CS/ENGRD 2110
Object-Oriented Programming and Data Structures

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Lecture 3: Objects and Encapsulation

In the Beginning…

- Goal: Build a search engine!
- What do we need?
  - Robot that crawls all web pages
  - A retrieval engine that finds the best matches for a query.
  - A web server that gets keyword queries from the user and presents search results.
- ➔ Break problem down into modules.

Modularity

- Examples:
  - Tires in a car (standard size, many vendors)
  - External keyboard for computer
  - Course at Cornell
  - …
- Delegate responsibility for individual modules

How does Java support modularity?

- Classes and Objects
  - Contain data
  - Contain methods for accessing data
  - Inheritance avoids duplication of effort
- Interfaces
  - Standardization across multiple classes
- Packages
  - Collections of classes and interfaces

Information Hiding

- Modules hide internal design decisions!
- Modules provide a well-defined external interface.

```
class Set {
  ...
  public void add(Object o) ...

  public boolean contains(Object o) ...

  public int size() ...
}
```

Encapsulation

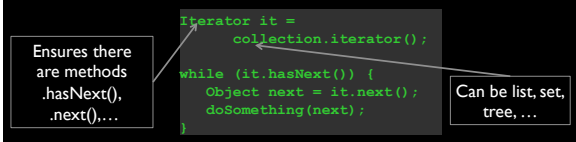
- By hiding code and data behind its interface, a class encapsulates its "inner workings"
- Why is that good?
  - Lets us change the implementation later without invalidating the code that uses the class

```
class LineSegment {
  private Point2D _p1, _p2;

  ...
  public double length() {
    return _p1.distance(_p2);
  }
}
```

```
class LineSegment {
  private Point2D _p;
  private double _length;
  private double _phi;

  ...
  public double length() {
    return _length;
  }
}
```

Encapsulation

- Why is that good? (continued)
  - Sometimes, we want a few different classes to implement some shared functionality
  - For example, the "iterator" construct :



- To support iteration, a class simply needs to implement the **`Iterable`** interface

Degenerate Interfaces

- Public fields are usually a Bad Thing:

```
class Set {
   public int _count = 0;

   public void add(Object o) ...

   public boolean contains(Object o) ...

   public int size() ...
}
```

- Anybody can change them; the class has no control

Interfaces vs. Implementations

- This says "I need this specific implementation":

```
public void doSomething(LinkedList items) ...
```

- This says "I can operate on anything that supports the Iterable interface"

```
public void doSomething(Iterable items) ...
```

- Interfaces represent higher levels of abstraction (they focus on "what" and leave out the "how")

Use of encapsulation and interfaces?

- Support of team work and modularity!
  - Rebecca agrees to implement web robot
  - Tom will implements the ranking algorithm
  - Willy is responsible for the user interface
  - → By agreeing on the interfaces between their respective modules, they can all work on the program simultaneously
- Can use work of others (later) without having to understand internals!
  - Faster development of code.
  - Use of well-tested components