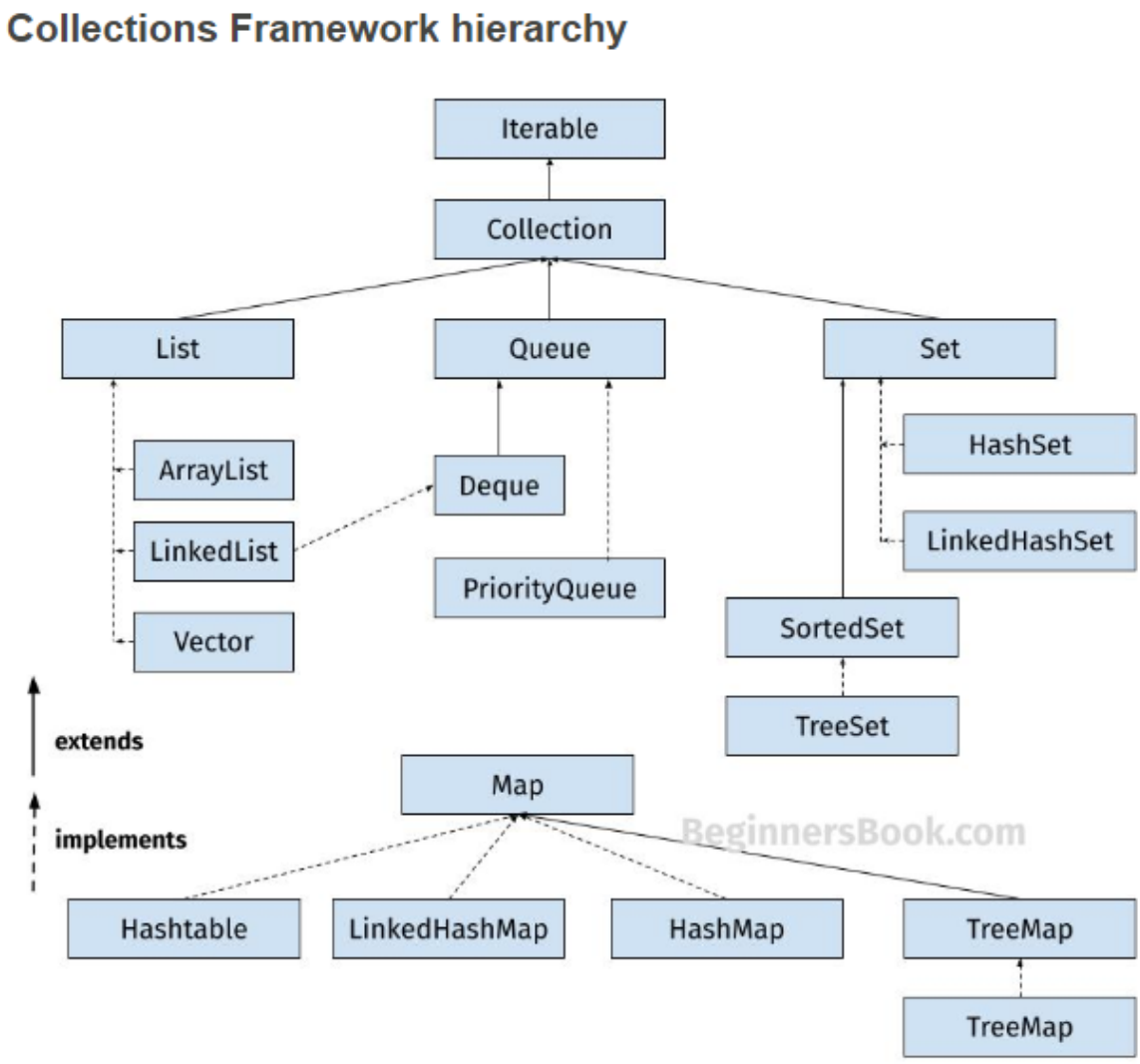
The **Java Collections Framework** is a collection of interfaces and classes, which helps in storing and processing the data efficiently. This framework has several useful classes which have tons of useful functions which makes a programmer task super easy.



1. List

A List is an ordered Collection (sometimes called a sequence). Lists may contain duplicate elements. Elements can be inserted or accessed by their position in the list, using a zero-based index. The classes that implements List interface are:

- ArrayList
- LinkedList
- Vector
- Stack

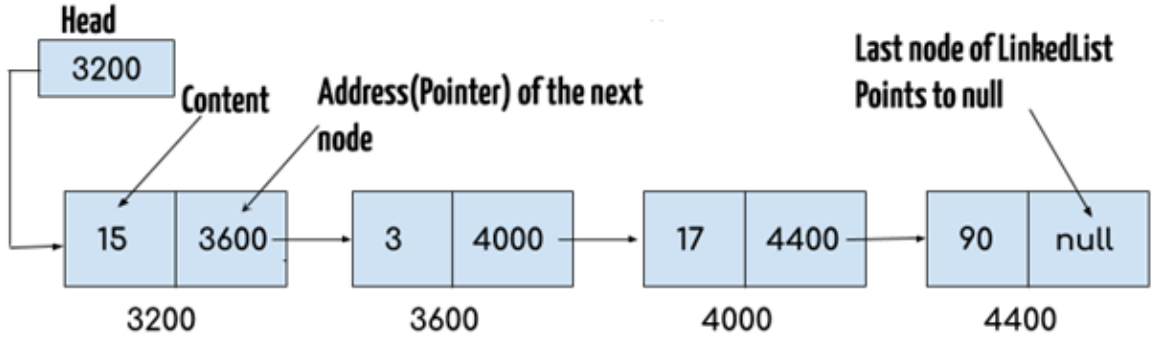
1.1 ArrayList

ArrayList is a popular alternative of **arrays in Java**. It is based on an Array **data structure**. ArrayList is a resizable-array implementation of the List interface. It implements all optional list operations, and permits all elements, including null.

```
import java.util.*;
class JavaExample{
  public static void main(String args[]){
    //creating ArrayList of string type
    ArrayList<String> arrList=new ArrayList<>();

    //adding few elements
    arrList.add("Cricket"); //list: ["Cricket"]
    arrList.add("Hockey"); //list: ["Cricket", "Hockey"]

    //inserting element at first position, index 0
    //represents first element because ArrayList is based
    //on zero based indexing system
    arrList.add(0, "BasketBall"); //list: ["BasketBall", "Cricket", "Hockey"]


    System.out.println("ArrayList Elements: ");
    //Traversing ArrayList using enhanced for loop
    for(String str:arrList)
      System.out.println(str);
  }
}
```

1.2 LinkedList

LinkedList is a linear data structure. However LinkedList elements are not stored in contiguous locations like arrays, they are linked with each other using pointers. Each element of the LinkedList has the reference(address/pointer) to the next element of the LinkedList.



```
import java.util.*;
public class JavaExample{
  public static void main(String args[]){
    LinkedList<String> linkList=new LinkedList<>();
    linkList.add("Apple"); //["Apple"]
    linkList.add("Orange"); //["Apple", "Orange"]

    //inserting element at first position
    linkList.add(0, "Banana"); ////["Banana", "Apple", "Orange"]

    System.out.println("LinkedList elements: ");
    //iterating LinkedList using iterator
    Iterator<String> it=linkList.iterator();
    while(it.hasNext()){
      System.out.println(it.next());
    }
  }
}
```

VECTOR

```
import java.util.*;
public class JavaExample{
  public static void main(String args[]){
    Vector<String> v=new Vector<>();
    v.add("item1"); //["item1"]
    v.add("item2"); //["item1", "item2"]
    v.add("item3"); //["item1", "item2", "item3"]

    //removing an element
    v.remove("item2"); //["item1", "item3"]

    System.out.println("Vector Elements: ");
    //iterating Vector using iterator
    Iterator<String> it=v.iterator();
    while(it.hasNext()){
      System.out.println(it.next());
    }
  }
}
```

1.4 Stack

Stack class extends Vector class, which means it is a subclass of Vector. Stack works on the concept of Last In First Out (LIFO). The elements are inserted using push() method at

the end of the stack, the pop() method removes the element which was inserted last in the Stack.

```
import java.util.*;
public class JavaExample{
  public static void main(String args[]){
    Stack<String> stack = new Stack<>();

    //push() method adds the element in the stack
    //and pop() method removes the element from the stack
    stack.push("Chaitanya"); //["Chaitanya"]
    stack.push("Ajeet"); //["Chaitanya", Ajeet]
    stack.push("Hari"); //["Chaitanya", "Ajeet", "Hari"]
    stack.pop(); //removes the last element
    stack.push("Steve"); //["Chaitanya", "Ajeet", "Steve"]
    stack.push("Carl"); //["Chaitanya", "Ajeet", "Steve", "Carl"]
    stack.pop(); //removes the last element

    System.out.println("Stack elements: ");
    for(String str: stack){
      System.out.println(str);
    }
  }
}
```

2. Set

A Set is a Collection that cannot contain duplicate elements. There are three main implementations of Set interface: HashSet, TreeSet, and LinkedHashSet.

2.1 HashSet

HashSet which stores its elements in a hash table, is the best-performing implementation. HashSet allows only unique elements. It doesn't maintain the insertion order which means element inserted last can appear at first when traversing the HashSet.

```
import java.util.*;
public class JavaExample{
  public static void main(String args[]){
    HashSet<String> set=new HashSet<>();
    set.add("Paul");
    set.add("Ram");
    set.add("Aaron");
    set.add("Leo");
    set.add("Becky");

    Iterator<String> it=set.iterator();
    while(it.hasNext()){
      System.out.println(it.next());
    }
  }
}
```

Output:

```
Aaron
Leo
Paul
Ram
Becky
```

2.2 LinkedHashSet

Unlike HashSet, the **LinkedHashSet** maintains insertion order.

```
import java.util.*;
public class JavaExample{
  public static void main(String args[]){
    LinkedHashSet<String> set=new LinkedHashSet<>();
    set.add("Paul");
    set.add("Ram");
    set.add("Aaron");
    set.add("Leo");
    set.add("Becky");

    Iterator<String> it=set.iterator();
    while(it.hasNext()){
      System.out.println(it.next());
    }
  }
}
```

Output:

```
Paul
Ram
Aaron
Leo
Becky
```

2.3 TreeSet

TreeSet stores elements in a red-black tree. It is substantially slower than HashSet. TreeSet class implements SortedSet interface, which allows TreeSet to order its elements based on their values, which means TreeSet elements are sorted in ascending order.

```
import java.util.*;
public class JavaExample{
  public static void main(String args[]){
    TreeSet<String> set=new TreeSet<>();
    set.add("Paul");
    set.add("Ram");
    set.add("Aaron");
    set.add("Leo");
    set.add("Becky");

    Iterator<String> it=set.iterator();
    while(it.hasNext()){
      System.out.println(it.next());
    }
  }
}
```

Output:

```
Aaron
Becky
Leo
Paul
Ram
```

3. Map

A Map is an object that maps keys to values. A map cannot contain duplicate keys. There are three main implementations of Map interfaces: HashMap, TreeMap, and LinkedHashMap.

3.1 HashMap

HashMap: HashMap is like HashSet, it doesn't maintain insertion order and doesn't sort the elements in any order. Refer **this guide** to **learn HashMap in detail**.

```
import java.util.*;
public class JavaExample{
  public static void main(String args[]){
    HashMap<Integer, String> hmap = new HashMap<>();

    //key and value pairs
    hmap.put(101, "Chaitanya");
    hmap.put(105, "Derick");
    hmap.put(111, "Logan");
    hmap.put(120, "Paul");

    //print HashMap elements
    Set set = hmap.entrySet();
    Iterator iterator = set.iterator();
    while(iterator.hasNext()) {
      Map.Entry m = (Map.Entry)iterator.next();
      System.out.print("key is: "+ m.getKey() + " & Value is: ");
      System.out.println(m.getValue());
    }
  }
}
```

Output:

```
key is: 101 & Value is: Chaitanya
key is: 120 & Value is: Paul
key is: 105 & Value is: Derick
key is: 111 & Value is: Logan
```

3.2 TreeMap

TreeMap: It stores its elements in a red-black tree. The elements of TreeMap are sorted in ascending order. It is substantially slower than HashMap. Refer **this guide** to **learn TreeMap with examples**.

This is the same example that we have seen above in HashMap. Here, elements are sorted based on keys.

```
import java.util.*;
public class JavaExample{
```

```
  public static void main(String args[]){
    TreeMap<Integer, String> hmap = new TreeMap<>();

    //key and value pairs
    hmap.put(101, "Chaitanya");
    hmap.put(105, "Derick");
    hmap.put(111, "Logan");
    hmap.put(120, "Paul");

    //print HashMap elements
    Set set = hmap.entrySet();
    Iterator iterator = set.iterator();
    while(iterator.hasNext()) {
      Map.Entry m = (Map.Entry)iterator.next();
      System.out.print("key is: "+ m.getKey() + " & Value is: ");
      System.out.println(m.getValue());
    }
  }
}
```

Output:

```
key is: 101 & Value is: Chaitanya
key is: 105 & Value is: Derick
key is: 111 & Value is: Logan
key is: 120 & Value is: Paul
```

3.3 LinkedHashMap

LinkedHashMap: It maintains insertion order. Refer **this guide**, to learn LinkedHashMap in detail. As you can see: In the following example, the key & value pairs maintained the insertion order.

```
import java.util.*;
public class JavaExample{
  public static void main(String args[]){
    LinkedHashMap<Integer, String> hmap = new LinkedHashMap<>();

    //key and value pairs
    hmap.put(100, "Chaitanya");
    hmap.put(120, "Paul");
    hmap.put(105, "Derick");
    hmap.put(111, "Logan");

    //print LinkedHashMap elements
```

```
    Set set = hmap.entrySet();
    Iterator iterator = set.iterator();
    while(iterator.hasNext()) {
      Map.Entry m = (Map.Entry)iterator.next();
      System.out.print("key is: "+ m.getKey() + " & Value is: ");
      System.out.println(m.getValue());
    }
  }
}
```

Output:

```
key is: 100 & Value is: Chaitanya
key is: 120 & Value is: Paul
key is: 105 & Value is: Derick
key is: 111 & Value is: Logan
```