

DESIGN AND ANALYSIS OF ALGORITHMS

ICS2301

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Assignment.

Find the time complexity of Quick Sort assuming the array is already sorted.

Given array:

[5, 10, 15, 20, 25, 30]

Solution

- If the first element is chosen as pivot
- The array is already sorted
- One portion has n-1, the other has 0

Therefore:

$$\begin{aligned} T(n) &= T(n-1) + c(n) \\ &= [T(n-2) + c(n-1)] + c(n) \\ &= T(n-2) + c(n-1) + c(n) \\ &= [T(n-3)+c(n-2)]+c(n-1)+c(n) \\ &= T(1) + C(2+3+4+\dots+n) \end{aligned}$$

$$\text{Summation of } i = n(n+1)/2 \Rightarrow (n^2 + n) * 1/2$$

Ignore the constants and pick the highest power of n which is n^2

$\Rightarrow O(n^2)$ will be the time complexity. Ans $\Rightarrow T(n)=O(n^2)$

Space Complexity:

- Recursive calls up to depth n
 - $\Rightarrow O(n)$

Design Strategy

\Rightarrow Divide and Conquer with Balanced Partitioning