

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 :

Ensures there are methods `.hasNext()`, `.next()`,...

```
Iterator it =  
    collection.iterator();  
  
while (it.hasNext()) {  
    Object next = it.next();  
    doSomething(next);  
}
```

Can be list, set, tree, ...

- 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