Data Structures and Algorithms

Exercises Week 7

1. Assuming that the priority queue is implemented as an unsorted array, show the operation of selection sort on an input sequence with the keys

   $$22, 15, 36, 44, 10, 3, 9, 13, 29, 25$$

   by completing a table such as the following:

Input	Priority Queue	output

   For each input object, show the input key and the (resulting) sequence of keys in the queue.

   When all the input has been read in, show, on successive lines, each output and the (resulting) sequence of keys in the queue.

2. Extend the table of Exercise 1 by two additional columns:

   (a) the number of keys that have to be examined in order to select which to output

   (b) the number of objects in the queue that have to be "shuffled up" when the selected object is output.

   At the end of the table, enter the totals of each of those two columns.

   What is the relation between the column total of number of examinations and the number of items in the input sequence?

3. Assuming that the priority queue is implemented as a sorted array, show the operation of insertion sort on the same input sequence as for Exercise 1 and with a similar table.

4. Extend the table of Exercise 3 by three additional columns:

   (a) the number of keys that have to be examined in order to find the position at which to insert the input object into the queue

   (b) the number of objects in the queue that have to be "shuffled up" when the input object is inserted into the queue

   (c) the total of the previous two columns.

   At the end of the table, enter the total of the final column.

   What is the relation between the overall total of numbers of examinations and places "shuffled up" and the number of items in the input sequence?

5. Show the binary search tree that results from inserting the same sequence of objects as for Exercise 1 into an initially empty tree.

6. Calculate how many comparisons were needed during construction of the tree in Exercise 5. Note that no comparison was needed for the first item; it went in the root. In general, an item stored in a node at depth d needed d comparisons.

   How does that total number of comparison operations compare to the totals of operations that you calculated in Exercises 2 and 4?

7. For the binary search tree from Exercise 5, consider how the sorted sequence could be obtained by inorder traversal of the tree.

   (a) For the recursive method, calculate how many method calls (including the first call at the root) are needed during the complete traversal.

   (b) How is that number related to the number of nodes in the tree (and, therefore, to the number of items in the original input sequence)?