

CSE-344 FINAL ASSIGNMENT

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Algorithm Design and Workflow

Upon starting the server side of the Pide Shop simulation, it begins listening for incoming client connections. Once the client side is initiated, it sends an order struct containing meals and other relevant details to the server. The server's listener thread, acting as a manager, reads this order via sockets and enqueues it into the `meals_queue`, subsequently posting cook semaphores to signal the availability of meals to be prepared. Each meal read from the order triggers a semaphore post, ensuring one cook thread will process each meal. When a cook thread passes through the semaphore, it begins preparing the meal, starting a timer represented by the `pseudoinverseMatrix` calculation. During preparation, the cook checks for its meal in the oven (managed by an oven linked list). Approximately halfway through the preparation time, the cook attempts to interact with the oven for two purposes: putting a meal in or taking a meal out. If putting a meal in, the cook checks for available space in the oven. If no space is available, the cook waits without attempting to acquire the aperture and door semaphores, preventing potential deadlocks. The waiting cooks will only proceed when another cook, intending to take a meal out, frees up space. Cooks coming to take meals will only race with other cooks aiming to take meals, not those putting meals in, thus ensuring smooth and deadlock-free operations.

Synchronization Elements

Semaphores

Semaphores are synchronization tools used to control access to shared resources by multiple threads. They are particularly useful in managing concurrent processes in critical sections.

In the Pide Shop system, the following semaphores are used:

- **meal_semaphore:** Controls the availability of meals to be prepared by the cooks.
- **oven_semaphore:** Limits the number of meals that can be placed in the oven at any time.
- **oven_aperture_semaphore:** Manages access to the oven aperture, ensuring that only a limited number of cooks can use the aperture simultaneously.
- **oven_door_semaphore:** Controls access to the oven door, ensuring that only a limited number of cooks can use the door simultaneously.

Mutexes

Mutexes (mutual exclusion objects) are used to prevent race conditions by ensuring that only one thread can access a critical section at a time.

The following mutexes are used in the system:

- **meals_mutex**: Protects access to the meals queue.
- **oven_mutex**: Protects access to the oven list.
- **delivery_mutex**: Protects access to the delivery queue.
- **delivery_mutex_for_bag**: Ensures that only one delivery person can access their delivery bag at a time.
- **cooked_meals_mutex**: Protects the count of cooked meals.
- **all_meals_mutex**: Protects access to the linked list of all meals.

Condition Variables

Condition variables are used to block a thread until a particular condition is met. They are usually used with mutexes to avoid race conditions.

The following condition variables are used:

- **cook_cond**: Signals cooks when there are meals available to prepare.
- **delivery_cond**: Signals delivery persons when there are meals ready to be delivered.

Threads and Their Responsibilities

Client Threads

- **Main Thread**: Handles the generation and sending of orders, receiving updates, and handling signals for resource cleanup.

Server Threads

- **Listener Thread**: Represents the manager. Listens for and accepts client connections, reads orders, and handles cancellation orders.
- **Cook Threads**: Represents the cook. Take meals from the meals queue, prepare them, place them in the oven, and update their status.
- **Delivery Threads**: Represents the Delivery persons. Take meals from the delivery queue, simulate the delivery process, update meal statuses, and handle cancellations during delivery.

server and client will create separate log files.

Test görüntüleri

CTRL-C in client:

```
hsnsvn@hsnsvn: ~/Desktop/System Programming/final/S...
Meal 7 for order 335255 is cooking
Delivery person(4) delivering meal 4 for order 335255
Cook(8) preparing meal 21 for order 335255
Meal 13 for order 335255 is cooking
Cook(1) finished meal 12 for order 335255
Cook(7) preparing meal 22 for order 335255
Meal 14 for order 335255 is cooking
Cook(4) preparing meal 23 for order 335255
Cook(9) finished meal 8 for order 335255
Cook(7) finished meal 13 for order 335255
Delivery person(5) delivering meal 12 for order 335255
Meal 18 for order 335255 is cooking
Cook(9) preparing meal 24 for order 335255
Delivery person(5) delivering meal 8 for order 335255
Meal 16 for order 335255 is cooking
Cook(4) finished meal 14 for order 335255
Cook(10) preparing meal 25 for order 335255
Delivery person(2) delivering meal 5 for order 335255
Delivery person(4) delivering meal 9 for order 335255
Delivery person(5) delivering meal 13 for order 335255
Delivery person(4) delivering meal 0 for order 335255
Connection established with client
Order canceled, PID 335255

hsnsvn@hsnsvn: ~/Desktop/System Programming/final/S...
Meal 10 for order 335255 updated to status DELIVERED
Meal 5 for order 335255 updated to status IN_DELIVERY
Meal 5 for order 335255 updated to status DELIVERED
Meal 4 for order 335255 updated to status DELIVERED
Meal 9 for order 335255 updated to status IN_DELIVERY
Meal 8 for order 335255 updated to status DELIVERED
Meal 13 for order 335255 updated to status IN_DELIVERY
Meal 13 for order 335255 updated to status DELIVERED
Meal 9 for order 335255 updated to status DELIVERED
Meal 0 for order 335255 updated to status IN_DELIVERY
Meal 0 for order 335255 updated to status DELIVERED
^COrder ID: 0
PID: 335255
Town Width: 10.00; Town Height: 10.00
Number of Meals: 1
Client Socket: -1
Meal 1:
  Order PID: 335255
  Meal ID: -1
  Coordinates: (0.00, 0.00)
  Status: CANCELED
^C signal .. cancelling orders.. editing log..
hsnsvn@hsnsvn: ~/Desktop/System Programming/final/SystemProgramming/final/src/final/musvetterFinal/final
```

CTRL-C in server:

```
hsnsvn@hsnsvn: ~/Desktop/System Programming/final/S...
Cook(6) finished meal 19 for order 335343
Cook(1) preparing meal 28 for order 335343
Meal 21 for order 335343 is cooking
Cook(2) preparing meal 29 for order 335343
Meal 20 for order 335343 is cooking
Cook(1) finished meal 18 for order 335343
Cook(5) finished meal 16 for order 335343
Cook(7) preparing meal 30 for order 335343
Delivery person(4) delivering meal 19 for order 335343
Meal 22 for order 335343 is cooking
Cook(2) finished meal 21 for order 335343
Cook(10) preparing meal 31 for order 335343
Delivery person(1) delivering meal 5 for order 335343
Delivery person(5) delivering meal 17 for order 335343
Delivery person(4) delivering meal 16 for order 335343
Delivery person(1) delivering meal 0 for order 335343
Delivery person(3) delivering meal 15 for order 335343
Delivery person(2) delivering meal 12 for order 335343
Delivery person(2) delivering meal 7 for order 335343
Delivery person(4) delivering meal 18 for order 335343
^CSIGINT caught, shutting down server...
Thanks Cook 6 Moto 1
hsnsvn@hsnsvn: ~/Desktop/System Programming/final/SystemProgramming/final/src/final/musvetterFinal/final

hsnsvn@hsnsvn: ~/Desktop/System Programming/final/S...
Meal 28 for order 335343 updated to status PREPARED
Meal 21 for order 335343 updated to status COOKED
Meal 30 for order 335343 updated to status PREPARED
Meal 31 for order 335343 updated to status PREPARED
Meal 3 for order 335343 updated to status DELIVERED
Meal 5 for order 335343 updated to status IN_DELIVERY
Meal 10 for order 335343 updated to status DELIVERED
Meal 17 for order 335343 updated to status IN_DELIVERY
Meal 19 for order 335343 updated to status DELIVERED
Meal 16 for order 335343 updated to status IN_DELIVERY
Meal 5 for order 335343 updated to status DELIVERED
Meal 0 for order 335343 updated to status IN_DELIVERY
Meal 1 for order 335343 updated to status DELIVERED
Meal 15 for order 335343 updated to status IN_DELIVERY
Meal 9 for order 335343 updated to status DELIVERED
Meal 12 for order 335343 updated to status IN_DELIVERY
Meal 12 for order 335343 updated to status DELIVERED
Meal 7 for order 335343 updated to status IN_DELIVERY
Meal 16 for order 335343 updated to status DELIVERED
Meal 18 for order 335343 updated to status IN_DELIVERY
Meal 0 for order 335343 updated to status SERVERDOWN
PidShop is burned down. Server is down.
hsnsvn@hsnsvn: ~/Desktop/System Programming/final/SystemProgramming/final/src/final/musvetterFinal/final
```

Cook will not wait while the previous is in the oven:

```
hsnsvn@hsnsvn: ~/Desktop/System Programming/final/S...
Cook(10) preparing meal 1 for order 335343
Cook(9) preparing meal 2 for order 335343
Cook(8) preparing meal 3 for order 335343
Cook(1) preparing meal 4 for order 335343
Cook(6) preparing meal 5 for order 335343
Cook(2) preparing meal 6 for order 335343
Cook(5) preparing meal 7 for order 335343
Cook(3) preparing meal 9 for order 335343
Cook(4) preparing meal 8 for order 335343
Meal 0 for order 335343 is cooking
Cook(7) preparing meal 10 for order 335343
Meal 3 for order 335343 is cooking
Cook(8) preparing meal 11 for order 335343
Meal 5 for order 335343 is cooking
Cook(6) preparing meal 12 for order 335343
Meal 1 for order 335343 is cooking
Cook(10) preparing meal 13 for order 335343
Meal 9 for order 335343 is cooking
Cook(3) preparing meal 14 for order 335343
Meal 4 for order 335343 is cooking
Cook(1) preparing meal 15 for order 335343
Meal 7 for order 335343 is cooking
Cook(5) preparing meal 16 for order 335343
Cook(8) finished meal 3 for order 335343
```

Best workers:

```
Delivery person(4) delivering meal 18 for order 335343
^CSIGINT caught, shutting down server...
Thanks Cook 6 Moto 1
hsnsvn@hsnsvn: ~/Desktop/System Programming/final/SystemProgramming/final/src/
```

```
hsnsvn@hsnsvn: ~/Desktop/System Programming/final/S...
Cook(7) finished meal 10 for order 335564
Cook(4) finished meal 16 for order 335564
Cook(5) finished meal 15 for order 335564
Delivery person(3) delivering meal 8 for order 335564
Delivery person(2) delivering meal 11 for order 335564
Cook(10) finished meal 4 for order 335564
Delivery person(4) delivering meal 10 for order 335564
Meal 14 for order 335564 is cooking
Delivery person(5) delivering meal 5 for order 335564
Meal 13 for order 335564 is cooking
Cook(3) finished meal 14 for order 335564
Cook(9) finished meal 13 for order 335564
Delivery person(3) delivering meal 0 for order 335564
Delivery person(4) delivering meal 16 for order 335564
Delivery person(2) delivering meal 7 for order 335564
Delivery person(5) delivering meal 15 for order 335564
Delivery person(1) delivering meal 1 for order 335564
Delivery person(4) delivering meal 2 for order 335564
Delivery person(2) delivering meal 9 for order 335564
Delivery person(3) delivering meal 12 for order 335564
Delivery person(4) delivering meal 14 for order 335564
Delivery person(2) delivering meal 13 for order 335564
Delivery person(5) delivering meal 4 for order 335564

Meal 5 for order 335564 updated to status DELIVERED
Meal 15 for order 335564 updated to status IN_DELIVERY
Meal 3 for order 335564 updated to status DELIVERED
Meal 1 for order 335564 updated to status IN_DELIVERY
Meal 16 for order 335564 updated to status DELIVERED
Meal 2 for order 335564 updated to status IN_DELIVERY
Meal 7 for order 335564 updated to status DELIVERED
Meal 9 for order 335564 updated to status IN_DELIVERY
Meal 8 for order 335564 updated to status DELIVERED
Meal 12 for order 335564 updated to status IN_DELIVERY
Meal 2 for order 335564 updated to status DELIVERED
Meal 9 for order 335564 updated to status DELIVERED
Meal 14 for order 335564 updated to status IN_DELIVERY
Meal 13 for order 335564 updated to status IN_DELIVERY
Meal 15 for order 335564 updated to status IN_DELIVERY
Meal 4 for order 335564 updated to status IN_DELIVERY
Meal 1 for order 335564 updated to status DELIVERED
Meal 12 for order 335564 updated to status DELIVERED
Meal 13 for order 335564 updated to status DELIVERED
Meal 4 for order 335564 updated to status DELIVERED
Meal 14 for order 335564 updated to status DELIVERED
All customers served
hsnsvn@hsnsvn: ~/Desktop/System Programming/final/SystemProgramming/final/src/
```

```
Meal 16 for order 335605 is cooking
Cook(8) finished meal 13 for order 335605
Cook(1) finished meal 3 for order 335605
Delivery person(5) delivering meal 9 for order 335605
Delivery person(5) delivering meal 12 for order 335605
Cook(6) finished meal 8 for order 335605
Meal 15 for order 335605 is cooking
Cook(4) finished meal 16 for order 335605
Cook(9) finished meal 7 for order 335605
Cook(3) finished meal 14 for order 335605
Cook(10) finished meal 15 for order 335605
Delivery person(4) delivering meal 3 for order 335605
Delivery person(4) delivering meal 8 for order 335605
Delivery person(1) delivering meal 1 for order 335605
Delivery person(3) delivering meal 4 for order 335605
Delivery person(3) delivering meal 6 for order 335605
Delivery person(2) delivering meal 10 for order 335605
Delivery person(5) delivering meal 13 for order 335605
Delivery person(4) delivering meal 16 for order 335605
Delivery person(2) delivering meal 5 for order 335605
Delivery person(1) delivering meal 14 for order 335605
Delivery person(1) delivering meal 7 for order 335605
Delivery person(1) delivering meal 15 for order 335605
Meal 4 for order 335605 updated to status DELIVERED
Meal 6 for order 335605 updated to status IN_DELIVERY
Meal 11 for order 335605 updated to status DELIVERED
Meal 10 for order 335605 updated to status IN_DELIVERY
Meal 12 for order 335605 updated to status DELIVERED
Meal 13 for order 335605 updated to status IN_DELIVERY
Meal 8 for order 335605 updated to status DELIVERED
Meal 16 for order 335605 updated to status IN_DELIVERY
Meal 1 for order 335605 updated to status DELIVERED
Meal 6 for order 335605 updated to status DELIVERED
Meal 10 for order 335605 updated to status DELIVERED
Meal 5 for order 335605 updated to status IN_DELIVERY
Meal 14 for order 335605 updated to status IN_DELIVERY
Meal 13 for order 335605 updated to status DELIVERED
Meal 14 for order 335605 updated to status DELIVERED
Meal 7 for order 335605 updated to status IN_DELIVERY
Meal 5 for order 335605 updated to status DELIVERED
Meal 7 for order 335605 updated to status DELIVERED
Meal 15 for order 335605 updated to status IN_DELIVERY
Meal 16 for order 335605 updated to status DELIVERED
Meal 15 for order 335605 updated to status DELIVERED
All customers served
hsnsn@hsnsn: ~/Desktop/System Programming/final/S...
hsnsn@hsnsn: ~/Desktop/System Programming/final/S...
Meal 0 for order 335602 updated to status DELIVERED
Meal 4 for order 335602 updated to status IN_DELIVERY
Meal 5 for order 335602 updated to status DELIVERED
Meal 1 for order 335602 updated to status IN_DELIVERY
Meal 14 for order 335602 updated to status DELIVERED
Meal 11 for order 335602 updated to status IN_DELIVERY
Meal 10 for order 335602 updated to status DELIVERED
Meal 16 for order 335602 updated to status IN_DELIVERY
Meal 4 for order 335602 updated to status DELIVERED
Meal 1 for order 335602 updated to status DELIVERED
Meal 13 for order 335602 updated to status DELIVERED
Meal 9 for order 335602 updated to status IN_DELIVERY
Meal 9 for order 335602 updated to status DELIVERED
Meal 12 for order 335602 updated to status IN_DELIVERY
Meal 11 for order 335602 updated to status DELIVERED
Meal 7 for order 335602 updated to status IN_DELIVERY
Meal 16 for order 335602 updated to status DELIVERED
Meal 6 for order 335602 updated to status IN_DELIVERY
Meal 12 for order 335602 updated to status DELIVERED
Meal 7 for order 335602 updated to status IN_DELIVERY
Meal 15 for order 335602 updated to status IN_DELIVERY
Meal 15 for order 335602 updated to status DELIVERED
Meal 6 for order 335602 updated to status DELIVERED
```

es

Responsibilities

it will work in big numbers:

```
Delivery person(5) delivering meal 23 for order 335741
Delivery person(3) delivering meal 47 for order 335741
Delivery person(4) delivering meal 49 for order 335741
Delivery person(2) delivering meal 25 for order 335741
Delivery person(5) delivering meal 20 for order 335741
Delivery person(1) delivering meal 31 for order 335741
Delivery person(3) delivering meal 46 for order 335741
Delivery person(4) delivering meal 35 for order 335741
Delivery person(2) delivering meal 33 for order 335741
Delivery person(2) delivering meal 29 for order 335741
Delivery person(2) delivering meal 27 for order 335741
Delivery person(5) delivering meal 14 for order 335741
Delivery person(3) delivering meal 38 for order 335741
Delivery person(2) delivering meal 42 for order 335741
Delivery person(2) delivering meal 17 for order 335741
Delivery person(5) delivering meal 44 for order 335741
Delivery person(5) delivering meal 39 for order 335741
Delivery person(1) delivering meal 36 for order 335741
Delivery person(3) delivering meal 40 for order 335741
Delivery person(2) delivering meal 32 for order 335741
Delivery person(2) delivering meal 34 for order 335741
Delivery person(5) delivering meal 48 for order 335741
Delivery person(3) delivering meal 41 for order 335741
Meal 42 for order 335741 updated to status DELIVERED
Meal 17 for order 335741 updated to status IN_DELIVERY
Meal 14 for order 335741 updated to status DELIVERED
Meal 44 for order 335741 updated to status IN_DELIVERY
Meal 44 for order 335741 updated to status DELIVERED
Meal 31 for order 335741 updated to status IN_DELIVERY
Meal 36 for order 335741 updated to status IN_DELIVERY
Meal 38 for order 335741 updated to status DELIVERED
Meal 40 for order 335741 updated to status IN_DELIVERY
Meal 35 for order 335741 updated to status DELIVERED
Meal 17 for order 335741 updated to status DELIVERED
Meal 32 for order 335741 updated to status IN_DELIVERY
Meal 36 for order 335741 updated to status DELIVERED
Meal 32 for order 335741 updated to status DELIVERED
Meal 34 for order 335741 updated to status IN_DELIVERY
Meal 39 for order 335741 updated to status DELIVERED
Meal 48 for order 335741 updated to status IN_DELIVERY
Meal 40 for order 335741 updated to status DELIVERED
Meal 41 for order 335741 updated to status IN_DELIVERY
Meal 34 for order 335741 updated to status DELIVERED
Meal 48 for order 335741 updated to status DELIVERED
Meal 41 for order 335741 updated to status DELIVERED
```