Books
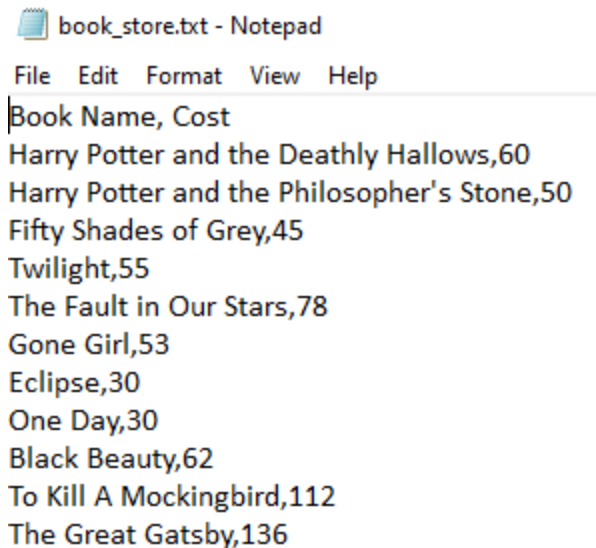**- Displays Receipt + HST tax + Data Stamp**

Challenges and Solutions

Throughout working on this assignment, I've faced many challenges but the one that troubled me the most was ensuring that the application consisted of a multi-threaded server so that it could handle multiple clients simultaneously. To make it easier for myself when trying to implement this, I decided not to add any high level functionality into my program until a client-handler was established and working. Some other challenges that I faced were calculating the total cost for the client because I had to make sure that the cost gets updated each time the client takes a new order and recommending a book to the client because I had to display the book to the client and take quantity input. In the end, I was able to work through these problems by carefully analyzing the state and action of the bugs that I faced.

Book Store:

The image to the left shows the bookstore based on which the client makes all the book orders. Each line in the text file contains the name of the book and its cost separated by a comma.

book_store.txt - Notepad

File   Edit   Format   View   Help

Book Name, Cost
Harry Potter and the Deathly Hallows,60
Harry Potter and the Philosopher's Stone,50
Fifty Shades of Grey,45
Twilight,55
The Fault in Our Stars,78
Gone Girl,53
Eclipse,30
One Day,30
Black Beauty,62
To Kill A Mockingbird,112
The Great Gatsby,136

The image below shows an example test of client 1 connected to the server, and you can see that server displays the list of options as soon as the client gets connected. Each time the client selects an option and once their request is completed, the menu options reappear so the client can choose what to do next. The client first orders the book by pressing 1, then it gets to enter its name and quantity. Then the server replies with "New Order Added Successfully". Now if the client wishes to see the total cost, client can type 2 as shown below and view the total cost, and 3 to get a book recommendation, and finally, 4 to see the receipt.

Client 1:

As shown below, a further two more clients have been connected to the same server and the server handles their request accordingly. All options selected by all clients have been handled correctly by the server. The Clients can manually terminate by typing -1.

Client 2:


```
C:\Windows\System32\cmd.exe                                                                    —    □
Microsoft Windows [Version 10.0.19042.1288]
(c) Microsoft Corporation. All rights reserved.

D:\Program Files\esam1\Github\ds-assignment-1>java Client localhost 5000
Connected
Please select one of the options: 1 - Give New Book Order , 2 - View Total Cost, 3 - Best Seller Recommendation, 4 - View Receipt, -1 - exit
1
Enter the name of the book:
Eclipse
Enter the quantity:
2
Server reply: New Order Addded Succesfully!
Please select one of the options: 1 - Give New Book Order , 2 - View Total Cost, 3 - Best Seller Recommendation, 4 - View Receipt, -1 - exit
2
Server reply:
Your total cost is: $60.0 plus tax
Please select one of the options: 1 - Give New Book Order , 2 - View Total Cost, 3 - Best Seller Recommendation, 4 - View Receipt, -1 - exit
4
Server reply:
Receipt: Your total order for today including HST (ON - 8%): 64.8 - Today's Date: 2021-10-20:15-25-03
Please select one of the options: 1 - Give New Book Order , 2 - View Total Cost, 3 - Best Seller Recommendation, 4 - View Receipt, -1 - exit
-1
```

Client 3:


```
C:\Windows\System32\cmd.exe                                                                    —
Microsoft Windows [Version 10.0.19042.1288]
(c) Microsoft Corporation. All rights reserved.

D:\Program Files\esam1\Github\ds-assignment-1>java Client localhost 5000
Connected
Please select one of the options: 1 - Give New Book Order , 2 - View Total Cost, 3 - Best Seller Recommendation, 4 - View Receipt, -1 - exit
1
Enter the name of the book:
One Day
Enter the quantity:
4
Server reply: New Order Addded Succesfully!
Please select one of the options: 1 - Give New Book Order , 2 - View Total Cost, 3 - Best Seller Recommendation, 4 - View Receipt, -1 - exit
2
Server reply:
Your total cost is: $120.0 plus tax
Please select one of the options: 1 - Give New Book Order , 2 - View Total Cost, 3 - Best Seller Recommendation, 4 - View Receipt, -1 - exit
3
Recommended Top Seller: To Kill A Mockingbird
Enter the quantity:
1
Server reply: New Order Addded Succesfully!
Please select one of the options: 1 - Give New Book Order , 2 - View Total Cost, 3 - Best Seller Recommendation, 4 - View Receipt, -1 - exit
4
Server reply:
Receipt: Your total order for today including HST (ON - 8%): 250.56 - Today's Date: 2021-10-20:15-27-34
Please select one of the options: 1 - Give New Book Order , 2 - View Total Cost, 3 - Best Seller Recommendation, 4 - View Receipt, -1 - exit
-1
```

The image below shows the server side. Each time a new client gets connected, the server prints a message on the terminal with its IP address and port number. The server also prints messages on what options the clients have selected, other information on what the client request is, for example "Taking order...", "Total Cost Displayed!", and "Client Exited!".

Server:

Full View:

Server window (java Server 5000):
```
D:\Program Files\esam1\Github\ds-assignment-1>java Server 5000
Server Listening on port 5000....
New Client Connected! IP Address and Port Number: 127.0.0.1 5000
Client Selected Option 1
Taking order...
Client Added Book!
Client Selected Option 2
Total Cost Displayed!
Client Selected Option 3
Taking order...
Recommending Top Seller...
Client Added Book!
Client Selected Option 2
Total Cost Displayed!
Client Selected Option 4
Receipt Displayed!
Client Selected Option -1
Client Exited!
New Client Connected! IP Address and Port Number: 127.0.0.1 5000
Client Selected Option 1
Taking order...
Client Added Book!
Client Selected Option 2
Total Cost Displayed!
Client Selected Option 4
Receipt Displayed!
Client Selected Option -1
Client E
New Clie
Client S Microsoft Windows [Version 10.0.19042.1288]
Taking o (c) Microsoft Corporation. All rights reserved.
Client A
Client S D:\Program Files\esam1\Github\ds-assignment-1>java Client localhost
Total Co Connected
Client S Please select one of the options: 1 - Give New Book Order , 2 - View
Taking o 1
Recommen Enter the name of the book:
Client A One Day
Client S Enter the quantity:
Receipt  4
Client S Server reply: New Order Addded Succesfully!
Client E Please select one of the options: 1 - Give New Book Order , 2 - View Total Cost, 3 - Best Seller Recommendation, 4 - View Receipt, -1 - exit
         2
         Server reply:
         Your total cost is: $120.0 plus tax
         Please select one of the options: 1 - Give New Book Order , 2 - View Total Cost, 3 - Best Seller Recommendation, 4 - View Receipt, -1 - exit
         3
         Recommended Top Seller: To Kill A Mockingbird
         Enter the quantity:
         1
         Server reply: New Order Addded Succesfully!
         Please select one of the options: 1 - Give New Book Order , 2 - View Total Cost, 3 - Best Seller Recommendation, 4 - View Receipt, -1 - exit
         4
         Server reply:
         Receipt: Your total order for today including HST (ON - 8%): 250.56 - Today's Date: 2021-10-20:15-27-34
         Please select one of the options: 1 - Give New Book Order , 2 - View Total Cost, 3 - Best Seller Recommendation, 4 - View Receipt, -1 - exit
         -1
```
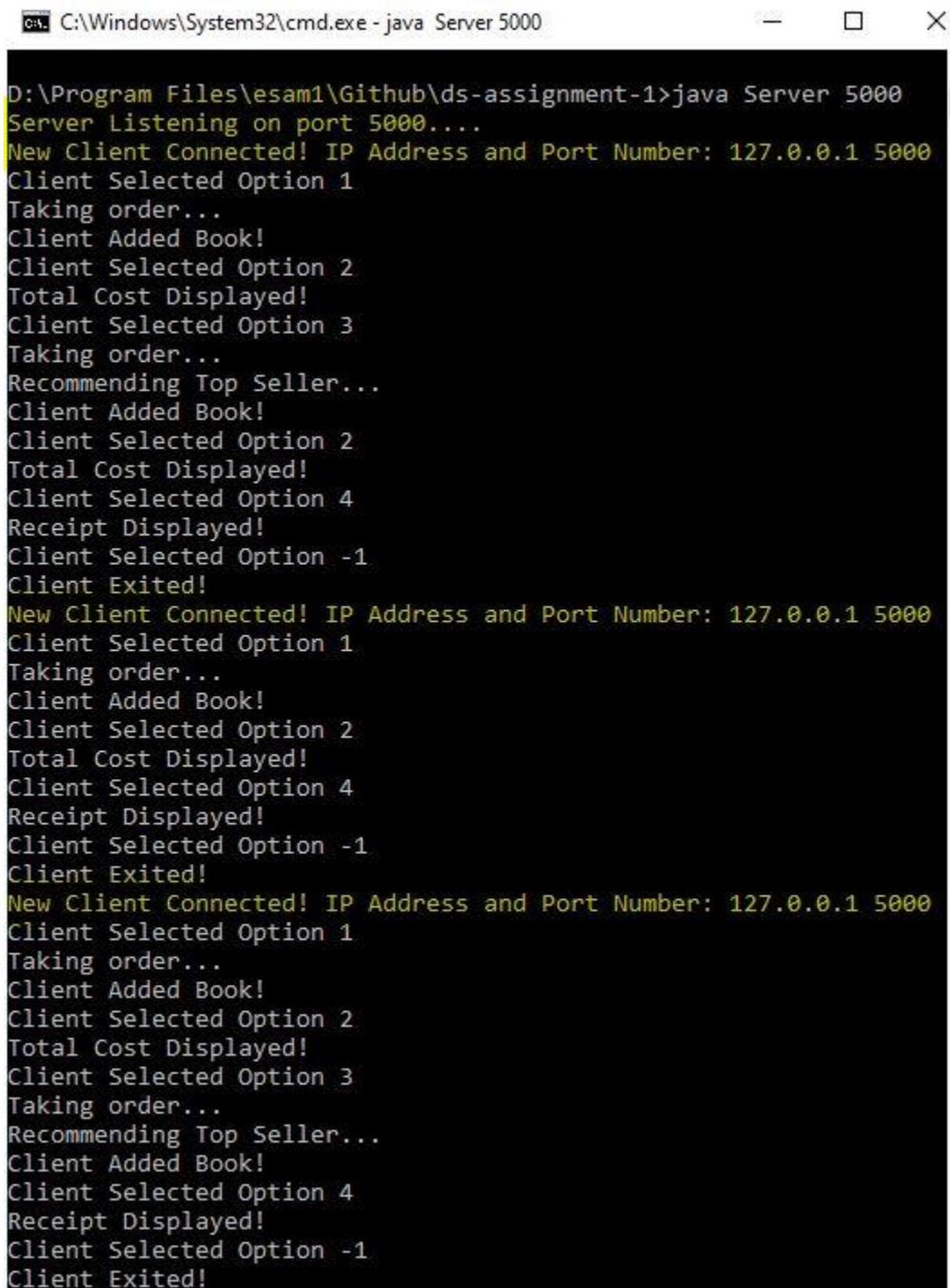
Top-right window:
```
Microsoft Windows [Version 10.0.19042.1288]
(c) Microsoft Corporation. All rights reserved.

...Files\esam1\Github\ds-assignment-1>java Client localhost 5000

...ct one of the options: 1 - Give New Book Order , 2 - View Total Cost, 3 - Best Seller Recommendation, 4 - View Receipt, -1 - exit

...ame of the book:

...uantity:

...y: New Order Addded Succesfully!
...ct one of the options: 1 - Give New Book Order , 2 - View Total Cost, 3 - Best Seller Recommendation, 4 - View Receipt, -1 - exit

...y:
...cost is: $53.0 plus tax
...ct one of...

... Top Sell
...uantity:

...y: New Or
...ct one of

...y:
...cost is:

...r total
```

Right window:
```
Microsoft Windows [Version 10.0.19042.1288]
(c) Microsoft Corporation. All rights reserved.

D:\Program Files\esam1\Github\ds-assignment-1>java Client localhost 5000
Connected
Please select one of the options: 1 - Give New Book Order , 2 - View Total Cost, 3 - Best Seller Recommendation, 4 - View Receipt, -1 - exit
1
Enter the name of the book:
Eclipse
Enter the quantity:
2
Server reply: New Order Addded Succesfully!
Please select one of the options: 1 - Give New Book Order , 2 - View Total Cost, 3 - Best Seller Recommendation, 4 - View Receipt, -1 - exit
2
Server reply:
Your total cost is: $60.0 plus tax
Please select one of the options: 1 - Give New Book Order , 2 - View Total Cost, 3 - Best Seller Recommendation, 4 - View Receipt, -1 - exit
4
Server reply:
Receipt: Your total order for today including HST (ON - 8%): 64.8 - Today's Date: 2021-10-20:15-25-03
Please select one of the options: 1 - Give New Book Order , 2 - View Total Cost, 3 - Best Seller Recommendation, 4 - View Receipt, -1 - exit
-1
```

Note window:
Book Store Register System

Services/Functionalities:

- Take New Order + Calculate Cost
- Display Total Cost

Novel Features:

- Recommends Best Seller Books
- Displays Receipt + HST tax + Data Stamp