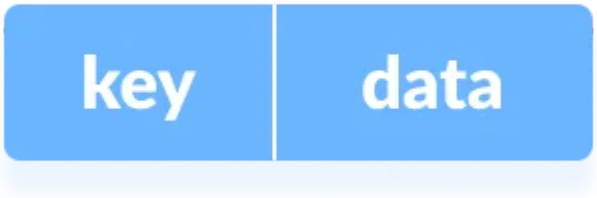
Hash Table

The Hash table data structure stores elements in key-value pairs where

- Key- unique integer that is used for indexing the values
- Value - data that are associated with keys.



Hashing (Hash Function)

In a hash table, a new index is processed using the keys. And, the element corresponding to that key is stored in the index. This process is called hashing.

Hash Collision

When the hash function generates the same index for multiple keys, there will be a conflict (what value to be stored in that index). This is called a hash collision.

We can resolve the hash collision using one of the following techniques.

- Collision resolution by chaining
- Open Addressing: Linear/Quadratic Probing and Double Hashing

Applications of Hash Table

- constant time lookup and insertion is required
- cryptographic applications
- indexing data is required

Java HashMap

The HashMap class of the Java collections framework provides the functionality of the hash table data structure.

It stores elements in key/value pairs. Here, keys are unique identifiers used to associate each value on a map.

Create a HashMap

In order to create a hash map, we must import the java.util.HashMap package first. Once we import the package, here is how we can create hashmaps in Java.

```
// hashMap creation
HashMap<K, V> numbers = new HashMap<>();
```

In the above code, we have created a hashmap named numbers. Here, K represents the key type and V represents the type of values. For example,

```
HashMap<String, Integer> numbers = new HashMap<>();
```

Here, the type of keys is String and the type of values is Integer.

Example 1: Create HashMap in Java

```
import java.util.HashMap;

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

    // create a hashmap
    HashMap<String, Integer> languages = new HashMap<>();

    // add elements to hashmap
    languages.put("Java", 8);
    languages.put("JavaScript", 1);
    languages.put("Python", 3);
    System.out.println("HashMap: " + languages);
  }
}
```

```
Output
```

```
HashMap: {Java=8, JavaScript=1, Python=3}
```

In the above example, we have created a HashMap named languages.

Here, we have used the put() method to add elements to the hashmap. We will learn more about the put() method later in this tutorial.

Basic Operations on Java HashMap

The HashMap class provides various methods to perform different operations on hashmaps. We will look at some commonly used arraylist operations in this tutorial:

- Add elements
- Access elements
- Change elements
- Remove elements

1. Add elements to a HashMap

To add a single element to the hashmap, we use the put() method of the HashMap class. For example,

```
import java.util.HashMap;

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

    // create a hashmap
    HashMap<String, Integer> numbers = new HashMap<>();

    System.out.println("Initial HashMap: " + numbers);
    // put() method to add elements
    numbers.put("One", 1);
    numbers.put("Two", 2);
    numbers.put("Three", 3);
    System.out.println("HashMap after put(): " + numbers);
  }
}
```

Output:

```
Initial HashMap: {}
HashMap after put(): {One=1, Two=2, Three=3}
```

Output :

```
Initial HashMap: {}
HashMap after put(): {One=1, Two=2, Three=3}
```

In the above example, we have created a HashMap named numbers. Here, we have used the put() method to add elements to numbers.

Notice the statement,

```
numbers.put("One", 1);
```

Here, we are passing the String value One as the key and Integer value 1 as the value to the put() method.

2. Access HashMap Elements

We can use the get() method to access the value from the hashmap. For example,

```
import java.util.HashMap;

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

    HashMap<Integer, String> languages = new HashMap<>();
    languages.put(1, "Java");
    languages.put(2, "Python");
    languages.put(3, "JavaScript");
    System.out.println("HashMap: " + languages);

    // get() method to get value
    String value = languages.get(1);
    System.out.println("Value at index 1: " + value);
  }
}
```

Output

```
HashMap: {1=Java, 2=Python, 3=JavaScript}
Value at index 1: Java
```

In the above example, notice the expression,

```
languages.get(1);
```

Here, the get() method takes the key as its argument and returns the corresponding value associated with the key.

We can also access the keys, values, and key/value pairs of the hashmap as set views using keySet(), values(), and entrySet() methods respectively. For example,

```
import java.util.HashMap;

class Main {
  public static void main(String[] args) {
    HashMap<Integer, String> languages = new HashMap<>();

    languages.put(1, "Java");
```

```
    languages.put(2, "Python");
    languages.put(3, "JavaScript");
    System.out.println("HashMap: " + languages);

    // return set view of keys
    // using keySet()
    System.out.println("Keys: " + languages.keySet());

    // return set view of values
    // using values()
    System.out.println("Values: " + languages.values());

    // return set view of key/value pairs
    // using entrySet()
    System.out.println("Key/Value mappings: " + languages.entrySet());
  }
}
```

Output

```
HashMap: {1=Java, 2=Python, 3=JavaScript}
Keys: [1, 2, 3]
Values: [Java, Python, JavaScript]
Key/Value mappings: [1=Java, 2=Python, 3=JavaScript]
```

In the above example, we have created a hashmap named languages. Here, we are accessing the keys, values, and key/value mappings from the hashmap.

3. Change HashMap Value

We can use the replace() method to change the value associated with a key in a hashmap. For example,

```
import java.util.HashMap;

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

    HashMap<Integer, String> languages = new HashMap<>();
    languages.put(1, "Java");
    languages.put(2, "Python");
    languages.put(3, "JavaScript");
    System.out.println("Original HashMap: " + languages);

    // change element with key 2
    languages.replace(2, "C++");
    System.out.println("HashMap using replace(): " + languages);
  }
}
```

Output

```
Original HashMap: {1=Java, 2=Python, 3=JavaScript}
HashMap using replace(): {1=Java, 2=C++, 3=JavaScript}
```

In the above example, we have created a hashmap named languages. Notice the expression,

```
languages.replace(2, "C++");
```

Here, we are changing the value referred to by key 2 with the new value C++.

The HashMap class also provides some variations of the replace() method. To learn more, visit

4. Remove HashMap Elements

To remove elements from a hashmap, we can use the remove() method. For example,

```
import java.util.HashMap;

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

    HashMap<Integer, String> languages = new HashMap<>();
    languages.put(1, "Java");
    languages.put(2, "Python");
    languages.put(3, "JavaScript");
    System.out.println("HashMap: " + languages);

    // remove element associated with key 2
    String value = languages.remove(2);
    System.out.println("Removed value: " + value);

    System.out.println("Updated HashMap: " + languages);
  }
}
```

Output

```
HashMap: {1=Java, 2=Python, 3=JavaScript}
Removed value: Python
Updated HashMap: {1=Java, 3=JavaScript}
```

Here, the remove() method takes the key as its parameter. It then returns the value associated with the key and removes the entry.

We can also remove the entry only under certain conditions. For example,

```
remove(2, "C++");
```

Here, the remove() method only removes the entry if the key 2 is associated with the value C++. Since 2 is not associated with C++, it doesn't remove the entry.

Other Methods of HashMap

Method Description

- clear() removes all mappings from the HashMap
- compute() computes a new value for the specified key
- computeIfAbsent() computes value if a mapping for the key is not present
- computeIfPresent() computes a value for mapping if the key is present
- merge() merges the specified mapping to the HashMap
- clone() makes the copy of the HashMap
- containsKey() checks if the specified key is present in Hashmap
- containsValue() checks if Hashmap contains the specified value
- size() returns the number of items in HashMap
- isEmpty() checks if the Hashmap is empty

Iterate through a HashMap

To iterate through each entry of the hashmap, we can use Java for-each loop. We can iterate through keys only, vales only, and key/value mapping. For example,

```
import java.util.HashMap;
import java.util.Map.Entry;

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

    // create a HashMap
    HashMap<Integer, String> languages = new HashMap<>();
    languages.put(1, "Java");
    languages.put(2, "Python");
    languages.put(3, "JavaScript");
    System.out.println("HashMap: " + languages);

    // iterate through keys only
    System.out.print("Keys: ");
    for (Integer key : languages.keySet()) {
      System.out.print(key);
      System.out.print(", ");
    }

    // iterate through values only
    System.out.print("\nValues: ");
```

```
    for (String value : languages.values()) {
      System.out.print(value);
      System.out.print(", ");
    }

    // iterate through key/value entries
    System.out.print("\nEntries: ");
    for (Entry<Integer, String> entry : languages.entrySet()) {
      System.out.print(entry);
      System.out.print(", ");
    }
  }
}
```

Output

```
HashMap: {1=Java, 2=Python, 3=JavaScript}
Keys: 1, 2, 3,
Values: Java, Python, JavaScript,
Entries: 1=Java, 2=Python, 3=JavaScript,
```

Note that we have used the Map.Entry in the above example. It is the nested class of the Map interface that returns a view (elements) of the map.

We first need to import the java.util.Map.Entry package in order to use this class.

This nested class returns a view (elements) of the map.