Software Engineering (SWE-250)

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Queries

In natural language specification pros & cons of writing the rationale and source of requirement with it?

Why to use a particular format as an standard for writing the requirements?

How tabular specification supports natural language and structured natural language specification?

What bits of information should we consider to put in form based specification?

How graphical notation can be used to represent requirements like user requirements?

What is UML and why it is called as a language?

Techniques of requirements validation?

What decisions to take in requirements management planning?

Process of requirements change management?

System Modeling

System modeling is the process of developing **abstract models of a system.**

Models are used during the requirements engineering process to **help derive** the **detailed requirements** for a system, during the design process to **describe the system to engineers implementing** the system, and after implementation to **document the system's structure and operation**.

Models of **existing systems** are used to clarify what existing system does.

Models of **new systems** help explain the proposed requirements of system to stakeholders.

Models present different views or perspectives of the system being developed.

Different System Perspectives

An **external perspective**, where **you model the external context or environment of the system**.

A **behavioral perspective**, where you model the **dynamic behavior (functionalities and chain of functionalities)** of the **system processes for the system** and how it **responds to events**.

An **interaction perspective**, where you model the **interactions between a system and its environment**, or **between the components of a system**.

A **structural perspective**, where you model the **structure of a system (depicting organization of its components) or the structure of the data** that is processed by the system.

External perspective: Context Model/Context Diagram

Context model is **high-level graphical representation** used to illustrate the **operational context** of a system that **shows what lies outside the system boundaries**.

The **operational context** of a system is defined as the **environment in which the system will operate** disclosing **information about all the entities may be other systems, hardware and people** that interact with the system, impacting the system through **their events** and may be **sharing the data with** the system or **receiving the data from** the system.

External perspective: Context Model

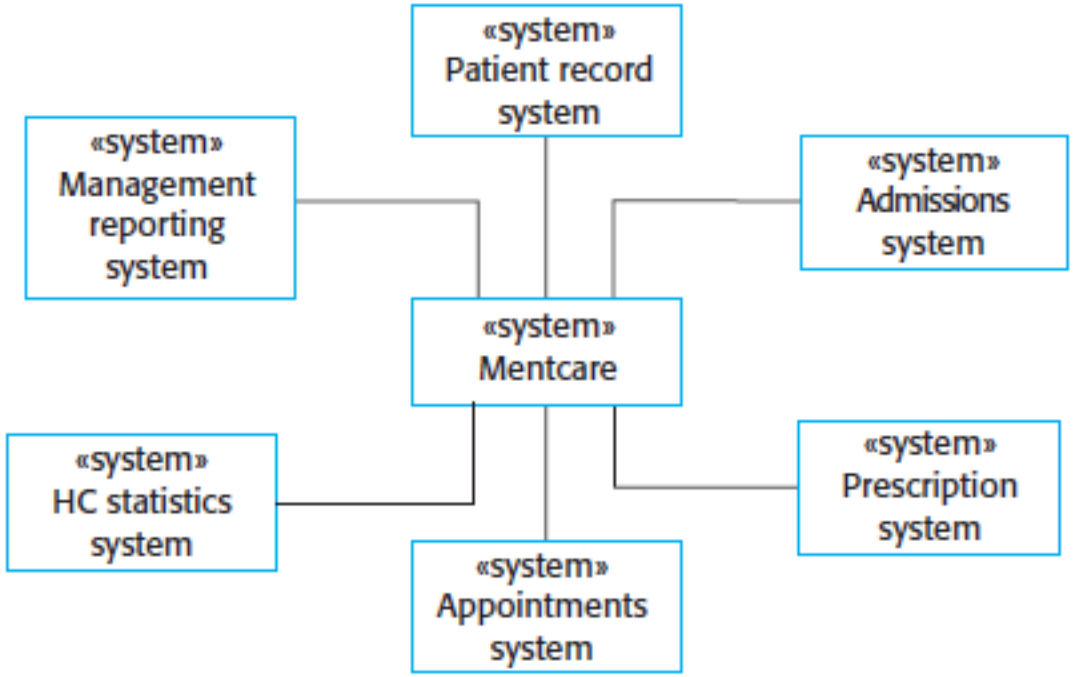
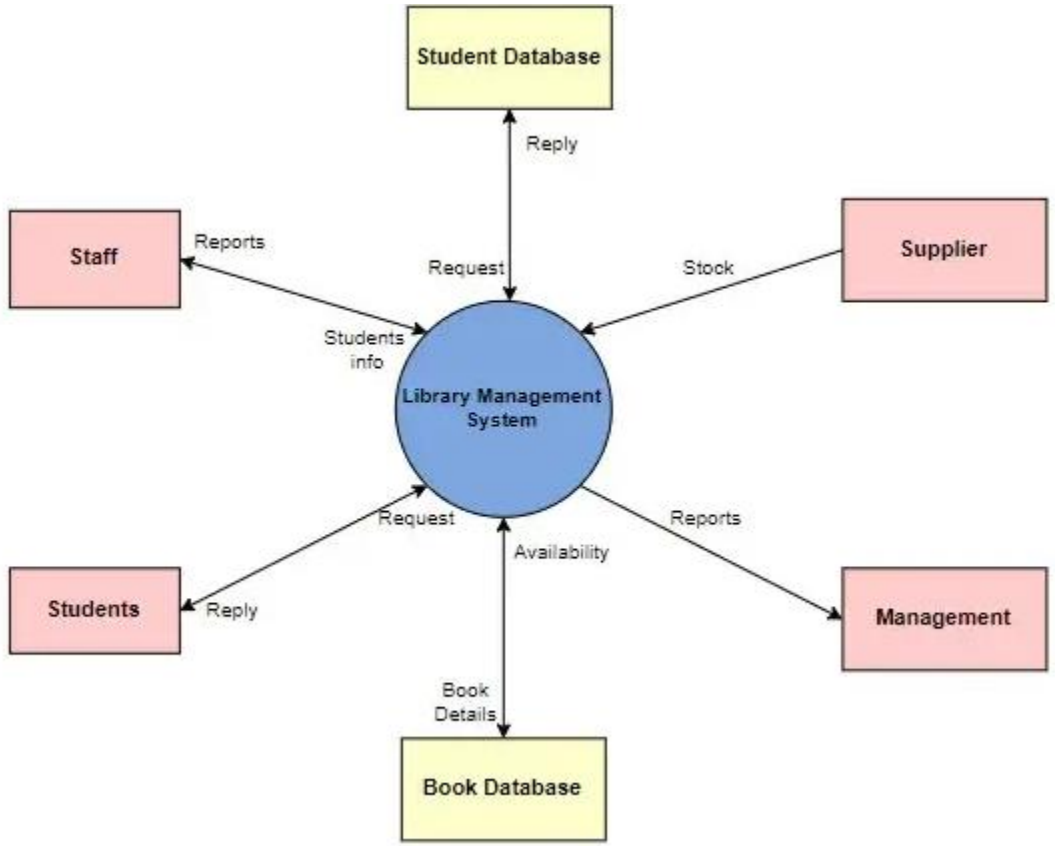


Figure 5.1 The context of the Mentcare system

External perspective: Context Model: Context Diagram



The Unified Modeling Language (UML: 2.5.1)

The Unified Modeling Language (UML) is a **general-purpose visual modeling language** that is used to **specify, visualize, construct, and document the artifacts of a software system**. (UML reference manual)

Modeling yields an understanding of a system. **No one model** is **ever sufficient**. Rather, **multiple models** are needed that are **connected to one another**. (UML guide)

Behavioral Perspective: UML Activity Diagram

An **Activity Diagram** is a type of **behavioral** diagram used in **(UML)** to **model/visualize processes/work flows** from **start to finish** showing the **sequence of activities**, **decisions** that may be taken to execute **selected activity** in the flow and **activities** that may be **executed in parallel** to complete the process.

Activity diagrams provide a clear picture of **simple & complex workflows** to understand **how various elements fit** together.

Behavioral Perspective: UML Activity Diagram

Examples Activity Diagram Usage Examples:

To model the **business process->flow of tasks and steps of tasks or components as elements for a system** (may not be a software system but software system may be the part/element of it)

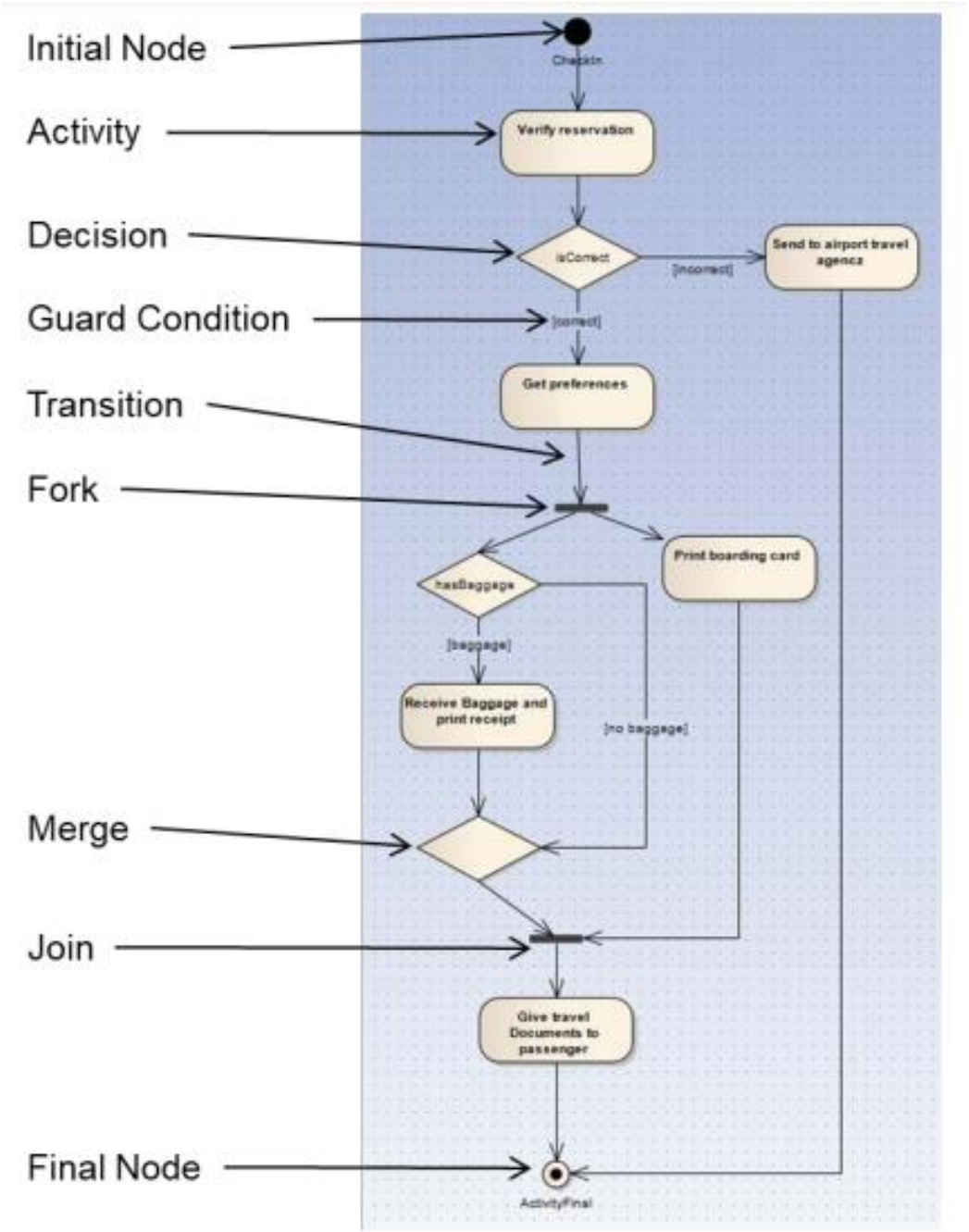
To model the **sequence of functions called** to perform some task within the system.

To model **data flow** between the **functions of a system**.

To model the **logic of an algorithm in steps**.

To model the **steps performed in a UML use case**.

UML Activity Diagram Notation and Business Process Modeling



UML Activity Diagram
Business Process Modeling

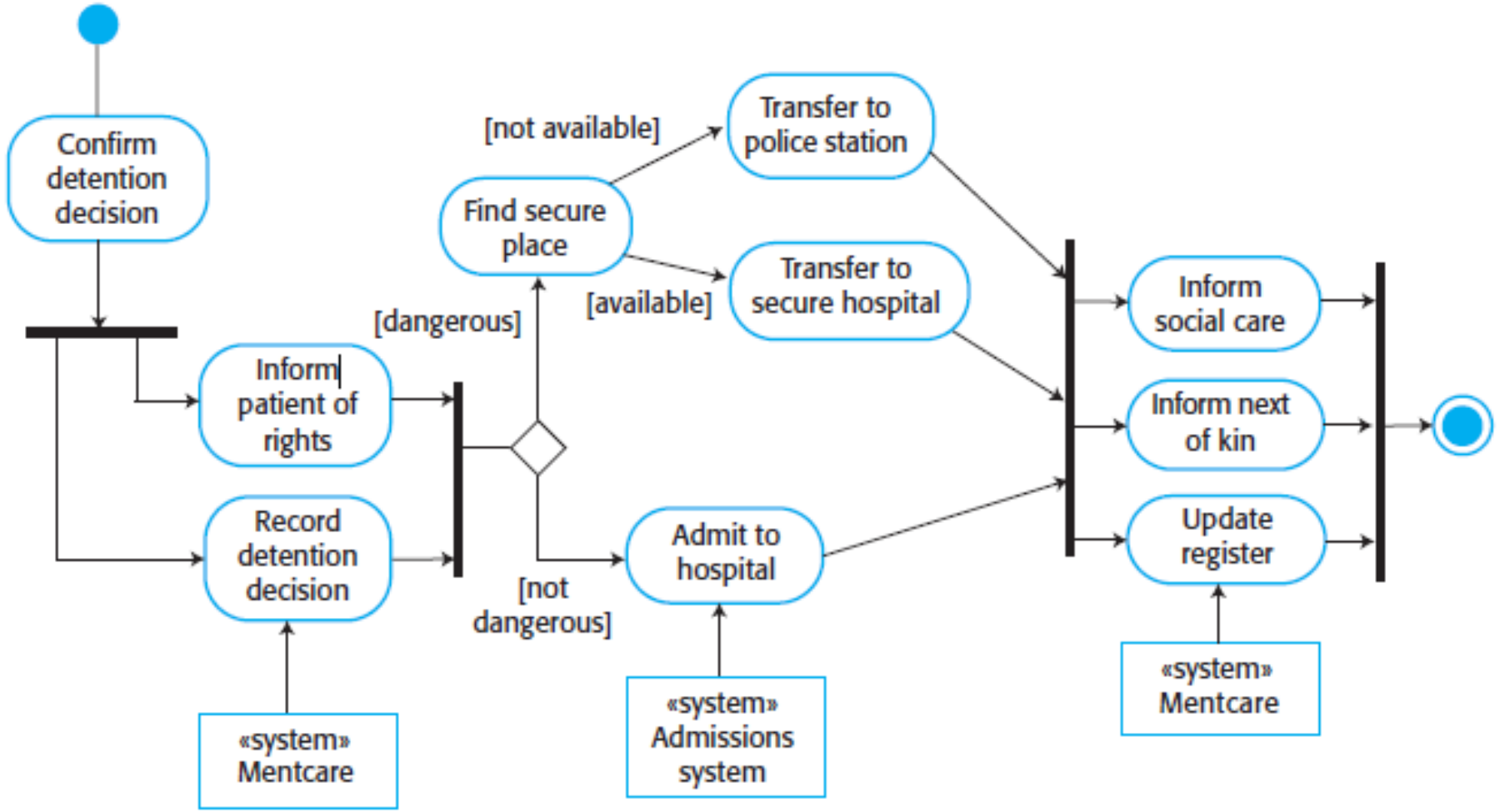
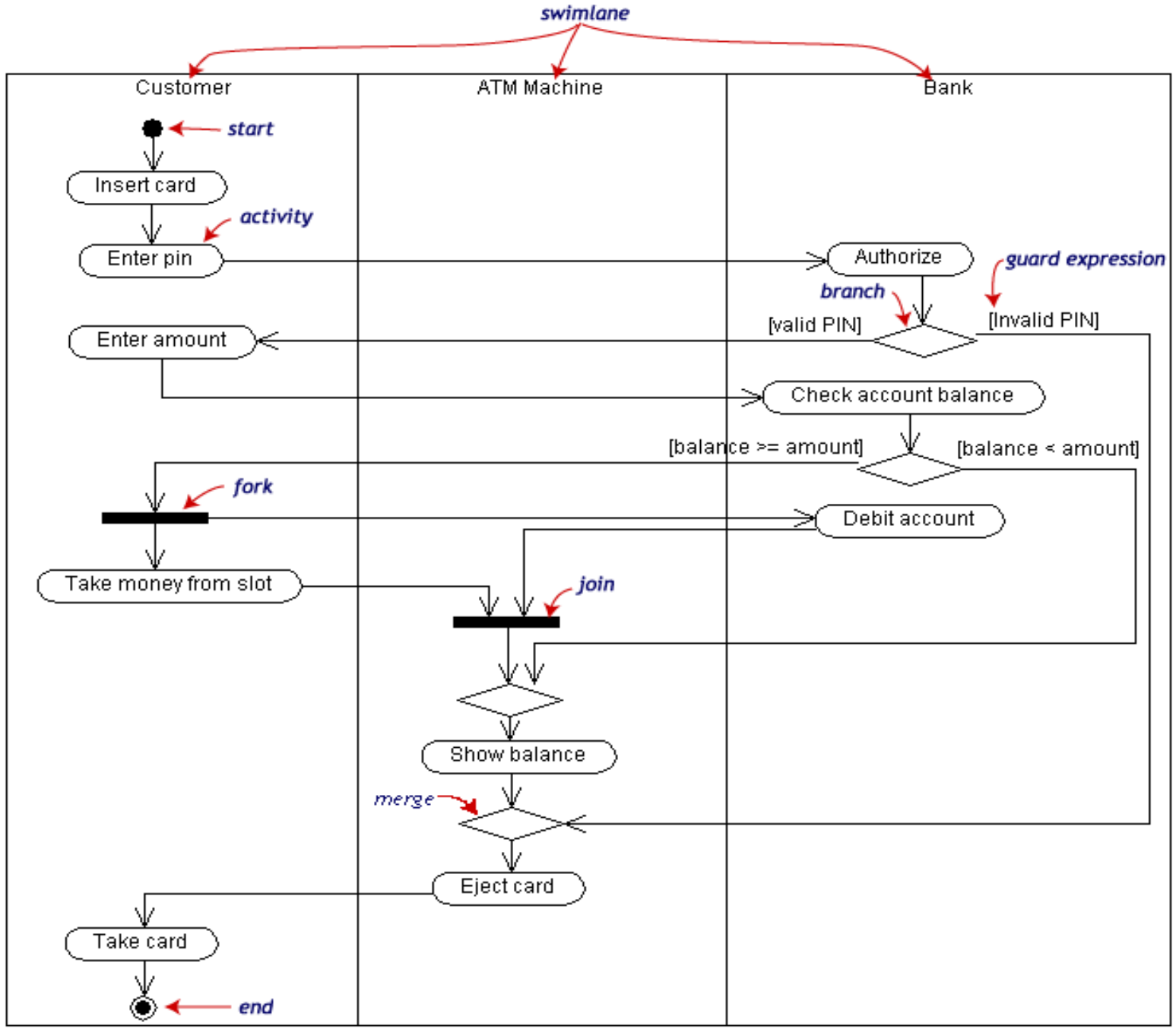


Figure 5.2 A process model of involuntary detention

Example: Activity Diagram for System behavior: Withdraw Money Process from ATM



Example: Activity Diagram as a Data Flow Diagram: Data Driven Modeling

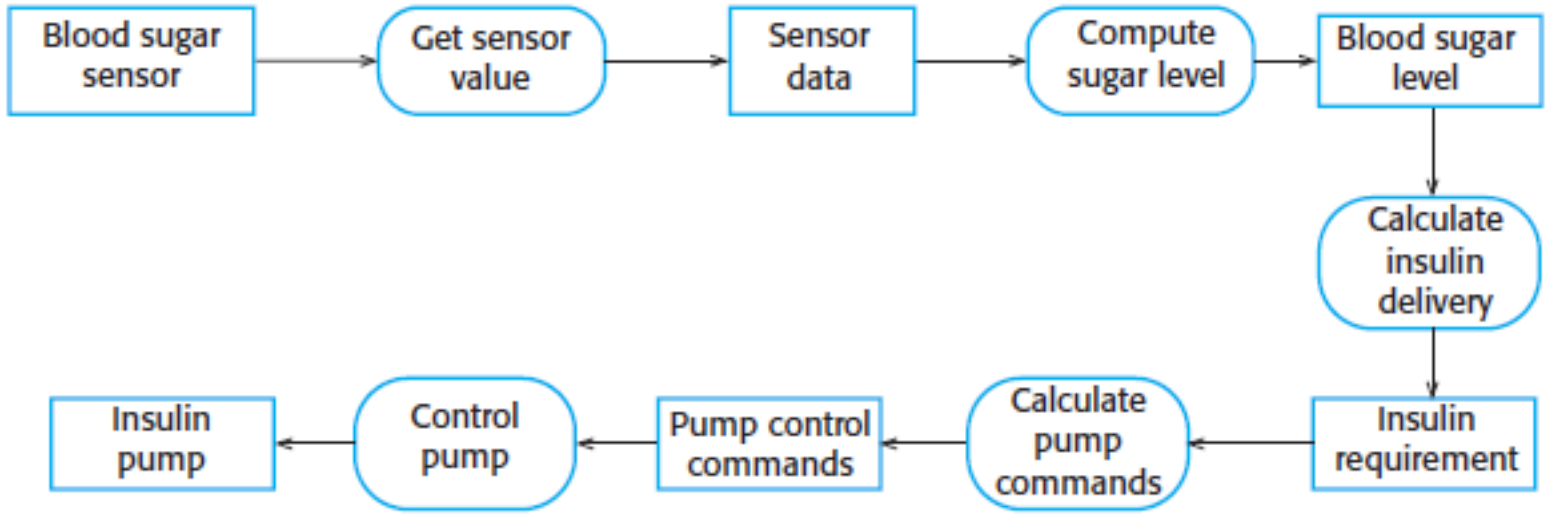


Figure 5.14 An activity model of the insulin pump's operation

Interaction Perspective: UML Use Case Diagram :Use Case Modeling

Use case modeling was originally developed by Ivar Jacobsen in the 1990s (Jacobsen et al. 1993).

A Use Case Diagram is a visual representation that illustrates the interactions between actors and a system.

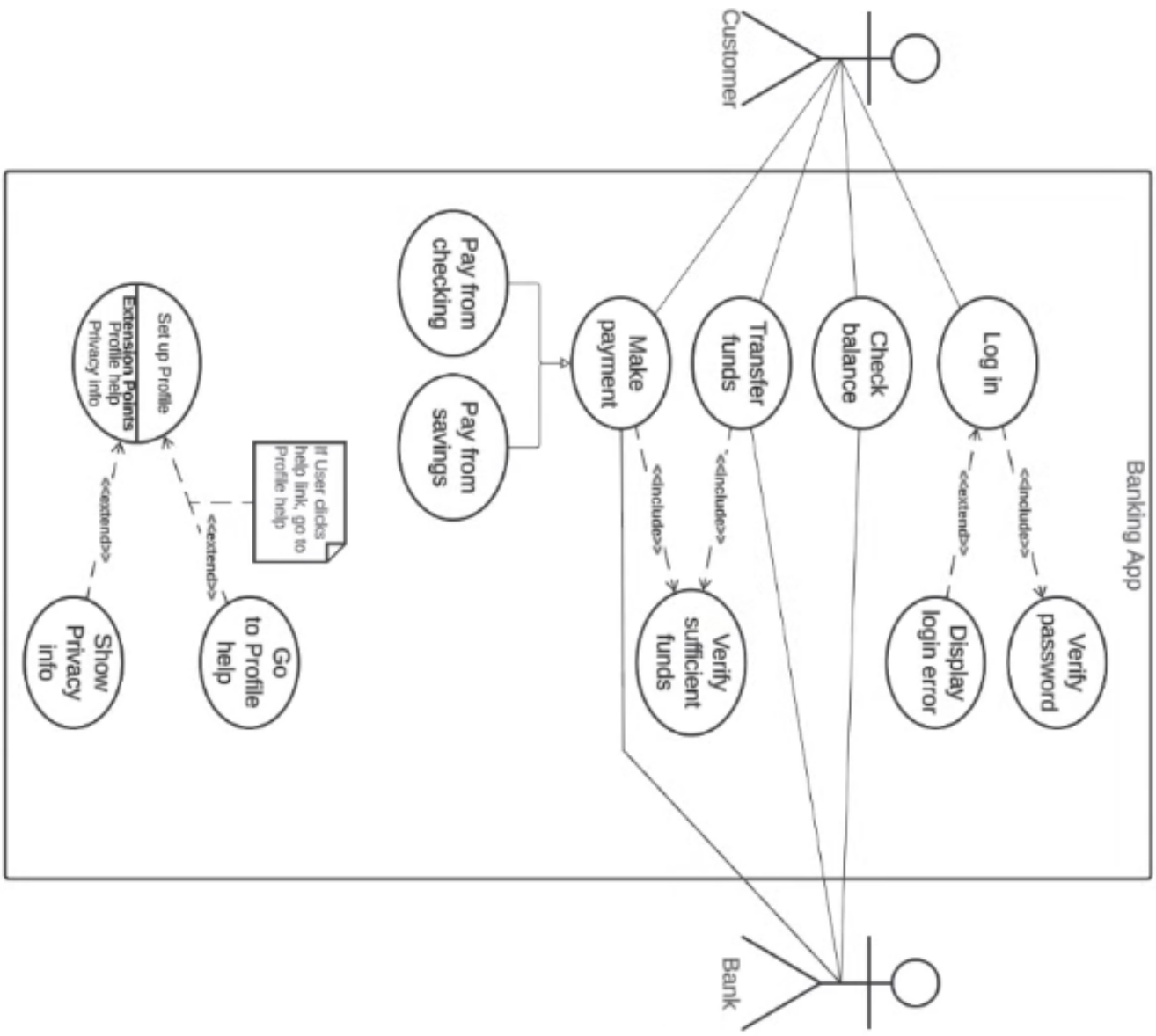
Each interaction **represents a discrete task** and is called as a use case.

In its simplest form, a **use case is shown as an ellipse**, with the **actors** involved in the use case represented as **stick figures**.

The **stick figure** notation was originally developed to cover **human interaction**, but it is also used to **represent other external systems and hardware**.

Use case diagrams give a **simple overview of an interaction**, and you need to add more **detail for complete interaction description**. This detail can either be a **simple textual description**, a **structured description** in a table, or a **sequence diagram**.

Interaction Perspective: UML Use Case Diagram :Use Case Modeling



Interaction Perspective: UML Use Case Diagram :Use Case Modeling

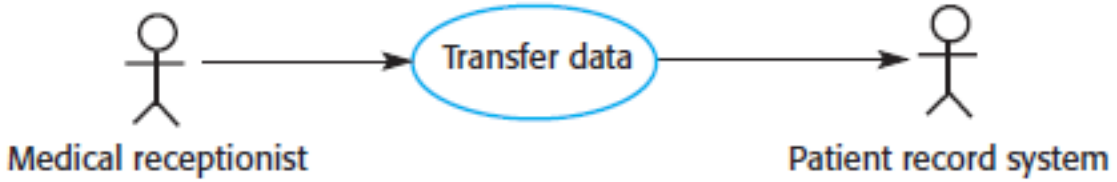


Figure 5.3 Transfer-data use case

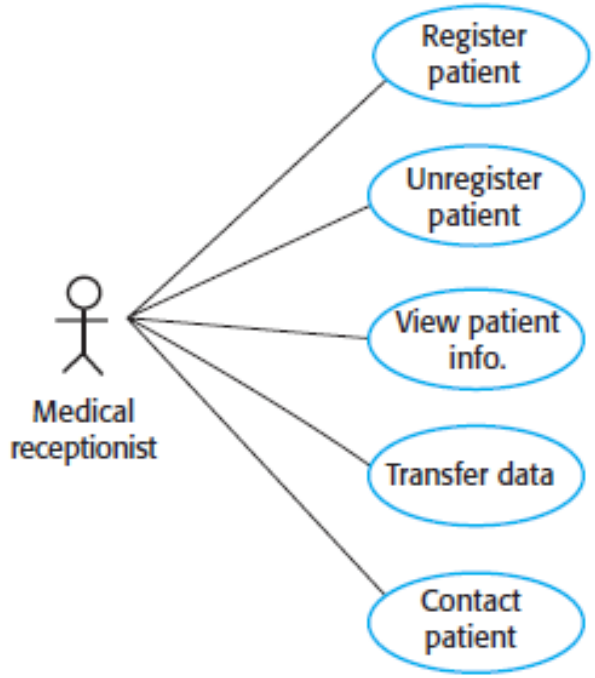


Figure 5.5 Use cases involving the role "Medical receptionist"

Interaction Perspective: Use Case Description

Mentcare system: Transfer data	
Actors	Medical receptionist, Patient records system (PRS)
Description	A receptionist may transfer data from the Mentcare system to a general patient record database that is maintained by a health authority. The information transferred may either be updated personal information (address, phone number, etc.) or a summary of the patient's diagnosis and treatment.
Data	Patient's personal information, treatment summary
Stimulus	User command issued by medical receptionist
Response	Confirmation that PRS has been updated
Comments	The receptionist must have appropriate security permissions to access the patient information and the PRS.

Figure 5.4 Tabular description of the Transfer-data use case

Interaction Perspective: Use Case Description

ID and Name:	UC-4 Request a Chemical		
Created By:	Lori	Date Created:	8/22/13
Primary Actor:	Requester	Secondary Actors:	Buyer, Chemical Stockroom, Training Database
Description:	The Requester specifies the desired chemical to request by entering its name or chemical ID number or by importing its structure from a chemical drawing tool. The system either offers the Requester a container of the chemical from the chemical stockroom or lets the Requester order one from a vendor.		
Trigger:	Requester indicates that he wants to request a chemical.		
Preconditions:	PRE-1. User's identity has been authenticated. PRE-2. User is authorized to request chemicals. PRE-3. Chemical inventory database is online.		
Postconditions:	POST-1. Request is stored in the CTS. POST-2. Request was sent to the Chemical Stockroom or to a Buyer.		
Normal Flow:	**4.0 Request a Chemical from the Chemical Stockroom** 1. Requester specifies the desired chemical. 2. System lists containers of the desired chemical that are in the chemical stockroom, if any. 3. System gives Requester the option to View Container History for any container. 4. Requester selects a specific container or asks to place a vendor order (see 4.1). 5. Requester enters other information to complete the request. 6. System stores the request and notifies the Chemical Stockroom.		
Alternative Flows:	**4.1 Request a Chemical from a Vendor** 1. Requester searches vendor catalogs for the chemical (see 4.1.E1). 2. System displays a list of vendors for the chemical with available container sizes, grades, and prices. 3. Requester selects a vendor, container size, grade, and number of containers. 4. Requester enters other information to complete the request. 5. System stores the request and notifies the Buyer.		
Exceptions:	**4.1.E1 Chemical Is Not Commercially Available** 1. System displays message: No vendors for that chemical. 2. System asks Requester if he wants to request another chemical (3a) or to exit (4a). 3a. Requester asks to request another chemical. 3b. System starts normal flow over. 4a. Requester asks to exit. 4b. System terminates use case.		
Priority:	High		
Frequency of Use:	Approximately 5 times per week by each chemist, 200 times per week by chemical stockroom staff		
Business Rules:	BR-28, BR-31		
Other Information:	The system must be able to import a chemical structure in the standard encoded form from any of the supported chemical drawing packages.		
Assumptions:	Imported chemical structures are assumed to be valid.		

FIGURE 8-3 Partial specification of the Chemical Tracking System's "Request a Chemical" use case.

Interaction Perspective: UML Use case diagram Creation Steps

How to draw a Use Case diagram in UML?

Step 1: Add System Boundary

Step 2: Identify Actors

Step 3: Identify Use Cases

Step 4: Connect Actors and Use Cases

Step 5: Define Relationships

Step 6: Review and Refine

Step 7: Validate

Interaction Perspective: UML Use case diagram Creation: Actors Identification

Questions to identify actors of a system in use case diagram?

Who uses the system?

Who gets information from the system?

Who provides information to the system?

What other systems are communicating with this system?

Who have to be notified in case of any event occurrence?

Interaction Perspective Modeling: UML Sequence Diagram

Sequence diagrams in the UML are **primarily used to model the interactions between the actors and the objects** in a system and the **interactions between the objects themselves in a system.**

Sequence diagrams are used because **they offer a clear and detailed visualization of the interactions between objects** in a system, focusing on the **order and timing** of these interactions.

A sequence diagram is drawn in **two** dimensions, **Horizontal** (object dimension) and **Vertical** (time dimensions).

Interaction Perspective Modeling: UML Sequence Diagram

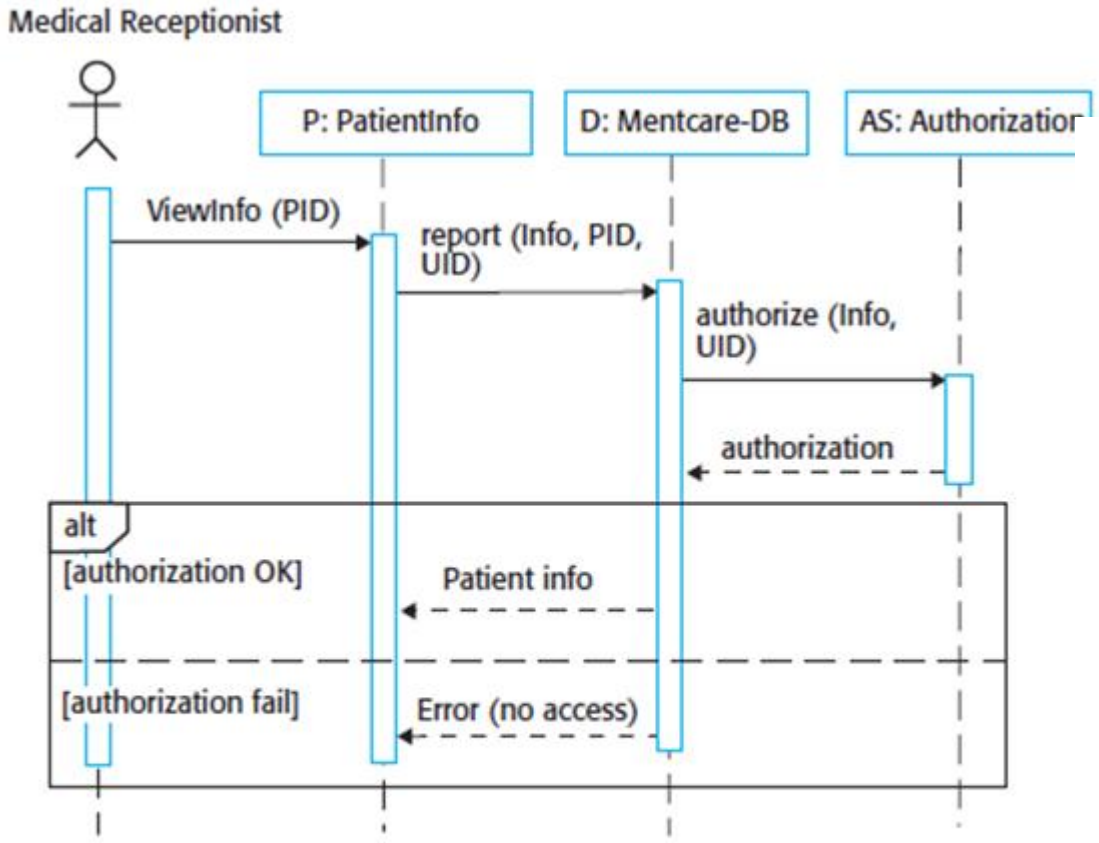
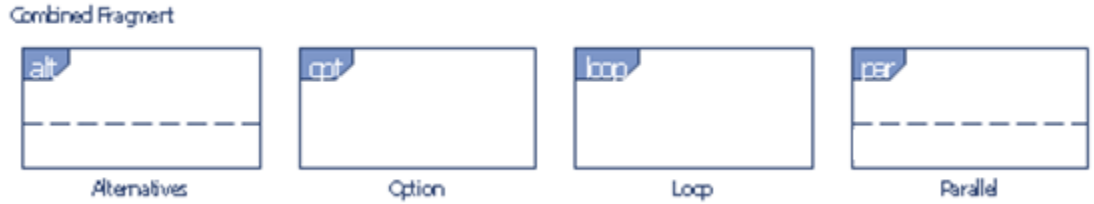
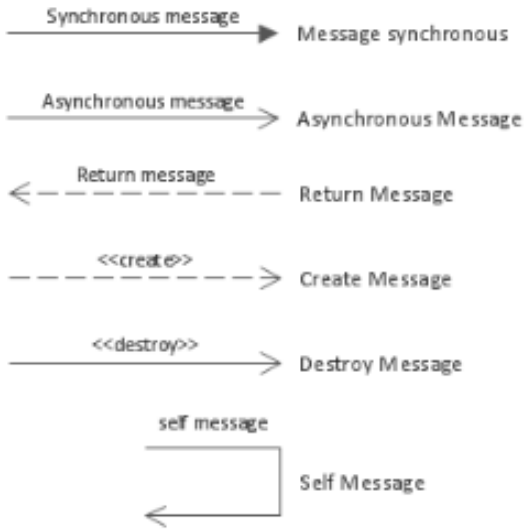


Figure 5.6 Sequence diagram for View patient information





Interaction Perspective Modeling: UML Sequence Diagram: Creation Steps

Steps sequence diagram creation:

Step 1: Identify the Scenario

Step 2: List the Participants (objects)

Step 3: Define Lifelines

Step 4: Arrange Lifelines

Step 5: Add Activation Bars (w.r.t calls)

Step 6: Draw Messages

Step 7: Include Return Messages

Step 8: Indicate Timing and Order

Step 9: Include Fragments

Step 10: Review and Refine

Step 11: Add Annotations and Comments