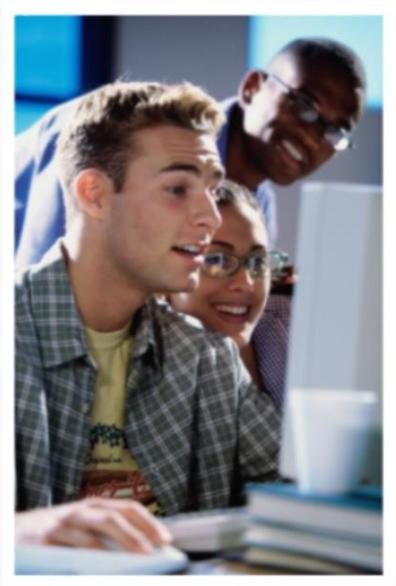




Java Foundations

8-2

ArrayLists



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Objectives

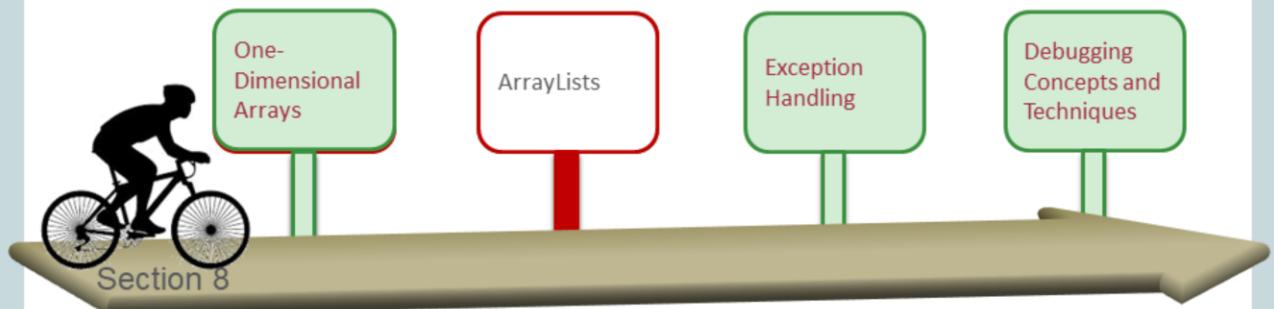
This lesson covers the following objectives:

- Create an ArrayList
- Manipulate an ArrayList by using its methods
- Traverse an ArrayList using iterators and for-each loops
- Use wrapper classes and Autoboxing to add primitive data types to an ArrayList



Topics

- Creating an ArrayList
- Manipulating an ArrayList by Using Its Methods
- Traversing an ArrayList by Using for-each Loops and Iterators
- Using Java Wrapper Classes



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4

Collection of Objects (Real Life)

- In real life, objects often appear in groups.
- For example:
 - Parking lots contain multiple cars.
 - Banks contain multiple accounts.
 - Stores have multiple customers.
 - A student has multiple assignment grades.



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5

Collection of Objects (Programming)

- When programming, you often gather data (objects).
- This is commonly referred to as a collection.



- In Java, the simplest way of collecting information is by using the `ArrayList`.
- The Java `ArrayList` class can store a group of many objects.

Managing Students Enrolled in a Class

- Say a group of students is enrolled in Java Programming 101.
- You want to write a Java program to track the enrolled students.
- The simplest way would be to create an array, as discussed in the previous lesson.



Using Arrays to Manage Enrolled Students

- You can write a student array like this:

```
String students={"Mary", "Sue", "Harry", "Rick", "Cindy", "Bob"}
```

- Consider a scenario where, after a week, two students (Mike and Larry) enroll in the course and Sue drops out.
- How easy do you think it is to modify the students array to accommodate these changes?



Limitations of Arrays

- Their size is fixed on creation and cannot grow or shrink after initialization.
- You have to create manual methods to manipulate their contents.
- For example: insert or delete an item from an array.

ArrayList Class

- Arrays aren't the only way to store lists of related data.
- Java provides a special utility class called ArrayList.
- The ArrayList class:
 - Is a part of the Java library, like the String and Math classes.
 - It can be used to store a list of objects.
 - Has a set of useful methods for managing its elements:
 - add(), get(), remove(), indexOf(), and many others.



ArrayList supports dynamic arrays that can grow as needed. In Java, standard arrays are of a fixed length. After arrays are created, they can't grow or shrink, which means that you must know, in advance, the number of elements in an array. But, sometimes, you may not know precisely how large an array you need until run time.

What Can an ArrayList Contain?

- An ArrayList can contain only objects, not primitives.
 - It may contain any object type, including a type that you created by writing a class.
- For example, an ArrayList can hold objects of type:
 - String
 - Person
 - Car



The slide example shows ArrayList, names, to which you are adding two String objects by using the add method of the ArrayList . You can remove an object from the ArrayList by using the remove method.

Importing and Declaring an ArrayList

- You must import `java.util.ArrayList` to use an `ArrayList`.

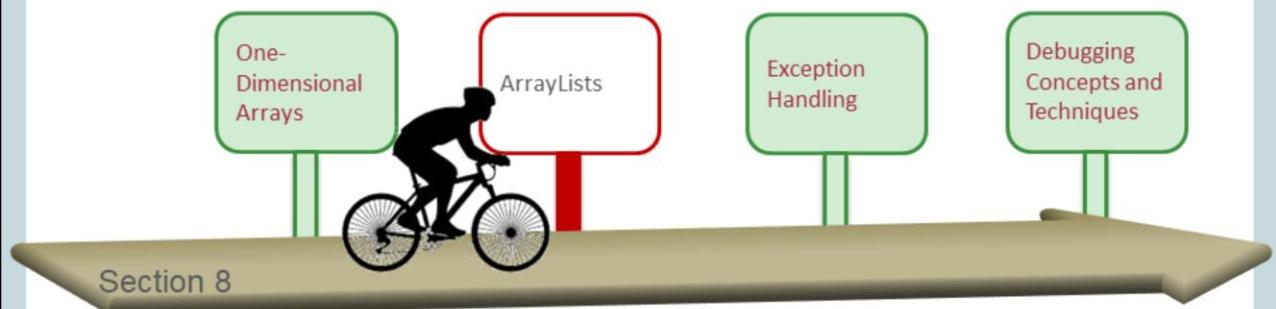
```
import java.util.ArrayList;
public class ArrayListExample {
    public static void main (String[] args) {
        ArrayList<String> states = new ArrayList<>();
    }
}
```

You can specify an initial capacity, but it isn't mandatory.

You may specify any object type, called as Type Parameters, specifies that it contains only String objects

Topics

- Creating an ArrayList
- Manipulating an ArrayList by Using Its Methods
- Traversing an ArrayList by Using for-each Loops and Iterators
- Using Java Wrapper Classes



Working with an ArrayList

- You don't access elements in an ArrayList by using index notation.
- Instead, you use a series of methods that are available in the ArrayList class.

Some ArrayList Methods

<code>add(value)</code>	Appends the value to the end of the list
<code>add(index, value)</code>	Inserts the given value just before the given index, shifting subsequent values to the right
<code>clear()</code>	Removes all elements of the list
<code>indexOf(value)</code>	Returns the first index where the given value is found in the list (-1 if not found)
<code>get(index)</code>	Returns the value at the given index
<code>remove(index)</code>	Removes the value at the given index, shifting subsequent values to the left
<code>set(index, value)</code>	Replaces the value at the given index with a given value
<code>size()</code>	Returns the number of elements in the list
<code>toString()</code>	Returns a string representation of the list, such as "[3, 42, -7, 15]"



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15

Working with an ArrayList

Here's an example that uses these methods:

```
ArrayList<String> names;           Instantiate the ArrayList  
names = new ArrayList();           Declare an ArrayList of Strings  
  
names.add("Jamie");  
names.add("Gustav");  
names.add("Alisa");  
names.add("Jose");  
names.add(2, "Prashant");          Add items  
  
String str=names.get(0);          Retrieve a value  
System.out.println(str);  
  
names.remove(0);  
names.remove(names.size() - 1);    Remove items  
names.remove("Gustav");  
  
System.out.println(names);        View an item
```



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16

When you declare an ArrayList, you use the diamond operator (<>) to indicate the object type.

In the slide example, there are a number of methods to add data to the ArrayList. This example uses the add method to add several String objects to the list: The add(int index, E element) method inserts an element at a specific location.

Using the remove method, you can delete an element by passing the index or by passing the item to be deleted.

- remove (0) removes the first element at index zero (in this case, "Jamie").
- remove (names.size() - 1) removes the last element, which would be "Jose."
- remove ("Gustav") removes an element that matches a specific value.

You can pass the ArrayList to System.out.println. The resulting output is [Prashant, Alisa].

Benefits of the ArrayList Class

- Dynamic resizing:
 - An ArrayList grows as you add elements.
 - An ArrayList shrinks as you remove elements.
- Several built-in methods:
 - An ArrayList has several methods to perform operations.
 - For example, to add, retrieve, or remove an element.

Exercise 1, Part 1



- Import and open the ArrayListsEx project.
- Examine ArrayListEx1.java.
- Modify the program to implement:
 - Create an ArrayList of Strings called students.
 - Add four students to the ArrayList: Amy, Bob, Cindy and David.
 - Print the elements in the ArrayList and display its size.

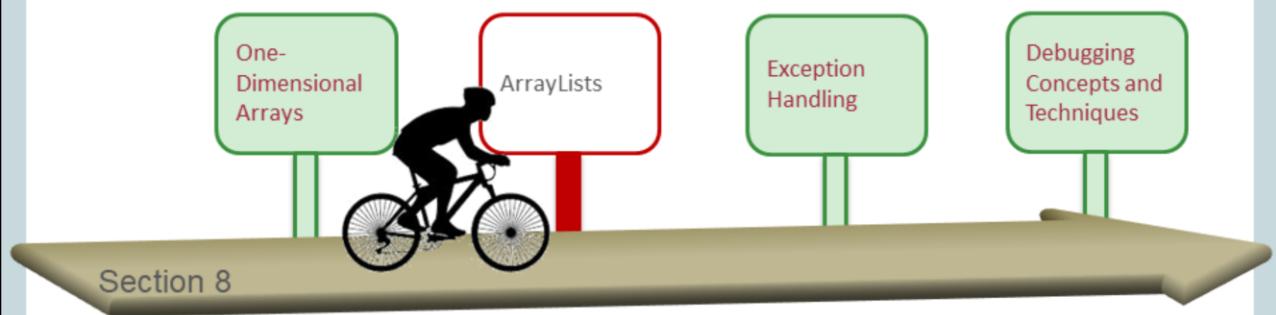


Exercise 1, Part 2

- Modify the program to implement:
 - Add two more students, Nick and Mike, at index 0 and 1,
 - Remove the student at index 3.
 - Print the elements in the ArrayList and display its size.

Topics

- Creating an ArrayList
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Traversing an ArrayList

- You can traverse an ArrayList in the following ways:
- Using the for-each loop
- Using an Iterator
- Using a ListIterator

Traversing an ArrayList: for-each Loop

- In the previous lesson, you used a for-each loop to traverse an array.
- You can use a for-each loop to traverse an ArrayList.
- The variable *i* represents a particular name as you loop through the names ArrayList.

Type of object
that's in the
ArrayList (in this
case, String)
Variable
ArrayList

```
for (String i : names) {  
    System.out.println("Name is "+i);  
}
```



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22

Traversing an ArrayList: for-each Loop

```
public class ArrayListTraversal {  
    public static void main(String[] args) {  
        ArrayList<String> names = new ArrayList<>();  
        names.add("Tom");  
        names.add("Mike");  
        names.add("Matt");  
        names.add("Nick");  
        System.out.println("");  
        for (String i : names) {  
            System.out.println("Name is "+i);  
        }  
    }  
}
```

Output:

```
Name is Tom  
Name is Mike  
Name is Matt  
Name is Nick
```



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23

Introducing Iterator

- Is a member of the collections framework.
- Enables traversing through all elements in the ArrayList, obtaining or removing elements.
- Has the following methods:
 - `hasNext()`, `next()`, `remove()`
- Is only used to traverse forward.
- You must import `java.util.Iterator` to use an Iterator.



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24

Traversing an ArrayList: Iterator

- Here's an example of traversing the names collection by using an iterator.

```
>Returns an  
iterator object    ArrayList  
Iterator<String> iterator = names.iterator();  
while (iterator.hasNext())  
{  
    System.out.println("Name is " + iterator.next());  
}  
  
Attaching a collection to an iterator
```



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25

To use an iterator to cycle through the contents of an ArrayList, follow these steps:

- Call the collection's iterator() method.
- Set up a loop that makes a call to hasNext(), and have the loop iterate as long as hasNext() returns true.
- Within the loop, obtain each element by calling next().

Introducing ListIterator

- Is a member of the collections framework.
- Allows you to traverse the ArrayList in both directions.
- Doesn't contain the remove method.
- You must import `java.util.ListIterator` to use an ListIterator.

Traversing an ArrayList: ListIterator

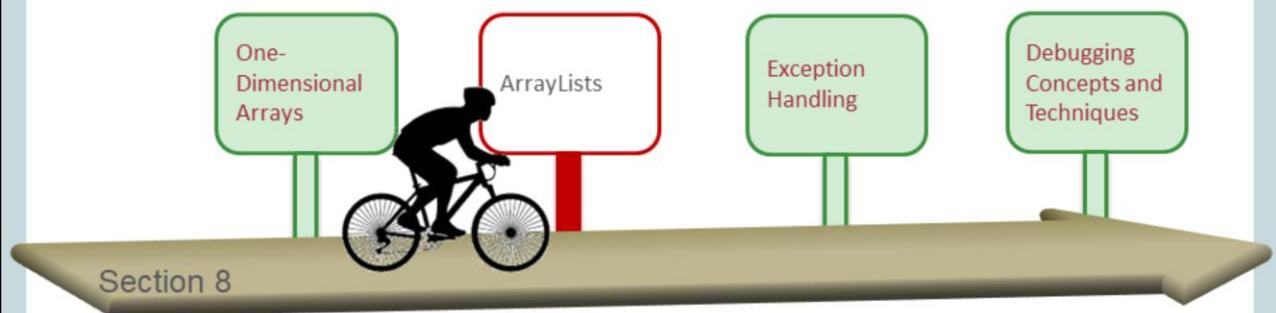
- Here's an example of using ListIterator to traverse the names ArrayList in forward and backward directions:

```
ListIterator<String> litr = names.listIterator();
System.out.println("Traversing list forwards: ");
while (litr.hasNext()) {
    System.out.println("Name is " + litr.next());
}
System.out.println("Traversing list backwards: ");
while (litr.hasPrevious()) {
    System.out.println("Name is " + litr.previous());
}
```



Topics

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28

ArrayList and Primitives

- An ArrayList can store only objects, not primitives.



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

int can't be a type parameter

- But you can still use ArrayList with primitive types by using special classes called wrapper classes.

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

Wrapper class for int



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29

Wrapper Classes

- Java provides classes, known as wrapper classes, that correspond to the primitive types.
- These classes encapsulate, or wrap, the primitive types within an object.
- The eight wrapper class types correspond to each primitive data type.

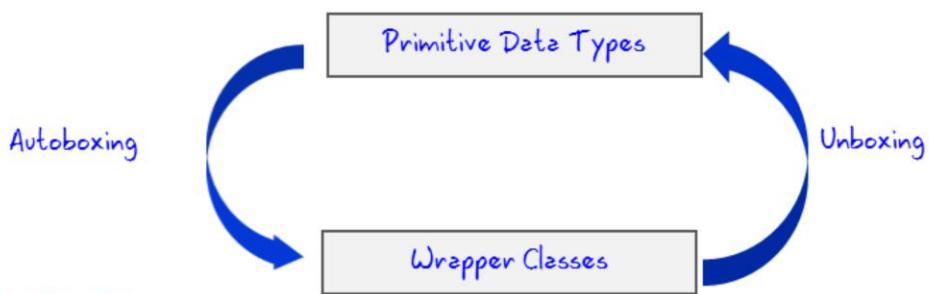
List of Wrapper Classes

Here's the list of primitive data types and their corresponding wrapper classes:

Primitive Type	Wrapper Type
byte	Byte
Short	Short
int	Integer
long	Long
float	Float
double	Double
char	Character
boolean	Boolean

Introducing AutoBoxing and Unboxing

- Java has a feature called Autoboxing and Unboxing.
- This feature performs automatic conversion of primitive data types to their wrapper classes and vice versa.
- It enables you to write leaner and cleaner code, making it easier to read.



What Is Autoboxing?

The automatic conversion that the Java compiler makes between the primitive types and their corresponding object wrapper classes.

```
Double score = 18.58;
```

Autoboxing of primitive double value

What Is Unboxing?

Converting an object of a wrapper type to its corresponding primitive value.

```
1 Double score = 18.58;  
2 double goal = score;
```

Unboxing of Double object, Score, to primitive double value score

ArrayList and Wrapper Classes

Wrapper classes allow an ArrayList to store primitive values.

```
public static void main(String args[]) {  
  
    ArrayList<Integer> nums = new ArrayList<>();  
    for (int i = 1; i < 50; i++) {  
        nums.add(i);  AutoBoxing  
    }  
    for(Integer i:nums ){  
        int nos=i;  UnBoxing  
        System.out.println(nos);  
    }  
}
```



The code example demonstrates how you can populate ArrayList with primitive data by using Autoboxing and Unboxing.

AutoBoxing: int is converted to Integer and is added to ArrayList without explicitly invoking the wrapper class, Integer.

UnBoxing: The Integer object is converted to the primitive int without invoking any method to do the conversion.



Exercise 2

- Import and open the ArrayListsEx project.
- Examine ArrayListEx2.java.
- Perform the following:
 - Create an ArrayList with a list of numbers.
 - Display the contents of the ArrayList by using Iterator.
 - Remove all even numbers.
 - Display the contents of the ArrayList.

Summary

In this lesson, you should have learned how to:

- Create an `ArrayList`
- Manipulate an `ArrayList` by using its methods
- Traverse an `ArrayList` by using iterators and
- `for-each` loops
- Use wrapper classes and Autoboxing to add primitive data types to an `ArrayList`



