AMSS Lecture 3: Requirements Analysis

UML Use Case / Sequence Diagrams

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Agenda

1. What are requirements?
2. Scenarios and use cases
3. UML Use Case Diagrams
4. **Interactive Exercise 1:** Identify actors and use cases
5. UML Sequence Diagrams
6. **Interactive Exercise 2:** Model an interaction
7. Wrap-up and discussion

What Are Requirements?

- **Definition:** Descriptions of what the system must do and under what constraints.
- **Purpose:** Ensure all stakeholders share a common understanding of the system.
- **Main types:**
    - **Functional requirements:** what the system should *do*
    - **Non-functional requirements:** how the system should *be*
    - **Domain requirements:** external or business rules

Examples:

A course management system should:

functional
: *allow registered students to submit assignments online*

non-functional
: *be able to accomodate up to 50k students*

domain
: *comply with GDPR regulations*

Why Requirements Matter

- Guide design and development
- Prevent misunderstandings between stakeholders
- Support validation and testing
- Serve as the basis for modeling and documentation

Without good requirements: models and implementations diverge from real needs.

Example (negative): Denver Airport Baggage System

Goal: Fully automated baggage handling system for all airlines

What Went Wrong:

- **Unclear & Changing Requirements:**
  Frequent scope changes, especially from airlines
- **Stakeholder Misalignment:**
  Conflicting airline needs not reconciled
- **Overly Ambitious Design:**
  Unrealistic automation goals
- **Poor Communication:**
  Incomplete and inconsistent requirement documentation

Impact:

- **16-month delay**
- **$560M cost overrun**
- **System never operational**

Key Lesson:

Clear, stable, and agreed-upon requirements are essential for complex system success.

From Requirements to Scenarios

- **Scenarios** = stories about how users interact with the system
- Each scenario focuses on one **goal** or **task**
- Scenarios help identify **actors** and **use cases**

Example Scenario:

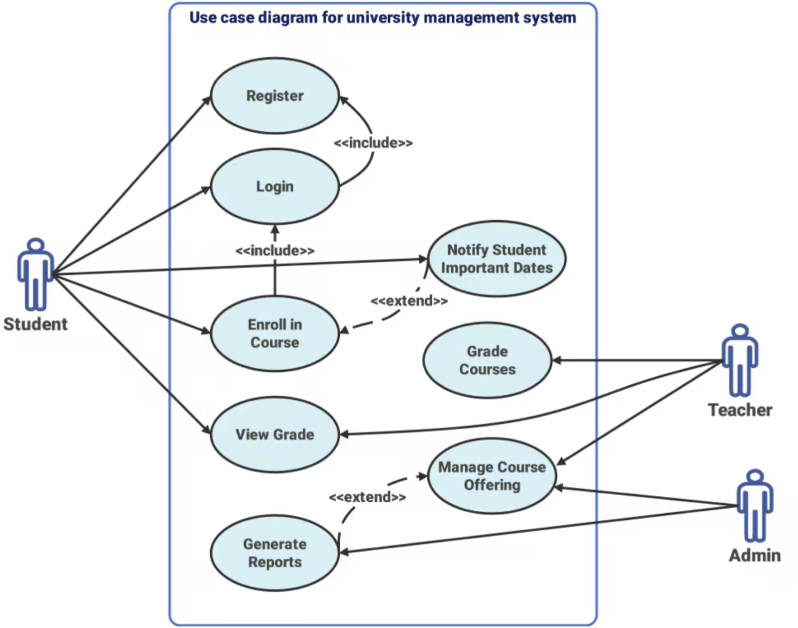
> *A student logs into the portal, views enrolled courses, and submits a project file.*

Use Cases

- A **use case** is a description of a system's behavior as it responds to a request from an actor.
- **Actors:** users or systems interacting with ours
- **System boundary:** separates internal from external elements

Notation: ovals (use cases), stick figures (actors), box (system boundary)

Example



Use case diagram for university management system
Register
<<include>>
Login
<<include>>
Notify Student Important Dates
<<extend>>
Enroll in Course
Grade Courses
View Grade
Manage Course Offering
<<extend>>
Generate Reports
Student
Teacher
Admin

Relationships Between Use Cases

- **Include:** mandatory reusable functionality
- **Extend:** optional or conditional behavior
- **Generalization:** specialization of an actor or use case

Example

- `Login` includes `Register`
- `Generate Reports` extends `Manage Course Offering`

Interactive Exercise 1: Identify Actors and Use Cases

Scenario: A university online examination system.

Students can register for exams, view schedules, and submit answers online. Professors can create exams, publish grades, and review submissions. The system authenticates all users.

Tasks

1. Identify at least 3 actors.
2. Define 5–7 use cases.
3. Sketch a use case diagram.

UML Sequence Diagrams

Visualize the sequence of interactions that fulfill a use case.

- Describe **how** objects interact to perform a use case
- Focus on **message order** and **lifelines** over time

Elements

- Actor / object lifelines
- Messages (synchronous, asynchronous, return)
- Activation bars (execution time)

Example Sequence Diagram

Scenario: “User logs into the system”

Actors and objects:

- `User`
- `LoginPage`
- `AuthService`
- `Database`

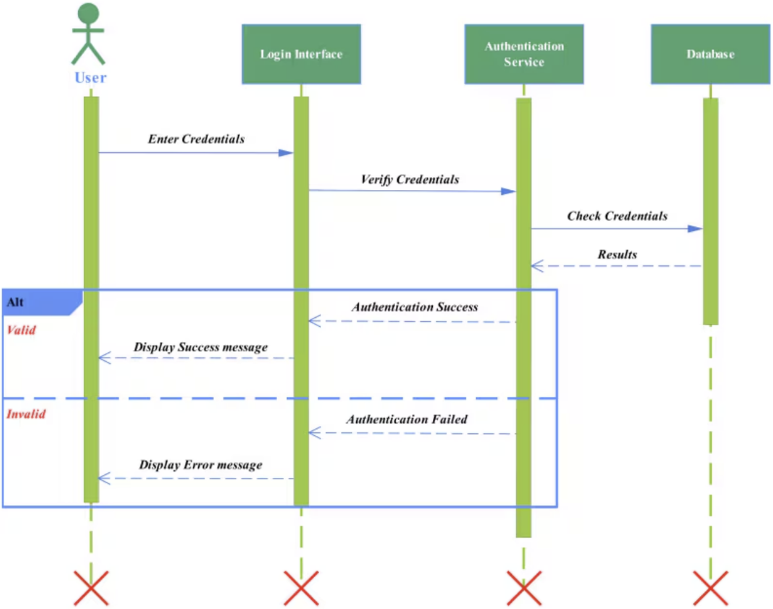
Steps

1. User enters credentials into a LoginInterface
2. The LoginPage send verify credentials message to an AuthenticationService
3. The AuthService sends check credentials to a Database
4. The Database returns result
5. The AuthService responds with success
6. The Login Interface replies with success message

5a. The AuthService responds with error: Authentication Failed.

`The Login Interface replies with success message`

Example


User
Login Interface
Authentication Service
Database
Enter Credentials
Verify Credentials
Check Credentials
Results
Alt
Valid
Authentication Success
Display Success message
Invalid
Authentication Failed
Display Error message

Interactive Exercise 2: Model an Interaction

Scenario: "Customer places an order in an online shop."

Actors and objects

- `Customer`
- `WebApp`
- `OrderService`
- `PaymentGateway`
- `Database`

Tasks

1. Identify the main sequence of messages.
2. Draw a sequence diagram (lifelines, messages, returns).
3. Include one alternative path (e.g., payment failure).

Wrap-Up

Key Takeaways

- Requirements describe *what* the system must do.
- Scenarios make requirements concrete.
- Use case diagrams capture system functionality and boundaries.
- Sequence diagrams model detailed interactions.

Next Lecture

Some design patterns