

Section 06: Sorting and Graphs

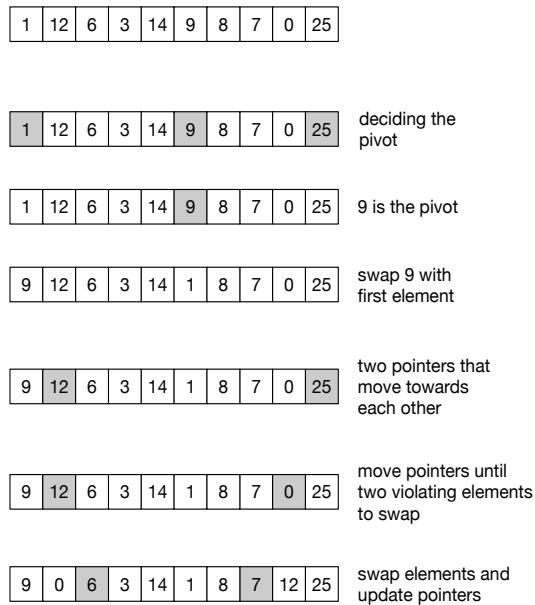
1. Worst Case Inputs for Sorting Algorithms

Describe the the worst case inputs in terms of the runtimes of the following sorting algorithms:

- (a) Selection Sort
- (b) Insertion Sort (assume that the subarray of sorted items are built from left to right)
- (c) Quick Sort (assume that the pivot is chosen as the median of $A[0], A[n-1], A[\lfloor n/2 \rfloor]$, where A is the input array and n is its length)

2. Quick Sort

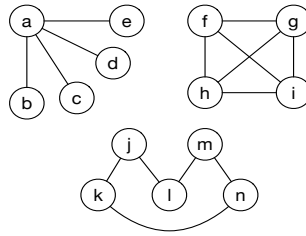
Consider the pivoting step of the Quick Sort algorithm. In other words, consider the algorithm that helps find a pivot and produces an array such that values of all elements to the left of the pivot are less than the pivot's value and to the right of the pivot are greater than the pivot's value. This algorithm can be visualized as in the following diagram.



- (a) Complete the steps until the element 9 (the pivot) is moved to its correct position.
- (b) Pictorially describe the pivoting step of Quick Sort on the array 1, 8, 33, 19, -2, -4, 9, 4, 5, 10.

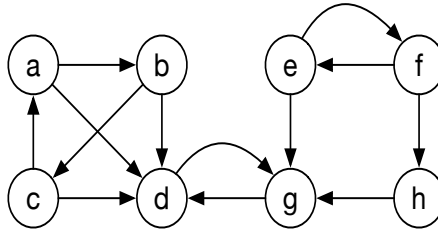
3. Graphs

- (a) Consider the following graph.



What are its connected components? What is the longest path in this graph and what is its length? What is the shortest path from j to n and what is its length?

(b) Consider the following directed graph.



What are its strongly connected components? What are its weakly connected components? Is a strongly connected graph also a weakly connected graph? Is a weakly connected graph also a strongly connected graph?