

University Parking System: Implementing Multithreading

for

Master of Science

Information Technology

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Background

The University has been enhancing a parking system that allows students and community members to register to use the parking lots and receive a bill afterwards. Last week, the enhancements included incorporating a more modern approach to using a client-server. There were several issues that arose last week that resulted in an unsuccessful implementation. For this week, the enhancements included extending the client-server so that multiple responses were being scanned at a time.

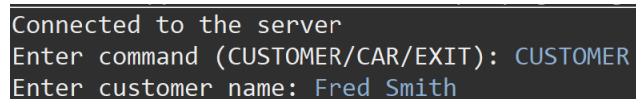
Implementation Challenges

While working through this week's implementation, the biggest challenge was getting last week's implementation to work, aside from grasping the concept in general. The issues that were left unresolved stem from my confusion on the topic itself. During last week's guidelines, the task was to use the command prompt to test the server. Despite extensive efforts, the command prompts remain unsuccessful. The feedback I received last week suggested that starting that part of the system might be a better option to help narrow down where the issue was coming from.

While I was going through the process of clearing the system class by class, I was able to find some of the errors. I compared my implementation to the example provided in last week's content and saw a different approach I could take, as well as some of the prior implementations, and combined them. This process took me about 10 hours to undo and redo. After revising the server implementation, I was able to get some of the server components working; however, there are still some flaws to iron out.

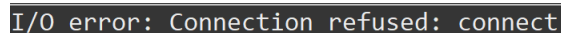
While running the client class the first few times, I had issues getting the system to prompt for the entry. The system would indicate that the server was running and would not accept any entry. After a few modifications, I was able to get the system to prompt the user for either CAR or CUSTOMER. Again, the system would not continue prompting the user and would not show anything else to indicate the server had finished scanning or if it was still processing. Several trials later, I was able to make modifications to the code's structure to continue prompting. I was able to get the code to run through each of the options, but after trying the unknown response and starting over, the server in the parking system would not allow for additional requests to be submitted.

When I restarted Eclipse, I reran the system to begin capturing snippets of the server. Unfortunately, the only snippet I was able to capture was for the CUSTOMER command. When indicating that I was doing the CUSTOMER command, I was prompted to enter the name. This is seen in Figure 1. However, when I tried the CAR command again, instead of prompting for the license as it had before, I received an error indicating that the connection was refused as seen in Figure 2.



```
Connected to the server
Enter command (CUSTOMER/CAR/EXIT): CUSTOMER
Enter customer name: Fred Smith
```

Figure 1. Server using CUSTOMER command.



```
I/O error: Connection refused: connect
```

Figure 2. Server error received when trying to recreate any other server attempt.

After reviewing a few online resources, it was indicated that the error resulted from the server being open or running elsewhere. In an attempt to resolve this, I closed Eclipse fully with

no success. I also ran a few commands in the shell, and there was no successful result. I attempted a few other options that were presented, such as adding additional code, but this caused a compilation issue that prevented everything else from running.

Implementation Decisions

All implementation decisions began with getting the server from last week to work. It also involved removing code and reorganizing the class structure within the packages. I rewatched the video on using sockets with the server to use that as a foundation. After a few modifications, I tailored the example to the parking system to ask for a customer and car command. I also included an option for an unknown command to prevent any error from happening with an unknown command. I also followed the example of how to incorporate multiple servers simultaneously. I noticed the example I used for the foundation included the use of sockets, so I began looking for examples of how to expand this type of server implementation. I added code to the system following the video on creating a multi-connection server using sockets (WhoteBatCodes 2022) as a possible solution. While following the example, I received numerous warning messages, so I reviewed the warning indicators until most of them were resolved.

For the multi-threading, I was unable to determine if the code worked or not because I spent most of my time trying to find out why the server stopped allowing me to enter a command type. One of the few warnings I wasn't able to resolve was an error indicating "The method fromJson(JsonObject) in the type ParkingRequest is not applicable for the arguments (String)." This is something I would need to continue exploring.

Future Implementations

Due to the time spent troubleshooting server errors for a single implementation that were not fully resolved, I will need to allocate more time to resolving the error I am encountering with the server refusing a connection. Once that is determined, I would proceed to explore the multithreading implementation. I added code that I believe should utilize multithreading, but I still need to learn how to run multiple servers concurrently and verify that it was done correctly. Since I occasionally encounter issues, which indicate that the server is running elsewhere, I may not have done this correctly. Unless I need to suggest a different port be used for the other connections, I may not have done this correctly. I will also need to do further research to enhance my understanding of multithreading in general, as it is frequently implemented incorrectly.

Conclusion

Through this exploration, I have identified server use as an area of opportunity for me. I recognize it is something that I do not fully comprehend and that will be useful to have a general understanding of in the future. Since the Multithreading component for this week relied on the server aspect from last week, I will need to continue troubleshooting to test the functionality of the code I added to the system to implement the server using multithreading.

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