

UNIVERSITY OF INFORMATION TECHNOLOGY

Faculty of Information Systems

Chapter 4

STRUCTURE MODELING

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LEARNING OBJECTIVES

1. Understand basic rules and guidelines for creating CRC cards, class diagrams, and object diagrams.
2. Have ability to create class diagrams, and object diagrams.
3. Understand the relationship among the structural models
4. Understand the relationship between the structural and functional models

CONTENTS

1. Introduction
2. Structure Models
 1. Class, Attribute, and Operation
 2. Relationship
3. Object Identification
4. Class diagram

INTRODUCTION

INTRODUCTION

- A **structural model** describes the structure of the data that supports the business processes
- It illustrates people, places, or things about which information is captured and how they are related to one another
- The structure of data used in the system is represented through *Class – Responsibility – Collaboration (CRC) cards, class diagrams, and object diagrams.*

INTRODUCTION

● 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

INTRODUCTION

- In UML:
 - **Structure Diagrams** show the **static structure** of the system and its parts on different abstraction and implementation **levels** and how they are related to each other.
 - The elements in a structure diagram represent the meaningful concepts of a system, and may include **abstract, real world** and **implementation concepts**.
 - Class Diagram, Object Diagram, Package Diagram, Composite Structure Diagram, Component Diagram, Deployment Diagram, Profile Diagram.

Structure Models

Structure Models

- Structural model does contain analysis classes, attributes, operations, and the relationships among the analysis classes
- The structural model at this point should represent the responsibilities of each class and the collaborations among the classes
- Typically, structural models are depicted using CRC cards, class diagrams, and, in some cases, object diagrams

Structure Models

1. Class: template to define specific instances or objects
2. Object: instantiation of a class
3. Attributes: describes the object
4. Behaviours: specify what an object can do
5. Relationships

Structure Models

Class

- Template to define specific instances or objects
 - Concrete (can have real instances): employee, customer
 - Abstract (only exists to hold subclasses): person
- Typical Example
 - Application domain
 - user-interface, data structure, file structure, operating environment, document, and multimedia classes
- Example: Customer, Patient, Doctor, Appointment, Symptom...

Structure Models

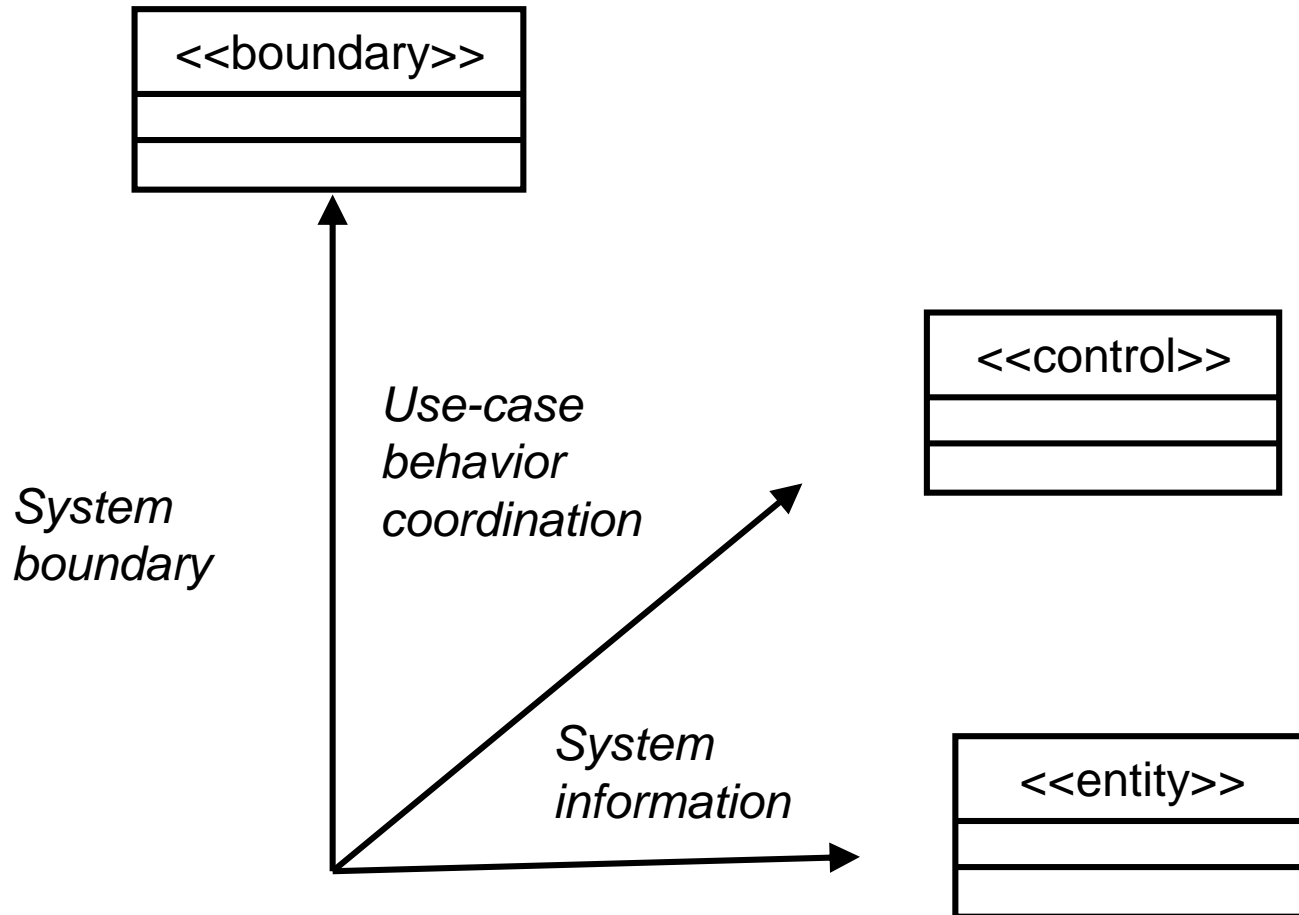
Class

● Nonstandard UML class

1. Boundary class: user interface screen, system interface or device interface object.
2. Control class: flow of control or behavior
3. Entity class: information or data. Course, Teacher, CourseGrade ...

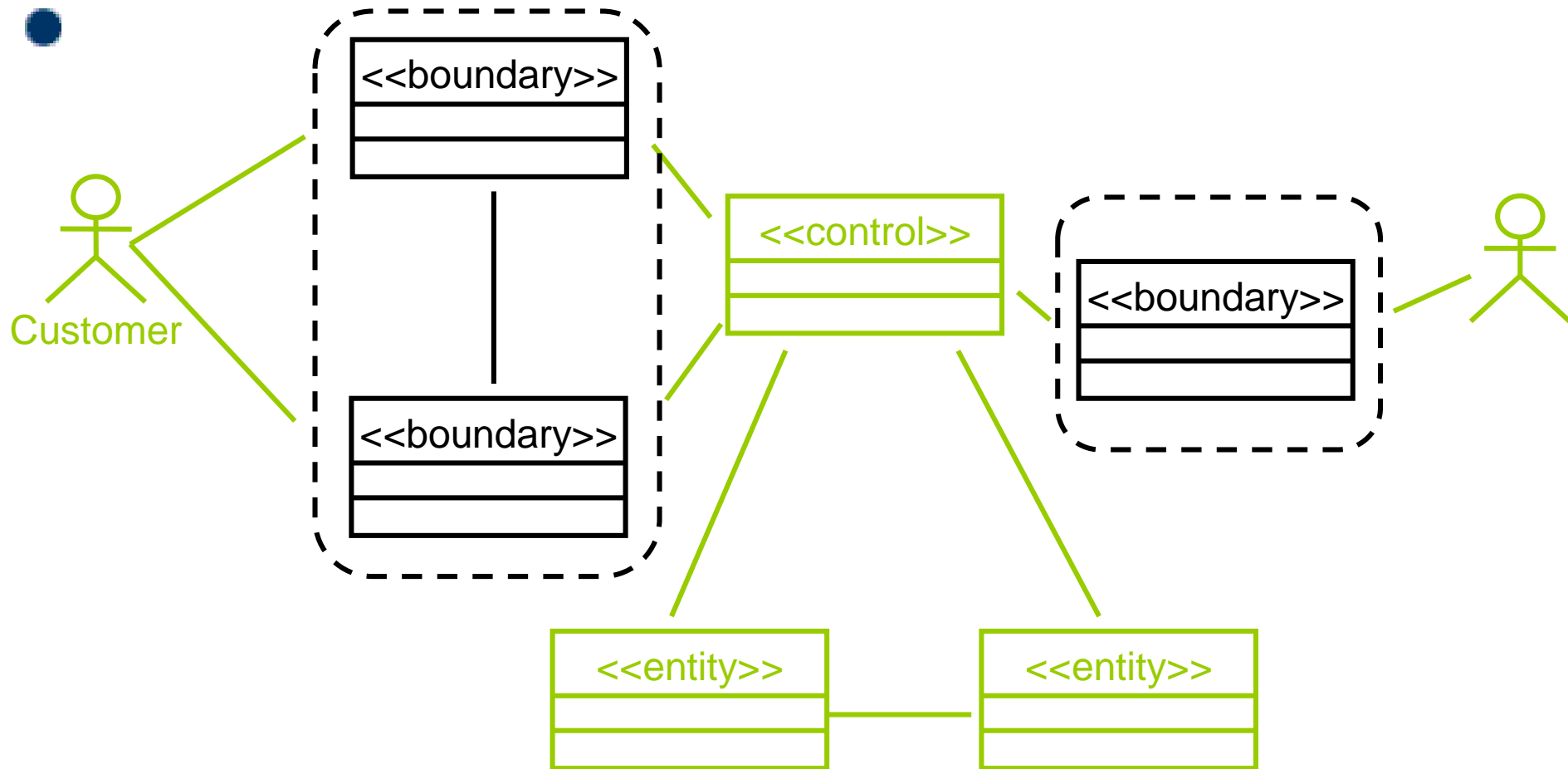
Structure Models

Class



Structure Models

Class



Structure Models

Attribute

- Units of information relevant to the description of the class
- Only attributes important to the task should be included
- Example:
 - Customer class: Name, Address, Phone number
 - Patient class: Name, Address, Phone, Insurance Carrier

Structure Models

Attribute

- Derived attributes: can be calculated from others
 - Age: calculated from birth date and current date
 - Overall score: calculated from midterm score, final score, homework score, attendance score, and bonus score
- Visibility
 - + Public (not hidden)
 - # Protected (hidden from all except immediate subclasses)
 - - Private (hidden from all other classes)

Classes and objects

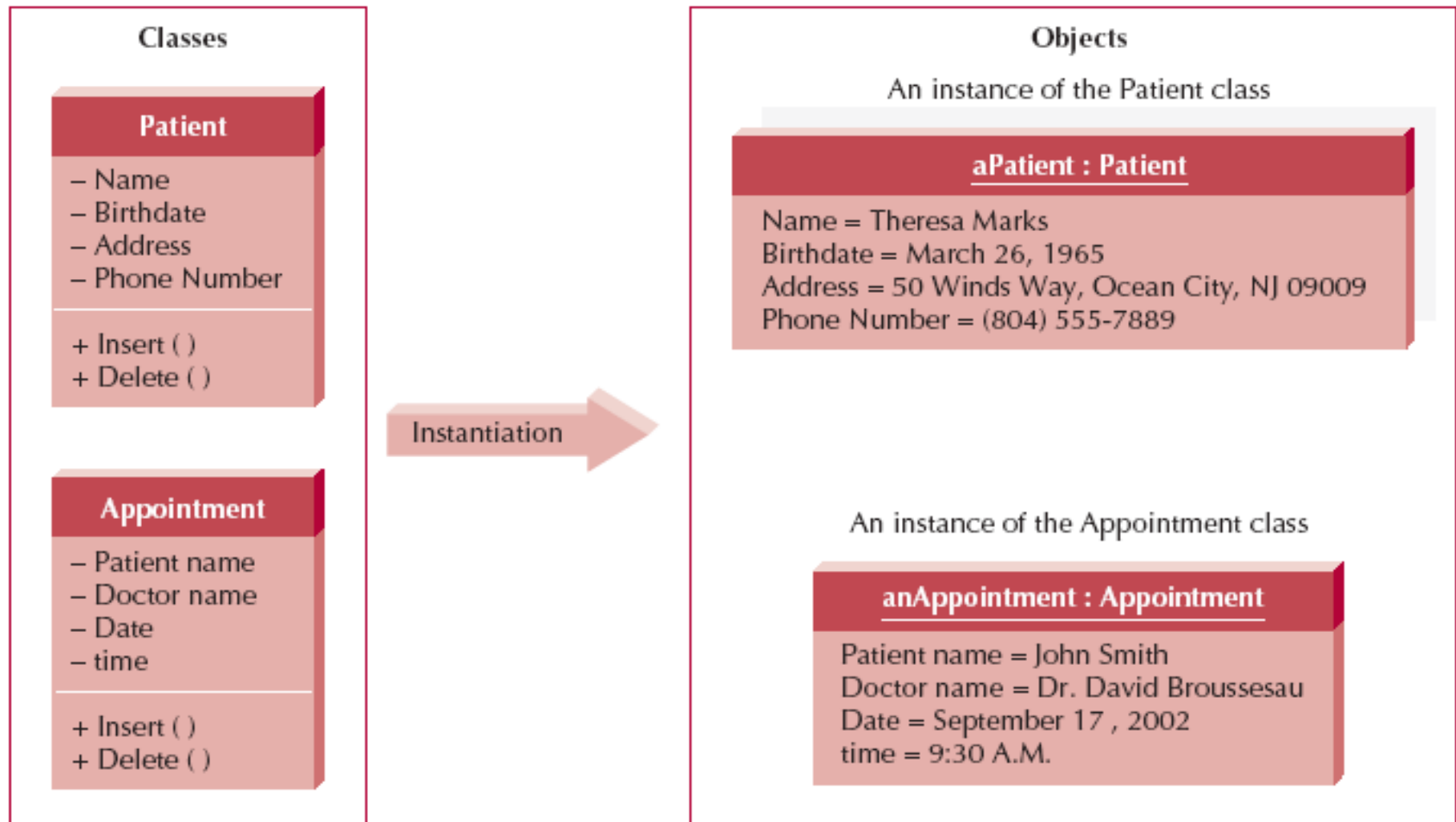


FIGURE 2-1 Classes and Objects

Structure Models

Behaviour (Operation/Method)

- Action that instances/objects can take
- Focus on relevant problem-specific operations (at this point)
- Example:
 - Patient object: make appointment, view appointment history
 - Student object: register for courses, check grade

Structure Models

Behaviour (Operation/Method)

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

Structure Models

Relationship

● *Generalization*

- Enables *inheritance* of attributes and operations
[...is a kind of...]

● *Aggregation*

- Relates *parts* to the whole [..is a part of..]

● *Association*

- Miscellaneous relationships between classes

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3. Object Identification
4. Class diagram
5. Creating class diagram

OBJECT IDENTIFICATION

Object Identification

1. Textual Analysis
2. Brainstorming
3. Common object lists
4. Patterns
5. Combination of above techniques

Object Identification

Textual Analysis

- ✓ Reviewing the use-case diagrams and examining the text in the use-case descriptions to identify potential objects, attributes, operations, and relationships.
- ✓ Nouns suggest possible classes
- ✓ Verbs suggest possible operations

Object Identification

Brainstorming

- ✓ Individuals suggest potential classes that could be useful for the problem under consideration.
- ✓ It simply asks the participants to identify the objects based on their past experiences.

Object Identification

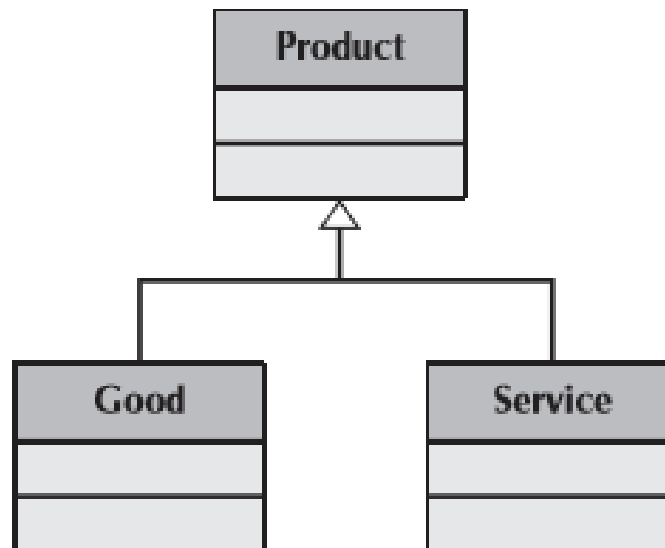
Common object lists

- ✓ List of objects common to the business domain of the system
- ✓ Reviewing the use cases can identify the roles that the people play in the problem, such as doctor, nurse, patient, or receptionist
- ✓ Places, containers, organizations, business records, catalogs, and policies

Object Identification

Patterns

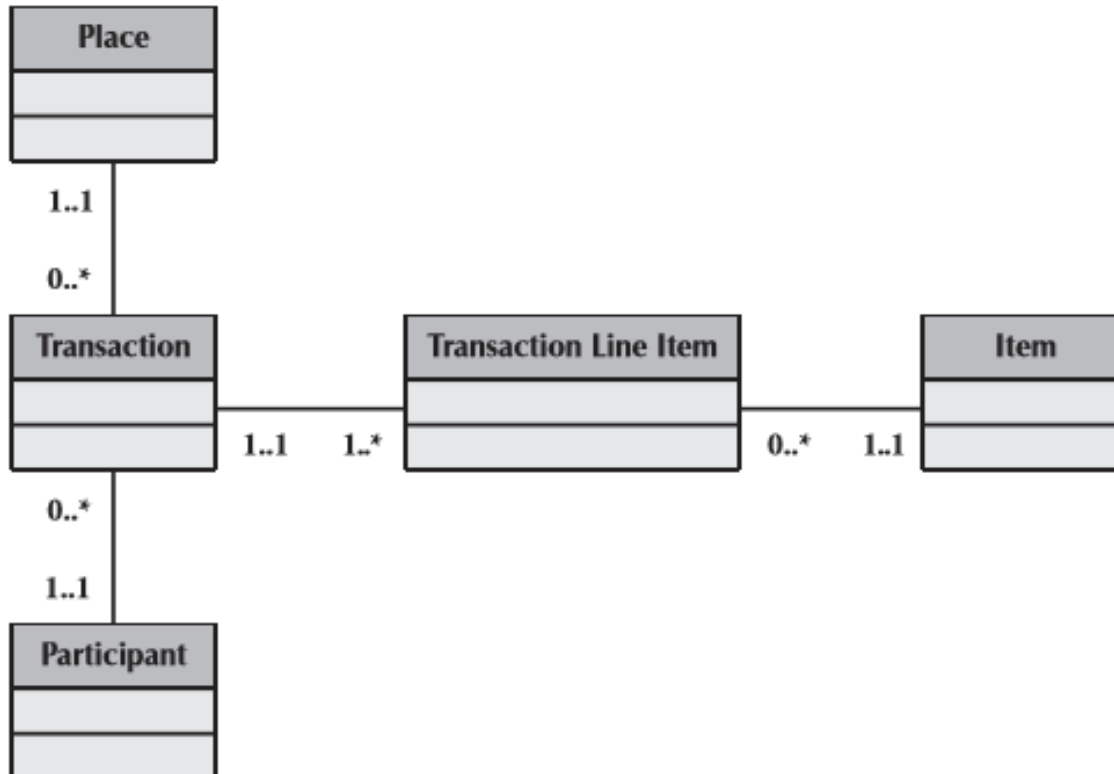
- ✓ a useful group of collaborating classes that provide a solution to a commonly occurring problem



Object Identification

Patterns

- ✓ a useful group of collaborating classes that provide a solution to a commonly occurring problem



CLASS DIAGRAM

Class diagram

1. Elements of a class diagram
2. Examples

Class diagram

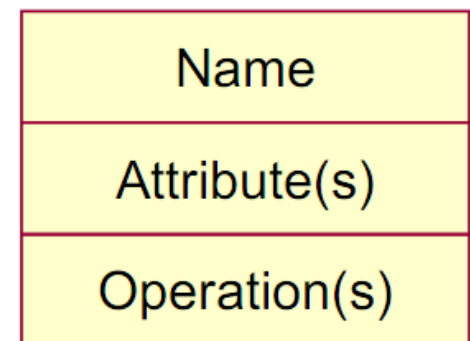
Elements of a class diagram

1. Class
2. Attribute
3. Operation
4. Association
5. Generalization
6. Aggregation
7. Composition

Class diagram

Elements of a class diagram

1. Class: represents a kind of person, place, or thing about which the system will need to capture and store information
2. Attribute: represents properties that describe the state of an object;
3. Operation: represents the actions or functions that a class can perform



Class diagram

Elements of a class diagram

4. Association:

- ✓ Represents a relationship between multiple classes or a class and itself
- ✓ Contains multiplicity symbols, which represent the minimum and maximum times a class instance can be associated with the related class instance



Class diagram

Elements of a class diagram

4. Association:

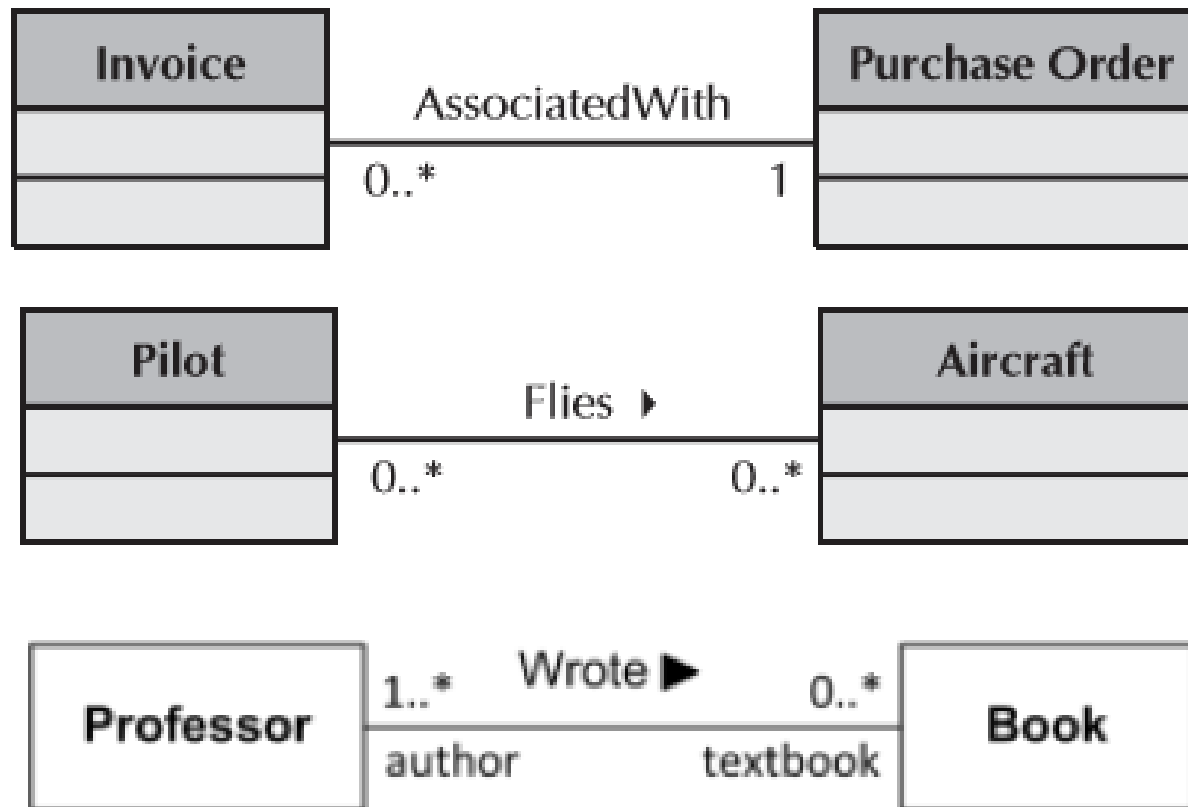
- ✓ Represents a relationship between multiple classes or a class and itself
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Class diagram

Elements of a class diagram




4. Association:



Class diagram

Elements of a class diagram



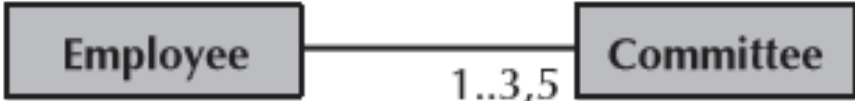
4. Association:

Exactly one	1		A department has one and only one boss.
Zero or more	0..*		An employee has zero to many children.
One or more	1..*		A boss is responsible for one or more employees.

Class diagram

Elements of a class diagram

4. Association:

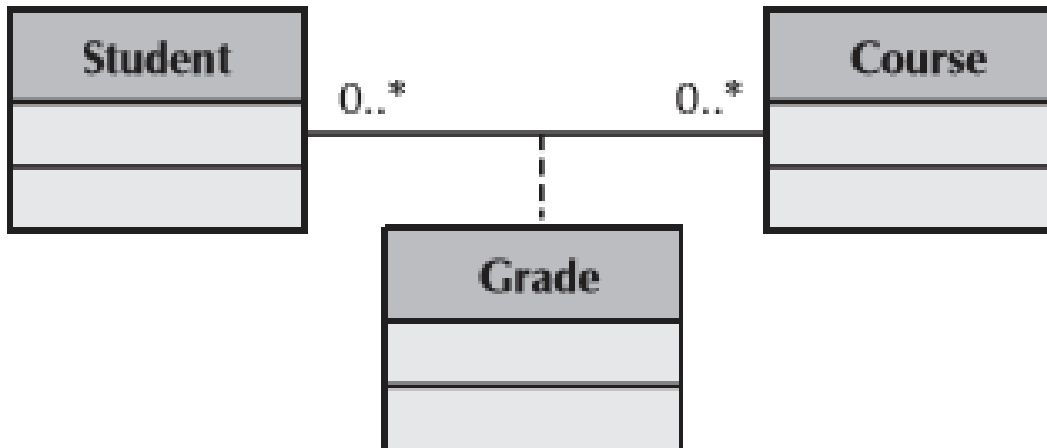
Zero or one	0..1	 <pre>classDiagram Employee "0..1" -- "0..1" Spouse</pre>	An employee can be married to zero or one spouse.
Specified range	2..4	 <pre>classDiagram Employee "2..4" -- "2..4" Vacation</pre>	An employee can take from two to four vacations each year.
Multiple, disjoint ranges	1..3,5	 <pre>classDiagram Employee "1..3,5" -- "1..3,5" Committee</pre>	An employee is a member of one to three or five committees.

Class diagram

Elements of a class diagram

4. Association:

Association Classes

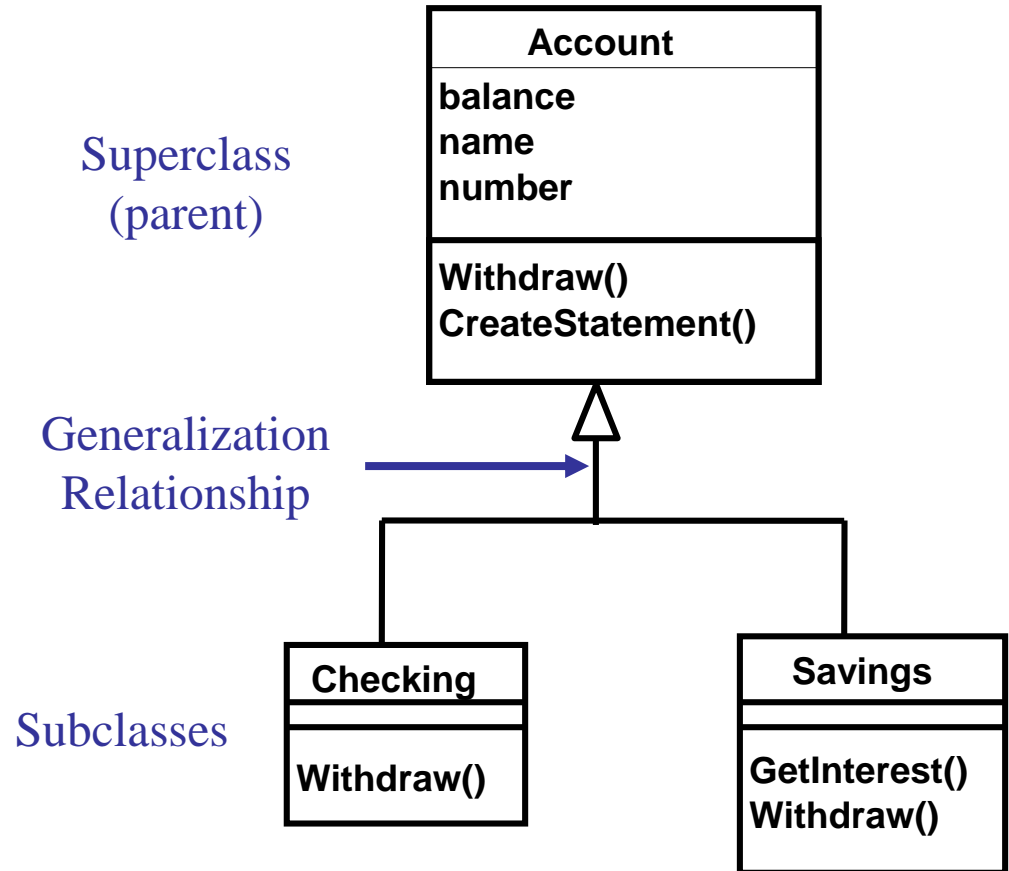


Class diagram

Elements of a class diagram

5. Generalization :

- ✓ Represents a-kind-of relationship between multiple classes



Class diagram

Elements of a class diagram

6. Aggregation:

- ✓ Represents a logical a-part-of relationship between multiple classes or a class and itself
- ✓ Is a special form of an association



Class diagram

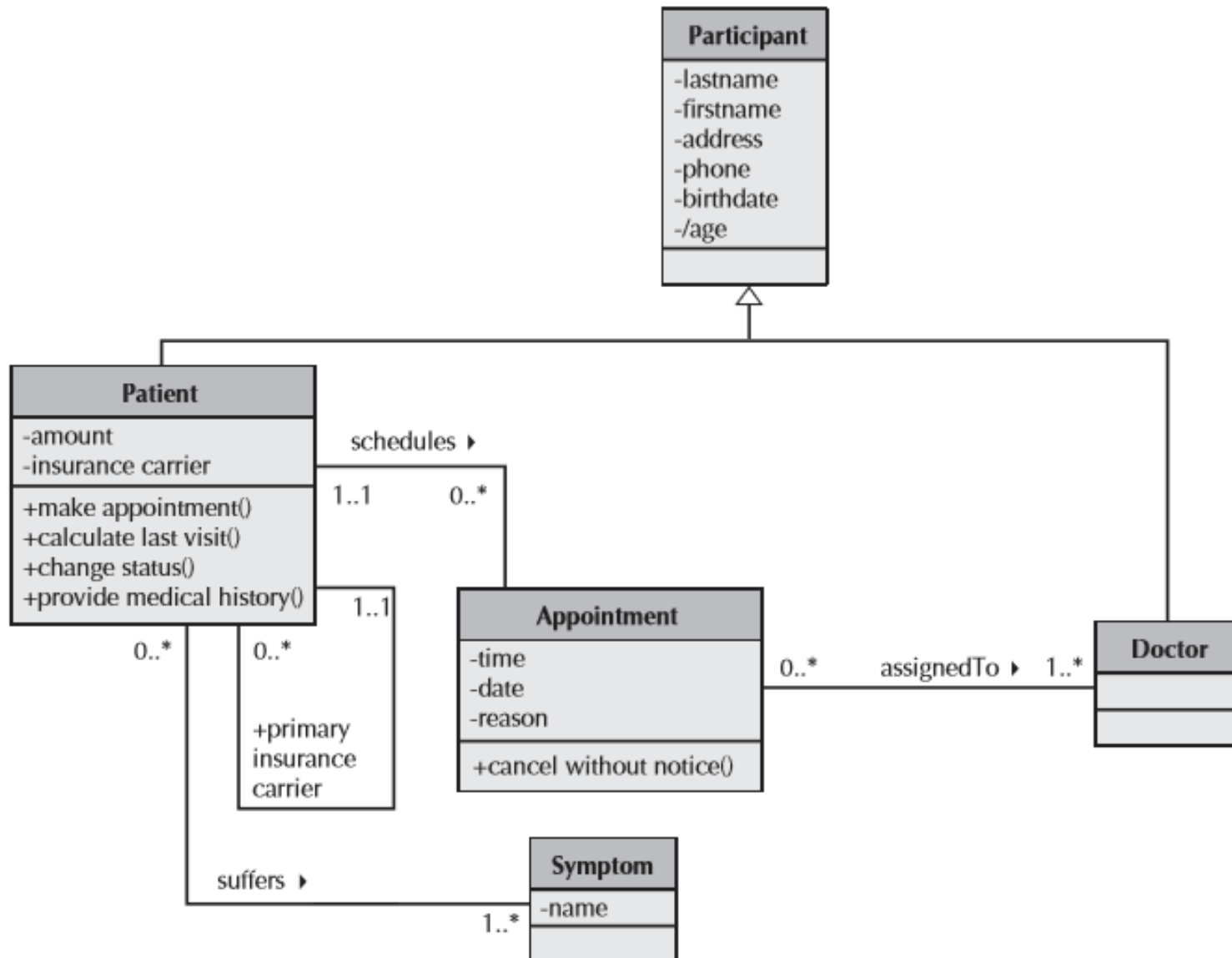
Elements of a class diagram

7. Composition:

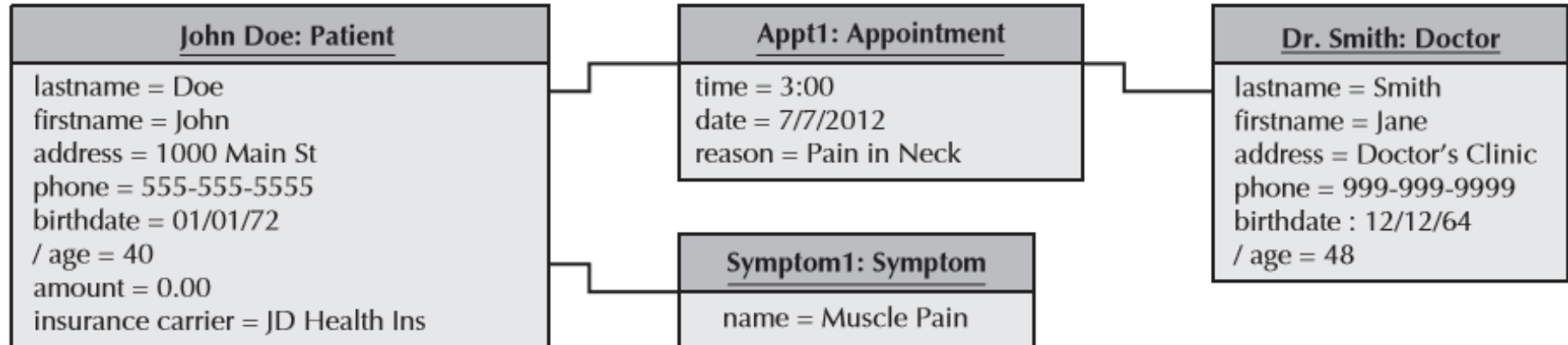
- ✓ Represents a physical a-part-of relationship between multiple classes or a class and itself
- ✓ It is a *whole/part* relationship.

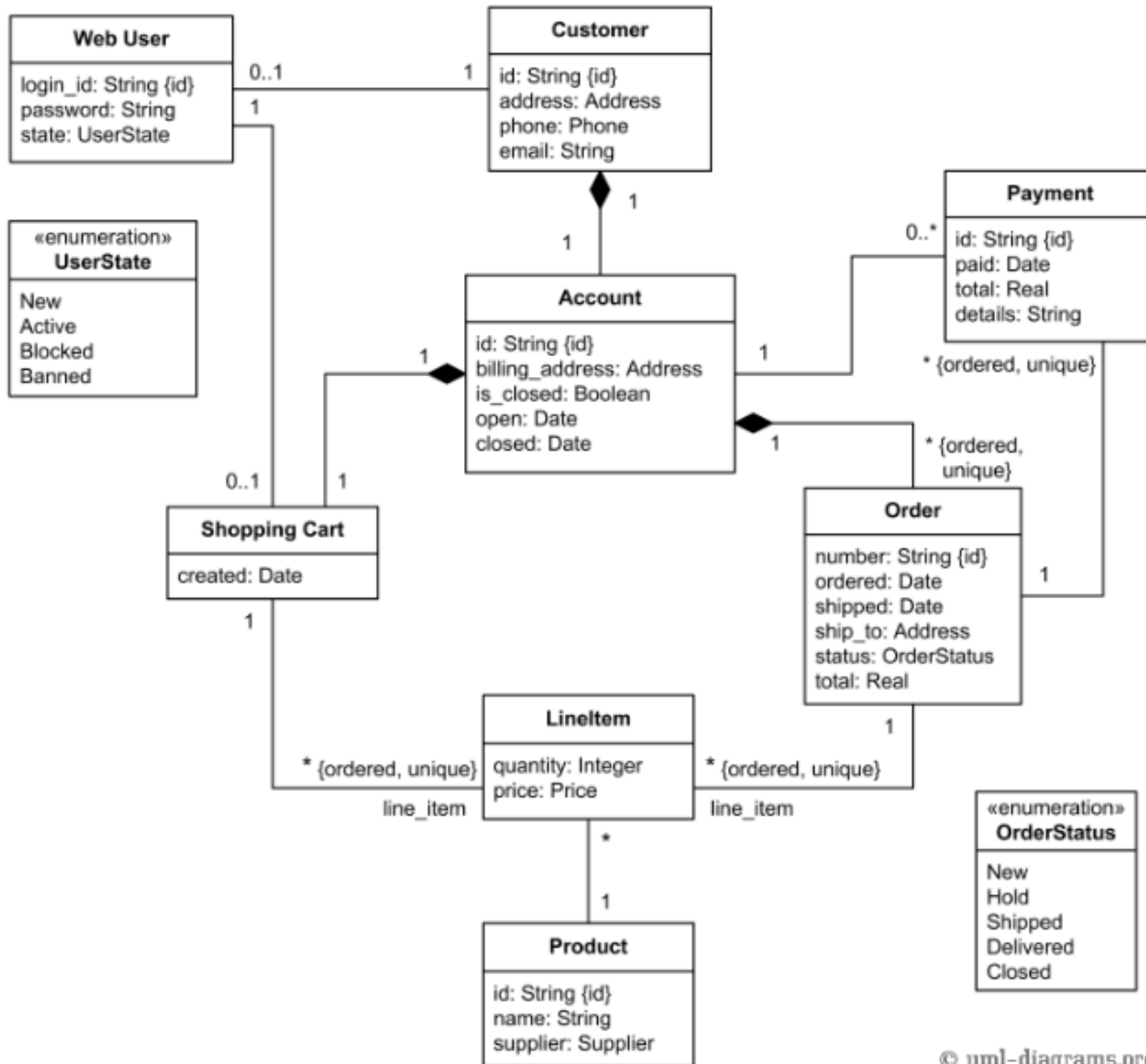


Class diagram



Object diagram





Group Discussion

- ❑ Group: 5 students; Time: 10 minutes.
- ❑ Create Class Diagram for:
 1. Course registration of an university
 2. Order process of a supermarket
 3. Transfer process using e-banking of a bank

