Today - Lecture 7 - CS163

* Begin Topic #6 on "Table ADT's"
* We will discuss:
  - what is a Table ADT
  - how efficient are the data structures
  - learn a new data structure
    (hash table with chaining — Prog #3)
    ↑ an array of LLL

Announcements:

Table Abstractions

- based on the VALUE of the data (not the position)

	Add	Remove	Search	Display
Sorted Array	+ Binary Search - Shifting - Memory	+ Binary Search - Shifting	**+ Binary Search**	**+ Displays in Sorted Order automatically**
Unsorted Array	**+ Direct Access** **+ No Shifting** **- Memory**	- Sequential Search - Shifting	- Sequential Search	- Must implement a sorting algorithm
Sorted LLL	- Sequential Search + No Shifting + Flexibility with Memory	- Sequential Search + No Shifting + Can Stop early if there is no match	- Sequential Search	**+ Supported**
Unsorted LLL	**+ Direct Access** **+ No Shifting** **+ Flexibility with Memory**	- Sequential Search + No Shifting + Flexibility with Memory	- Sequential Search	- Must implement a sorting algorithm

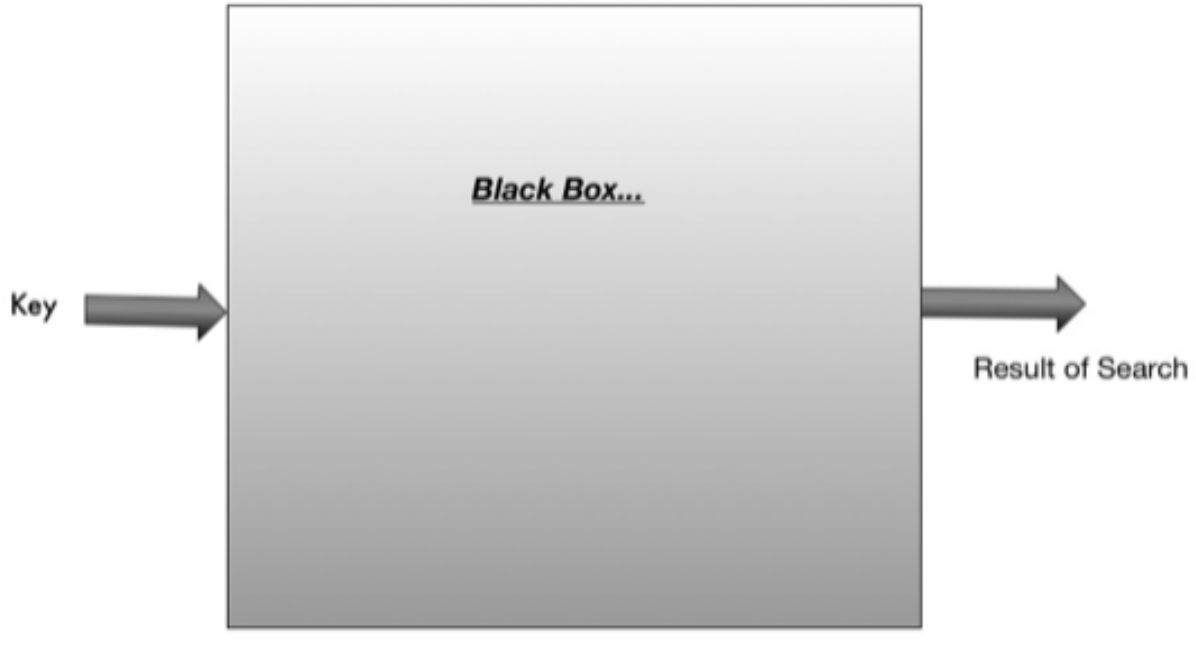
With hash tables

* using a "collision resolution" technique of chaining

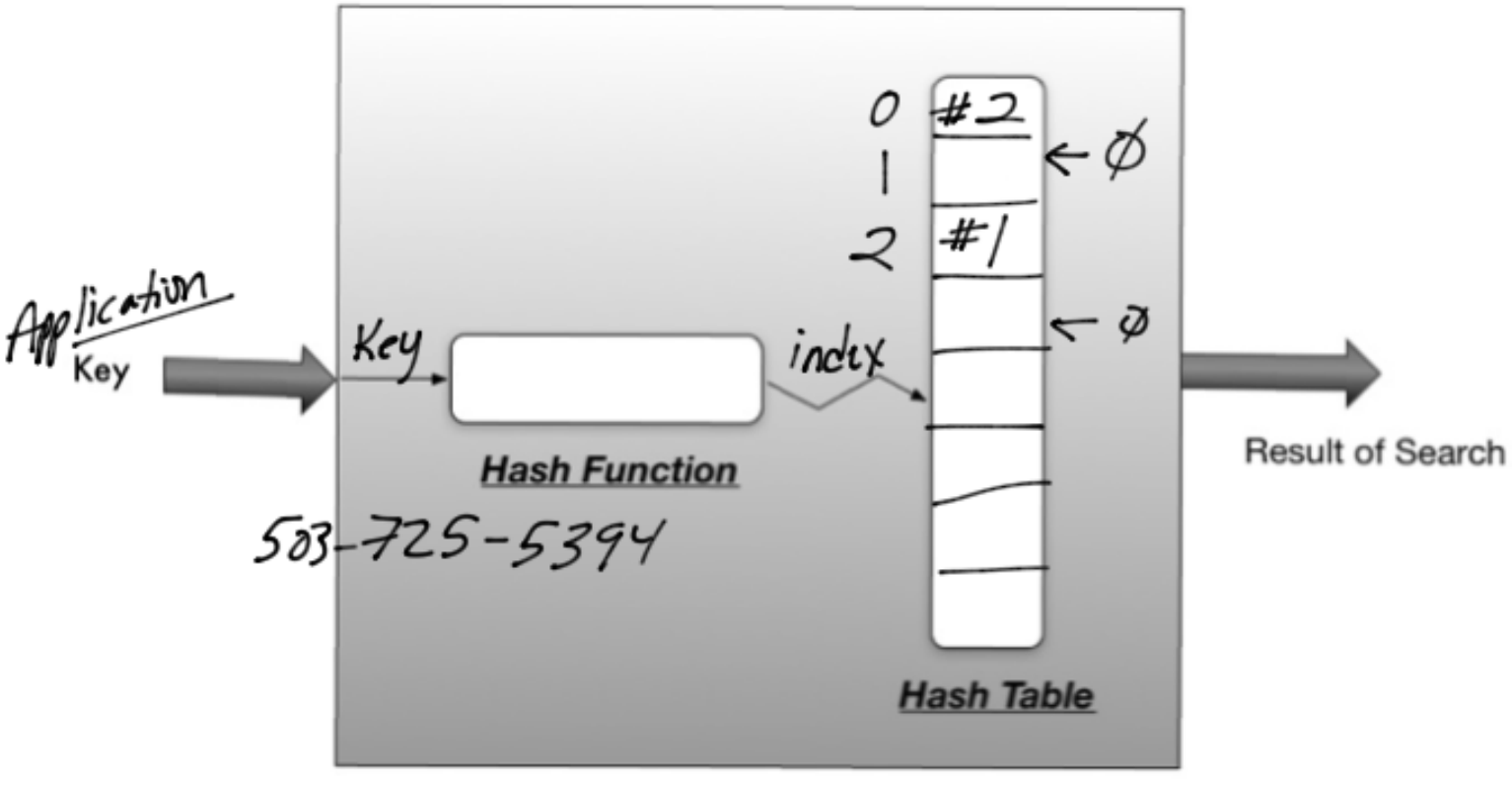
	Add	Remove	Search	Display
Sorted Array	+ Binary Search - Shifting - Memory	+ Binary Search - Shifting	**+ Binary Search**	**+ Displays in Sorted Order automatically**
Sorted LLL	- Sequential Search + No Shifting + Flexibility with Memory	- Sequential Search + No Shifting + Can Stop early if there is no match	- Sequential Search	**+ Supported**
Hash Table using Chaining	**+ Instantaneous** **+ Direct Access** **+ Flexibility with Memory**	**+ Instantaneous** **+ Direct Access** **+ Flexibility with Memory**	**+ Instantaneous** **+ Direct Access** **+ Flexibility with Memory**	- Not Available (would need to use an alternate data structure)

Hash Tables from a "client" perspective

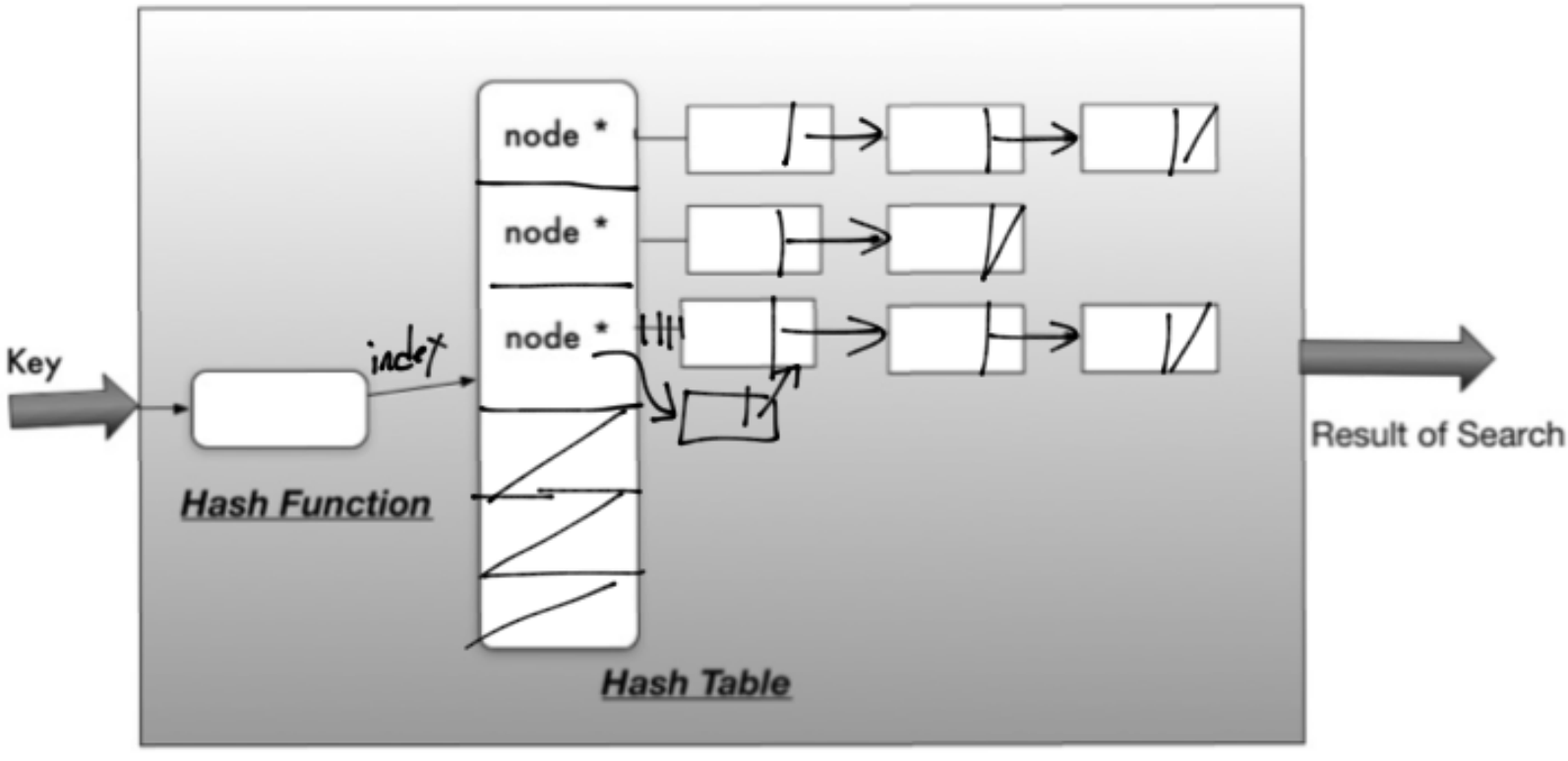
* Remember, the client is only aware that they are interested in finding information based on the "value" of the search request!



Hash Table using Linear Probing



Hash tables with chaining (as the collision resolution technique)



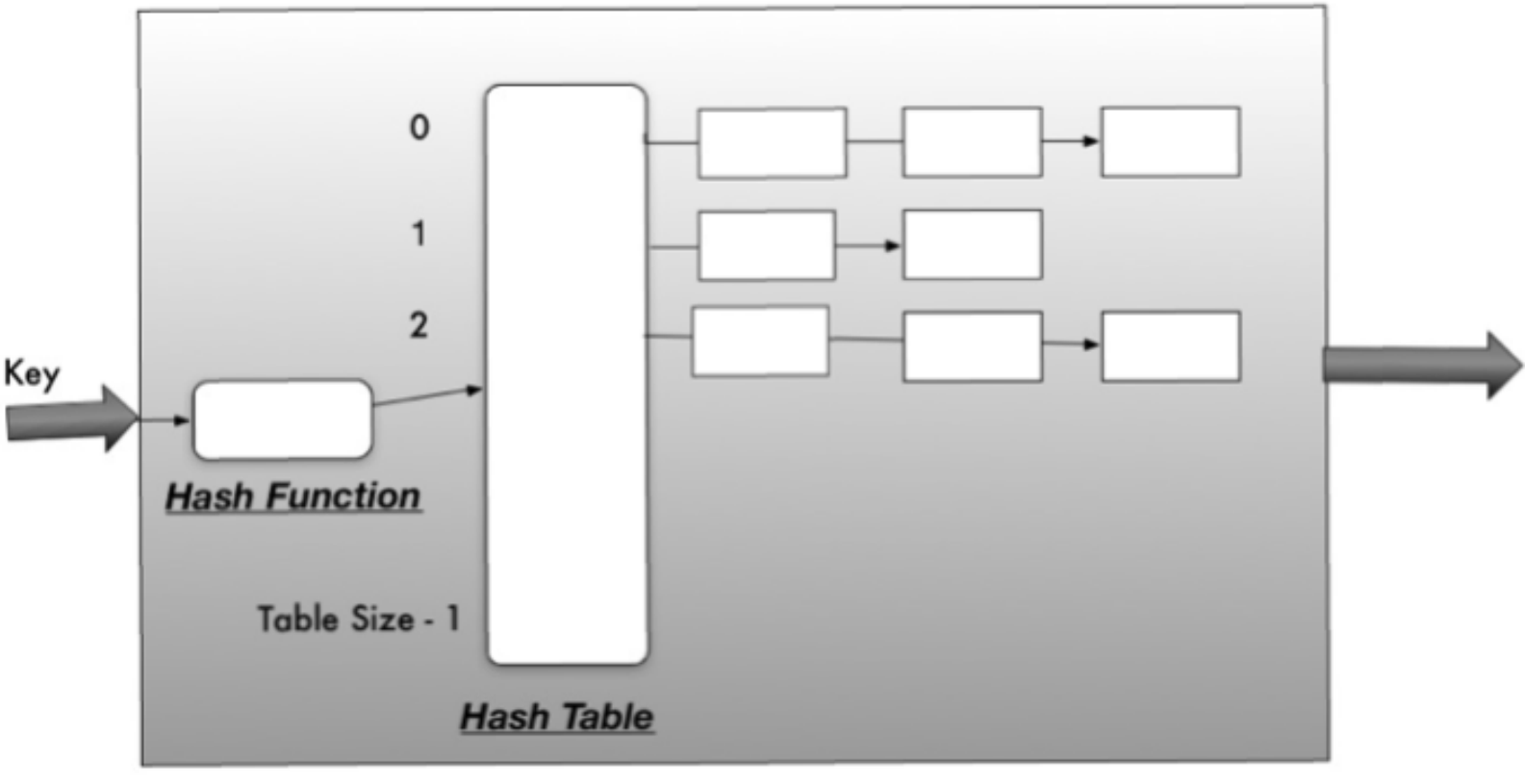
(Add will insert at the head of a chain even if there is a collision. chains are not ordered)

"Chaining"

1) collision resolution technique
2) hash table is an array of head ptrs
3) The array must be initialized so that each "head" pointer is NULL
4) We will know that there is a collision because "head" (for that array element) is NULL
5) Chains are not sorted
6) The length of a chain represents the number of collisions

Hash Functions and Hash Table Size

1) Goal - distribute data across chains
2) Hash table size should be a prime #
3) Examine "Key Value" to determine how to write a hash function that will map all or part to an index $(\phi \rightarrow TableSize - 1)$



More ideas:

why not [1]?

```
index = (name[0] + name[2]) % size;
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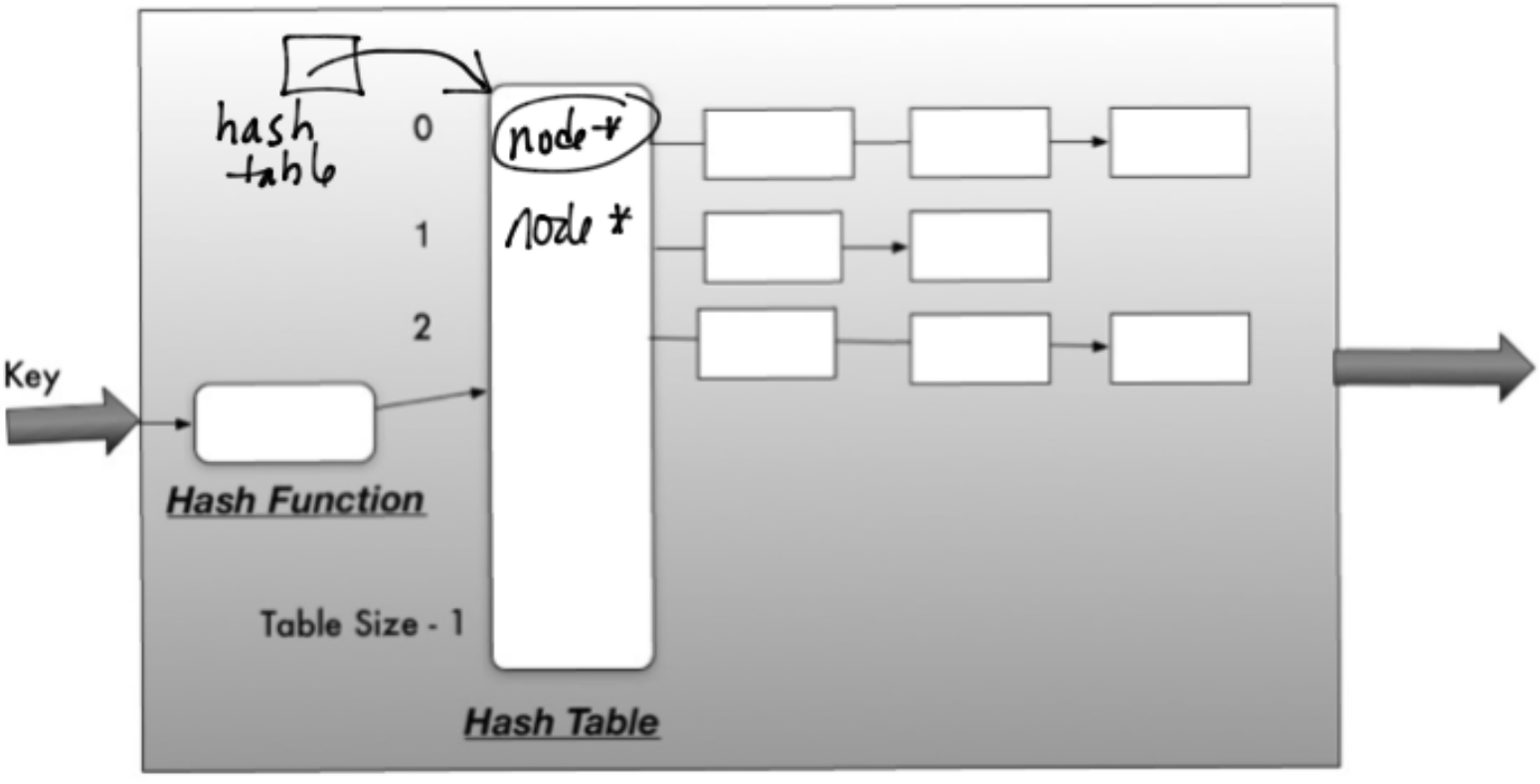
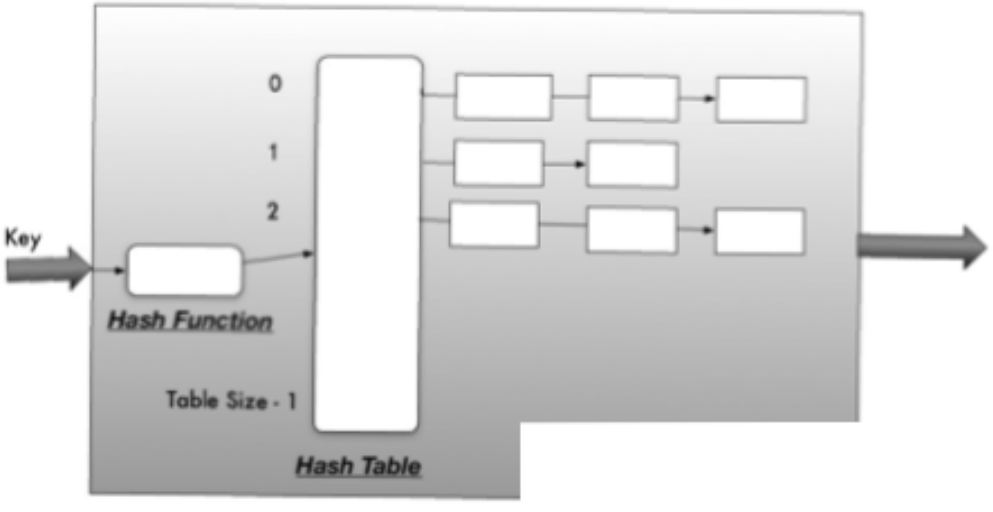
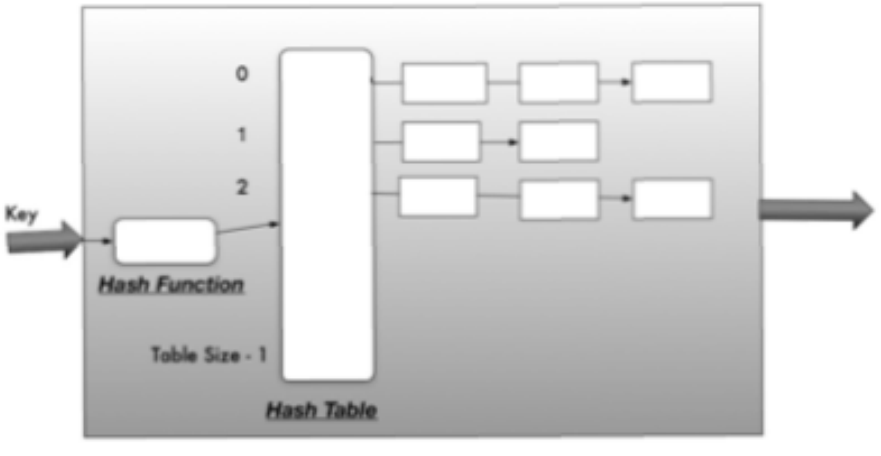


Working with multiple Key Values:
(multiple hash tables)

Array or Other data structure that contains the Actual Data (possibly maintained in sorted order by one of the key values.





Problems

1. Key → Index → perfect function
                → many collisions

2. NOT Sorted → Requires a different data struct.

3. NO Range checking — MUST have EXACT Match!