

Question 4

1.) Worst Case Complexity (Quick Sort)

The worst-case complexity for quick sort is when the pivot is the smallest or largest value. This leads to the complexity being quadratic, which is $O(n^2)$. This is because this creates a subarray of size 0 and another of size $n - 1$.

$[N + (N - 1) + (N - 2) + (N - 3) + \dots + 1 + 2] = [N(N+1)/2 - 1] = O(N^2)$. This is a quadratic time complexity.

2.) Let the array of 16 elements be vector = [2, 1, 3, 5, 4, 6, 7, 8, 9, 10, 12, 11, 13, 14, 15, 16]. The, for worst case scenario, the pivot must either be the smallest value or the largest value, so we will choose 16 as the pivot.

Elements larger than 16: []

Elements smaller than 16: [2, 1, 3, 5, 4, 6, 7, 8, 9, 12, 11, 13, 14, 15]. The array with the pivot at the end becomes:

[2, 1, 3, 5, 4, 6, 7, 8, 9, 10, 12, 11, 13, 14, 15, |16|]. The left pointer will not find an element larger than 16. Instead, each step will reduce the number of steps by 1 ($n-1$, $n-2$... etc). This reflects the worst-case scenario, which is $O(n^2)$

4.)The graph shows the complexity is accurate.