



Assignment #2 - Multithreaded Parking System Simulation

In this assignment, you will simulate a parking system using semaphores and threads. The parking lot has a limited number of parking spots and three gates through which cars can enter. Each car will arrive at a specific time, stay in the parking for a predetermined duration, and exit. The challenge is to manage the parking spots among the cars arriving at different gates using thread synchronization mechanisms effectively.

Objectives:

- Thread Synchronization: Utilize threading and semaphores to manage access to the parking spots.
- Concurrency Management: Ensure that the system handles concurrent arrivals and departures without error.
- Simulation Realism: Cars should come in at specific times, and the simulation should reflect this timing accurately.
- Status Reporting: Implement feature to report the number of cars currently parked and the total number of cars served over time.

System Specifications:

- Parking Spots: 4 spots available in total.
- Gates: 3 gates (Gate 1, Gate 2, Gate 3).
- Car Arrival: Each gate will receive cars at different times, specified as per the arrival schedule.

Tasks:

- Setup Parking Lot: Create a parking lot with 4 parking spots.
- Implement Gates: Simulate car arrivals at three different gates using separate threads.
- Car Threads: Each car is represented by a thread that attempts to enter the parking lot.
- Semaphores: Use semaphores to manage the parking spots availability.
- Logging and Reporting: Log the activity of each car and report the number of cars currently in the parking and the total served once the simulation ends.

Implementation Details:

- Thread Function: Each car's thread should try to acquire a parking spot, stay for its duration, and then release the spot.
- Arrival Times: Use sleep() to simulate arrival times.
- Duration in Parking: Use sleep() to simulate the duration for which each car stays in the

parking lot.

- Concurrency Control: Use a semaphore to manage the parking spots and ensure there are no race conditions.
- Input is read and parsed from a txt file.

Notes:

- You should expect your program to be tested with different input examples during the discussion, not just the example below.

Car Arrival Schedule and Parking Duration Test Case note that the input time is of units:

Expected Input file format:

Gate 1, Car 0, Arrive 0, Parks 3
Gate 1, Car 1, Arrive 1, Parks 4
Gate 1, Car 2, Arrive 2, Parks 2
Gate 1, Car 3, Arrive 3, Parks 5
Gate 1, Car 4, Arrive 4, Parks 3
Gate 2, Car 5, Arrive 3, Parks 4
Gate 2, Car 6, Arrive 6, Parks 3
Gate 2, Car 7, Arrive 7, Parks 2
Gate 2, Car 8, Arrive 8, Parks 5
Gate 2, Car 9, Arrive 9, Parks 3
Gate 3, Car 10, Arrive 2, Parks 4
Gate 3, Car 11, Arrive 5, Parks 3
Gate 3, Car 12, Arrive 7, Parks 2
Gate 3, Car 13, Arrive 10, Parks 5
Gate 3, Car 14, Arrive 11, Parks 3

Expected Output

Car 0 from Gate 1 arrived at time 0
Car 0 from Gate 1 parked. (Parking Status: 1 spots occupied)
Car 1 from Gate 1 arrived at time 1
Car 1 from Gate 1 parked. (Parking Status: 2 spots occupied)
Car 2 from Gate 1 arrived at time 2
Car 2 from Gate 1 parked. (Parking Status: 3 spots occupied)
Car 10 from Gate 3 arrived at time 2
Car 10 from Gate 3 parked. (Parking Status: 4 spots occupied)
Car 3 from Gate 1 arrived at time 3
Car 3 from Gate 1 waiting for a spot.
Car 5 from Gate 2 arrived at time 3
Car 5 from Gate 2 waiting for a spot.
Car 0 from Gate 1 left after 3 units of time. (Parking Status: 3 spots occupied)
Car 3 from Gate 1 parked after waiting for 1 units of time. (Parking Status: 4 spots occupied)

Car 4 from Gate 1 arrived at time 4
Car 4 from Gate 1 waiting for a spot.
Car 2 from Gate 1 left after 2 units of time. (Parking Status: 3 spots occupied)
Car 5 from Gate 2 parked after waiting for 2 units of time. (Parking Status: 4 spots occupied)
Car 11 from Gate 3 arrived at time 5
Car 11 from Gate 3 waiting for a spot.
Car 1 from Gate 1 left after 4 units of time. (Parking Status: 3 spots occupied)
Car 4 from Gate 1 parked after waiting for 1 units of time. (Parking Status: 4 spots occupied)
Car 6 from Gate 2 arrived at time 6
Car 6 from Gate 2 waiting for a spot.
Car 10 from Gate 3 left after 4 units of time. (Parking Status: 3 spots occupied)
Car 11 from Gate 3 parked after waiting for 1 units of time. (Parking Status: 4 spots occupied)
Car 7 from Gate 2 arrived at time 7
Car 7 from Gate 2 waiting for a spot.
Car 12 from Gate 3 arrived at time 7
Car 12 from Gate 3 waiting for a spot.
Car 4 from Gate 1 left after 3 units of time. (Parking Status: 3 spots occupied)
Car 6 from Gate 2 parked after waiting for 1 units of time. (Parking Status: 4 spots occupied)
Car 8 from Gate 2 arrived at time 8
Car 8 from Gate 2 waiting for a spot.
Car 3 from Gate 1 left after 5 units of time. (Parking Status: 3 spots occupied)
Car 7 from Gate 2 parked after waiting for 1 units of time. (Parking Status: 4 spots occupied)
Car 9 from Gate 2 arrived at time 9
Car 9 from Gate 2 waiting for a spot.
Car 5 from Gate 2 left after 4 units of time. (Parking Status: 3 spots occupied)
Car 8 from Gate 2 parked after waiting for 1 units of time. (Parking Status: 4 spots occupied)
Car 13 from Gate 3 arrived at time 10
Car 13 from Gate 3 waiting for a spot.
Car 11 from Gate 3 left after 3 units of time. (Parking Status: 3 spots occupied)
Car 9 from Gate 2 parked after waiting for 1 units of time. (Parking Status: 4 spots occupied)
Car 14 from Gate 3 arrived at time 11
Car 14 from Gate 3 waiting for a spot.
Car 6 from Gate 2 left after 3 units of time. (Parking Status: 3 spots occupied)
Car 13 from Gate 3 parked after waiting for 1 units of time. (Parking Status: 4 spots occupied)
Car 12 from Gate 3 left after 2 units of time. (Parking Status: 3 spots occupied)
Car 14 from Gate 3 parked after waiting for 1 units of time. (Parking Status: 4 spots occupied)
Car 7 from Gate 2 left after 2 units of time. (Parking Status: 3 spots occupied)
Car 8 from Gate 2 left after 5 units of time. (Parking Status: 2 spots occupied)
Car 9 from Gate 2 left after 3 units of time. (Parking Status: 1 spots occupied)
Car 13 from Gate 3 left after 5 units of time. (Parking Status: 0 spots occupied)
Car 14 from Gate 3 left after 3 units of time. (Parking Status: 0 spots occupied)

...

Total Cars Served: 15

Current Cars in Parking: 0

Details:

- Gate 1 served 5 cars.
- Gate 2 served 5 cars.
- Gate 3 served 5 cars.

Guidelines:

- **Language:** Java.
- **Submission Deadline:** 12th Nov, 2024 11:59 PM.
- **Submission Format:** You must submit only one “.zip” file containing the source code, and the submitted file name must follow this format: ID1_ID2_ID3_Group **for example** 20190000_20190001_20190002_DS1.
- **Team Members:** The assignment is submitted in groups of **4** students and **only 4** not less than or greater than 4. All team members must be from the **same group**.