Collections

Managing Common Data by Using Collections

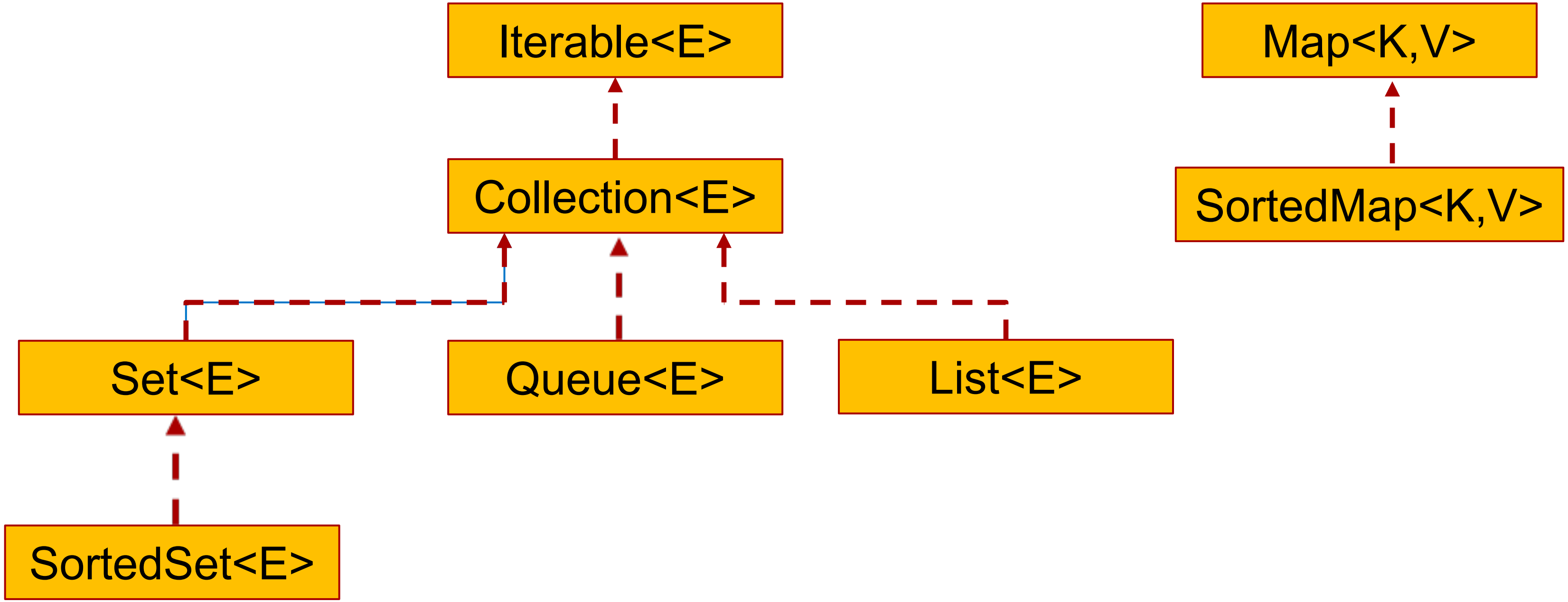
Overview

- Collections
- Collection-related interfaces
- Interface description
- Collections
- Main Underlying Structures

Collections

- Dynamic set of items of the same type.
- Choice based on
  - Performance (Add, Retrieve, Insert, Resize, Search, Sort)
  - Retrieval order (LIFO, FIFO, Random)
  - Retrieval by key or index
  - Sorted
  - Specialized

Collection-Related Interfaces



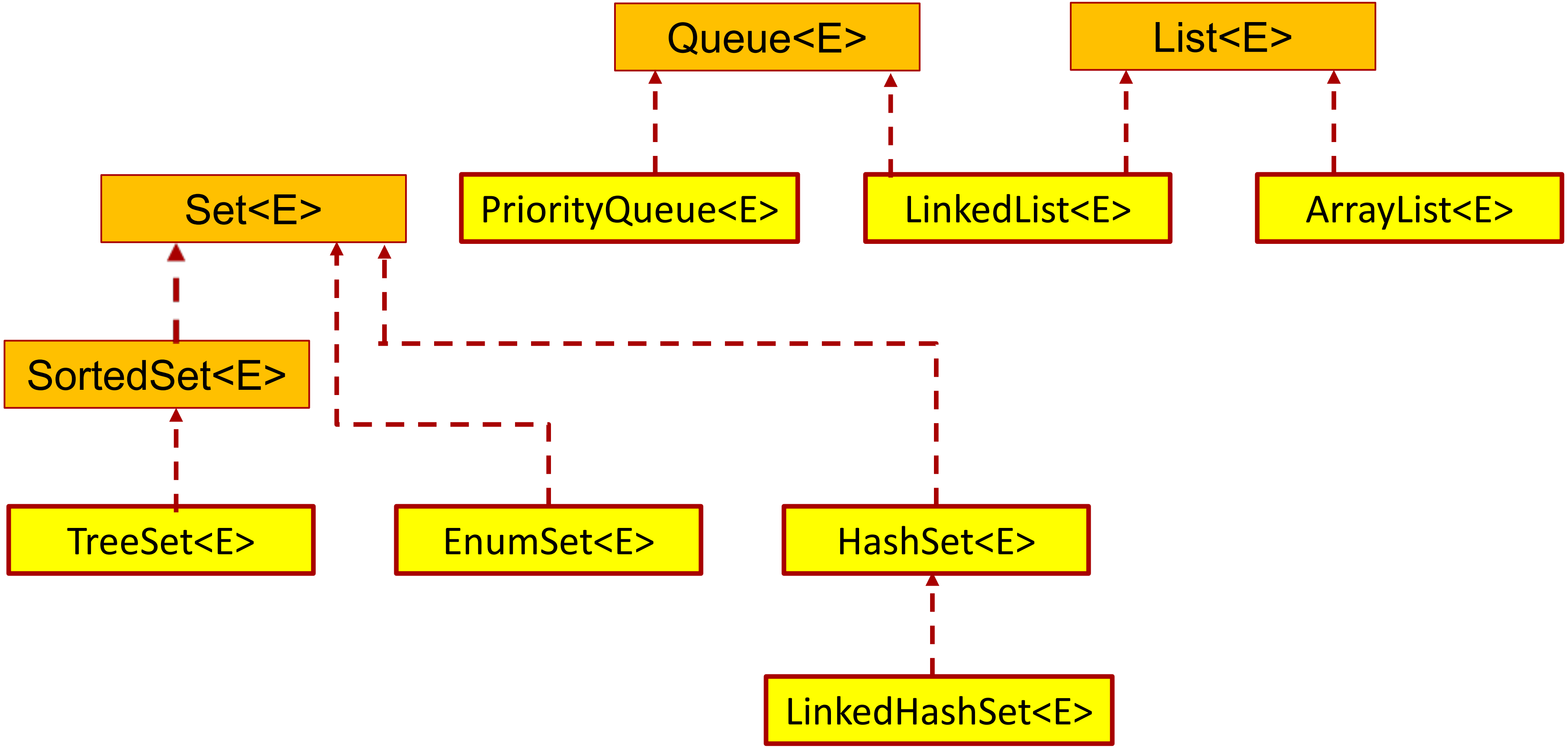
Interface description

Interface	Description
Iterable<E>	Provides an Iterator and so can be used by the enhanced for statement
Collection<E>	Root interface for collections. Provides methods as add, remove, size, toArray.
Set<E>	Collection, no duplicate elements
SortedSet<E>	Set whose elements are sorted
Queue<E>	Collection with FIFO structure

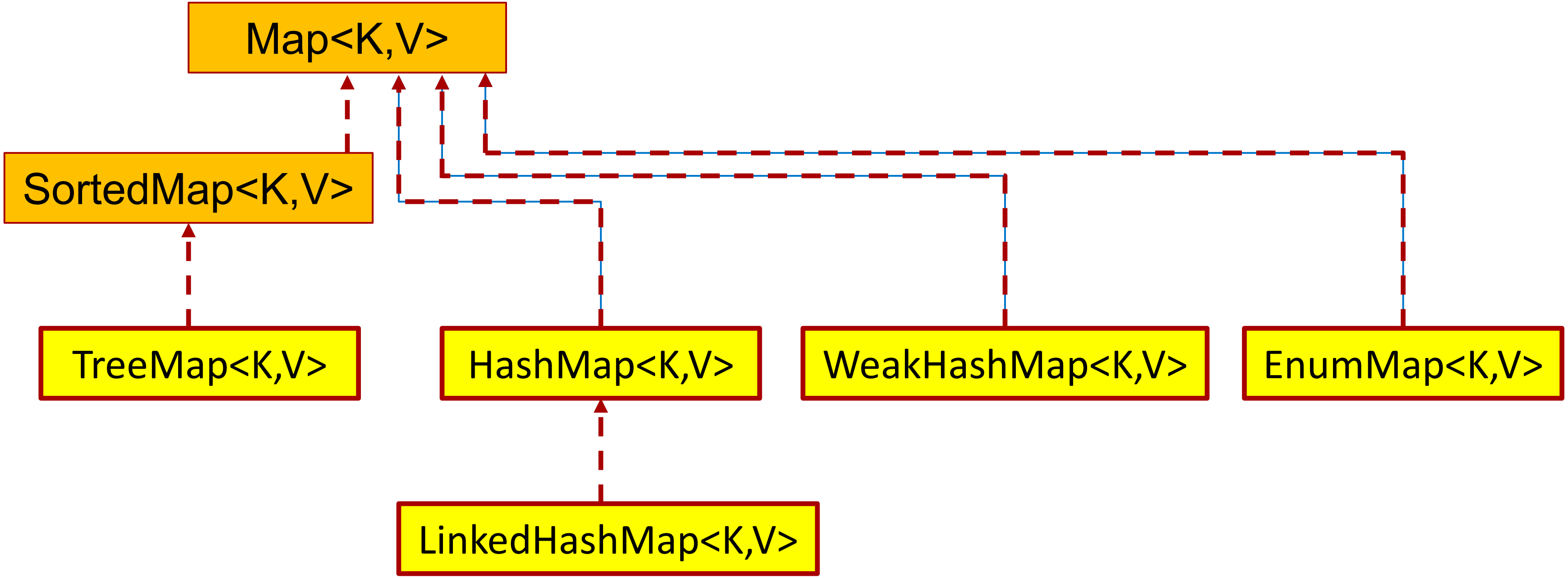
Interface description

Interface	Description
Map<K,V>	Mapping of Keys to a Value
SortedMap<K,V>	Map with sorted Keys

Collections



Collections



Main Underlying Structures

- Array
- HashTable
- LinkedList
- BinaryTree

Array

- Uses indices.
- Indexed based access is O(1)
- Append is O(1),Insert is O(n), delete is O(n).
- Searches are of O(n), when sorted O(log n)
- Sorting is of O(n.log n).
- Fixed size. Size adjustments come at high costs (reallocation and copying).
- Index based insertion is complex.
- Continuous block allocation in memory.
- Size must be known in advance.

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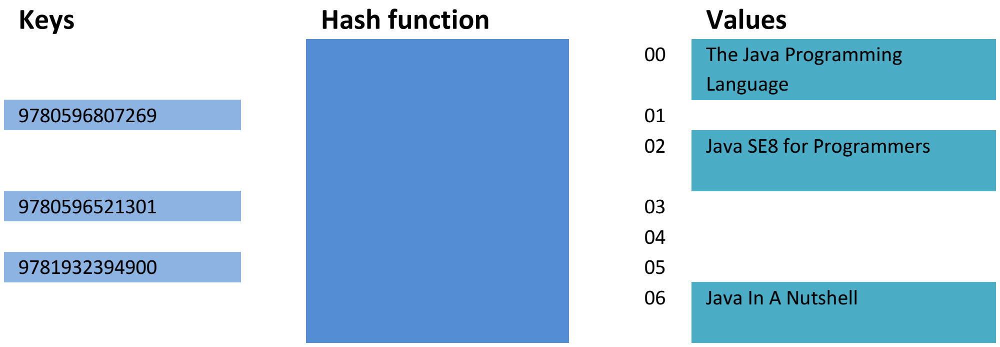
Array implementation

```java
ArrayList<String> cities=new ArrayList<String>
(Arrays.asList("Veenendaal", "Utrecht", "Amersfoort" ));
cities.add("Ede");
for (int i = 0; i < cities.size(); i++) {
  System.out.println(cities.get(i));
}
if(cities.contains("Utrecht")){
  System.out.println("Found Utrecht");
}
```

HashTable



Keys

9780596807269

9780596521301

9781932394900

Hash function

Values

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04	
05	
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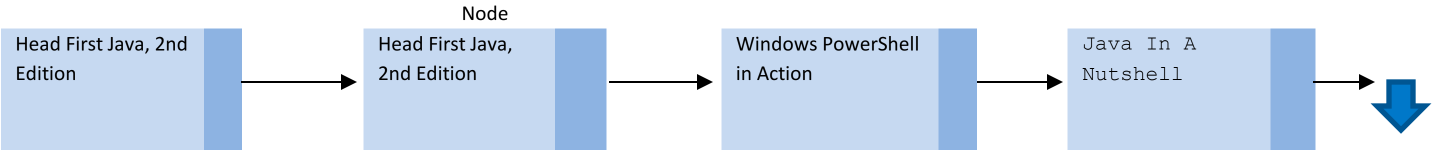
Maps Keys to their associated Values. The Hash function transforms the Key into the Index

- No (external) index.
- Arbitrary insertions and deletions.
- Searches are fast O(1), so are inserts and deletes.
- Resizing is a costly operation.

HashTable implementation

```java
Map<String, String> books = new HashMap<String, String>();
books.put("9780596807269", "The Java Programming Language");
books.put("9780596521301", "Windows PowerShell in Action");
books.put("9781932394900", "Java In A Nutshell");
Set<String> keys = books.keySet();
for (String key : keys) {
  System.out.println(books.get(key));
}
if(books.containsKey("9780123743190")==false){
  books.put("9780123743190", "DW2.0");
}
String searchISBN = "9780596807269";
System.out.printf("Book with ISBN:%s has title:%s”
                    ,searchISBN,books.get(searchISBN));
```

LinkedList


Node
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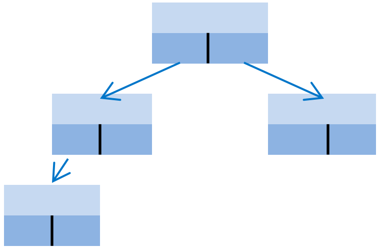
- No Indices.
- Searches are (sequential) slow O(n).
- Insert is O(1), delete is of O(1) when based on position.
- Resizable at minor costs.
- Can use memory fragments.
- Size not known in advance.
- Relatively complex in comparison to Arrays.

LinkedList implementation

```java
LinkedList<String> cities = new LinkedList<String>
              (Arrays.asList("Veenendaal", "Utrecht"));
cities.addLast("Ede");
int nodeIndex = cities.indexOf("Utrecht");
cities.add(nodeIndex, "Amersfoort");//add before Utrecht
for (String city : cities) {
  System.out.println(city);//Veenendaal Amersfoort Utrecht Ede
}
cities.remove("Utrecht");
cities.removeFirst();
for (String city : cities) {
  System.out.println(city);// Amersfoort Ede
}
```

Binary Tree



- No indices
- Complex structure
- Balancing is complex.
- Each node has at most two child nodes.
- Search is on average O(log n).
- Insert is of O(log n), Delete is of O(log n)
- Insertions and deletions are simple.
- Arranging data in a hierarchy.

BinaryTree implementation

```
TreeMap<String, String> orderedDictionary =
                    new TreeMap<String, String>();
orderedDictionary.put("9780596807269", "The Java Programming Language");
orderedDictionary.put("9780596521301", "Windows PowerShell in Action");
orderedDictionary.put("9781932394900", "Java In A Nutshell");
Set<String> keyCollection = orderedDictionary.keySet();
for (String item : keyCollection) {
  System.out.printf("Key: %s, Value %s%n", item,
  orderedDictionary.get(item));
}
```

Lab: Collections

- Exercise 1 : Collections