Software Engineering

Experiment 3: Implement UML Use-case

Learning Objective: To implement UML use-case for the project.

Tools: MS Word, draw.io

Theory:

Use case diagrams

Use case diagrams belong to the category of behavioral diagram of UML diagrams. They present a graphical overview of the functionality provided by the system. It consists of a set of actions (referred to as use cases) that the concerned system can perform one or more actors, and dependencies among them.

Actor

An actor can be defined as an object or set of objects, external to the system, which interacts with the system to get some meaningful work done. Actors could be human, devices, or even other systems.

For example, consider the case where a customer *withdraws cash* from an ATM. Here, the customer is a human actor.

Actors can be classified as below:

- **Primary actor**: They are principal users of the system, who fulfill their goal by availing some service from the system. For example, a customer uses an ATM to withdraw cash when he needs it. A customer is the primary actor here.
- **Supporting actor**: They render some kind of service to the system. "Bank representatives", who replenishes the stock of cash, is such an example. It may be noted that replenishing stock of cash in an ATM is not the prime functionality of an ATM.

In a use case diagram primary actors are usually drawn on the top left side of the diagram.

Use Case

A use case is simply a functionality provided by a system.

Continuing with the example of the ATM, *withdraw cash* is a functionality that the ATM provides. Therefore, this is a use case. Other possible use cases include, *check balance*, *change PIN*, and so on.

Use cases include both successful and unsuccessful scenarios of user interactions with the system. For example, authentication of a customer by the ATM would fail if he entered the wrong PIN. In such case, an error message is displayed on the screen of the ATM.

Subject

Subject is simply the system under consideration.

Graphical Representation

An actor is represented by a stick figure and the name of the actor is written below it. A use case is depicted by an ellipse and the name of the use case is written inside it. The subject is shown by drawing a rectangle. Labels for the system could be put inside it. Use cases are drawn inside the rectangle, and actors are drawn outside the rectangle, as shown in figure - 01.

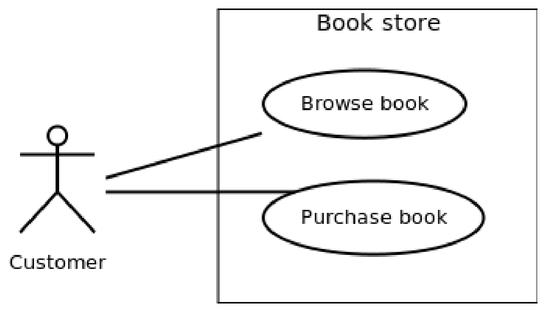


Figure - 01: A use case diagram for a bookstore

Association between Actors and Use Cases

A use case is triggered by an actor. Actors and use cases are connected through binary associations indicating that the two communicate through message passing.

An actor must be associated with at least one use case. Similarly, a given use case must be associated with at least one actor. Association among the actors is usually not shown. However, one can depict the class hierarchy among actors.

Use Case Relationships

Three types of relationships exist among use cases:

- Include relationship
- Extend relationship
- Use case generalization

Include Relationship

Include relationships are used to depict common behavior that are shared by multiple use cases. This could be considered analogous to writing functions in a program in order to avoid repetition of writing the same code. Such a function would be called from different points within the program.

Example

For example, consider an email application. A user can send a new mail, reply to an email he has received, or forward an email. However, in each of these three cases, the user must be logged in to perform those actions. Thus, we could have a *login* use case, which is included by *compose mail*, *reply*, and *forward email* use cases. The relationship is shown in figure - 02.

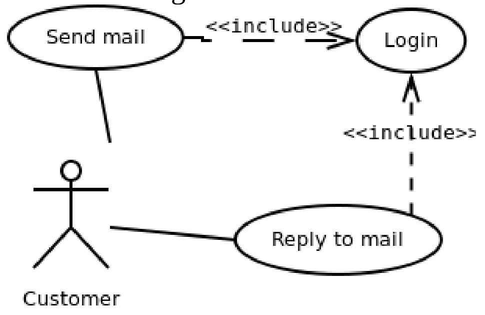


Figure - 02: Include relationship between use cases

Notation

Include relationship is depicted by a dashed arrow with a «include» stereotype from the including use case to the included use case.

Extend Relationship

Use case extensions are used to depict any variation to an existing use case. They are used to specify the changes required when any assumption made by the existing use case becomes false.

Example

Let's consider an online bookstore. The system allows an authenticated user to buy selected book(s). While the order is being placed, the system also allows specifying any special shipping instructions, for example, call the customer before delivery. This *Shipping Instructions* step is optional, and not a part of the main *Place Order* use case. Figure - 03 depicts such relationship.

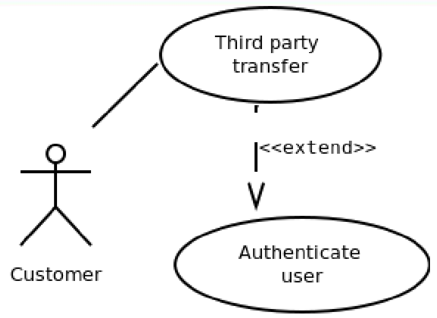


Figure - 03: Extend relationship between use cases

Notation

Extend relationship is depicted by a dashed arrow with a «extend» stereotype from the extending use case to the extended use case.

Generalization Relationship

Generalization relationship is used to represent the inheritance between use cases. A derived use case specializes in some functionality it has already inherited from the base use case.

Example

To illustrate this, consider a graphical application that allows users to draw polygons. We could have a use case *draw polygon*. Now, a rectangle is a particular instance of a polygon having four sides at right angles to each other. So, the use case *draw rectangle* inherits the properties of the use case *draw polygon* and overrides its drawing method. This is an example of a generalization relationship. Similarly, a generalization relationship exists between *draw rectangle* and *draw square* use cases. The relationship has been illustrated in figure - 04.

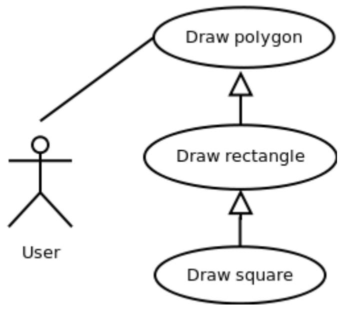


Figure - 04: Generalization relationship among use cases

Notation

Generalization relationship is depicted by a solid arrow from the specialized (derived) use case to the more generalized (base) use case.

Identifying Actors

Given a problem statement, the actors could be identified by asking the following questions:

- Who gets most of the benefits from the system? (The answer would lead to the identification of the primary actor)
- Who keeps the system working? (This will help to identify a list of potential users)
- What other software / hardware does the system interact with?
- Any interface (interaction) between the concerned system and any other system?

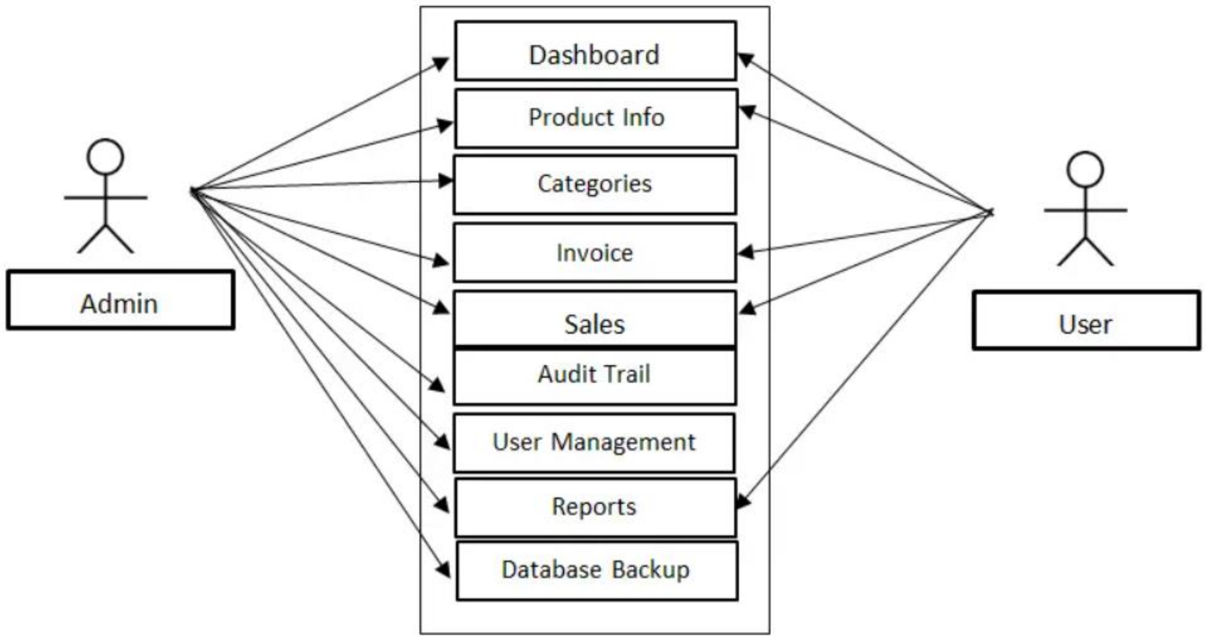
Identifying Use cases

Once the primary and secondary actors have been identified, we have to find out their goals i.e. what the functionality they can obtain from the system is. Any use case name should start with a verb like, "Check balance".

Guidelines for drawing Use Case diagrams
Following general guidelines could be kept in mind while trying to draw a use case diagram:

- Determine the system boundary
- Ensure that individual actors have well-defined purpose
- Use cases identified should let some meaningful work done by the actors
- Associate the actors and use cases -- there shouldn't be any actor or use case floating without any connection
- Use includes relationships to encapsulate common behavior among use cases, if any.

Result and Discussion:



Learning Outcomes: The student should have the ability to:
LO 1: Identify the importance of use-case diagrams.
LO 2: Draw use-case diagrams for a given scenario.

Course Outcomes: Upon completion of the course students will be able to understand and demonstrate use-case diagrams.

Conclusion: We understood the concept of UML and specifically Use Case Diagrams and how they can be used to demonstrate the functional relations of a project. We successfully implemented a use case diagram for the Hospital Appointment System and defined the scenario of the project. Several concepts related to Software Engineering were revised while performing the experiment.

Viva Questions:

1. What is use-case diagrams used for?
2. What is extends and include? Differentiate between the two.
3. What is a generalization relationship in a use-case?
4. "Use case diagrams belong to the category of behavioral diagram". What does the statement mean?

For Faculty Use

Correction Parameters	**Formative Assessment [40%]**	**Timely completion of Practical [40%]**	**Attendance / Learning Attitude [20%]**	
Marks Obtained				