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java.util

## Class ArrayList<E>

java.lang.Object

java.util.AbstractCollection&lt;E&gt;

java.util.AbstractList&lt;E&gt;

java.util.ArrayList&lt;E&gt;

### All Implemented Interfaces:

[Serializable](#), [Cloneable](#), [Iterable<E>](#), [Collection<E>](#), [List<E>](#), [RandomAccess](#)

### Direct Known Subclasses:

[AttributeList](#), [RoleList](#), [RoleUnresolvedList](#)

```
public class ArrayList<E>
    extends AbstractList<E>
    implements List<E>, RandomAccess, Cloneable, Serializable
```

Resizable-array implementation of the [List](#) interface. Implements all optional list operations, and permits all elements, including `null`. In addition to implementing the [List](#) interface, this class provides methods to manipulate the size of the array that is used internally to store the list. (This class is roughly equivalent to [Vector](#), except that it is unsynchronized.)

The `size`, `isEmpty`, `get`, `set`, `iterator`, and `listIterator` operations run in constant time. The `add` operation runs in *amortized constant time*, that is, adding `n` elements requires  $O(n)$  time. All of the other operations run in linear time (roughly speaking). The constant factor is low compared to that for the [LinkedList](#) implementation.

Each [ArrayList](#) instance has a *capacity*. The capacity is the size of the array used to store the elements in the list. It is always at least as large as the list size. As elements are added to an [ArrayList](#), its capacity grows automatically. The details of the growth policy are not specified beyond the fact that adding an element has constant amortized time cost.

An application can increase the capacity of an [ArrayList](#) instance before adding a large number of elements using the `ensureCapacity` operation. This may reduce the amount of incremental reallocation.

**Note that this implementation is not synchronized.** If multiple threads access an [ArrayList](#) instance concurrently, and at least one of the threads modifies the list structurally, it *must* be synchronized externally. (A structural modification is any operation that adds or deletes one or more elements, or explicitly resizes the backing array; merely setting the value of an element is not a structural modification.) This is typically accomplished by synchronizing on some object that naturally encapsulates the list. If no such object exists, the list should be "wrapped" using the [Collections.synchronizedList](#) method. This is best done at creation time, to prevent accidental unsynchronized access to the list:

```
List list = Collections.synchronizedList(new ArrayList(...));
```

The iterators returned by this class's `iterator` and `listIterator` methods are *fail-fast*: if the list is structurally modified at any time after the iterator is created, in any way except through the iterator's own `remove` or `add` methods, the iterator will throw a [ConcurrentModificationException](#). Thus, in the face of concurrent modification, the iterator fails quickly and cleanly, rather than risking arbitrary, non-deterministic behavior at an undetermined time in the future.

Note that the fail-fast behavior of an iterator cannot be guaranteed as it is, generally speaking, impossible to make any hard guarantees in the presence of unsynchronized concurrent modification. Fail-fast iterators throw [ConcurrentModificationException](#) on a best-effort basis. Therefore, it would be wrong to write a program that depended on this exception for its correctness: *the fail-fast behavior of iterators should be used only to detect bugs*.

This class is a member of the [Java Collections Framework](#).

### Since:

1.2

### See Also:

## Field Summary

### Fields inherited from class java.util.[AbstractList](#)

`modCount`

## Constructor Summary

### Constructors

#### Constructor and Description

##### [ArrayList\(\)](#)

Constructs an empty list with an initial capacity of ten.

##### [ArrayList\(Collection<? extends E> c\)](#)

Constructs a list containing the elements of the specified collection, in the order they are returned by the collection's iterator.

##### [ArrayList\(int initialCapacity\)](#)

Constructs an empty list with the specified initial capacity.

## Method Summary

### Methods

Modifier and Type	Method and Description
boolean	<a href="#">add(E e)</a> Appends the specified element to the end of this list.
void	<a href="#">add(int index, E element)</a> Inserts the specified element at the specified position in this list.
boolean	<a href="#">addAll(Collection&lt;? extends E&gt; c)</a> Appends 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.
boolean	<a href="#">addAll(int index, Collection&lt;? extends E&gt; c)</a> Inserts all of the elements in the specified collection into this list, starting at the specified position.
void	<a href="#">clear()</a> Removes all of the elements from this list.
<a href="#">Object</a>	<a href="#">clone()</a> Returns a shallow copy of this <a href="#">ArrayList</a> instance.
boolean	<a href="#">contains(Object o)</a> Returns true if this list contains the specified element.
void	<a href="#">ensureCapacity(int minCapacity)</a> Increases the capacity of this <a href="#">ArrayList</a> instance, if necessary, to ensure that it can hold at least the number of elements specified by the minimum capacity argument.
<a href="#">E</a>	<a href="#">get(int index)</a> Returns the element at the specified position in this list.
int	<a href="#">indexOf(Object o)</a>

	Returns the index of the first occurrence of the specified element in this list, or -1 if this list does not contain the element.
boolean	<b>isEmpty()</b> Returns true if this list contains no elements.
<b>Iterator&lt;E&gt;</b>	<b>iterator()</b> Returns an iterator over the elements in this list in proper sequence.
int	<b>lastIndexOf(Object o)</b> Returns the index of the last occurrence of the specified element in this list, or -1 if this list does not contain the element.
<b>ListIterator&lt;E&gt;</b>	<b>listIterator()</b> Returns a list iterator over the elements in this list (in proper sequence).
<b>ListIterator&lt;E&gt;</b>	<b>listIterator(int index)</b> Returns a list iterator over the elements in this list (in proper sequence), starting at the specified position in the list.
<b>E</b>	<b>remove(int index)</b> Removes the element at the specified position in this list.
boolean	<b>remove(Object o)</b> Removes the first occurrence of the specified element from this list, if it is present.
boolean	<b>removeAll(Collection&lt;?&gt; c)</b> Removes from this list all of its elements that are contained in the specified collection.
protected void	<b>removeRange(int fromIndex, int toIndex)</b> Removes from this list all of the elements whose index is between fromIndex, inclusive, and toIndex, exclusive.
boolean	<b>retainAll(Collection&lt;?&gt; c)</b> Retains only the elements in this list that are contained in the specified collection.
<b>E</b>	<b>set(int index, E element)</b> Replaces the element at the specified position in this list with the specified element.
int	<b>size()</b> Returns the number of elements in this list.
<b>List&lt;E&gt;</b>	<b>subList(int fromIndex, int toIndex)</b> Returns a view of the portion of this list between the specified fromIndex, inclusive, and toIndex, exclusive.
<b>Object[]</b>	<b>toArray()</b> Returns an array containing all of the elements in this list in proper sequence (from first to last element).
<b>&lt;T&gt; T[]</b>	<b>toArray(T[] a)</b> Returns an array containing all of the elements in this list in proper sequence (from first to last element); the runtime type of the returned array is that of the specified array.
void	<b>trimToSize()</b> Trims the capacity of this ArrayList instance to be the list's current size.

### Methods inherited from class java.util.AbstractList

equals, hashCode

### Methods inherited from class java.util.AbstractCollection

containsAll, toString

### Methods inherited from class java.lang.Object

finalize, getClass, notify, notifyAll, wait, wait, wait

### Methods inherited from interface java.util.List

`containsAll, equals, hashCode`

## Constructor Detail

### ArrayList

```
public ArrayList(int initialCapacity)
```

Constructs an empty list with the specified initial capacity.

**Parameters:**

`initialCapacity` - the initial capacity of the list

**Throws:**

`IllegalArgumentException` - if the specified initial capacity is negative

### ArrayList

```
public ArrayList()
```

Constructs an empty list with an initial capacity of ten.

### ArrayList

```
public ArrayList(Collection<? extends E> c)
```

Constructs a list containing the elements of the specified collection, in the order they are returned by the collection's iterator.

**Parameters:**

`c` - the collection whose elements are to be placed into this list

**Throws:**

`NullPointerException` - if the specified collection is null

## Method Detail

### trimToSize

```
public void trimToSize()
```

Trims the capacity of this `ArrayList` instance to be the list's current size. An application can use this operation to minimize the storage of an `ArrayList` instance.

### ensureCapacity

```
public void ensureCapacity(int minCapacity)
```

Increases the capacity of this ArrayList instance, if necessary, to ensure that it can hold at least the number of elements specified by the minimum capacity argument.

**Parameters:**

minCapacity - the desired minimum capacity

**size**

```
public int size()
```

Returns the number of elements in this list.

**Specified by:**

`size` in interface `Collection<E>`

**Specified by:**

`size` in interface `List<E>`

**Specified by:**

`size` in class `AbstractCollection<E>`

**Returns:**

the number of elements in this list

**isEmpty**

```
public boolean isEmpty()
```

Returns true if this list contains no elements.

**Specified by:**

`isEmpty` in interface `Collection<E>`

**Specified by:**

`isEmpty` in interface `List<E>`

**Overrides:**

`isEmpty` in class `AbstractCollection<E>`

**Returns:**

true if this list contains no elements

**contains**

```
public boolean contains(Object o)
```

Returns true if this list contains the specified element. More formally, returns true if and only if this list contains at least one element `e` such that `(o==null ? e==null : o.equals(e))`.

**Specified by:**

`contains` in interface `Collection<E>`

**Specified by:**

`contains` in interface `List<E>`

**Overrides:**

`contains` in class `AbstractCollection<E>`

**Parameters:**

`o` - element whose presence in this list is to be tested

**Returns:**

true if this list contains the specified element

**indexOf**

```
public int indexOf(Object o)
```

Returns the index of the first occurrence of the specified element in this list, or -1 if this list does not contain the element. More formally, returns the lowest index *i* such that (`o==null ? get(i)==null : o.equals(get(i))`), or -1 if there is no such index.

**Specified by:**

`indexOf` in interface `List<E>`

**Overrides:**

`indexOf` in class `AbstractList<E>`

**Parameters:**

`o` - element to search for

**Returns:**

the index of the first occurrence of the specified element in this list, or -1 if this list does not contain the element

**lastIndexOf**

```
public int lastIndexOf(Object o)
```

Returns the index of the last occurrence of the specified element in this list, or -1 if this list does not contain the element. More formally, returns the highest index *i* such that (`o==null ? get(i)==null : o.equals(get(i))`), or -1 if there is no such index.

**Specified by:**

`lastIndexOf` in interface `List<E>`

**Overrides:**

`lastIndexOf` in class `AbstractList<E>`

**Parameters:**

`o` - element to search for

**Returns:**

the index of the last occurrence of the specified element in this list, or -1 if this list does not contain the element

**clone**

```
public Object clone()
```

Returns a shallow copy of this `ArrayList` instance. (The elements themselves are not copied.)

**Overrides:**

`clone` in class `Object`

**Returns:**

a clone of this `ArrayList` instance

**See Also:**

`Cloneable`

**toArray**

```
public Object[] toArray()
```

Returns an array containing all of the elements in this list in proper sequence (from first to last element).

The returned array will be "safe" in that no references to it are maintained by this list. (In other words, this method must allocate a new array). The caller is thus free to modify the returned array.

This method acts as bridge between array-based and collection-based APIs.

**Specified by:**

`toArray` in interface `Collection<E>`

**Specified by:**

`toArray` in interface `List<E>`

**Overrides:**

`toArray` in class `AbstractCollection<E>`

**Returns:**

an array containing all of the elements in this list in proper sequence

**See Also:**

`Arrays.asList(Object[])`

**toArray**

```
public <T> T[] toArray(T[] a)
```

Returns an array containing all of the elements in this list in proper sequence (from first to last element); the runtime type of the returned array is that of the specified array. If the list fits in the specified array, it is returned therein. Otherwise, a new array is allocated with the runtime type of the specified array and the size of this list.

If the list fits in the specified array with room to spare (i.e., the array has more elements than the list), the element in the array immediately following the end of the collection is set to `null`. (This is useful in determining the length of the list *only* if the caller knows that the list does not contain any null elements.)

**Specified by:**

`toArray` in interface `Collection<E>`

**Specified by:**

`toArray` in interface `List<E>`

**Overrides:**

`toArray` in class `AbstractCollection<E>`

**Parameters:**

a - the array into which the elements of the list are to be stored, if it is big enough; otherwise, a new array of the same runtime type is allocated for this purpose.

**Returns:**

an array containing the elements of the list

**Throws:**

`ArrayStoreException` - if the runtime type of the specified array is not a supertype of the runtime type of every element in this list

`NullPointerException` - if the specified array is null

**get**

```
public E get(int index)
```

Returns the element at the specified position in this list.

**Specified by:**

`get` in interface `List<E>`

**Specified by:**

`get` in class `AbstractList<E>`

**Parameters:**

index - index of the element to return

**Returns:**

the element at the specified position in this list

**Throws:**

`IndexOutOfBoundsException` - if the index is out of range (`index < 0 || index >= size()`)

**set**

```
public E set(int index,  
            E element)
```

Replaces the element at the specified position in this list with the specified element.

**Specified by:**

`set` in interface `List<E>`

**Overrides:**

`set` in class `AbstractList<E>`

**Parameters:**

index - index of the element to replace

element - element to be stored at the specified position

**Returns:**

the element previously at the specified position

**Throws:**

`IndexOutOfBoundsException` - if the index is out of range (`index < 0 || index >= size()`)



## add

```
public boolean add(E e)
```

Appends the specified element to the end of this list.

**Specified by:**

`add` in interface `Collection<E>`

**Specified by:**

`add` in interface `List<E>`

**Overrides:**

`add` in class `AbstractList<E>`

**Parameters:**

`e` - element to be appended to this list

**Returns:**

true (as specified by `Collection.add(E)`)

## add

```
public void add(int index,  
               E element)
```

Inserts the specified element at the specified position in this list. Shifts the element currently at that position (if any) and any subsequent elements to the right (adds one to their indices).

**Specified by:**

`add` in interface `List<E>`

**Overrides:**

`add` in class `AbstractList<E>`

**Parameters:**

`index` - index at which the specified element is to be inserted

`element` - element to be inserted

**Throws:**

`IndexOutOfBoundsException` - if the index is out of range (`index < 0 || index > size()`)

## remove

```
public E remove(int index)
```

Removes the element at the specified position in this list. Shifts any subsequent elements to the left (subtracts one from their indices).

**Specified by:**

`remove` in interface `List<E>`

**Overrides:**

`remove` in class `AbstractList<E>`

**Parameters:**

index - the index of the element to be removed

**Returns:**

the element that was removed from the list

**Throws:**

`IndexOutOfBoundsException` - if the index is out of range (`index < 0 || index >= size()`)

**remove**

```
public boolean remove(Object o)
```

Removes the first occurrence of the specified element from this list, if it is present. If the list does not contain the element, it is unchanged. More formally, removes the element with the lowest index *i* such that (`o==null ? get(i)==null : o.equals(get(i))`) (if such an element exists). Returns true if this list contained the specified element (or equivalently, if this list changed as a result of the call).

**Specified by:**

`remove` in interface `Collection<E>`

**Specified by:**

`remove` in interface `List<E>`

**Overrides:**

`remove` in class `AbstractCollection<E>`

**Parameters:**

`o` - element to be removed from this list, if present

**Returns:**

true if this list contained the specified element

**clear**

```
public void clear()
```

Removes all of the elements from this list. The list will be empty after this call returns.

**Specified by:**

`clear` in interface `Collection<E>`

**Specified by:**

`clear` in interface `List<E>`

**Overrides:**

`clear` in class `AbstractList<E>`

**addAll**

```
public boolean addAll(Collection<? extends E> c)
```

Appends 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. The behavior of this operation is undefined if the specified collection is modified while the operation is in progress. (This implies that the behavior of this call is undefined if the specified collection is this list, and this list is nonempty.)

**Specified by:**

`addAll` in interface `Collection<E>`

**Specified by:**

`addAll` in interface `List<E>`

**Overrides:**

`addAll` in class `AbstractCollection<E>`

**Parameters:**

`c` - collection containing elements to be added to this list

**Returns:**

true if this list changed as a result of the call

**Throws:**

`NullPointerException` - if the specified collection is null

**See Also:**

`AbstractCollection.add(Object)`

**addAll**

```
public boolean addAll(int index,
                     Collection<? extends E> c)
```

Inserts all of the elements in the specified collection into this list, starting at the specified position. Shifts the element currently at that position (if any) and any subsequent elements to the right (increases their indices). The new elements will appear in the list in the order that they are returned by the specified collection's iterator.

**Specified by:**

`addAll` in interface `List<E>`

**Overrides:**

`addAll` in class `AbstractList<E>`

**Parameters:**

`index` - index at which to insert the first element from the specified collection

`c` - collection containing elements to be added to this list

**Returns:**

true if this list changed as a result of the call

**Throws:**

`IndexOutOfBoundsException` - if the index is out of range (`index < 0 || index > size()`)

`NullPointerException` - if the specified collection is null

**removeRange**

```
protected void removeRange(int fromIndex,
                           int toIndex)
```

Removes from this list all of the elements whose index is between `fromIndex`, inclusive, and `toIndex`, exclusive. Shifts any succeeding elements to the left (reduces their index). This call shortens the list by `(toIndex - fromIndex)` elements. (If `toIndex==fromIndex`, this operation has no effect.)

**Overrides:**

`removeRange` in class `AbstractList<E>`

**Parameters:**

`fromIndex` - index of first element to be removed

`toIndex` - index after last element to be removed

**Throws:**

`IndexOutOfBoundsException` - if `fromIndex` or `toIndex` is out of range (`fromIndex < 0 || fromIndex >= size()` || `toIndex > size()` || `toIndex < fromIndex`)

**removeAll**

```
public boolean removeAll(Collection<?> c)
```

Removes from this list all of its elements that are contained in the specified collection.

**Specified by:**

`removeAll` in interface `Collection<E>`

**Specified by:**

`removeAll` in interface `List<E>`

**Overrides:**

`removeAll` in class `AbstractCollection<E>`

**Parameters:**

`c` - collection containing elements to be removed from this list

**Returns:**

true if this list changed as a result of the call

**Throws:**

`ClassCastException` - if the class of an element of this list is incompatible with the specified collection (*optional*)

`NullPointerException` - if this list contains a null element and the specified collection does not permit null elements (*optional*), or if the specified collection is null

**See Also:**

`Collection.contains(Object)`

**retainAll**

```
public boolean retainAll(Collection<?> c)
```

Retains only the elements in this list that are contained in the specified collection. In other words, removes from this list all of its elements that are not contained in the specified collection.

**Specified by:**

`retainAll` in interface `Collection<E>`

**Specified by:**

`retainAll` in interface `List<E>`

**Overrides:**

`retainAll` in class `AbstractCollection<E>`

**Parameters:**

c - collection containing elements to be retained in this list

**Returns:**

true if this list changed as a result of the call

**Throws:**

[ClassCastException](#) - if the class of an element of this list is incompatible with the specified collection ([optional](#))

[NullPointerException](#) - if this list contains a null element and the specified collection does not permit null elements ([optional](#)), or if the specified collection is null

**See Also:**

[Collection.contains\(Object\)](#)

## listIterator

```
public ListIterator<E> listIterator(int index)
```

Returns a list iterator over the elements in this list (in proper sequence), starting at the specified position in the list. The specified index indicates the first element that would be returned by an initial call to [next](#). An initial call to [previous](#) would return the element with the specified index minus one.

The returned list iterator is *fail-fast*.

**Specified by:**

[listIterator](#) in interface [List](#)<E>

**Overrides:**

[listIterator](#) in class [AbstractList](#)<E>

**Parameters:**

index - index of the first element to be returned from the list iterator (by a call to [next](#))

**Returns:**

a list iterator over the elements in this list (in proper sequence), starting at the specified position in the list

**Throws:**

[IndexOutOfBoundsException](#) - if the index is out of range (`index < 0 || index > size()`)

## listIterator

```
public ListIterator<E> listIterator()
```

Returns a list iterator over the elements in this list (in proper sequence).

The returned list iterator is *fail-fast*.

**Specified by:**

[listIterator](#) in interface [List](#)<E>

**Overrides:**

[listIterator](#) in class [AbstractList](#)<E>

**Returns:**

a list iterator over the elements in this list (in proper sequence)

**See Also:**

```
listIterator(int)
```

## iterator

```
public Iterator<E> iterator()
```

Returns an iterator over the elements in this list in proper sequence.

The returned iterator is *fail-fast*.

### Specified by:

`iterator` in interface `Iterable<E>`

### Specified by:

`iterator` in interface `Collection<E>`

### Specified by:

`iterator` in interface `List<E>`

### Overrides:

`iterator` in class `AbstractList<E>`

### Returns:

an iterator over the elements in this list in proper sequence

## subList

```
public List<E> subList(int fromIndex,  
                      int toIndex)
```

Returns a view of the portion of this list between the specified `fromIndex`, inclusive, and `toIndex`, exclusive. (If `fromIndex` and `toIndex` are equal, the returned list is empty.) The returned list is backed by this list, so non-structural changes in the returned list are reflected in this list, and vice-versa. The returned list supports all of the optional list operations.

This method eliminates the need for explicit range operations (of the sort that commonly exist for arrays). Any operation that expects a list can be used as a range operation by passing a `subList` view instead of a whole list. For example, the following idiom removes a range of elements from a list:

```
list.subList(from, to).clear();
```

Similar idioms may be constructed for `indexOf(Object)` and `lastIndexOf(Object)`, and all of the algorithms in the `Collections` class can be applied to a `subList`.

The semantics of the list returned by this method become undefined if the backing list (i.e., this list) is *structurally modified* in any way other than via the returned list. (Structural modifications are those that change the size of this list, or otherwise perturb it in such a fashion that iterations in progress may yield incorrect results.)

### Specified by:

`subList` in interface `List<E>`

### Overrides:

`subList` in class `AbstractList<E>`

### Parameters:

`fromIndex` - low endpoint (inclusive) of the `subList`

`toIndex` - high endpoint (exclusive) of the `subList`

### Returns:

a view of the specified range within this list

**Throws:**

[IndexOutOfBoundsException](#) - if an endpoint index value is out of range (`fromIndex < 0` || `toIndex > size`)

[IllegalArgumentException](#) - if the endpoint indices are out of order (`fromIndex > toIndex`)

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