



Java Programming

2-5

Collections – Part 2



Overview

This lesson covers the following topics:

- Implement a HashMap
- Implement a stack by using a deque
- Define a link list
- Define a queue
- Implement a comparable interface

Collections

- We have seen previously that we can use ArrayLists and HashSets to store multiple data.
- Java has a rich library of collections that will handle a varied list of requirements.

Maps

- A map is a collection that links a key to a value.
- Similar to how an array links an index to a value, a map links a key (one object) to a value (another object).
- Maps, like sets, cannot contain duplicates.
- This means each key can only exist once and can only link to a single value.
- Since Map is an interface, you must use one of the classes that implement Map such as HashMap to instantiate a map.

HashMaps

- HashMaps are maps that link a Key to a Value.
- The Key and Value can be of any type, but their types must be consistent for every element in the HashMap.
- Below is a generic breakdown of how to initialize a HashMap.

```
HashMap<KeyType,ValueType> mapName = new HashMap<KeyType,ValueType>();
```

HashMaps fruitBowl Example

- For example, we wish to group together many different fruits and wish to be able to store and later retrieve their color.
- The first step to do this is to initialize a HashMap.

```
HashMap<String,String> fruitBowl = new HashMap<String,String>();
```

Add Fruits to fruitBowl Example

- To add fruits to our fruitBowl, simply use the put(Key,Value) function of HashMaps.
- Add a few fruits to the fruitBowl.
- Each code segment adds the key (fruit name) and value (color) to the HashMap.

```
fruitBowl.put("Apple", "Red");
```

```
fruitBowl.put("Orange", "Orange");
```

```
fruitBowl.put("Banana", "Yellow");
```


get(Key) Method of HashMap

- The Key of a HashMap can be thought of as the index linked to the element, even though it does not necessarily have to be an integer.
- Getting the value stored is easy once we understand that the key is the index: Use the get(Key) method of HashMap.
- To get the color of the Banana in the fruit bowl, use this method which searches through the HashMap until it finds a Key match to the parameter (“Banana”) and returns the Value for that Key (“Yellow”).

```
String bananaColor = fruitBowl.get("Banana");
```

More HashMap Methods

Method	Method Description
<code>boolean containsKey(Object Key)</code>	Returns true if the HashMap contains the specified Key.
<code>boolean containsValue(Object Value)</code>	Returns true if this map maps one or more keys to the specified value.
<code>Set<K> keySet()</code>	Returns a set of the keys contained in the HashMap.
<code>Collection<V> values()</code>	Returns a collection of the values contained in the HashMap.
<code>V remove(Object Key)</code>	Removes the mapping for the specified key from this map if present.
<code>int size()</code>	Returns the number of key-value mappings in the HashMap.

Queues

- A Queue is a list of elements with a first in first out ordering.
- When you enqueue an element, it adds it to the end of the list.
- When you dequeue an element, it returns the element at the front of the list and removes that element from the list.
- For example, picture a line at the movie theater.
- The first person there is the first person to get their ticket (First In First Out, also known as FIFO).

Stacks

- Stacks are Queues that have reverse ordering to the standard Queue.
- Instead of FIFO ordering (like a queue or line at the theater), the ordering of a stack is last in first out.
- This can be represented by the acronym LIFO.

Stack of Pancakes Example

- For example, you have a pile of pancakes.
- Typically this would be called a “stack” of pancakes because the pancakes are added on top of the previous leaving the most recently added pancake at the top of the stack.
- To remove a pancake, you would have to take off the one that was most recently added: The pancake on the top of the stack.
- If you tried to remove the pancake that was added first, you would most likely make a very large mess.

Implementing a Stack: Deque

- One way to implement a Stack is by using a Double-Ended Queue (or deque, pronounced “deck”, for short).
- These allow us to insert and remove elements from either end of the queue using methods inside the Deque class.
- Deques like building blocks, allow you to put pieces on the bottom of your structure or on the top, and likewise pull pieces off from the bottom or top.
- Deques can be implemented by LinkedLists.

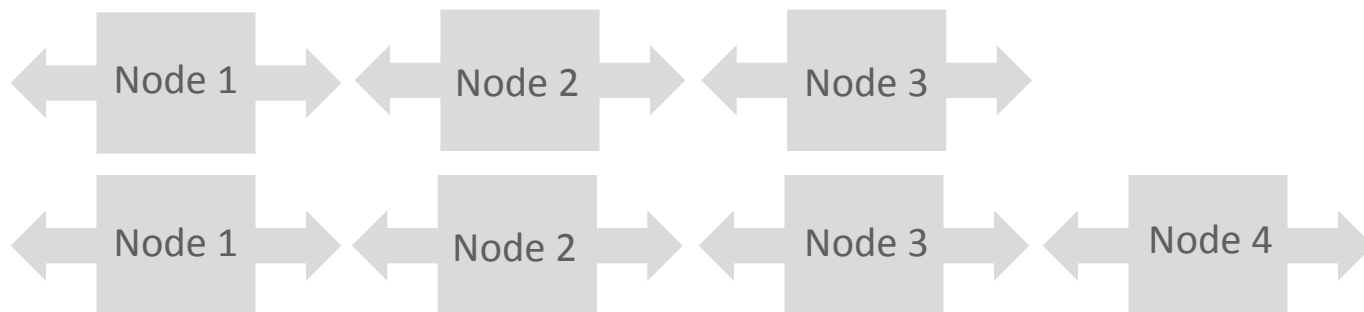
LinkedLists

- A LinkedList is a list of dynamically-stored elements.
- Like an ArrayList, it changes size and has an explicit ordering, but it doesn't use an array to store information.
- It uses an object known as a Node.
- Nodes are like roadmaps: they tell you where you are (the element you are looking at), and where you can go (the previous element and the next element).



Adding Nodes to LinkedLists

- Ultimately, we have a list of Nodes, which point to other Nodes and have an element attached to them.
- To add a Node, set its left Node to the one on its left, and its right Node to the one on its right.
- Do not forget to change the Nodes around it as well.
- A fourth node was added to the end of this linked list:



Initializing a LinkedList

- A LinkedList is initialized in the same way as ArrayList.
- The following code shows how to initialize a LinkedList of pancakes.

```
LinkedList<Pancake> myStack = new LinkedList<Pancake>();
```

LinkedList Methods

FIFO LinkedList Methods	LIFO LinkedList Methods
<code>add(E e)</code> Appends the given element to the end of the list.	<code>add(E e)</code> Appends the given element to the end of the list.
<code>removeFirst()</code> Removes the first element from the list and returns it.	<code>removeLast()</code> Removes the last element from the list and returns it.
<code>getFirst()</code> Returns the first element of the list.	<code>getLast()</code> Returns the last element of the list.

Collection.sort

- We saw earlier to sort a collection with a simple element that we can use `Collections.sort()`.
- In a previous example we saw an `ArrayList` of strings called `groupNames` being sorted by:

```
Collections.sort(groupNames);
```

- This will sort our `ArrayList` in its natural order.

Collection.sort

- This is fine with simple elements but what about our Cell class?
- What if we had additional fields, then which field should it order on?

```
public class Cell {  
    private String data  
    private String data2;  
}
```

Comparable Interface

- For our classes to have a natural order we can implement the interface `java.lang.Comparable`.

```
public interface Comparable<T> {  
    int compareTo(T o);  
}
```

- So if we implement this interface we must write the code for `compareTo` for our class.

compareTo

- The compareTo method will return an integer based on the following:
- Return a negative value if this object is smaller than the other object
- Return 0 (zero) if this object is equal to the other object.
- Return a positive value if this object is larger than the other object.

Comparable Interface

```
public class Cell implements Comparable<Cell> {  
    private String data;  
  
    public void set(String celldata)  
    {  
        data = celldata;  
    }  
    public String get() {  
        return data;  
    }  
    public int compareTo(Cell c2) {  
        if(data.compareTo(c2.get()) < 0 ) return -1;  
        if (data.compareTo(c2.get()) == 0) return 0;  
        return 1;  
    }  
}
```

Comparable Interface

- Our compareTo method implementation could have used any or multiple fields from our class.
- We have chosen to simply use the String field called data.

```
public class Cell implements Comparable<Cell> {  
    private String data;  
    <snip>  
    public int compareTo(Cell c2) {  
        if(data.compareTo(c2.get()) < 0 ) return -1;  
        if (data.compareTo(c2.get()) == 0) return 0;  
        return 1;  
    }  
}
```


Cell Driver

- Simple driver class.

```
Cell c1 = new Cell();
c1.set("Alison");
Cell c2 = new Cell();
c2.set("Brian");

ArrayList<Cell> list = new ArrayList<Cell>();
list.add(c2);
list.add(c1);

for (Cell c : list) {
    System.out.println(c.get());
}

Collections.sort(list);
System.out.println("*Sorted*");
for (Cell c : list) {
    System.out.println(c.get());
}
```

- Output

```
Brian
Alison
*Sorted*
Alison
Brian
```

Terminology

Key terms used in this lesson included:

- Deque
- HashMap
- LinkedList
- Node
- Queue
- Stack
- Comparable

Summary

In this lesson, you should have learned how to:

- Implement a HashMap
- Implement a stack by using a deque
- Implement Comparable Interface

