CS 2050
Computer Science II

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Agenda

- Hash Tables:
  - Overview
  - Hash Function
    - Examples
  - Implementation:
    - Big Picture
    - HashNode Class
    - HashTable Class

Hash Table

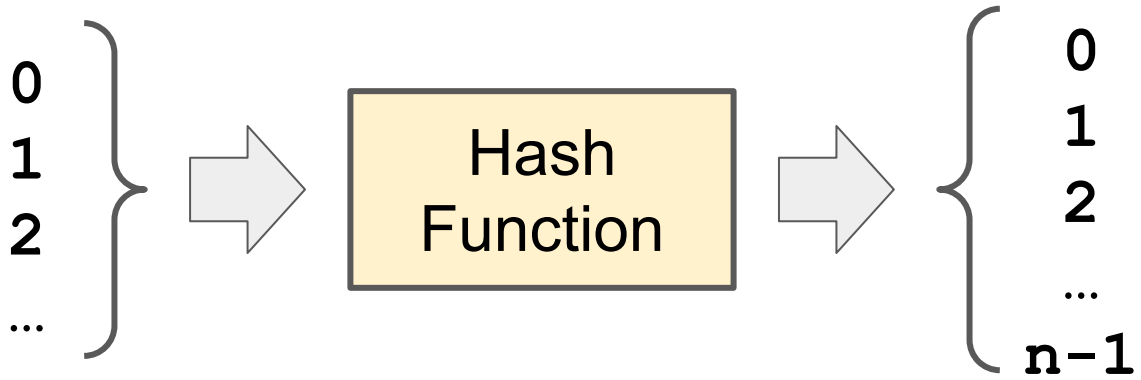
- A hash table, also called hash map, is a type of associative array
- It constitutes of a collection of (key, value) pairs such that each key is unique

Hash Table

- Internally a hash table uses an array to store the (key, value) pairs of the collection
- To index this internal array, a *hash function* is applied on the keys

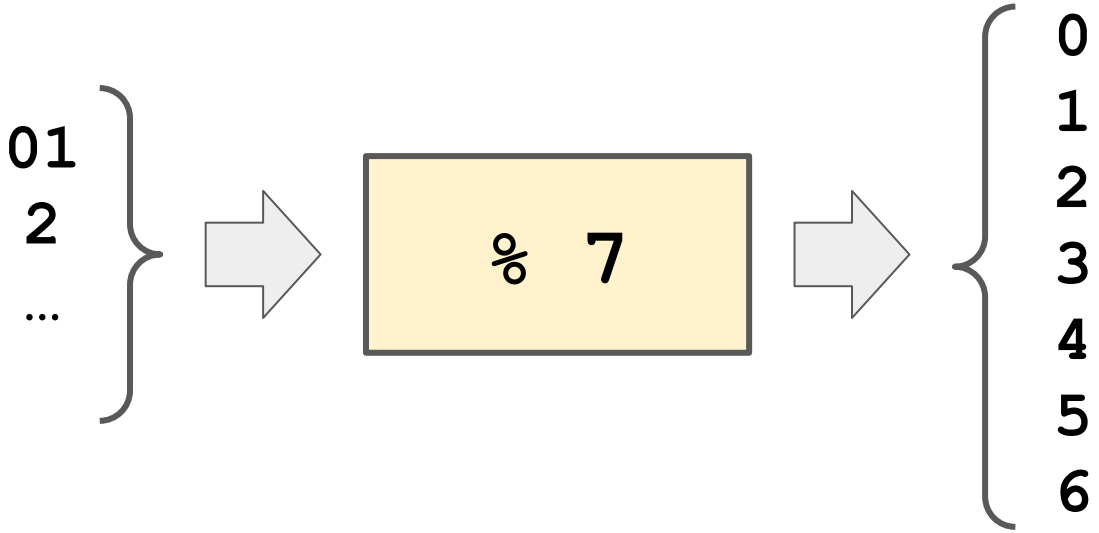
Hash Function

- A function that maps a value in an arbitrary range to another value in a fixed range

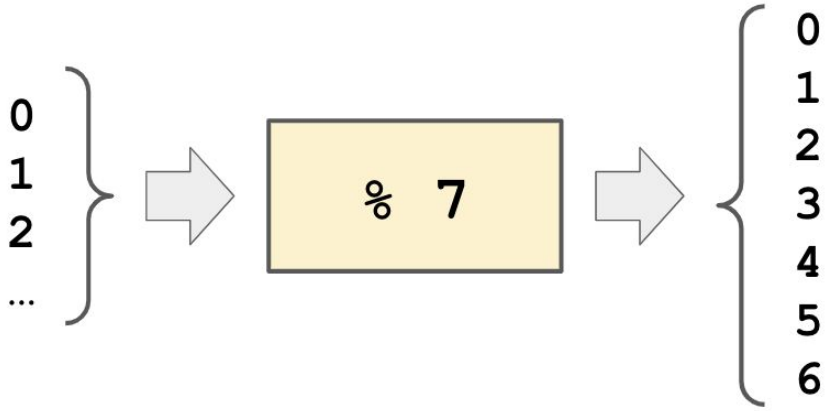


Hash Function

- Example #1:



Hash Function

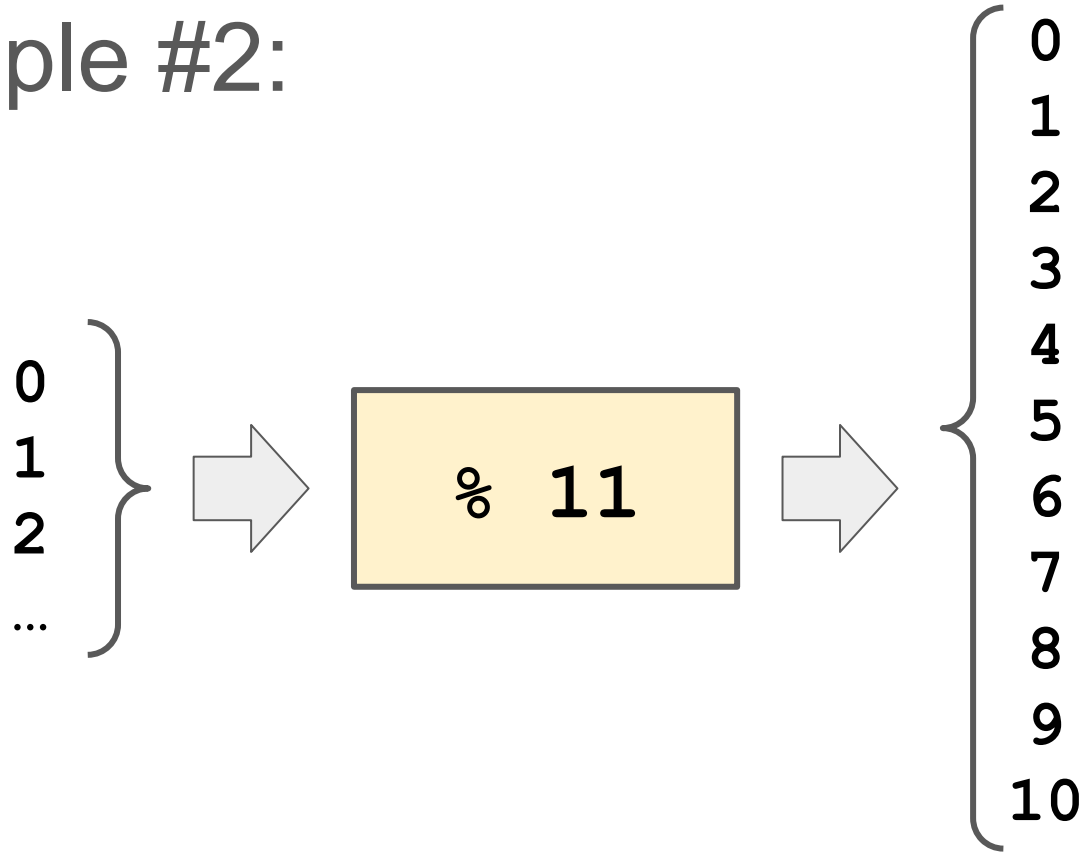


- Example #1:
  - hashing of 5 yields 5
  - hashing of 32 yields 4
  - hashing of 35 yields 0
  - hashing of 70 yields 0
  - hashing of 24593 yields 2
  - hashing of 293849585 yields 1

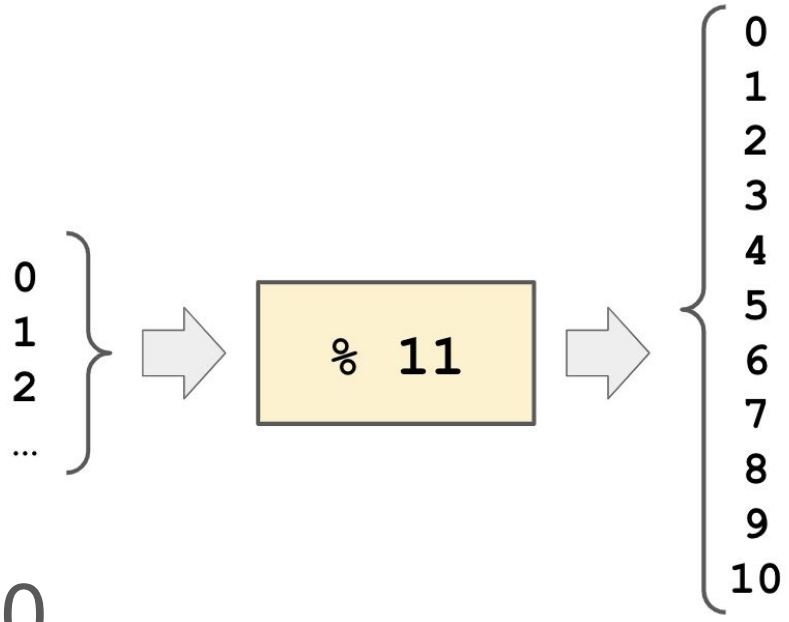
hash collision!

Hash Function

- Example #2:



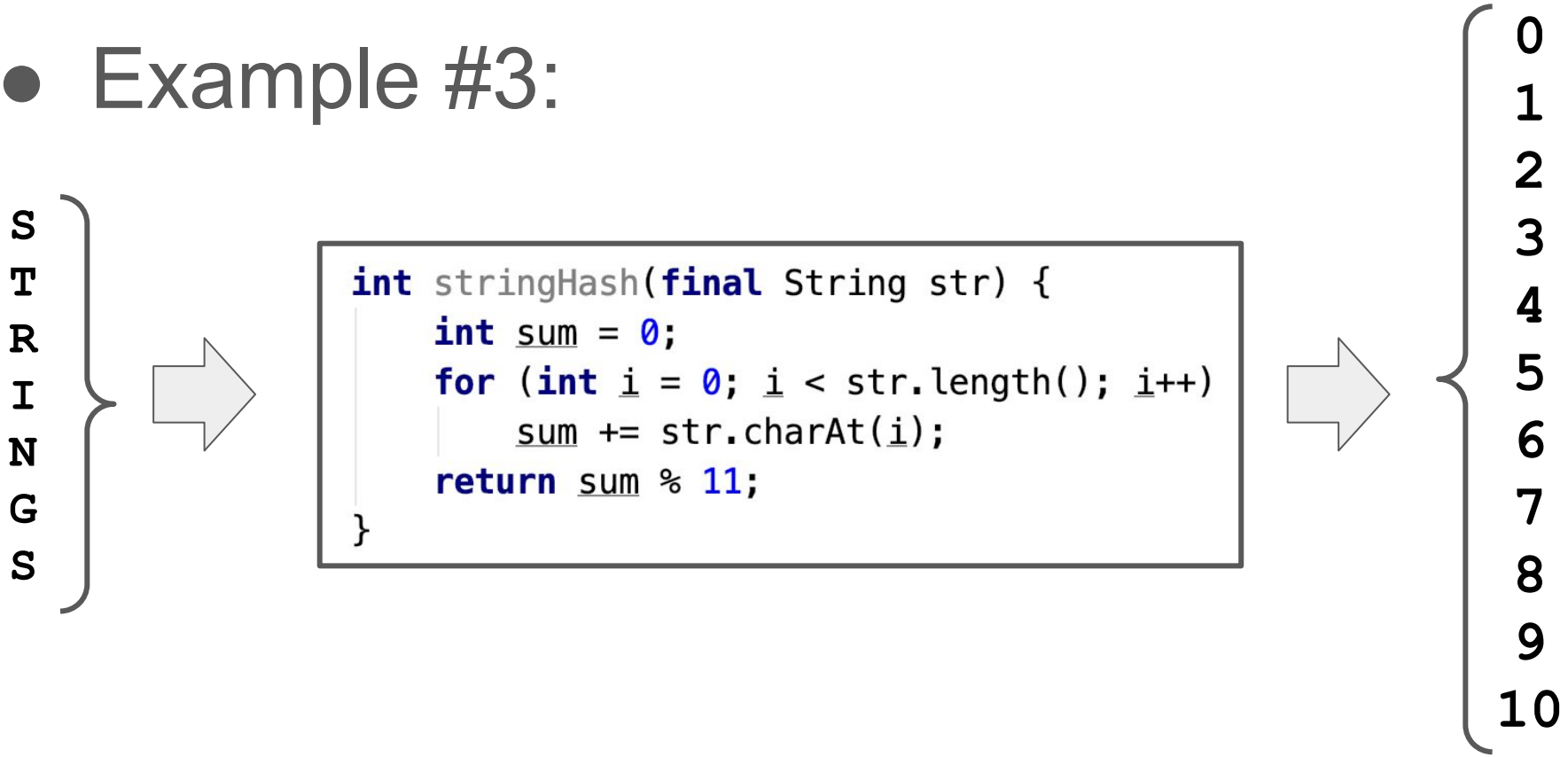
Hash Function



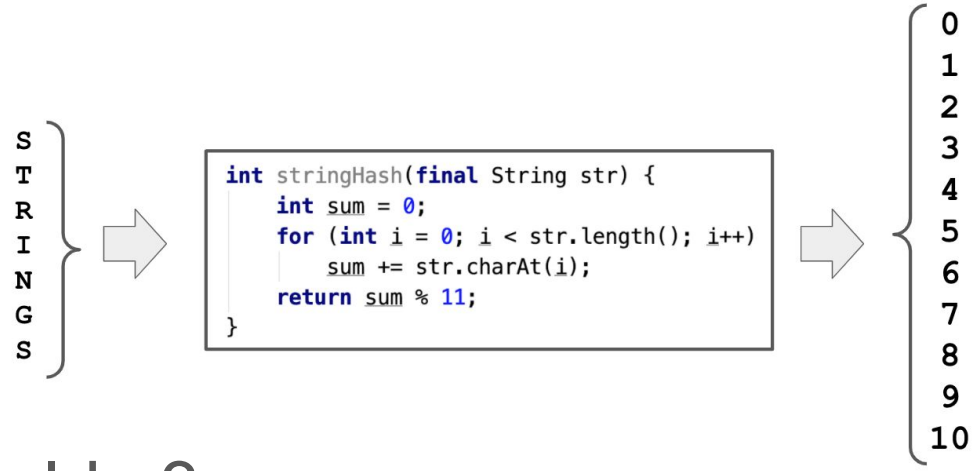
- Example #2:
  - hashing of 5 yields 5
  - hashing of 32 yields 10
  - hashing of 35 yields 3
  - hashing of 70 yields 4
  - hashing of 24593 yields 8
  - hashing of 293849585 yields 7

Hash Function

- Example #3:



Hash Function

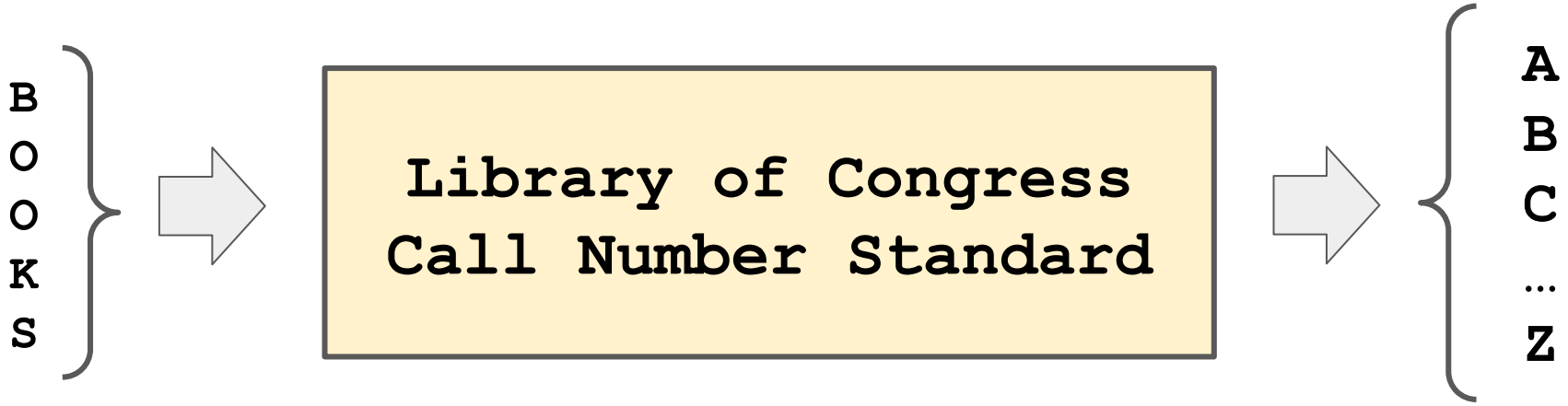


- Example #3:
  - hashing of “John” yields 3
  - hashing of “Mary” yields 2
  - hashing of “Computer Science II” yields 6
  - hashing of “Hashing is cool!” yields 0
  - hashing of “Marathon” yields 1
  - hashing of “Fortaleza” yields 1
  - hashing of “Thyago Mota” yields 8

hash collision!

Hash Function

- Example #4:



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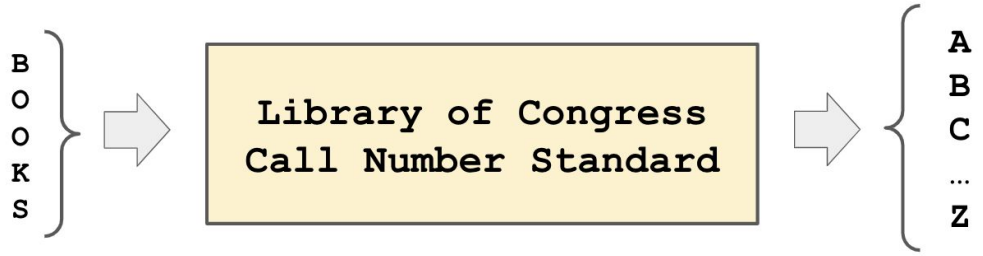
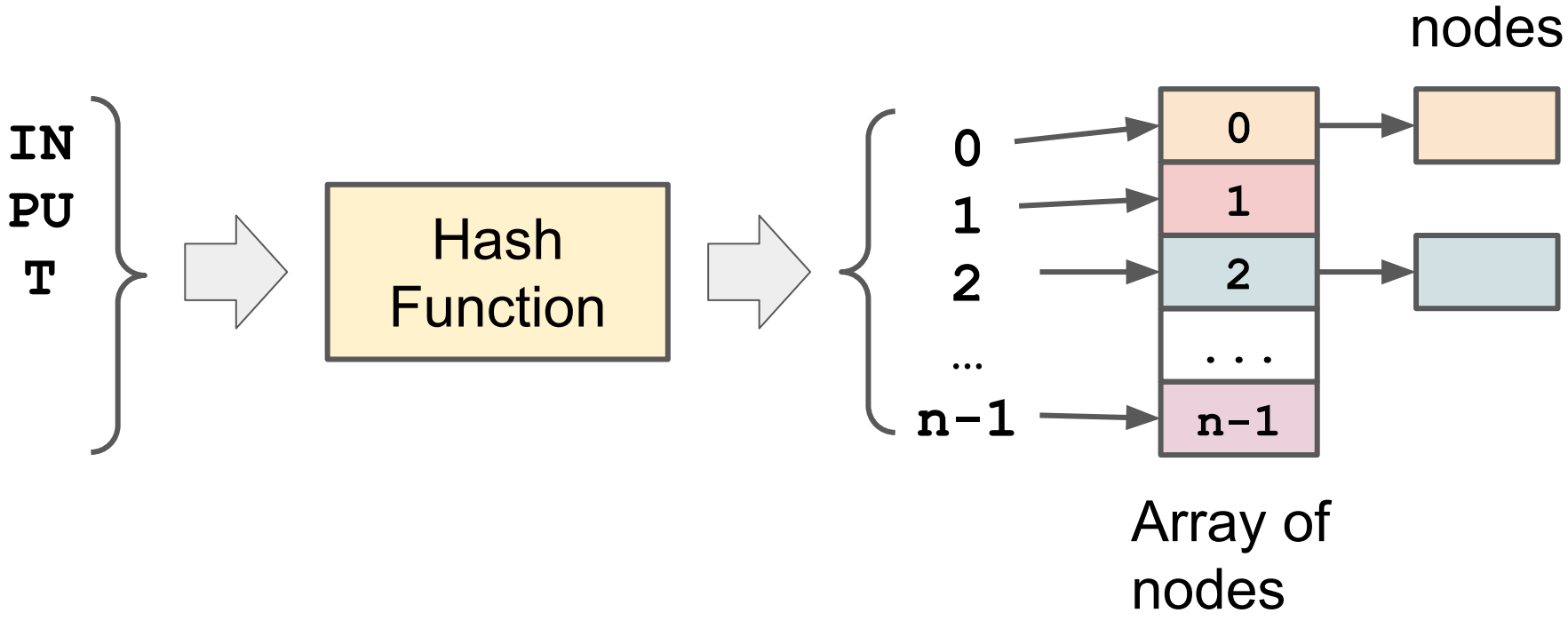
Hash Function

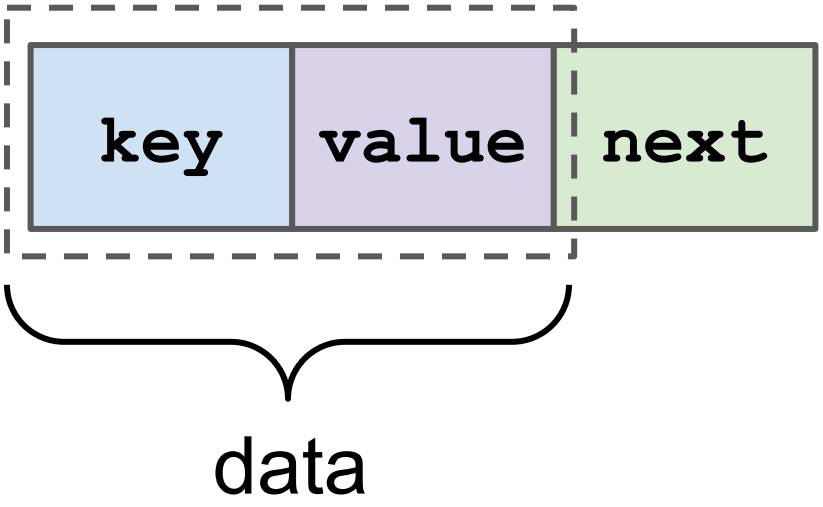


- Example #4:
  - hashing of “Seminar in Virology” maps to QR (microbiology)
  - hashing of “Head First Java” maps to QA (mathematics / computer science)
  - hashing of “History of Brazil” maps to F (history of new world)

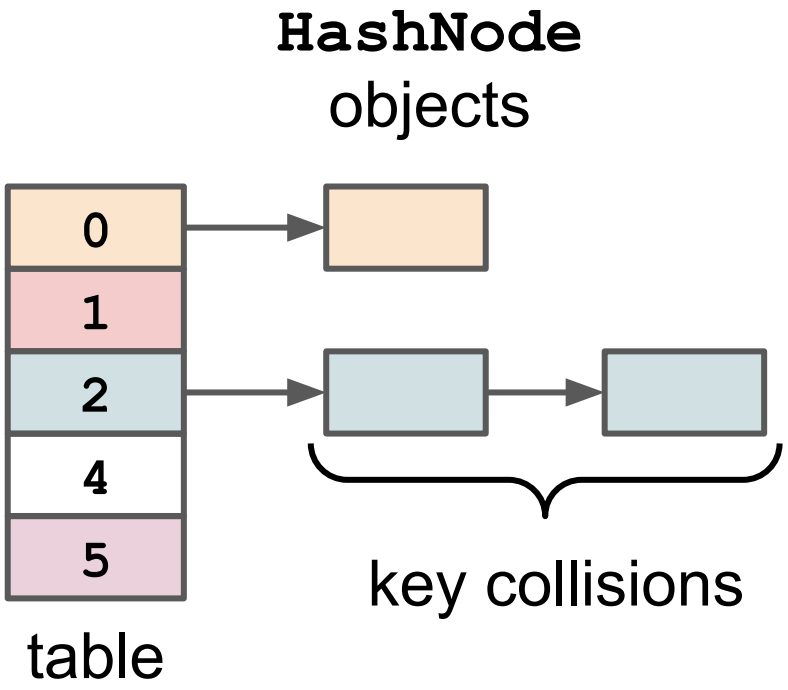
Implementation: Big Picture



Implementation: HashNode



Implementation: HashTable



Implementation: HashTable

- Constructor:
  - Creates the hash table's internal array of hash nodes
  - Important design decision:
    - size of the table
    - hash function to use

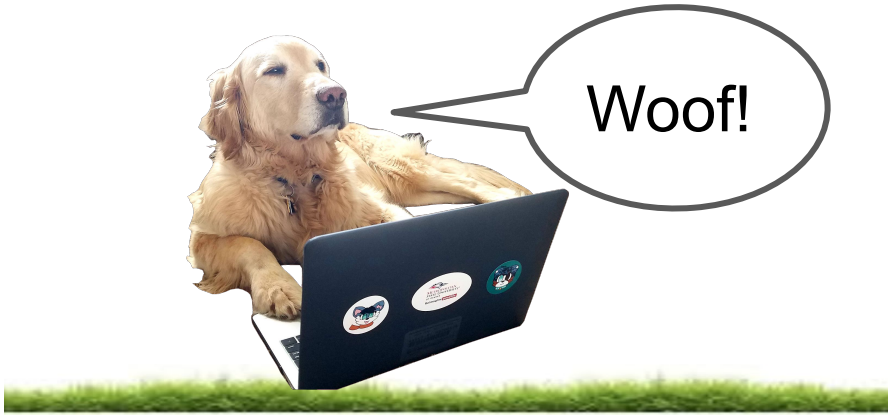
Implementation: HashTable

- Methods:
  - **`void put(key, value):`**
    - searches the hash table for the key
    - if the key is found, the new mapping should overrides the previous one
    - otherwise, a new mapping should be stored

Implementation: HashTable

- Methods:
  - **`value get(key):`**
    - searches the hash table for the key
    - if the key is found, the corresponding value is returned
    - otherwise, null is returned indicating that a mapping for the key wasn't found

HashTable



- Practice:
  - Get the code for this lesson from our GitHub repository
  - Study the code for the **`HashNode`** class
  - Finish the implementation of the **`HashTable`** class
  - Finally, run the **`HashTableDriver`** class