1. Derive the formula for worst-case complexity.

Quicksort is a recursive algorithm that continues to partition the array until each partition has one or no elements, so for the worst-case complexity the recursion relation will be

T(n) = T(n-1) + n

T(n) = T(n-2) + (n-1) + n

If the recursion is done by k times then,

T(n) = T(n-k) + kn – (k(k-1))/2
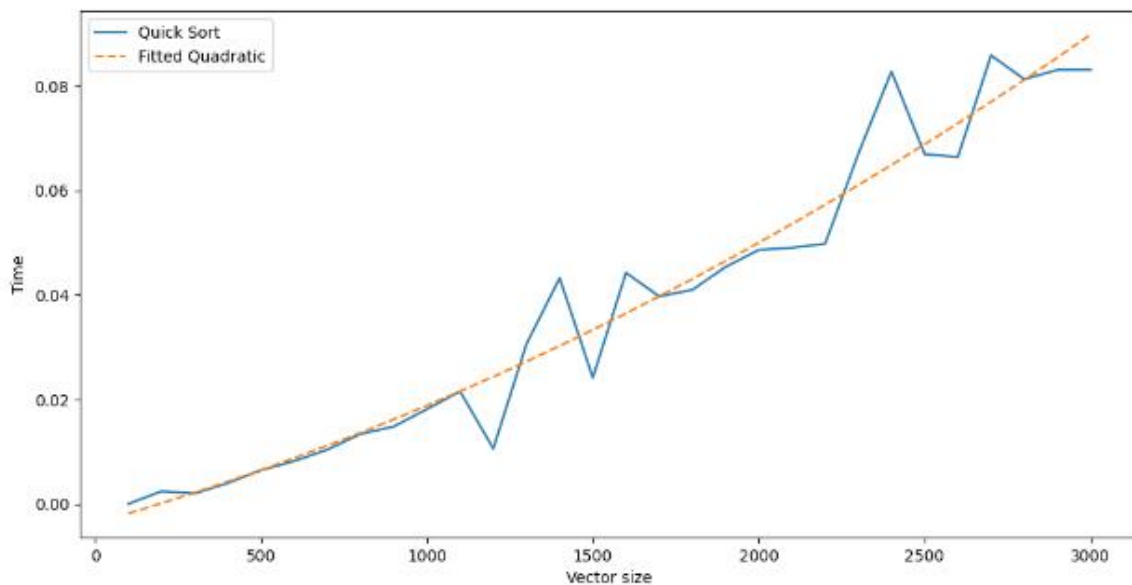
Then we put k = N in the above equation, then

T(N) = T(0) + N*N – (N(N-1))/2

     = N^2 – (N(N-1))/2

     = N^2/2 + N/2

Therefore, the worst-case complexity for the Quicksort is O(N^2).

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The actual graph has the line of best fit showing quadratic, which we were expecting.