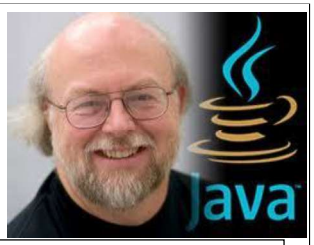
Topic 7
Interfaces



I once attended a Java user group meeting where James Gosling (one of Java's creators) was the featured speaker. During the memorable Q&A session, someone asked him: "If you could do Java over again, what would you change?" "**I'd leave out classes**," he replied. After the laughter died down, he explained that the real problem wasn't classes per se, but rather implementation inheritance (the extends relationship). Interface inheritance (the implements relationship) is preferable.

- Allen Holub

Clicker 1

- How many sorts do you want to have to write?

```
public static void selSort(double[] data) {
   for(int i = 0; i < data.length; i++) {
      int small = i;
      for(int j = i + 1; j < data.length; j++) {
         if (data[j] < data[small])
            small = j;
      }
      double temp = data[i];
      data[i] = data[small];
      data[small] = temp;
   }
}
```

A. 0
B. 1
C. 2
D. 3
E. >= 4

Why interfaces?

- Interfaces allow the creation of *abstract types*
  - "A set of data values and associated operations that are precisely specified independent of any particular implementation. "
  - multiple implementations allowed
- Interfaces allow a data type to be specified without worrying about the implementation
  - do design first
  - What will this data type do?
  - Don't worry about implementation until design is done.
  - separation of concerns.
  - allow us to create *generic algorithms*

Interfaces

```
public interface List<E> {
```

- No constructors
- No instance variables
- abstract methods
- default methods
- static methods
- class constants (prefer enums)

```
  public static final int DEFAULT_CAP = 10;
  public void add(E val);
```

Implementing Interfaces

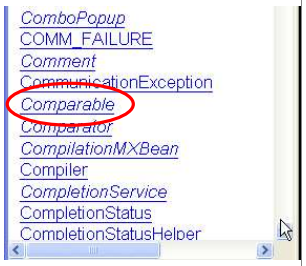
- In Java, a class inherits (extends) exactly one other class, but …
- A class can *implement* as many interfaces as it likes

```
public class ArrayList implements List
```

- A class that implements an interface must provide implementations of all non default method declared in the interface or the class must be abstract
- interfaces can extend other interfaces

The Comparable Interface

- The Java Standard Library contains a number of interfaces
  - names are italicized in the class listing
- One of the most important interfaces is the Comparable interface



Comparable Interface

```
package java.lang;

public interface Comparable<T> {
     public int compareTo(T other);
}
```

- compareTo must return
  - an int <0 if the calling object is less than the parameter,
  - 0 if they are equal
  - an int >0 if the calling object is greater than the parameter
- compareTo should be *consistent with equals* but this isn't required.

Interfaces

- "Use interfaces to ensure a class has methods that ***other*** classes or methods will use." (In other words, clients of your class.)
  - Anthony, Spring 2013
- The other classes or methods may already be written.
- The other methods or classes use interface type for the parameters of methods.
- POLYMORPHISM
  - old code using new code

Clicker Question 2

- What is output by the following code?

```
Comparable c1 = new Comparable();
Comparable c2 = new Comparable();
System.out.println(c1.compareTo(c2));
```

A. A value < 0

B. 0

C. A value > 0

D. Unknown until program run

E. Compile error

Example `compareTo`

- Suppose we have a class to model playing cards
  - Ace of Spades, King of Hearts, Two of Clubs
- each card has a suit and a value, represented by ints
- this version of `compareTo` will compare values first and then break ties with suits

`compareTo` in a `Card` class

```
public class Card implements Comparable<Card> {

      public int compareTo(Card otherCard) {
            return this.rank - other.rank;
      }
      // other methods not shown
}
```

Assume ints for ranks (2, 3, 4, 5, 6,...) and suits (0 is clubs, 1 is diamonds, 2 is hearts, 3 is spades).

Interfaces and Polymorphism

- Interfaces may be used as the data type for object variables
- Can't simply create objects of that type
- Can refer to any objects that implement the interface or descendants
- Assume `Card` implements `Comparable`

```
Card c = new Card();
Comparable comp1 = new Card();
Comparable comp2 = c;
```

Clicker Question 3

- Which of the following lines of code causes a syntax error?

```
Comparable c1; // A
c1 = "Ann"; // B
Comparable c2 = "Kelly"; // C
int x = c2.compareTo(c1); // D
// E No syntax errors.

// what is x after statement?
```


Why Make More Work?

- Why bother implementing an interface such as Comparable
  - objects can use method that expect an interface type
- Example if I implement Comparable:

  Arrays.sort(Object[] a)

  public static void sort(Object[] a)

  All elements in the array must implement the Comparable interface. Furthermore, all elements in the array must be *mutually comparable*
- objects of my type can be stored in data structures that accept Comparables

A List Interface

- What if we wanted to specify the operations for a List, but no implementation?
- Allow for multiple, different implementations.
- Provides a way of creating *abstractions.*
  - a central idea of computer science and programming.
  - specify "what" without specifying "how"
  - "Abstraction is a mechanism and practice to reduce and factor out details so that one can focus on a few concepts at a time. "

List Interface

```
public interface List <E> {
  public void add(E val);
  public int size();
  public E get(int location);
  public void insert(int location, E val);
  public E remove(int location);
}
```

One Sort

```
public static void sort(Comparable[] data) {
   final int LIMIT = data.length - 1;
   for(int i = 0; i < LIMIT; i++) {
      int small = i;
      for(int j = i + 1; j < data.length; j++) {
          int d = data[j].compareTo(data[small]);
          if( d < 0)
            small = j;
      }
      Comparable temp = data[i];
      data[i] = data[small];
      data[small] = temp;
   } // end of i loop
}
```