

16.9 Sets

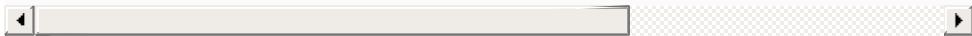
A **Set** is a collection of unique elements (i.e., no duplicates). The collections framework contains several **Set** implementations, including **HashSet** and **TreeSet**. **HashSet** stores its elements (unordered) in a *hash table*, and **TreeSet** stores its elements (ordered) in a *tree*. Hash tables are presented in [Section 16.10](#). Trees are discussed in [Section 21.7](#). [Figure 16.15](#) uses a **HashSet** to *remove duplicate strings* from a **List**. Recall that both **List** and **Collection** are generic types, so line 14 creates a **List** that contains **String** objects, and line 18 passes the collection to method **printNonDuplicates** (lines 22–33), which takes a **Collection** argument. Line 24 constructs a **HashSet<String>** from the **Collection<String>** argument. By definition, **Sets** do *not* contain duplicates, so when the **HashSet** is constructed, it *removes any duplicates* in the **Collection**. Lines 28–30 output elements in the **Set**.

```
1  // Fig. 16.15: SetTest.java
2  // HashSet used to remove duplicate values from
3  import java.util.List;
4  import java.util.Arrays;
5  import java.util.HashSet;
6  import java.util.Set;
7  import java.util.Collection;
```

```

 9  public class SetTest {
10  public static void main(String[] args) {
11      // create and display a List<String>
12      String[] colors = {"red", "white", "blue",
13          "orange", "tan", "white", "cyan", "peac
14      List<String> list = Arrays.asList(colors);
15      System.out.printf("List: %s%n", list);
16
17      // eliminate duplicates then print the uni
18      printNonDuplicates(list);
19  }
20
21      // create a Set from a Collection to eliminat
22      private static void printNonDuplicates(Collec
23          // create a HashSet
24          Set<String> set = new HashSet<>(values);
25
26          System.out.printf("%nNonduplicates are: ")
27
28          for (String value : set) {
29              System.out.printf("%s ", value);
30          }
31
32          System.out.println();
33      }
34  }

```



List: [red, white, blue, green, gray, orange, tan, wh
orange]

Nonduplicates are: tan green peach cyan red orange gr

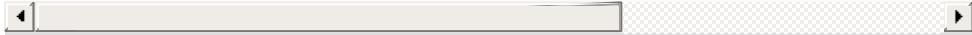


Fig. 16.15

`HashSet` used to remove duplicate values from an array of strings.

Sorted Sets

The collections framework also includes the `SortedSet` **interface** (which extends `Set`) for sets that maintain their elements in *sorted* order—either the *elements' natural order* (e.g., numbers are in *ascending* order) or an order specified by a `Comparator`. Class `TreeSet` implements `SortedSet`. The program in Fig. 16.16 places `Strings` into a `TreeSet`. The `Strings` are sorted as they're added to the `TreeSet`. This example also demonstrates *rangeview* methods, which enable a program to view a portion of a collection.

```
1 // Fig. 16.16: SortedSetTest.java
2 // Using SortedSets and TreeSets.
3 import java.util.Arrays;
4 import java.util.SortedSet;
5 import java.util.TreeSet;
6
7 public class SortedSetTest {
8     public static void main(String[] args) {
9         // create TreeSet from array colors
10        String[] colors = {"yellow", "green", "bla
11        "white", "orange", "red", "green"};
12        SortedSet<String> tree = new TreeSet<>(Arr
13
14        System.out.print("sorted set: ");
15        printSet(tree);
16
17        // get headSet based on "orange"
18        System.out.print("headSet (\"orange\"): ")
```

```

19      printSet(tree.headSet("orange"));
20
21      // get tailSet based upon "orange"
22      System.out.print("tailSet (\"orange\"): ")
23      printSet(tree.tailSet("orange"));
24
25      // get first and last elements
26      System.out.printf("first: %s%n", tree.firs
27      System.out.printf("last : %s%n", tree.last
28      }
29
30      // output SortedSet using enhanced for statem
31      private static void printSet(SortedSet<String
32          for (String s : set) {
33              System.out.printf("%s ", s);
34          }
35
36          System.out.println();
37      }
38  }

```

```

sorted set: black green grey orange red tan white yel
    headSet ("orange"): black green grey
    tailSet ("orange"): orange red tan white yellow
        first: black
        last : yellow

```

Fig. 16.16

Using **SortedSets** and **TreeSets**.

Line 12 creates a **TreeSet<String>** that contains the

elements of array `colors`, then assigns the new `TreeSet<String>` to `SortedSet<String>` variable `tree`. Line 15 outputs the initial set of strings using method `printSet` (lines 31–37), which we discuss momentarily. Line 19 calls `TreeSet` **method** `headSet` to get a subset of the `TreeSet` in which every element is less than "orange". The view returned from `headSet` is then output with `printSet`. If any changes are made to the subset, they'll *also* be made to the original `TreeSet`, because the subset returned by `headSet` is a view of the `TreeSet`.

Line 23 calls `TreeSet` **method** `tailSet` to get a subset in which each element is greater than or equal to "orange", then outputs the result. Any changes made through the `tailSet` view are made to the original `TreeSet`. Lines 26–27 call `SortedSet` methods `first` and `last` to get the smallest and largest elements of the set, respectively.

Method `printSet` (lines 31–37) accepts a `SortedSet` as an argument and prints it. Lines 32–34 print each element of the `SortedSet` using the enhanced `for` statement.