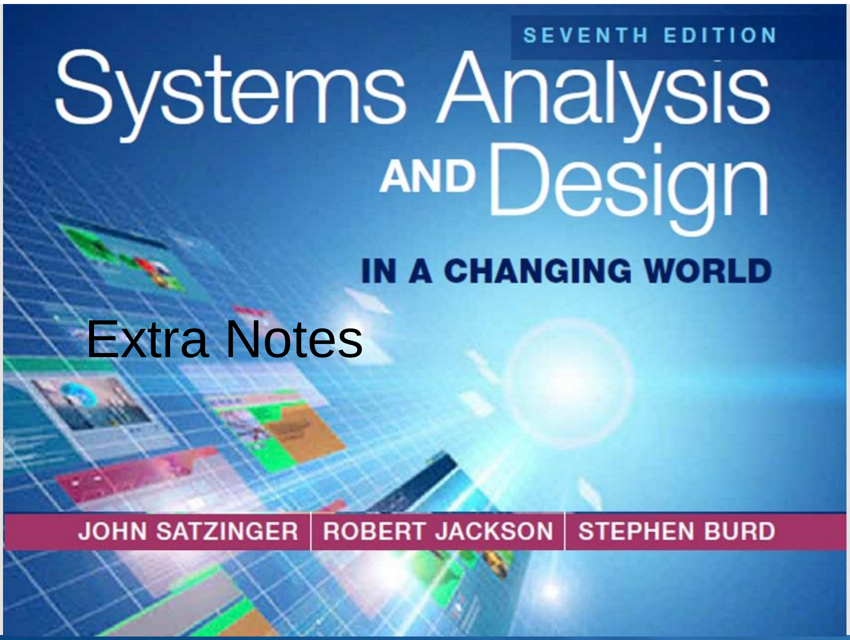
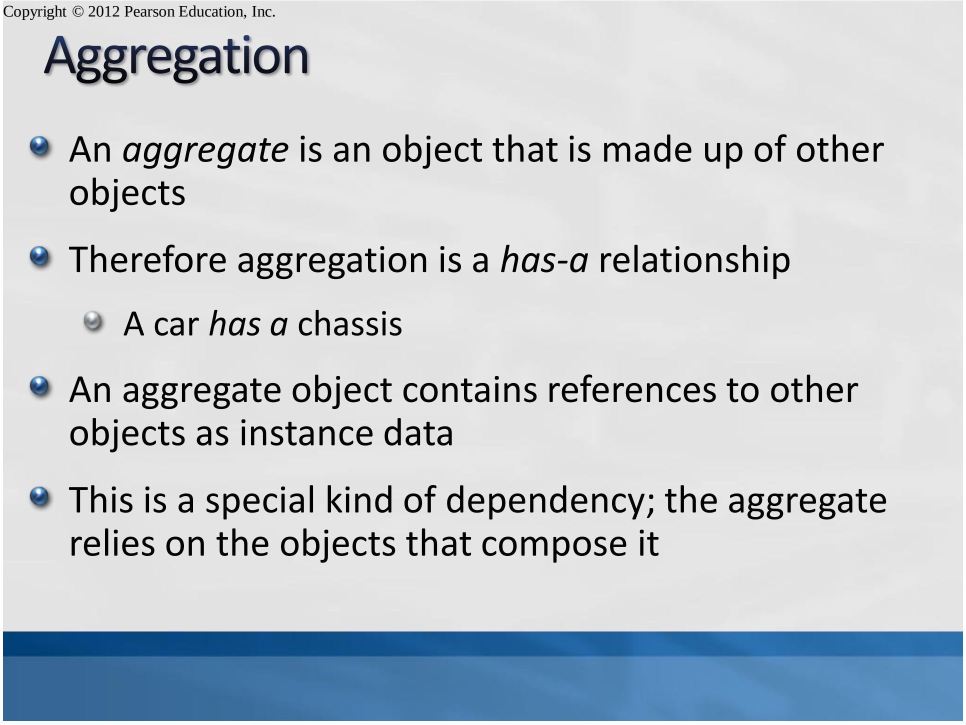


Extra Notes

Systems Analysis and Design in a Changing World, 7th Edition - Chapter 12

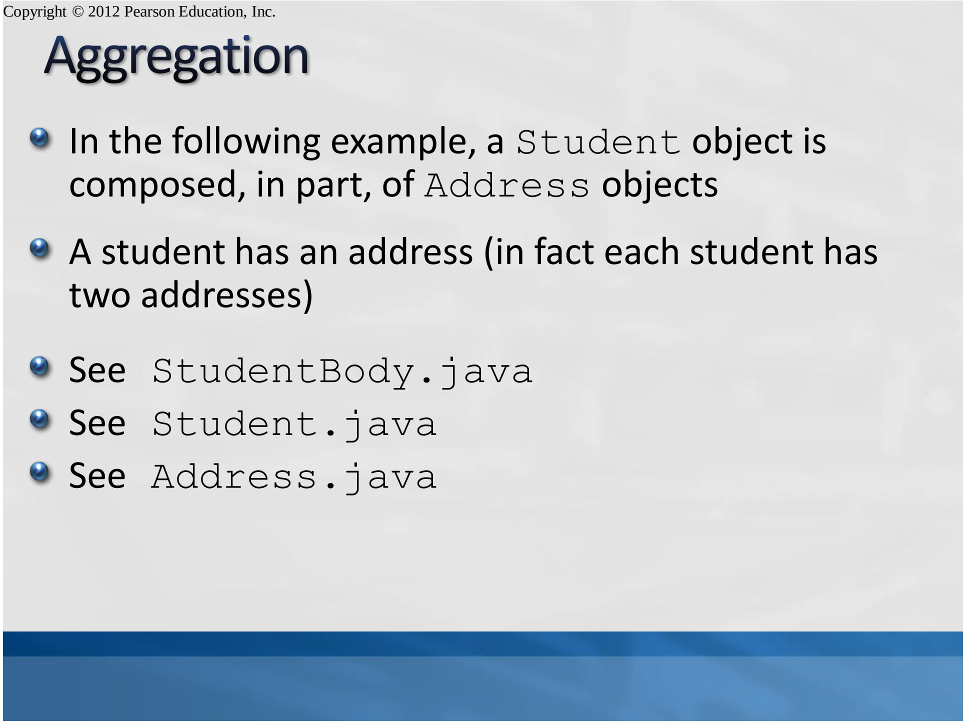
Class Relationships

- Classes in a software system can have various types of relationships to each other
- Three of the most common relationships:
  - Aggregation: A *has-a* B
  - Dependency: A *uses* B
  - Inheritance: A *is-a* B



Aggregation

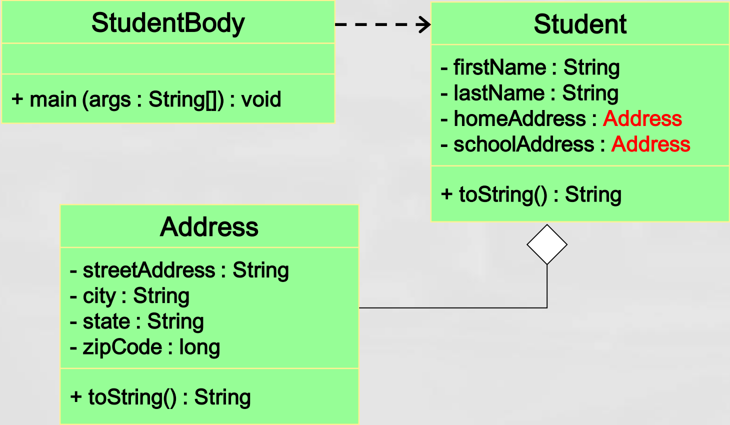
- An *aggregate* is an object that is made up of other objects
- Therefore aggregation is a *has-a* relationship
  - A car *has a* chassis
- An aggregate object contains references to other objects as instance data
- This is a special kind of dependency; the aggregate relies on the objects that compose it



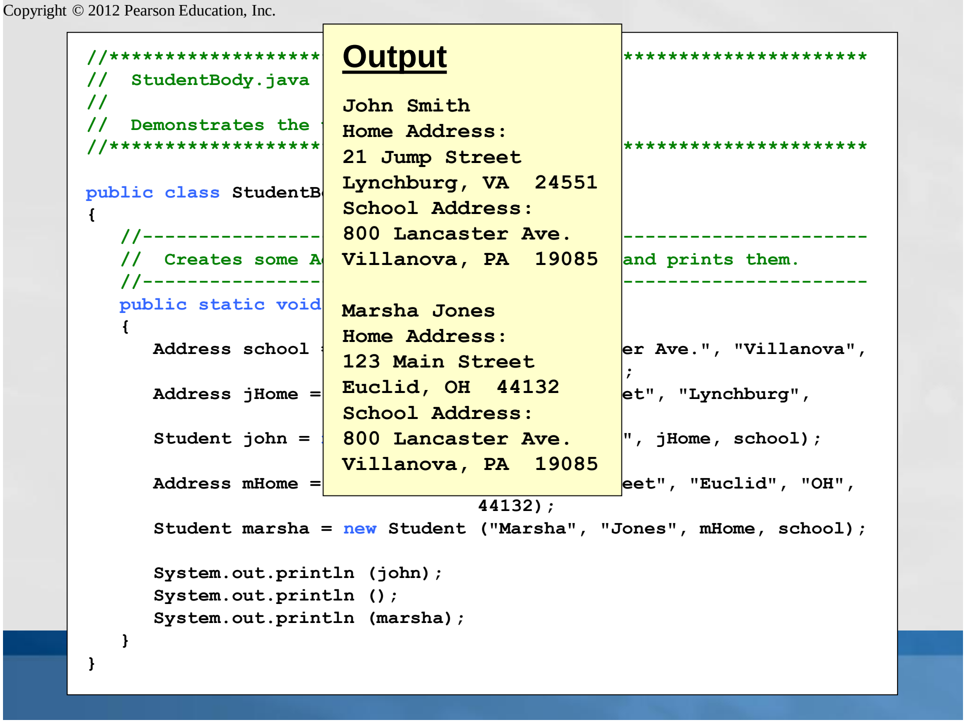
Aggregation

- In the following example, a `Student` object is composed, in part, of `Address` objects
- A student has an address (in fact each student has two addresses)
- See `StudentBody.java`
- See `Student.java`
- See `Address.java`

Aggregation in UML



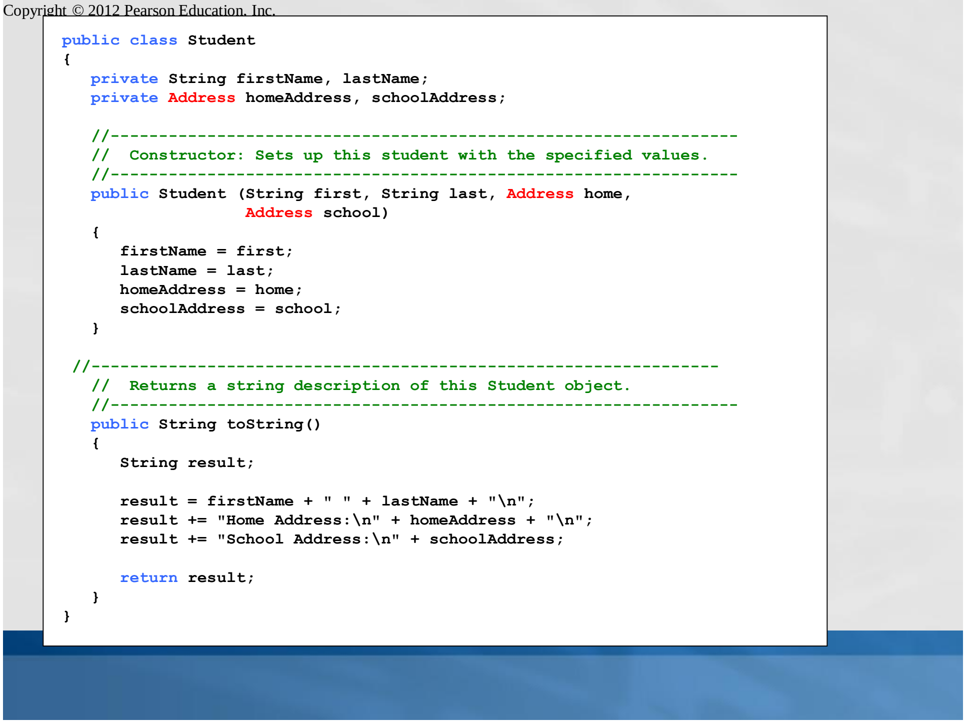
```
//********************************************************************
//  StudentBody.java       Author: Lewis/Loftus
//
//  Demonstrates the use of an aggregate class.
//********************************************************************

public class StudentBody
{
   //-----------------------------------------------------------------
   //  Creates some Address and Student objects and prints them.
   //-----------------------------------------------------------------
   public static void main (String[] args)
   {
      Address school = new Address ("800 Lancaster Ave.", "Villanova",
                                    "PA", 19085);
      Address jHome = new Address ("21 Jump Street", "Lynchburg",
                                   "VA", 24551);
      Student john = new Student ("John", "Smith", jHome, school);

      Address mHome = new Address ("123 Main Street", "Euclid", "OH",
                                   44132);
      Student marsha = new Student ("Marsha", "Jones", mHome, school);

      System.out.println (john);
      System.out.println ();
      System.out.println (marsha);
   }
}
```



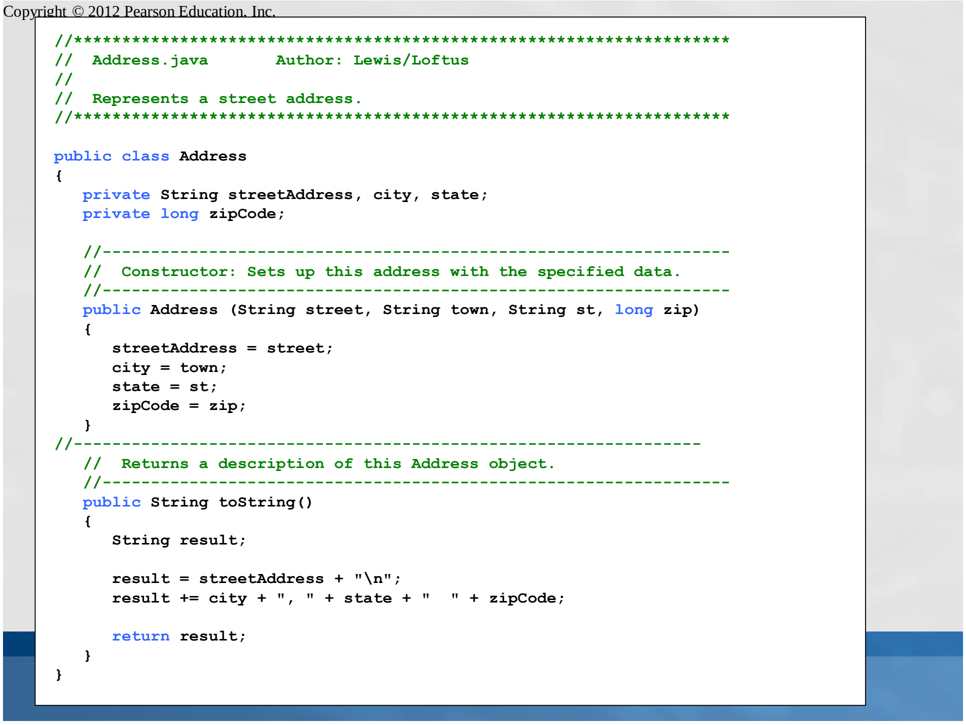
```
//*******************                    **********************
//  StudentBody.java
//
//  Demonstrates the
//*******************                    **********************

public class StudentB
{
   //----------------                    ----------------------
   //  Creates some A                    and prints them.
   //----------------                    ----------------------
   public static void
   {
      Address school =                   er Ave.", "Villanova",
                                         ;
      Address jHome =                    et", "Lynchburg",

      Student john =                     ", jHome, school);

      Address mHome =                    eet", "Euclid", "OH",
                               44132);
      Student marsha = new Student ("Marsha", "Jones", mHome, school);

      System.out.println (john);
      System.out.println ();
      System.out.println (marsha);
   }
}
```

Output

```
John Smith
Home Address:
21 Jump Street
Lynchburg, VA  24551
School Address:
800 Lancaster Ave.
Villanova, PA  19085

Marsha Jones
Home Address:
123 Main Street
Euclid, OH  44132
School Address:
800 Lancaster Ave.
Villanova, PA  19085
```



```
public class Student
{
   private String firstName, lastName;
   private Address homeAddress, schoolAddress;

   //-----------------------------------------------------------------
   //  Constructor: Sets up this student with the specified values.
   //-----------------------------------------------------------------
   public Student (String first, String last, Address home,
                   Address school)
   {
      firstName = first;
      lastName = last;
      homeAddress = home;
      schoolAddress = school;
   }

  //-----------------------------------------------------------------
   //  Returns a string description of this Student object.
   //-----------------------------------------------------------------
   public String toString()
   {
      String result;

      result = firstName + " " + lastName + "\n";
      result += "Home Address:\n" + homeAddress + "\n";
      result += "School Address:\n" + schoolAddress;

      return result;
   }
}
```



```
//********************************************************************
//  Address.java       Author: Lewis/Loftus
//
//  Represents a street address.
//********************************************************************

public class Address
{
   private String streetAddress, city, state;
   private long zipCode;

   //-----------------------------------------------------------------
   //  Constructor: Sets up this address with the specified data.
   //-----------------------------------------------------------------
   public Address (String street, String town, String st, long zip)
   {
      streetAddress = street;
      city = town;
      state = st;
      zipCode = zip;
   }
//-----------------------------------------------------------------
   //  Returns a description of this Address object.
   //-----------------------------------------------------------------
   public String toString()
   {
      String result;

      result = streetAddress + "\n";
      result += city + ", " + state + "  " + zipCode;

      return result;
   }
}
```