Software Engineering Course

Chapter 3

UML Use Case Diagram: Functional View

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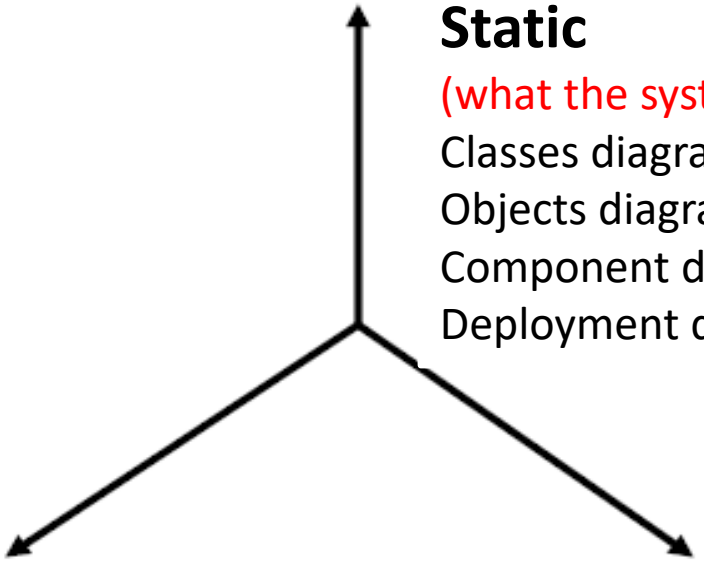
UML Modeling Axes

✓There are three modeling axes:

Modeling axes



Static
(what the system is)
Classes diagram
Objects diagram
Component diagram
Deployment diagram

In this chapter, we are interested in:

Fonctionnel

Functional
(what the system is doing)
Use cases diagram

Dynamic
(how the system evolves)
State / transition diagram
Activity diagram
Sequence diagram
Deployment diagram

What is a Use Cases Diagram?

✓The **Use Case Diagram** (UCD) is an UML diagram used to give an **overall view of the functional behavior** of a software system.

✓A UCD makes it possible to:

- ✓ Define the **main uses** of the system
- ✓ Define the **system environment**
- ✓ Define **system limits**

What Is a Use Cases Diagram?

A Use case diagram is useful because:

✓It allows the **design of a system from the end user's perspective**.

✓It enables **communicating the desired behavior** by **specifying the external visible** system behaviors in **user language.**

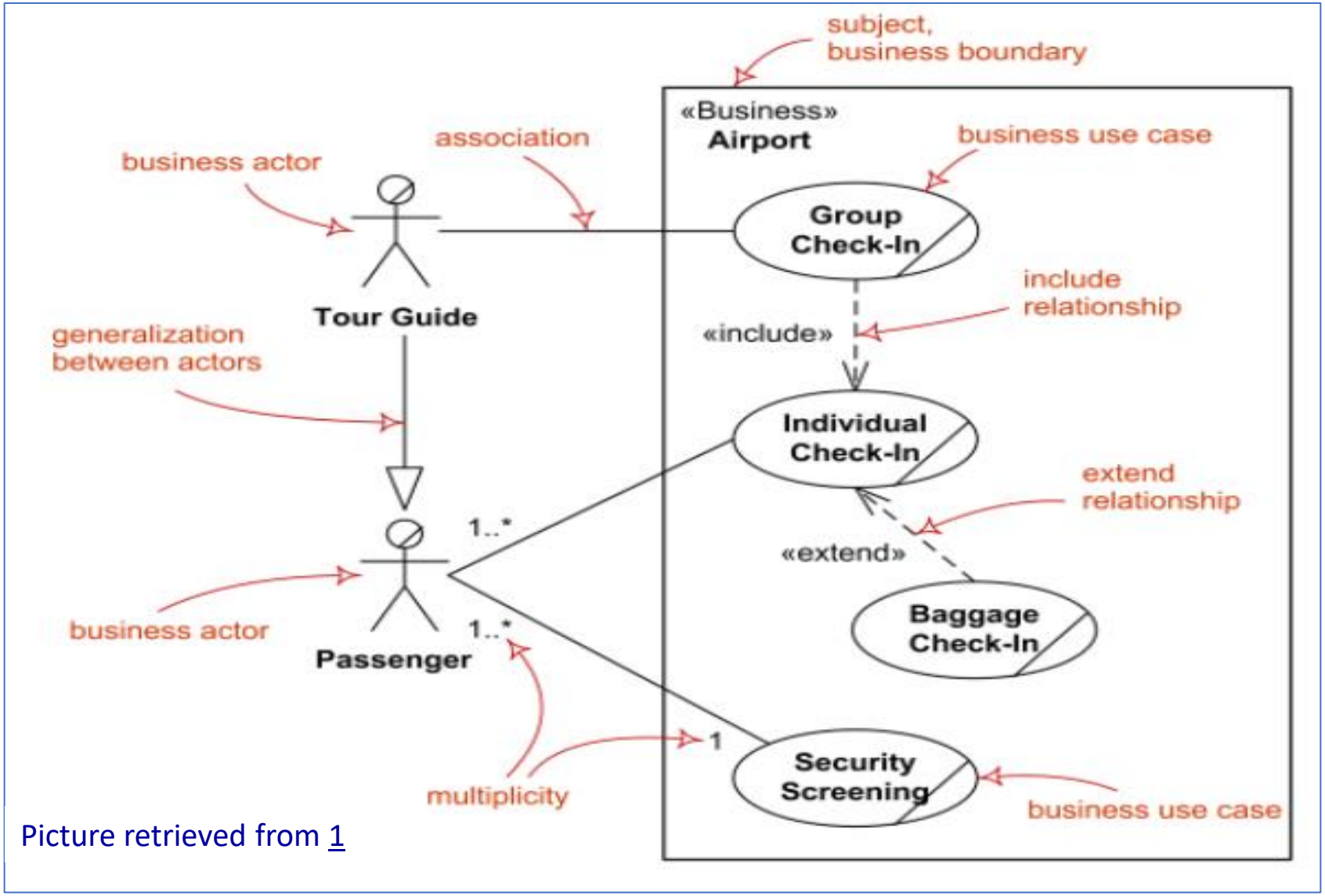
When Using Use Cases Diagram?

- ✓It **can model different scenarios** by illustrating the interaction between the system with people, other systems, or organizations.
- ✓It **can be utilized to specify and discuss the main goals that users** (or "actors") accomplish using the system.

Use Case Diagram Elements

This Figure illustrates the **major elements of UML Use Case Diagram :**

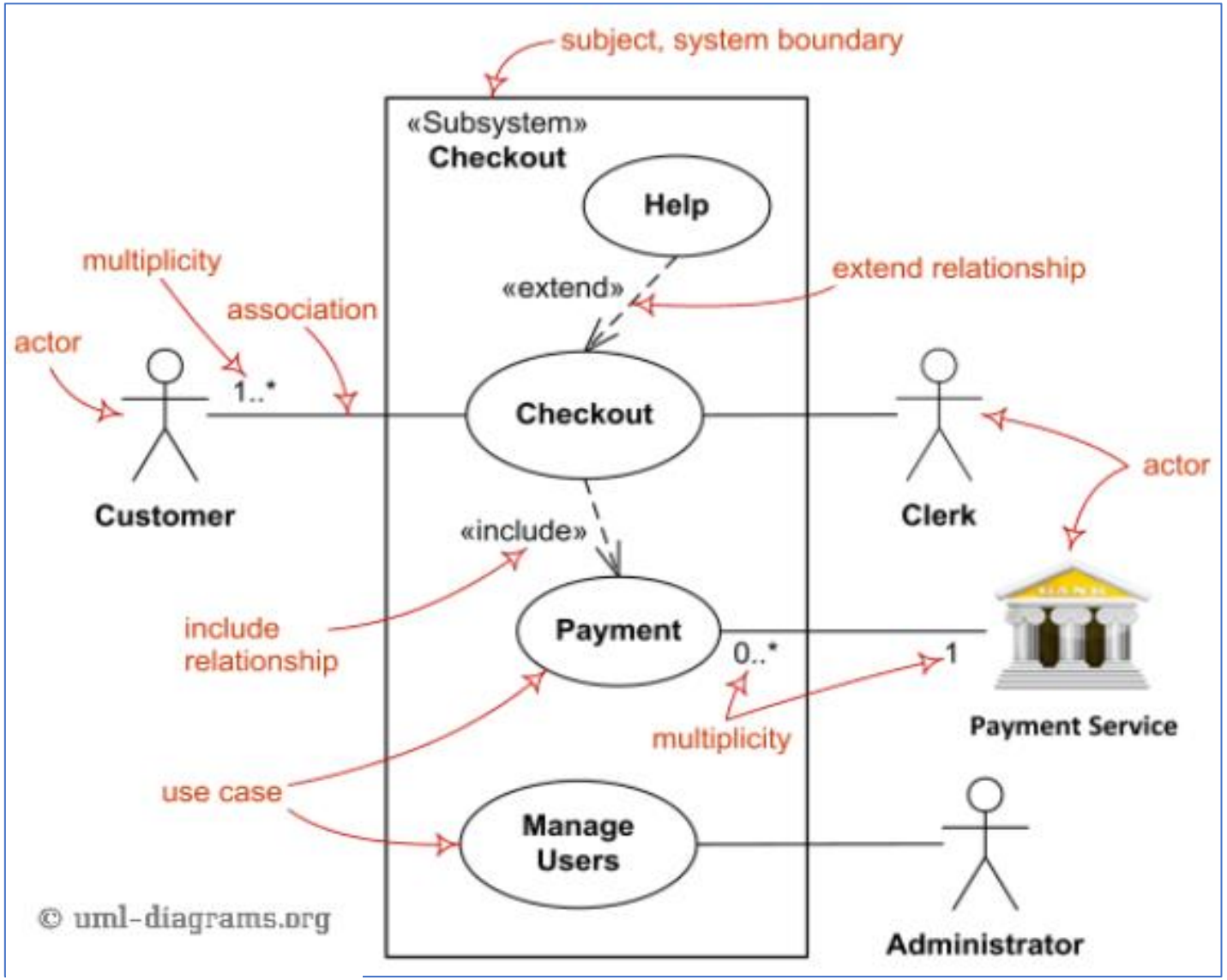
- ✓ **Actor** and **relationship** between actors.
- ✓ **Use cases** and **relationship** between use cases.
- ✓ **Association**.
- ✓ **System boundary.**
- ✓ **Multiplicity**



Picture retrieved from 1

Use Case Diagram Elements

This Figure illustrates a Use Case Diagram, for a subsystem named “Checkout”



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Use Case Diagram Elements

Actor

- ✓An **actor** represents a **role** played by an external entity to the system (**human** or other **system**), **which interacts directly** with the system under design .
- ✓A **user** can be represented by several actors
- ✓**Several users** can be represented by the same actor

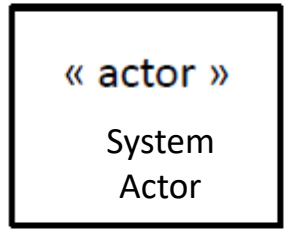
Use Case Diagram Elements

Actor

- ✓An actor is a user **outside** the system. This may be:
- ✓- A **person**.
- ✓- **Equipment** (sensors, motors, relays, etc.).
- ✓- A **different system**.

Notation:

Actor Name



Use Case Diagram Elements

Actor

Two kinds of actors are distinguished:

- ✓**Primary Actors** : main actor who initiates a use case and has a goal to achieve by interacting with the system.
- ✓**Secondary Actors** : is an actor who supports the primary actor to achieve their goal.

Use Case

- ✓A **use case** represents **a complete service expected from the system**.
- ✓A use case has a clearly identified **start and end**.
- ✓A use case is described with **a verb form**.
- ✓Notation: it is shown as an **ellipse** including the name of the use case.
- ✓**Examples**:

User Registration ***use case***

Web Search Use Case

Purchase Ticket Use Case

Use Case Diagram Elements

Relationship

There are **five kinds of relationship** in a use case diagram:

- ✓**Association**
- ✓**Generalization**
- ✓**Extension**
- ✓**Inclusion**
- ✓**Generalization**

Use Case Diagram Elements

Associations

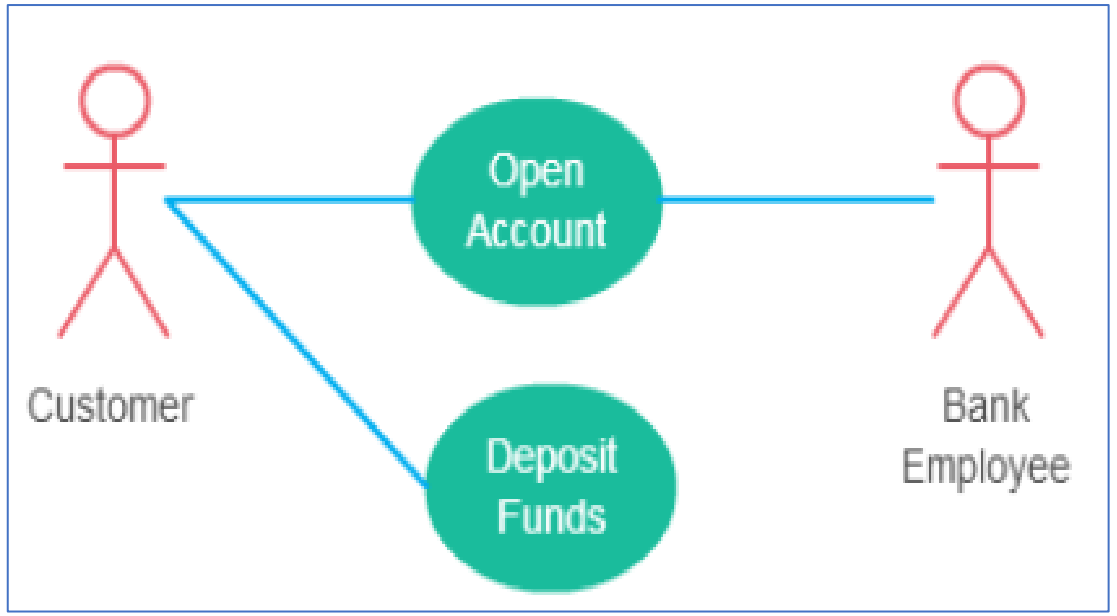
Association Between Actor and Use Case: it is straightforward and present in each use case diagram. It is characterized by:

- ✓**An actor must** be associated with at least one use case.
- ✓**An actor can** be associated with multiple use cases.
- ✓**Multiple actors can** be associated with a single use case.

Use Case Diagram Elements

Associations

This figure illustrates the association relationship that can appears in use case diagrams



Use Case Diagram Elements

Generalization of an Actor

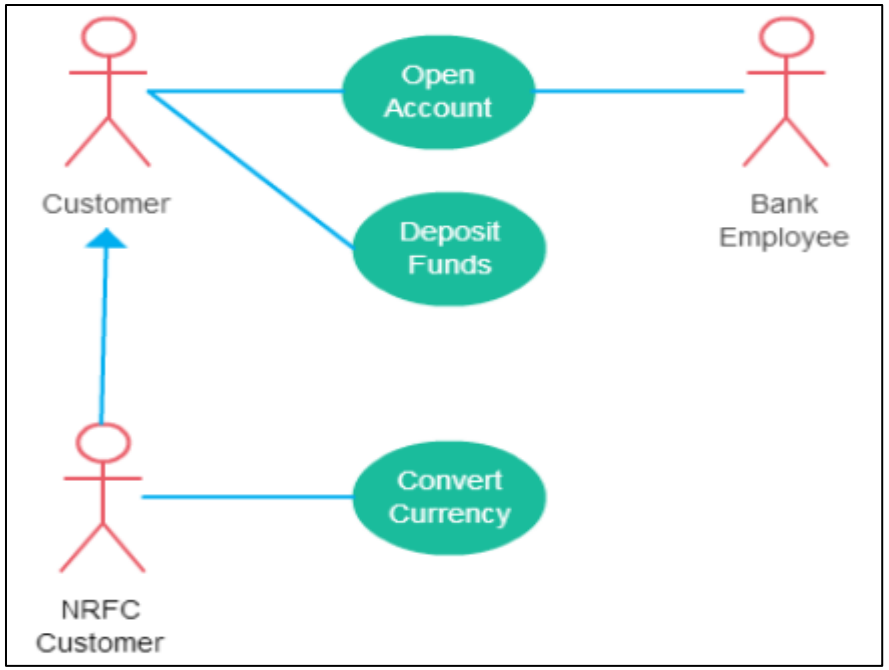
✓Generalization of an actor = One actor **can inherit from another actor** (inherit its role).

✓The **child** inherits all **parent's** use cases .

✓The **child** has one or more specific use cases.

✓**Example:**

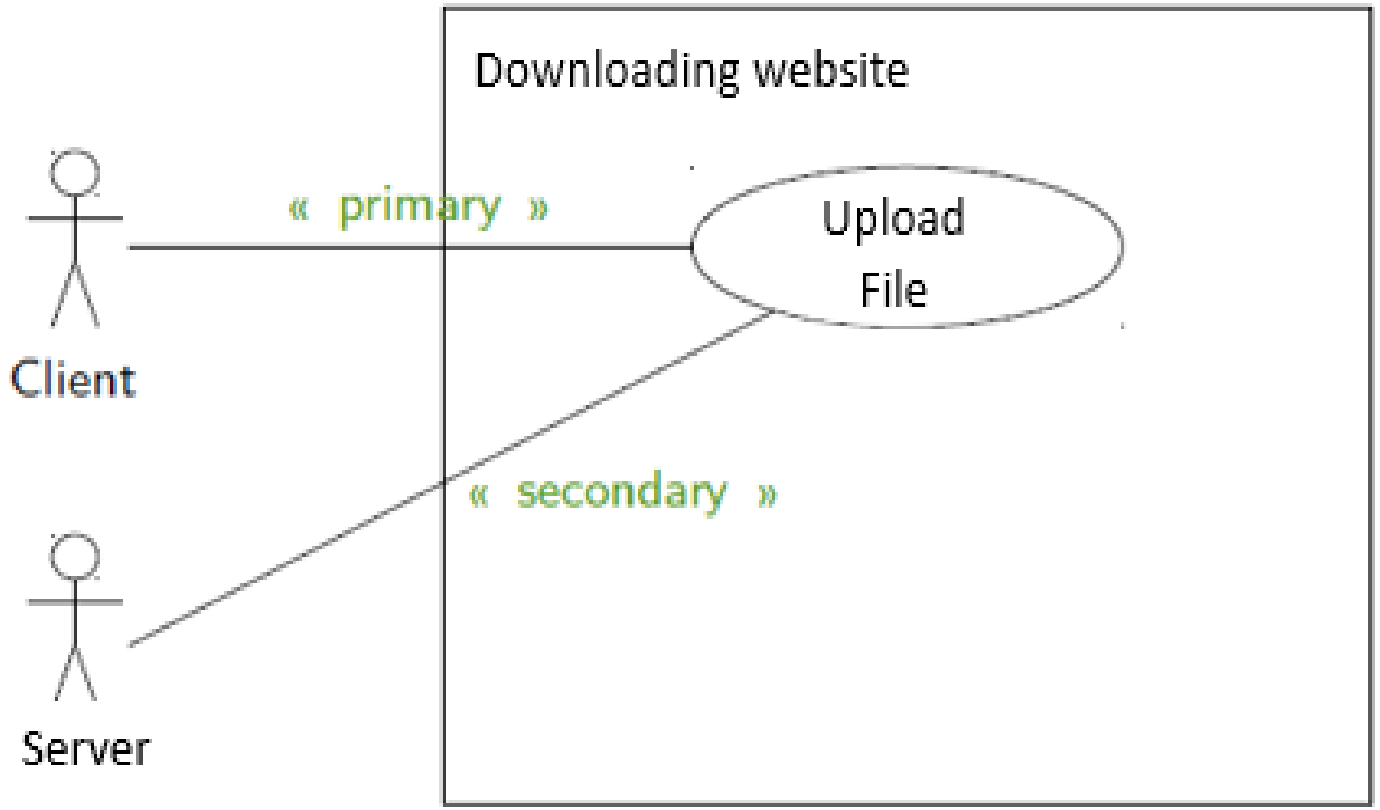
NRFC Customer can do everything that **Customer** does.



Use Case Diagram Elements

Associations and primary and secondary actor

Recall that: **primary actor** is an actor that trigger the use case. However, **secondary actor** is called upon by the use case.



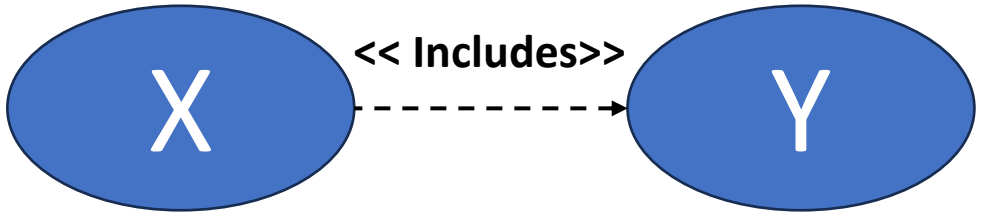
Relationships between cases: Include

- It shows that the **included use case** behavior is part of the **including use case**.
- The purpose of "**include**" is to **reuse shared actions** through multiple use cases.
- It **simplify complex behaviors**.
- Include relationship is represented by a dashed line with an open arrowhead directed from the included use case to the including use case. The arrow is labeled with the stereotype <<include>>.
- The **base use case** is incomplete without **the included use case**.
- The **included use case** is **MANDATORY** (not optional).

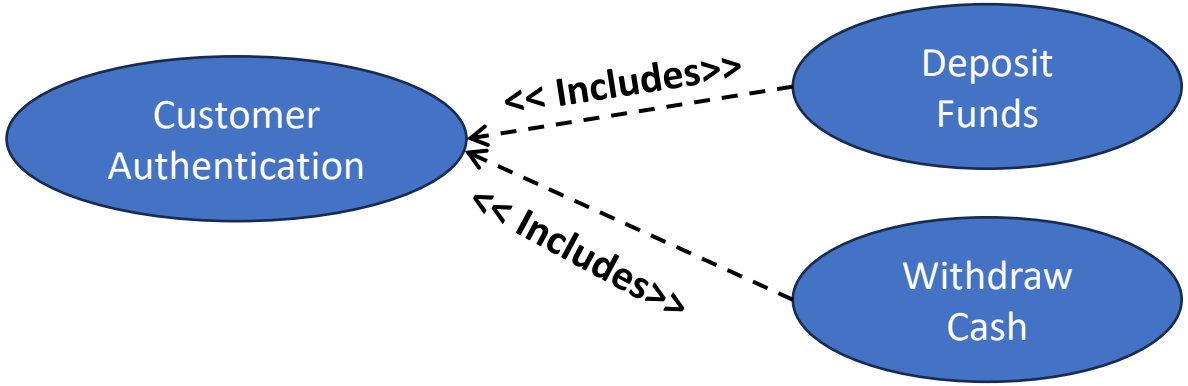
Use Case Diagram Elements

Relationships between cases: Include

- Inclusion: X <<**includes**>> Y → X **imply** Y



- Example



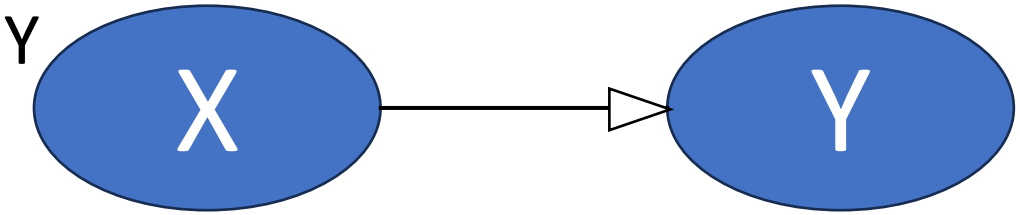
Relationships between cases: Generalization

- ✓**Similar** to the actor generalization .
- ✓The **behavior of the Parent** is inherited **by the Child**.
- ✓Utilized **when there is shared or a common behavior between two use cases and specialized behavior particular to each one**.

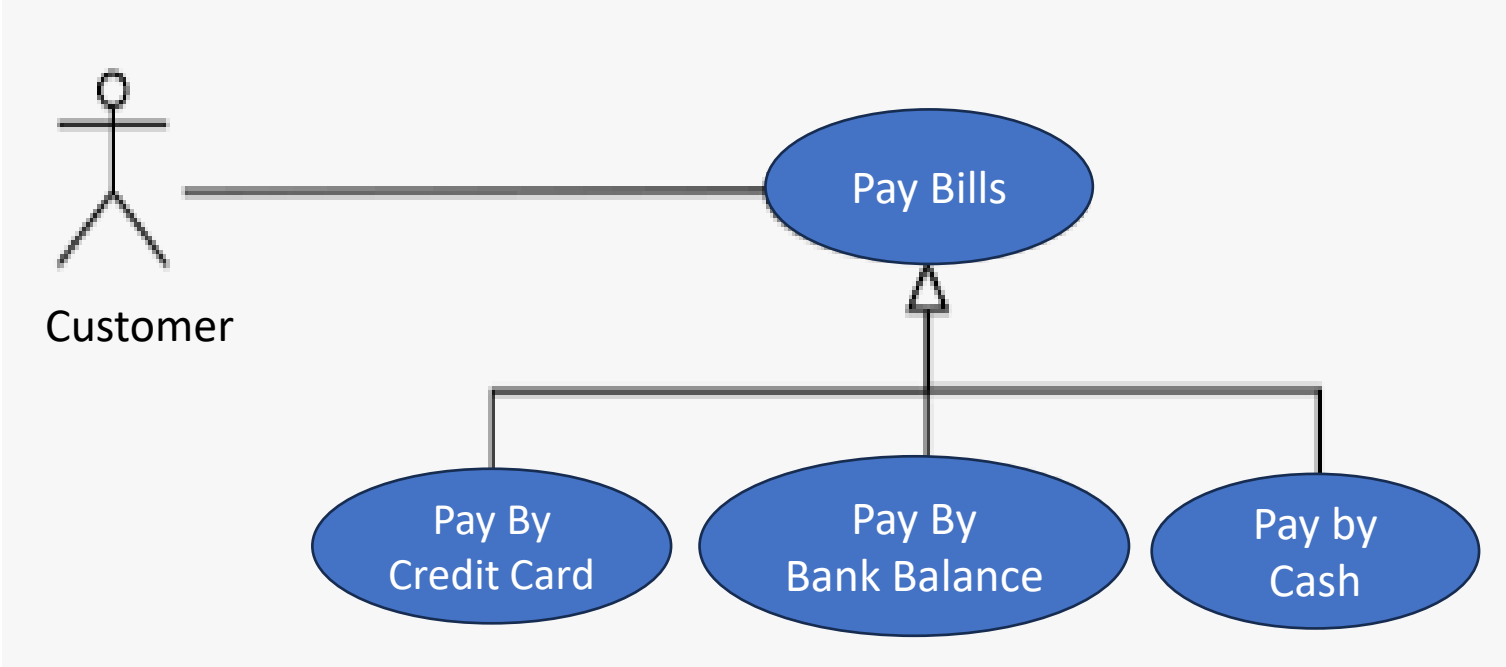
Use Case Diagram Elements

Relationships between cases: Generalization

✓**Generalization**: X **is a special use case** of Y



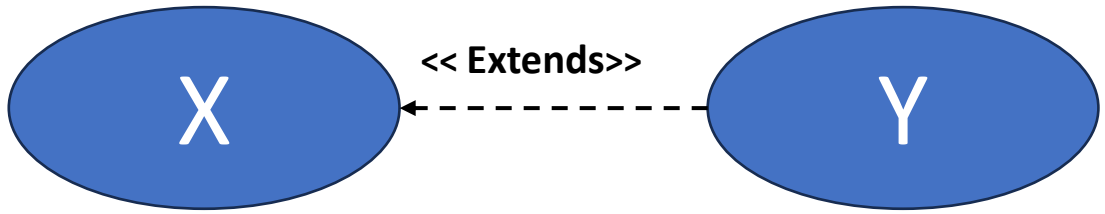
✓**Example**: The use case “Pay Bills”, is a generalization of “Pay by Credit Card”, “Pay by Bank Balance” use cases.



Use Case Diagram Elements

Relationships between cases: Extends

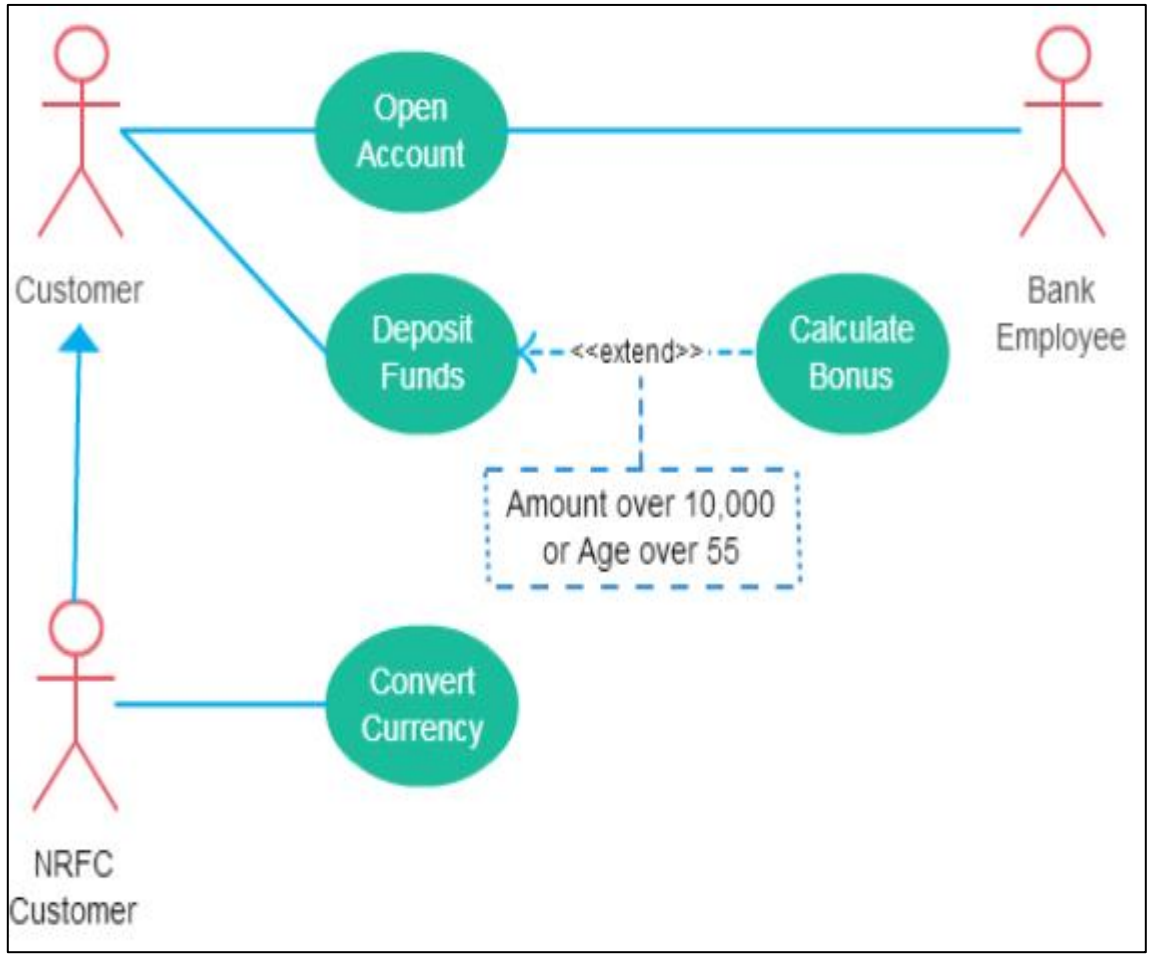
- ✓It extends the **base use case** and enhance the system by additional functionality .
- ✓It is represented by a dashed line with an open arrowhead directed from the extending use case to the extended (base) use case. The arrow is labeled with the stereotype «extends».
- ✓**Extension**: X Extends Y →
  - ✓X can be caused by Y.
  - ✓X is **OPTIONAL** to Y.
- ✓**Notation**



Use Case Diagram Elements

Relationships between cases: Extends

- **Example and characteristics**



✓ The **extending use case** depends on the **extended base one**.

✓ "**Calculate Bonus**" have no impact without the "**Deposit Funds**".

✓ The **extending use case** is optional, it can also be **activated conditionally**.

✓ **Calculate Bonus** is triggered only for deposits over 10,000 or when the age is over 55.

✓ The **extended base use case** should be important on its own. (it should be **independent** and **must not depend on the behavior of the extending use case**).

Use Case Diagram Elements

Relationships between cases: Extends

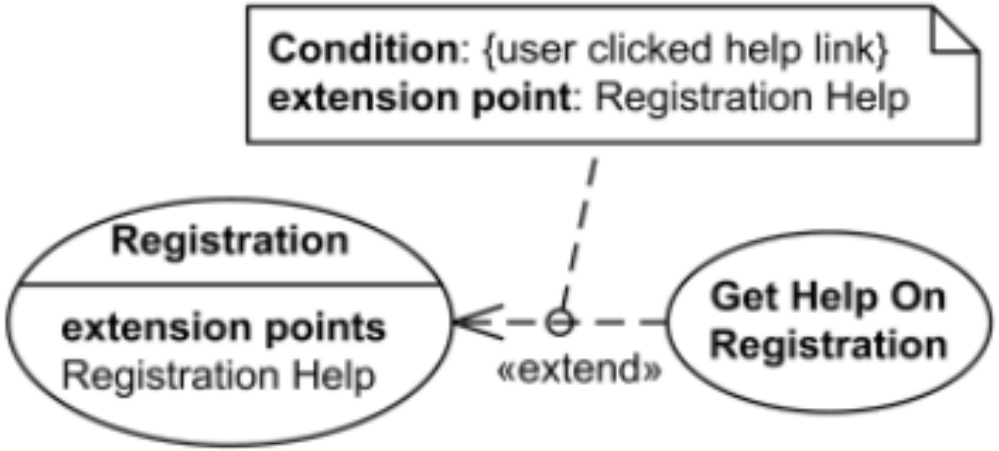
- ✓It extends the **base use case** and adds more functionality to the system.
- ✓It is represented by the stereotype <<**extends**>>.
- ✓**Extension**: X Extends Y →
  - ✓X can be caused by Y.
  - ✓X is **OPTIONAL** to Y.
- ✓ it is possible to have the following situations:
  - ✓The same extending use case can extend more than use case,
  - ✓The extending use case may itself be extended.

Use Case Diagram Elements

Relationships between cases: Extends

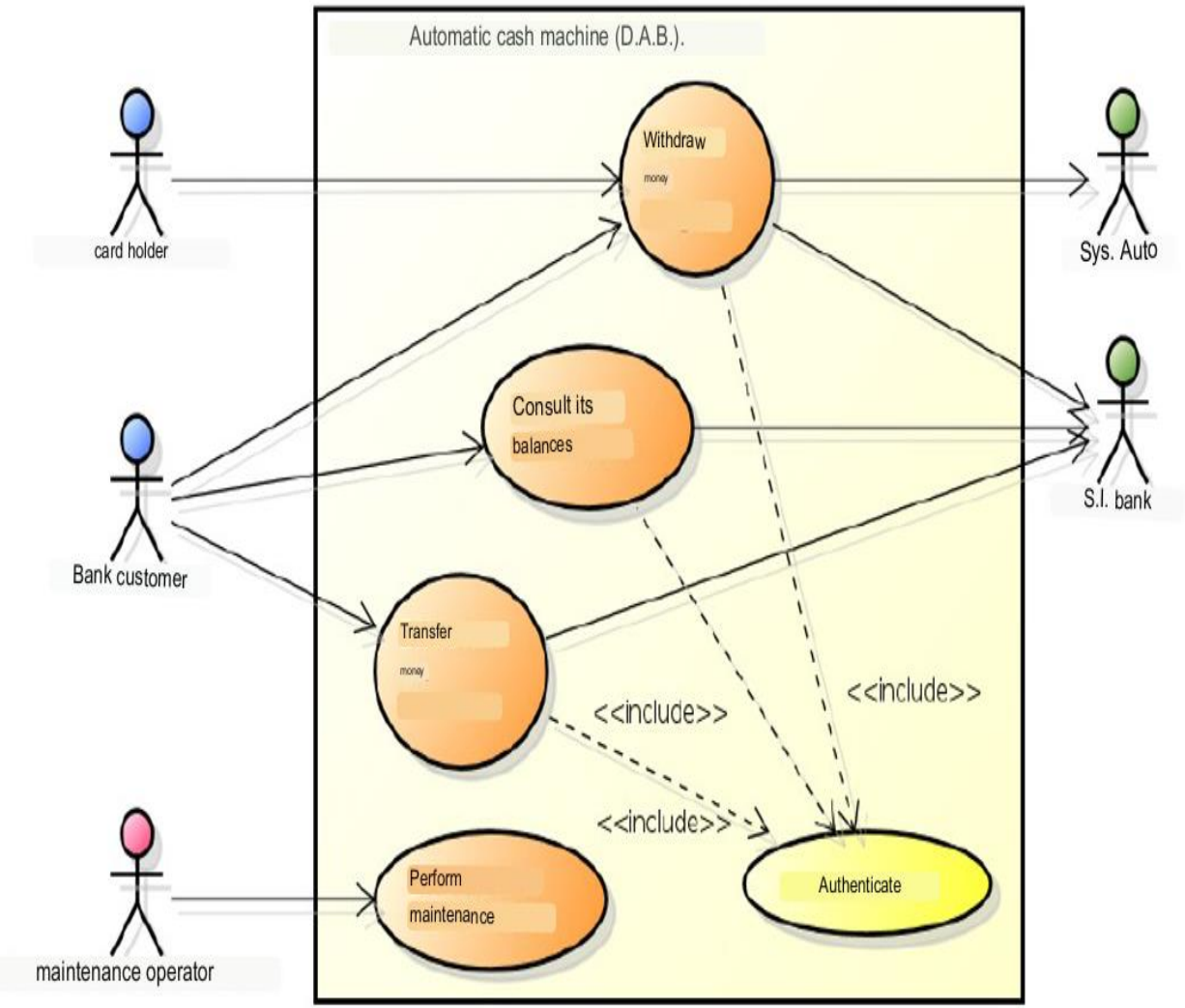
✓The extension takes place at one or more **extension points** defined in the **extended use case**.

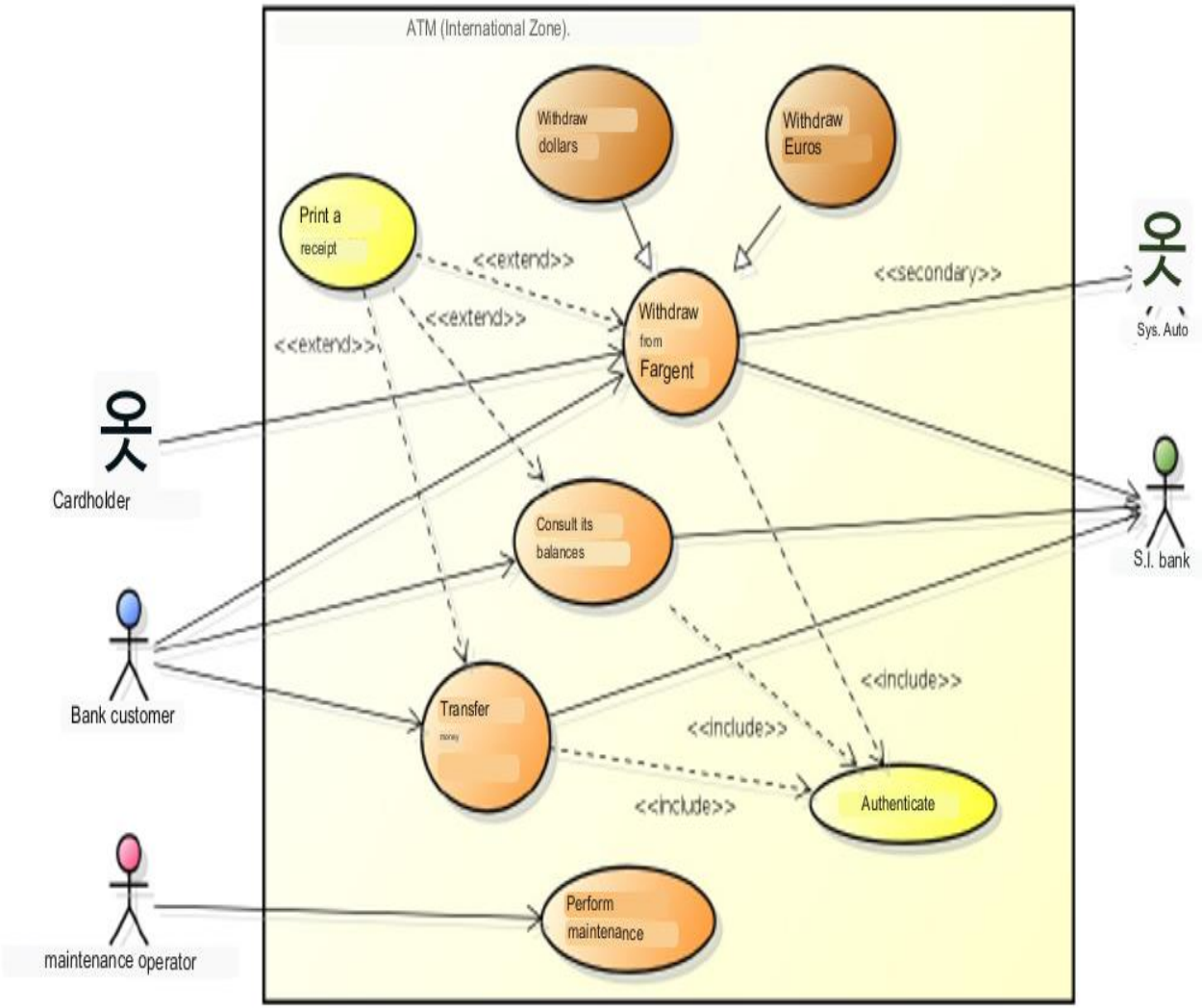
✓Example:



✓The condition of the extend relationship as well as the references to the extension points are optionally shown in a comment note attached to the corresponding extend relationship.

Further use cases diagram examples





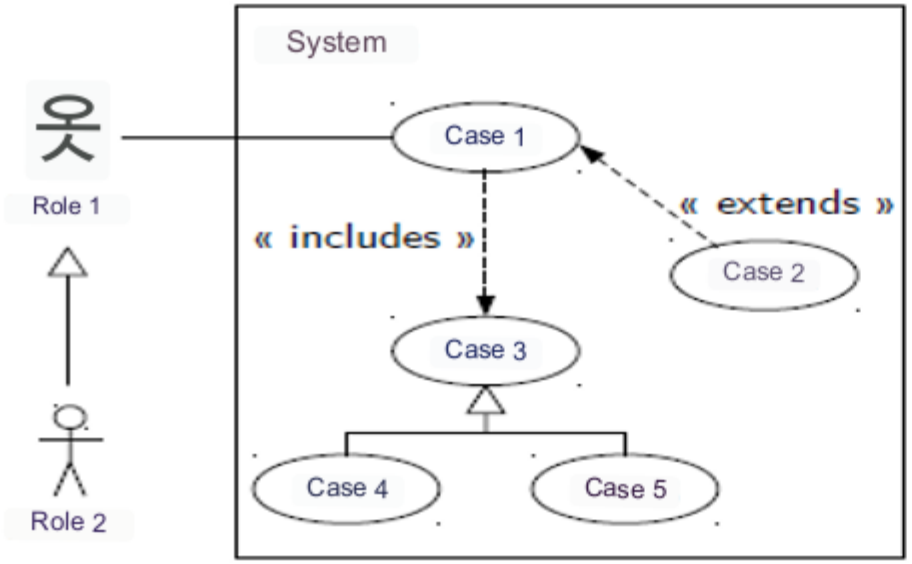
Steps for creating a use cases diagram

Creating a use cases diagram encompasses four steps:

- ✓Step 1: Specify topic
- ✓Step 2: actors Identification
- ✓Step 3: use cases Identification
- ✓Step 4: relationships Identification

Use case Specification

Use case diagrams



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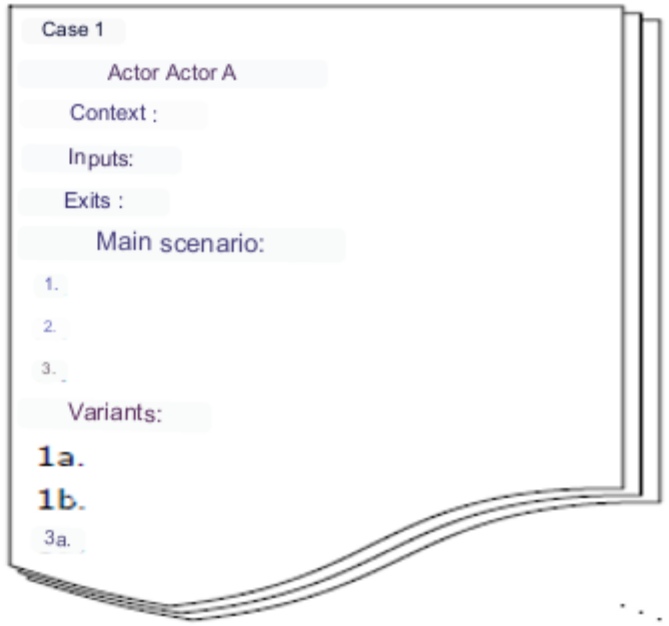
Text description



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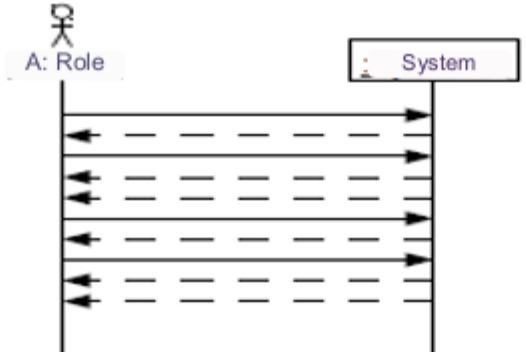
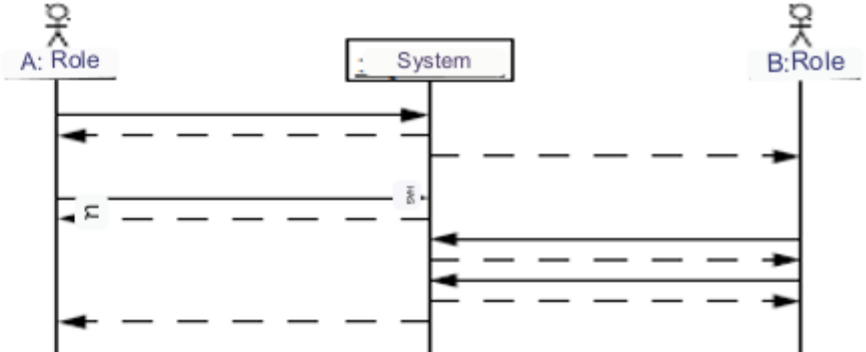
Usage scenarios





Use cases diagram characteristics

- ✓ **Useful for discussion with the client** because intuitive and concise
- ✓ **Not sufficient for the development team**
- ✓ **Necessity of a detailed description** of the scenarios, represented by each case:
  - ✓ **Textual description** in structured natural language
  - ✓ Precise vocabulary corresponding to diagrams

Textual Description of a Use Case (1)

A textual description of a Use Case includes:

- **Name** of use case
- **Brief description**
- **Actors**
- **Context**
- **Input** data and **préconditions**
- **Output** data and **postcondition**
- **Principal scenario** for the use case
  - Steps to follow to carry out this use case.
- **Variants or alternatives and error cases**
  - Deviations from main scenario steps, alternative scenarios, error scenarios

Textual Description of a Use Case (2)

An example of textual description of a Use Case is given by:

- **Name: Order**
- **Brief description: Order …..**
- **Actor: Customer**
- **Context**
- **Input** data and **préconditions: customer selected product**

the case starts when the customer clicks on the order button.

- **Output** data and **postcondition:**
- **Principal scenario**

- **Variants or alternatives and error cases**
  - Deviations from main scenario steps, alternative scenarios, error scenarios

Textual Description of a Use Case (3)

1. The system asks the customer to enter his username and password.
2. The customer enters his username and password and validates.
3. The system asks the customer to choose their delivery address from their list of addresses or to enter a new one.
4. The customer chooses a valid delivery address.
5. The system asks the customer to choose a shipping method from a predefined list (to be specified).
6. The customer chooses a shipping model and validates.

Textual Description of a Use Case (4)

7. The system displays a summary of the order, indicates the total amount of the delivery and asks the customer to choose a payment method from a predefined list (to be specified)
8. The customer chooses a method of payment and validates
9. The system asks the customer to enter their payment information and validates.
10. The customer enters his payment information and validates.
11. The system informs the customer that the transaction has been carried out correctly and an order summary email is sent to the customer

Textual Description of a Use Case (5)

Error Scenario: Unknown Client

- **3a**. The customer is unknown to the system. The system displays an error message.
- Return to step 1.

Alternative Scenario: New Shipping Address

- **4a**. The customer enters a new delivery address and validates
- The scenario resumes at step 5

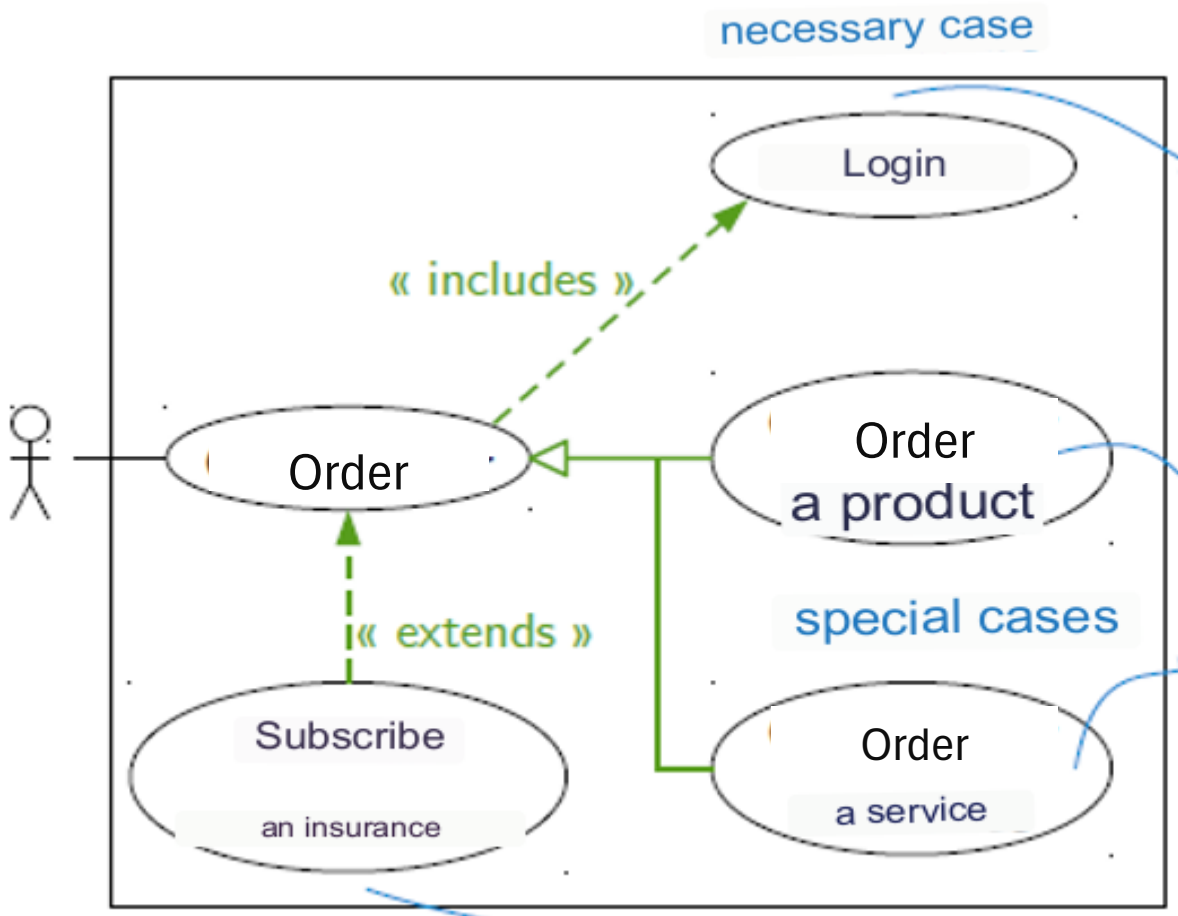
Alternate Scenario: Changing Delivery Choices

- **8a**. The customer asks to change his delivery address.
- Return to step 5.

Error Scenario: Unable to Transaction

11a. The system notifies the customer that their payment information is incorrect. Return to step 9.

Example of links between diagram and text



Order

Actor: Customer

Pre-condition: The client must be identified

Main scenario

1. ...

2. ...

3.1 The object of the order is a product.

Triggering of the Order a product case.

3.2 The object of the order is a service.

Triggering of the Order a service case.

Alternative scenario

2a. The client chooses to take out insurance.