

## Tutorial 10

1. You are given a function  $\text{median}(A, p, r)$  that finds the index corresponding to the median of an array  $A$  with starting index  $p$  and ending index  $r$ , in worst-case complexity  $\Theta(n)$  where  $n$  is the length of  $A$ . Making use of the given median function, write an algorithm with complexity  $\Theta(n)$  to partition the array  $A$  using its median as the pivot. You may call the functions discussed in class.
2. Using your algorithm in Qn 1, write an algorithm that selects the  $i$ th smallest element of  $A$  in worst-case complexity  $O(n)$ . Prove that your algorithm indeed has complexity  $O(n)$ , justifying every step clearly. Note that the select algorithm given in class has worst-case complexity  $O(n^2)$ .

3. Consider performing counting sort on the following array:

5	7	5	1	3	7	6	3	1	6	6	5	3
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- (i) What does the final count array look like?
  - (ii) Use the count array to determine the sorted array.
4. Trace the steps of radix sort on the following sequence of numbers, each with 4 digits.  
  
5890, 6204, 8267, 6850, 4668
  5. An  $n$ -element array  $A$  contains only the numbers 0, 1, 2. Write an  $O(n)$  algorithm to sort the numbers. Legal operations on the data are swapping two elements in the array.
  6. Explain how bucket sort can be used to sort the following sequence of numbers between 0 and 1:

0.93, 0.08, 0.46, 0.28, 0.36, 0.67, 0.91, 0.27, 0.48, 0.04