Lecture 3: Binary Search

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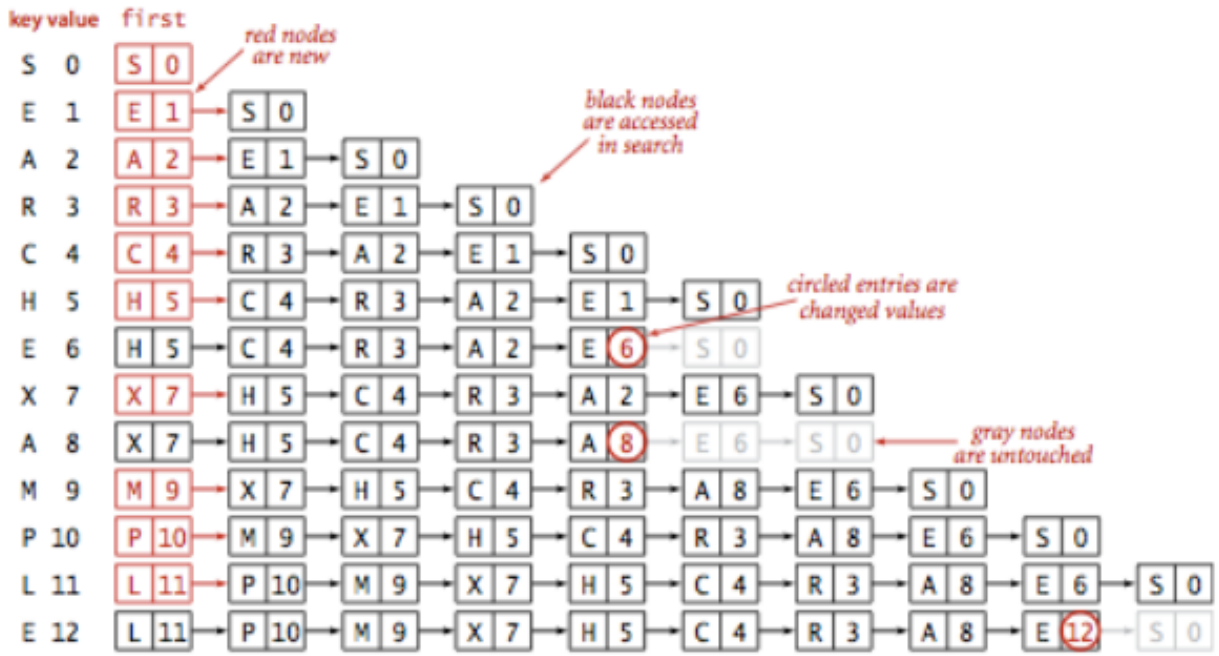
Symbol Tables

application	purpose of search	key	value
dictionary	find definition	word	definition
book index	find relevant pages	term	list of page numbers
file share	find song to download	name of song	computer ID
account management	process transactions	account number	transaction details
web search	find relevant web pages	keyword	list of page names
compiler	find type and value	variable name	type and value

Typical symbol-table applications

Linear Search

- Linear search checks each element in sequence.
- Time complexity: $O(n)$ in worst case.



Trace of linked-list ST implementation for standard indexing client

Linear Search Resource

For more explanation and practice problems, see:
`https://www.geeksforgeeks.org/dsa/linear-search/`

Binary Search Resource

For more explanation and practice problems, see:
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Why Binary Search Takes $\log n$ Steps

Binary search halving argument:

$$n \to \frac{n}{2} \to \frac{n}{4} \to \cdots \to \frac{n}{2^t}$$

Stop when $\frac{n}{2^t} \leq 1 \Rightarrow 2^t \geq n \Rightarrow t \geq \log_2 n$.

Binary Search in Sorted Array

- Requires sorted array.
- At each step, compare target with middle element.
- Discard half of the array each iteration.
- Time complexity: $O(\log n)$.