System Modeling

Chapter 5
part A

System Modeling
in the textbook

- **Context models**
- **Interaction models**
- Structural models
- Behavioral models
- Model-driven engineering

System Modeling

- System modeling is
  - the process of developing abstract models of a system,
  - each presenting a different view or perspective of that system.
- System models are **Abstract**
  - Not an alternate representation

System Perspectives

Different perspectives presented by models:

- **external**: context or environment of system
- **interaction**: between system and environment, or between components
- **structural**: organization of the system, or structure of data
- **behavioral**: dynamic behavior, how the system responds to events

System Modeling

- Notation to represent the models:
  - Graphical/diagrams (UML=Unified Modeling Language)
  - Formal/mathematical (ch 12)
- Models of the new system are used in:
  - Requirements development
  - Design process
  - Model-driven engineering
- Precision, completeness: not always necessary

UML Diagrams

We'll discuss these UML Diagrams

- **Activity diagrams**: the activities in a process.
- **Use case diagrams**: interactions between a system and its environment.
- **Sequence diagrams**: interactions between actors and the system and components.
- **Class diagrams**: classes in the system and the associations between these classes.
- **State diagrams**: how the system reacts to events.

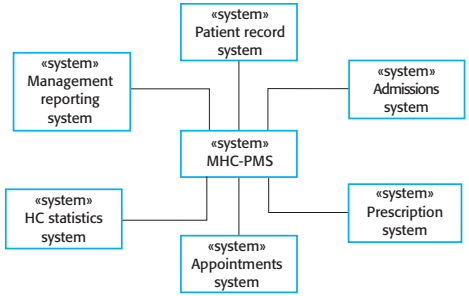
5.1 Context Models

- Primarily an external perspective
  - shows how system is situated or involved in its context
- Static View
  - shows what other systems it will interact with
- Dynamic View
  - shows how it is involved in business processes

Simple Context Model

- Static view
- Used to define system boundaries
  - what is done by new system, manually, or by another system
  - stakeholders must decide early
- Simple context model:
  - Boxes show each of the systems involved
  - Lines show interaction between systems
  - Overly simplified architectural model (ch 6)
  - Technically NOT a UML diagram

Fig 5.1: The context of the MHC-PMS



Note: <<system>> is an example of a "stereotype" in UML
A mechanism to categorize an element in some way

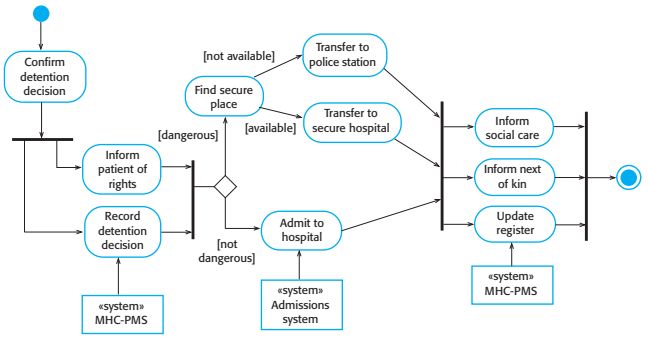
Process Model

- Dynamic view
- Shows how system is used in business processes
- UML Activity diagram
  - Shows activity and flow of control

filled circle: start
filled concentric circle: finish
rounded rectangles: activities
rectangles: other objects (the different systems in fig 5.2)
arrows: flow of work
diamonds: branch (and merge)
guards: condition under which flow is taken out of branch
solid bar: activity coordination/concurrency control (fork, join)

Fig 5.2: Process model of involuntary detention

Example of a UML Activity diagram



Note: This diagram is missing one branch and 2 merge diamonds

5.2 Interaction Models

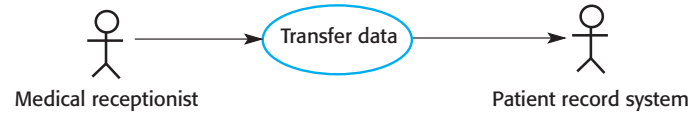
- Represents interactions
  - between system and environment or users
  - between components
- Uses:
  - user and system: developing requirements
  - system components: help to understand flow of control in an object oriented system
- Use Cases: user - system interactions
- Sequence Diagrams: components and external actors in more detail

5.2.1 Use Case Modeling

- Main purpose: requirements elicitation + analysis
- Overview of one discrete user/system interaction
  - Focusing on one goal of the actor
- Diagram components:
  - **stick figure:** actor (user or system)
  - **ellipse:** named interaction (verb-noun)
  - **line:** indicates involvement in interaction
- Diagram is supplemented with further details
  - textual description
  - structured description (form/template/table)
  - sequence diagram(s)

Fig 5.3: Transfer data use case

Example of a UML Use case diagram



Note: arrows are not part of UML, but shows direction of data flow

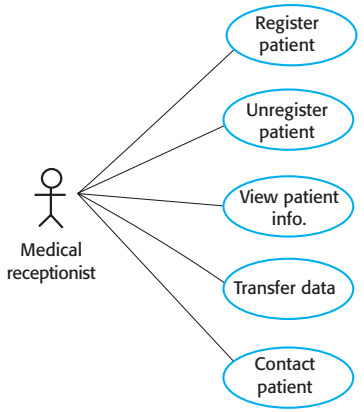
Note: primary actor on left, supporting actor on right

Fig 5.4: Tabular description of Transfer data use case

MHC-PMS: Transfer data	
Actors	Medical receptionist, patient records system (PRS)
Description	A receptionist may transfer data from the MHC-PMS 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.

Fig 5.5: Use cases involving Medical Receptionist

A composite use case diagram:
all interactions involving a given actor



5.2.2 Sequence Diagram

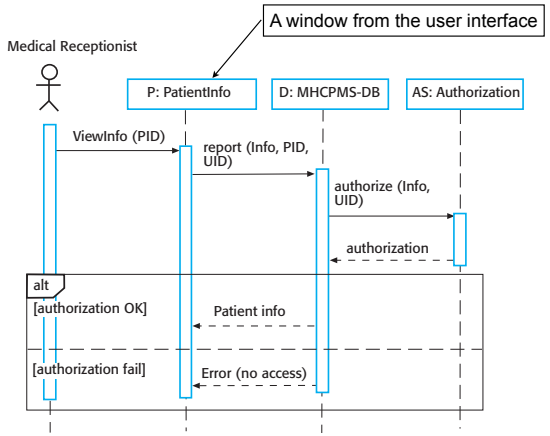
- Models the interactions between actors and objects within a system in some detail
- Shows the sequence of interactions in a given use case
- Diagram notes:

Read sequence from top to bottom

objects and actors: listed across top with dotted lines going down
boxes on dotted line: lifetime of object (in this interaction)
dotted arrows between lines from objects: interactions
annotations on arrows: calls to objects with parameters, return values
box named alt with conditions in brackets: for branching/alternatives

Fig 5.6: View patient information

Example of a UML Sequence diagram



Sequence Diagram Uses

- Requirements Development:
  - Leave out detail, so as not to constrain developers
  - For example:

  Minimal sequence diagram: only two components: user and system
  Use to show **sequence** of interactions between user and system

- Implementation:
  - Details are required:
  - Interfaces to method calls between objects
  - Source of parameters in method calls