MMSE – 2nd Tutorial Session

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Aggregation Relationships in Class Diagrams

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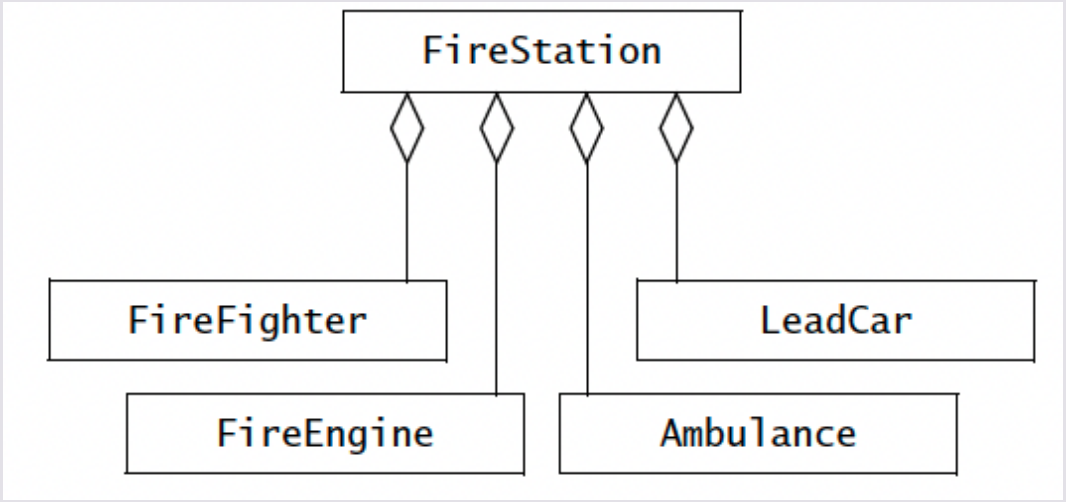

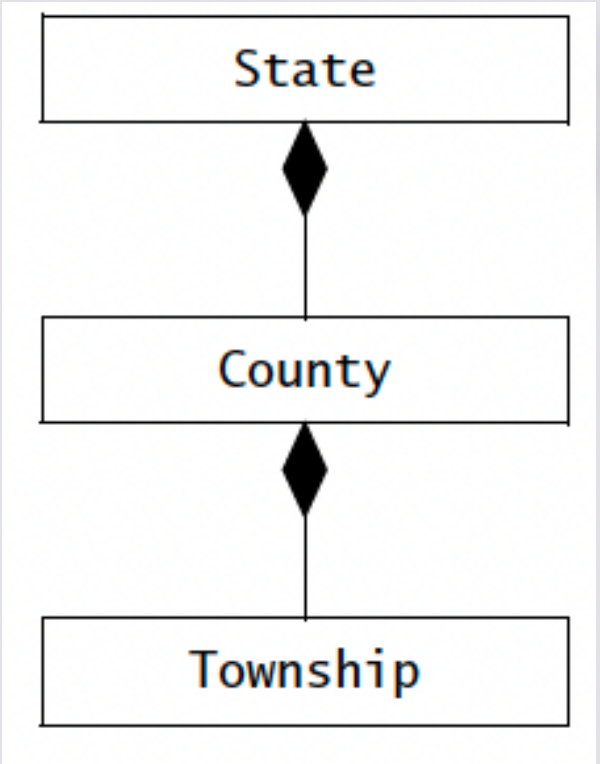

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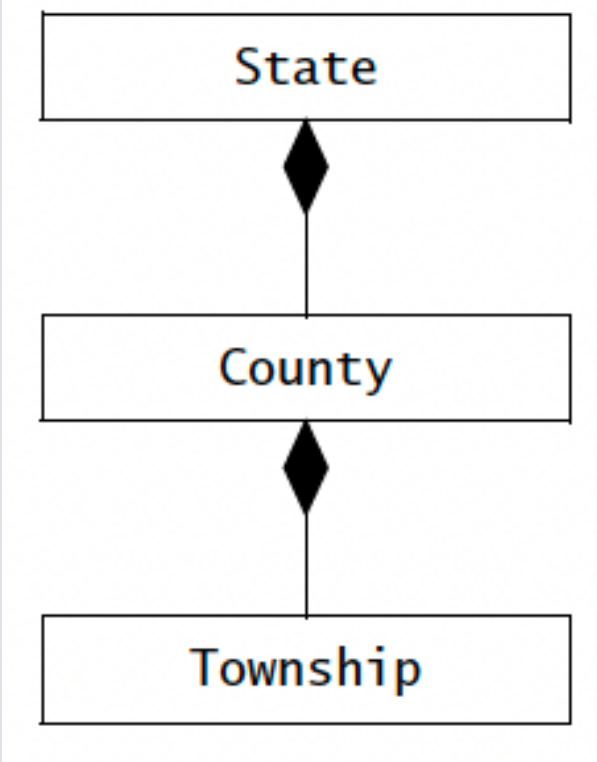
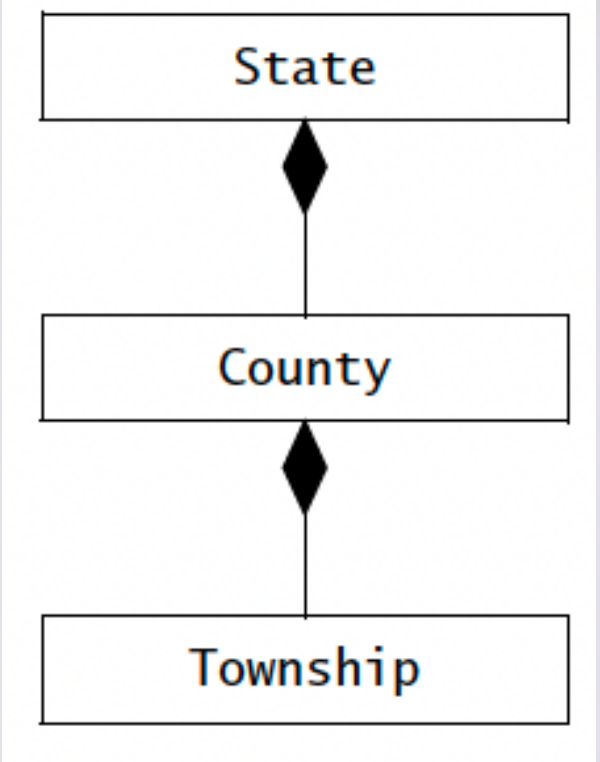
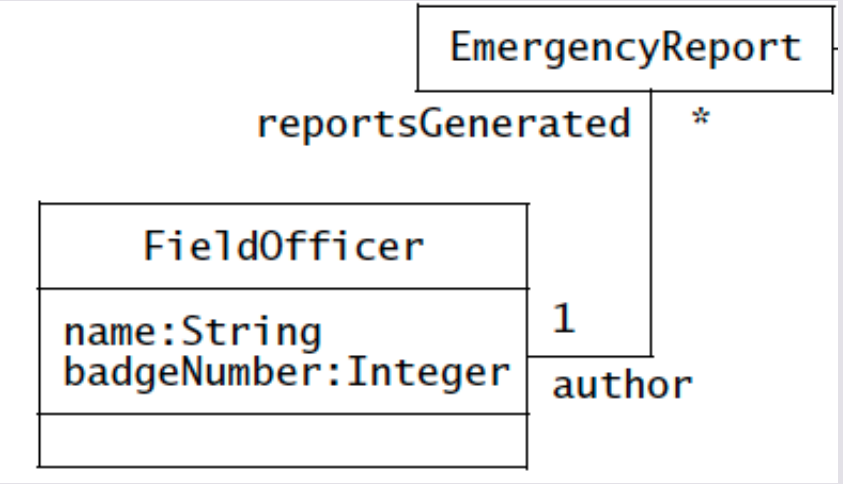


Aggregation Relationships in Class Diagrams

- Aggregation Relationships:
  - Denotes a whole-part relationship.
  - Can be composition -> existence of the part Depends on the whole.
- One-to-many associations and aggregations, although similar, cannot be used interchangeably.





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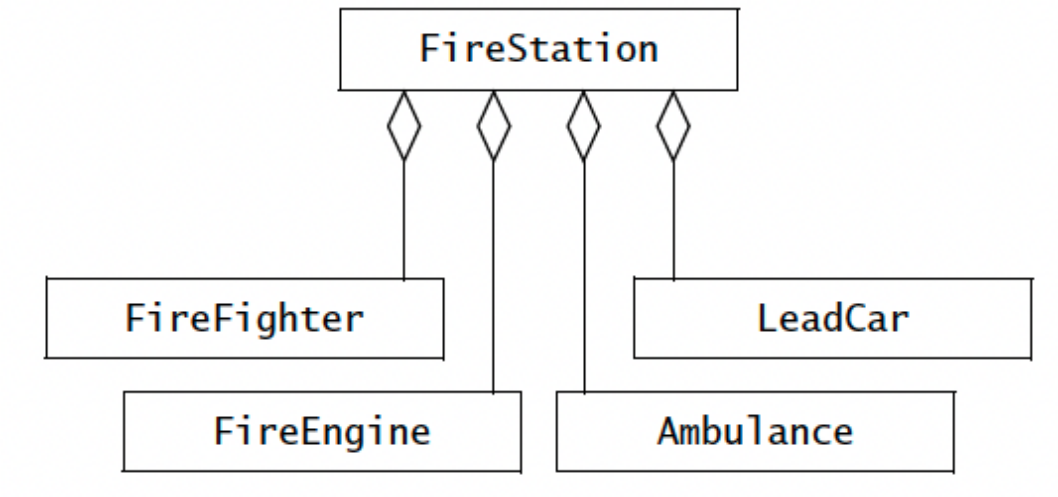
  - Can be shared aggregation -> whole and part exist independently.



Exercise 1

- Why do we need the use cases and scenarios?
- What is the difference between a scenario and a use case?
- When do you use each construct?

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- Requirements engineering aims at defining the requirements of the system under construction.
- Requirements engineering includes requirements elicitation and analysis.
- Requirements elicitation results in the specification of the system that the client understands.
- Analysis results in an analysis model that the developers can unambiguously interpret.

Exercise 1

- **Why do we need the use cases and scenarios?**
- Requirements elicitation is more challenging because it requires the collaboration of several groups of participants with different backgrounds.
- The clients often have little experience in software development.
- The developers have experience in building systems, but with little knowledge of the user environment.
- Scenarios and Use cases provide tools for bridging this gap.

Exercise 1

- **What is the difference between a scenario and a use case? When do you use each construct?**
- A **scenario** is an actual sequence of interactions (i.e., an instance) describing one specific situation (concrete example).
- A **use case** is an abstraction that describes a class of scenarios (general sequences).
- A **use case** describes all possible scenarios involving the described functionality.

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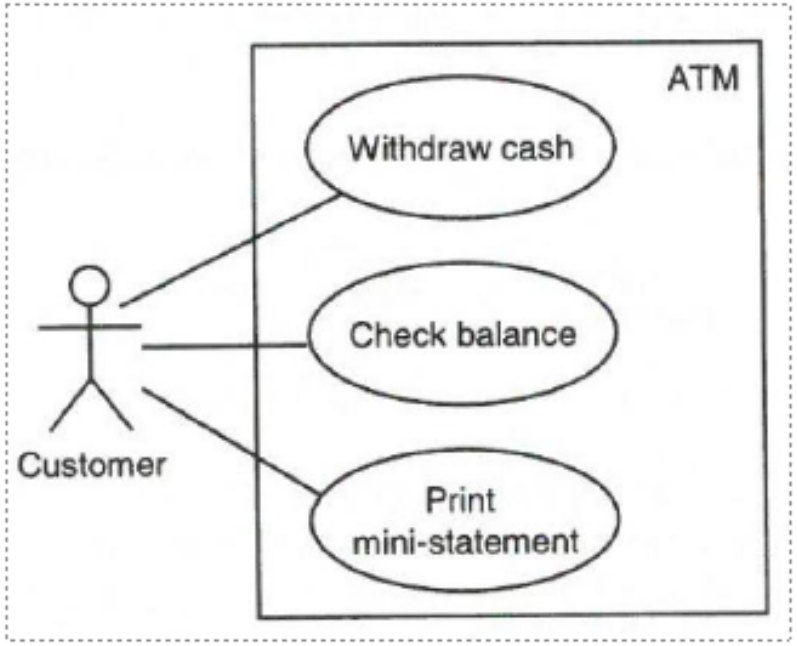
- A **use case** describes all possible scenarios involving the described functionality.
- The focus of each of them is on:
  - Use Case -> Completeness
  - Scenario -> Understandability

Requirements elicitation includes the following activities:

- *Identifying actors*. During this activity, developers identify the different types of users the future system will support.
- *Identifying scenarios*. During this activity, developers observe users and develop a set of detailed scenarios for typical functionality provided by the future system. Scenarios are concrete examples of the future system in use. Developers use these scenarios to communicate with the user and deepen their understanding of the application domain.
- *Identifying use cases*. Once developers and users agree on a set of scenarios, developers derive from the scenarios a set of use cases that completely represent the future system. Whereas scenarios are concrete examples illustrating a single case, use cases are abstractions describing all possible cases. When describing use cases, developers determine the scope of the system.
- *Refining use cases*. During this activity, developers ensure that the requirements specification is complete by detailing each use case and describing the behavior of the system in the presence of errors and exceptional conditions.
- *Identifying relationships among use cases*. During this activity, developers identify dependencies among use cases. They also consolidate the use case model by factoring out common functionality. This ensures that the requirements specification is consistent.
- *Identifying nonfunctional requirements*. During this activity, developers, users, and clients agree on aspects that are visible to the user, but not directly related to functionality. These include constraints on the performance of the system, its documentation, the resources it consumes, its security, and its quality.

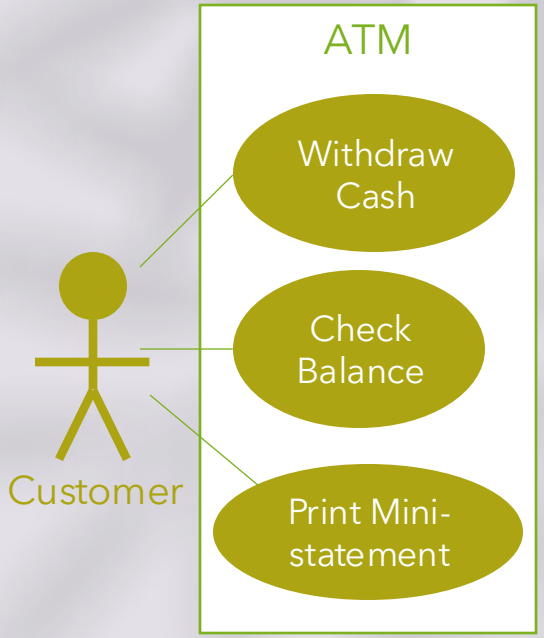
Exercise 1

Example: In a use case that defines the interaction that takes place between customers and automated teller machines (ATMs), the Customer actor represents the class of all customers who will use the ATM subsystem. When you use the ATM to withdraw cash, you are an instance of Customer using a particular instance of the use case Withdraw cash. Somebody else may use an instance of the use case Check Balance or Print mini-statement. *You may successfully withdraw cash from the machine, but the person behind you may find that he or she does not have enough money deposited, and the use case instance will proceed along a different course from yours, rejecting the request.*



Exercise 1

- **What different scenarios might exist for the use case “Withdraw Cash”?**
- Interactions between customers and ATMs:
  - Actor: Customer
  - Use cases: Withdraw cash, check balance, print mini-statement, …
- Focus is on ‘Withdraw Cash’ use case
- Successful scenario



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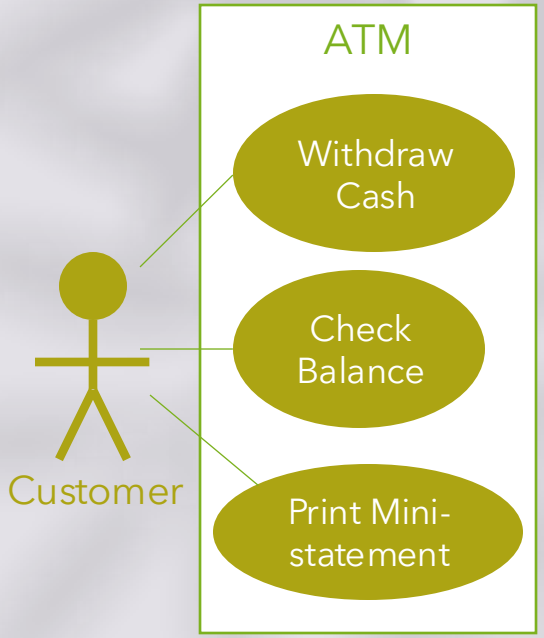
- Different scenarios for ‘Withdraw Cash’ use case
  - Problems with the card:
    - The customer’s card is not recognized and is rejected.



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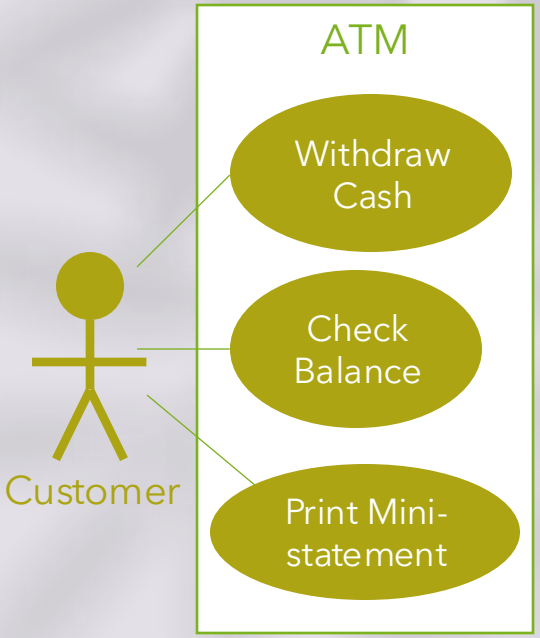
    - The customer enters the wrong PIN three times and the card is retained by the ATM.



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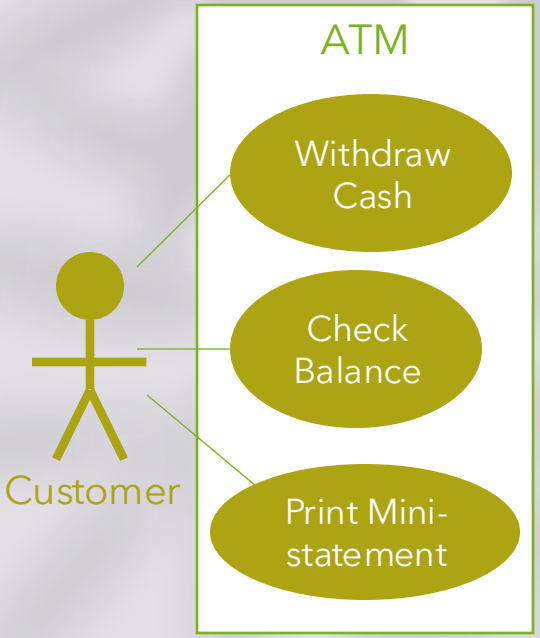
  - Network problems:
    - The ATM attempts to connect to the bank’s system but it is out of action or there is a network failure, so it cannot connect.



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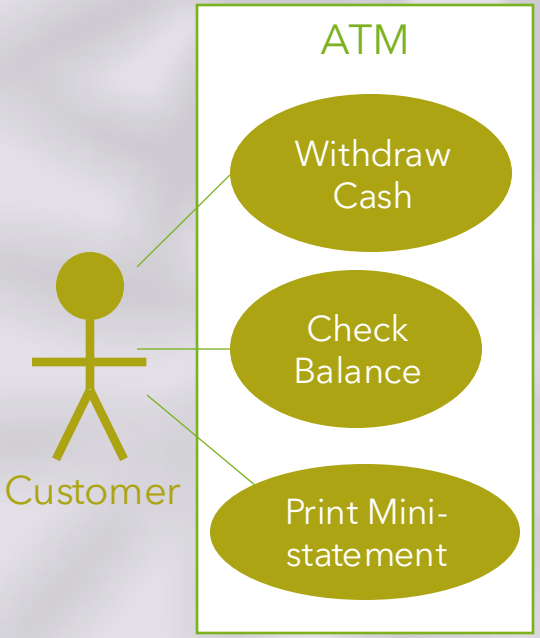

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  - Network problems:
    - The ATM attempts to connect to the bank's system but it is out of action or there is a network failure, so it cannot connect.
  - Not enough balance or cash:
    - The ATM doesn't have enough cash to meet the customer's request.
    - The customer's account doesn't have enough funds to meet the request.
  - Customers need to cancel the transaction:
    - The customer cancels the transaction part way through.

Exercise 2 (Identification of Actors)

- **Actors** are the people or systems that interact with use cases.
- A system analyst who is producing use case diagrams and descriptions will normally be working from source documents such as notes and transcripts of interviews. Below is a short excerpt from an interview transcript with one of the directors who is setting up **CarMatch** (car renting company). Mick is the system analyst and Janet is the director.

Exercise 2

Mike Perez (MK): System Analyst
Janet Hoffner (JH): Director

- MK: So, you are saying that car sharers will be able to register by telephoning the office and speaking to someone there who will enter their details into the system.
- JH: Yes. Either the franchisee, or more likely one of the office staff will take the call and enter the details into the computer.
- MK: Who are the office staff?
- JH: Well, there is one or two clerks, a receptionist, and a supervisor. They all have a role in the administration of the system.
- MK: What will they enter?
- JH: The person's name and address, details of the journeys they want to share, any preferences they have, such as being non-smoker.
- MK: Is that the only way that this information will get into the system?
- JH: No, it could also be transferred in from the national web-server.
- MK: How will this information be used?
- JH: Two ways. Firstly, it will be used to match up potential car sharers, and secondly, it will be used to produce a management report for the franchisee showing the number of registrations per week, whether they come from the web-server or by telephone and breaking them down by area.

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Q1: The people who will use this system to enter information?

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Q2: **The people who will use this system as recipients of information?**

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Q3: Other systems that the system interact with? Credit card system

Q4: Can car-sharer be considered as an actor? Why?

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Q3: Other systems that the system interact with? Credit card system

Q4: Can car-sharer be considered as an actor? Why? No! Car-sharers do not interact with the system directly.

Exercise 2

- Sum up:
  - ***Q1:*** The people who will use this system to enter information?
    - Franchisee,
    - Clerks,
    - Receptionist,
    - Supervisor
  - ***Q2:*** The people who will use this system as recipients of information? Franchisee
  - ***Q3:*** Other systems that the system interact with? Credit card system, Web-server
  - ***Q4:*** Can car-sharer be considered as an actor? Why? No!

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  - ***Q3:*** Other systems that the system interact with? Credit card system, Web-server
  - ***Q4:*** Can car-sharer be considered as an actor? Why? No!

  - **Actors**: Franchisee, CarMatch Admin, Credit Card System, Web-server

Exercise 3

- Generalization Relationship
  - Happens when there is more than one version of a use case
  - The different versions have some actions in common
  - Some actions that are unique to each one

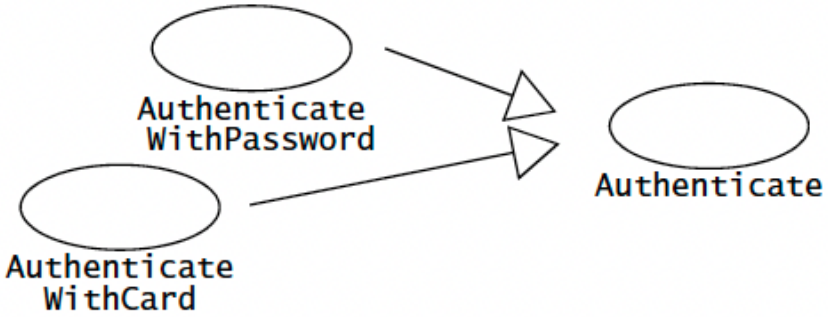

Figure 2-19 An example of an inheritance relationship (UML use case diagram). The `Authenticate` use case is a high-level use case describing, in general terms, the process of authentication. `AuthenticateWithPassword` and `AuthenticateWithCard` are two specializations of `Authenticate`.

Exercise 3

- Let us say that we have three different ways for adding a new car sharer to the system:
  - Manually
  - From the web-service (for third-parties)
  - Transferring car-sharer from the web-server

- What type of relationships can be perceived from this description? Why?
  1. extend
  2. include
  3. generalization

Exercise 3

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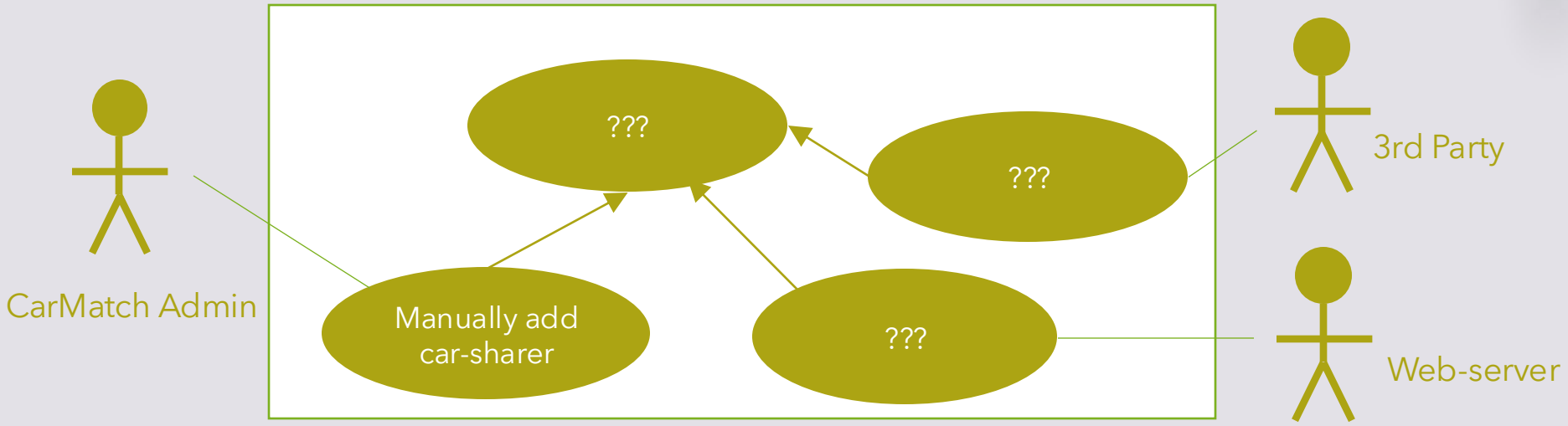

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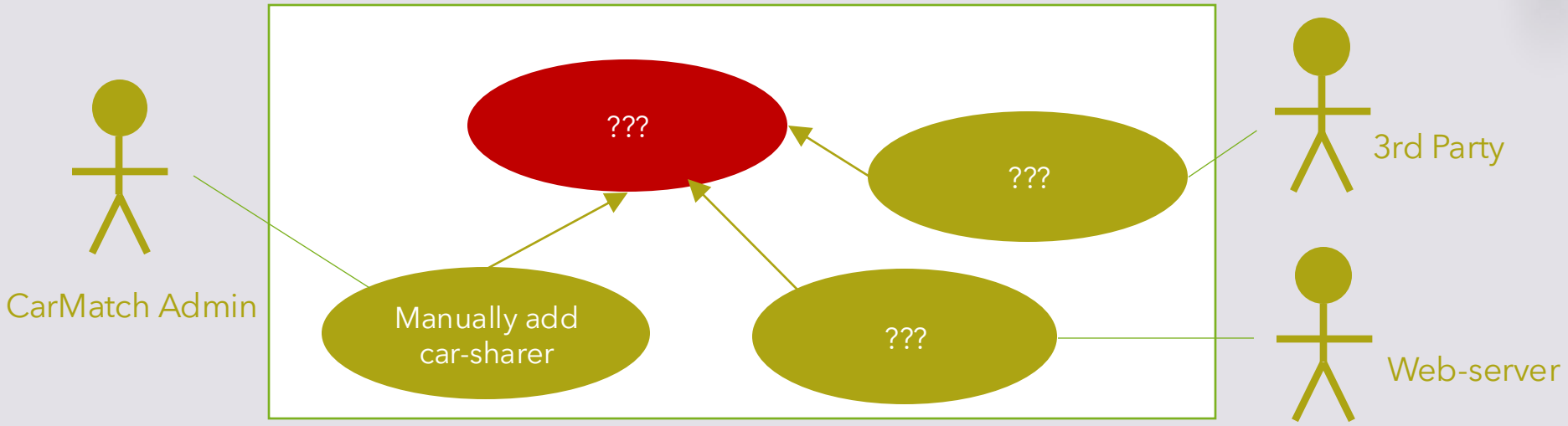

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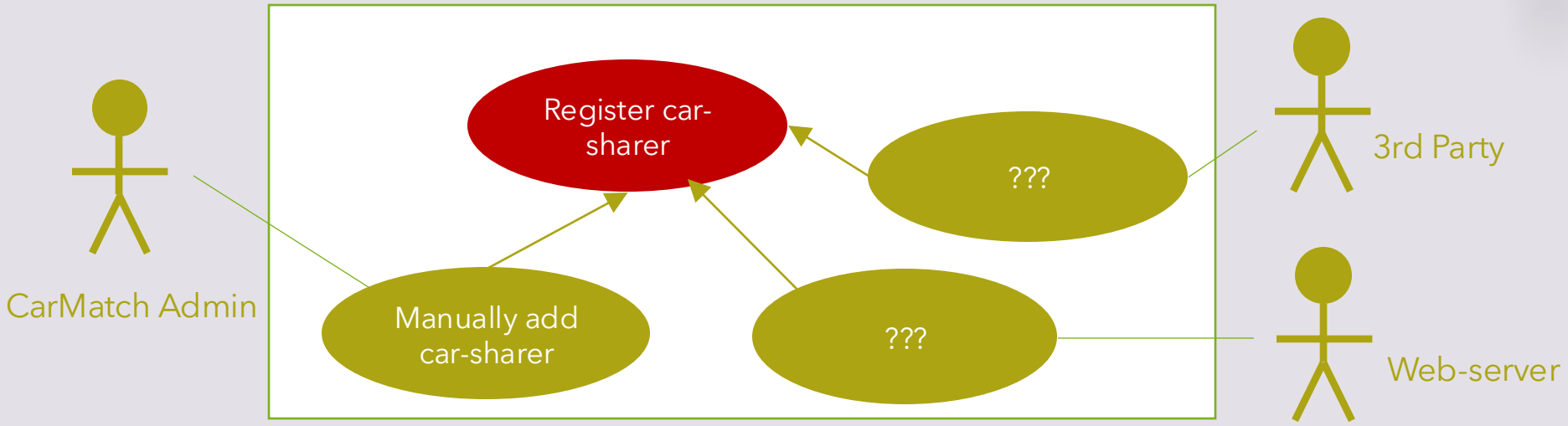

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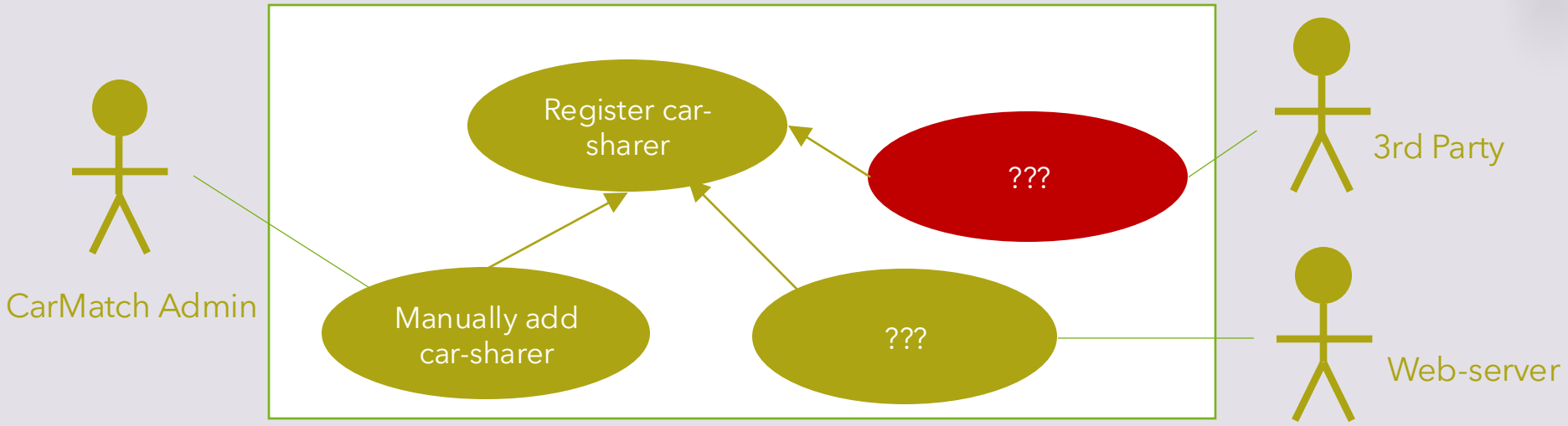

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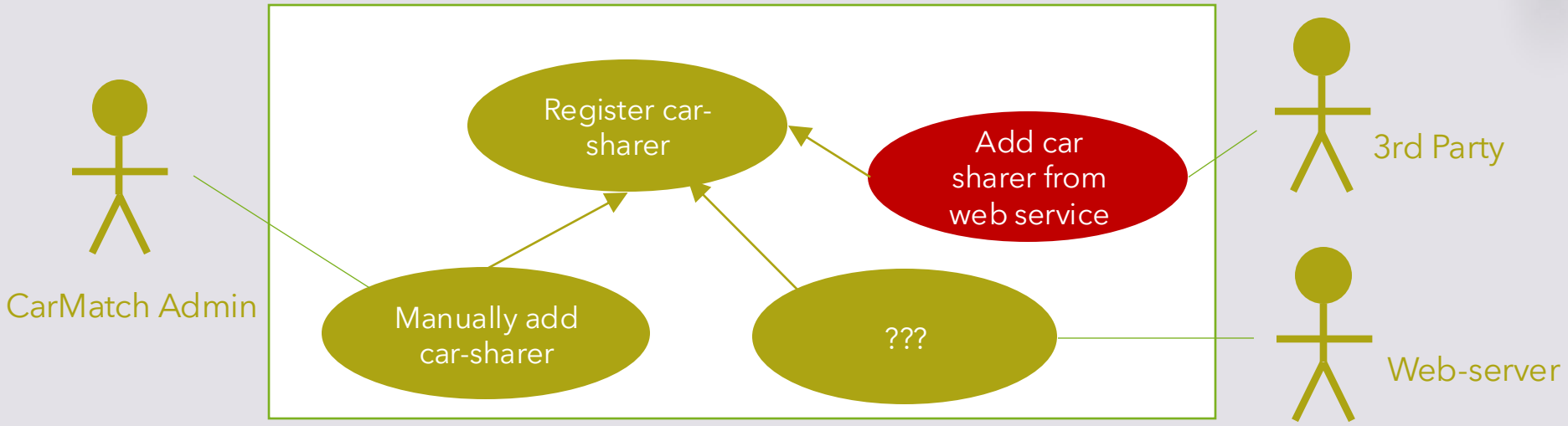

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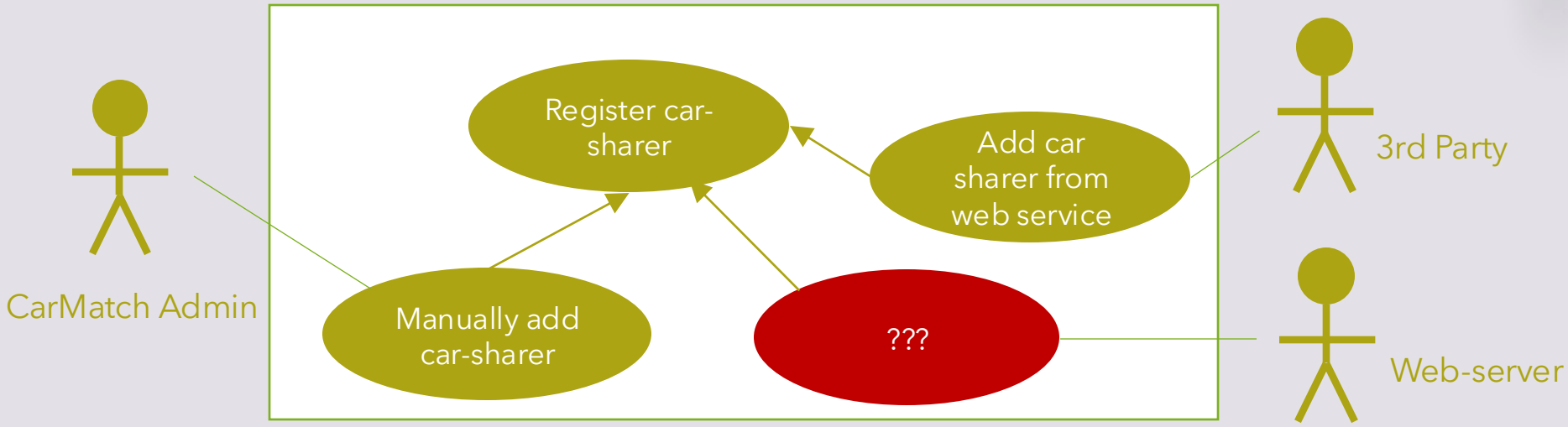

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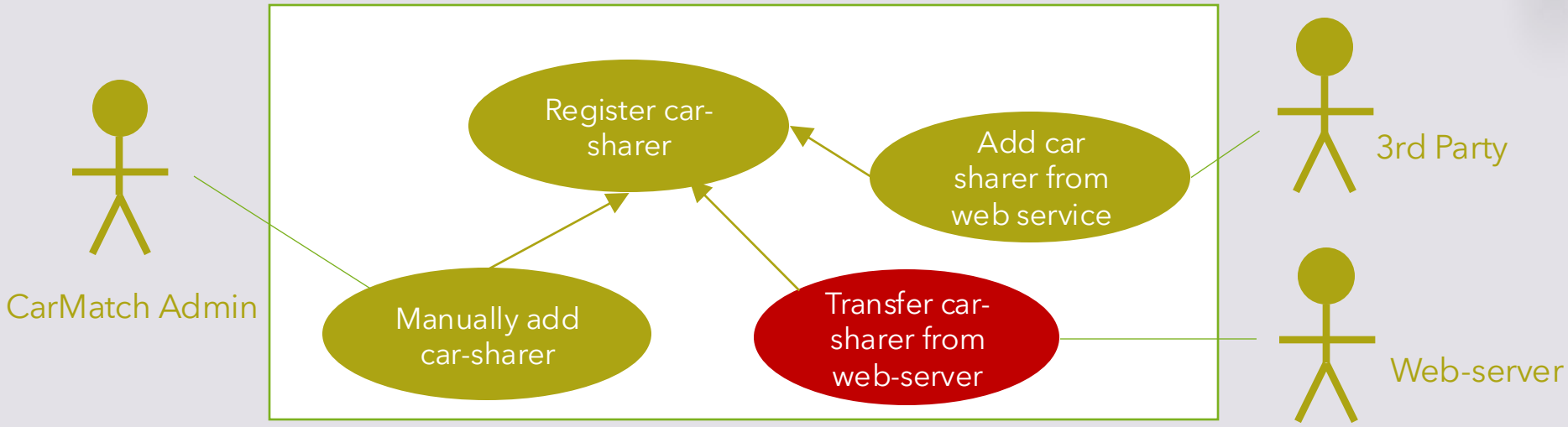
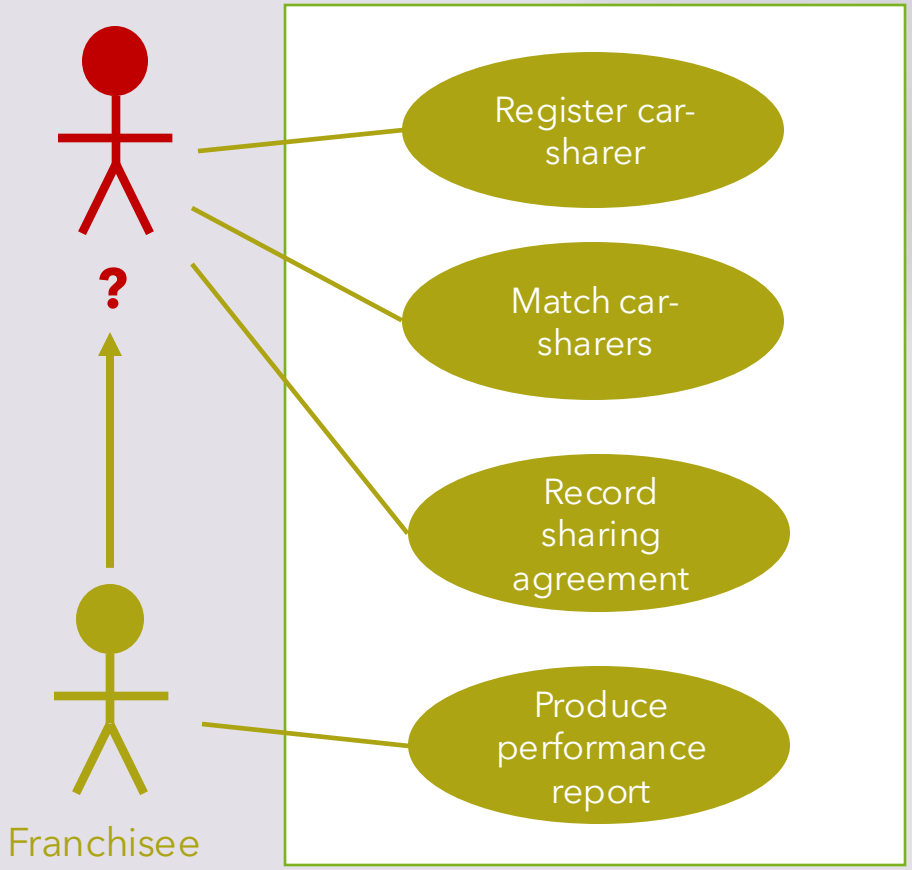


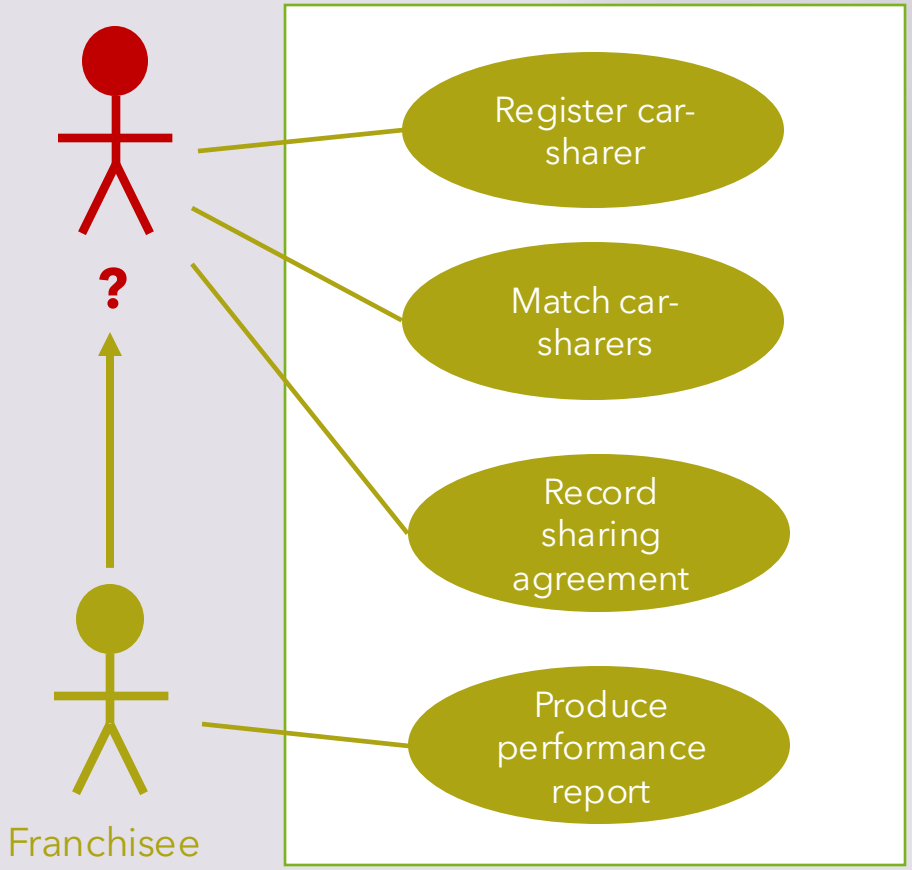
Exercise 3

- Let us say that the Franchisee can handle registration of new car sharers but can also be the recipient of management reports.
- Franchisee is a specialisation of ????



Exercise 3

- Let us say that the Franchisee can handle registration of new car sharers but can also be the recipient of management reports.
- Franchisee is a specialisation of ????
  - CarMatch Admin



Exercise 3

- Include Relationships vs Extend Relationship
- Include and extend are similar constructs, and initially, it may not be clear to the developer when to use each one [Jacobson et al., 1992].

Franchisee

Exercise 3

- Include Relationships
  - One use case extends the behavior of another use case.
- A behavior that is strongly tied to an event and that occurs only in a relatively few use cases.
- We use **include** relationships to reduce redundancy among use cases.

Franchisee

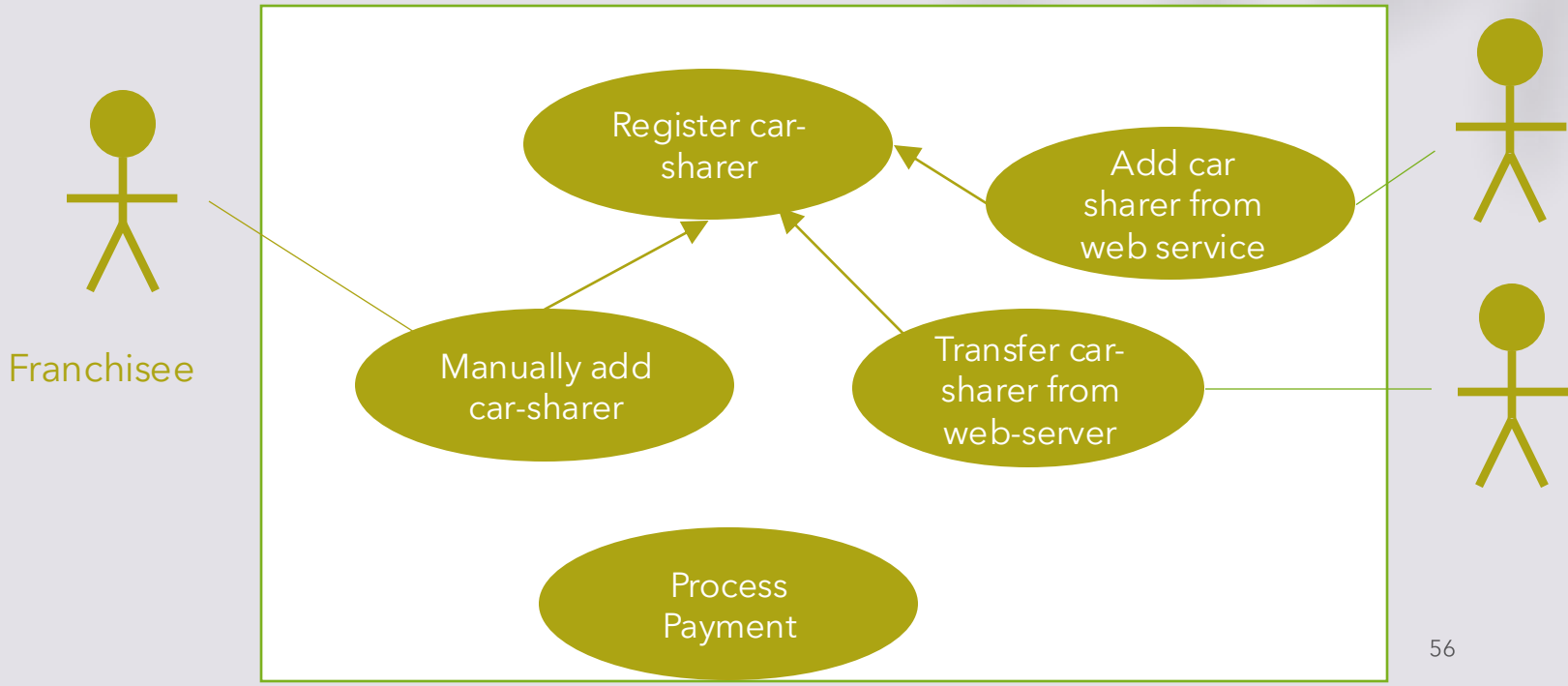
Exercise 3

- Extend Relationships
  - One use case can optionally be extended by the functionality in another use case (based on certain conditions).
- For **extend relationships**, a behavior that can happen anytime as an exception or an option (a behavior that *can be more easily specified as an entry condition*).
- We use **include** relationships to separate exceptional and common flows of events.

Franchisee

Exercise 3

- Include Relationships
  - Sometime one use case can include the functionality of another use case
  - When they manually add car-sharer, they have to set up the payment
  - Can be done separately in another use case -> remove redundancy



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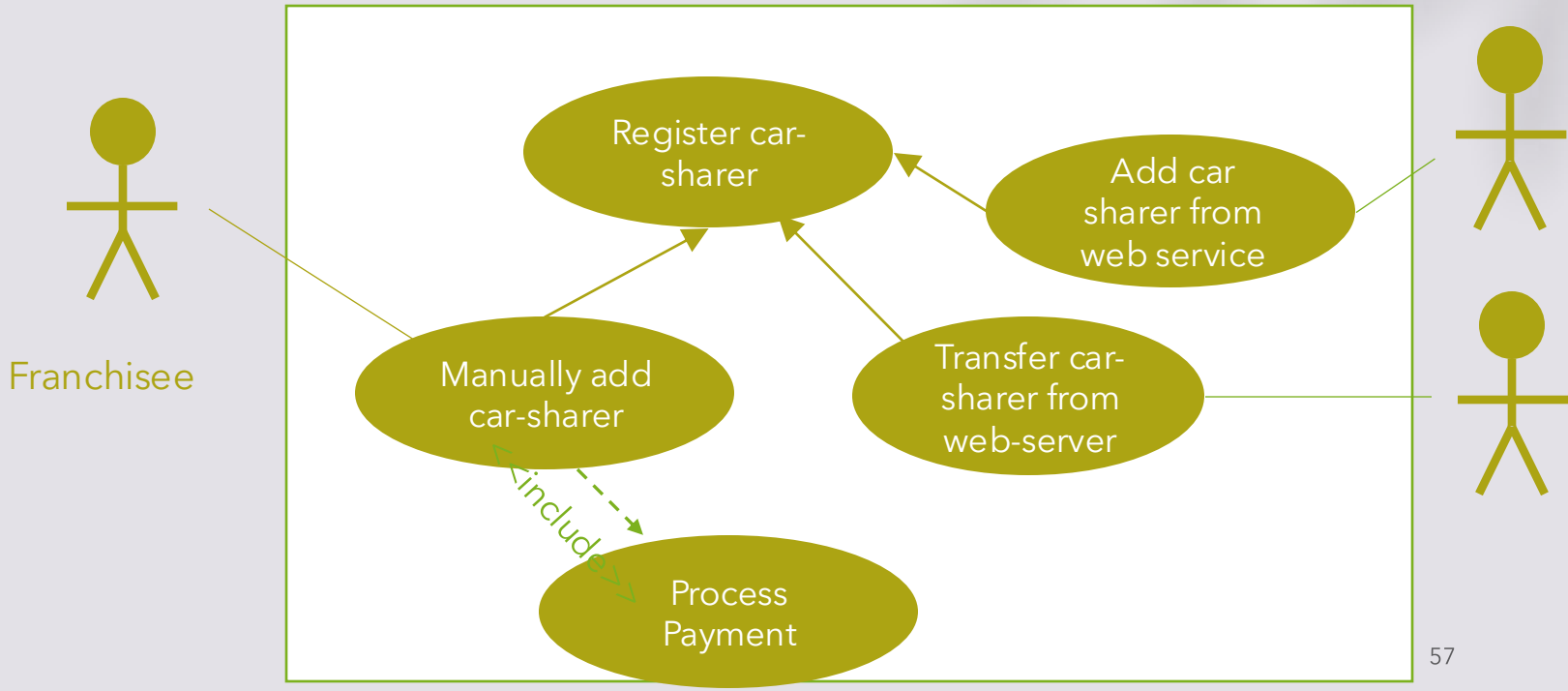
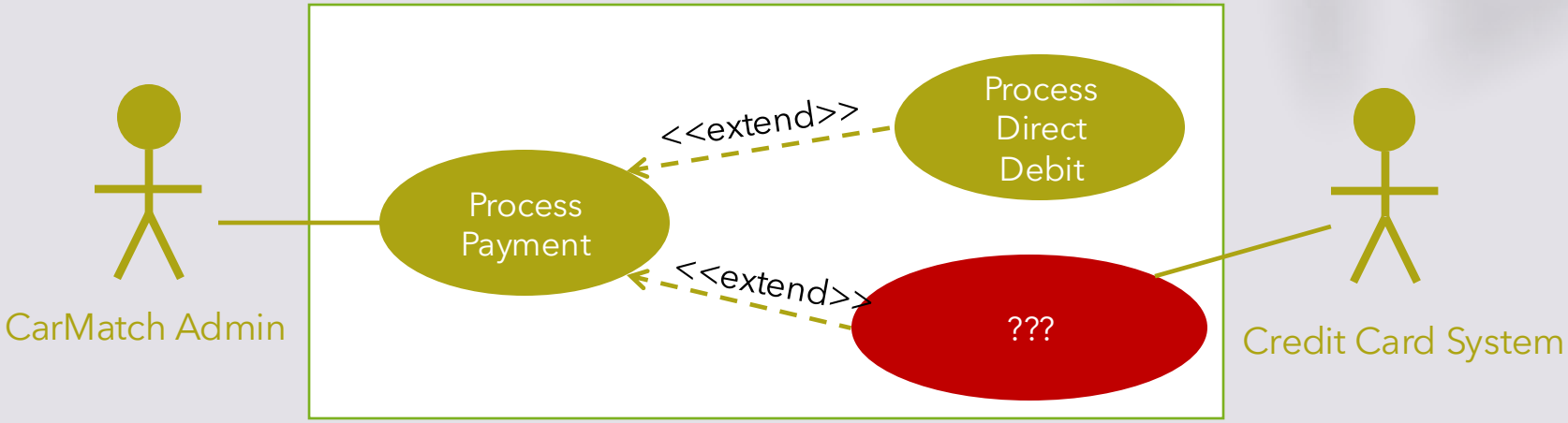


Exercise 3

- Reminder ➔ JH: … When we process the payment, the person can pay either by a regular debit card or using a credit or debit card.



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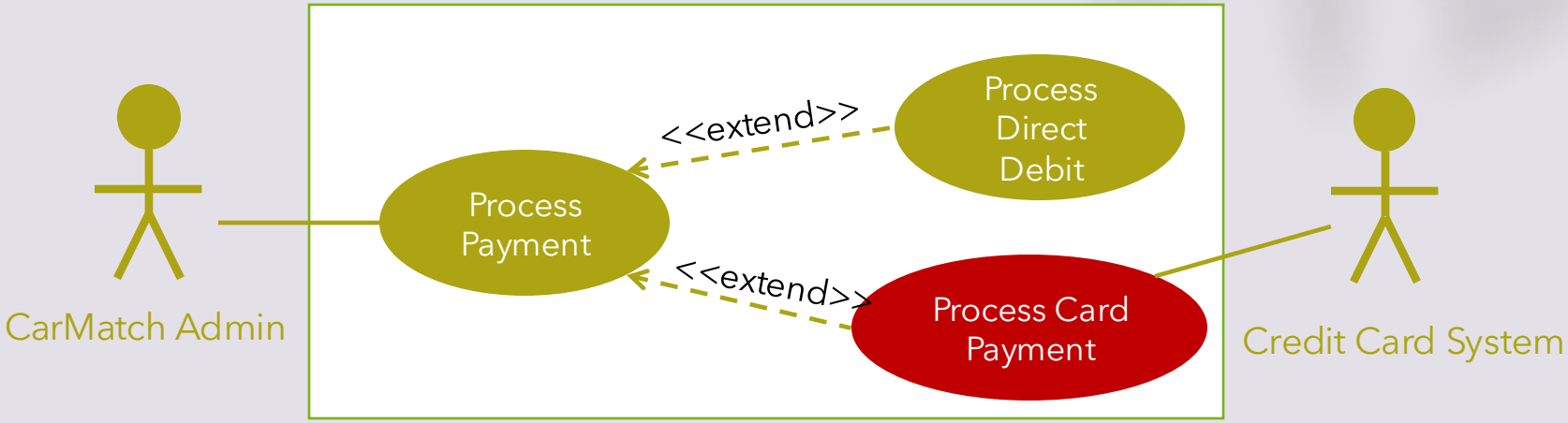

Exercise 4

Exercise 4 (non-functional requirements)

- A company hires out tools and equipment (for example drills, power saws, cement mixers, ladders, scaffolding) to customers and requires a computerized system to record details of bookings. Equipment may be booked in advance, or customers may appear at the reception desk and ask if there is an item available for immediate hire. When dealing with a booking or allocating an available item to a customer, the receptionist has to check whether the customer has previously hired equipment from the company or is a new customer. For a new customer, the receptionist has to enter the customer's details. Otherwise, the receptionist has to retrieve the existing customer's record and update any details if necessary. The minimum period of hire is one day and all hires are made for a number of complete days. The return of an item at the end of the hire period is recorded by the receptionist, or by a technician if the reception desk is closed. The manager of the company requires a summary of the status of all equipment at the beginning of each day, giving details of: items out on hire, items booked and items that will be available for hire that day.

Exercise 4

- Requirement:

Exercise 4

- Requirement:
  - is a feature that the system must have or a constraint that it must satisfy to be accepted by the client.
- Requirement Elicitation:

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Exercise 4

- Requirement:
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- Requirement Elicitation:
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- Functional Requirements:
  - describe the interactions between the system and its environment independent of its implementation.
- None-functional Requirements:
  - describe aspects of the system that are not directly related to the functional behaviour of the system, e.g., constraints, performance and usability.

Exercise 4

- Functional Requirements:
  - System services
  - Scope of the system
  - Necessary business functions
  - Required data structures

Exercise 4

- Functional Requirements:
  - System services
  - Scope of the system
  - Necessary business functions
  - Required data structures

- Non-functional Requirements:
  - System constraints
  - Performance
  - Look and feel

Exercise 4

Functional	
Non-Functional	

Equipment may be booked in advance, or customers may appear at the reception desk and ask if there is an item available for immediate hire.

Exercise 4

Functional	• Booking a tool in advance
Non-Functional	

Equipment may be booked in advance, or customers may appear at the reception desk and ask if there is an item available for immediate hire.

Exercise 4

Functional	• Booking a tool in advance • Hire a tool immediately
Non-Functional	

Equipment may be booked in advance, or customers may appear at the reception desk and ask if there is an item available for immediate hire.

Exercise 4

Functional	• Booking a tool in advance • Hire a tool immediately • Check item availability
Non-Functional	

Equipment may be booked in advance, or customers may appear at the reception desk and ask if there is an item available for immediate hire.

Exercise 4

Functional	
Non-Functional	

When dealing with a booking or allocating an available item to a customer, the receptionist has to check whether the customer has previously hired equipment from the company or is a new customer.

Exercise 4

Functional	• Check if the customer is new
Non-Functional	

When dealing with a booking or allocating an available item to a customer, the receptionist has to check whether the customer has previously hired equipment from the company or is a new customer.

Exercise 4

Functional	• Check if the customer is new • Check if the customer has hired an equipment
Non-Functional	

When dealing with a booking or allocating an available item to a customer, the receptionist has to check whether the customer has previously hired equipment from the company or is a new customer.

Exercise 4

Functional	
Non-Functional	

For a new customer, the receptionist has to enter the customer's details. Otherwise, the receptionist has to retrieve the existing customer's record and update any details if necessary.

Exercise 4

Functional	• Create a new customer
Non-Functional	

For a new customer, the receptionist has to enter the customer's details. Otherwise, the receptionist has to retrieve the existing customer's record and update any details if necessary.

Exercise 4

Functional	• Create a new customer • Retrieve customers' details
Non-Functional	

For a new customer, the receptionist has to enter the customer's details. Otherwise, the receptionist has to retrieve the existing customer's record and update any details if necessary.

Exercise 4

Functional	• Create a new customer • Retrieve customers' details • Update customers' details
Non-Functional	

For a new customer, the receptionist has to enter the customer's details. Otherwise, the receptionist has to retrieve the existing customer's record and update any details if necessary.

Exercise 4

Functional	
Non-Functional	

The minimum period of hire is one day and all hires are made for a number of complete days.

Exercise 4

Functional	• Specify the minimum period of hire
Non-Functional	

The minimum period of hire is one day and all hires are made for a number of complete days.

Exercise 4

Functional	• Specify the minimum period of hire
Non-Functional	• The minimum period of hire is one day

The minimum period of hire is one day and all hires are made for a number of complete days.

Exercise 4

Functional	• Specify the minimum period of hire
Non-Functional	• The minimum period of hire is one day. • Hire is for a number of complete days.

The minimum period of hire is one day and all hires are made for a number of complete days.

Exercise 4

Functional	
Non-Functional	

The return of an item at the end of the hire period is recorded by the receptionist, or by a technician if the reception desk is closed.

Exercise 4

Functional	• Record the return of an item
Non-Functional	

The return of an item at the end of the hire period is recorded by the receptionist, or by a technician if the reception desk is closed.

Exercise 4

Functional	
Non-Functional	

The manager of the company requires a summary of the status of all equipment at the beginning of each day, giving details of: items out on hire, items booked and items that will be available for hire that day.

Exercise 4

Functional	• Produce management summary
Non-Functional	

The manager of the company requires a summary of the status of all equipment at the beginning of each day, giving details of: items out on hire, items booked and items that will be available for hire that day.

Exercise 4

Functional	• Booking a tool in advance • Hire a tool immediately • Check item availability • Check if the customer is new • Check if the customer has hired an equipment • Create a new customer • Retrieve customers' details • Update customers' details • Specify the minimum period of hire • Record the return of an item • Produce management summary
Non-Functional	• The minimum period of hire is one day. • Hire is for a number of complete days.

Exercise 4

- Any implicit or missing requirement?
  - Functional:

Exercise 4

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  - Functional:
    - Record damage to tools
    - Allow regular repeated bookings
    - Record late returns and penalties
    - Changing or cancelling existing bookings
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  - Non-functional:

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- Any implicit or missing requirement?
  - Functional:
    - Record damage to tools
    - Allow regular repeated bookings
    - Record late returns and penalties
    - Changing or cancelling existing bookings
    - …
  - Non-functional:
    - Type of required user interface
    - Security aspects -> security of the running computer
    - Backup of data -> make automatic backup at certain frequency
    - Performance aspects -> Service Level Objectives (SLOs)
    - …

Exercise 4 (non-functional requirements)

- A company hires out tools and equipment (for example drills, power saws, cement mixers, ladders, scaffolding) to customers and requires a computerized system to record details of bookings. Equipment may be booked in advance, or customers may appear at the reception desk and ask if there is an item available for immediate hire. When dealing with a booking or allocating an available item to a customer, the receptionist has to check whether the customer has previously hired equipment from the company or is a new customer. For a new customer, the receptionist has to enter the customer's details. Otherwise, the receptionist has to retrieve the existing customer's record and update any details if necessary. The minimum period of hire is one day and all hires are made for a number of complete days. The return of an item at the end of the hire period is recorded by the receptionist, or by a technician if the reception desk is closed. The manager of the company requires a summary of the status of all equipment at the beginning of each day, giving details of: items out on hire, items booked and items that will be available for hire that day.