

Unit 4.2 – SkipList

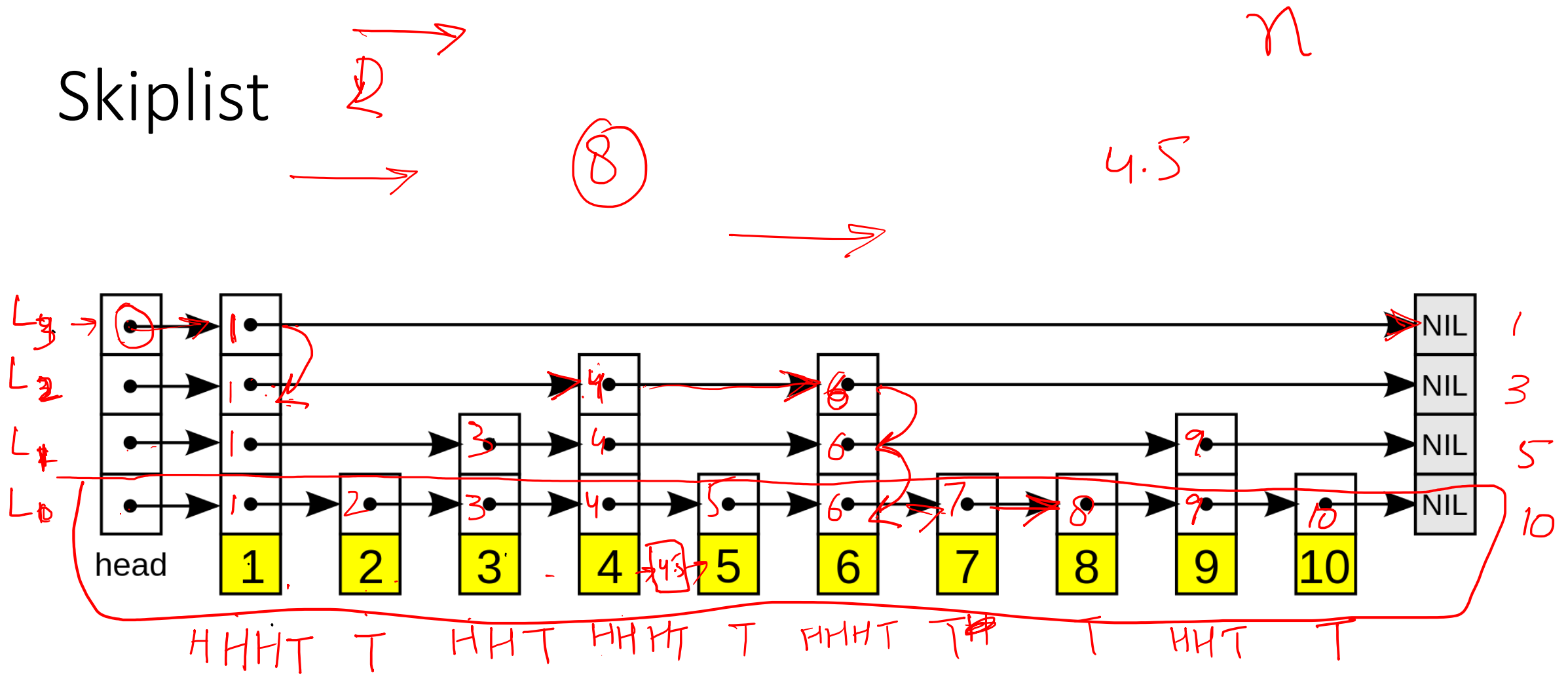
CS 201 - Data Structures II

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Habib University

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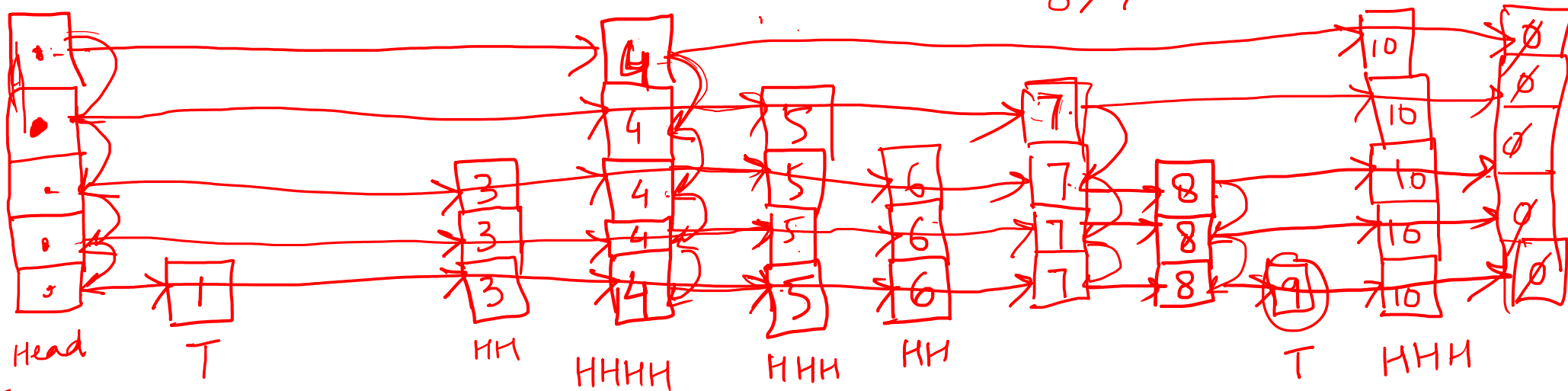
Skiplist



- https://en.wikipedia.org/wiki/Skip_list

Building a Skiplist

$\frac{7}{3}$ $\frac{8}{2}$ $\frac{9}{0}$ $\frac{4}{4}$ $\frac{3}{2}$ $\frac{6}{2}$ $\frac{1}{0}$ $\frac{5}{3}$
 877



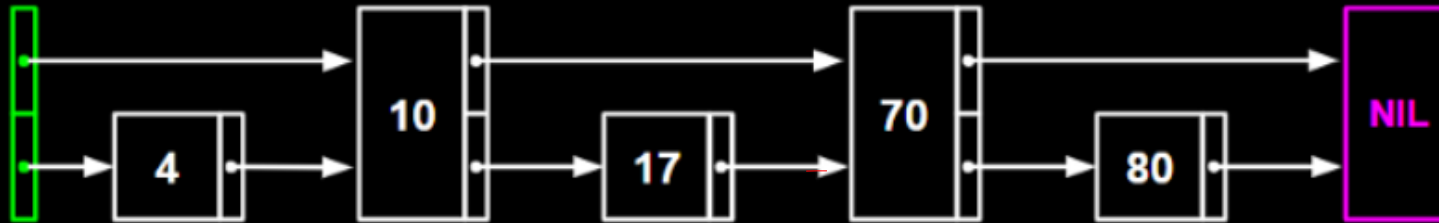
Node
 { data
 *next
 }

Node
 { data
 *next []
 }

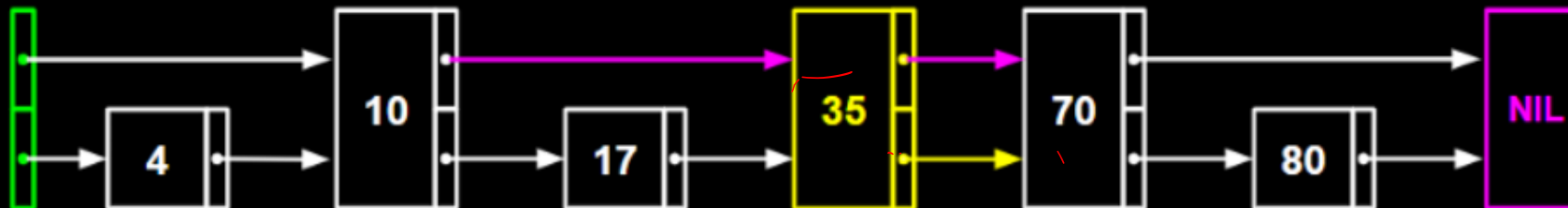
4
 next[0]
 next[1]

Skip List - Insertion

How to Insert 35 ?

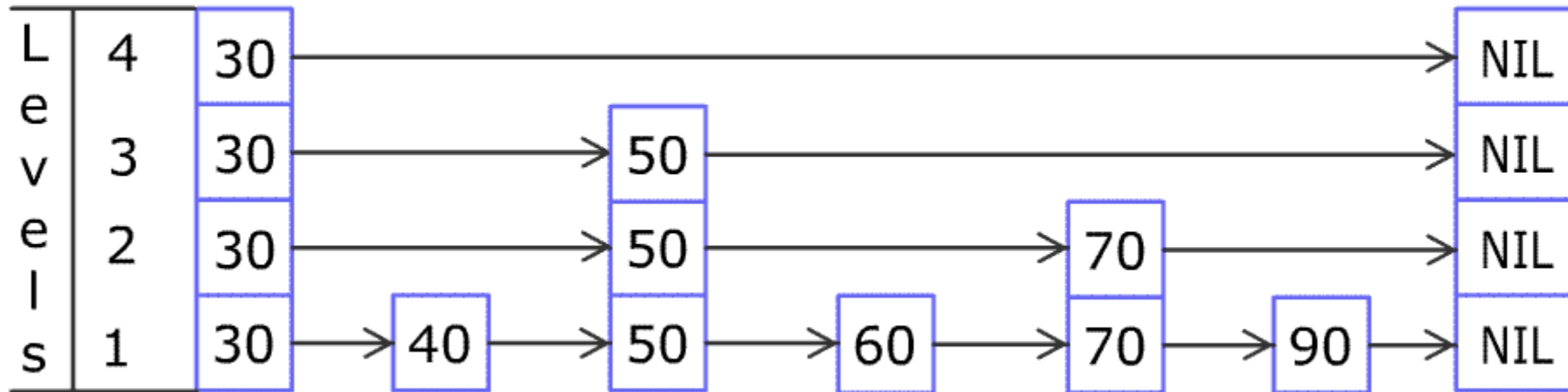


HEADS [add
1 level]



TAILS
[terminate]

Skip List - Insertion



Skip list – Insertion

- keeping track of pointers using Stack

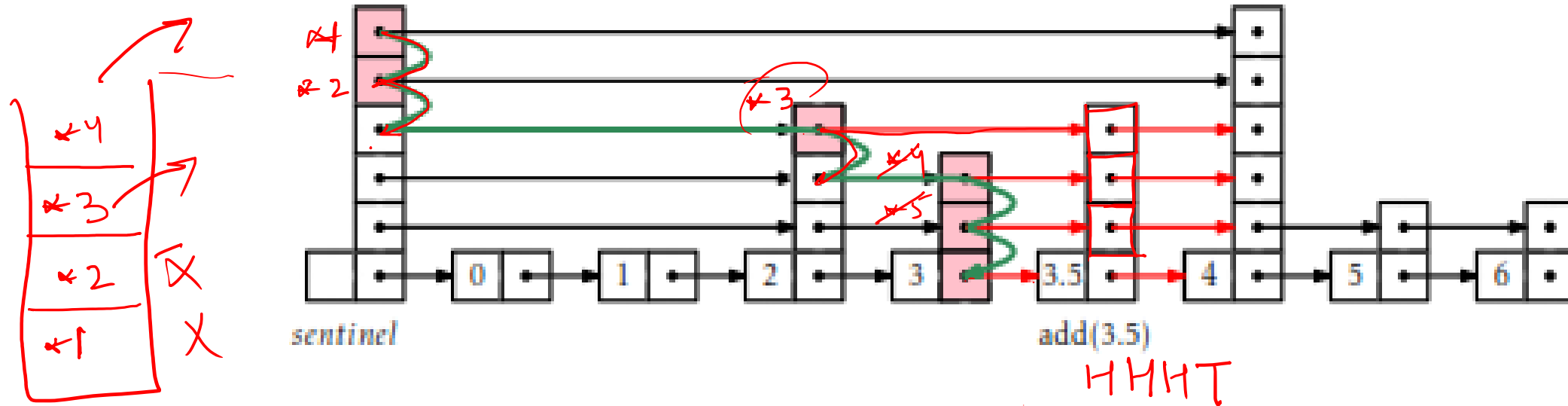


Figure 4.3: Adding the node containing 3.5 to a skiplist. The nodes stored in *stack* are highlighted.

Skip List - Deletion

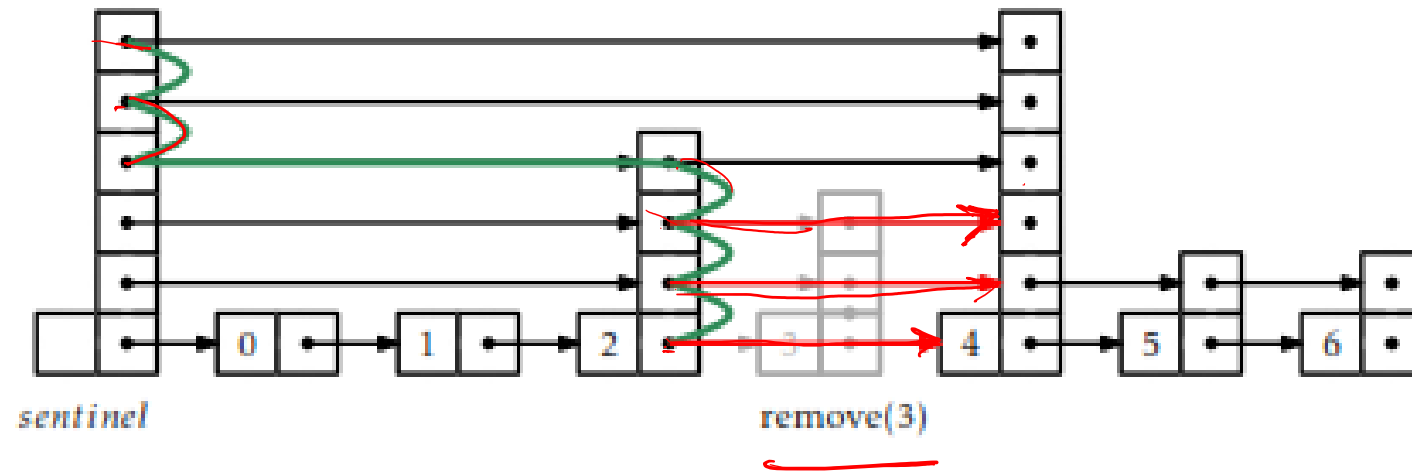
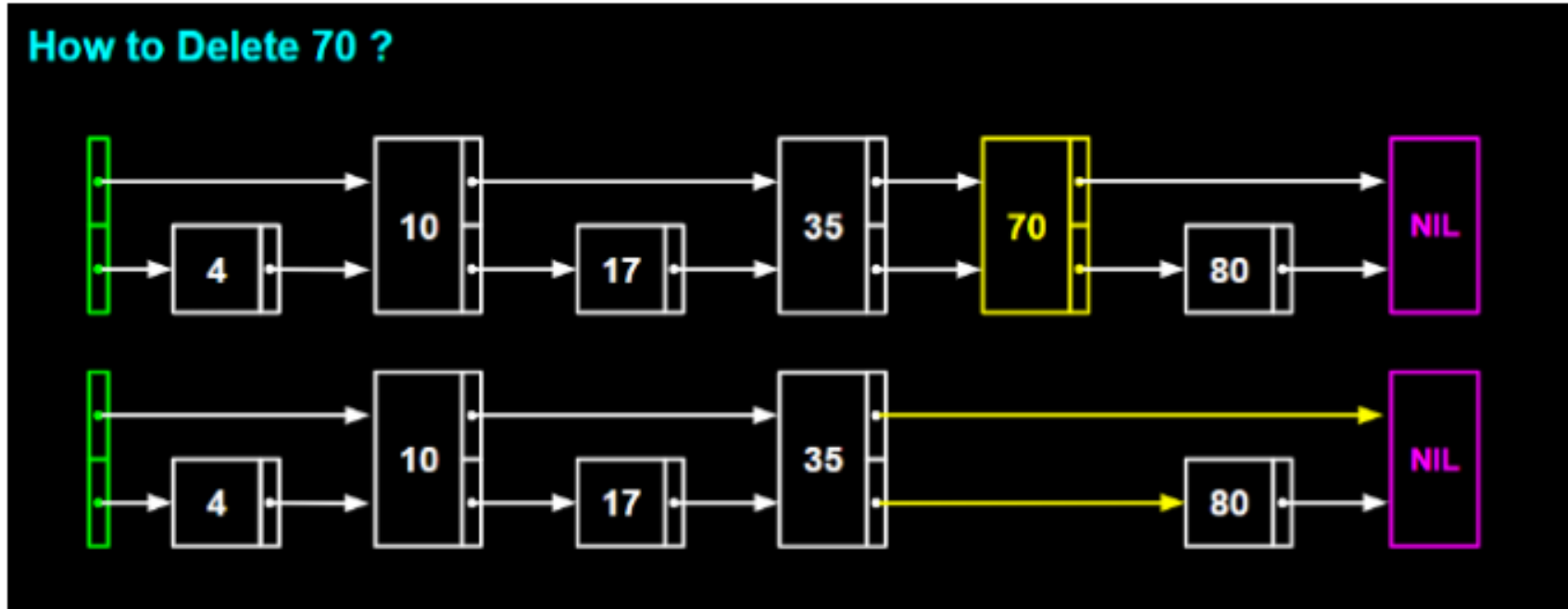
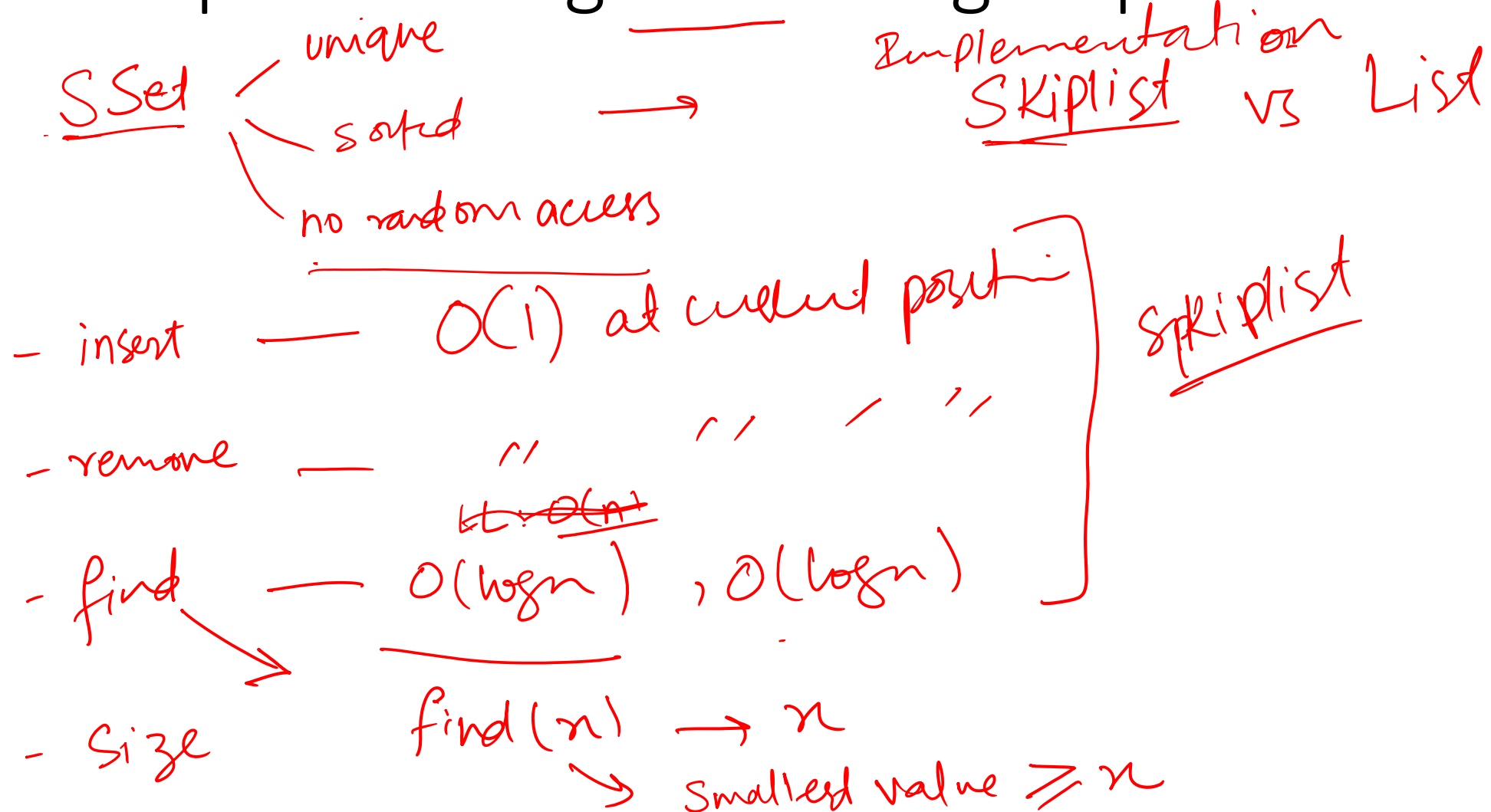


Figure 4.4: Removing the node containing 3 from a skiplist.

Skip List - Deletion



Implementing SSet using SkipList



Analysis of Skip List

Lemma 4.3. *The expected number of nodes in a skiplist containing n elements, not including occurrences of the sentinel, is $2n$.*

$$0.5 \times 0.5 =$$

Search $O(\log n)$

3



Binary Search

Merge Sort

$$\therefore \underline{2n} \rightarrow \underline{O(n^2)}$$

Lemma 4.4. *The expected height of a skiplist containing n elements is at most $\log n + 2$.*

Lemma 4.5. *The expected number of nodes in a skiplist containing n elements, including all occurrences of the sentinel, is $2n + O(\log n)$.*

Lemma 4.6. *The expected length of a search path in a skiplist is at most $2 \log n + O(1)$.*

Resources

- Open Data Structures (pseudocode edition), by Pat Morin. Available online at <http://opendatastructures.org>
- Data Structures and Algorithms in Python, by Michael T. Goodrich, Roberto Tamassia, and Michael H. Goldwasser. 2013. (1st. ed.). Wiley Publishing
- <https://www.khanacademy.org/computing/computer-science/algorithms/asymptotic-notation/a/asymptotic-notation>
- <https://www.javatpoint.com/skip-list-in-data-structure#:~:text=The%20skip%20list%20is%20used,known%20as%20a%20skip%20list.>

Thanks