

Q: Give an example showing that quicksort is not a stable sorting algorithm.

A: Recall that for sorting algorithm to be stable, it maintains the relative order of any two equal elements in its input (if an input list has two equal elements in positions  $i$  and  $j$  where  $i < j$ , then they should be in positions  $i'$  and  $j'$  such that  $i' < j'$  in the sorted list)

Say there is an array = [(5,1), (5,7), (3,2), (2,9)] and this array is supposed to be sorted by  $y$  first, then by  $x$ .

A stable sorting algorithm should sort the given array to [(2,9), (3,2), (5,1), (5,7)], but quicksort might sort the array to [(2,9), (3,2), (5,7), (5,1)]

[(5,1), (3,2), (5,7), (2,9)]	(sorted by $y$ )
[(2,9), (3,2), (5,7), (5,1)]	(now sorted by $x$ )

Since quicksort swaps elements according to the pivot's position, there is no guarantee that the relative order of equal elements is maintained as it reorders, which counters the definition for a sorting algorithm to be stable.