Overview

- Collaborative Object Modeling and architectural design mETHod (COMET)
  - Object Oriented Analysis and Design Method
  - Uses UML (Unified Modeling Language) notation
    - Standard approach for describing a software design
    - COMET = UML + Method
- Provides steps and guidelines for
  - Software Modeling and Design
  - From Use Case Models to Software Architecture
Overview of Software Architecture

Lecture 7

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Figure 6.1 COMET object-oriented software life cycle model
Steps in Using COMET/UML

1 Develop Software Requirements Model
2 Develop Software Analysis Model
3 Develop Software Design Model
   - Design Overall Software Architecture (Chapter 12, 13)
   - Design Distributed Component-based Subsystems (Chapter 13, 15)
   - Structure Subsystems into Concurrent Tasks (Chapter 18)
   - Design Information Hiding Classes (Chapter 14)
   - Develop Detailed Software Design

Design of Software Architecture

- Software Architecture
  - Structure of software system
  - Software elements
    - Externally visible properties of elements
    - Relationships among elements
- Develop initial software architecture
  - Synthesize from communication diagrams
  - Structure system into subsystems
- Subsystems determined using subsystem structuring criteria
  - Use stereotypes for subsystem structuring criteria
    - E.g., <<client>>, <<service>>
  - Depict subsystems on subsystem communication diagrams
Active and Passive Objects

- Objects may be active or passive
- **Active object**
  - Concurrent task or component
  - Has thread of control
- **Passive object**
  - a.k.a. Information Hiding Object
  - Has no thread of control
  - Operations of passive object are executed by task

Multiple Views of Software Architecture

- **Structural view**
  - Subsystem class diagram
Multiple Views of Software Architecture

- **Dynamic view**
  - Subsystem communication diagram

```
+ software system : BankingSystem
+ service
  + subsystem : BankingService
  + subsystem : ATMService

+ external I/O device : CardReader
+ external I/O device : ReceiptPrinter
+ external I/O device : CardDispenser
+ external user : ATMCustomer
+ external user : Operator
+ external user : Operator

- «external user» : Operator
- «external user» : ATMCustomer
- «external user» : Operator
- «external I/O device» : CardReader
- «external I/O device» : ReceiptPrinter
- «external I/O device» : CardDispenser

+ service
  + subsystem : BankingService

- «service» : BankingService
- «service» : ATMService
- «service» : BankingService

+ external user : ATMCustomer
+ external user : Operator
+ external user : Operator
- «external user» : Operator
- «external I/O device» : CardReader
- «external I/O device» : ReceiptPrinter
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```

- **Deployment view**
  - Physical configuration on deployment diagram

```
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```

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Transition from Analysis to Design: Integration of Communication Diagrams

- Used to determine overall structure of system
- Merger of communication diagrams
  - Start with first communication diagram
  - Superimpose other communication diagrams
    - Add new objects and new message interactions from each subsequent diagram
    - Objects and interactions that appear on multiple diagrams are only shown once
  - Consider alternative scenarios for each use case
- Integrated communication diagram
  - Shows all objects and their interactions

Figure 11.1 Communication diagram: ATM Client – Validate PIN use case – Valid Pin
Figure 21.16 Communication diagram: ATM Client – Withdraw Funds use case

Figure 13.2 Integrated communication diagram for ATM Client subsystem
Integration of Communication Diagrams

- Subsystem communication diagram
  - High-level communication diagram
  - Shows subsystems and their interactions
- Integrated communication diagram
  - If there are too many objects for one integrated communication diagram
  - Develop subsystem communication diagram
  - Develop integrated communication diagram for each subsystem

Design of Software Architecture

- Software Architecture
  - Define overall structure of system
    - Component interfaces and interconnections
      - Separately from component internals
  - Each subsystem performs major service
    - Contains highly coupled objects
    - Relatively independent of other subsystems
    - May be decomposed further into smaller subsystems
    - Subsystem is aggregate or composite object
- Candidates for subsystem
  - Objects that participate in same use case
Separation of Subsystem Concerns

- **Aggregate/composite object.**
  - Objects that are part of aggregate/composite object
  - Structure in same subsystem (e.g., Fig. 13.3)
- **Interface to external objects**
  - External real-world object should interface to 1 subsystem (e.g., Fig. 13.7)
- **Scope of Control**
  - Control object & objects it controls are in same subsystem (e.g., Fig. 13.2)
- **Geographical location**
  - Objects at different locations are in separate subsystems (e.g., Fig. 13.5)
- **Clients and Services**
  - Place in separate subsystems (e.g., Fig. 13.5, 13.7)
- **User Interaction**
  - Separate client subsystem (e.g., Fig. 13.5, 13.6)

![Figure 13.3 Example of composite class](image)
Figure 13.7 Interface to external classes – Banking System

Figure 13.5: Example of geographical distribution: Emergency Monitoring System
Subsystem Structuring Criteria

- **Client**
  - Requester of one or more services (e.g., Fig. 13.7)
- **User Interaction**
  - Collection of objects supporting needs of user (e.g., Fig. 13.6, 13.10)
- **Service**
  - Provides service for client subsystems (e.g., Fig. 13.5, 13.7)
- **Control**
  - Subsystem controls given aspect of system (e.g., Fig. 13.10)
- **Coordinator**
  - Coordinates several control subsystems (e.g., Fig. 13.10)
- **Input / Output**
  - Performs I/O operations for other subsystems (e.g., Fig. 13.5)
Figure 13.10 Example of coordinator and control subsystems - Factory Automation System