Collections in Java

[**1.8**](https://www.geeksforgeeks.org/basic/)

A Collection is a group of individual objects represented as a single unit. Java provides Collection Framework which defines several classes and interfaces to represent a group of objects as a single unit.

The Collection interface (**java.util.Collection**) and Map interface (**java.util.Map**) are two main root interfaces of Java collection classes.

**Need for Collection Framework :**

Before Collection Framework (or before JDK 1.2) was introduced, the standard methods for grouping Java objects (or collections) were array or Vector or Hashtable. All three of these collections had no common interface.  
For example, if we want to access elements of array, vector or Hashtable. All these three have different methods and syntax for accessing members:

|  |
| --- |
| // Java program to show whey collection framework was needed  import java.io.\*;  import java.util.\*;    class Test  {      public static void main (String[] args)      {          // Creating instances of array, vector and hashtable          int arr[] = new int[] {1, 2, 3, 4};          Vector<Integer> v = new Vector();          Hashtable<Integer, String> h = new Hashtable();          v.addElement(1);          v.addElement(2);          h.put(1,"geeks");          h.put(2,"4geeks");            // Array instance creation requires [], while Vector          // and hastable require ()          // Vector element insertion requires addElement(), but          // hashtable element insertion requires put()            // Accessing first element of array, vector and hashtable          System.out.println(arr[0]);          System.out.println(v.elementAt(0));          System.out.println(h.get(1));            // Array elements are accessed using [], vector elements          // using elementAt() and hashtable elements using get()      }  } |

Run on IDE

Output:

1

1

geek

As we can see, none of the collections (Array, Vector or Hashtable) implements a standard member access interface. So, it was very difficult for programmers to write algorithm that can work for all kind of collections.  
Another drawback is that, most of the ‘Vector’ methods are final. So, we cannot extend ’Vector’ class to implement a similar kind of collection.  
***Java developers decided to come up with a common interface to deal with the above mentioned problems and introduced Collection Framework***, they introduced collections in JDK 1.2 and changed the legacy Vector and Hashtable to conform to the collection framework.

**Advantages of Collection Framework:**

1. Consistent API : The API has basic set of interfaces like Collection, Set, List, or Map. All those classes (such as ArrayList, LinkedList, Vector etc) which implements, these interfaces have some common set of methods.
2. Reduces programming effort: The programmer need not to worry about design of Collection rather than he can focus on its best use in his program.
3. Increases program speed and quality: Increases performance by providing high-performance implementations of useful data structures and algorithms.

**Hierarchy of Collection Framework**

Collection Map

/ / \ \ |

/ / \ \ |

Set List Queue Dequeue SortedMap

/

/

SortedSet

**Core Interfaces in Collections**

Note that this diagram shows only core interfaces.

**Collection :** Root interface with basic methods like add(), remove(),

contains(), isEmpty(), addAll(), ... etc.

**Set :** Doesn't allow duplicates. Example implementations of Set

interface are HashSet (Hashing based) and TreeSet (balanced

BST based). Note that TreeSet implements **SortedSet**.

**List :** Can contain duplicates and elements are ordered. Example

implementations are LinkedList (linked list based) and

[ArrayList](https://www.geeksforgeeks.org/array-vs-arraylist-in-java/) (dynamic array based)

**Queue :** Typically order elements in FIFO order except exceptions

like PriorityQueue.

**Deque :** Elements can be inserted and removed at both ends. Allows

both LIFO and FIFO.

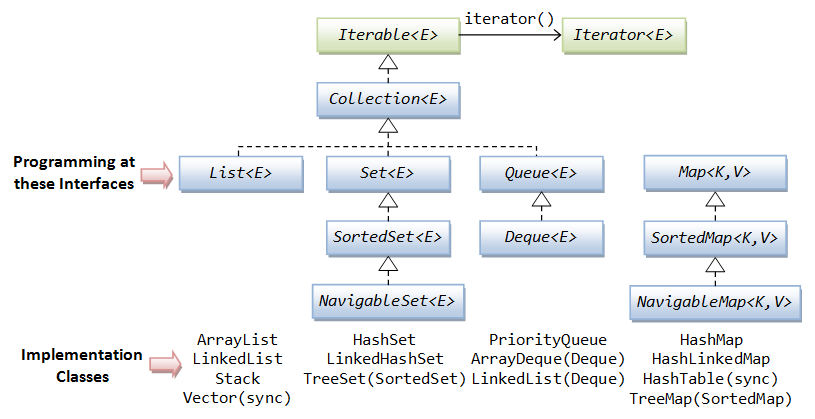
**Map :** Contains Key value pairs. Doesn't allow duplicates. Example

implementation are [HashMap and TreeMap](https://www.geeksforgeeks.org/hashmap-treemap-java/).

TreeMap implements **SortedMap**.

The difference between Set and Map interface is, in Set we have only

keys, but in Map, we have key value pairs.



Collections in Java

1. [Java Collection Framework](https://www.javatpoint.com/collections-in-java)
2. [Hierarchy of Collection Framework](https://www.javatpoint.com/collections-in-java#collectionhierarchy)
3. [Collection interface](https://www.javatpoint.com/collections-in-java#collectionmethods)
4. [Iterator interface](https://www.javatpoint.com/collections-in-java#collectioniterator)

**Collections in java** is a framework that provides an architecture to store and manipulate the group of objects.

All the operations that you perform on a data such as searching, sorting, insertion, manipulation, deletion etc. can be performed by Java Collections.

Java Collection simply means a single unit of objects. Java Collection framework provides many interfaces (Set, List, Queue, Deque etc.) and classes (ArrayList, Vector, LinkedList, PriorityQueue, HashSet, LinkedHashSet, TreeSet etc).

What is Collection in java

Collection represents a single unit of objects i.e. a group.

What is framework in java

* provides readymade architecture.
* represents set of classes and interface.
* is optional.

What is Collection framework

Collection framework represents a unified architecture for storing and manipulating group of objects. It has:

1. Interfaces and its implementations i.e. classes
2. Algorithm

### Hierarchy of Collection Framework

Let us see the hierarchy of collection framework.The **java.util** package contains all the classes and interfaces for Collection framework.

hierarchy of collection framework

### Methods of Collection interface

There are many methods declared in the Collection interface. They are as follows:

|  |  |  |
| --- | --- | --- |
| **No.** | **Method** | **Description** |
| 1 | public boolean add(Object element) | is used to insert an element in this collection. |
| 2 | public boolean addAll(Collection c) | is used to insert the specified collection elements in the invoking collection. |
| 3 | public boolean remove(Object element) | is used to delete an element from this collection. |
| 4 | public boolean removeAll(Collection c) | is used to delete all the elements of specified collection from the invoking collection. |
| 5 | public boolean retainAll(Collection c) | is used to delete all the elements of invoking collection except the specified collection. |
| 6 | public int size() | return the total number of elements in the collection. |
| 7 | public void clear() | removes the total no of element from the collection. |
| 8 | public boolean contains(Object element) | is used to search an element. |
| 9 | public boolean containsAll(Collection c) | is used to search the specified collection in this collection. |
| 10 | public Iterator iterator() | returns an iterator. |
| 11 | public Object[] toArray() | converts collection into array. |
| 12 | public boolean isEmpty() | checks if collection is empty. |
| 13 | public boolean equals(Object element) | matches two collection. |
| 14 | public int hashCode() | returns the hashcode number for collection. |

### Iterator interface

|  |
| --- |
| Iterator interface provides the facility of iterating the elements in forward direction only. |

#### Methods of Iterator interface

There are only three methods in the Iterator interface. They are:

|  |  |  |
| --- | --- | --- |
| **No.** | **Method** | **Description** |
| 1 | public boolean hasNext() | It returns true if iterator has more elements. |
| 2 | public Object next() | It returns the element and moves the cursor pointer to the next element. |
| 3 | public void remove() | It removes the last elements returned by the iterator. It is rarely used. |

What we are going to learn in Java Collections Framework

1. [ArrayList class](https://www.javatpoint.com/java-arraylist)
2. [LinkedList class](https://www.javatpoint.com/java-linkedlist)
3. [List interface](https://www.javatpoint.com/java-list)
4. [HashSet class](https://www.javatpoint.com/java-hashset)
5. [LinkedHashSet class](https://www.javatpoint.com/java-linkedhashset)
6. [TreeSet class](https://www.javatpoint.com/java-treeset)
7. [PriorityQueue class](https://www.javatpoint.com/java-priorityqueue)
8. [Map interface](https://www.javatpoint.com/java-map)
9. [HashMap class](https://www.javatpoint.com/java-hashmap)
10. [LinkedHashMap class](https://www.javatpoint.com/java-linkedhashmap)
11. [TreeMap class](https://www.javatpoint.com/TreeMap-class-in-collection-framework)
12. [Hashtable class](https://www.javatpoint.com/Hashtable-class-in-collection-framework)
13. [Sorting](https://www.javatpoint.com/Sorting-in-collection-framework)
14. [Comparable interface](https://www.javatpoint.com/Comparable-interface-in-collection-framework)
15. [Comparator interface](https://www.javatpoint.com/Comparator-interface-in-collection-framework)
16. [Properties class in Java](https://www.javatpoint.com/properties-class-in-java)

# Java ArrayList class

Java ArrayList class hierarchy

Java ArrayList class uses a dynamic array for storing the elements. It inherits AbstractList class and implements List interface.

The important points about Java ArrayList class are:

* Java ArrayList class can contain duplicate elements.
* Java ArrayList class maintains insertion order.
* Java ArrayList class is non synchronized.
* Java ArrayList allows random access because array works at the index basis.
* In Java ArrayList class, manipulation is slow because a lot of shifting needs to be occurred if any element is removed from the array list.

### Hierarchy of ArrayList class

As shown in above diagram, Java ArrayList class extends AbstractList class which implements List interface. The List interface extends Collection and Iterable interfaces in hierarchical order.

### ArrayList class declaration

Let's see the declaration for java.util.ArrayList class.

1. **public** **class** ArrayList<E> **extends** AbstractList<E> **implements** List<E>, RandomAccess, Cloneable, Serializable

### Constructors of Java ArrayList

|  |  |
| --- | --- |
| **Constructor** | **Description** |
| ArrayList() | It is used to build an empty array list. |
| ArrayList(Collection c) | It is used to build an array list that is initialized with the elements of the collection c. |
| ArrayList(int capacity) | It is used to build an array list that has the specified initial capacity. |

### Methods of Java ArrayList

|  |  |
| --- | --- |
| **Method** | **Description** |
| void add(int index, Object element) | It is used to insert the specified element at the specified position index in a list. |
| boolean addAll(Collection c) | It is used to append all of the elements in the specified collection to the end of this list, in the order that they are returned by the specified collection's iterator. |
| void clear() | It is used to remove all of the elements from this list. |
| int lastIndexOf(Object o) | It is used to return the index in this list of the last occurrence of the specified element, or -1 if the list does not contain this element. |
| Object[] toArray() | It is used to return an array containing all of the elements in this list in the correct order. |
| Object[] toArray(Object[] a) | It is used to return an array containing all of the elements in this list in the correct order. |
| boolean add(Object o) | It is used to append the specified element to the end of a list. |
| boolean addAll(int index, Collection c) | It is used to insert all of the elements in the specified collection into this list, starting at the specified position. |
| Object clone() | It is used to return a shallow copy of an ArrayList. |
| int indexOf(Object o) | It is used to return the index in this list of the first occurrence of the specified element, or -1 if the List does not contain this element. |
| void trimToSize() | It is used to trim the capacity of this ArrayList instance to be the list's current size. |

### Java Non-generic Vs Generic Collection

Java collection framework was non-generic before JDK 1.5. Since 1.5, it is generic.

Java new generic collection allows you to have only one type of object in collection. Now it is type safe so typecasting is not required at run time.

Let's see the old non-generic example of creating java collection.

1. ArrayList al=**new** ArrayList();//creating old non-generic arraylist

Let's see the new generic example of creating java collection.

1. ArrayList<String> al=**new** ArrayList<String>();//creating new generic arraylist

In generic collection, we specify the type in angular braces. Now ArrayList is forced to have only specified type of objects in it. If you try to add another type of object, it gives *compile time error*.

For more information of java generics, click here [Java Generics Tutorial](https://www.javatpoint.com/generics-in-java).

### Java ArrayList Example

1. **import** java.util.\*;
2. **class** TestCollection1{
3. **public** **static** **void** main(String args[]){
4. ArrayList<String> list=**new** ArrayList<String>();//Creating arraylist
5. list.add("Ravi");//Adding object in arraylist
6. list.add("Vijay");
7. list.add("Ravi");
8. list.add("Ajay");
9. //Traversing list through Iterator
10. Iterator itr=list.iterator();
11. **while**(itr.hasNext()){
12. System.out.println(itr.next());
13. }
14. }
15. }

[**Test it Now**](http://www.javatpoint.com/opr/test.jsp?filename=TestCollection1)

Ravi

Vijay

Ravi

Ajay

### Two ways to iterate the elements of collection in java

There are two ways to traverse collection elements:

1. By Iterator interface.
2. By for-each loop.

In the above example, we have seen traversing ArrayList by Iterator. Let's see the example to traverse ArrayList elements using for-each loop.

### Iterating Collection through for-each loop

1. **import** java.util.\*;
2. **class** TestCollection2{
3. **public** **static** **void** main(String args[]){
4. ArrayList<String> al=**new** ArrayList<String>();
5. al.add("Ravi");
6. al.add("Vijay");
7. al.add("Ravi");
8. al.add("Ajay");
9. **for**(String obj:al)
10. System.out.println(obj);
11. }
12. }

[**Test it Now**](http://www.javatpoint.com/opr/test.jsp?filename=TestCollection2)

Ravi

Vijay

Ravi

Ajay

### User-defined class objects in Java ArrayList

Let's see an example where we are storing Student class object in array list.

1. **class** Student{
2. **int** rollno;
3. String name;
4. **int** age;
5. Student(**int** rollno,String name,**int** age){
6. **this**.rollno=rollno;
7. **this**.name=name;
8. **this**.age=age;
9. }
10. }
11. **import** java.util.\*;
12. **public** **class** TestCollection3{
13. **public** **static** **void** main(String args[]){
14. //Creating user-defined class objects
15. Student s1=**new** Student(101,"John",23);
16. Student s2=**new** Student(102,"Ravi",21);
17. Student s2=**new** Student(103,"Hanumat",25);
18. //creating arraylist
19. ArrayList<Student> al=**new** ArrayList<Student>();
20. al.add(s1);//adding Student class object
21. al.add(s2);
22. al.add(s3);
23. //Getting Iterator
24. Iterator itr=al.iterator();
25. //traversing elements of ArrayList object
26. **while**(itr.hasNext()){
27. Student st=(Student)itr.next();
28. System.out.println(st.rollno+" "+st.name+" "+st.age);
29. }
30. }
31. }

[**Test it Now**](http://www.javatpoint.com/opr/test.jsp?filename=TestCollection3)

101 John 23

102 Ravi 21

103 Hanumat 25

### Example of addAll(Collection c) method

1. **import** java.util.\*;
2. **class** TestCollection4{
3. **public** **static** **void** main(String args[]){
4. ArrayList<String> al=**new** ArrayList<String>();
5. al.add("Ravi");
6. al.add("Vijay");
7. al.add("Ajay");
8. ArrayList<String> al2=**new** ArrayList<String>();
9. al2.add("John");
10. al2.add("Hanumat");
11. al.addAll(al2);//adding second list in first list
12. Iterator itr=al.iterator();
13. **while**(itr.hasNext()){
14. System.out.println(itr.next());
15. }
16. }
17. }

[**Test it Now**](http://www.javatpoint.com/opr/test.jsp?filename=TestCollection4)

Ravi

Vijay

Ajay

John

Hanumat

### Example of removeAll() method

1. **import** java.util.\*;
2. **class** TestCollection5{
3. **public** **static** **void** main(String args[]){
4. ArrayList<String> al=**new** ArrayList<String>();
5. al.add("Ravi");
6. al.add("Vijay");
7. al.add("Ajay");
8. ArrayList<String> al2=**new** ArrayList<String>();
9. al2.add("Ravi");
10. al2.add("Hanumat");
11. al.removeAll(al2);
12. System.out.println("iterating the elements after removing the elements of al2...");
13. Iterator itr=al.iterator();
14. **while**(itr.hasNext()){
15. System.out.println(itr.next());
16. }
18. }
19. }

[**Test it Now**](http://www.javatpoint.com/opr/test.jsp?filename=TestCollection5)

iterating the elements after removing the elements of al2...

Vijay

Ajay

### Example of retainAll() method

1. **import** java.util.\*;
2. **class** TestCollection6{
3. **public** **static** **void** main(String args[]){
4. ArrayList<String> al=**new** ArrayList<String>();
5. al.add("Ravi");
6. al.add("Vijay");
7. al.add("Ajay");
8. ArrayList<String> al2=**new** ArrayList<String>();
9. al2.add("Ravi");
10. al2.add("Hanumat");
11. al.retainAll(al2);
12. System.out.println("iterating the elements after retaining the elements of al2...");
13. Iterator itr=al.iterator();
14. **while**(itr.hasNext()){
15. System.out.println(itr.next());
16. }
17. }
18. }

[**Test it Now**](http://www.javatpoint.com/opr/test.jsp?filename=TestCollection6)

iterating the elements after retaining the elements of al2...

Ravi

### Java ArrayList Example: Book

Let's see an ArrayList example where we are adding books to list and printing all the books.

1. **import** java.util.\*;
2. **class** Book {
3. **int** id;
4. String name,author,publisher;
5. **int** quantity;
6. **public** Book(**int** id, String name, String author, String publisher, **int** quantity) {
7. **this**.id = id;
8. **this**.name = name;
9. **this**.author = author;
10. **this**.publisher = publisher;
11. **this**.quantity = quantity;
12. }
13. }
14. **public** **class** ArrayListExample {
15. **public** **static** **void** main(String[] args) {
16. //Creating list of Books
17. List<Book> list=**new** ArrayList<Book>();
18. //Creating Books
19. Book b1=**new** Book(101,"Let us C","Yashwant Kanetkar","BPB",8);
20. Book b2=**new** Book(102,"Data Communications & Networking","Forouzan","Mc Graw Hill",4);
21. Book b3=**new** Book(103,"Operating System","Galvin","Wiley",6);
22. //Adding Books to list
23. list.add(b1);
24. list.add(b2);
25. list.add(b3);
26. //Traversing list
27. **for**(Book b:list){
28. System.out.println(b.id+" "+b.name+" "+b.author+" "+b.publisher+" "+b.quantity);
29. }
30. }
31. }

[**Test it Now**](http://www.javatpoint.com/opr/test.jsp?filename=TestCollection101)

Output:

101 Let us C Yashwant Kanetkar BPB 8

102 Data Communications & Networking Forouzan Mc Graw Hill 4

103 Operating System Galvin Wiley 6

# Java LinkedList class

Java LinkedList class hierarchy

Java LinkedList class uses doubly linked list to store the elements. It provides a linked-list data structure. It inherits the AbstractList class and implements List and Deque interfaces.

The important points about Java LinkedList are:

* Java LinkedList class can contain duplicate elements.
* Java LinkedList class maintains insertion order.
* Java LinkedList class is non synchronized.
* In Java LinkedList class, manipulation is fast because no shifting needs to be occurred.
* Java LinkedList class can be used as list, stack or queue.

### Hierarchy of LinkedList class

As shown in above diagram, Java LinkedList class extends AbstractSequentialList class and implements List and Deque interfaces.

### Doubly Linked List

In case of doubly linked list, we can add or remove elements from both side.

java LinkedList class using doubly linked list

### LinkedList class declaration

Let's see the declaration for java.util.LinkedList class.

1. **public** **class** LinkedList<E> **extends** AbstractSequentialList<E> **implements** List<E>, Deque<E>, Cloneable, Serializable

### Constructors of Java LinkedList

|  |  |
| --- | --- |
| **Constructor** | **Description** |
| LinkedList() | It is used to construct an empty list. |
| LinkedList(Collection c) | It is used to construct a list containing the elements of the specified collection, in the order they are returned by the collection's iterator. |

### Methods of Java LinkedList

|  |  |
| --- | --- |
| **Method** | **Description** |
| void add(int index, Object element) | It is used to insert the specified element at the specified position index in a list. |
| void addFirst(Object o) | It is used to insert the given element at the beginning of a list. |
| void addLast(Object o) | It is used to append the given element to the end of a list. |
| int size() | It is used to return the number of elements in a list |
| boolean add(Object o) | It is used to append the specified element to the end of a list. |
| boolean contains(Object o) | It is used to return true if the list contains a specified element. |
| boolean remove(Object o) | It is used to remove the first occurence of the specified element in a list. |
| Object getFirst() | It is used to return the first element in a list. |
| Object getLast() | It is used to return the last element in a list. |
| int indexOf(Object o) | It is used to return the index in a list of the first occurrence of the specified element, or -1 if the list does not contain any element. |
| int lastIndexOf(Object o) | It is used to return the index in a list of the last occurrence of the specified element, or -1 if the list does not contain any element. |

### Java LinkedList Example

1. **import** java.util.\*;
2. **public** **class** TestCollection7{
3. **public** **static** **void** main(String args[]){
5. LinkedList<String> al=**new** LinkedList<String>();
6. al.add("Ravi");
7. al.add("Vijay");
8. al.add("Ravi");
9. al.add("Ajay");
11. Iterator<String> itr=al.iterator();
12. **while**(itr.hasNext()){
13. System.out.println(itr.next());
14. }
15. }
16. }

[**Test it Now**](http://www.javatpoint.com/opr/test.jsp?filename=TestCollection7)

Output:Ravi

Vijay

Ravi

Ajay

### Java LinkedList Example: Book

1. **import** java.util.\*;
2. **class** Book {
3. **int** id;
4. String name,author,publisher;
5. **int** quantity;
6. **public** Book(**int** id, String name, String author, String publisher, **int** quantity) {
7. **this**.id = id;
8. **this**.name = name;
9. **this**.author = author;
10. **this**.publisher = publisher;
11. **this**.quantity = quantity;
12. }
13. }
14. **public** **class** LinkedListExample {
15. **public** **static** **void** main(String[] args) {
16. //Creating list of Books
17. List<Book> list=**new** LinkedList<Book>();
18. //Creating Books
19. Book b1=**new** Book(101,"Let us C","Yashwant Kanetkar","BPB",8);
20. Book b2=**new** Book(102,"Data Communications & Networking","Forouzan","Mc Graw Hill",4);
21. Book b3=**new** Book(103,"Operating System","Galvin","Wiley",6);
22. //Adding Books to list
23. list.add(b1);
24. list.add(b2);
25. list.add(b3);
26. //Traversing list
27. **for**(Book b:list){
28. System.out.println(b.id+" "+b.name+" "+b.author+" "+b.publisher+" "+b.quantity);
29. }
30. }
31. }

Output:

101 Let us C Yashwant Kanetkar BPB 8

102 Data Communications & Networking Forouzan Mc Graw Hill 4

103 Operating System Galvin Wiley 6

# Difference between ArrayList and LinkedList

ArrayList and LinkedList both implements List interface and maintains insertion order. Both are non synchronized classes.

But there are many differences between ArrayList and LinkedList classes that are given below.

|  |  |
| --- | --- |
| **ArrayList** | **LinkedList** |
| 1) ArrayList internally uses **dynamic array** to store the elements. | LinkedList internally uses **doubly linked list** to store the elements. |
| 2) Manipulation with ArrayList is **slow** because it internally uses array. If any element is removed from the array, all the bits are shifted in memory. | Manipulation with LinkedList is **faster** than ArrayList because it uses doubly linked list so no bit shifting is required in memory. |
| 3) ArrayList class can **act as a list** only because it implements List only. | LinkedList class can **act as a list and queue** both because it implements List and Deque interfaces. |
| 4) ArrayList is **better for storing and accessing**data. | LinkedList is **better for manipulating**data. |

### Example of ArrayList and LinkedList in Java

Let's see a simple example where we are using ArrayList and LinkedList both.

1. **import** java.util.\*;
2. **class** TestArrayLinked{
3. **public** **static** **void** main(String args[]){
5. List<String> al=**new** ArrayList<String>();//creating arraylist
6. al.add("Ravi");//adding object in arraylist
7. al.add("Vijay");
8. al.add("Ravi");
9. al.add("Ajay");
11. List<String> al2=**new** LinkedList<String>();//creating linkedlist
12. al2.add("James");//adding object in linkedlist
13. al2.add("Serena");
14. al2.add("Swati");
15. al2.add("Junaid");
17. System.out.println("arraylist: "+al);
18. System.out.println("linkedlist: "+al2);
19. }
20. }

[**Test it Now**](http://www.javatpoint.com/opr/test.jsp?filename=TestArrayLinked)

Output:

arraylist: [Ravi,Vijay,Ravi,Ajay]

linkedlist: [James,Serena,Swati,Junaid]

# Java List Interface

List Interface is the subinterface of Collection.It contains methods to insert and delete elements in index basis.It is a factory of ListIterator interface.

### List Interface declaration

1. **public** **interface** List<E> **extends** Collection<E>

### Methods of Java List Interface

|  |  |
| --- | --- |
| **Method** | **Description** |
| void add(int index,Object element) | It is used to insert element into the invoking list at the index passed in the index. |
| boolean addAll(int index,Collection c) | It is used to insert all elements of c into the invoking list at the index passed in the index. |
| object get(int index) | It is used to return the object stored at the specified index within the invoking collection. |
| object set(int index,Object element) | It is used to assign element to the location specified by index within the invoking list. |
| object remove(int index) | It is used to remove the element at position index from the invoking list and return the deleted element. |
| ListIterator listIterator() | It is used to return an iterator to the start of the invoking list. |
| ListIterator listIterator(int index) | It is used to return an iterator to the invoking list that begins at the specified index. |

### Java List Example

1. **import** java.util.\*;
2. **public** **class** ListExample{
3. **public** **static** **void** main(String args[]){
4. ArrayList<String> al=**new** ArrayList<String>();
5. al.add("Amit");
6. al.add("Vijay");
7. al.add("Kumar");
8. al.add(1,"Sachin");
9. System.out.println("Element at 2nd position: "+al.get(2));
10. **for**(String s:al){
11. System.out.println(s);
12. }
13. }
14. }

Output:

Element at 2nd position: Vijay

Amit

Sachin

Vijay

Kumar

## Java ListIterator Interface

ListIterator Interface is used to traverse the element in backward and forward direction.

### ListIterator Interface declaration

1. **public** **interface** ListIterator<E> **extends** Iterator<E>

### Methods of Java ListIterator Interface:

|  |  |
| --- | --- |
| **Method** | **Description** |
| boolean hasNext() | This method return true if the list iterator has more elements when traversing the list in the forward direction. |
| Object next() | This method return the next element in the list and advances the cursor position. |
| boolean hasPrevious() | This method return true if this list iterator has more elements when traversing the list in the reverse direction. |
| Object previous() | This method return the previous element in the list and moves the cursor position backwards. |

### Example of ListIterator Interface

1. **import** java.util.\*;
2. **public** **class** TestCollection8{
3. **public** **static** **void** main(String args[]){
4. ArrayList<String> al=**new** ArrayList<String>();
5. al.add("Amit");
6. al.add("Vijay");
7. al.add("Kumar");
8. al.add(1,"Sachin");
9. System.out.println("element at 2nd position: "+al.get(2));
10. ListIterator<String> itr=al.listIterator();
11. System.out.println("traversing elements in forward direction...");
12. **while**(itr.hasNext()){
13. System.out.println(itr.next());
14. }
15. System.out.println("traversing elements in backward direction...");
16. **while**(itr.hasPrevious()){
17. System.out.println(itr.previous());
18. }
19. }
20. }

[**Test it Now**](http://www.javatpoint.com/opr/test.jsp?filename=TestCollection8)

Output:

element at 2nd position: Vijay

traversing elements in forward direction...

Amit

Sachin

Vijay

Kumar

traversing elements in backward direction...

Kumar

Vijay

Sachin

Amit

### Example of ListIterator Interface: Book

1. **import** java.util.\*;
2. **class** Book {
3. **int** id;
4. String name,author,publisher;
5. **int** quantity;
6. **public** Book(**int** id, String name, String author, String publisher, **int** quantity) {
7. **this**.id = id;
8. **this**.name = name;
9. **this**.author = author;
10. **this**.publisher = publisher;
11. **this**.quantity = quantity;
12. }
13. }
14. **public** **class** ListExample {
15. **public** **static** **void** main(String[] args) {
16. //Creating list of Books
17. List<Book> list=**new** ArrayList<Book>();
18. //Creating Books
19. Book b1=**new** Book(101,"Let us C","Yashwant Kanetkar","BPB",8);
20. Book b2=**new** Book(102,"Data Communications & Networking","Forouzan","Mc Graw Hill",4);
21. Book b3=**new** Book(103,"Operating System","Galvin","Wiley",6);
22. //Adding Books to list
23. list.add(b1);
24. list.add(b2);
25. list.add(b3);
26. //Traversing list
27. **for**(Book b:list){
28. System.out.println(b.id+" "+b.name+" "+b.author+" "+b.publisher+" "+b.quantity);
29. }
30. }
31. }

Output:

101 Let us C Yashwant Kanetkar BPB 8

102 Data Communications & Networking Forouzan Mc Graw Hill 4

103 Operating System Galvin Wiley 6

# ava HashSet class

Java HashSet class hierarchy

Java HashSet class is used to create a collection that uses a hash table for storage. It inherits the AbstractSet class and implements Set interface.

The important points about Java HashSet class are:

* HashSet stores the elements by using a mechanism called **hashing.**
* HashSet contains unique elements only.

## Difference between List and Set

List can contain duplicate elements whereas Set contains unique elements only.

### Hierarchy of HashSet class

The HashSet class extends AbstractSet class which implements Set interface. The Set interface inherits Collection and Iterable interfaces in hierarchical order.

### HashSet class declaration

Let's see the declaration for java.util.HashSet class.

1. **public** **class** HashSet<E> **extends** AbstractSet<E> **implements** Set<E>, Cloneable, Serializable

### Constructors of Java HashSet class:

|  |  |
| --- | --- |
| **Constructor** | **Description** |
| HashSet() | It is used to construct a default HashSet. |
| HashSet(Collection c) | It is used to initialize the hash set by using the elements of the collection c. |
| HashSet(int capacity) | It is used to initialize the capacity of the hash set to the given integer value capacity. The capacity grows automatically as elements are added to the HashSet. |

### Methods of Java HashSet class:

|  |  |
| --- | --- |
| **Method** | **Description** |
| void clear() | It is used to remove all of the elements from this set. |
| boolean contains(Object o) | It is used to return true if this set contains the specified element. |
| boolean add(Object o) | It is used to adds the specified element to this set if it is not already present. |
| boolean isEmpty() | It is used to return true if this set contains no elements. |
| boolean remove(Object o) | It is used to remove the specified element from this set if it is present. |
| Object clone() | It is used to return a shallow copy of this HashSet instance: the elements themselves are not cloned. |
| Iterator iterator() | It is used to return an iterator over the elements in this set. |
| int size() | It is used to return the number of elements in this set. |

### Java HashSet Example

1. **import** java.util.\*;
2. **class** TestCollection9{
3. **public** **static** **void** main(String args[]){
4. //Creating HashSet and adding elements
5. HashSet<String> set=**new** HashSet<String>();
6. set.add("Ravi");
7. set.add("Vijay");
8. set.add("Ravi");
9. set.add("Ajay");
10. //Traversing elements
11. Iterator<String> itr=set.iterator();
12. **while**(itr.hasNext()){
13. System.out.println(itr.next());
14. }
15. }
16. }

[**Test it Now**](http://www.javatpoint.com/opr/test.jsp?filename=TestCollection9)

Ajay

Vijay

Ravi

### Java HashSet Example: Book

Let's see a HashSet example where we are adding books to set and printing all the books.

1. **import** java.util.\*;
2. **class** Book {
3. **int** id;
4. String name,author,publisher;
5. **int** quantity;
6. **public** Book(**int** id, String name, String author, String publisher, **int** quantity) {
7. **this**.id = id;
8. **this**.name = name;
9. **this**.author = author;
10. **this**.publisher = publisher;
11. **this**.quantity = quantity;
12. }
13. }
14. **public** **class** HashSetExample {
15. **public** **static** **void** main(String[] args) {
16. HashSet<Book> set=**new** HashSet<Book>();
17. //Creating Books
18. Book b1=**new** Book(101,"Let us C","Yashwant Kanetkar","BPB",8);
19. Book b2=**new** Book(102,"Data Communications & Networking","Forouzan","Mc Graw Hill",4);
20. Book b3=**new** Book(103,"Operating System","Galvin","Wiley",6);
21. //Adding Books to HashSet
22. set.add(b1);
23. set.add(b2);
24. set.add(b3);
25. //Traversing HashSet
26. **for**(Book b:set){
27. System.out.println(b.id+" "+b.name+" "+b.author+" "+b.publisher+" "+b.quantity);
28. }
29. }
30. }

Output:

101 Let us C Yashwant Kanetkar BPB 8

102 Data Communications & Networking Forouzan Mc Graw Hill 4

103 Operating System Galvin Wiley 6

# Java LinkedHashSet class

Java HashSet class hierarchy

Java LinkedHashSet class is a Hash table and Linked list implementation of the set interface. It inherits HashSet class and implements Set interface.

The important points about Java LinkedHashSet class are:

* Contains unique elements only like HashSet.
* Provides all optional set operations, and permits null elements.
* Maintains insertion order.

## Hierarchy of LinkedHashSet class

The LinkedHashSet class extends HashSet class which implements Set interface. The Set interface inherits Collection and Iterable interfaces in hierarchical order.

### LinkedHashSet class declaration

Let's see the declaration for java.util.LinkedHashSet class.

1. **public** **class** LinkedHashSet<E> **extends** HashSet<E> **implements** Set<E>, Cloneable, Serializable

### Constructors of Java LinkedHashSet class

|  |  |
| --- | --- |
| **Constructor** | **Description** |
| HashSet() | It is used to construct a default HashSet. |
| HashSet(Collection c) | It is used to initialize the hash set by using the elements of the collection c. |
| LinkedHashSet(int capacity) | It is used initialize the capacity of the linkedhashset to the given integer value capacity. |
| LinkedHashSet(int capacity, float fillRatio) | It is used to initialize both the capacity and the fill ratio (also called load capacity) of the hash set from its argument. |

### Example of LinkedHashSet class:

1. **import** java.util.\*;
2. **class** TestCollection10{
3. **public** **static** **void** main(String args[]){
4. LinkedHashSet<String> al=**new** LinkedHashSet<String>();
5. al.add("Ravi");
6. al.add("Vijay");
7. al.add("Ravi");
8. al.add("Ajay");
9. Iterator<String> itr=al.iterator();
10. **while**(itr.hasNext()){
11. System.out.println(itr.next());
12. }
13. }
14. }

[**Test it Now**](http://www.javatpoint.com/opr/test.jsp?filename=TestCollection10)

Ravi

Vijay

Ajay

### Java LinkedHashSet Example: Book

1. **import** java.util.\*;
2. **class** Book {
3. **int** id;
4. String name,author,publisher;
5. **int** quantity;
6. **public** Book(**int** id, String name, String author, String publisher, **int** quantity) {
7. **this**.id = id;
8. **this**.name = name;
9. **this**.author = author;
10. **this**.publisher = publisher;
11. **this**.quantity = quantity;
12. }
13. }
14. **public** **class** LinkedHashSetExample {
15. **public** **static** **void** main(String[] args) {
16. LinkedHashSet<Book> hs=**new** LinkedHashSet<Book>();
17. //Creating Books
18. Book b1=**new** Book(101,"Let us C","Yashwant Kanetkar","BPB",8);
19. Book b2=**new** Book(102,"Data Communications & Networking","Forouzan","Mc Graw Hill",4);
20. Book b3=**new** Book(103,"Operating System","Galvin","Wiley",6);
21. //Adding Books to hash table
22. hs.add(b1);
23. hs.add(b2);
24. hs.add(b3);
25. //Traversing hash table
26. **for**(Book b:hs){
27. System.out.println(b.id+" "+b.name+" "+b.author+" "+b.publisher+" "+b.quantity);
28. }
29. }
30. }

Output:

101 Let us C Yashwant Kanetkar BPB 8

102 Data Communications & Networking Forouzan Mc Graw Hill 4

103 Operating System Galvin Wiley 6

# Java TreeSet class

TreeSet class hierarchy

Java TreeSet class implements the Set interface that uses a tree for storage. It inherits AbstractSet class and implements NavigableSet interface. The objects of TreeSet class are stored in ascending order.

The important points about Java TreeSet class are:

* Contains unique elements only like HashSet.
* Access and retrieval times are quiet fast.
* Maintains ascending order.

### Hierarchy of TreeSet class

As shown in above diagram, Java TreeSet class implements NavigableSet interface. The NavigableSet interface extends SortedSet, Set, Collection and Iterable interfaces in hierarchical order.

### TreeSet class declaration

Let's see the declaration for java.util.TreeSet class.

1. **public** **class** TreeSet<E> **extends** AbstractSet<E> **implements** NavigableSet<E>, Cloneable, Serializable

### Constructors of Java TreeSet class

|  |  |
| --- | --- |
| **Constructor** | **Description** |
| TreeSet() | It is used to construct an empty tree set that will be sorted in an ascending order according to the natural order of the tree set. |
| TreeSet(Collection c) | It is used to build a new tree set that contains the elements of the collection c. |
| TreeSet(Comparator comp) | It is used to construct an empty tree set that will be sorted according to given comparator. |
| TreeSet(SortedSet ss) | It is used to build a TreeSet that contains the elements of the given SortedSet. |

### Methods of Java TreeSet class

|  |  |
| --- | --- |
| **Method** | **Description** |
| boolean addAll(Collection c) | It is used to add all of the elements in the specified collection to this set. |
| boolean contains(Object o) | It is used to return true if this set contains the specified element. |
| boolean isEmpty() | It is used to return true if this set contains no elements. |
| boolean remove(Object o) | It is used to remove the specified element from this set if it is present. |
| void add(Object o) | It is used to add the specified element to this set if it is not already present. |
| void clear() | It is used to remove all of the elements from this set. |
| Object clone() | It is used to return a shallow copy of this TreeSet instance. |
| Object first() | It is used to return the first (lowest) element currently in this sorted set. |
| Object last() | It is used to return the last (highest) element currently in this sorted set. |
| int size() | It is used to return the number of elements in this set. |

### Java TreeSet Example

1. **import** java.util.\*;
2. **class** TestCollection11{
3. **public** **static** **void** main(String args[]){
4. //Creating and adding elements
5. TreeSet<String> al=**new** TreeSet<String>();
6. al.add("Ravi");
7. al.add("Vijay");
8. al.add("Ravi");
9. al.add("Ajay");
10. //Traversing elements
11. Iterator<String> itr=al.iterator();
12. **while**(itr.hasNext()){
13. System.out.println(itr.next());
14. }
15. }
16. }

[**Test it Now**](http://www.javatpoint.com/opr/test.jsp?filename=TestCollection11)

Output:

Ajay

Ravi

Vijay

### Java TreeSet Example: Book

Let's see a TreeSet example where we are adding books to set and printing all the books. The elements in TreeSet must be of Comparable type. String and Wrapper classes are Comparable by default. To add user-defined objects in TreeSet, you need to implement Comparable interface.

1. **import** java.util.\*;
2. **class** Book **implements** Comparable<Book>{
3. **int** id;
4. String name,author,publisher;
5. **int** quantity;
6. **public** Book(**int** id, String name, String author, String publisher, **int** quantity) {
7. **this**.id = id;
8. **this**.name = name;
9. **this**.author = author;
10. **this**.publisher = publisher;
11. **this**.quantity = quantity;
12. }
13. **public** **int** compareTo(Book b) {
14. **if**(id>b.id){
15. **return** 1;
16. }**else** **if**(id<b.id){
17. **return** -1;
18. }**else**{
19. **return** 0;
20. }
21. }
22. }
23. **public** **class** TreeSetExample {
24. **public** **static** **void** main(String[] args) {
25. Set<Book> set=**new** TreeSet<Book>();
26. //Creating Books
27. Book b1=**new** Book(121,"Let us C","Yashwant Kanetkar","BPB",8);
28. Book b2=**new** Book(233,"Operating System","Galvin","Wiley",6);
29. Book b3=**new** Book(101,"Data Communications & Networking","Forouzan","Mc Graw Hill",4);
30. //Adding Books to TreeSet
31. set.add(b1);
32. set.add(b2);
33. set.add(b3);
34. //Traversing TreeSet
35. **for**(Book b:set){
36. System.out.println(b.id+" "+b.name+" "+b.author+" "+b.publisher+" "+b.quantity);
37. }
38. }
39. }

Output:

101 Data Communications & Networking Forouzan Mc Graw Hill 4

121 Let us C Yashwant Kanetkar BPB 8

233 Operating System Galvin Wiley 6

# Java Queue Interface

Java Queue interface orders the element in FIFO(First In First Out) manner. In FIFO, first element is removed first and last element is removed at last.

### Queue Interface declaration

1. **public** **interface** Queue<E> **extends** Collection<E>

### Methods of Java Queue Interface

|  |  |
| --- | --- |
| **Method** | **Description** |
| boolean add(object) | It is used to insert the specified element into this queue and return true upon success. |
| boolean offer(object) | It is used to insert the specified element into this queue. |
| Object remove() | It is used to retrieves and removes the head of this queue. |
| Object poll() | It is used to retrieves and removes the head of this queue, or returns null if this queue is empty. |
| Object element() | It is used to retrieves, but does not remove, the head of this queue. |
| Object peek() | It is used to retrieves, but does not remove, the head of this queue, or returns null if this queue is empty. |

## PriorityQueue class

The PriorityQueue class provides the facility of using queue. But it does not orders the elements in FIFO manner. It inherits AbstractQueue class.

### PriorityQueue class declaration

Let's see the declaration for java.util.PriorityQueue class.

1. **public** **class** PriorityQueue<E> **extends** AbstractQueue<E> **implements** Serializable

### Java PriorityQueue Example

1. **import** java.util.\*;
2. **class** TestCollection12{
3. **public** **static** **void** main(String args[]){
4. PriorityQueue<String> queue=**new** PriorityQueue<String>();
5. queue.add("Amit");
6. queue.add("Vijay");
7. queue.add("Karan");
8. queue.add("Jai");
9. queue.add("Rahul");
10. System.out.println("head:"+queue.element());
11. System.out.println("head:"+queue.peek());
12. System.out.println("iterating the queue elements:");
13. Iterator itr=queue.iterator();
14. **while**(itr.hasNext()){
15. System.out.println(itr.next());
16. }
17. queue.remove();
18. queue.poll();
19. System.out.println("after removing two elements:");
20. Iterator<String> itr2=queue.iterator();
21. **while**(itr2.hasNext()){
22. System.out.println(itr2.next());
23. }
24. }
25. }

[**Test it Now**](http://www.javatpoint.com/opr/test.jsp?filename=TestCollection12)

Output:head:Amit

head:Amit

iterating the queue elements:

Amit

Jai

Karan

Vijay

Rahul

after removing two elements:

Karan

Rahul

Vijay

### Java PriorityQueue Example: Book

Let's see a PriorityQueue example where we are adding books to queue and printing all the books. The elements in PriorityQueue must be of Comparable type. String and Wrapper classes are Comparable by default. To add user-defined objects in PriorityQueue, you need to implement Comparable interface.

1. **import** java.util.\*;
2. **class** Book **implements** Comparable<Book>{
3. **int** id;
4. String name,author,publisher;
5. **int** quantity;
6. **public** Book(**int** id, String name, String author, String publisher, **int** quantity) {
7. **this**.id = id;
8. **this**.name = name;
9. **this**.author = author;
10. **this**.publisher = publisher;
11. **this**.quantity = quantity;
12. }
13. **public** **int** compareTo(Book b) {
14. **if**(id>b.id){
15. **return** 1;
16. }**else** **if**(id<b.id){
17. **return** -1;
18. }**else**{
19. **return** 0;
20. }
21. }
22. }
23. **public** **class** LinkedListExample {
24. **public** **static** **void** main(String[] args) {
25. Queue<Book> queue=**new** PriorityQueue<Book>();
26. //Creating Books
27. Book b1=**new** Book(121,"Let us C","Yashwant Kanetkar","BPB",8);
28. Book b2=**new** Book(233,"Operating System","Galvin","Wiley",6);
29. Book b3=**new** Book(101,"Data Communications & Networking","Forouzan","Mc Graw Hill",4);
30. //Adding Books to the queue
31. queue.add(b1);
32. queue.add(b2);
33. queue.add(b3);
34. System.out.println("Traversing the queue elements:");
35. //Traversing queue elements
36. **for**(Book b:queue){
37. System.out.println(b.id+" "+b.name+" "+b.author+" "+b.publisher+" "+b.quantity);
38. }
39. queue.remove();
40. System.out.println("After removing one book record:");
41. **for**(Book b:queue){
42. System.out.println(b.id+" "+b.name+" "+b.author+" "+b.publisher+" "+b.quantity);
43. }
44. }
45. }

Output:

Traversing the queue elements:

101 Data Communications & Networking Forouzan Mc Graw Hill 4

233 Operating System Galvin Wiley 6

121 Let us C Yashwant Kanetkar BPB 8

After removing one book record:

121 Let us C Yashwant Kanetkar BPB 8

233 Operating System Galvin Wiley 6

# Java Deque Interface

Java Deque Interface is a linear collection that supports element insertion and removal at both ends. Deque is an acronym for **"double ended queue".**

## Deque Interface declaration

1. **public** **interface** Deque<E> **extends** Queue<E>

### Methods of Java Deque Interface

|  |  |
| --- | --- |
| **Method** | **Description** |
| boolean add(object) | It is used to insert the specified element into this deque and return true upon success. |
| boolean offer(object) | It is used to insert the specified element into this deque. |
| Object remove() | It is used to retrieves and removes the head of this deque. |
| Object poll() | It is used to retrieves and removes the head of this deque, or returns null if this deque is empty. |
| Object element() | It is used to retrieves, but does not remove, the head of this deque. |
| Object peek() | It is used to retrieves, but does not remove, the head of this deque, or returns null if this deque is empty. |

java arraydeque hierarchy

## ArrayDeque class

The ArrayDeque class provides the facility of using deque and resizable-array. It inherits AbstractCollection class and implements the Deque interface.

The important points about ArrayDeque class are:

* Unlike Queue, we can add or remove elements from both sides.
* Null elements are not allowed in the ArrayDeque.
* ArrayDeque is not thread safe, in the absence of external synchronization.
* ArrayDeque has no capacity restrictions.
* ArrayDeque is faster than LinkedList and Stack.

### ArrayDeque Hierarchy

The hierarchy of ArrayDeque class is given in the figure displayed at the right side of the page.

### ArrayDeque class declaration

Let's see the declaration for java.util.ArrayDeque class.

1. **public** **class** ArrayDeque<E> **extends** AbstractCollection<E> **implements** Deque<E>, Cloneable, Serializable

## Java ArrayDeque Example

1. **import** java.util.\*;
2. **public** **class** ArrayDequeExample {
3. **public** **static** **void** main(String[] args) {
4. //Creating Deque and adding elements
5. Deque<String> deque = **new** ArrayDeque<String>();
6. deque.add("Ravi");
7. deque.add("Vijay");
8. deque.add("Ajay");
9. //Traversing elements
10. **for** (String str : deque) {
11. System.out.println(str);
12. }
13. }
14. }

Output:

Ravi

Vijay

Ajay

## Java ArrayDeque Example: offerFirst() and pollLast()

1. **import** java.util.\*;
2. **public** **class** DequeExample {
3. **public** **static** **void** main(String[] args) {
4. Deque<String> deque=**new** ArrayDeque<String>();
5. deque.offer("arvind");
6. deque.offer("vimal");
7. deque.add("mukul");
8. deque.offerFirst("jai");
9. System.out.println("After offerFirst Traversal...");
10. **for**(String s:deque){
11. System.out.println(s);
12. }
13. //deque.poll();
14. //deque.pollFirst();//it is same as poll()
15. deque.pollLast();
16. System.out.println("After pollLast() Traversal...");
17. **for**(String s:deque){
18. System.out.println(s);
19. }
20. }
21. }

Output:

After offerFirst Traversal...

jai

arvind

vimal

mukul

After pollLast() Traversal...

jai

arvind

vimal

## Java ArrayDeque Example: Book

1. **import** java.util.\*;
2. **class** Book {
3. **int** id;
4. String name,author,publisher;
5. **int** quantity;
6. **public** Book(**int** id, String name, String author, String publisher, **int** quantity) {
7. **this**.id = id;
8. **this**.name = name;
9. **this**.author = author;
10. **this**.publisher = publisher;
11. **this**.quantity = quantity;
12. }
13. }
14. **public** **class** ArrayDequeExample {
15. **public** **static** **void** main(String[] args) {
16. Deque<Book> set=**new** ArrayDeque<Book>();
17. //Creating Books
18. Book b1=**new** Book(101,"Let us C","Yashwant Kanetkar","BPB",8);
19. Book b2=**new** Book(102,"Data Communications & Networking","Forouzan","Mc Graw Hill",4);
20. Book b3=**new** Book(103,"Operating System","Galvin","Wiley",6);
21. //Adding Books to Deque
22. set.add(b1);
23. set.add(b2);
24. set.add(b3);
25. //Traversing ArrayDeque
26. **for**(Book b:set){
27. System.out.println(b.id+" "+b.name+" "+b.author+" "+b.publisher+" "+b.quantity);
28. }
29. }
30. }

Output:

101 Let us C Yashwant Kanetkar BPB 8

102 Data Communications & Networking Forouzan Mc Graw Hill 4

103 Operating System Galvin Wiley 6

# Java Map Interface

A map contains values on the basis of key i.e. key and value pair. Each key and value pair is known as an entry. Map contains only unique keys.

Map is useful if you have to search, update or delete elements on the basis of key.

### Useful methods of Map interface

|  |  |
| --- | --- |
| **Method** | **Description** |
| Object put(Object key, Object value) | It is used to insert an entry in this map. |
| void putAll(Map map) | It is used to insert the specified map in this map. |
| Object remove(Object key) | It is used to delete an entry for the specified key. |
| Object get(Object key) | It is used to return the value for the specified key. |
| boolean containsKey(Object key) | It is used to search the specified key from this map. |
| Set keySet() | It is used to return the Set view containing all the keys. |
| Set entrySet() | It is used to return the Set view containing all the keys and values. |

## Map.Entry Interface

Entry is the sub interface of Map. So we will be accessed it by Map.Entry name. It provides methods to get key and value.

### Methods of Map.Entry interface

|  |  |
| --- | --- |
| **Method** | **Description** |
| Object getKey() | It is used to obtain key. |
| Object getValue() | It is used to obtain value. |

### Java Map Example: Generic (New Style)

1. **import** java.util.\*;
2. **class** MapInterfaceExample{
3. **public** **static** **void** main(String args[]){
4. Map<Integer,String> map=**new** HashMap<Integer,String>();
5. map.put(100,"Amit");
6. map.put(101,"Vijay");
7. map.put(102,"Rahul");
8. **for**(Map.Entry m:map.entrySet()){
9. System.out.println(m.getKey()+" "+m.getValue());
10. }
11. }
12. }

Output:

102 Rahul

100 Amit

101 Vijay

### Java Map Example: Non-Generic (Old Style)

1. //Non-generic
2. **import** java.util.\*;
3. **public** **class** MapExample1 {
4. **public** **static** **void** main(String[] args) {
5. Map map=**new** HashMap();
6. //Adding elements to map
7. map.put(1,"Amit");
8. map.put(5,"Rahul");
9. map.put(2,"Jai");
10. map.put(6,"Amit");
11. //Traversing Map
12. Set set=map.entrySet();//Converting to Set so that we can traverse
13. Iterator itr=set.iterator();
14. **while**(itr.hasNext()){
15. //Converting to Map.Entry so that we can get key and value separately
16. Map.Entry entry=(Map.Entry)itr.next();
17. System.out.println(entry.getKey()+" "+entry.getValue());
18. }
19. }
20. }

Output:

1 Amit

2 Jai

5 Rahul

6 Amit

# Java HashMap class

Java HashMap class hierarchy

Java HashMap class implements the map interface by using a hashtable. It inherits AbstractMap class and implements Map interface.

The important points about Java HashMap class are:

* A HashMap contains values based on the key.
* It contains only unique elements.
* It may have one null key and multiple null values.
* It maintains no order.

### Hierarchy of HashMap class

As shown in the above figure, HashMap class extends AbstractMap class and implements Map interface.

### HashMap class declaration

Let's see the declaration for java.util.HashMap class.

1. **public** **class** HashMap<K,V> **extends** AbstractMap<K,V> **implements** Map<K,V>, Cloneable, Serializable

### HashMap class Parameters

Let's see the Parameters for java.util.HashMap class.

* **K**: It is the type of keys maintained by this map.
* **V**: It is the type of mapped values.

### Constructors of Java HashMap class

|  |  |
| --- | --- |
| **Constructor** | **Description** |
| HashMap() | It is used to construct a default HashMap. |
| HashMap(Map m) | It is used to initializes the hash map by using the elements of the given Map object m. |
| HashMap(int capacity) | It is used to initializes the capacity of the hash map to the given integer value, capacity. |
| HashMap(int capacity, float fillRatio) | It is used to initialize both the capacity and fill ratio of the hash map by using its arguments. |

### Methods of Java HashMap class

|  |  |
| --- | --- |
| **Method** | **Description** |
| void clear() | It is used to remove all of the mappings from this map. |
| boolean containsKey(Object key) | It is used to return true if this map contains a mapping for the specified key. |
| boolean containsValue(Object value) | It is used to return true if this map maps one or more keys to the specified value. |
| boolean isEmpty() | It is used to return true if this map contains no key-value mappings. |
| Object clone() | It is used to return a shallow copy of this HashMap instance: the keys and values themselves are not cloned. |
| Set entrySet() | It is used to return a collection view of the mappings contained in this map. |
| Set keySet() | It is used to return a set view of the keys contained in this map. |
| Object put(Object key, Object value) | It is used to associate the specified value with the specified key in this map. |
| int size() | It is used to return the number of key-value mappings in this map. |
| Collection values() | It is used to return a collection view of the values contained in this map. |

### Java HashMap Example

1. **import** java.util.\*;
2. **class** TestCollection13{
3. **public** **static** **void** main(String args[]){
4. HashMap<Integer,String> hm=**new** HashMap<Integer,String>();
5. hm.put(100,"Amit");
6. hm.put(101,"Vijay");
7. hm.put(102,"Rahul");
8. **for**(Map.Entry m:hm.entrySet()){
9. System.out.println(m.getKey()+" "+m.getValue());
10. }
11. }
12. }

[**Test it Now**](http://www.javatpoint.com/opr/test.jsp?filename=TestCollection13)

Output:102 Rahul

100 Amit

101 Vijay

### Java HashMap Example: remove()

1. **import** java.util.\*;
2. **public** **class** HashMapExample {
3. **public** **static** **void** main(String args[]) {
4. // create and populate hash map
5. HashMap<Integer, String> map = **new** HashMap<Integer, String>();
6. map.put(101,"Let us C");
7. map.put(102, "Operating System");
8. map.put(103, "Data Communication and Networking");
9. System.out.println("Values before remove: "+ map);
10. // Remove value for key 102
11. map.remove(102);
12. System.out.println("Values after remove: "+ map);
13. }
14. }

Output:

Values before remove: {102=Operating System, 103=Data Communication and Networking, 101=Let us C}

Values after remove: {103=Data Communication and Networking, 101=Let us C}

### Difference between HashSet and HashMap

HashSet contains only values whereas HashMap contains entry(key and value).

### Java HashMap Example: Book

1. **import** java.util.\*;
2. **class** Book {
3. **int** id;
4. String name,author,publisher;
5. **int** quantity;
6. **public** Book(**int** id, String name, String author, String publisher, **int** quantity) {
7. **this**.id = id;
8. **this**.name = name;
9. **this**.author = author;
10. **this**.publisher = publisher;
11. **this**.quantity = quantity;
12. }
13. }
14. **public** **class** MapExample {
15. **public** **static** **void** main(String[] args) {
16. //Creating map of Books
17. Map<Integer,Book> map=**new** HashMap<Integer,Book>();
18. //Creating Books
19. Book b1=**new** Book(101,"Let us C","Yashwant Kanetkar","BPB",8);
20. Book b2=**new** Book(102,"Data Communications & Networking","Forouzan","Mc Graw Hill",4);
21. Book b3=**new** Book(103,"Operating System","Galvin","Wiley",6);
22. //Adding Books to map
23. map.put(1,b1);
24. map.put(2,b2);
25. map.put(3,b3);
27. //Traversing map
28. **for**(Map.Entry<Integer, Book> entry:map.entrySet()){
29. **int** key=entry.getKey();
30. Book b=entry.getValue();
31. System.out.println(key+" Details:");
32. System.out.println(b.id+" "+b.name+" "+b.author+" "+b.publisher+" "+b.quantity);
33. }
34. }
35. }

Output:

1 Details:

101 Let us C Yashwant Kanetkar BPB 8

2 Details:

102 Data Communications & Networking Forouzan Mc Graw Hill 4

3 Details:

103 Operating System Galvin Wiley 6

# Java LinkedHashMap class

Java LinkedHashMap class hierarchy

Java LinkedHashMap class is Hash table and Linked list implementation of the Map interface, with predictable iteration order. It inherits HashMap class and implements the Map interface.

The important points about Java LinkedHashMap class are:

* A LinkedHashMap contains values based on the key.
* It contains only unique elements.
* It may have one null key and multiple null values.
* It is same as HashMap instead maintains insertion order.

### LinkedHashMap class declaration

Let's see the declaration for java.util.LinkedHashMap class.

1. **public** **class** LinkedHashMap<K,V> **extends** HashMap<K,V> **implements** Map<K,V>

### LinkedHashMap class Parameters

Let's see the Parameters for java.util.LinkedHashMap class.

* **K**: It is the type of keys maintained by this map.
* **V**: It is the type of mapped values.

### Constructors of Java LinkedHashMap class

|  |  |
| --- | --- |
| **Constructor** | **Description** |
| LinkedHashMap() | It is used to construct a default LinkedHashMap. |
| LinkedHashMap(int capacity) | It is used to initialize a LinkedHashMap with the given capacity. |
| LinkedHashMap(int capacity, float fillRatio) | It is used to initialize both the capacity and the fillRatio. |
| LinkedHashMap(Map m) | It is used to initialize the LinkedHashMap with the elements from the given Map class m. |

### Methods of Java LinkedHashMap class

|  |  |
| --- | --- |
| **Method** | **Description** |
| Object get(Object key) | It is used to return the value to which this map maps the specified key. |
| void clear() | It is used to remove all mappings from this map. |
| boolean containsKey(Object key) | It is used to return true if this map maps one or more keys to the specified value. |

### Java LinkedHashMap Example

1. **import** java.util.\*;
2. **class** TestCollection14{
3. **public** **static** **void** main(String args[]){
5. LinkedHashMap<Integer,String> hm=**new** LinkedHashMap<Integer,String>();
7. hm.put(100,"Amit");
8. hm.put(101,"Vijay");
9. hm.put(102,"Rahul");
11. **for**(Map.Entry m:hm.entrySet()){
12. System.out.println(m.getKey()+" "+m.getValue());
13. }
14. }
15. }

[**Test it Now**](http://www.javatpoint.com/opr/test.jsp?filename=TestCollection14)

Output:100 Amit

101 Vijay

102 Rahul

### Java LinkedHashMap Example:remove()

1. **import** java.util.\*;
2. **public** **class** LinkedHashMapExample {
3. **public** **static** **void** main(String args[]) {
4. // Create and populate linked hash map
5. Map<Integer, String> map = **new** LinkedHashMap<Integer, String>();
6. map.put(101,"Let us C");
7. map.put(102, "Operating System");
8. map.put(103, "Data Communication and Networking");
9. System.out.println("Values before remove: "+ map);
10. // Remove value for key 102
11. map.remove(102);
12. System.out.println("Values after remove: "+ map);
13. }
14. }

Output:

Values before remove: {101=Let us C, 102=Operating System, 103=Data Communication and Networking}

Values after remove: {101=Let us C, 103=Data Communication and Networking}

### Java LinkedHashMap Example: Book

1. **import** java.util.\*;
2. **class** Book {
3. **int** id;
4. String name,author,publisher;
5. **int** quantity;
6. **public** Book(**int** id, String name, String author, String publisher, **int** quantity) {
7. **this**.id = id;
8. **this**.name = name;
9. **this**.author = author;
10. **this**.publisher = publisher;
11. **this**.quantity = quantity;
12. }
13. }
14. **public** **class** MapExample {
15. **public** **static** **void** main(String[] args) {
16. //Creating map of Books
17. Map<Integer,Book> map=**new** LinkedHashMap<Integer,Book>();
18. //Creating Books
19. Book b1=**new** Book(101,"Let us C","Yashwant Kanetkar","BPB",8);
20. Book b2=**new** Book(102,"Data Communications & Networking","Forouzan","Mc Graw Hill",4);
21. Book b3=**new** Book(103,"Operating System","Galvin","Wiley",6);
22. //Adding Books to map
23. map.put(2,b2);
24. map.put(1,b1);
25. map.put(3,b3);
27. //Traversing map
28. **for**(Map.Entry<Integer, Book> entry:map.entrySet()){
29. **int** key=entry.getKey();
30. Book b=entry.getValue();
31. System.out.println(key+" Details:");
32. System.out.println(b.id+" "+b.name+" "+b.author+" "+b.publisher+" "+b.quantity);
33. }
34. }
35. }

Output:

2 Details:

102 Data Communications & Networking Forouzan Mc Graw Hill 4

1 Details:

101 Let us C Yashwant Kanetkar BPB 8

3 Details:

103 Operating System Galvin Wiley 6

# Java TreeMap class

Java TreeMap class hierarchy

Java TreeMap class implements the Map interface by using a tree. It provides an efficient means of storing key/value pairs in sorted order.

The important points about Java TreeMap class are:

* A TreeMap contains values based on the key. It implements the NavigableMap interface and extends AbstractMap class.
* It contains only unique elements.
* It cannot have null key but can have multiple null values.
* It is same as HashMap instead maintains ascending order.

### TreeMap class declaration

Let's see the declaration for java.util.TreeMap class.

1. **public** **class** TreeMap<K,V> **extends** AbstractMap<K,V> **implements** NavigableMap<K,V>, Cloneable, Serializable

### TreeMap class Parameters

Let's see the Parameters for java.util.TreeMap class.

* **K**: It is the type of keys maintained by this map.
* **V**: It is the type of mapped values.

### Constructors of Java TreeMap class

|  |  |
| --- | --- |
| **Constructor** | **Description** |
| TreeMap() | It is used to construct an empty tree map that will be sorted using the natural order of its key. |
| TreeMap(Comparator comp) | It is used to construct an empty tree-based map that will be sorted using the comparator comp. |
| TreeMap(Map m) | It is used to initialize a tree map with the entries from **m**, which will be sorted using the natural order of the keys. |
| TreeMap(SortedMap sm) | It is used to initialize a tree map with the entries from the SortedMap **sm**, which will be sorted in the same order as **sm.** |

### Methods of Java TreeMap class

|  |  |
| --- | --- |
| **Method** | **Description** |
| boolean containsKey(Object key) | It is used to return true if this map contains a mapping for the specified key. |
| boolean containsValue(Object value) | It is used to return true if this map maps one or more keys to the specified value. |
| Object firstKey() | It is used to return the first (lowest) key currently in this sorted map. |
| Object get(Object key) | It is used to return the value to which this map maps the specified key. |
| Object lastKey() | It is used to return the last (highest) key currently in this sorted map. |
| Object remove(Object key) | It is used to remove the mapping for this key from this TreeMap if present. |
| void putAll(Map map) | It is used to copy all of the mappings from the specified map to this map. |
| Set entrySet() | It is used to return a set view of the mappings contained in this map. |
| int size() | It is used to return the number of key-value mappings in this map. |
| Collection values() | It is used to return a collection view of the values contained in this map. |

### Java TreeMap Example:

1. **import** java.util.\*;
2. **class** TestCollection15{
3. **public** **static** **void** main(String args[]){
4. TreeMap<Integer,String> hm=**new** TreeMap<Integer,String>();
5. hm.put(100,"Amit");
6. hm.put(102,"Ravi");
7. hm.put(101,"Vijay");
8. hm.put(103,"Rahul");
9. **for**(Map.Entry m:hm.entrySet()){
10. System.out.println(m.getKey()+" "+m.getValue());
11. }
12. }
13. }

[**Test it Now**](http://www.javatpoint.com/opr/test.jsp?filename=TestCollection15)

Output:100 Amit

101 Vijay

102 Ravi

103 Rahul

### Java TreeMap Example: remove()

1. **import** java.util.\*;
2. **public** **class** TreeMapExample {
3. **public** **static** **void** main(String args[]) {
4. // Create and populate tree map
5. Map<Integer, String> map = **new** TreeMap<Integer, String>();
6. map.put(102,"Let us C");
7. map.put(103, "Operating System");
8. map.put(101, "Data Communication and Networking");
9. System.out.println("Values before remove: "+ map);
10. // Remove value for key 102
11. map.remove(102);
12. System.out.println("Values after remove: "+ map);
13. }
14. }

Output:

Values before remove: {101=Data Communication and Networking, 102=Let us C, 103=Operating System}

Values after remove: {101=Data Communication and Networking, 103=Operating System}

### What is difference between HashMap and TreeMap?

|  |  |
| --- | --- |
| **HashMap** | **TreeMap** |
| 1) HashMap can contain one null key. | TreeMap can not contain any null key. |
| 2) HashMap maintains no order. | TreeMap maintains ascending order. |

### Java TreeMap Example: Book

1. **import** java.util.\*;
2. **class** Book {
3. **int** id;
4. String name,author,publisher;
5. **int** quantity;
6. **public** Book(**int** id, String name, String author, String publisher, **int** quantity) {
7. **this**.id = id;
8. **this**.name = name;
9. **this**.author = author;
10. **this**.publisher = publisher;
11. **this**.quantity = quantity;
12. }
13. }
14. **public** **class** MapExample {
15. **public** **static** **void** main(String[] args) {
16. //Creating map of Books
17. Map<Integer,Book> map=**new** TreeMap<Integer,Book>();
18. //Creating Books
19. Book b1=**new** Book(101,"Let us C","Yashwant Kanetkar","BPB",8);
20. Book b2=**new** Book(102,"Data Communications & Networking","Forouzan","Mc Graw Hill",4);
21. Book b3=**new** Book(103,"Operating System","Galvin","Wiley",6);
22. //Adding Books to map
23. map.put(2,b2);
24. map.put(1,b1);
25. map.put(3,b3);
27. //Traversing map
28. **for**(Map.Entry<Integer, Book> entry:map.entrySet()){
29. **int** key=entry.getKey();
30. Book b=entry.getValue();
31. System.out.println(key+" Details:");
32. System.out.println(b.id+" "+b.name+" "+b.author+" "+b.publisher+" "+b.quantity);
33. }
34. }
35. }

Output:

1 Details:

101 Let us C Yashwant Kanetkar BPB 8

2 Details:

102 Data Communications & Networking Forouzan Mc Graw Hill 4

3 Details:

103 Operating System Galvin Wiley 6

# Java Hashtable class

Java Hashtable class implements a hashtable, which maps keys to values. It inherits Dictionary class and implements the Map interface.

The important points about Java Hashtable class are:

* A Hashtable is an array of list. Each list is known as a bucket. The position of bucket is identified by calling the hashcode() method. A Hashtable contains values based on the key.
* It contains only unique elements.
* It may have not have any null key or value.
* It is synchronized.

### Hashtable class declaration

Let's see the declaration for java.util.Hashtable class.

1. **public** **class** Hashtable<K,V> **extends** Dictionary<K,V> **implements** Map<K,V>, Cloneable, Serializable

### Hashtable class Parameters

Let's see the Parameters for java.util.Hashtable class.

* **K**: It is the type of keys maintained by this map.
* **V**: It is the type of mapped values.

### Constructors of Java Hashtable class

|  |  |
| --- | --- |
| **Constructor** | **Description** |
| Hashtable() | It is the default constructor of hash table it instantiates the Hashtable class. |
| Hashtable(int size) | It is used to accept an integer parameter and creates a hash table that has an initial size specified by integer value size. |
| Hashtable(int size, float fillRatio) | It is used to create a hash table that has an initial size specified by size and a fill ratio specified by fillRatio. |

### Methods of Java Hashtable class

|  |  |
| --- | --- |
| **Method** | **Description** |
| void clear() | It is used to reset the hash table. |
| boolean contains(Object value) | This method return true if some value equal to the value exist within the hash table, else return false. |
| boolean containsValue(Object value) | This method return true if some value equal to the value exists within the hash table, else return false. |
| boolean containsKey(Object key) | This method return true if some key equal to the key exists within the hash table, else return false. |
| boolean isEmpty() | This method return true if the hash table is empty; returns false if it contains at least one key. |
| void rehash() | It is used to increase the size of the hash table and rehashes all of its keys. |
| Object get(Object key) | This method return the object that contains the value associated with the key. |
| Object remove(Object key) | It is used to remove the key and its value. This method return the value associated with the key. |
| int size() | This method return the number of entries in the hash table. |

### Java Hashtable Example

1. **import** java.util.\*;
2. **class** TestCollection16{
3. **public** **static** **void** main(String args[]){
4. Hashtable<Integer,String> hm=**new** Hashtable<Integer,String>();
6. hm.put(100,"Amit");
7. hm.put(102,"Ravi");
8. hm.put(101,"Vijay");
9. hm.put(103,"Rahul");
11. **for**(Map.Entry m:hm.entrySet()){
12. System.out.println(m.getKey()+" "+m.getValue());
13. }
14. }
15. }

[**Test it Now**](http://www.javatpoint.com/opr/test.jsp?filename=TestCollection16)

Output:

103 Rahul

102 Ravi

101 Vijay

100 Amit

### Java Hashtable Example: remove()

1. **import** java.util.\*;
2. **public** **class** HashtableExample {
3. **public** **static** **void** main(String args[]) {
4. // create and populate hash table
5. Hashtable<Integer, String> map = **new** Hashtable<Integer, String>();
6. map.put(102,"Let us C");
7. map.put(103, "Operating System");
8. map.put(101, "Data Communication and Networking");
9. System.out.println("Values before remove: "+ map);
10. // Remove value for key 102
11. map.remove(102);
12. System.out.println("Values after remove: "+ map);
13. }
14. }

Output:

Values before remove: {103=Operating System, 102=Let us C, 101=Data Communication and Networking}

Values after remove: {103=Operating System, 101=Data Communication and Networking}

### Java Hashtable Example: Book

1. **import** java.util.\*;
2. **class** Book {
3. **int** id;
4. String name,author,publisher;
5. **int** quantity;
6. **public** Book(**int** id, String name, String author, String publisher, **int** quantity) {
7. **this**.id = id;
8. **this**.name = name;
9. **this**.author = author;
10. **this**.publisher = publisher;
11. **this**.quantity = quantity;
12. }
13. }
14. **public** **class** HashtableExample {
15. **public** **static** **void** main(String[] args) {
16. //Creating map of Books
17. Map<Integer,Book> map=**new** Hashtable<Integer,Book>();
18. //Creating Books
19. Book b1=**new** Book(101,"Let us C","Yashwant Kanetkar","BPB",8);
20. Book b2=**new** Book(102,"Data Communications & Networking","Forouzan","Mc Graw Hill",4);
21. Book b3=**new** Book(103,"Operating System","Galvin","Wiley",6);
22. //Adding Books to map
23. map.put(1,b1);
24. map.put(2,b2);
25. map.put(3,b3);
26. //Traversing map
27. **for**(Map.Entry<Integer, Book> entry:map.entrySet()){
28. **int** key=entry.getKey();
29. Book b=entry.getValue();
30. System.out.println(key+" Details:");
31. System.out.println(b.id+" "+b.name+" "+b.author+" "+b.publisher+" "+b.quantity);
32. }
33. }
34. }

Output:

3 Details:

103 Operating System Galvin Wiley 6

2 Details:

102 Data Communications & Networking Forouzan Mc Graw Hill 4

1 Details:

101 Let us C Yashwant Kanetkar BPB 8

# Difference between HashMap and Hashtable

HashMap and Hashtable both are used to store data in key and value form. Both are using hashing technique to store unique keys.

But there are many differences between HashMap and Hashtable classes that are given below.

|  |  |
| --- | --- |
| **HashMap** | **Hashtable** |
| 1) HashMap is **non synchronized**. It is not-thread safe and can't be shared between many threads without proper synchronization code. | Hashtable is **synchronized**. It is thread-safe and can be shared with many threads. |
| 2) HashMap **allows one null key and multiple null values**. | Hashtable **doesn't allow any null key or value**. |
| 3) HashMap is a **new class introduced in JDK 1.2**. | Hashtable is a **legacy class**. |
| 4) HashMap is **fast**. | Hashtable is **slow**. |
| 5) We can make the HashMap as synchronized by calling this code Map m = Collections.synchronizedMap(hashMap); | Hashtable is internally synchronized and can't be unsynchronized. |
| 6) HashMap is **traversed by Iterator**. | Hashtable is **traversed by Enumerator and Iterator**. |
| 7) Iterator in HashMap is **fail-fast**. | Enumerator in Hashtable is **not fail-fast**. |
| 8) HashMap inherits **AbstractMap** class. | Hashtable inherits **Dictionary**class. |

# Java EnumSet class

Java EnumSet class is the specialized Set implementation for use with enum types. It inherits AbstractSet class and implements the Set interface.

### EnumSet class hierarchy

The hierarchy of EnumSet class is given in the figure given below.

EnumSet class hierarchy

## EnumSet class declaration

Let's see the declaration for java.util.EnumSet class.

1. **public** **abstract** **class** EnumSet<E **extends** Enum<E>> **extends** AbstractSet<E> **implements** Cloneable, Serializable

### Methods of Java EnumSet class

|  |  |
| --- | --- |
| **Method** | **Description** |
| static <E extends Enum<E>> EnumSet<E> allOf(Class<E> elementType) | It is used to create an enum set containing all of the elements in the specified element type. |
| static <E extends Enum<E>> EnumSet<E> copyOf(Collection<E> c) | It is used to create an enum set initialized from the specified collection. |
| static <E extends Enum<E>> EnumSet<E> noneOf(Class<E> elementType) | It is used to create an empty enum set with the specified element type. |
| static <E extends Enum<E>> EnumSet<E> of(E e) | It is used to create an enum set initially containing the specified element. |
| static <E extends Enum<E>> EnumSet<E> range(E from, E to) | It is used to create an enum set initially containing the specified elements. |
| EnumSet<E> clone() | It is used to return a copy of this set. |

## Java EnumSet Example

1. **import** java.util.\*;
2. **enum** days {
3. SUNDAY, MONDAY, TUESDAY, WEDNESDAY, THURSDAY, FRIDAY, SATURDAY
4. }
5. **public** **class** EnumSetExample {
6. **public** **static** **void** main(String[] args) {
7. Set<days> set = EnumSet.of(days.TUESDAY, days.WEDNESDAY);
8. // Traversing elements
9. Iterator<days> iter = set.iterator();
10. **while** (iter.hasNext())
11. System.out.println(iter.next());
12. }
13. }

Output:

TUESDAY

WEDNESDAY

## Java EnumSet Example: allOf() and noneOf()

1. **import** java.util.\*;
2. **enum** days {
3. SUNDAY, MONDAY, TUESDAY, WEDNESDAY, THURSDAY, FRIDAY, SATURDAY
4. }
5. **public** **class** EnumSetExample {
6. **public** **static** **void** main(String[] args) {
7. Set<days> set1 = EnumSet.allOf(days.**class**);
8. System.out.println("Week Days:"+set1);
9. Set<days> set2 = EnumSet.noneOf(days.**class**);
10. System.out.println("Week Days:"+set2);
11. }
12. }

Output:

Week Days:[SUNDAY, MONDAY, TUESDAY, WEDNESDAY, THURSDAY, FRIDAY, SATURDAY]

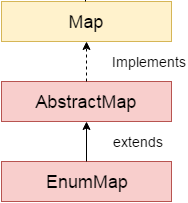
Week Days:[]

# Java EnumMap class

Java EnumMap class is the specialized Map implementation for enum keys. It inherits Enum and AbstractMap classes.

### EnumMap class hierarchy

The hierarchy of EnumMap class is given in the figure given below.



## EnumMap class declaration

Let's see the declaration for java.util.EnumMap class.

1. **public** **class** EnumMap<K **extends** Enum<K>,V> **extends** AbstractMap<K,V> **implements** Serializable, Cloneable

## EnumMap class Parameters

Let's see the Parameters for java.util.EnumMap class.

* **K:** It is the type of keys maintained by this map.
* **V:** It is the type of mapped values.

### Constructors of Java EnumMap class

|  |  |
| --- | --- |
| **Constructor** | **Description** |
| EnumMap(Class<K> keyType) | It is used to create an empty enum map with the specified key type. |
| EnumMap(EnumMap<K,? extends V> m) | It is used to create an enum map with the same key type as the specified enum map. |
| EnumMap(Map<K,? extends V> m) | It is used to create an enum map initialized from the specified map. |

### Methods of Java EnumMap class

|  |  |
| --- | --- |
| **Method** | **Description** |
| void clear() | It is used to remove all mappings from this map. |
| boolean containsKey(Object key) | This method return true if this map contains a mapping for the specified key. |
| boolean containsValue(Object value) | This method return true if this map maps one or more keys to the specified value. |
| boolean equals(Object o) | It is used to compare the specified object with this map for equality. |
| V get(Object key) | This method returns the value to which the specified key is mapped. |
| V put(K key, V value) | It is used to associate the specified value with the specified key in this map. |
| V remove(Object key) | It is used to remove the mapping for this key. |
| Collection<V> values() | It is used to return a Collection view of the values contained in this map. |
| int size() | It is used to return the number of key-value mappings in this map. |

## Java EnumMap Example

1. **import** java.util.\*;
2. **public** **class** EnumMapExample {
3. // create an enum
4. **public** **enum** Days {
5. Monday, Tuesday, Wednesday, Thursday
6. };
7. **public** **static** **void** main(String[] args) {
8. //create and populate enum map
9. EnumMap<Days, String> map = **new** EnumMap<Days, String>(Days.**class**);
10. map.put(Days.Monday, "1");
11. map.put(Days.Tuesday, "2");
12. map.put(Days.Wednesday, "3");
13. map.put(Days.Thursday, "4");
14. // print the map
15. **for**(Map.Entry m:map.entrySet()){
16. System.out.println(m.getKey()+" "+m.getValue());
17. }
18. }
19. }

Output:

Monday 1

Tuesday 2

Wednesday 3

Thursday 4

## Java EnumMap Example: Book

1. **import** java.util.\*;
2. **class** Book {
3. **int** id;
4. String name,author,publisher;
5. **int** quantity;
6. **public** Book(**int** id, String name, String author, String publisher, **int** quantity) {
7. **this**.id = id;
8. **this**.name = name;
9. **this**.author = author;
10. **this**.publisher = publisher;
11. **this**.quantity = quantity;
12. }
13. }
14. **public** **class** EnumMapExample {
15. // Creating enum
16. **public** **enum** Key{
17. One, Two, Three
18. };
19. **public** **static** **void** main(String[] args) {
20. EnumMap<Key, Book> map = **new** EnumMap<Key, Book>(Key.**class**);
21. // Creating Books
22. Book b1=**new** Book(101,"Let us C","Yashwant Kanetkar","BPB",8);
23. Book b2=**new** Book(102,"Data Communications & Networking","Forouzan","Mc Graw Hill",4);
24. Book b3=**new** Book(103,"Operating System","Galvin","Wiley",6);
25. // Adding Books to Map
26. map.put(Key.One, b1);
27. map.put(Key.Two, b2);
28. map.put(Key.Three, b3);
29. // Traversing EnumMap
30. **for**(Map.Entry<Key, Book> entry:map.entrySet()){
31. Book b=entry.getValue();
32. System.out.println(b.id+" "+b.name+" "+b.author+" "+b.publisher+" "+b.quantity);
33. }
34. }
35. }

Output:

101 Let us C Yashwant Kanetkar BPB 8

102 Data Communications & Networking Forouzan Mc Graw Hill 4

103 Operating System Galvin Wiley 6

# Java Collections class

Java collection class is used exclusively with static methods that operate on or return collections. It inherits Object class.

The important points about Java Collections class are:

* Java Collection class supports the **polymorphic algorithms** that operate on collections.
* Java Collection class throws a **NullPointerException** if the collections or class objects provided to them are null.

## Collections class declaration

Let's see the declaration for Java.util.Collections class.

1. **public** **class** Collections **extends** Object

### Methods of Java Collections class

|  |  |
| --- | --- |
| **Method** | **Description** |
| static <T> boolean addAll(Collection<? super T> c, T... elements) | It is used to add all of the specified elements to the specified collection. |
| static <T> Queue<T> asLifoQueue(Deque<T> deque) | It is used to return a view of a Deque as a Last-In-First-Out (LIFO) Queue. |
| static <T> int binarySearch(List<? extends T> list, T key, Comparator<? super T< c) | It is used to search the specified list for the specified object using the binary search algorithm. |
| static <E> List<E> checkedList(List<E> list, Class<E> type) | It is used to return a dynamically typesafe view of the specified list. |
| static <E> Set<E> checkedSet(Set<E> s, Class<E> type) | It is used to return a dynamically typesafe view of the specified set. |
| static <E> SortedSet<E>checkedSortedSet(SortedSet<E> s, Class<E> type) | It is used to return a dynamically typesafe view of the specified sorted set |
| static void reverse(List<?> list) | It is used to reverse the order of the elements in the specified list. |
| static <T> T max(Collection<? extends T> coll, Comparator<? super T> comp) | It is used to return the maximum element of the given collection, according to the order induced by the specified comparator. |
| static <T extends Object & Comparable<? super T>>T min(Collection<? extends T> coll) | It is used to return the minimum element of the given collection, according to the natural ordering of its elements. |
| static boolean replaceAll(List list, T oldVal, T newVal) | It is used to replace all occurrences of one specified value in a list with another. |

## Java Collections Example

1. **import** java.util.\*;
2. **public** **class** CollectionsExample {
3. **public** **static** **void** main(String a[]){
4. List<String> list = **new** ArrayList<String>();
5. list.add("C");
6. list.add("Core Java");
7. list.add("Advance Java");
8. System.out.println("Initial collection value:"+list);
9. Collections.addAll(list, "Servlet","JSP");
10. System.out.println("After adding elements collection value:"+list);
11. String[] strArr = {"C#", ".Net"};
12. Collections.addAll(list, strArr);
13. System.out.println("After adding array collection value:"+list);
14. }
15. }

Output:

Initial collection value:[C, Core Java, Advance Java]

After adding elements collection value:[C, Core Java, Advance Java, Servlet, JSP]

After adding array collection value:[C, Core Java, Advance Java, Servlet, JSP, C#, .Net]

## Java Collections Example: max()

1. **import** java.util.\*;
2. **public** **class** CollectionsExample {
3. **public** **static** **void** main(String a[]){
4. List<Integer> list = **new** ArrayList<Integer>();
5. list.add(46);
6. list.add(67);
7. list.add(24);
8. list.add(16);
9. list.add(8);
10. list.add(12);
11. System.out.println("Value of maximum element from the collection: "+Collections.max(list));
12. }
13. }

Output:

Value of maximum element from the collection: 67

## Java Collections Example: min()

1. **import** java.util.\*;
2. **public** **class** CollectionsExample {
3. **public** **static** **void** main(String a[]){
4. List<Integer> list = **new** ArrayList<Integer>();
5. list.add(46);
6. list.add(67);
7. list.add(24);
8. list.add(16);
9. list.add(8);
10. list.add(12);
11. System.out.println("Value of minimum element from the collection: "+Collections.min(list));
12. }
13. }

Output:

Value of minimum element from the collection: 8

# Sorting in Collection

We can sort the elements of:

1. String objects
2. Wrapper class objects
3. User-defined class objects

|  |
| --- |
| **Collections** class provides static methods for sorting the elements of collection.If collection elements are of Set type, we can use TreeSet.But We cannot sort the elements of List.Collections class provides methods for sorting the elements of List type elements. |

### Method of Collections class for sorting List elements

|  |
| --- |
| **public void sort(List list):** is used to sort the elements of List.List elements must be of Comparable type. |

#### Note: String class and Wrapper classes implements the Comparable interface.So if you store the objects of string or wrapper classes, it will be Comparable.

### Example of Sorting the elements of List that contains string objects

1. **import** java.util.\*;
2. **class** TestSort1{
3. **public** **static** **void** main(String args[]){
5. ArrayList<String> al=**new** ArrayList<String>();
6. al.add("Viru");
7. al.add("Saurav");
8. al.add("Mukesh");
9. al.add("Tahir");
11. Collections.sort(al);
12. Iterator itr=al.iterator();
13. **while**(itr.hasNext()){
14. System.out.println(itr.next());
15. }
16. }
17. }

[**Test it Now**](http://www.javatpoint.com/opr/test.jsp?filename=TestSort1)

Output:Mukesh

Saurav

Tahir

Viru

### Example of Sorting the elements of List that contains Wrapper class objects

1. **import** java.util.\*;
2. **class** TestSort2{
3. **public** **static** **void** main(String args[]){
5. ArrayList al=**new** ArrayList();
6. al.add(Integer.valueOf(201));
7. al.add(Integer.valueOf(101));
8. al.add(230);//internally will be converted into objects as Integer.valueOf(230)
10. Collections.sort(al);
12. Iterator itr=al.iterator();
13. **while**(itr.hasNext()){
14. System.out.println(itr.next());
15. }
16. }
17. }

[**Test it Now**](http://www.javatpoint.com/opr/test.jsp?filename=TestSort2)

Output:101

201

230

# Java Comparable interface

Java Comparable interface is used to order the objects of user-defined class.This interface is found in java.lang package and contains only one method named compareTo(Object). It provide single sorting sequence only i.e. you can sort the elements on based on single data member only. For example it may be rollno, name, age or anything else.

### compareTo(Object obj) method

**public int compareTo(Object obj):** is used to compare the current object with the specified object.

We can sort the elements of:

1. String objects
2. Wrapper class objects
3. User-defined class objects

### Collections class

**Collections** class provides static methods for sorting the elements of collections. If collection elements are of Set or Map, we can use TreeSet or TreeMap. But We cannot sort the elements of List. Collections class provides methods for sorting the elements of List type elements.

### Method of Collections class for sorting List elements

**public void sort(List list):** is used to sort the elements of List. List elements must be of Comparable type.

#### Note: String class and Wrapper classes implements Comparable interface by default. So if you store the objects of string or wrapper classes in list, set or map, it will be Comparable by default.

## Java Comparable Example

Let's see the example of Comparable interface that sorts the list elements on the basis of age.

*File: Student.java*

1. **class** Student **implements** Comparable<Student>{
2. **int** rollno;
3. String name;
4. **int** age;
5. Student(**int** rollno,String name,**int** age){
6. **this**.rollno=rollno;
7. **this**.name=name;
8. **this**.age=age;
9. }
11. **public** **int** compareTo(Student st){
12. **if**(age==st.age)
13. **return** 0;
14. **else** **if**(age>st.age)
15. **return** 1;
16. **else**
17. **return** -1;
18. }
19. }

*File: TestSort3.java*

1. **import** java.util.\*;
2. **import** java.io.\*;
3. **public** **class** TestSort3{
4. **public** **static** **void** main(String args[]){
5. ArrayList<Student> al=**new** ArrayList<Student>();
6. al.add(**new** Student(101,"Vijay",23));
7. al.add(**new** Student(106,"Ajay",27));
8. al.add(**new** Student(105,"Jai",21));
10. Collections.sort(al);
11. **for**(Student st:al){
12. System.out.println(st.rollno+" "+st.name+" "+st.age);
13. }
14. }
15. }

[**Test it Now**](http://www.javatpoint.com/opr/test.jsp?filename=TestSort3)

Output:105 Jai 21

101 Vijay 23

106 Ajay 27

# ava Comparator interface

**Java Comparator interface** is used to order the objects of user-defined class.

This interface is found in java.util package and contains 2 methods compare(Object obj1,Object obj2) and equals(Object element).

It provides multiple sorting sequence i.e. you can sort the elements on the basis of any data member, for example rollno, name, age or anything else.

#### compare() method

**public int compare(Object obj1,Object obj2):** compares the first object with second object.

## Collections class

**Collections** class provides static methods for sorting the elements of collection. If collection elements are of Set or Map, we can use TreeSet or TreeMap. But we cannot sort the elements of List. Collections class provides methods for sorting the elements of List type elements also.

#### Method of Collections class for sorting List elements

**public void sort(List list, Comparator c):** is used to sort the elements of List by the given Comparator.

## ava Comparator Example (Non-generic Old Style)

Let's see the example of sorting the elements of List on the basis of age and name. In this example, we have created 4 java classes:

1. Student.java
2. AgeComparator.java
3. NameComparator.java
4. Simple.java

**Student.java**

This class contains three fields rollno, name and age and a parameterized constructor.

1. **class** Student{
2. **int** rollno;
3. String name;
4. **int** age;
5. Student(**int** rollno,String name,**int** age){
6. **this**.rollno=rollno;
7. **this**.name=name;
8. **this**.age=age;
9. }
10. }

**AgeComparator.java**

This class defines comparison logic based on the age. If age of first object is greater than the second, we are returning positive value, it can be any one such as 1, 2 , 10 etc. If age of first object is less than the second object, we are returning negative value, it can be any negative value and if age of both objects are equal, we are returning 0.

1. **import** java.util.\*;
2. **class** AgeComparator **implements** Comparator{
3. **public** **int** compare(Object o1,Object o2){
4. Student s1=(Student)o1;
5. Student s2=(Student)o2;
7. **if**(s1.age==s2.age)
8. **return** 0;
9. **else** **if**(s1.age>s2.age)
10. **return** 1;
11. **else**
12. **return** -1;
13. }
14. }

**NameComparator.java**

This class provides comparison logic based on the name. In such case, we are using the compareTo() method of String class, which internally provides the comparison logic.

1. **import** java.util.\*;
2. **class** NameComparator **implements** Comparator{
3. **public** **int** compare(Object o1,Object o2){
4. Student s1=(Student)o1;
5. Student s2=(Student)o2;
7. **return** s1.name.compareTo(s2.name);
8. }
9. }

**Simple.java**

In this class, we are printing the objects values by sorting on the basis of name and age.

1. **import** java.util.\*;
2. **import** java.io.\*;
4. **class** Simple{
5. **public** **static** **void** main(String args[]){
7. ArrayList al=**new** ArrayList();
8. al.add(**new** Student(101,"Vijay",23));
9. al.add(**new** Student(106,"Ajay",27));
10. al.add(**new** Student(105,"Jai",21));
12. System.out.println("Sorting by Name...");
14. Collections.sort(al,**new** NameComparator());
15. Iterator itr=al.iterator();
16. **while**(itr.hasNext()){
17. Student st=(Student)itr.next();
18. System.out.println(st.rollno+" "+st.name+" "+st.age);
19. }
21. System.out.println("sorting by age...");
23. Collections.sort(al,**new** AgeComparator());
24. Iterator itr2=al.iterator();
25. **while**(itr2.hasNext()){
26. Student st=(Student)itr2.next();
27. System.out.println(st.rollno+" "+st.name+" "+st.age);
28. }

31. }
32. }

Sorting by Name...

106 Ajay 27

105 Jai 21

101 Vijay 23

Sorting by age...

105 Jai 21

101 Vijay 23

106 Ajay 27

## Java Comparator Example (Generic)

**Student.java**

1. **class** Student{
2. **int** rollno;
3. String name;
4. **int** age;
5. Student(**int** rollno,String name,**int** age){
6. **this**.rollno=rollno;
7. **this**.name=name;
8. **this**.age=age;
9. }
10. }

**AgeComparator.java**

1. **import** java.util.\*;
2. **class** AgeComparator **implements** Comparator<Student>{
3. **public** **int** compare(Student s1,Student s2){
4. **if**(s1.age==s2.age)
5. **return** 0;
6. **else** **if**(s1.age>s2.age)
7. **return** 1;
8. **else**
9. **return** -1;
10. }
11. }

**NameComparator.java**

This class provides comparison logic based on the name. In such case, we are using the compareTo() method of String class, which internally provides the comparison logic.

1. **import** java.util.\*;
2. **class** NameComparator **implements** Comparator<Student>{
3. **public** **int** compare(Student s1,Student s2){
4. **return** s1.name.compareTo(s2.name);
5. }
6. }

**Simple.java**

In this class, we are printing the objects values by sorting on the basis of name and age.

1. **import** java.util.\*;
2. **import** java.io.\*;
3. **class** Simple{
4. **public** **static** **void** main(String args[]){
6. ArrayList<Student> al=**new** ArrayList<Student>();
7. al.add(**new** Student(101,"Vijay",23));
8. al.add(**new** Student(106,"Ajay",27));
9. al.add(**new** Student(105,"Jai",21));
11. System.out.println("Sorting by Name...");
13. Collections.sort(al,**new** NameComparator());
14. **for**(Student st: al){
15. System.out.println(st.rollno+" "+st.name+" "+st.age);
16. }
18. System.out.println("sorting by age...");
20. Collections.sort(al,**new** AgeComparator());
21. **for**(Student st: al){
22. System.out.println(st.rollno+" "+st.name+" "+st.age);
23. }
25. }
26. }

Output:Sorting by Name...

106 Ajay 27

105 Jai 21

101 Vijay 23

Sorting by age...

105 Jai 21

101 Vijay 23

106 Ajay 27

# Properties class in Java

The **properties** object contains key and value pair both as a string. The java.util.Properties class is the subclass of Hashtable.

It can be used to get property value based on the property key. The Properties class provides methods to get data from properties file and store data into properties file. Moreover, it can be used to get properties of system.

### Advantage of properties file

**Recompilation is not required, if information is changed from properties file:** If any information is changed from the properties file, you don't need to recompile the java class. It is used to store information which is to be changed frequently.

#### Methods of Properties class

The commonly used methods of Properties class are given below.

|  |  |
| --- | --- |
| **Method** | **Description** |
| public void load(Reader r) | loads data from the Reader object. |
| public void load(InputStream is) | loads data from the InputStream object |
| public String getProperty(String key) | returns value based on the key. |
| public void setProperty(String key,String value) | sets the property in the properties object. |
| public void store(Writer w, String comment) | writers the properties in the writer object. |
| public void store(OutputStream os, String comment) | writes the properties in the OutputStream object. |
| storeToXML(OutputStream os, String comment) | writers the properties in the writer object for generating xml document. |
| public void storeToXML(Writer w, String comment, String encoding) | writers the properties in the writer object for generating xml document with specified encoding. |

### Example of Properties class to get information from properties file

To get information from the properties file, create the properties file first.

**db.properties**

1. user=system
2. password=oracle

Now, lets create the java class to read the data from the properties file.

**Test.java**

1. **import** java.util.\*;
2. **import** java.io.\*;
3. **public** **class** Test {
4. **public** **static** **void** main(String[] args)**throws** Exception{
5. FileReader reader=**new** FileReader("db.properties");
7. Properties p=**new** Properties();
8. p.load(reader);
10. System.out.println(p.getProperty("user"));
11. System.out.println(p.getProperty("password"));
12. }
13. }

Output:system

oracle

Now if you change the value of the properties file, you don't need to compile the java class again. That means no maintenance problem.

### Example of Properties class to get all the system properties

By System.getProperties() method we can get all the properties of system. Let's create the class that gets information from the system properties.

**Test.java**

1. **import** java.util.\*;
2. **import** java.io.\*;
3. **public** **class** Test {
4. **public** **static** **void** main(String[] args)**throws** Exception{
6. Properties p=System.getProperties();
7. Set set=p.entrySet();
9. Iterator itr=set.iterator();
10. **while**(itr.hasNext()){
11. Map.Entry entry=(Map.Entry)itr.next();
12. System.out.println(entry.getKey()+" = "+entry.getValue());
13. }
15. }
16. }

Output:

java.runtime.name = Java(TM) SE Runtime Environment

sun.boot.library.path = C:\Program Files\Java\jdk1.7.0\_01\jre\bin

java.vm.version = 21.1-b02

java.vm.vendor = Oracle Corporation

java.vendor.url = http://java.oracle.com/

path.separator = ;

java.vm.name = Java HotSpot(TM) Client VM

file.encoding.pkg = sun.io

user.country = US

user.script =

sun.java.launcher = SUN\_STANDARD

...........

### Example of Properties class to create properties file

Now lets write the code to create the properties file.

**Test.java**

1. **import** java.util.\*;
2. **import** java.io.\*;
3. **public** **class** Test {
4. **public** **static** **void** main(String[] args)**throws** Exception{
6. Properties p=**new** Properties();
7. p.setProperty("name","John Smith");
8. p.setProperty("email","Johnsmith@javatpoint.com");
10. p.store(**new** FileWriter("info.properties"),"Javatpoint Properties Example");
12. }
13. }

Let's see the generated properties file.

**info.properties**

1. #Javatpoint Properties Example
2. #Thu Oct 03 22:35:53 IST 2013
3. email=Johnsmith@javatpoint.com
4. name=John Smith

# Difference between ArrayList and Vector

ArrayList and Vector both implements List interface and maintains insertion order.

But there are many differences between ArrayList and Vector classes that are given below.

|  |  |
| --- | --- |
| **ArrayList** | **Vector** |
| 1) ArrayList is **not synchronized**. | Vector is **synchronized**. |
| 2) ArrayList **increments 50%**of current array size if number of element exceeds from its capacity. | Vector **increments 100%** means doubles the array size if total number of element exceeds than its capacity. |
| 3) ArrayList is **not a legacy**class, it is introduced in JDK 1.2. | Vector is a **legacy** class. |
| 4) ArrayList is **fast** because it is non-synchronized. | Vector is **slow** because it is synchronized i.e. in multithreading environment, it will hold the other threads in runnable or non-runnable state until current thread releases the lock of object. |
| 5) ArrayList uses **Iterator**interface to traverse the elements. | Vector uses **Enumeration** interface to traverse the elements. But it can use Iterator also. |

### Example of Java ArrayList

Let's see a simple example where we are using ArrayList to store and traverse the elements.

1. **import** java.util.\*;
2. **class** TestArrayList21{
3. **public** **static** **void** main(String args[]){
5. List<String> al=**new** ArrayList<String>();//creating arraylist
6. al.add("John");//adding object in arraylist
7. al.add("Michael");
8. al.add("James");
9. al.add("Andy");
10. //traversing elements using Iterator
11. Iterator itr=al.iterator();
12. **while**(itr.hasNext()){
13. System.out.println(itr.next());
14. }
15. }
16. }

[**Test it Now**](http://www.javatpoint.com/opr/test.jsp?filename=TestArrayList21)

Output:

John

Michael

James

Andy

### Example of Java Vector

Let's see a simple example of java Vector class that uses Enumeration interface.

1. **import** java.util.\*;
2. **class** TestVector1{
3. **public** **static** **void** main(String args[]){
4. Vector<String> v=**new** Vector<String>();//creating vector
5. v.add("umesh");//method of Collection
6. v.addElement("irfan");//method of Vector
7. v.addElement("kumar");
8. //traversing elements using Enumeration
9. Enumeration e=v.elements();
10. **while**(e.hasMoreElements()){
11. System.out.println(e.nextElement());
12. }
13. }
14. }

[**Test it Now**](http://www.javatpoint.com/opr/test.jsp?filename=TestVector1)

Output:

umesh

irfan

kumar