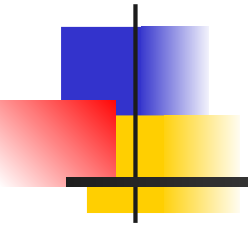


ArrayList

James Brucker

Limitations of Arrays

You allocate space for array when you create it:

```
numWords = console.nextInt();

String [ ] words = new String[numWords];
```

What if you don't know the **size of data** in advance?

Example: reading words from a file, but you don't know how many words are in the file?

After you create an array, you cannot change the size.

ArrayList

ArrayList is an alternative for variable size data

- ArrayList is an ordered collection of elements
- ArrayList grows and shrinks as needed!
- can add, delete, replace objects anywhere
- **ArrayList** is a class in Java

```
ArrayList food = new ArrayList( );
food.size();  // returns 0.  Its empty
food.add("Apple");
food.add("Banana");
food.size();  // returns 2
System.out.println( food.get(0) ); // Apple
System.out.println( food.get(1) ); // Banana
```

List and ArrayList

List is a basic data type (not a class).

- in Java, *List* is an interface, not a class
- you cannot create "List" objects

ArrayList is a class that behaves like a *List*

- you can ignore "List" for now

Untyped ArrayList holds Objects

- A plain "ArrayList" accepts any kind of Object
- When you "get" an element, it always returns type Object

```
ArrayList list = new ArrayList( );
list.add( "Apple" );  // a string
list.add( LocalDate.now() );  // LocalDate object
list.add( new Double(3.14) ); // another object

// Get something from arraylist
Object obj = list.get(1);
// If you want a String you must use a cast
String fruit = (String) list.get(0);
```

Using a *cast* is dangerous

- To get a "String" from ArrayList, we must *cast* the result to String.
- What if the element is not a String?

```
// Get Strings.  Must cast the result
String fruit = (String) list.get(0);

// If get(1) not a String, an Exception occurs
String fruit2 = (String) list.get(1);

java.lang.ClassCastException: line 5
```

Typed ArrayList

- Arraylist for String (only): ArrayList<String>
- <String> is called a **type parameter**.
- Type can be any class name, but not primitive

```
ArrayList<String> fruit =
                          new ArrayList<String>( );
list.add( "Apple" );    // a string
list.add( "Orange" );   // string
list.add( new Double(3.14) ); // Compile Error
// Compiler will not allow to add a Double

// No cast!  Result is automatically String
String s = list.get(1);  // No cast!
```

"ArrayList of String"

ArrayList<String> means "ArrayList of Strings"

ArrayList<Food> means "ArrayList of Food"

Common operations

```
ArrayList<String> fruit =
                          new ArrayList<String>( );
list.add( "Apple" );    // add at end of list (0)
list.add( "Orange" );   // add at end of list (1)
list.add( 1, "Banana" ); // add at index 1

list.size( );           // 3 things in list
list.get(1);            // "Banana" was inserted
list.get(2);            // "Orange" was pushed down
list.contains("Fig")    // false

list.remove("Apple")    // remove first occurence
list.get(0)             // "Banana"
```

Demo

View and inspect an ArrayList using BlueJ.

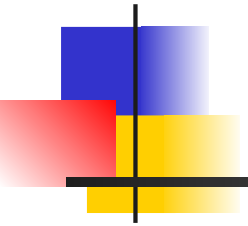
Notice what happens when number of items in ArrayList increases.

Useful ArrayList<T> Methods

- int size( ) returns # items in ArrayList
- add(T obj) add an object to ArrayList (at end)
- add(int k, T obj) add obj at position k (push others down)
- T get(int index) get object at given index
- T remove(int index) delete item from ArrayList & return it
- clear( ) remove all items from List
- set(int index, T obj) replace the object at index
- contains(T obj) "true" if obj is in ArrayList
- ensureCapacity(int size) make sure ArrayList can hold at least this many elements without resizing

T = the type used to create ArrayList, can be String, Person, Food,...

ensureCapacity( ) improved efficiency when you are adding a *lot* of items to an Arraylist.



Working with ArrayList

Some useful methods

Iterate over all the elements

- Print everything in the restaurant menu

```
ArrayList<String> menu = Restaurant.getMenu( );
for(int k=0; k<menu.size(); k++) {
    System.out.println( list.get(k) );
}
```

- Print the menu using a for-each loop

```
ArrayList<String> list = Restaurant.getMenu( );
for( String menuItem: menu ) {
    System.out.println( menuItem );
}
```

Copying ArrayList to Array

- Use an ArrayList to save data when you don't know how big the data set is.
- **`list.toArray( array )`** - copy to Array

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

... read all the data and save in list

// create an array large enough to store the data
String [ ] words = new String[ list.size( ) ];
// copy ArrayList to Array
list.toArray( words );
```

Sorting

Sort an ArrayList using the java.util.Collections class

- **Collections.sort(anyList)**
- anyList must contain objects that are *Comparable*
  - String, Double, Long, Int, Date...
  - any class that has a compareTo method

```
ArrayList<String> list = Restaurant.getMenu( );

Collections.sort( list ); // sorts the menu
```

Summary

ArrayList is a collection that:

- elements are ordered
- can add, remove, or set elements at any pos'n
- duplicate values are allowed
- size grows/shrinks automatically

ArrayList is not an array.

More Information

- *Big Java*, Chapter 7 *or Core Java*, Volume 1.
- Java Tutorial - has examples
- Java API documentation.