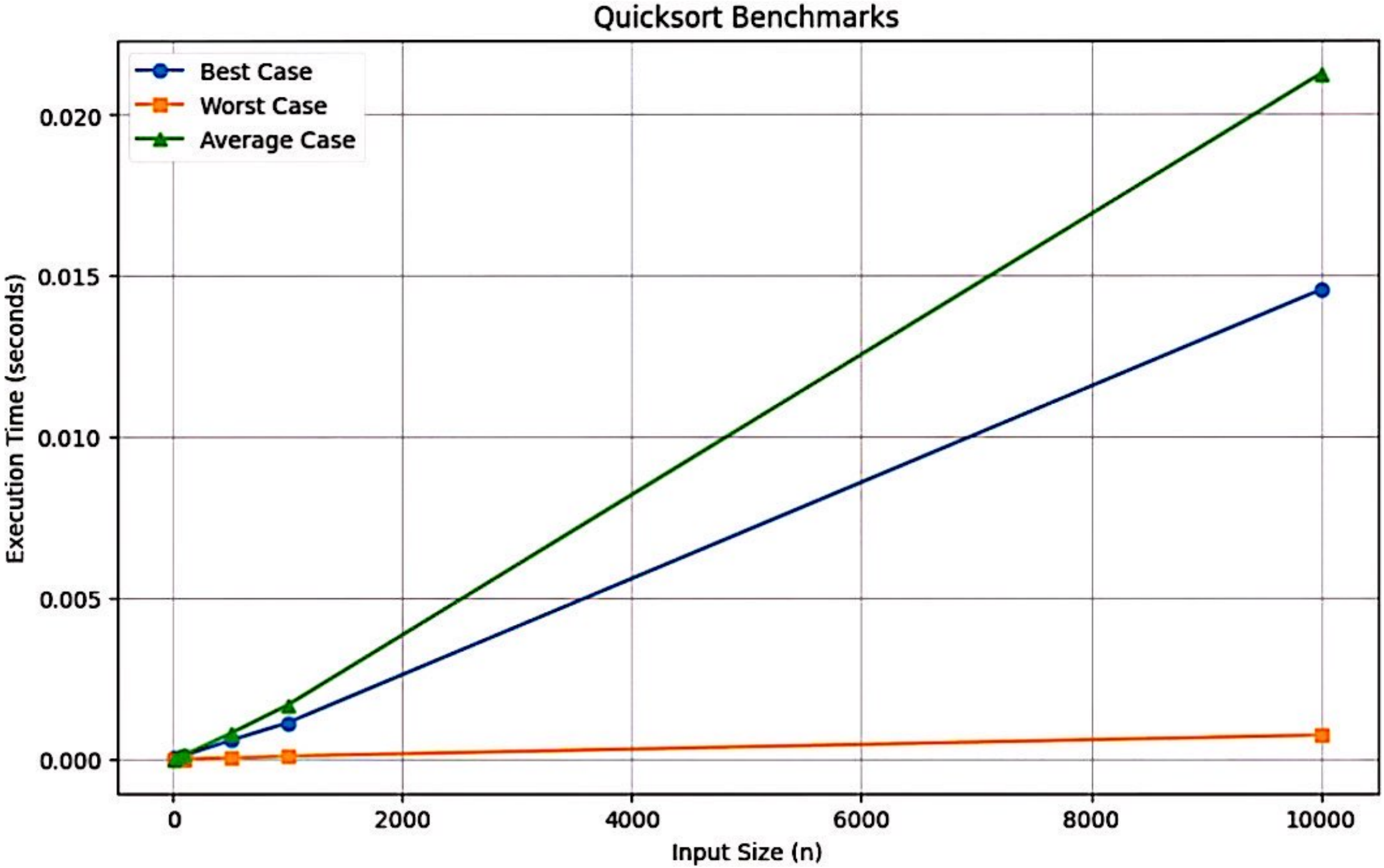
Input Size (n)	Best Case Time (s)	Worst Case Time (s)	Average Case Time (s)
10	2.14577e-05	4.29153e-06	1.35899e-05
50	5.57899e-05	5.96046e-06	6.81877e-05
100	0.00010705	1.07288e-05	0.000128269
500	0.000574827	3.91006e-05	0.000789881
1000	0.00112534	9.05991e-05	0.00167465
10000	0.0145483	0.000739098	0.02125



3. mathematically derive the average runtime Complexity of the non-random pivot Version of Quick sort.

A) Reccurrance relation is

$$T(n) = T(K) + T(n-K-1) + O(n)$$

Here,

$T(n)$ = Time Complexity of Quicksort for an array of Sizen.

K = number of elements in the left Subarray.

$n-K-1$ = no of elements in right array

$O(n)$ = represents time array.

Considering Average Case

$$T(n) = 2T(n/2) + \Theta(n)$$

Here, $2T(n/2)$ represents average time for recursively.

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

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

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

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

Therefore, Runtime complexity of Quick Sort for Average case is $\Theta(n \log n)$

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