

## Sender–Receiver Exercise 2: Reading for Receivers

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The goals of this exercise are:

- to develop your skills at understanding, distilling, and communicating proofs and the conceptual ideas in them
- to practice reasoning about updates to dynamic data structures and binary search trees in particular

We have seen in the lecture that a variety of different operations can be performed on BSTs in time  $O(h)$ , including `insert` updates. Here we will complete the proof, by showing that `delete` updates can also be done in time  $O(h)$ .

**Theorem 0.1.** *Given a binary search tree  $T$  of height  $h$ , and a key  $K$  stored in the tree, we can delete a matching key-value pair  $(K, V)$  from  $T$  in time  $O(h)$ . Deletion means that we produce a new binary search tree that contains all of the key-value pairs in  $T$  except for one less occurrence of a pair with key  $K$ .*

To prepare for the exercise, we recommend reviewing Section 4.4 of the textbook to make sure you are comfortable with BSTs and how to implement the simpler operations on them (`insert`, `search`, `min/max`, and `predecessor/successor`).

## The Proof