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Keeping Keys Sorted with SortedMap and NavigableMap

Methods Added by SortedMap

The JDK provides two extensions of the [Map](#) interface: [SortedMap](#) and [NavigableMap](#). [NavigableMap](#) is an extension of [SortedMap](#). Both interfaces are implemented by the same class: [TreeMap](#). The [TreeMap](#) class is a red-black tree, a well-known data structure.

[SortedMap](#) and [NavigableMap](#) keep their key/value pairs sorted by key. Just as for [SortedSet](#) and [NavigableSet](#), you need to provide a way to compare these keys. You have two solutions to do this: either the class of your keys implements [Comparable](#), or you provide a [Comparator](#) for your keys when creating your [TreeMap](#). If you provide a [Comparator](#), it will be used even if your keys are comparable.

If the implementation you chose for your [SortedMap](#) or [NavigableMap](#) is [TreeMap](#), then you can safely cast the set returned by a call to [keySet\(\)](#) or [entrySet\(\)](#) to [SortedSet](#) or [NavigableSet](#). [NavigableMap](#) has a method, [navigableKeySet\(\)](#) that returns an instance of [NavigableSet](#) that you can use instead of the plain [keySet\(\)](#) method. Both methods return the same object.

The [SortedMap](#) interface adds the following methods to [Map](#):

- [firstKey\(\)](#) and [lastKey\(\)](#): returns the lowest and the greatest key of your map;

- [headMap\(toKey_\)](#) and [tailMap\(fromKey_\)](#): returns a [SortedMap](#) whose keys are strictly less than `toKey`, or greater than or equal to `fromKey`;
- [subMap\(fromKey_, toKey_\)](#): returns a [SortedMap](#) whose keys are strictly lesser than `toKey`, or greater than or equal to `fromKey`.

These maps are instances of [SortedMap](#) and are views backed by this map. Any change made to this map will be seen in these views. These views can be updated, with a restriction: you cannot insert a key outside the boundaries of the map you built.

You can see this behavior on the following example:

```

1  SortedMap<Integer, String> map = new TreeMap<>();
2  map.put(1, "one");
3  map.put(2, "two");
4  map.put(3, "three");
5  map.put(5, "five");
6  map.put(6, "six");
7
8  SortedMap<Integer, String> headMap = map.headMap(3);
9  headMap.put(0, "zero"); // this line is ok
10 headMap.put(4, "four"); // this line throws an IllegalArgumentException

```

Methods Added by NavigableMap

Accessing to Specific Keys or Entries

The [NavigableMap](#) adds more methods to [SortedMap](#). The first set of methods gives you access to specific keys and entries in your map.

- [firstKey\(\)](#), [firstEntry\(\)](#), [lastEntry\(\)](#), and [lastKey\(\)](#): return the lowest or greatest key or entry from this map.
- [ceilingKey\(key_\)](#), [ceilingEntry\(key_\)](#), [higherKey\(key_\)](#), [higherEntry\(key_\)](#): return the lowest key or entry greater than the provided key. The `ceiling` methods may return a key that is equal to the provided key, whereas the key returned by the `higher` methods is strictly greater.

- [floorKey\(key\)](#), [floorEntry\(key\)](#), [lowerKey\(key\)](#), [lowerEntry\(key\)](#): return the greatest key or entry lesser than the provided key. The **floor** methods may return a key that is equal to the provided key, whereas the key returned by the **higher** methods is strictly lower.

Accessing your Map with Queue-Like Features

The second set gives you queue-like features:

- [pollFirstEntry\(\)](#): returns and removes the lowest entry
- [pollLastEntry\(\)](#): returns and removes the greatest entry.

Traversing your Map in the Reverse Order

The third set reverses your map, as if it had been built on the reversed comparison logic.

- [navigableKeySet\(\)](#) is a convenience method that returns a [NavigableSet](#) so that you do not have to cast the result of [keySet\(\)](#).
- [descendingKeySet\(\)](#): returns a [NavigableSet](#) backed by the map, on which you can iterate in the descending order
- [descendingMap\(\)](#): returns a [NavigableMap](#) with the same semantic.

Both views support element removal, but you cannot add anything through them.

Here is an example to demonstrate how you can use them.

```
1  NavigableMap<Integer, String> map = new TreeMap<>();
2  map.put(1, "one");
3  map.put(2, "two");
4  map.put(3, "three");
5  map.put(4, "four");
6  map.put(5, "five");
7
8  map.keySet().forEach(key -> System.out.print(key + " "));
9  System.out.println();
10
11 NavigableSet<Integer> descendingKeys = map.descendingKeySet();
12 descendingKeys.forEach(key -> System.out.print(key + " "));
```

Running this code prints out the following result.

```
1 | 1 2 3 4 5
2 | 5 4 3 2 1
```

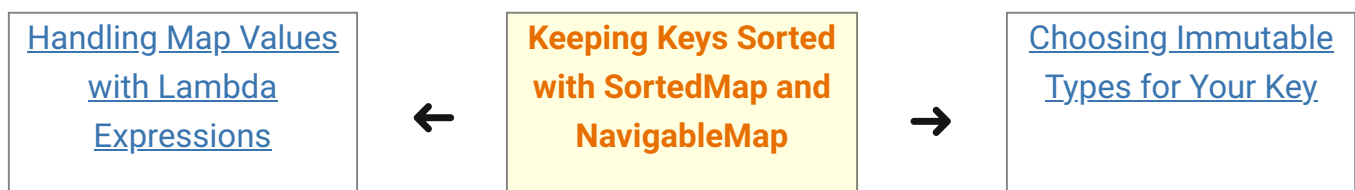
Getting Submap Views

The last set of methods give you access to views on portions of your map.

- [`subMap\(fromKey, fromInclusive, toKey, toInclusive\)`](#): returns a submap where you can decide to include or not the boundaries
- [`headMap\(toKey, inclusive\)`](#): same for the head map
- [`tailMap\(fromKey, inclusive\)`](#): same for the tail map.

These maps are views on this map, which you can update by removing or adding key/value pairs. There is one restriction on adding elements though: you cannot add keys outside the boundaries on which the view has been created.

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