#ASLI ENGINEERING

Linear Probing in Hash Tables

SWIPE

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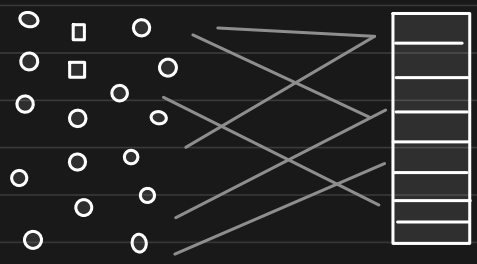
Conflict Resolution with Linear Probing

Conflicts are inevitable!



With Open Addressing, we use a probing function to find the slot where the key should be placed

One such method is linear Probing

Probing Function

key → k, attempt → i

Probing Function is defined as $p(k, i) = j$ ← index

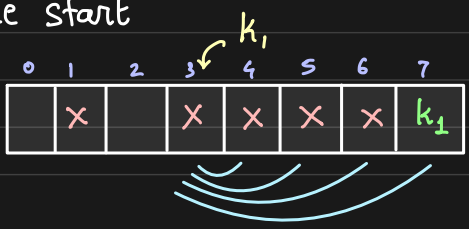
we use the probing function to find the first available slot

the same function is used during lookups

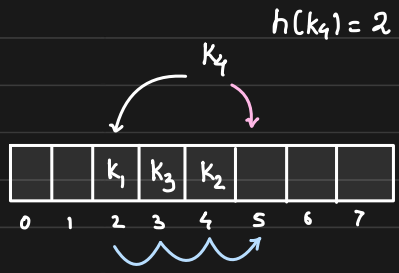
Linear Probing

$p(k,i) = (h(k) + i) \% m$

We search linearly from the hashed index until the end of the table and then wrap from the start



Hash Table Operations: Adding a key

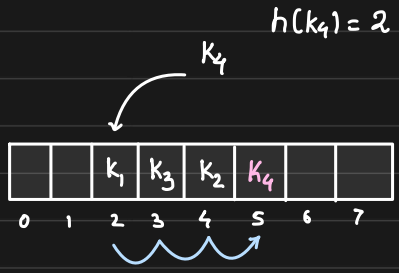


We invoke the probing function to find the slot in the hash table.

if that slot is occupied, we traverse the hash table and find first available slot.

It is like a linear search from the slot

Hash Table Operations: Key lookup



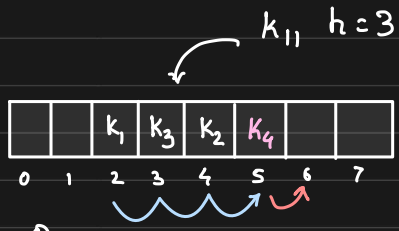
We invoke the probing function to get the slot.

if key present at that index, we return

if not, we traverse to the right and try to find the key.

if we encounter the key, we return

if we reach the end, we start from index 0

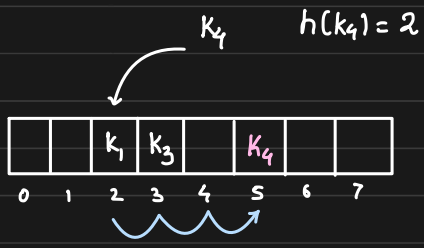


we stop iteration as soon as we encounter an empty slot.

Worst case: Linear lookup across entire table

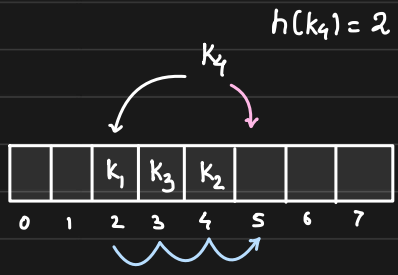
Hash Table Operations : Deleting a key

Say, DEL K_2 then GET K_4



Delete is a soft delete so that we could continue reaching to the keys slotted further

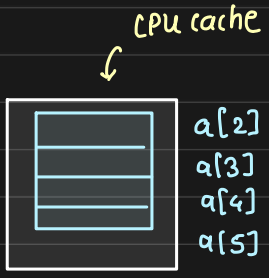
Linear probing is simple and fast



Simple: we literally linearly iterate to find the next slot

Fast: isn't linear traversing slow?

Not really! because we leverage *localized access*.



When we access a memory location, the page is cached on CPU and the page contains neighbouring elements.

So, subsequent accesses are served from CPU cache

Linear probing gives a constant time performance

Worst case is still painful ↳ avg case = few collisions

Challenges with Linear Probing

1. A bad hash function would make linear probing a full hash table search and hence inefficient

Hence, using a good hash function is very important

MurmurHash is preferred

2. Linear probing suffers from clustered collisions

if k_1 hashes to 2
k_2 hashes to 2
k_3 hashes to 3

Because k_1 and k_2 collided,
k_3's primary slot got occupied!

and this would also impact keys hashed to subsequent locations

Hence a good uniform hash function is essential for linear probing to be efficient.