IBM Software Group

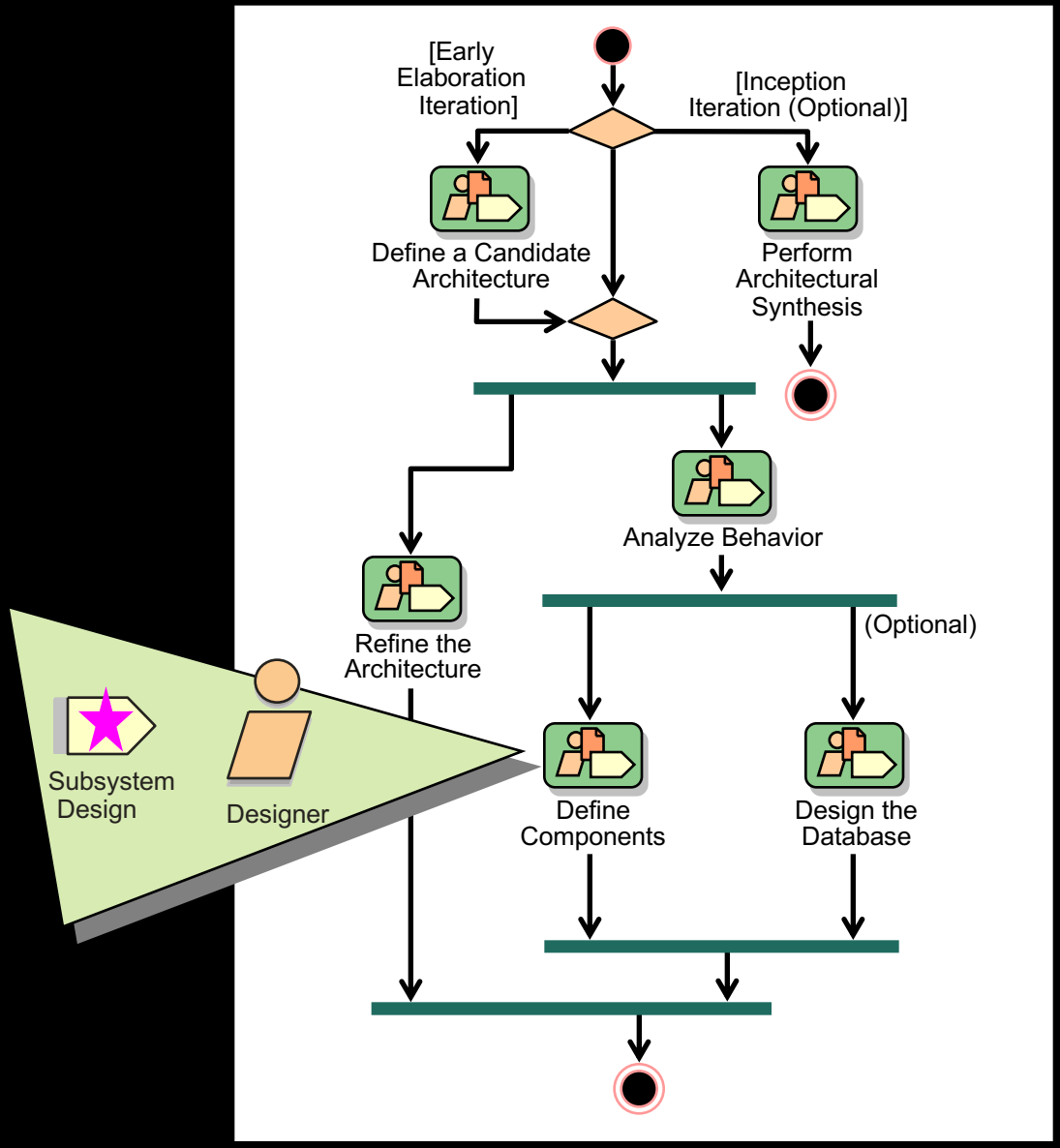
Mastering OOAD: UML 1.x to 2.0 Migration
Module 3: Subsystem Design

Rational. software

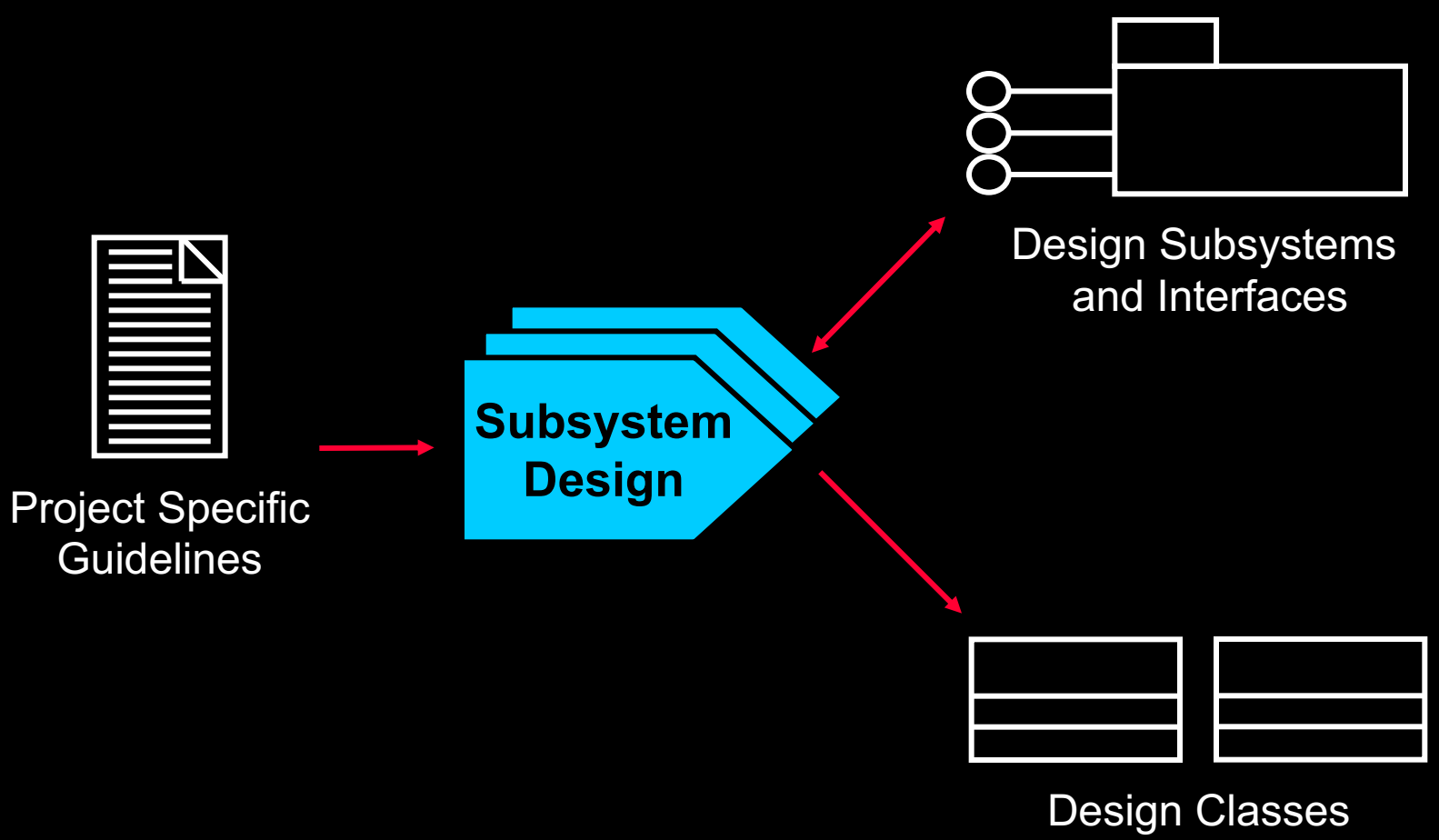
Objectives: Subsystem Design

- Describe how the subsystem's behaviors are distributed to internal elements
- Explain how to document and model the internal structure of a subsystem
- Define relationships to external elements, upon which the subsystem might be dependent

Subsystem Design in Context



Subsystem Design Overview



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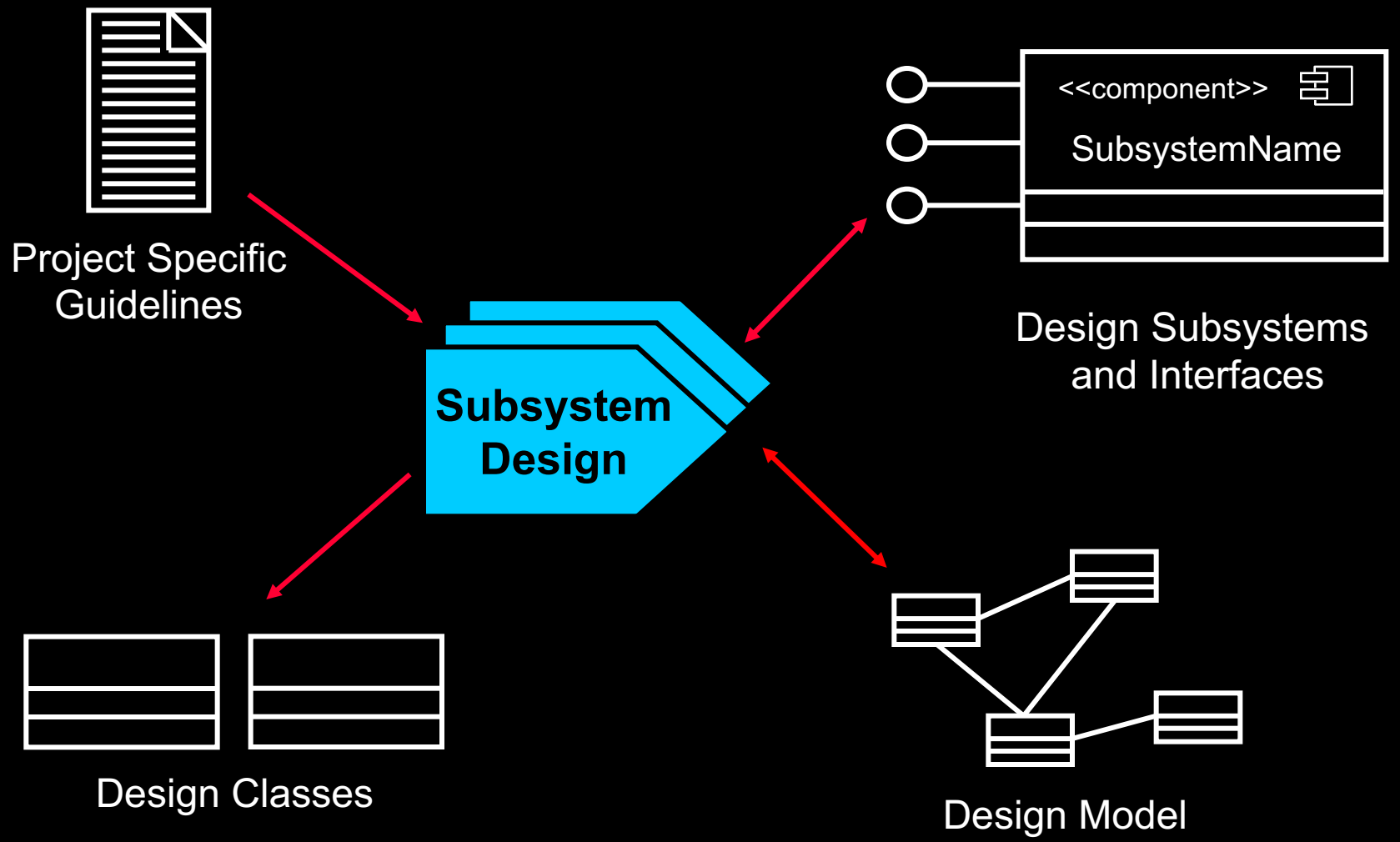
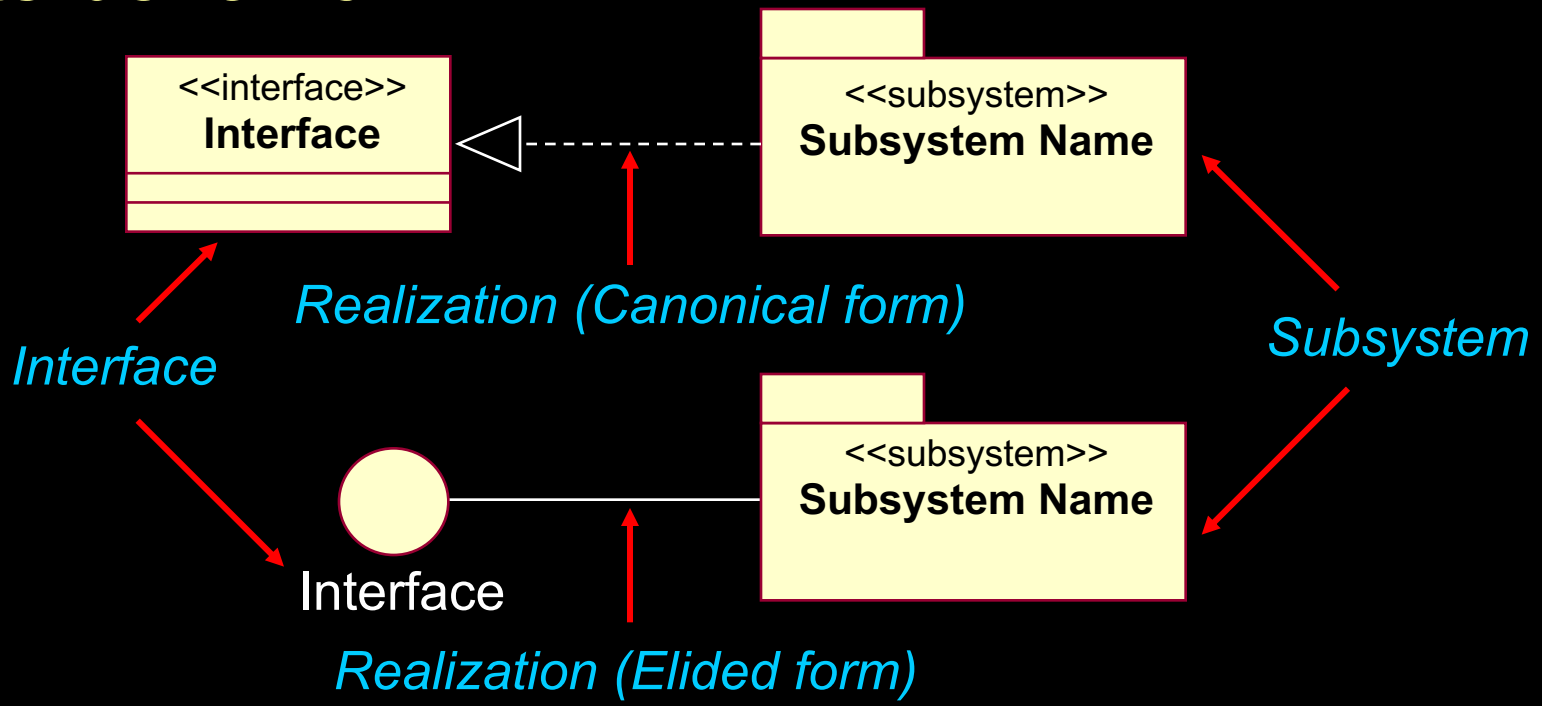


Review: Subsystems and Interfaces

A Subsystem:

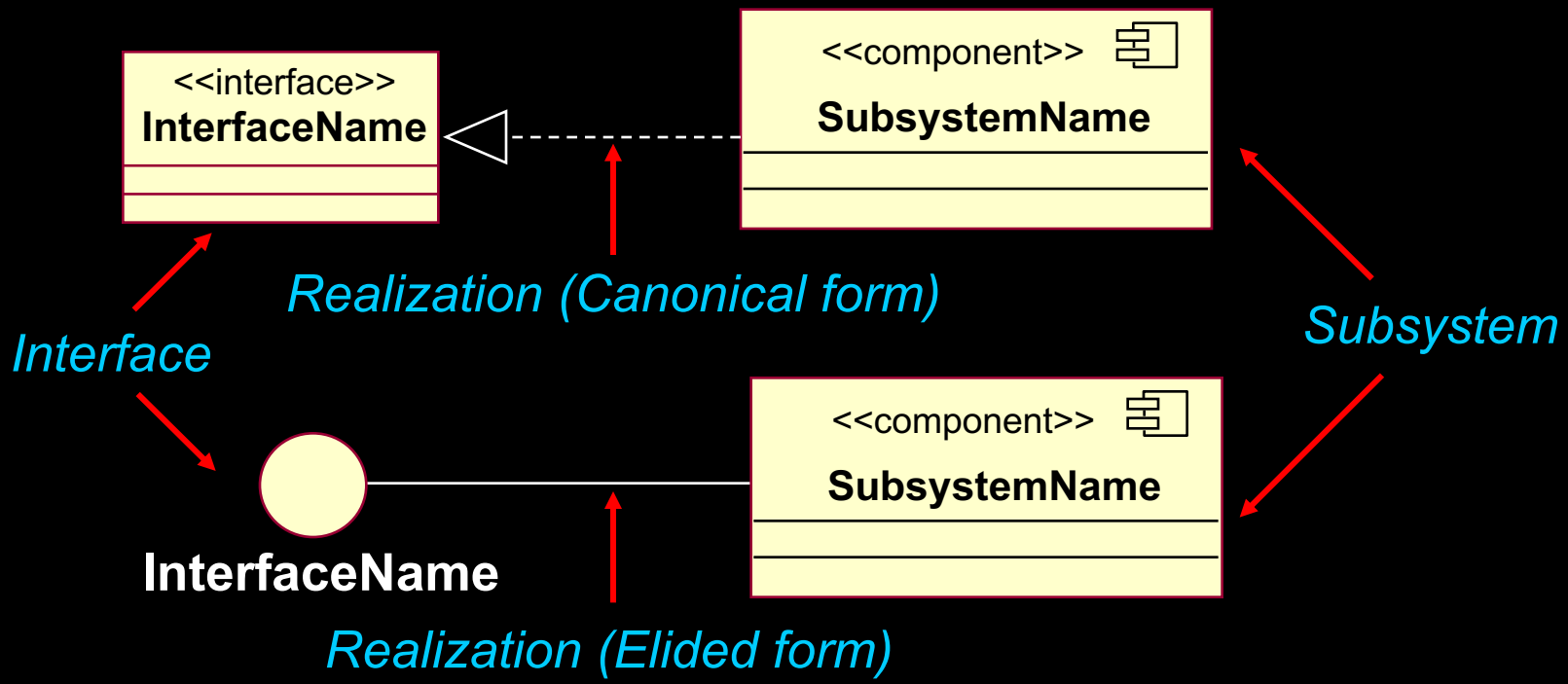
- Is a cross between a package and a class
- Realizes one or more interfaces that define its behavior



Review: Subsystems and Interfaces

A Subsystem:

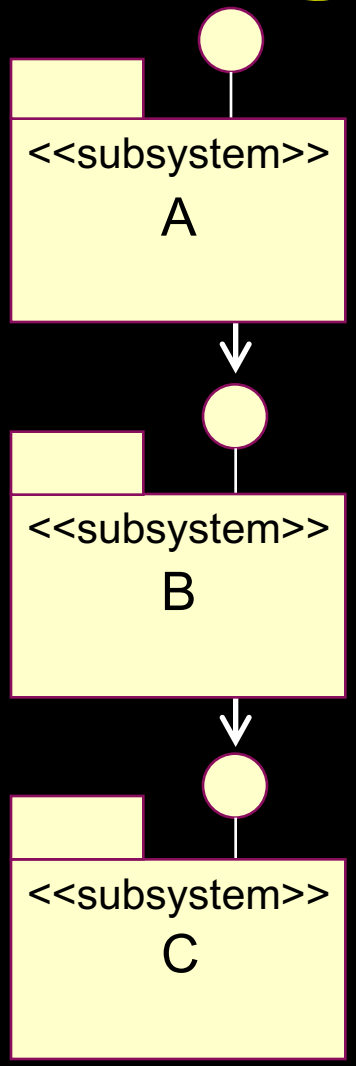
- Is a first class element modeled as a component
- Realizes one or more interfaces that define its behavior



Subsystem Guidelines

1.x

- 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

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Subsystem Guidelines

2.0

- Goals
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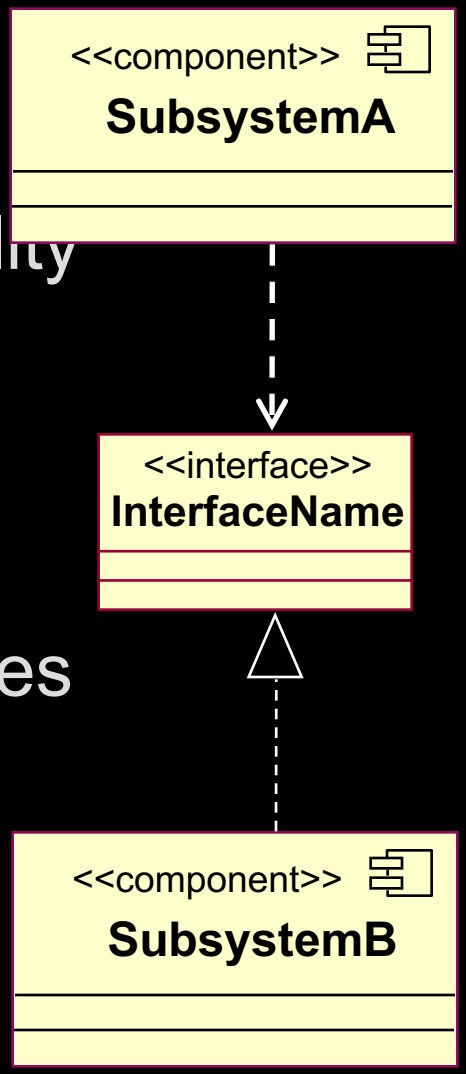

Key is abstraction and encapsulation

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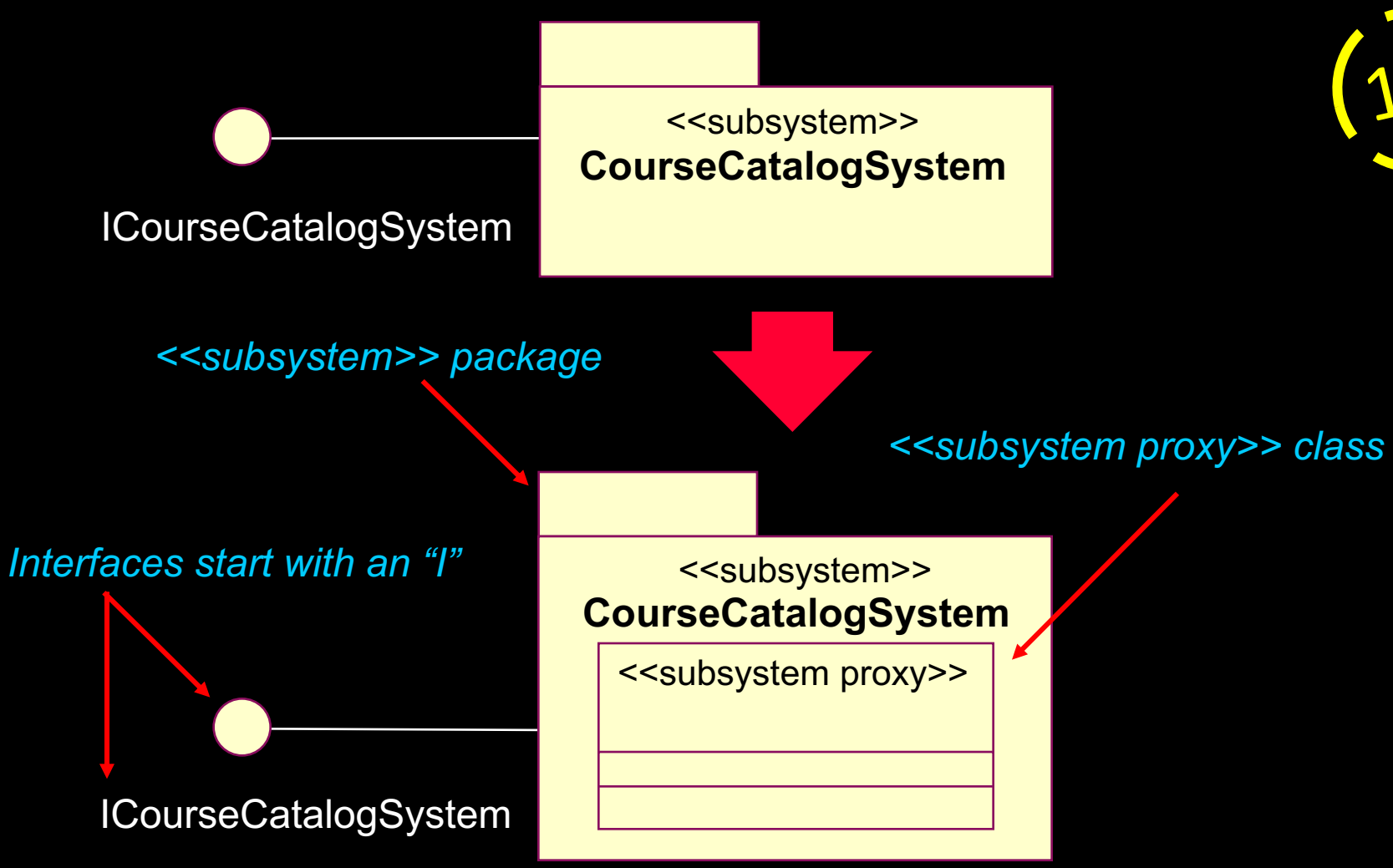
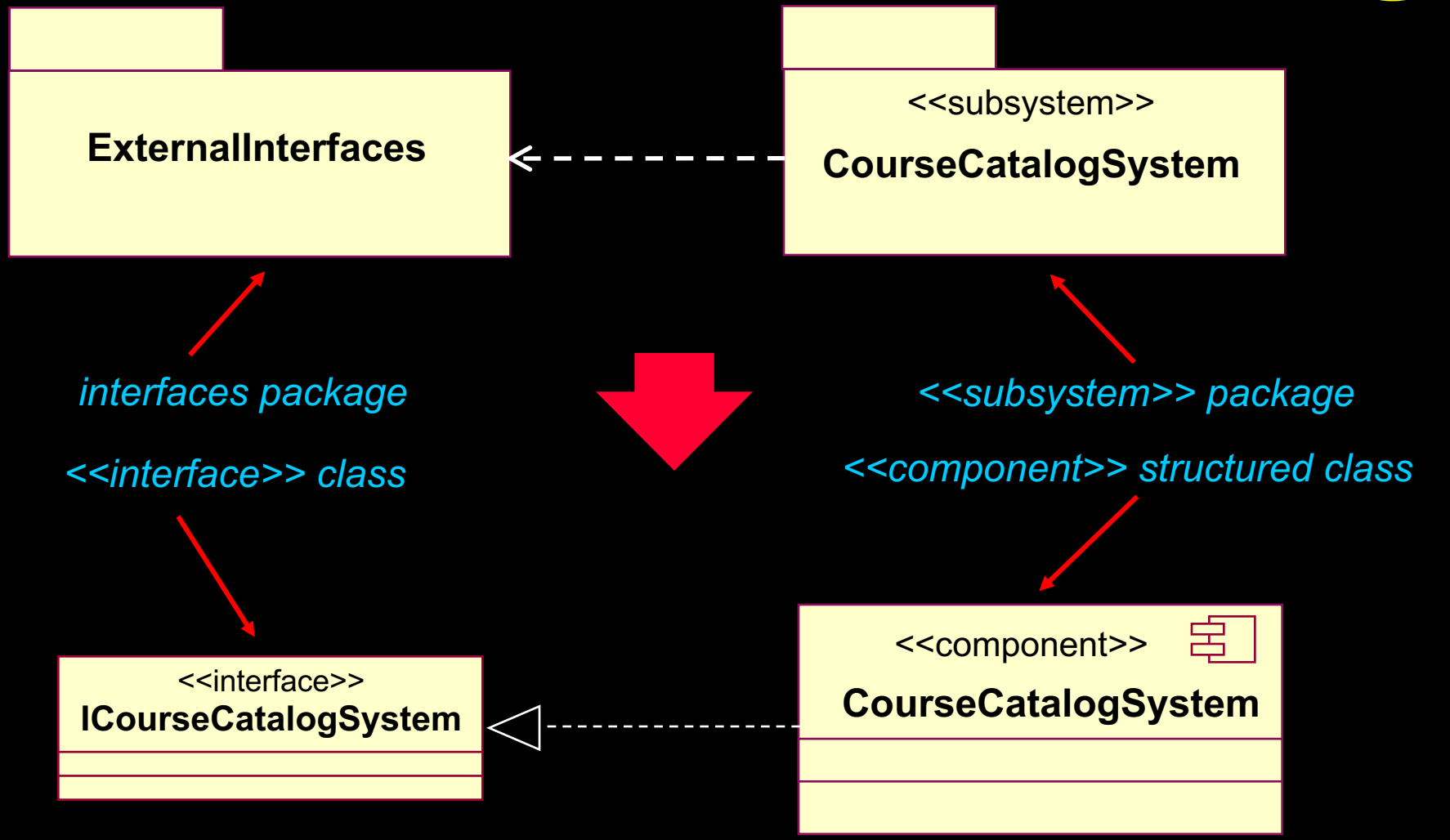
Review: Modeling Convention for Subsystems and Interfaces



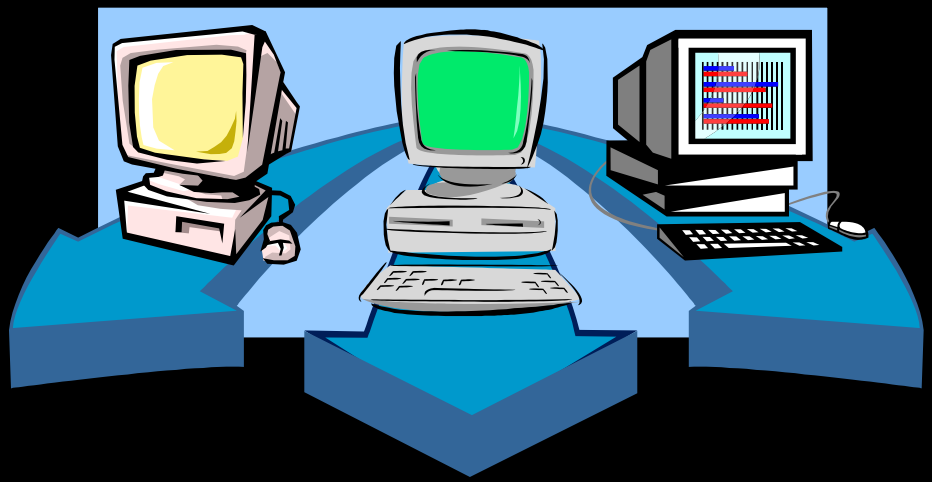
Interfaces are EXTERNAL to the subsystem.

Modeling Convention for Subsystems and Interfaces



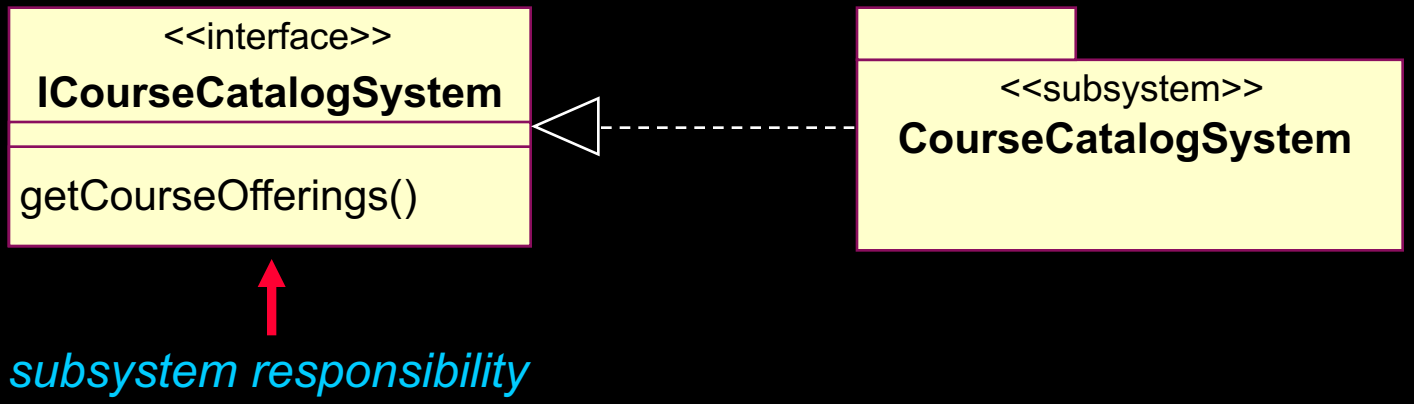
Subsystem Design Steps

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



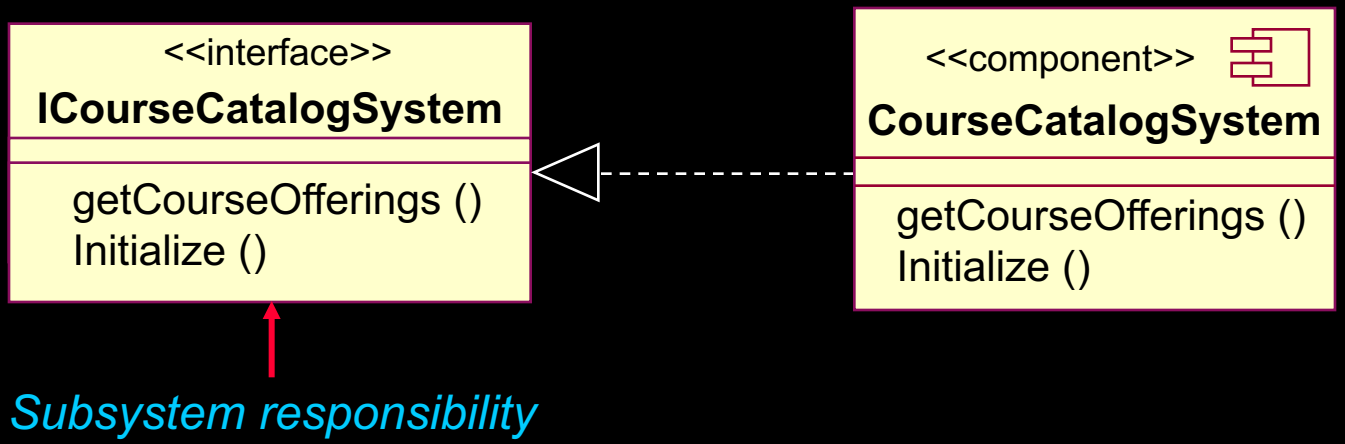
Subsystem Responsibilities

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



Subsystem Responsibilities

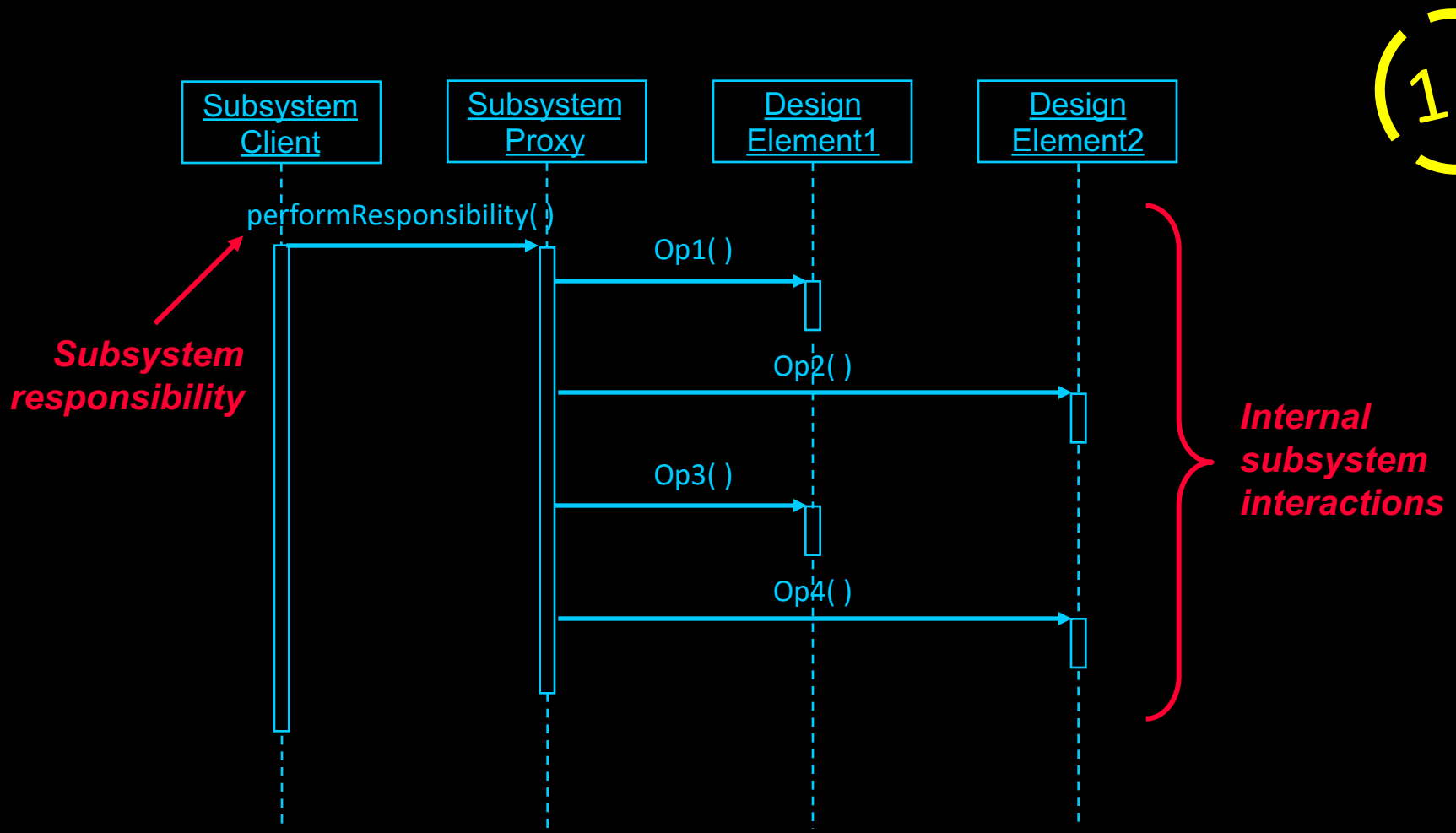
- Subsystem responsibilities defined by interface operations
  - Model interface realizations
- Interface operations may be realized by
  - Internal class behavior
  - Subsystem behavior



Distributing Subsystem Responsibilities

- Identify new, or reuse existing, design elements (for example, classes and 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 diagrams containing the required design element relationships
- Revisit “*Identify Design Elements*”
  - Adjust subsystem boundaries and dependencies, as needed

Modeling Convention: Subsystem Interaction Diagrams

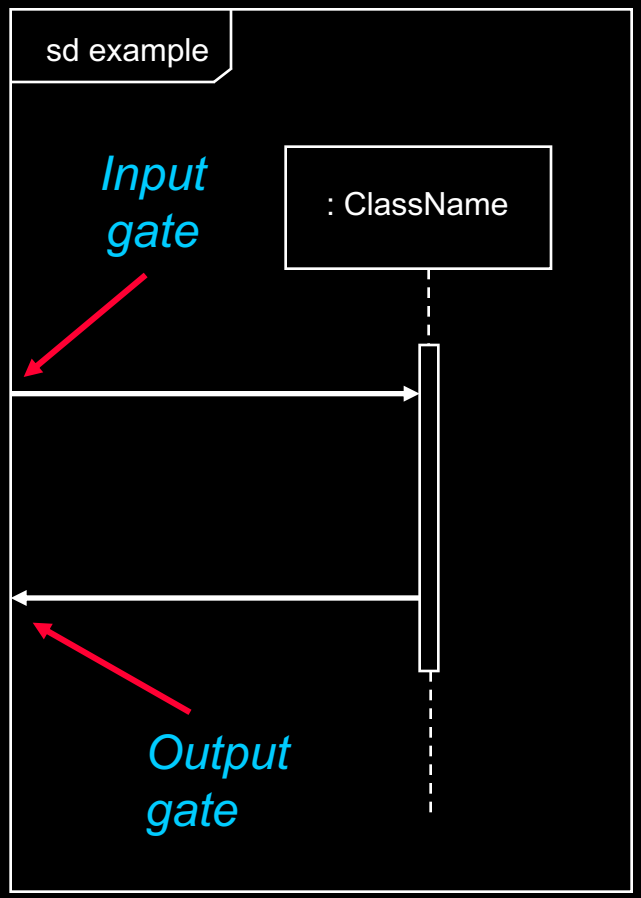


Subsystem interface not shown

What Are Gates?

2.0

- A connection point for a message entering or exiting an interaction.
  - A point on the boundary of the sequence diagram
  - The name of the connected message is the name of the gate



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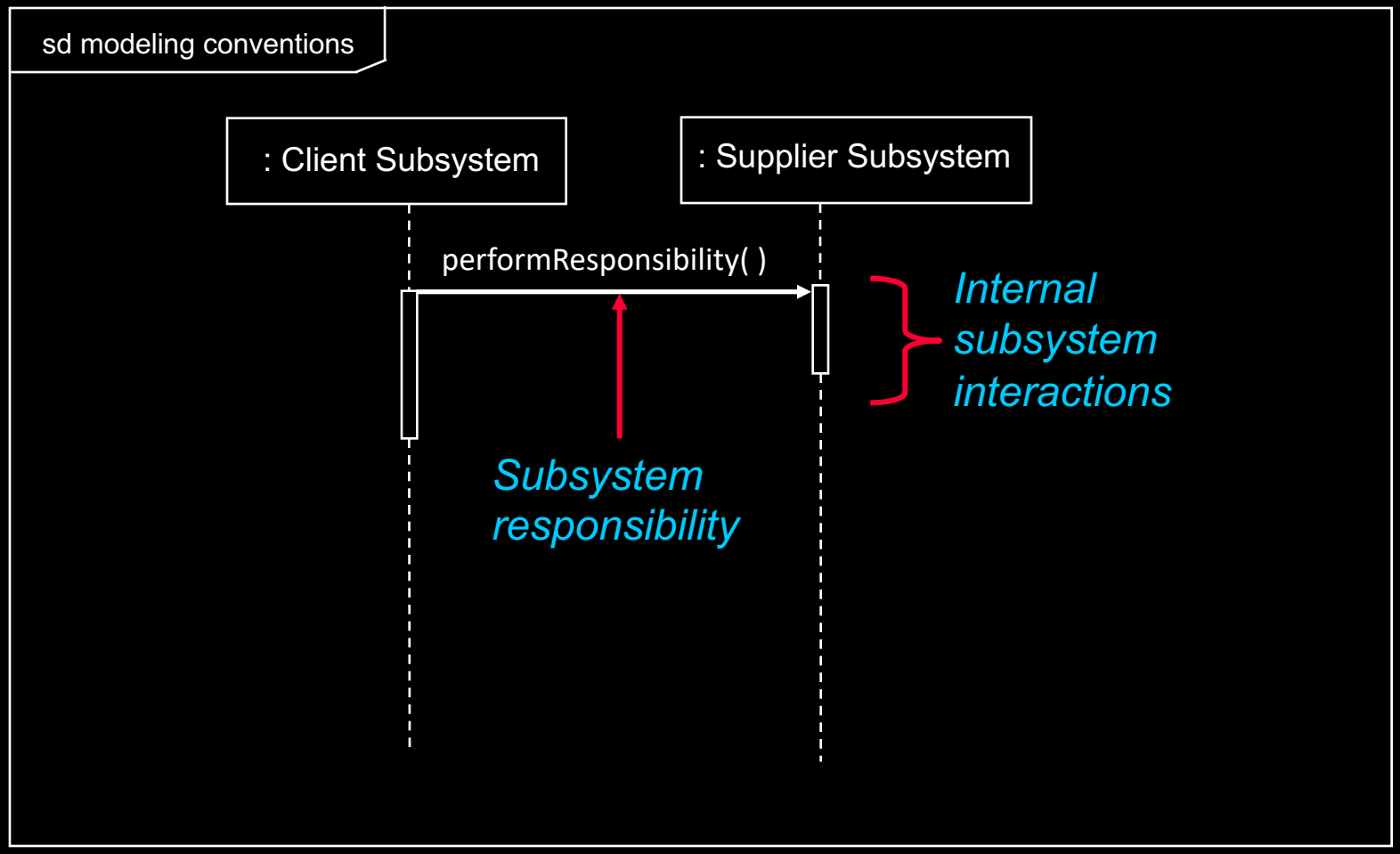
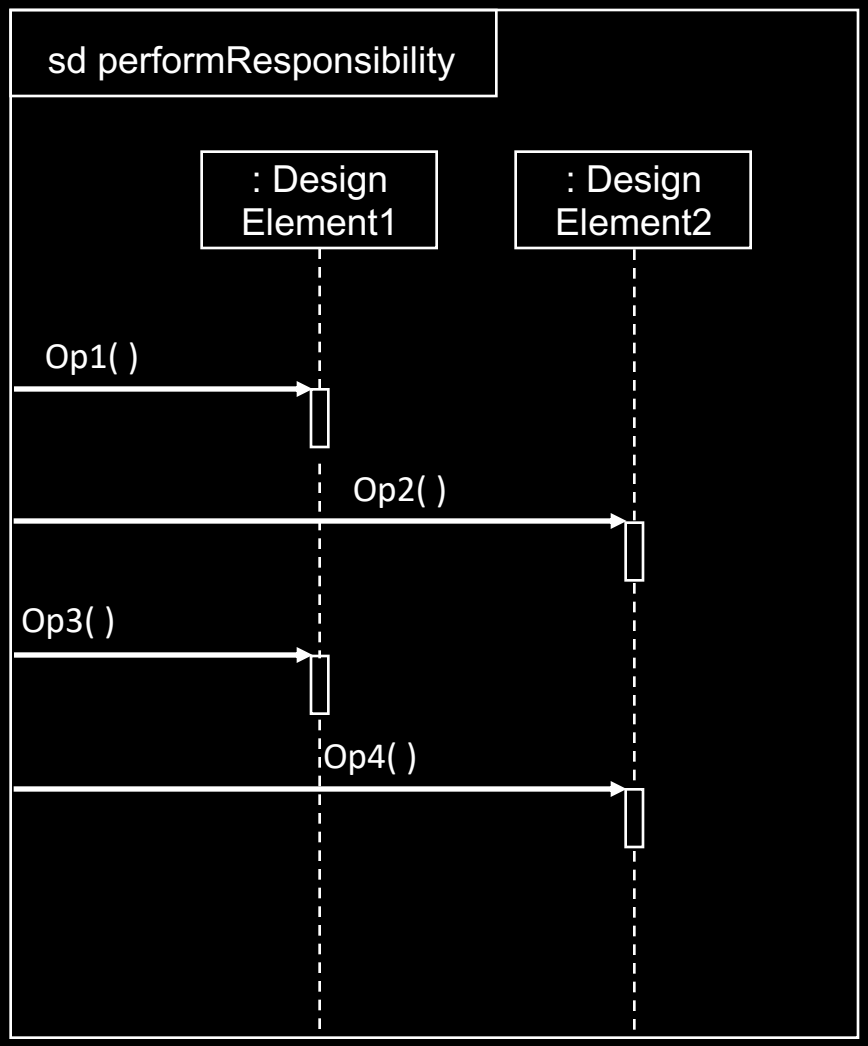
Subsystem Interaction Diagrams



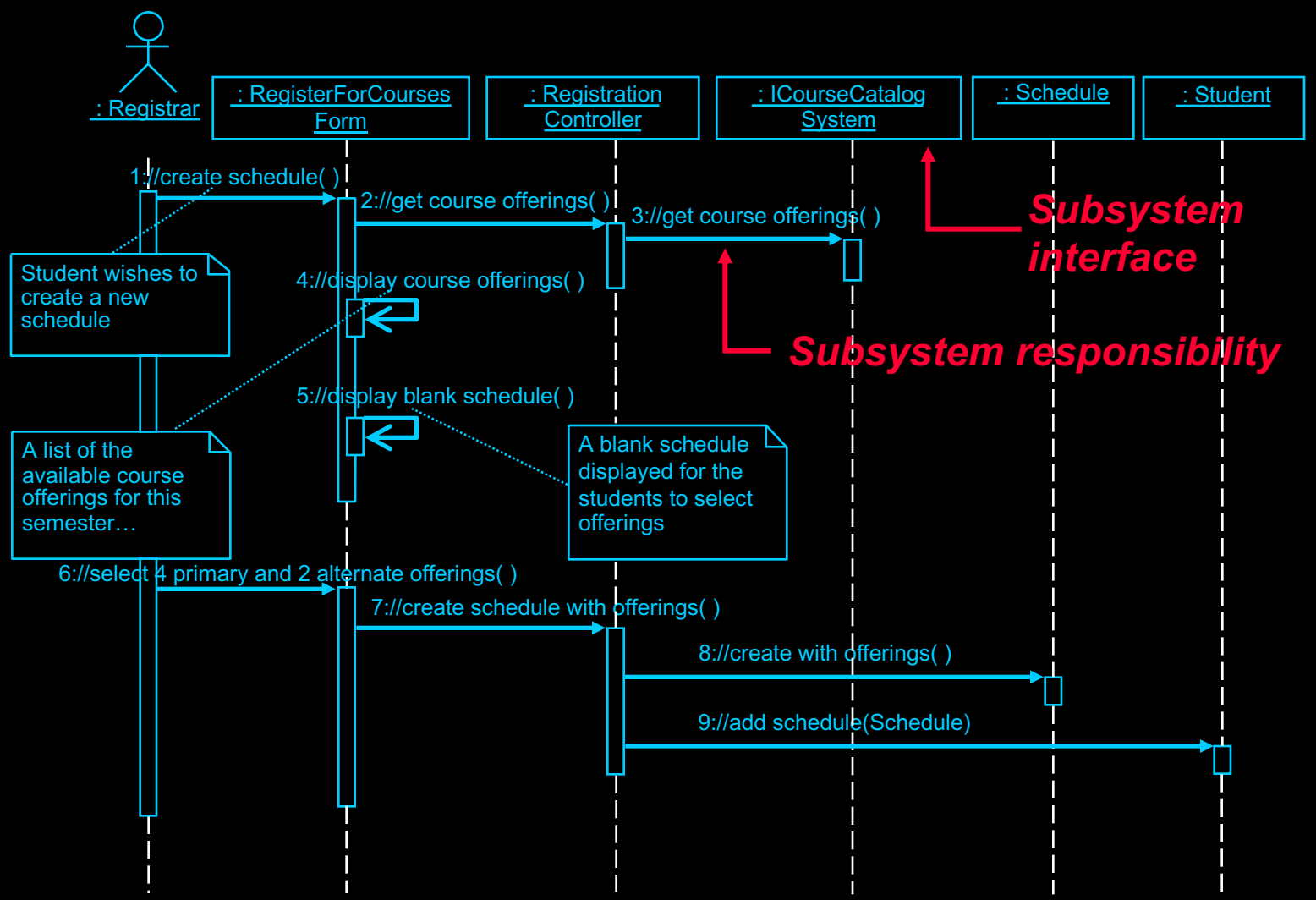
External view of subsystem interactions

Internal Subsystem Interaction



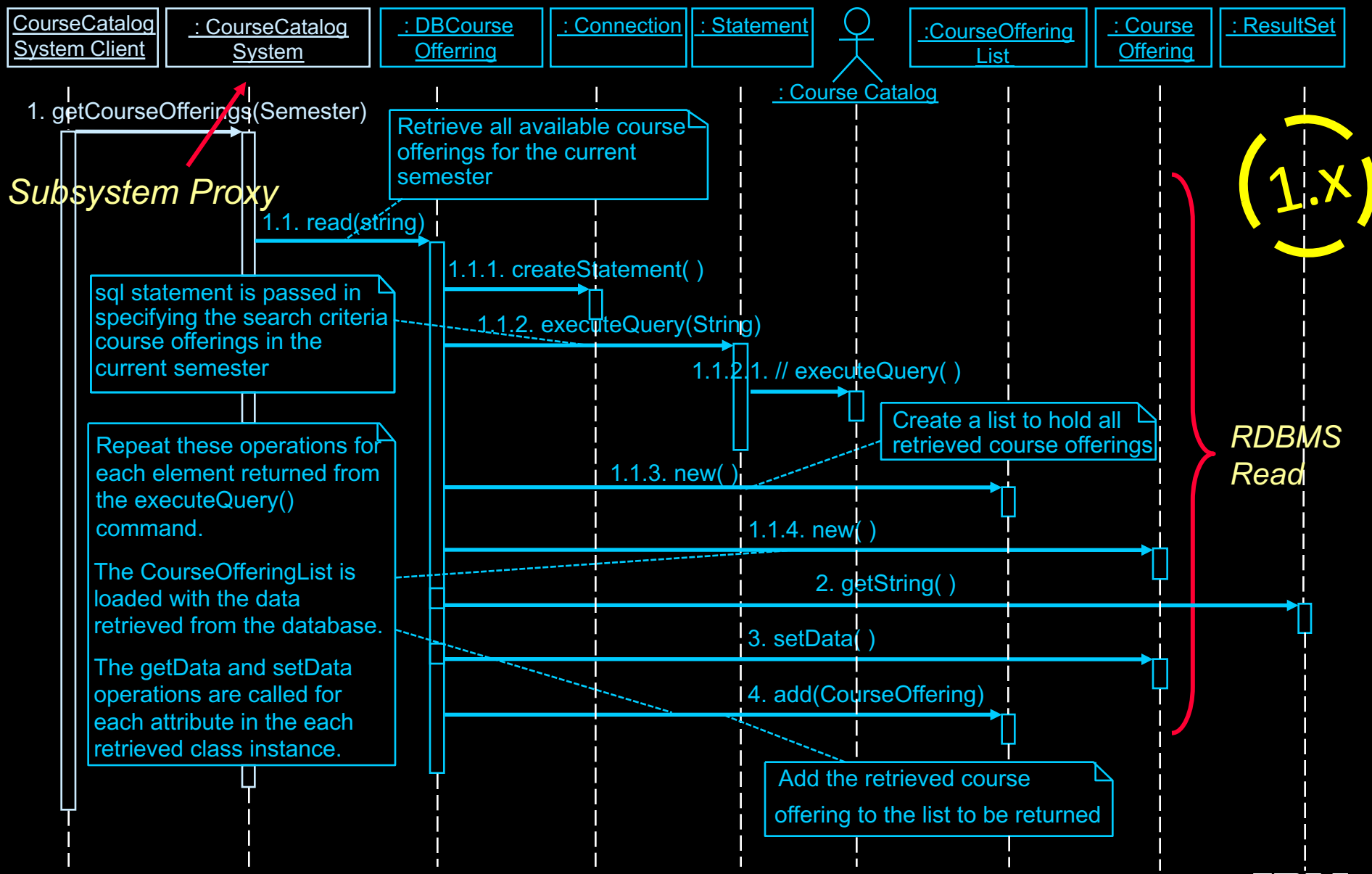
Internal view of Supplier Subsystem

Example: CourseCatalogSystem Subsystem in Context

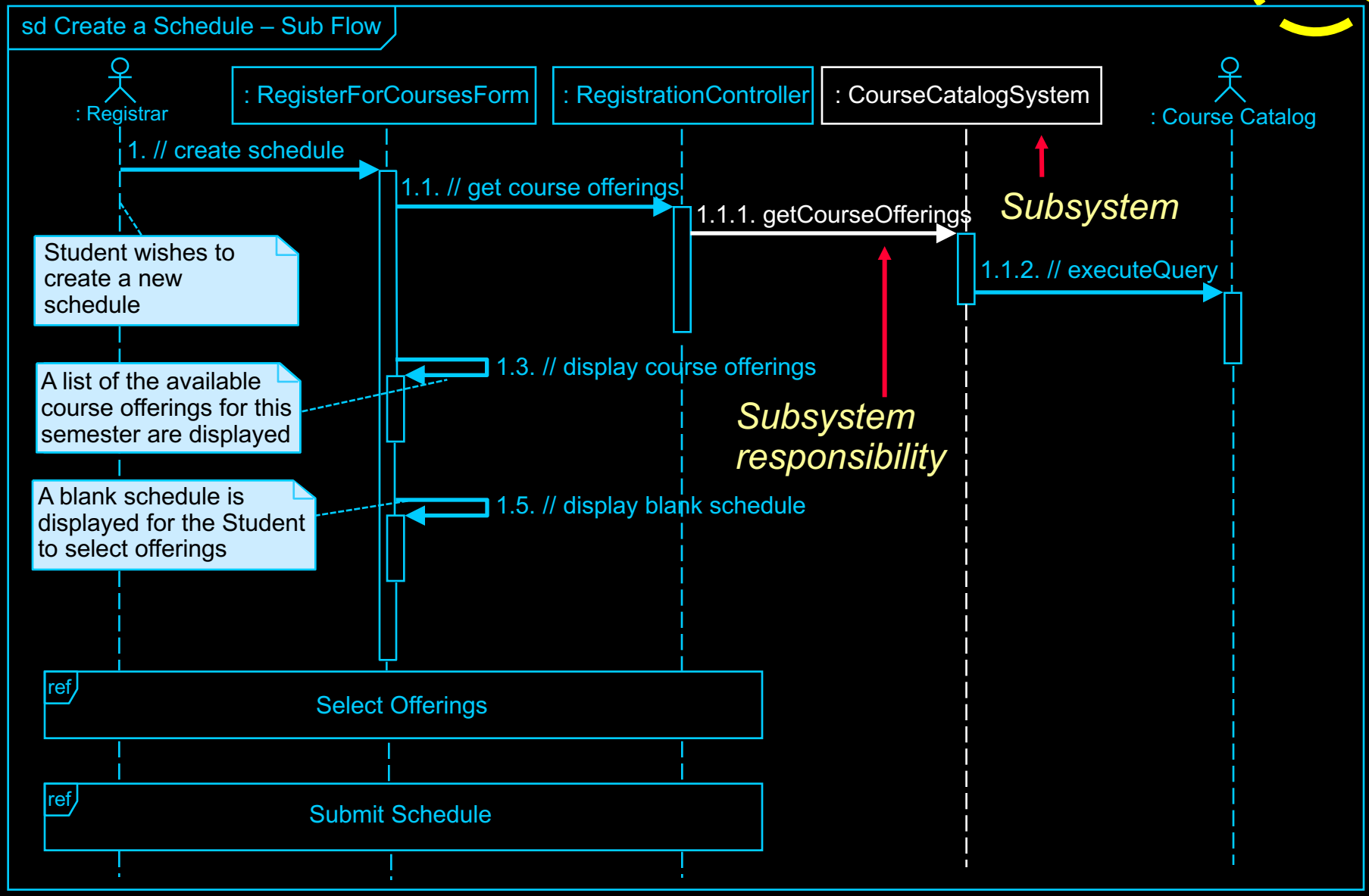


Legacy RDBMS Database Access

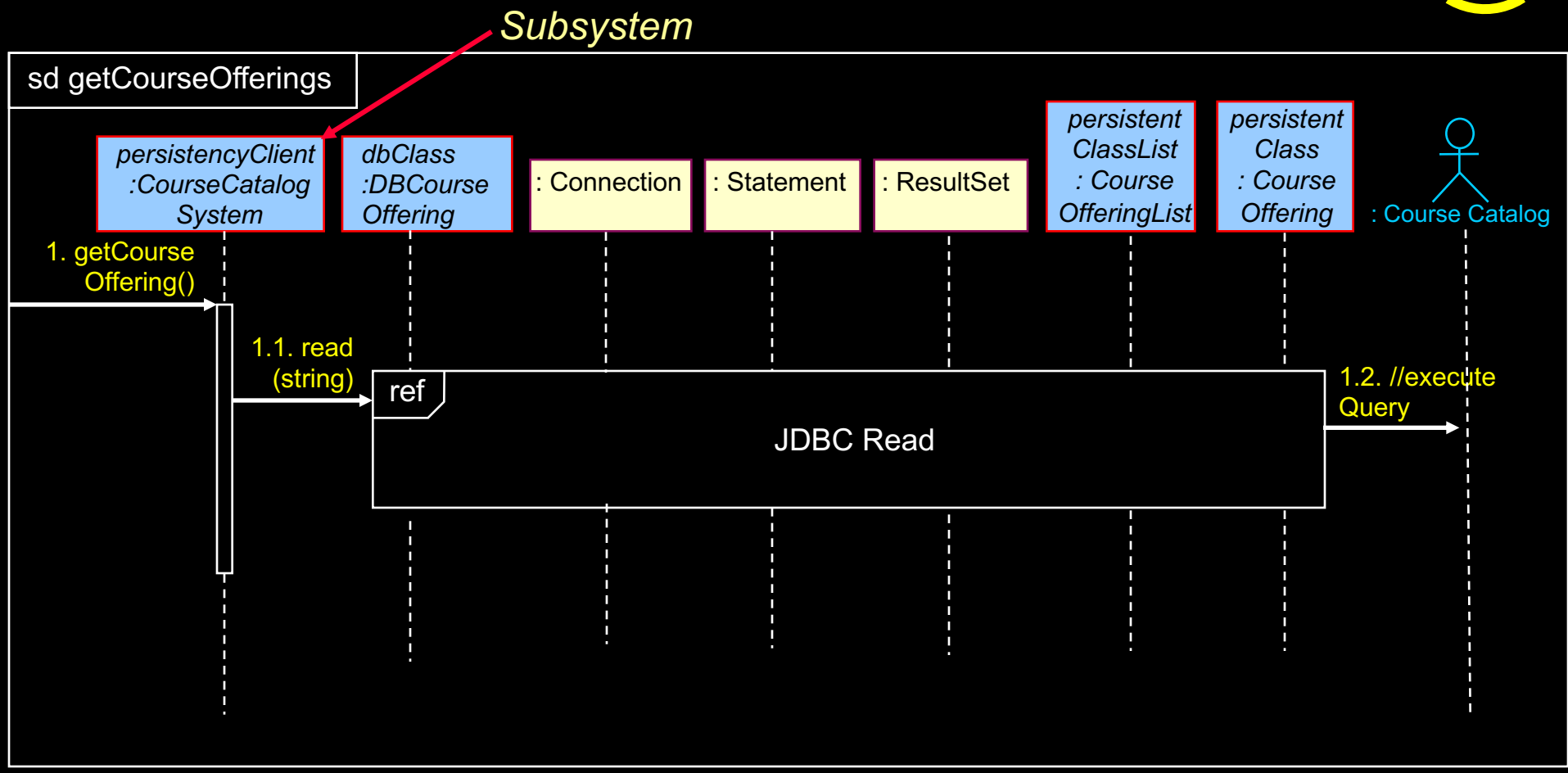
Example: Local CourseCatalogSystem Subsystem Interaction



Example: CourseCatalogSystem Subsystem in Context



Example: Local CourseCatalogSystem Subsystem Interaction (2.0)



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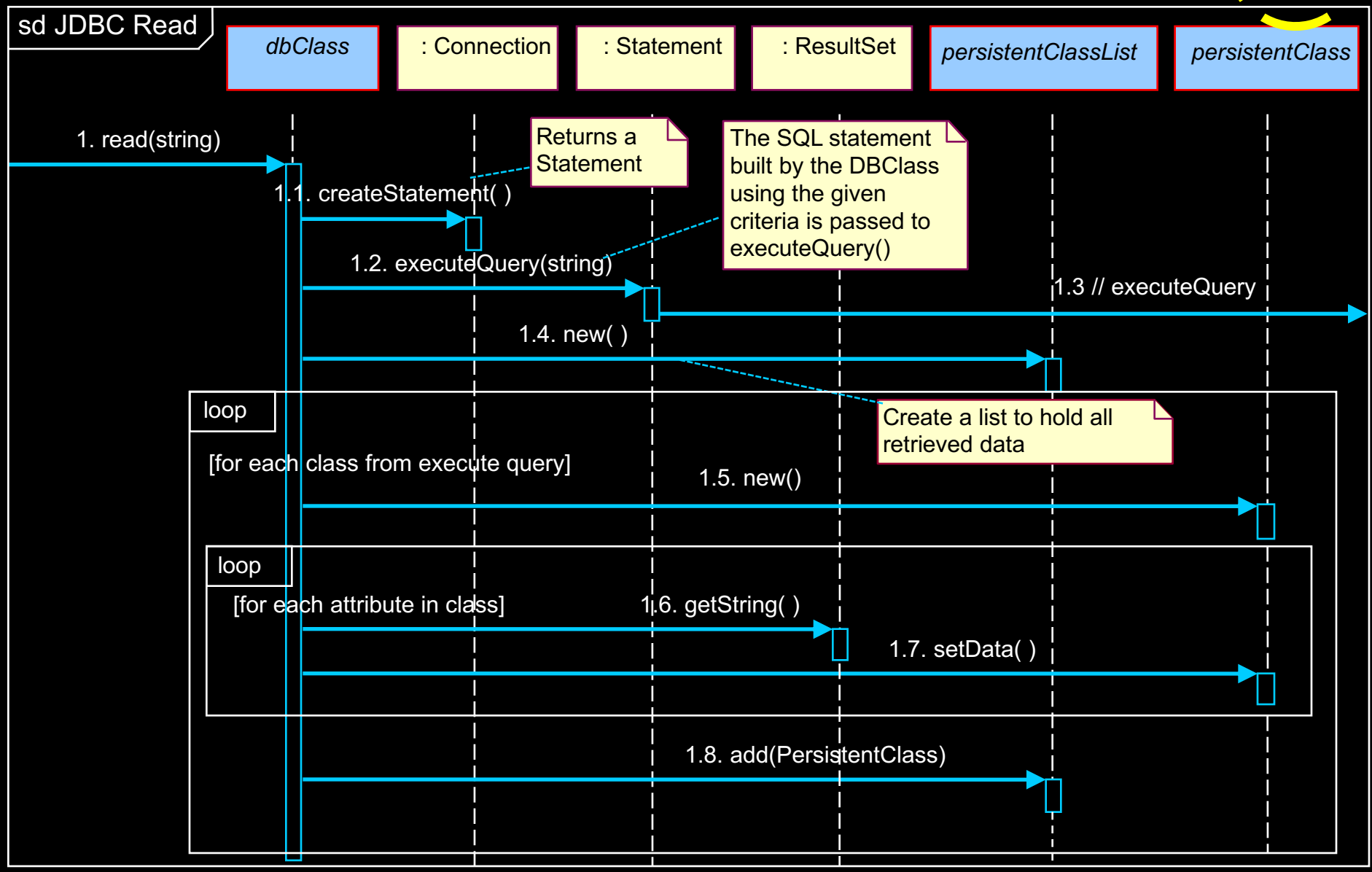
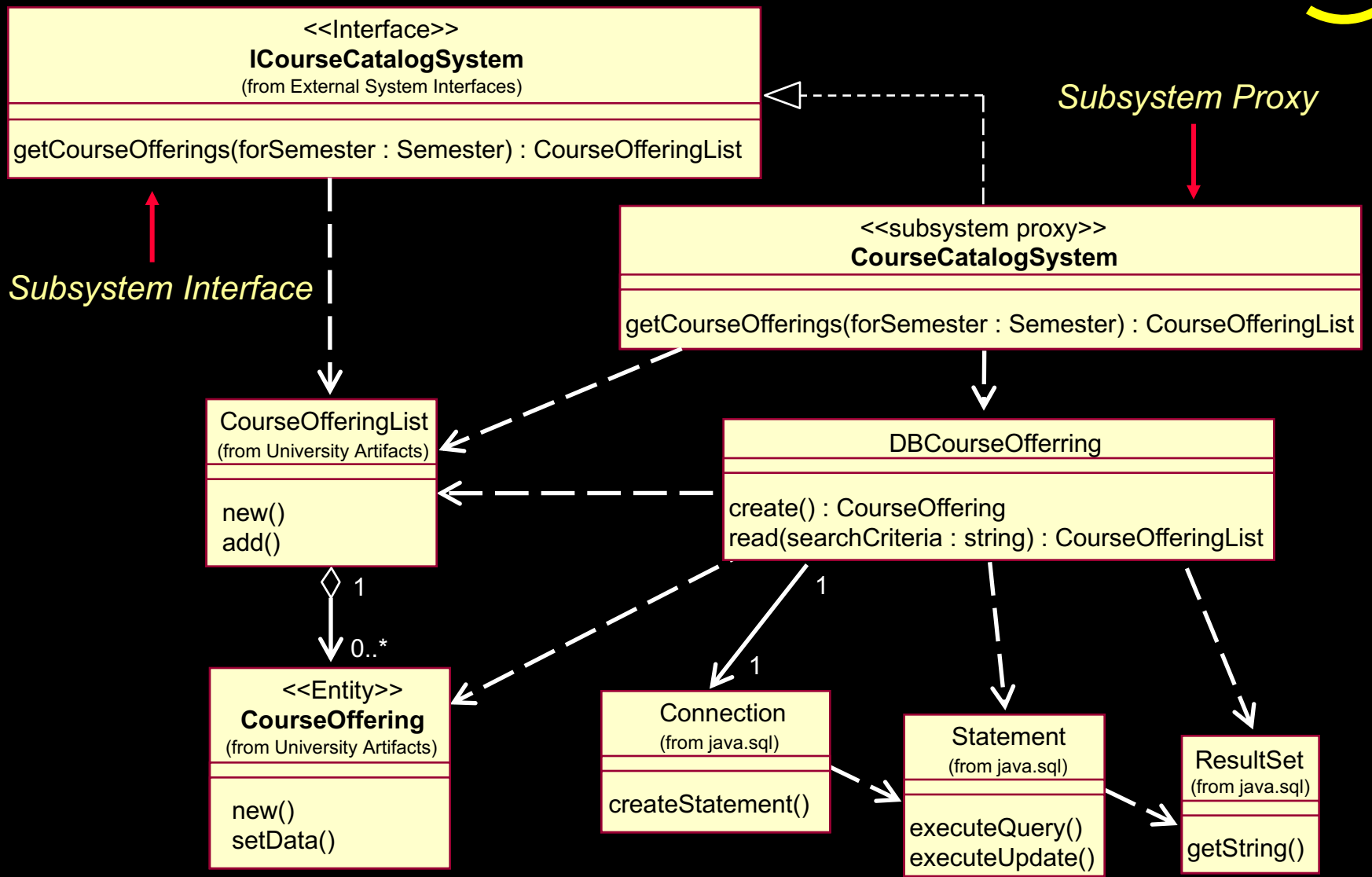
Example: Persistency: RDBMS: JDBC: Read



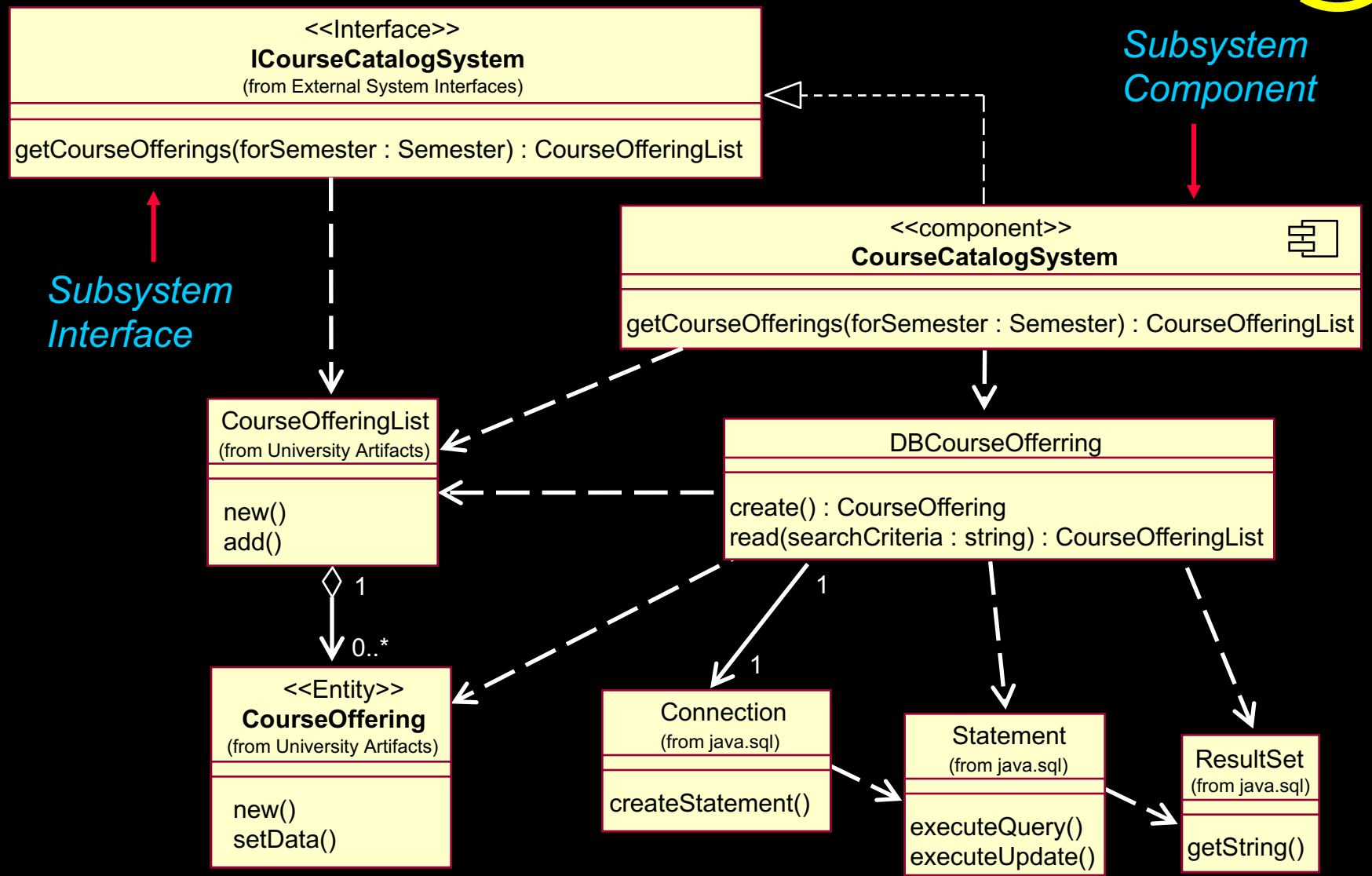
Subsystem Design Steps

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

Example: CourseCatalogSystem Subsystem Elements



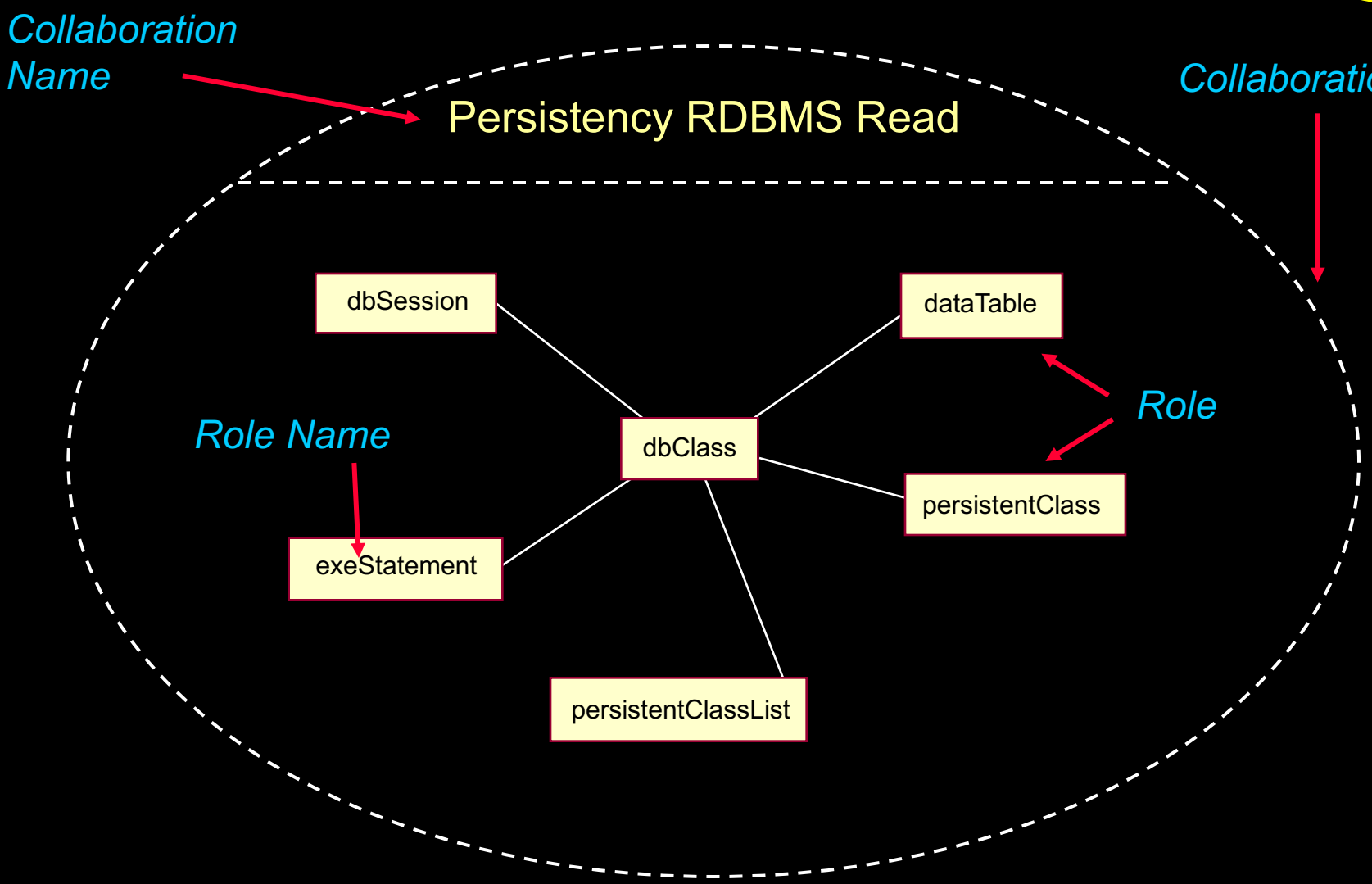
Example: CourseCatalogSystem Subsystem Elements



What is a Collaboration?

- Describes a structure of elements working together to accomplish some desired functionality
  - Typically only incorporates aspects that are deemed relevant to the explanation.
  - Details, such as the identity or precise class of the actual participating instances, are suppressed.
  - Relationships are shown as connectors between the roles which specify communication paths.

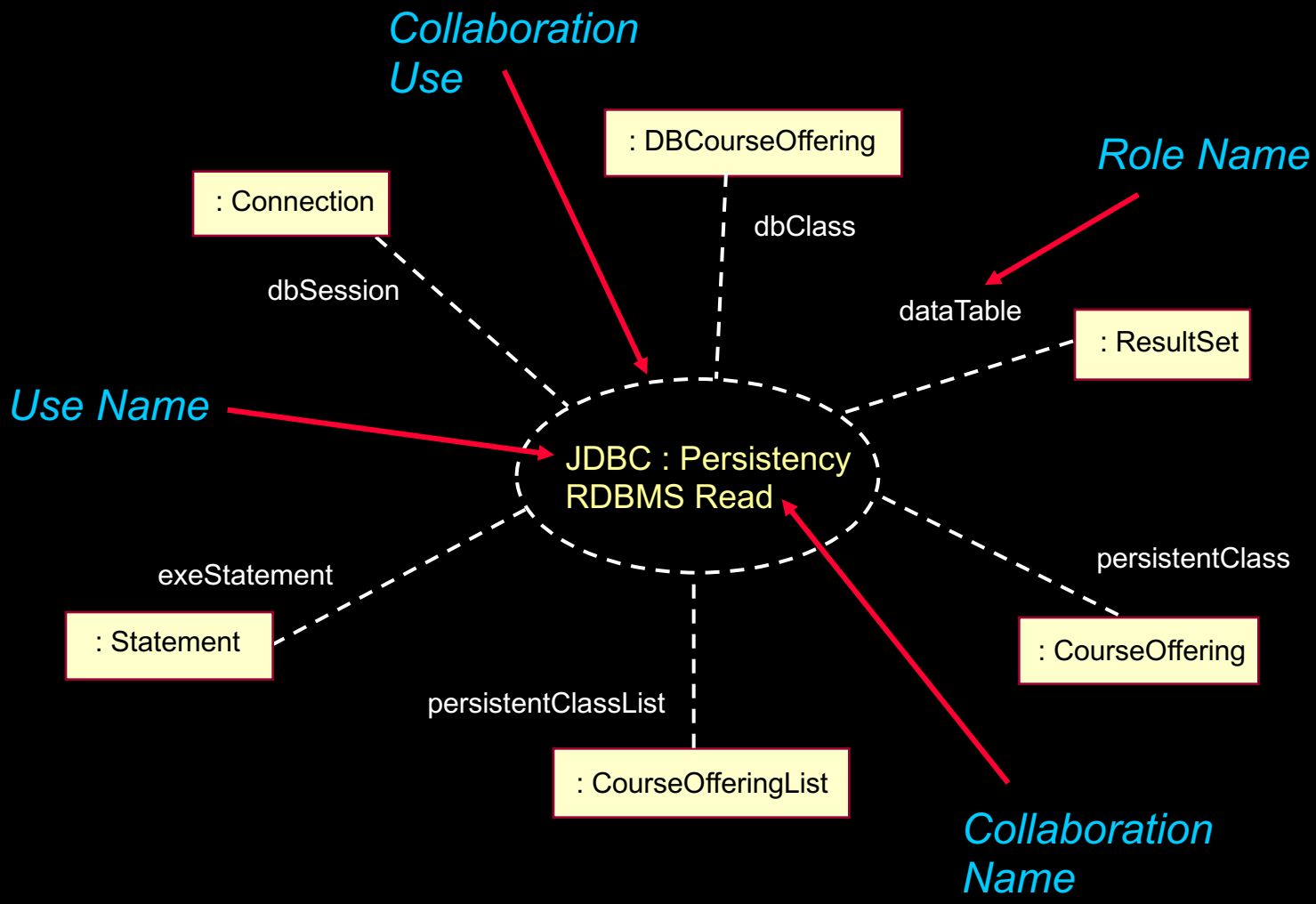
Example Collaboration



What is a Collaboration Use?

- Represents the application, or use, of a collaboration within a context
  - A specific situation involving classes or instances fulfilling the roles of the collaboration
- May appear in the definition of a larger collaboration
  - In this case, roles are bound to roles in the larger collaboration.
  - Roles bound in the larger collaboration are automatically bound to roles of the inner collaboration.

Example Collaboration Use



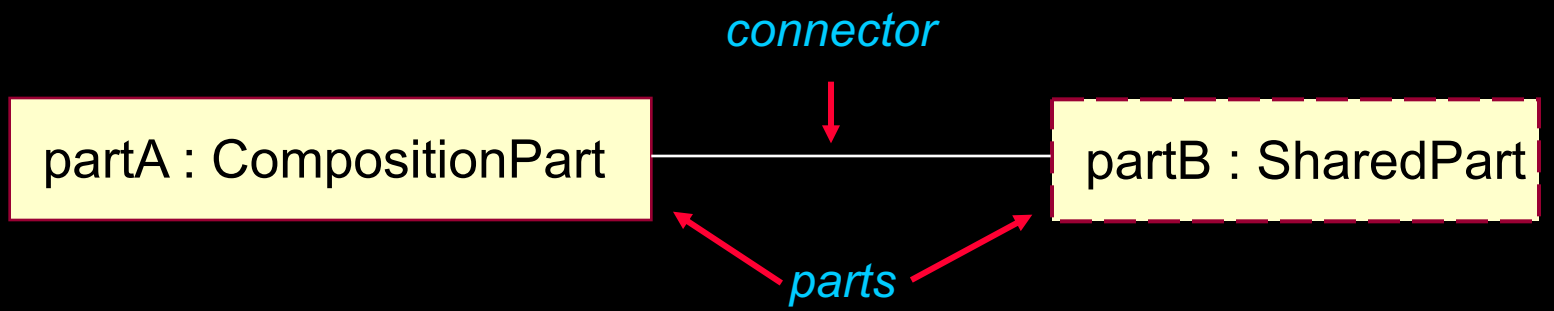
Review: What Is a Structured Class?

- A structured class contains parts or roles that form its structure and realize its behavior.
  - Describes the internal implementation structure
- The parts themselves may also be structured classes.
  - Allows hierarchical structure to permit a clear expression of multilevel models.
- A connector is used to represent an association in a particular context.
  - Represents communications paths among parts

Structured Class Notation

2.0

- A part or role is shown by using the symbol for a class (a rectangle)
  - A composite aggregation represents an owned part and is represented by a solid rectangle.
  - A shared aggregation represents an external part (one not owned by the enclosing whole) and is represented by a dashed rectangle.



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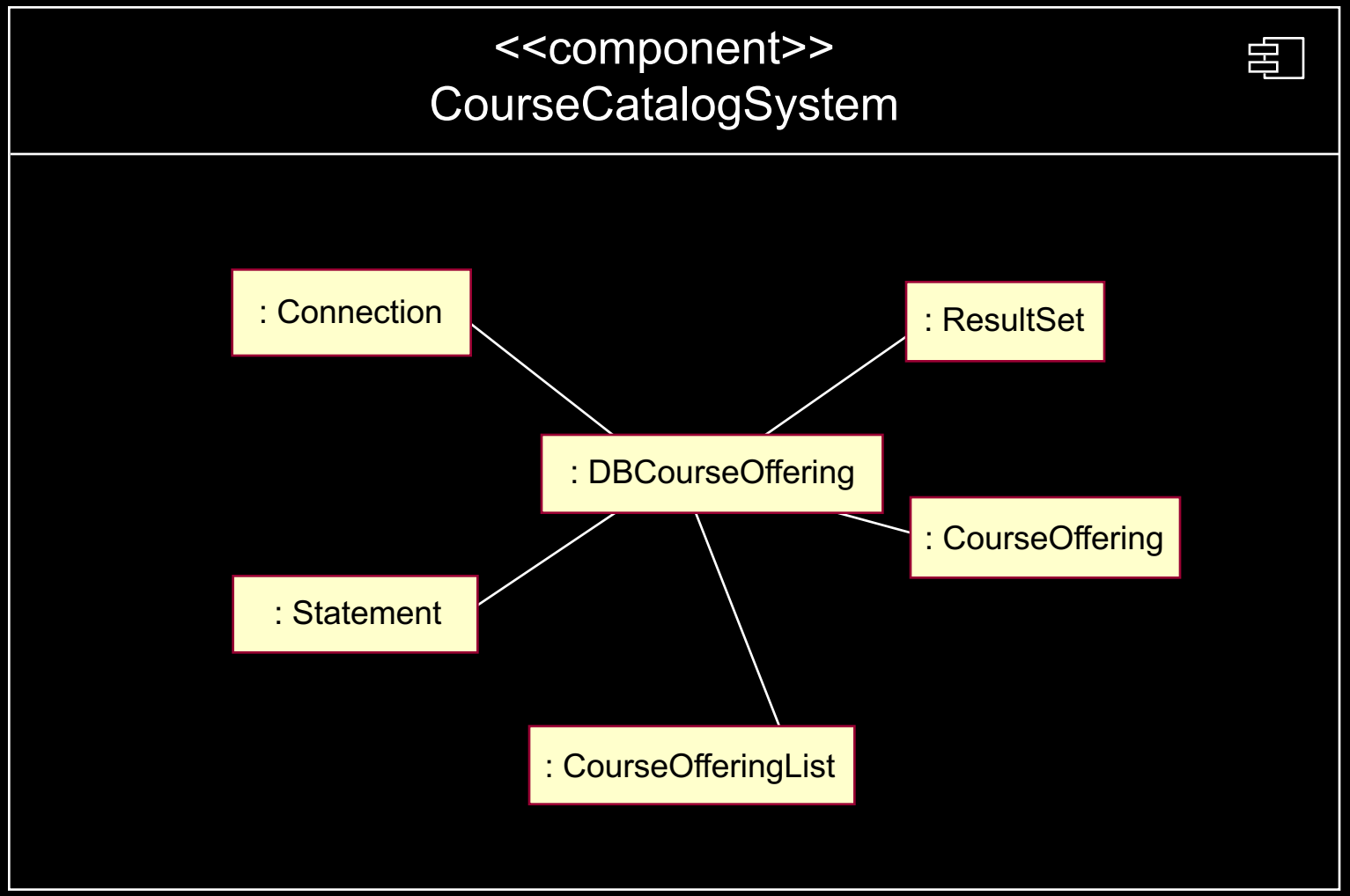
Example: Composite Structure Diagram



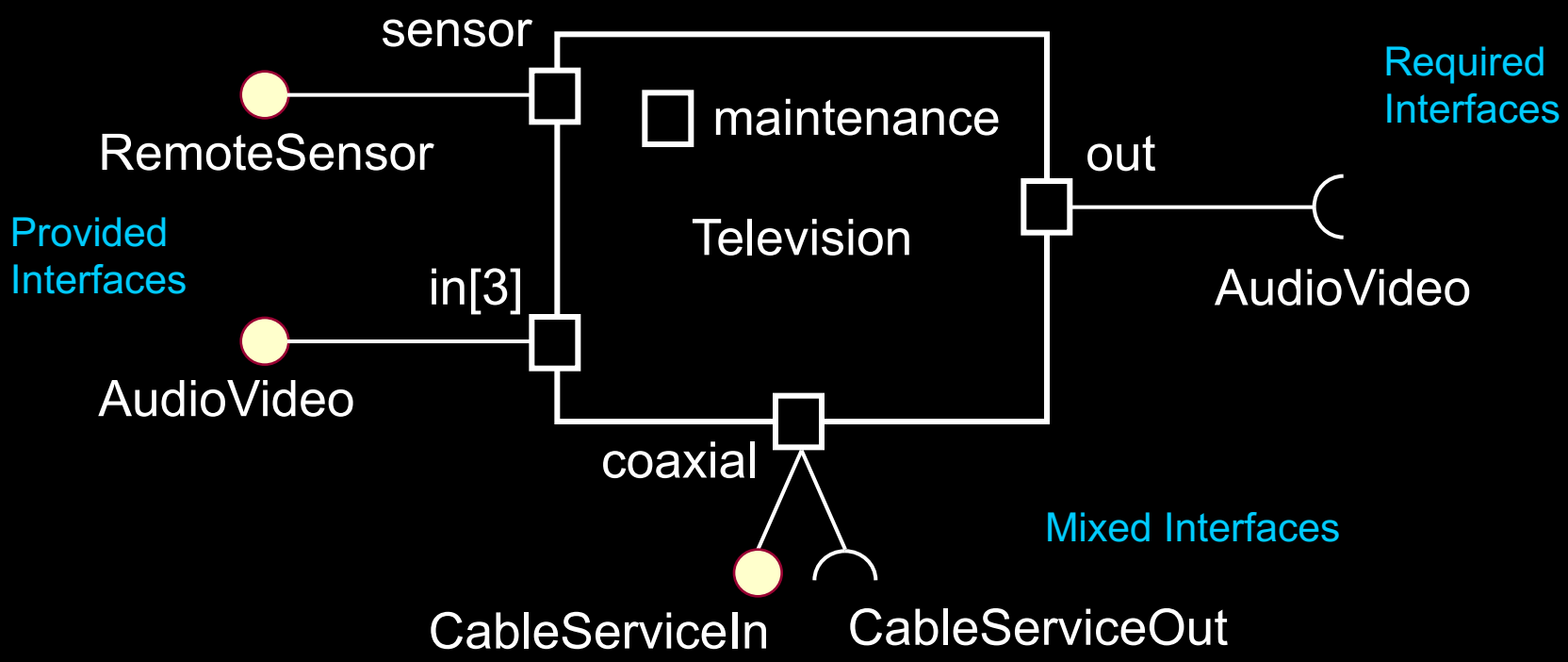
What Is a Port?

- A port is a structural feature that encapsulates the interaction between the contents of a class and its environment.
  - Port behavior is specified by its provided and required interfaces.
- A port permits the internal structure to be modified without affecting external clients.
  - External clients have no visibility to internals.
- A class may have a number of ports.
  - Each port has a set of provided and required interfaces.

Port Notation

2.0

- A public port is shown as a small square *straddling* the boundary of a classifier.
- A private port is shown as a small square *inside* the boundary of a classifier.



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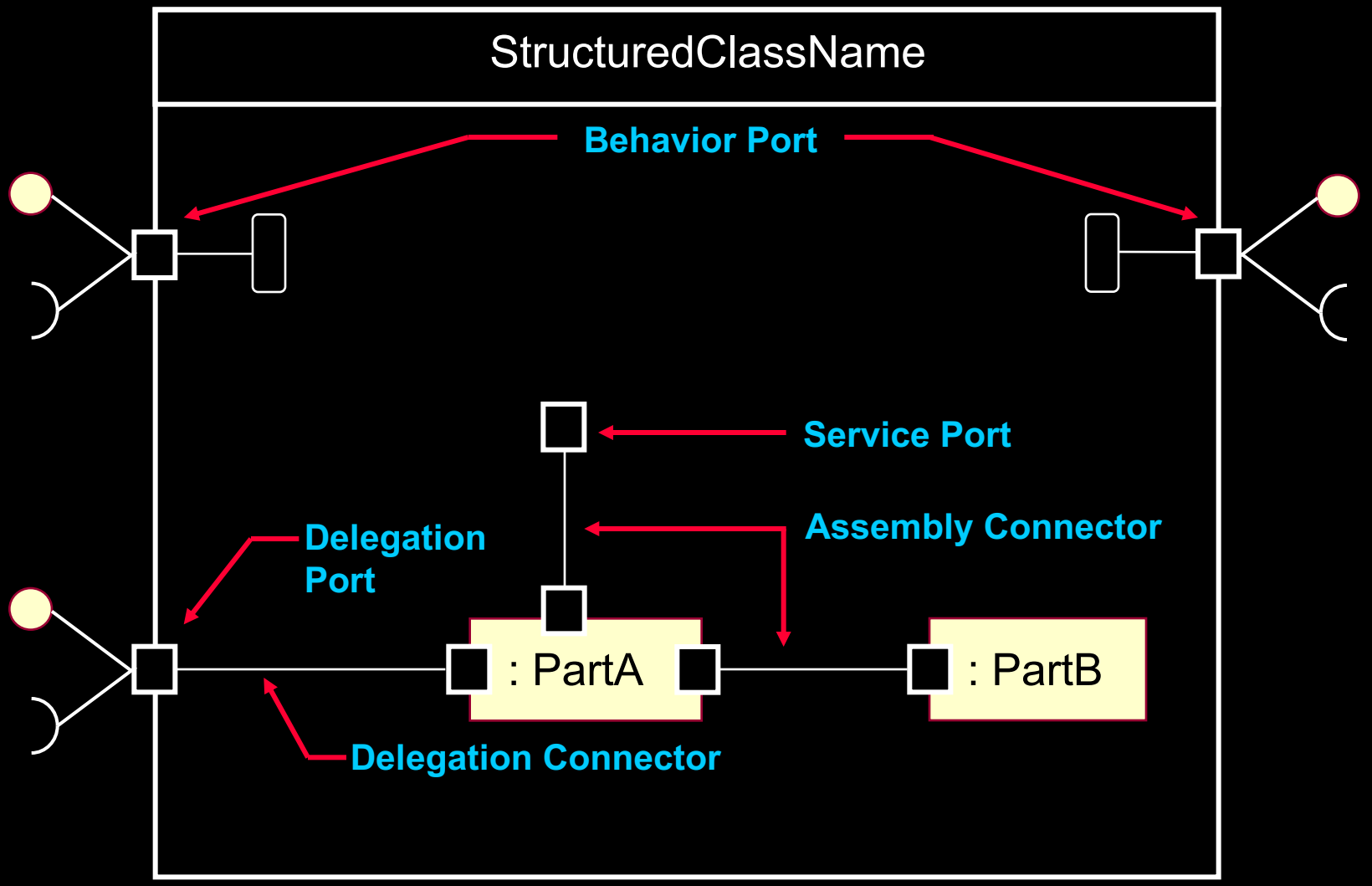
Port Types

- Ports can have different implementation types:
  - Service Port - Is only used for the internal implementation of the class
  - Behavior Port - Requests on the port are implemented directly by the class
  - Delegation Port – Requests on the port are transmitted to internal parts for implementation

What Is a Connector?

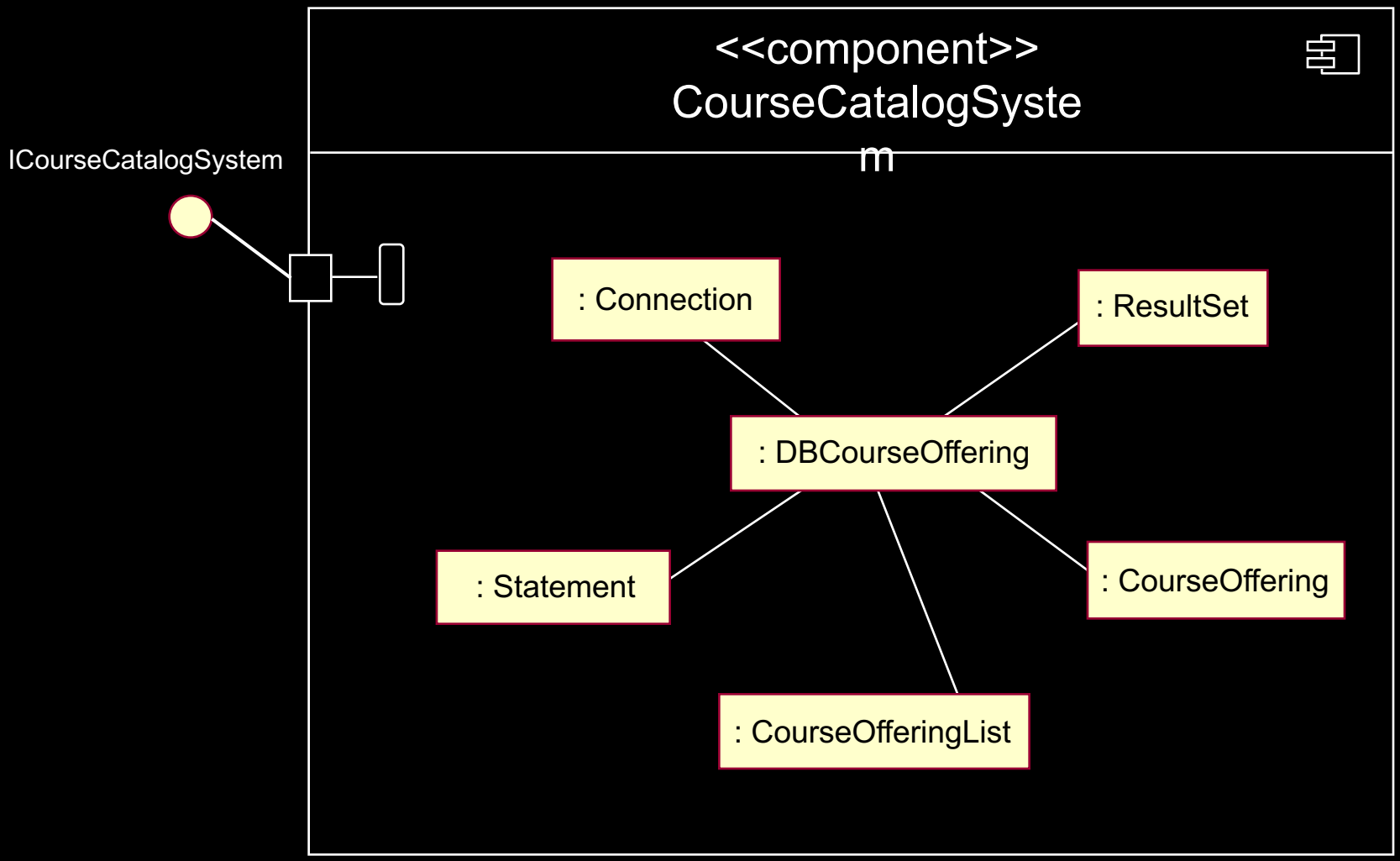
- A connector models the communication link between interconnected parts. For example:
  - Assembly connectors - Reside between two elements (parts or ports) in the internal implementation specification of a structured class.
  - Delegation connectors - Reside between a delegation port and an internal part in the internal implementation specification of a structured class.

Example: Composite Structure Diagram with Ports



Example Composite Structure Diagram

2.0



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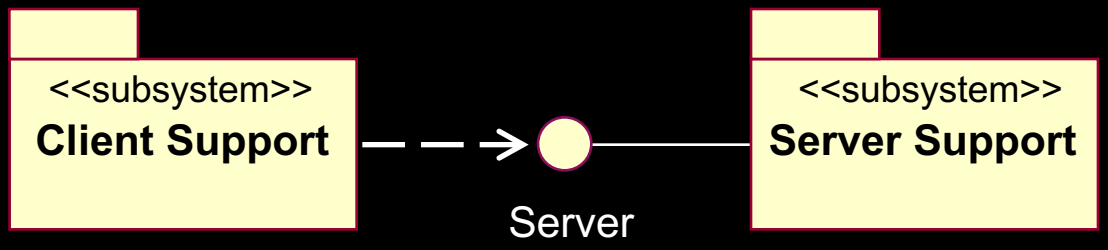
Subsystem Design Steps

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

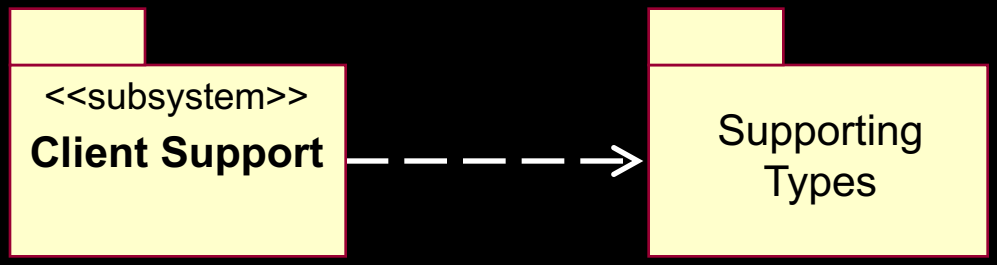
Subsystem Dependencies: Guidelines

- Subsystem dependency on a subsystem



Flexible, Preferred

- Subsystem dependency on a package



Use with care

Subsystem Dependencies: Guidelines

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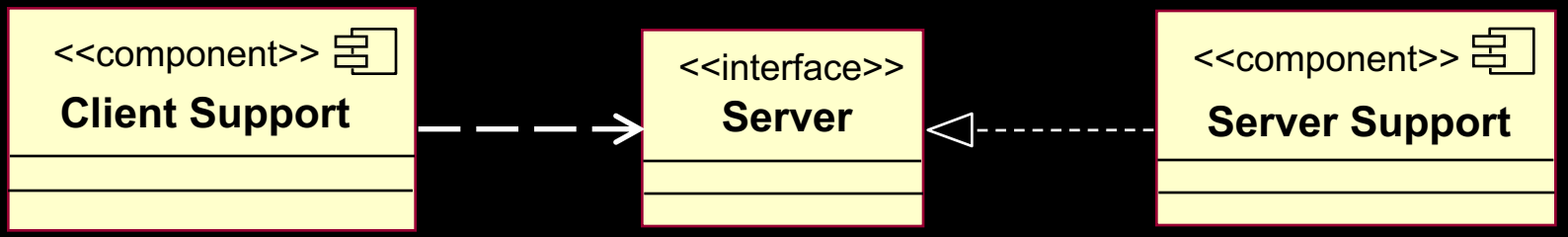

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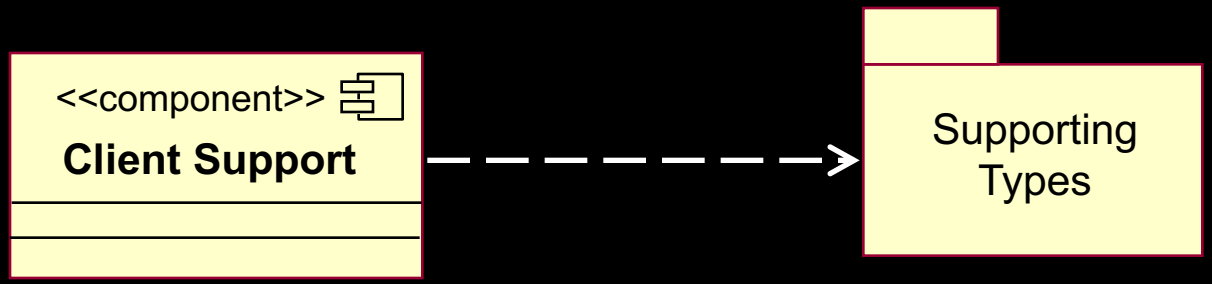


Use with care

Review: Subsystem Design

- What are gates?
- What is the difference between a collaboration and a collaboration use?
- What is a port and name the different types.
- Why should dependencies be to the subsystem's interface?

Exercise: Subsystem Design

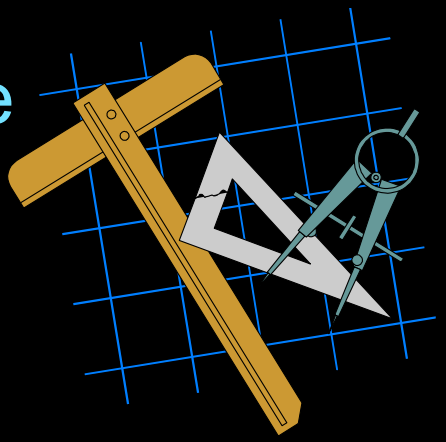
- Given the following:
  - The defined subsystems, their interfaces and their relationships with other design elements (the subsystem context diagrams)
    - Payroll Exercise Solution: Identify Design Elements, Subsystem Context Diagrams section

Exercise: Subsystem Design (continued)

- Identify the following for a particular subsystems:
  - The design elements contained within the subsystem and their relationships
  - The interactions needed to implement the subsystem interface operations

Exercise: Subsystem Design (continued)

- Produce the following for a particular subsystem(s):
  - "Interface realizations"
    - Interaction diagram for each interface operation
    - Composite structure diagram containing the subsystem design elements that realize the interface responsibilities and their communication paths



Exercise: Review

- Compare your Subsystem Interface Realizations
  - Have all the main and subflows for the interface operations been handled?
  - Has all behavior been distributed among the participating design elements?
  - Has behavior been distributed to the right design elements?
  - Are there any messages coming from the interfaces?