3. Average runtime complexity of non-random pivot of quicksort.

Let 'n' be the no. of elements to be sorted and 'k' be position of partition.

There are 'k-1' elements in left sub array and 'n-k' elements in right subarray

Assume left to right moves over k smaller element and thus k comparisons. So when right to left crosses left-to-right it has made (n-k+1) comparisons. so first call on partition makes (n+1) comparisons.

The recurrence relation can be written as

$$T(n) = (n+1) + \frac{1}{n}\sum_{k=1}^{n}\left[T(k-1) + T(n-k)\right]$$

here let's assume k iterations array size, will be 1 when reaches base cas.

$$T(n) = \log_2 n\, O(1) + n \cdot T(1)$$

Here T(1) is constant

After solving the recurrence relations we have.

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