

Here, we say List is a **generic interface** with a **type variable** named Element.

A **generic type** can be used to represent an arbitrary number of types created by filling in any object type for the **type variable**.

```
interface List< Element > {
    void add( Element s);
    Element get(int index);
    int size();
}
```

Here, we say ArrayList is a **generic class** with a **type variable** named E.

Another term for generics is **parametric polymorphism**.

```
public class ArrayList<E> implements List<E> {

    E[] elements;
    int size;

    @SuppressWarnings("unchecked")
    public ArrayList() {
        this.elements = (E[])new Object[2];
        this.size = 0;
    }

    public void add(E s) {
        expandCapacity();
        this.elements[this.size] = s;
        this.size += 1;
    }

    public E get(int index) {
        // TODO: Check for out-of-bound
        // throw IndexOutOfBoundsException
        return this.elements[index];
    }

    public int size() {
        return this.size;
    }

    private void expandCapacity() {
        int currentCapacity = this.elements.length;
        if(this.size < currentCapacity) { return; }

        // How to construct new array here?

        for(int i = 0; i < this.size; i += 1) {
            expanded[i] = this.elements[i];
        }
        this.elements = expanded;
    }
}
```

```
public interface List< String > {
    void add( String s);
    String get(int index);
    int size();
}
```

```
public interface List< Integer > {
    void add( Integer s);
    Integer get(int index);
    int size();
}
```

```
class ArrayList<String> implements List<String> {
    void add(String s) { ... }
    String get(int index) { ... }
    int size() { ... }
}
```

```
class ArrayList<Integer> implements List<Integer> {
    void add(Integer s) { ... }
    Integer get(int index) { ... }
    int size() { ... }
}
```

```
import static org.junit.Assert.assertEquals;
import org.junit.Test;
```

```
public class TestList {
```

```
    @Test
    public void testAdd() {
        List<String> slist = new ArrayList<String>();
        slist.add("banana"); slist.add("apple");
        assertEquals("banana", slist.get(0));
        assertEquals("apple", slist.get(1));
    }
```

```
    @Test
    public void testAddThenSize() {
        List<Integer> ilist = new ArrayList<Integer>();
        ilist.add(500); ilist.add(12);
        assertEquals(2, ilist.size());
    }
```

```
    @Test
    public void testListOfLists() {
        // Fill in declaration of bllist
```

```
        bllist.add(new ArrayList<String>());
        bllist.add(new ArrayList<String>());
        bllist.get(0).add("a");
        bllist.get(0).add("b");
        bllist.get(1).add("c");
        bllist.get(1).add("d");
```

```
        assertEquals("a", bllist.get(0).get(0));
        assertEquals("b", bllist.get(0).get(1));
        assertEquals("c", bllist.get(1).get(0));
        assertEquals("d", bllist.get(1).get(1));
    }
```

```
}
```

```
public class IndexOutOfBoundsException
extends RuntimeException
```

Thrown to indicate that an index of some sort (such as to an array, to a string, or to a vector) is out of range.

```
public class AList<E> implements List<E> {
    ... code from other side ...

    public E get(int index) {
        // TODO: Check for out-of-bounds

        return this.elements[index];
    }
}
```

Design principle: at the start of CSE12 we will mostly be writing code to **throw an informative exception** and **test for it** more than trying to **catch and handle exceptions**.

If the program is going wrong, it should probably stop before it can do any harm, and tell the user what happened. Catching errors and continuing is a whole-system design concern that shouldn't be handled by a data structure.

```
import static org.junit.Assert.assertEquals;
import org.junit.Test;

public class TestList {

    @Test(expected = IndexOutOfBoundsException.class)
    public void testNegativeIndex() {
        List<String> slist = new AList<String>();
        slist.add("banana");
        slist.get(-1);
    }

    // more tests for index out of bounds here!

}
```