Handout chapter 10 and 11

Wrapper Classes Examples:

Here are some examples to illustrate the Integer methods:

```
Integer intObj = new Integer(6);  //boxes 6 in Integer object
int j = intObj.intValue();        //unboxes 6 from Integer object

System.out.println("Integer value is " + intObj);
//calls toString() for intObj
//output is
Integer value is 6
```

```
Object object = new Integer(5);   //Integer is a subclass of Object

Integer intObj2 = new Integer(3);
int k = intObj2.intValue();
if (intObj.equals(intObj2))       //OK, evaluates to false
    ...
if (intObj.intValue() == intObj2.intValue())
    ...               //OK, since comparing primitive types

if (k.equals(j))      //error, k and j not objects
    ...
if ((intObj.intValue()).compareTo(intObj2.intValue()) < 0)
    ...               //error, can't use compareTo on primitive types

if (intObj.compareTo(object) < 0)  //OK
    ...
if (object.compareTo(intObj) < 0)  //error, no compareTo in Object
    ...
if (((Integer) object).compareTo(intObj) < 0)  //OK
    ...
```

Here are some examples:

```
Double dObj = new Double(2.5);     //boxes 2.5 in Double object
double d = dObj.doubleValue();     //unboxes 2.5 from Double object

Object object = new Double(7.3);   //Double is a subclass of Object
Object intObj = new Integer(4);
if (dObj.compareTo(object) > 0)    //OK
    ...
if (dObj.compareTo(intObj) > 0)    //ClassCastException
    ...                            //can't compare Integer to Double
```

ArrayLists

1)

```
1  // Short program that creates a list of the birthdays of the
2  // first 5 U.S. Presidents and that puts them into sorted order.
3
4  import java.util.*;
5
6  public class CalendarDateTest {
7      public static void main(String[] args) {
8          ArrayList<CalendarDate> dates =
9                  new ArrayList<CalendarDate>();
10         dates.add(new CalendarDate(2, 22));   // Washington
11         dates.add(new CalendarDate(10, 30));  // Adams
12         dates.add(new CalendarDate(4, 13));   // Jefferson
13         dates.add(new CalendarDate(3, 16));   // Madison
14         dates.add(new CalendarDate(4, 28));   // Monroe
15
16         System.out.println("birthdays = " + dates);
17         Collections.sort(dates);
18         System.out.println("birthdays = " + dates);
19     }
20 }
```

2)

Table 10.1 Basic `ArrayList` Methods

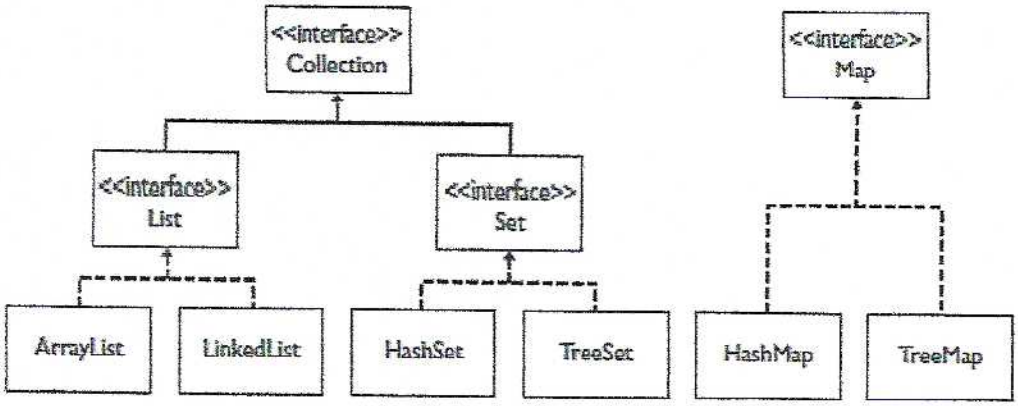
Method	Description	`ArrayList<String>` example
`add(value)`	adds the given value at the end of the list	`list.add("end");`
`add(index, value)`	adds the given value at the given index, shifting subsequent values right	`list.add(1, "middle");`
`clear()`	removes all elements from the list	`list.clear();`
`get(index)`	gets the value at the given index	`list.get(1)`
`remove(index)`	removes the value at the given index, shifting subsequent values left	`list.remove(1);`
`set(index, value)`	replaces the value at the given index with the given value	`list.set(2, "hello");`
`size()`	returns the current number of elements in the list	`list.size()`

3)

Table 11.3 Useful Static Methods of the `Collections` Class

Method	Description
`binarySearch(list, value)`	Searches a sorted list for a given element value and returns its index
`copy(destinationList, sourceList)`	Copies all elements from the source list to the destination list
`fill(list, value)`	Replaces every element in the given list with the given value
`max(list)`	Returns the element with the highest value
`min(list)`	Returns the element with the lowest value
`replaceAll(list, oldValue, newValue)`	Replaces all occurrences of the old value with the new value
`reverse(list)`	Reverses the order of the elements in the given list
`rotate(list, distance)`	Shifts each element to the right by the given number of indexes, moving the final element to the front
`shuffle(list)`	Rearranges the elements into random order
`sort(list)`	Rearranges the elements into sorted (nondecreasing) order
`swap(list, index1, index2)`	Switches the element values at the given two indexes

4)



5) Other ArrayList Examples:

Example 2

```
//Traversing an ArrayList of Integer.
//Print the elements of list, one per line.
for (Integer num : list)
    System.out.println(num);
```

Example 3

```
/* Precondition:  List list is an ArrayList that contains Integer
 *                values sorted in increasing order.
 * Postcondition: value inserted in its correct position in list. */
public static void insert(List<Integer> list, Integer value)
{
    int index = 0;
    //find insertion point
    while (index < list.size() &&
           value.compareTo(list.get(index)) > 0)
        index++;
    //insert value
    list.add(index, value);
}
```

NOTE

Suppose `value` is larger than all the elements in `list`. Then the `insert` method will throw an `IndexOutOfBoundsException` if the first part of the test is omitted, namely `index < list.size()`.

Example 4

```
//Return an ArrayList of random integers from 0 to 100.
public static List<Integer> getRandomIntList()
{
    List<Integer> list = new ArrayList<Integer>();
    System.out.print("How many integers? ");
    int length = IO.readInt();     //read user input
    for (int i = 0; i < length; i++)
    {
        int newNum = (int) (Math.random() * 101);
        list.add(new Integer(newNum));
    }
    return list;
}
```

NOTE

1. The variable `list` is declared to be of type `List<Integer>` (the interface) but is instantiated as type `ArrayList<Integer>` (the implementation).
2. The `add` method in `getRandomIntList` is the `List` method that appends its parameter to the end of the list.

Example 5

```
//Swap two values in list, indexed at i and j.
public static void swap(List<E> list, int i, int j)
{
    E temp = list.get(i);
    list.set(i, list.get(j));
    list.set(j, temp);
}
```

Example 6

```
//Print all negatives in list a.
//Precondition: a contains Integer values.
public static void printNegs(List<Integer> a)
{
    System.out.println("The negative values in the list are: ");
    for (Integer i : a)
        if (i.intValue() < 0)
            System.out.println(i);
}
```

Example 7

```
//Change every even-indexed element of strList to the empty string.
//Precondition: strList contains String values.
public static void changeEvenToEmpty(List<String> strList)
{
    boolean even = true;
    int index = 0;
    while (index < strList.size())
    {
        if (even)
            strList.set(index, "");
        index++;
        even = !even;
    }
}
```

Iterators:

Definition of an Iterator

An *iterator* is an object whose sole purpose is to traverse a collection, one element at a time. During iteration, the iterator object maintains a current position in the collection, and is the controlling object in manipulating the elements of the collection.

The `Iterator<E>` Interface

The package `java.util` provides a generic interface, `Iterator<E>`, whose methods are `hasNext`, `next`, and `remove`. The Java Collections API allows iteration over each of its collections classes.

THE METHODS OF `Iterator<E>`

`boolean hasNext()`

Returns `true` if there's at least one more element to be examined, `false` otherwise.

`E next()`

Returns the next element in the iteration. If no elements remain, the method throws a `NoSuchElementException`.

`void remove()`

Deletes from the collection the last element that was returned by `next`. This method can be called only once per call to `next`. It throws an `IllegalStateException` if the `next` method has not yet been called, or if the `remove` method has already been called after the last call to `next`.

Using a Generic Iterator

To iterate over a parameterized collection, you must use a parameterized iterator whose parameter is the same type.

Example 1

```
List<String> list = new ArrayList<String>();
<code to initialize list with strings>
//Print strings in list, one per line.
Iterator<String> itr = list.iterator();
while (itr.hasNext())
    System.out.println(itr.next());
```

NOTE

1. Only classes that allow iteration can use the for-each loop. This is because the loop operates by using an iterator. Thus, the loop in the above example is equivalent to

```
for (String str : list)     //no iterator in sight!
    System.out.println(str);
```

2. Recall, however, that a for-each loop cannot be used to remove elements from the list. The easiest way to "remove all occurrences of ..." from an `ArrayList` is to use an iterator.

Example 2

```
//Remove all 2-character strings from strList.
//Precondition: strList initialized with String objects.
public static void removeTwos(List<String> strList)
{
    Iterator<String> itr = strList.iterator();
    while (itr.hasNext())
        if (itr.next().length() == 2)
            itr.remove();
}
```

Example 3

```
//Assume a list of integer strings.
//Remove all occurrences of "6" from the list.
Iterator<String> itr = list.iterator();
while (itr.hasNext())
{
    String num = itr.next();
    if (num.equals("6"))
    {
        itr.remove();
        System.out.println(list);
    }
}
```

If the original list is 2 6 6 3 5 6 the output will be

```
[2, 6, 3, 5, 6]
[2, 3, 5, 6]
[2, 3, 5]
```

Example 6

```
//Remove all negatives from intList.
//Precondition: intList contains Integer objects.
public static void removeNegs(List<Integer> intList)
{
    Iterator<Integer> itr = intList.iterator();
    while (itr.hasNext())
        if (itr.next().intValue() < 0)
            itr.remove();
}
```

NOTE

In a given program, the declaration

```
Iterator<SomeType> itr = list.iterator();
```

must be made every time you need to initialize the iterator to the beginning of the list.