ITSS SOFTWARE DEVELOPMENT

5. INTERFACE DESIGN

Nguyen Thi Thu Trang
trangntt@soict.hust.edu.vn

Interface design

1. Graphical user interface design
2. System/Device interface design

References

[1] Textbook for Software Design & Development Engineers, *No. 3 – System Development, Operations and Maintenance, 2nd Edition;* Japan Information Processing Development Corporation, Japan Information-Technology Engineers Examination Center.

1. Graphical user interface design

1.1. Standardizing the screen configuration

1.2. Creating screen images

1.3. Creating a screen transition diagram

1.4. Creating screen specifications

Standardizing

- **Display**
  - Physical size, resolution, and number of colors supported by displays
- **Screen:** divided into displayed objects called windows (Window)
  - Location of standard buttons (e.g., OK, Cancel, Register, Search)
  - Display location of messages, etc.
  - Display of screen title and menus
  - Consistency in expression of alphanumeric characters
  - Expression of sentences and detailed items
  - Color coordination

Standardizing

- **Control**
  - Style, size, color, and characters displayed
  - Input check process
  - Sequence of moving the focus (e.g., defining the tab sequence)
- **Menu**
  - Design menus with consideration of the standard specification (common client area) of the screen
- **Direct input from a keyboard**
  - Maintain consistency in the assignment of shortcut keys

Standardizing

- **Messages**
  - Determine how messages are displayed when a time-consuming process is executed (busy).
- **Error**
  - Execute standardized processing if an error occurs
- **Help**
  - Develop detailed Help information in accordance with the manual, and maintain consistency in terminology, descriptions, and explanations of methods.

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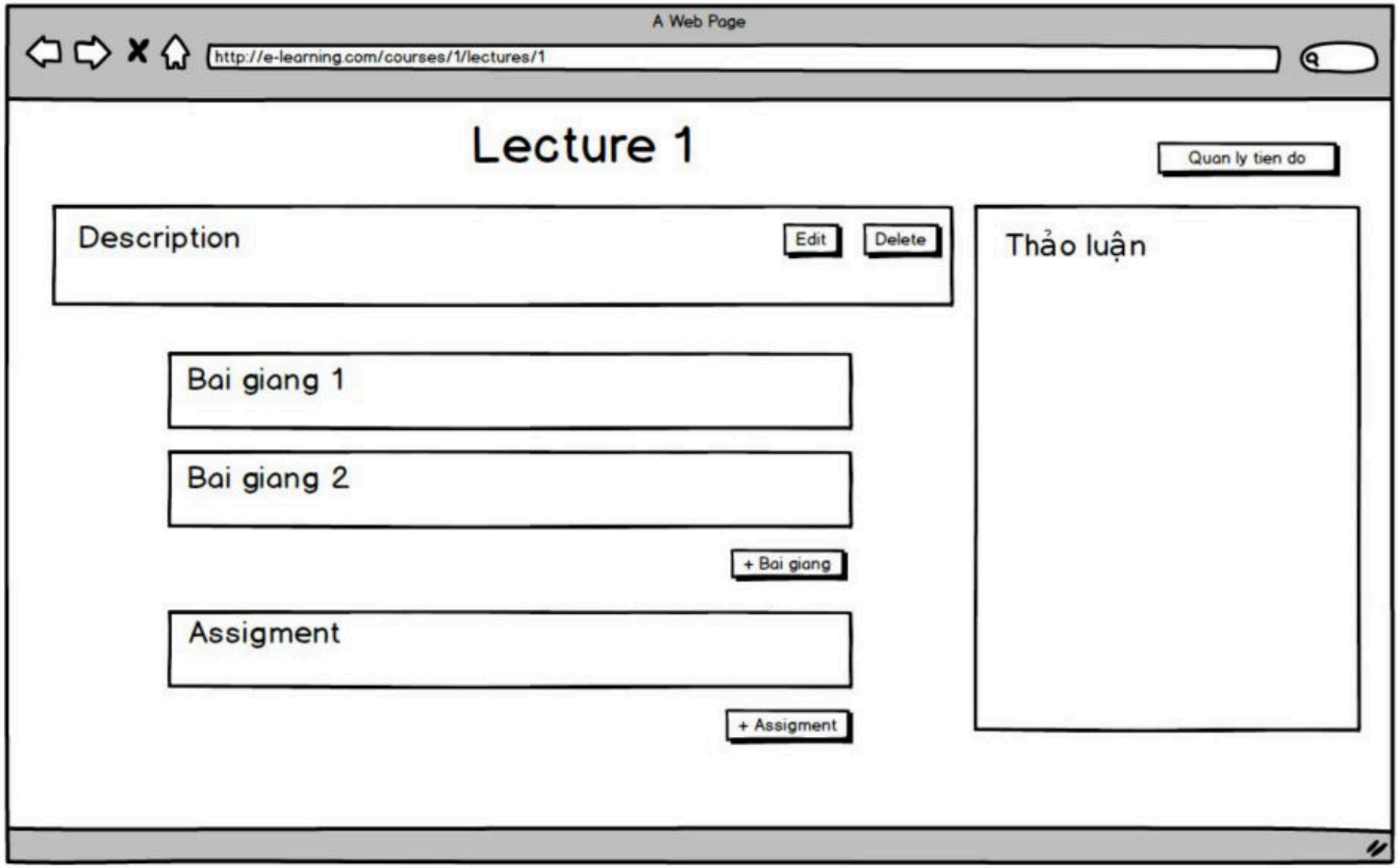
From use case

- Based on use case and boundary classes which interact with users
  - Map these boundary classes to screens
- Based on input/output description in use case specification/scenario

=> Design screen using tools

GUI Design tools

- Simple tools
  - Notepad
  - Microsoft Excel/Powerpoint/Word/FrontPage
- Professional tools
  - Free
    - InVision
    - IDEs: Eclipse, NetBean
  - Commercial
    - Adobe Dreamweaver
    - Axure RP
    - Photoshop
    - IDEs: Visual Studio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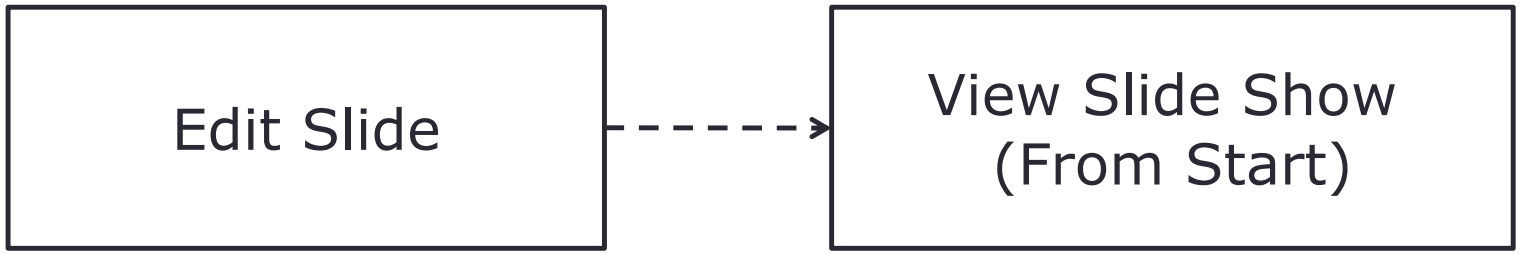
Display transition diagram

- Summarize the correlation of screens in the screen transition diagram
  - Classify the screens into the four patterns by focusing on the transition pattern
  - Link the screens in accordance with the classifications

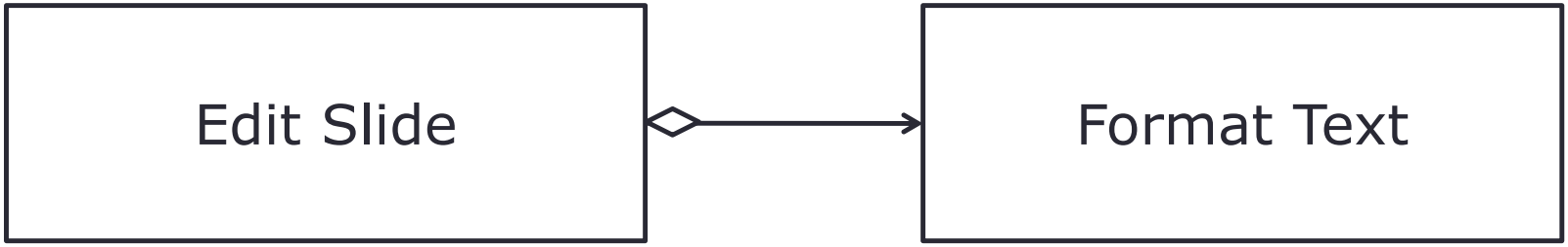
Four transition patterns

- *1. Simple screen transition:*
  - A conventional simple transition to an independent screen



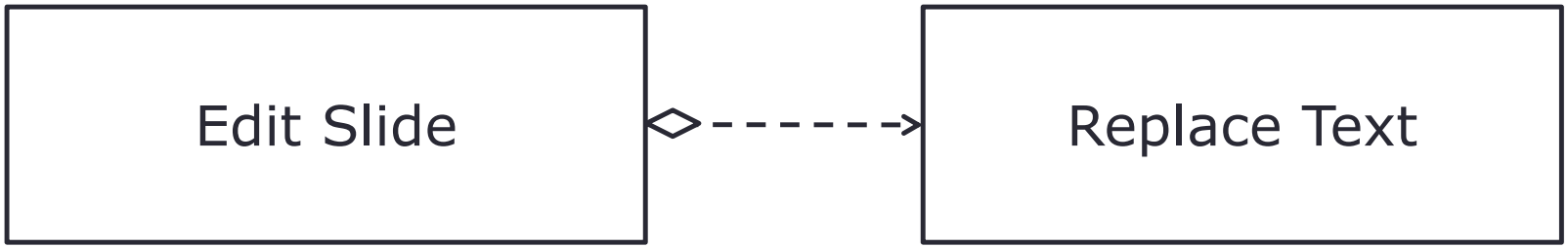
Four transition patterns (2)

- *2. Transition to a dependent child screen:*
  - Move to a pop-up screen
  - When a child screen is displayed on the parent screen, the underlying parent screen cannot be operated



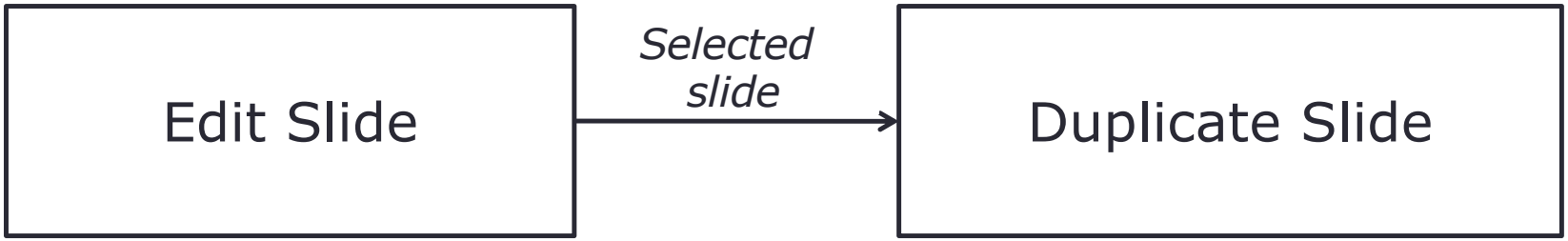
Four transition patterns (3)

- *3. Transition to an independent child screen:*
  - Move to a pop-up screen,
  - Parent screen and other screens can be operated while the child screen is displayed.

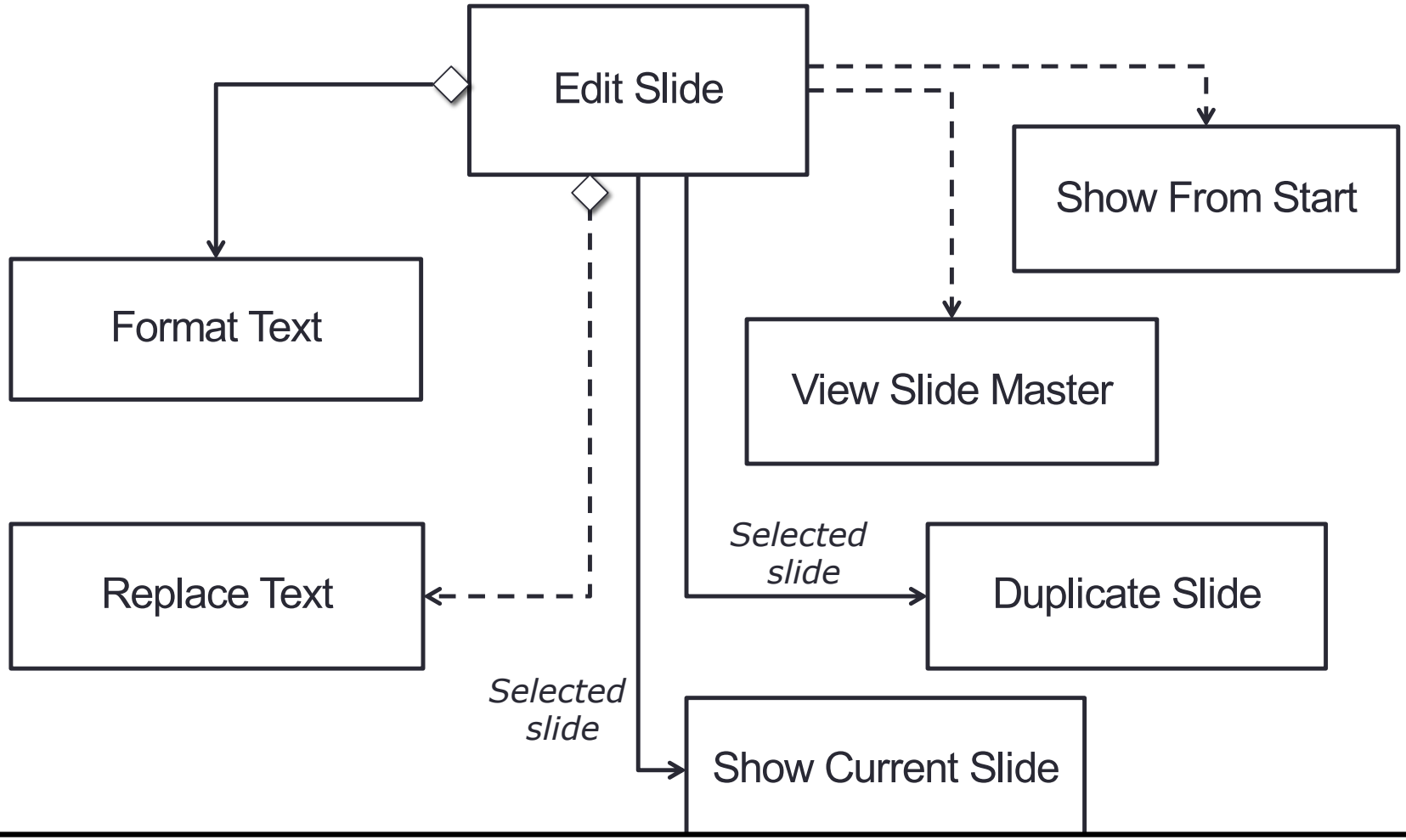


Four transition patterns (4)

- *4. Transition to a dependent screen:*
  - Start a dependent new screen with data



Link the screen: Screen transition diagram



1. Graphical user interface design

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4. Screen specification

- Decide on a detailed format for a screen specification
- Define field attributes based on the new screen information identified while deciding on screen images and the screen transition diagram

Screen specification

- Screen image
  - This is the screen image to be displayed. If screen images are created in advance with the screen design tool, attach a hardcopy.
- List of functions
  - Defines the names of parts such as the buttons on the screen, and summarizes their functions.
  - Provide descriptions of events for individual screens, attributes of parts, input check specifications and output specifications, etc.
- Defining the field attributes

Screen specification example

Liquor sales basic system (general-purpose search subsystem for sales information)		Date of creation	Approved by	Reviewed by	Person in charge
Screen specification	Displaying detail table				

Control	Operation	Function
Area for displaying detail table	Initial	-Displays in a table information meeting the conditions defined in the search specification screen. -This follows the setting specified in the display settings screen for display items and sequence of display.
Graph display button	Click	Displays the graph display screen
Table print button	Click	Displays the print preview screen
Return button	Click	Displays the search specification screen

[1]: Section 3.2.1, pp 3-54

Defining the field attributes

- Decide on the field attributes of input and output items
- Summarize them in descriptions of items for screen display.
- The screen consists of multiple fields.
- Each field consists of a one-byte (equivalent to a single character) attribute at the beginning and a variable item

Example: Defining the field attributes

Screen name	Order entry

[1]

Item name	Number of digits (bytes)	Type	Field attribute	Remarks
Transaction category	3	Numeral	Green (blink)	Error items blink.
Customer code	5	Numeral	Green (blink)	Error items blink.
Customer name	30	Character	White	15 characters, left-justified
Product code	8	Numeral	Green (blink)	Error items blink.
Product name	22	Character	White	11 characters, left-justified
Quantity	6	Numeral	Green (blink)	Error items blink.
Unit price	7	Numeral	White	
Amount	9	Numeral	White	
Quantity in stock	10	Numeral, special character	White	Displayed in the format of ZZZ, ZZZ, ZZ9

[1]: Section 3.2.1, pp 3-57

Interface design

1. Graphical user interface design
2. System/Device interface design

2. System/Device interface design

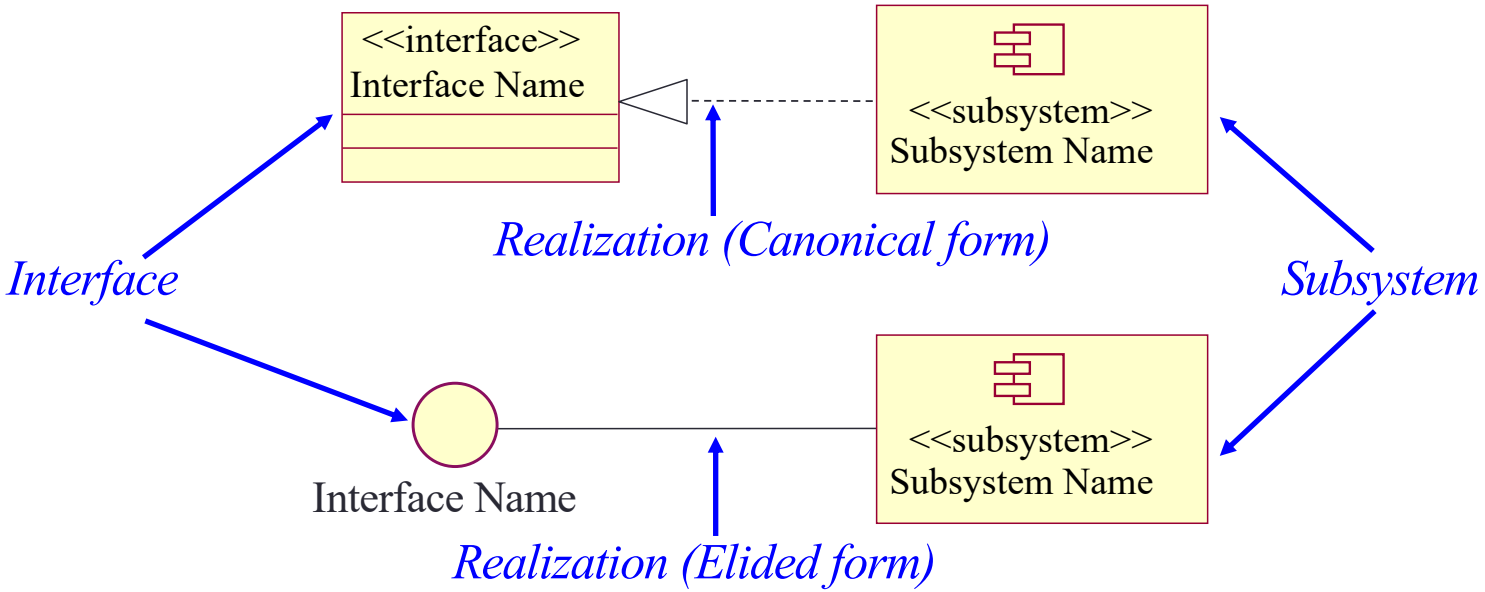
2.1. Identify subsystem

2.2. Identify subsystem interfaces

2.3. Subsystem design

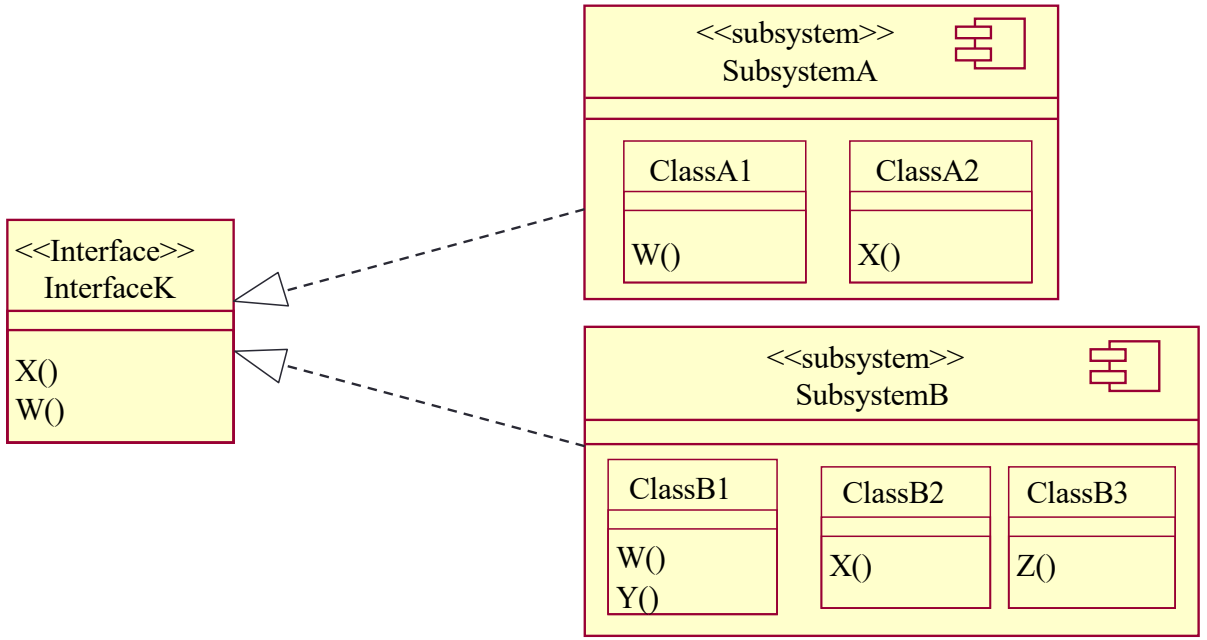
Subsystems and Interfaces

- Realizes one or more interfaces that define its behavior



Subsystems and Interfaces (continued)

- Subsystems :
  - Completely encapsulate behavior
  - Represent an independent capability with clear interfaces (potential for reuse)
  - Model multiple implementation variants



- class ClientClass{
  - InterfaceK subsystem;

  - m(){
    - subsystem = new SubsystemA();
    - subsystem.X();
    - subsystem.W();
  - }

- }

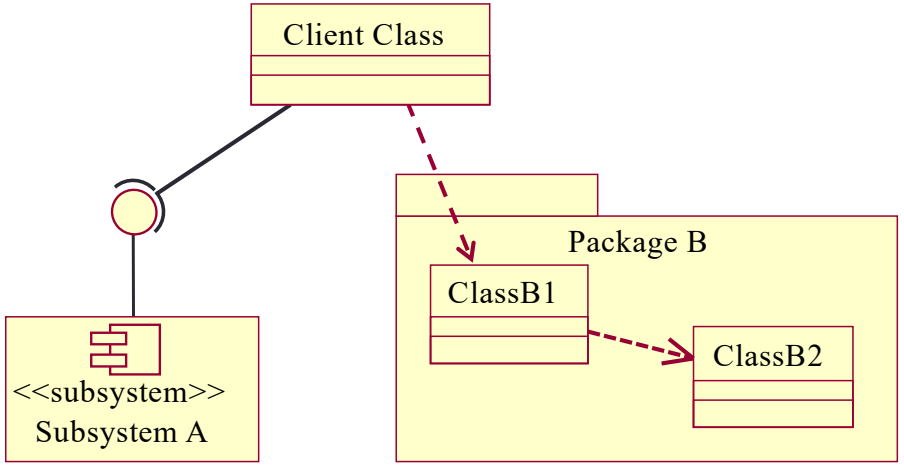
Packages versus Subsystems

Subsystems

- Provide behavior
- Completely encapsulate their contents
- Are easily replaced

Packages

- Don't provide behavior
- Don't completely encapsulate their contents
- May not be easily replaced



Encapsulation is the key!

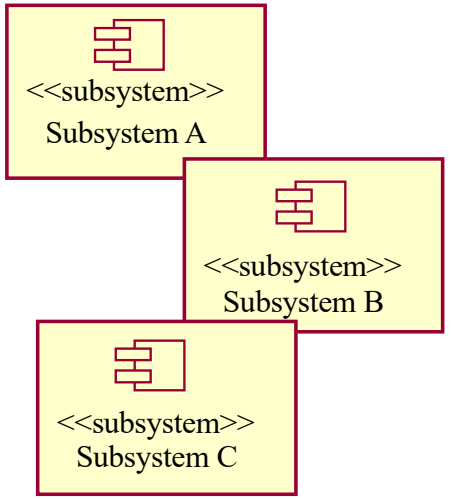
Subsystem Usage

- Subsystems can be used to partition the system into parts that can be independently:
  - ordered, configured, or delivered
  - developed, as long as the interfaces remain unchanged
  - deployed across a set of distributed computational nodes
  - changed without breaking other parts of the systems
- Subsystems can also be used to:
  - partition the system into units which can provide restricted security over key resources
  - represent existing products or external systems in the design (e.g. components)

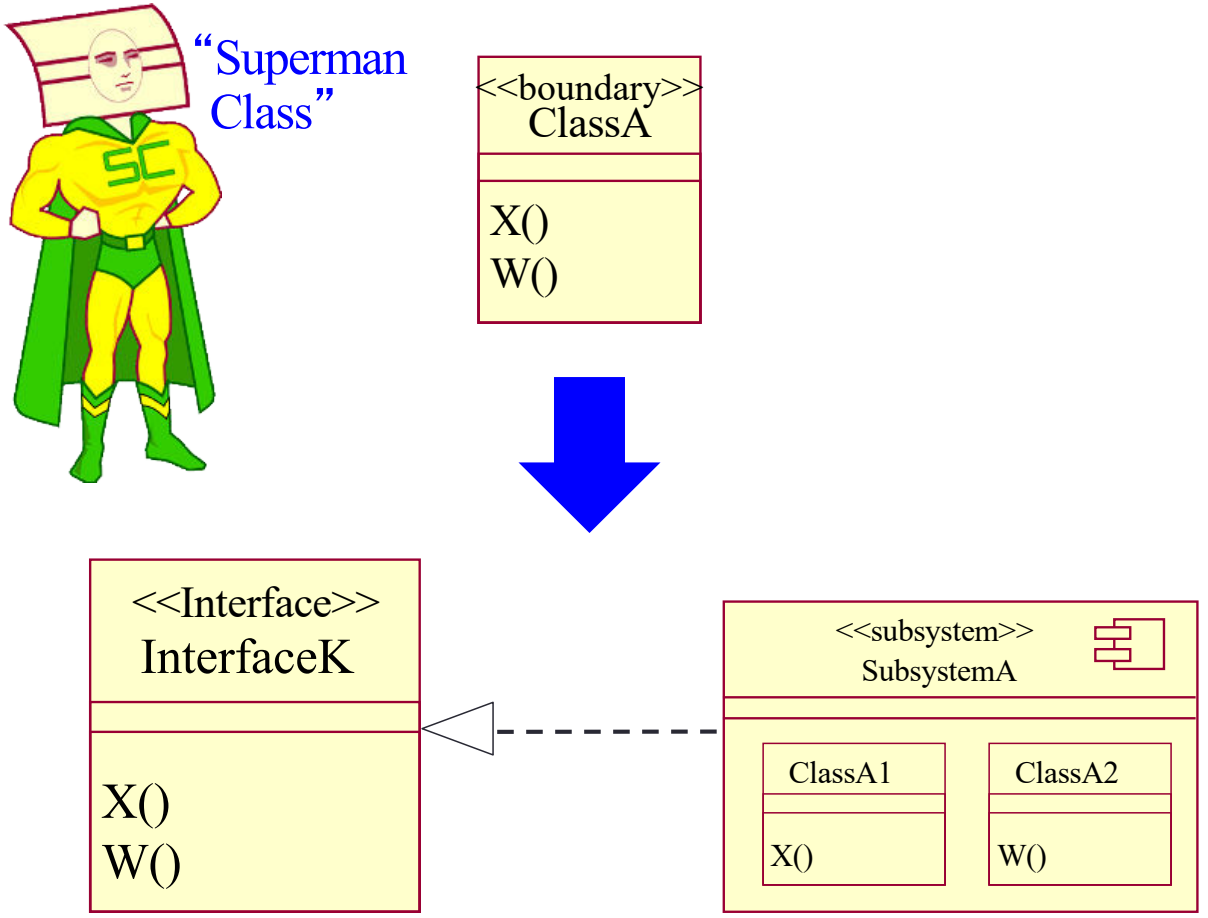
Subsystems raise the level of abstraction.

Candidate Subsystems

- Analysis classes which may evolve into subsystems:
  - Classes providing complex services and/or utilities
  - Boundary classes (user interfaces and external system interfaces)
- Existing products or external systems in the design (e.g., components):
  - Communication software
  - Database access support
  - Types and data structures
  - Common utilities
  - Application-specific products



Identifying Subsystems



2. System/Device interface design

2.1. Identify subsystem

2.2. Identify subsystem interfaces

2.3. Subsystem design

Identifying Interfaces

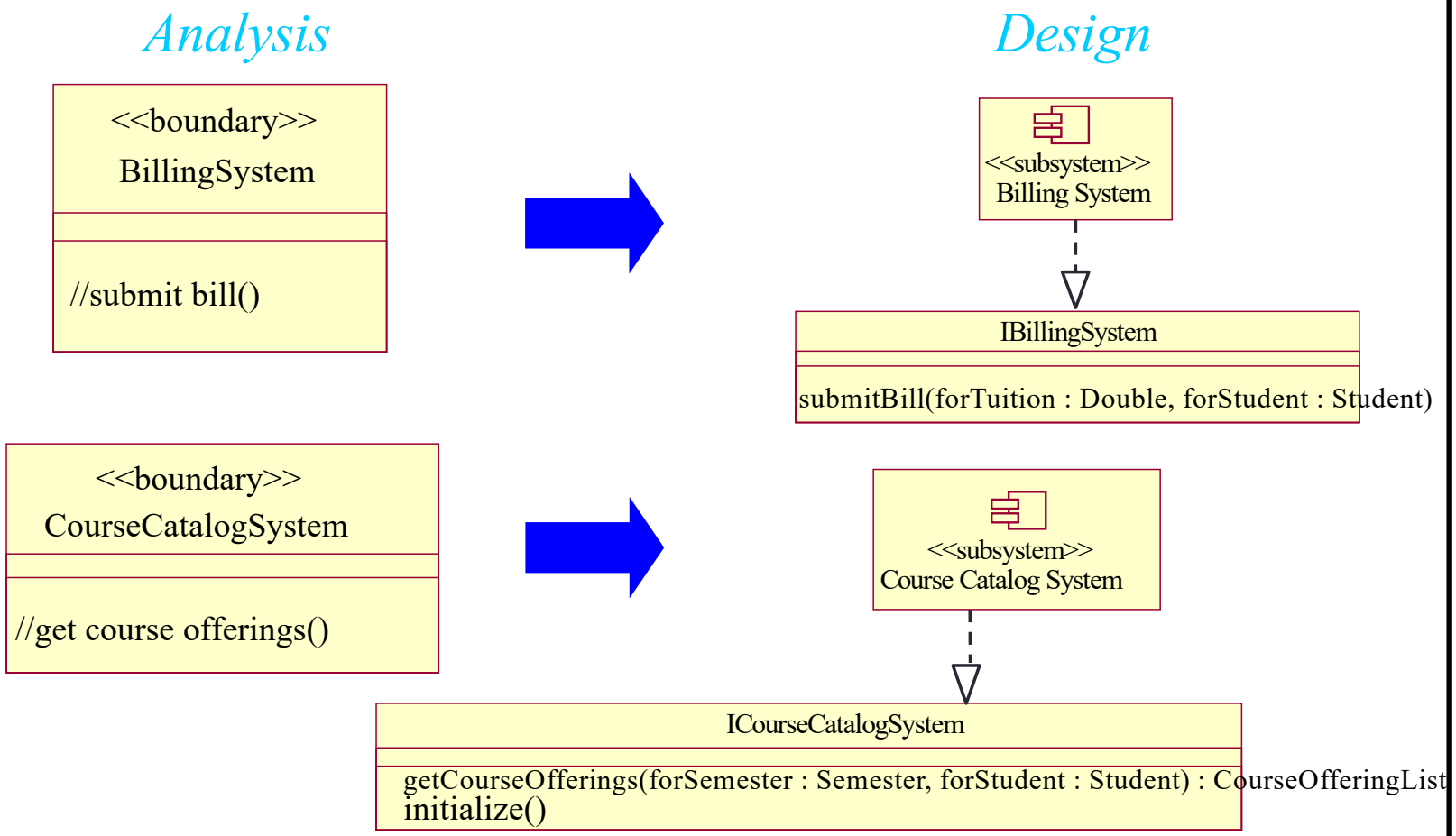
- Purpose
  - To identify the interfaces of the subsystems based on their responsibilities
- Steps
  - Identify a set of candidate interfaces for all subsystems.
  - Look for similarities between interfaces.
  - Define interface dependencies.
  - Map the interfaces to subsystems.
  - Define the behavior specified by the interfaces.
  - Package the interfaces.

Stable, well-defined interfaces are key to a stable, resilient architecture.

Interface Guidelines

- Interface name
  - Reflects role in system
- Interface description
  - Conveys responsibilities
- Operation definition
  - Name should reflect operation result
  - Describes what operation does, all parameters and result
- Interface documentation
  - Package supporting info: sequence and state diagrams, test plans, etc.

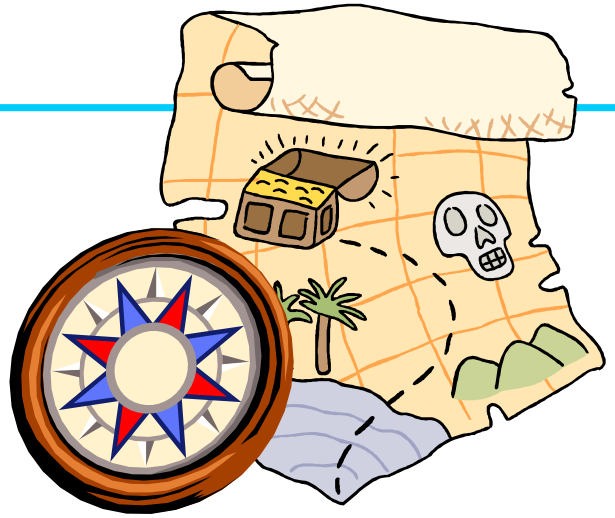
Example: Design Subsystems and Interfaces



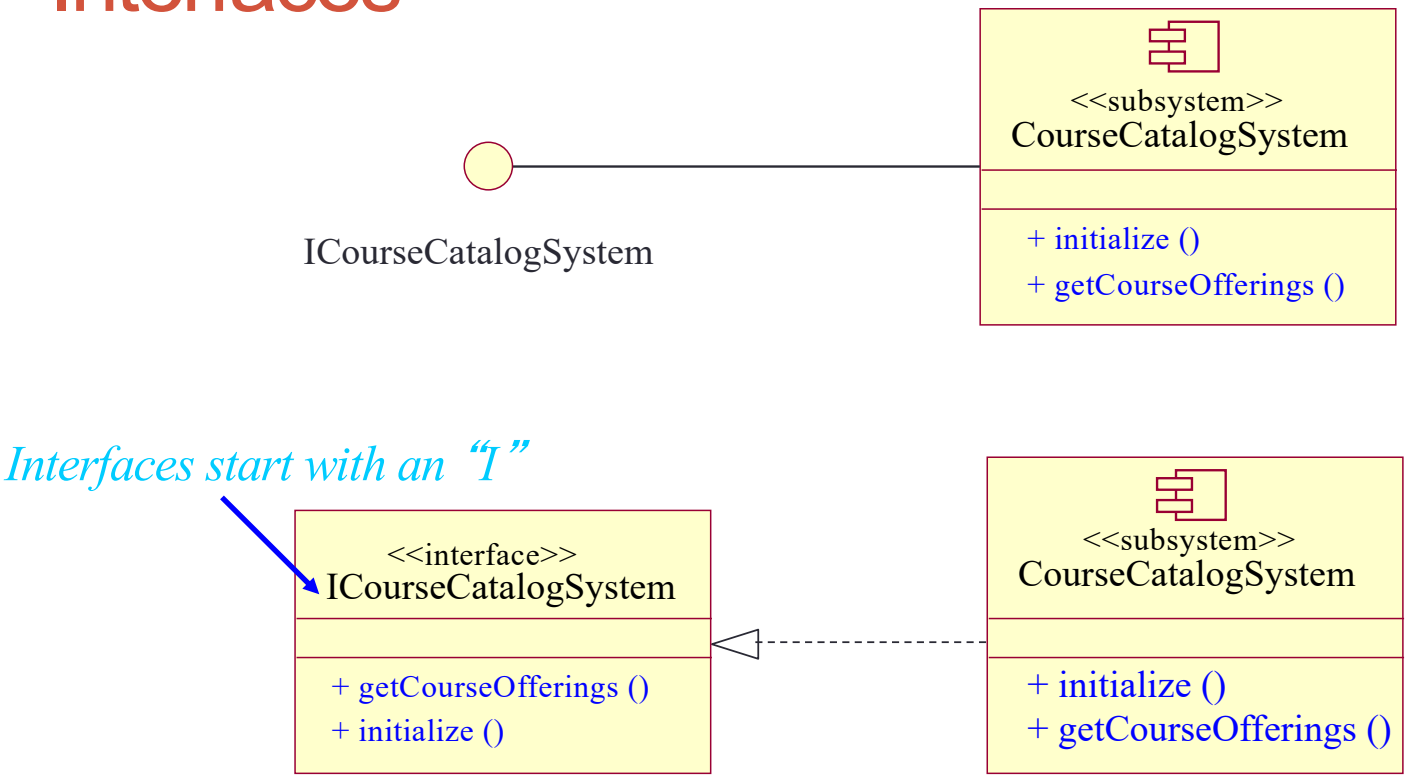
All other analysis classes map directly to design classes.

Example: Analysis-Class-To-Design-Element Map

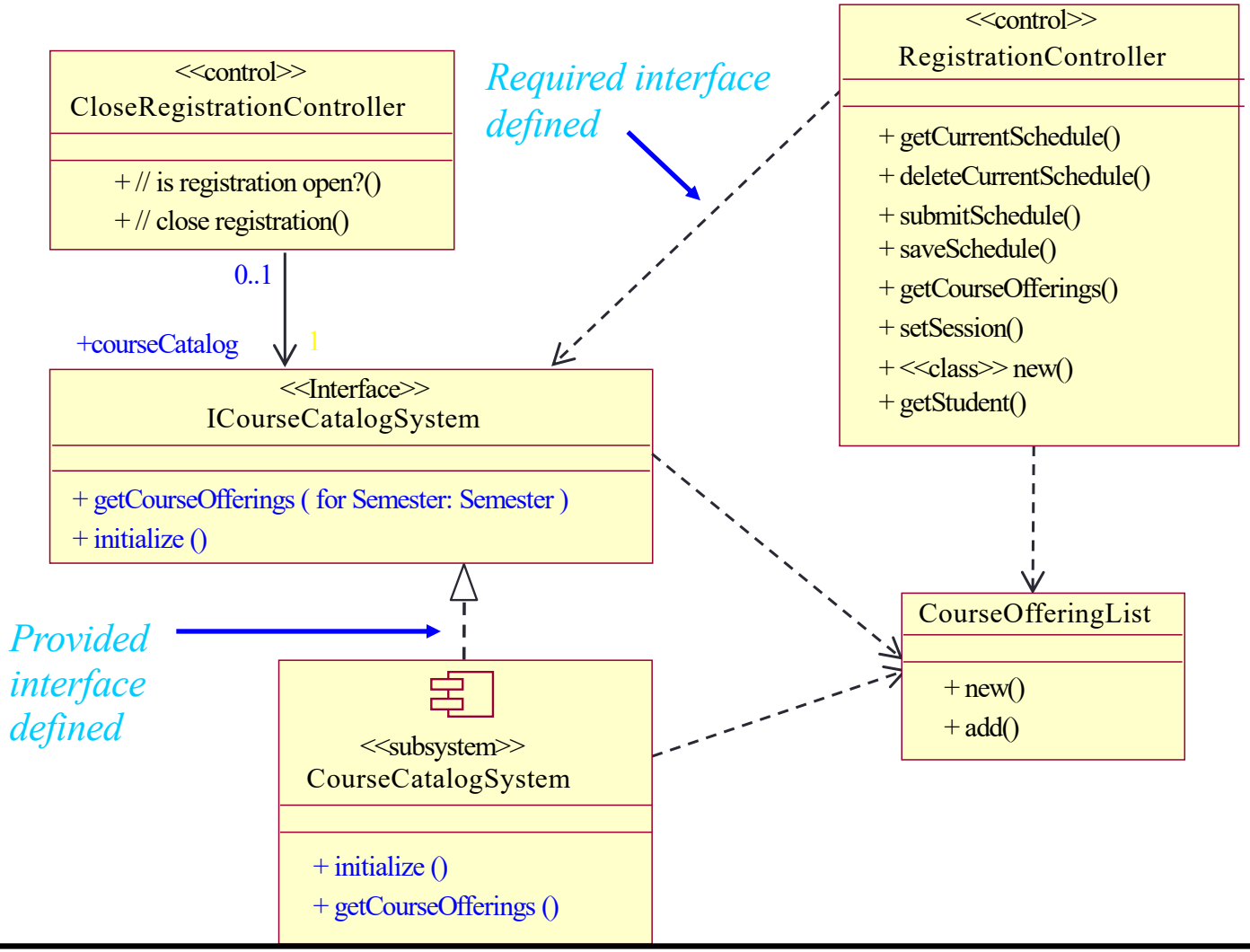
Analysis Class	Design Element
CourseCatalogSystem	CourseCatalogSystem Subsystem
BillingSystem	BillingSystem Subsystem
All other analysis classes map directly to design classes	



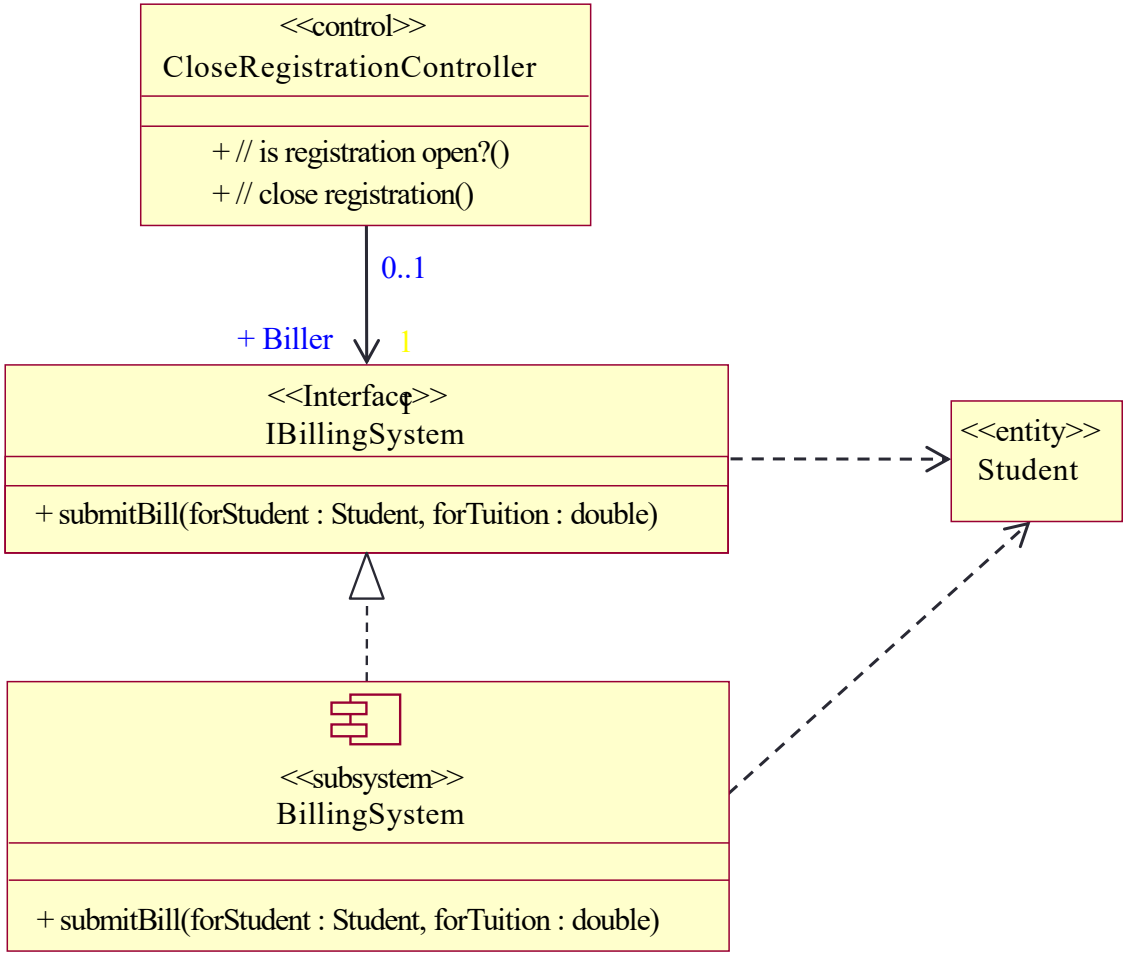
Modeling Convention: Subsystems and Interfaces



Example: Subsystem Context: CourseCatalogSystem



Example: Subsystem Context: Billing System



2. System/Device interface design

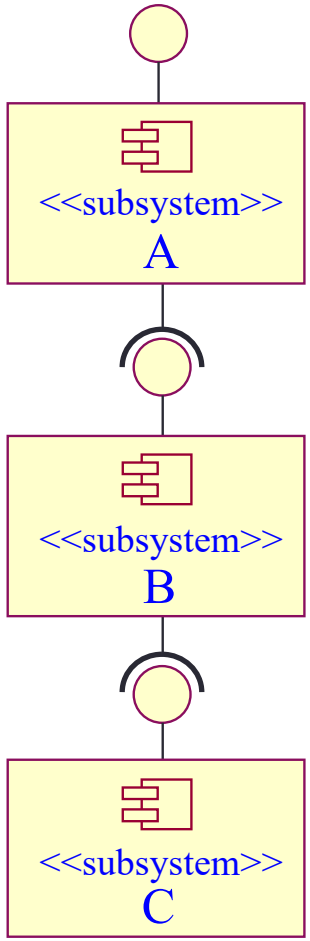
2.1. Identify subsystem

2.2. Identify subsystem interfaces

2.3. Subsystem design

Subsystem Guidelines

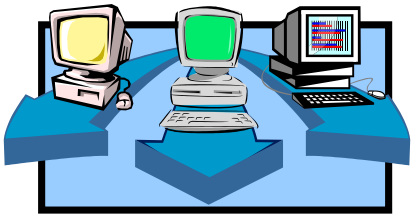
- Goals
  - Loose coupling
  - Portability, plug-and-play compatibility
  - Insulation from change
  - Independent evolution
- Strong Suggestions
  - Do not expose details, only interfaces
  - Depend only on other interfaces



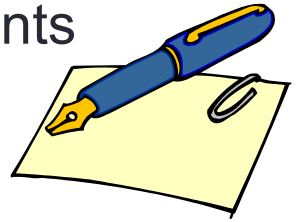
Key is abstraction and encapsulation

Subsystem Design Steps

- Distribute subsystem behavior to subsystem elements



- Document subsystem elements



- Describe subsystem dependencies

- Checkpoints

Subsystem Design Steps

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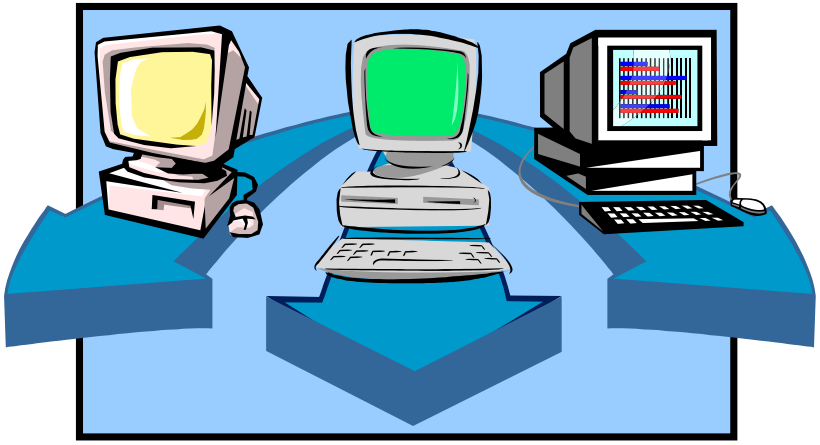
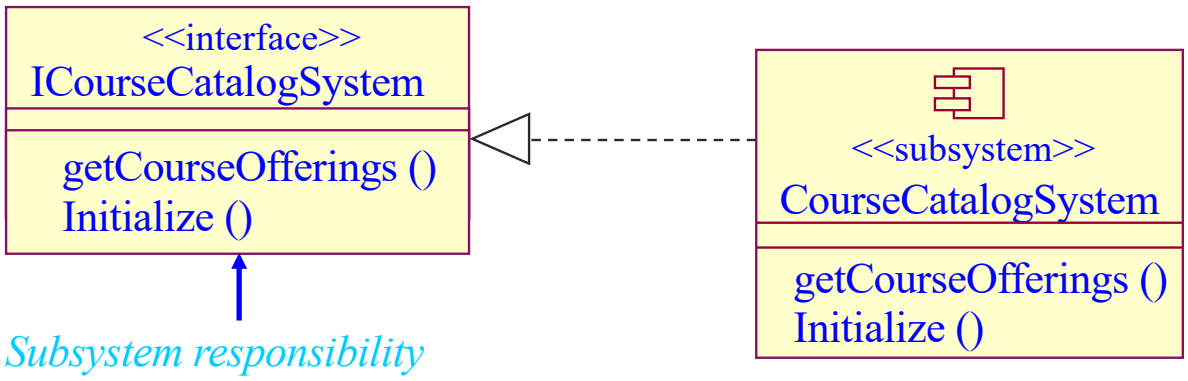


Subsystem Responsibilities

- Subsystem responsibilities defined by interface operations
  - Model interface realizations
- Interface may be realized by
  - Internal class behavior
  - Subsystem behavior

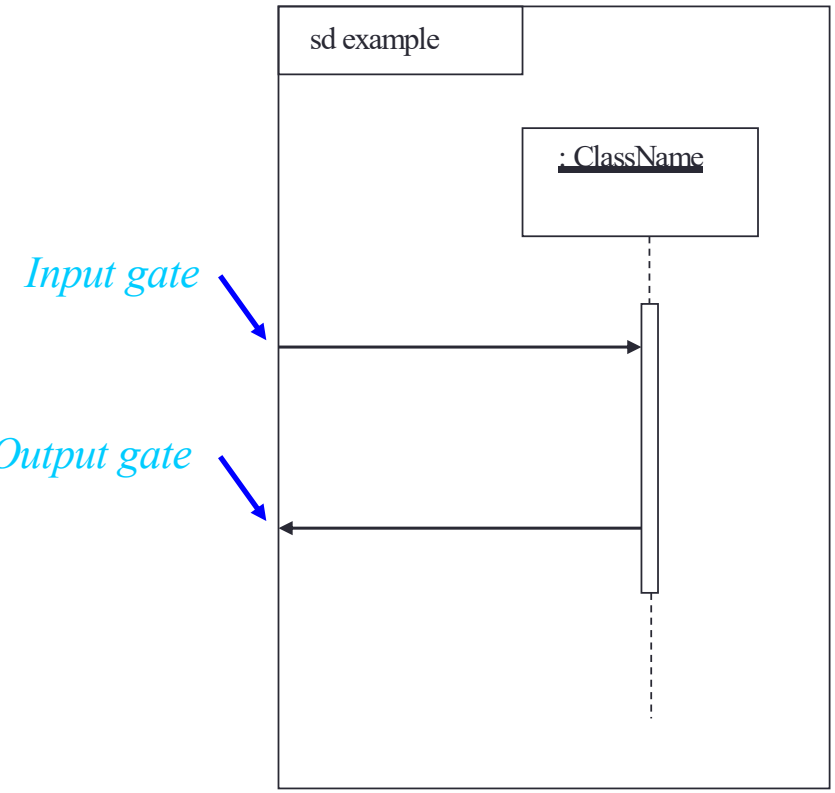


Distributing Subsystem Responsibilities

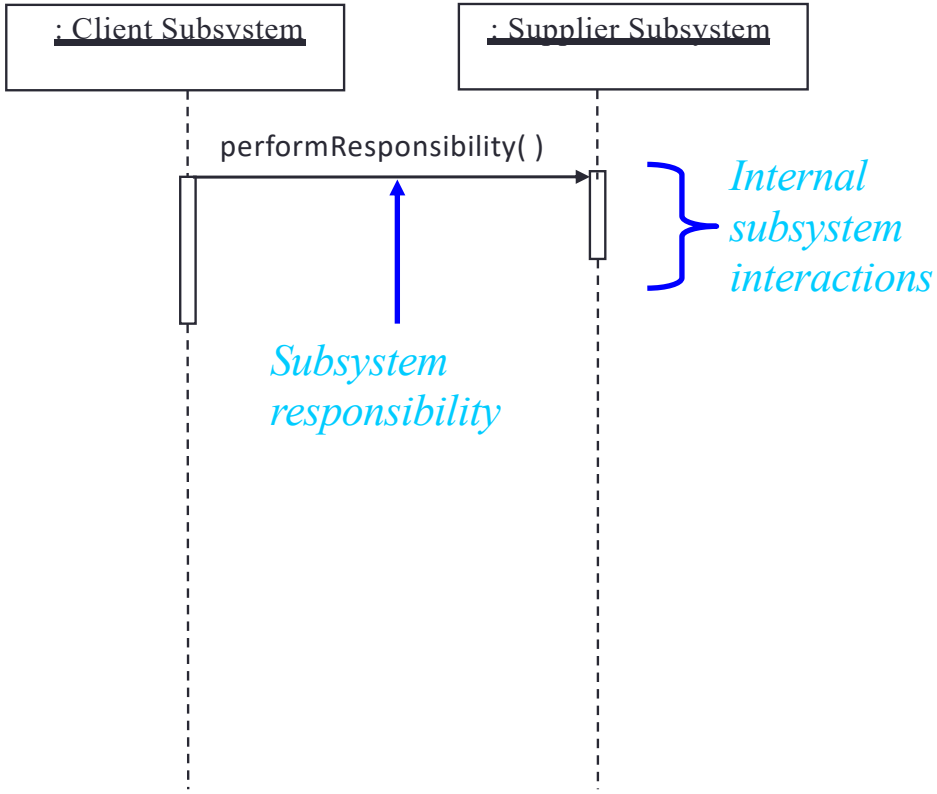
- Identify new, or reuse existing, design elements (for example, classes and/or subsystems)
- Allocate subsystem responsibilities to design elements
- Incorporate applicable mechanisms (for example, persistence, distribution)
- Document design element collaborations in “interface realizations”
  - One or more interaction diagrams per interface operation
  - Class diagram(s) containing the required design element relationships
- Revisit “*Identify Design Elements*”
  - Adjust subsystem boundaries and dependencies, as needed

What Are Gates?

- A connection point in an interaction for a message that comes into or goes outside the interaction.
  - A point on the boundary of the sequence diagram
  - The name of the connected message is the name of the gate



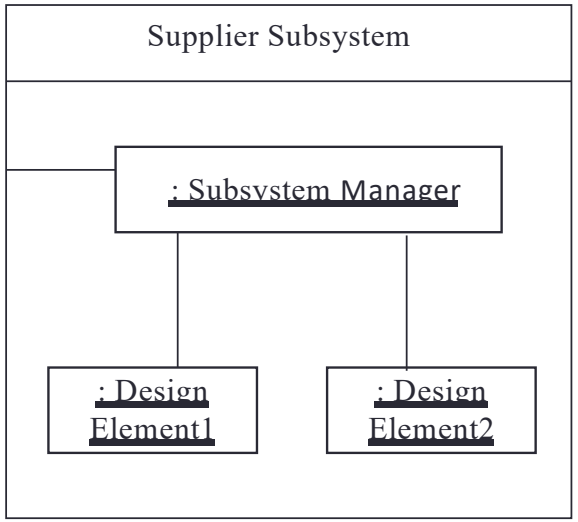
Subsystem Interaction Diagrams



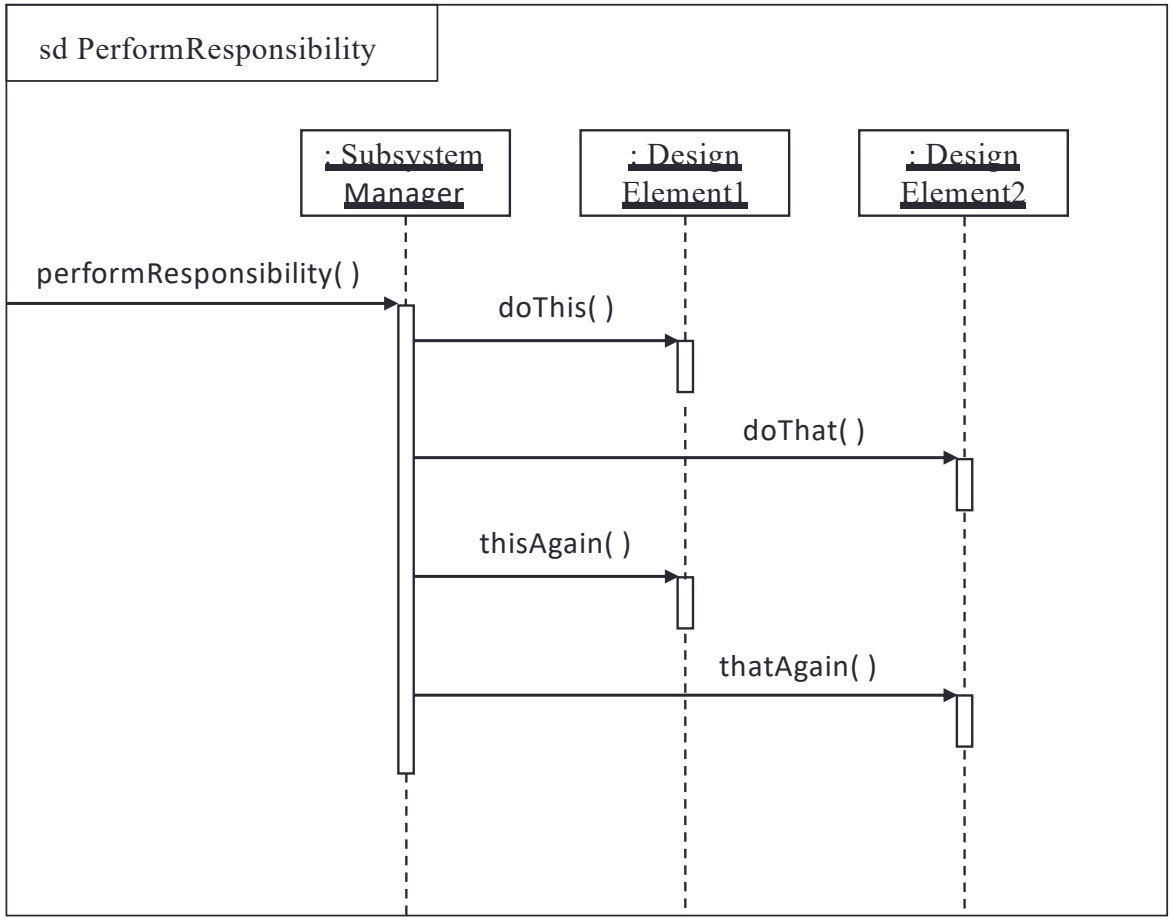
Black box view of subsystems

Internal Structure of Supplier Subsystem

- Subsystem Manager coordinates the internal behavior of the subsystem.
- The complete subsystem behavior is distributed amongst the internal Design Element classes.

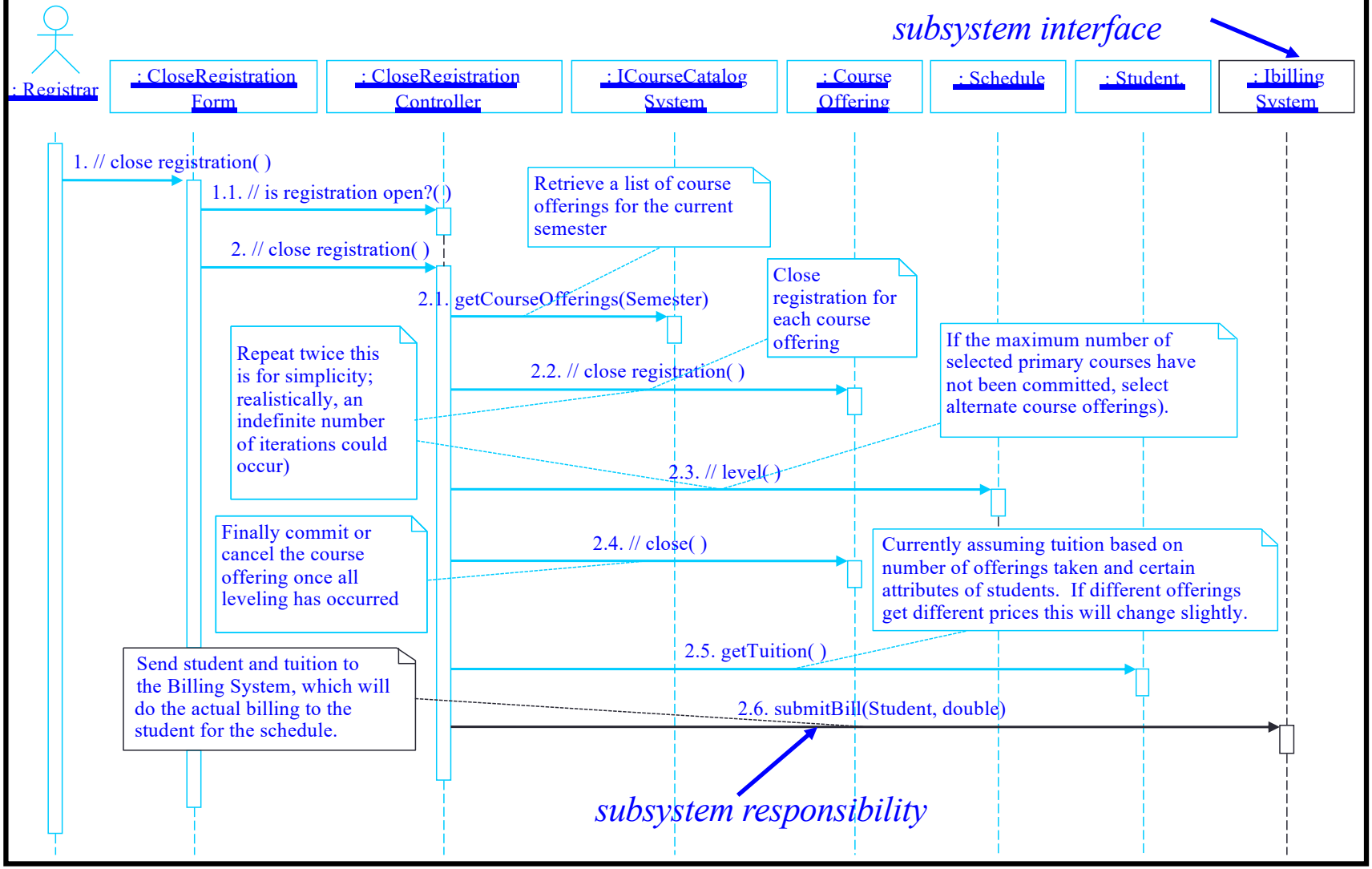


Modeling Convention: Internal Subsystem Interaction

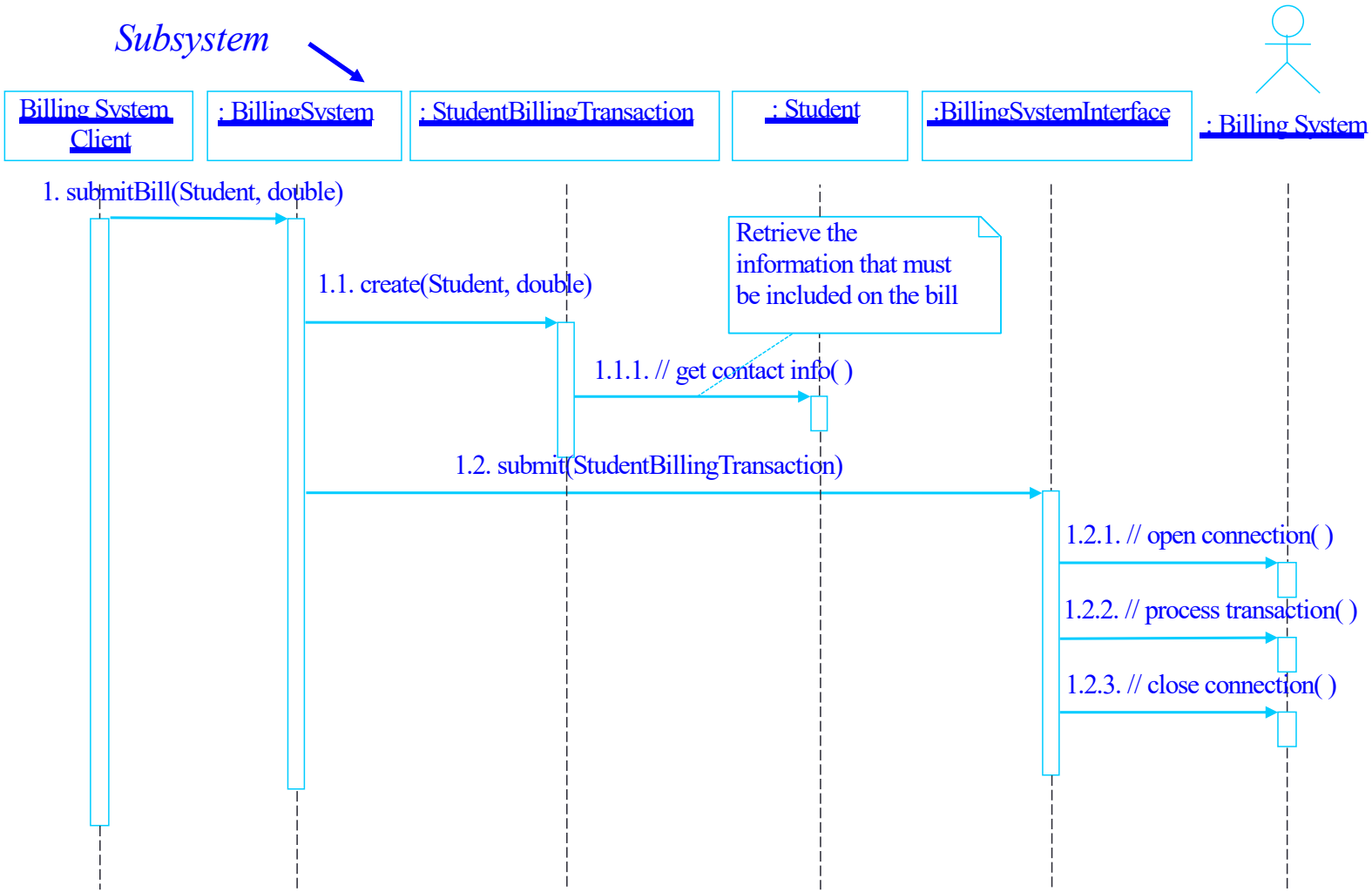


White box view of Supplier Subsystem

Example: Billing System Subsystem In Context

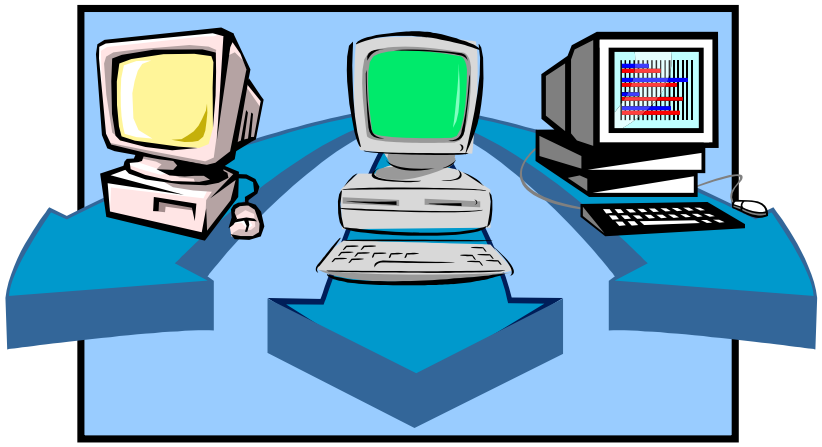


Example: Local BillingSystem Subsystem Interaction

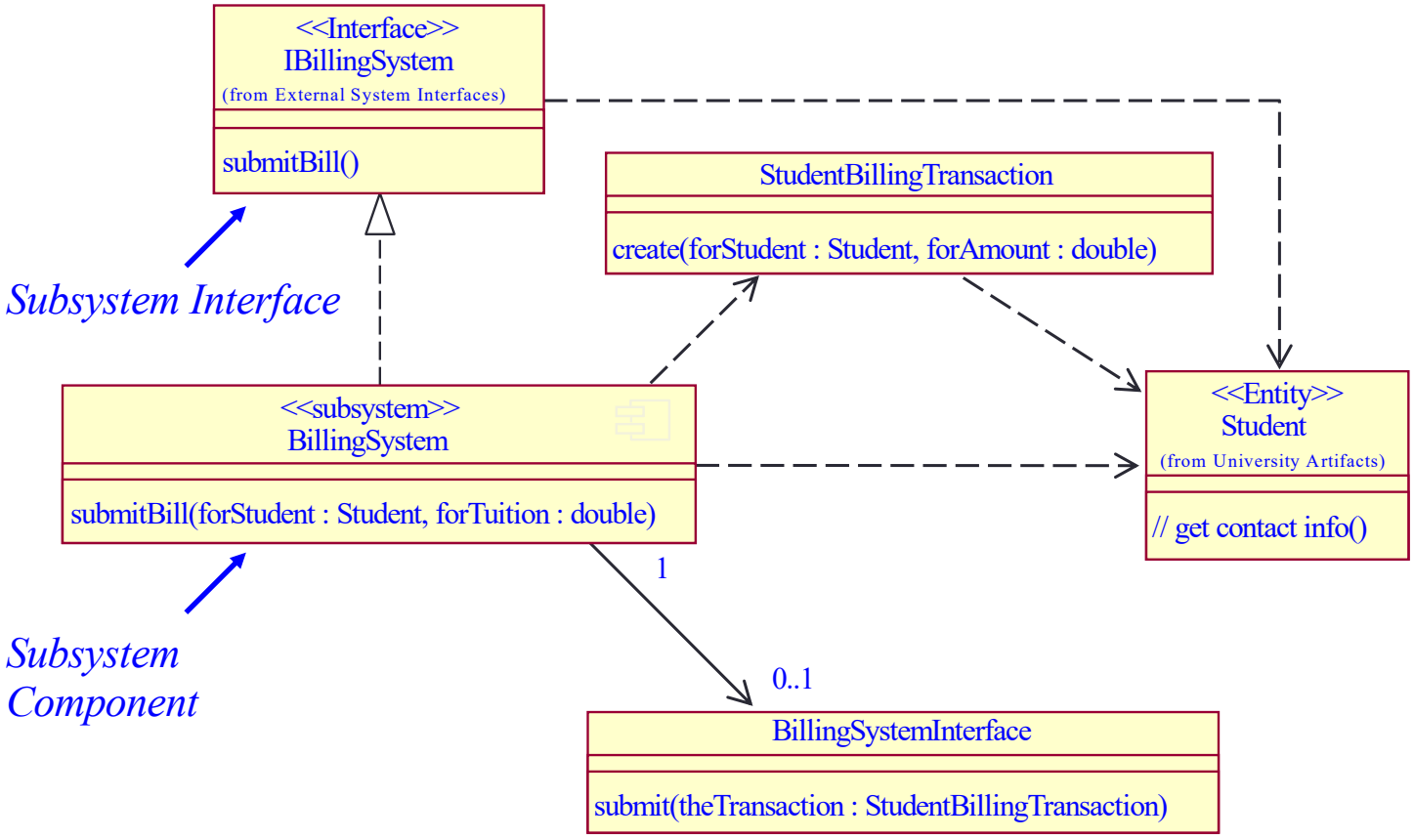


Subsystem Design Steps

- Distribute subsystem behavior to subsystem elements
- Document subsystem elements
- Describe subsystem dependencies
- Checkpoints



Example: Billing System Subsystem Elements



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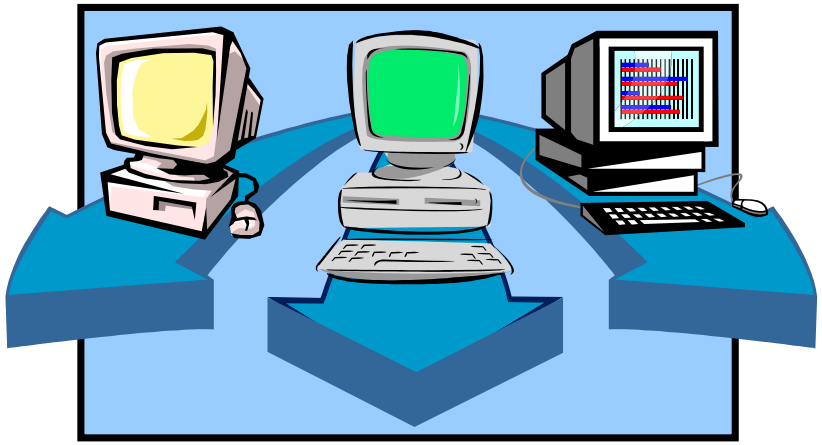
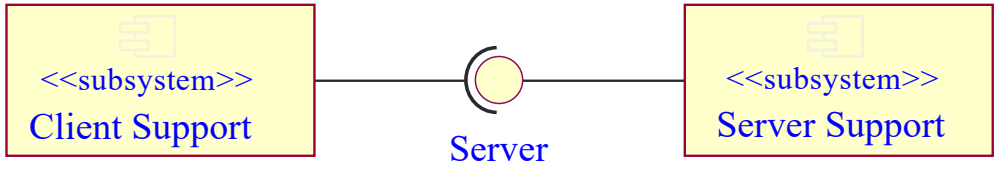


Subsystem Dependencies: Guidelines

- Subsystem dependency on a subsystem

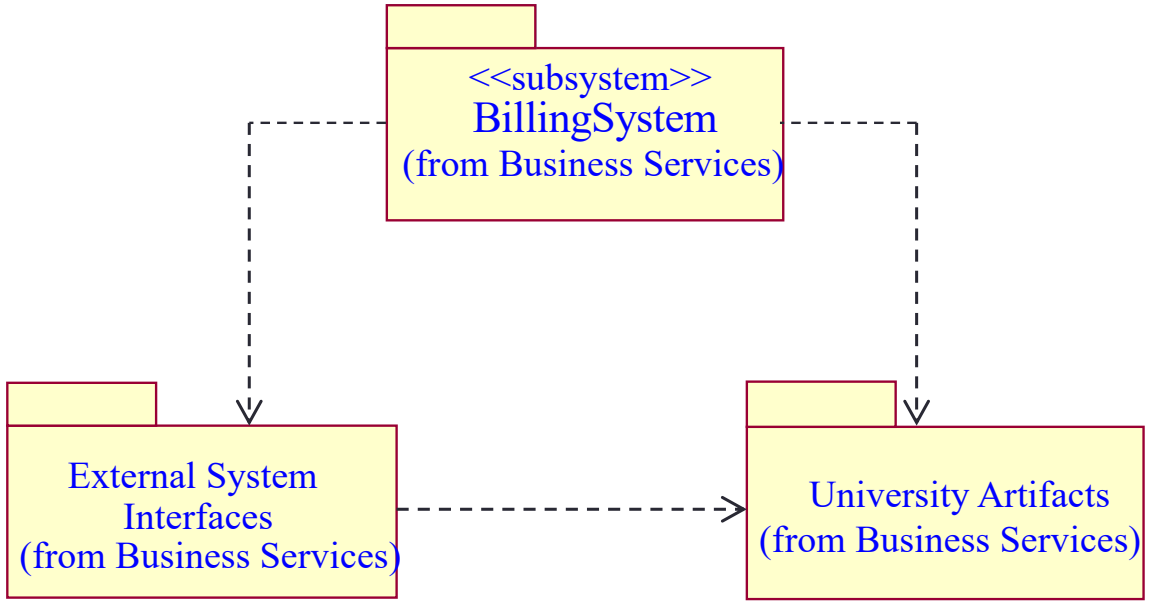


Flexible, Preferred

- Subsystem dependency on a package

Use with care

Example: BillingSystem Subsystem Dependencies



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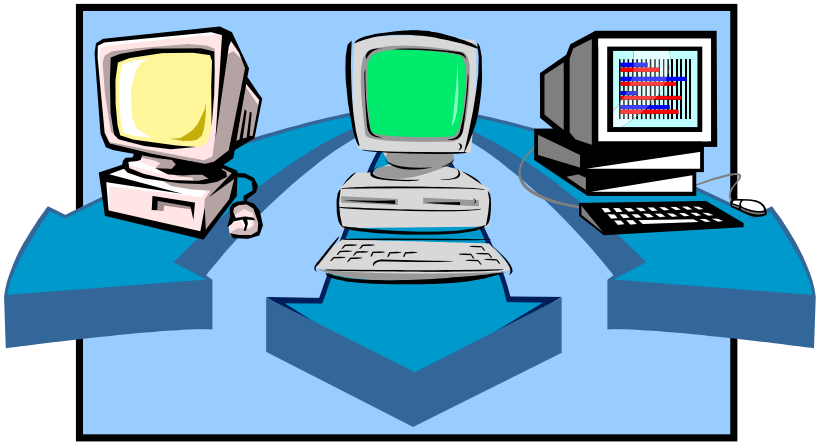

Checkpoints: Design Subsystems

- Is a realization association defined for each interface offered by the subsystem?
- Is a dependency association defined for each interface used by the subsystem?
- Are you sure that none of the elements within the subsystem have public visibility?
- Is each operation on an interface realized by the subsystem documented in a interaction diagram? If not, is the operation realized by a single class, so that it is easy to see that there is a simple 1:1 mapping between the class operation and the interface operation?

Review: Subsystem Design

- What is the purpose of Subsystem Design?
- What are gates?
- Why should dependencies on a subsystem be on the subsystem interface?

Question?