Iterators and Collections

CSE 142, Summer 2003

Computer Programming 1

http://www.cs.washington.edu/education/courses/142/03su/

Readings and References

- Reading
  - » The discussion in *Intro to Programming and Object-Oriented Design Using Java*, Niño and Hosch is about their own home-grown Lists and Iterators, *not* the ones in java.util
- Other References
  - » The Java tutorial on Collections
    - http://java.sun.com/docs/books/tutorial/collections/index.html

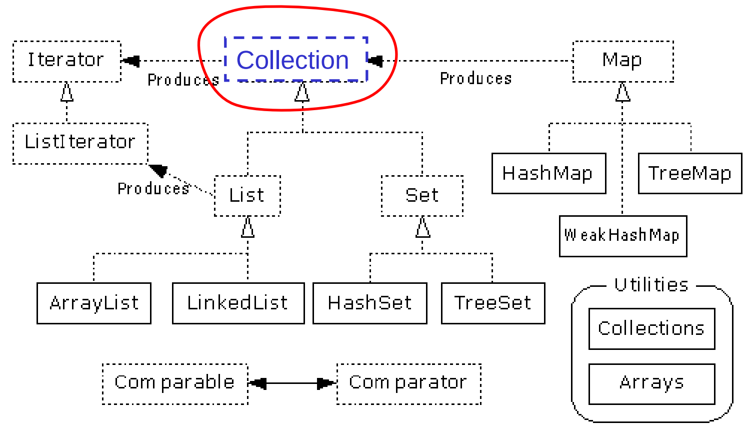
Java fundamentals

- Object oriented programming
  - » classes and objects
  - » interfaces and inheritance
  - » constructors, methods, variables
- The Java language
  - » types, expressions
  - » control flow
  - » exceptions
- Development tools
  - » editors, compiler, Java virtual machine

Java data structures

- Arrays
  - » can hold primitive types directly
- ArrayLists
  - » representative of the many Collection types
- but these are only the beginning
  - » Java provides many well designed interfaces, implementations, and algorithms to help you manage your data

Collection interface



•Interfaces, Implementations, and Algorithms
•From Thinking in Java, page 462

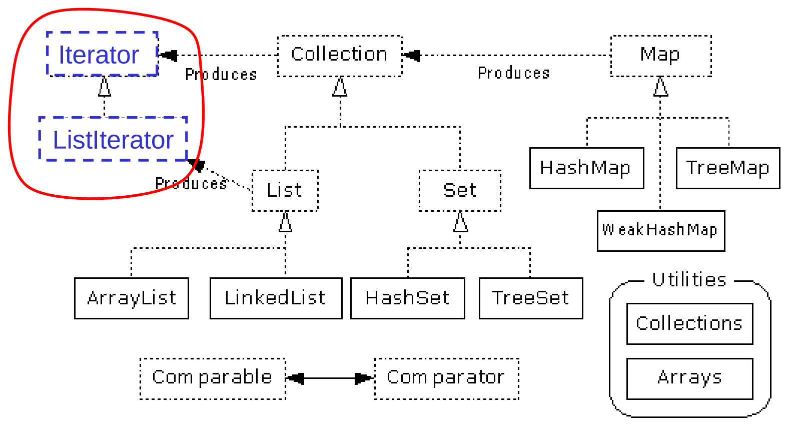
java.util.Collection Interface

- Collection is the root interface in the collection hierarchy
  - » A collection represents a group of objects (the elements of the collection)
  - » Some collections allow duplicate elements and others do not
  - » Some collections are ordered and others are unordered

Collection interface methods

- Defines two fundamental methods
  - » boolean add(Object o)
  - » Iterator iterator()
- These two methods are enough to define the basic behavior of a collection
- An Iterator lets you step through the elements in the Collection without knowing the index

Iterator interface



Iterator Interface

- Defines fundamental methods
  - » Object next()
  - » boolean hasNext()
- These methods provide access to the contents of the collection
- An Iterator knows position within collection
- Each call to **`next()`** gets the next element from the collection

Iterator Position with next()

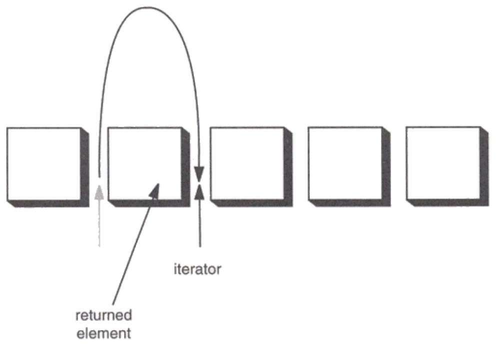
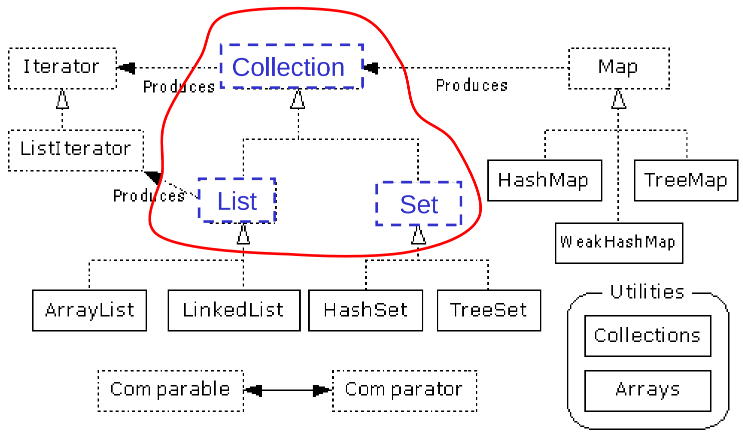


Figure 2–3: Advancing an iterator

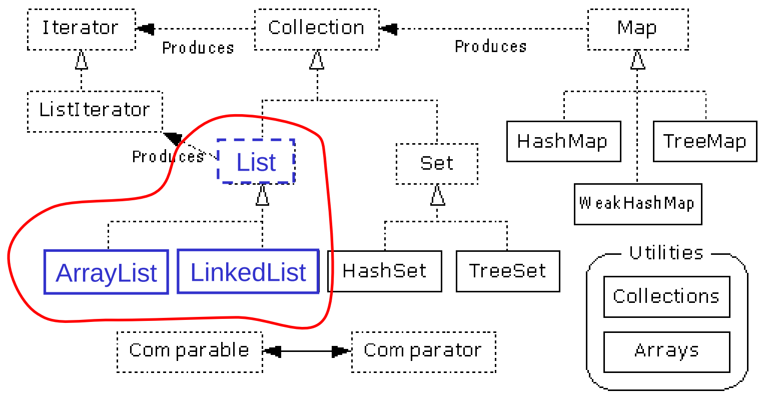
List and Set interfaces



List and Set

- **`public interface List extends Collection`**
  - » An ordered collection (also known as a *sequence*)
  - » User can store and access elements by their integer index and search for elements in the list
  - » Lists typically allow duplicate elements
- **`public interface Set extends Collection`**
  - » A collection that contains no duplicate elements and at most one null element
  - » Models the mathematical *set* abstraction

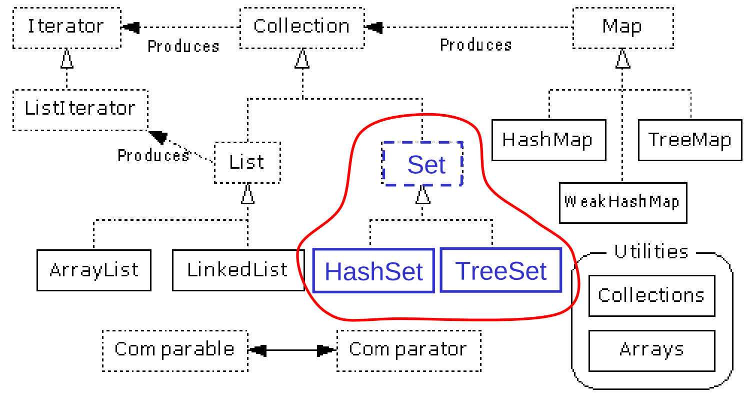
Concrete classes that implement List



ArrayList and LinkedList

- ArrayList
  - » fast access to any element in the List by index
  - » implemented with an array of Objects, ie, Object[]
  - » automatically increases array size when needed
  - » add at the end is fast, but add in the front requires copying the entire array to make room
- LinkedList
  - » fast insert and delete at any point in a list
  - » slow if you want to access elements by index

Concrete classes that implement Set



HashSet and TreeSet

- HashSet
  - » Like all Collections, a HashSet stores objects
  - » This class offers constant time performance for the basic operations (add, remove, contains and size)
  - » No guarantee as to the order of the elements
- TreeSet
  - » Guarantees that the set will be sorted in ascending element order

Example - CollectionManager

```
import java.util.*;
public class CollectionManager  {
  public void fillCollection(Collection c) {
    System.out.println("\nFilling "+c.getClass().getName());
    for (int i=4; i >= 0; i--) {
      c.add(i + " * " + i + " = "+i*i);  // first entry
      c.add(i + " * " + i + " = "+i*i);  // duplicate entry
    }
  }
  public void printCollection(Collection c) {
    Iterator iter = c.iterator();
    while (iter.hasNext()) {
      System.out.println(iter.next());
    }
  }
}
```

Iterators vs Indexed Access

- We can process an ArrayList using get(index)

```
for (int k = 0; k < names.size( ); k++) {
      process names.get(k);
}
```

- Tradeoffs
  - » Iterators are more general – work on all collections, even if the collection doesn't support indexed access
  - » Iterators only support traversal of a collection from one element to the next (or previous) – if we want to go in some other arbitrary order, we need indexed access