Parking Lot Management System

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Project Overview

Project Information:

•This project is a Parking Lot Management System that allows users to park their vehicles, calculates parking fees based on parking time, and manages parking slots.

•The purpose of this system is to automate the parking process, manage vehicle entry and exit, track parking slot availability, and calculate parking fees efficiently. Objectives include reducing parking management overhead, ensuring smooth vehicle handling, and calculating fees accurately.

•This system is intended for parking lot owners, vehicle owners, and administrators who need to manage parking operations effectively.

Project Overview

Problem Statement:

•It addresses the challenges of managing parking spaces, keeping track of parking fees, and automating the entry and exit process.

•Parking lots in urban areas often face congestion and inefficiencies in managing vehicles. Automating the system can save time, reduce human errors, and streamline the overall parking process.

System Architecture

Class Diagram:

•Classes to include:

Vehicle Class: Manages vehicle details (e.g., type, plate number).

Parking Slot Class: Represents parking slots and manages their status (occupied, free).

Ticket Class: Manages the ticketing system for each vehicle (entry time, exit time, fee calculation).

•Class Relationships:

Inheritance: Use inheritance for vehicle types (e.g., Car, Truck inheriting from Vehicle).

Associations: A Ticket is associated with a specific Vehicle and a Parking Slot.

Composition: A Parking Lot contains multiple Parking Slot objects.

Key Features

- Feature 1: Vehicle Management

Allows users to register vehicles with a type and license plate number.

- Feature 2: Parking Slot Management

Monitors the availability of parking slots and allocates vehicles accordingly.

- Feature 3: Bill Calculation

Calculates the parking bill based on the time spent in the parking lot.

OOP Concepts Implemented

Key Concepts:

•Classes and Objects:

Core classes are Vehicle, Parking Slot, and Ticket, which interact to form the system.

•Encapsulation:

Private attributes are used for storing vehicle details, parking slot status, and ticket data. Getters and setters are provided for each.

•Inheritance:

The Vehicle class is extended by Car and Truck classes, representing different vehicle types.

•Polymorphism:

Methods like calculateBill() are overridden in subclasses to cater to specific vehicle types (e.g., different parking fees for trucks).

•Abstraction:

The Vehicle class is abstract, providing a template for specific vehicle types (like Car or Truck), and some methods are abstract to be implemented by subclasses.

Evaluation of OOP Concepts

Classes & Objects	There are three primary classes: Vehicle, ParkingSlot, and Ticket, each representing distinct parts of the system.
Encapsulation	Private fields like licensePlate, slotNumber, and entryTime are used, with public getters and setters for data access.
Inheritance	The Vehicle class has been extended by Car and Truck classes, with specialized methods for each vehicle type.
Polymorphism	Method overriding is used in calculateFee() to provide different fee calculations for cars and trucks.
Abstraction	The Vehicle class is abstract, with methods like startEngine() to be implemented by subclasses.

Challenges Faced

Difficulties Encountered:

One challenge was ensuring that parking slots are accurately marked as occupied or available.

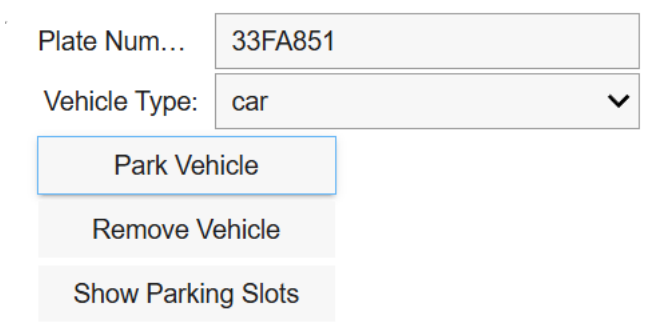
How Did You Overcome These Challenges?:

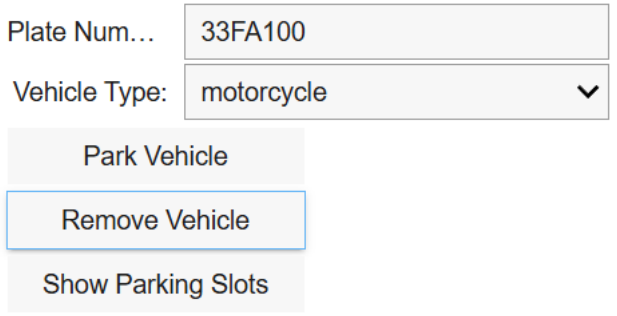
I implemented a system where parking slots are checked dynamically whenever a vehicle enters or exits, updating their status.

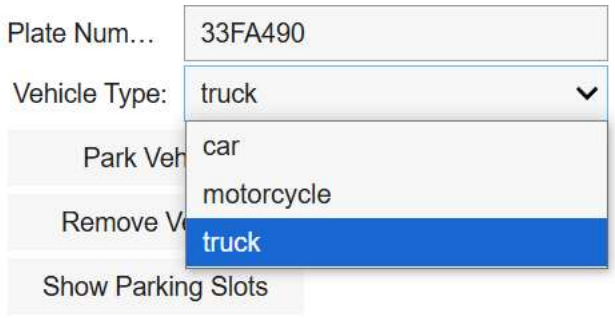
Code Generator Tools Used:

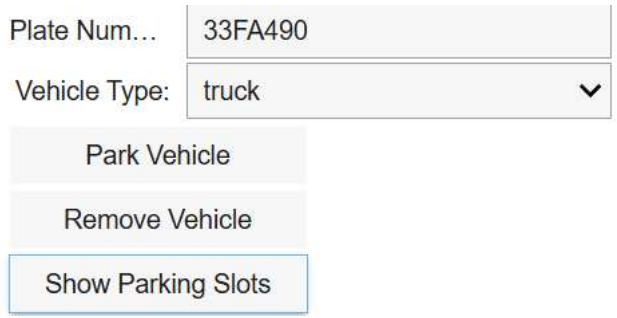
I used Eclipse for writing the code, and no specific code generation tools were used.

Project Screenshots









Project Screenshots

```
Before Parking:
Slot Number: 1
Occupied: No
Slot Number: 2
Occupied: No

After Parking:
Slot Number: 1
Occupied: Yes
Vehicle Plate Number: ABC123
Vehicle Type: Car
Slot Number: 2
Occupied: Yes
Vehicle Plate Number: XYZ789
Vehicle Type: Truck

After Removing Vehicles:
Slot Number: 1
Occupied: No
Slot Number: 2
Occupied: No
```

```
Ticket Details:
Ticket ID: 1
Vehicle Plate Number: ABC123
Vehicle Type: car
Parking Slot Number: 1
Entry Time: 2025-01-12T14:19:26.754471971
Exit Time: 2025-01-12T14:19:26.754557969
Parking Fee: $0.0
------------------------
Ticket ID: 2
Vehicle Plate Number: XYZ789
Vehicle Type: motorcycle
Parking Slot Number: 2
Entry Time: 2025-01-12T14:19:26.754549624
Exit Time: 2025-01-12T14:19:26.754753316
Parking Fee: $0.0
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```

```
Ticket Created:
Ticket ID: 1
Vehicle Plate Number: ABC123
Vehicle Type: car
Parking Slot Number: 1
Entry Time: 2025-01-12T14:22:45.265367562
Vehicle is still parked.
Plate Number: ABC123
Type: car
Owner Name: John Doe
Parking Fee (5 hours): $50.0
Ticket after exit:
Ticket ID: 1
Vehicle Plate Number: ABC123
Vehicle Type: car
Parking Slot Number: 1
Entry Time: 2025-01-12T14:22:45.265367562
Exit Time: 2025-01-12T14:22:45.281695900
Parking Fee: $0.0
```