Linear probing technique explanation with example

Data Structure

- The simplest approach to resolve a collision is linear probing. In this technique, if a value is already stored at a location generated by h(k), it means collision occurred then we do a sequential search to find the empty location.
- Here the idea is to place a value in the next available position. Because in this approach searches are performed sequentially so it’s known as linear probing.
- Here array or hash table is considered circular because when the last slot reached an empty location not found then the search proceeds to the first location of the array.

Clustering is a major drawback of linear probing.

Below is a hash function that calculates the next location. If the location is empty then store value otherwise find the next location.

Following hash function is used to resolve the collision in:

h(k, i) = [h(k) + i] mod m

Where

m = size of the hash table,

h(k) = (k mod m),

i = the probe number that varies from **0 to m−1**.

Therefore, for a given key k, the first location is generated by **[h(k) + 0]** mod m, the first time i=0.

If the location is free, the value is stored at this location. If value successfully **stores** then probe count is 1 means location is founded on the first go.

If location is not free then second probe generates the address of the location given by **[h(k) + 1]mod m**.

Similarly, if the generated location is occupied, then subsequent probes generate the address as **[h(k) + 2]mod m**, **[h(k) + 3]mod m**, **[h(k) + 4]mod m**, **[h(k) + 5]mod m**, and so on, until a free location is found.

Probes is a count to find the free location for each value to store in the hash table.

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Linear Probing Example

Insert the following sequence of keys in the hash table

{9, 7, 11, 13, 12, 8}

Use linear probing technique for collision resolution

h(k, i) = [h(k) + i] mod m

h(k) = 2k + 5

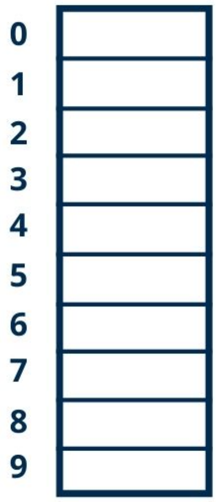
m=10

Solution:

Step 01:

First Draw an empty hash table of Size 10.

The possible range of hash values will be [0, 9].



Step 02:

Insert the given keys one by one in the hash table.

First Key to be inserted in the hash table = 9.

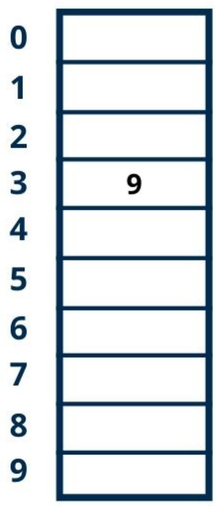
h(k) = 2k + 5

h(9) = 2*9 + 5 = 23

h(k, i) = [h(k) + i] mod m

h(9, 0) = [23 + 0] mod 10 = 3

So, key 9 will be inserted at index 3 of the hash table



Step 03:

Next Key to be inserted in the hash table = 7.

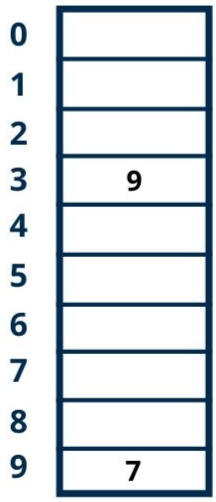
h(k) = 2k + 5

h(7) = 2*7 + 5 = 19

h(k, i) = [h(k) + i] mod m

h(7, 0) = [19 + 0] mod 10 = 9

So, key 7 will be inserted at index 9 of the hash table



Step 04:

Next Key to be inserted in the hash table = 11.

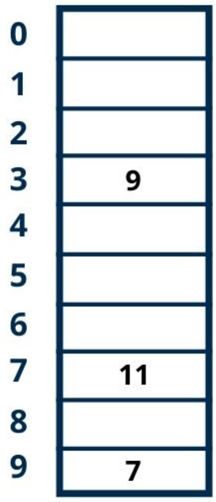
h(k) = 2k + 5

h(11) = 2*11 + 5 = 27

h(k, i) = [h(k) + i] mod m

h(11, 0) = [27 + 0] mod 10 = 7

So, key 11 will be inserted at index 7 of the hash table



Step 05:

Next Key to be inserted in the hash table = 13.

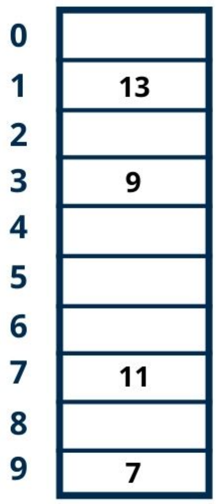
h(k) = 2k + 5

h(13) = 2*13 + 5 = 31

h(k, i) = [h(k) + i] mod m

h(13, 0) = [31 + 0] mod 10 = 1

So, key 13 will be inserted at index 1 of the hash table



Step 06:

Next key to be inserted in the hash table = 12.

h(k) = 2k + 5

h(12) = 2*12 + 5 = 27

h(k, i) = [h(k) + i] mod m

h(12, 0) = [27 + 0] mod 10 = 7

Here Collision has occurred because **index 7** is already filled.

Now we will increase **i by 1**.

h(12, 1) = [27 + 1] mod 10 = 8

So, key 12 will be inserted at index 8 of the hash table.

0	
1	13
2	
3	9
4	
5	
6	
7	11
8	12
9	7

Step 07:

Next key to be inserted in the hash table = 8.

h(k) = 2k + 5

h(8) = 2*8 + 5 = 21

h(k, i) = [h(k) + i] mod m

h(8, 0) = [21 + 0] mod 10 = 1

Here Collision has occurred because **index 1** is already filled.

Now we will increase i by 1 now i become 1.

h(k) = 2k + 5

h(8) = 2*8 + 5 = 21

h(k, i) = [h(k) + i] mod m

h(8, 0) = [21 + 1] mod 10 = 2

index 2 is vacant so 8 will be inserted at index 2.

0	
1	13
2	8
3	9
4	
5	
6	
7	11
8	12
9	7

This is how the linear probing collision resolution technique works.

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