



ECAP770

ADVANCE DATA STRUCTURES

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Learning Outcomes



After this lecture, you will be able to

- understand rehashing,
- load factor.

Rehashing

- It is process of re-calculating the hash code of already stored entries.
- The Hash table provides Constant time complexity of insertion and searching, provided the hash function is able to distribute the input load evenly.
- In case of Collision, the time complexity can go up to $O(N)$ in the worst case

Rehashing

- Rehashing of a hash map is done when the number of elements in the map reaches the maximum threshold value.

Rehashing

- When load factor increases to more than its predefined value, complexity increases.
- To overcome this problem, size of array is increased, and all the values are hashed again and stored in new double size array to maintain a low **load factor** and **complexity**.

Load factor

- Load factor is number of element (n) divide by number of bucket (m).
- Load factor (λ) = n/m
- $\lambda < 1$ i.e. $m > n$
- if $\lambda < 1$ then no need to apply rehashing
- if $\lambda > 1$ then we need to increase number of buckets
- Increase in bucket size is known as rehashing.

Rehashing steps

- Increase number of buckets.
- Modify hash function
 - Hash function before rehashing : $x \bmod m$
after rehashing $x \bmod m'$
- apply changed hash function to existing elements.

m' calculation

- $m' =$ closet prime number of $2m$
- Example:
- $m=3$ $m' = 2(3) = 6$
- Closet prime number = 5 or 7.

Example: Rehashing

$$h(x) = x \bmod 3$$

Elements: 12, 13, 14



$$n = 3$$

$$m = 3$$

$$\text{Load factor } (\lambda) = 1$$

λ is not less than 1 so need to perform rehashing

Example: Rehashing

- $m' = 2n$
- $m' = 2 \times 3 \Rightarrow 6$
- Nearest prime numbers are 5 and 7
- $m' = 7$
- $x \bmod m' \Rightarrow x \bmod 7$

Example: Rehashing

$$h(x) = x \bmod 7$$

Elements: 12, 13, 14

$$12 \bmod 3 = 0$$

$$13 \bmod 3 = 1$$

$$14 \bmod 3 = 2$$

$$n = 3$$

$$m' = 7$$

$$\text{Load factor } (\lambda) = 0.42$$

Load factor (λ) is less than 1

Index

0

1

2

3

4

5

6

14
12
13

Hash table



That's all for now...