

CSE 344 System Programming – HW3 Report

Project Introduction

The project aims to simulate a parking lot scenario where automobiles and pickups attempt to park in a lot with limited temporary and permanent parking spots. The simulation involves car owners who try to park their vehicles and vales who move vehicles from temporary spot to permanent spots. The synchronization of these activities is achieved using semaphores. The simulation runs for 20 seconds, during which vehicles periodically leave the parking lot to simulate turnover.

Problem Definition

1. Automobile or pickup parks if temporary spot available.
2. Vales moves cars from temporary spots to permanent spots.
3. Cars leave the permanent spots periodically, allowing new cars to park.

Solutions

Threads

a) carOwner Thread

The **carOwner** thread represents a car owner who attempts to park their vehicle in a parking lot. The parking lot has both temporary and permanent parking spots, and the car owner must first park in a temporary spot if the permanent spots are full. The car owner then waits for a parking attendant to move their car to a permanent spot.

The **carOwner** thread simulates the behavior of a car owner trying to park in a lot with limited temporary and permanent spots. It uses semaphores and mutexes to ensure synchronized access to shared resources and proper coordination with the parking attendant threads.

b) carAttendant Thread

The **carAttendant** thread represents a parking attendant responsible for moving vehicles from temporary parking spots to permanent parking spots. The attendant waits for a signal from car owners, indicating that their vehicles are ready to be moved to a permanent spot.

The **carAttendant** thread simulates the behavior of a parking attendant who moves vehicles from temporary spots to permanent spots as they become available. It uses semaphores and mutexes to ensure synchronized access to shared resources and proper coordination with the car owner threads. The attendant waits for signals from car owners, checks for available permanent spots, moves vehicles accordingly, and notifies the car owners once the vehicles are parked.

c) vehicleDeparture Thread

The ***vehicleDeparture*** thread is responsible for simulating the departure of vehicles from the permanent parking spots at regular intervals. This ensures that there are always opportunities for new vehicles to move into the permanent parking spots from the temporary spots.

The ***vehicleDeparture*** thread simulates the periodic departure (every 2 seconds) of vehicles from the permanent parking spots. It ensures that new vehicles have the opportunity to move into these spots by regularly freeing up space. The thread uses semaphores and mutexes to coordinate with other threads and protect shared resources, ensuring synchronized access and modification of parking spot counts. This creates a dynamic parking simulation where vehicles continuously enter and leave the permanent spots, and the parking attendant manages the process efficiently.

Functions

Main function

- Sets up signal handling and starts the alarm for 20 seconds.
- Initializes semaphores and mutexes.
- Creates threads for car owners, attendants, and vehicle departures.
- Waits for threads to complete after the simulation period.
- Cleans up and destroys semaphores and mutexes.

Signal Handler

- Sets the terminate flag when the alarm signal is received to stop the simulation after 20 seconds.

Semaphores and their usage

newAutomobile and ***newPickup***: These semaphores are used to notify the car attendant threads that there are vehicles in the temporary lot waiting to be moved to the permanent lot.

inChargeforAutomobile and ***inChargeforPickup*** These semaphores are used to notify the car owner threads that their vehicles have been moved from the temporary lot to the permanent lot.

Other variables and usage

mutexParking: used for protecting shared resources.

free_auto: Temporary spots for automobiles.

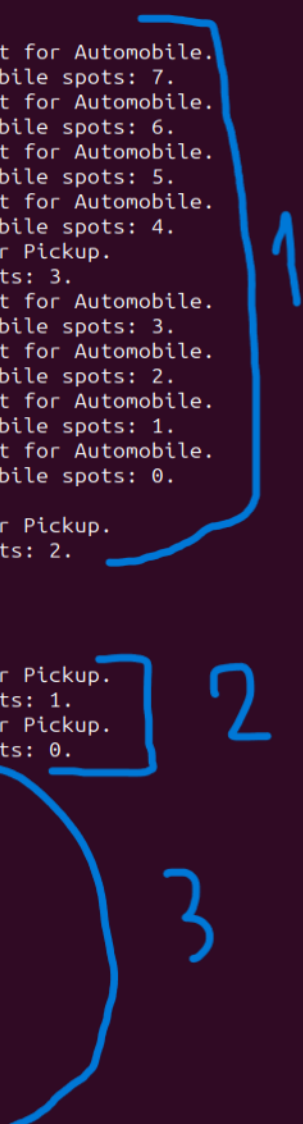
free_pickup: Temporary spots for pickups.

mFree_automobile: Permanent spots available for automobiles.

mFree_pickups: Permanent spots available for pickups.

Example Outputs

```
gcc -pthread -o main main.c
./main
Automobile owner parked in temporary lot. Vale looks for an empty spot for Automobile.
Automobile moved to permanent lot by vale. Remaining permanent automobile spots: 7.
Automobile owner parked in temporary lot. Vale looks for an empty spot for Automobile.
Automobile moved to permanent lot by vale. Remaining permanent automobile spots: 6.
Automobile owner parked in temporary lot. Vale looks for an empty spot for Automobile.
Automobile moved to permanent lot by vale. Remaining permanent automobile spots: 5.
Automobile owner parked in temporary lot. Vale looks for an empty spot for Automobile.
Automobile moved to permanent lot by vale. Remaining permanent automobile spots: 4.
Pickup owner parked in temporary lot. Vale looks for an empty spot for Pickup.
Pickup moved to permanent lot by vale. Remaining permanent pickup spots: 3.
Automobile owner parked in temporary lot. Vale looks for an empty spot for Automobile.
Automobile moved to permanent lot by vale. Remaining permanent automobile spots: 3.
Automobile owner parked in temporary lot. Vale looks for an empty spot for Automobile.
Automobile moved to permanent lot by vale. Remaining permanent automobile spots: 2.
Automobile owner parked in temporary lot. Vale looks for an empty spot for Automobile.
Automobile moved to permanent lot by vale. Remaining permanent automobile spots: 1.
Automobile owner parked in temporary lot. Vale looks for an empty spot for Automobile.
Automobile moved to permanent lot by vale. Remaining permanent automobile spots: 0.
Automobile owner parked in temporary lot but no permanent spots left.
Pickup owner parked in temporary lot. Vale looks for an empty spot for Pickup.
Pickup moved to permanent lot by vale. Remaining permanent pickup spots: 2.
Automobile owner parked in temporary lot but no permanent spots left.
Automobile owner parked in temporary lot but no permanent spots left.
Automobile owner parked in temporary lot but no permanent spots left.
Automobile owner parked in temporary lot but no permanent spots left.
Pickup owner parked in temporary lot. Vale looks for an empty spot for Pickup.
Pickup moved to permanent lot by vale. Remaining permanent pickup spots: 1.
Pickup owner parked in temporary lot. Vale looks for an empty spot for Pickup.
Pickup moved to permanent lot by vale. Remaining permanent pickup spots: 0.
Pickup owner parked in temporary lot but no permanent spots left.
Automobile owner parked in temporary lot but no permanent spots left.
Pickup owner parked in temporary lot but no permanent spots left.
Automobile owner parked in temporary lot but no permanent spots left.
Automobile owner parked in temporary lot but no permanent spots left.
Automobile owner parked in temporary lot but no permanent spots left.
Automobile owner parked in temporary lot but no permanent spots left.
Pickup owner parked in temporary lot but no permanent spots left.
Pickup owner parked in temporary lot but no permanent spots left.
Automobile owner parked in temporary lot but no permanent spots left.
Automobile owner parked in temporary lot but no permanent spots left.
Pickup owner parked in temporary lot but no permanent spots left.
Automobile owner parked in temporary lot but no permanent spots left.
Automobile owner parked in temporary lot but no permanent spots left.
Automobile owner parked in temporary lot but no permanent spots left.
```



(1-2) Automobiles and pickups parks the temporary parks and vales parks the parking area one by one.

(3) After all permanent spots full other automobiles and pickups tries to park to the parking area.

```
Pickup owner parked in temporary lot but no permanent spots left.
Pickup owner parked in temporary lot but no permanent spots left.
Pickup owner parked in temporary lot but no permanent spots left.
Automobile owner parked in temporary lot but no permanent spots left.
Automobile owner parked in temporary lot but no permanent spots left.
Pickup owner parked in temporary lot but no permanent spots left.
Pickup owner parked in temporary lot but no permanent spots left.
Pickup left the permanent lot. Remaining permanent pickup spots: 1.
Pickup owner parked in temporary lot. Vale looks for an empty spot for Pickup.
Pickup moved to permanent lot by vale. Remaining permanent pickup spots: 0.
Pickup left the permanent lot. Remaining permanent pickup spots: 1.
Pickup owner parked in temporary lot. Vale looks for an empty spot for Pickup.
Pickup moved to permanent lot by vale. Remaining permanent pickup spots: 0.
Pickup left the permanent lot. Remaining permanent pickup spots: 1.
Pickup owner parked in temporary lot. Vale looks for an empty spot for Pickup.
Pickup moved to permanent lot by vale. Remaining permanent pickup spots: 0.
Pickup left the permanent lot. Remaining permanent pickup spots: 1.
Pickup owner parked in temporary lot. Vale looks for an empty spot for Pickup.
Pickup moved to permanent lot by vale. Remaining permanent pickup spots: 0.
Pickup left the permanent lot. Remaining permanent pickup spots: 1.
Pickup owner parked in temporary lot. Vale looks for an empty spot for Pickup.
Pickup moved to permanent lot by vale. Remaining permanent pickup spots: 0.
Automobile left the permanent lot. Remaining permanent automobile spots: 1.
Automobile owner parked in temporary lot. Vale looks for an empty spot for Automobile.
Automobile moved to permanent lot by vale. Remaining permanent automobile spots: 0.
Automobile left the permanent lot. Remaining permanent automobile spots: 1.
Automobile owner parked in temporary lot. Vale looks for an empty spot for Automobile.
Automobile moved to permanent lot by vale. Remaining permanent automobile spots: 0.
Automobile left the permanent lot. Remaining permanent automobile spots: 1.
Automobile owner parked in temporary lot. Vale looks for an empty spot for Automobile.
Automobile moved to permanent lot by vale. Remaining permanent automobile spots: 0.
Automobile left the permanent lot. Remaining permanent automobile spots: 1.
Automobile owner parked in temporary lot. Vale looks for an empty spot for Automobile.
Simulation complete. All vehicles processed.
```

(4) On the periodic intervals cars leave from the parking area and other parks the spot.

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