Design And Analysis Of Algorithms

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HANDSON - 12

HW - 17

a) aggregate method

→ In the aggregate method, first we have to calculate the total cost of performing a sequence of operations and then divide by the number of operations to get amoritized cost per operation.

1. Cost Analysis

(i) we denote 'n' as the no of elements inserted and 'm' as the no of resizing operations.

(ii) Let C_i be the cost of the i^{th} insertion operation.

(iii) When inserting the i^{th} element, if a resize operation is not needed then the cost is $O(1)$. If a resize happens cost is $O(i)$ as it involves copying the existing elements to the new table of size 2^K (K is the number of resizes performed)

2. Total cost

$$\sum_{i=1 \text{ to } n} c_i = O(n) + O(2) + O(4) + \cdots + O(2^m)$$

$$= O(n + 2 + 4 + \cdots + 2^m)$$

$$= O(n + 2^{(m+1)} - 1)$$

$$= 2^{(m+1)} - 1$$

3. Amoritized cost per operation:

→ Since the number of resizes is atmost $\log_2(n)$, the amoritized cost per insertion is $O(1)$.

(b) Accounting method:-

Pseudocode -

```
for i=1 to n
    if table is full
        new table = create new table
        with size 2 current size &
        then copy elements from old
        table to new table.
        table = new table
    insert element i into table
    initial charge = 0
for i = 1 to n:
    charges += 2
    if table doubled in size from
        m to 2m
```

credits += m

total charge = 2 * n = O(n)

total credits = m + 2m + ---- + n/2 + m = O(n)

Amoritized cost per Insertion = Total/n

= O(n/n)

= O(1)

Runtime per Insertion = O(1)

total time = O(n)