

Spring 2022

CSE 317: Design and Analysis of Algorithms, Quiz - 2 [Section 3]

Monday, February 28, 2022. Total marks: 10 point, Duration: 15 minutes.

Name: _____, Student ID: _____

1. (10 points) Given an array A of n integers and an integer b . Design an efficient *divide-and-conquer* algorithms to compute the frequency of b in A (i.e., count the number of times b appears in A). Evaluate time complexity of your algorithm.

Solution: Algorithm: DC-FREQUENCY

Input: An array $A[l..h]$ of $h - l + 1$ integers and b

Output: Frequency of b in $A[l..h]$

1. **if** $l = h$ **then**
2. **if** $A[l] = b$ **then return** 1
3. **else return** 0
4. **else**
5. $m = \lfloor (h - l) / 2 \rfloor$
6. $f_L = \text{DC-FREQUENCY}(A[l..m], b)$
7. $f_R = \text{DC-FREQUENCY}(A[m + 1..h], b)$
8. **return** $(f_L + f_R)$

Time complexity: Let $T(n)$ represents the time required by above algorithm then

$$T(n) \leq 2T(n/2) + 1 \quad \text{with} \quad T(1) = 1.$$

We can solve this recurrence using Master Theorem and get $T(n) = O(n)$.