

# Use Case Diagrams

Software Process Modeling

# Session Outcomes



- Introduction
- Components of a Use case diagram
  - System
  - Actors
  - Use cases
  - Relationships
- Applying use case diagrams in real world applications
- Use case scenarios

# Requirements Specification

- Structured Natural Language
  - User Stories
- Mathematical Specifications
  - Decision Trees
  - Decision Tables
- Graphical Notations
  - **Use Case Diagrams and Use Case Scenarios**
  - Activity Diagrams

# What is a Use Case Diagram?

- Use Case Model;
  - Graphically represent the proposed functionality of the new system.
  - Use Case Model captures the functional requirements of a system.
  - Help to demonstrate the high-level behavior of the proposed system to the clients

# Use Cases for Requirements Engineering

- Use case modelling support **Requirements Specification**
- Use cases act as a means of **communicating with stakeholders** about what the system is intended to do.
  - It is an excellent way to communicate to management, customers, and other non-development people:
  - WHAT** a system will do when it is completed.
  - But....it does not go into detail of **HOW** a system will do anything.



# Components of a Use Case Diagram

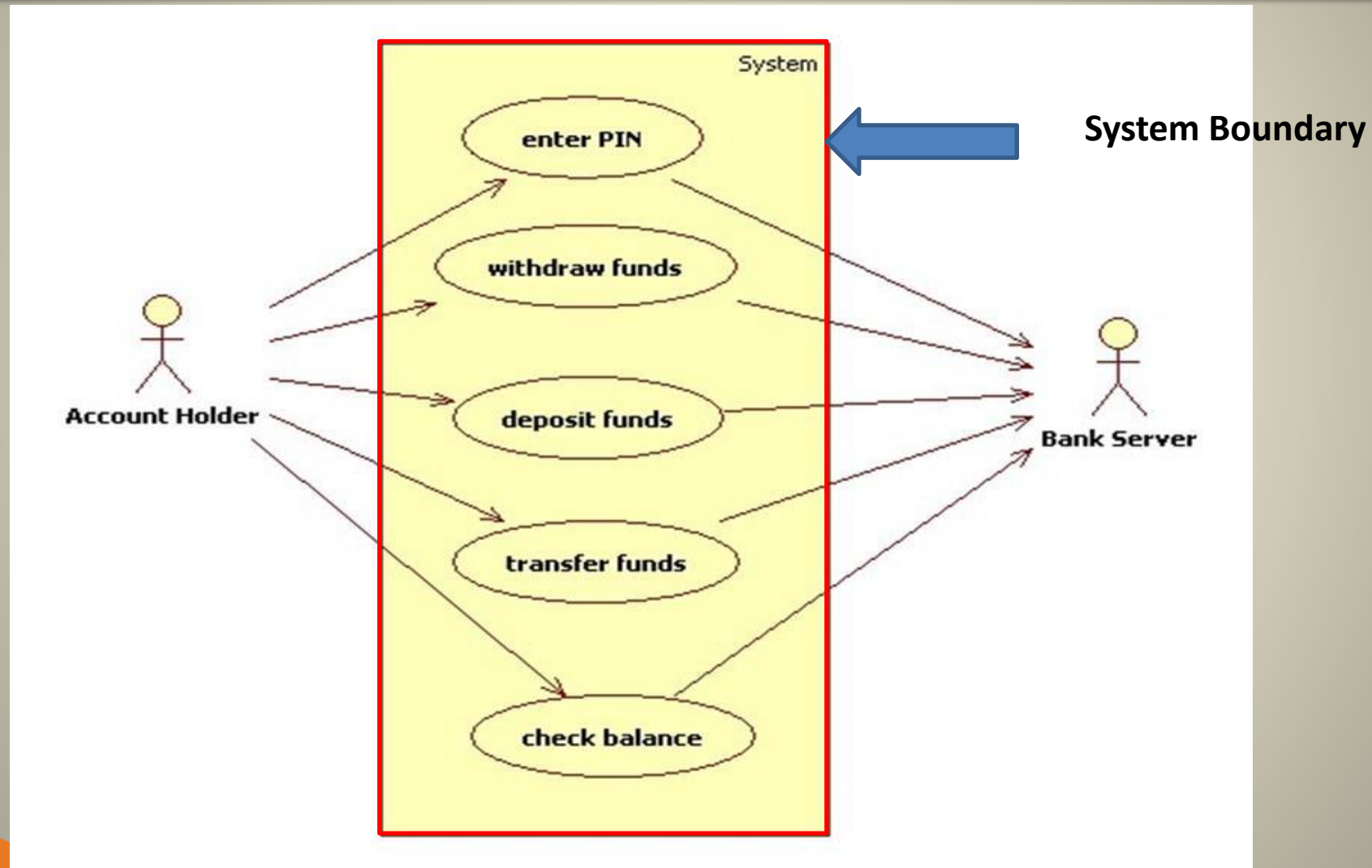
- To construct a Use Case diagram, there are FOUR basic **components**.
  - **System**: something that performs function(s).
  - **Actors**: the roles adopted by those participating.
  - **Use Cases**: high level activities to be supported by the system.
  - **Relationships / Links**: which actors are involved in which use cases (dependency, generalization, and association).

# 1) System

- **System** is something which perform function(s).
- **System Boundary** Represents the boundary between the (physical) system and the actors who interact with the (physical) system.



# System - example

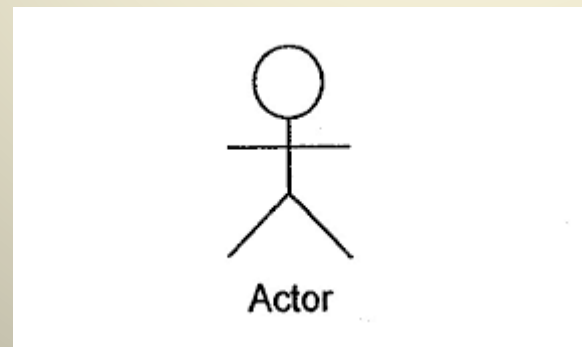




## 2) Actors

- A Use Case Diagram shows the interaction between the system and entities **external** to the system. These external entities are referred to as Actors.
- Actors represent **roles** which may include **human users**, **external hardware** or **other systems**.
- Actors have **direct interactions** with the system

- Notation →



# Activity

- Identify Actors of the SLIIT Library system.



# Activity

- Identify actors of the SLIIT Library system.
  - *Students* of a SLIIT campus are allowed to use the Library of another SLIIT campus for reference while *Academic staff* is eligible to borrow books from any campus they teach
  - To become a *library member* a student have to keep ....
    - Students – Member, Non-member
    - Staff – Academic/non academic? Member, Non-member?
  - The *library staff* can generate reports ....
    - Librarian and Library Assistant?
    - Is library assistant really needed?



# Activity - Answer

- Actors
  - Guest
  - Student member
  - Staff member
    - Academic
    - Non-academic
  - Library assistant
  - Librarian
  - System admin



### 3) Use Case

- A Use Case is a **unit of behavior** in the proposed system
- It represents a unit of interaction between a user and the proposed system.
- Use case name typically has a verb-noun phrase
- Notation →



Make Payment



# How to Identify a Use case?

- Consider what each actor requires of the system.
- For each actor, human or not, ask yourself the following questions in order to figure out the relevant use cases.
  - What are the primary tasks the actor wants the system to perform?
  - Will the actor create, store, change, remove, or read data in the system?
  - Will the actor need to inform the system about sudden, external changes?
  - Does the actor need to be informed about certain occurrences in the system?
  - Will the actor perform a system start-up or shutdown?

# Activity

- Identify use cases for each of the actors in the SLIIT Library System.



# Activity - Answer

- Use Cases and actors

- Register to the system
- Search book/magazine/CD (item)
- Add book
- Add staff
- Reserve book
- Borrow book
- Return book
- Pay fine

Guest

Member, Guest

Librarian

System Admin

Member

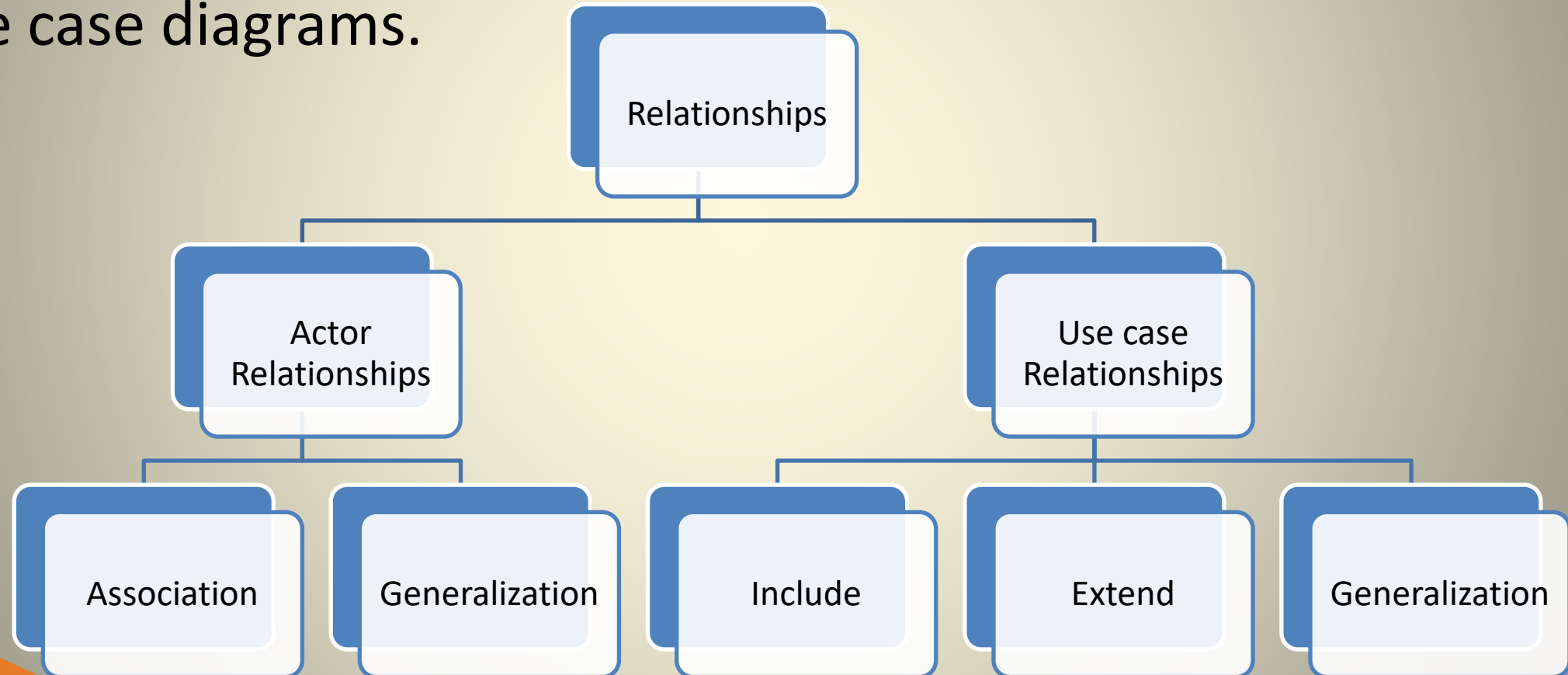
Member/Library Assistant

Member/Library Assistant

Member/Library Assistant

## 4) Relationships

- Below mentioned are the main types of relationships used in use case diagrams.

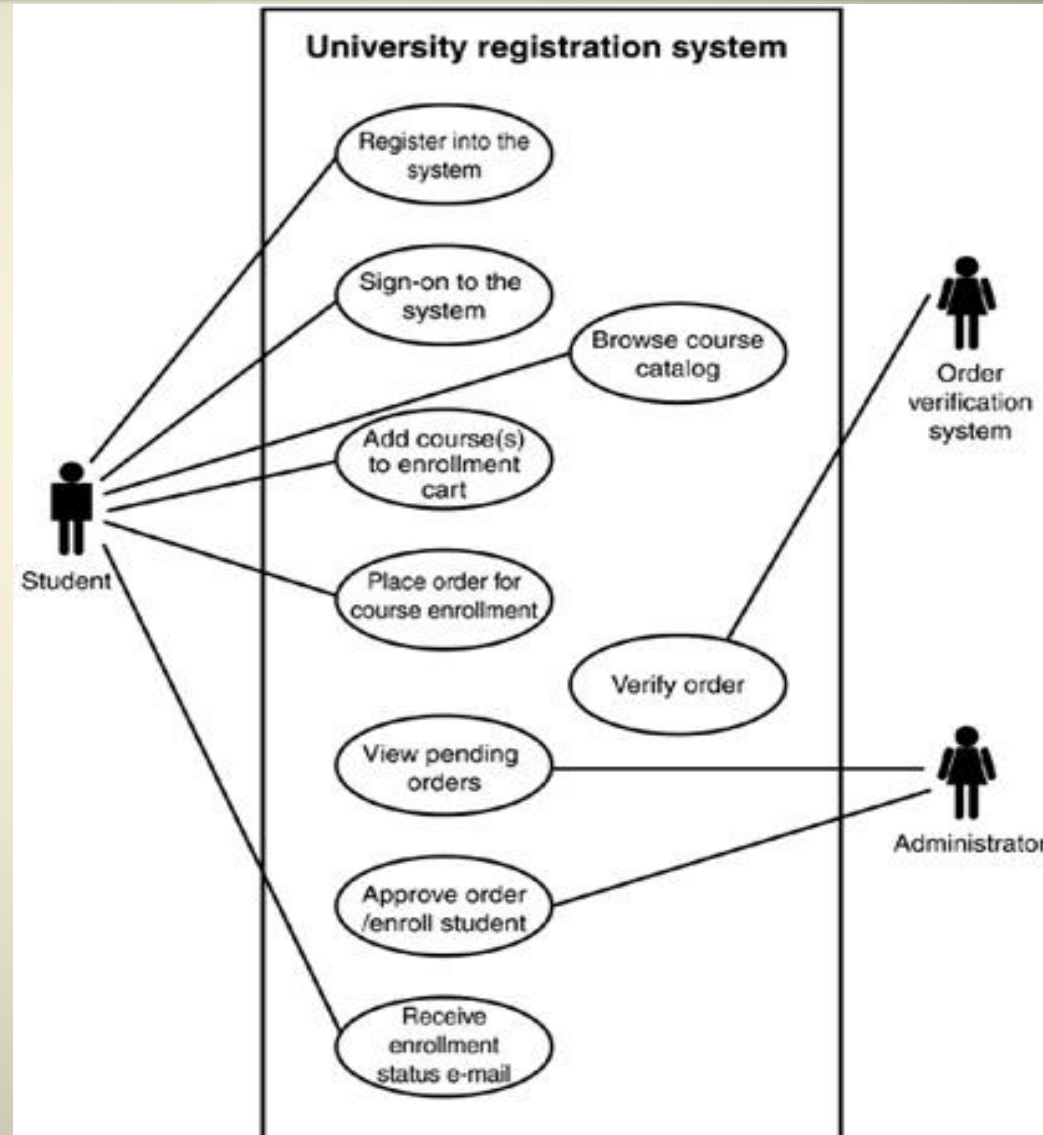




# Actor to Use case Relationships

## Association.

- indicates that an actor participates in (i.e. communicates with) the use case.



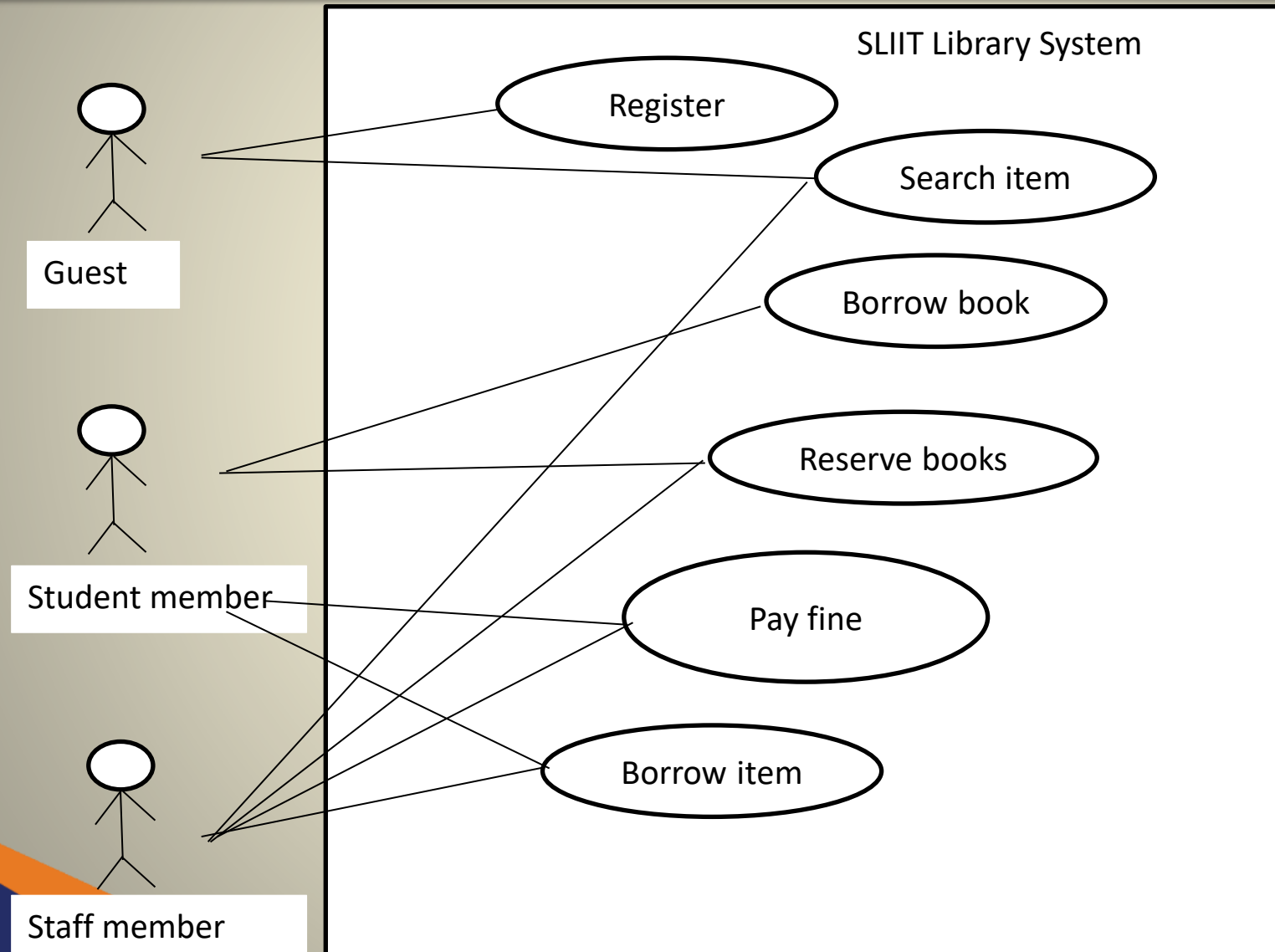


# Activity

- Draw the Actors and Associations for the SLIIT Library System



# SLIIT Library System – Sample

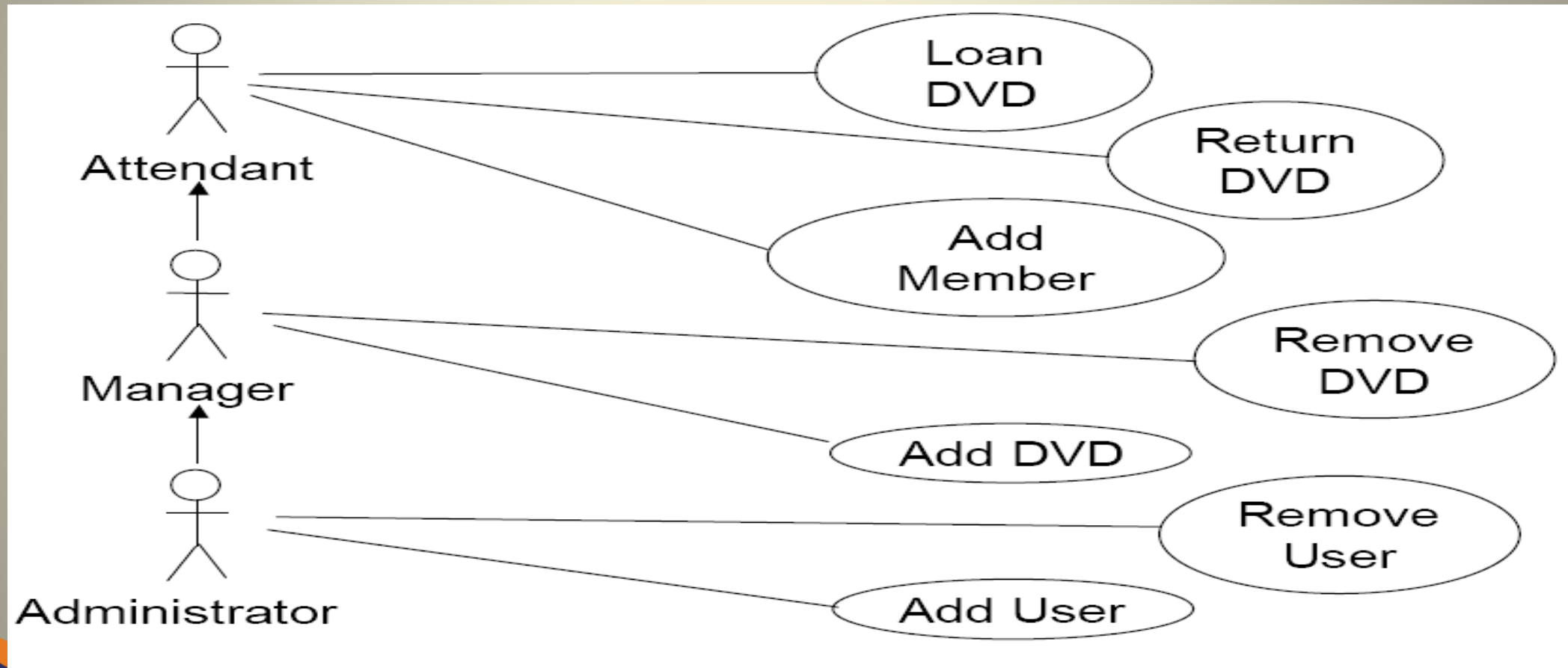


# Actor to Actor Relationships

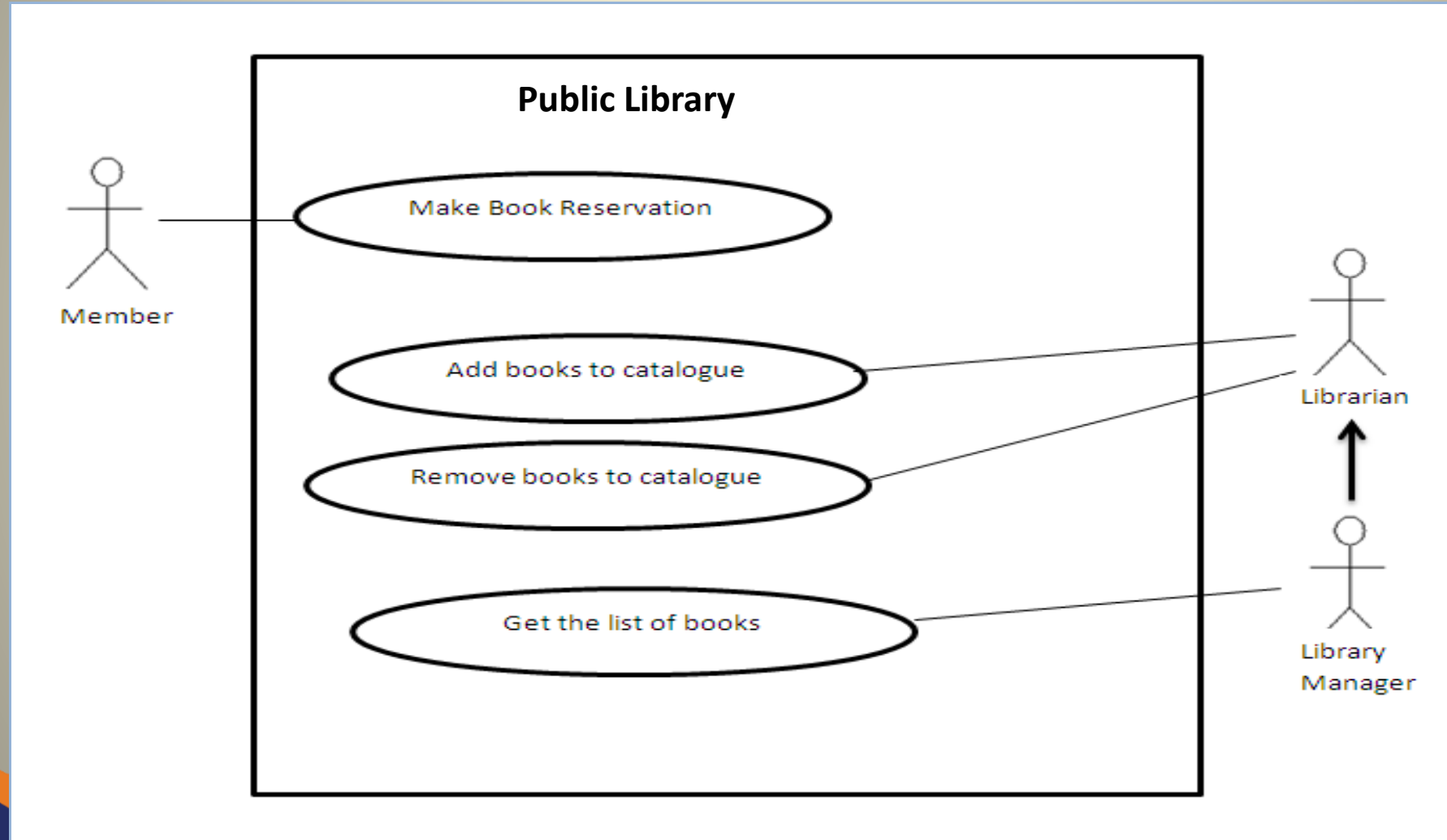
## Generalization.

- Actor Generalization is drawn from the concept of inheritance in Object Oriented Programming.
- A **child actor** Inherits all of the characteristics and behavior of the **parent actor**.
- Can add , modify, or ignore any of the characteristics and behaviors of the parent actor.

## Who has the most rights in the system?



# Example – Public Library

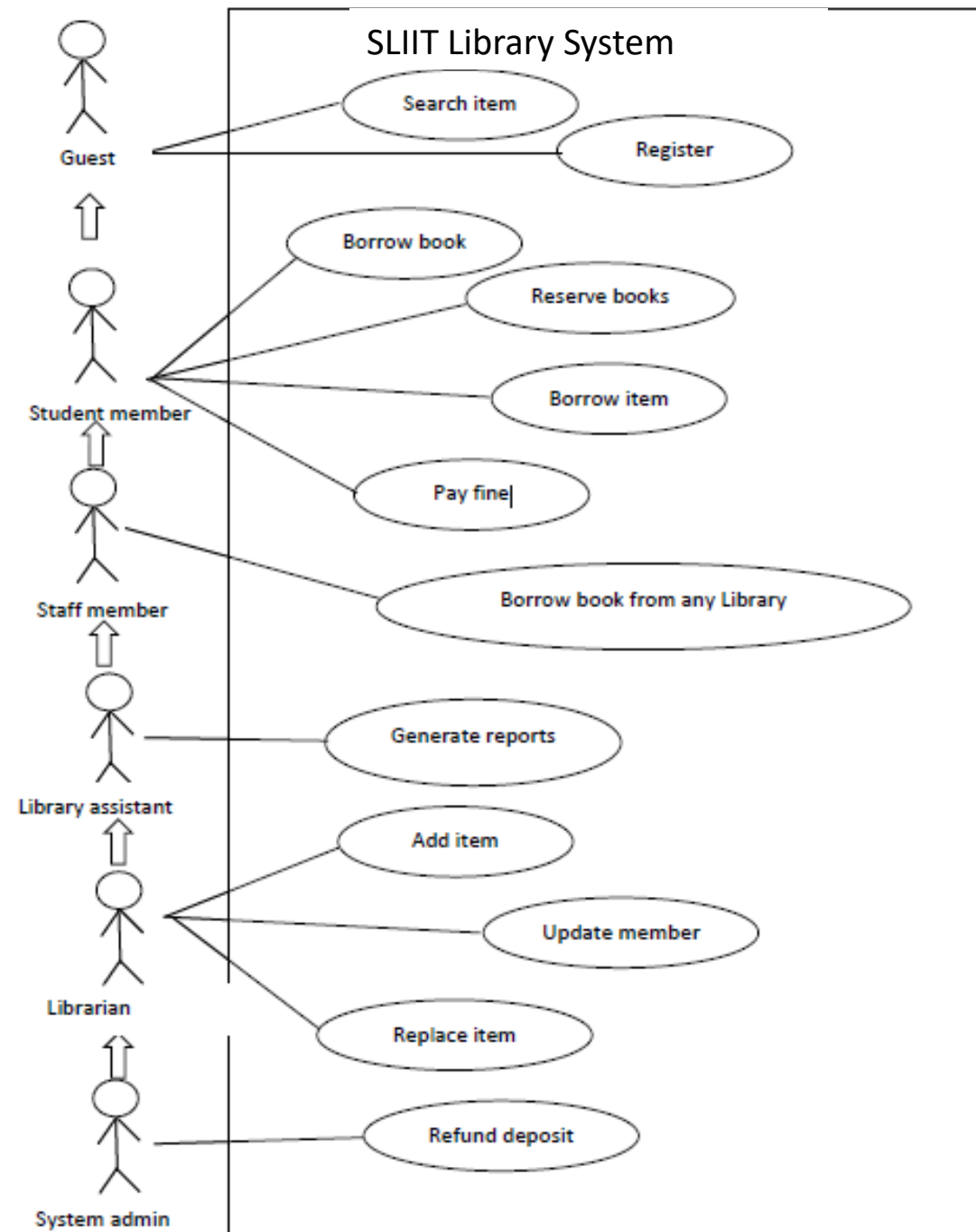




# Activity

- Draw the actor to actor relationships for the SLIIT Library System

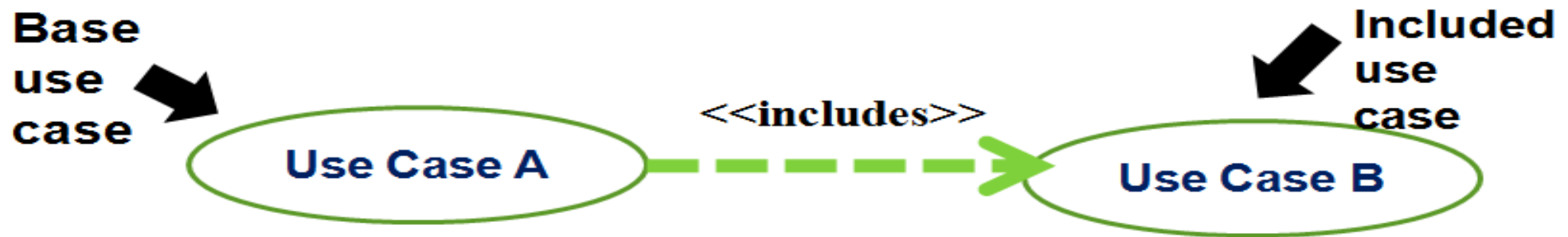




# Include Relationship

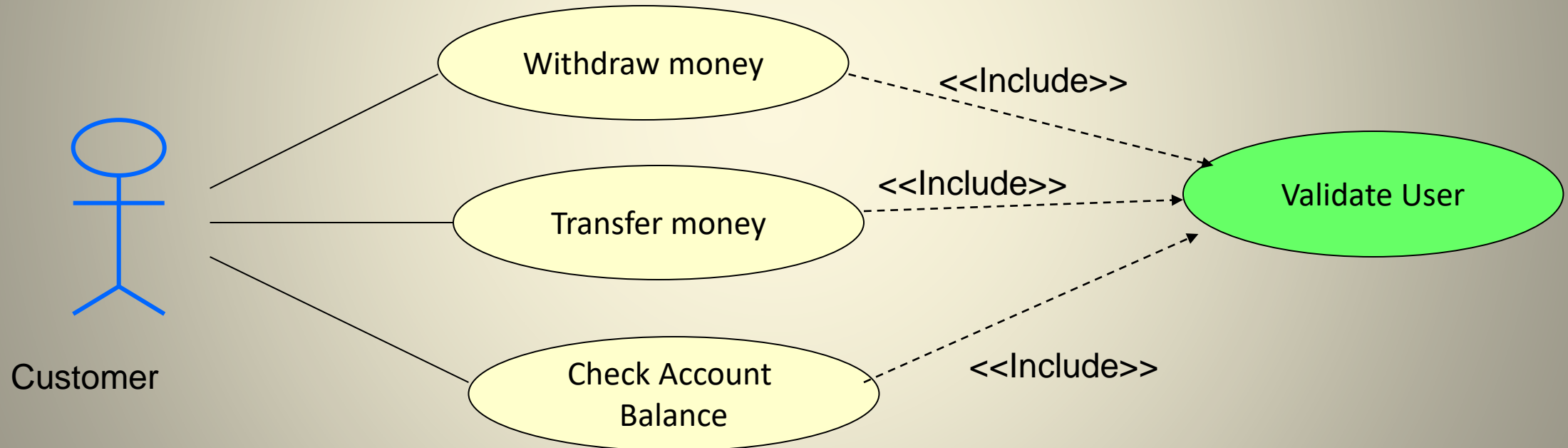
## 1) Include

- The base use case explicitly incorporates the behavior of another use case at a location specified in the base.
- The included use case never stands alone. It only occurs as a part of some larger base that includes it.



# Include Relationship

- Enables us to avoid describing the same flow of events several times by putting the common behavior in a use case of its own.

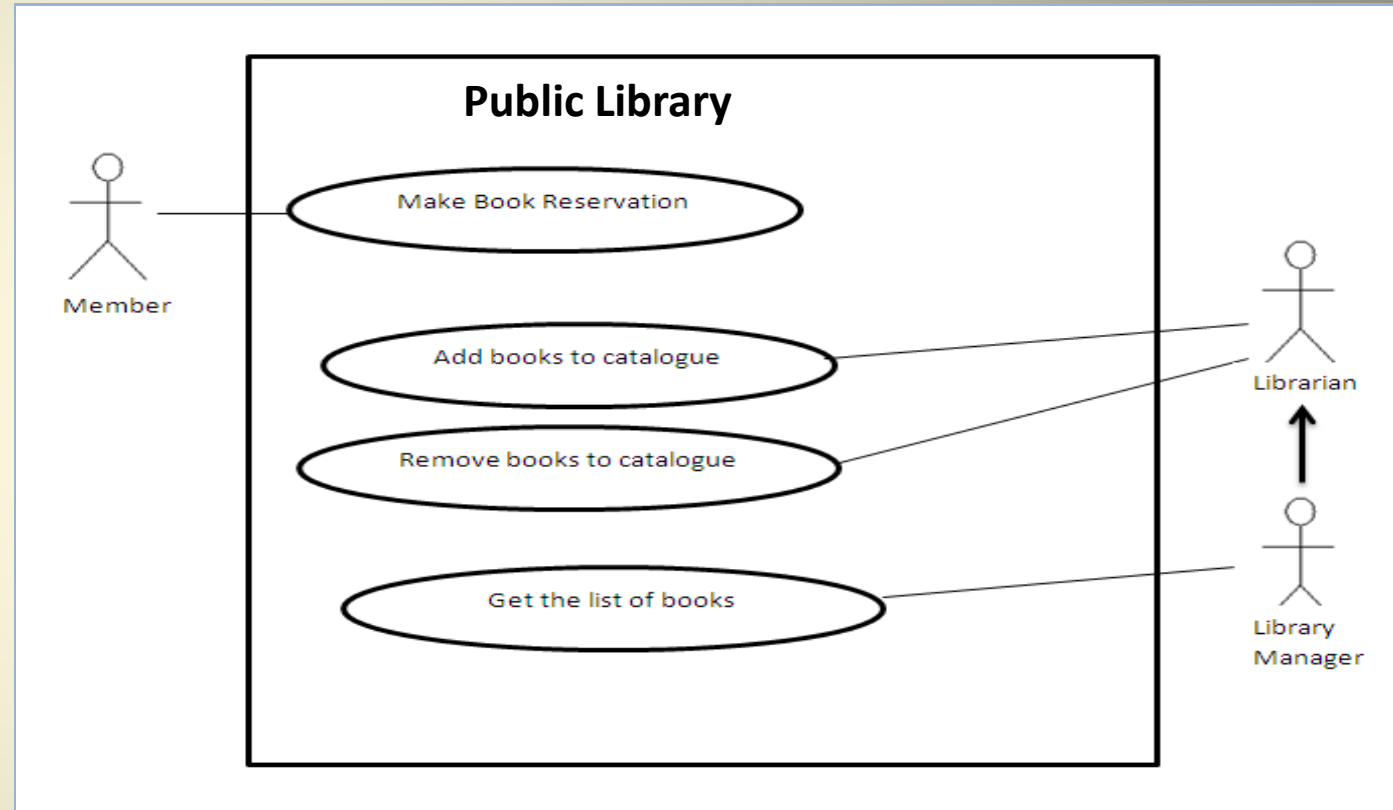




# Activity

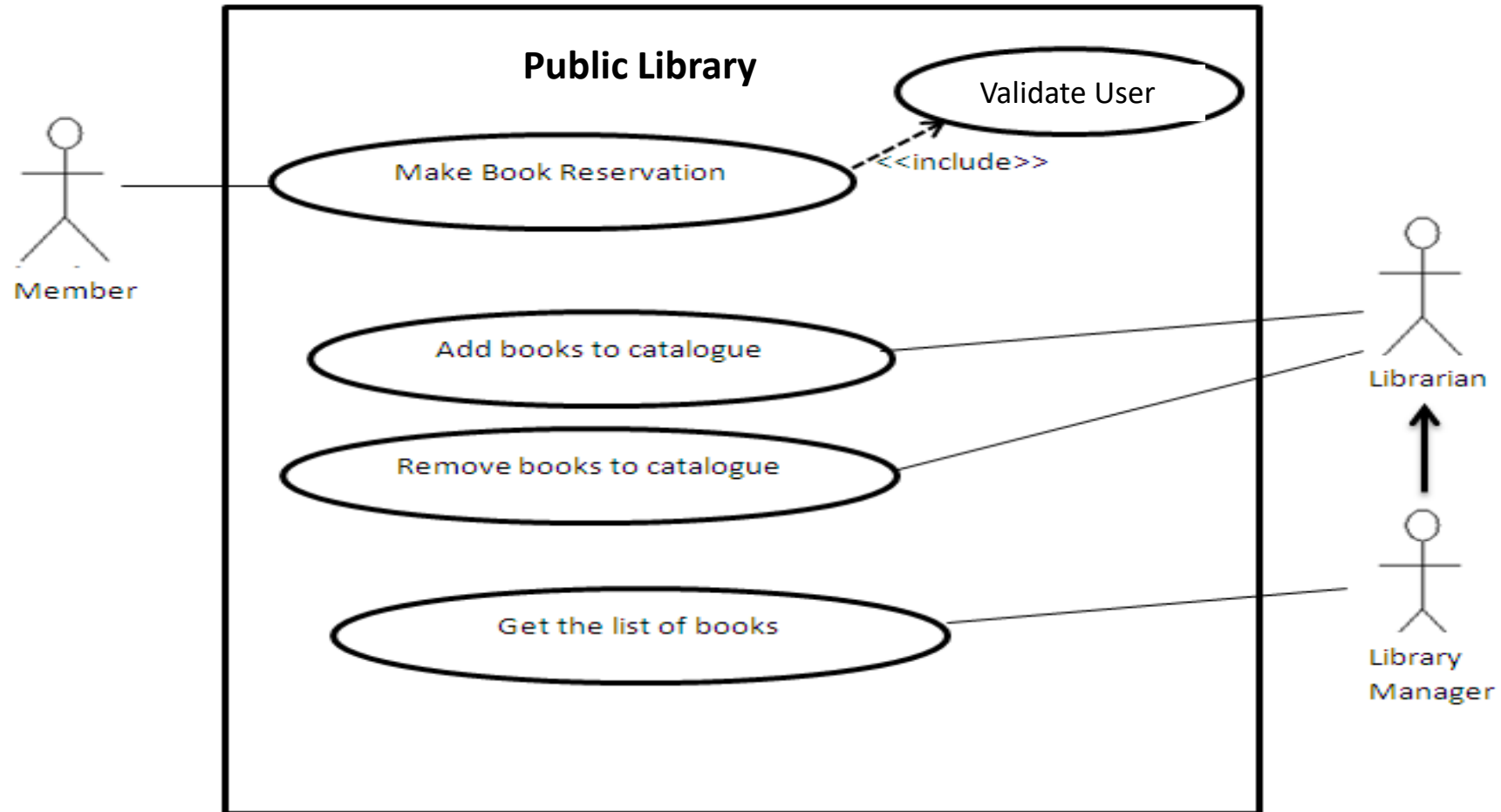
Update the use case diagram of the Public Library for the below given criteria.

*When member is reserving the books he/she has to login to the system.*





# Activity Answer

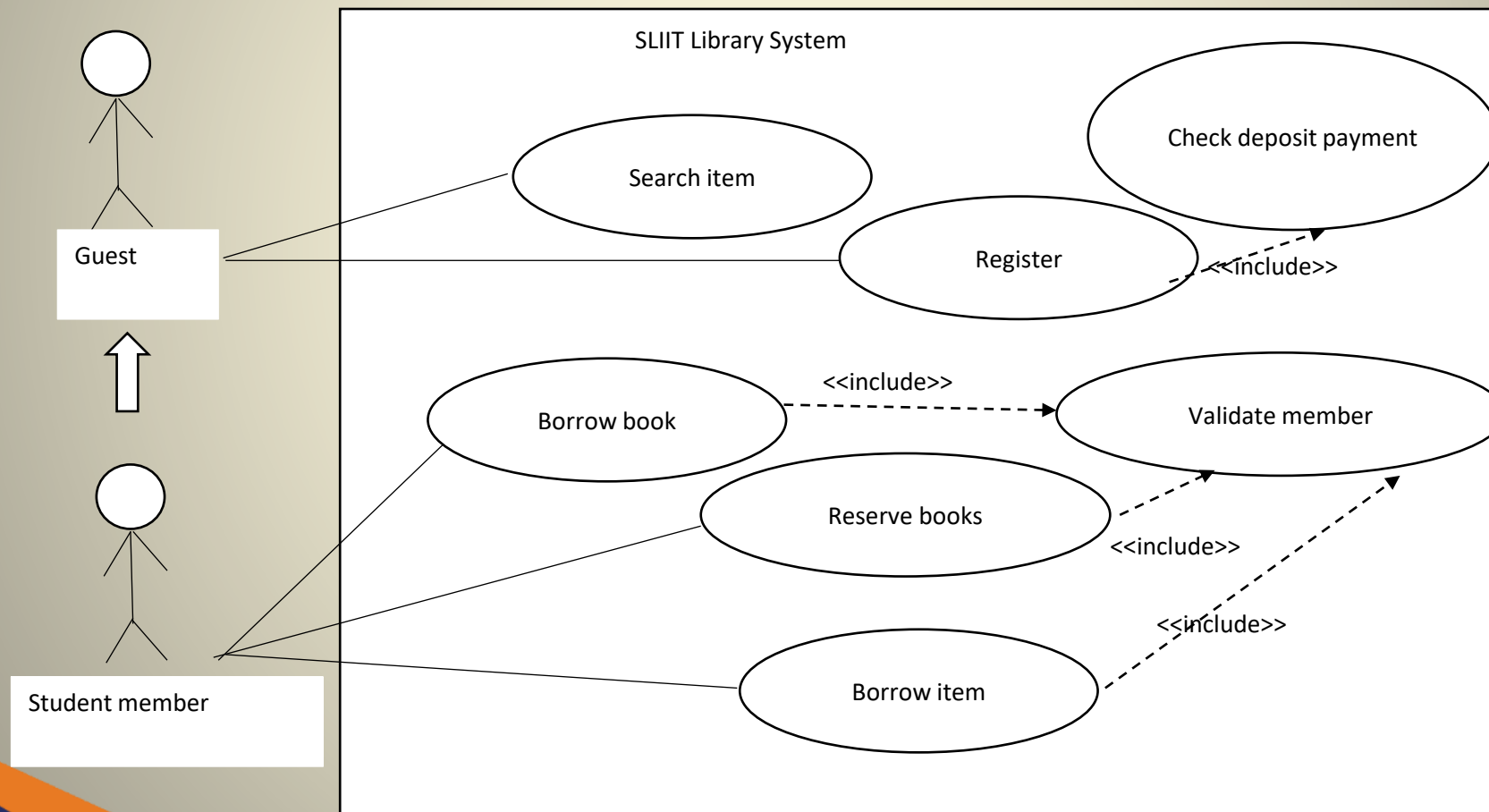


# Activity

- Draw the **include** relationships between the use cases for the SLIIT Library System



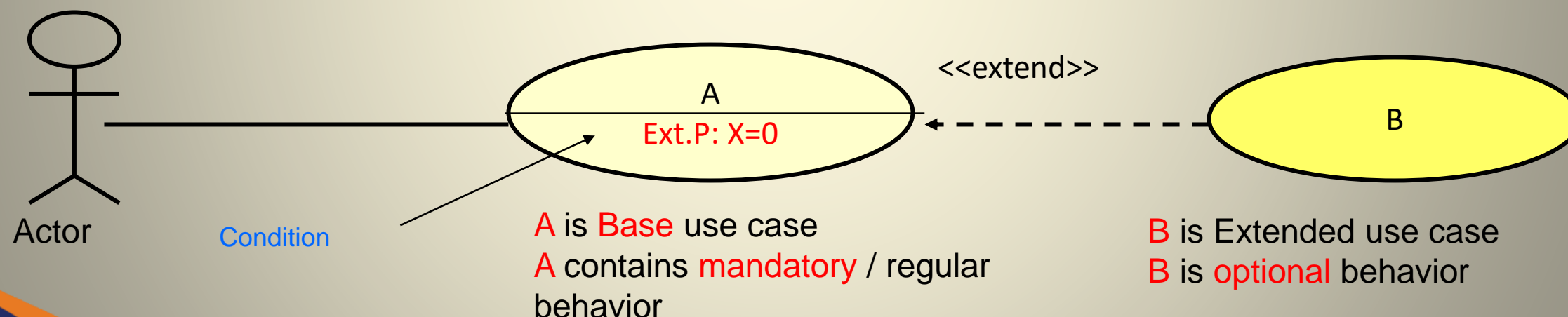
# SLIIT Library System – Sample Answer



# Extend Relationship

## 2) Extend

- The base use case implicitly incorporates the behavior of another use case at certain points called extension points.
- The base use case may stand alone, but under certain conditions its behavior may be extended by the behavior of another use case.





# Extend Relationship

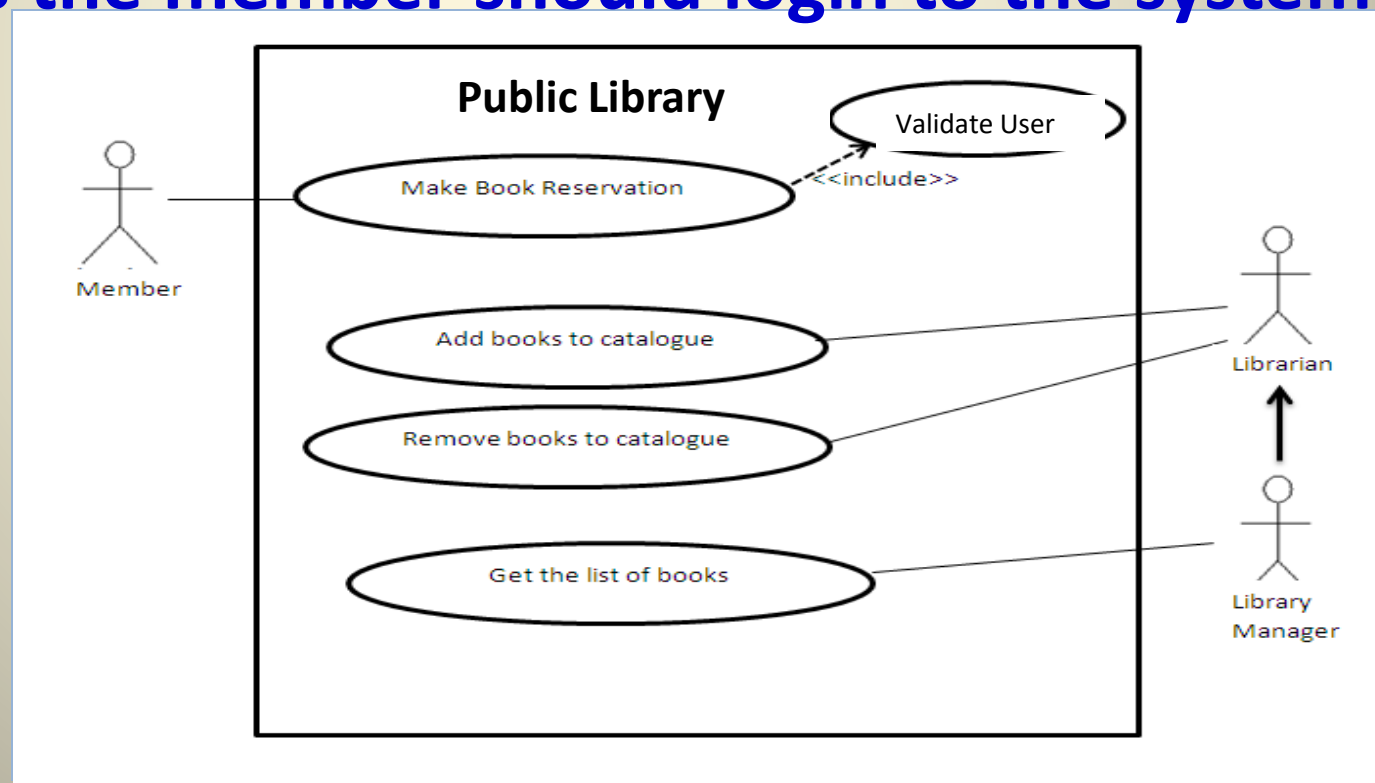
- Eg:- When a student get enrolls in the university they perform a visa check if he/she is a foreign student.



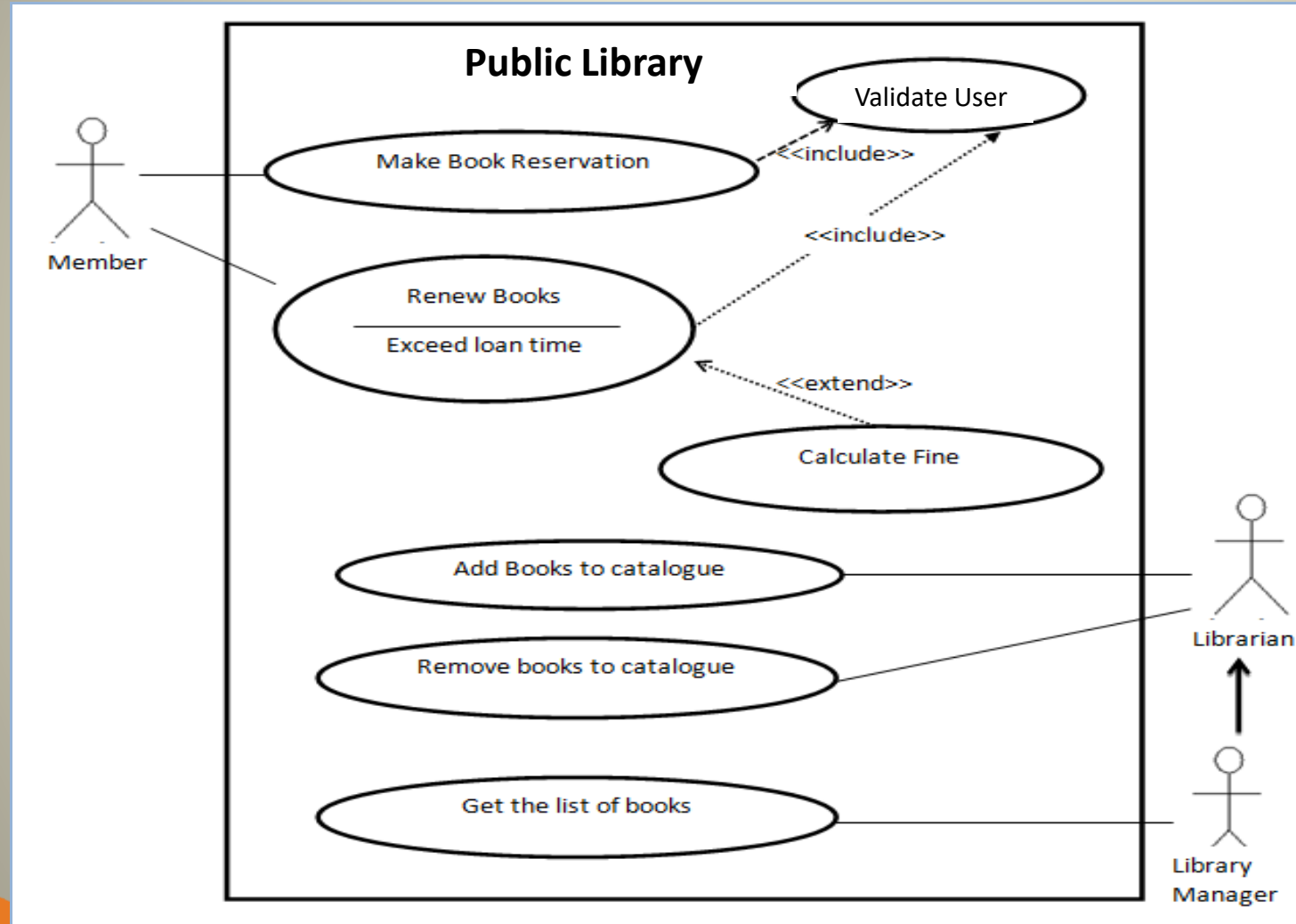
# Activity

Update the Public Library for the below given criteria.

**Member can renew the books he/she has borrowed. When renewing if book has exceeded the loan period a fine will be calculated. For renewing purposes the member should login to the system.**



# Activity Answer



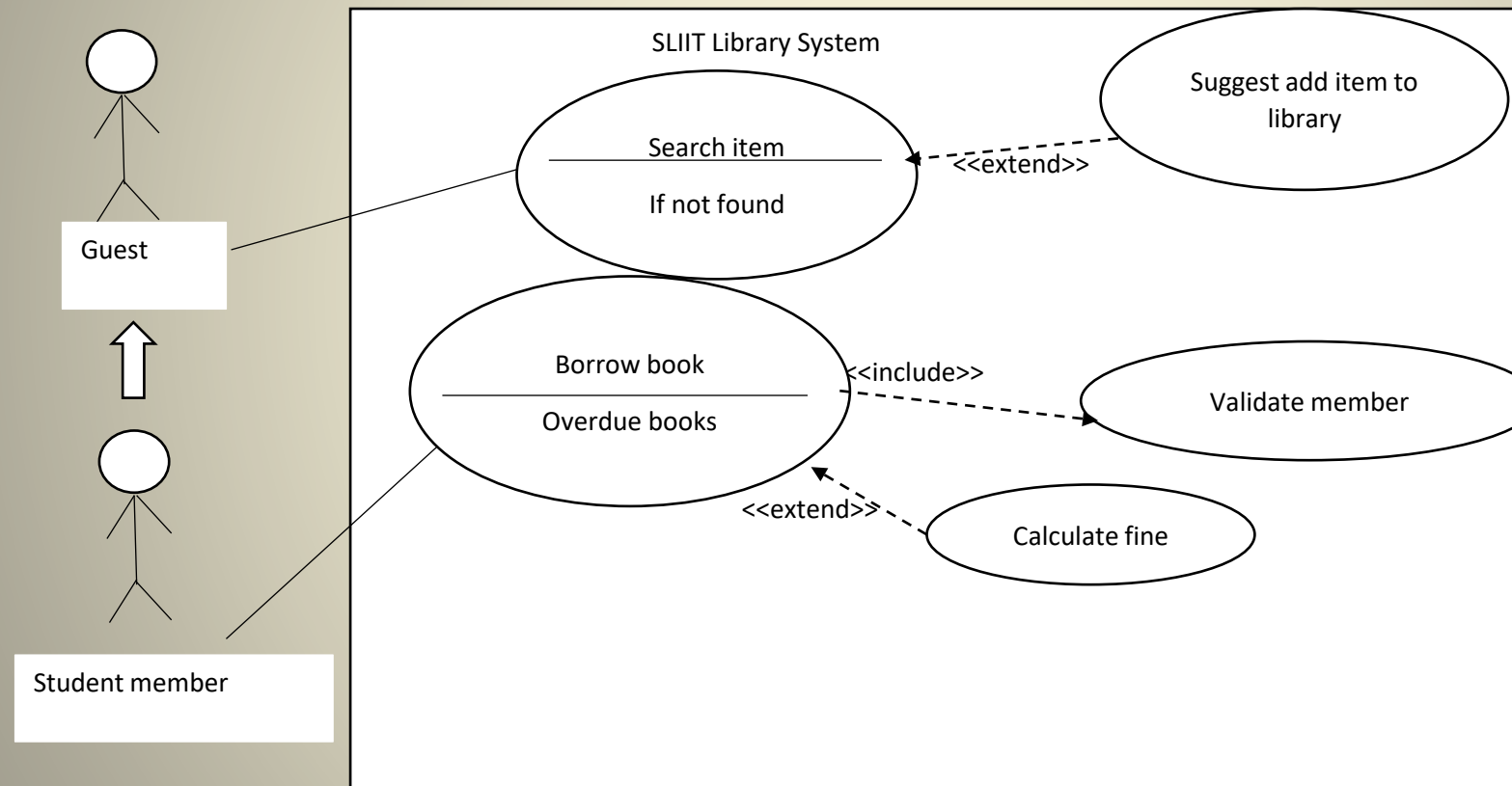
# Activity

- Draw the extends relationships for the SLIIT Library System





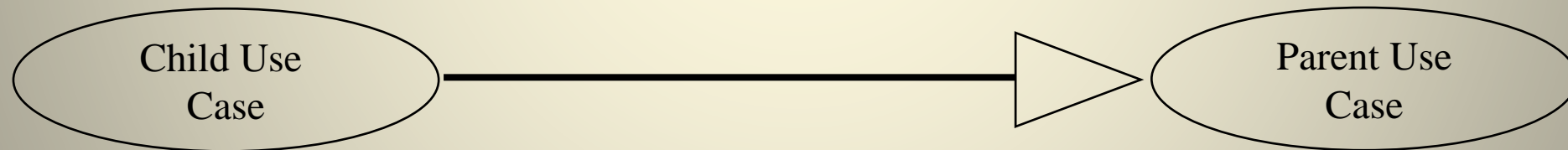
# SLIIT Library System – Sample Answer



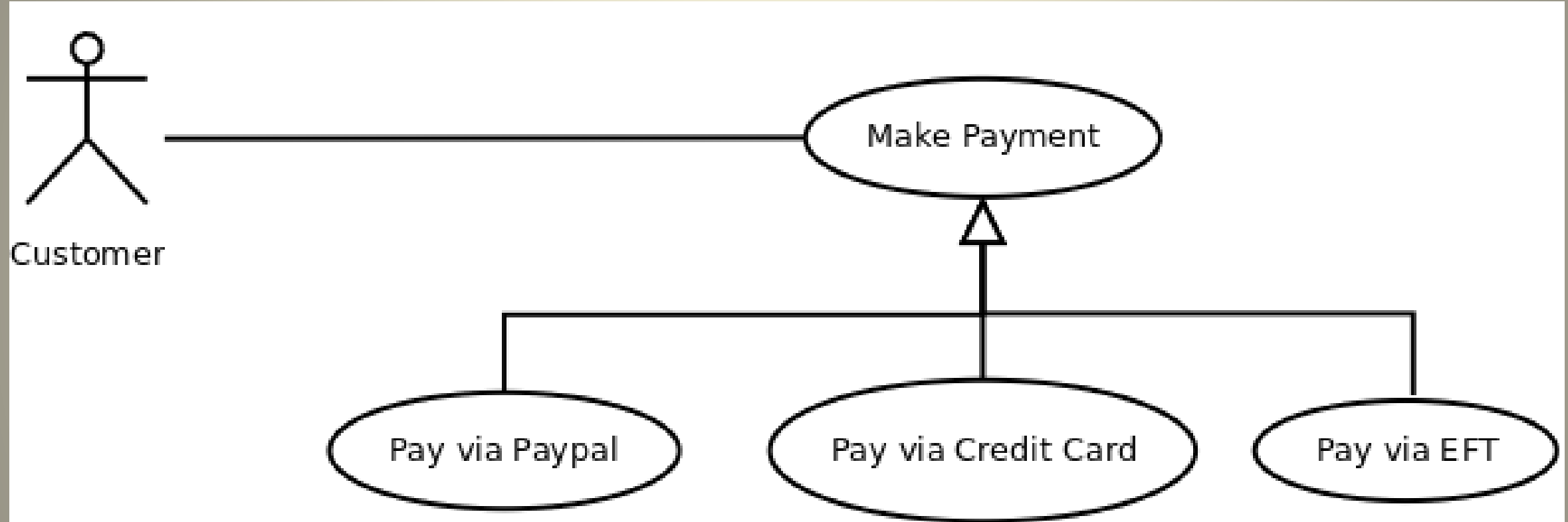
# Generalization Relationship

## 3) Generalization

- The child use case inherits the behavior and meaning of the parent use case.
- The child may add to or override the behavior of its parent.



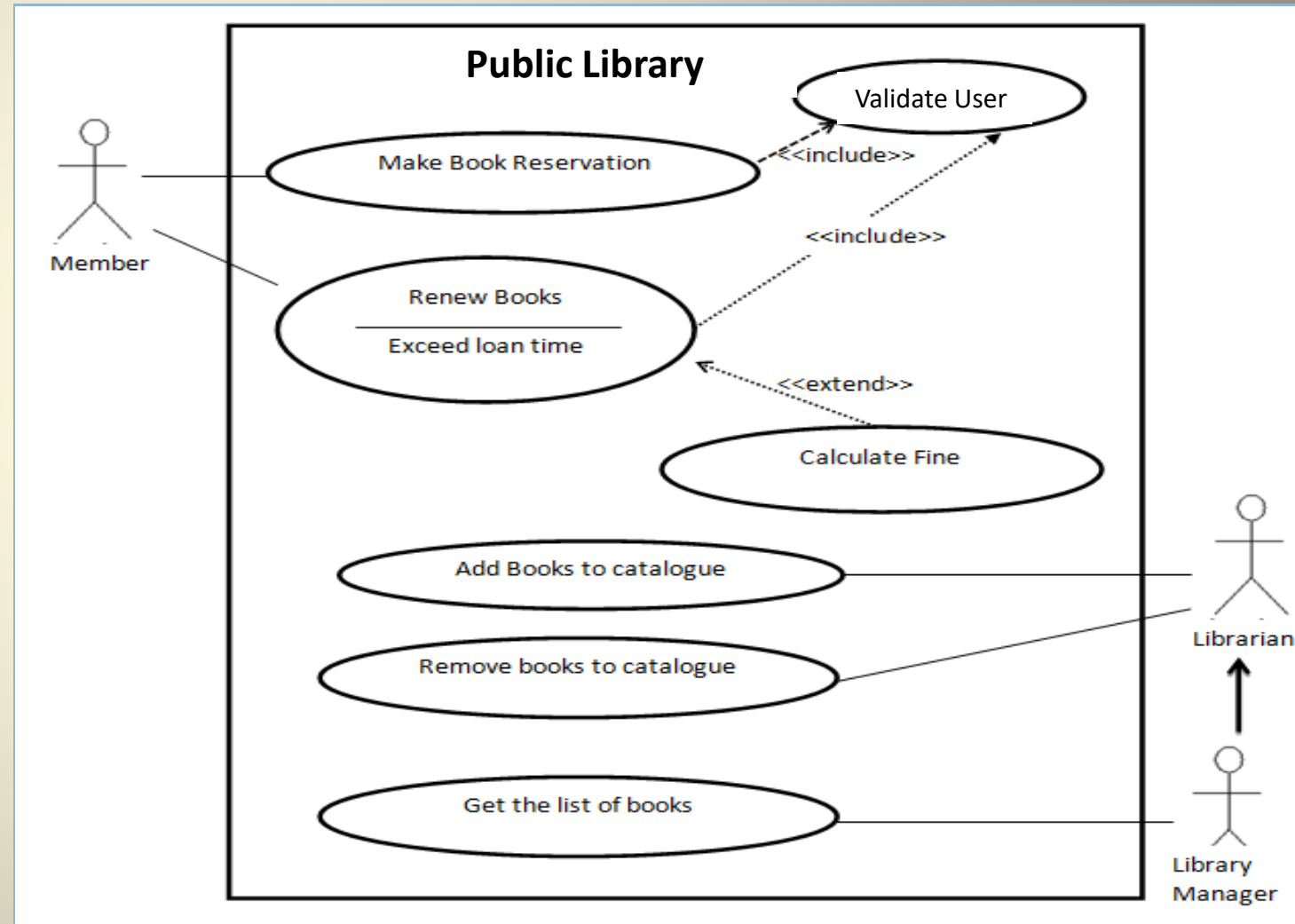
# Generalization Relationship



# Activity

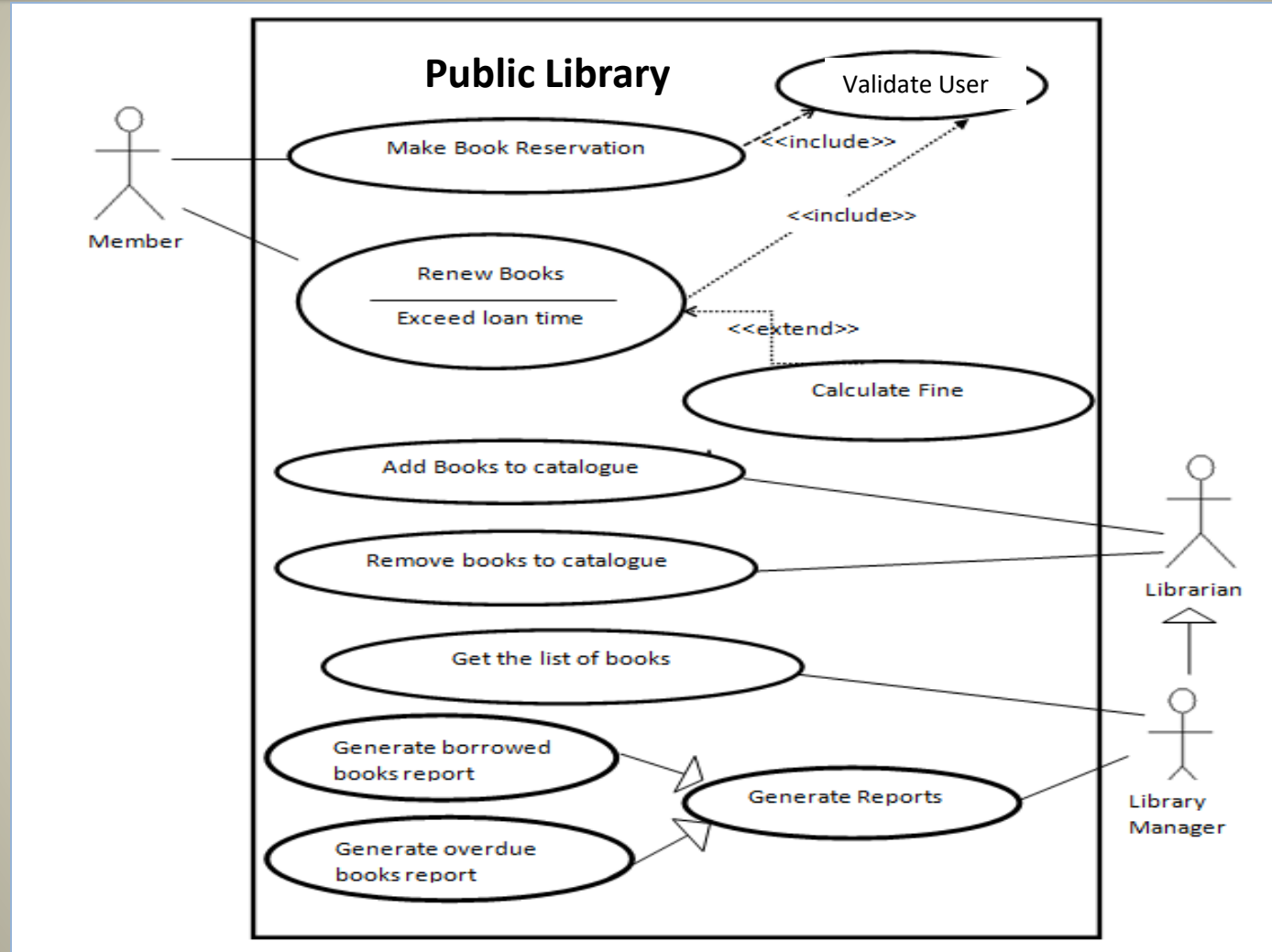
Update the use case diagram of the Public Library for the below given criteria.

*Library Manager can generate reports of the Borrowed books, Overdue books at the end of each month.*




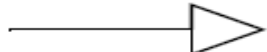


# Activity Answer



# Relationship Summary

**Table 6-1:** *Kinds of Use Case Relationships*

<i>Relationship</i>	<i>Function</i>	<i>Notation</i>
association	The communication path between an actor and a use case that it participates in	
extend	The insertion of additional behavior into a base use case that does not know about it	«extend» - - - - ➤
include	The insertion of additional behavior into a base use case that explicitly describes the insertion	«include» - - - - ➤
use case generalization	A relationship between a general use case and a more specific use case that inherits and adds features to it	

# Use Case Scenarios

- A Scenario is a formal description of the flow of events that occur during the execution of a Use Case instance. It defines the specific sequence of events between the system and the external Actors.
- There is usually a **Main scenario**, which describes what happens when everything goes to plan. It is written under the assumption that everything is okay, no errors or problems occur, and it leads directly to the desired outcome of the use-case.

# Use Case Scenarios

- **Other scenarios** describe what happens when variations to the Main scenario arise, often leading to different outcomes.
- So the flow of events should include:
  - **How** and **when** the use case **starts** and **ends**
  - When the use case **interacts** with the actors
  - What objects are exchanged
  - The **basic flow** and
  - **Alternative flows** (exceptional) of the behavior.



# Use Case Sample Template

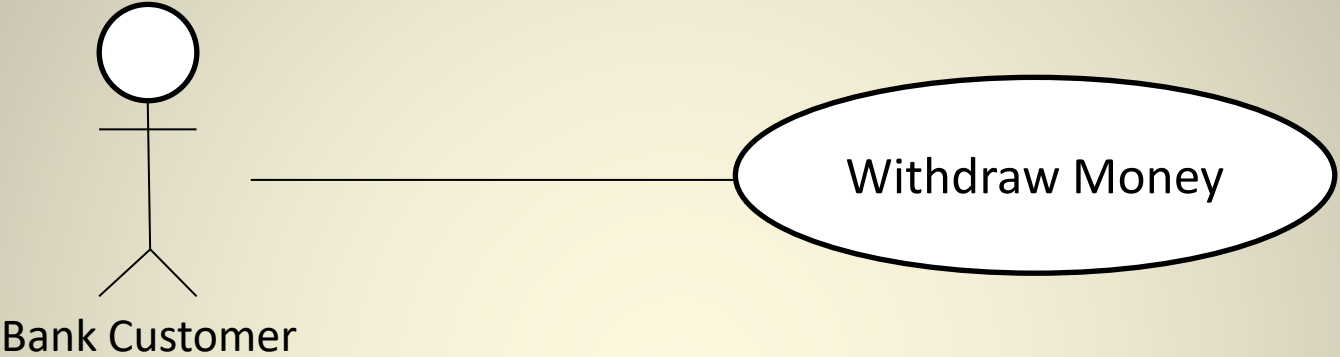
1. Use Case ID and name
2. Characteristic Information
  - » Goal in Context
  - » Scope
  - » Level
3. Pre-Conditions
4. Primary Actor
5. Main Success Scenario Steps
6. Extensions
7. Optional Information

## Use Case Specification Template\*

<b>Number</b>	<i>Unique use case number</i>	
<b>Name</b>	<i>Brief noun-verb phrase</i>	
<b>Summary</b>	<i>Brief summary of use case major actions</i>	
<b>Priority</b>	<i>1-5 (1 = lowest priority, 5 = highest priority)</i>	
<b>Preconditions</b>	<i>What needs to be true before use case “executes”</i>	
<b>Postconditions</b>	<i>What will be true after the use case successfully “executes”</i>	
<b>Primary Actor(s)</b>	<i>Primary actor name(s)</i>	
<b>Secondary Actor(s)</b>	<i>Secondary actor name(s)</i>	
<b>Trigger</b>	<i>The action that causes this use case to begin</i>	
<b>Main Scenario</b>	<b>Step</b>	<b>Action</b>
	<i>Step #</i>	<i>This is the “main success scenario” or “happy path.”</i>
	<i>...</i>	<i>Description of steps in successful use case “execution”</i>
	<i>...</i>	<i>This should be in a “system-user-system, etc.” format.</i>
<b>Extensions</b>	<b>Step</b>	<b>Branching Action</b>
	<i>Step #</i>	<i>Alternative paths that the use case may take</i>
<b>Open Issues</b>	<i>Issue #</i>	<i>Issues regarding the use case that need resolution</i>

\*Adapted from A. Cockburn, “Basic Use Case Template”

# Use Case Specification Template Example



Number	1
Name	Withdraw Money
Summary	User withdraws money from one of his/her accounts
Priority	5
Preconditions	User has logged into ATM
Postconditions	User has withdrawn money and received a receipt
Primary Actor(s)	Bank Customer

Continued ...

<b>Trigger</b>	User has chosen to withdraw money	
<b>Main Scenario</b>	<b>Step</b>	<b>Action</b>
	1	System displays account types
	2	User chooses account type
	3	System asks for amount to withdraw
	4	User enters amount
	5	System debits user's account and dispenses money
	6	User removes money
	7	System prints and dispenses receipt
	8	User removes receipt
	9	System displays closing message and dispenses user's ATM card
	11	User removes card
	10	System displays welcome message
<b>Extensions</b>	<b>Step</b>	<b>Branching Action</b>
	5a	System notifies user that account funds are insufficient
	5b	System gives current account balance
	5c	System exits option
<b>Open Issues</b>	1	Should the system ask if the user wants to see the balance?



# Activity

- Write a Use Case Scenario for “**Borrowing a Book**”

You could consider the process given below as the manual system procedure.

The member identifies him or herself to the librarian and indicates which books they wish to borrow.

If it is acceptable for them to borrow these books, i.e. they are not marked “for reference only”, or the number of books on loan to the customer is less than some predetermined maximum, then the books are loaned to the customer for a specified loan period.

The members loan record is updated to reflect the loaned books. The libraries card index system is updated to show who has borrowed the books.

## Activity Sample Answer– Borrow a book

<b>Number</b>	1
<b>Name</b>	Borrow a book
<b>Summary</b>	User borrows a specific book
<b>Preconditions</b>	User has access to the system
<b>Postconditions</b>	User gets the confirmation
<b>Primary Actor(s)</b>	Library User

Continued ...

<b>Trigger</b>	User has chosen to borrow a book	
<b>Main Scenario</b>	<b>Step</b>	<b>Action</b>
	1	User logs in to the system
	2	User scans the ISBN of the book
	3	System checks the validity of the request
	4	System shows the summary of the request with the user's membership details
	5	User confirms the request summary
	10	System displays the confirmation message
<b>Extensions</b>	<b>Step</b>	<b>Branching Action</b>
	1a	System notifies login details are invalid, exits
	1b	System notifies invalid membership, exits
	2a	System cannot read ISBN, ask the user to enter the ISBN manually
	3a	System notifies the title is for "Reference Only", exits
	3b	System notifies the user has exceeded the number of books he can borrow, exits
	5a	User Cancels the request, system exits

# References

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- *Writing Effective Use Cases*
  - *By Dr. Alistair Cockburn*
- UML 2 Bible