

CISC 3115 TY11

Relationships of Classes: Part I

Hui Chen

Department of Computer & Information Science

CUNY Brooklyn College

Outline

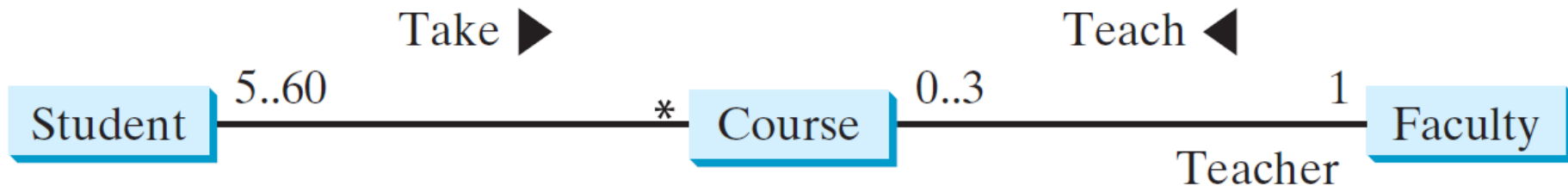
- Discussed
 - Concepts of two programming paradigms
 - Procedural and Object-Oriented
 - Design classes for problem solving
 - Think in terms of class
- Discover relationship of classes
 - Association
 - Aggregation
 - Composition (to be revisited in Chapter 13)
 - Inheritance (to be discussed in Chapter 11)

Relationship of Classes

- To analyze the problem and design classes, we need to explore the relationships among classes (and objects of the classes).
 - Association
 - Aggregation
 - Composition (to be revisited in Chapter 13)
 - Inheritance (to be discussed in Chapter 11)

Association

- A general binary relationship that describes an activity between two classes
- UML diagram
 - Consider 3 classes, Student, Course, and Faculty



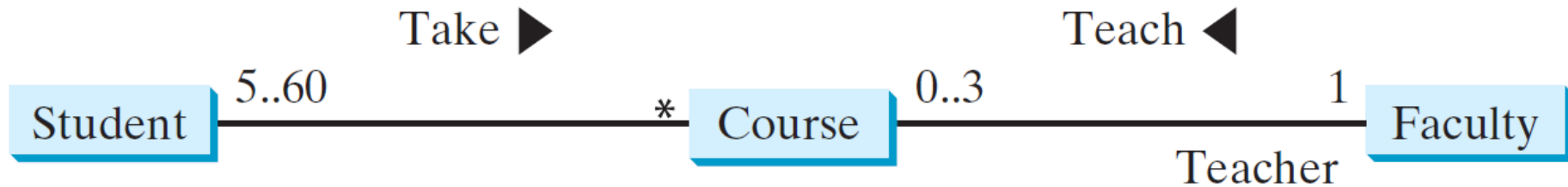
Association: UML notation



- Role
 - Take, Teach; arrow indicates “subject” & “object” in English
- Multiplicity
 - A course has 5 ~ 60 students (5..60)
 - A student takes any number of courses (*)
 - A faculty teaches 0 ~ 3 courses (0..3)
 - A course has 1 faculty (1)

Class Representation: Association

- Using data fields and methods



```
public class Student {
    private Course[] courseList;
    public void addCourse(Course c) {
    }
}
```

```
public class Course {
    private Student[] studentList;
    private Faculty faculty;
    public void addStudent(Student s) {
    }
    public void setFaculty(Faculty f) {
    }
}
```

```
public class Faculty {
    private Course[] courseList;
    public void addCourse(Course c) {
    }
}
```

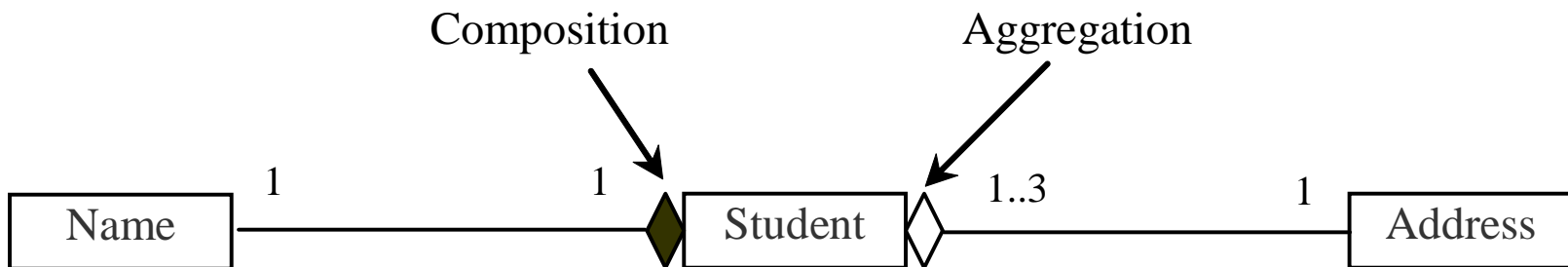
Aggregation

- A special form of association that represents an ownership relationship between two objects
 - It models a has-a relationship
 - Owner object/class: aggregating object/class
 - Subject object/class: aggregated object/class
- UML diagram
 - Consider 2 classes, Student and Address



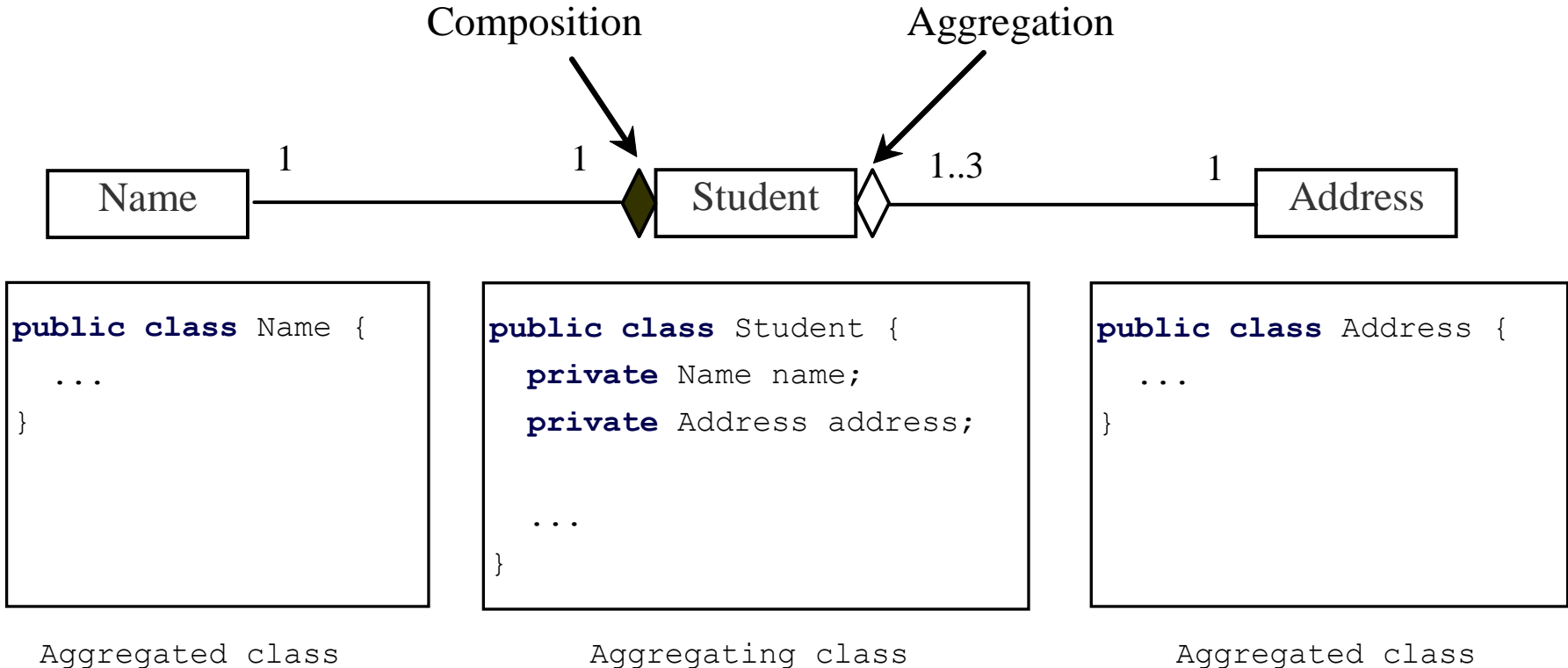
Composition

- A special case of the aggregation relationship where the existence of the aggregated object is dependent on the aggregating object (i.e., aggregated object does not exist by itself)
- UML diagram
 - Consider 3 classes, Name, Student, and Address



Class Representation: Aggregation and Composition

- An aggregation relationship is usually represented as a data field in the aggregating class.



Aggregation or Composition

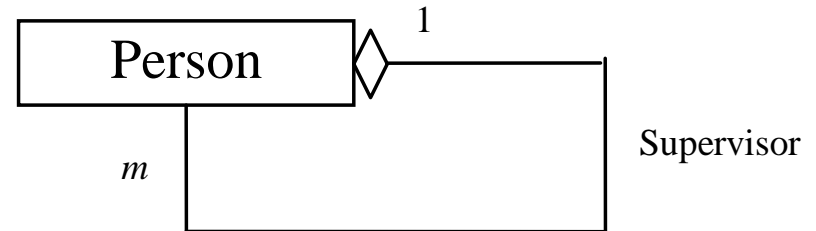
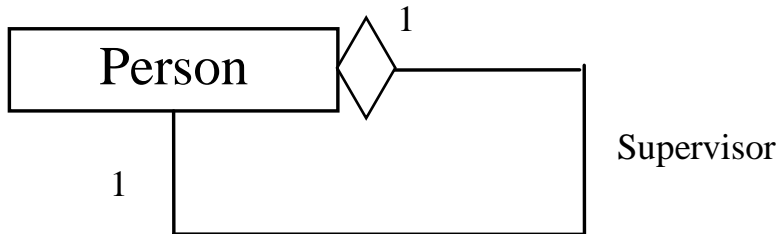
- Aggregation and composition relationships are represented using classes in similar ways, many texts do not differentiate them and call both compositions.

Aggregation Between Same Class

- Aggregation may exist between objects of the same class.
- Example
 - A person may have a supervisor who is also a person.

Self-Aggregation: UML Diagram and Class Representation

- UML diagram



- Class representation

```
public class Person {  
    // The type for the data is the class itself  
    private Person supervisor;  
    ...  
}
```

```
public class Person {  
    // The type for the data is the class itself  
    private Person[] supervisors;  
    ...  
}
```

Example: The Course Class

Course
<pre>-courseName: String -students: String[] -numberOfStudents: int</pre>
<pre>+Course(courseName: String) +getCourseName(): String +addStudent(student: String): void +dropStudent(student: String): void +getStudents(): String[] +getNumberOfStudents(): int</pre>

The name of the course.

An array to store the students for the course.

The number of students (default: 0).

Creates a course with the specified name.

Returns the course name.

Adds a new student to the course.

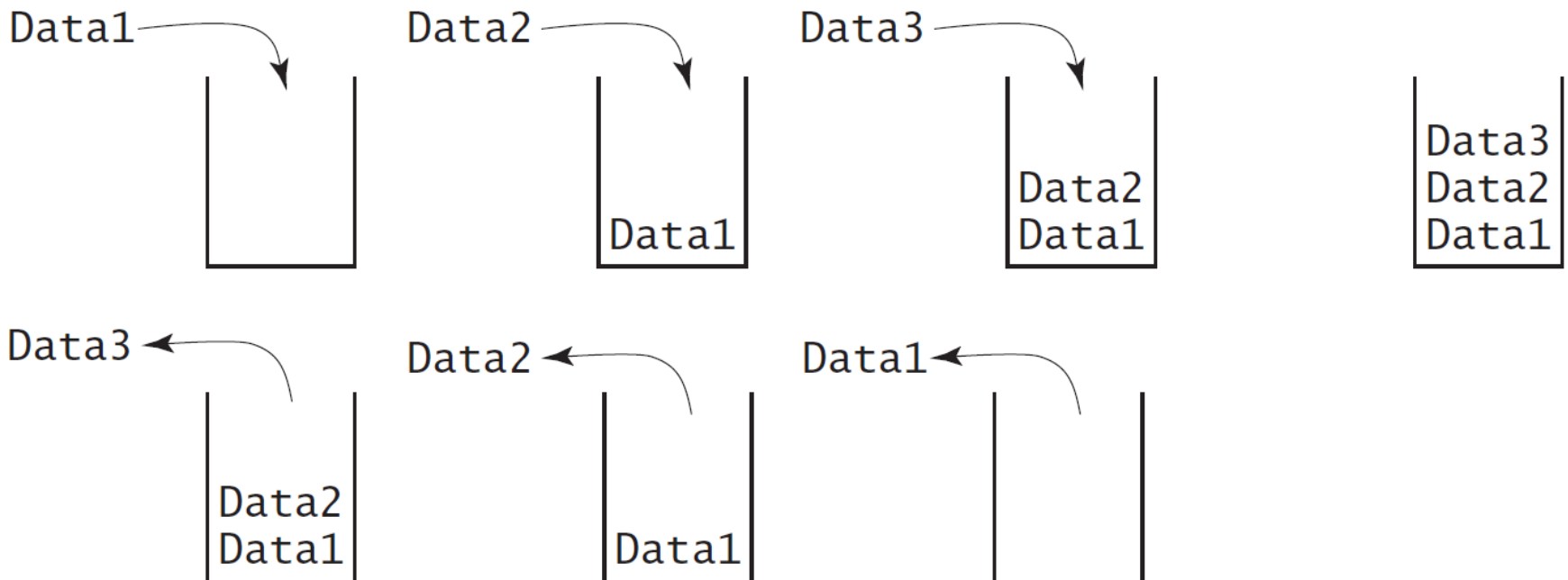
Drops a student from the course.

Returns the students in the course.

Returns the number of students in the course.

Example: Designing The StackOfInteger Class

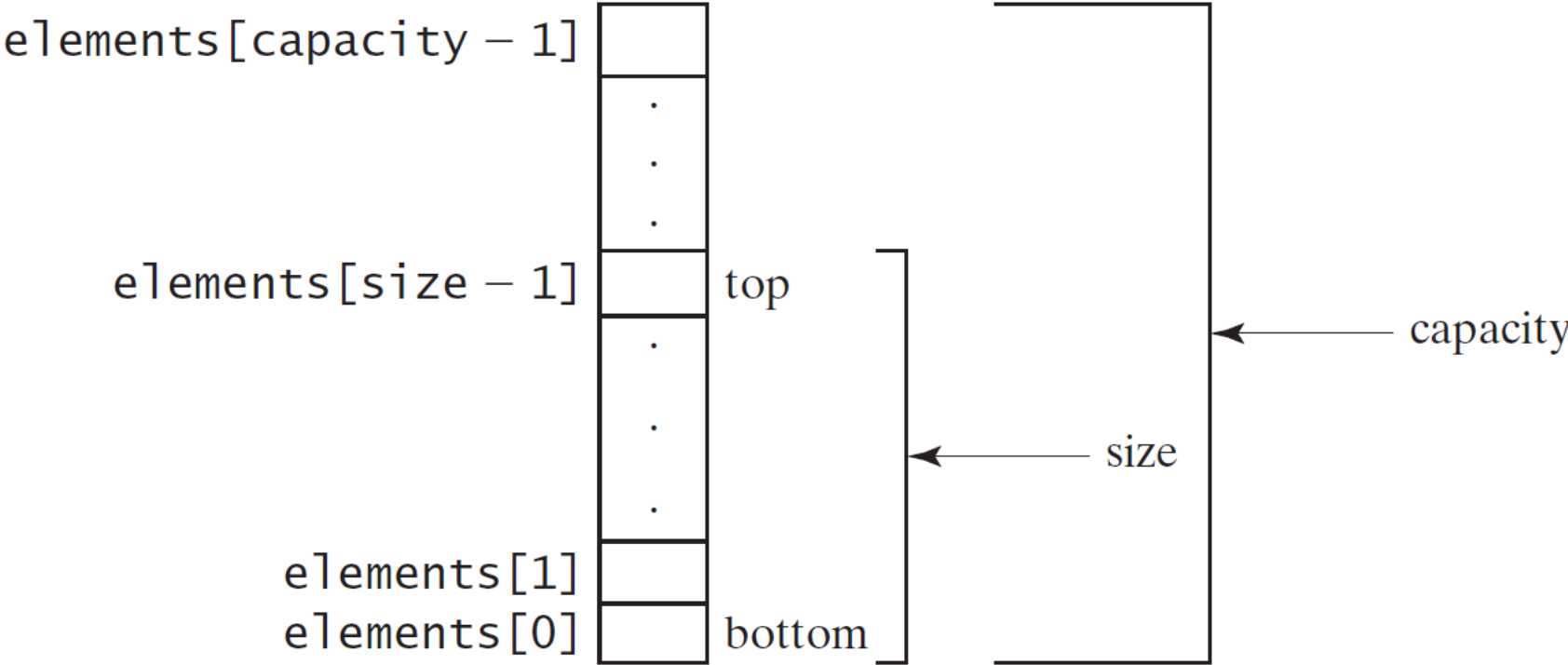
- A stack is a data structure that holds data in a last-in, first-out fashion



Example: The StackOfInteger Class

StackOfIntegers	
-elements: int[]	An array to store integers in the stack.
-size: int	The number of integers in the stack.
+StackOfIntegers()	Constructs an empty stack with a default capacity of 16.
+StackOfIntegers(capacity: int)	Constructs an empty stack with a specified capacity.
+empty(): boolean	Returns true if the stack is empty.
+peek(): int	Returns the integer at the top of the stack without removing it from the stack.
+push(value: int): int	Stores an integer into the top of the stack.
+pop(): int	Removes the integer at the top of the stack and returns it.
+getSize(): int	Returns the number of elements in the stack.

Example: Implementing the StackOfInteger Class



Exercise

- Implement the StackOfInteger class.

Questions?

- Relationship among classes
 - Association
 - Aggregation
 - Composition (to be revisited in Chapter 13)
 - Inheritance (to be discussed in Chapter 11)
 - How to represent the relationship using classes/objects?