1. Describe an algorithm that, given an array of $n$ integers in the range 0 to $k$, preprocesses its input and then answers any query about how many of the $n$ integers fall into a range $[a..b]$ in $O(1)$ time. Your algorithm should use no more than $O(n + k)$ preprocessing time.

2. Design a simple scheme that makes any comparison-based sorting algorithm stable.

3. An undirected graph is said to be a tree if it is connected and contains no simple cycle. Modify the basic depth-first search algorithm such that it answers whether or not a given undirected graph is a tree.