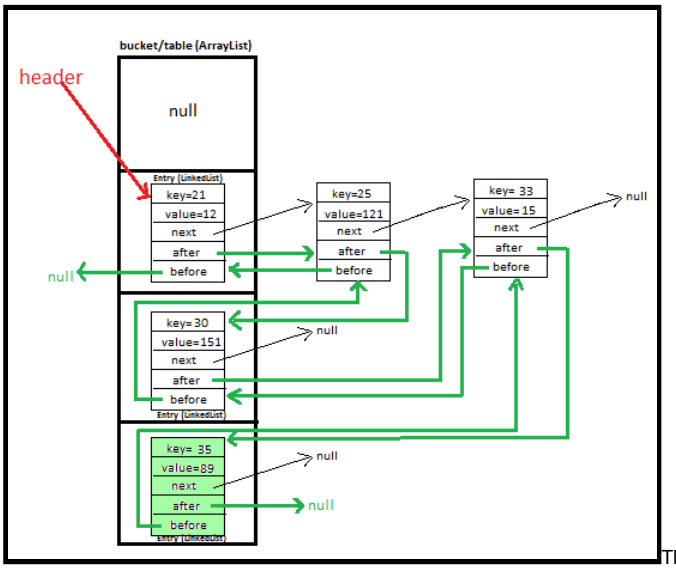
LinkedHashMap Custom implementation in java - How LinkedHashMap works internally with diagrams and full program

Contents of page :

1) Custom LinkedHashMap >



This is very **important and trending** topic. In this post i will be explaining **LinkedHashMap** custom implementation with diagrams which will help you in **visualizing** the LinkedHashMap implementation.

I will be explaining how we will **put** and **get** key-value pair in HashMap by overriding-
>**equals** method - helps in checking equality of entry objects.
>**hashCode** method - helps in finding bucket's index on which data will be stored.

We will maintain **bucket (ArrayList)** which will store **Entry (LinkedList).**

- Overriding equals and hashCode
- PostgreSQL
- Producer Consumer problem/pattern
- Pyramid generation
- RegEx
- Serialization
- Thread Concurrency
- Threads
- TUTORIALS
- Windows

Join our Groups>

- FACEBOOK
- LINKED IN

Most salient feature of **LinkedHashMap** is that it **maintains insertion order** of key-value pairs. We will maintain doubly Linked List for doing so.

While our HashMap didn't maintained insertion order.

2) Entry<K,V>

We store key-value pair by using `Entry<K,V>`

By using, **`Entry<K,V> before, after -`** we keep track of newly added entry in LinkedHashMap, which helps us in **maintaining insertion order**.

Entry contains

- K **key,**
- V **value,**
- `Entry<K,V>` **next** (i.e. next entry on that location of bucket),
- `Entry<K,V>` **before** and
- `Entry<K,V>` **after**

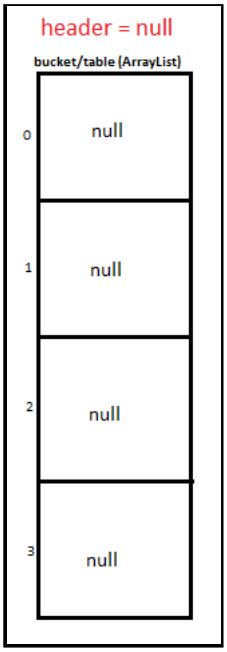
```
        static class Entry<K, V> {
         K key;
         V value;
         Entry<K,V> next;
         Entry<K,V> before, after ;

         public Entry(K key, V value, Entry<K,V> next){
             this.key = key;
             this.value = value;
             this.next = next;
         }
    }
```

3) Putting 5 key-value pairs in own/custom LinkedHashMap (step-by-step)>

I will explain you the whole concept of **LinkedHashMap** by putting **5 key-value pairs in HashMap**.

Initially, we have bucket of **capacity=4.** (all indexes of bucket i.e. 0,1,2,3 are pointing to null)



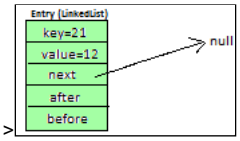
Let's put first key-value pair in LinkedHashMap-

Key=21, value=12

All Labels

Algorithm(7) Apache To
Java(30) Autoboxing(5)
beginners(15) Binary T
Framework(65) Colle
Collections implement
Comparator program(2
core java Basics(38) C
Core Java Differences(11
CRUD MongoDB java(5
MongoDB(3) Custom im
Structures(11) Data Stru
Database Tutorials(3) Da
DeSerialization(19) ec
File IO/File handling(
java(43) Generics(5) Ha
Interview questions(14
4(1) java 5(3) Java 7(32
keywords(11) Java Mcq(
Java Programs(8) Java Q
JDBC(74) JUNIT(7)
(beginners)(31) Level2
(intermediate)(23) Lev
(advanced)(13) Linux(
MongoDB(87) Mor
MultiThreading(96
Oracle(18) OutOfMem
equals and hashCode(11)
PostgreSQL(1) Producer C
Pyramid generation(14
Serialization(20) Seria
questions and answers
Concurrency(34) Thre
Windows(8)

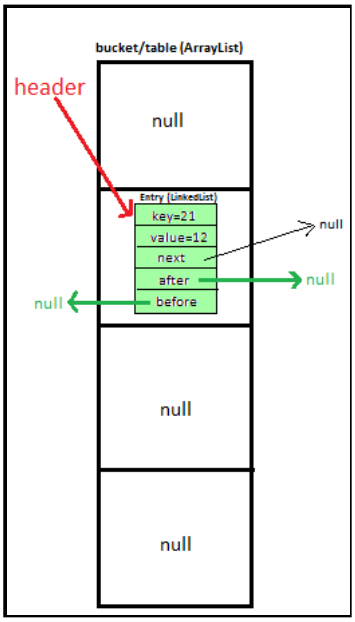
newEntry Object will be formed like this >



We will calculate hash by using our **hash(K key)** method **-** in this case it returns **key/capacity= 21%4= 1**.
So, **1** will be the **index of bucket** on which **newEntry object** will be stored.
We will go to **1st** index as it is pointing to null we will **put our newEntry object there**.

Additionally, for maintaining insertion order-
Update **header**, it will start pointing to **newEntry object**

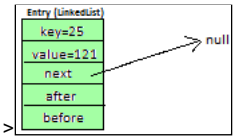
At completion of this step, our HashMap will look like this-



Let's put second key-value pair in LinkedHashMap-

Key=25, value=121

newEntry Object will be formed like this >



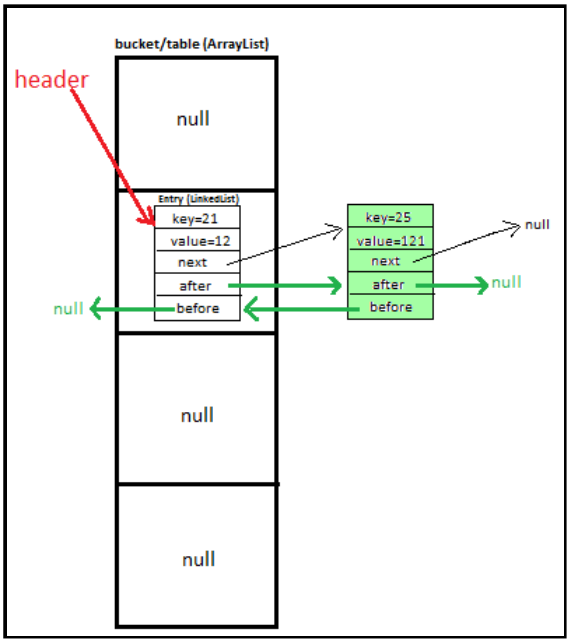
We will calculate hash by using our **hash(K key)** method - in this case it returns **key/capacity= 25%4= 1.**
So, 1 will be the **index of bucket** on which **newEntry object** will be stored.
We will go to **1st** index, it contains **entry with key=21**, we will compare two keys(i.e. **compare 21 with 25** by using **equals method**), as **two keys are different** we check whether entry with key=21's **next is null or not**, **if next is null** we will **put** our **newEntry object** on **next.**

Additionally, for maintaining insertion order-
Update **header.after**, it will start pointing to **newEntry object** (i.e make Entry with key=21's after point to **newEntry object**], and also make **newEntry object's** before point to header (Entry with key=21')

At completion of this step our HashMap will look like this-

Popular Posts
JavaMadeSoE

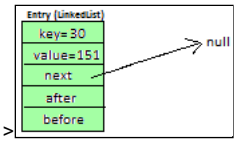
- HashMap Custom i
  How HashMap wor
  and full program
- Collection Quiz in
  choice questions
- THREADS - Top 8
  answers in java for
  experienced(detaile
  programs) Set-1 > (
- Core Java Tutorial
  programs - BEST E
- COLLECTION - T
  and answers in java
  experienced in deta
- CORE JAVA - Top
  important interview
  core java
- HashMap Custom i
  remove Employee
- Display in required
- Why wait(), notify(
  Object class and no
- EXCEPTIONS - T
  and answers in java
  experienced - detail
  diagrams Set-1 > Q



Let's put third key-value pair in HashMap-

Key=30, value=151

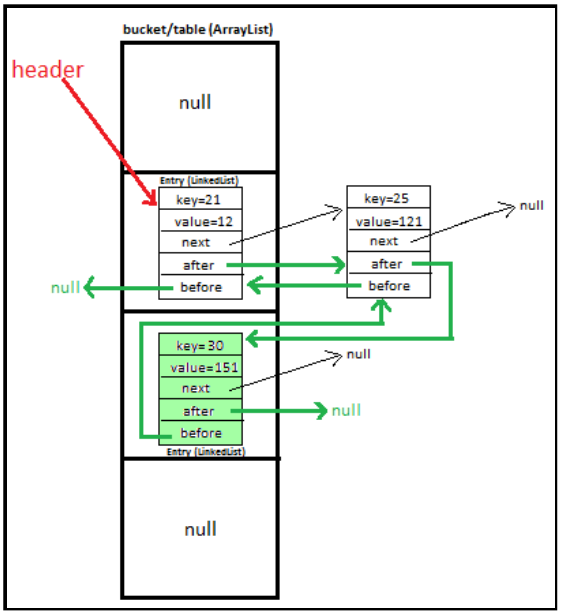
newEntry Object will be formed like this >



We will calculate hash by using our **hash(K key)** method **-** in this case it returns **key/capacity= 30%4= 2**.
So, **2** will be the **index of bucket** on which **newEntry object** will be stored.
We will go to **2nd** index as it is pointing to null we will **put our newEntry object there**.

Additionally, for maintaining insertion order-
Update doubly linked list 's **after and before.**

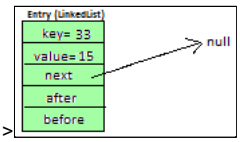
At completion of this step, our HashMap will look like this-



Let's put fourth key-value pair in LinkedHashMap-

Key=33, value=15

Entry Object will be formed like this >



We will calculate hash by using our **hash(K key)** method - in this case it returns
key/capacity= 33%4= 1,
So, 1 will be the **index of bucket** on which **newEntry object** will be stored.

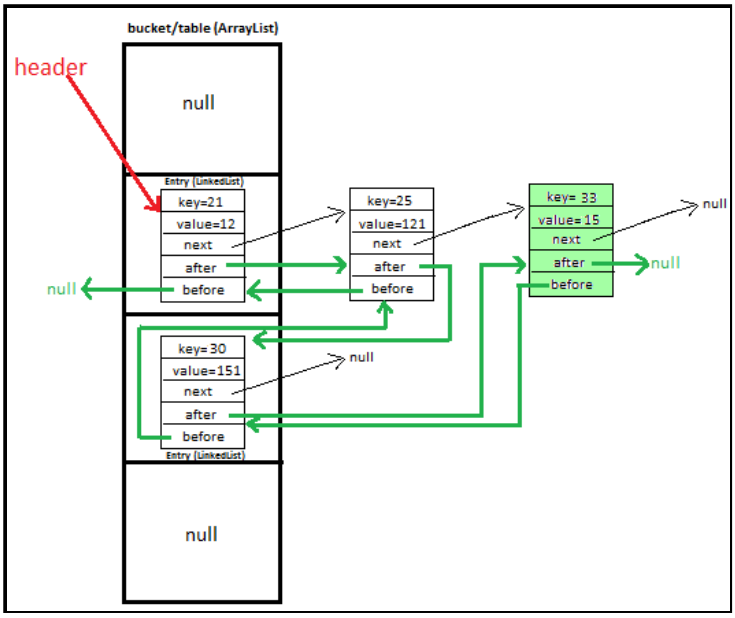
We will go to **1st** index -

>it contains **entry with key=21**, we will **compare** two keys (i.e. **compare 21 with 33** by using **equals method**, as **two keys are different,** proceed to next of **entry with key=21 (**proceed only if **next is not null).**

>now, next contains **entry with key=25**, we will **compare** two keys (i.e. **compare 25 with 33** by using **equals method**, as **two keys are different,** now **next of entry with key=25** is pointing to **null** so we won't proceed **further,** we will **put our newEntry object on next.**

Additionally, for maintaining insertion order-
Update doubly linked list's **after and before** (for maintaining insertion order)

At completion of this step our HashMap will look like this-

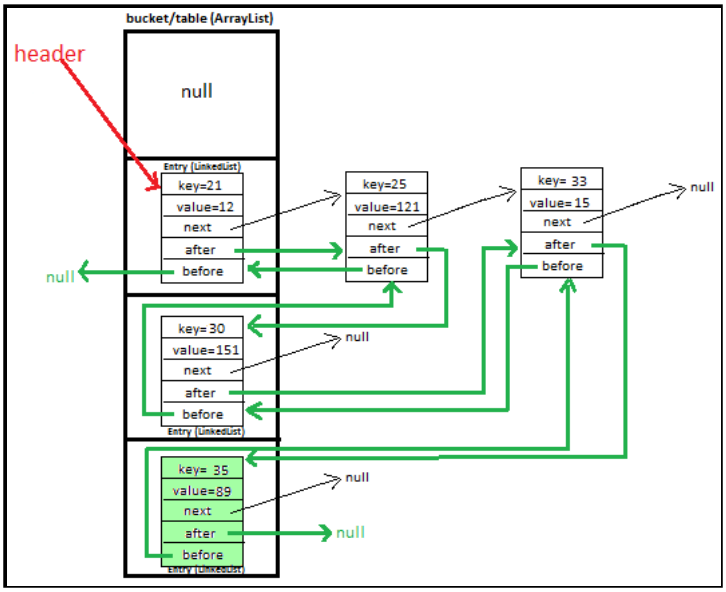


Let's put fifth key-value pair in LinkedHashMap-

Key=35, value=89

Repeat above mentioned steps.

At completion of this step our HashMap will look like this-



Must read: Set Custom implementation.

4) Methods used in custom LinkedHashMap >

public void **put**(K newKey, V data)	-Method allows you put key-value pair in HashMap -If the map already contains a mapping for the key, the old value is replaced. -provide complete functionality how to override equals method. -provide complete functionality how to override hashCode method.
public V **get**(K key)	Method returns value corresponding to key.
public boolean **remove**(K deleteKey)	Method removes key-value pair from **LinkedHashMapCustom**.
public void **display**()	-Method displays all key-value pairs present in **LinkedHashMapCustom**., **-insertion order is guaranteed**.
private int **hash**(K key)	-Method implements hashing functionality, which helps in finding the appropriate bucket location to store our data. -This is very important method, as performance of **LinkedHashMapCustom** is very much dependent on this method's implementation.
private void **maintainOrderAfterInsert**(Entry<K, V> newEntry)	Methods helps in maintaining insertion order after insertion of key-value pair.
private void **maintainOrderAfterDeletion**(Entry<K, V> deleteEntry)	Methods helps in maintaining insertion order after deletion of key-value pair.

For more Refer : LinkedHashMap Custom implementation - put, get, remove Employee object

5) Full Program/SourceCode for implementing custom LinkedHashMap>

```
package com.ankit;

/**
* @author AnkitMittal, JavaMadeSoEasy.com
* Copyright (c), AnkitMittal . All Contents are copyrighted and must not be
* reproduced in any form.
* This class provides custom implementation of LinkedHashMap(without using java api's)-
* which allows us to store data in key-value pair form.
* It maintains insertion order, uses DoublyLinkedList for doing so.
* If key which already exists is added again, its value is overridden but
```

```
 * insertion order does not change,
 * BUT, if key-value pair is removed and value is again added than insertion order
 * changes(which is quite natural behavior).
 * @param <K>
 * @param <V>
 */
class LinkedHashMapCustom<K, V> {

    private Entry<K,V>[] table;   //Array of Entry.
    private int capacity= 4;  //Initial capacity of HashMap
    private Entry<K,V> header; //head of the doubly linked list.
    private Entry<K,V> last; //last of the doubly linked list.

    /*
     * before and after are used for maintaining insertion order.
     */
    static class Entry<K, V> {
        K key;
        V value;
        Entry<K,V> next;
        Entry<K,V> before,after;

        public Entry(K key, V value, Entry<K,V> next){
            this.key = key;
            this.value = value;
            this.next = next;
        }
    }


   @SuppressWarnings("unchecked")
   public LinkedHashMapCustom(){
      table = new Entry[capacity];
   }



   /**
    * Method allows you put key-value pair in LinkedHashMapCustom.
    * If the map already contains a mapping for the key, the old value is replaced.
    * Note: method does not allows you to put null key thought it allows null values.
    * Implementation allows you to put custom objects as a key as well.
    * Key Features: implementation provides you with following features:-
    *     >provide complete functionality how to override equals method.
    *  >provide complete functionality how to override hashCode method.
    * @param newKey
    * @param data
    */
    public void put(K newKey, V data){
      if(newKey==null)
          return;    //does not allow to store null.

      int hash=hash(newKey);

      Entry<K,V> newEntry = new Entry<K,V>(newKey, data, null);
      maintainOrderAfterInsert(newEntry);
       if(table[hash] == null){
        table[hash] = newEntry;
       }else{
          Entry<K,V> previous = null;
          Entry<K,V> current = table[hash];
          while(current != null){ //we have reached last entry of bucket.
          if(current.key.equals(newKey)){
              if(previous==null){  //node has to be insert on first of bucket.
                    newEntry.next=current.next;
                    table[hash]=newEntry;
                    return;
              }
              else{
                  newEntry.next=current.next;
                  previous.next=newEntry;
                  return;
              }
          }
          previous=current;
            current = current.next;
       }
       previous.next = newEntry;
      }
   }
```

```
/**
 * below method helps us in ensuring insertion order of LinkedHashMapCustom
 * after new key-value pair is added.
 */
private void maintainOrderAfterInsert(Entry<K, V> newEntry) {

   if(header==null){
       header=newEntry;
       last=newEntry;
       return;
   }

   if(header.key.equals(newEntry.key)){
       deleteFirst();
       insertFirst(newEntry);
       return;
   }

   if(last.key.equals(newEntry.key)){
       deleteLast();
       insertLast(newEntry);
       return;
   }

   Entry<K, V> beforeDeleteEntry=    deleteSpecificEntry(newEntry);
   if(beforeDeleteEntry==null){
       insertLast(newEntry);
   }
   else{
       insertAfter(beforeDeleteEntry,newEntry);
   }


}

/**
 * below method helps us in ensuring insertion order of LinkedHashMapCustom,
 * after deletion of key-value pair.
 */
private void maintainOrderAfterDeletion(Entry<K, V> deleteEntry) {

   if(header.key.equals(deleteEntry.key)){
       deleteFirst();
       return;
   }

   if(last.key.equals(deleteEntry.key)){
       deleteLast();
       return;
   }

   deleteSpecificEntry(deleteEntry);

}

/**
 * returns entry after which new entry must be added.
 */
private void insertAfter(Entry<K, V> beforeDeleteEntry, Entry<K, V> newEntry) {
   Entry<K, V> current=header;
       while(current!=beforeDeleteEntry){
              current=current.after;  //move to next node.
       }

       newEntry.after=beforeDeleteEntry.after;
       beforeDeleteEntry.after.before=newEntry;
       newEntry.before=beforeDeleteEntry;
       beforeDeleteEntry.after=newEntry;

}


/**
 * deletes entry from first.
 */
private void deleteFirst(){

   if(header==last){ //only one entry found.
              header=last=null;
              return;
       }
       header=header.after;
```

```
        header.before=null;

    }

    /**
     * inserts entry at first.
     */
    private void insertFirst(Entry<K, V> newEntry){

        if(header==null){ //no entry found
            header=newEntry;
            last=newEntry;
            return;
        }

        newEntry.after=header;
        header.before=newEntry;
        header=newEntry;

    }

    /**
     * inserts entry at last.
     */
    private void insertLast(Entry<K, V> newEntry){

        if(header==null){
            header=newEntry;
            last=newEntry;
            return;
        }
        last.after=newEntry;
        newEntry.before=last;
        last=newEntry;

    }

    /**
     * deletes entry from last.
     */
    private void deleteLast(){

        if(header==last){
            header=last=null;
            return;
        }

        last=last.before;
        last.after=null;
    }


    /**
     * deletes specific entry and returns before entry.
     */
    private Entry<K, V> deleteSpecificEntry(Entry<K, V> newEntry){

        Entry<K, V> current=header;
        while(!current.key.equals(newEntry.key)){
            if(current.after==null){   //entry not found
                return null;
            }
            current=current.after;  //move to next node.
        }

        Entry<K, V> beforeDeleteEntry=current.before;
        current.before.after=current.after;
        current.after.before=current.before;  //entry deleted
        return beforeDeleteEntry;
    }


    /**
     * Method returns value corresponding to key.
     * @param key
     */
     public V get(K key){
        int hash = hash(key);
        if(table[hash] == null){
         return null;
        }else{
         Entry<K,V> temp = table[hash];
```

```
        while(temp!= null){
            if(temp.key.equals(key))
                return temp.value;
            temp = temp.next; //return value corresponding to key.
        }
        return null;   //returns null if key is not found.
       }
    }


    /**
     * Method removes key-value pair from HashMapCustom.
     * @param key
     */
     public boolean remove(K deleteKey){

       int hash=hash(deleteKey);

      if(table[hash] == null){
            return false;
      }else{
        Entry<K,V> previous = null;
        Entry<K,V> current = table[hash];

        while(current != null){ //we have reached last entry node of bucket.
           if(current.key.equals(deleteKey)){
               maintainOrderAfterDeletion(current);
               if(previous==null){  //delete first entry node.
                     table[hash]=table[hash].next;
                     return true;
               }
               else{
                     previous.next=current.next;
                   return true;
               }
           }
           previous=current;
             current = current.next;
         }
        return false;
      }

    }


    /**
     * Method displays all key-value pairs present in HashMapCustom.,
     * insertion order is not guaranteed, for maintaining insertion order
     * refer linkedHashMapCustom.
     * @param key
     */
    public void display(){

       Entry<K, V> currentEntry=header;
       while(currentEntry!=null){
           System.out.print("{"+currentEntry.key+"="+currentEntry.value+"}" +" ");
           currentEntry=currentEntry.after;
       }

    }
    /**
     * Method implements hashing functionality, which helps in finding the appropriate
     * bucket location to store our data.
     * This is very important method, as performance of HashMapCustom is very much
     * dependent on this method's implementation.
     * @param key
     */
    private int hash(K key){
        return Math.abs(key.hashCode()) % capacity;
    }

}


/** Copyright (c), AnkitMittal  JavaMadeSoEasy.com */
/**
 * Main class- to test HashMap functionality.
 */
public class LinkedHashMapCustomApp {

    public static void main(String[] args) {
```

```
            LinkedHashMapCustom<Integer, Integer> linkedHashMapCustom = new
LinkedHashMapCustom<Integer, Integer>();

            linkedHashMapCustom.put(21, 12);
            linkedHashMapCustom.put(25, 121);
            linkedHashMapCustom.put(30, 151);
            linkedHashMapCustom.put(33, 15);
            linkedHashMapCustom.put(35, 89);

            System.out.println("Display values corresponding to keys>");
            System.out.println("value corresponding to key 21="
                        + linkedHashMapCustom.get(21));
            System.out.println("value corresponding to key 51="
                        + linkedHashMapCustom.get(51));

            System.out.print("Displaying : ");
            linkedHashMapCustom.display();

            System.out.println("\n\nvalue corresponding to key 21 removed: "
                        + linkedHashMapCustom.remove(21));
            System.out.println("value corresponding to key 22 removed: "
                        + linkedHashMapCustom.remove(22));

            System.out.print("Displaying : ");
            linkedHashMapCustom.display();

    }
}

/*Output

Display values corresponding to keys>
value corresponding to key 21=12
value corresponding to key 51=null
Displaying : {21=12} {25=121} {30=151} {33=15} {35=89}

value corresponding to key 21 removed: true
value corresponding to key 22 removed: false
Displaying : {25=121} {30=151} {33=15} {35=89}

*/
```

6) Complexity calculation of put and get methods in LinkedHashMap >

Complexity offered by put and get methods of LinkedHashMap is same as that of HashMap. **Additionally, for maintaining insertion order during put method -** doubly linked list's **header**, **after and before** are also updated (whichever is needed to be updated).

*6.1) **put** method - **worst Case** complexity >*

O(n) + for maintaining insertion order during put method - doubly linked list's **header**, **after and before** are also updated (whichever is needed to be updated).

*6.2) **put** method - **best Case** complexity >*

O(1). for maintaining insertion order during put method - doubly linked list's **header**, **after and before** are also updated (whichever is needed to be updated).

*6.3) **get** method - **worst Case** complexity >*

O(n)

*6.4) **get** method - **best Case** complexity >*

O(1)

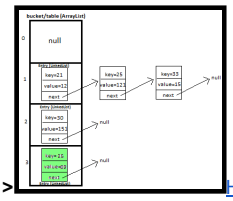
Summary of article >

In this tutorial we learned how to create and implement own/custom LinkedHashMap in java with full program, diagram and examples to insert and retrieve key-value pairs in it.

Having any doubt? or you you liked the tutorial! Please comment in below section.

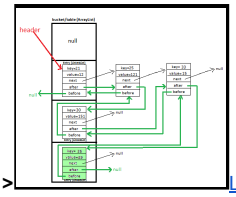
*Please express your love by liking **JavaMadeSoEasy.com** (**JMSE**) on **facebook**, following on **google+** or Twitter.*

RELATED LINKS>



>HashMap Custom implementation

>HashMap Custom implementation - put, get, remove Employee object



>LinkedHashMap Custom implementation

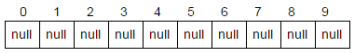
>LinkedHashMap Custom implementation - put, get, remove Employee object

>Set Custom implementation

>Set Custom implementation - add, contains, remove Employee object

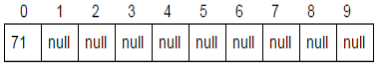
>LinkedHashSet Custom implementation

>LinkedHashSet Custom implementation - add, contains, remove Employee object



>ArrayList custom implementation

>ArrayList custom implementation - add, get, remove Employee object



>Vector custom implementation

Labels: Collections implementation Core Java Custom implementation of Data Structures Custom implementation of Map Hashing How map works internally Map Overriding equals and hashCode Set Single Linked List

Must read for you :

Newer Post Home Older Post