UML Class Diagrams

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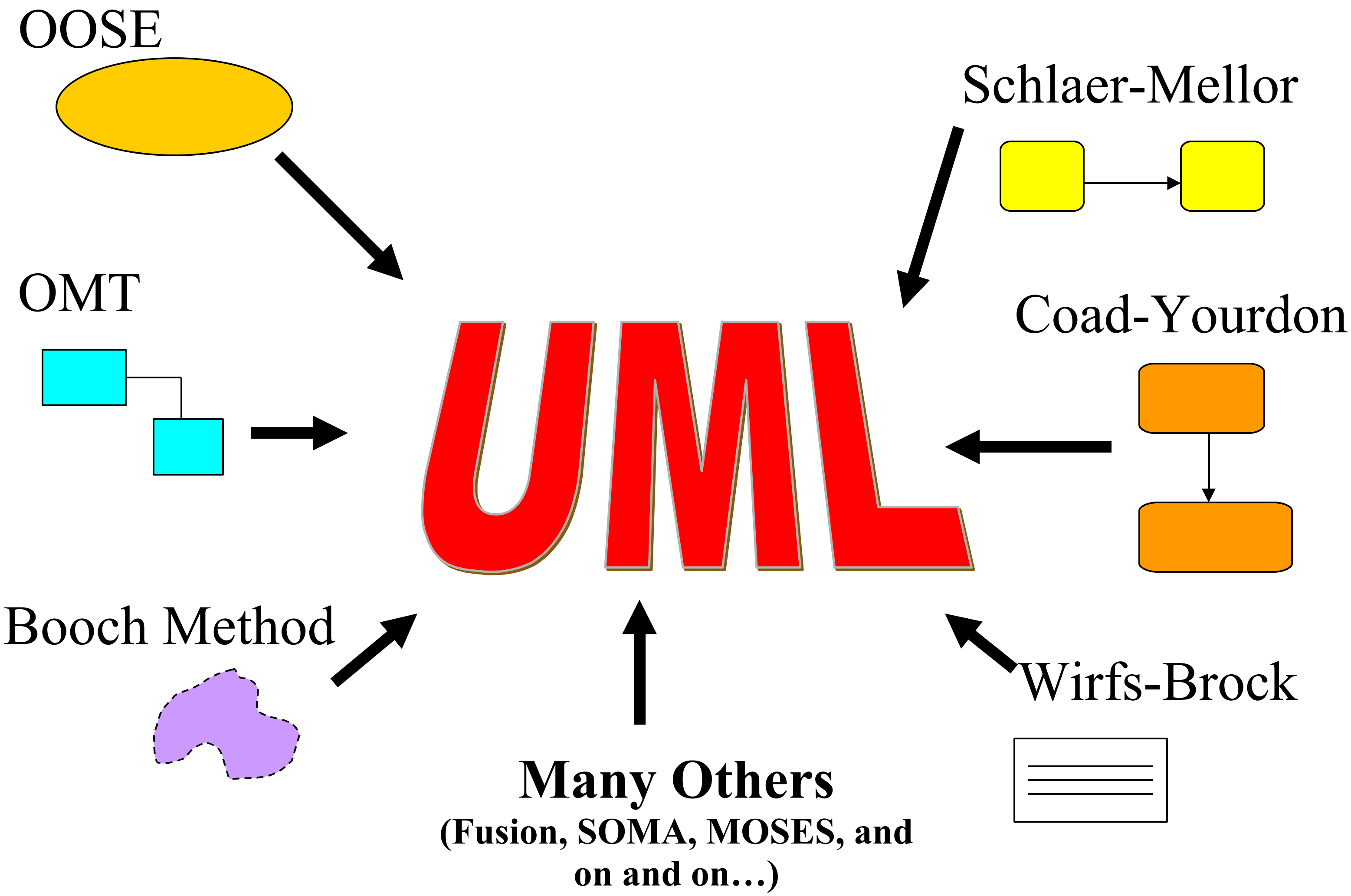
Outline

- ➔ UML Introduction
- Class Diagrams
- Java Mapping

What is UML?

- Unified Modeling Language (UML)
- Specification, Visualization, Construction, & Documentation of software systems.
- Precise and Unambiguous.
- It is *not* a software process.
  - Does have focus on software process.
- Extensible Language
  - Stereotypes, Constraints, Tagged Values

UML’s Roots



OOSE

OMT

Booch Method

UML

Schlaer-Mellor

Coad-Yourdon

Wirfs-Brock

Many Others

(Fusion, SOMA, MOSES, and on and on…)

Software Process

- UML and Process are loosely coupled
- UML customized to your process
  - Architecture-Centric
  - Use Case Driven
  - Iterative and Incremental
- Diagrams work together to form views.

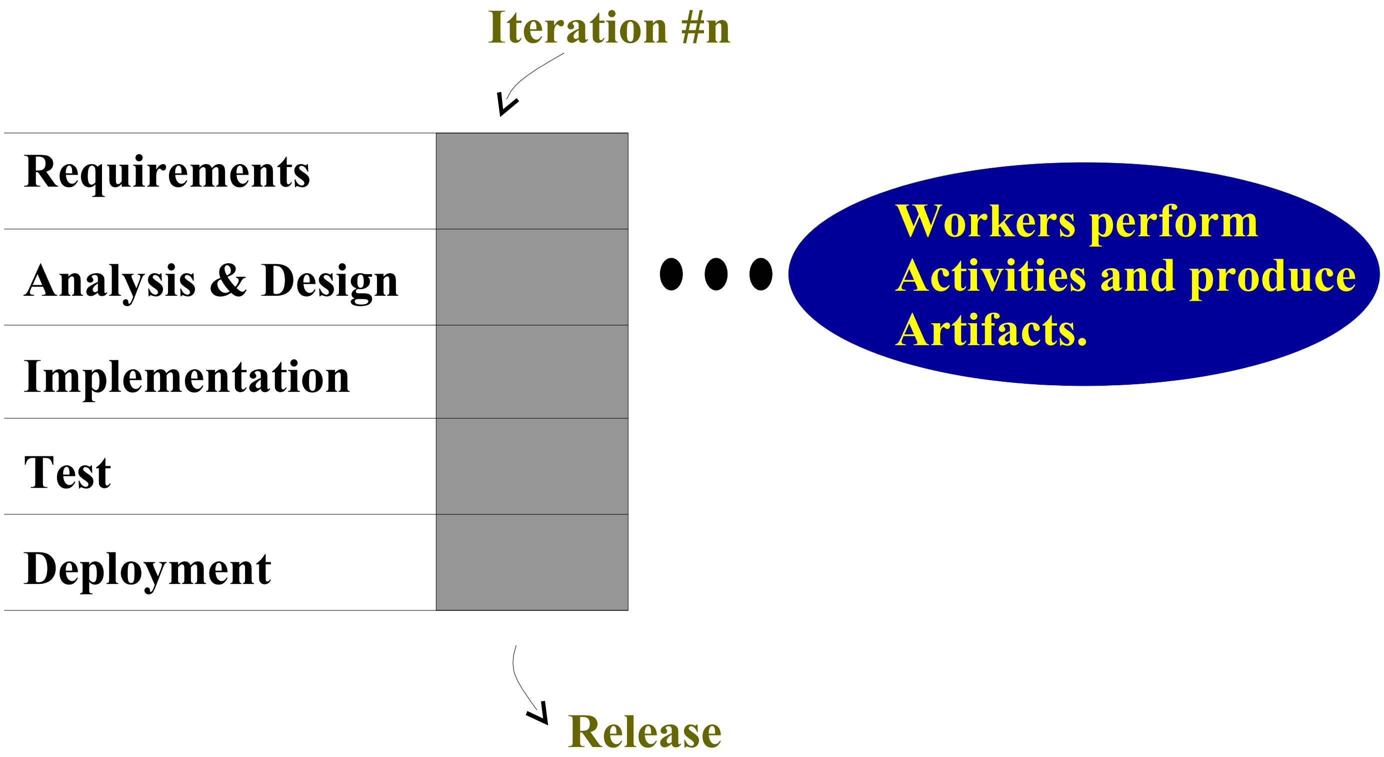
Process and UML

Requirements	
Analysis & Design	
Implementation	
Test	
Deployment	

• • •

Workers perform Activities and produce Artifacts.

Process and UML



Iteration #n

Requirements

Analysis & Design

Implementation

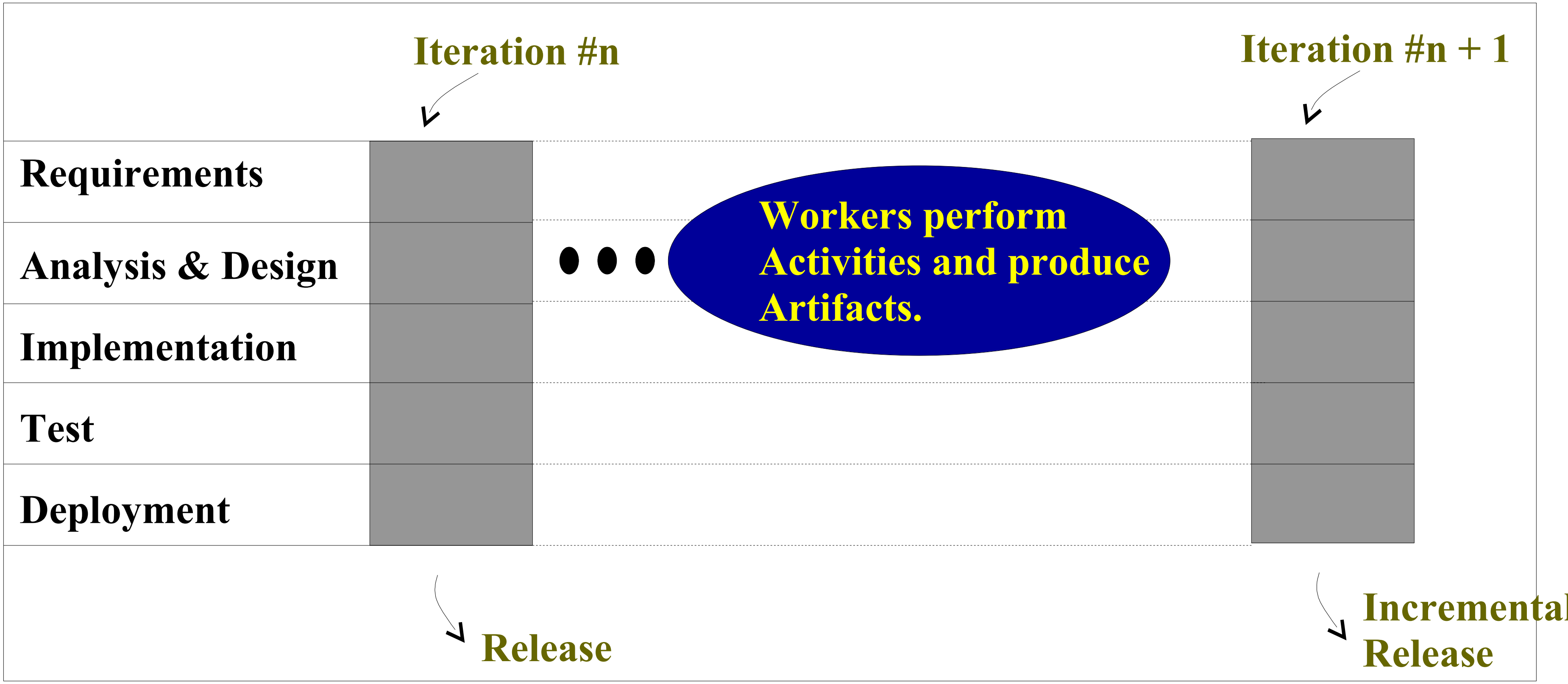
Test

Deployment

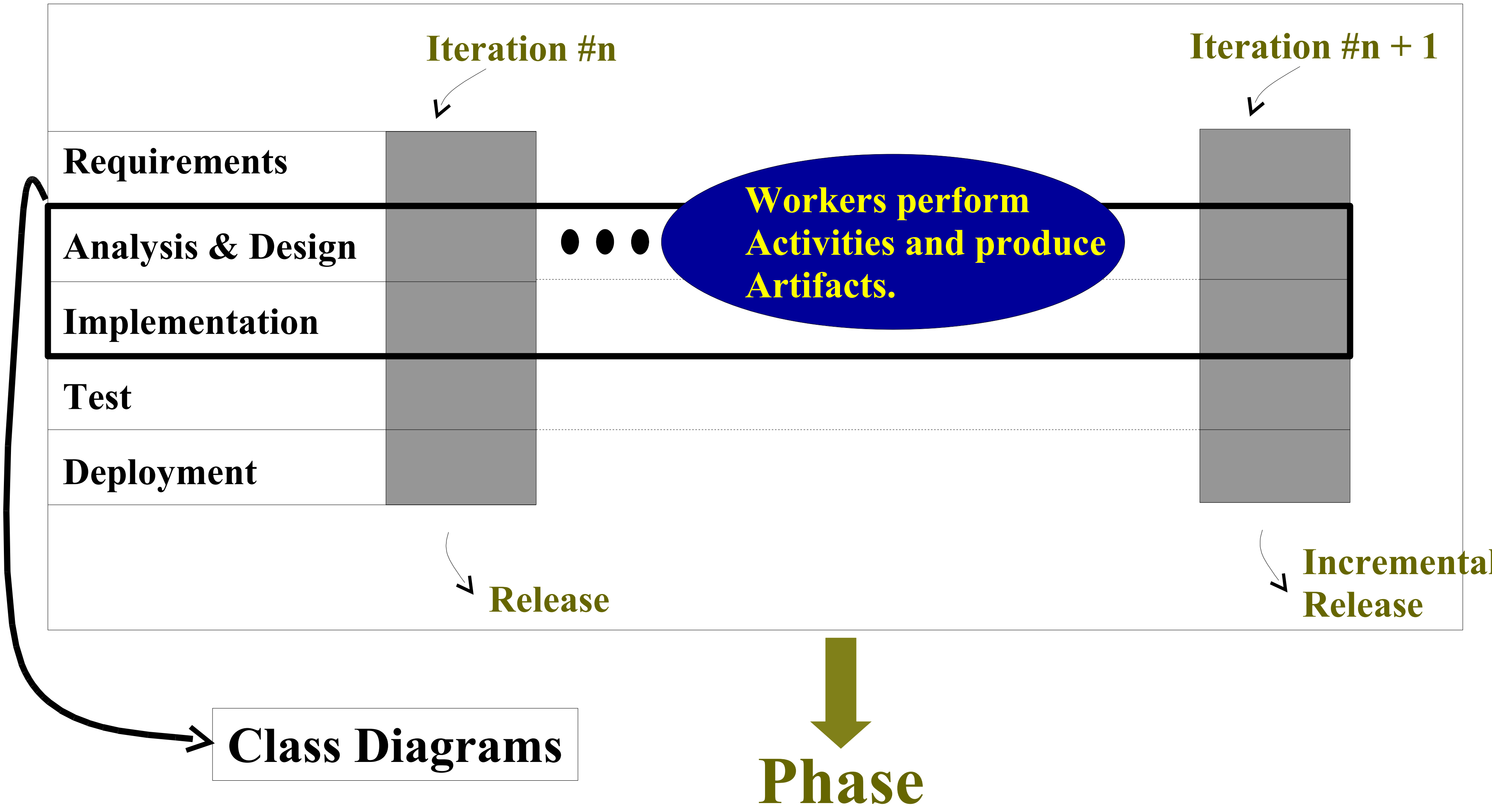
Release

Workers perform Activities and produce Artifacts.

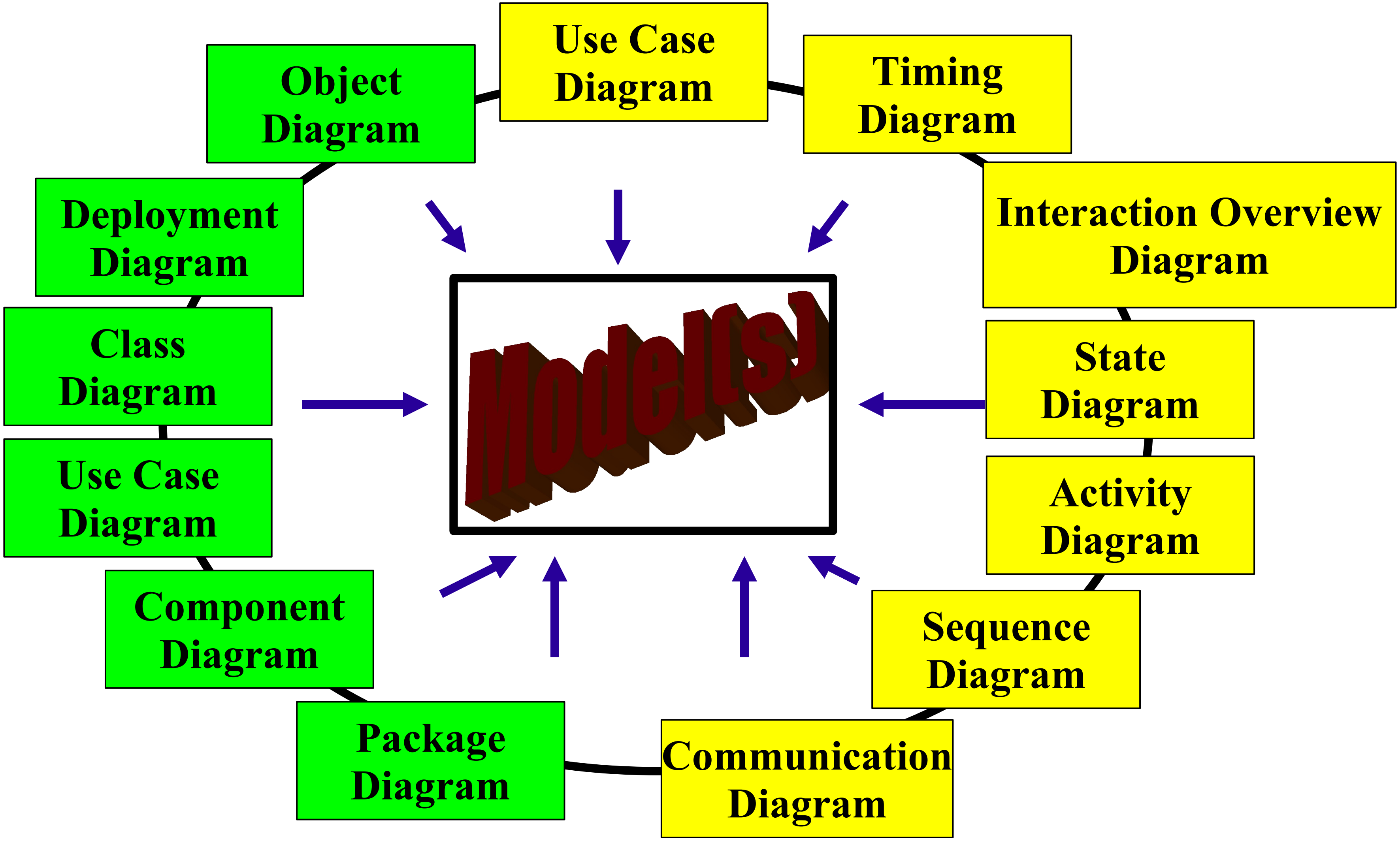
Process and UML



Process and UML



UML Diagrams



Use Case Diagram

Timing Diagram

Interaction Overview Diagram

State Diagram

Activity Diagram

Sequence Diagram

Communication Diagram

Package Diagram

Component Diagram

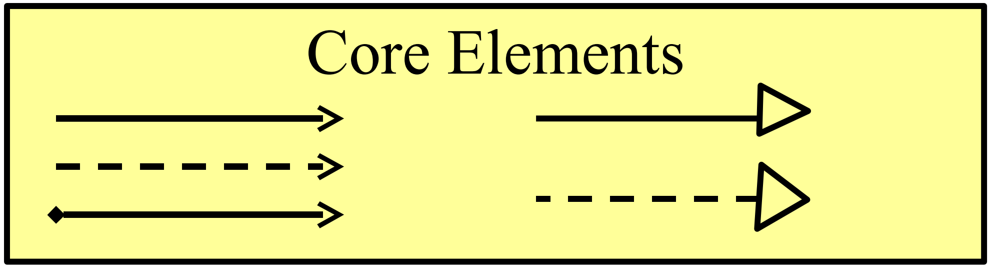
Use Case Diagram

Class Diagram

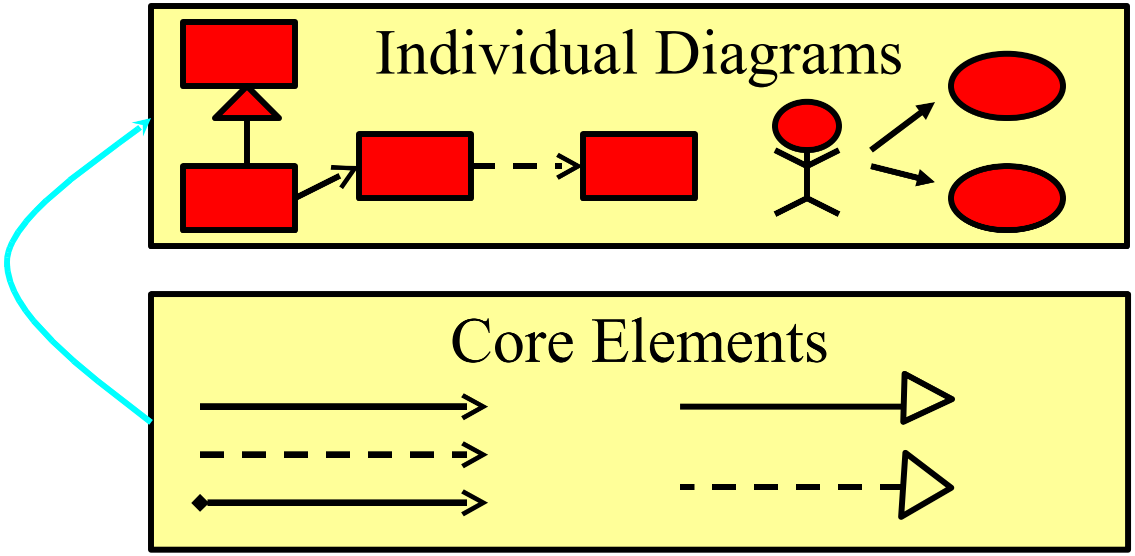
Deployment Diagram

Object Diagram

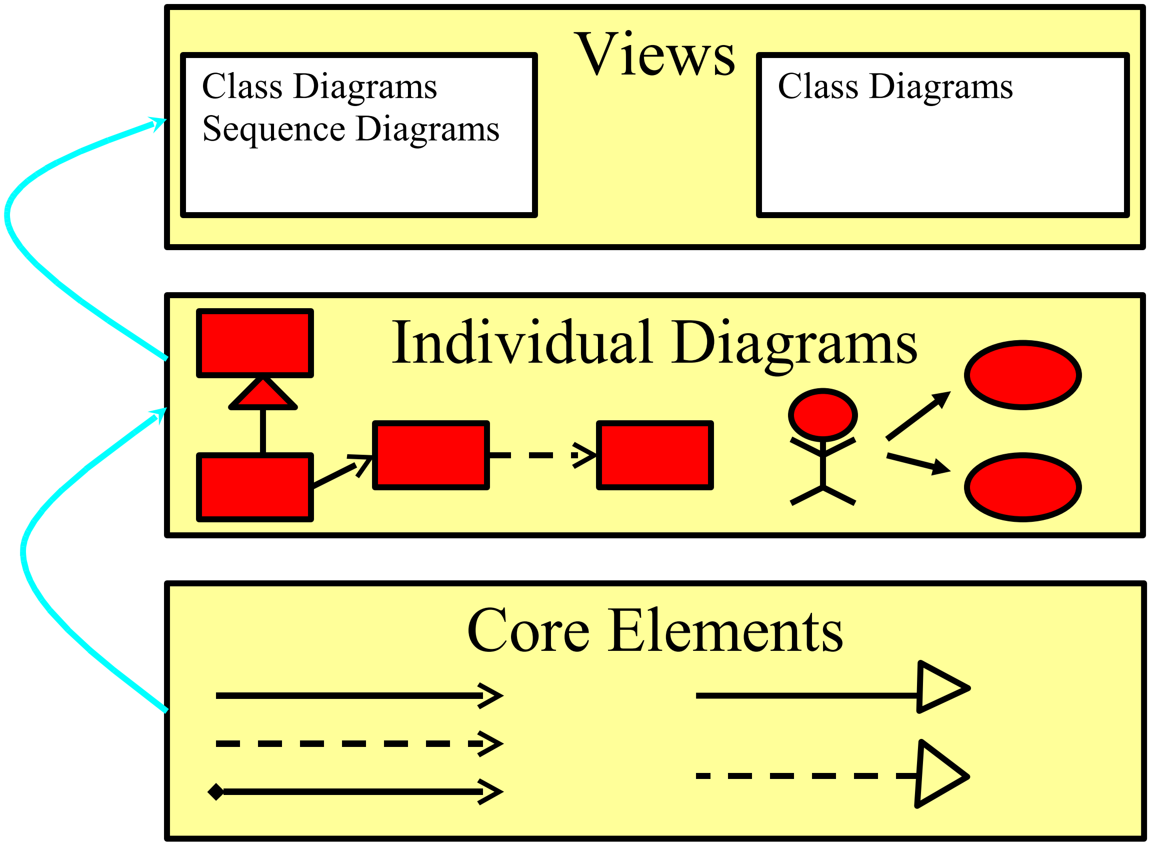
Core Elements



Diagrams



Views



Views

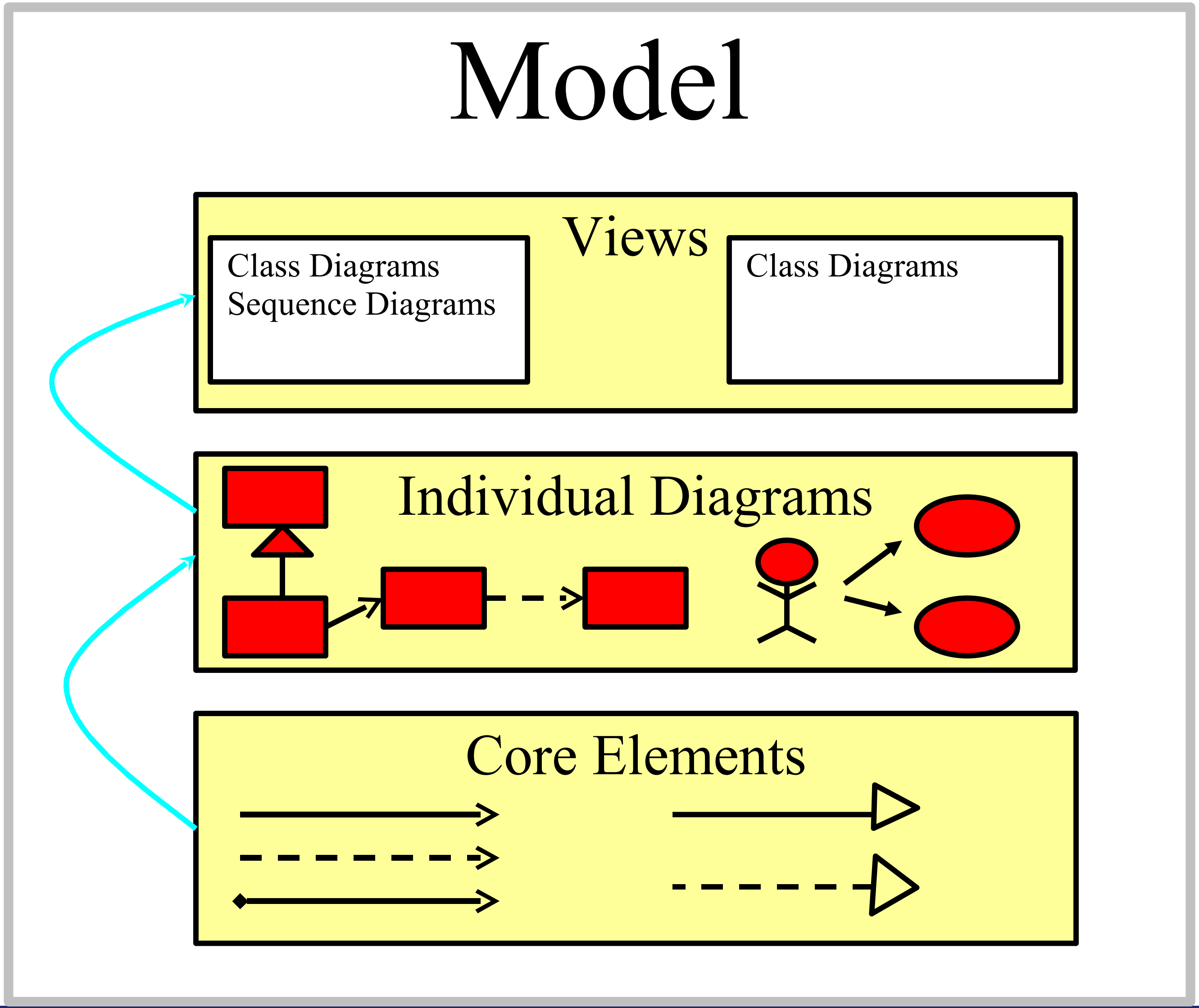
Class Diagrams
Sequence Diagrams

Class Diagrams

Individual Diagrams

Core Elements

View of Software



Model

Views

Class Diagrams
Sequence Diagrams

Class Diagrams

Individual Diagrams

Core Elements

Diagram Categories

- Behavioral
  - – Focus on the dynamic aspect of a system.
  - – Allow us to map out a system’s behavior.
- Structural
  - – Focus on the static aspects of a system.
  - – Allow us to focus on the system’s structure.

Diagram Composition

- Diagrams are composed of fundamental modeling elements.
- Fundamental elements are reused across many diagrams.
- Diagrams are used together to form complete models.
  - Different views of our system.

Outline

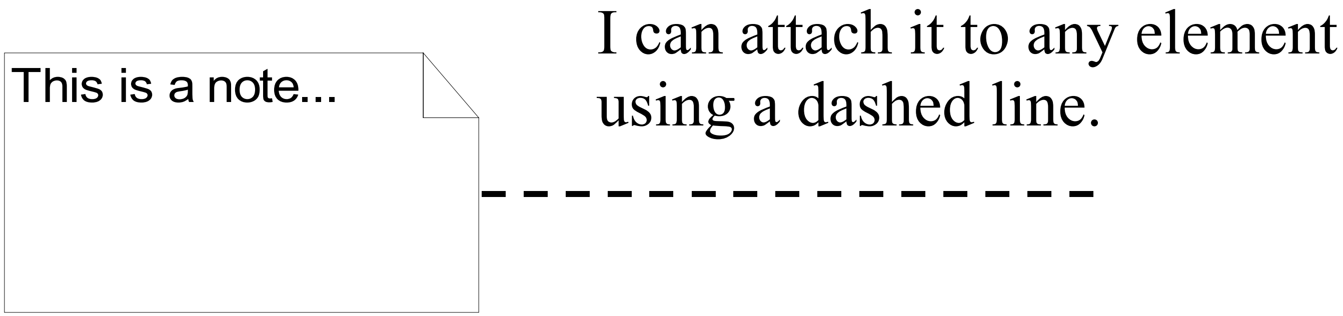
- UML Introduction

➔ Class Diagrams

- Java Mapping

Notes

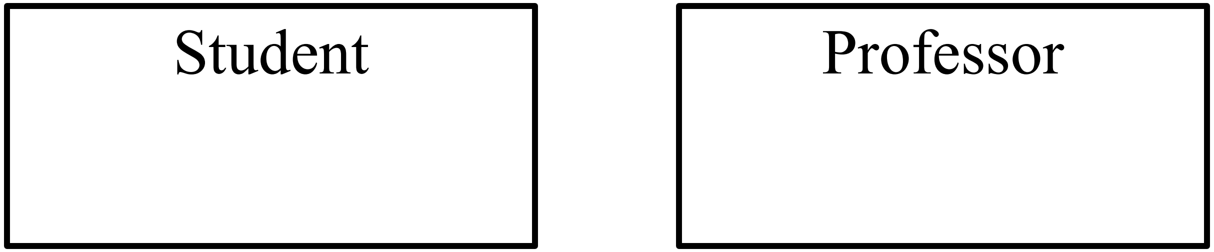
- Graphically represented as a dog-eared rectangle.
- Can contain a textual description which documents a portion of your model.
- Similar to a comment in code.
- Can be attached to any, or no, modeling element.



I can attach it to any element using a dashed line.

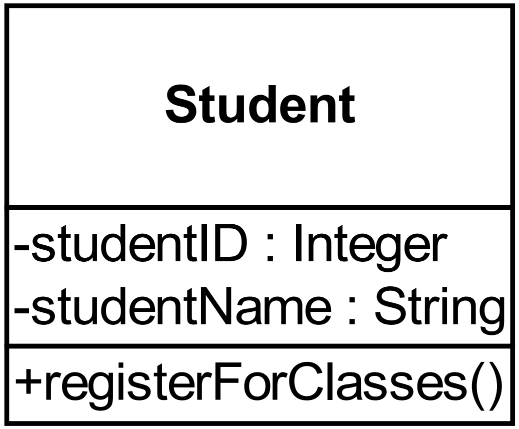
Class

- Represented with a rectangle.
- Must have a name.
- Can have optional compartments representing attributes and operations.



Class Compartments

- Attributes represent a property of an object.
- Operations represent the behavior of an object.

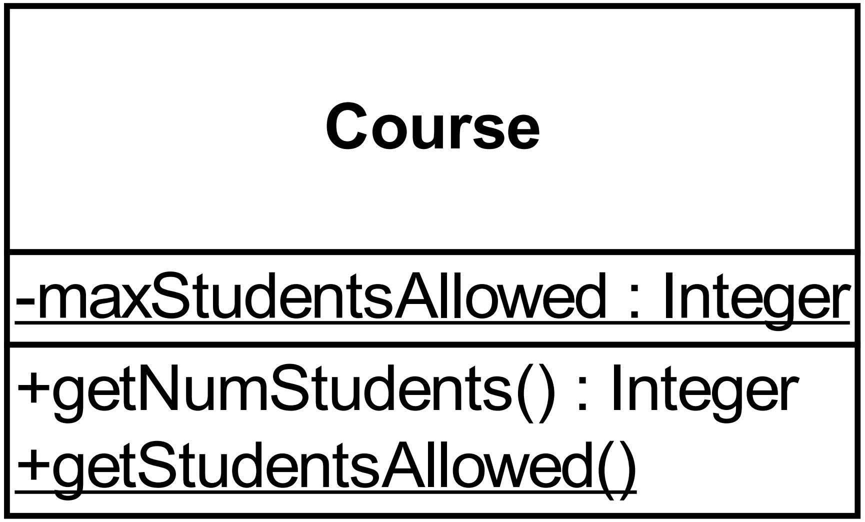


Student

-studentID : Integer
-studentName : String

+registerForClasses()

+ → public
# → protected
- → private



Course

-maxStudentsAllowed : Integer

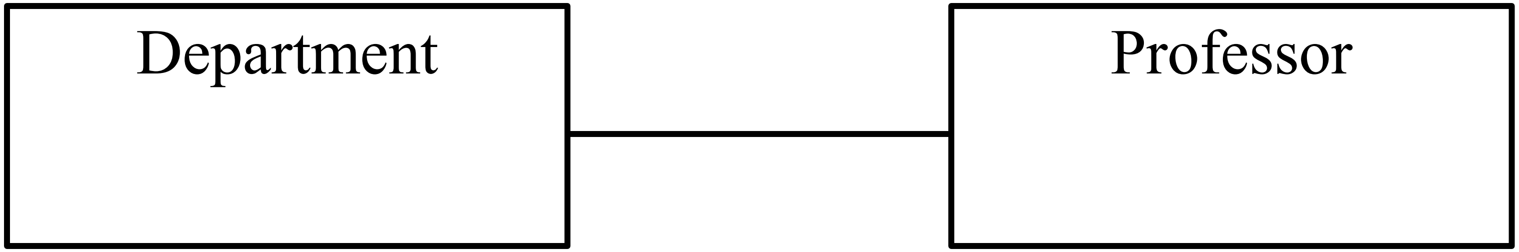
+getNumStudents() : Integer
+getStudentsAllowed()

Relationships

- Association
  - Aggregation
  - Composition
- Dependency
- Generalization
- Realization

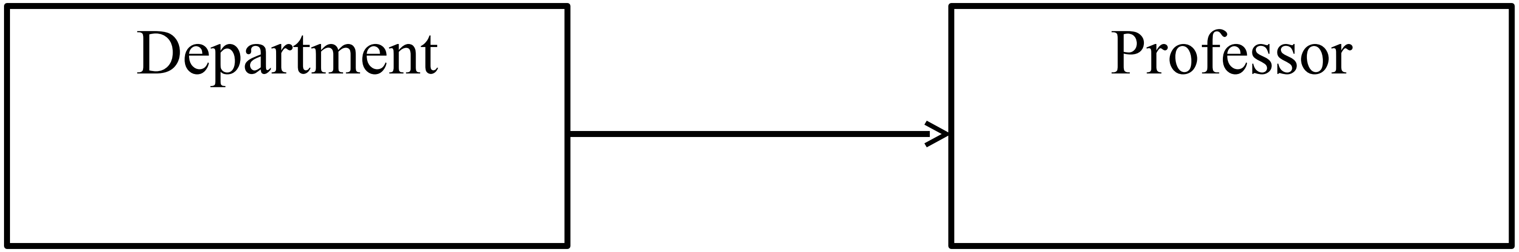
Association

- Structural relationship between two classes.
- “Uses a” relationship between two classes.
- Exists at the instance level.
- Classes at the same conceptual level.



Navigability

- Specification of object references in an associative type of relationship.
- Bi-Directional and Uni-Directional



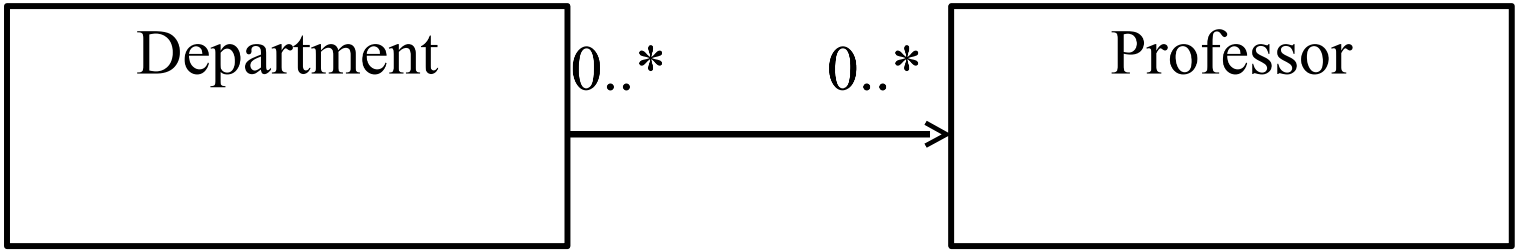
Department can call methods on Professor, but Professor cannot call methods on Department.

Multiplicity

- Specifies number of instances one class has of another.

A Department may consist of many Professors.

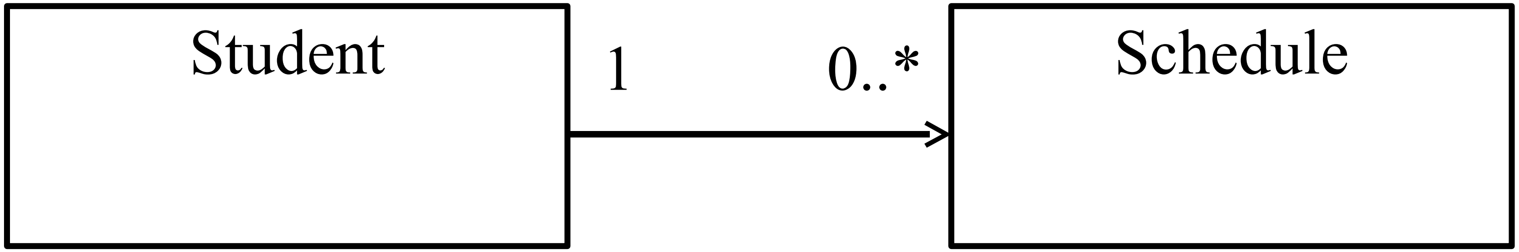
A Professor can belong to many Departments.



Department 0..* 0..* Professor

A Schedule belongs to one and only one Student

A Student can have many schedules



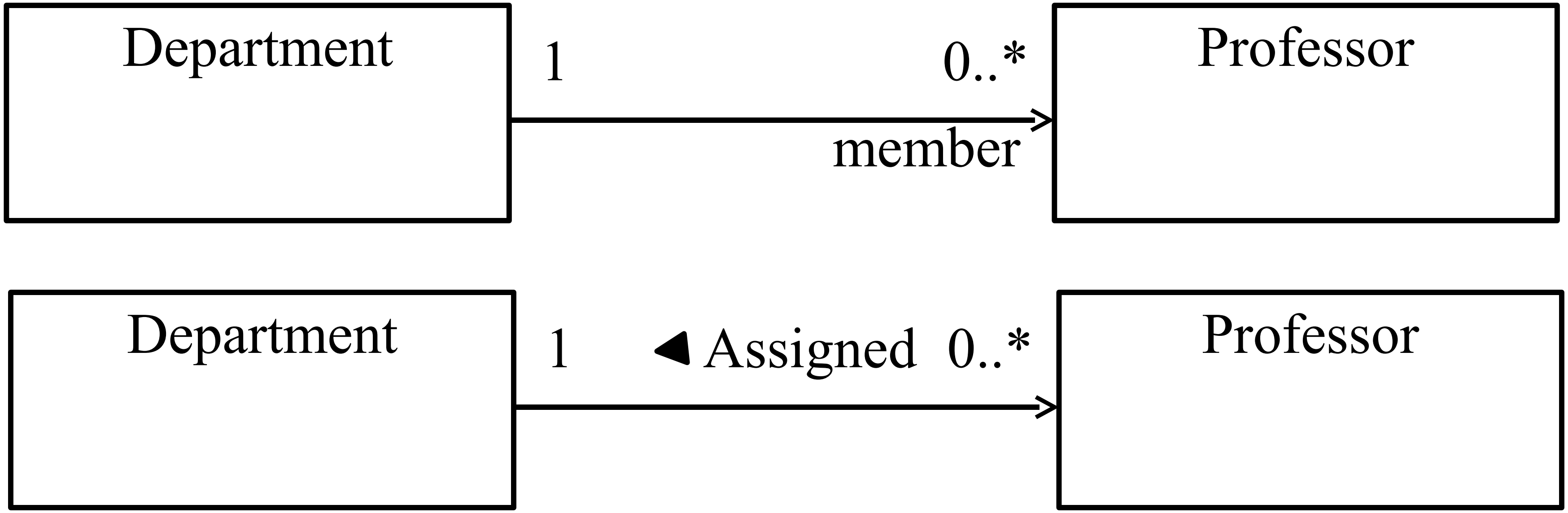
Student 1 0..* Schedule

Multiplicity

• Exactly One	1
• Zero or More	0..*
• Zero or One	0..1
• One or More	1..*
• Range	2..4

Names and Roles

- Associations are typically assigned names or roles to help identify the semantic relationship.
- Roles map to the variable names in code.

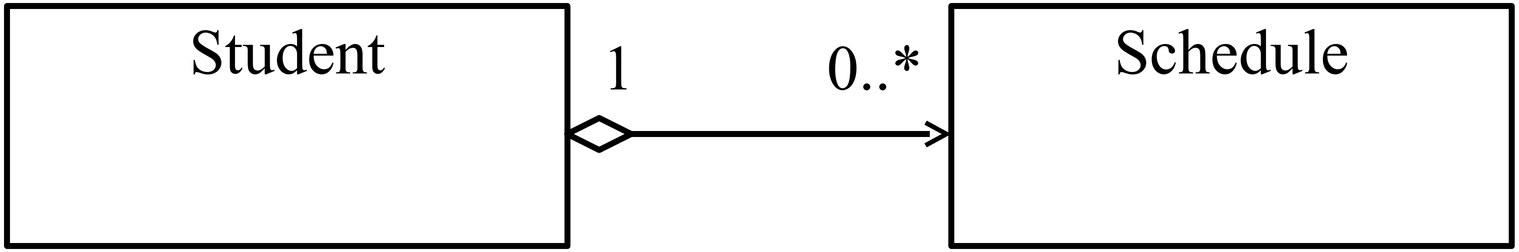


Aggregation

"Has a" relationship between two classes.

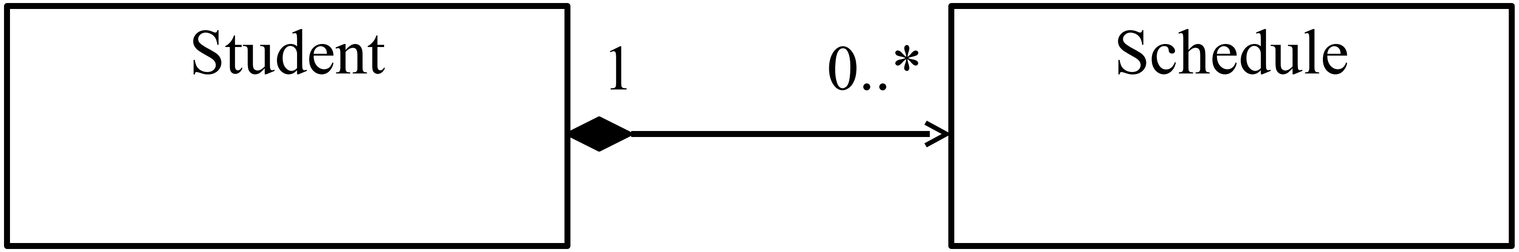
Exists at the instance level.

Whole/Part relationship modeling different conceptual levels.



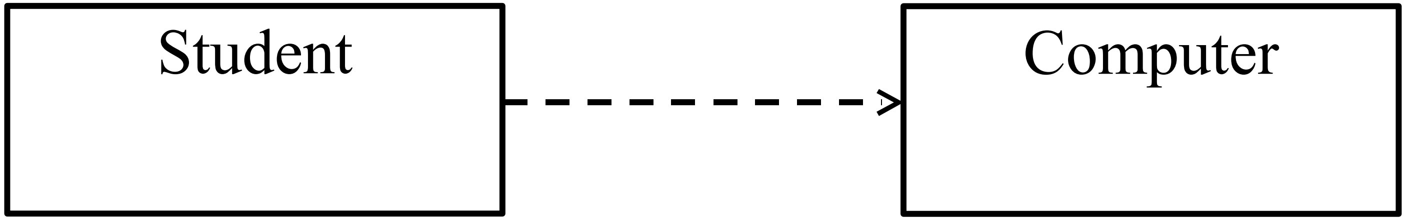
Composition

- “Has a” relationship between two classes.
- Exists at the instance level.
- Whole/Part relationship modeling different conceptual levels.
- Whole make “lifetime decision” of part.
- Part is not shared across instances.



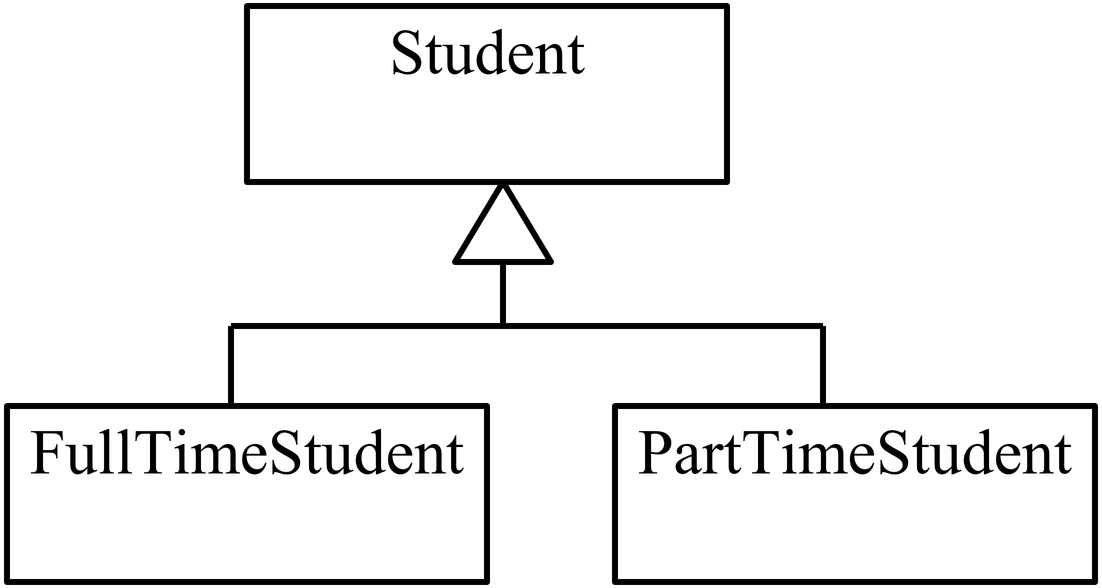
Dependency

- “Uses a” relationship between two classes.
- Local, Global, or Parameter scope to an object.
- Always a 1:1 relationship.



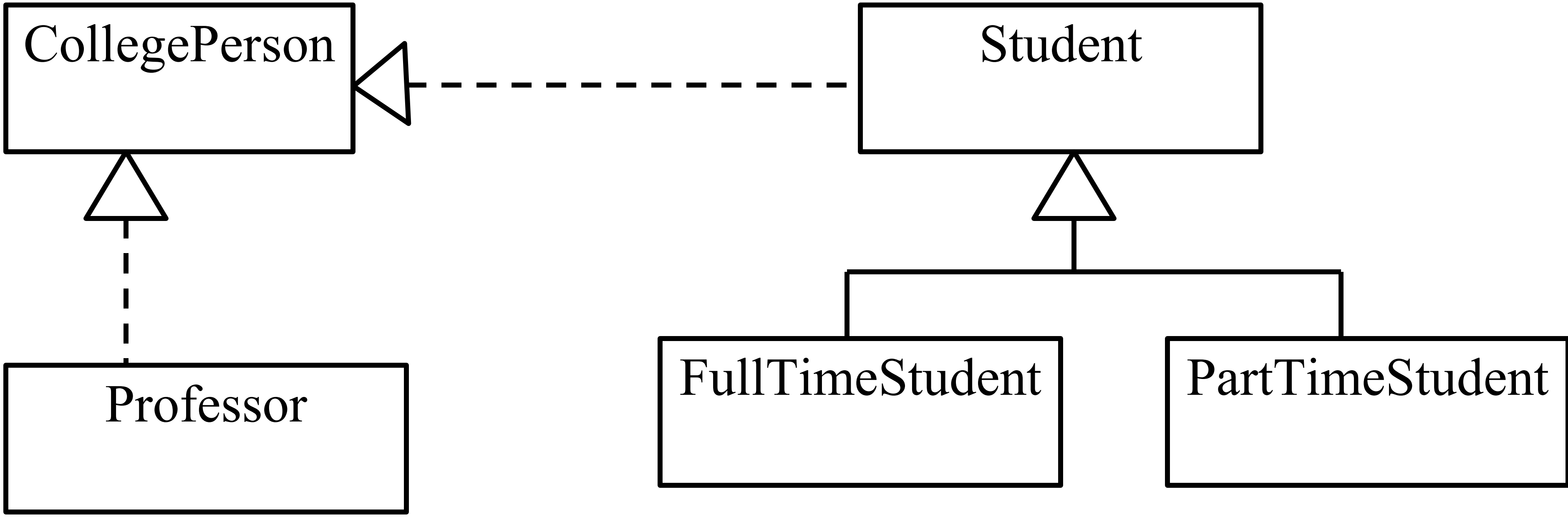
Generalization

- Relationship between a general and specific type of entity.
- “Is a special kind of” relationship.



Realization

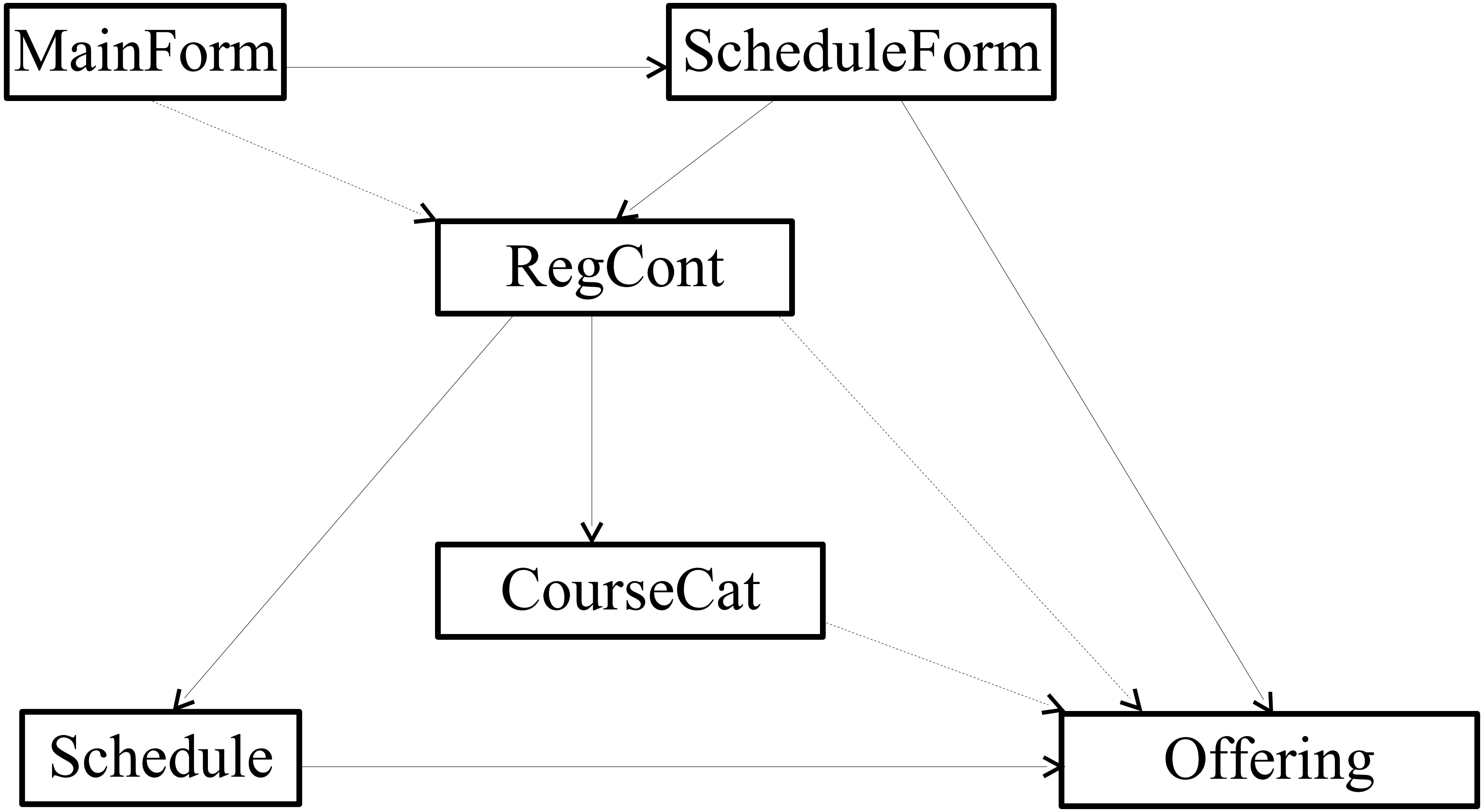
- Specification of a contract in one entity that is carried out by another entity.
- Used to model interface inheritance.



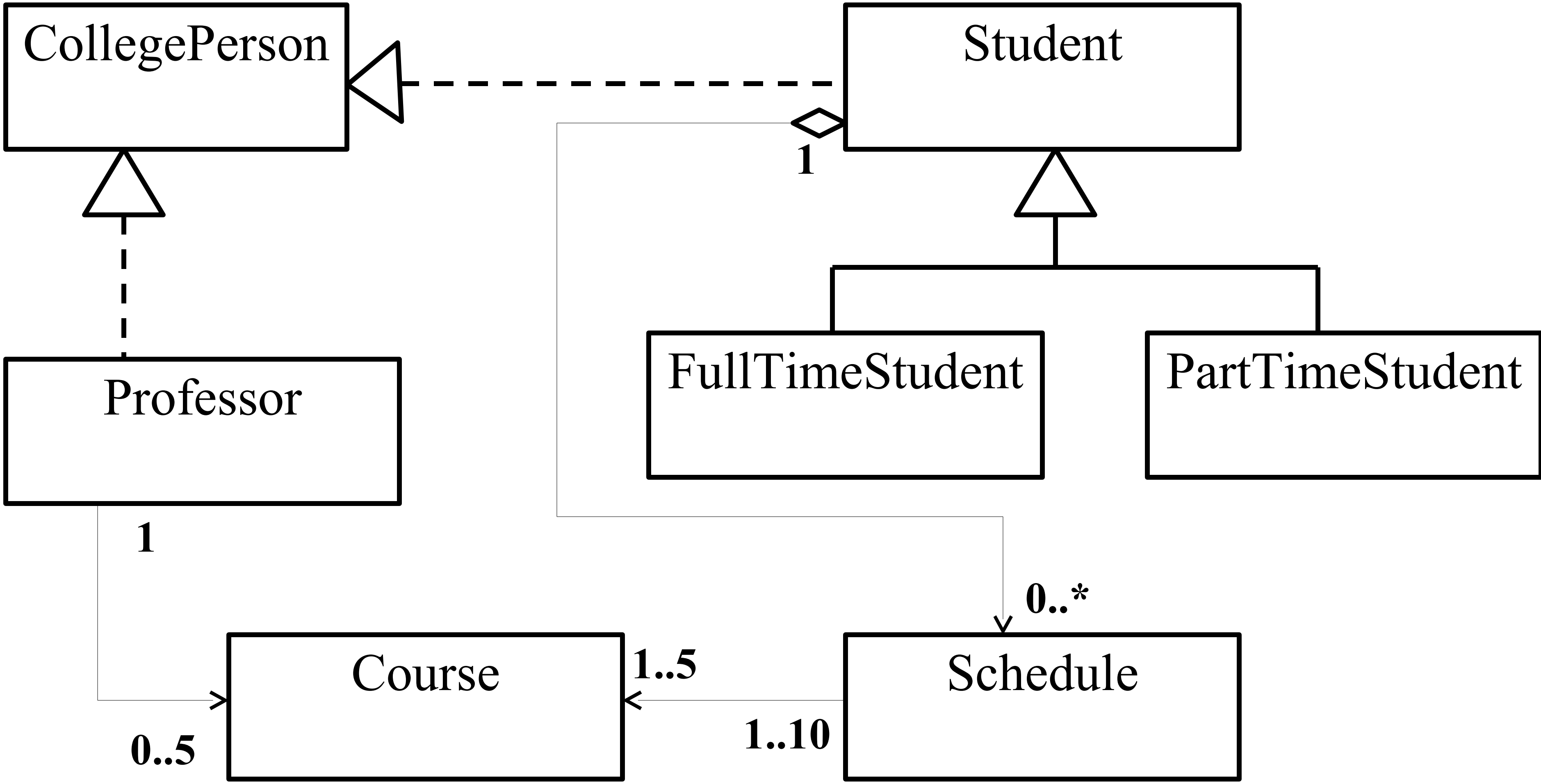
Common Class Diagrams

- Diagrams to depict the classes responsible for fulfilling responsibilities of a Use Case.
- Diagrams to illustrate the relationships between packages in our system.
- Diagrams to document the structural relationships that exist amongst classes contained in the packages.
- Any other class diagram to satisfy need.

Register for Courses VOPC



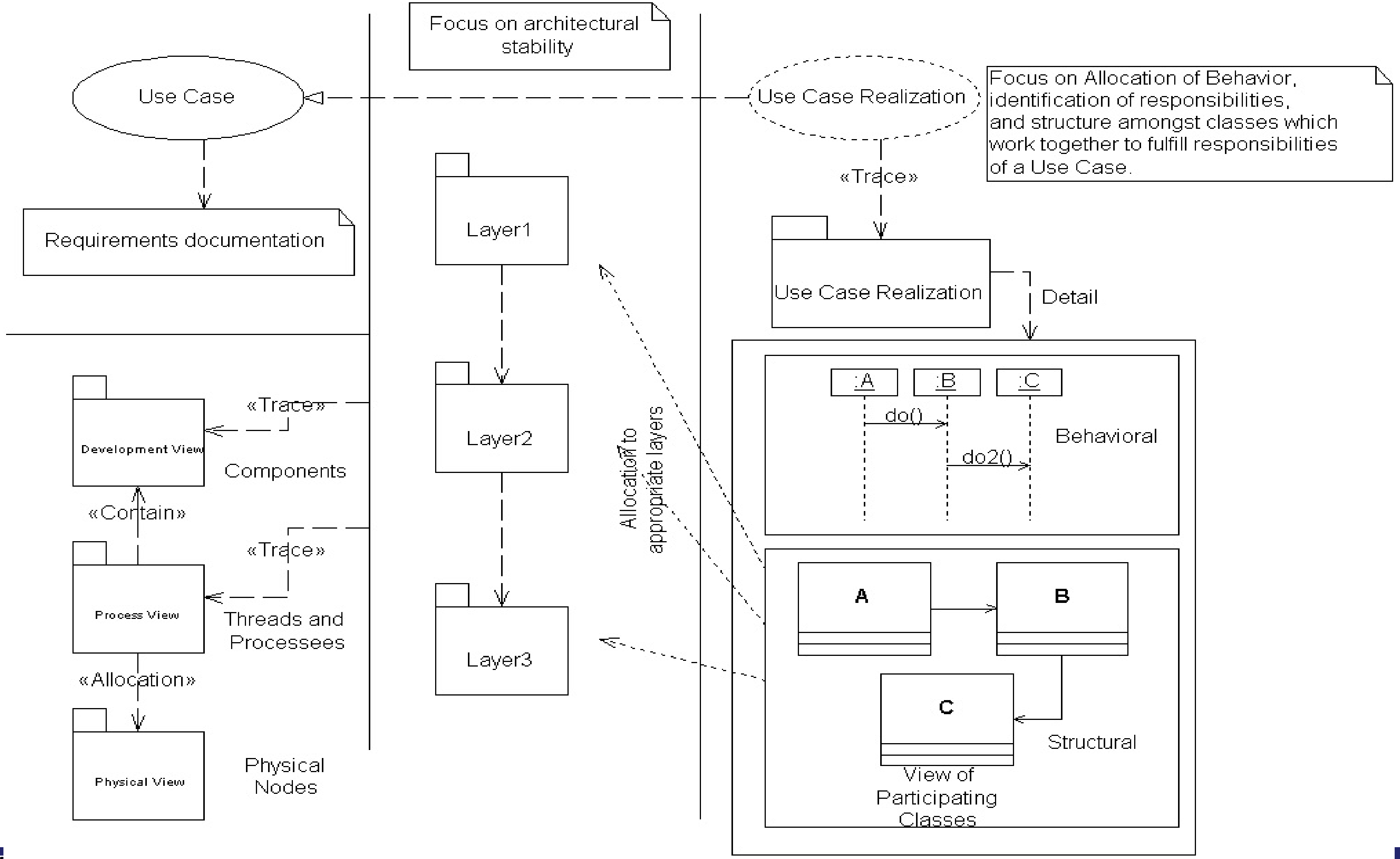
Class Diagram



Design View

- Class diagrams
  - Classes and Packages
- Interaction diagrams
- Software Architecture Document
- Use Case Realizations
  - Translation of Use Case Flow of Events to collaborations amongst objects.
  - Consists of Interaction diagrams and View of Participating Classes (VOPC).

The Lifecycle



Focus on architectural stability

Focus on Allocation of Behavior, identification of responsibilities, and structure amongst classes which work together to fulfill responsibilities of a Use Case.

Use Case

Requirements documentation

Use Case Realization

«Trace»

Use Case Realization

Detail

Layer1

Layer2

Layer3

Allocation to appropriate layers

:A

:B

:C

do()

do2()

Behavioral

A

B

C

Structural

View of Participating Classes

Development View

«Trace»

Components

«Contain»

Process View

«Trace»

Threads and Processees

«Allocation»

Physical View

Physical Nodes

Outline

- UML Introduction
- Class Diagrams

➔ Java Mapping

Language Mappings

- UML maps very well to Java.
- Modeling tools engineer code.
  - Forward engineering.
  - Reverse engineering.
- UML Profiles define concrete mappings.
  - See www.omg.org for Java Profiles.

UML and Java Reference Card