① partition (A. p. q)

when $x \leftarrow A[p]$

$i \leftarrow p$

for $j = p+1$ to r

if $A[j] <= x$

$i = i+1$.

exchange $A[i]$ with $A[j]$

exchange $A[i]$ with $A[p]$

return i.

② Inversions is that a sorted array has no inversions in it. since every element should be smaller than everything coming after it and larger than everything coming before it.

So, when inversions sort runs, it always swaps adjacent element in the array, and it only swaps the two elements if they form an inversion.

We can assume $A[j]$ and $A[j+1]$ swaps. since it starts in 1, each swaps will decrease the number by exactly one. the number of swaps equals the number of inversions.

like 4 6 3 1 2 5

4 (6) 3 1 2 5

4 6 (3) 1 2 5

4 3 (6) 1 2 5

3 4 (6) 1 2 5

so it take n^2 comparisons.

3 4 6 ① 2 5

1 3 4 6 ② 5

1 2 3 4 6 ⑤

1 2 3 4 5 ⑥

③. best-case: iq sort.

$O(n) + O(n \log n) + O(n-r)$

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

worst-case.

$O(n) + O(r^2) + O((n-r)^2)$

$= O(n^2)$

average-case.

$O(n) + O(n \log n) + O((n-r)^2)$

$= O(n^2)$

(4)