CISC 3115 EWQ6

Relationships of Classes: Part I

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Outline

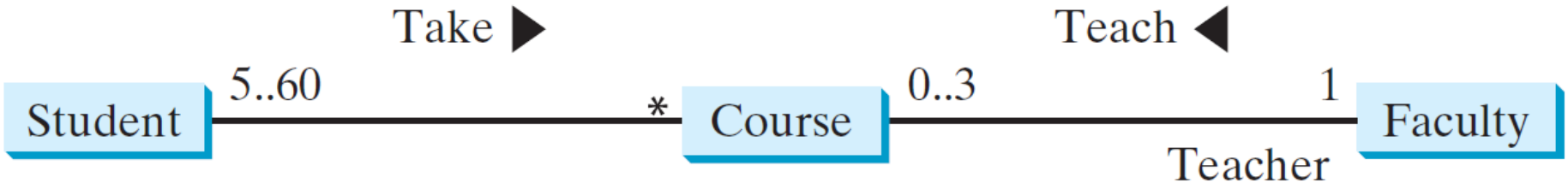
- Discussed
  - Concepts of two programming paradigms
    - Procedural and Object-Oriented
  - Design classes for problem solving
    - Think in terms of class
- Discover relationship of classes
  - Association
  - Aggregation
  - Composition (to be revisited in Chapter 13)
  - Inheritance (to be discussed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

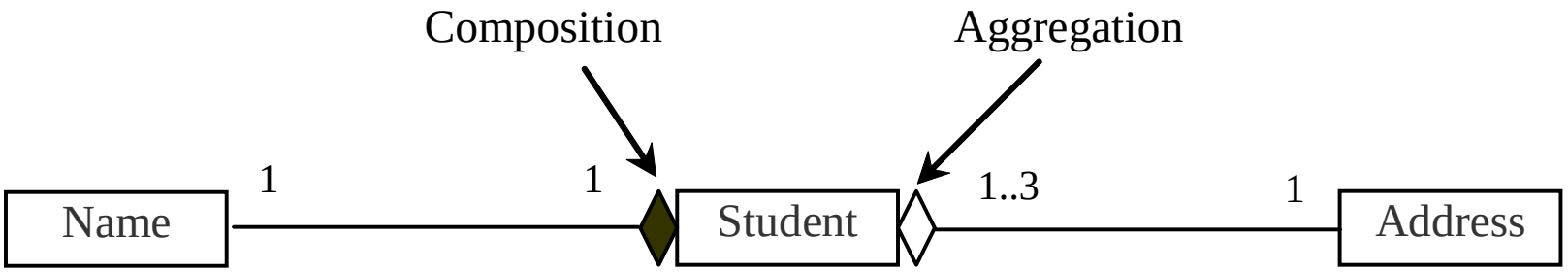
```
public class Faculty {
  private Course[] courseList;
  public void addCourse(Course c) {
  }
}
```

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

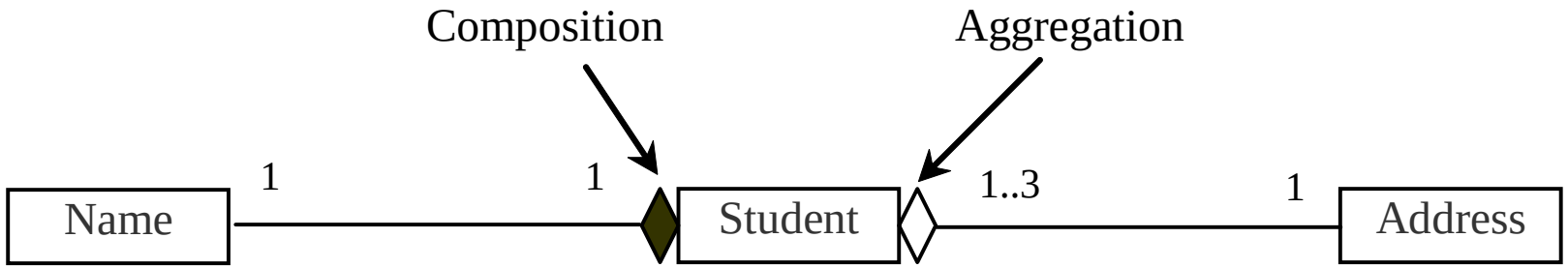
Composition

- 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.




```
public class Name {
  ...
}
```

Aggregated class

```
public class Student {
  private Name name;
  private Address address;

  ...
}
```

Aggregating class

```
public class Address {
  ...
}
```

Aggregated class

Aggregation or Composition

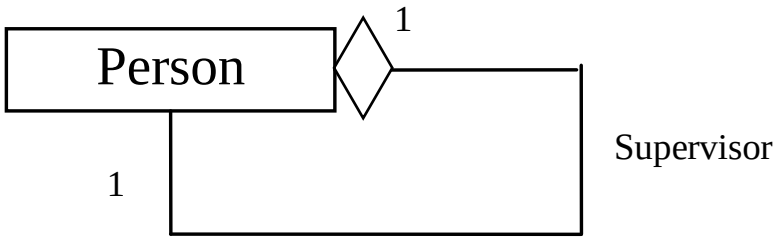
- Aggregation and composition relationships are represented using classes in similar ways, many texts do not differentiate them and call both compositions.

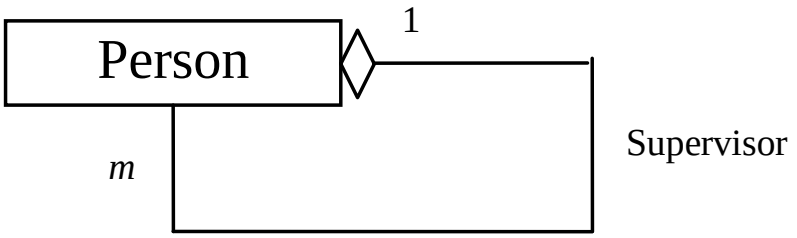
Aggregation Between Same Class

- 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;
  …
}
```

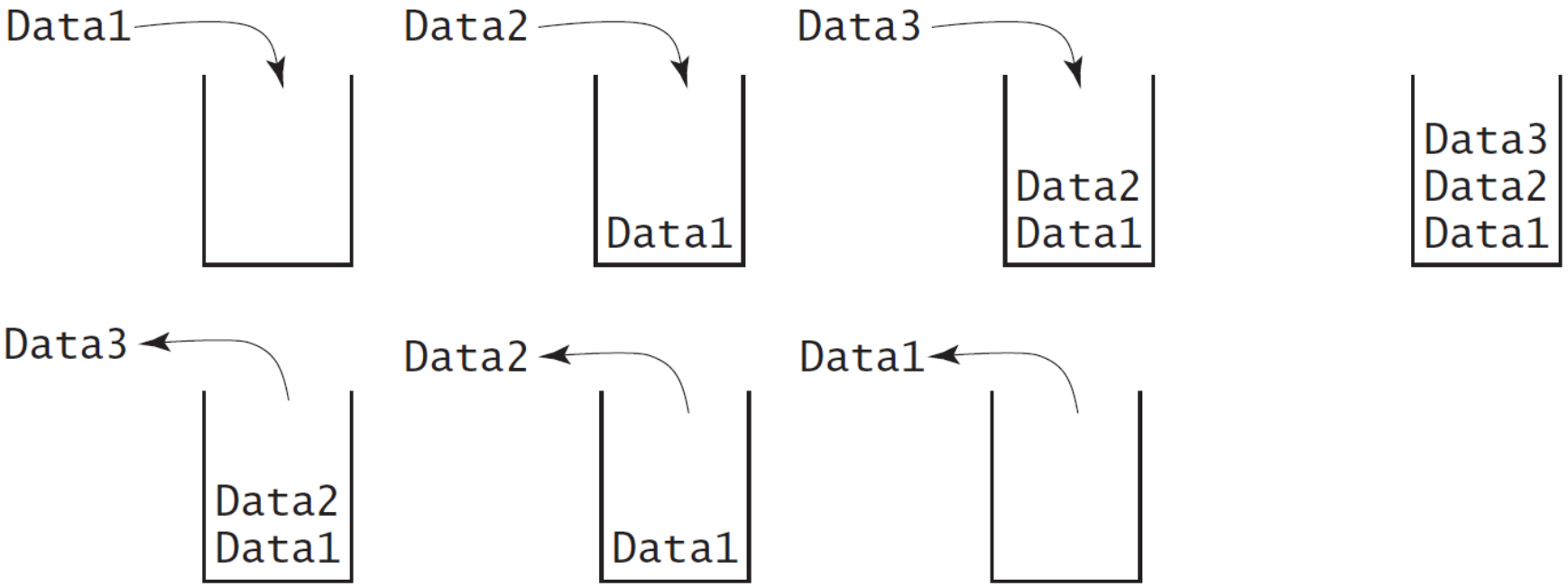
```
public class Person {
  // The type for the data is the class itself
  private Person[] supervisors;
  …
}
```

Example: The Course Class

Course	
`-courseName: String`	The name of the course.
`-students: String[]`	An array to store the students for the course.
`-numberOfStudents: int`	The number of students (default: 0).
`+Course(courseName: String)`	Creates a course with the specified name.
`+getCourseName(): String`	Returns the course name.
`+addStudent(student: String): void`	Adds a new student to the course.
`+dropStudent(student: String): void`	Drops a student from the course.
`+getStudents(): String[]`	Returns the students in the course.
`+getNumberOfStudents(): int`	Returns the number of students in the course.

Example: Designing The StackOfInteger Class

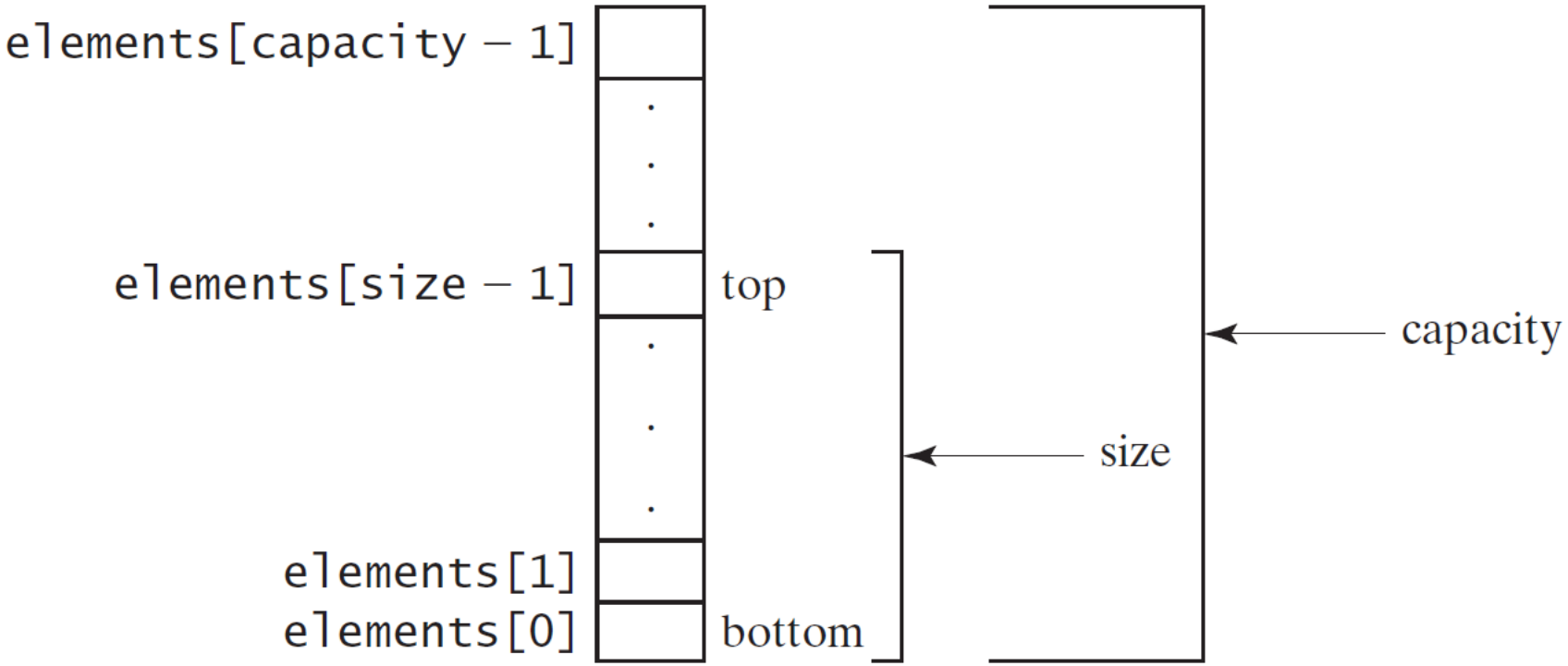
- A stack is a data structure that holds data in a last-in, first-out fashion



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?