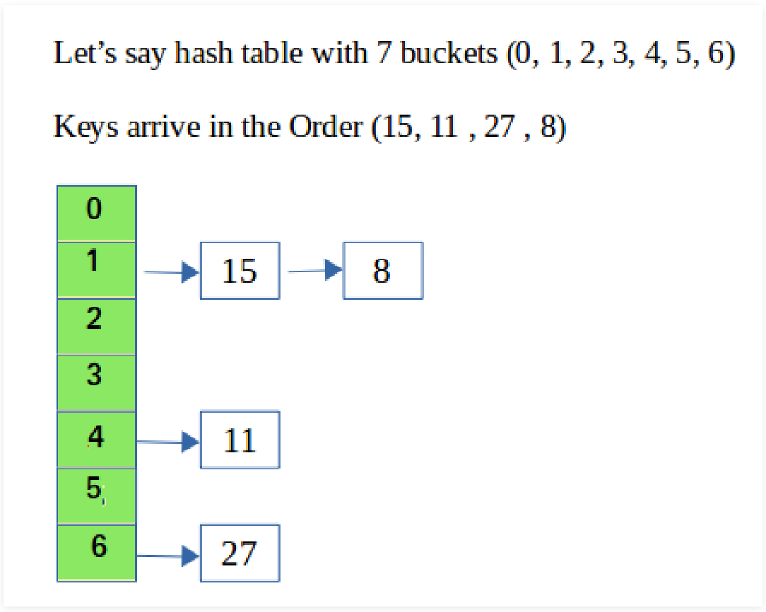
Hashing in Java

In

hashing

there is a hash function that maps keys to some values. But these hashing function may lead to collision that is two or more keys are mapped to same value. **Chain hashing** avoids collision. The idea is to make each cell of hash table point to a linked list of records that have same hash function value.
Let’s create a hash function, such that our hash table has ‘N’ number of buckets.
To insert a node into the hash table, we need to find the hash index for the given key. And it could be calculated using the hash function.
Example: hashIndex = key % noOfBuckets
Insert: Move to the bucket corresponds to the above calculated hash index and insert the new node at the end of the list.
Delete: To delete a node from hash table, calculate the hash index for the key, move to the bucket corresponds to the calculated hash index, search the list in the current bucket to find and remove the node with the given key (if found).


Let’s say hash table with 7 buckets (0, 1, 2, 3, 4, 5, 6)
Keys arrive in the Order (15, 11 , 27 , 8)
0
1
2
3
4
5
6
15
8
11
27

Methods to implement Hashing in Java

- **With help of HashTable (A synchronized implementation of hashing)**

```java
// Java program to demonstrate working of HashTable
import java.util.*;

class GFG {
    public static void main(String args[])
    {

        // Create a HashTable to store
        // String values corresponding to integer keys
        Hashtable<Integer, String>
            hm = new Hashtable<Integer, String>();

        // Input the values
        hm.put(1, "Geeks");
        hm.put(12, "forGeeks");
        hm.put(15, "A computer");
        hm.put(3, "Portal");

        // Printing the Hashtable
        System.out.println(hm);
    }
}
```

Output:

```
{15=A computer, 3=Portal, 12=forGeeks, 1=Geeks}
```

- **With the help of HashMap (A non-synchronized faster implementation of hashing)**

```java
// Java program to create HashMap from an array
// by taking the elements as Keys and
// the frequencies as the Values

import java.util.*;

class GFG {

    // Function to create HashMap from array
    static void createHashMap(int arr[])
    {
        // Creates an empty HashMap
        HashMap<Integer, Integer> hmap = new HashMap<Integer, Integer>();

        // Traverse through the given array
        for (int i = 0; i < arr.length; i++) {

            // Get if the element is present
            Integer c = hmap.get(arr[i]);

            // If this is first occurrence of element
            // Insert the element
            if (hmap.get(arr[i]) == null) {
                hmap.put(arr[i], 1);
            }

            // If elements already exists in hash map
            // Increment the count of element by 1
            else {
                hmap.put(arr[i], ++c);
            }
        }

        // Print HashMap
        System.out.println(hmap);
    }

    // Driver method to test above method
    public static void main(String[] args)
    {
        int arr[] = { 10, 34, 5, 10, 3, 5, 10 };
        createHashMap(arr);
    }
}
```

Output:

```
{34=1, 3=1, 5=2, 10=3}
```

- **With the help of LinkedHashMap (Similar to HashMap, but keeps order of elements)**

```
// Java program to demonstrate working of LinkedHashMap
import java.util.*;

public class BasicLinkedHashMap
{
    public static void main(String a[])
    {
        LinkedHashMap<String, String> lhm =
```

```java
                      new LinkedHashMap<String, String>();
        lhm.put("one", "practice.geeksforgeeks.org");
        lhm.put("two", "code.geeksforgeeks.org");
        lhm.put("four", "quiz.geeksforgeeks.org");

        // It prints the elements in same order
        // as they were inserted
        System.out.println(lhm);

        System.out.println("Getting value for key 'one': "
                                        + lhm.get("one"));
        System.out.println("Size of the map: " + lhm.size());
        System.out.println("Is map empty? " + lhm.isEmpty());
        System.out.println("Contains key 'two'? "+
                                   lhm.containsKey("two"));
        System.out.println("Contains value 'practice.geeks"
        +"forgeeks.org'? "+ lhm.containsValue("practice"+
        ".geeksforgeeks.org"));
        System.out.println("delete element 'one': " +
                           lhm.remove("one"));
        System.out.println(lhm);
    }
}
```

Output:

```
{one=practice.geeksforgeeks.org, two=code.geeksforgeeks.org, four=quiz.geeksforgeeks.o
Getting value for key 'one': practice.geeksforgeeks.org
Size of the map: 3
Is map empty? false
Contains key 'two'? true
Contains value 'practice.geeksforgeeks.org'? true
delete element 'one': practice.geeksforgeeks.org
{two=code.geeksforgeeks.org, four=quiz.geeksforgeeks.org}
```

- **With the help of ConcurretHashMap(Similar to Hashtable, Synchronized, but faster as multiple locks are used)**

```java
// Java program to demonstrate working of ConcurrentHashMap

import java.util.concurrent.*;
```

```java
class ConcurrentHashMapDemo {
    public static void main(String[] args)
    {
        ConcurrentHashMap<Integer, String> m =
                   new ConcurrentHashMap<Integer, String>();
        m.put(100, "Hello");
        m.put(101, "Geeks");
        m.put(102, "Geeks");

        // Printing the ConcurrentHashMap
        System.out.println("ConcurentHashMap: " + m);

        // Adding Hello at 101 key
        // This is already present in ConcurrentHashMap object
        // Therefore its better to use putIfAbsent for such cases
        m.putIfAbsent(101, "Hello");

        // Printing the ConcurrentHashMap
        System.out.println("\nConcurentHashMap: " + m);

        // Trying to remove entry for 101 key
        // since it is present
        m.remove(101, "Geeks");

        // Printing the ConcurrentHashMap
        System.out.println("\nConcurentHashMap: " + m);

        // replacing the value for key 101
        // from "Hello" to "For"
        m.replace(100, "Hello", "For");

        // Printing the ConcurrentHashMap
        System.out.println("\nConcurentHashMap: " + m);
    }
}
```

Output:

```
ConcurentHashMap: {100=Hello, 101=Geeks, 102=Geeks}


ConcurentHashMap: {100=Hello, 101=Geeks, 102=Geeks}


ConcurentHashMap: {100=Hello, 102=Geeks}


ConcurentHashMap: {100=For, 102=Geeks}
```

- **With the help of HashSet (Similar to HashMap, but maintains only keys, not pair)**

```java
// Java program to demonstrate working of HashSet
import java.util.*;

class Test {
    public static void main(String[] args)
    {
        HashSet<String> h = new HashSet<String>();

        // Adding elements into HashSet using add()
        h.add("India");
        h.add("Australia");
        h.add("South Africa");
        h.add("India"); // adding duplicate elements

        // Displaying the HashSet
        System.out.println(h);

        // Checking if India is present or not
        System.out.println("\nHashSet contains India or not:"
                           + h.contains("India"));

        // Removing items from HashSet using remove()
        h.remove("Australia");

        // Printing the HashSet
        System.out.println("\nList after removing Australia:" + h);

        // Iterating over hash set items
        System.out.println("\nIterating over list:");
        Iterator<String> i = h.iterator();
        while (i.hasNext())
            System.out.println(i.next());
    }
}
```

Output:

```
[South Africa, Australia, India]


HashSet contains India or not:true


List after removing Australia:[South Africa, India]


Iterating over list:
```

```
South Africa
India
```

With the help of LinkedHashSet (Similar to LinkedHashMap, but maintains only keys, not pair)

```
// Java program to demonstrate working of LinkedHashSet

import java.util.LinkedHashSet;
public class Demo
{
    public static void main(String[] args)
    {
        LinkedHashSet<String> linkedset =
                           new LinkedHashSet<String>();

        // Adding element to LinkedHashSet
        linkedset.add("A");
        linkedset.add("B");
        linkedset.add("C");
        linkedset.add("D");

        // This will not add new element as A already exists
        linkedset.add("A");
        linkedset.add("E");

        System.out.println("Size of LinkedHashSet = " +
                                    linkedset.size());
        System.out.println("Original LinkedHashSet:" + linkedset);
        System.out.println("Removing D from LinkedHashSet: " +
                            linkedset.remove("D"));
        System.out.println("Trying to Remove Z which is not "+
                            "present: " + linkedset.remove("Z"));
        System.out.println("Checking if A is present=" +
                            linkedset.contains("A"));
        System.out.println("Updated LinkedHashSet: " + linkedset);
    }
}
```

Output:

```
Size of LinkedHashSet = 5
Original LinkedHashSet:[A, B, C, D, E]
Removing D from LinkedHashSet: true
```

```
Trying to Remove Z which is not present: false
Checking if A is present=true
Updated LinkedHashSet: [A, B, C, E]
```

- **With the help of TreeSet (Implements the SortedSet interface, Objects are stored in a sorted and ascending order).**

```java
// Java program to demonstrate working of TreeSet

import java.util.*;

class TreeSetDemo {
    public static void main(String[] args)
    {
        TreeSet<String> ts1 = new TreeSet<String>();

        // Elements are added using add() method
        ts1.add("A");
        ts1.add("B");
        ts1.add("C");

        // Duplicates will not get insert
        ts1.add("C");

        // Elements get stored in default natural
        // Sorting Order(Ascending)
        System.out.println("TreeSet: " + ts1);

        // Checking if A is present or not
        System.out.println("\nTreeSet contains A or not:"
                           + ts1.contains("A"));

        // Removing items from TreeSet using remove()
        ts1.remove("A");

        // Printing the TreeSet
        System.out.println("\nTreeSet after removing A:" + ts1);

        // Iterating over TreeSet items
        System.out.println("\nIterating over TreeSet:");
        Iterator<String> i = ts1.iterator();
        while (i.hasNext())
            System.out.println(i.next());
    }
}
```

Output:

```
TreeSet: [A, B, C]


TreeSet contains A or not:true


TreeSet after removing A:[B, C]


Iterating over TreeSet:
B
C
```