

ECE573 - Internet Protocols

Project 1

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Introduction

This document provides an overview of our project implementation, including instructions on how to compile and run the code, as well as key screenshots demonstrating the system's functionality. Throughout this README, we have included detailed explanations of the different components of the auction server, client interactions through the required screenshots.

Team Members

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Relevant Screenshots

1. Starting the Auctioneer Server

```
PS C:\Users\OneDrive\Desktop> python auc_server.py 127.0.0.1 12345
Auctioneer is ready for hosting auctions!
```

2. Starting the client (Seller)

On the seller side

```
PS C:\Users\OneDrive\Desktop> python auc_client.py 127.0.0.1 123
45
seller
Connected to the Auctioneer server.

Your role is: [Seller]
Please submit auction request: wrong
Server: Invalid auction request!
Please submit auction request: 1 100 3 WolfPackSword
Server: Auction Start.
```

On the server side

```
PS C:\Users\DELL\OneDrive\Desktop> python auc_server.py 127.0.0.1 12345
Auctioneer is ready for hosting auctions!
Seller is connected from ('127.0.0.1', 60730)
>> New Seller Thread spawned
Auction request received. Now waiting for Buyers.
[]
```

While server is getting connected and any other client tries to build a connection, then it gets server busy

```
PS C:\Users\DELL\OneDrive\Desktop> python auc_client.py 127.0.0.1 12345
Server is busy. Try to connect again later.
PS C:\Users\DELL\OneDrive\Desktop> []
```

3. Starting the client (Buyer)

On the buyer side it gets a message that server is waiting for the other clients

```
PS C:\Users\DELL\OneDrive\Desktop> python auc_client.py 127.0.0.1 12345
buyer
Connected to the Auctioneer server.
```

```
Your role is: [Buyer]
The Auctioneer is still waiting for other Buyer to connect...
[]
```

On the Server side

```
PS C:\Users\DELL\OneDrive\Desktop> python auc_server.py 127
.0.0.1 12345
Auctioneer is ready for hosting auctions!
Seller is connected from ('127.0.0.1', 61192)
>> New Seller Thread spawned
Auction request received. Now waiting for Buyers.
Buyer 1 is connected from ('127.0.0.1', 61209)
[]
```

4. All Buyers are connected:

Now when all the buyers are connected, then all the Buyers are notified that the bidding is getting started and the server displays all the buyers connected for the auction

Server Side

```
Seller is connected from ('127.0.0.1', 61449)
auctions!
27.0.0.1', 61449)
>> New Seller Thread spawned
Auction request received. Now waiting for Buyers.
Buyer 1 is connected from ('127.0.0.1', 61457)
Buyer 2 is connected from ('127.0.0.1', 61465)
>> Bidding Thread spawned
Requested number of bidders arrived. Let's start bidding!
[]
```

Buyer Side

```
PS C:\Users\DELL\OneDrive\Desktop> python auc_
client.py 127.0.0.1 12345
buyer
Connected to the Auctioneer server.

Your role is: [Buyer]
The Auctioneer is still waiting for other Buyer to connect...
The bidding has started!
Please submit you bid:[]
```

```
PS C:\Users\DELL\OneDrive\Desktop> python auc_cli
ent.py 127.0.0.1 12345
buyer
Connected to the Auctioneer server.

Your role is: [Buyer]
The bidding has started!
Please submit you bid:[]
```

5. Bidding Starts

On the server side

```
Seller is connected from ('127.0.0.1', 62433)
>> New Seller Thread spawned
Auction request received. Now waiting for Buyers.
Buyer 1 is connected from ('127.0.0.1', 62443)
Buyer 2 is connected from ('127.0.0.1', 62452)
Buyer 3 is connected from ('127.0.0.1', 62456)
>> Bidding Thread spawnedRequested number of bidders arrived. Let's start bidding!
Buyer 1 bid: $130
Buyer 2 bid: $150
Buyer 3 bid: $180
```

On the Buyer side

```
Your role is: [Buyer]
The Auctioneer is still waiting for other Buyer to connect...
The bidding has started!
Please submit you bid:-150
Server: Invalid bid. Please submit a positive integer!
Please submit you bid:150
Server: Bid received. Please wait...
```

6. Get the final auction result

On the server side, as auction type is 1, so the highest bid is selected

```
Auction request received. Now waiting for Buyers.
Buyer 1 is connected from ('127.0.0.1', 62478)
Buyer 2 is connected from ('127.0.0.1', 62479)
Buyer 3 is connected from ('127.0.0.1', 62480)
>> Bidding Thread spawnedRequested number of bidders arrived. Let's start bidding!
Buyer 1 bid: $130
Buyer 2 bid: $150
Buyer 3 bid: $180
Item sold! The highest bid is 180. The actual payment is 180.
[]
```

On the Buyer side - The Winning Bid

```
Connected to the Auctioneer server.

Your role is: [Buyer]
The bidding has started!
Please submit you bid:180
Server: Bid received. Please wait...
Auction finished!
You won this item: WolfPackSword!
Your payment due is 180.
Disconnecting from the Auctioneer server.
Auction is over!
```

All the other buyers:

```
PS C:\Users\OneDrive\Desktop> python auc_client.py 127.0.0.1
12345
connect...
The bidding has started!
Please submit you bid:150
Server: Bid received. Please wait...
Auction finished!
Unfortunately, you did not win in the last round.
Disconnecting from the Auctioneer server. Auction is over!
```

Seller side results

```
Auction is finished. Here is the result:
Auction finished!
Success! Your item WolfPackSword has been sold for 170.
Disconnecting from the Auctioneer server. Auction is over!
```

When Auction type is 2

```
PS C:\Users\DELL\python auc_server.py 12345
127.0.0.1', 61061). Now waiting for Buyers.
Buyer 1 is connected from ('127.0.0.1', 61070)
Buyer 2 is connected from ('127.0.0.1', 61073)
>> Bidding Thread spawned
Requested number of bidders arrived. Let's start
bidding!
Buyer 1 bid: $300
Buyer 2 bid: $210
Item sold! The highest bid is 300. The actual pa
yment is 210.
```

When all the bids are lower than the lowest price

The screenshot displays three terminal windows side-by-side, illustrating the interaction between an auctioneer server and two buyers.

- Top Terminal:** Shows the auctioneer server (auc_server.py) running on port 12345. It receives connections from two buyers (Buyer 1 and Buyer 2) and starts a bidding process. The highest bid is \$300, and the payment is set at \$210.
- Middle Terminal:** Shows a buyer client (auc_client.py) connecting to the auctioneer on port 152.7.177.168. The client identifies itself as a seller and submits an auction request for item "Wolf" with a low price of \$100. The server responds that the bidding has started.
- Bottom Terminal:** Shows another buyer client connecting to the same auctioneer. This client also identifies itself as a buyer and submits a bid of \$20. The server responds that the auction failed because the highest bid does not meet the lowest price requirement.

How to compile and run the code

To run the code on VLC, we need one VM for server, one for sellers and N VMs for N buyers.

Command to run the server is “**python3 auc_server.py <port_number>**”

Command to run the client is “**python3 auc_client.py <server_IP_address> <port_number>**”

For example:

Server command: python3 auc_server.py 3005

Client command: python3 auch_client.py 127.0.0.1 3005

Extra Credit

1. First-Price or Second-Price Auction?

Ans Second-Price Auction

2. Reasoning

The goal is for the Seller to learn the true valuation of each Buyer while still selling the item for a reasonable price.

In a second-price auction, the winning Buyer pays the price of the second-highest bid rather than their own bid. This encourages Buyers to bid their true valuation of the item because:

- If they bid lower than their true valuation, they risk losing the auction, even though they value the item more than the second-highest bidder.
- If they bid higher than their true valuation, they might end up winning but paying more than the item is worth to them, resulting in negative utility.

In contrast, in a first-price auction, each Buyer has an incentive to bid below their true valuation to maximize their utility, as they would have to pay the amount they bid. This does not serve the Seller's goal of learning the true valuation because Buyers will likely shade their bids to pay less.

3. Execution steps of the programs that validate the reasoning.

To validate the reasoning mentioned above, let's take 2 Buyers B1 and B2 with their private valuations V1 and V2 respectively.

V1 = \$100

V2 = \$80

Now let's consider the case when the auction is of type 1 that is first price auction

Scenario 1: Both Buyers Bid Their True Valuation

Buyer 1: Valuation = 100, Bid = 100

Buyer 2: Valuation = 80, Bid = 80

Winner: Buyer 1 (since 100 > 80)

Therefore, Utility of B1 = 100-100 = 0

Utility of B2 = 0

The image shows four terminal windows arranged in a 2x2 grid, illustrating the auction process between a server and two clients.

- Top Left Terminal:** Shows the auctioneer's perspective. It starts with "Auctioneer is ready for hosting auctions!" and "Seller is connected from ('152.7.177.192', 57124)". It then receives bids from "Buyer 1" and "Buyer 2". "Buyer 1" bid \$100 and "Buyer 2" bid \$80. The server then sells the item to "Buyer 1" for \$100.
- Top Right Terminal:** Shows "Buyer 1" connecting to the auctioneer. It receives a role assignment ("Your role is: [Buyer]"), bidding instructions ("The bidding has started! Please submit your bid: 100"), and confirmation messages ("Bid received. Please wait...", "Auction finished!", "You won this item: WolfPackSword!", "Your payment due is 100.", "Disconnecting from the Auctioneer server.", "Auction is over!", "Exiting after auction finished message.", "Connection closed by the server").
- Bottom Left Terminal:** Shows "Buyer 2" connecting to the auctioneer. It receives a role assignment ("Your role is: [Seller]"), bidding instructions ("Please submit auction request: 1 50 2 WolfPackSword"), and confirmation messages ("Server: Auction Start", "Auction is finished. Here is the result:", "Success! Your item WolfPackSword has been sold for 100.", "Disconnecting from the Auctioneer server. Auction is over!").
- Bottom Right Terminal:** Shows "Buyer 2" connecting to the auctioneer. It receives a role assignment ("Your role is: [Buyer]"), bidding instructions ("The bidding has started! Please submit your bid: 80"), and confirmation messages ("Server: Bid received. Please wait...", "Auction finished!", "Unfortunately, you did not win in the last round.", "Disconnecting from the Auctioneer server. Auction is over!", "Exiting after auction finished message.", "Connection closed by the server").

Scenario 2: Buyer 1 bids lower strategically

Buyer 1: Valuation = 100, Bid = 90

Buyer 2: Valuation = 80, Bid = 80

Winner: Buyer 1 (since 90 > 80)

Therefore, Utility of B1 = 100-90 = 10

Utility of B2 = 0

```

● ● ● sakhibasapure — sbasapu@vclvm177-168:~/Project — ssh sbasapu@152...
[sbasapu@vclvm177-168 Project]$ python3 auc_server.py 3001
Auctioneer is ready for hosting auctions!
Seller is connected from ('152.7.177.192', 57124)
>> New Seller Thread spawned
Auction request received from ('152.7.177.192', 57124). Now waiting for Buyers.
Buyer 1 is connected from ('152.7.177.47', 54858)
Buyer 2 is connected from ('152.7.177.62', 33786)
>> Bidding Thread spawned
Requested number of bidders arrived. Let's start bidding!
Buyer 1 bid: $100
Buyer 2 bid: $80
Item sold! The highest bid is 100. The actual payment is 100.
Seller is connected from ('152.7.177.192', 57126)
>> New Seller Thread spawned
Auction request received from ('152.7.177.192', 57126). Now waiting for Buyers.
Buyer 1 is connected from ('152.7.177.47', 54860)
Buyer 2 is connected from ('152.7.177.62', 33788)
>> Bidding Thread spawned
Requested number of bidders arrived. Let's start bidding!
Buyer 1 bid: $90
Buyer 2 bid: $80
Item sold! The highest bid is 90. The actual payment is 90.
[]

● ● ● sakhibasapure — sbasapu@vclvm177-192:~/Project — ssh sbasapu@152...
[sbasapu@vclvm177-192 Project]$ python3 auc_client.py 152.7.177.168 3001
Connected to the Auctioneer server.

Your role is: [Seller]
Please submit auction request: 1 50 2 WolfPackSword
Server: Auction Start
Auction is finished. Here is the result:
Auction finished!
Success! Your item WolfPackSword has been sold for 100.
Disconnecting from the Auctioneer server. Auction is over!
[sbasapu@vclvm177-192 Project]$ python3 auc_client.py 152.7.177.168 3001
Connected to the Auctioneer server.

Your role is: [Seller]
Please submit auction request: 1 50 2 WolfPackSword
Server: Auction Start
Auction is finished. Here is the result:
Auction finished!
Success! Your item WolfPackSword has been sold for 90.
Disconnecting from the Auctioneer server. Auction is over!
[sbasapu@vclvm177-192 Project]$ []

● ● ● sakhibasapure — sbasapu@vclvm177-47:~/Project — ssh sbasapu@152...
[sbasapu@vclvm177-47 Project]$ python3 auc_client.py 152.7.177.168 3001
Connected to the Auctioneer server.

Your role is: [Buyer]
The bidding has started!
Please submit your bid: 90
Server: Bid received. Please wait...
Auction finished!
You won this item: WolfPackSword!
Your payment due is 100.
Disconnecting from the Auctioneer server.
Auction is over!
Exiting after auction finished message.
Connection closed by the server.
[sbasapu@vclvm177-47 Project]$ 

Your role is: [Buyer]
The bidding has started!
Please submit your bid: 90
Server: Bid received. Please wait...
Auction finished!
You won this item: WolfPackSword!
Your payment due is 90.
Disconnecting from the Auctioneer server.
Auction is over!
Exiting after auction finished message.
Connection closed by the server.
[sbasapu@vclvm177-47 Project]$ 

Connected to the Auctioneer server.

Your role is: [Buyer]
The bidding has started!
Please submit your bid: 80
Server: Bid received. Please wait...
Auction finished!
Unfortunately, you did not win in the last round.
Disconnecting from the Auctioneer server. Auction is over!
Exiting after auction finished message.
Connection closed by the server.
[sbasapu@vclvm177-62 Project]$ python3 auc_client.py 152.7.177.168 3001
Connected to the Auctioneer server.

Your role is: [Buyer]
The bidding has started!
Please submit your bid: 80
Server: Bid received. Please wait...
Auction finished!
Unfortunately, you did not win in the last round.
Disconnecting from the Auctioneer server. Auction is over!
Exiting after auction finished message.
Connection closed by the server.
[sbasapu@vclvm177-62 Project]$ 
```

Hence, this benefits the buyer but seller will not know or will now be able to guess the valuation even if bidder bids low.

Next, let's consider auction type 2 which is a second-price auction.

Scenario 3: Both Buyers Bid Their True Valuation

Buyer 1: Valuation = 100, Bid = 100

Buyer 2: Valuation = 80, Bid = 80

Winner: Buyer 1 (since $100 > 80$) but will pay 80

Therefore, Utility of B1 = $100 - 80 = 20$

Utility of B2 = 0

```

● ● ● sakshibasapure — sbasapu@vclvm177-168:~/Project — ssh sbasapu@15...
Buyer 1 bid: $100
Buyer 2 bid: $80
Item sold! The highest bid is 100. The actual payment is 100.
Seller is connected from ('152.7.177.192', 57126)
>> New Seller Thread spawned
Auction request received from ('152.7.177.192', 57126). Now waiting for Buyers.
Buyer 1 is connected from ('152.7.177.47', 54860)
Buyer 2 is connected from ('152.7.177.62', 33788)
>> Bidding Thread spawned
Requested number of bidders arrived. Let's start bidding!
Buyer 1 bid: $90
Buyer 2 bid: $80
Item sold! The highest bid is 90. The actual payment is 90.
Seller is connected from ('152.7.177.192', 57128)
>> New Seller Thread spawned
Auction request received from ('152.7.177.192', 57128). Now waiting for Buyers.
Buyer 1 is connected from ('152.7.177.47', 54862)
Buyer 2 is connected from ('152.7.177.62', 33790)
>> Bidding Thread spawned
Requested number of bidders arrived. Let's start bidding!
Buyer 1 bid: $100
Buyer 2 bid: $80
Item sold! The highest bid is 100. The actual payment is 80.
[ ] 

● ● ● sakshibasapure — sbasapu@vclvm177-192:~/Project — ssh sbasapu@15...
Auction finished!
Success! Your item WolfPackSword has been sold for 100.
Disconnecting from the Auctioneer server. Auction is over!
[sbasapu@vclvm177-192 Project]$ python3 auc_client.py 152.7.177.168 3001
Connected to the Auctioneer server.

Your role is: [Seller]
Please submit auction request: 1 50 2 WolfPackSword
Server: Auction Start
Auction is finished. Here is the result:
Auction finished!
Success! Your item WolfPackSword has been sold for 90.
Disconnecting from the Auctioneer server. Auction is over!
[sbasapu@vclvm177-192 Project]$ python3 auc_client.py 152.7.177.168 3001
Connected to the Auctioneer server.

Your role is: [Seller]
Please submit auction request: 2 50 2 WolfPackSword
Server: Auction Start
Auction is finished. Here is the result:
Auction finished!
Success! Your item WolfPackSword has been sold for 80.
Disconnecting from the Auctioneer server. Auction is over!
[sbasapu@vclvm177-192 Project]$ [ ] 

● ● ● sakshibasapure — sbasapu@vclvm177-62:~/Project — ssh sbasapu@15...
Connected to the Auctioneer server.

Your role is: [Buyer]
The bidding has started!
Please submit your bid: 80
Server: Bid received. Please wait...
Auction finished!
Unfortunately, you did not win in the last round.
Disconnecting from the Auctioneer server. Auction is over!
Exiting after auction finished message.
Connection closed by the server.
[sbasapu@vclvm177-62 Project]$ python3 auc_client.py 152.7.177.168 3001
Connected to the Auctioneer server.

Your role is: [Buyer]
The bidding has started!
Please submit your bid: 80
Server: Bid received. Please wait...
Auction finished!
Unfortunately, you did not win in the last round.
Disconnecting from the Auctioneer server. Auction is over!
Exiting after auction finished message.
Connection closed by the server.
[sbasapu@vclvm177-62 Project]$ [ ] 

```

In this case Buyer 1 gets a positive utility of 20 even by bidding the true valuation giving Buyer 1 a reason to reveal its true valuation.

Scenario 4:Buyer 1 bids lower strategically

Buyer 1: Valuation = 100, Bid = 90

Buyer 2: Valuation = 80, Bid = 80

Winner: Buyer 1 (since $90 > 80$) but will pay 80

Therefore, Utility of B1 = $100 - 80 = 20$

Utility of B2 = 0

```

sakhibasapu — sbasapu@vclvm177-168:~/Project — ssh sbasapu@15...
Buyer 1 bid: $90
Buyer 2 bid: $88
Item sold! The highest bid is 90. The actual payment is 90.
Seller is connected from ('152.7.177.192', 57128)
>> New Seller Thread spawned
Auction request received from ('152.7.177.192', 57128). Now waiting for Buyers.
Buyer 1 is connected from ('152.7.177.47', 54862)
Buyer 2 is connected from ('152.7.177.62', 33798)
>> Bidding Thread spawned
Requested number of bidders arrived. Let's start bidding!
Buyer 1 bid: $100
Buyer 2 bid: $88
Item sold! The highest bid is 100. The actual payment is 80.
Seller is connected from ('152.7.177.192', 57130)
>> New Seller Thread spawned
Auction request received from ('152.7.177.192', 57130). Now waiting for Buyers.
Buyer 1 is connected from ('152.7.177.47', 54864)
Buyer 2 is connected from ('152.7.177.62', 33792)
>> Bidding Thread spawned
Requested number of bidders arrived. Let's start bidding!
Buyer 1 bid: $98
Buyer 2 bid: $88
Item sold! The highest bid is 90. The actual payment is 80.

sakhibasapu — sbasapu@vclvm177-192:~/Project — ssh sbasapu@15...
Auction finished!
Success! Your item WolfPackSword has been sold for 90.
Disconnecting from the Auctioneer server. Auction is over!
[ssbasapu@vclvm177-192 Project]$ python3 auc_client.py 152.7.177.168 3001
Connected to the Auctioneer server.

Your role is: [Seller]
[Please submit auction request: 2 50 2 WolfPackSword
Server: Auction Start
Auction is finished. Here is the result:
Auction finished!
Success! Your item WolfPackSword has been sold for 80.
Disconnecting from the Auctioneer server. Auction is over!
[ssbasapu@vclvm177-192 Project]$ python3 auc_client.py 152.7.177.168 3001
Connected to the Auctioneer server.

Your role is: [Seller]
[Please submit auction request: 2 50 2 WolfPackSword
Server: Auction Start
Auction is finished. Here is the result:
Auction finished!
Success! Your item WolfPackSword has been sold for 80.
Disconnecting from the Auctioneer server. Auction is over!
[ssbasapu@vclvm177-192 Project]$ 

sakhibasapu — sbasapu@vclvm177-47:~/Project — ssh sbasapu@15...
Server: Bid received. Please wait...
Auction finished!
You won this item: WolfPackSword!
Your payment due is 80.
Disconnecting from the Auctioneer server.
Auction is over!
Exiting after auction finished message.
Connection closed by the server.
[ssbasapu@vclvm177-47 Project]$ python3 auc_client.py 152.7.177.168 3001
Connected to the Auctioneer server.

Your role is: [Buyer]
The Auctioneer is still waiting for other Buyer to connect...
The bidding has started!
[Please submit your bid: 90
Server: Bid received. Please wait...
Auction finished!
You won this item: WolfPackSword!
Your payment due is 80.
Disconnecting from the Auctioneer server.
Auction is over!
Exiting after auction finished message.
Connection closed by the server.
[ssbasapu@vclvm177-47 Project]$ 

sakhibasapu — sbasapu@vclvm177-62:~/Project — ssh sbasapu@15...
Connected to the Auctioneer server.

Your role is: [Buyer]
The bidding has started!
[Please submit your bid: 80
Server: Bid received. Please wait...
Auction finished!
Unfortunately, you did not win in the last round.
Disconnecting from the Auctioneer server. Auction is over!
Exiting after auction finished message.
Connection closed by the server.
[ssbasapu@vclvm177-62 Project]$ python3 auc_client.py 152.7.177.168 3001
Connected to the Auctioneer server.

Your role is: [Buyer]
The bidding has started!
[Please submit your bid: 80
Server: Bid received. Please wait...
Auction finished!
Unfortunately, you did not win in the last round.
Disconnecting from the Auctioneer server. Auction is over!
Exiting after auction finished message.
Connection closed by the server.
[ssbasapu@vclvm177-62 Project]$ 

```

In this scenario, the utility of Biyer 1 remains the same even after lowering the price, thus giving all the more reasons for the buyer to bid its true valuation.

These scenarios provide a good basis that selecting the second-price auction will increase the chances of the seller to know the buyer's true valuation and also get a reasonable price for the product

Note: Took partial reference from ChatGPT to understand the question.

Grading Rubric

The output for the grading rubric are from the VCL.

1. Output: Terminal output similar to the skeleton: Shown above in the screenshots.
2. Client 1 connected as Seller
3. Seller socket created
4. Seller receives role prompt from Auctioneer

The image shows two terminal windows side-by-side. The left window, titled 'sakhibasapure — sbasapu@vclvm177-168:~/Project — ssh sbasapu@15...', displays the output of running the auctioneer server: 'Auctioneer is ready for hosting auctions!', 'Seller is connected from ('152.7.177.192', 42704)', and '>> New Seller Thread spawned'. The right window, titled 'sakhibasapure — sbasapu@vclvm177-192:~/Project — ssh sbasapu@15...', shows a client connecting to the auctioneer at 152.7.177.168 port 3002, receiving the message 'Connected to the Auctioneer server.', and being assigned the role '[Seller]'. It also prompts 'Please submit auction request:'.

5. Another client tries to connect during Seller process and shows waiting for Seller

The image shows three terminal windows. The top-left window shows the auctioneer server running. The bottom-left window shows a client connecting to the auctioneer, receiving the message 'Connected to the Auctioneer server.', and being assigned the role '[Seller]'. It also prompts 'Please submit auction request:'. The rightmost window shows another client attempting to connect to the auctioneer at 152.7.177.168 port 3002, but receiving the message 'Server is busy. Try to connect again later.' because the seller socket is already in use.

6. Seller sends incorrect auction request and receives feedback
7. Seller sends correct auction request to Auctioneer
8. Seller receives auction start prompt

```

[sakhibasapure — sbasapu@vclvm177-168:~/Project — ssh sbasapu@15...]
[[sbasapu@vclvm177-168 Project]$ python3 auc_server.py 3002
Auctioneer is ready for hosting auctions!
Seller is connected from ('152.7.177.192', 42704)
>> New Seller Thread spawned
Auction request received from ('152.7.177.192', 42704). Now waiting for Buyers.
[]

[sakhibasapure — sbasapu@vclvm177-192:~/Project — ssh sbasapu@15...]
[[sbasapu@vclvm177-192 Project]$ python3 auc_client.py 152.7.177.168 3002
Connected to the Auctioneer server.

Your role is: [Seller]
[Please submit auction request: some wrong input
Server: Invalid auction request!
[Please submit auction request: 1 100 3 WolfPackSword
Server: Auction Start.
[]


```

9. Clients 2 to (N+1) connected as Buyers 1 to N
10. Buyers 1 to N sockets created
11. Buyers 1 to (N-1) receive role and waiting prompt from Auctioneer
12. Buyers 1 to N receive bidding start prompt from Auctioneer

```

[sakhibasapure — sbasapu@vclvm177-168:~/Project — ssh sbasapu@15...]
[[sbasapu@vclvm177-168 Project]$ python3 auc_server.py 3002
Auctioneer is ready for hosting auctions!
Seller is connected from ('152.7.177.192', 42704)
>> New Seller Thread spawned
Auction request received from ('152.7.177.192', 42704). Now waiting for Buyers.
Buyer 1 is connected from ('152.7.177.47', 44218)
Buyer 2 is connected from ('152.7.177.62', 40860)
Buyer 3 is connected from ('152.7.177.191', 55366)
>> Bidding Thread spawned
Requested number of bidders arrived. Let's start bidding!
[]

[sakhibasapure — sbasapu@vclvm177-192:~/Project — ssh sbasapu@15...]
[[sbasapu@vclvm177-192 Project]$ python3 auc_client.py 152.7.177.168 3002
Connected to the Auctioneer server.

Your role is: [Seller]
[Please submit auction request: some wrong input
Server: Invalid auction request!
[Please submit auction request: 1 100 3 WolfPackSword
Server: Auction Start.
[]

[sakhibasapure — sbasapu@vclvm177-47:~/Project — ssh sbasapu@15...]
[[sbasapu@vclvm177-47 Project]$ python3 auc_client.py 152.7.177.168 3002
Connected to the Auctioneer server.

Your role is: [Buyer]
The Auctioneer is still waiting for other Buyer to connect...
The bidding has started!
Please submit your bid: []

[sakhibasapure — sbasapu@vclvm177-62:~/Project — ssh sbasapu@15...]
[[sbasapu@vclvm177-62 Project]$ python3 auc_client.py 152.7.177.168 3002
Connected to the Auctioneer server.

Your role is: [Buyer]
The Auctioneer is still waiting for other Buyer to connect...
The bidding has started!
Please submit your bid: []

[sakhibasapure — sbasapu@vclvm177-191:~/Project — ssh sbasapu@15...]
[[sbasapu@vclvm177-191 Project]$ python3 auc_client.py 152.7.177.168 3002
Connected to the Auctioneer server.

Your role is: [Buyer]
The bidding has started!
Please submit your bid: []


```

13. Another client tries to connect during bidding and shows bidding in-progress

```
[sbasapu@vclvm177-62 Project]$ python3 auc_client.py 152.7.177.168 3009
buyerBidding on-going!
[sbasapu@vclvm177-62 Project]$
```

14. A Buyer sends incorrect bids and receives feedback

```
● ● ● sakshibasapure — sbasapu@vclvm177-47:~/Project — ssh sbasapu@15...
[[sbasapu@vclvm177-47 Project]$ python3 auc_client.py 152.7.177.168 3002
Connected to the Auctioneer server.

Your role is: [Buyer]
The Auctioneer is still waiting for other Buyer to connect...
The bidding has started!
[Please submit your bid: -100
Server: Invalid bid. Please submit a positive integer!
[Please submit your bid: 120
Server: Bid received. Please wait...
[]
```

15. Auctioneer (internally) displays all bids and auction result (sold/unsold, price)

```
● ● ● sakshibasapure — sbasapu@vclvm177-168:~/Project — ssh sbasapu@15...
>> New Seller Thread spawned
Auction request received from ('152.7.177.192', 42704). Now waiting for Buyers.
Buyer 1 is connected from ('152.7.177.47', 44218)
Buyer 2 is connected from ('152.7.177.62', 40860)
Buyer 3 is connected from ('152.7.177.191', 55366)
>> Bidding Thread spawned
Requested number of bidders arrived. Let's start bidding!
Buyer 1 bid: $120
Buyer 2 bid: $150
Buyer 3 bid: $170
Item sold! The highest bid is 170. The actual payment is 170.
```

16. Seller receives final auction result (sold/unsold, price)

```
● ● ● sakshibasapure — sbasapu@vclvm177-192:~/Project — ssh sbasapu@15...
[sbasapu@vclvm177-192 Project]$ python3 auc_client.py 152.7.177.168 3002
Connected to the Auctioneer server.

Your role is: [Seller]
Please submit auction request: 1 100 3 WolfPackSword
Server: Auction Start
Auction is finished. Here is the result:
Auction finished!
Success! Your item WolfPackSword has been sold for 170.
Disconnecting from the Auctioneer server. Auction is over!
[sbasapu@vclvm177-192 Project]$
```

17. Buyers 1 to N receive final auction result (win/lose, payment due)

18. All sockets (Seller & Buyers) closed

```
sakshibasapure — sbasapu@vclvm177-47:~/Project — ssh sbasapu@152....  
[[sbasapu@vclvm177-47 Project]$ python3 auc_client.py 152.7.177.168 3002  
Connected to the Auctioneer server.  
  
Your role is: [Buyer]  
The Auctioneer is still waiting for other Buyer to connect...  
The bidding has started!  
[Please submit your bid: -100  
Server: Invalid bid. Please submit a positive integer!  
[Please submit your bid: 120  
Server: Bid received. Please wait...  
Auction finished!  
Unfortunately, you did not win in the last round.  
Disconnecting from the Auctioneer server. Auction is over!  
[[sbasapu@vclvm177-62 Project]$ python3 auc_client.py 152.7.177.168 3002  
Connected to the Auctioneer server.  
  
Your role is: [Buyer]  
The Auctioneer is still waiting for other Buyer to connect...  
The bidding has started!  
[Please submit your bid: 150  
Server: Bid received. Please wait...  
Auction finished!  
Unfortunately, you did not win in the last round.  
Disconnecting from the Auctioneer server. Auction is over!  
Exiting after auction finished message.  
Connection closed by the server.  
[sbasapu@vclvm177-62 Project]$  
  
sakshibasapure — sbasapu@vclvm177-191:~/Project — ssh sbasapu@152...  
[[sbasapu@vclvm177-191 Project]$ python3 auc_client.py 152.7.177.168 3002  
Connected to the Auctioneer server.  
  
Your role is: [Buyer]  
The bidding has started!  
[Please submit your bid: 170  
Server: Bid received. Please wait...  
Auction finished!  
You won this item: WolfPackSword!  
Your payment due is 170.  
Disconnecting from the Auctioneer server.  
Auction is over!  
Exiting after auction finished message.  
Connection closed by the server.  
[sbasapu@vclvm177-191 Project]$
```

19. Another client tries to connect after current auction is done

20. Another round with a different auction type works as above

The screenshot displays four terminal windows side-by-side, each showing the output of running `auc_client.py` on port 3232. The windows are arranged in a grid-like fashion.

- Top Left Terminal:** Shows a successful auction for a pen. The highest bid is \$170, and the payment is \$170. It also shows bids from three buyers: \$120, \$130, and \$140.
- Top Right Terminal:** Shows a buyer role. The auctioneer is waiting for another buyer. A bid of \$120 is received, but the auction ends because no higher bid was submitted.
- Bottom Left Terminal:** Shows a seller role. An auction request is submitted for a pen at \$100. The auction starts, and it ends successfully with a payment of \$130.
- Bottom Right Terminal:** Shows a buyer role. A bid of -10 is submitted, which is invalid. A bid of 140 is then submitted, and the auction ends successfully with a payment of \$130.

```
Project — sbasapu@vclvm176-239:~/Project — ssh sbasapu@152.7.176.2...
Item sold! The highest bid is 170. The actual payment is 170.
Seller is connected from ('152.7.177.47', 57174)
>> New Seller Thread spawned
Auction request received from ('152.7.177.47', 57174). Now waiting for Buyers.
Buyer 1 is connected from ('152.7.177.62', 57558)
Buyer 2 is connected from ('152.7.176.66', 51774)
>> Bidding Thread spawned
Requested number of bidders arrived. Let's start bidding!
Buyer 1 bid: $170
Buyer 2 bid: $120
Item sold! The highest bid is 170. The actual payment is 170.
Seller is connected from ('152.7.177.47', 57174)
>> New Seller Thread spawned
Auction request received from ('152.7.177.47', 57176). Now waiting for Buyers.
Buyer 1 is connected from ('152.7.177.62', 57566)
Buyer 2 is connected from ('152.7.177.51', 58528)
Buyer 3 is connected from ('152.7.176.66', 51782)
>> Bidding Thread spawned
Requested number of bidders arrived. Let's start bidding!
Buyer 1 bid: $120
Buyer 2 bid: $130
Buyer 3 bid: $140
Item sold! The highest bid is 140. The actual payment is 130.

[sakhibasapure — sbasapu@vclvm177-47:~/Project — ssh sbasapu@152.7.177-47 Project]$ python3 auc_client.py 152.7.176.239 3232
Connected to the Auctioneer server.

Your role is: [Seller]
Please submit auction request: 2 100 3 Pen
Server: Auction Start
Auction is finished. Here is the result:
Auction finished!
Success! Your item Pen has been sold for 130.
Disconnecting from the Auctioneer server. Auction is over!
[sbasapu@vclvm177-47 Project]$ 

[sakhibasapure — sbasapu@vclvm177-62:~/Project — ssh sbasapu@152.7.177-62 Project]$ python3 auc_client.py 152.7.176.239 3232
Connected to the Auctioneer server.

Your role is: [Buyer]
The Auctioneer is still waiting for other Buyer to connect...
The bidding has started!
Please submit your bid: 120
Server: Bid received. Please wait...
Auction finished!
Unfortunately, you did not win in the last round.
Disconnecting from the Auctioneer server. Auction is over!
Exiting after auction finished message.
Connection closed by the server.
[sbasapu@vclvm177-62 Project]$ 

[sakhibasapure — sbasapu@vclvm177-51:~/Project — ssh sbasapu@152.7.177-51 Project]$ python3 auc_client.py 152.7.176.239 3232
Connected to the Auctioneer server.

Your role is: [Buyer]
The Auctioneer is still waiting for other Buyer to connect...
The bidding has started!
Please submit your bid: 130
Server: Bid received. Please wait...
Auction finished!
Unfortunately, you did not win in the last round.
Disconnecting from the Auctioneer server. Auction is over!
Exiting after auction finished message.
Connection closed by the server.
[sbasapu@vclvm177-51 Project]$ 

[sakhibasapure — sbasapu@vm17-175:~/Project — ssh sbasapu@152.7.176-175 Project]$ python3 auc_client.py 152.7.176.239 3232
Connected to the Auctioneer server.

Your role is: [Buyer]
The bidding has started!
Please submit your bid: -10
Server: Invalid bid. Please submit a positive integer!
Please submit your bid: 140
Server: Bid received. Please wait...
Auction finished!
You won this item: Pen!
Your payment due is 130.
Disconnecting from the Auctioneer server.
Auction is over!
Exiting after auction finished message.
Connection closed by the server.
[sbasapu@vm17-175 Project]$ 
```