UNIVERSITI TEKNOLOGI MARA

CSC508 Data Structures

Topic 2 : Array

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Recap

- Data types
- Definition of Data Structures
- Java Collection Framework
- Review
  - Java Abstract Classes
  - Java Interfaces

Topic Structure

- Collection hierarchy
- Array definition
- Array implementation
  - `ArrayList`
  - User-defined

Learning Outcomes

- At the end of this lesson, students should be able to:
  - Define the concept array
  - Describe array characteristics
  - Implement array operation

Collection Hierarchy

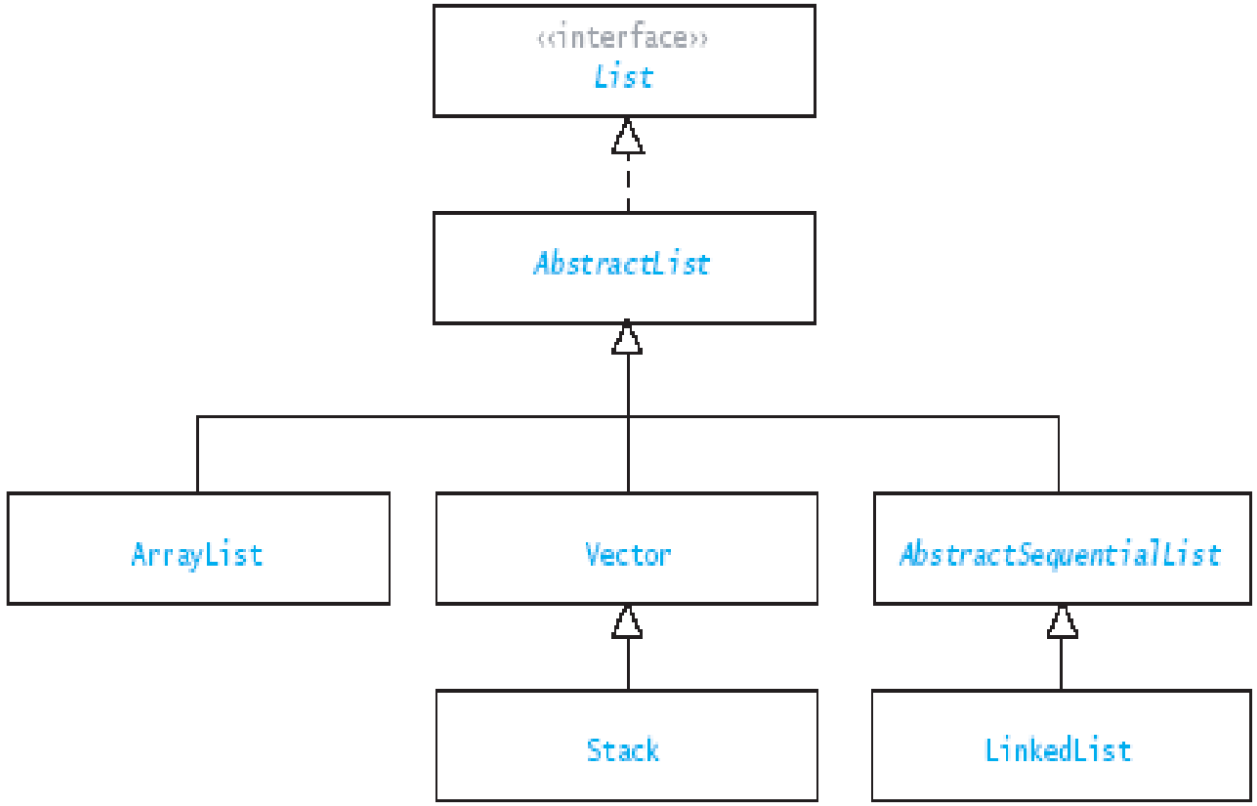
- The Collection interface specifies a subset of the methods specified in the List interface. Definition of Data Structures
- Collection interface is the root of the collection hierarchy
  - Two branches: one rooted by the List interface and the other by the Set interface

List Interface

- List: A collection of elements of the same type.
  - Example: ▫ A list of students ▫ A list of books
- Allowed operations on the List interface include:
  - Finding a specified target
  - Adding an element to either end
  - Removing an item from either end
  - Traversing the list structure without a subscript

List Interface (cont.)

FIGURE 4.1
The java.util.List Interface and Its Implementers



Array

- A collection of a fixed number of components wherein all of the components have the same data type.
- Content of an array is referred using index, or subscript, ranging from 0 (the first element in the array) until n-1 (the last element in the array)
  - Where n is the size of an array.

1	3	5	7	9	11	13	15	17	19
[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]

Figure 1.1 Array 1

A	L	G	O	R	I	T	H	M	S
[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]

Figure 1.2 Array 2

Array Characteristic

- Homogenous
  - Array only stores data of the same type.
- Fixed-size
  - In general, the size of array is fixed upon creation.
- Random access
  - Element of an array can access in random

Operation on Arrays

- Create and initialize
- Determine whether an array is full or empty
- Insert an element in the list at the specified location
- Remove an element from the list at the specified location
- Retrieve an element from the list at the specified location
- Replace an item at the specified location with another item
- Search the array for a given element

ArrayList Class

- The Java API provides the `ArrayList` class, which uses an array as the underlying structure to implement the `List`.
  - An `ArrayList` class is the class that implements the `List` interface.
- An `ArrayList` object is an improved version of a one-dimensional array, where;
  - It can select its elements in arbitrary order (random) using a subscript value.
  - The size automatically increases or decreases as new elements are added or removed.

Methods in ArrayList

TABLE 4.1
Methods of Class `java.util.ArrayList`

Method	Behavior
`public Object get(int index)`	Returns a reference to the element at position `index`.
`public Object set(int index, Object anEntry)`	Sets the element at position `index` to reference `anEntry`. Returns the previous value.
`public int size()`	Gets the current size of the `ArrayList`.
`public boolean add(Object anEntry)`	Adds a reference to `anEntry` at the end of the `ArrayList`. Always returns `true`.
`public void add(int index, Object anEntry)`	Adds a reference to `anEntry`, inserting it before the item at position `index`.
`int indexOf(Object target)`	Searches for `target` and returns the position of the first occurrence, or –1 if it is not in the `ArrayList`.
`public Object remove(int index)`	Returns and removes the item at position `index` and shifts the items that follow it to fill the vacated space.

Sample Implementation ArrayList

```
import java.util.ArrayList; //Import ArrayList from java.util

public class Topic2Array {
   public static void main(String[] args) {
      //Create an ArrayList object
      ArrayList<String> customer = new ArrayList<String>();

      //Adding three elements into the array
      customer.add("John");
      customer.add("Mike");
      customer.add("Sue");
      customer.add("Joanna");

      //Print the array content
      for(int i = 0; i < customer.size(); i++) {
         System.out.println("Index " + i + " : " + customer.get(i));
      }
```

```
Index 0 : John
Index 1 : Mike
Index 2 : Sue
Index 3 : Joanna
```

Sample Implementation ArrayList (cont.)

```
        customer.remove(2); //Remove element at index 2

        //Print the array content
        for(int i = 0; i < customer.size(); i++) {
            System.out.println("Index " + i + " : " + customer.get(i));
        }

        customer.set(1, "Hendry"); //Update the content at index 1

        //Print the array content
        for(int i = 0; i < customer.size(); i++) {
            System.out.println("Index " + i + " : " + customer.get(i));
        }
    }
}
```

```
Index 0 : John
Index 1 : Mike
Index 2 : Joanna
```

```
Index 0 : John
Index 1 : Hendry
Index 2 : Joanna
```

User-defined array

- Create your on class myArray.

```
class myArray{
    private int size;
    public int[] newArray;

    public myArray(){
        newArray = new int[10];//Create array of 10 elements
        size = 0;
        System.out.println("Array Created.");}
```

Define the variable to update the array size

Reference variable to the array

Constructor to initialize the array

User-defined array (cont.)

- Methods to add an element at the end of the array.

```
public void addElement(int a) {
    newArray[size] = a;
    size++;
}
```

- Methods to remove an element from a specific index.

```
public void deleteElement(int index) {
    if (size == 0 || index >= size)
        System.err.println("Invalid index");
    else {
        for (int i = index; i < size; i++)
        newArray[i] = newArray[i+1];
        size --;
    }
}
```

Check the array size first before remove

Shift the array element one by one

User-defined array (cont.)

- Print array element

```
public void printArray() {
    if (size == 0)
        System.err.println("Array is Empty.");
    else {
        for (int i = 0; i < size; i++)
            System.out.println(newArray[i]);
    }
}
```

- Get array size

```
public int getSize() {
    return size;
}
```

Testing myArray class

```
public static void main(String[] args) {
    myArray arr1 = new myArray();
    //arr1.printArray();
    arr1.addElement(4);
    arr1.addElement(6);
    arr1.addElement(78);
    arr1.printArray();
    arr1.deleteElement(0);
    arr1.printArray();
    System.out.println(arr1.getSize());
}
```

```
Array Created.
4
6
78
6
78
2
```

Summary

- Array is a collection of a fixed number of components wherein all of the components have the same data type.
- Build-in array implementation using `ArrayList` class.
- Self-defined array implementation
  - Create array
  - Insert element
  - Removing element
  - Print element

Next Topic…

- Linear list
  - Linked List
    - Concept
    - Implementation
    - Application

References

- Carrano, F. & Savitch, W. 2005. *Data Structures and Abstractions with Java, 2nd ed. Prentice-Hall.*
- Malik D.S, & Nair P.S., Data Structures Using Java, Thomson Course Technology, 2003.
- Rada Mihalcea, CSCE 3110 Data Structures and Algorithm Analysis notes, U of North Texas.