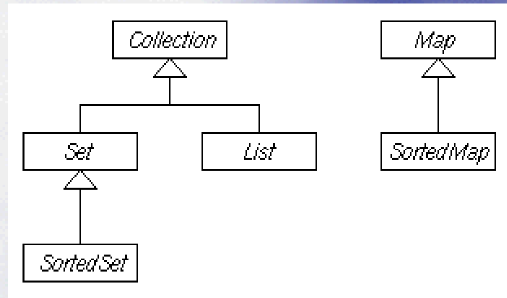
Java Collection Framework



Interface `Collection`

- `add(o)` Add a new element
- `clear()` Remove all elements
- `contains(o)` Membership checking.
- `IsEmpty()` Whether it is empty
- `iterator()` Return an iterator
- `remove(o)` Remove an element
- `size()` The number of elements

Interface `List`

- `add(i,o)` Insert `o` at position `i`
- `add(o)` Append `o` to the end
- `get(i)` Return the `i`-th element
- `remove(i)` Remove the `i`-th element
- `remove(o)` Remove the element `o`
- `set(i,o)` Replace the `i`-th element with `o`

Interface `Map`

- `Clear()` Remove all mappings
- `containsKey(k)` Whether contains a mapping for `k`
- `containsValue(v)` Whether contains a mapping to `v`
- `SetentrySet()` Set of key-value pairs
- `get(k)` The value associated with `k`
- `isEmpty()` Whether it is empty
- `keySet()` Set of keys
- `put(k,v)` Associate `v` with `k`
- `remove(k)` Remove the mapping for `k`
- `size()` The number of pairs
- `values()` The collection of values

Concrete Collections

concrete collection	implements	description
`HashSet`	`Set`	hash table
`TreeSet`	`SortedSet`	balanced binary tree
`ArrayList`	`List`	resizable-array
`LinkedList`	`List`	linked list
`Vector`	`List`	resizable-array
`HashMap`	`Map`	hash table
`TreeMap`	`SortedMap`	balanced binary tree
`Hashtable`	`Map`	hash table

Iterate Through Collections

- The `Itertor` interface:

```
interface Iterator {
  boolean hasNext();
  Object next();
  void remove();
}
```

- The `iterator()` method defined in the `Collection` interface:

```
Iterator iterator()
```

Using `Set`

```
Set set = new HashSet(); // instantiate a concrete set
// ...
set.add(obj); // insert an elements
// ...
int n = set.size(); // get size
// ...
if (set.contains(obj)) {...} // check membership

// iterate through the set
Iterator iter = set.iterator();
while (iter.hasNext()) {
  Object e = iter.next();
  // downcast e
  // ...
}
```

Using `Map`

```
Map map = new HashMap(); // instantiate a concrete map
// ...
map.put(key, val); // insert a key-value pair
// ...
// get the value associated with key
Object val = map.get(key);
map.remove(key); // remove a key-value pair
// ...
if (map.containsValue(val)) { ... }
if (map.containsKey(kay)) { ... }
Set keys = map.keySet(); // get the set of keys
// iterate through the set of keys
Iterator iter = keys.iterator();
while (iter.hasNext()) {
  Key key = (Key) iter.next();
  // ...
}
```

Counting Different Words

```
public class CountWords {
  static public void main(String[] args) {
    Set words = new HashSet();
    BufferedReader in =
          new BufferedReader(
              new InputStreamReader(System.in));
    String delim = " \t\n.,:;?!-/()[]\"\'";
    String line;
    int count = 0;
```

Counting Different Words

```
    try {
      while ((line = in.readLine()) != null) {
        StringTokenizer st =
          new StringTokenizer(line, delim);
        while (st.hasMoreTokens()) {
          count++;
          words.add(
            st.nextToken().toLowerCase());
        }
      }
    } catch (IOException e) {}
    System.out.println("Total number of words: "
                       + count);
    System.out.println("Number of different words: "
                       + words.size());
  }
}
```

Word Frequency

```
public class Count {
  public Count(String word, int i) {
    this.word = word;
    this.i = i;
  }

  public String word;
  public int i;
}
```

Word Frequency (cont'd)

```
public class WordFrequency {

  static public void main(String[] args) {
    Map words = new HashMap();
    String delim = " \t\n.,:;?!-/()[]\"\'";
    BufferedReader in =
      new BufferedReader(
        new InputStreamReader(System.in));
    String line, word;
    Count count;
```

Word Frequency (cont'd)

(class `WordFrequency` continued.)

```
try {
  while ((line = in.readLine()) != null) {
    StringTokenizer st =
      new StringTokenizer(line, delim);
    while (st.hasMoreTokens()) {
      word = st.nextToken().toLowerCase();
      count = (Count) words.get(word);
      if (count == null) {
        words.put(word,
                  new Count(word, 1));
      } else {
        count.i++;
      }
    }
  }
} catch (IOException e) {}
```

Word Frequency (cont'd)

(class `WordFrequency` continued.)

```
    Set set = words.entrySet();
    Iterator iter = set.iterator();
    while (iter.hasNext()) {
      Map.Entry entry =
                  (Map.Entry) iter.next();
      word = (String) entry.getKey();
      count = (Count) entry.getValue();
      System.out.println(word +
          (word.length() < 8 ? "\t\t" : "\t") +
          count.i);
    }
  }
}
```

Word Frequency Output

Using President Lincoln's *The Gettysburg Address* as the input, the output is:

```
devotion        2
years           1
civil           1
place           1
gave            2
they            3
struggled       1
......
men             2
remember        1
who             3
did             1
work            1
rather          2
fathers         1
```

Ordering and Sorting

There are two ways to define orders on objects.

- Each class can define a *natural order* among its instances by implementing the `Comparable` interface.

```
int compareTo(Object o)
```

- Arbitrary orders among different objects can be defined by *comparators*, classes that implement the `Comparator` interface.

```
int compare(Object o1, Object o2)
```

Word Frequency II

```
public class WordFrequency2 {
  static public void main(String[] args) {
    Map words = new TreeMap();
    <smae as WordFrequency>
  }
}
```

Word Frequency II Output

Using President Lincoln's *The Gettysburg Address* as the input, the output is:

```
a               7
above           1
add             1
address         1
advanced        1
ago             1
all             1
......
whether         1
which           2
who             3
will            1
work            1
world           1
years           1
```

User-Defined Order

Reverse alphabetical order of strings

```
public class StringComparator
     implements Comparator  {
  public int compare(Object o1, Object o2) {
    if (o1 != null &&
        o2 != null &&
        o1 instanceof String &&
        o2 instanceof String) {
      String s1 = (String) o1;
      String s2 = (String) o2;
      return - (s1.compareTo(s2));
    } else {
      return 0;
    }
  }
}
```

Word Frequency III

```
public class WordFrequency3 {
  static public void main(String[] args) {
    Map words =
      new TreeMap(new StringComparator());
    <smae as WordFrequency>
  }
}
```

Word Frequency III Output

Using President Lincoln's *The Gettysburg Address* as the input, the output is:

```
years           1
world           1
work            1
will            1
who             3
which           2
whether         1
......
all             1
ago             1
advanced        1
address         1
add             1
above           1
a               7
```

Sorting

```
public class CountComparator
    implements Comparator {
  public int compare(Object o1, Object o2) {
    if (o1 != null &&
        o2 != null &&
        o1 instanceof Count &&
        o2 instanceof Count) {
      Count c1 = (Count) o1;
      Count c2 = (Count) o2;
      return (c2.i - c1.i);
    } else {
      return 0;
    }
  }
}
```

Word Frequency IV

```
public class WordFrequency4 {
  static public void main(String[] args) {
    <smae as WordFrequency>
    List list = new ArrayList(words.values());
    Collections.sort(list,
        new CountComparator());
    Iterator iter = list.iterator();
    while (iter.hasNext()) {
      count = (Count) iter.next();
      word = count.word;
      System.out.println(word +
          (word.length() < 8 ? "\t\t" : "\t") +
          count.i);
    }
  }
}
```

Word Frequency IV Output

Using President Lincoln's *The Gettysburg Address* as the input, the output is:

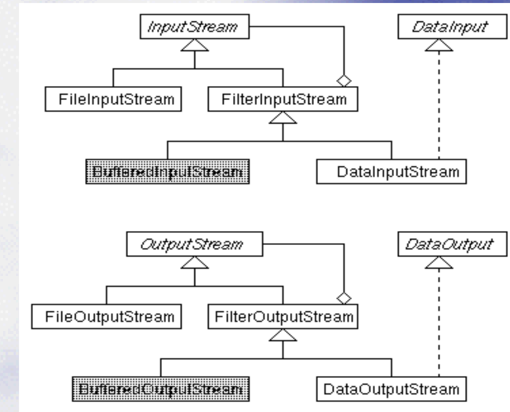
```
the             13
that            12
we              10
here            8
to              8
a               7
and             6
......
consecrate      1
world           1
consecrated     1
remember        1
did             1
work            1
fathers         1
```

The Input/Output Framework

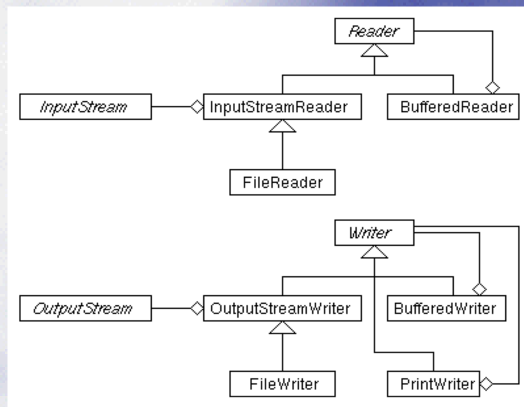
Java supports two types of IO:

- Stream IO
  - A stream is a sequence of bytes.
  - Stream-based IO supports reading or writing data *sequentially*.
  - A stream may be opened for reading or writing, but not reading and writing.
  - There are tow types of streams: the *byte streams* and the *character stream*.
- Random access IO
  - Random access IO support reading and writing data at any positions of a file. A random access file may be opened for reading and writing.

Byte Streams



Character Streams



Standard Input/Output Streams

```
public class java.lang.System {
  public static final InputStream in;
  public static final PrintStream out;
  public static final PrintStream err;
  //...
}
```

Using Reader and Writer

```
BufferedReader in
   = new BufferedReader(
       new FileReader("foo.in"));

BufferedReader in
   = new BufferedReader(
       new InputStreamReader(System.in));

PrintWriter out
   = new PrintWriter(
       new BufferedWriter(
         new FileWriter("foo.out")));

Writer out
   = new BufferedWriter(
       new OutputStreamWriter(System.out));
```

Character Encoding

By default, the character encoding is specified by the system property;

```
      file.encoding=8859_1
```

You can use other encoding by doing the following

```
BufferedReader in =
  new BufferedReader(
    new InputStreamReader(
      new FileInputStream("foo.in"), "GB2312"));

PrintWriter out =
  new PrintWriter(
    new BufferedWriter(
      new OutputStreamWriter(
        new FileOutputStream("foo.out", "GB2312"))));
```