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Traffic Signal Simulation System

Simulating Traffic Flow with **Java Threads** and **Synchronization**

Project Presentation of Exploratory Project (EP)

Traffic Signal Simulation System

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Objective

To simulate traffic lights and vehicle flow using Java threads and synchronization

- Thread-based signal control
- Synchronization mechanisms
- Vehicle flow simulation
- Real-time signal transitions

Vehicle 1 Vehicle 2 Vehicle 3

Module Overview

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Signal Module

Simulate Red/Yellow/Green traffic signals

Vehicle Module

Represent vehicles waiting at signals

Controller Module

Manage timing and transitions between signals

Threads

Synchronization

Exception Handling

How Data Is store

log.csv

Stores simulation data in **CSV format** for analysis and debugging

- **Timestamp**
- **SignalState**
- **VehicleCount**

Timestamp	SignalState	VehicleCount
2023-10-29 10:00:00	RED	5
2023-10-29 10:00:30	YELLOW	5
2023-10-29 10:01:00	GREEN	3
2023-10-29 10:01:30	YELLOW	2
2023-10-29 10:02:00	RED	7

Alogorithmic flow

1

Start traffic simulation

2

Thread changes light every few seconds

3

Log signal states and vehicle data

Simulation Process

Initialize system components

Execute signal transitions

Record simulation data

Suggested Class Structure

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com.traffic

model

- Signal.java
- Vehicle.java

service

Suggested Class Structure

- TrafficService.java
- FileService.java
- LogService.java

main

- TrafficApp.java

OUTPUT

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```
PS C:\Users\Sneha\OneDrive\Desktop\traffic-signal-simulator> cd traffic-simulation
PS C:\Users\Sneha\OneDrive\Desktop\traffic-signal-simulator\traffic-simulation> javac -d out src/com/traffic/model/*.java src/com/traffic/service/*.java src/com/traffic/main/*.java
>>
PS C:\Users\Sneha\OneDrive\Desktop\traffic-signal-simulator\traffic-simulation> java -cp out com.traffic.main.TrafficSimulation
? Traffic Signal Simulation System ?
====================================
Traffic signal simulation started...
Signal SIGNAL-001 changed to: RED

Commands:
  'stop' - Stop simulation
  'exit' - Exit program
Press Enter to stop...
Logged: 2025-11-19 17:03:50,RED,0
New vehicle arrived: Vehicle{vehicleId='V1', type=MOTORCYCLE} | Total vehicles: 1
New vehicle arrived: Vehicle{vehicleId='V2', type=MOTORCYCLE} | Total vehicles: 2
New vehicle arrived: Vehicle{vehicleId='V3', type=CAR} | Total vehicles: 3
Signal SIGNAL-001 changed to: GREEN
Logged: 2025-11-19 17:03:55,GREEN,3
New vehicle arrived: Vehicle{vehicleId='V4', type=BUS} | Total vehicles: 4
1 vehicle(s) departed. Remaining: 3
New vehicle arrived: Vehicle{vehicleId='V5', type=CAR} | Total vehicles: 4
3 vehicle(s) departed. Remaining: 1
New vehicle arrived: Vehicle{vehicleId='V6', type=CAR} | Total vehicles: 2
Signal SIGNAL-001 changed to: YELLOW
Logged: 2025-11-19 17:04:02,YELLOW,2
1 vehicle(s) departed. Remaining: 1
Signal SIGNAL-001 changed to: RED
Logged: 2025-11-19 17:04:04,RED,1
New vehicle arrived: Vehicle{vehicleId='V7', type=BUS} | Total vehicles: 2
stop
Stopping traffic simulation...
Simulation ended. Check logs/log.csv for details.
New vehicle arrived: Vehicle{vehicleId='V8', type=BUS} | Total vehicles: 3
Signal SIGNAL-001 changed to: GREEN
Logged: 2025-11-19 17:04:09,GREEN,3
Signal SIGNAL-001 changed to: YELLOW
Logged: 2025-11-19 17:04:16,YELLOW,3

Shutting down simulation...
Stopping traffic simulation...
```

TRAFFIC SIMULATION CODE

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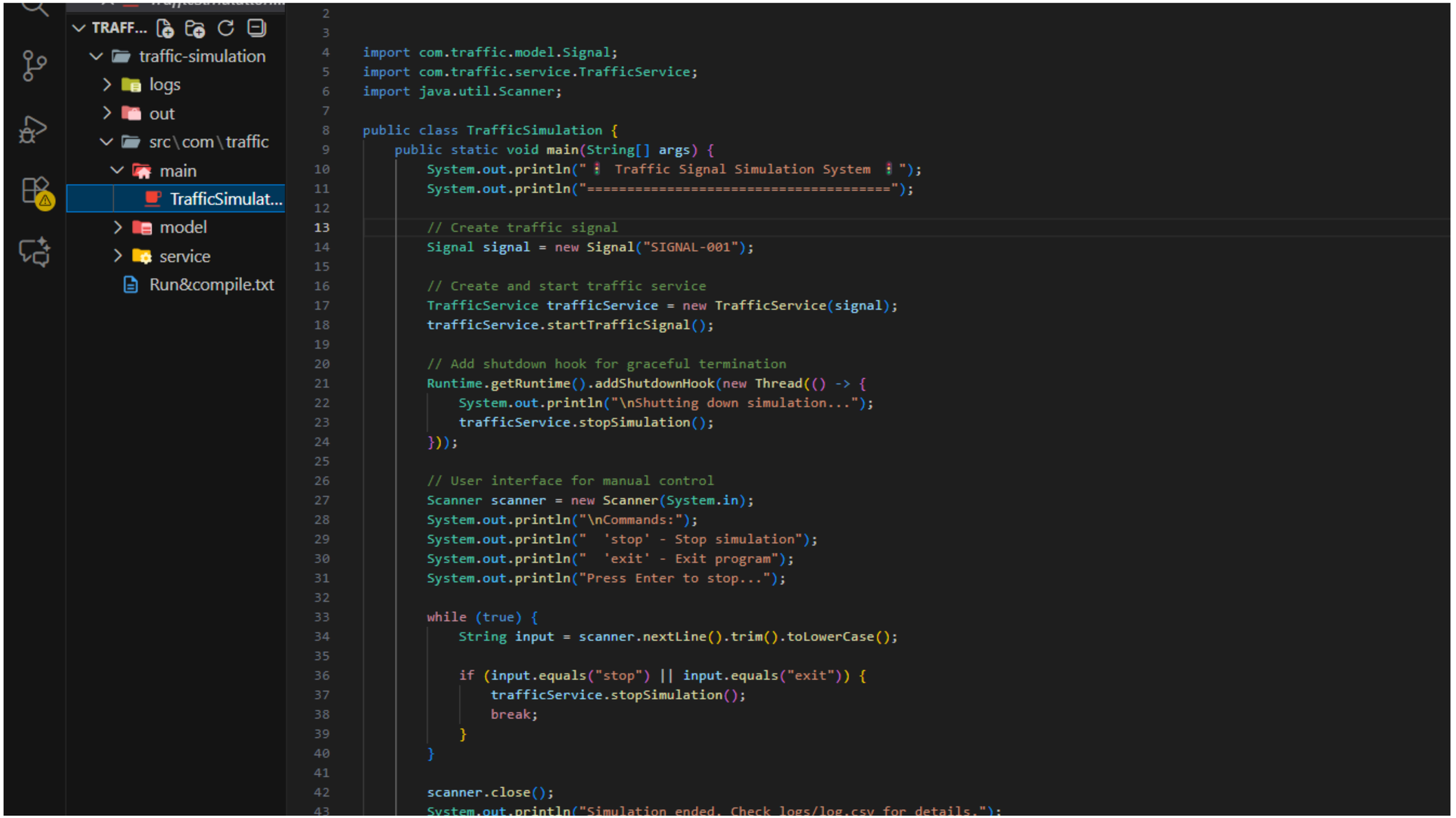


```java
import com.traffic.model.Signal;
import com.traffic.service.TrafficService;
import java.util.Scanner;

public class TrafficSimulation {
    public static void main(String[] args) {
        System.out.println("🚦 Traffic Signal Simulation System 🚦");
        System.out.println("=====================================");

        // Create traffic signal
        Signal signal = new Signal("SIGNAL-001");

        // Create and start traffic service
        TrafficService trafficService = new TrafficService(signal);
        trafficService.startTrafficSignal();

        // Add shutdown hook for graceful termination
        Runtime.getRuntime().addShutdownHook(new Thread(() -> {
            System.out.println("\nShutting down simulation...");
            trafficService.stopSimulation();
        }));

        // User interface for manual control
        Scanner scanner = new Scanner(System.in);
        System.out.println("\nCommands:");
        System.out.println("  'stop' - Stop simulation");
        System.out.println("  'exit' - Exit program");
        System.out.println("Press Enter to stop...");

        while (true) {
            String input = scanner.nextLine().trim().toLowerCase();

            if (input.equals("stop") || input.equals("exit")) {
                trafficService.stopSimulation();
                break;
            }
        }

        scanner.close();
        System.out.println("Simulation ended. Check logs/log.csv for details.");
```