Hashtable in Java

Difficulty Level : Medium Last Updated : 24 Nov, 2020

The **Hashtable** class implements a hash table, which maps keys to values. Any non-null object can be used as a key or as a value. To successfully store and retrieve objects from a hashtable, the objects used as keys must implement the hashCode method and the equals method.

Features of Hashtable

- It is similar to HashMap, but is synchronized.
- Hashtable stores key/value pair in hash table.
- In Hashtable we specify an object that is used as a key, and the value we want to associate to that key. The key is then hashed, and the resulting hash code is used as the index at which the value is stored within the table.
- The initial default capacity of Hashtable class is 11 whereas loadFactor is 0.75.
- HashMap doesn’t provide any Enumeration, while Hashtable provides not fail-fast Enumeration.

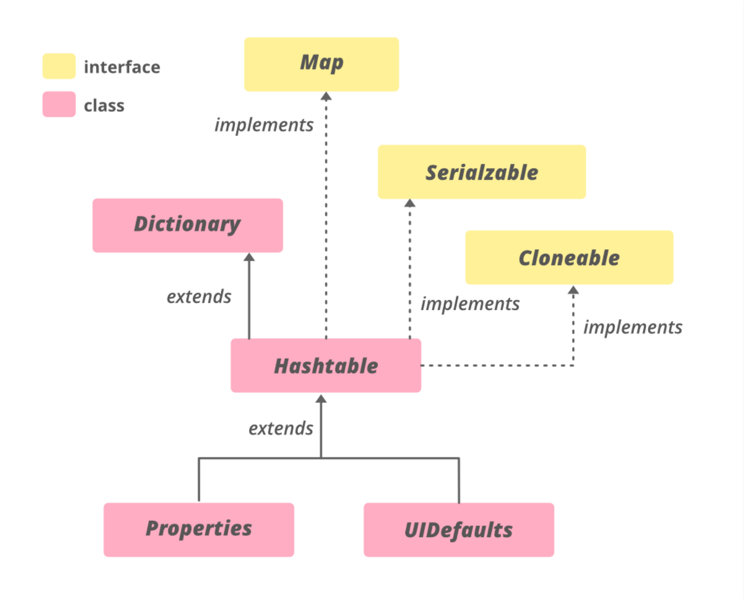
Declaration:

```
public class Hashtable<K,V> extends Dictionary<K,V> implements Map<K,V>, Clone
```

Type Parameters:

- **K** – the type of keys maintained by this map
- **V** – the type of mapped values

The Hierarchy of Hashtable



Hashtable implements **Serializable**, **Cloneable**, Map<K,V> interfaces and extends Dictionary<K,V>. The direct subclasses are Properties, **UIDefaults**.

Constructors:

In order to create a Hashtable, we need to import it from **java.util.Hashtable**. There are various ways in which we can create a Hashtable.

1. Hashtable(): This creates an empty hashtable with the default load factor of 0.75 and an initial capacity is 11.

> *Hashtable<K, V> ht = new Hashtable<K, V>();*

```java
// Java program to demonstrate
// adding elements to Hashtable

import java.io.*;
import java.util.*;
```

```
class AddElementsToHashtable {
    public static void main(String args[])
    {
        // No need to mention the
        // Generic type twice
        Hashtable<Integer, String> ht1 = new Hashtable<>();

        // Initialization of a Hashtable
        // using Generics
        Hashtable<Integer, String> ht2
            = new Hashtable<Integer, String>();

        // Inserting the Elements
        // using put() method
        ht1.put(1, "one");
        ht1.put(2, "two");
        ht1.put(3, "three");

        ht2.put(4, "four");
        ht2.put(5, "five");
        ht2.put(6, "six");

        // Print mappings to the console
        System.out.println("Mappings of ht1 : " + ht1);
        System.out.println("Mappings of ht2 : " + ht2);
    }
}
```

Output

```
Mappings of ht1 : {3=three, 2=two, 1=one}
Mappings of ht2 : {6=six, 5=five, 4=four}
```

2. Hashtable(int initialCapacity): This creates a hash table that has an initial size specified by initialCapacity and the default load factor is 0.75.

Hashtable<K, V> ht = new Hashtable<K, V>(int initialCapacity);

```
// Java program to demonstrate
// adding elements to Hashtable
```

```java
import java.io.*;
import java.util.*;

class AddElementsToHashtable {
    public static void main(String args[])
    {
        // No need to mention the
        // Generic type twice
        Hashtable<Integer, String> ht1 = new Hashtable<>(4);

        // Initialization of a Hashtable
        // using Generics
        Hashtable<Integer, String> ht2
            = new Hashtable<Integer, String>(2);

        // Inserting the Elements
        // using put() method
        ht1.put(1, "one");
        ht1.put(2, "two");
        ht1.put(3, "three");

        ht2.put(4, "four");
        ht2.put(5, "five");
        ht2.put(6, "six");

        // Print mappings to the console
        System.out.println("Mappings of ht1 : " + ht1);
        System.out.println("Mappings of ht2 : " + ht2);
    }
}
```

Output

```
Mappings of ht1 : {3=three, 2=two, 1=one}
Mappings of ht2 : {4=four, 6=six, 5=five}
```

3. Hashtable(int size, float fillRatio): This version creates a hash table that has an initial size specified by size and fill ratio specified by fillRatio. fill ratio: Basically, it determines how full a hash table can be before it is resized upward and its Value lies between 0.0 to 1.0.

Hashtable<K, V> ht = new Hashtable<K, V>(int size, float fillRatio);

```java
// Java program to demonstrate
// adding elements to Hashtable

import java.io.*;
import java.util.*;

class AddElementsToHashtable {
    public static void main(String args[])
    {
        // No need to mention the
        // Generic type twice
        Hashtable<Integer, String> ht1
            = new Hashtable<>(4, 0.75f);

        // Initialization of a Hashtable
        // using Generics
        Hashtable<Integer, String> ht2
            = new Hashtable<Integer, String>(3, 0.5f);

        // Inserting the Elements
        // using put() method
        ht1.put(1, "one");
        ht1.put(2, "two");
        ht1.put(3, "three");

        ht2.put(4, "four");
        ht2.put(5, "five");
        ht2.put(6, "six");

        // Print mappings to the console
        System.out.println("Mappings of ht1 : " + ht1);
        System.out.println("Mappings of ht2 : " + ht2);
    }
}
```

Output

```
Mappings of ht1 : {3=three, 2=two, 1=one}
Mappings of ht2 : {6=six, 5=five, 4=four}
```

4. Hashtable(Map<? extends K,? extends V> m): This creates a hash table that is initialized with the elements in m.

Hashtable<K, V> ht = new Hashtable<K, V>(Map m);

```java
// Java program to demonstrate
// adding elements to Hashtable

import java.io.*;
import java.util.*;

class AddElementsToHashtable {
    public static void main(String args[])
    {
        // No need to mention the
        // Generic type twice
        Map<Integer, String> hm = new HashMap<>();

        // Inserting the Elements
        // using put() method
        hm.put(1, "one");
        hm.put(2, "two");
        hm.put(3, "three");

        // Initialization of a Hashtable
        // using Generics
        Hashtable<Integer, String> ht2
            = new Hashtable<Integer, String>(hm);

        // Print mappings to the console

        System.out.println("Mappings of ht2 : " + ht2);
    }
}
```

Output

```
Mappings of ht2 : {3=three, 2=two, 1=one}
```

Example:

```java
// Java program to illustrate
// Java.util.Hashtable

import java.util.*;

public class GFG {
    public static void main(String[] args)
    {
        // Create an empty Hashtable
        Hashtable<String, Integer> ht = new Hashtable<>();

        // Add elements to the hashtable
        ht.put("vishal", 10);
        ht.put("sachin", 30);
        ht.put("vaibhav", 20);

        // Print size and content
        System.out.println("Size of map is:- " + ht.size());
        System.out.println(ht);

        // Check if a key is present and if
        // present, print value
        if (ht.containsKey("vishal")) {
            Integer a = ht.get("vishal");
            System.out.println("value for key"
                               + " \"vishal\" is:- " + a);
        }
    }
}
```

Output

```
Size of map is:- 3
{vaibhav=20, vishal=10, sachin=30}
value for key "vishal" is:- 10
```

Performing Various Operations on Hashtable

1. Adding Elements: In order to add an element to the hashtable, we can use the put() method. However, the insertion order is not retained in the hashtable. Internally, for every element, a separate hash is generated and the elements are indexed based on this hash to make it more efficient.

```
// Java program to demonstrate
// adding elements to Hashtable

import java.io.*;
import java.util.*;

class AddElementsToHashtable {
    public static void main(String args[])
    {
        // No need to mention the
        // Generic type twice
        Hashtable<Integer, String> ht1 = new Hashtable<>();

        // Initialization of a Hashtable
        // using Generics
        Hashtable<Integer, String> ht2
            = new Hashtable<Integer, String>();

        // Inserting the Elements
          // using put() method
        ht1.put(1, "Geeks");
        ht1.put(2, "For");
        ht1.put(3, "Geeks");

        ht2.put(1, "Geeks");
        ht2.put(2, "For");
        ht2.put(3, "Geeks");

          // Print mappings to the console
        System.out.println("Mappings of ht1 : " + ht1);
        System.out.println("Mappings of ht2 : " + ht2);
    }
}
```

Output

```
Mappings of ht1 : {3=Geeks, 2=For, 1=Geeks}
Mappings of ht2 : {3=Geeks, 2=For, 1=Geeks}
```

2. Changing Elements: After adding the elements if we wish to change the element, it can be done by again adding the element with the put() method. Since the elements in the hashtable are indexed using the keys, the value of the key can be changed by simply inserting the updated value for the key for which we wish to change.

```
// Java program to demonstrate
// updating Hashtable

import java.io.*;
import java.util.*;
class UpdatesOnHashtable {
    public static void main(String args[])
    {

        // Initialization of a Hashtable
        Hashtable<Integer, String> ht
            = new Hashtable<Integer, String>();

        // Inserting the Elements
          // using put method
        ht.put(1, "Geeks");
        ht.put(2, "Geeks");
        ht.put(3, "Geeks");

          // print initial map to the console
        System.out.println("Initial Map " + ht);

          // Update the value at key 2
        ht.put(2, "For");

          // print the updated map
        System.out.println("Updated Map " + ht);
    }
}
```

Output

```
Initial Map {3=Geeks, 2=Geeks, 1=Geeks}
Updated Map {3=Geeks, 2=For, 1=Geeks}
```

3. Removing Element: In order to remove an element from the Map, we can use the remove() method. This method takes the key value and removes the mapping for a key from this map if it is present in the map.

```java
// Java program to demonstrate
// the removing mappings from Hashtable

import java.io.*;
import java.util.*;
class RemovingMappingsFromHashtable {

    public static void main(String args[])
    {
        // Initialization of a Hashtable
        Map<Integer, String> ht
            = new Hashtable<Integer, String>();

        // Inserting the Elements
          // using put method
        ht.put(1, "Geeks");
        ht.put(2, "For");
        ht.put(3, "Geeks");
        ht.put(4, "For");

        // Initial HashMap
        System.out.println("Initial map : " + ht);

          // Remove the map entry with key 4
        ht.remove(4);

        // Final Hashtable
        System.out.println("Updated map : " + ht);
    }
}
```

Output

```
Initial map : {4=For, 3=Geeks, 2=For, 1=Geeks}
Updated map : {3=Geeks, 2=For, 1=Geeks}
```

4. Traversal of a Hashtable: To iterate the table, we can make use of an advanced for loop. Below is the example of iterating a hashtable.

```
// Java program to illustrate
// traversal of Hashtable

import java.util.Hashtable;
import java.util.Map;

public class IteratingHashtable {
    public static void main(String[] args)
    {
          // Create an instance of Hashtable
        Hashtable<String, Integer> ht = new Hashtable<>();

          // Adding elements using put method
        ht.put("vishal", 10);
        ht.put("sachin", 30);
        ht.put("vaibhav", 20);

          // Iterating using enhanced for loop
        for (Map.Entry<String, Integer> e : ht.entrySet())
            System.out.println(e.getKey() + " "
                               + e.getValue());
    }
}
```

Output

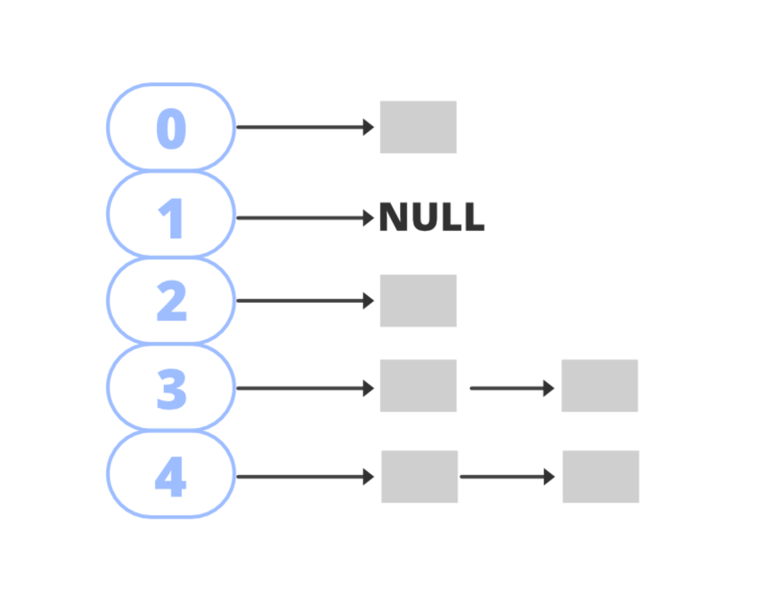
```
vaibhav 20
vishal 10
sachin 30
```

Internal Working of Hashtable

Hashtable datastructure is an array of buckets which stores the key/value pairs in them. It makes use of **hashCode() method** to determine which bucket the key/value pair should map.

The hash function helps to determine the location for a given key in the bucket list. Generally, hashcode is a non-negative integer that is equal for equal Objects and may or may not be equal for unequal Objects. To determine whether two objects are equal or not, hashtable makes use of the equals() method.

It is possible that two unequal Objects have the same hashcode. This is called a **collision**. To resolve collisions, hashtable uses an array of lists. The pairs mapped to a single bucket (array index) are stored in a list and list reference is stored in the array index.



Methods of Hashtable

- **K** – The type of the keys in the map.
- **V** – The type of values mapped in the map.

METHOD	DESCRIPTION
clear()	Clears this hashtable so that it contains no keys.
clone()	Creates a shallow copy of this hashtable.
compute(K key, BiFunction<? super K,? super V,? extends V> remappingFunction)	Attempts to compute a mapping for the specified key and its current mapped value (or null if there is no current mapping).

METHOD	DESCRIPTION
computeIfAbsent(K key, Function<? super K,? extends V> mappingFunction)	If the specified key is not already associated with a value (or is mapped to null), attempts to compute its value using the given mapping function and enters it into this map unless null.
computeIfPresent(K key, BiFunction<? super K,? super V,? extends V> remappingFunction)	If the value for the specified key is present and non-null, attempts to compute a new mapping given the key and its current mapped value.
contains(Object value)	Tests if some key maps into the specified value in this hashtable.
containsKey(Object key)	Tests if the specified object is a key in this hashtable.
containsValue(Object value)	Returns true if this hashtable maps one or more keys to this value.
elements()	Returns an enumeration of the values in this hashtable.
entrySet()	Returns a Set view of the mappings contained in this map.
equals(Object o)	Compares the specified Object with this Map for equality, as per the definition in the Map interface.
get(Object key)	Returns the value to which the specified key is mapped, or null if this map contains no mapping for the key.
hashCode()	Returns the hash code value for this Map as per the definition in the Map interface.
isEmpty()	Tests if this hashtable maps no keys to values.
keys()	Returns an enumeration of the keys in this hashtable.
keySet()	Returns a Set view of the keys contained in this map.
merge(K key, V value, BiFunction<? super V,? super V,? extends V> remappingFunction)	If the specified key is not already associated with a value or is associated with null, associates it with the given non-null value.

METHOD	DESCRIPTION
put(K key, V value)	Maps the specified key to the specified value in this hashtable.
putAll(Map<? extends K,? extends V> t)	Copies all of the mappings from the specified map to this hashtable.
rehash()	Increases the capacity of and internally reorganizes this hashtable, in order to accommodate and access its entries more efficiently.
remove(Object key)	Removes the key (and its corresponding value) from this hashtable.
size()	Returns the number of keys in this hashtable.
toString()	Returns a string representation of this Hashtable object in the form of a set of entries, enclosed in braces and separated by the ASCII characters “, ” (comma and space).
values()	Returns a Collection view of the values contained in this map.

Methods declared in interface java.util.Map

METHOD	DESCRIPTION
forEach(BiConsumer<? super K,? super V> action)	Performs the given action for each entry in this map until all entries have been processed or the action throws an exception.
getOrDefault(Object key, V defaultValue)	Returns the value to which the specified key is mapped, or defaultValue if this map contains no mapping for the key.
putIfAbsent(K key, V value)	If the specified key is not already associated with a value (or is mapped to null) associates it with the given value and returns null, else returns the current value.

METHOD	DESCRIPTION
remove(Object key, Object value)	Removes the entry for the specified key only if it is currently mapped to the specified value.
replace(K key, V value)	Replaces the entry for the specified key only if it is currently mapped to some value.
replace(K key, V oldValue, V newValue)	Replaces the entry for the specified key only if currently mapped to the specified value.
replaceAll(BiFunction<? super K,? super V,? extends V> function)	Replaces each entry's value with the result of invoking the given function on that entry until all entries have been processed or the function throws an exception.

Must Read:

- Differences between HashMap and HashTable in Java

Reference: https://docs.oracle.com/en/java/javase/11/docs/api/java.base/java/util/Hashtable.html