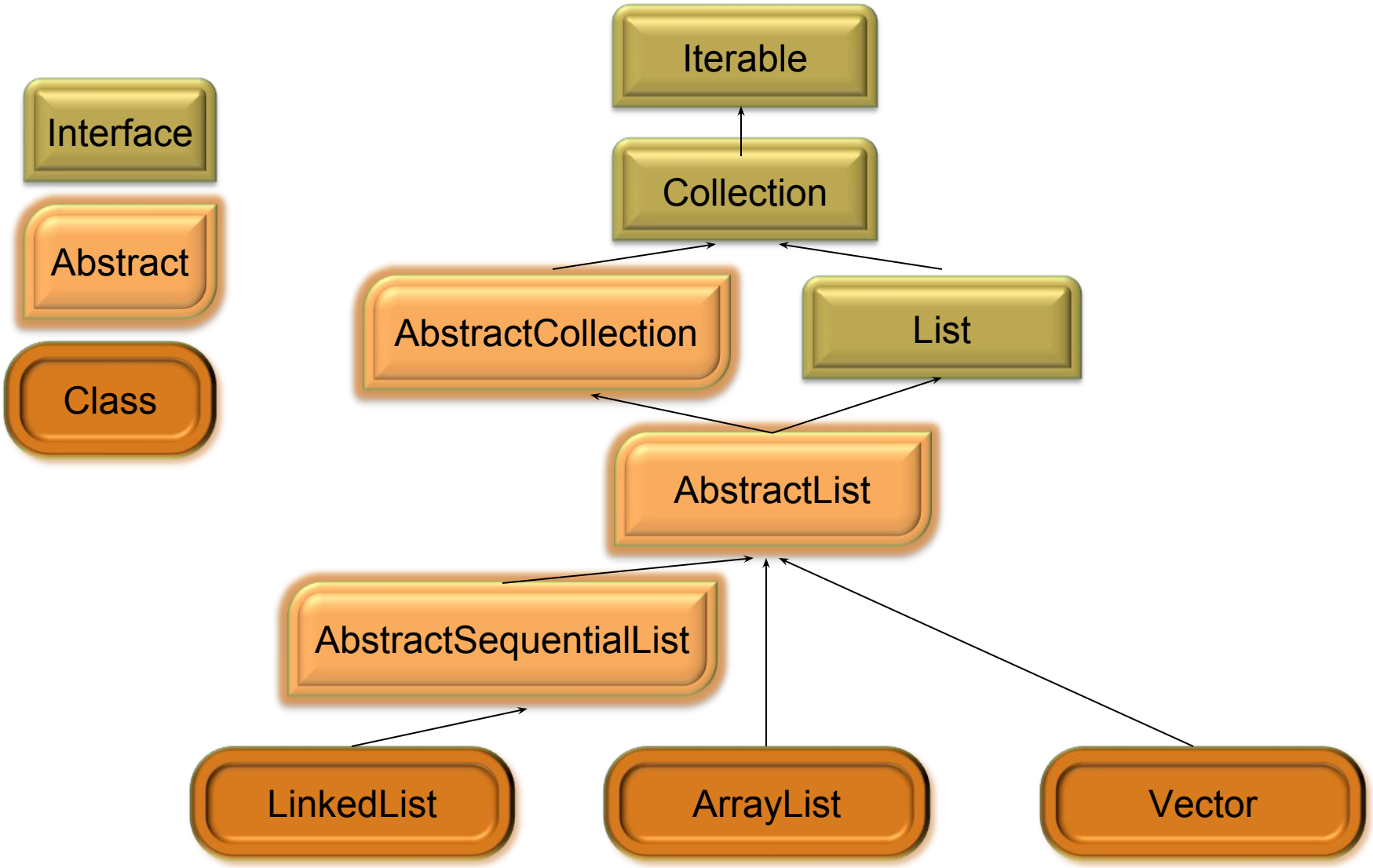
JAC444 - Lecture 9

Java Collections

Segment 3 - List

Type Hierarchy



The `List<E>` Interface

A **`List`** is an ordered **`Collection`** (called a sequence)

```
public interface List<E> extends Collection<E> {
      // Positional Access
      E get(int index);
      E set(int index, E element);
      void add(int index, E element);
      E remove(int index);
      boolean addAll(int index, Collection c);

      // Search
      int indexOf(E o);
      int lastIndexOf(E o);

      // Iteration
      ListIterator listIterator();
      ListIterator listIterator(int index);

      // Range-view
      List subList(int from, int to);
  }
```

1. Access
2. Search
3. Iteration
4. Range

ListIterator<E>

```
public interface ListIterator<E> extends Iterator<E> {
        boolean hasNext();
        E next();

        boolean hasPrevious();
        E previous();

        int nextIndex();
        int previousIndex();

        void remove();      // Optional
        void set(E o);      // Optional
        void add(E o);      // Optional
    }
```

Standard idiom for iterating backwards through a list

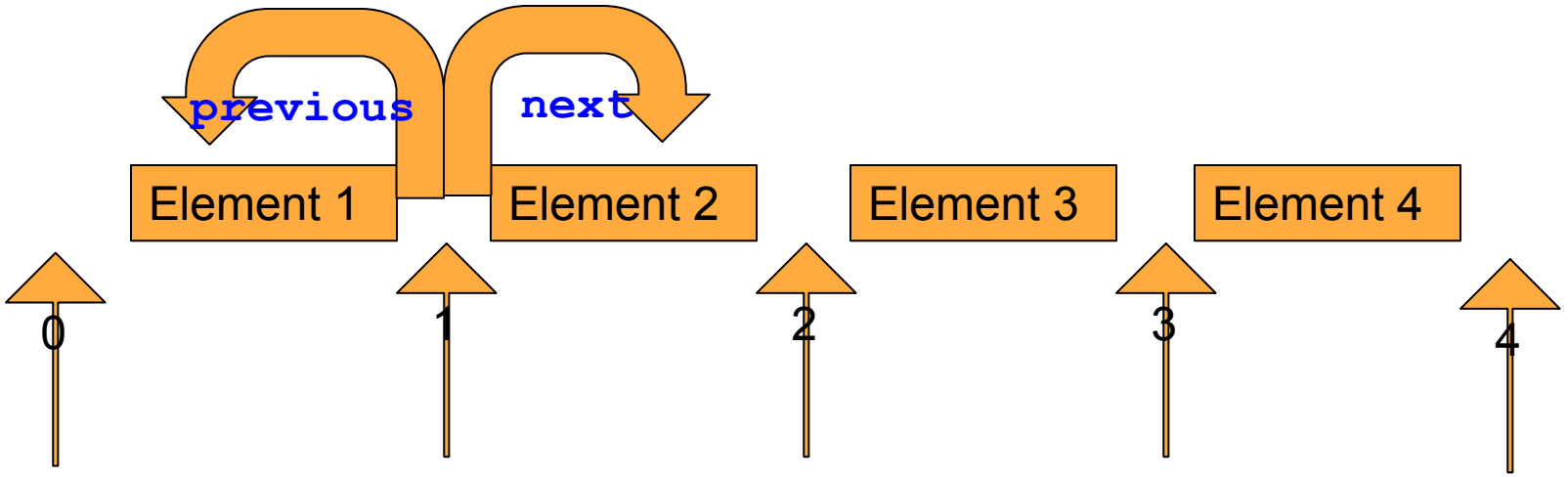
```
for ( ListIterator<E> i = list.listIterator(list.size()); i.hasPrevious();) {
            E o =  i.previous();
```

Operations on List

- Positional access — manipulates elements based on their numerical position in the list.
- Search — a specified object in the list and returns its numerical position.
- Iteration — extends Iterator semantics to take advantage of the list's sequential nature.
- Range-view — The `sublist` method performs arbitrary range operations on the list.

Cursor Positions in a List

The cursor is always between two elements of a list



In a list of length n, there are n+1 valid values for index, from 0 to n, inclusive.

List Implementations

There are two List implementations:

1. **`ArrayList<E>`** fast, offers constant-time positional access

2. **`LinkedList<E>`** better for adding elements at the beginning or deleting from interior

LinkedList

- The `LinkedList<E>` class extends `AbstractSequentialList<E>` and implements the `List<E>` interface

- It has two constructors: the default and `LinkedList(Collection<? extends E> c)`
- Multithreaded

```
Collections.synchronizedList(new LinkedList(...));
```

- Important method

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

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

Working with List

`new List()` does not work, since `List` is an interface

To build an object of type `List` one needs to use the implementations without exposing the implementation

Idioms:

```
List<E> list = new LinkedList<E>();
List<E> list = new ArrayList<E>();
```

Never expose the implementation:

```
ArrayList<E> list = new ArrayList<E>();
```

Position Access

Example to swap `list` elements at positions `k` and `h`:

```
public <String> void swap(List<String> list, int k, int h) {

        String s = list.get(k);
        list.set(k, list.get(h));
        list.set(h, s);
}
```

Algorithms on List

Some of the important algorithms on list:

`sort`	Sorts list using mergesort
`shuffle`	Randomly shuffles elements
`reverse`	Reverses order of elements
`rotate`	Rotates list by specified number
`fill`	Overwrites every element with specified element
`copy`	Copies source list into destination
`binarySearch`	Performs search using binary search