Solution for Exercise 04: E-Scooter Ride-Share System

TU Clausthal | Institut für Software and Systems Engineering
Course: Requirements Engineering | **Exercise:** 04 (Agent-Oriented Modeling)
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1. Agents and Roles

Based on the project scenario, the system involves the interaction between the commuter, the physical scooter, and the backend service.

Agent	Assigned Role	Description
Commuter (Human)	Commuter Role	Responsible for the user-side process: registering, reserving the scooter, riding safely, and authorizing payment.
E-Scooter (Hardware)	Fleet Manager Role	Handles the physical state of the vehicle (locking/unlocking) and reports real-time status (Idle/Reserved) and location.
Backend System (Software)	Payment Processor Role	Manages the logic for account verification, fee computation, and secure financial debiting.

2. Goals

Functional Goals (FG)

- **FG-01 (Registration):** The system shall allow new commuters to register by validating their personal identity and payment details.
- **FG-02 (Reservation):** The Commuter shall be able to locate an idle scooter and reserve it, changing its status to prevent other users from booking it.
- **FG-03 (Commute):** The Commuter shall be able to unlock the specific scooter and ride to their destination.
- **FG-04 (End Ride):** The system shall detect when the user terminates the ride and immediately lock the scooter.
- **FG-05 (Payment):** The system shall automatically calculate the final fee and debit the registered payment method without manual intervention.

Quality Goals (QG)

- **QG-01 (Data Accuracy):** The status of all scooters (Idle vs. Reserved) must be updated in real-time to avoid synchronization errors.
- **QG-02 (Billing Precision):** The ride fee calculation must be mathematically precise based on the exact duration recorded by the backend.
- **QG-03 (Security):** Commuter payment details must be stored securely and only accessed during the automatic debit process.

3. Ride Cost Computation

The system implements a **Time-Based pricing strategy**.

$$\text{TotalFee} = \text{UnlockFee} + (\text{Duration}_{\text{minutes}} \times \text{Rate}_{\text{min}})$$

Variable	Description	Example
UnlockFee	A fixed starting fee	€1.00
Duration	Time difference between Unlock and End Ride (rounded up)	15 minutes
Rate	Per-minute usage cost	€0.20

4. AOM Behavioral Interface Model (BIM)

The Behavioral Interface Model illustrates the dynamic interaction between roles, consistent with the Leaf Goals defined in the Goal Model.

Process Flow:

1. **Registration/Reservation:** The Commuter creates an account or reserves an Idle scooter.
2. **Unlock:** Upon successful reservation, the Fleet Manager unlocks the hardware.
3. **Commute:** The Commuter uses the vehicle.
4. **End Ride:** The user ends the session, prompting the Fleet Manager to lock the device.
5. **Payment:** The Payment Processor calculates the fee and debits the account.

Figure 1: Behavioral Interface Model - State Diagram showing ride lifecycle

5. Goal Hierarchy Diagram (3-Level Tree)

The following diagram shows the hierarchical decomposition of goals with 3 levels as required by the assignment.

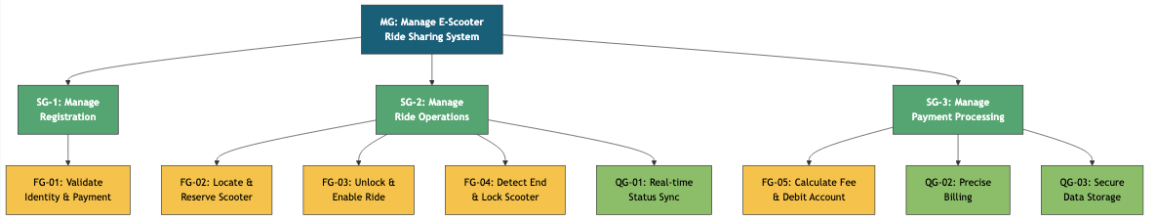

Figure 2: AOM Goal Model - 3-Level Hierarchy

Diagram Legend: Level 1 (Blue): Main System Goal Level 2 (Green): Sub-Goals
Level 3 (Yellow): Functional Goals Level 3 (Light Green): Quality Goals

Summary

This solution presents a comprehensive Agent-Oriented Model for an E-Scooter Ride-Share System:

- Three primary agents with distinct roles (Commuter, Fleet Manager, Payment Processor)
- Functional and quality goals ensuring system effectiveness and reliability
- A transparent time-based pricing model with clear formula
- A behavioral interface model illustrating the complete ride lifecycle
- A 3-level goal hierarchy diagram showing goal decomposition