CS 240: Data Structures and Data Management
Module 5 Study Guide

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Key Concepts

- **Self-organizing searches** allow us to take advantage of probability distributions to access elements.

    - Optimal static ordering sorts elements by non-increasing access probability.
    - OSO is the best possible ordering, but we require complete knowledge of the probability distribution.
    - The move-to-front heuristic sorts elements by the time they were last accessed.
    - The transpose heuristic sorts elements by swapping pairs.
    - MTF is better with changing access patterns, but transpose is better with "rare" accesses.

- A **skip list** is a series of linked lists stacked on top of one another.

- Lists that form higher levels contain subsets of elements that are in lower levels.

- We traverse a skip list by skipping over elements we don't care about and jumping down to lower levels.

- Skip lists have $O(n)$ expected space usage and $O(\log(n))$ expected height.

- Operations:

    - SEARCH — $O(\log(n))$ expected, find largest key less than search key at each level and drop down
    - INSERT — $O(\log(n))$ expected, search to determine where to insert and flip coins to determine height
    - DELETE — $O(\log(n))$ expected, search to determine deletion positions and check for deleted key

Suggested Readings

- **Sedgewick:** 13.5 (Skip Lists)

- **Goodrich/Tamassia:** 3.5 (Skip Lists)

Practice Questions

Sedgewick

13.75. Draw the skip list that results when you insert items with the keys E A S Y Q U T I O N in that order into an initially empty list, assuming that RANDOM returns the sequence of values 1, 3, 1, 1, 2, 2, 1, 4, 1, and 1.

(*Note:* you can interpret these values as the number of heads flipped before the first tails flip.)

13.76. Draw the skip list that results when you insert items with the keys A E I N O Q S T U Y in that order into an initially empty list, assuming the same RANDOM return values as for exercise 13.75.

Goodrich/Tamassia

R-3.18. Draw an example skip list resulting from performing the following sequence of operations on the skip list in Figure 3.51: REMOVE(38), INSERT(48), INSERT(24), REMOVE(55). Assume the coin flips for the first insertion yield two heads followed by tails, and those for the second insertion yield three heads followed by tails.
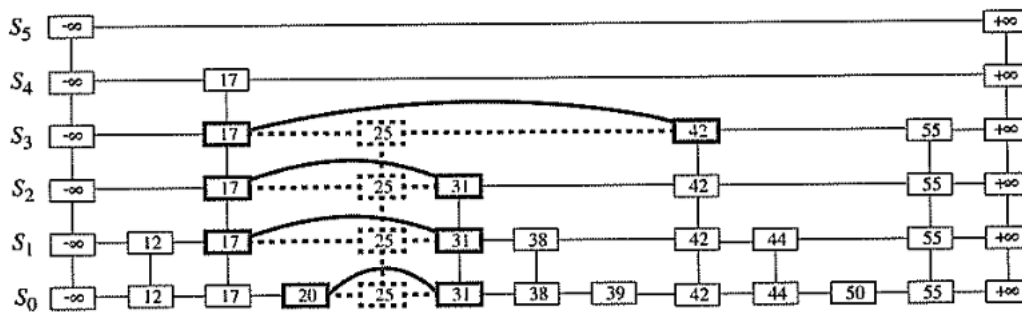

Figure 3.51: Removal of the item with key 25 from a skip list. The positions visited and the links traversed after the initial search are drawn with thick lines. The positions removed are drawn with dashed lines.

R-3.19. Give a pseudocode description of the REMOVE dictionary operation, assuming the dictionary is implemented by a skip list structure.