BIRZEIT UNIVERSITY

Thinking in Objects

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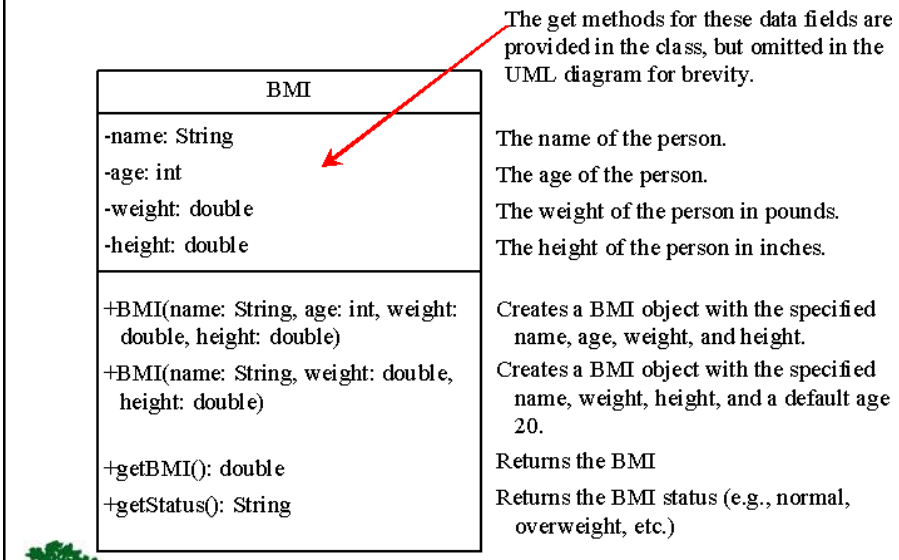
2015/2016

Class Abstraction and Encapsulation

- Class ***abstraction*** means to separate class implementation from the use of the class.
- The creator of the class provides a description of the class and let the user know how the class can be used.
- The user of the class does not need to know how the class is implemented.
- The detail of implementation is encapsulated and hidden from the user.

Class implementation is like a black box hidden from the clients → **Class** | Class Contract (Signatures of public methods and public constants) ↔ Clients use the class through the contract of the class

Case Study: The BMI Class



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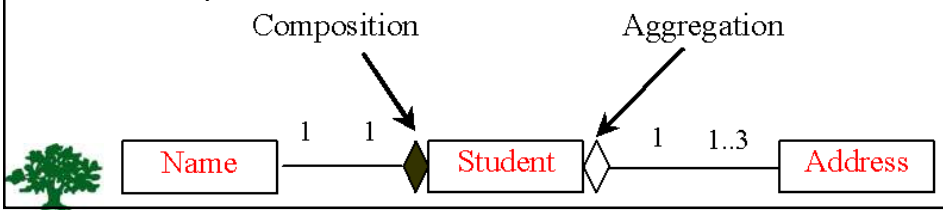
Object Composition

- **Aggregation** models ***has-a*** relationships and represents an **ownership** relationship between two objects.
- The owner object is called an ***aggregating object*** and its class an ***aggregating class***.
- The subject object is called an ***aggregated object*** and its class an ***aggregated class***.
- **Composition** is actually a special case of the aggregation relationship.



Class Representation

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

❖ For example, the relationship in the previous Figure can be represented as follows:

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

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

  ...
}
```

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

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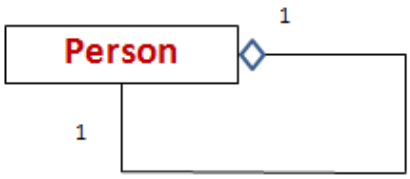
Aggregation Between Same Class

❖ Aggregation may exist between objects of the same class.

❖ For example, a **person** may have a **supervisor**:

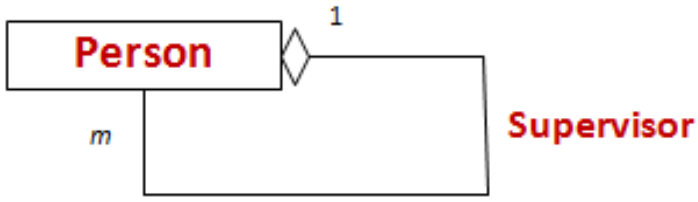


Supervisor

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

Aggregation Between Same Class

❖ What happens if a person has several supervisors?




```
public class Person {
  private Person[ ] supervisors;
  …
}
```

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Example: The Course Class

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

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

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Designing a Class

- (**Coherence**) A class should describe a single entity, and all the class operations should logically fit together to support a coherent purpose.
- You can use a class for **students**, for example, but you should not combine **students** and **staff** in the same class, because students and staff have different entities.

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Designing a Class cont.

- (**Separating responsibilities**) A single entity with too many responsibilities can be broken into several classes to separate responsibilities.
- Example: the classes **String**, **StringBuilder**, and **StringBuffer** all deal with strings, for example, but have different responsibilities:
  - **String** class deals with immutable strings.
  - **StringBuilder** class is for creating mutable strings.
  - **StringBuffer** class is similar to **StringBuilder** except that **StringBuffer** contains synchronized methods for updating strings.

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Designing a Class cont.

❖ Classes are designed for **reuse**.

❖ Users can incorporate classes in many different combinations, orders, and environments. Therefore, you should design a class that imposes no restrictions on what or when the user can do with it:

- Design the **properties** to ensure that the user can set properties in any order, with any combination of values.
- Design **methods** to function independently of their order of occurrence.

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Designing a Class cont.

❖ **Follow standard Java programming style and naming conventions:**

- Choose **informative names** for classes, data fields, and methods.
- Always place the data declaration before the constructor, and place constructors before methods.
- Always provide a constructor and **initialize** variables to avoid programming errors.

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Wrapper Classes

- Boolean
- Character
- Short
- Byte
- Integer
- Long
- Float
- Double

NOTE:

(1) The wrapper classes **do not** have **no-arg** constructors.

(2) The instances of all wrapper classes are **immutable**, i.e., their internal values cannot be changed once the objects are created.

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The Integer and Double Classes

java.lang.Integer
-value: int
+MAX_VALUE: int
+MIN_VALUE: int
+Integer(value: int)
+Integer(s: String)
+byteValue(): byte
+shortValue(): short
+intValue(): int
+longVlaue(): long
+floatValue(): float
+doubleValue():double
+compareTo(o: Integer): int
+toString(): String
+valueOf(s: String): Integer
+valueOf(s: String, radix: int): Integer
+parseInt(s: String): int
+parseInt(s: String, radix: int): int

java.lang.Double
-value: double
+MAX_VALUE: double
+MIN_VALUE: double
+Double(value: double)
+Double(s: String)
+byteValue(): byte
+shortValue(): short
+intValue(): int
+longVlaue(): long
+floatValue(): float
+doubleValue():double
+compareTo(o: Double): int
+toString(): String
+valueOf(s: String): Double
+valueOf(s: String, radix: int): Double
+parseDouble(s: String): double
+parseDouble(s: String, radix: int): double

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Numeric Wrapper Class Constructors

❖ You can construct a wrapper object either from a **primitive data type value** or from a **string** representing the numeric value.

❖ The constructors for **Integer** and **Double** are:

public Integer(int value)

public Integer(String s)

public Double(double value)

public Double(String s)

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Numeric Wrapper Class Constants

❖ Each numerical wrapper class has the constants **MAX_VALUE** and **MIN_VALUE**.

❖ **MAX_VALUE** represents the maximum value of the corresponding primitive data type.

❖ For **Byte**, **Short**, **Integer**, and **Long**, **MIN_VALUE** represents the minimum **byte**, **short**, **int**, and **long** values.

❖ For **Float** and **Double**, **MIN_VALUE** represents the minimum *positive* **float** and **double** values.

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Conversion Methods

❖ Each numeric wrapper class implements the abstract methods **doubleValue**, **floatValue**, **intValue**, **longValue**, and **shortValue**, which are defined in the **Number** class.

❖ These methods "**convert**" objects into primitive type values.

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The Static valueOf Methods

❖ The numeric wrapper classes have a useful class method, **valueOf(String s)**.

❖ This method creates a new object initialized to the value represented by the specified string.

❖ For example:

```
Double doubleObject = Double.valueOf("12.4");
Integer integerObject = Integer.valueOf("12");
```

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The Methods for Parsing Strings into Numbers

❖ You have used the **parseInt** method in the **Integer** class to parse a numeric string into an **int** value and the **parseDouble** method in the **Double** class to parse a numeric string into a **double** value.

❖ Each numeric wrapper class has two overloaded parsing methods to parse a numeric string into an appropriate numeric value.

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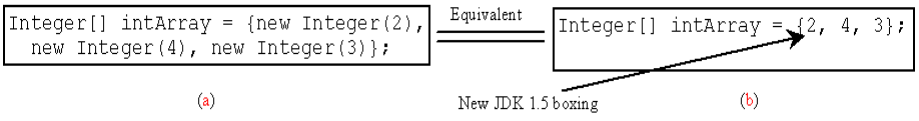
Automatic Conversion Between Primitive Types and Wrapper Class Types

❖ **JDK 1.5** allows primitive type and wrapper classes to be converted automatically. For example, the following statement in (a) can be simplified as in (b):




```
Integer[] arr = {1, 2, 3};

System.out.println(arr[0] + arr[1] + arr[2]);
```

Unboxing

BigInteger and BigDecimal

❖ If you need to compute with **very large integers** or **high precision floating-point** values, you can use the **BigInteger** and **BigDecimal** classes in the **java.math** package.

❖ Both are ***immutable***.

BigInteger and BigDecimal

```
BigInteger a = new BigInteger("9223372036854775807");
BigInteger b = new BigInteger("2");
BigInteger c = a.multiply(b); // 9223372036854775807 * 2
System.out.println(c);
```

```
BigDecimal a = new BigDecimal(1.0);
BigDecimal b = new BigDecimal(3);
BigDecimal c = a.divide(b, 20, BigDecimal.ROUND_UP);
System.out.println(c);
```