

Hashtable :-

It is use in Spell checker means checking spelling) and use to make Dictionaries, Compiled, Code editor.

Every language use hashtable by different name:-

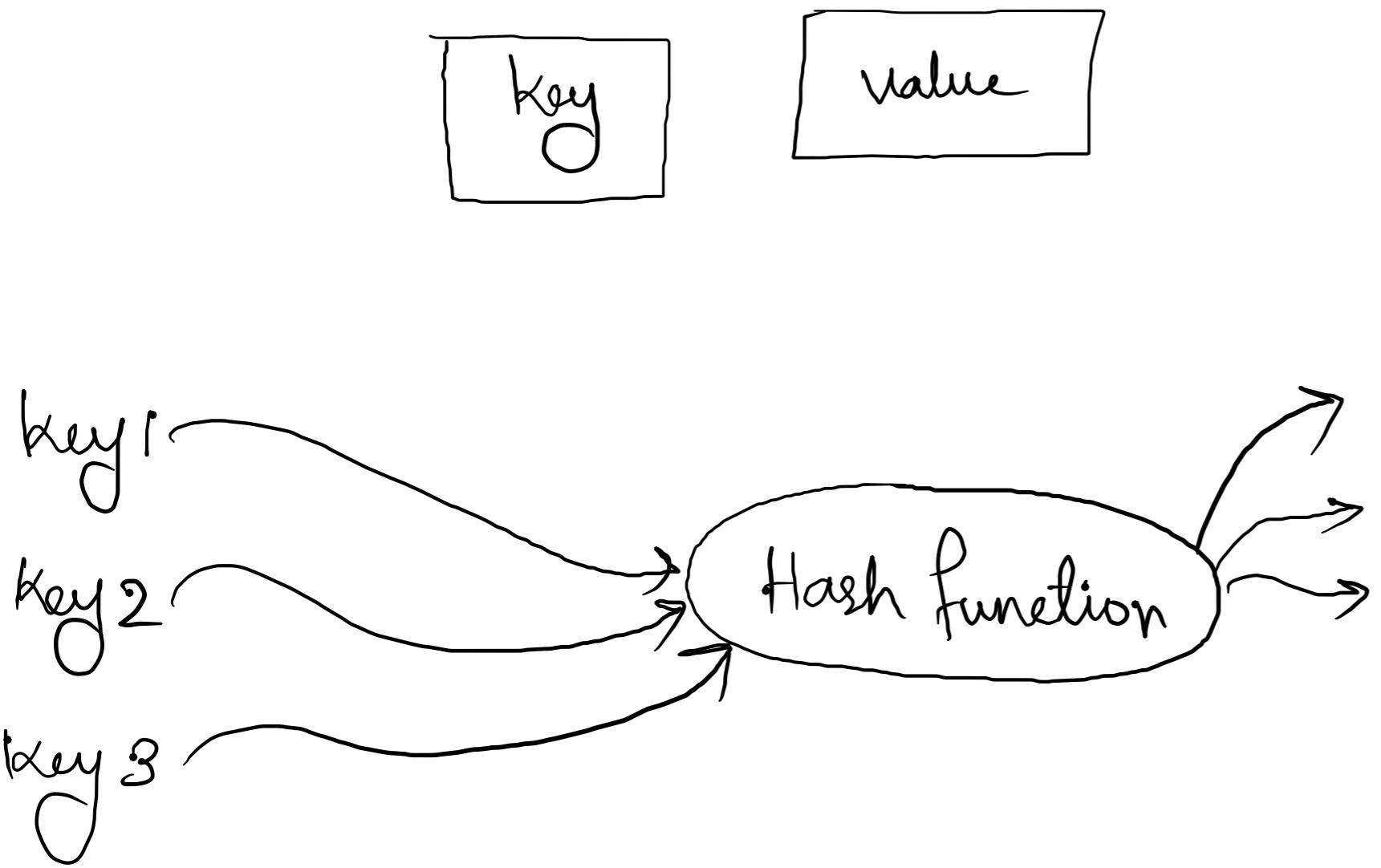
Java → Hashmap

JavaScript → Object

Python/C# → Dictionary

Hashtable associated with two items one is key and another one is value
key is a data and value is that data's unique index value.

Structure of Hashtable :-



Hashtable is (deterministic)

Hashtable use array data structure internally

For same keyvalue hashtable gives same value at all time

Operations in
Hashtable:-

Insert	$O(1)$
Lookup	$O(1)$
Delete	$O(1)$

Hashset :-

Like Hashmap and Hashtable Hashset is a similar data structure in Java and many other language. In case of hashmap we use map interface that contained two arguments that are key and value but in case of set only contained key argument. Like map set do not allowed duplicates values set also dont allowed duplicates values.

Set is a interface and HashSet is a implementation.

Hash function:-

It is a function that return the index value of a key in hashmap by using that index we access the value this process is called hashing.

Collision :-

Collision means crash or accident. When two key generate same hash value then collision occurs.

To avoid collision by two ways one is chaining and another one is open addressing.

$\text{key 1} = \text{key 2} \rightarrow$ collision occurs in mapping value

Chaining :-

In chaining process we use a linked list in same hash value of two different keys. Values are added in last node of the linked list. The operation is shown in below:-

$$k_1 = 11$$

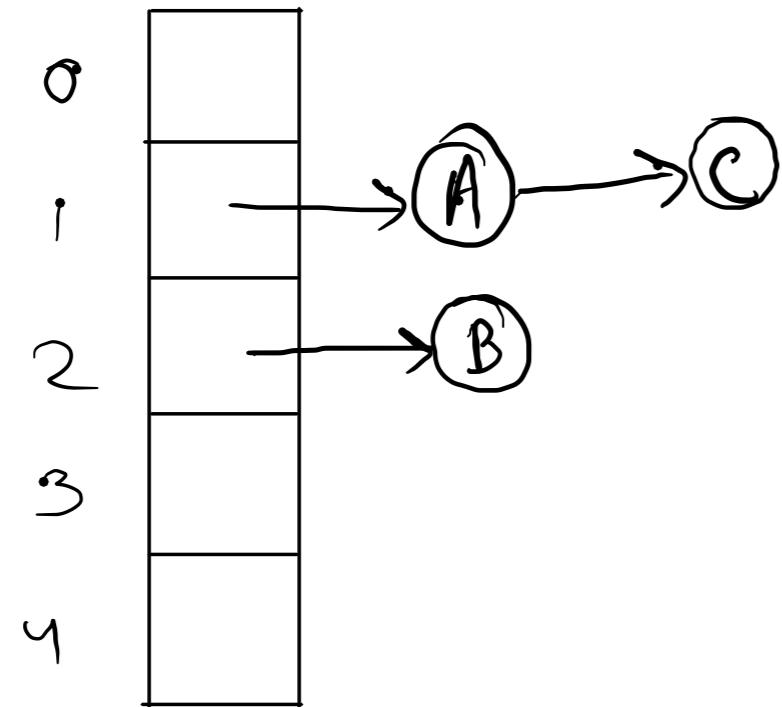
$$v = A$$

$$k_2 = 2$$

$$v = B$$

$$k_3 = 6$$

$$v = C$$



index of the array is find by remainder of keyvalue by length of the array

$$\text{index} = \text{key \% array length}$$

$$\text{index } k_1 \text{ is } (11 \% 5) = 1$$

Instead of storing value in index 1.

index is pointing a linked list. If another key value have same index then add in last in the linked list

Open addressing :-

In this process have several way to avoid collision. Linear probing is one of that type. In linear probing if the key value is same then the algorithm find another empty address for storing the value pair in the hash table.

In this process one condition appear when next address is not empty So searching next empty address up to the size of hashtable. This non empty set of address is called **Cluster**.



this thing is called cluster.

The equation of linear probing is

$$\text{index} = \text{Hash(key)} + i$$

Quadratic probing:-

By using this algorithm next index is find next address by increment in quadratic order means the equation look like

$$\text{index} = \text{Hash(key)} + i^2$$

Implementation of this algorithm is practically not possible because it run into infinite loop. For that reason Double Hashing algorithm is use.

Double Hashing :-

Formula for finding the index is

$$\text{Hash 1(key)} = \text{key \% table size}$$

$$\text{Hash 2(key)} = \text{prime} - (\text{key \% prime})$$

$$\text{index} = (\text{Hash 1(key)} + i * \text{Hash 2(key)}) \% \text{table size}$$

prime is the prime number = (size of hash table) - 2