Ised for fost data retrieval Pependo on the Offment in Doonings / insertions / deletions O(1) collisions

lock table ~ hash wap - maps keys to values

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con under (lock for a very) Constant tense complexity O(1)

2. Key Concepts

- Hash Function: A function that takes an input (key) and returns an integer (hash code). This hash
 code is typically converted into an array index where the value is stored.
- Collision Two different keys may generate the same hash code, leading to a conflict. Hash tables must handle collisions to maintain efficiency.
- Buckets: The array used by the hash table to store key-value pairs. Each bucket can hold multiple items in case of collisions.

B3 V1 V2 B3 V1 V2 B1 V1 V2

3. Collision Handling Techniques

- Separate Chaining: Each bucket is a linked list (or another data structure). When collisions occur, multiple elements are stored in the same bucket by chaining them together.
- Open Addressing: Instead of using linked lists, open addressing probes (searches) for the next available slot when a collision occurs.
 - Linear Probing: If a collision occurs, the algorithm checks the next slot (linearly) until an empty slot is found.
 - Quadratic Probing: Instead of linearly searching for the next slot, this method uses a
 quadratic function to find the next available position.
 - Double Hashing: Uses a second hash function to determine the step size for probing.

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Them, add the value to the lined list at the poster -> Use good losh pretrons to ensure that the hope are well deturbated and reduce the number of colisions The 'll love collisions !!! - Large amount of deta - Threed seefe - Not worted - Emplemented as unardered - may <? Coche information for fost retrionel LOAD FACTOR (LF) No of overlable buenets

High hf -> More linely to lare collisions
(* When cross a troshold -> Resize 46 hosh table

6. Time Complexity

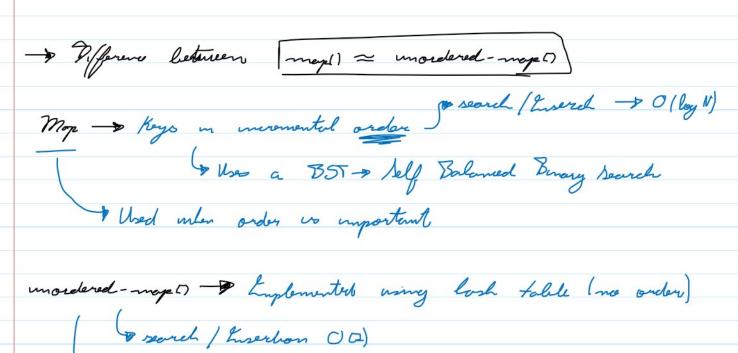
- Insert: O(1) on average, O(n) in the worst case (when many collisions occur).
- Lookup: O(1) on average, O(n) in the worst case.
- Delete: O(1) on average, O(n) in the worst case.

5. Hash Table Operations in C++

In C++, hash tables can be implemented using std::unordered_map, which provides the basic functionality of a hash table with separate chaining for collision resolution.

Example:

```
Copy code
срр
#include <iostream>
#include <unordered_map>
                                      ony the key
int main() {
   std::unordered_map<std::string, int> hashTable;
  >// Insert key-value pairs
  hashTable["apple"] = 1;
hashTable["banana"] = 2;
hashTable["orange"] = 3;
   // Access elements
   std::cout << "apple: " << hashTable["apple"] << std::endl;
                                                      -> Supper important
   // Check if a key exists
   if (hashTable.find("banana") != hashTable.end()) {
                                                      before my ours point
       std::cout << "banana exists" << std::endl;</pre>
   // Delete a key
   hashTable.erase("orange");
                       Lo Just reed to poor the Key
   return 0;
}
```



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6 Unformly - Deskulute the values evenly 9 Define this bush functions as a private method For't went to expos it so publice