CSE-5311 HandsOn-11

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Q1.

A)

Aggregate Method :

The aggregate method looks at the total cost for n operations and divides it by n to find the amortized cost.

1. Cost Analysis:
    - For a single insertion, the cost is O(1) if no resizing is needed.
    - When resizing is required, the table doubles in size, so we must copy all current elements to the new table. After k insertions, this copying cost is O(k).
2. Total Cost Calculation:
    - Every time the table doubles, the number of elements copied is cumulative:
        - After 1st doubling: 1 element copied
        - After 2nd doubling: 2 elements copied
        - After 3rd doubling: 4 elements copied
        - And so forth.
    - If we insert n elements, the total cost of resizing is the sum of a geometric series: $1+2+4+\cdots+n=O(n)$
3. Amortized Cost:
    - The total cost for n insertions is O(n).
    - Dividing by n, the amortized cost per insertion is $O(n)/n=O(1)$

Thus, the amortized cost of each insertion remains O(1) on average.

B.

Accounting Method

The accounting method assigns a "credit" to each operation to cover not only its immediate cost but also future costs (such as resizing).

1. **Assigning Costs**:
    - For each insertion, we assign a cost of 3 units:
        - 1 unit is used for the actual insertion.
        - 2 units are "saved" for future resizing operations.
2. **Using Credits for Resizing**:
    - When resizing occurs (i.e., when the table doubles in size), we need to copy k elements from the old table to the new one, where k is the size of the table before resizing.
    - The saved credits cover the cost of copying during resizing:
        - For example, after doubling from size k to 2k, each of the k elements already in the table has 2 units of saved credit, enough to pay for the copying.
3. **Amortized Cost**:
    - Since each insertion is assigned a constant charge of 3 units, the amortized cost per insertion is O(1).