CSN-103: Fundamentals of Object Oriented Programming

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Unified Modeling Language

- Unified Modeling Language (**UML)**
- **Structure Charts***:* To illustrate the organizational relationships among the modules of a program or system
- To add some consistency to the diagrams
  - Programmers started using a standard called *UML* (*Unified Modeling Language)*

Class Diagram

- UML class diagrams allow us to denote
  - Contents of classes
    - Member variables
    - Member methods of a class
  - Relationships between classes
    - One class inherits from another
    - One class contains an object of another class

We can depict all the *source code dependencies* between classes

The Basics: Classes

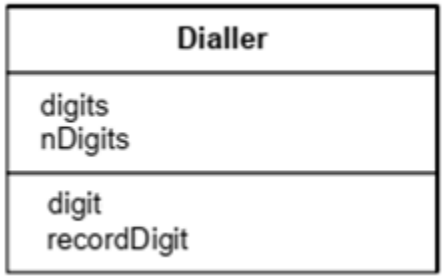
- The simplest form of class diagram


```
public class Dialler
{
}
```

- The classes on most diagrams don't need any more than their name

Compartments

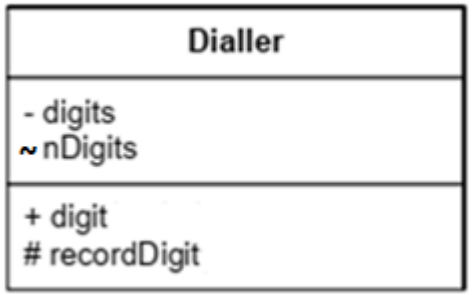
- A class icon can be subdivided into compartments
  - The top compartment is for the name of the class
  - The second is for the variables of the class
  - The third is for the methods of the class




```
Public class Dialler
{
        private double digits;
        int nDigits;
        public void digit(int n);
        protected boolean recordDigit(int n);
}
```

Visibility

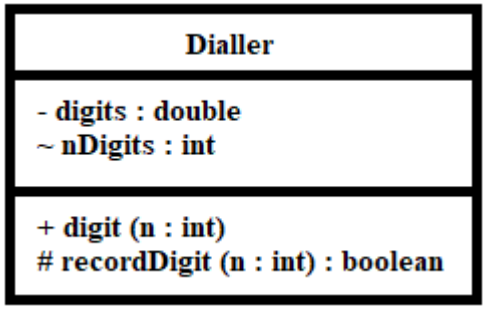
- For class members
  - A dash (-) denotes private
  - A hash (#) denotes protected
  - A plus (+) denotes public
  - A plus (~) denotes package-private (default)




```
Public class Dialler
{
        private double digits;
        int nDigits;
        public void digit(int n);
        protected boolean recordDigit(int n);
}
```

Variable, Argument, and Return Type

- The type of a variable/argument
  - Colon following the variable/argument name
- The return type of a method is shows after the colon following the function




```
Public class Dialler
{
        private double digits;
        int nDigits;
        public void digit(int n);
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}
```
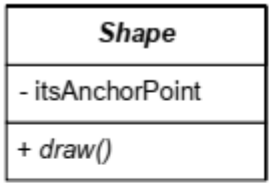
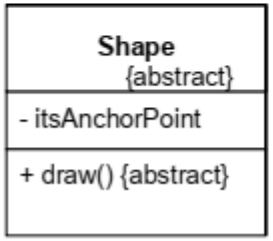

Abstract Classes

- Two ways to denote that a class/method is abstract
  - Italics: Class or method name (Do Not Use in Exam)
  - Use {abstract} word






```
public abstract class Shape
{
  private Point itsAnchorPoint;
  public abstract void draw();
}
```

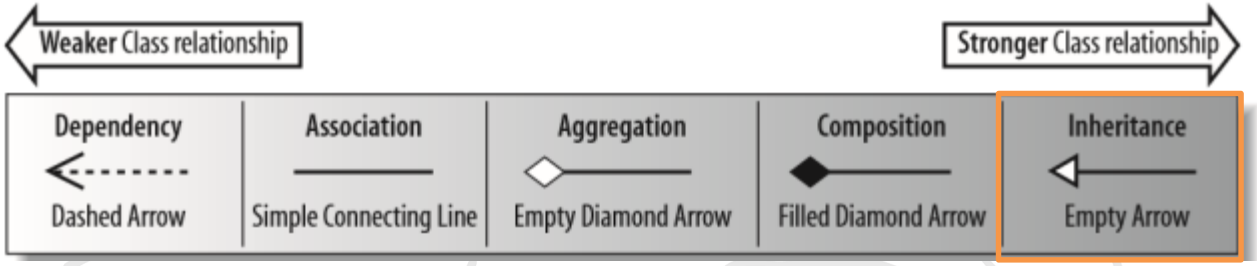
«interface»

- **«interface»:** All the methods of classes marked with this stereotype are abstract
  - None of the methods can be implemented
- Moreover, «interface» classes can have no instance variables
- The only variables they can have are static variables.


```
interface Transaction
{
  public void execute();
}
```

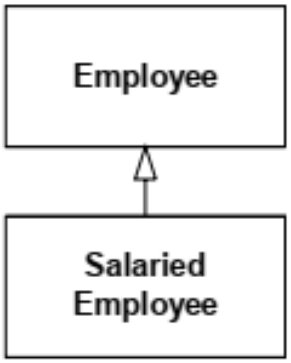
Relationships

- A relationship is a connection between two or more UML model elements
- Different kinds of relationships:



Inheritance

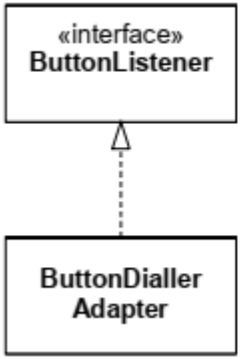
- Very careful with the arrowhead's direction in UML
- Example: **SalariedEmployee** is inherited from **Employee**




```
public class Employee
{
   ...
}

public class SalariedEmployee extends Employee
{
   ...
}
```

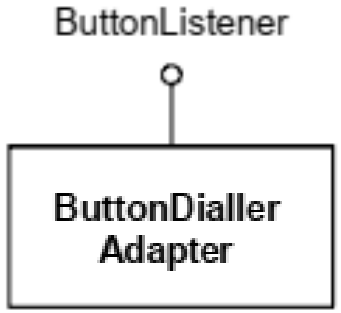
Interface

- UML has a special notation for inheritance
  - Used with a Java **interface**




```
interface ButtonListener
{
   ...
}

public class ButtonDiallerAdapter
   implements ButtonListener
{
   ...
}
```

OR



Garbage Collection

Garbage Collection

- In Java, objects are dynamically operated by the **new** operator
- How objects are destroyed and memory is released for future reallocation?
- In some languages, dynamically allocated objects are **manually** released
- Java handles deallocation automatically using **Garbage Collection**

Garbage Collection

- When no reference to an object exists
  - Java assumes that the object is no longer needed
  - The memory occupied by object can be reclaimed
- No explicit need to destroy objects
- Garbage collection occurs rarely during program execution
  - System.gc();

- Example

```
Box b1=new Box();
Box b2=new Box();
b1=b2;  OR  b1=null;
```

- The first object referred by *b1* is available for garbage collection