Systems Analysis and Design with UML Version 2.0, Second Edition

Alan Dennis, Barbara Haley Wixom, and David Tegarden

Chapter 7: Structural Modeling

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Structural Modeling

Chapter 7

Key Ideas

- A structural or conceptual model describes the structure of the data that supports the business processes in an organization..
- The structure of data used in the system is represented through *CRD cards*, *class diagrams*, and *object diagrams*.

STRUCTURAL MODELS

Purpose of Structural Models

- Reduce the "semantic gap" between the real world and the world of software
- Create a vocabulary for analysts and users
- Represent things, ideas, and concepts of importance in the application domain

Classes

- Templates for creating instances or objects
  - Concrete
  - Abstract
- Typical examples:
  - Application domain, user interface, data structure, file structure, operating environment, document, and multimedia classes

Attributes

- Units of information relevant to the description of the class
- Only attributes important to the task should be included

Operations

- Action that instances/objects can take
- Focus on relevant problem-specific operations (at this point)

Relationships

- Generalization
  - Enables inheritance of attributes and operations
- Aggregation
  - Relates parts to wholes
- Association
  - Miscellaneous relationships between classes

Your Turn

- What classes, attributes, and operations that would be required to describe the process of registration for campus housing?

CLASS-RESPONSIBILITY-COLLABORATION CARDS

Responsibilities and Collaborations

- Responsibilities
  - Knowing
  - Doing
- Collaboration
  - Objects working together to service a request

A CRC Card

Front:

Class Name: Patient	**ID:** 3	**Type:** Concrete, Domain
Description: An Individual that needs to receive or has received medical attention		**Associated Use Cases:** 2

Responsibilities	Collaborators
Make appointment	Appointment
Calculate last visit	
Change status	
Provide medical history	Medical history

Back of CRC Card

Attributes:

Amount (double)

Insurance carrier (text)

Relationships:

Generalization (a-kind-of): Person

Aggregation (has-parts): Medical History

Other Associations: Appointment

CLASS DIAGRAMS

Example Class Diagram

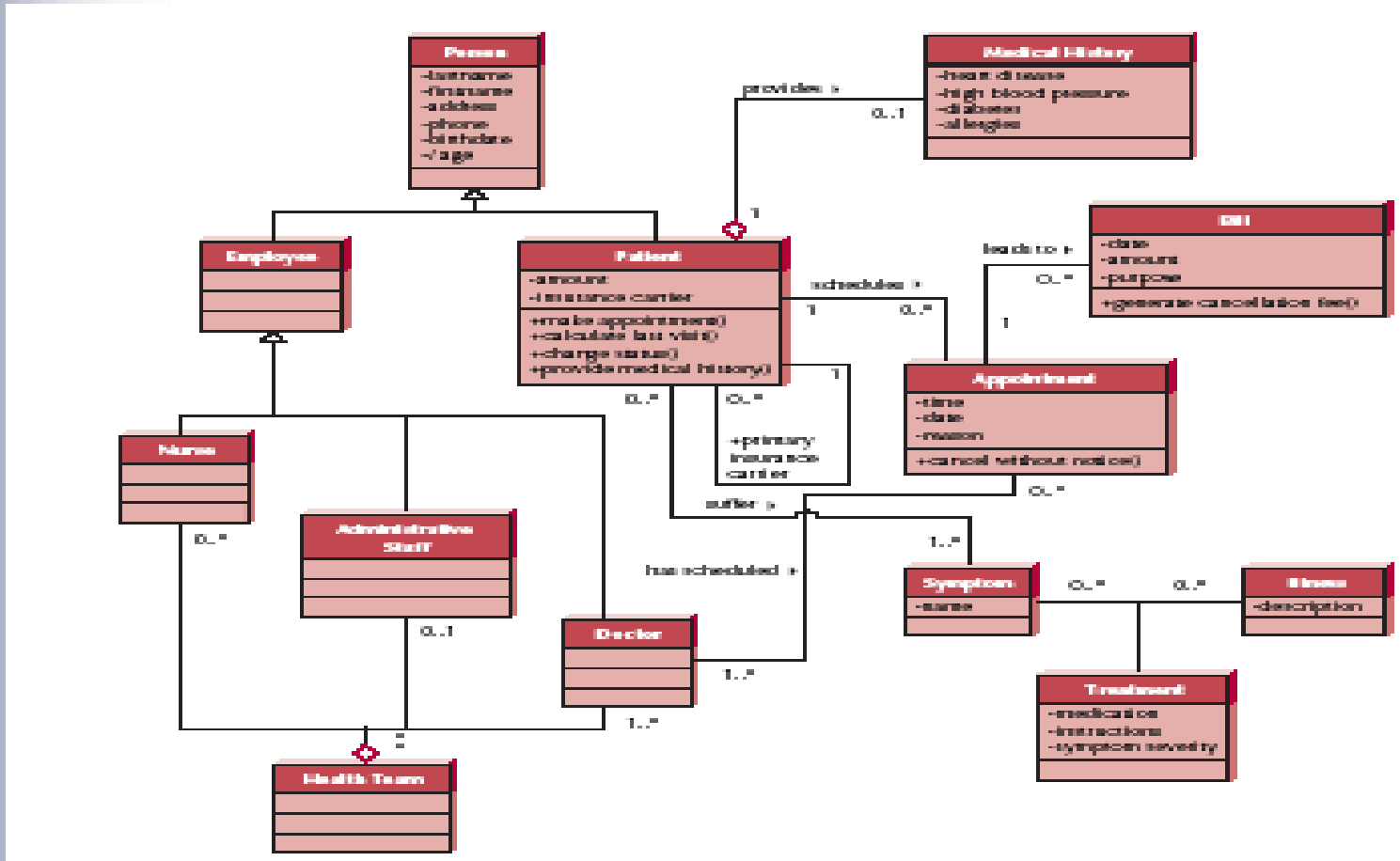
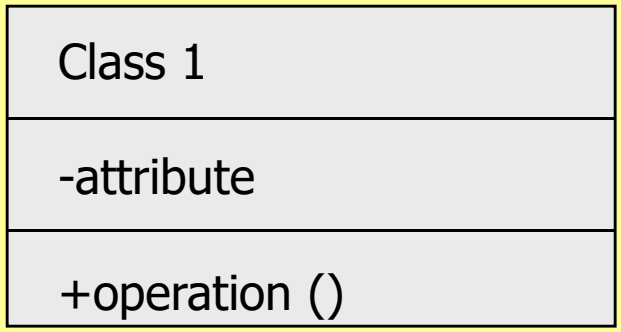
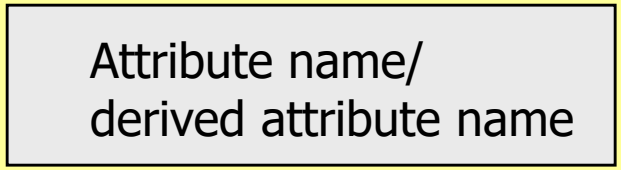
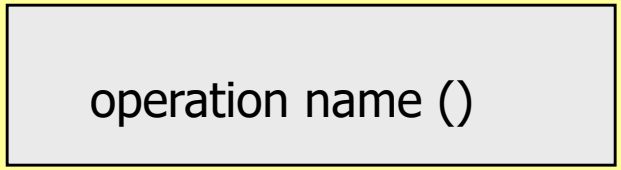
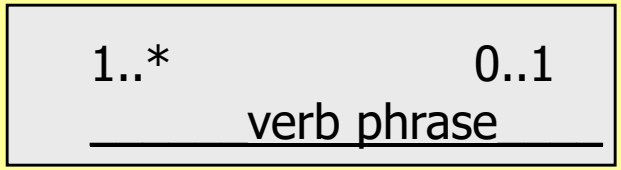


FIGURE 7-2 Example Class Diagram

Class Diagram Syntax

A CLASS	
AN ATTRIBUTE	
AN OPERATION	
AN ASSOCIATION	

More on Attributes

- Derived attributes
  - /age, for example can be calculated from birth date and current date
- Visibility
  - Public
  - Protected
  - Private

More on Operations

- Constructor
  - Creates object
- Query
  - Makes information about state available
- Update
  - Changes values of some or all attributes

Generalization and Aggregation

- Generalization shows that a subclass inherits from a superclass
  - Doctors, nurses, admin personnel are kinds of employees
- Aggregation classes comprise other classes
  - Health team class comprised of doctor, nurses, admin personnel classes

More on Relationships

- Class can be related to itself (role)
- Multiplicity
  - Exactly one, zero or more, one or more, zero or one, specified range, multiple disjoint ranges
- Association class

Simplifying Class Diagrams

- The view mechanism shows a subset of information
- Packages show aggregations of classes (or any elements in UML)

Object Diagrams

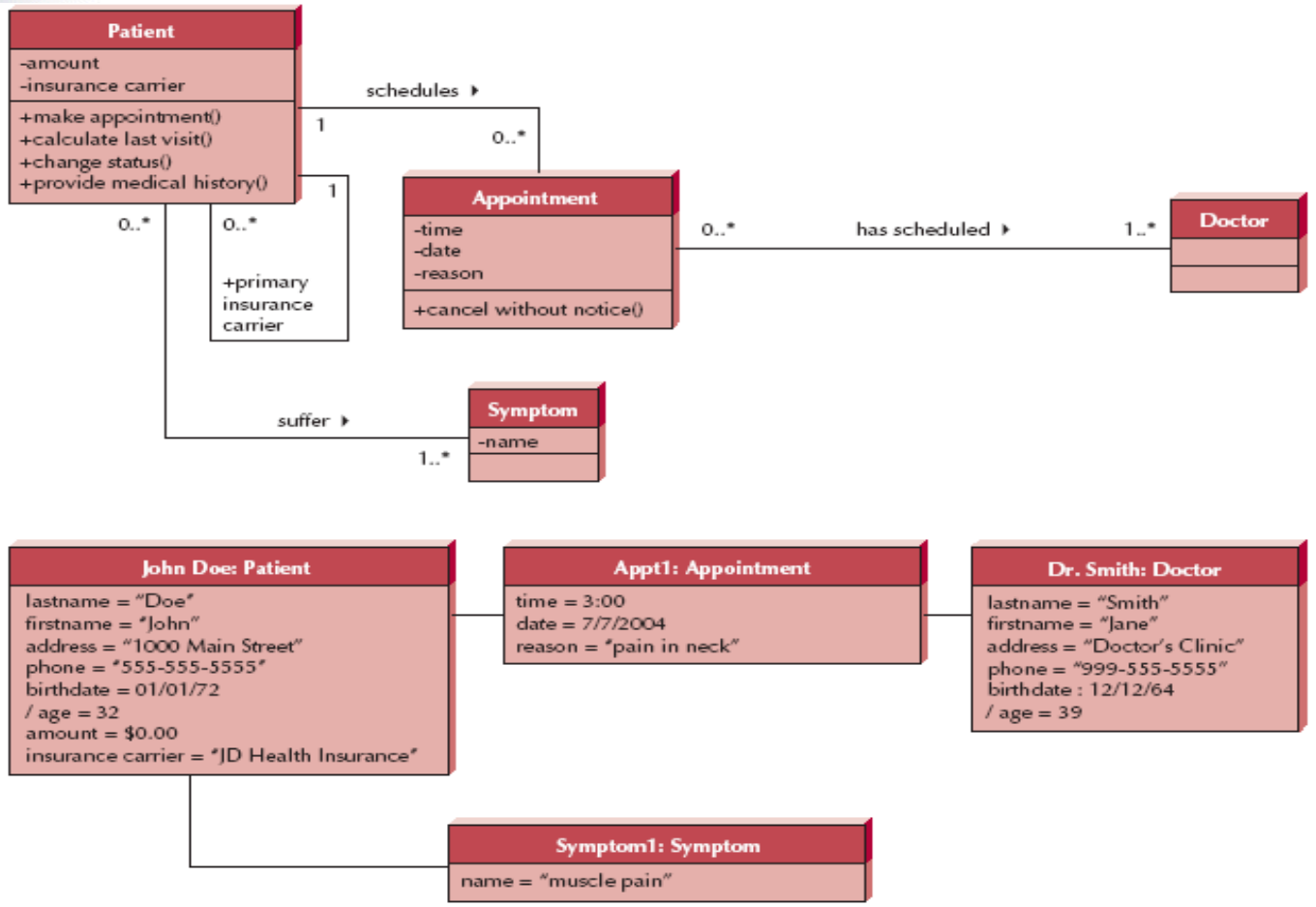


FIGURE 7-5 Example Object Diagram

CREATING CRC CARDS AND CLASS DIAGRAMS

Object Identification

- Textual analysis of use-case information
  - Nouns suggest classes
  - Verbs suggest operations
- Creates a rough first cut
- Common object list
- Incidents
- Roles

Patterns

- Useful groupings of classes that recur in various situations
- Transactions
  - Transaction class
  - Transaction line item class
  - Item class
  - Location class
  - Participant class

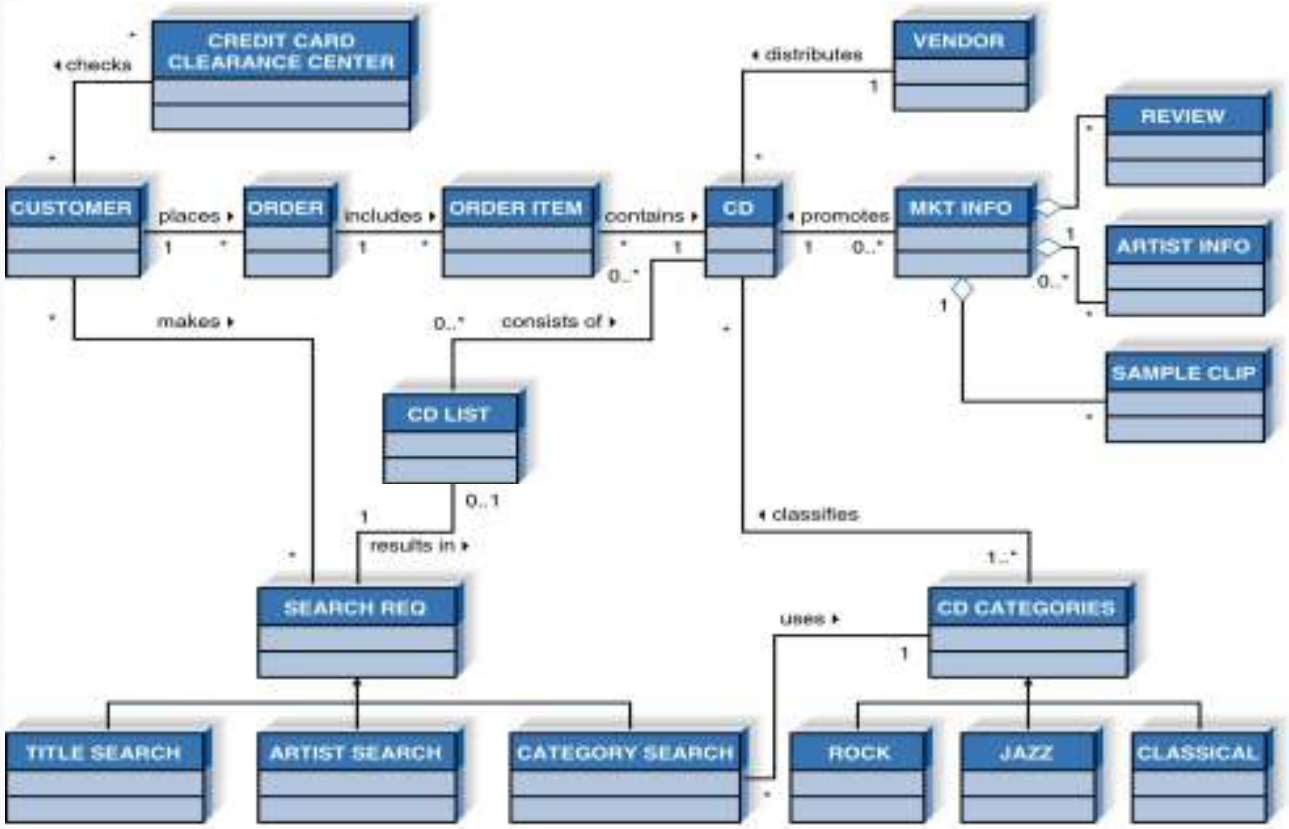
Steps for Object Identification and Structural Modeling

1. Create CRC cards by performing textual analysis on the use-cases.
2. Brainstorm additional candidate classes, attributes, operations, and relationships by using the common object list approach.
3. Role-play each use-case using the CRC cards.
4. Create the class diagram based on the CRC cards.
5. Review the structural model for missing and/or unnecessary classes, attributes, operations, and relationships.
6. Incorporate useful patterns.
7. Review the structural model.

CD Selections

- Create CRC cards.
- Examine common object lists.
- Role-play the CRC cards.
- Create the class diagram.
- Review the class diagram.
- Incorporate patterns.
- Review the model.

CD Selections



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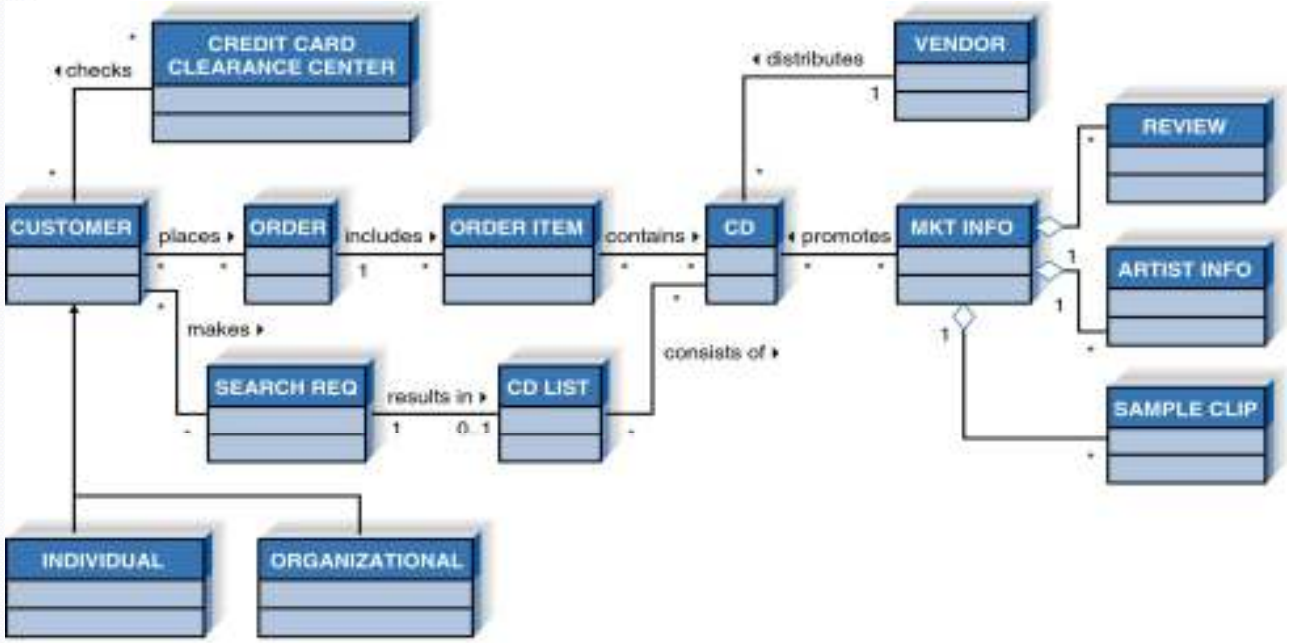
CD Selections



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Summary

- *CRC cards* capture the essential elements of a class.
- *Class and object diagrams* show the underlying structure of an object-oriented system.
- Constructing the structural model is an iterative process involving: *textual analysis, brainstorming objects, role playing, creating the diagrams*, and *incorporating useful patterns.*

Expanding the Domain

- A quirky and interesting tutorial regarding CRC cards can be found at:
- *http://www.csc.calpoly.edu/~dbutler/tutorials/winter96/crc_b/*