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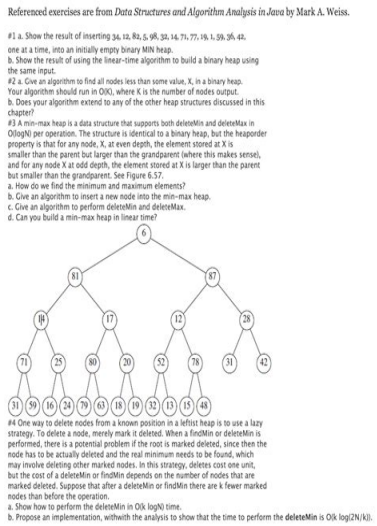

Referenced exercises are from *Data Structures and Algorithm Analysis in Java* by Mark A. Weiss.

#1 a. Show the result of inserting 34, 12, 82, 5, 98, 32, 14, 71, 77, 19, 1, 59, 36, 42, one at a time, into an initially empty binary MIN heap.
b. Show the result of using the linear-time algorithm to build a binary heap using the same input.
#2 a. Give an algorithm to find all nodes less than some value, X, in a binary heap. Your algorithm should run in O(K), where K is the number of nodes output.
b. Does your algorithm extend to any of the other heap structures discussed in this chapter?
#3 A min-max heap is a data structure that supports both deleteMin and deleteMax in O(logN) per operation. The structure is identical to a binary heap, but the heaporder property is that for any node, X, at even depth, the element stored at X is smaller than the parent but larger than the grandparent (where this makes sense), and for any node X at odd depth, the element stored at X is larger than the parent but smaller than the grandparent. See Figure 6.57.
a. How do we find the minimum and maximum elements?
b. Give an algorithm to insert a new node into the min-max heap.
c. Give an algorithm to perform deleteMin and deleteMax.
d. Can you build a min-max heap in linear time?

#4 One way to delete nodes from a known position in a leftist heap is to use a lazy strategy. To delete a node, merely mark it deleted. When a findMin or deleteMin is performed, there is a potential problem if the root is marked deleted, since then the node has to be actually deleted and the real minimum needs to be found, which may involve deleting other marked nodes. In this strategy, deletes cost one unit, but the cost of a deleteMin or findMin depends on the number of nodes that are marked deleted. Suppose that after a deleteMin or findMin there are k fewer marked nodes than before the operation.
a. Show how to perform the deleteMin in O(k logN) time.
b. Propose an implementation, withwith the analysis to show that the time to perform the **deleteMin** is O(k log(2N/k)).