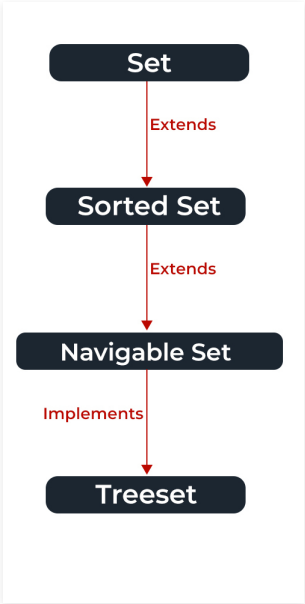
Set in Java

Difficulty Level : Easy Last Updated : 01 Nov, 2021

The set interface is present in java.util package and extends the Collection interface is an unordered collection of objects in which duplicate values cannot be stored. It is an interface that implements the mathematical set. This interface contains the methods inherited from the Collection interface and adds a feature that restricts the insertion of the duplicate elements. There are two interfaces that extend the set implementation namely SortedSet and NavigableSet.



In the above image, the navigable set extends the sorted set interface. Since a set doesn't retain the insertion order, the navigable set interface provides the implementation to navigate through the Set. The class which implements the navigable set is a TreeSet which is an implementation of a self-balancing tree. Therefore, this interface provides us with a way to navigate through this tree.

Declaration: The Set interface is declared as:

```
public interface Set extends Collection
```

Creating Set Objects

Since Set is an interface, objects cannot be created of the typeset. We always need a class that extends this list in order to create an object. And also, after the introduction of Generics in Java 1.5, it is possible to restrict the type of object that can be stored in the Set. This type-safe set can be defined as:

```
// Obj is the type of the object to be stored in Set
Set<Obj> set = new HashSet<Obj> ();
```

Let us discuss methods present in the Set interface provided below in a tabular format below as follows:

Method	Description
add(element)	This method is used to add a specific element to the set. The function adds the element only if the specified element is not already present in the set else the function returns False if the element is already present in the Set.
addAll(collection)	This method is used to append all of the elements from the mentioned collection to the existing set. The elements are added randomly without following any specific order.
clear()	This method is used to remove all the elements from the set but not delete the set. The reference for the set still exists.
contains(element)	This method is used to check whether a specific element is present in the Set or not.
containsAll(collection)	This method is used to check whether the set contains all the elements present in the given collection or not. This method returns true if the set contains all the elements and returns false if any of the elements are missing.
hashCode()	This method is used to get the hashCode value for this instance of the Set. It returns an integer value which is the hashCode value for this instance of the Set.
isEmpty()	This method is used to check whether the set is empty or not.
iterator()	This method is used to return the iterator of the set. The elements from the set are returned in a random order.
remove(element)	This method is used to remove the given element from the set. This method returns True if the specified element is present in the Set otherwise it returns False.
removeAll(collection)	This method is used to remove all the elements from the collection which are present in the set. This method returns true if this set changed as a result of the call.

Method	Description
retainAll(collection)	This method is used to retain all the elements from the set which are mentioned in the given collection. This method returns true if this set changed as a result of the call.
size()	This method is used to get the size of the set. This returns an integer value which signifies the number of elements.
toArray()	This method is used to form an array of the same elements as that of the Set.

Illustration: Sample Program to Illustrate Set interface

```
// Java program Illustrating Set Interface

// Importing utility classes
import java.util.*;

// Main class
public class GFG {

    // Main driver method
    public static void main(String[] args)
    {
        // Demonstrating Set using HashSet
        // Declaring object of type String
        Set<String> hash_Set = new HashSet<String>();

        // Adding elements to the Set
        // using add() method
        hash_Set.add("Geeks");
        hash_Set.add("For");
        hash_Set.add("Geeks");
        hash_Set.add("Example");
        hash_Set.add("Set");

        // Printing elements of HashSet object
        System.out.println(hash_Set);
    }
}
```

Output

```
[Set, Example, Geeks, For]
```

Operations on the Set Interface

The set interface allows the users to perform the basic mathematical operation on the set. Let's take two arrays to understand these basic operations. Let set1 = [1, 3, 2, 4, 8, 9, 0] and set2 = [1, 3, 7, 5, 4, 0, 7, 5]. Then the possible operations on the sets are:

1. Intersection: This operation returns all the common elements from the given two sets. For the above two sets, the intersection would be:

```
Intersection = [0, 1, 3, 4]
```

2. Union: This operation adds all the elements in one set with the other. For the above two sets, the union would be:

```
Union = [0, 1, 2, 3, 4, 5, 7, 8, 9]
```

3. Difference: This operation removes all the values present in one set from the other set. For the above two sets, the difference would be:

```
Difference = [2, 8, 9]
```

Now let us implement the following operations as defined above as follows:

Example:

```
// Java Program Demonstrating Operations on the Set
// such as Union, Intersection and Difference operations

// Importing all utility classes
import java.util.*;

// Main class
public class SetExample {

    // Main driver method
    public static void main(String args[])
    {
        // Creating an object of Set class
```

```
        // Declaring object of Integer type
        Set<Integer> a = new HashSet<Integer>();

        // Adding all elements to List
        a.addAll(Arrays.asList(
            new Integer[] { 1, 3, 2, 4, 8, 9, 0 }));

      // Again declaring object of Set class
      // with reference to HashSet
        Set<Integer> b = new HashSet<Integer>();

      b.addAll(Arrays.asList(
            new Integer[] { 1, 3, 7, 5, 4, 0, 7, 5 }));


        // To find union
        Set<Integer> union = new HashSet<Integer>(a);
        union.addAll(b);
        System.out.print("Union of the two Set");
        System.out.println(union);

        // To find intersection
        Set<Integer> intersection = new HashSet<Integer>(a);
        intersection.retainAll(b);
        System.out.print("Intersection of the two Set");
        System.out.println(intersection);

        // To find the symmetric difference
        Set<Integer> difference = new HashSet<Integer>(a);
        difference.removeAll(b);
        System.out.print("Difference of the two Set");
        System.out.println(difference);
    }
}
```

Output

```
Union of the two Set[0, 1, 2, 3, 4, 5, 7, 8, 9]
Intersection of the two Set[0, 1, 3, 4]
Difference of the two Set[2, 8, 9]
```

Performing Various Operations on SortedSet

After the introduction of Generics in Java 1.5, it is possible to restrict the type of object that can be stored in the Set. Since Set is an interface, it can be used only with a class that implements this interface. HashSet is one of the widely used classes which

implements the Set interface. Now, let's see how to perform a few frequently used operations on the HashSet. We are going to perform the following operations as follows:

1. Adding elements
2. Accessing elements
3. Removing elements
4. Iterating elements
5. Iterating through Set

Now let us discuss these operations individually as follows:

Operations 1: Adding Elements

In order to add an element to the Set, we can use the add() method. However, the insertion order is not retained in the Set. Internally, for every element, a hash is generated and the values are stored with respect to the generated hash. the values are compared and sorted in ascending order. We need to keep a note that duplicate elements are not allowed and all the duplicate elements are ignored. And also, Null values are accepted by the Set.

Example

```
// Java Program Demonstrating Working of Set by
// Adding elements using add() method

// Importing all utility classes
import java.util.*;

// Main class
class GFG {

    // Main driver method
    public static void main(String[] args)
    {
        // Creating an object of Set and
        // declaring object of type String
        Set<String> hs = new HashSet<String>();

        // Adding elements to above object
        // using add() method
        hs.add("B");
        hs.add("B");
        hs.add("C");
        hs.add("A");
```

```
        // Printing the elements inside the Set object
        System.out.println(hs);
    }
}
```

Output

```
[A, B, C]
```

Operation 2: Accessing the Elements

After adding the elements, if we wish to access the elements, we can use inbuilt methods like contains().

Example

```
// Java code to demonstrate Working of Set by
// Accessing the Elements og the Set object

// Importing all utility classes
import java.util.*;

// Main class
class GFG {

    // Main driver method
    public static void main(String[] args)
    {
        // Creating an object of Set and
        // declaring object of type String
        Set<String> hs = new HashSet<String>();

        // Elements are added using add() method
        // Later onwards we wil show accessing the same

        // Custom input elements
        hs.add("A");
        hs.add("B");
        hs.add("C");
        hs.add("A");

        // Print the Set object elements
        System.out.println("Set is " + hs);
```

```
        // Declaring a string
        String check = "D";

        // Check if the above string exists in
        // the SortedSet or not
        // using contains() method
        System.out.println("Contains " + check + " "
                           + hs.contains(check));
    }
}
```

Output

```
Set is [A, B, C]
Contains D false
```

Operation 3: Removing the Values

The values can be removed from the Set using the remove() method.

Example

```
// Java Program Demonstrating Working of Set by
// Removing Element/s from the Set

// Importing all utility classes
import java.util.*;

// Main class
class GFG {

    // Main driver method
    public static void main(String[] args)
    {
        // Declaring object of Set of type String
        Set<String> hs = new HashSet<String>();

        // Elements are added
        // using add() method

        // Custom input elements
        hs.add("A");
        hs.add("B");
```

```
        hs.add("C");
        hs.add("B");
        hs.add("D");
        hs.add("E");

        // Printing initial Set elements
        System.out.println("Initial HashSet " + hs);

        // Removing custom element
        // using remove() method
        hs.remove("B");

        // Printing Set elements after removing an element
        // and printing updated Set elements
        System.out.println("After removing element " + hs);
    }
}
```

Output

```
Initial HashSet [A, B, C, D, E]
After removing element [A, C, D, E]
```

Operation 4: Iterating through the Set

There are various ways to iterate through the Set. The most famous one is to use the enhanced for loop.

Example

```
// Java Program to Demonstrate Working of Set by
// Iterating through the Elements

// Importing utility classes
import java.util.*;

// Main class
class GFG {

    // Main driver method
    public static void main(String[] args)
    {
        // Creating object of Set and declaring String type
        Set<String> hs = new HashSet<String>();
```

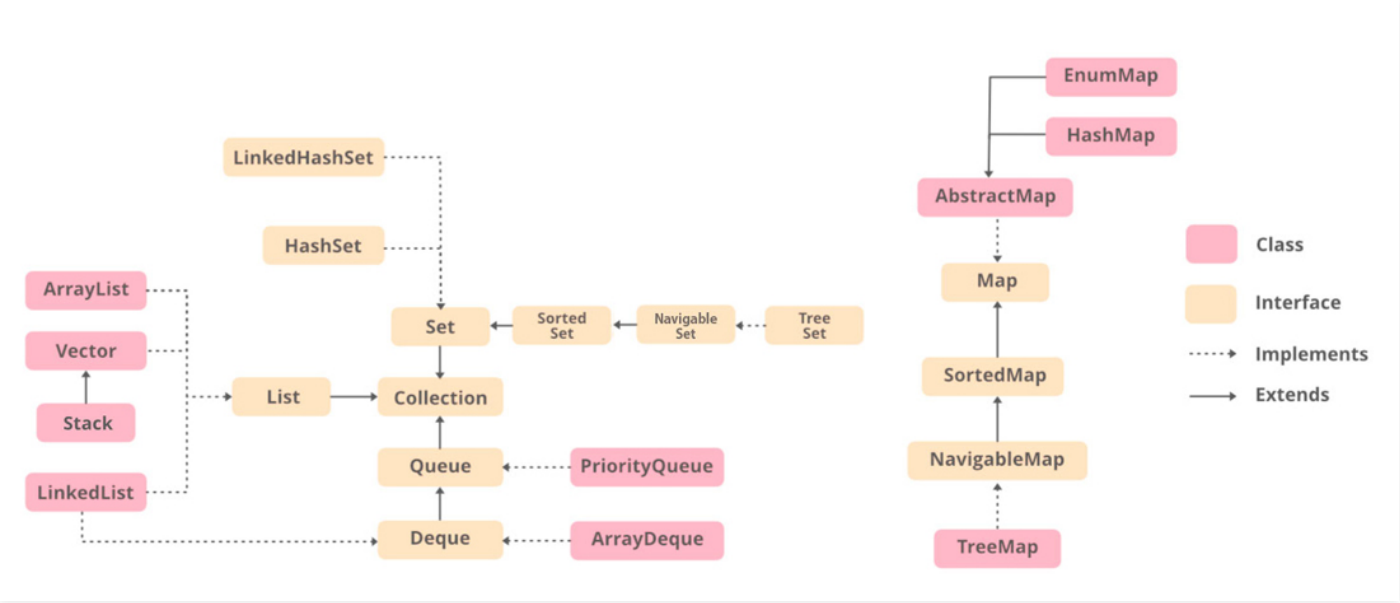
```
        // Adding elements to Set
        // using add() method

        // Custom input elements
        hs.add("A");
        hs.add("B");
        hs.add("C");
        hs.add("B");
        hs.add("D");
        hs.add("E");

        // Iterating through the Set
        // via for-each loop
        for (String value : hs)

            // Printing all the values inside the object
            System.out.print(value + ", ");

        System.out.println();
    }
}
```

Output

```
A, B, C, D, E,
```

Classes that implement the Set interface in Java Collections can be easily perceive d from the image below as follows and are listed as follows:

- *HashSet*
- *EnumSet*
- *LinkedHashSet*
- *TreeSet*



Class 1: HashSet

HashSet class which is implemented in the collection framework is an inherent implementation of the hash table data structure. The objects that we insert into the HashSet do not guarantee to be inserted in the same order. The objects are inserted based on their hashcode. This class also allows the insertion of NULL elements. Let's see how to create a set object using this class.

Example

```
// Java program Demonstrating Creation of Set object
// Using the Hashset class

// Importing utility classes
import java.util.*;

// Main class
class GFG {

    // Main driver method
    public static void main(String[] args)
    {
        // Creating object of Set of type String
        Set<String> h = new HashSet<String>();

        // Adding elements into the HashSet
        // using add() method

        // Custom input elements
        h.add("India");
```

```
        h.add("Australia");
        h.add("South Africa");

        // Adding the duplicate element
        h.add("India");

        // Displaying the HashSet
        System.out.println(h);

        // Removing items from HashSet
        // using remove() method
        h.remove("Australia");
        System.out.println("Set after removing "
                           + "Australia:" + h);

        // Iterating over hash set items
        System.out.println("Iterating over set:");

        // Iterating through iterators
        Iterator<String> i = h.iterator();

        // It holds true till there is a single element
        // remaining in the object
        while (i.hasNext())

            System.out.println(i.next());
    }
}
```

Output

```
[South Africa, Australia, India]
Set after removing Australia:[South Africa, India]
Iterating over set:
South Africa
India
```

Class 2: EnumSet

EnumSet class which is implemented in the collections framework is one of the specialized implementations of the Set interface for use with the enumeration type. It is a high-performance set implementation, much faster than HashSet. All of the elements in an enum set must come from a single enumeration type that is specified when the set is created either explicitly or implicitly. Let's see how to create a set object using this class.

Example

```
// Java program to demonstrate the
// creation of the set object
// using the EnumSet class
import java.util.*;

enum Gfg { CODE, LEARN, CONTRIBUTE, QUIZ, MCQ }
;

public class GFG {

    public static void main(String[] args)
    {
        // Creating a set
        Set<Gfg> set1;

        // Adding the elements
        set1 = EnumSet.of(Gfg.QUIZ, Gfg.CONTRIBUTE,
                          Gfg.LEARN, Gfg.CODE);

        System.out.println("Set 1: " + set1);
    }
}
```

Output

```
Set 1: [CODE, LEARN, CONTRIBUTE, QUIZ]
```

Class 3: LinkedHashSet

LinkedHashSet class which is implemented in the collections framework is an ordered version of HashSet that maintains a doubly-linked List across all elements. When the iteration order is needed to be maintained this class is used. When iterating through a HashSet the order is unpredictable, while a LinkedHashSet lets us iterate through the elements in the order in which they were inserted. Let's see how to create a set object using this class.

Example

```
// Java program to demonstrate the
// creation of Set object using
// the LinkedHashset class
import java.util.*;

class GFG {

    public static void main(String[] args)
    {
        Set<String> lh = new LinkedHashSet<String>();

        // Adding elements into the LinkedHashSet
        // using add()
        lh.add("India");
        lh.add("Australia");
        lh.add("South Africa");

        // Adding the duplicate
        // element
        lh.add("India");

        // Displaying the LinkedHashSet
        System.out.println(lh);

        // Removing items from LinkedHashSet
        // using remove()
        lh.remove("Australia");
        System.out.println("Set after removing "
                           + "Australia:" + lh);

        // Iterating over linked hash set items
        System.out.println("Iterating over set:");
        Iterator<String> i = lh.iterator();
        while (i.hasNext())
            System.out.println(i.next());
    }
}
```

Output

```
[India, Australia, South Africa]
Set after removing Australia:[India, South Africa]
Iterating over set:
India
South Africa
```

Class 4: TreeSet

TreeSet class which is implemented in the collections framework and implementation of the SortedSet Interface and SortedSet extends Set Interface. It behaves like a simple set with the exception that it stores elements in a sorted format. TreeSet uses a tree data structure for storage. Objects are stored in sorted, ascending order. But we can iterate in descending order using the method TreeSet.descendingIterator(). Let's see how to create a set object using this class.

Example

```
// Java Program Demonstrating Creation of Set object
// Using the TreeSet class

// Importing utility classes
import java.util.*;

// Main class
class GFG {

    // Main driver method
    public static void main(String[] args)
    {
        // Creating a Set object and declaring it of String
        // type
        // with reference to TreeSet
        Set<String> ts = new TreeSet<String>();

        // Adding elements into the TreeSet
        // using add()
        ts.add("India");
        ts.add("Australia");
        ts.add("South Africa");

        // Adding the duplicate
        // element
        ts.add("India");

        // Displaying the TreeSet
        System.out.println(ts);

        // Removing items from TreeSet
        // using remove()
        ts.remove("Australia");
        System.out.println("Set after removing "
                           + "Australia:" + ts);

        // Iterating over Tree set items
        System.out.println("Iterating over set:");
```

```
        Iterator<String> i = ts.iterator();

        while (i.hasNext())
            System.out.println(i.next());
    }
}
```

Output

```
[Australia, India, South Africa]
Set after removing Australia:[India, South Africa]
Iterating over set:
India
South Africa
```