CSE 344 System Programming Final Assignment Report



Author

Mert Emir ŞEKER 200104004085

Date

15.06.2024

Table Of Contents

1.	Makefile	3
2.	Makefile Commands	3
3.	How to run the code?	3
	Code Explanation	
4.1	1 Server.c	4
	4.1.1. Thread-Safe Queue Implementation	4
	4.1.2. Order Management Functions	4
	4.1.3. Matrix Operations for Complex Numbers	
	4.1.4. Cook and Bake Time Calculation	5
	4.1.5. Thread Functions for Handling Clients, Cooking, and Delive	ries 5
4.2	2 Client.c	5
5.	Example Outputs	6
5.1	1 Customer number is 50	6
5.2	2 Customer number is 70	8
5.3	3 Customer number is 100 with ctrl-c signal	11

1. Makefile:

2. Makefile Commands:

All: Compiles the code.

Compile: Compiles the code.

Clean: Clears terminal.

3. How to run the code?

To run the program, first you have to write make or make all to compile the code. Then you have to start server like ./PideShop ipaddress portnumber cookthreadpoolsize deliverypoolsize k. Then you can connect server like this ./HungryVeryMuch ipaddress portnumber numberofclients p q.

4. Code Explanation:

4.1. Server.c:

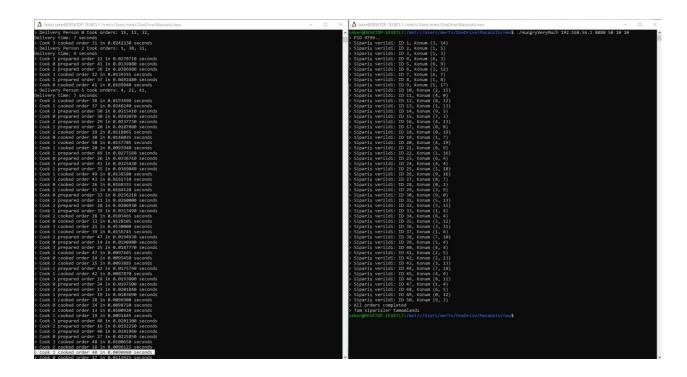
- 4.1.1. Thread-Safe Queue Implementation: Our queue implementation provides a thread-safe structure using a linked list. The QueueNode structure contains an Order and a pointer to the next node. The Queue structure maintains pointers to the front and rear nodes, a mutex for thread synchronization, a condition variable for signaling, and a counter for the number of elements in the queue. The init_queue function initializes these components. The enqueue function adds an order to the rear of the queue and signals any waiting threads that a new item is available. The dequeue function removes an order from the front, waiting if necessary until an item becomes available. The free_queue function deallocates all nodes in the queue. The get_queue_size function returns the current number of elements in the queue. This queue implementation ensures that multiple threads can safely add to and remove from the queue concurrently without data races.
- 4.1.2. Order Management Functions: This section includes functions for managing the dynamic array of orders and synchronizing delivery processes. The expand_order_array function ensures the orders array has sufficient capacity by doubling its size or setting it to 10 if initially zero, with proper thread safety using expand_mutex. increment_pending_deliveries and decrement_pending_deliveries functions manage the count of pending deliveries with mutex locks and condition variable signaling to synchronize delivery tasks. The wait_for_all_deliveries function blocks until all pending deliveries are complete, ensuring synchronization across threads. Finally, check_and_expand_order_array iterates through client queues to verify if the orders array needs expansion, calling expand_order_array when necessary to handle increasing order volumes.
- 4.1.3. Matrix Operations for Complex Numbers: This section contains functions to perform various matrix operations on complex numbers. The create_matrix function initializes a matrix with random complex numbers. The matrix_multiply function performs matrix multiplication, computing the product C=A×B for given matrices A and B. An alternative multiplication function, matrix_multiply_alt, does the same but with different matrix dimensions. The matrix_transpose function computes the transpose of a given matrix. The matrix_inverse function calculates the inverse of a square matrix using Gaussian elimination, ensuring it handles complex numbers correctly. Lastly, the calculate_pseudo_inverse function computes the Moore-Penrose pseudo-inverse of a matrix by first transposing the matrix, multiplying it by its transpose, inverting the result, and then multiplying by the transposed matrix. These functions together enable complex matrix manipulations essential for advanced numerical computations.

- 4.1.4. Cook and Bake Time Calculation: This section includes functions to simulate and calculate the preparation and baking times for cooking processes. The calculate_cook_time function first creates a matrix with random complex numbers. It then records the start time, repeatedly calculates the pseudo-inverse of the matrix in a loop to simulate an extended computational task, and records the end time. The preparation time (cook_time) is determined by calculating the difference between the start and end times in seconds. The calculate_bake_time function estimates the baking time as half of the preparation time, reflecting a simplified assumption that baking takes half as long as the preparation. These functions are used to simulate the time-consuming tasks involved in cooking within the program.
- 4.1.5. Thread Functions for Handling Clients, Cooking, and Deliveries: This section details the thread functions responsible for managing client connections, cooking processes, and deliveries. The handle_client function processes incoming client orders by reading order details, expanding the order array if necessary, and adding the order to the global array. The cook_function simulates a cook's activity by preparing and cooking orders, calculating preparation and cooking times, and logging these activities while updating order states and signaling delivery threads. The delivery_function manages deliveries by waiting for the delivery person's bag to fill, simulating delivery times based on distance, and updating order states to reflect completion, while also logging the process. Additionally, handle_status_updates listens for status updates from clients for monitoring, and handle_completion_updates notifies when all orders are completed. Finally, handle_signal ensures a graceful shutdown by logging a shutdown message, cleaning up resources, and exiting the program. These functions collectively ensure efficient and synchronized processing of orders from reception to delivery.
- 4.2. Client.c: This client program manages multiple client connections, sending orders to a server and waiting for their completion. It starts by parsing command-line arguments to obtain the server's IP address, port, number of clients, and map dimensions (p and q). After initializing the clients, it sends these initial values to the server. Each client creates a socket, connects to the server, and sends order details including order ID, customer coordinates, and the client PID. The receive_completion_status function waits for the server's signal that all orders are complete by reading messages from a specific port. The program includes signal handling to gracefully close all sockets and free allocated memory on receiving SIGINT or SIGTERM, ensuring proper cleanup and termination.

5. Example Outputs:

5.1. Customer number is 50:

```
A personal control of the control of
```



```
A description of the control of the
```

```
A unserplaced with the next becomes and order to be location (6, 12) and Thanks Cook 1 and Reto 1

Solitory Parties 1 delivers don't 30 to location (6, 12) and Thanks Cook 2 and Reto 2

Solitory Parties 1 delivers don't 30 to location (7, 40) and Thanks Cook 8 and Reto 2

Solitory Parties 1 delivers don't 30 to location (8, 12) and Thanks Cook 8 and Reto 2

Solitory Parties 1 delivers don't 30 to location (9, 10) and Thanks Cook 8 and Reto 2

Solitory Parties 1 delivers don't 30 to location (1, 10) and Thanks Cook 8 and Reto 2

Solitory There 1 delivers don't 30 to location (1, 10) and Thanks Cook 8 and Reto 3

Solitory There 1 delivers don't 30 to location (1, 10) and Thanks Cook 8 and Reto 3

Solitory There 1 delivers don't 40 to location (1, 10) and Thanks Cook 3 and Reto 3

Solitory There 1 delivers don't 40 to location (1, 10) and Thanks Cook 3 and Reto 3

Solitory There 1 delivers don't 40 to location (1, 10) and Thanks Cook 3 and Reto 3

Solitory There 1 delivers don't 40 to location (1, 10) and Thanks Cook 3 and Reto 4

Solitory There 1 delivers don't 40 to location (1, 10) and Thanks Cook 3 and Reto 3

Solitory There 1 delivers don't 40 to location (1, 10) and Thanks Cook 3 and Reto 2

Solitory There 1 delivers don't 40 to location (1, 10) and Thanks Cook 3 and Reto 3

Solitory There 1 delivers don't 40 to location (1, 10) and Thanks Cook 3 and Reto 3

Solitory There 1 delivers don't 40 to location (1, 10) and Thanks Cook 3 and Reto 2

Solitory There 1 delivers don't 40 to location (1, 10) and Thanks Cook 3 and Reto 3

Solitory There 1 delivers don't 40 to location (1, 10) and Thanks Cook 3 and Reto 3

Solitory There 1 delivers don't 40 to location (1, 10) and Thanks Cook 3 and Reto 3

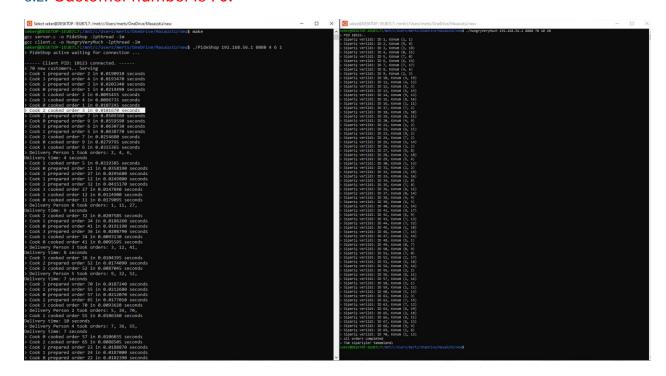
Solitory There 1 delivers don't 40 to location (1, 10) and Thanks Cook 3 and Reto 3

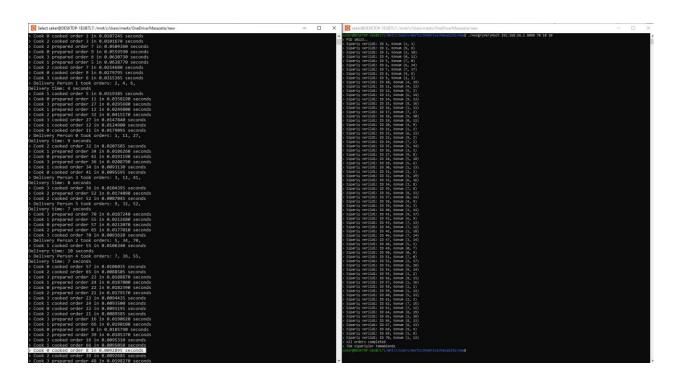
Solitory There 1 delivers don't 40 to location (1, 10) and Thanks Cook 3 and Reto 3

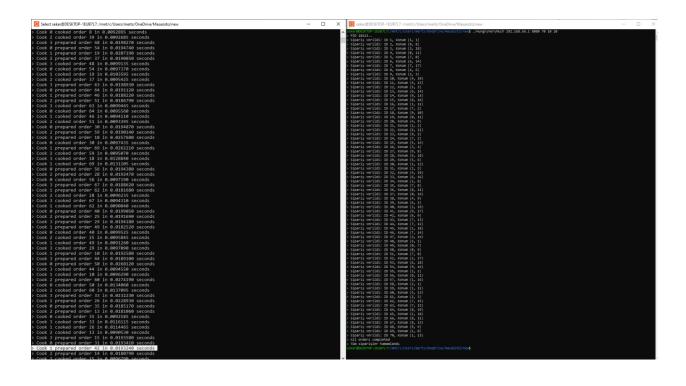
Solitory There 1 delivers don't 40 to location (1, 10) and Thanks Cook 3 and Reto 3

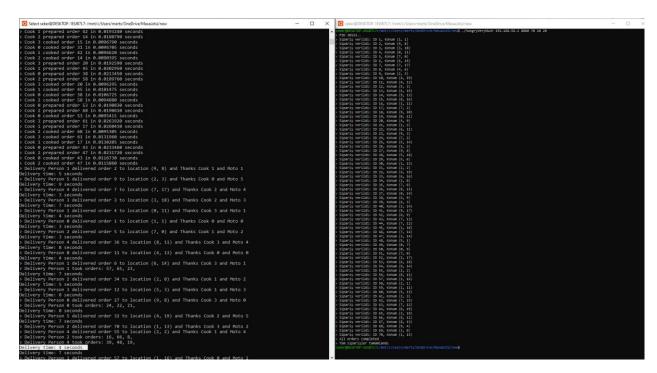
Solitory There 1 delivers don't 40 to location (1, 10) and Thanks C
```

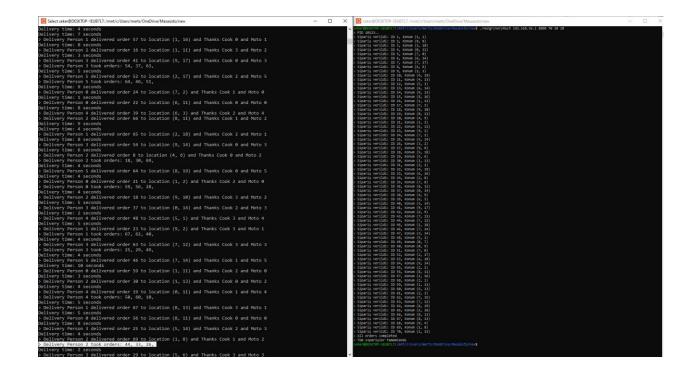
5.2. Customer number is 70:

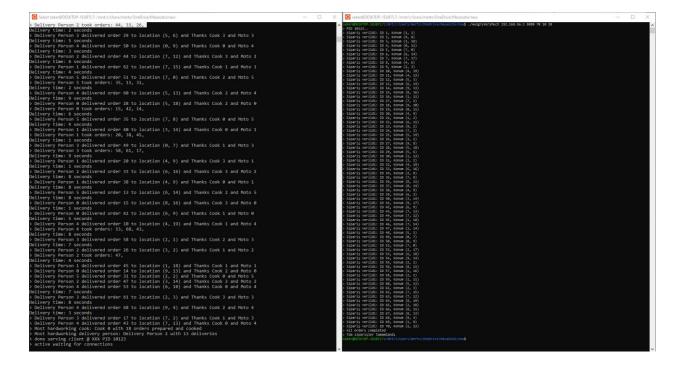












5.3. Customer number is 100 with ctrl-c signal:

