## Tutorial 9

1. **What are two properties of a max-heap? Explain whether the sequence:**

   *23, 17, 14, 6, 13, 10, 1, 5, 7, 12*
   **is a max-heap?**

2. **Write a *siftup* algorithm for a max-heap. The input to *siftup* is an index i and a max-heap structure in which the value of each node is greater than or equal to the values of its children (if any), except for the node at index i which has a value which is greater than its parent. siftup restores the max-heap.**

3. **Let A be the following array.**

   | 16 | 23 | 31 | 20 | 4 |
   |----|----|----|----|---|

   **(i) Show the array A after calling heapify on it to produce a max-heap.**

   **(ii) Starting from the array in (i), trace the steps of the heapsort algorithm on A.**

4. **For a heap of size $n$, show that the time complexity of applying heapify to it is $O(n)$.**

5. **Trace the execution of the partition algorithm to show how it partitions the array: 'N', 'A', 'N', 'Y', 'A', 'N', 'G', 'U', 'N', 'I' in the alphabetical order.**

6. **Explain clearly each step of the partition algorithm on the following array.**

   | 60 | 47 | 90 | 12 | 58 | 70 |
   |----|----|----|----|----|----|

7. **Show the steps of quicksort on the array:**

   **12, 30, 21, 8, 6, 9, 1, 7**