**Red–black BST with no extra memory.** Describe how to save the memory for storing the color information when implementing a red–black BST.

**Document search.** Design an algorithm that takes a sequence of *n* document words and a sequence of *m* query words and find the shortest interval in which the *m* query words appear in the document in the order given. The length of an interval is the number of words in that interval.

**Generalized queue**. Design a generalized queue data type that supports all of the following operations in logarithmic time (or better) in the worst case.

* Create an empty data structure.
* Append an item to the end of the queue.
* Remove an item from the front of the queue.
* Return the *ith* item in the queue.
* Remove the *ith* item from the queue.