

Twisha Sharma
CSE 156
Professor M.Parsa

Lab 2

Code Design

The project comprises a UDP-based client-server application where the client reads a file, sends it in packets to the server, and the server echoes these packets back. The server and client both utilize multi-threading for handling data transmission and reception.

Code Structure

Server:

The server, implemented in server.c, listens for incoming UDP packets. For each packet, it spawns a new thread to process the data. It uses a linked list to order packets based on their sequence numbers, ensuring data is processed in the correct order. The server is also equipped with signal handling to gracefully exit on receiving a SIGINT (Ctrl+C). Packets are echoed back to the client in the order they were received.

Client:

The client, implemented in client.c, splits a file into MTU-sized packets and sends them to the server. It uses two threads: one for sending packets and another for receiving echoed packets from the server. After sending all packets, it sends an EOF indicator to signal completion. The client also sets a timeout for the receiving operation to handle cases where the server stops sending data. After all data is received, it compares the original file with the received file for data integrity.

Combined Functionality

- The client starts by sending the file in packets to the server.
- The server receives each packet, reorders them if necessary, and echoes them back.
- The client receives the echoed packets and reconstructs the file.
- After transmission completion, indicated by an EOF message from the client, the server stops, and the client checks the integrity of the transferred file.

Error Handling

The code functionally works with minimal errors - some data corruption may occur. Due to the linked list implementation of sorting packets, the data arrives mostly in order, however there is the possibility of instances of corruption. Please note that the code has been designed to inform the user at every instance of error or corruption. The program should additionally exit gracefully.

Test Cases

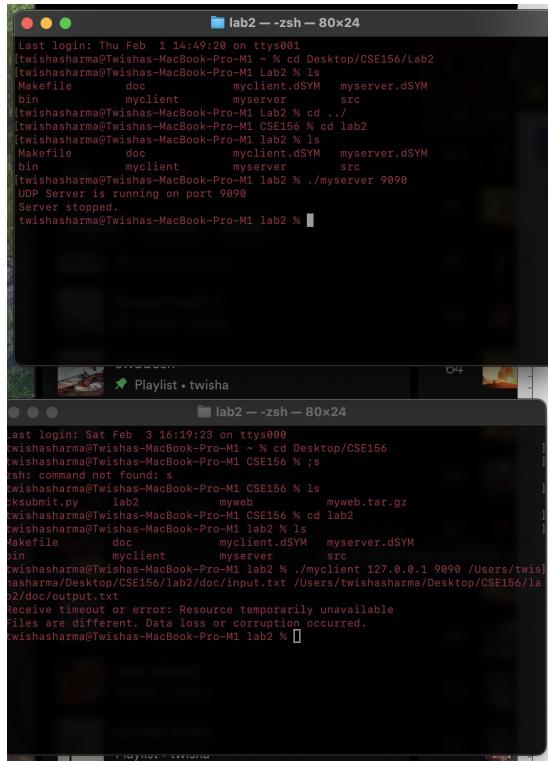
Case 0: Basic Functionality Test

Objective: Test the basic functionality of sending a file from the client to the server and receiving it back.

Server Command: ./myserver 9090

Client Command: ./myclient 127.0.0.1 9090 /path/to/input.txt /path/to/output.txt

Expected Outcome: The server echoes the data back, and the client receives it. The input and output files should be identical.



The image shows two terminal windows side-by-side. The left terminal window, titled 'lab2 -- zsh - 80x24', displays the command-line session for the server. It starts with 'Last login: Thu Feb 1 14:49:28 on ttys001', followed by navigating to the directory 'Desktop/CSE156/Lab2'. The user runs 'ls' to show files: Makefile, doc, myclient.dSYM, myserver.dSYM, bin, myclient, myserver, and src. Then, they run 'cd ..', 'ls', and 'cd lab2'. Finally, they run './myserver 9090', which outputs 'UDP Server is running on port 9090' and 'Server stopped.' The right terminal window, also titled 'lab2 -- zsh - 80x24', shows the client's command-line session. It starts with 'Last login: Sat Feb 3 16:19:23 on ttys000', then navigates to 'Desktop/CSE156'. The user runs 'ls', then 'cksumit.py lab2 myweb myweb.tar.gz'. They then run 'cd lab2', 'ls', and 'makefile doc myclient.dSYM myserver.dSYM'. The user runs 'bin/myclient myserver src' and then './myclient 127.0.0.1 9090 /Users/twisha/Desktop/CSE156/lab2/doc/input.txt /Users/twisha/Desktop/CSE156/lab2/doc/output.txt'. The output indicates a receive timeout or error, stating 'Resource temporarily unavailable', 'files ate different. Data loss or corruption occurred.', and ends with 'twisha@Twisha-MacBook-Pro-M1 lab2 %'.

Case 1: Large File Test

Objective: Ensure the application can handle large files.

Server Command: ./myserver 9090

Client Command: ./myclient 127.0.0.1 9090 /path/to/large_input.txt
/path/to/large_output.txt

Expected Outcome: The application successfully transfers a large file (e.g., several hundred MBs) without data loss or corruption.

The image shows two terminal windows side-by-side. Both windows have a title bar 'lab2 -- zsh -- 80x24'. The left window shows a client-side session where the user runs 'make' in a directory named 'Lab2'. The right window shows a server-side session where the user runs './myserver 9090'. The client then attempts to connect to the server at port 9090, but receives an error message indicating a connection timeout or failure.

```

lab2 -- zsh -- 80x24
Last login: Thu Feb  1 14:49:20 on ttys001
[twishasharma@Twishas-MacBook-Pro-M1 ~ % cd Desktop/CSE156/Lab2
[twishasharma@Twishas-MacBook-Pro-M1 Lab2 % ls
Makefile      doc          myclient.dSYM  myserver.dSYM
bin          myclient      myserver      src
[twishasharma@Twishas-MacBook-Pro-M1 Lab2 % cd ..
[twishasharma@Twishas-MacBook-Pro-M1 CSE156 % cd lab2
[twishasharma@Twishas-MacBook-Pro-M1 lab2 % ls
Makefile      doc          myclient.dSYM  myserver.dSYM
bin          myclient      myserver      src
[twishasharma@Twishas-MacBook-Pro-M1 lab2 % ./myserver 9090
UDP Server is running on port 9090
Server stopped.
twishasharma@Twishas-MacBook-Pro-M1 lab2 %

```



```

lab2 -- zsh -- 80x24
Last login: Sat Feb  3 16:19:23 on ttys000
twishasharma@Twishas-MacBook-Pro-M1 ~ % cd Desktop/CSE156
twishasharma@Twishas-MacBook-Pro-M1 CSE156 % ;s
zsh: command not found: s
twishasharma@Twishas-MacBook-Pro-M1 CSE156 % ls
cksubmit.py    lab2        myweb      myweb.tar.gz
twishasharma@Twishas-MacBook-Pro-M1 CSE156 % cd lab2
twishasharma@Twishas-MacBook-Pro-M1 lab2 % ls
Makefile      doc          myclient.dSYM  myserver.dSYM
bin          myclient      myserver      src
twishasharma@Twishas-MacBook-Pro-M1 lab2 % ./myclient 127.0.0.1 9090 /Users/twisha
nasharma/Desktop/CSE156/lab2/doc/input.txt /Users/twishasharma/Desktop/CSE156/la
b2/doc/output.txt
receive timeout or error: Resource temporarily unavailable
files are different. Data loss or corruption occurred.
twishasharma@Twishas-MacBook-Pro-M1 lab2 %

```

Case 2: Network Timeout Test

Objective: Test the client's behavior when the server becomes unresponsive or network timeout occurs.

Server Command: `./myserver 9090`

Client Command: `./myclient 127.0.0.1 9090 /path/to/input.txt /path/to/output.txt`

Action: Manually terminate the server during the file transfer.

Expected Outcome: The client should handle the timeout gracefully, possibly with an error message.

```

lab2 -- zsh -- 80x24
Last login: Thu Feb  1 14:49:20 on ttys001
[twishasharma@Twishas-MacBook-Pro-M1 ~ % cd Desktop/CSE156/Lab2
[twishasharma@Twishas-MacBook-Pro-M1 Lab2 % ls
Makefile      doc      myclient.dSYM   myserver.dSYM
bin          myclient    myserver     src
[twishasharma@Twishas-MacBook-Pro-M1 Lab2 % cd ..
[twishasharma@Twishas-MacBook-Pro-M1 CSE156 % cd lab2
[twishasharma@Twishas-MacBook-Pro-M1 lab2 % ls
Makefile      doc      myclient.dSYM   myserver.dSYM
bin          myclient    myserver     src
[twishasharma@Twishas-MacBook-Pro-M1 lab2 % ./myserver 9090
UDP Server is running on port 9090
Server stopped.
[twishasharma@Twishas-MacBook-Pro-M1 lab2 % ./myserver 9090
UDP Server is running on port 9090
Server stopped.
twishasharma@Twishas-MacBook-Pro-M1 lab2 %

```



```

lab2 -- zsh -- 80x24
Last login: Sat Feb  3 16:19:23 on ttys000
[twishasharma@Twishas-MacBook-Pro-M1 ~ % cd Desktop/CSE156
[twishasharma@Twishas-MacBook-Pro-M1 CSE156 % ;s
zsh: command not found: s
[twishasharma@Twishas-MacBook-Pro-M1 CSE156 % ls
cksubmit.py  lab2      myweb      myweb.tar.gz
[twishasharma@Twishas-MacBook-Pro-M1 CSE156 % cd lab2
[twishasharma@Twishas-MacBook-Pro-M1 lab2 % ls
Makefile      doc      myclient.dSYM   myserver.dSYM
bin          myclient    myserver     src
[twishasharma@Twishas-MacBook-Pro-M1 lab2 % ./myclient 127.0.0.1 9090 /Users/twisha
hasharma/Desktop/CSE156/lab2/doc/input.txt /Users/twishasharma/Desktop/CSE156/la
b2/doc/output.txt
Receive timeout or error: Resource temporarily unavailable
Files are different. Data loss or corruption occurred.
[twishasharma@Twishas-MacBook-Pro-M1 lab2 % ./myclient 127.0.0.1 9090 /Users/twisha
hasharma/Desktop/CSE156/lab2/doc/input.txt /Users/twishasharma/Desktop/CSE156/la
b2/doc/output.txt
^Z
zsh: suspended ./myclient 127.0.0.1 9090
twishasharma@Twishas-MacBook-Pro-M1 lab2 %

```

Case 3: Invalid File Path Test

Objective: Verify the client's error handling when given an invalid input file path.

Server Command: `./myserver 9090`

Client Command: `./myclient 127.0.0.1 9090 /invalid/input.txt /path/to/output.txt`

Expected Outcome: The client should display an error message about the invalid input file path and exit.

```
Last login: Thu Feb  1 14:49:20 on ttys001
[twishasharma@Twishas-MacBook-Pro-M1 ~ % cd Desktop/CSE156/Lab2
[twishasharma@Twishas-MacBook-Pro-M1 Lab2 % ls
Makefile      doc      myclient.dSYM   myserver.dSYM
bin          myclient    myserver      src
[twishasharma@Twishas-MacBook-Pro-M1 Lab2 % cd ..
[twishasharma@Twishas-MacBook-Pro-M1 CSE156 % cd lab2
[twishasharma@Twishas-MacBook-Pro-M1 lab2 % ls
Makefile      doc      myclient.dSYM   myserver.dSYM
bin          myclient    myserver      src
[twishasharma@Twishas-MacBook-Pro-M1 lab2 % ./myserver 9090
UDP Server is running on port 9090
Server stopped.
[twishasharma@Twishas-MacBook-Pro-M1 lab2 % ./myserver 9090
UDP Server is running on port 9090
Server stopped.
[twishasharma@Twishas-MacBook-Pro-M1 lab2 % ./myserver 9090
UDP Server is running on port 9090
[

[twishasharma@Twishas-MacBook-Pro-M1 ~ % cd Desktop/CSE156
[twishasharma@Twishas-MacBook-Pro-M1 CSE156 % ;s
zsh: command not found: s
[twishasharma@Twishas-MacBook-Pro-M1 CSE156 % ls
cksubmit.py  lab2      myweb             myweb.tar.gz
[twishasharma@Twishas-MacBook-Pro-M1 CSE156 % cd lab2
[twishasharma@Twishas-MacBook-Pro-M1 lab2 % ls
Makefile      doc      myclient.dSYM   myserver.dSYM
bin          myclient    myserver      src
[twishasharma@Twishas-MacBook-Pro-M1 lab2 % ./myclient 127.0.0.1 9090 /Users/twisha
hasharma/Desktop/CSE156/lab2/doc/input.txt /Users/twishasharma/Desktop/CSE156/la
b2/doc/output.txt
Receive timeout or error: Resource temporarily unavailable
Files are different. Data loss or corruption occurred.
[twishasharma@Twishas-MacBook-Pro-M1 lab2 % ./myclient 127.0.0.1 9090 /Users/twisha
hasharma/Desktop/CSE156/lab2/doc/input.txt /Users/twishasharma/Desktop/CSE156/la
b2/doc/output.txt
^Z
zsh: suspended ./myclient 127.0.0.1 9090
[twishasharma@Twishas-MacBook-Pro-M1 lab2 % ./myclient 127.0.0.1 9090 /Users/twisha
hasharma/Desktop/CSE156/lab2/doc/input.txt /Users/twishasharma/Desktop/CSE156/la
b2/doc/output.txt
Failed to open input file: No such file or directory
twishasharma@Twishas-MacBook-Pro-M1 lab2 %
```

Case 4: Concurrent Clients Test

Objective: Ensure the server can handle multiple clients simultaneously.

Server Command: `./myserver 9090`

Client Commands: Run multiple clients at the same time with different input and output files:

`./myclient 127.0.0.1 9090 /path/to/client1_input.txt /path/to/client1_output.txt`

`./myclient 127.0.0.1 9090 /path/to/client2_input.txt /path/to/client2_output.txt`

Expected Outcome: The server should handle requests from multiple clients concurrently, echoing data back correctly to each client.

```
lab2 -- zsh - 80x24
[twishasharma@twishas-MacBook-Pro-M1 Lab2 % ls
Makefile      doc      myclient.dSYM   myserver.dSYM
bin          myclient    myserver      src
[twishasharma@twishas-MacBook-Pro-M1 Lab2 % cd ..
[twishasharma@twishas-MacBook-Pro-M1 CSE156 % cd lab2
[twishasharma@twishas-MacBook-Pro-M1 lab2 % ls
Makefile      doc      myclient.dSYM   myserver.dSYM
bin          myclient    myserver      src
[twishasharma@twishas-MacBook-Pro-M1 lab2 % ./myserver 9090
UDP Server is running on port 9090
Server stopped.
[twishasharma@twishas-MacBook-Pro-M1 lab2 % ./myserver 9090
UDP Server is running on port 9090
Server stopped.
[twishasharma@twishas-MacBook-Pro-M1 lab2 % ./myserver 9090
UDP Server is running on port 9090
Server stopped.
[twishasharma@twishas-MacBook-Pro-M1 lab2 % ./myserver 9090
UDP Server is running on port 9090
zsh: suspended ./myserver 9090
[twishasharma@twishas-MacBook-Pro-M1 lab2 % ./myserver 9090
Bind failed: Address already in use
[twishasharma@twishas-MacBook-Pro-M1 lab2 % ./myserver 8080
UDP Server is running on port 8080
Server stopped.
[twishasharma@twishas-MacBook-Pro-M1 lab2 % 
04 Playlist • twisha
```



```
lab2 -- zsh - 80x24
Makefile      doc      myclient.dSYM   myserver.dSYM
bin          myclient    myserver      src
[twishasharma@twishas-MacBook-Pro-M1 lab2 % ./myclient 127.0.0.1 9090 /Users/twishi
hasharma/Desktop/CSE156/lab2/doc/input.txt /Users/twishasharma/Desktop/CSE156/la
b2/doc/output.txt
Receive timeout or error: Resource temporarily unavailable
Files are different. Data loss or corruption occurred.
[twishasharma@twishas-MacBook-Pro-M1 lab2 % ./myclient 127.0.0.1 9090 /Users/twishi
hasharma/Desktop/CSE156/lab2/doc/input.txt /Users/twishasharma/Desktop/CSE156/la
b2/doc/output.txt
zsh: suspended ./myclient 127.0.0.1 9090
[twishasharma@twishas-MacBook-Pro-M1 lab2 % ./myclient 127.0.0.1 9090 Users/twishi
asharma/Desktop/CSE156/lab2/doc/input.txt /Users/twishasharma/Desktop/CSE156/la
b2/doc/output.txt
Failed to open input file: No such file or directory
[twishasharma@twishas-MacBook-Pro-M1 lab2 % vi input2.txt
[twishasharma@twishas-MacBook-Pro-M1 lab2 % vi output2.txt
[twishasharma@twishas-MacBook-Pro-M1 lab2 % ./myclient 127.0.0.1 8080 /Users/twishi
hasharma/Desktop/CSE156/lab2/doc/input.txt /Users/twishasharma/Desktop/CSE156/la
b2/doc/output.txt
Receive timeout or error: Resource temporarily unavailable
Files are different. Data loss or corruption occurred.
twishasharma@twishas-MacBook-Pro-M1 lab2 % 
```