CSC/ECE 573 Internet Protocols, Sections 001
2024 Fall Socket Programming Assignment

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How to run the code :

Module Name : auc_server.py
Description : This script implements an auction server that manages the auction process. It listens for clients (buyers and sellers), handles auction requests, processes bids, and determines the winner based on first-price or second-price auction types.
Usage : Run this script on a server to manage auctions. The first client connection will be treated as a seller, and subsequent connections will be buyers.
Example :
$ python3 auc_server.py <port>
Where '<port>' is the TCP port where the server will listen.

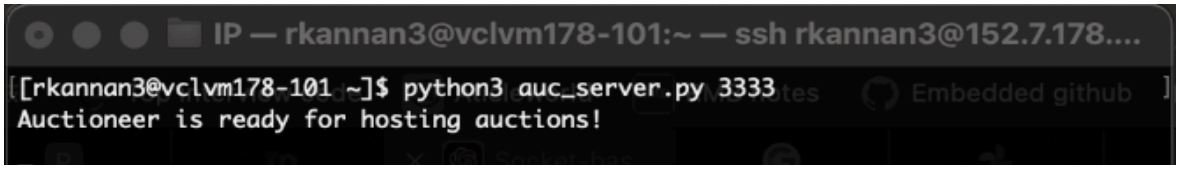
Module Name : auc_client.py
Description : This script implements a client that can either act as a seller or a buyer. The seller submits an auction request, and buyers submit bids. The server manages the auction process and determines the winner.
Usage : Run this script to connect to the auction server as either a seller or buyer. The server must be running for this client to connect.
Example :
$ python3 auc_client.py <host> <port>
Where '<host>' is the server's IP address, and '<port>' is the port number the server is listening on.

Communication between the Seller/Buyer clients and the Auctioneer Server.

1. **Starting the Auctioneer Server:**

First run the server i.e., auc_server.py
python3 auc_server.py <Port Number>
python3 auc_server.py 3333

It starts the service and waits for the client.

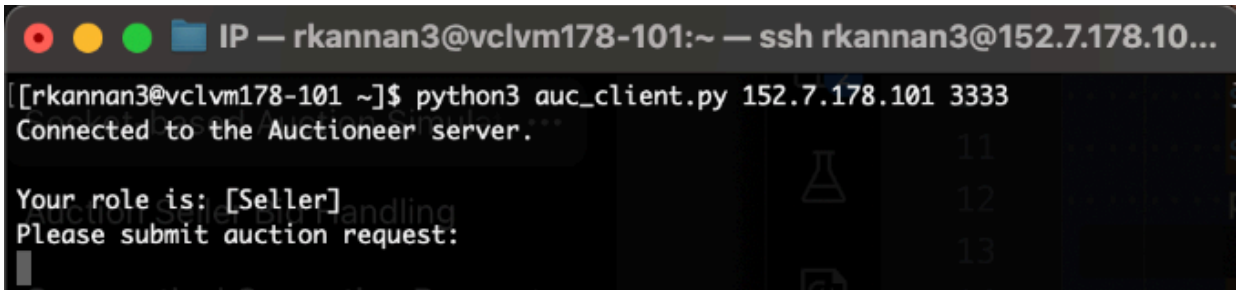


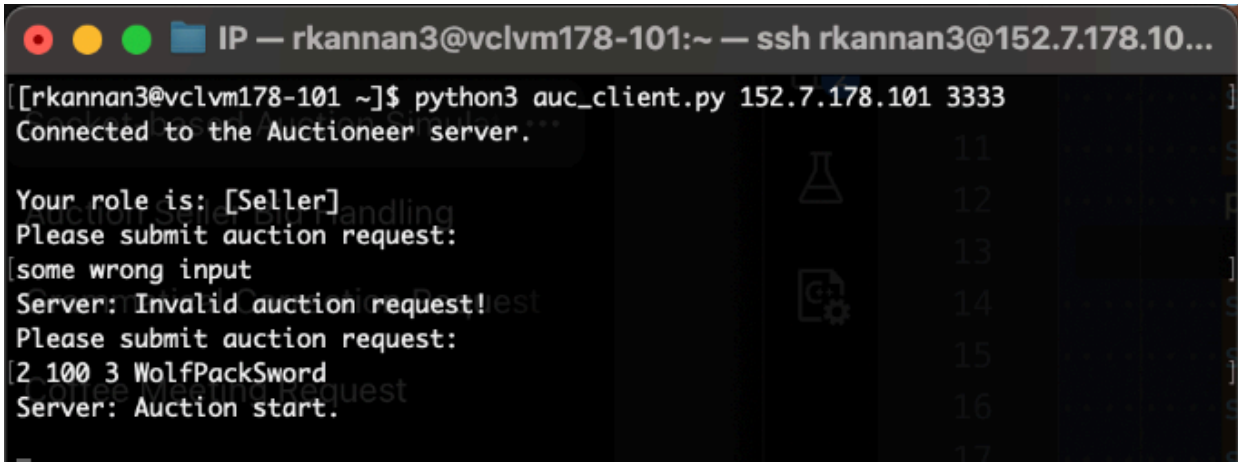
2. **Starting the client (Seller):**

Now run the client i.e., auc_client.py
python3 auc_client.py <Server IP Address> <ServerPort>
python3 auc_client.py 152.7.178.101 3333

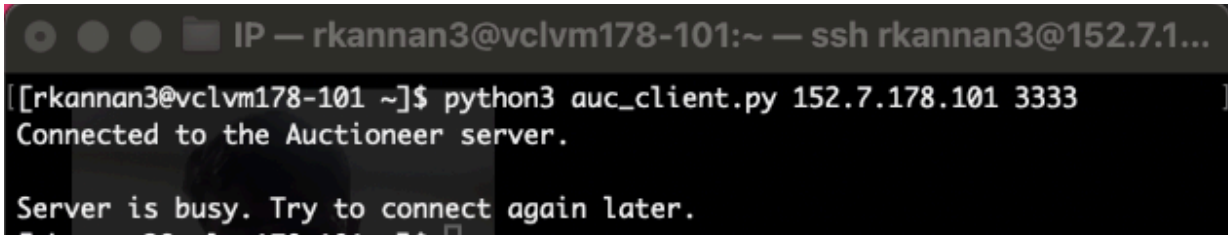
It starts the client and connects to the server. Role of the client (Seller) is received from the server after connection.

Data validation has been implemented on both the Seller and Buyer sides, and the server will only accept valid requests. A prompt will be issued from the server.
Valid bid (type, min_price, #bids, name).

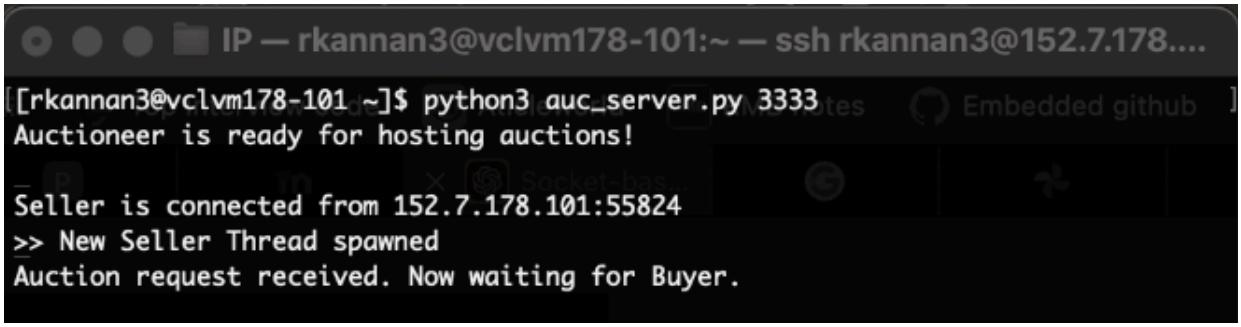




If a client or Buyer tries to connect before the Seller's auction is received, the server will display a "Server Busy" prompt and close the connection.

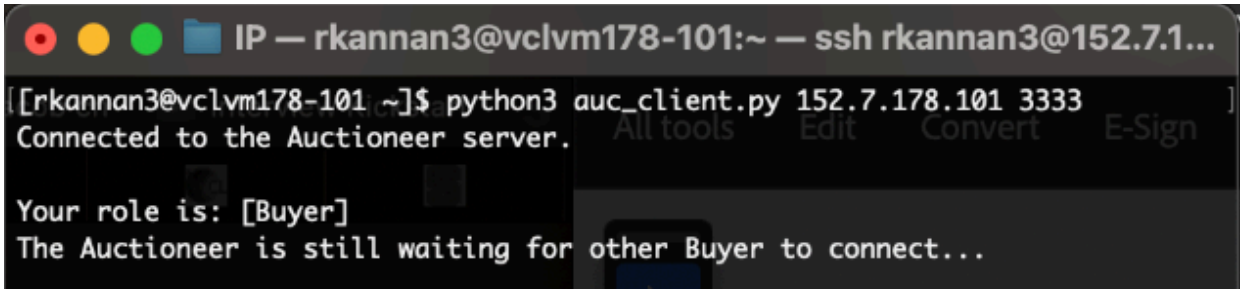


On the server side:
Once the server receives a valid request, it will spawn a new thread and wait for Buyers to connect.

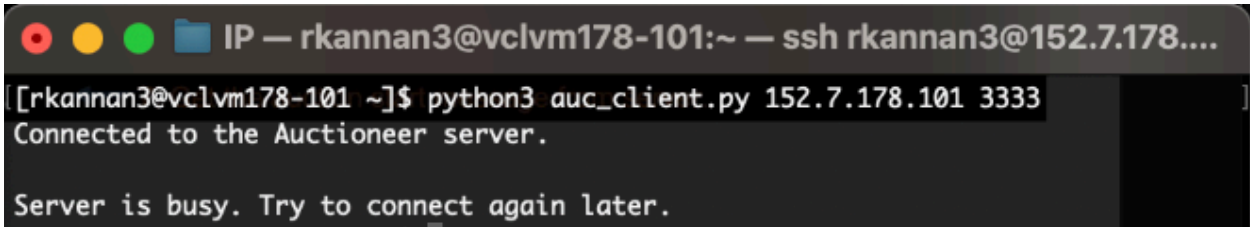


3. **Starting the client (Buyer):**

As the server receives a request from the Seller, Buyer clients can start to connect. Once connected, the assigned role was communicated, and a waiting/bid start prompt was automatically sent by the server. The buyer was connected and waiting for other buyers.



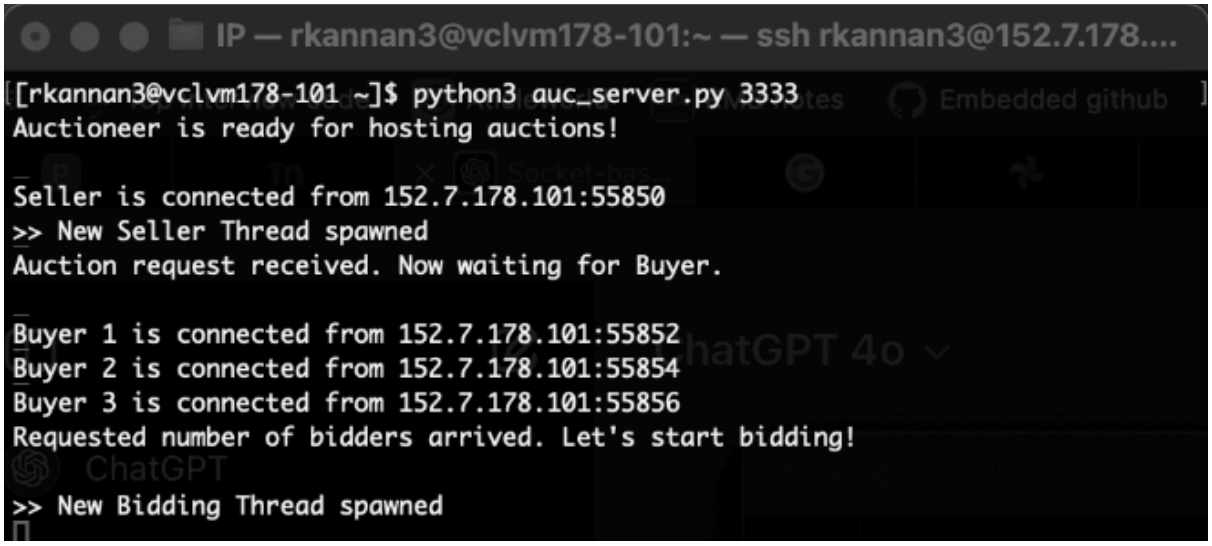
The server will only accept the number of buyers specified by the seller. If additional buyers attempt to connect, the client will display a "Server Busy" prompt and close the connection.



On the server side:

The server will post a message whenever a client connects, inform all clients of their roles, and whether it is still waiting for more Buyers.

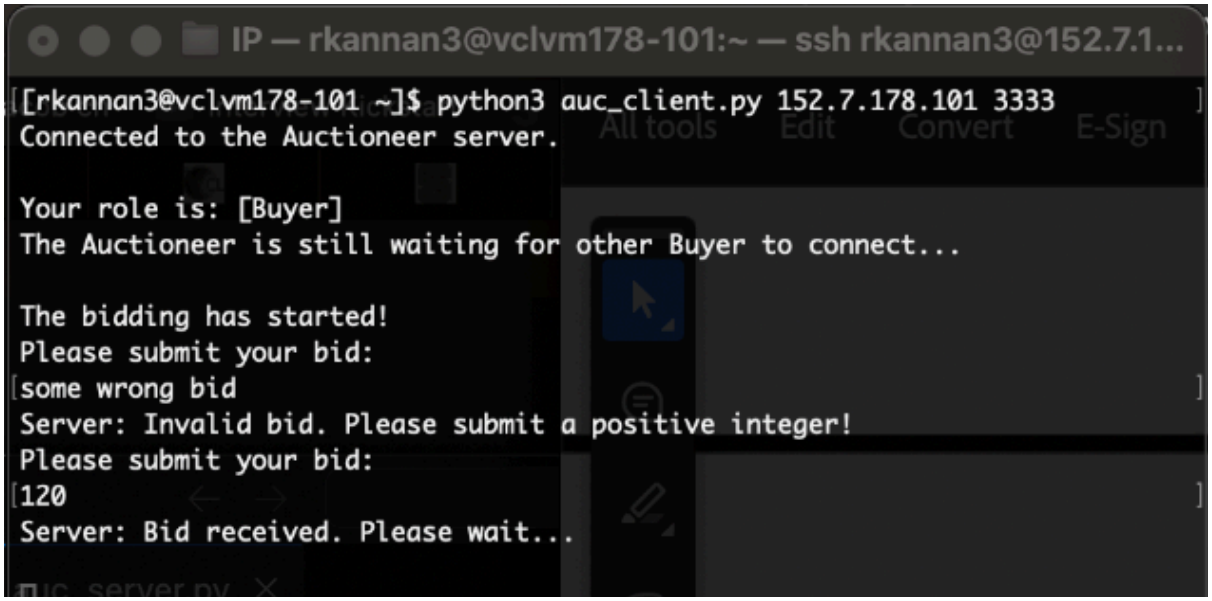
Once the required number of buyers are connected, the server will announce the start of bidding, send prompts to all Buyers, and spawn a new thread to handle the bidding process.



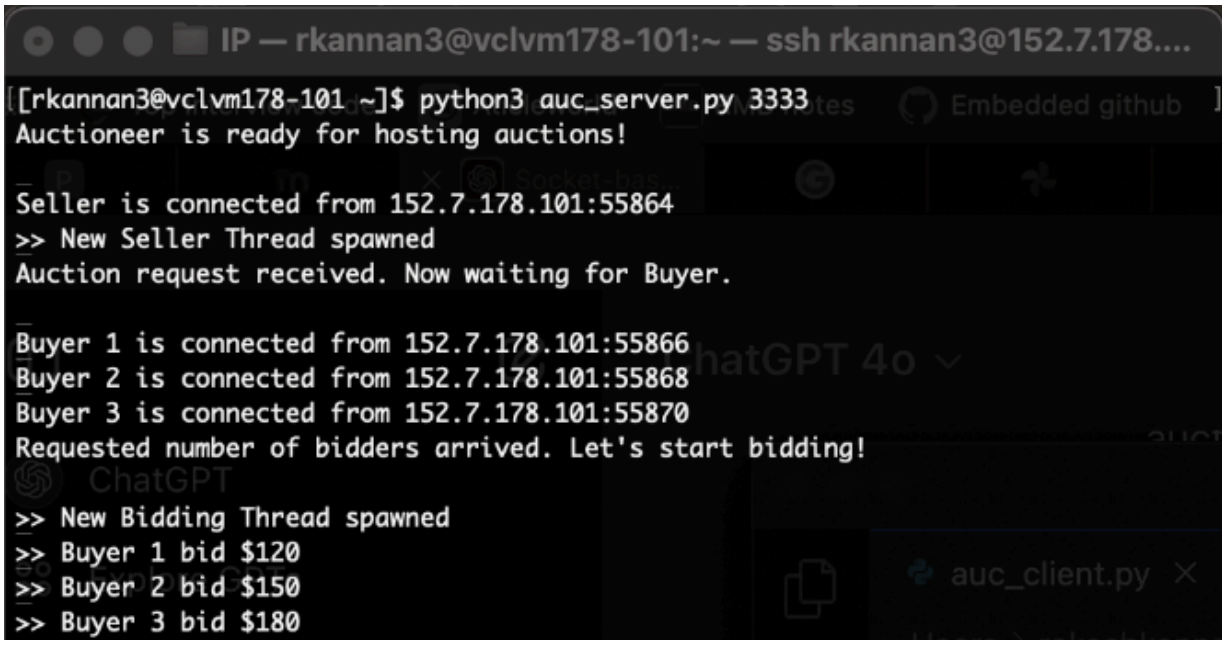
4. **Bidding start :**

On the Buyer side:

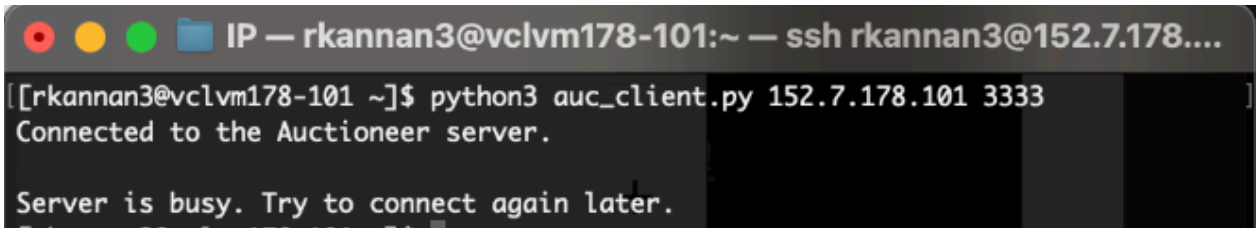
Received the bidding start message from the server. Once the bid is entered, it receives a message confirming that the bid was received and waits for the results.



The server will need to display each bid that is received.



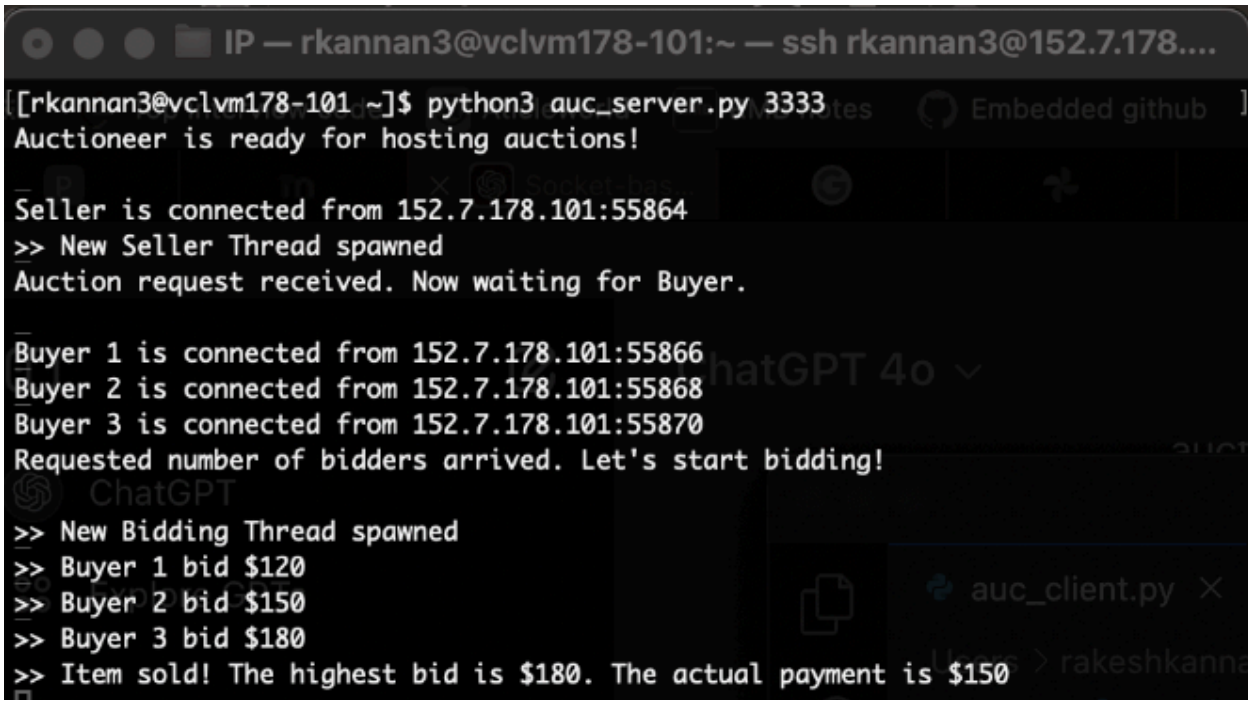
If another client attempts to connect to the server during bidding, the server should accept the connection, inform the client that it is busy, and then close the connection.



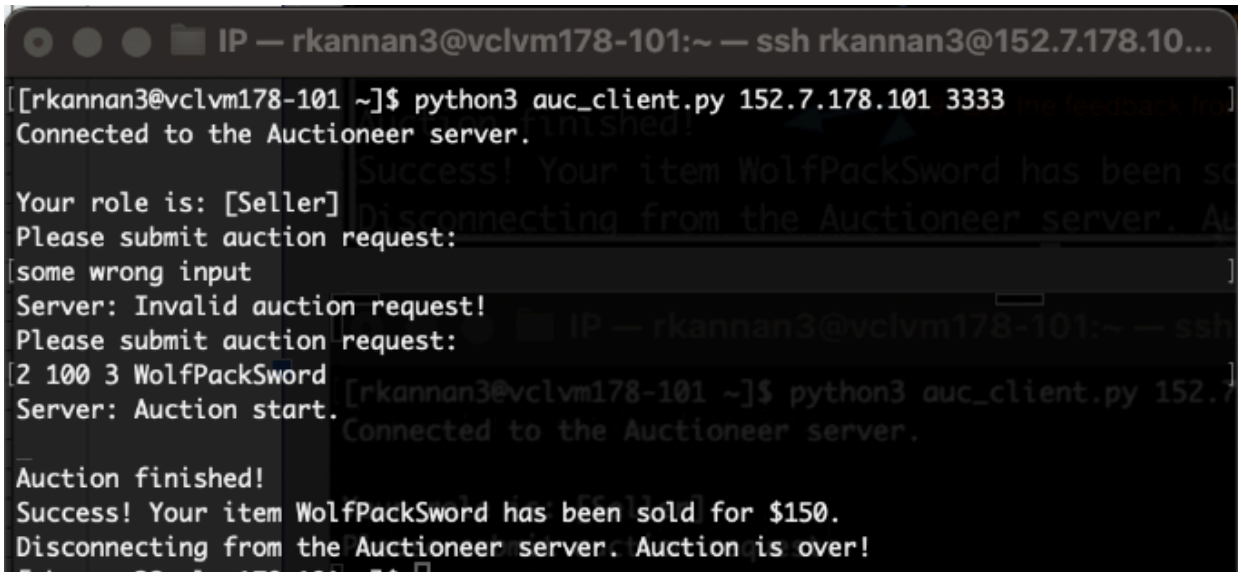
5. **Get the final auction result :**

After all bids are received, the server will determine the winning buyer and the price based on the seller's policy defined in the request.

On the server side :

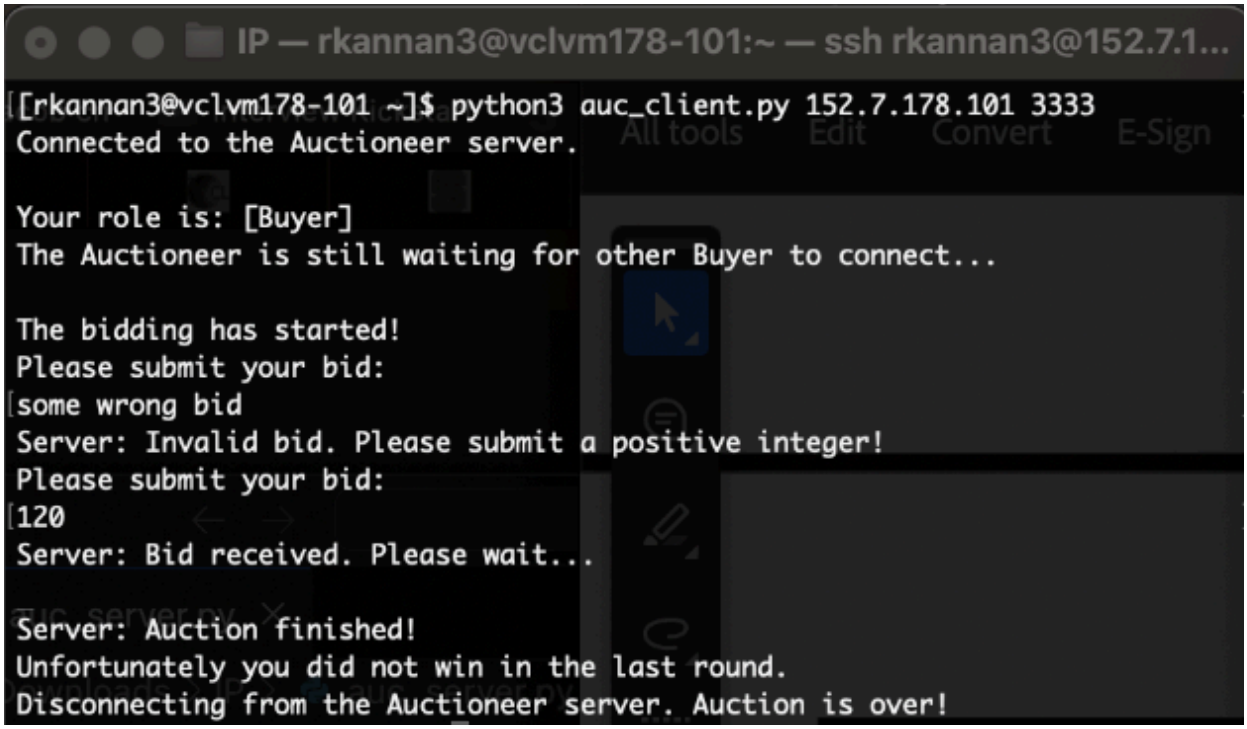


On the Seller side :
Server will then send the results to the seller.

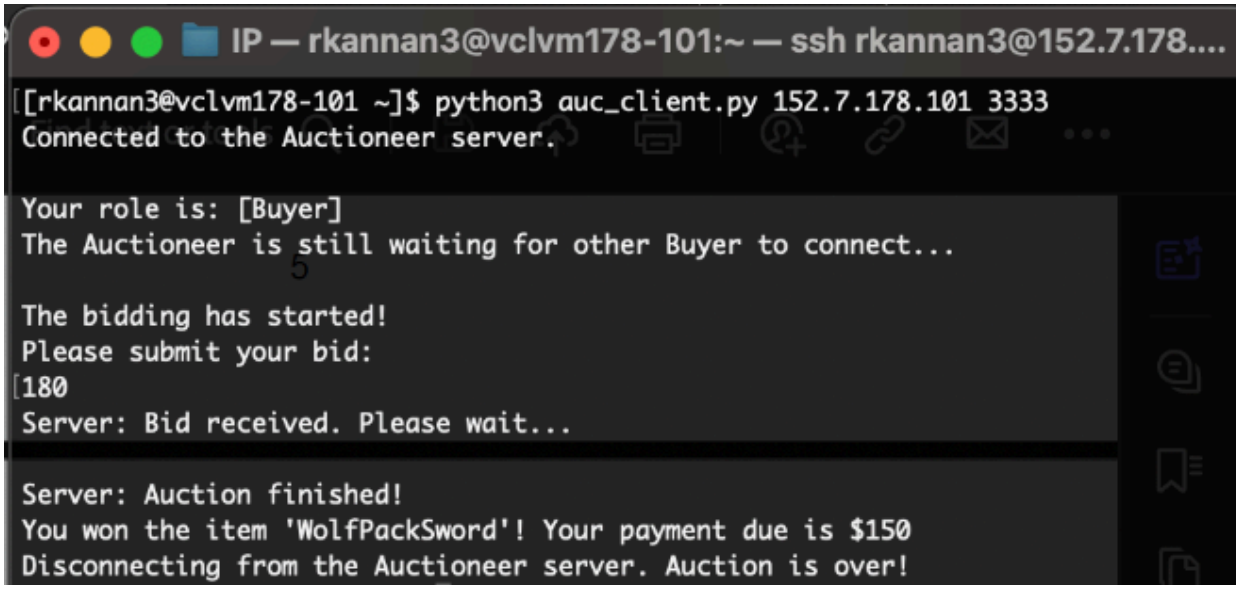


The winning Buyer and the losing Buyer will receive messages from the server. Finally, the server will close connections with all clients. and wait for the next seller to connect for another round of auction.

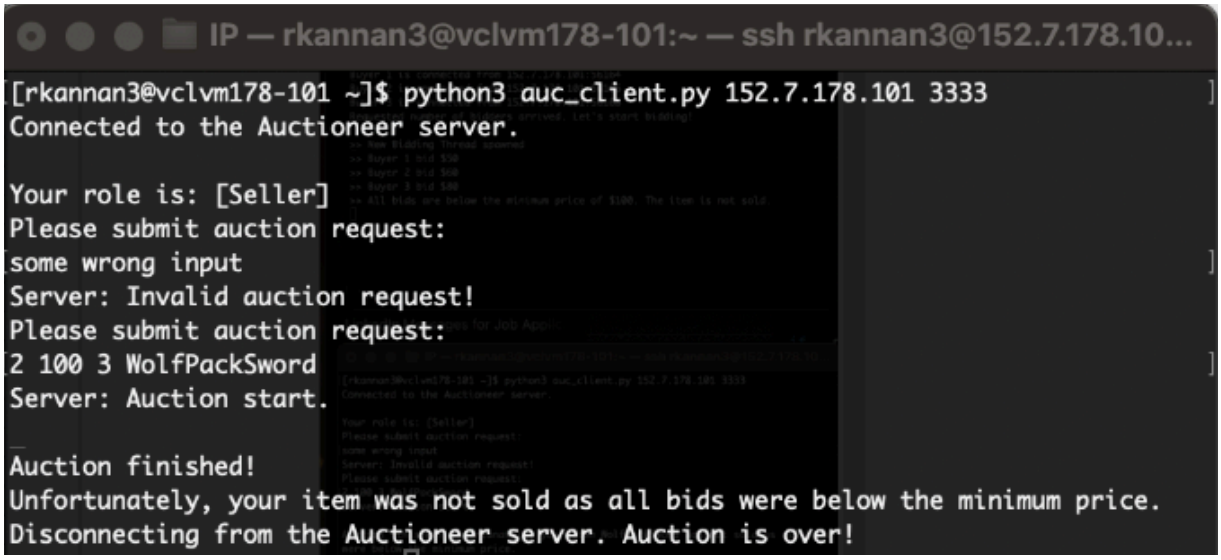
On the losing Buyer side :



On the winning Buyer side :



If the highest bid is below the minimum price, the server notifies the Seller and other clients that the item was not sold, then closes all connections.



Extra Credit Question:

1. Answer : Second-Price Auction

2. Reasoning :

In a first-price auction, each Buyer bids strategically lower than their true valuation to avoid paying the maximum amount. Since the highest bidder wins and pays their own bid, there is an incentive for Buyers to submit lower bids to maximize their utility (u = vi - p). This makes it difficult for the Seller to know the true valuation of each Buyer because Buyers underbid their true value.

In a second-price auction, Buyers are incentivized to bid their true valuation because they pay the second-highest bid, not their own. The utility is still u = vi - p, but here p is the second-highest bid. Bidding below or above their true valuation does not increase a Buyer's utility in this case. If a Buyer bids lower than their true valuation, they risk losing the auction. If they bid higher, they don't gain any extra utility since they pay the second-highest price, not their bid. As a result, a second-price auction provides the Seller with a more accurate view of each Buyer's true valuation.

Utility Analysis for Second-Price Auction:

If the Buyer wins:
u = vi - second_highest_bid

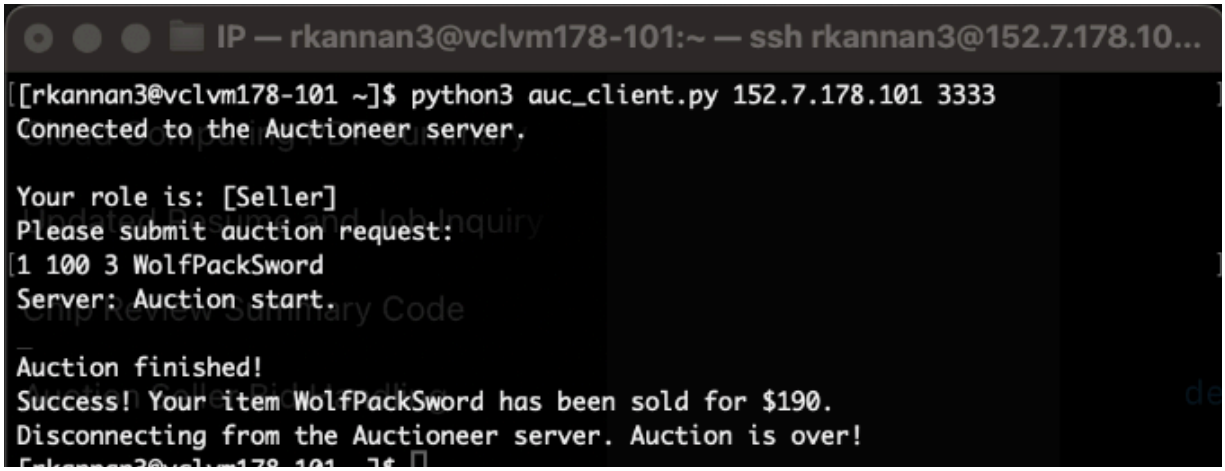
If the Buyer loses:
u = 0

By bidding truthfully, the Buyer maximizes their utility without losing the auction or overpaying. This fulfills the Seller's goal of understanding the true valuation of the Buyers while still selling at a reasonable price.

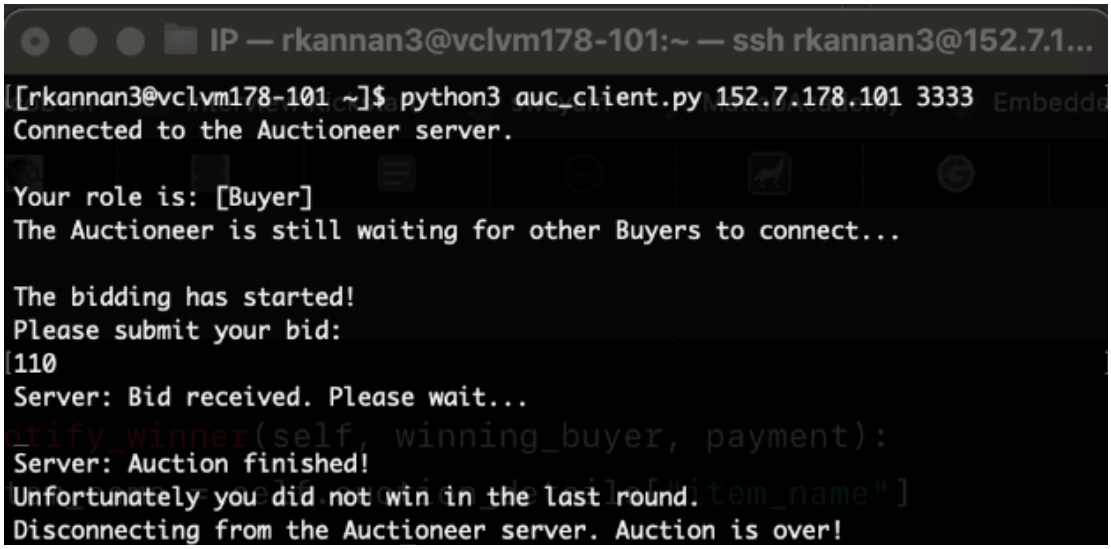
3. Execution steps :

In a first-price auction, each Buyer strategically bids lower than their actual valuation to avoid paying the highest price.

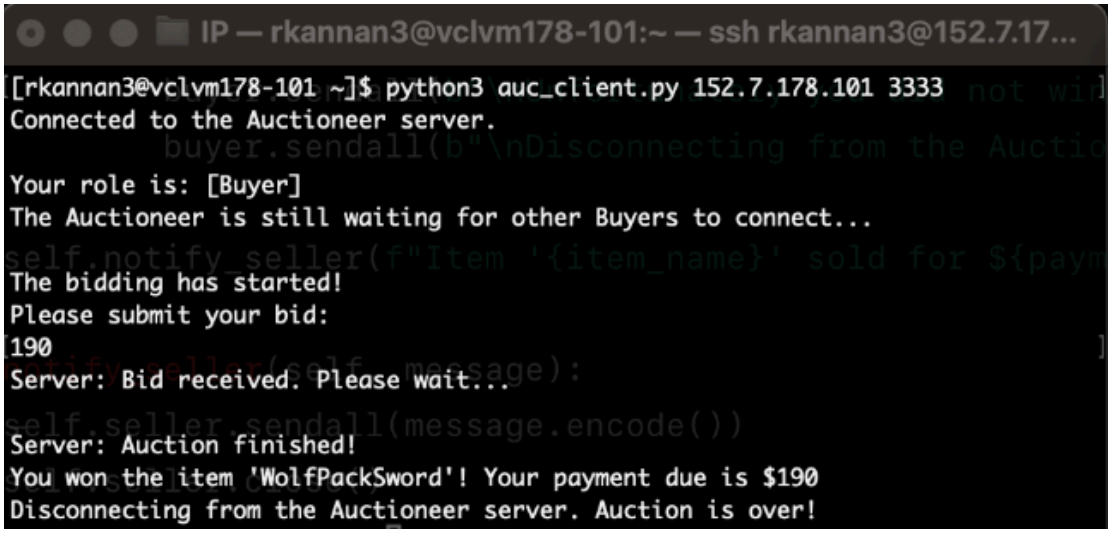
On the Seller side :



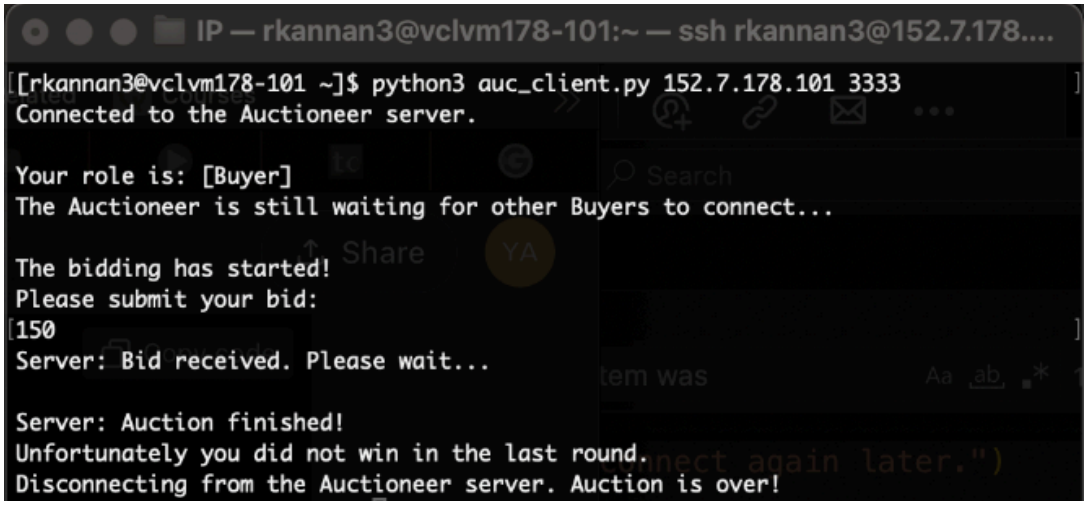
On the Buyer-1 side :



On the Buyer-2 side :

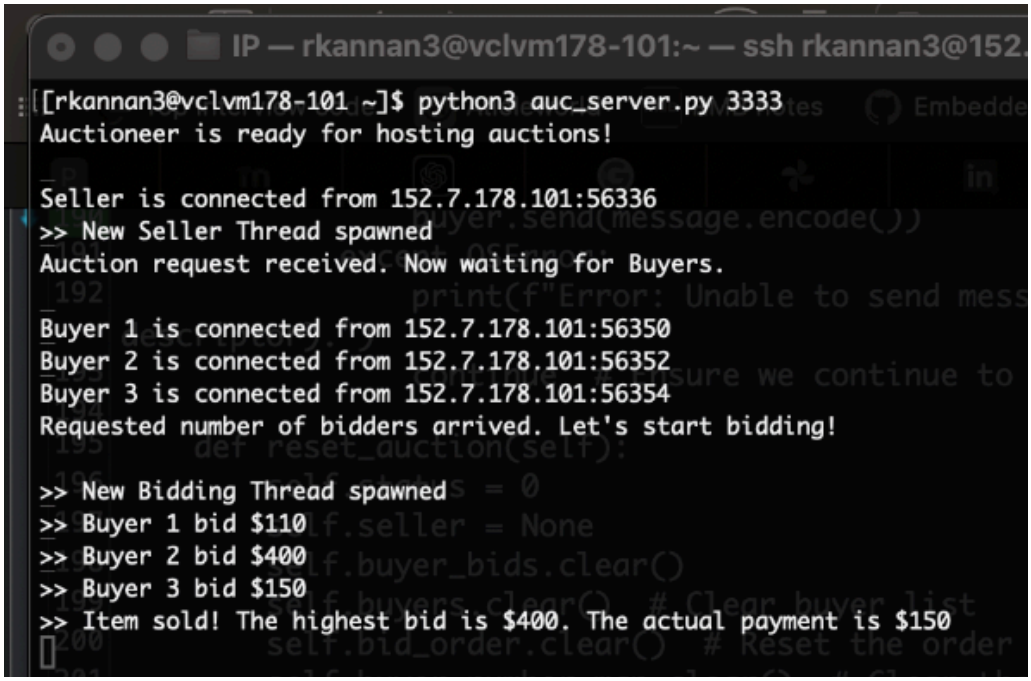


On the Buyer-3 side :

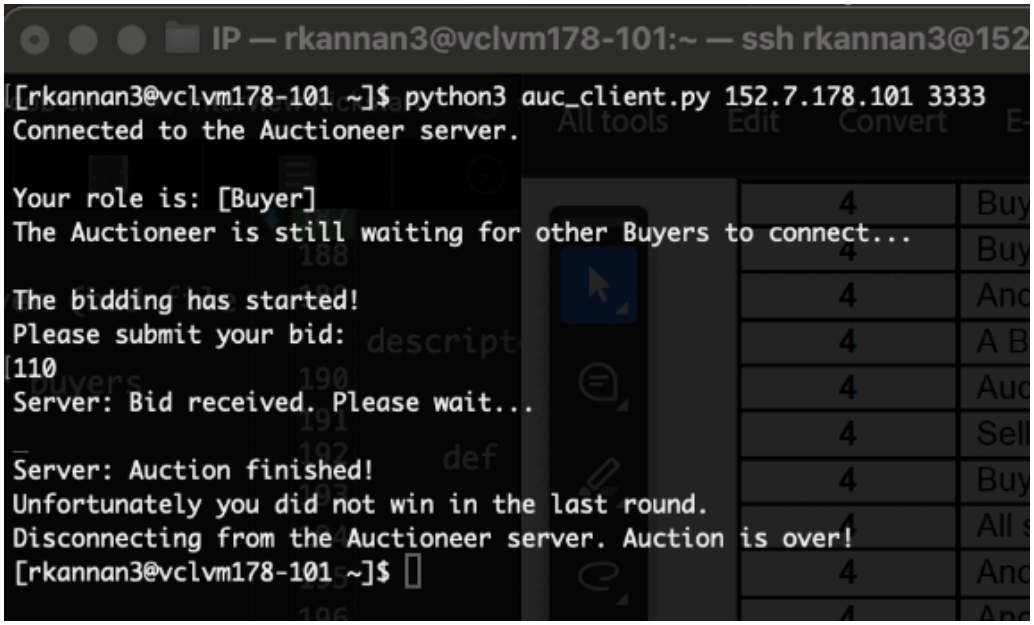


In a second-price auction, Buyers are encouraged to bid their true valuation since they pay the second-highest bid rather than their own.

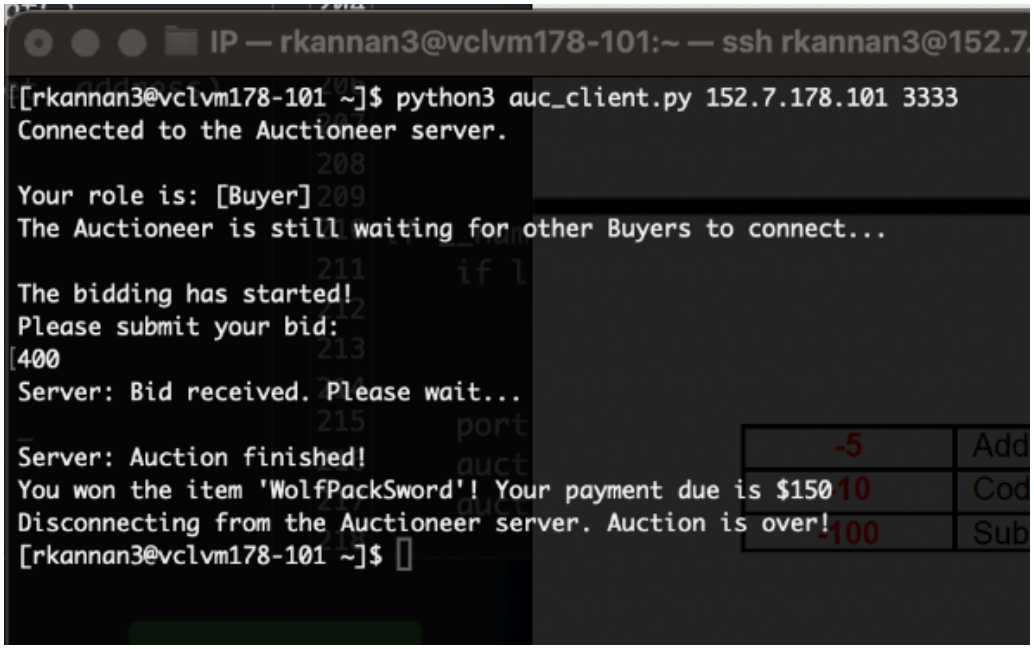
On the Seller side :



On the Buyer-1 side :



On the Buyer-2 side :



On the Buyer-3 side :