Computer Science Guidance

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Chapter 7: Software Engineering

Computer Science: An Overview
Twelfth Edition

by
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Dennis Brylow

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Chapter 7: Software Engineering

- 7.1 The Software Engineering Discipline
- 7.2 The Software Life Cycle
- 7.3 Software Engineering Methodologies
- 7.4 Modularity
- 7.5 Tools of the Trade
- 7.6 Testing
- 7.7 Documentation
- 7.8 Software Ownership and Liability

The Software Engineering Discipline

- Distinct from other engineering fields
  - Prefabricated components
  - Metrics
- Practitioners versus Theoreticians
- Professional Organizations: ACM, IEEE, etc.
  - Codes of professional ethics
  - Standards

Computer Aided Software Engineering (CASE) tools

- Project planning
- Project management
- Documentation
- Prototyping and simulation
- Interface design
- Programming

Figure 7.1 The software life cycle

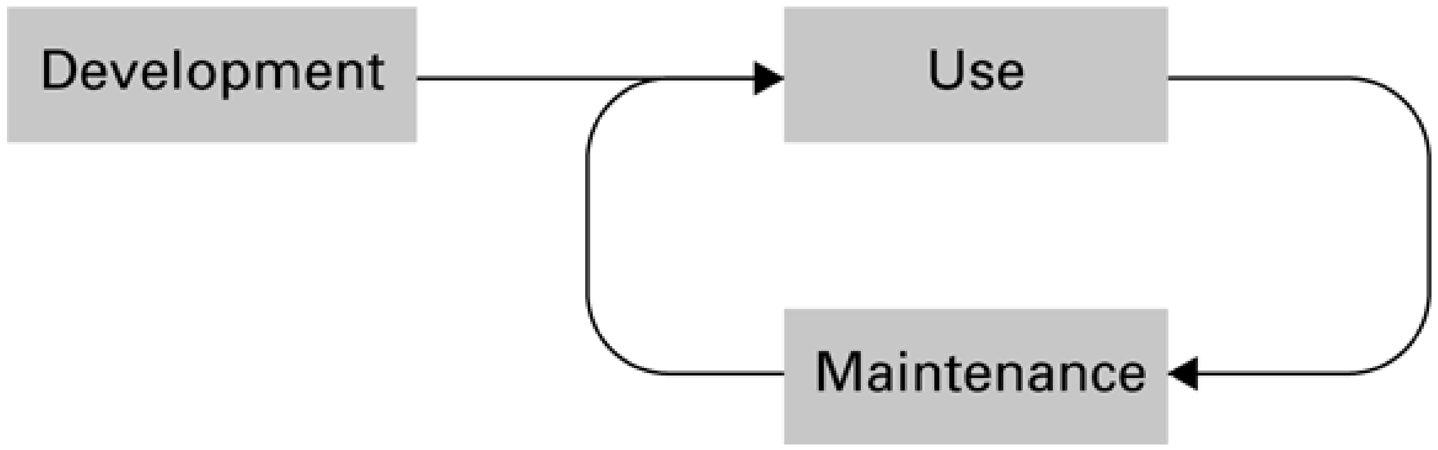
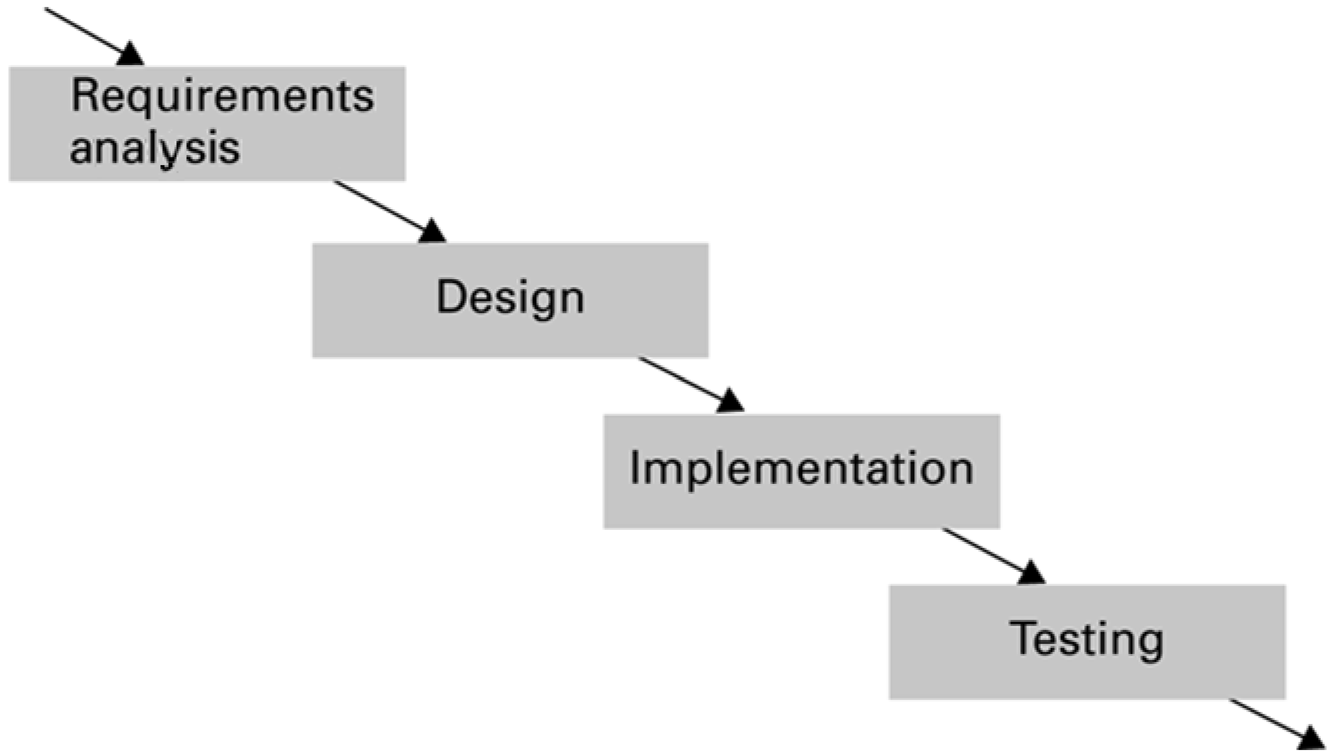


Figure 7.2 **The development phase of the software life cycle**



Analysis Stage

- Requirements
  - Application oriented
- Specifications
  - Technically oriented
- Software requirements document

Design Stage

- Methodologies and tools (discussed later)
- Human interface (psychology and ergonomics)

Implementation Stage

- Create system from design
  - Write programs
  - Create data files
  - Develop databases
- Role of “software analyst” versus “programmer”

Testing Stage

- Validation testing
  - Confirm that system meets specifications
- Defect testing
  - Find bugs

Software Engineering Methodologies

- Waterfall Model
- Incremental Model
  - Prototyping (Evolutionary vs. Throwaway)
- Open-source Development
- Extreme Programming

Modularity

- Functions – Imperative paradigm
  - Structure charts
- Objects – Object-oriented paradigm
  - Collaboration diagrams
- Components – Component architecture

Figure 7.3 **A simple structure chart**

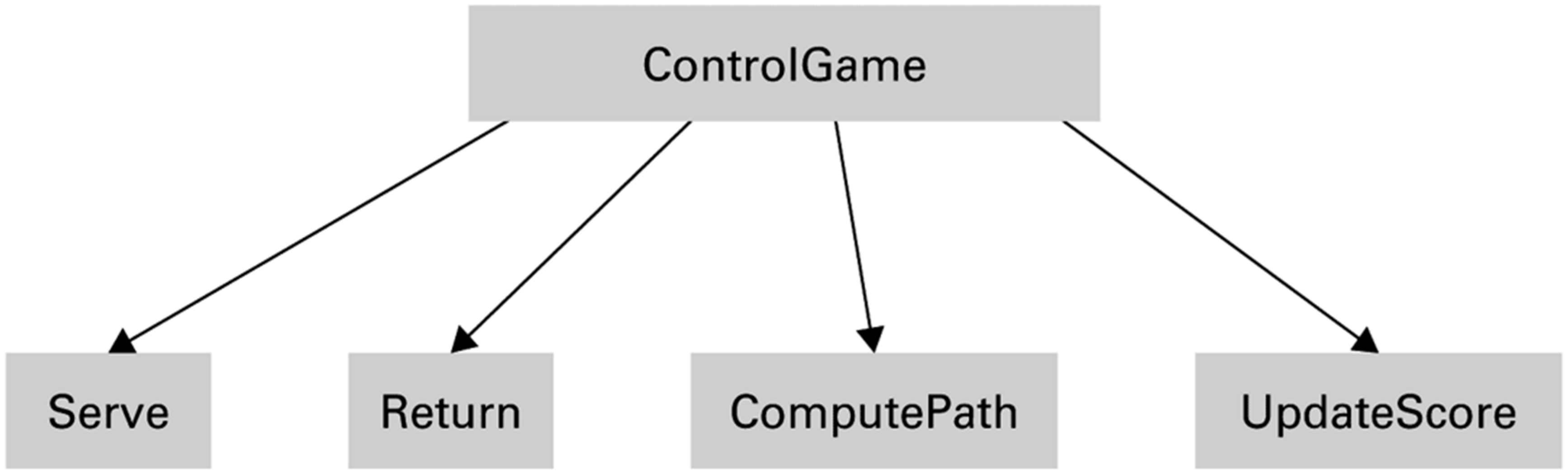


Figure 7.4 **The structure of PlayerClass and its instances**

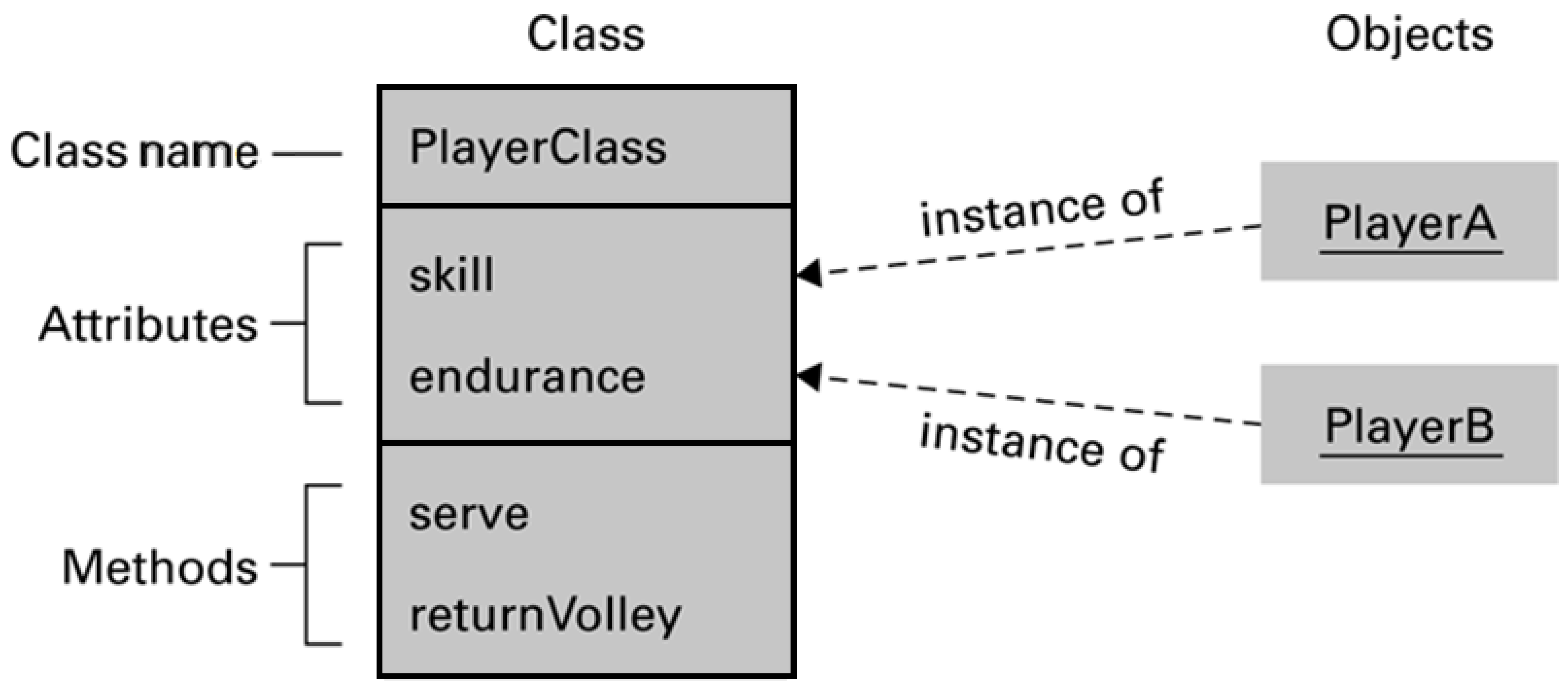


Figure 7.5 **The interaction between objects resulting from PlayerA's serve**

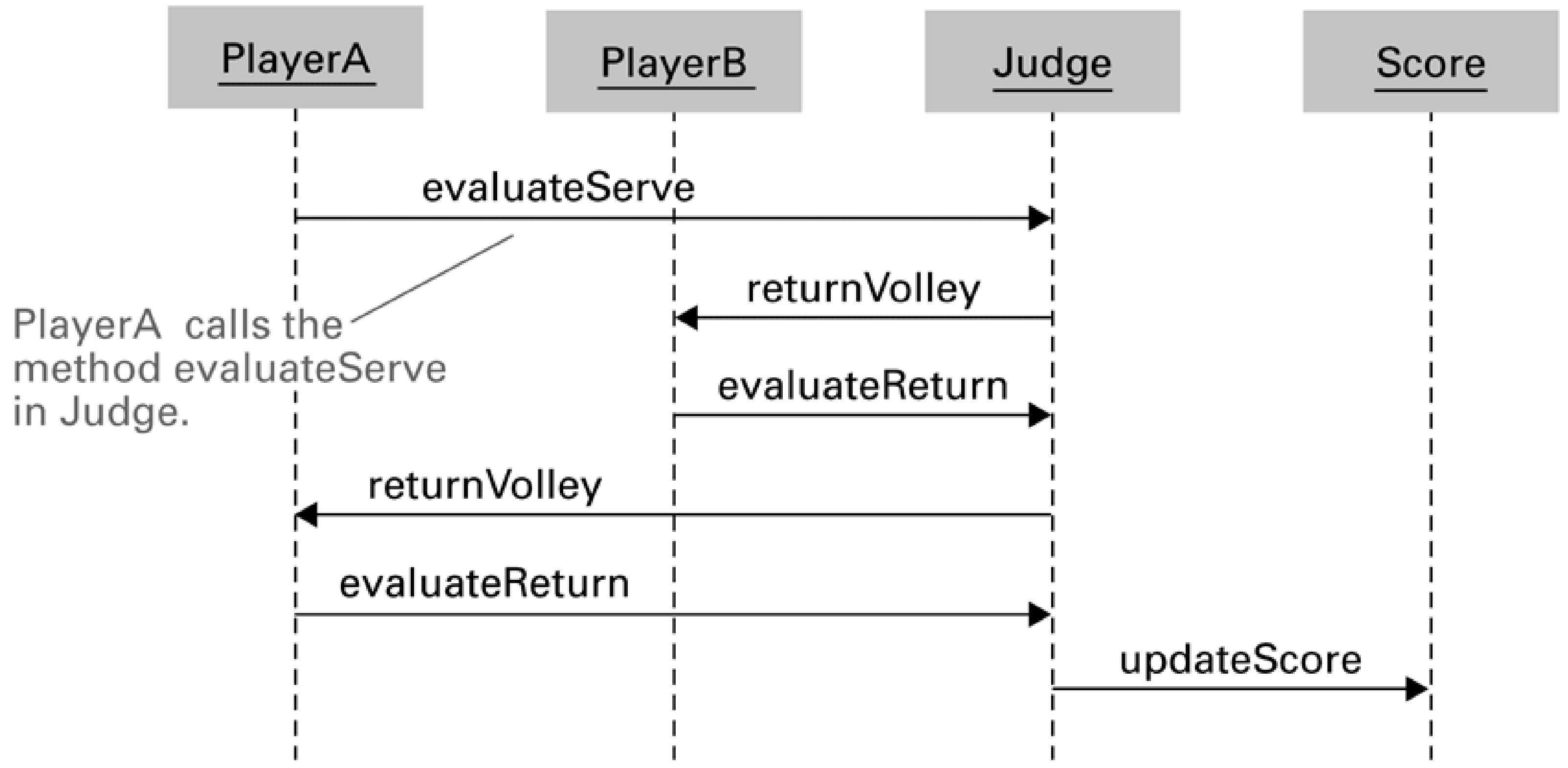
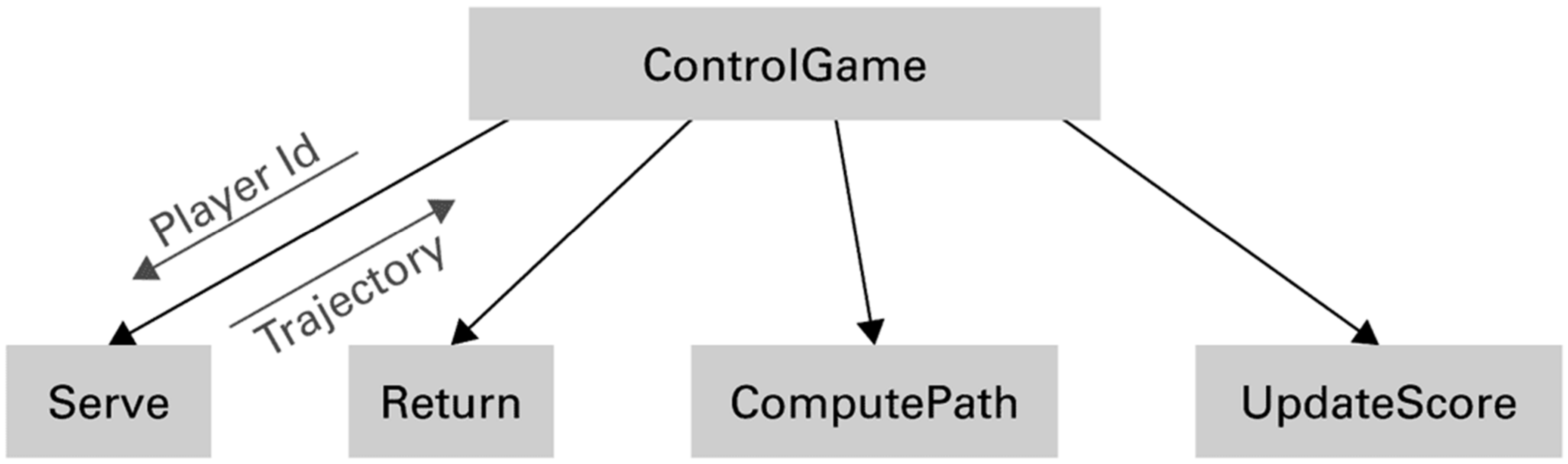


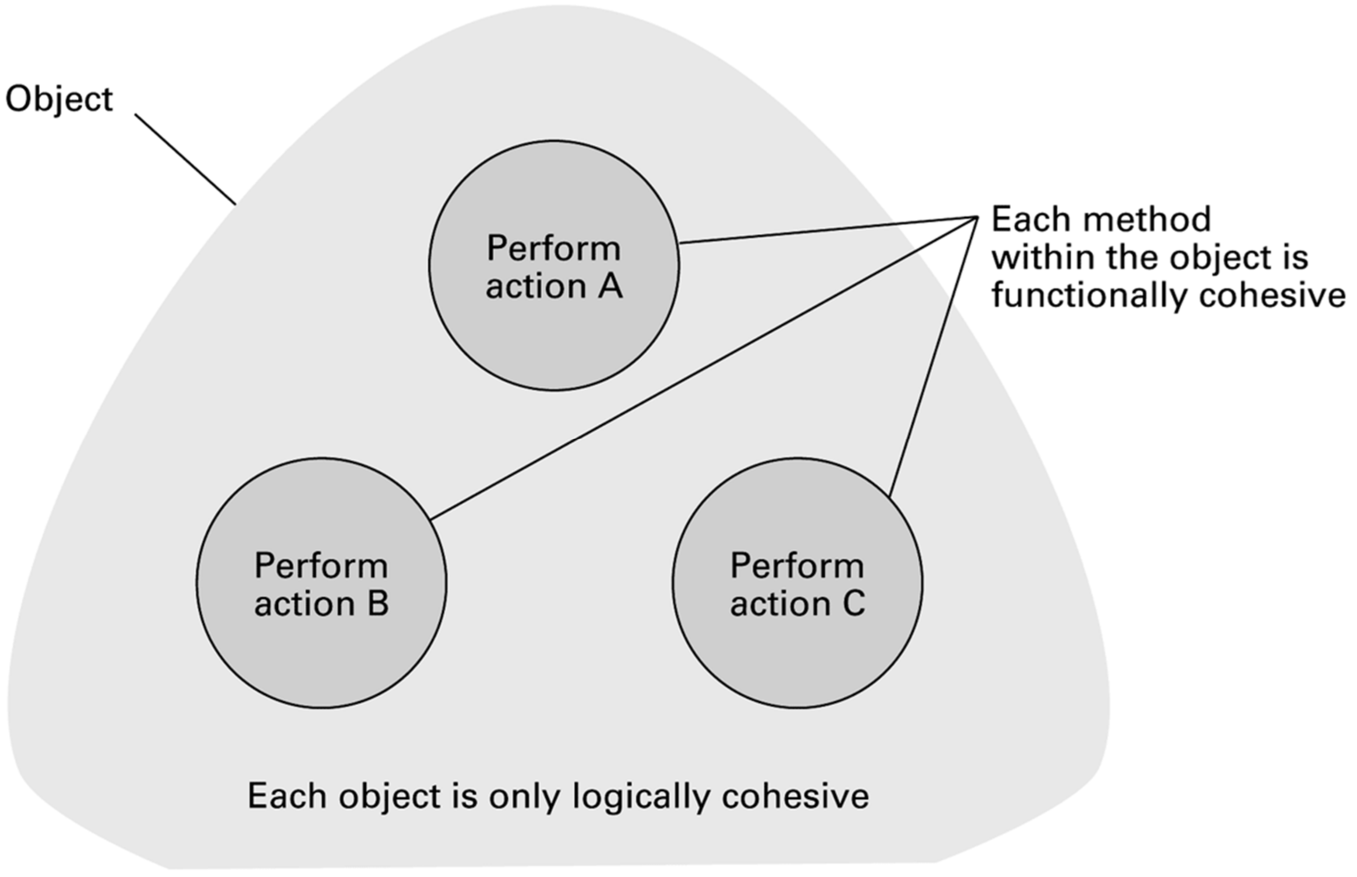
Figure 7.6 **A structure chart including data coupling**



Coupling versus Cohesion

- Coupling
  - Control coupling
  - Data coupling
- Cohesion
  - Logical cohesion
  - Functional cohesion

Figure 7.7 **Logical and functional cohesion within an object**


Object
Perform action A
Perform action B
Perform action C
Each method within the object is functionally cohesive
Each object is only logically cohesive

Tools of the Trade

- Data Flow Diagram
- Entity-Relationship Diagram
  - One-to-one relation
  - One-to-many relation
  - Many-to-many relation
- Data Dictionary

Figure 7.8 **A simple dataflow diagram**

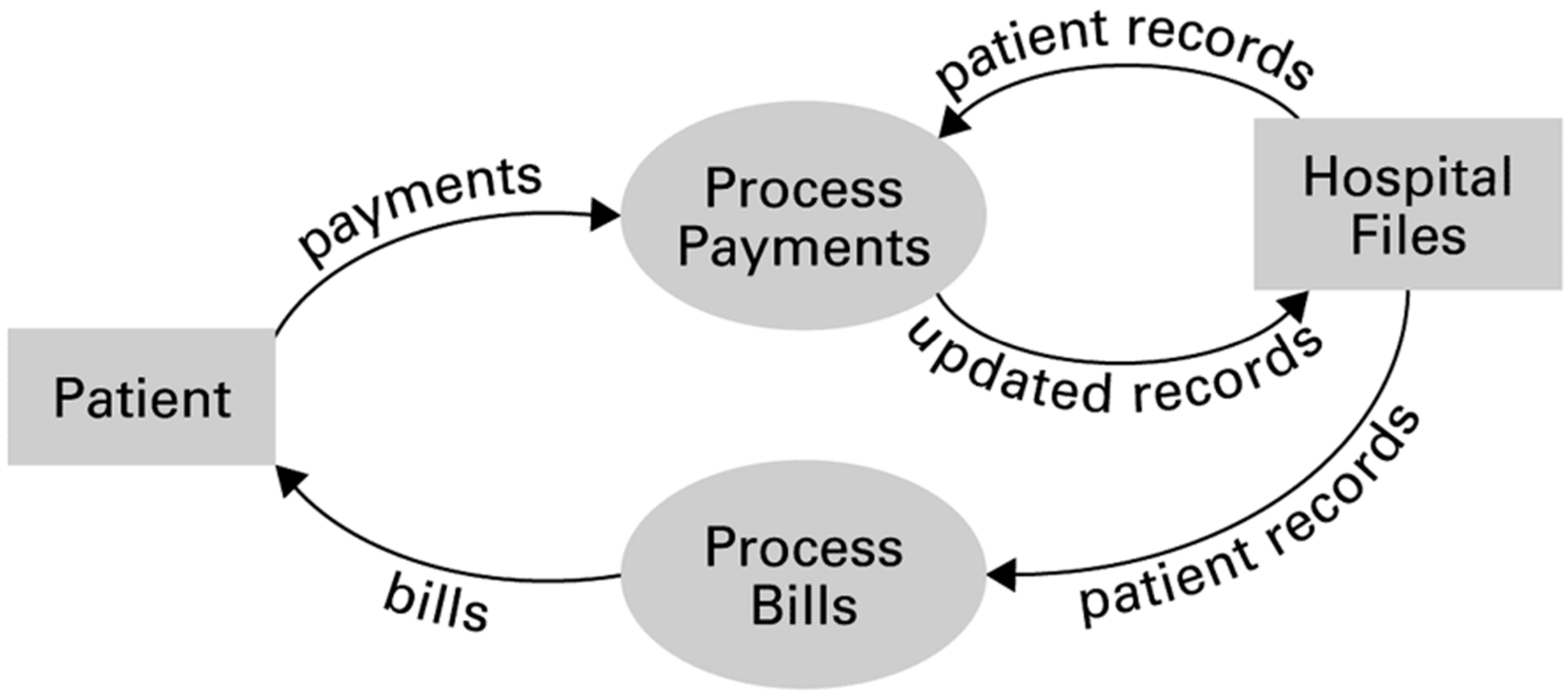


Figure 7.9 **A simple use case diagram**

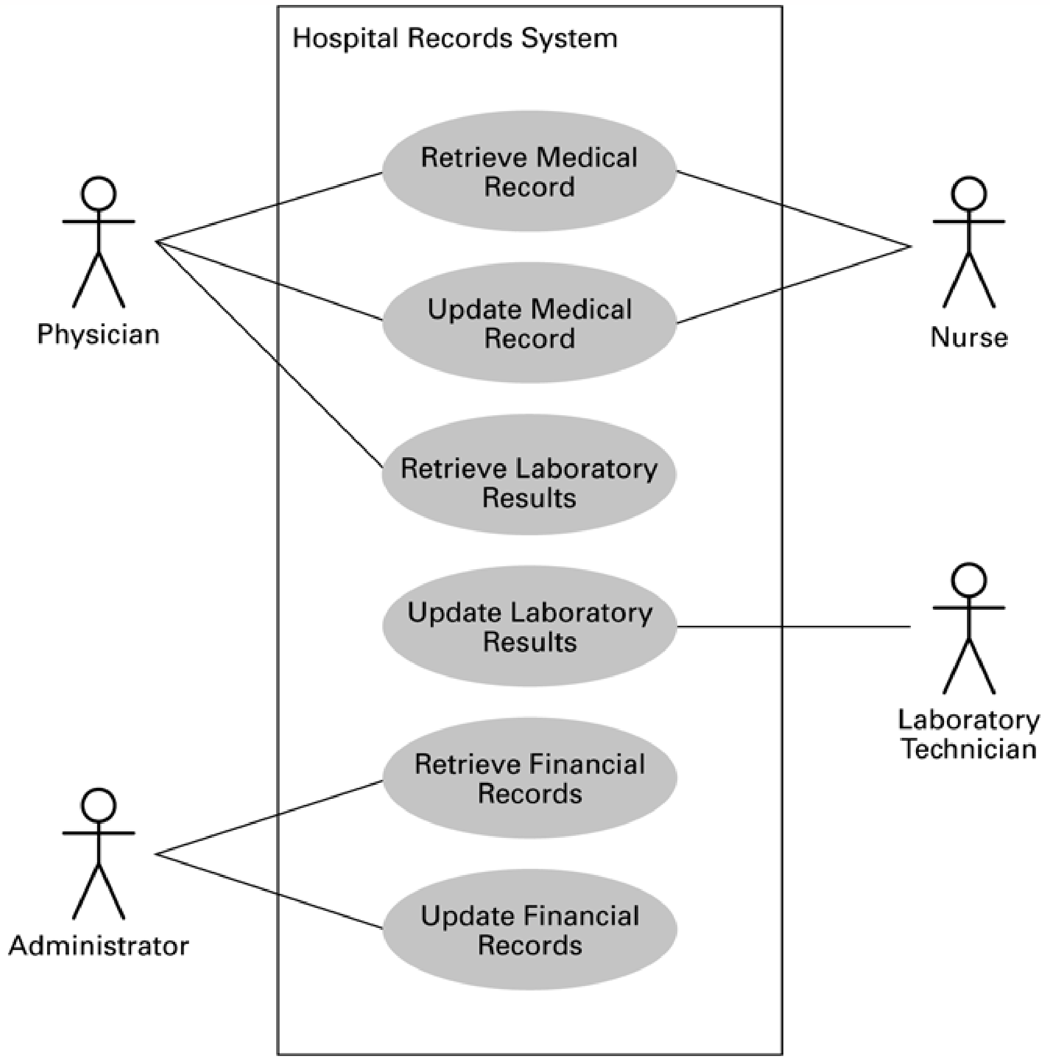
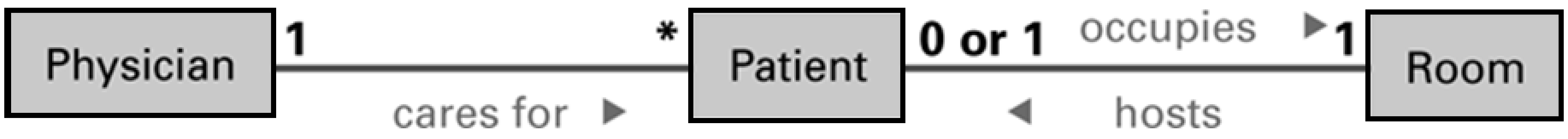


Figure 7.10 **A simple class diagram**



Unified Modeling Language

- Use Case Diagram
  - Use cases
  - Actors
- Class Diagram

Figure 7.11 **One-to-one, one-to-many, and many-to-many relationships between entities of types X and Y**

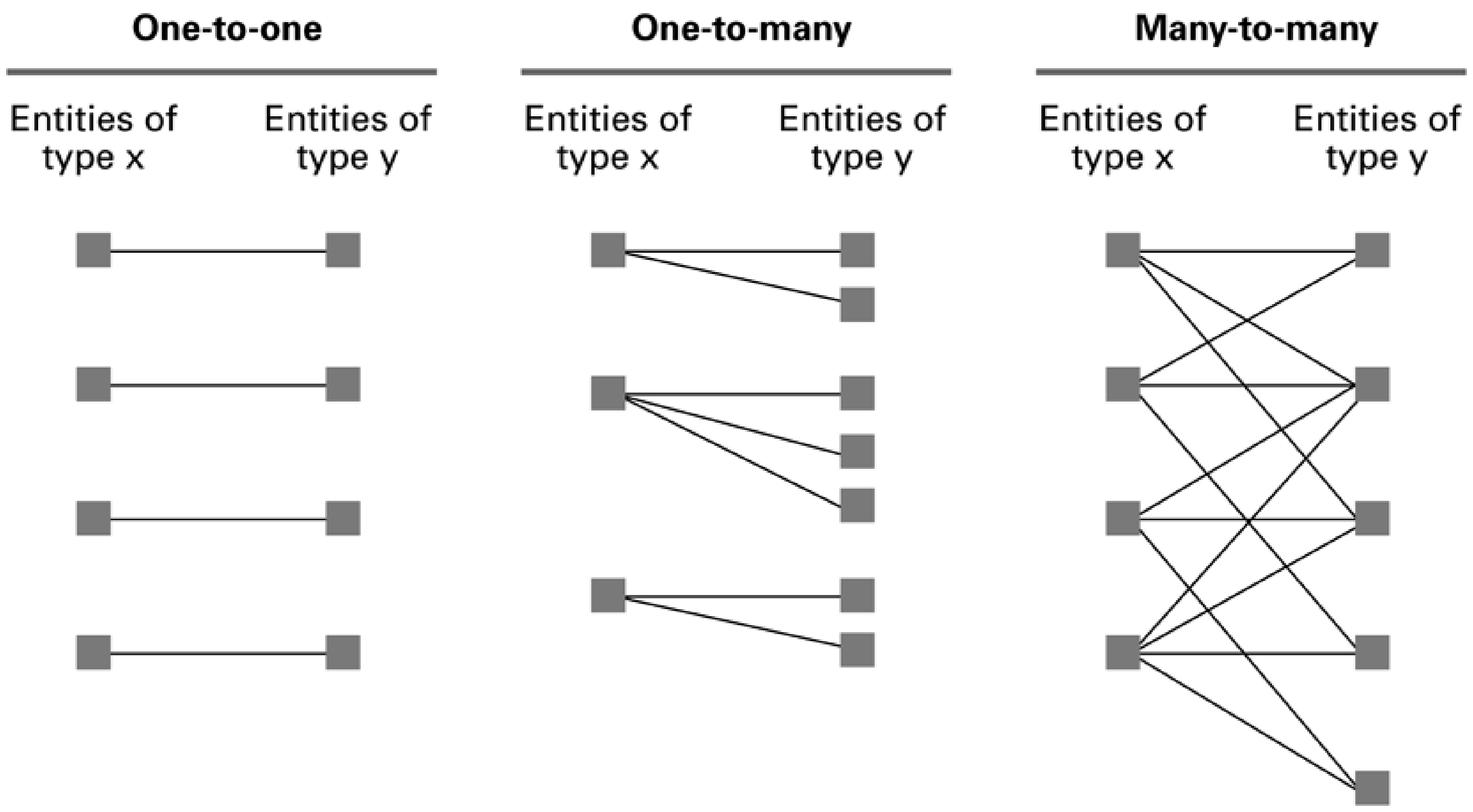


Figure 7.12 **A class diagram depicting generalizations**

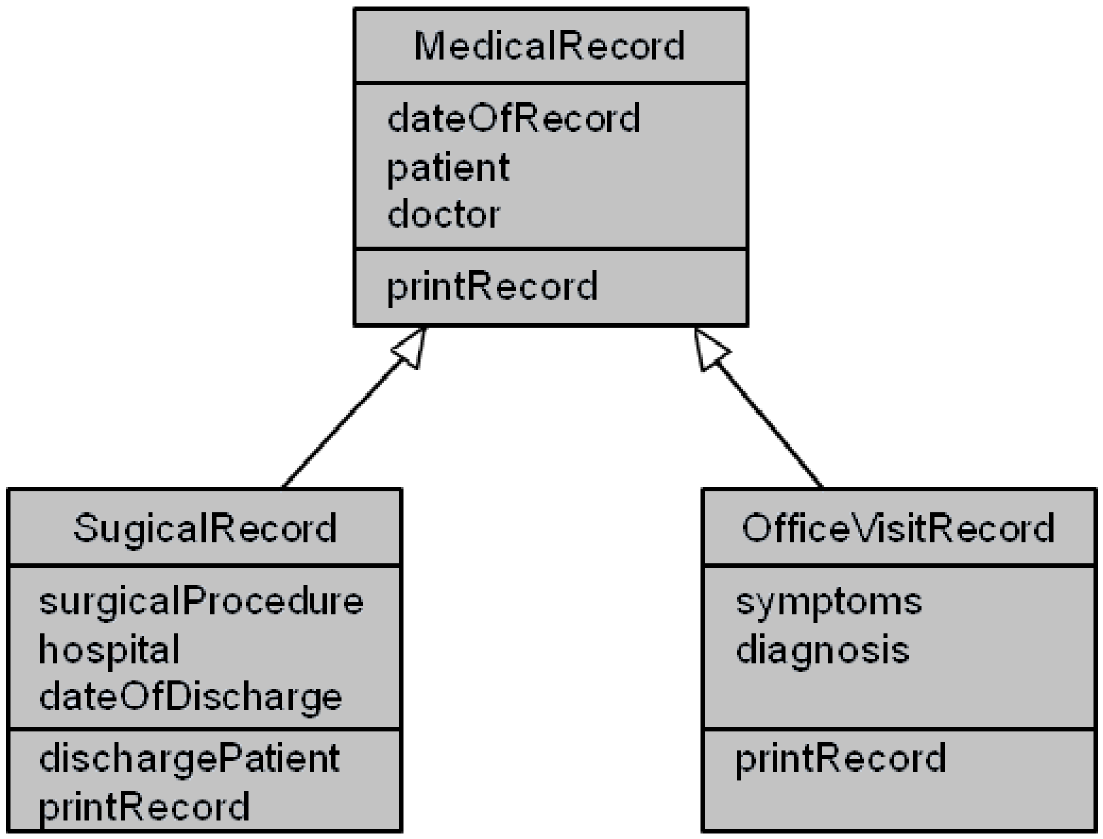
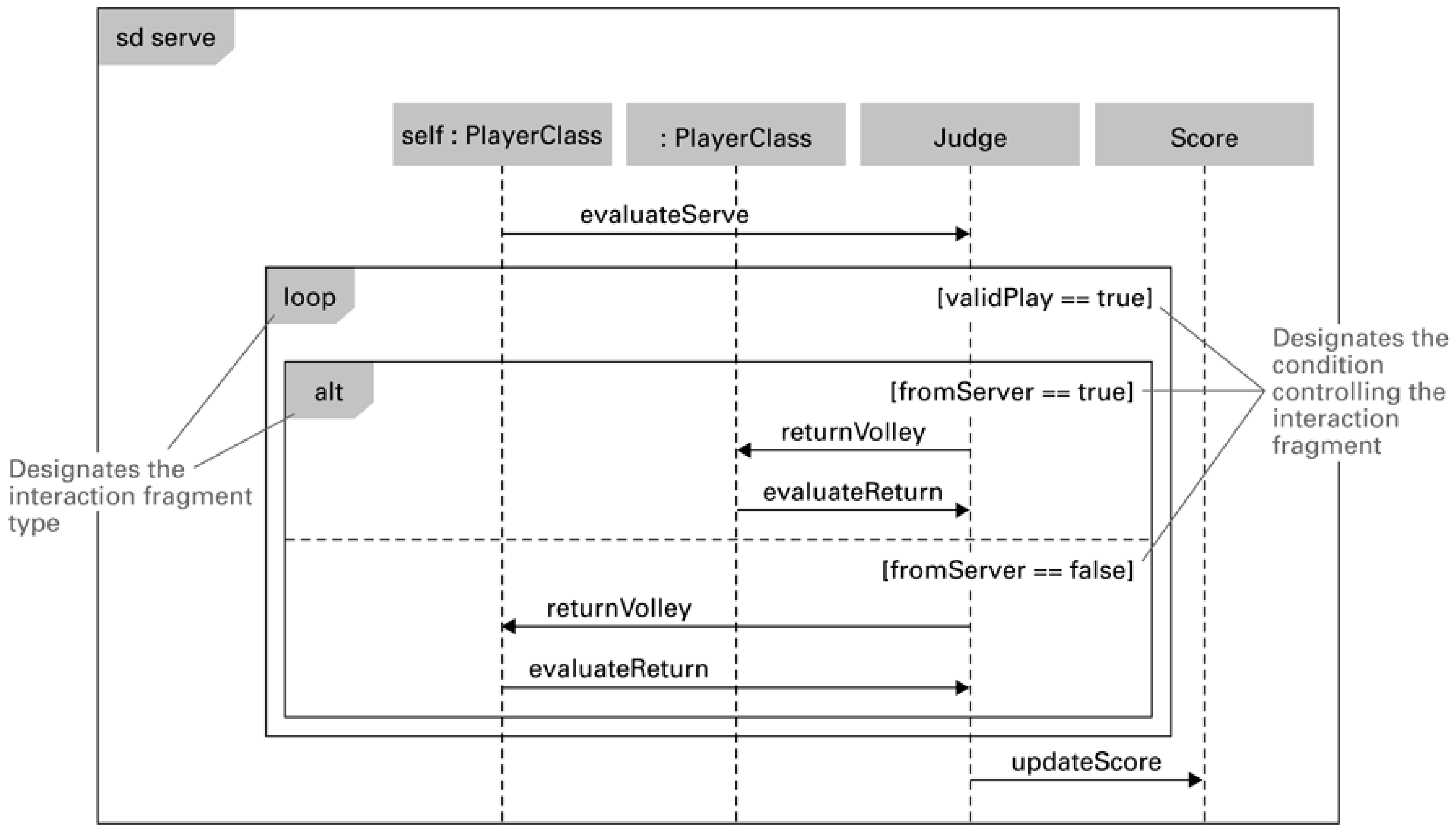


Figure 7.13 **A sequence diagram depicting a generic volley**



Structured Walkthoughs

- “Theatrical” experiment
- Class-responsibility-collaboration cards

Design Patterns

- Well designed “templates” for solving recurring problems
- Examples:
  - Adapter pattern: Used to adapter a module’s interface to current needs
  - Decorator pattern: Used to control the complexity involved when many different combinations of the same activities are required
- Inspired by the work of Christopher Alexander in architecture

Software Testing Strategies

- Glass-box testing
  - Pareto principle
  - Basis path testing
- Black-box testing
  - Boundary value analysis
  - Redundancy testing
  - Beta testing

Documentation

- User Documentation
  - Printed book for all customers
  - On-line help modules
- System Documentation
  - Source code
  - Design documents
- Technical Documentation
  - For installing, customizing, updating, etc.

Software Ownership

- Copyright
  - Allow a product to be released while retaining ownership of intellectual property
  - Asserted in all works:
    - Specifications
    - Source code
    - Final product

Software Ownership (continued)

- Software License
  - A legal agreement that grants the user certain permissions without transferring ownership
- Patents
  - Must demonstrate that it is new, usable, and not obvious to others with similar backgrounds
  - Process is expensive and time-consuming

Q&A