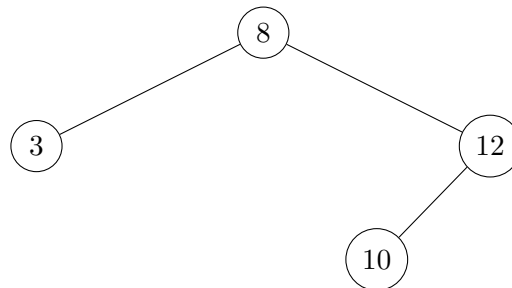


## Algorithms and Data Structures Winter Term 2020/2021 Exercise Sheet 6

### Exercise 1: Binary Search Trees I

Consider the following binary search tree



1. Give all sequences of `insert(key)` operations that generate the tree.
2. Draw the tree after the following sequence of operations: `insert(6)`, `insert(5)`, `remove(3)`.

### Exercise 2: Binary Search Trees II

- (a) Describe a function that takes a binary search tree  $B$  and a key  $x$  as input and generates the following output:
- If there is an element  $v$  in  $B$  with  $v.key = x$ , return  $v$ .
  - Otherwise, return the pair  $(u, w)$  where  $u$  is the tree element with the next smaller key and  $w$  is the element with the next larger key. It should be  $u = \text{None}$  if  $x$  is smaller than any key in the tree and  $w = \text{None}$  if  $x$  is larger than any key in the tree.

For your description you can use pseudo code or a sufficiently detailed description in English.  
Analyze the runtime of your function.

- (b) Describe a function which returns the depth of a binary search tree and analyze the runtime.
- (c) Describe a function that for a given binary search tree with  $n$  nodes and a given  $k \leq n$  returns a list with the  $k$  smallest keys from the tree. Analyze the runtime.