PS Algorithms and Data Structures 2024

Task sheet 5

Task 13

A *stack* is a *LIFO* structure (last-in-first-out). This means that elements are retrieved (pop) in exactly the opposite order to that in which they were previously saved (push). Specify the two operations push(S,x) and pop(S) in pseudocode if a simple linked list is used for the stack S. This means that the elements should only have a key and a next reference to the next element. Both operations should have time complexity $O(1)$; a constant number of pointers may need to be added.

Task 14

Prove or disprove: Deletion in a binary search tree is "commutative". This means that deleting element a and then b or deleting b and then a results in the same tree solution.

Task 15

Show that Heap-Sort has runtime $\Omega(n \log n)$ if the input array A has the following structure: The first $2^{k-1} - 1$ entries consist of the numbers $2^{k-1} + 1$ to $2^k - 1$ (in descending order) and the last 2^{k-1} entries consist of the numbers 1 to 2^{k-1} (in ascending order), where $k \geq 1$ is a natural number and therefore A has the length $n = 2^k - 1$.

Note: It is not enough to argue that Max-Heapify generally has runtime $\Omega(\log n)$.