Object-Oriented Programming (OOP)

- Approach to improving software
  - View software as a collection of objects (entities)

- Motivated by software engineering concerns
  - To be discussed later in the semester

- OOP takes advantage of two techniques
  - Abstraction
  - Encapsulation
Techniques – Abstraction

Abstraction
- Provide high-level model of activity or data

Procedural abstraction
- Specify what actions should be performed
- Hide algorithms

Data abstraction
- Specify data objects for problem
- Hide representation
Techniques – Encapsulation

- Encapsulation
  - Confine information so it is only visible / accessible through an associated external interface

- Approach
  - For some entity X in program
    - Abstract data in X
    - Abstract actions on data in X
    - Collect data & actions on X in same location
    - Protects and hides X

- Extension of abstraction
Abstraction & Encapsulation Example

Abstraction of a Roster

- Data
  - List of student names

- Actions
  - Create roster
  - Add student
  - Remove student
  - Print roster

Encapsulation

- Only these actions can access names in roster

<table>
<thead>
<tr>
<th>ROSTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>List of names</td>
</tr>
<tr>
<td>create( )</td>
</tr>
<tr>
<td>addStudent( )</td>
</tr>
<tr>
<td>removeStudent( )</td>
</tr>
<tr>
<td>print( )</td>
</tr>
</tbody>
</table>
Java Programming Language

Language constructs designed to support OOP
- **Example**
  - Interface – specifies a contract
  - Class – implements/defines contracts, supports encapsulation of implementation

Class libraries designed using OOP principles
- **Example**
  - Java Collections Framework
  - Java Swing
Java Interface

- An Interface defines a contract
  - Collection of
    - Constants
  - Abstract methods; no implementations
  - Can not be instantiated
- Classes can implement interfaces
  - Must implement all methods in interface
  - Example
    class Foo implements Bar { … }
- Similar to abstract class
  - But class can “inherit” from multiple interfaces
Java Collections Framework

- **Collection**
  - Object that groups multiple elements into one unit
  - Also called container
  - Example: ArrayList

- **Collection framework** consists of
  - **Interfaces**
    - Abstract data type
  - **Implementations**
    - Reusable data structures
  - **Algorithms**
    - Reusable functionality

- **Collection – Java Interface**
  - See Java API entry for Collection
  - Example (CollectionExample.java)