SYSTEM ANALYSIS AND DESIGN

Object-Oriented Analysis and Design

Learning Objectives

- ✓ Key terms
  - ✓ Association
  - ✓ Class diagram
  - ✓ Event
  - ✓ Object
  - ✓ Object class
  - ✓ Operation
  - ✓ Sequence diagram
  - ✓ State
  - ✓ State transition
  - ✓ Unified Modeling Language (UML)
  - ✓ Use case

Learning Objectives (continued)

- ✓ Discuss the concepts and principles underlying the object-oriented approach.
- ✓ Learn to develop requirements models using use-case diagrams.
- ✓ Learn to use class diagrams to develop object models of the problem domain.
- ✓ Learn to develop requirements models using state and sequence diagrams.

The Object-Oriented Modeling Approach

Benefits

1. The ability to tackle more challenging problem domains
2. Improved communication among users, analysts, designers, and programmers
3. Reusability of analysis, design, and programming results
4. Increased consistency among the models developed during object-oriented analysis, design, and programming

The Object-Oriented Modeling Approach (continued)

- Object-Oriented Systems Development Life Cycle
  - **Process of progressively developing representation of a system component (or object) through the phases of analysis, design, and implementation**
  - **The model is abstract in the early stages**
  - **As the model evolves, it becomes more and more detailed**

The Object-Oriented Systems Development Life Cycle

- Analysis Phase
  - Model of the real-world application is developed showing its important properties
  - Model specifies the functional behavior of the system independent of implementation details
- Design Phase
  - Analysis model is refined and adapted to the environment
- Implementation Phase
  - Design is implemented using a programming language or database management system

The Object-Oriented Systems Development Life Cycle (continued)

Unified Modeling Language (UML)

- **A notation that allows the modeler to specify, visualize and construct the artifacts of software systems, as well as business models**
- **Techniques and notations**
  - **Use cases**
  - **Class diagrams**
  - **State diagrams**
  - **Sequence diagrams**

Use-Case Modeling

- Applied to analyze functional requirements of the system
- Performed during the analysis phase to help developers understand functional requirements of the system without regard for implementation details
- Use Case
  - A complete sequence of related actions initiated by an actor
- Actor
  - An external entity that interacts with the system

Use-Case Modeling

- Use cases represent complete functionality of the system
- Use cases may participate in relationships with other use cases
- Use cases may also use other use cases

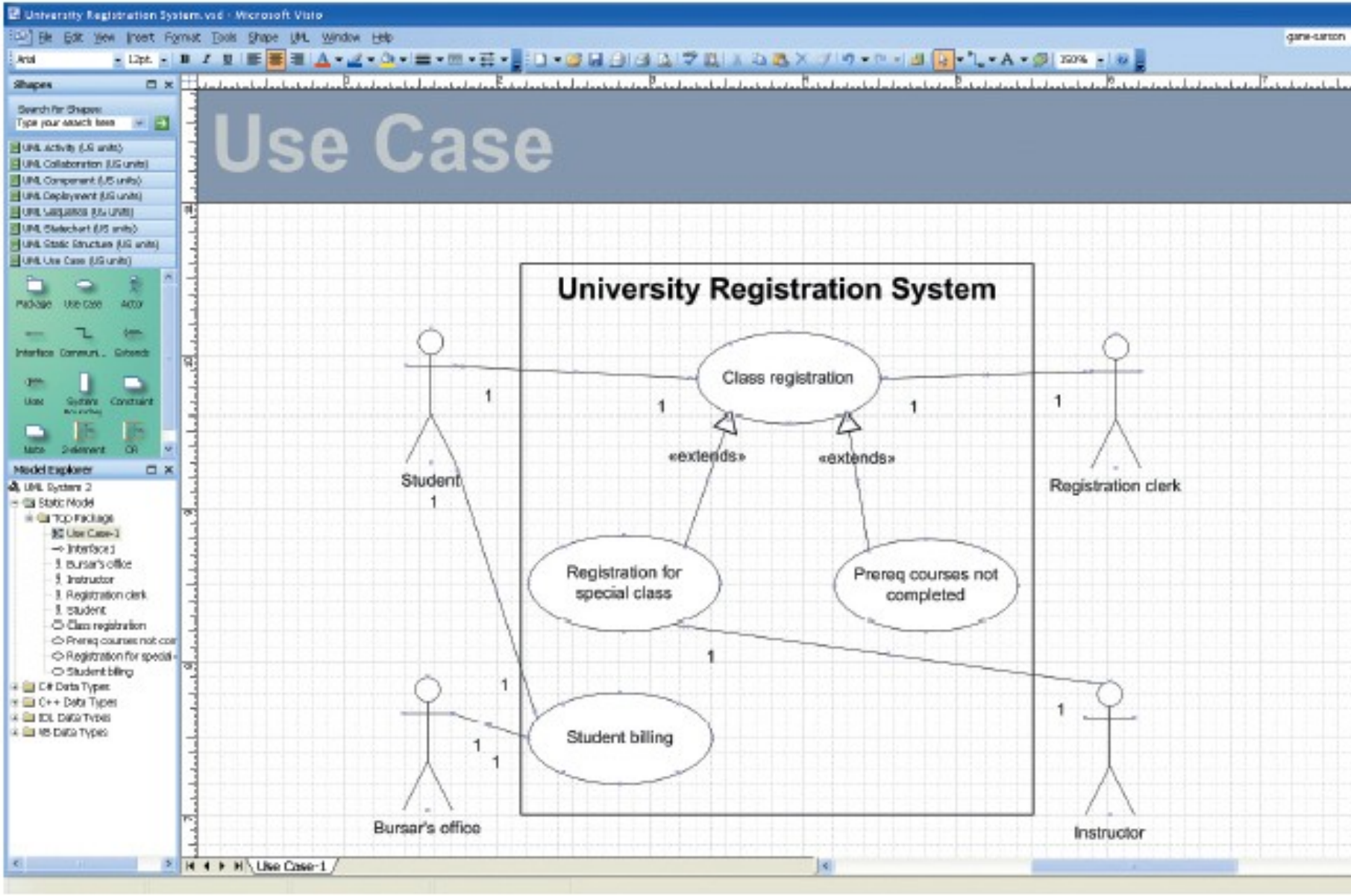


FIGURE A-1

USE-CASE DIAGRAM FOR A UNIVERSITY REGISTRATION SYSTEM DRAWN USING MICROSOFT VISIO

Object Modeling: Class Diagrams

- Object
  - An entity that has a well-defined role in the application domain, and has state, behavior, and identity
- State
  - A condition that encompasses an object's properties and the values those properties have
- Behavior
  - A manner that represents how an object acts and reacts
- Object Class
  - A set of objects that share a common structure and a common behavior

Object Modeling: Class Diagrams (continued)

- Class Diagram
  - **Class is represented as a rectangle with three compartments**
  - **Objects can participate in relationships with objects of the same class**

Object Modeling: Object Diagrams

- Object Diagram
  - **A graph of instances that are compatible with a given class diagram; also called an instance diagram**
  - **Object is represented as a rectangle with two compartments**
- Operation
  - **A function or service that is provided by all the instances of a class**
- Encapsulation
  - **The technique of hiding the internal implementation details of an object from its external view**

Figure A.3a UML Class and Object Diagrams — Class Diagram Showing Two Classes

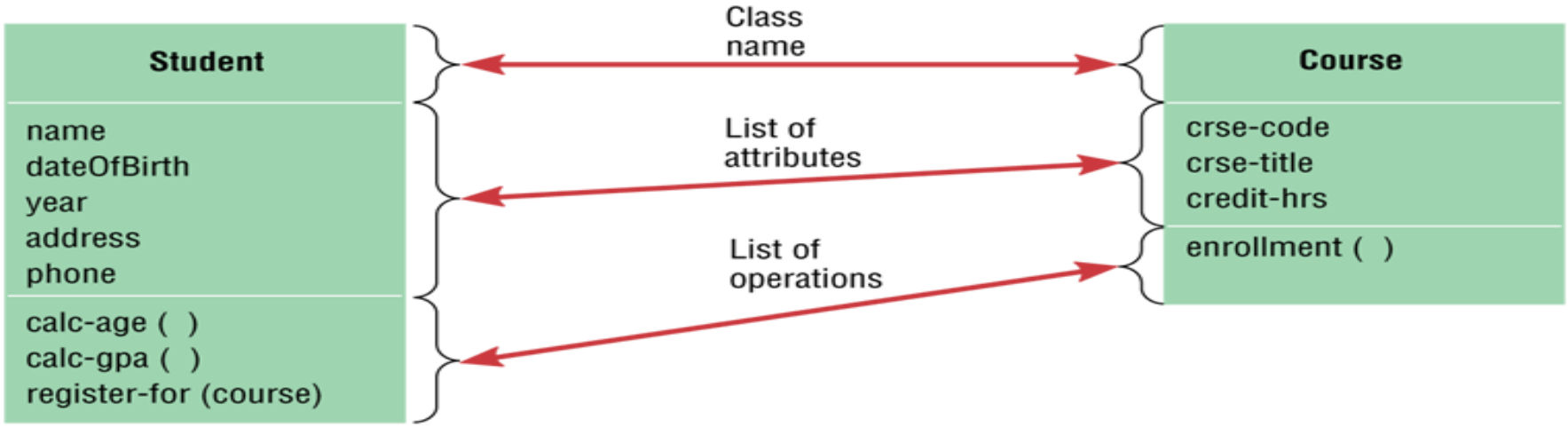


Figure A.3b UML Class and Object Diagrams — Object Diagram with Two Instances

Representing Associations

- Association
  - A relationship between object classes
  - Degree may be unary, binary, ternary or higher
  - Depicted as a solid line between participating classes
- Association Role
  - The end of an association where it connects to a class
  - Each role has multiplicity, which indicates how many objects participate in a given association relationship

Figure A.4a Examples of Association Relationships of Different Degrees — Unary

Figure A.4b Examples of Association Relationships of Different Degrees — Binary

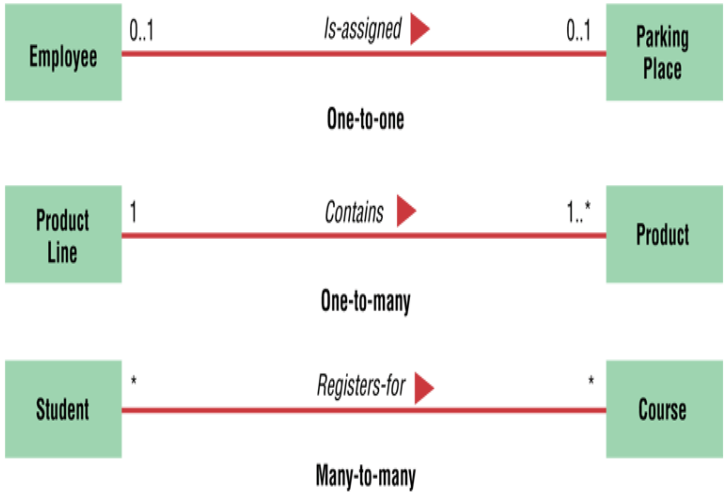
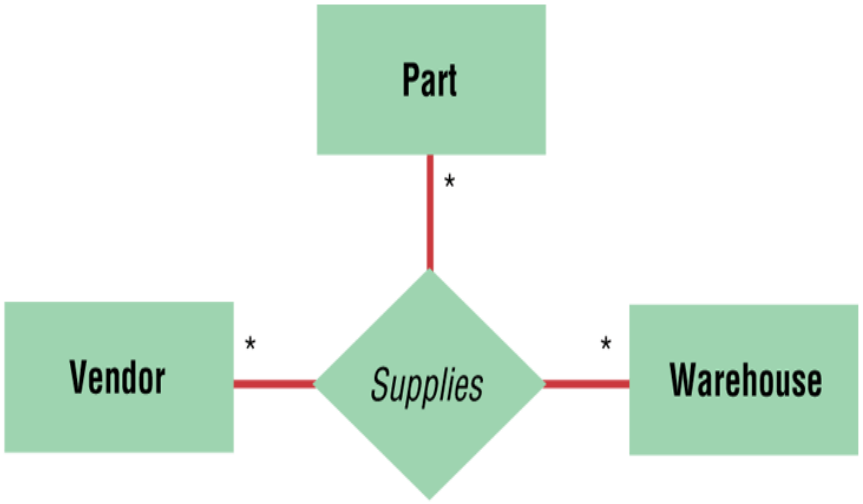


Figure A.4c Examples of Association Relationships of Different Degrees — Ternary



Representing Generalization

- Generalization
  - Abstraction of common features among multiple classes, as well as their relationships, into a more general class
- Subclass
  - A class that has been generalized
- Superclass
  - A class that is composed of several generalized subclasses

Representing Generalization (continued)

- Discriminator
  - Shows which property of an object class is being abstracted by a generalization relationship
- Inheritance
  - A property that a subclass inherits the features from its superclass
- Abstract Class
  - A class that has no direct instances but whose descendents may have direct instances
- Concrete Class
  - A class that can have direct instances

Figure A.6a Examples of Generalization, Inheritance, and Constraints — Employee Superclass with Three Subclasses

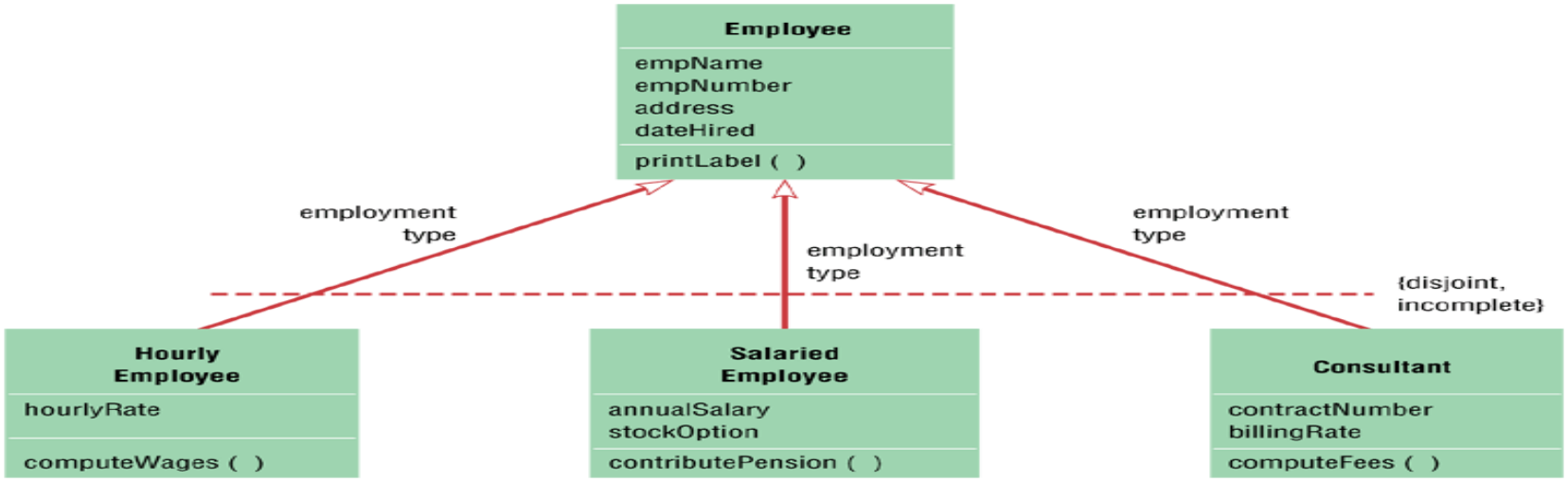
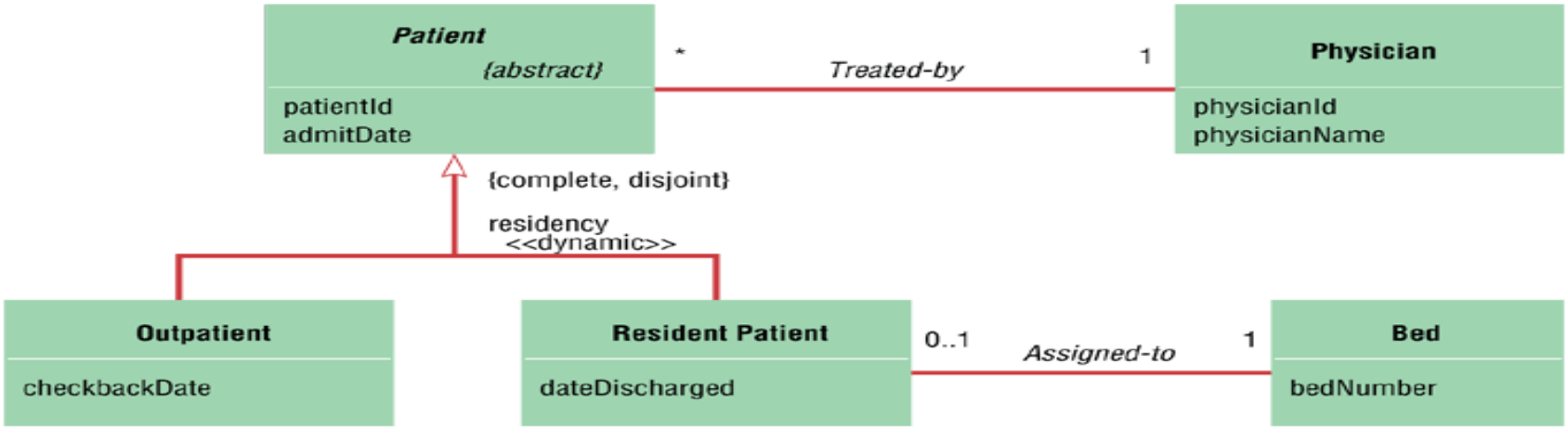


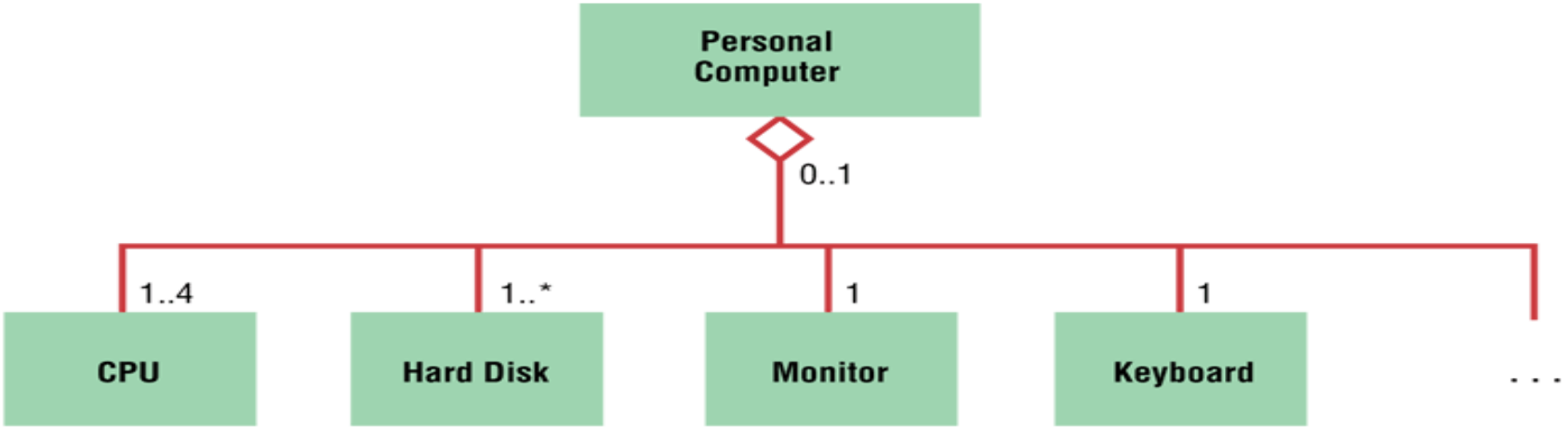
Figure A.6b Examples of Generalization, Inheritance, and Constraints — Abstract Patient Class with Two Concrete Subclasses



Representing Aggregation

- Aggregation
  - A part-of relationship between a component object and an aggregate object
  - Example: Personal computer
    - Composed of CPU, Monitor, Keyboard, etc.

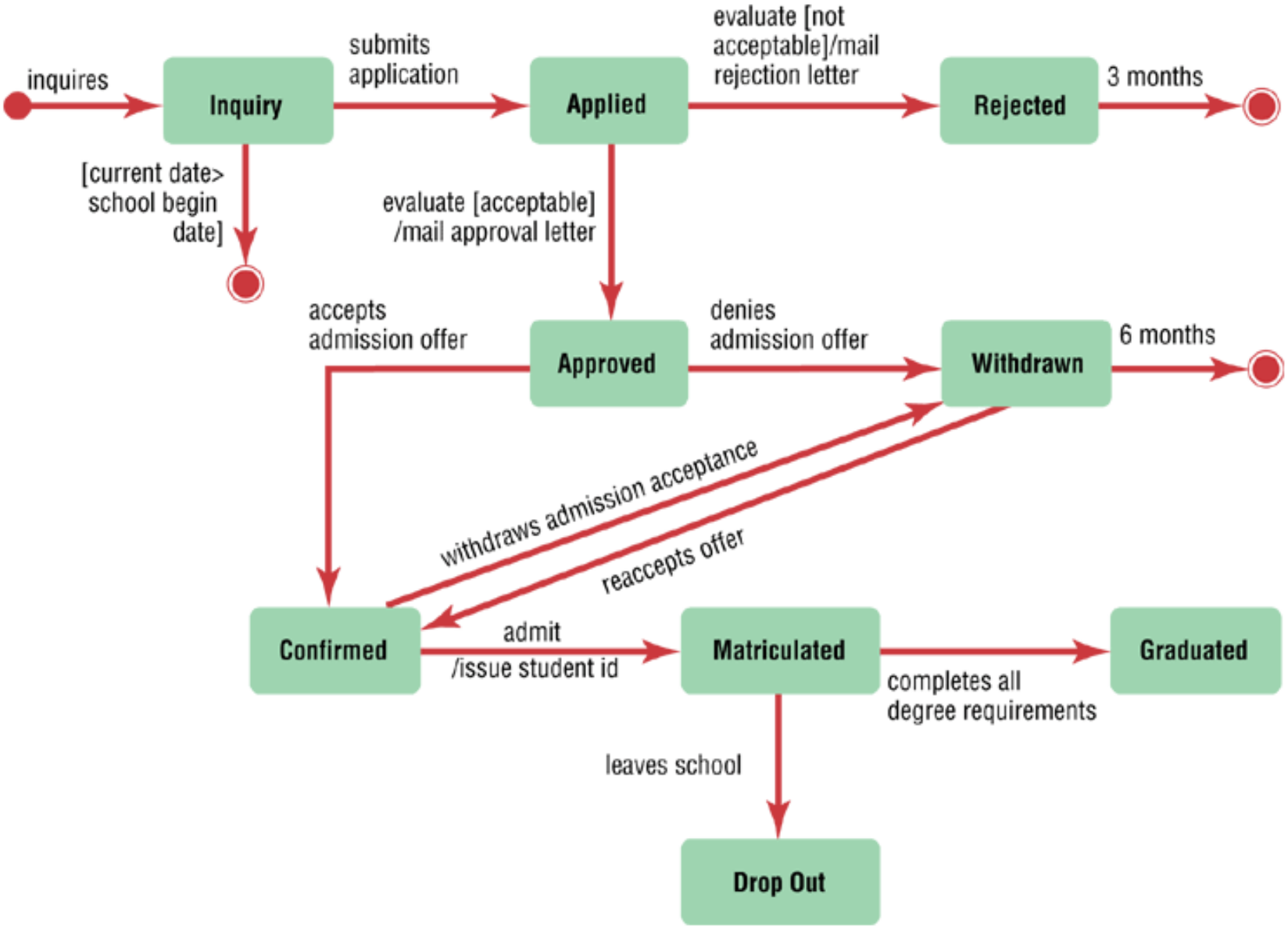
Figure A.7 Example of Aggregation



Dynamic Modeling: State Diagrams

- State
  - A condition during the life of an object during which it satisfies some conditions, performs some actions or waits for some events
  - Shown as a rectangle with rounded corners
- State Transition
  - The changes in the attributes of an object or in the links an object has with other objects
  - Shown as a solid arrow
  - Diagrammed with a guard condition and action

Figure A.8 State Diagram for the Student Object



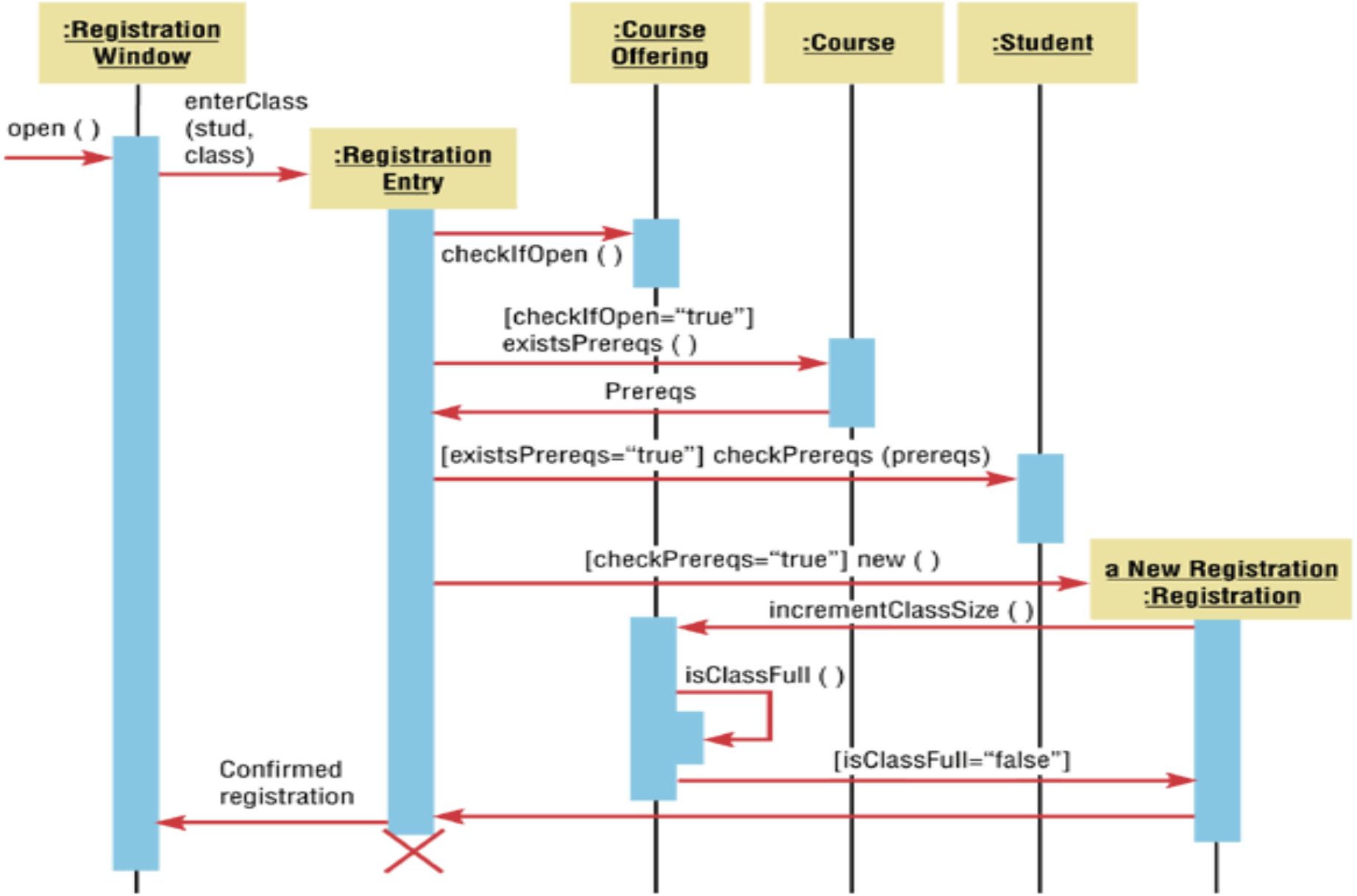
Dynamic Modeling: Sequence Diagrams

- Sequence Diagram
  - A depiction of the interaction among objects during certain periods of time
- Activation
  - The time period during which an object performs an operation
- Messages
  - Means by which objects communicate with each other

Dynamic Modeling: Sequence Diagrams (continued)

- Synchronous Message
  - A type of message in which the caller has to wait for the receiving object to finish executing the called operation before it can resume execution itself
- Simple Message
  - A message that transfers control from the sender to the recipient without describing the details of the communication

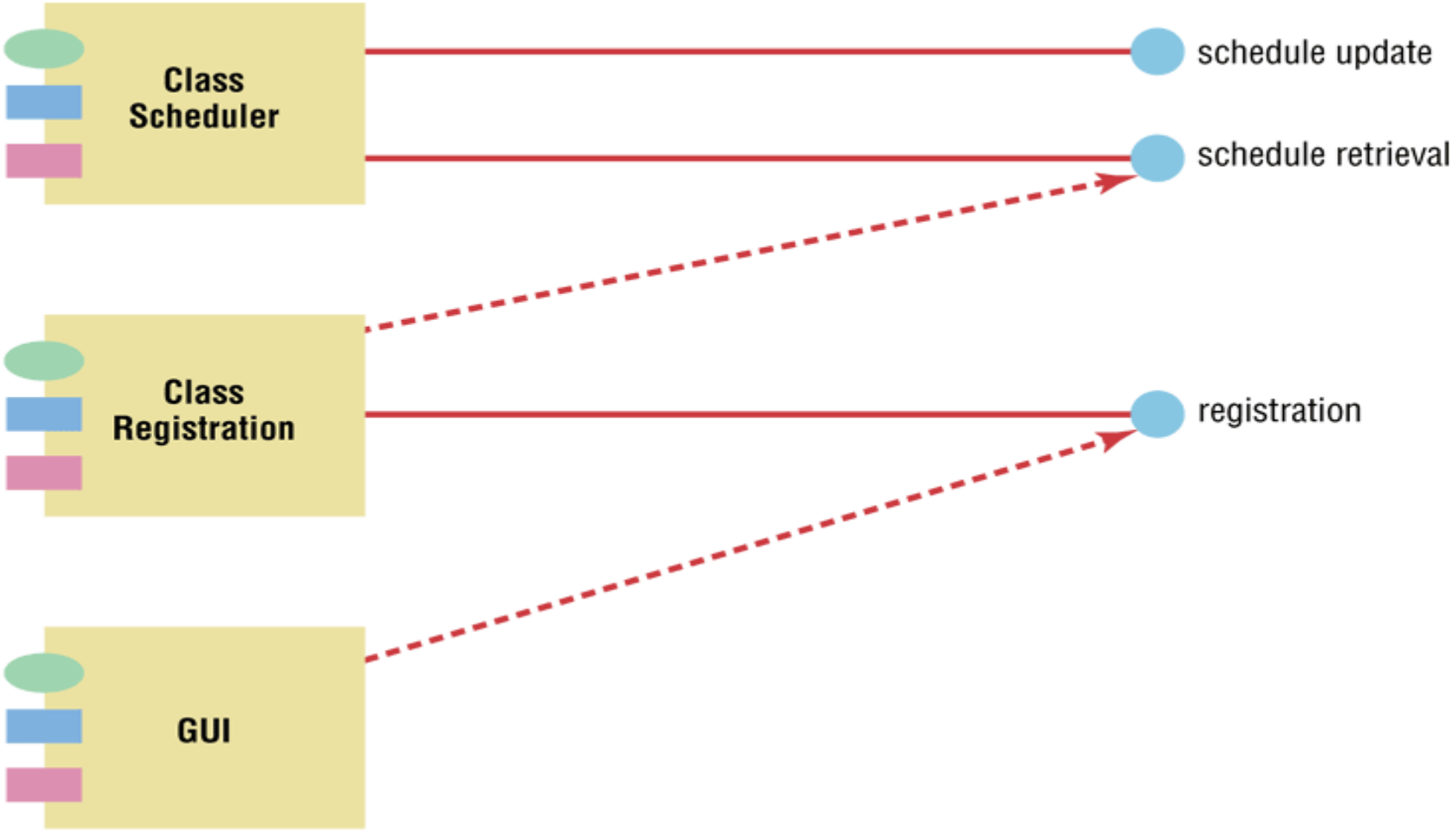
Figure A.9 Sequence Diagram for a Class Registration Scenario with Prerequisites



Moving to Design

- Start with existing set of analysis model
- Progressively add technical details
- Design model must be more detailed than analysis model
- Component Diagram
  - A diagram that shows the software components or modules and their dependencies
- Deployment Diagram
  - A diagram that shows how the software components, processes and objects are deployed into the physical architecture of the system

Figure A.11 A Component Diagram for Class Registration



Summary

- Object-Oriented Modeling Approach
  - Benefits
  - Unified Modeling Language
    - Use cases
    - Class diagrams
    - State diagrams
    - Sequence diagrams
- Use Case Modeling

Summary (continued)

- Object Modeling: Class Diagrams
  - Associations
  - Generalizations
  - Aggregation
- Dynamic Modeling: State Diagrams
- Dynamic Modeling: Sequence Diagrams
- Moving to Design

- THANKS FOR ALL