CISC 3115

Map

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Outline

- Discussed
  - Concept of data structure
  - Use data structures
    - List
    - Sorting and searching in lists and arrays
  - Stack
  - Queue and priority queue
  - Set
- To discuss
  - map

Outline of This Lecture

- Concept of the Map data structure
- Map in Java
- Map, HashMap, LinkedHashMap, and TreeMap
- Examples

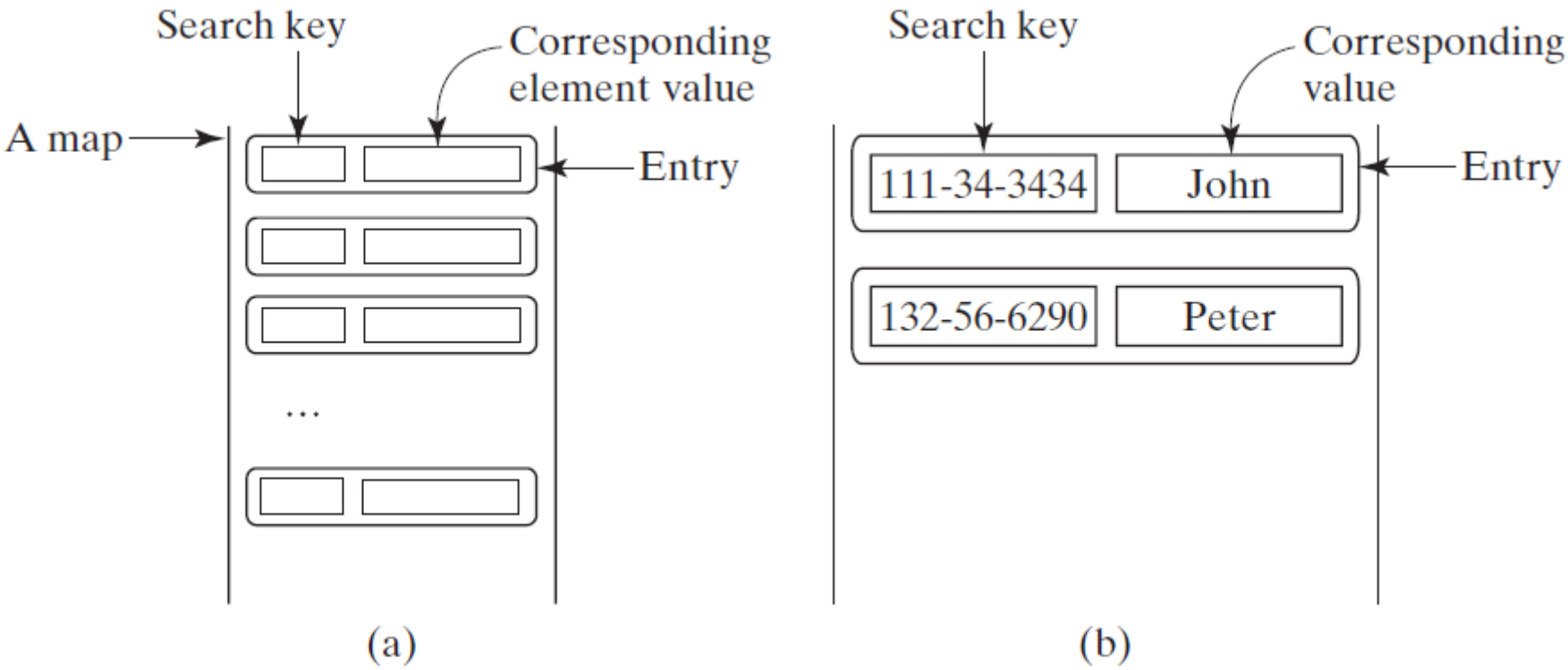
Motivation

- In many applications, we want to find an element in collection
  - Students enrolled in a class. Find a student given her or his name
  - Passengers on board an airplane. Find a passenger given her or his seat no.
- How may we do it?
  - Sequential search. Inefficient, if we do it a lot
  - Sort and binary search. Great, just remember to sort.
  - Use a map

The Map Data Structure

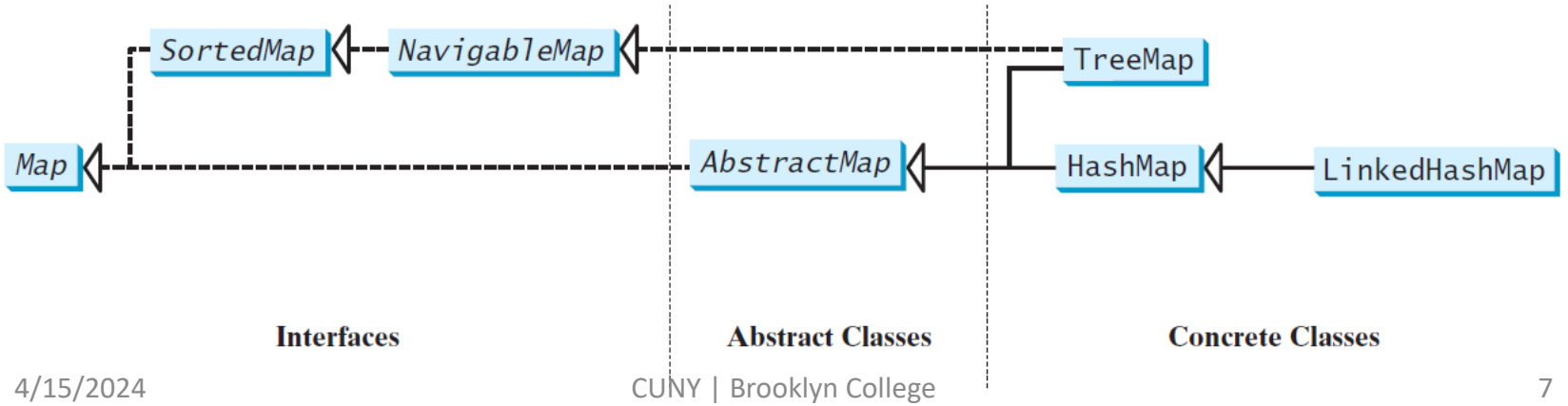
- A map maps keys to values.
- A map cannot contain duplicate keys.
- Each key can map to at most one value.
  - Note: if we remove this constraint, i.e., a key can map to more than one value, we call it a multi-set.
- Compare to List
  - In a list, the indexes are integer. It is like map an integer to the object at the index
  - In a map, it is like that indexes can be any data type. It maps an object to another.
    - Example: a student's name → a Student

Map and List

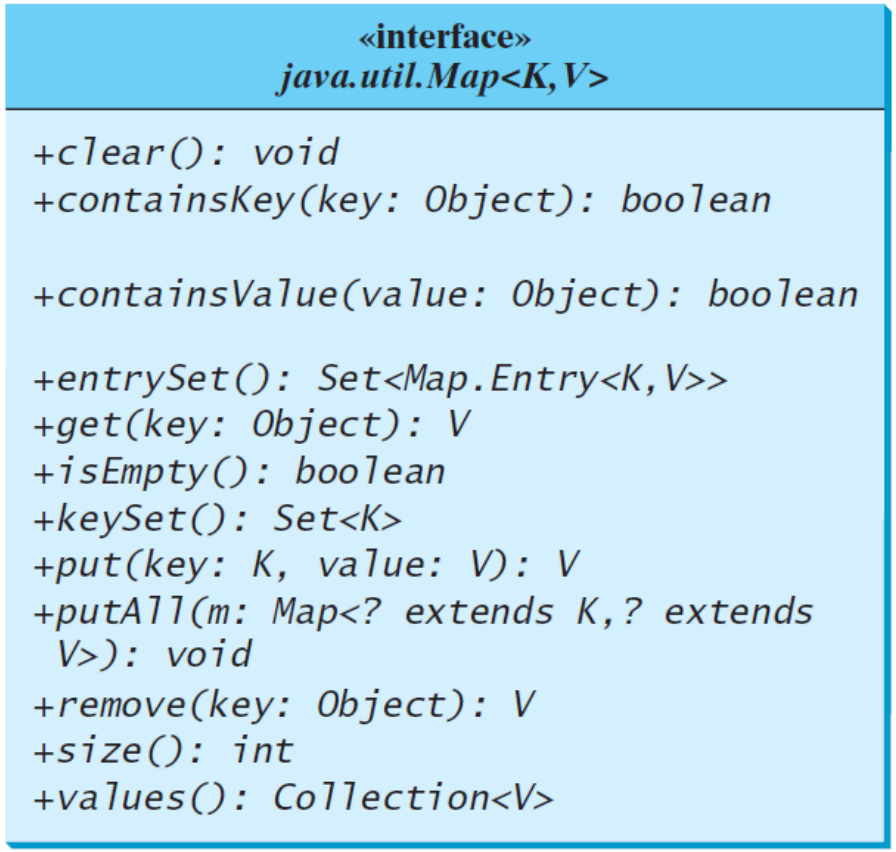

Search key
Corresponding element value
A map
Entry
...
(a)
Search key
Corresponding value
111-34-3434
John
Entry
132-56-6290
Peter
(b)

Map Interface and Type Hierarchy

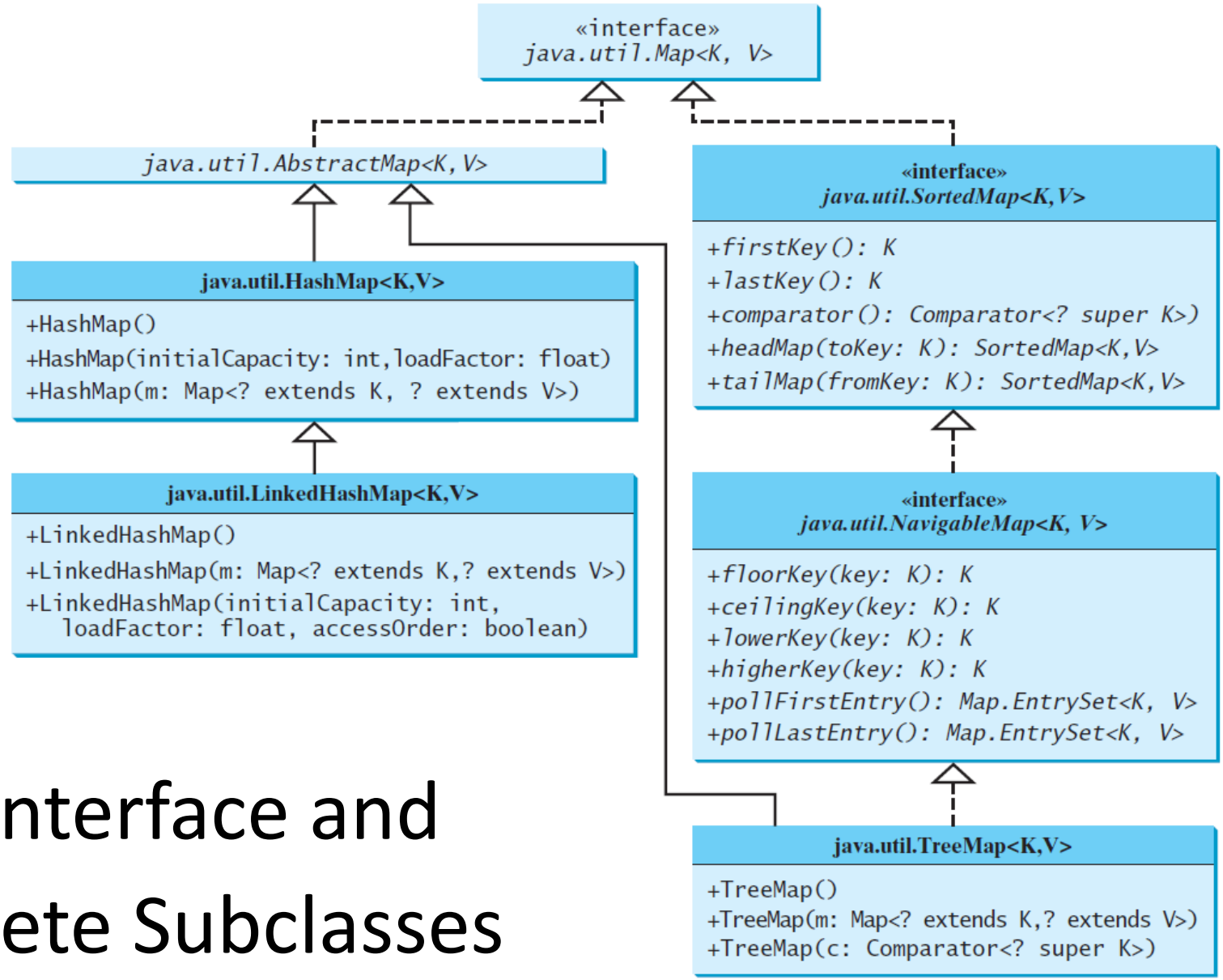
- Map: a group of objects, each of which is associated with a key.
- Must use a key to get the object from a map
- Must use a key to put the object into the map



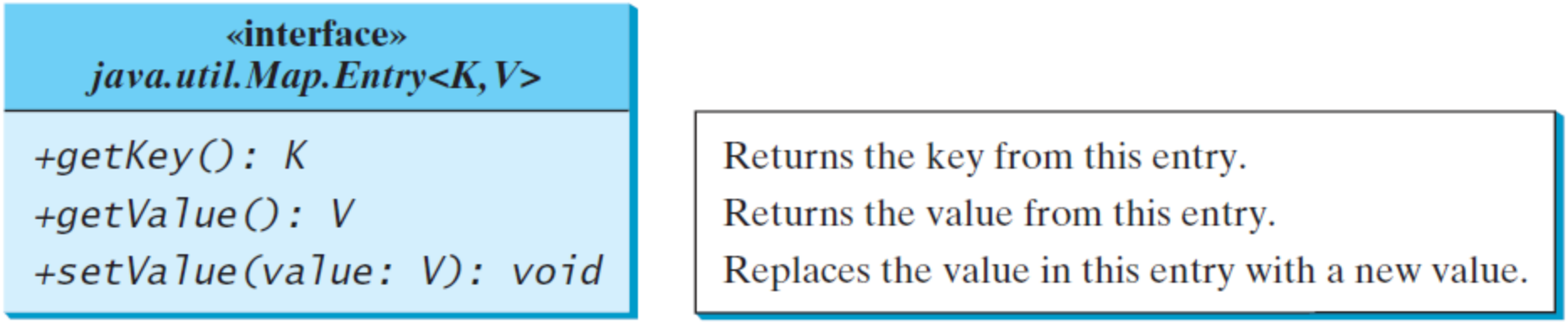
Map Interface in Java



Map Interface and Concrete Subclasses



Entry Interface



HashMap and TreeMap

- Two concrete implementations of the Map interface.
- The HashMap class is efficient for locating a value, inserting a mapping, and deleting a mapping.
- The TreeMap class, implementing SortedMap, is efficient for traversing the keys in a sorted order

LinkedHashMap

- It extends HashMap with a linked list implementation that supports an ordering of the entries in the map. T
- The entries in a HashMap are not ordered, but the entries in a LinkedHashMap can be retrieved in either insertion order or the access order
- Insertion order: the order in which they were inserted into the map
  - The no-arg constructor constructs a LinkedHashMap with the insertion order.
- Access order: the order in which they were last accessed, from least recently accessed to most recently.
  - To construct a LinkedHashMap with the access order, use the LinkedHashMap(initialCapacity, loadFactor, true)

HashMap and TreeMap: Example 1

- This example creates a hash map that maps borrowers to mortgages.
- The program first creates a hash map with the borrower's name as its key and mortgage as its value.
- The program then creates a tree map from the hash map, and displays the mappings in ascending order of the keys

HashMap and TreeMap: Example 2

- Write an application counts the occurrences of words in a text and displays the words and their occurrences in ascending order of the words.
- The program uses a hash map to store a pair consisting of a word and its count.
  - For each word, check whether it is already a key in the map. If not, add the key and value 1 to the map. Otherwise, increase the value for the word (key) by 1 in the map.
- To sort the map, convert it to a tree map.

Questions?

- Map, HashMap, LinkedHashMap, TreeMap