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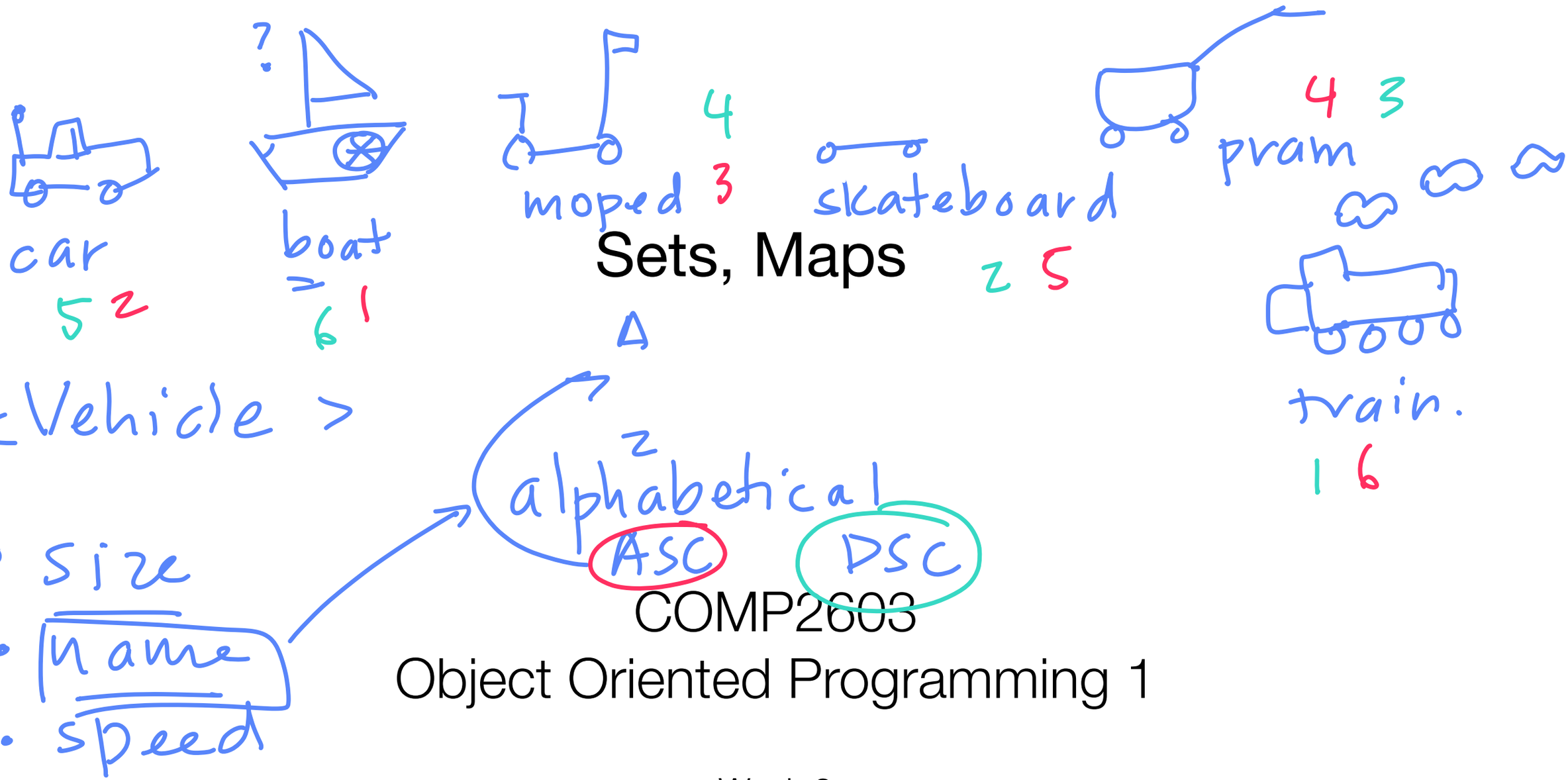
Container Classes



COMP2603

Object Oriented Programming 1

Week 9

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Outline

- Java Collections Framework
- Collection Interface
  - List
    - Linked List ✓
    - ArrayList ✓
    - Vector ✓
  - Set
    - SortedSet
- Map
  - SortedMap

Reading: Chapter 13 - Container Classes: P. Mohan 2013

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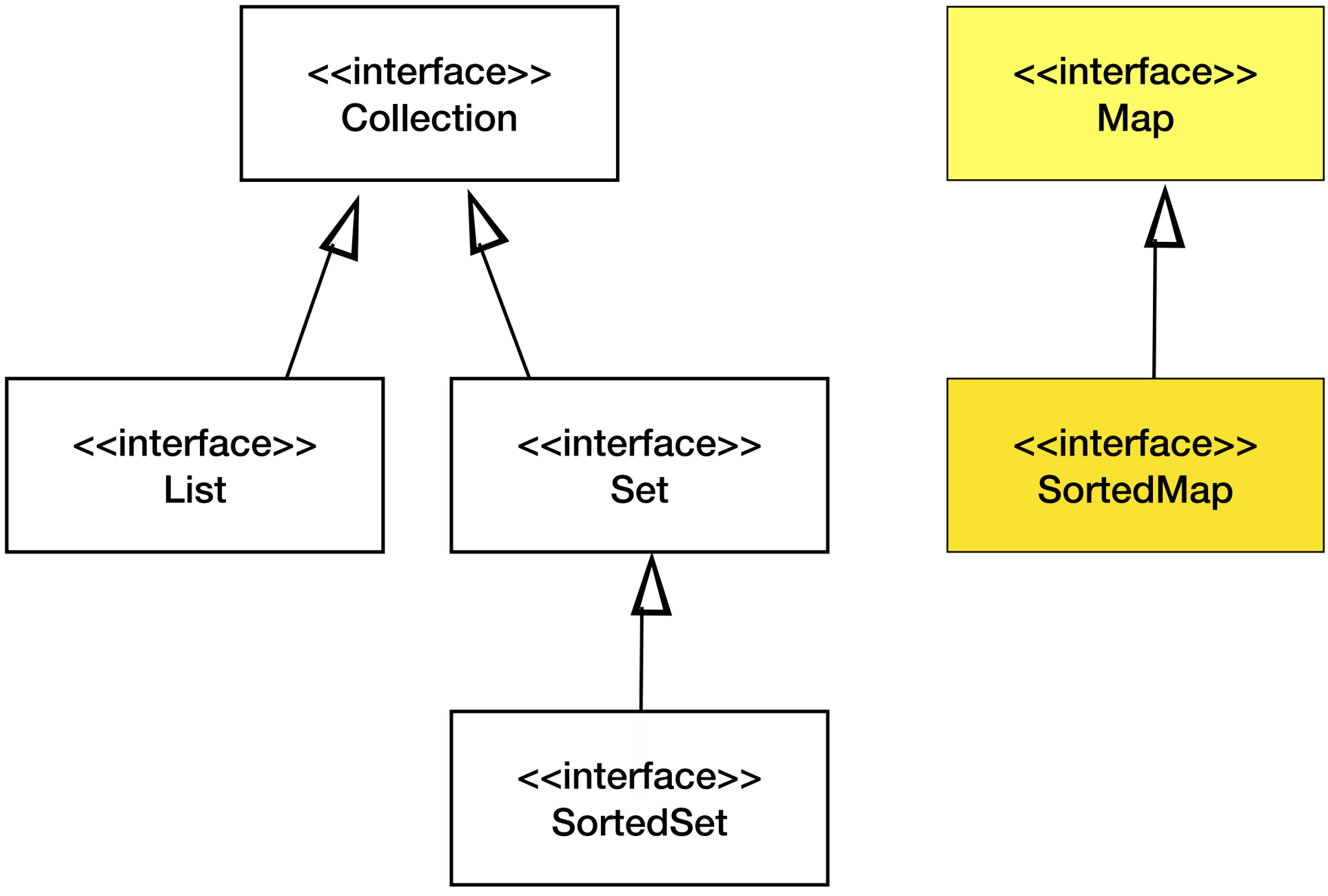
Interfaces in the Java Collections Framework



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The Set Interface

The Set interface represents an unordered collection of objects that contains no duplicate elements.

It therefore cannot contain two elements e1 and e2 where e1.equals(e2).

A Set can contain at most one null element.

The Set interface declares the same methods as its super-interface, Collection.

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The Set Interface (same as Collection)

Method	Description
boolean add (E o)	Inserts the object of the specified type into the collection; returns true if the object was added, false otherwise
boolean addAll (Collection c)	Inserts all the objects from the specified collection into the current collection
void clear( )	Removes all the elements from the collection
boolean contains (Object o)	Returns true id the specified object is present in the colleciton, and false otherwise
boolean isEmpty( )	Returns true if there are no elements in the collection, and false otherwise
boolean remove(Object o)	Deletes the specified object from the collection
int size( )	Returns the number of elements currently in the collection

https://docs.oracle.com/javase/7/docs/api/java/util/Set.html

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The Set Interface - Adding Elements

The Set interface does not allow the add( ) and addAll( ) methods to duplicate elements to the Set.

If a Set already contains the element being added, its add( ) and addAll( ) methods return false.

In order for a Set to determine if it already contains an element, it uses the equals( ) method of the element to check if the element is equal to an existing element in the Set.

It is therefore necessary to override the equals( ) method of the objects that will be inserted into a Set.

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The Sorted Set Interface

The SortedSet interface is a Set that sorts its elements and guarantees that elements are enumerated in sorted order.

It declares a few methods of its own such as first( ) and last( ) which return the lowest and highest elements in the set, respectively (as determined by the sort order).

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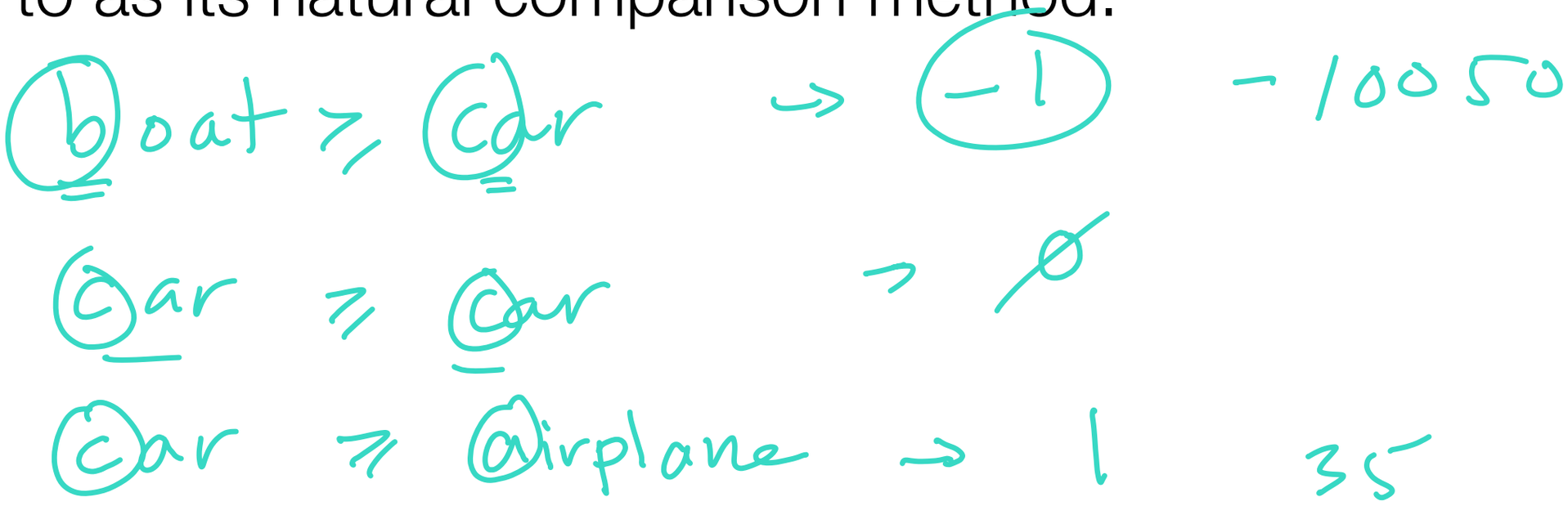
Comparable Interface

This interface imposes a total ordering on the objects of each class that implements it.

This ordering is referred to as the class's natural ordering, and the class's **compareTo** method is referred to as its natural comparison method.



https://docs.oracle.com/javase/7/docs/api/java/lang/Comparable.html

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int compareTo(Object obj)

Compares this object with the specified object for order. Returns a negative integer, zero, or a positive integer as this object is less than, equal to, or greater than the specified object.

https://docs.oracle.com/javase/7/docs/api/java/lang/Comparable.html

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Comparable Interface

The natural ordering for a class C is said to be consistent with equals if and only if e1.compareTo(e2) == 0 has the same boolean value as e1.equals(e2) for every e1 and e2 of class C.

Note that null is not an instance of any class, and e.compareTo(null) should throw a NullPointerException even though e.equals(null) returns false.

https://docs.oracle.com/javase/7/docs/api/java/lang/Comparable.html

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Example 1 - Plant Class

```
public class Plant implements Comparable{
    private String name;
    …
    …
    // Compare by Name - ascending A-Z
    public int compareTo(Object obj){
      if(obj instanceof Plant){
        Plant p = (Plant)obj;
        return name.compareTo(p.name);
      }
      throw new ClassCastException("Not a Plant");
    }
}
```

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Example 2 - Plant Class

```
public class Plant implements Comparable{
    private int ID;
    …
    …// 1 , 2
    // Compare by ID – ascending order
1.  public int compareTo(Object obj){
2.    if(obj instanceof Plant){
3.      Plant p = (Plant)obj;
        if(this.ID == p.ID) return 0;
        if(this.ID > p.ID) return 1;
        if(this.ID < p.ID) return -1;
      }
      throw new ClassCastException("Not a Plant");
    }
}
```

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The Map Interface

The Map interface represents a collection of mappings between key objects and value objects. Hash tables are examples of maps.

The set of key objects in a Map must not have any duplicates. However, the collection of value objects may contain duplicates.

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The Map Interface

Method	Description
boolean containsKey(Object key)	Returns true if the Map contains a mapping for the specified key, and false otherwise
V get (Object key)	Returns the value object associated with the specified key or null if there is no mapping for the key
Set<E> keySet( )	Returns a Set of all the key objects in the Map
V put(K key, V value)	Creates a key/value mapping in the Map. If the key already exists in the Map, put( ) replaces the value currently in the Map with the value supplied as an argument and returns the value replaced; otherwise it returns the value.
Collection<V> values( )	Returns a Collection of all the value objects in the Map

https://docs.oracle.com/javase/7/docs/api/java/util/Map.html

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Example - Map

```
public class Plant{
    private String name;

    public Plant(String n){
       name = n;
    }
    public String getName(){
       return name;
    }

}
```

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Example - Map
Adding objects

```
Map<Plant> plants;
//assumed plants is initialised

Plant aloe = new Plant(“Aloe”); // value
String plantName = aloe.getName(); // key
plants.put(plantName, aloe);

Plant basil = new Plant(“Basil”);
plants.put(basil.getName(), basil);
```

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The Map Interface
Preventing duplicate keys

To ensure that the set of key objects in the Map does not contain duplicates, it is important that the Key objects override the equals( ) method of the Object class, based on the content of the key.

Duplicates depend on how the equals( ) method is defined.

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Example - equals( )

```
public class Plant{
    private String name;
    …

    public boolean equals(Object obj){
       if(obj instanceof Plant){
          Plant p = (Plant) obj;
          if(this.name.equals(p.name))
             return true;
       }
       return false;
    }

}
```

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Example - hashCode( )

```
public class Plant{
    private String name;
    …

    public int hashCode( ){
       //use the String class hashCode
       return name.hashCode( );
    }

}
```

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The Sorted Map Interface

The SortedMap interface represents a Map object that keeps its set of key objects in sorted order. Its keySet( ) and values( ) methods inherited from Map return collection that can be traversed in sorted order of the key.

It also declares methods of its own such as firstKey( ) and lastKey() that return the lowest and highest key values in the SortedMap.

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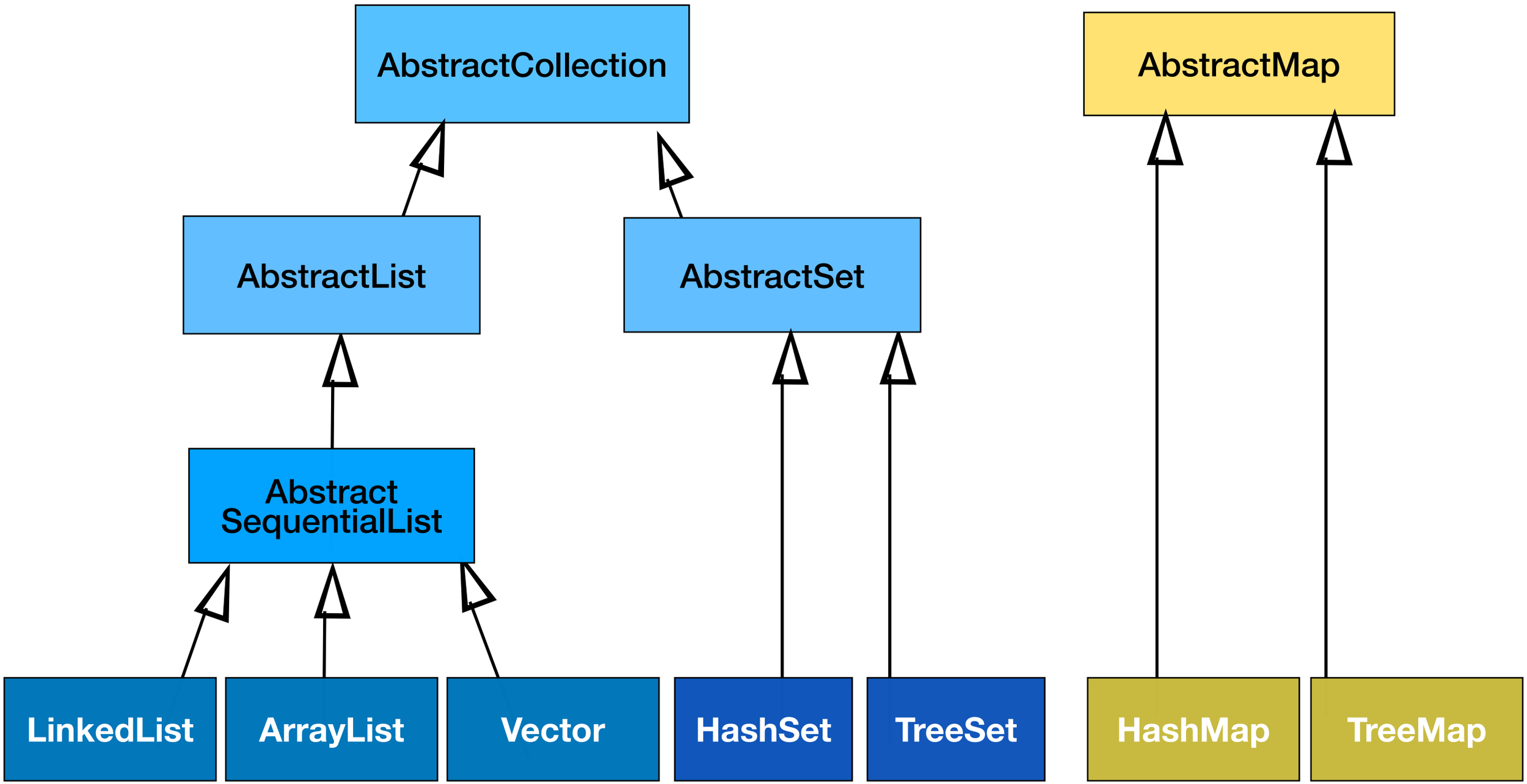
Classes in the Java Collections Framework