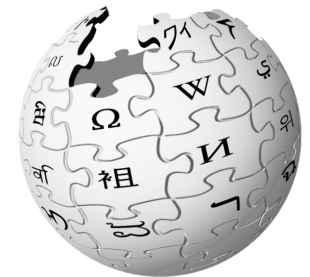


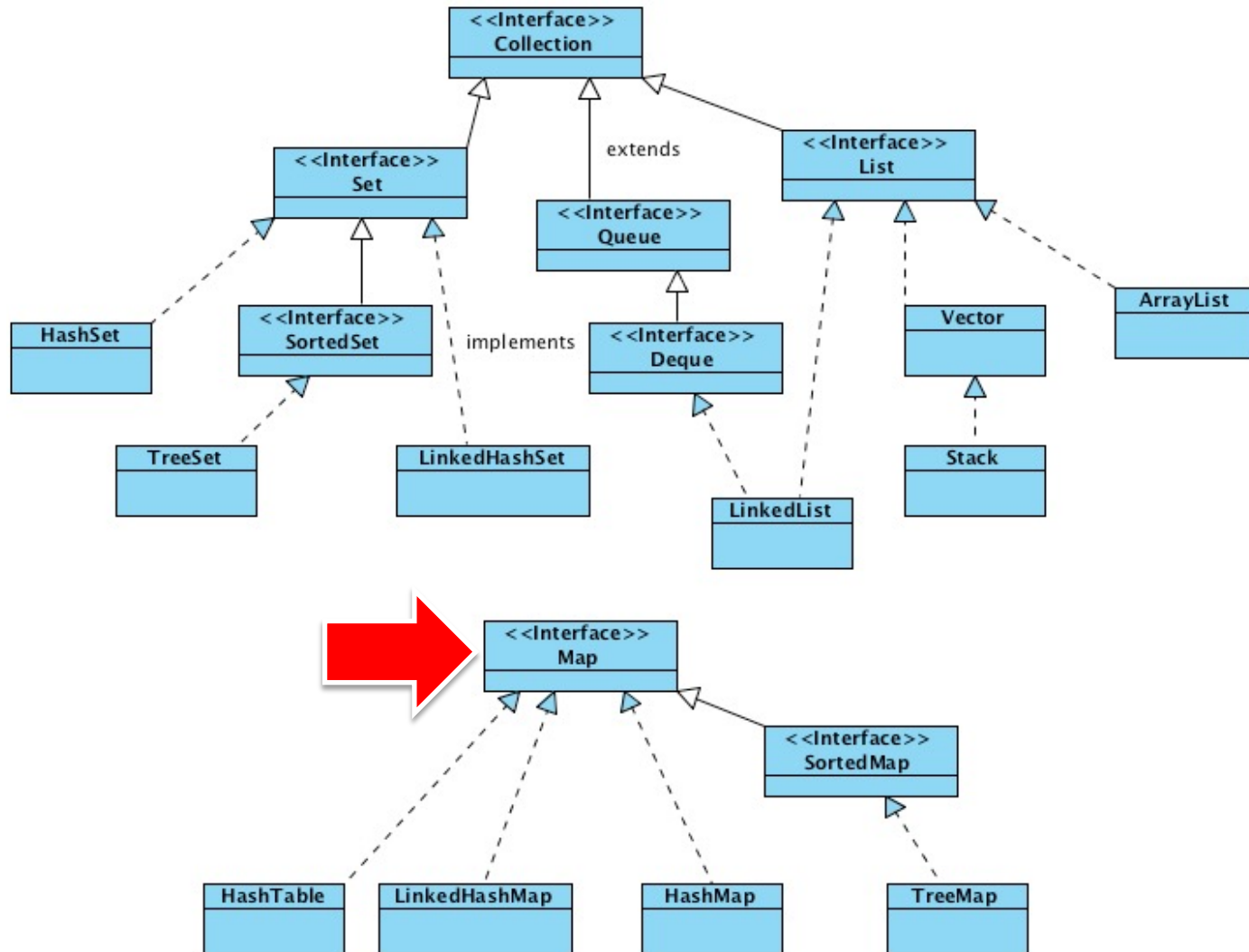
Definition

- In computer science, an **associative array**, **map**, or **dictionary** is an abstract data type composed of (key, value) pairs, such that each key appears at most once
- Modern programming languages natively supports them
E.g. Perl, Python, Ruby, Go
- Implemented through hash tables or tree data structure

```
V1[42] = "h2g2"  
V2["h2g2"] = 42
```



Java Collection Framework





Map interface

Map<K,V>

- K: the type of keys maintained by this map
- V: the type of mapped values

Add/remove elements

- value **put**(key, value)
- value **remove**(key)

Search

- boolean **containsKey**(key)
- boolean **containsValue**(value)



Map interface (cont.)

□ Nested Class

- `Map.Entry<K,V>`

- A map entry (key-value pair).

□ `Set<Map.Entry<K,V>> entrySet()`

- Returns a **Set view** of the mappings contained in this map

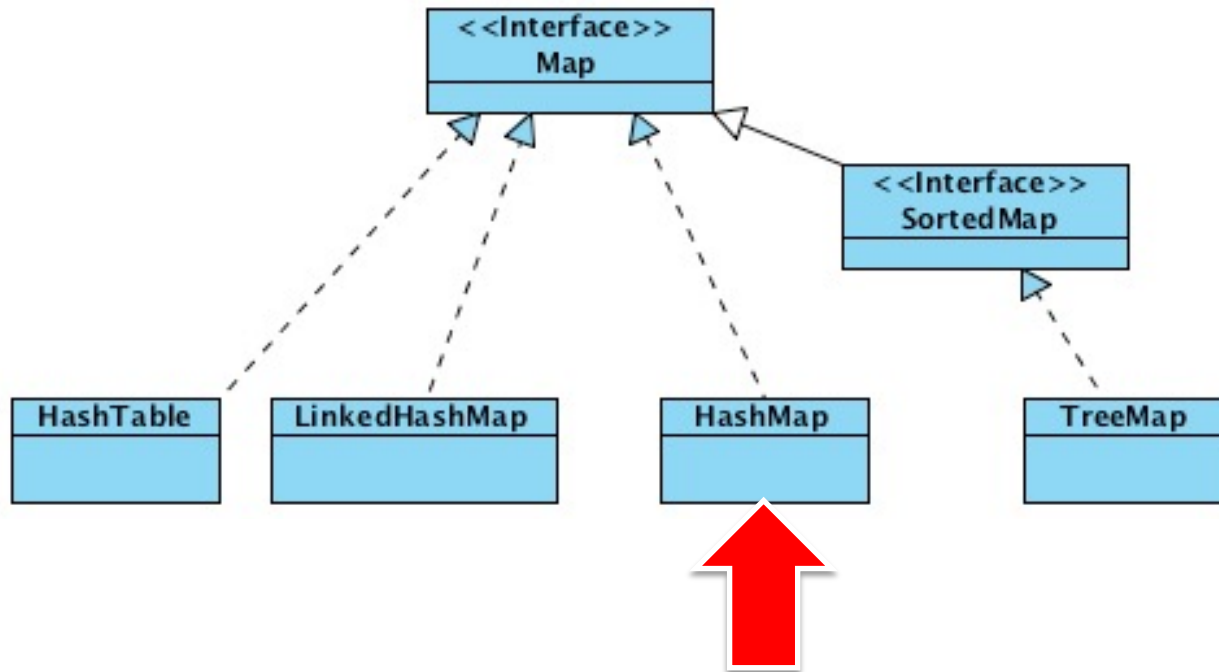
□ `Set<K> keySet()`

- Returns a **Set view** of the keys contained in this map

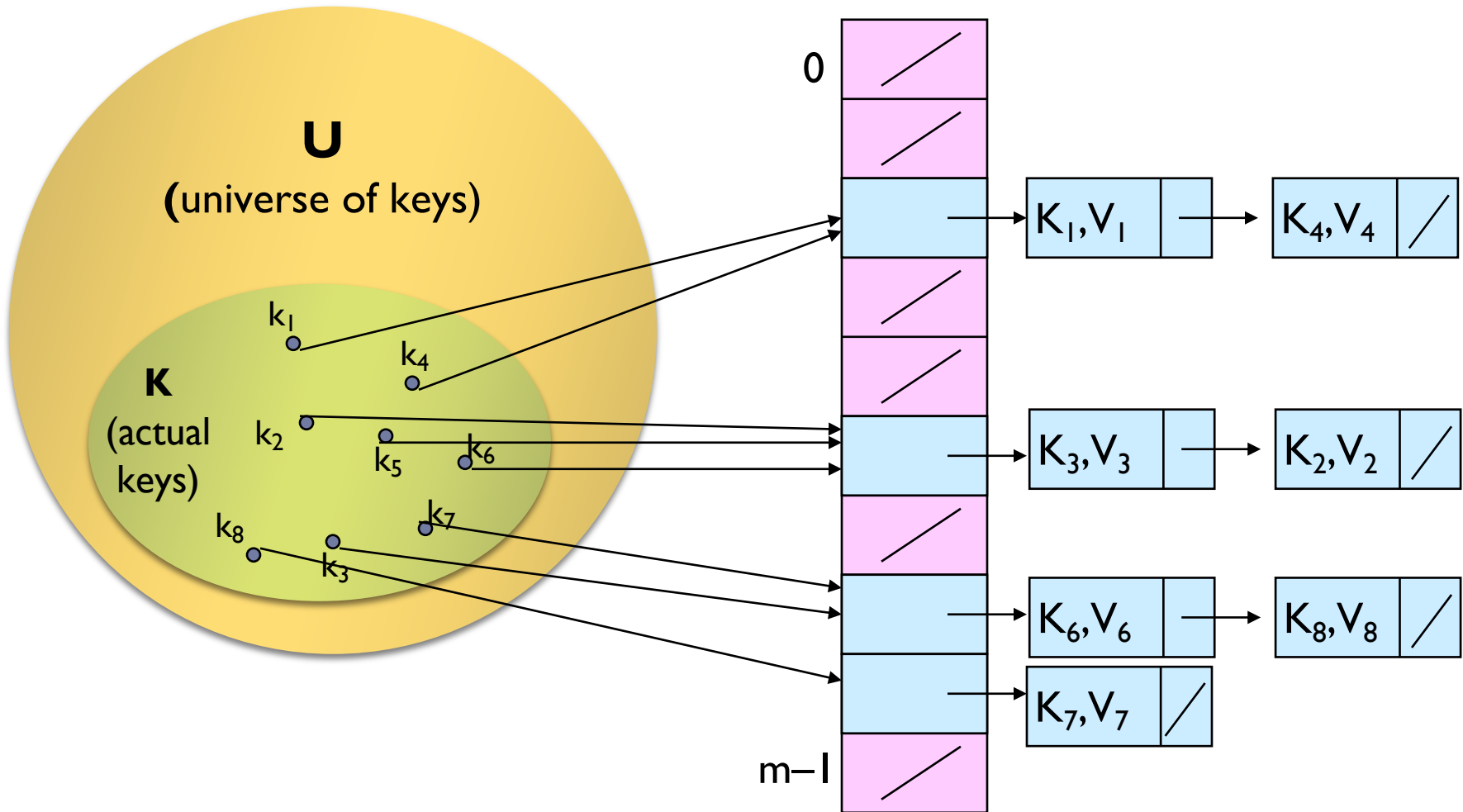
□ `Collection<V> values()`

- Returns a **Collection** view of the values contained in this map

HashMap



HashMap and Chaining



HashMap and Chaining

- Non duplicated keys (values could be duplicated)
 - Chaining is not used to store multiple keys with the same value. Each key should be unique
 - Chaining is used to solve the collision problem.





HashMap

- ❑ Non duplicated keys (values could be duplicated)
- ❑ Not ordered (neither sorted)

- ❑ Implementation is based on a hash table
 - ❑ Operations *put(k, v)*, *get(k)*, *remove(k)*, *containsKey(k)* are immediate

- ❑ Requires to override *hashCode()* & *equals()*
- ❑ Key object must be immutable



HashMap vs HashSet

- ❑ HashMap allows to insert key-value pairs. Each key is associated to a value

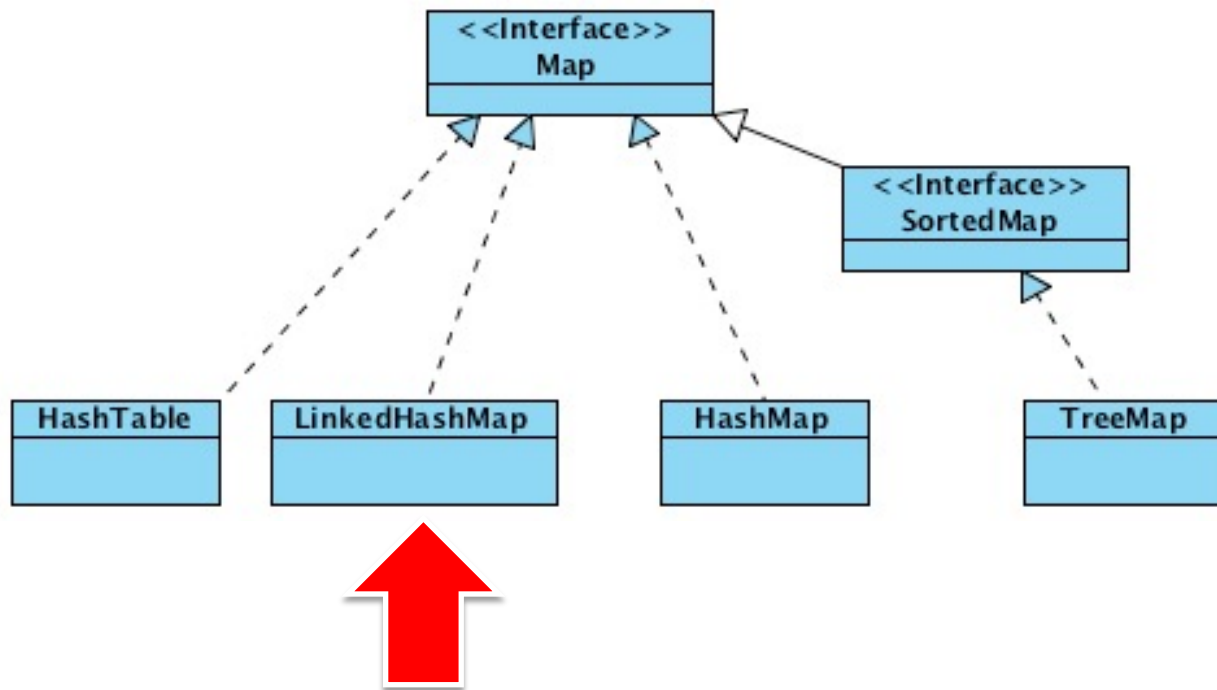
- ❑ HashSet allows to insert an object in a collection of objects. The object itself (or part of it) is the key

- ❑ Similarities:
 - ❑ Do not accept duplicated key
 - ❑ Not ordered (neither sorted)
 - ❑ Implementation is based on a hash table
 - ❑ Requires to override hashCode() & equals() for the Key object
 - ❑ Key object must be immutable (at least for the field used in hashCode() and equals())

HashMap operations

| | HashMap |
|-----------------------|------------------|
| put(key, object) | IMMEDIATE |
| get(key) | IMMEDIATE |
| remove(key) | IMMEDIATE |
| containsKey(key) | IMMEDIATE |
| containsValue(object) | SLUGGISH |

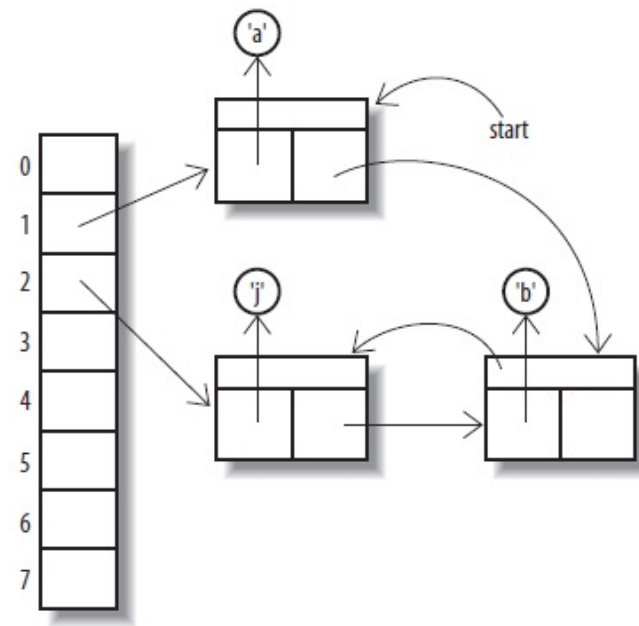
LinkedHashMap










LinkedHashMap

- Implementation is based on a hash table and a double-linked list running through all of its entries:
 - Operations $put(k, v)$, $get(k)$, $remove(k)$, $containsKey(k)$ are immediate
- Non duplicated keys
 - Values could be duplicated
- Ordered (usually insertion-order)
 - Insertion order is not affected a key is re-inserted
- Not sorted



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