HANDSON-6

DESIGN ANALYSIS AMD ALGORITHMS

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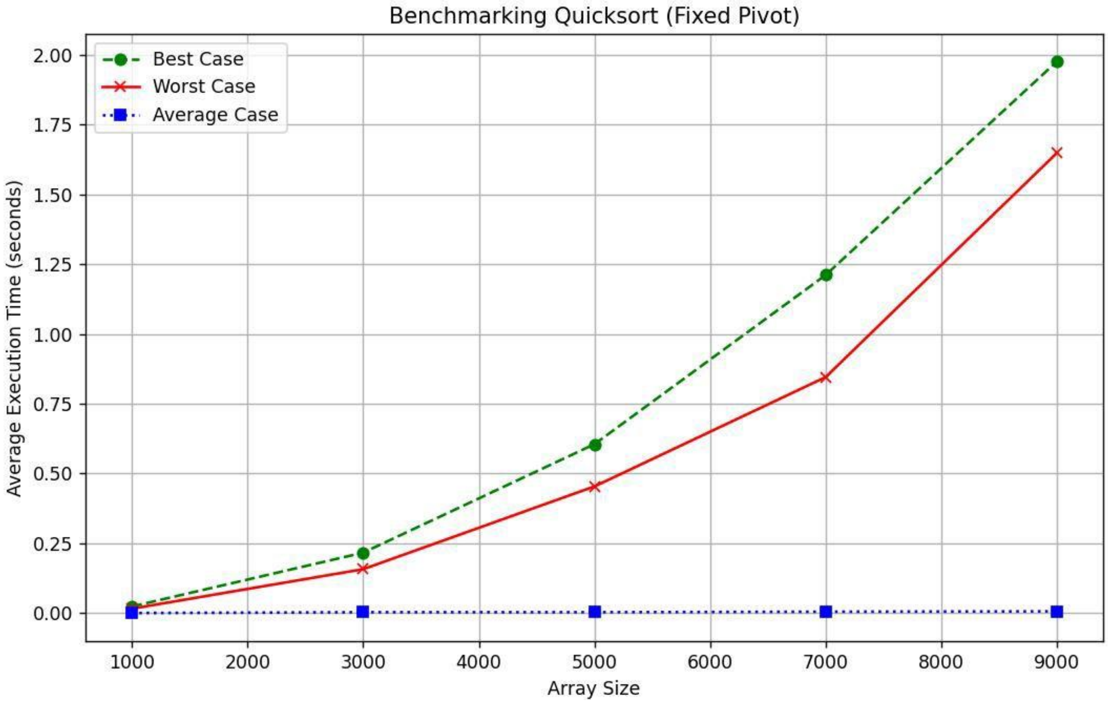
2.



3.

3\. Mathematically derive the average runtime complexity of the non-random pivot version of quicksort

Quicksort: Quicksort is efficient sorting algorithm that employs divide and conquer strategy to sort elements in array or list.

Recursive relation is $T(n) = T(n-1) + T(n-r) + \Theta(n)$

Where $T(n)$ = Time complexity of quicksort for array of size n

n = position of positive element after positioning the array.

$T(n-1)$, $T(n-r)$ - Time to sort left and right subarray less and greater than elements than the pivot element.

$\Theta(n)$ - represents time array.

Now, considering and average case

$$T(n) = T\left(\frac{n}{2}\right) + \Theta(n)$$

here $2T\left(\frac{n}{2}\right)$ represents avg time for recursive calls.

$$So,\ T(n) = O(n) + 2 \cdot T(n/2)$$

$$T(n) = O(n) + 2\left(O(n/2) + 2\,T\left(\frac{n}{4}\right)\right)$$

$$T(n) = O(n) + 2\left(O\left(\frac{n}{2}\right)\right) + 4\,T\left(\frac{n}{4}\right)$$

$$\therefore T(n) = k \cdot O\left(\frac{n}{2^k}\right) + 2^k \cdot T\left(\frac{n}{2^k}\right)$$

Runtime complexity of quicksort for average case is $\Theta(n \log n)$

$$T(n) = \Theta(n \log n)$$

<u>Advantage</u>: 1. Has Better Cache performance.

2. fewer data movement operations.

<u>Disadvantages</u>:

1. Worst case performance can be poor.