IT4490 – ITSS SOFTWARE DEVELOPMENT

3. ARCHITECTURAL DESIGN

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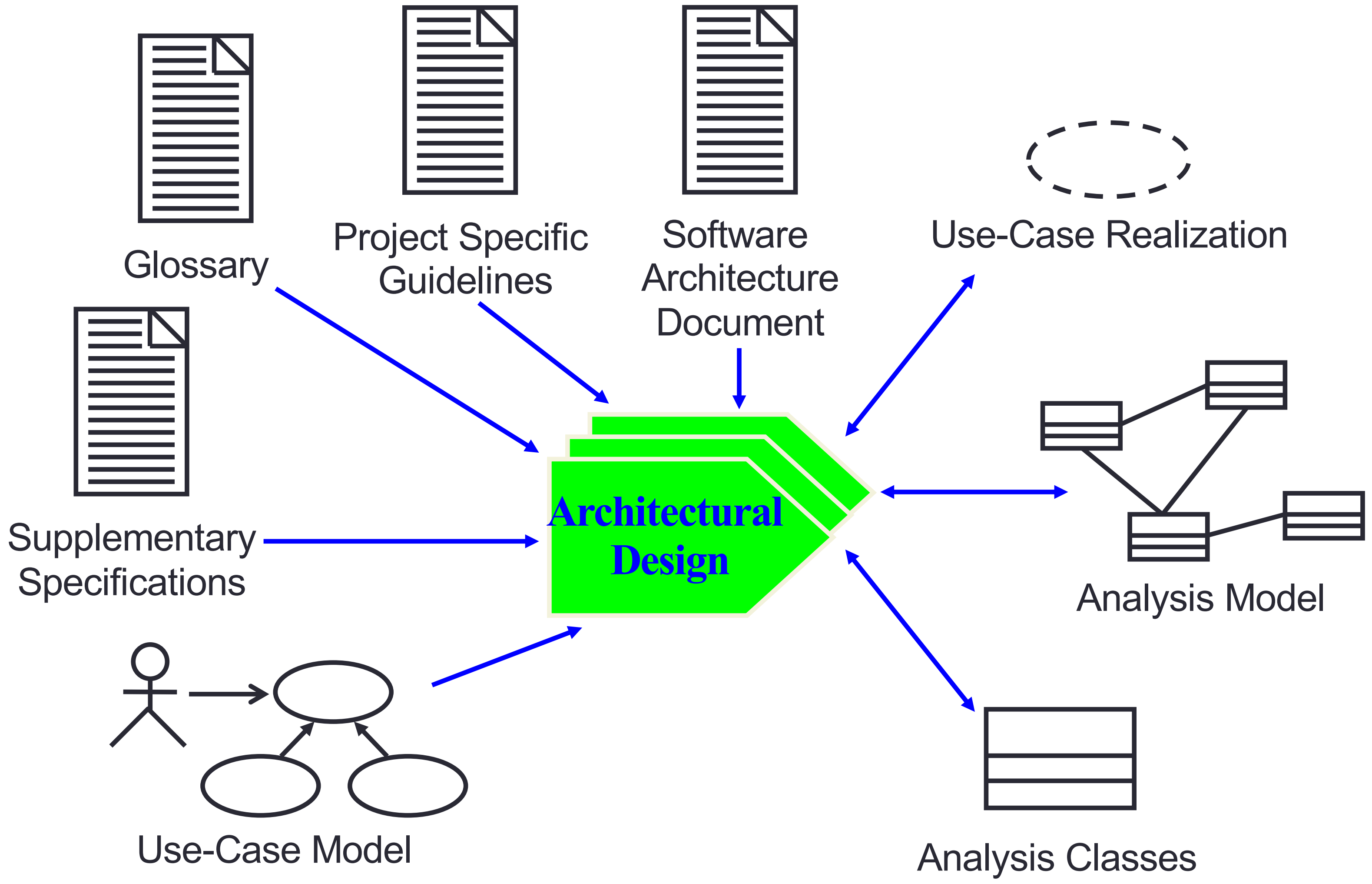
Some slides extracted from IBM coursewares

Content

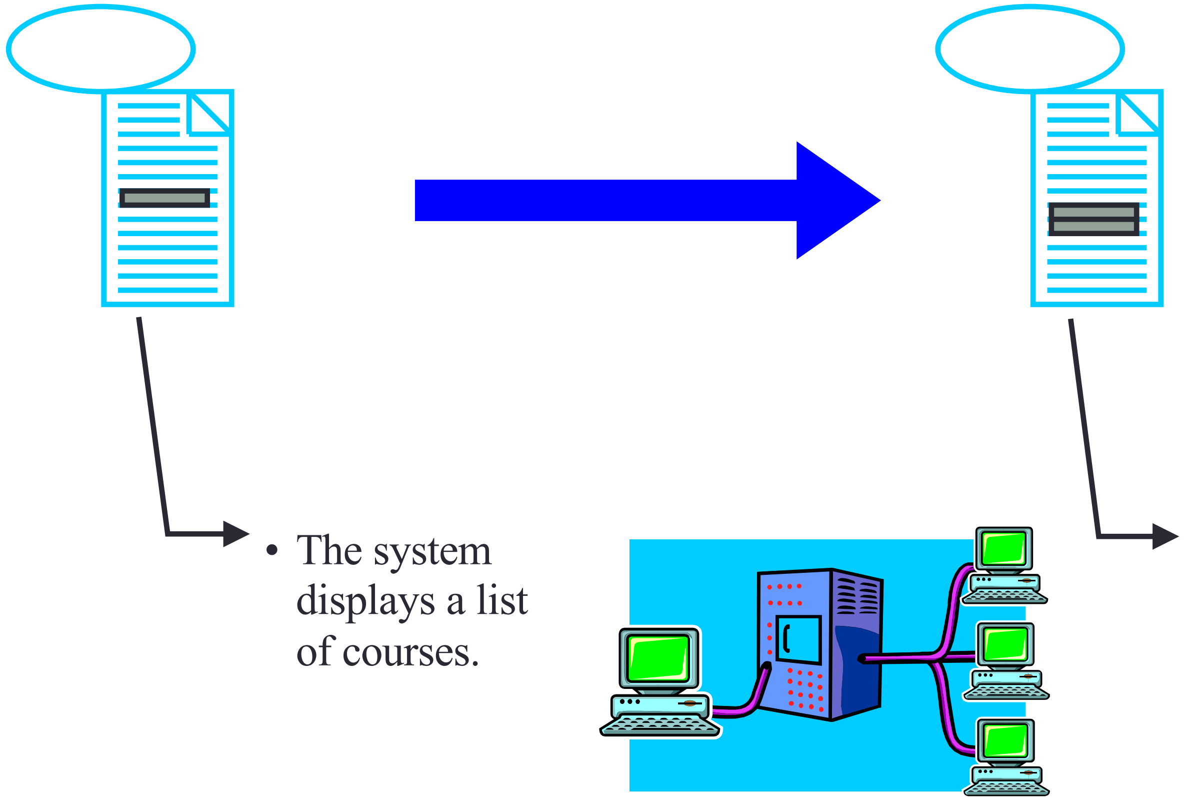
Review: Software Architectural Design process

- Purpose: "to provide a design for the software that implements and can be verified against the requirements"
- Software architecture is designed from the software requirements
- Main items
  - a top-level structure of the software and the software components which constructs the software
  - a top-level design for the interfaces external to the software and between the software components
  - a top-level design for the database

Architectural Design Overview



Supplement the Use-Case Specification

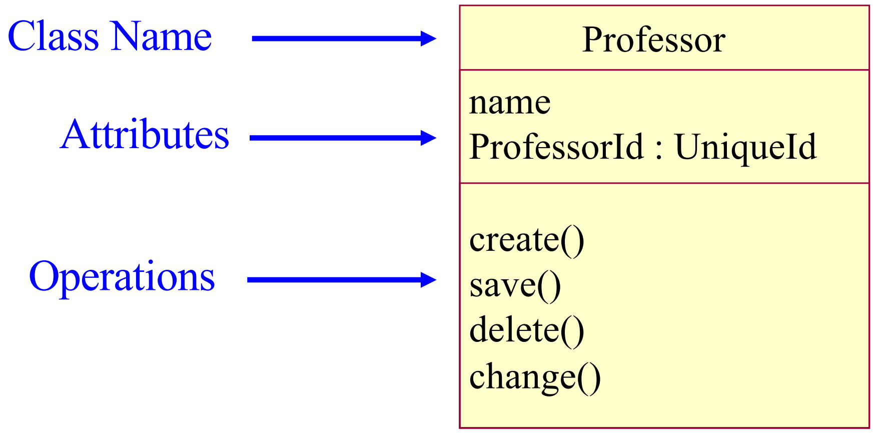


- The system displays a list of courses.
- The system retrieves and displays a list of current courses from the course catalog legacy database.

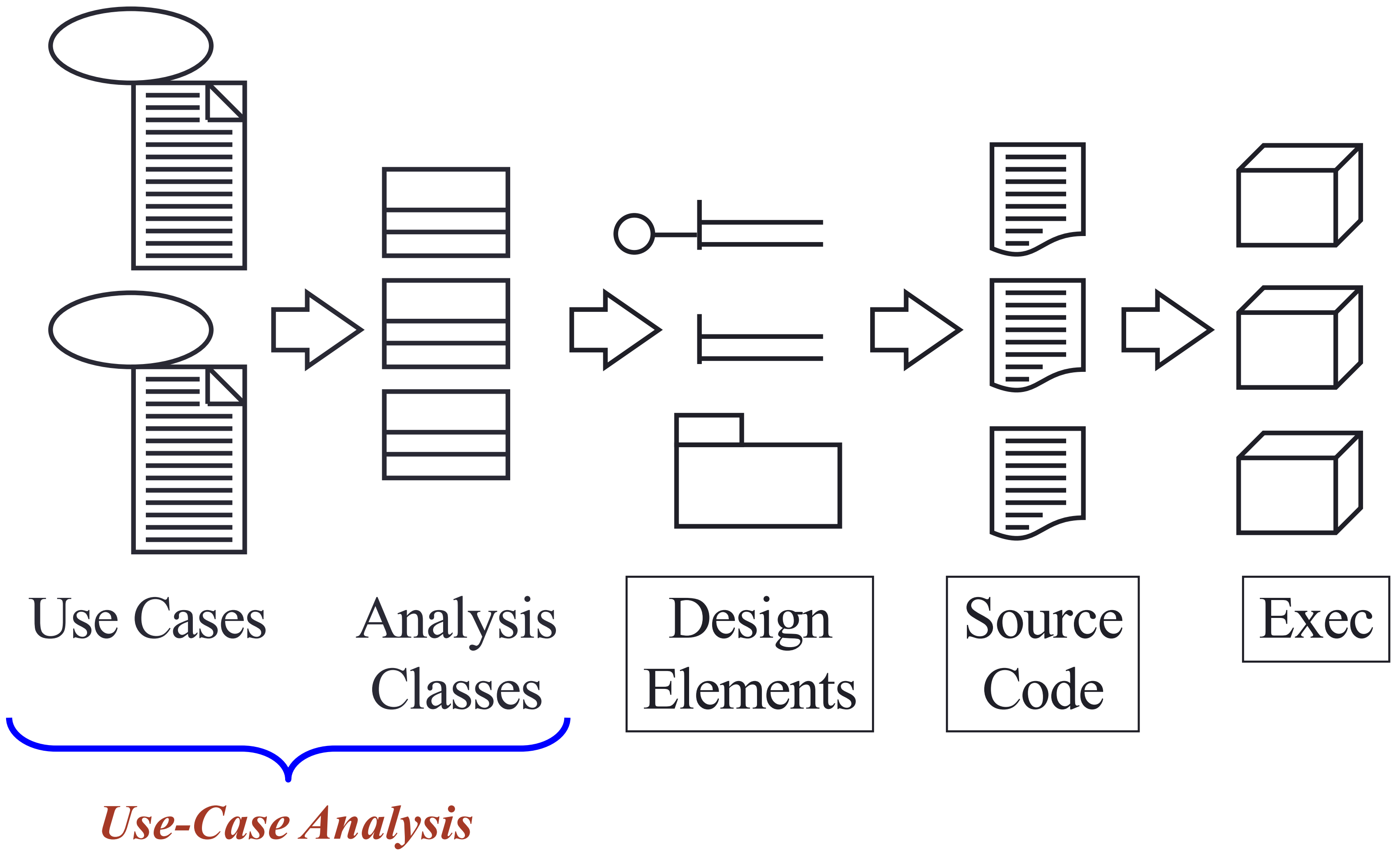
Content

Review: Class

- An abstraction
- Describes a group of objects with common:
  - Properties (attributes)
  - Behavior (operations)
  - Relationships
  - Semantics

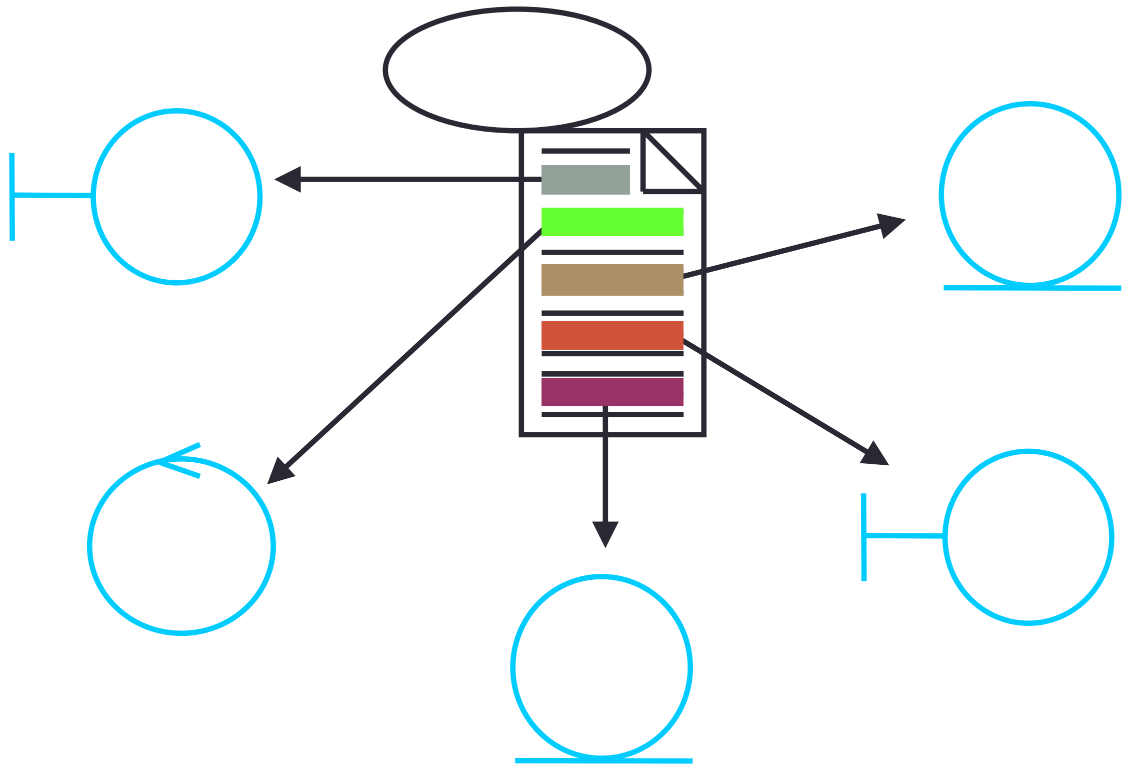


Analysis Classes: A First Step Toward Executables

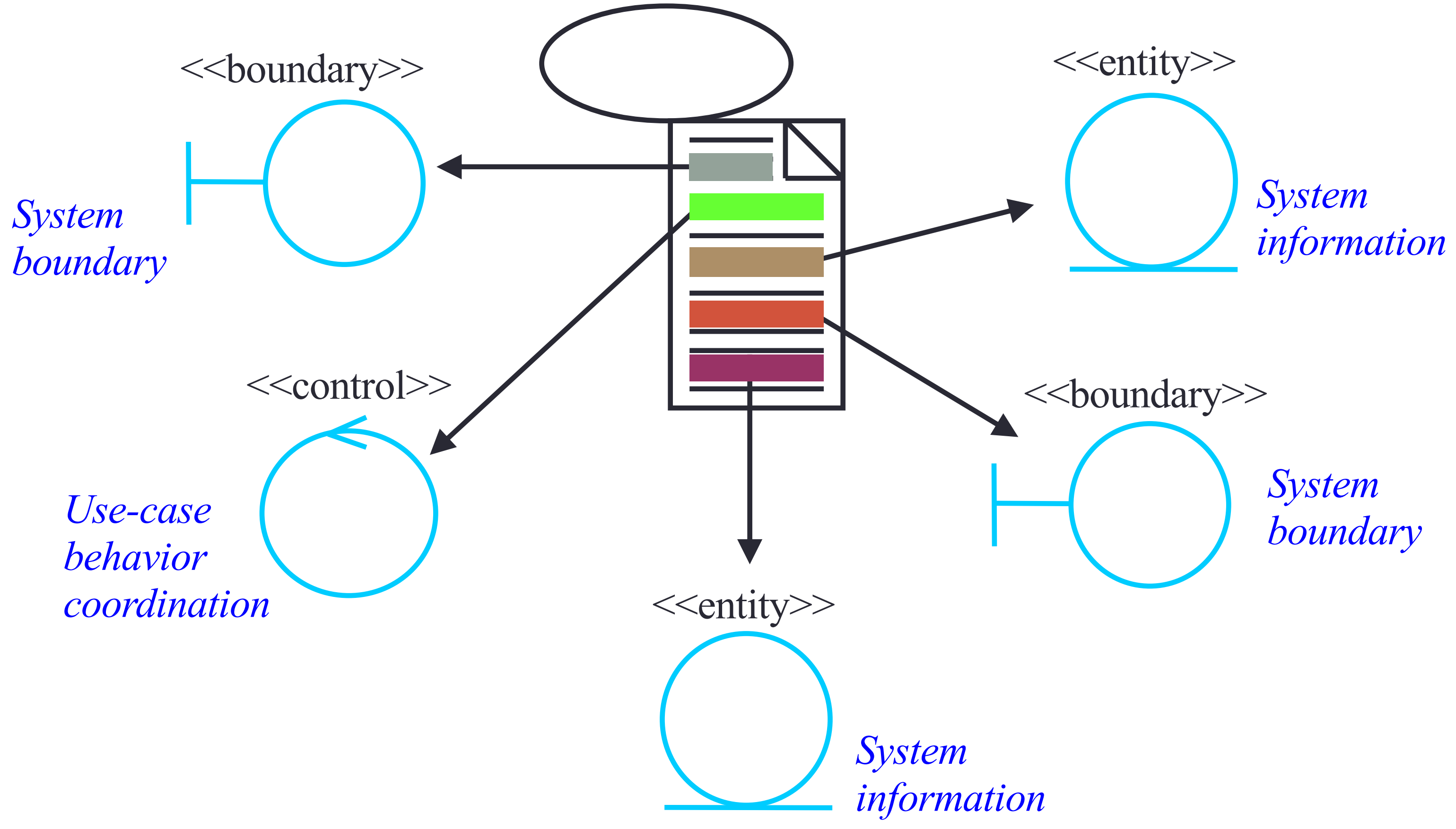


Find Classes from Use-Case Behavior

- The complete behavior of a use case has to be distributed to analysis classes



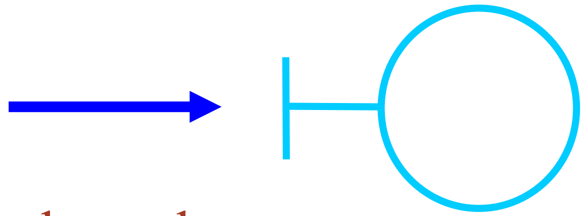
Types of Analysis Classes



2.1. Boundary Classes

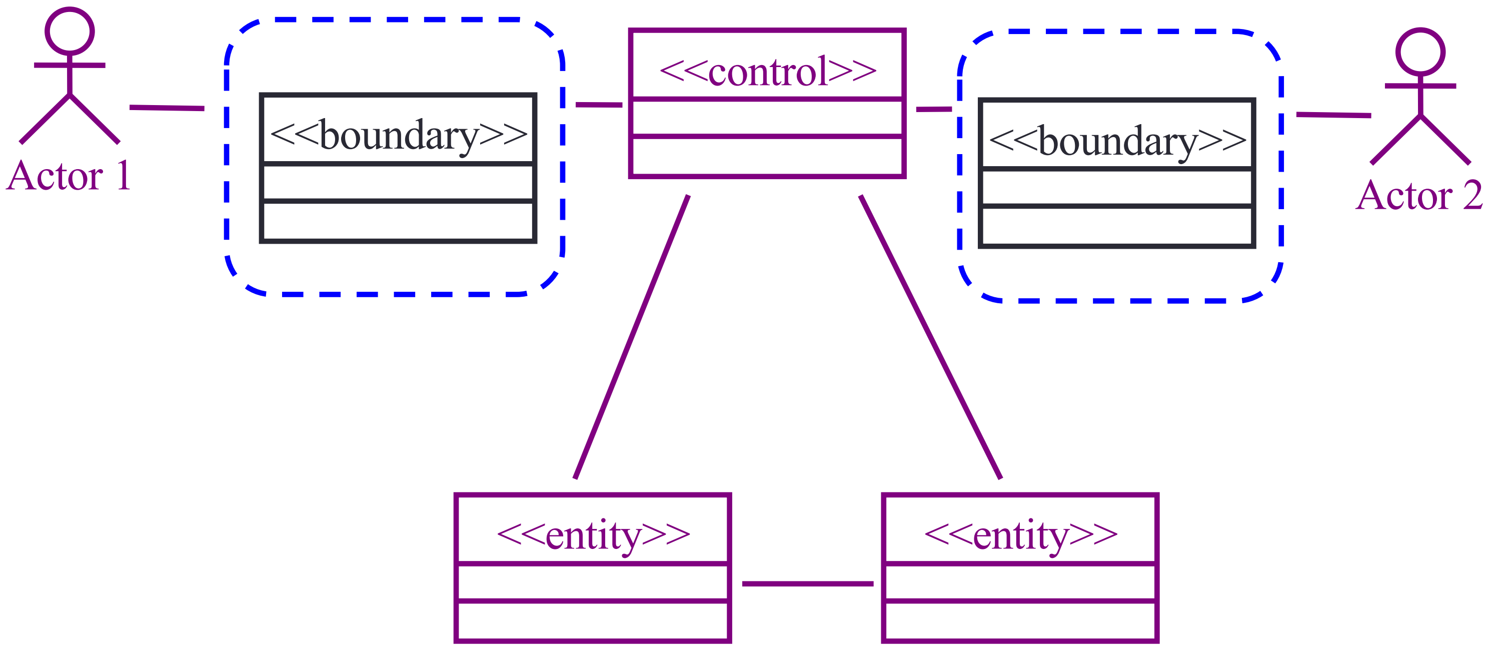
- Intermediate between the interface and something outside the system
- Several Types
  - User interface classes
  - System interface classes
  - Device interface classes
- One boundary class per actor/use-case pair

Analysis class stereotype



Environment dependent.

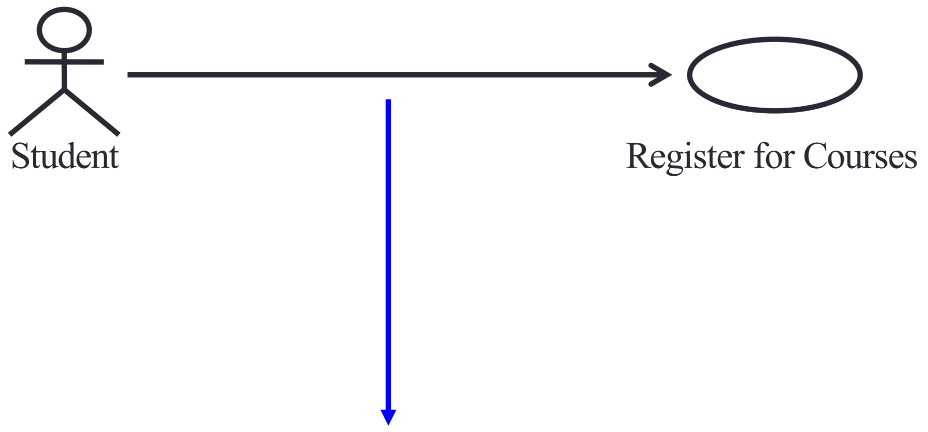
The Role of a Boundary Class



Model interaction between the system and its environment.

Example in Course Registration CS: Finding Boundary Classes

- One boundary class per actor/use case pair



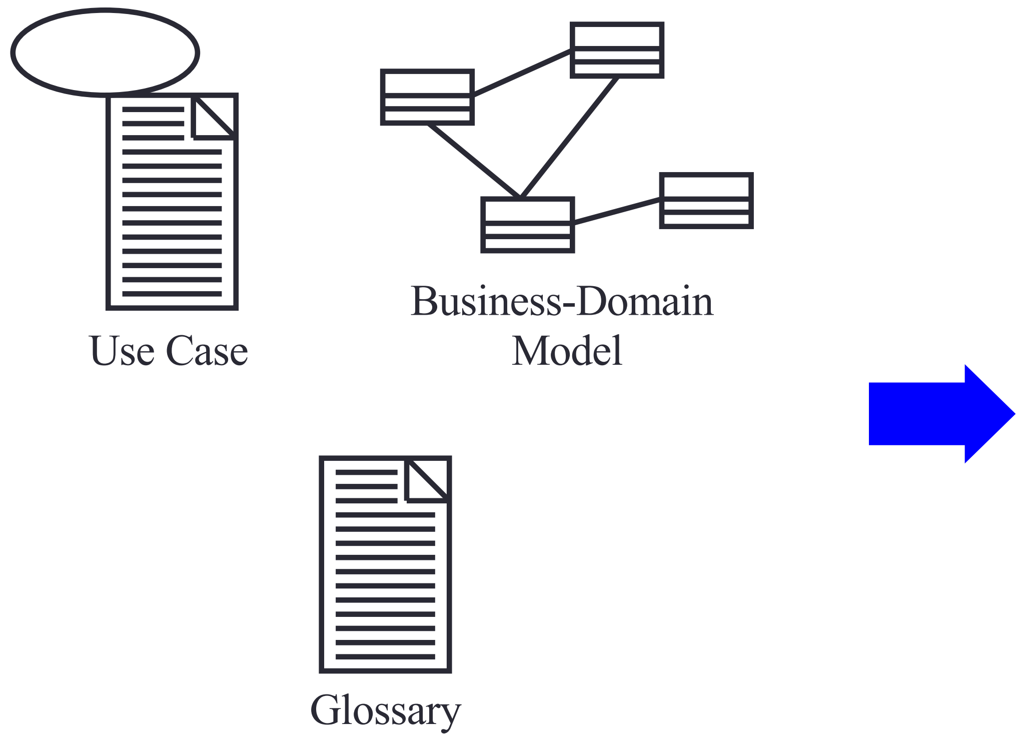
Guidelines: Boundary Classes

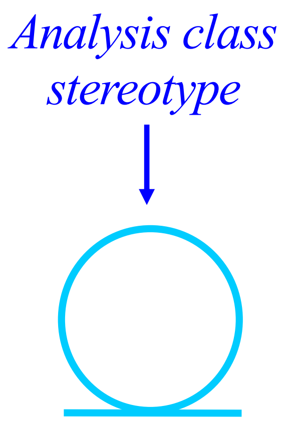
- User Interface Classes
  - Concentrate on what information is presented to the user
  - Do NOT concentrate on the UI details
- System and Device Interface Classes
  - Concentrate on what protocols must be defined
  - Do NOT concentrate on how the protocols will be implemented

Concentrate on the responsibilities, not the details!

2.2. Entity Classes

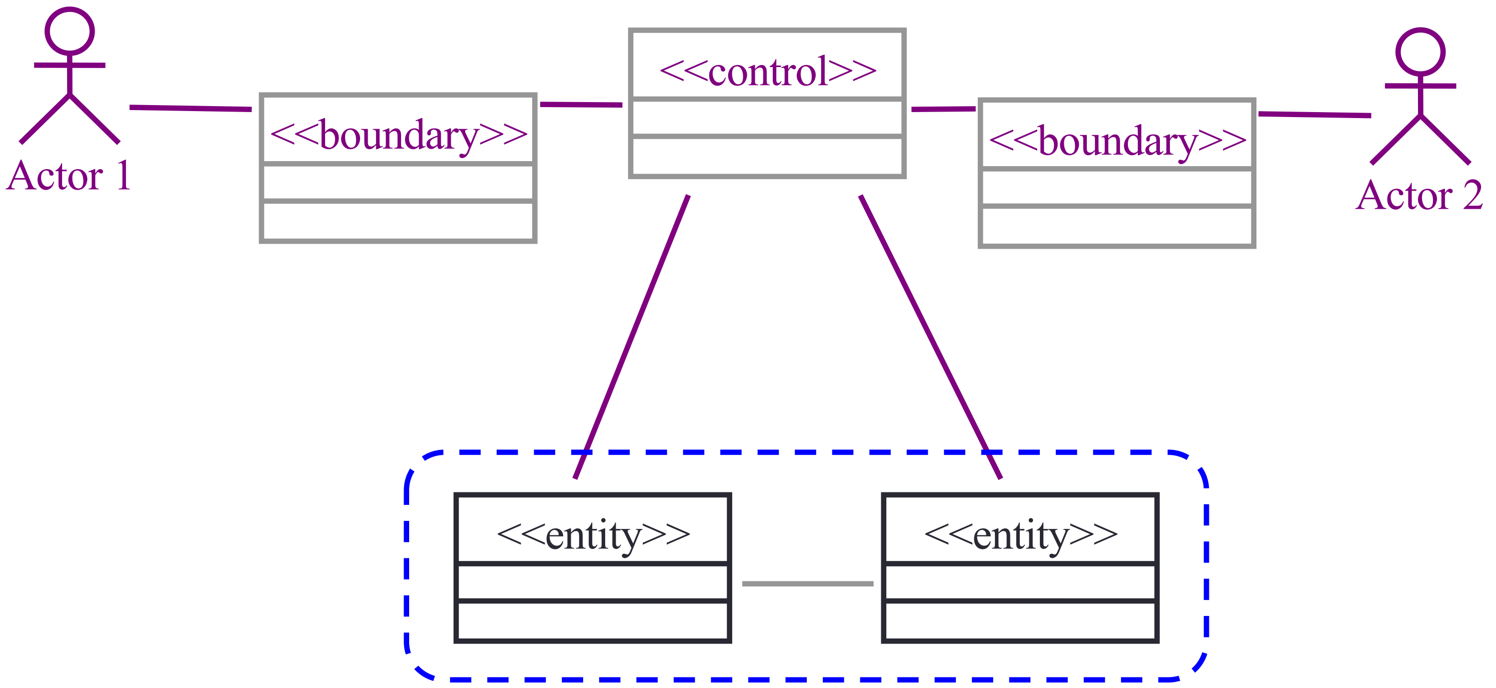
- Key abstractions of the system





Environment independent.

The Role of Entity Classes



Store and manage information in the system.

Guidelines: Entity Classes

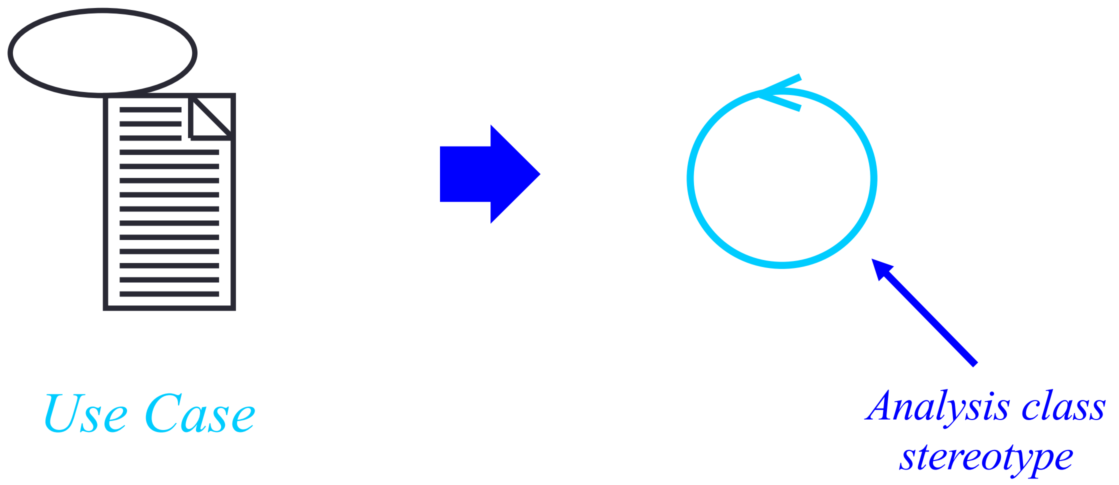
- Use use-case flow of events as input
- Key abstractions of the use case
- Traditional, filtering nouns approach
  - Underline noun clauses in the use-case flow of events
  - Remove redundant candidates
  - Remove vague candidates
  - Remove actors (out of scope)
  - Remove implementation constructs
  - Remove attributes (save for later)
  - Remove operations

Example in Course Registration CS: Finding Entity Classes

- For “Register For Course” use case, there are some candidate entity classes:

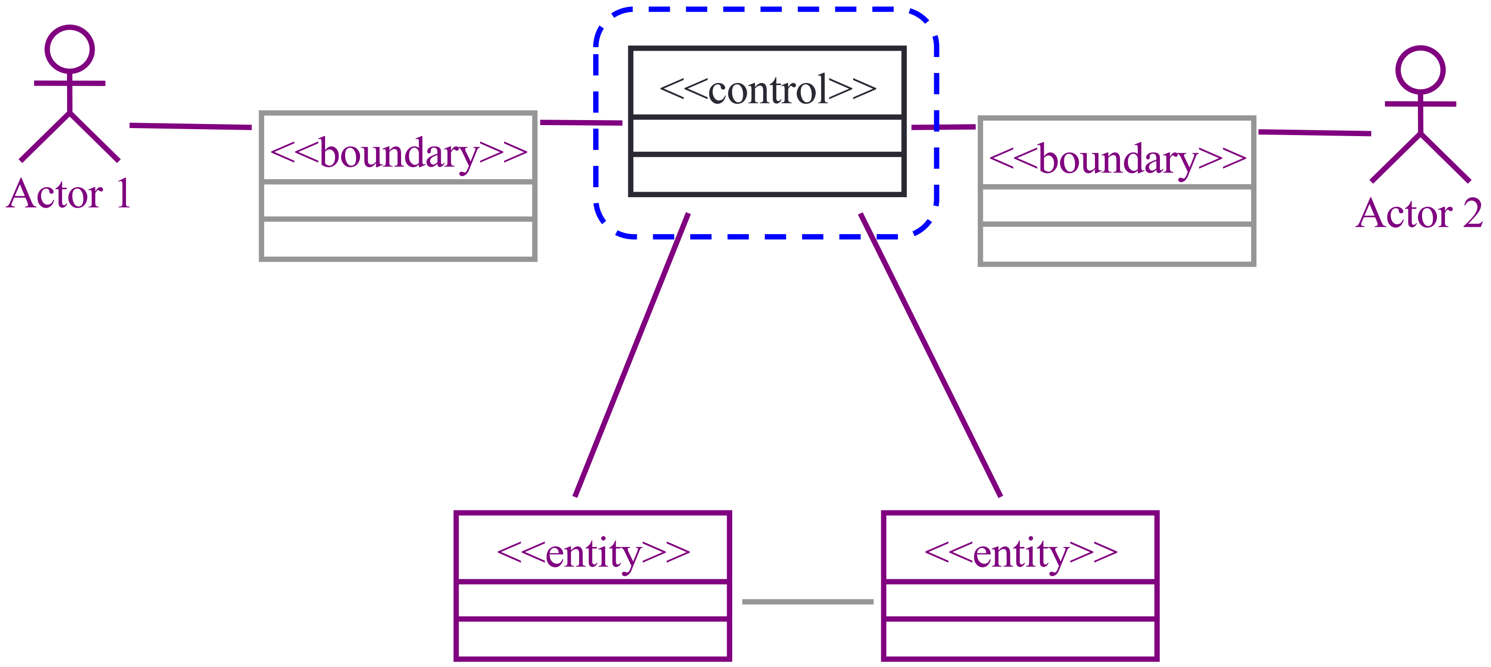
3.3. Control Classes

- Provide coordinating behavior in the system
- model control behavior specific to one or more use cases



Use-case dependent. Environment independent.

The Role of Control Classes



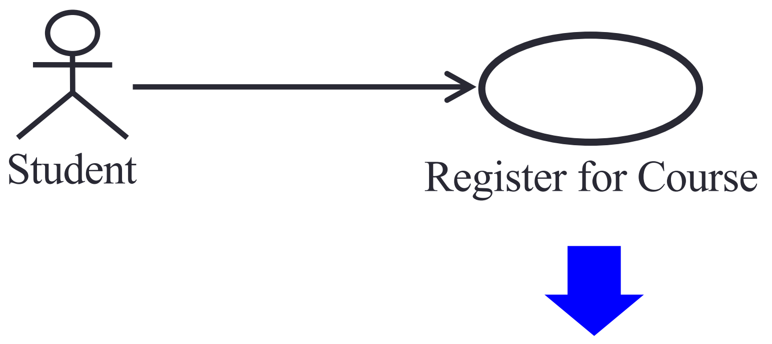
Coordinate the use-case behavior.

Guidelines: Control Classes

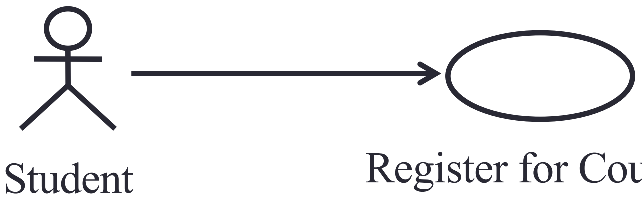
- In general, identify one control class per use case.
- The system can perform some use cases without control classes by using just entity and boundary classes.
  - This is particularly true for use cases that involve only the simple manipulation of stored information.
- More complex use cases generally require one or more control classes to coordinate the behavior of other objects in the system.
  - Examples of control classes include transaction managers, resource coordinators, and error handlers.

Example in Course Registration CS: Finding Control Classes

- For “Register for Course” use case:



Course Registration CS Summary: Analysis Classes



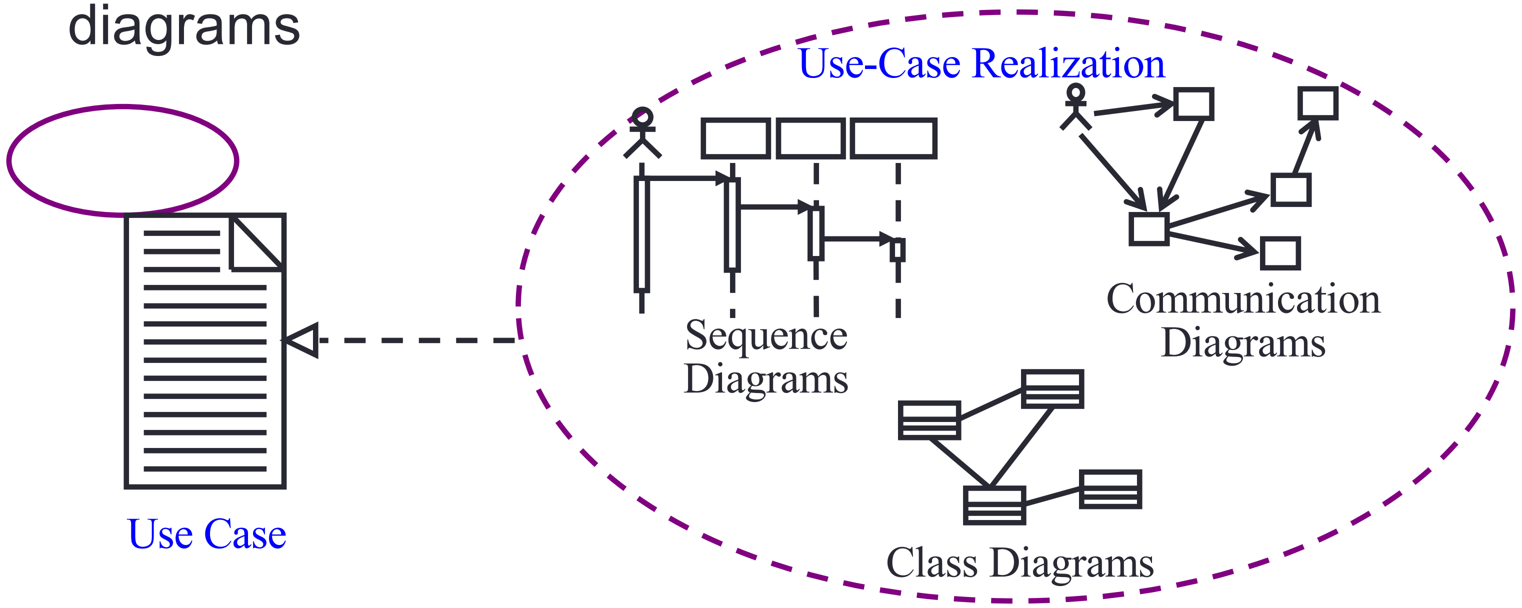
Use-Case Model

Analysis Model

Content

3. Distribute Use-Case Behavior to Classes

- For each use-case flow of events:
  - Identify analysis classes
  - Allocate use-case responsibilities to analysis classes
  - Model analysis class interactions in Interaction diagrams



3.1. Allocating Responsibilities to Classes

- Use analysis class stereotypes as a guide
  - Boundary Classes
    - Behavior that involves communication with an actor
  - Entity Classes
    - Behavior that involves the data encapsulated within the abstraction
  - Control Classes
    - Behavior specific to a use case or part of a very important flow of events

3.1. Allocating Responsibilities to Classes (2)

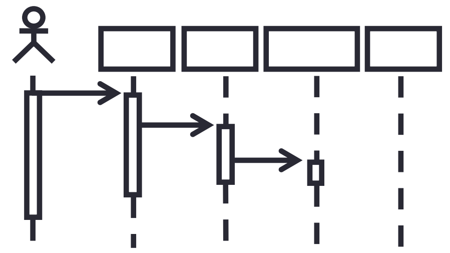
- Who has the data needed to perform the responsibility?
  - If one class has the data, put the responsibility with the data
  - If multiple classes have the data:
    - Put the responsibility with one class and add a relationship to the other
    - Create a new class, put the responsibility in the new class, and add relationships to classes needed to perform the responsibility
    - Put the responsibility in the control class, and add relationships to classes needed to perform the responsibility

3.2. Interaction Diagrams

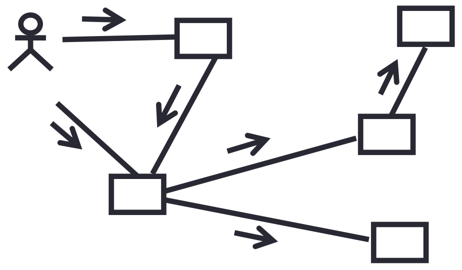
- Generic term that applies to several diagrams that emphasize object interactions
  - Sequence Diagram
  - Communication Diagram
- Specialized Variants
  - Timing Diagram
  - Interaction Overview Diagram

3.2. Interaction Diagrams (2)

- Sequence Diagram
  - Time oriented view of object interaction

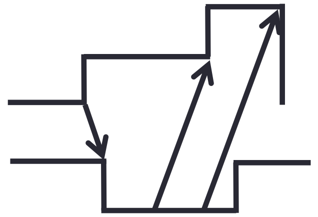

Sequence Diagrams

- Communication Diagram
  - Structural view of messaging objects

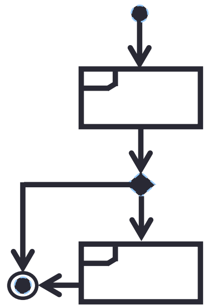

Communication Diagrams

3.2. Interaction Diagrams (3)

- Timing Diagram
  - Time constraint view of messages involved in an interaction

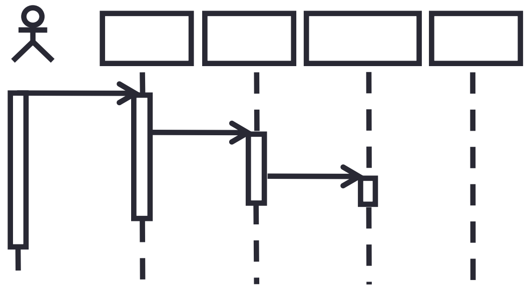

Timing Diagrams

- Interaction Overview Diagram
  - High level view of interaction sets combined into logic sequence

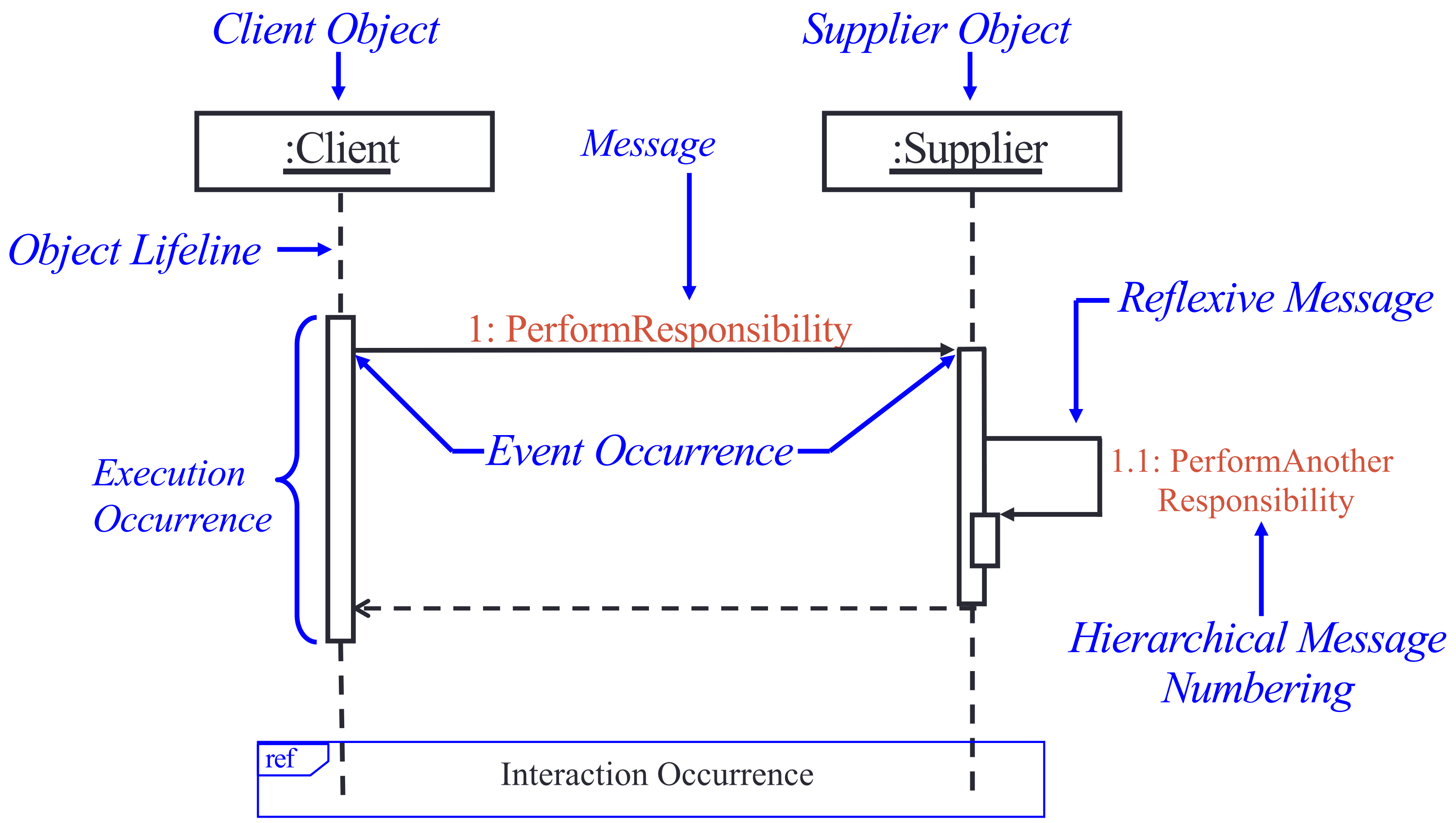

Interaction Overview Diagrams

3.2.1. Sequence Diagram

- A sequence diagram is an interaction diagram that emphasizes the time ordering of messages.
- The diagram shows:
  - The objects participating in the interaction.
  - The sequence of messages exchanged.


Sequence Diagram

The Anatomy of Sequence Diagrams

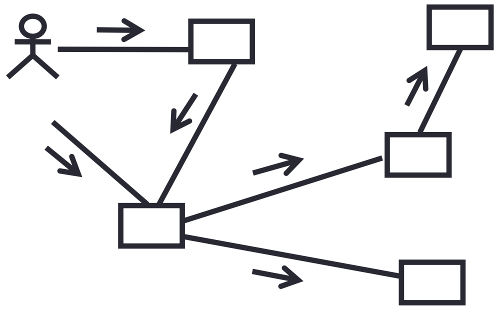


Exercise: Course Registration CS

- Draw a sequence diagram for “Register for course” use case

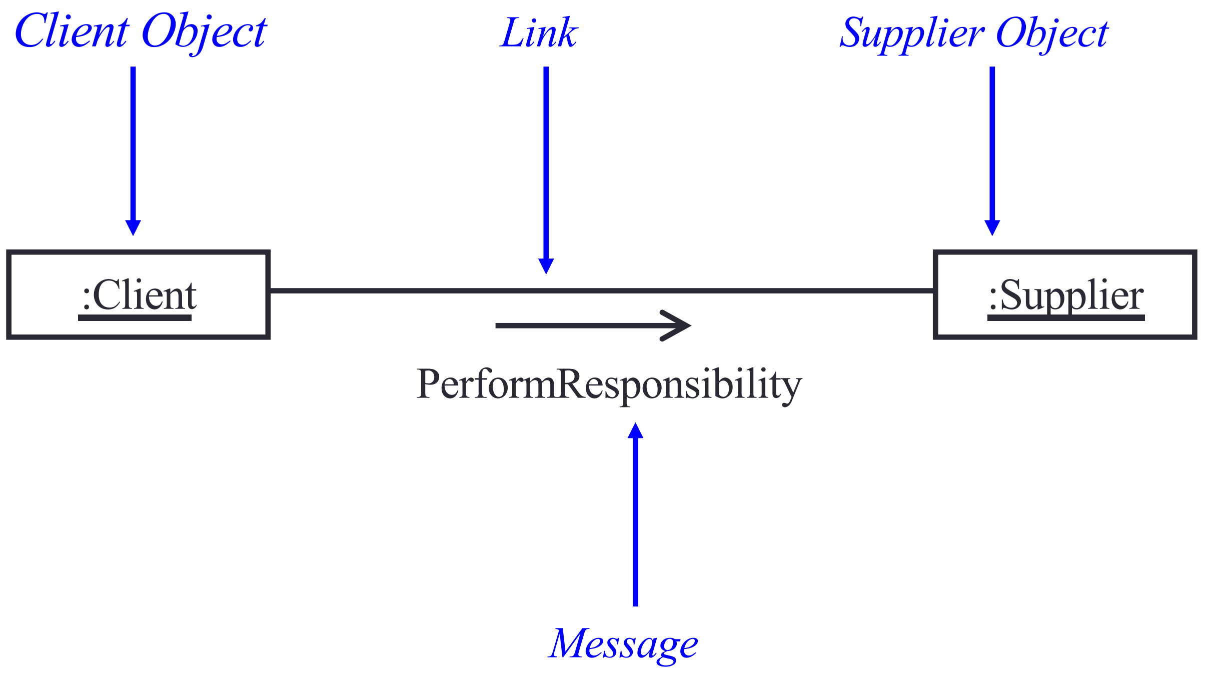
3.2.2. Communication Diagram

- A communication diagram emphasizes the organization of the objects that participate in an interaction.
- The communication diagram shows:
  - The objects participating in the interaction.
  - Links between the objects.
  - Messages passed between the objects.



Communication Diagrams

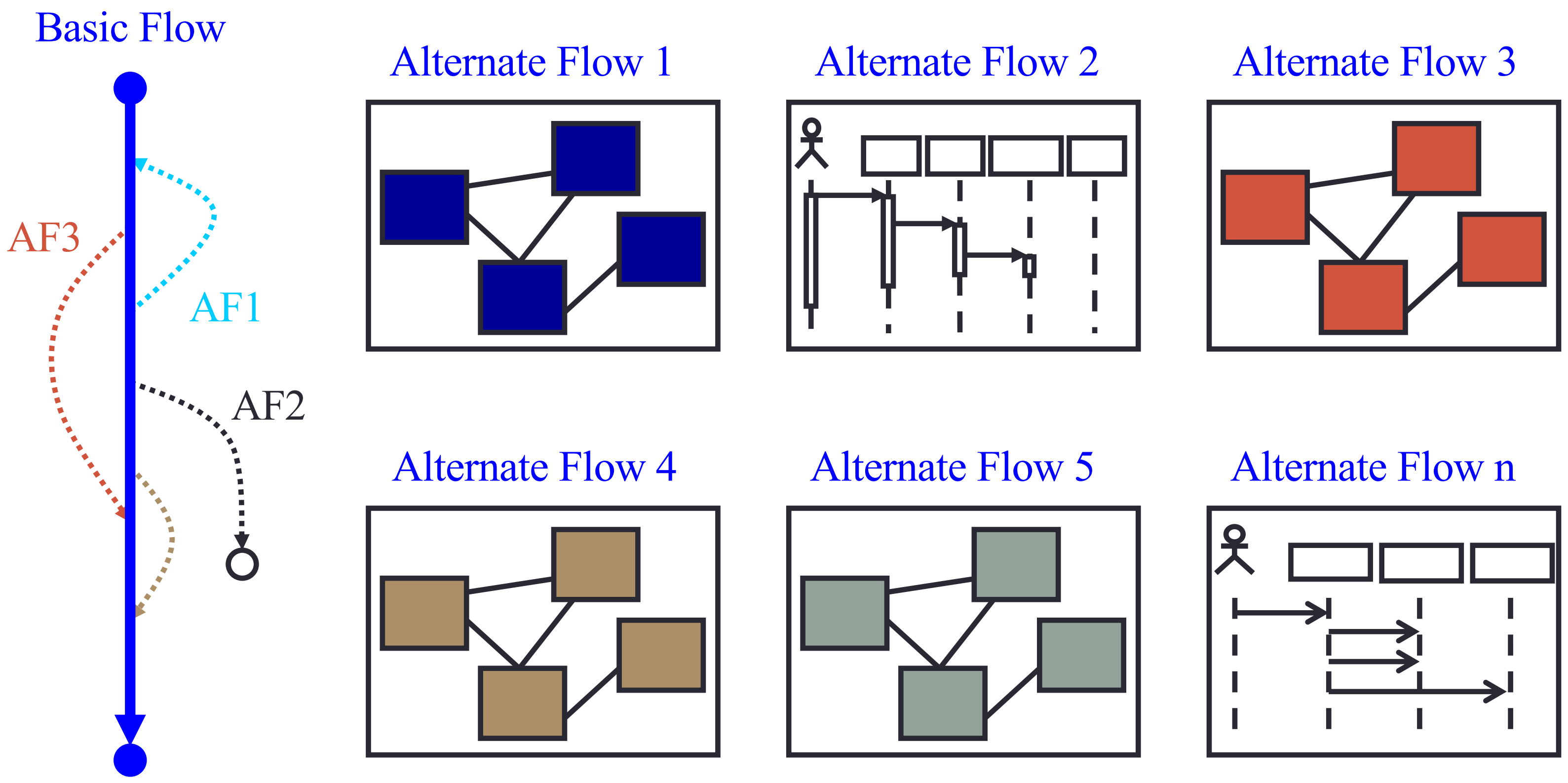
The Anatomy of Communication Diagrams



Exercise: Course Registration CS

- Draw a communication diagram for “Register for course” use case

One Interaction Diagram May Be Not Good Enough



3.2.3. Sequence and Communication Diagram Comparison

- Similarities
  - Semantically equivalent
    - Can convert one diagram to the other without losing any information
  - Model the dynamic aspects of a system
  - Model a use-case scenario

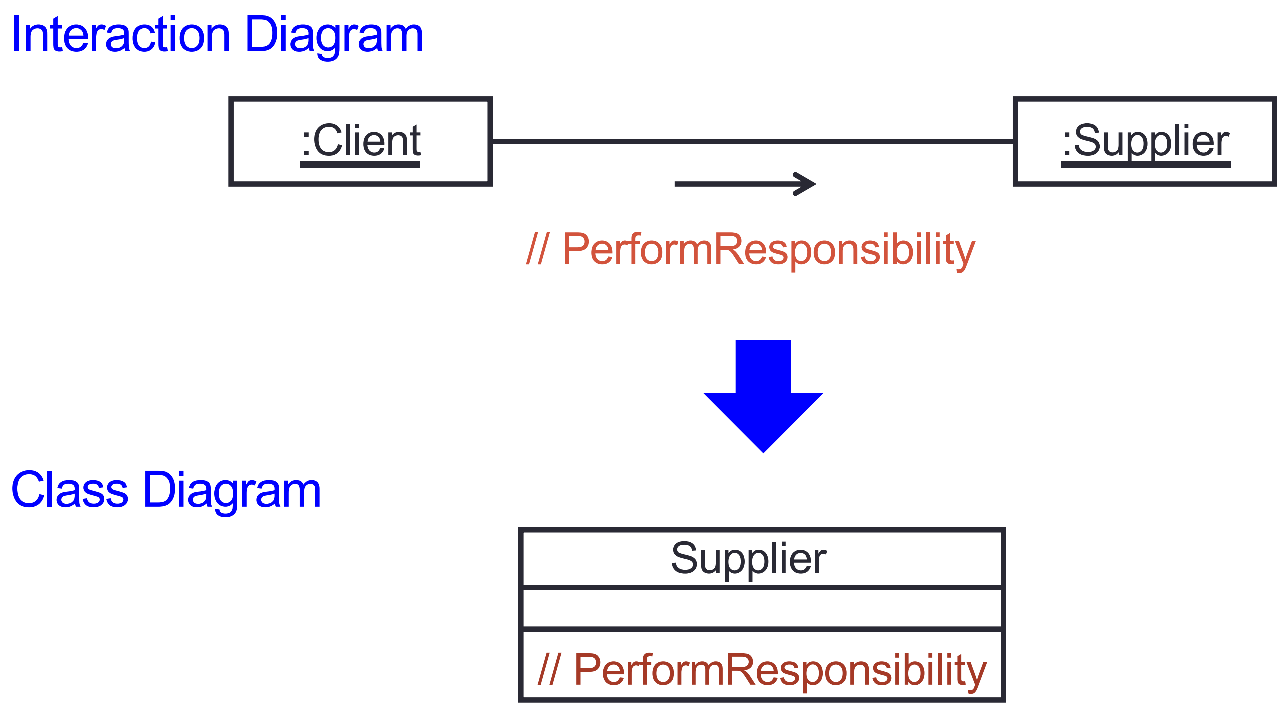
3.2.3. Sequence and Communication Diagram Comparison (2)

Sequence diagrams	Communication diagrams
▪ Show the explicit sequence of messages ▪ Show execution occurrence ▪ Better for visualizing overall flow ▪ Better for real-time specifications and for complex scenarios	▪ Show relationships in addition to interactions ▪ Better for visualizing patterns of communication ▪ Better for visualizing all of the effects on a given object ▪ Easier to use for brainstorming sessions

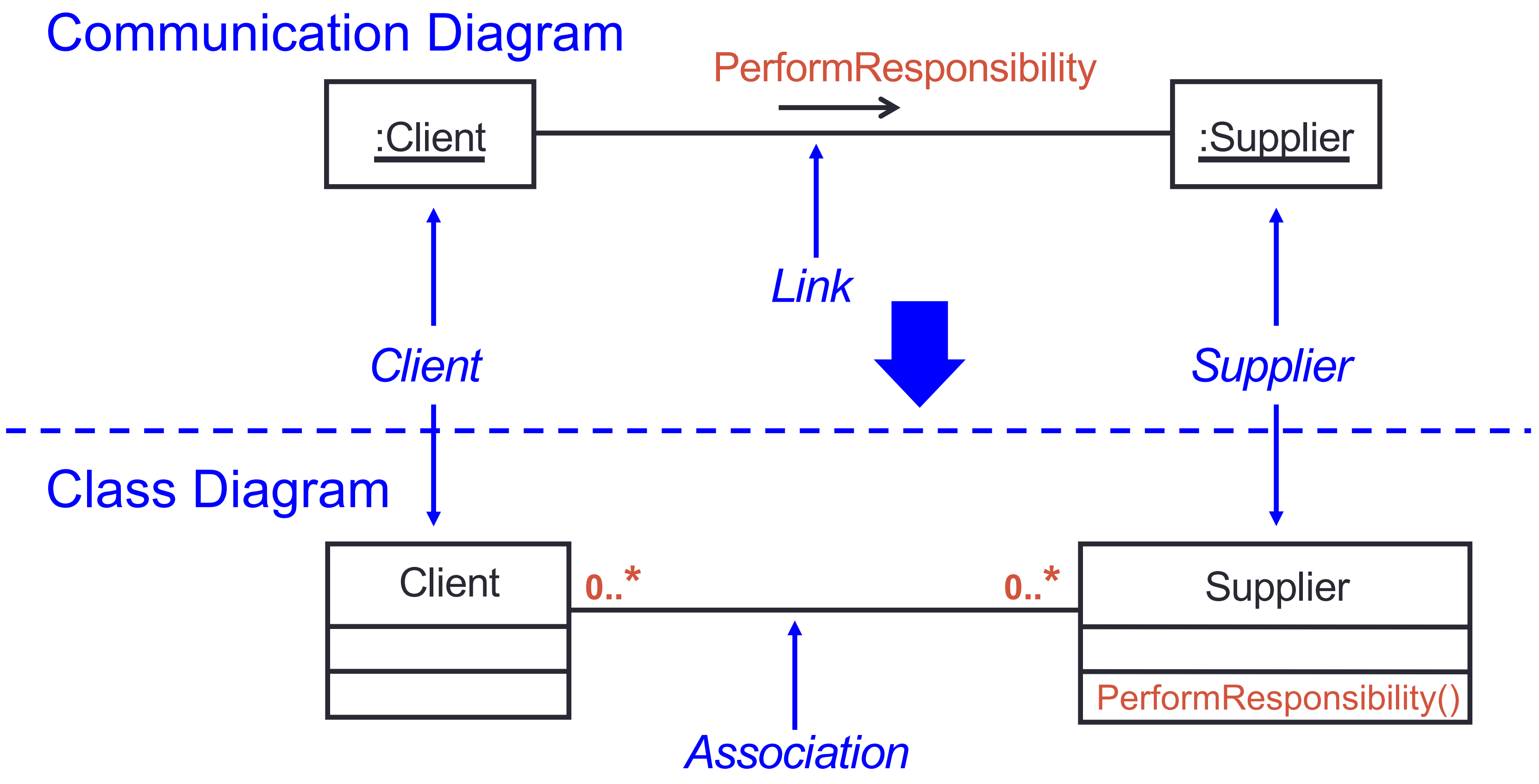
Content

Describe Responsibilities

- What are responsibilities?
- How do I find them?

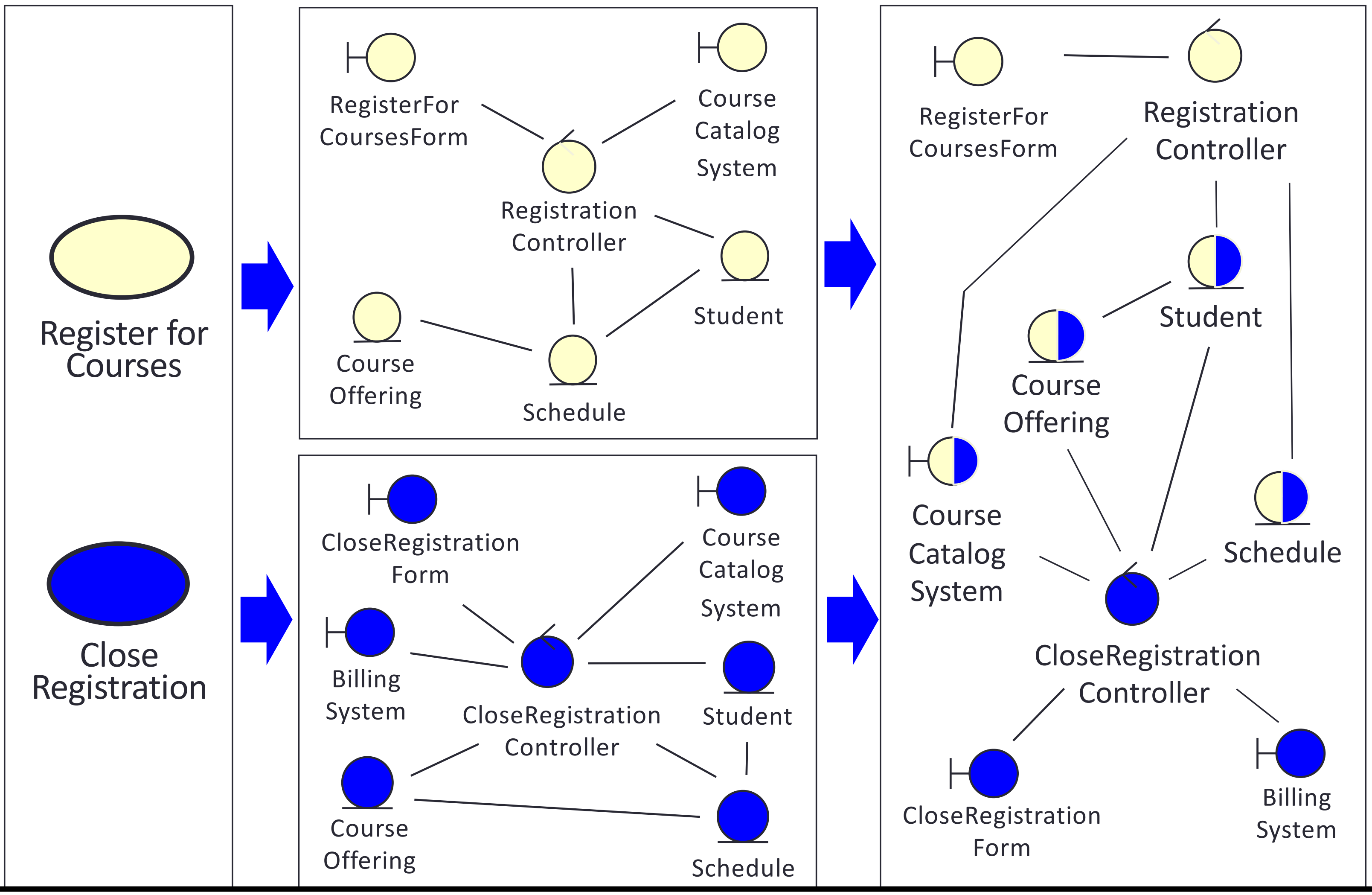


Finding Relationships



Relationship for every link!

Unify Analysis Classes



Reviewpoints: Analysis Classes

- Are the classes reasonable?
- Does the name of each class clearly reflect the role it plays?
- Does the class represent a single well-defined abstraction?
- Are all responsibilities functionally coupled?
- Does the class offer the required behavior?
- Are all specific requirements on the class addressed?

Review points: Message Design

- Have all the main and/or sub-flows been handled, including exceptional cases?
- Have all the required objects been found?
- Have all behaviors been unambiguously distributed to the participating objects?
- Have behaviors been distributed to the right objects?
- Where there are several Interaction diagrams, are their relationships clear and consistent?

Question?