

CSE-344
SPRING 2024
FINAL PROJECT
REPORT

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In the assignment we are expected to build a system by ensuring proper synchronization between cooks, oven, deliveries and customers. The main idea is using mutexes and semaphores to provide correct synchronization. There are two sides which are server (pideci) and client (customers). In the client side each customer is created with threads so they can connect to the server at the same time by using socket. In the server side there are two thread pools for deliveries and cooks. And also there is one more thread for manager.

There are two ways to provide communication by using socket. One of them is using only port and other one is ip address. When the program starts it checks the number of arguments. According to number it decides to use ip or port.

When program starts threads are created. Manager thread is in an infinite loop because it always checks if there is a new order. It creates new socket for each accept. It is designed as nonblocking because if the orders are gotten from customers, manager should not wait the orders, it should continue because it gives order to the cooks and then gives to the deliveries. When order comes, manager adds it to the order queue and it checks the available cooks. It finds first available cook and it sends condition signal to wake them up. Cook gets order from queue and prepares. Then by using semaphore protection it tries to put the order to the oven. If semaphore returns something other than zero it means entries for the oven is full and cook should wait. Then it checks the number of orders in the oven with a variable. If they are more than 6 it waits again. When cook gets order from oven it puts order to the delivery order queue. For each order which comes from oven semaphore is used.

In the manager thread, it tries to find first available delivery to give order. By using semaphore it checks if there are ready order. It uses `sem_wait` not to block manager thread. If there is order, it pops from general delivery queue and it assigns to the delivery's personal delivery queue. It tries to give first delivery person. If delivery person has max order, it goes second delivery and checks the number of order of the delivery. For each delivery assignment, mutex is used. Each mutex is unique for the deliveries. When the delivery has max number order, it means delivery is ready to go to customers. It sends condition signal to the delivery thread and if delivery person is not available (which means he is assigned for delivering) it checks its own personal order delivery queue and it distributes orders.

For each step which are order received, prepared, in the way, delivered, server sends message to the client. And for each customer steps are printed. When CTRL C signal comes to the server, signal handler calls kill function to terminate client. To terminate client, it sends signal to the client. In the signal handler which is in the client handles this signal and terminates the client. When the order came, client informations are stored in the order struct (like socket number, client pid, customer

coordinates). When CTRL C interrupt comes to the client side, it sends it to the server side by using SIGPIPE signal. And server deletes queue.

For each operation for the cook and delivery, when their thread is started to the operation, it records time. There are array of cooks and delivery people. Each of them has their own struct. And their total work time is stored in this struct. In their struct they have their own mutexes and their own order queues. So they do not have to wait other people to do their job. And with special queues each order is assigned to a specific delivery people and cooks. And it makes easier providing synchronization. And each location of the customers are generated randomly and stored in order struct.

By using port number:

```
root@DESKTOP-PLJPMRB:/home/final# ./PideShop 8080 3 2 3
> Manager is waiting for orders...
> Chef 1 is preparing order 0
> Chef 2 is preparing order 1
> Chef 0 is preparing order 2
> Chef 1 put order 0 to the oven. Total pides in the oven: 1
> Chef 0 put order 2 to the oven. Total pides in the oven: 2
> Chef 2 put order 1 to the oven. Total pides in the oven: 3
> Chef 1 took a order 0 out of the oven. Total pides in the oven: 2
> Chef 2 took a order 1 out of the oven. Total pides in the oven: 1
> Chef 1 is preparing order 3
> Chef 0 took a order 2 out of the oven. Total pides in the oven: 0
> Chef 2 is preparing order 4
> Chef 0 is preparing order 5
> Delivery 0 is delivering order 0 to adress (28, 61)
> Chef 2 put order 4 to the oven. Total pides in the oven: 1
> Chef 1 put order 3 to the oven. Total pides in the oven: 2
> Chef 0 put order 5 to the oven. Total pides in the oven: 3
> Chef 2 took a order 4 out of the oven. Total pides in the oven: 2
> Chef 0 took a order 5 out of the oven. Total pides in the oven: 1
> Chef 2 is preparing order 6
> Chef 1 took a order 3 out of the oven. Total pides in the oven: 0
> Delivery 0 delivered order 0 to adress (28, 61). Remaining pides to deliver: 2
> Delivery 0 is delivering order 1 to adress (28, 61)
> Delivery 1 is delivering order 3 to adress (28, 61)
> Chef 2 put order 6 to the oven. Total pides in the oven: 1
> Chef 2 took a order 6 out of the oven. Total pides in the oven: 0
> Delivery 0 delivered order 1 to adress (28, 61). Remaining pides to deliver: 1
> Delivery 0 is delivering order 2 to adress (28, 61)
> Delivery 1 delivered order 3 to adress (28, 61). Remaining pides to deliver: 2
> Delivery 1 is delivering order 4 to adress (33, 30)
> Delivery 0 delivered order 2 to adress (28, 61). Remaining pides to deliver: 0
> Delivery 1 delivered order 4 to adress (33, 30). Remaining pides to deliver: 1
> Delivery 1 is delivering order 5 to adress (68, 11)
> Delivery 0 is delivering order 6 to adress (68, 11)
> Delivery 1 delivered order 5 to adress (68, 11). Remaining pides to deliver: 0
> Delivery 0 delivered order 6 to adress (68, 11). Remaining pides to deliver: 0
> done serving client 208874
> Best employee is Chef 0, thank you sir!
> Best employee is Delivery 1, thank you sir!
[]

root@DESKTOP-PLJPMRB:/home/final# ./HungryVeryMuch 8080 7 70 70
> PID: 208874
> Customer 1: Order sent
> Customer 2: Order sent
> Customer 3: Order sent
> Customer 4: Order sent
> Customer 1 Order received
> Customer 2 Order received
> Customer 3 Order received
> Customer 5: Order sent
> Customer 0: Order sent
> Customer 6: Order sent
> Customer 1 Order ready for delivery
> Customer 4 Order received
> Customer 2 Order ready for delivery
> Customer 3 Order ready for delivery
> Customer 5 Order received
> Customer 6 Order received
> Customer 1 Order is in the way
> Customer 5 Order ready for delivery
> Customer 0 Order received
> Customer 6 Order ready for delivery
> Customer 4 Order ready for delivery
> Customer 1 Order is delivered
> Customer 2 Order is in the way
> Customer 4 Order is in the way
> Customer 0 Order ready for delivery
> Customer 2 Order is delivered
> Customer 3 Order is in the way
> Customer 4 Order is delivered
> Customer 5 Order is in the way
> Customer 3 Order is delivered
> Customer 5 Order is delivered
> Customer 6 Order is in the way
> Customer 0 Order is in the way
> Customer 6 Order is delivered
> Customer 0 Order is delivered
> All orders are served
root@DESKTOP-PLJPMRB:/home/final#
```

Server is still open and done more client connected:

```
Delivery 1 is delivering order 5 to adress (68, 11)
Delivery 0 is delivering order 6 to adress (68, 11)
Delivery 1 delivered order 5 to adress (68, 11). Remaining pides to deliver: 0
Delivery 0 delivered order 6 to adress (68, 11). Remaining pides to deliver: 0
done serving client 208874
Best employee is Chef 0, thank you sir!
Best employee is Delivery 1, thank you sir!
Chef 0 is preparing order 7
Chef 2 is preparing order 8
Chef 0 put order 7 to the oven. Total pides in the oven: 1
Chef 2 put order 8 to the oven. Total pides in the oven: 2
Chef 0 took a order 7 out of the oven. Total pides in the oven: 1
Chef 2 took a order 8 out of the oven. Total pides in the oven: 0
Delivery 0 is delivering order 7 to adress (30, 25)
Delivery 1 is delivering order 8 to adress (30, 25)
Delivery 0 delivered order 7 to adress (30, 25). Remaining pides to deliver: 0
Delivery 1 delivered order 8 to adress (30, 25). Remaining pides to deliver: 0
done serving client 209478
Best employee is Chef 1, thank you sir!
Best employee is Delivery 1, thank you sir!
[]

Customer 3 Order is delivered
Customer 5 Order is delivered
Customer 6 Order is in the way
Customer 0 Order is in the way
Customer 6 Order is delivered
Customer 0 Order is delivered
All orders are served
root@DESKTOP-PLJPMRB:/home/final# ./HungryVeryMuch 8080 2 70 70
> PID: 209478
> Customer 0: Order sent
> Customer 1: Order sent
> Customer 0 Order received
> Customer 1 Order received
> Customer 0 Order ready for delivery
> Customer 1 Order ready for delivery
> Customer 0 Order is in the way
> Customer 1 Order is in the way
> Customer 0 Order is delivered
> Customer 1 Order is delivered
> All orders are served
root@DESKTOP-PLJPMRB:/home/final#
```

Server interrupted, and client is terminated

```
root@DESKTOP-PLJPMRB:/home/final# ./PideShop 8080 3 2 3
> Manager is waiting for orders...
> Chef 0 is preparing order 0
> Chef 2 is preparing order 1
> Chef 1 is preparing order 2
> Chef 2 put order 1 to the oven. Total pides in the oven: 1
> Chef 1 put order 2 to the oven. Total pides in the oven: 2
> Chef 0 put order 0 to the oven. Total pides in the oven: 3
> Chef 2 took a order 1 out of the oven. Total pides in the oven: 2
> Chef 0 took a order 0 out of the oven. Total pides in the oven: 1
> Chef 2 is preparing order 3
> Chef 0 is preparing order 4
> Chef 1 took a order 2 out of the oven. Total pides in the oven: 0
> Chef 1 is preparing order 5
^C ^C.. Upps quitting.. writing log file
All chefs and deliveries joined
root@DESKTOP-PLJPMRB:/home/final# █

root@DESKTOP-PLJPMRB:/home/final# ./HungryVeryMuch 8080 15 70 70
> PID: 210460
> Customer 0: Order sent
> Customer 1: Order sent
> Customer 3: Order sent
> Customer 2: Order sent
> Customer 0 Order received
> Customer 1 Order received
> Customer 3 Order received
> Customer 6: Order sent
> Customer 14: Order sent
> Customer 12: Order sent
> Customer 8: Order sent
> Customer 11: Order sent
> Customer 7: Order sent
> Customer 4: Order sent
> Customer 9: Order sent
> Customer 10: Order sent
> Customer 2 Order received
> Customer 1 Order ready for delivery
> Customer 0 Order ready for delivery
> Customer 14 Order received
> Customer 3 Order ready for delivery
> Customer 9 Order received
> ^C signal .. cancelling orders.. editing log..
root@DESKTOP-PLJPMRB:/home/final# █
```

Log file:

```
server.c  log.txt  X
log.txt
1  [2024-06-15 08:28:02] Chef 0 is preparing order 0
2
3  [2024-06-15 08:28:02] Chef 2 is preparing order 1
4
5  [2024-06-15 08:28:02] Chef 1 is preparing order 2
6
7  [2024-06-15 08:28:04] Chef 2 put order 1 to the oven. Total pides in the oven: 1
8
9  [2024-06-15 08:28:04] Chef 1 put order 2 to the oven. Total pides in the oven: 2
10
11 [2024-06-15 08:28:04] Chef 0 put order 0 to the oven. Total pides in the oven: 3
12
13 [2024-06-15 08:28:05] Chef 2 took a order 1 out of the oven. Total pides in the oven: 2
14
15 [2024-06-15 08:28:05] Chef 0 took a order 0 out of the oven. Total pides in the oven: 1
16
17 [2024-06-15 08:28:05] Chef 2 is preparing order 3
18
19 [2024-06-15 08:28:05] Chef 0 is preparing order 4
20
21 [2024-06-15 08:28:05] Chef 1 took a order 2 out of the oven. Total pides in the oven: 0
22
23 [2024-06-15 08:28:05] Chef 1 is preparing order 5
24
25 [2024-06-15 08:28:05] Server is closed by ^C
26 ✨
27 |
```

Client connected with ip adress and server interrupted:

```
root@DESKTOP-PLJPMRB:/home/final# ./PideShop 127.0.0.1 8080 3 2 3
> Manager is waiting for orders...
> Chef 2 is preparing order 2
> Chef 0 is preparing order 0
> Chef 1 is preparing order 1
> Chef 0 put order 0 to the oven. Total pides in the oven: 1
> Chef 2 put order 2 to the oven. Total pides in the oven: 2
> Chef 1 put order 1 to the oven. Total pides in the oven: 3
> Chef 0 took a order 0 out of the oven. Total pides in the oven: 2
> Chef 1 took a order 1 out of the oven. Total pides in the oven: 1
> Chef 0 is preparing order 3
> Chef 2 took a order 2 out of the oven. Total pides in the oven: 0
> Delivery 0 is delivering order 0 to adress (44, 52)
> Chef 0 put order 3 to the oven. Total pides in the oven: 1
> Chef 0 took a order 3 out of the oven. Total pides in the oven: 0
> Delivery 0 delivered order 0 to adress (44, 52). Remaining pides to deliver: 2
> Delivery 0 is delivering order 2 to adress (44, 52)
> Delivery 0 delivered order 2 to adress (44, 52). Remaining pides to deliver: 1
> Delivery 0 is delivering order 1 to adress (44, 52)
> Delivery 0 delivered order 1 to adress (44, 52). Remaining pides to deliver: 0
^C ^C.. Upps quitting.. writing log file
All chefs and deliveries joined
root@DESKTOP-PLJPMRB:/home/final#
```

```
root@DESKTOP-PLJPMRB:/home/final# ./HungryVeryMuch 127.0.0.1 8080 4 70 70
> PID: 211857
> Customer 0: Order sent
> Customer 1: Order sent
> Customer 2: Order sent
> Customer 3: Order sent
> Customer 0 Order received
> Customer 1 Order received
> Customer 2 Order received
> Customer 0 Order ready for delivery
> Customer 3 Order received
> Customer 1 Order ready for delivery
> Customer 2 Order ready for delivery
> Customer 0 Order is in the way
> Customer 3 Order ready for delivery
> Customer 0 Order is delivered
> Customer 2 Order is in the way
> Customer 2 Order is delivered
> Customer 1 Order is in the way
> Customer 1 Order is delivered
> ^C signal .. cancelling orders.. editing log..
root@DESKTOP-PLJPMRB:/home/final#
```

Client side is interrupted:

```
QUEUE bosaltilyor.
> Delivery 1 is delivering order 3 to adress (52, 30)
> Chef 2 put order 6 to the oven. Total pides in the oven: 1
> Chef 1 put order 7 to the oven. Total pides in the oven: 2
> Chef 2 took a order 6 out of the oven. Total pides in the oven: 1
QUEUE bosaltilyor.
> Chef 1 took a order 7 out of the oven. Total pides in the oven: 0
QUEUE bosaltilyor.
> Delivery 0 delivered order 0 to adress (52, 30). Remaining pides to deliver: 1
QUEUE bosaltilyor.
> Delivery 0 is delivering order 2 to adress (52, 30)
> Delivery 1 delivered order 3 to adress (52, 30). Remaining pides to deliver: 2
QUEUE bosaltilyor.
> Delivery 1 is delivering order 4 to adress (28, 12)
> Delivery 0 delivered order 2 to adress (52, 30). Remaining pides to deliver: 0
QUEUE bosaltilyor.
> Delivery 1 delivered order 4 to adress (28, 12). Remaining pides to deliver: 1
QUEUE bosaltilyor.
> Delivery 1 is delivering order 5 to adress (45, 69)
QUEUE bosaltilyor.
> Delivery 0 is delivering order 6 to adress (28, 45)
> Delivery 1 delivered order 5 to adress (45, 69). Remaining pides to deliver: 0
QUEUE bosaltilyor.
> Delivery 0 delivered order 6 to adress (28, 45). Remaining pides to deliver: 0
QUEUE bosaltilyor.
> Delivery 0 is delivering order 7 to adress (28, 45)
> Delivery 0 delivered order 7 to adress (28, 45). Remaining pides to deliver: 0
QUEUE bosaltilyor.
> done serving client 212608
> Best employee is Chef 0, thank you sir!
> Best employee is Delivery 1, thank you sir!
```

```
root@DESKTOP-PLJPMRB:/home/final# ./HungryVeryMuch 127.0.0.1 8080 8 70 70
> PID: 212608
> Customer 0: Order sent
> Customer 1: Order sent
> Customer 2: Order sent
> Customer 3: Order sent
> Customer 0 Order received
> Customer 2 Order received
> Customer 5: Order sent
> Customer 7: Order sent
> Customer 6: Order sent
> Customer 4: Order sent
> Customer 1 Order ready for delivery
> Customer 5 Order received
> Customer 2 Order ready for delivery
> Customer 3 Order received
> Customer 0 Order ready for delivery
> Customer 4 Order received
> Customer 1 Order is in the way
> ^C ^C signal .. cancelling orders.. editing log..
root@DESKTOP-PLJPMRB:/home/final#
```

With large numbers of clients, cooks and deliveries:

```
root@DESKTOP-PLJPMRB:/home/final# ./PideShop 8080 15 9 8
> Manager is waiting for orders...
> Chef 0 is preparing order 0
> Chef 1 is preparing order 1
> Chef 2 is preparing order 2
> Chef 3 is preparing order 3
> Chef 8 is preparing order 4
> Chef 11 is preparing order 5
> Chef 12 is preparing order 6
> Chef 4 is preparing order 7
> Chef 5 is preparing order 8
> Chef 6 is preparing order 9
> Chef 7 is preparing order 10
> Chef 13 is preparing order 12
> Chef 9 is preparing order 11
> Chef 0 put order 0 to the oven. Total pides in the oven: 1
> Chef 1 put order 1 to the oven. Total pides in the oven: 2
> Chef 2 put order 2 to the oven. Total pides in the oven: 3
> Chef 3 put order 3 to the oven. Total pides in the oven: 4
> Chef 8 put order 4 to the oven. Total pides in the oven: 5
> Chef 12 put order 6 to the oven. Total pides in the oven: 6
> Chef 0 took a order 0 out of the oven. Total pides in the oven: 5
> Chef 1 took a order 1 out of the oven. Total pides in the oven: 4
> Chef 2 took a order 2 out of the oven. Total pides in the oven: 3
> Chef 3 took a order 3 out of the oven. Total pides in the oven: 2
> Chef 4 put order 7 to the oven. Total pides in the oven: 3
> Chef 5 put order 8 to the oven. Total pides in the oven: 4
> Chef 6 put order 9 to the oven. Total pides in the oven: 5
> Chef 7 put order 10 to the oven. Total pides in the oven: 6
> Chef 8 took a order 4 out of the oven. Total pides in the oven: 5
> Chef 12 took a order 6 out of the oven. Total pides in the oven: 4
> Chef 11 put order 5 to the oven. Total pides in the oven: 5
> Chef 14 is preparing order 13
```

```
root@DESKTOP-PLJPMRB:/home/final# ./HungryVeryMuch 8080 50 70 70
> PID: 213474
> Customer 39: Order sent
> Customer 47: Order sent
> Customer 34: Order sent
> Customer 18: Order sent
> Customer 47 Order received
> Customer 34 Order received
> Customer 18 Order received
> Customer 39 Order received
> Customer 10: Order sent
> Customer 2: Order sent
> Customer 3: Order sent
> Customer 10 Order received
> Customer 3 Order received
> Customer 2 Order received
> Customer 7: Order sent
> Customer 24: Order sent
> Customer 32: Order sent
> Customer 49: Order sent
> Customer 16: Order sent
> Customer 41: Order sent
> Customer 7 Order received
> Customer 24 Order received
> Customer 32 Order received
> Customer 49 Order received
> Customer 41 Order received
> Customer 16 Order received
> Customer 47 Order ready for delivery
> Customer 34 Order ready for delivery
> Customer 39 Order ready for delivery
> Customer 18 Order ready for delivery
> Customer 10 Order ready for delivery
```

When it is interrupted:

```
> Delivery 3 delivered order 29 to adress (57, 19). Remaining pides to deliver: 2
> Delivery 3 is delivering order 30 to adress (2, 649)
> Delivery 0 delivered order 7 to adress (62, 25). Remaining pides to deliver: 0
> Delivery 5 delivered order 44 to adress (34, 68). Remaining pides to deliver: 3
> Delivery 5 is delivering order 45 to adress (34, 68)
> Delivery 2 delivered order 22 to adress (57, 19). Remaining pides to deliver: 1
> Delivery 2 is delivering order 23 to adress (44, 29)
> Delivery 4 delivered order 37 to adress (19, 27). Remaining pides to deliver: 2
> Delivery 4 is delivering order 38 to adress (48, 44)
> Delivery 1 delivered order 15 to adress (65, 48). Remaining pides to deliver: 0
> Delivery 3 delivered order 30 to adress (2, 649). Remaining pides to deliver: 1
> Delivery 3 is delivering order 31 to adress (65, 48)
> Delivery 5 delivered order 45 to adress (34, 68). Remaining pides to deliver: 2
> Delivery 5 is delivering order 46 to adress (65, 48)
> Delivery 2 delivered order 23 to adress (44, 29). Remaining pides to deliver: 0
> Delivery 4 delivered order 38 to adress (48, 44). Remaining pides to deliver: 1
> Delivery 4 is delivering order 39 to adress (44, 57)
> Delivery 3 delivered order 31 to adress (65, 48). Remaining pides to deliver: 0
> Delivery 5 delivered order 46 to adress (65, 48). Remaining pides to deliver: 1
> Delivery 5 is delivering order 47 to adress (65, 48)
> Delivery 4 delivered order 39 to adress (44, 57). Remaining pides to deliver: 0
> Delivery 5 delivered order 47 to adress (65, 48). Remaining pides to deliver: 0
^C> ^C.. Upps quitting.. writing log file
All chefs and deliveries joined
root@DESKTOP-PLJPMRB:/home/final#
```

```
> Customer 20 Order is in the way
> Customer 21 Order is delivered
> Customer 30 Order is in the way
> Customer 7 Order is delivered
> Customer 17 Order is delivered
> Customer 42 Order is in the way
> Customer 27 Order is delivered
> Customer 28 Order is in the way
> Customer 46 Order is delivered
> Customer 13 Order is in the way
> Customer 20 Order is delivered
> Customer 14 Order is in the way
> Customer 30 Order is delivered
> Customer 42 Order is delivered
> Customer 9 Order is in the way
> Customer 28 Order is delivered
> Customer 19 Order is delivered
> Customer 29 Order is in the way
> Customer 14 Order is delivered
> Customer 9 Order is delivered
> Customer 12 Order is in the way
> Customer 29 Order is delivered
> Customer 12 Order is delivered
> ^C signal .. cancelling orders.. editing log..
root@DESKTOP-PLJPMRB:/home/final#
```