Quick Sort Runtime

Partitioning time = cn

Left subarray recursive call = $T(k)$

Right subarray recursive call = $T(n-k-1)$

Total Expected time:

$$T(n) = cn + E[T(k) + T(n-k-1)]$$

Since the Pivot element is the last one:

$$T(n) = cn + \frac{1}{n}\sum_{k=0}^{n-1}(T(k) + T(n-k-1))$$

$$T(n) = cn + \frac{2}{n}\sum_{k=0}^{n-1} T(k)$$

Solving this we get:

$$T(n) = 2T\left(\frac{n-1}{2}\right) + cn$$

Applying master theorem,

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

[Average Case]