

CS062

DATA STRUCTURES AND ADVANCED PROGRAMMING

17: Dictionaries



Alexandra Papoutsaki
she/her/hers

Lecture 17: Dictionaries

- ▶ Dictionaries

Dictionaries

- ▶ Also known as: symbol tables, maps, indices, associative arrays.
- ▶ Key-value pair abstractions that support two operations:
 - ▶ **Insert** a key-value pair.
 - ▶ Given a key, **search** for the corresponding value.
- ▶ Supported either with built-in or external libraries by the majority of programming languages.

Basic dictionary API

- ▶ `public class Dictionary <Key extends Comparable<Key>, Value>`
- ▶ `Dictionary()`: create an empty dictionary. By convention, values are not null.
- ▶ `void put(Key key, Value val)`: insert key-value pair.
 - ▶ Overwrites old value with new value if key already exists.
- ▶ `Value get(Key key)`: return value associated with key.
 - ▶ Returns null if key not present.
- ▶ `boolean contains(Key key)`: is there a value associated with key?
- ▶ `Iterable keys()`: all the keys in the dictionary.
- ▶ `void delete(Key key)`: delete key and associated value.
- ▶ `boolean isEmpty()`: is the dictionary empty?
- ▶ `int size()`: number of key-value pairs.

Ordered dictionaries

```

                                keys      values
                                -----
min() → 09:00:00 Chicago
        09:00:03 Phoenix
        09:00:13 Houston
get(09:00:13) → 09:00:59 Chicago
               09:01:10 Houston
floor(09:05:00) → 09:03:13 Chicago
                 09:10:11 Seattle
select(7) → 09:10:25 Seattle
            09:14:25 Phoenix
            09:19:32 Chicago
            09:19:46 Chicago
keys(09:15:00, 09:25:00) → 09:21:05 Chicago
                           09:22:43 Seattle
                           09:22:54 Seattle
                           09:25:52 Chicago
ceiling(09:30:00) → 09:35:21 Chicago
                  09:36:14 Seattle
max() → 09:37:44 Phoenix

size(09:15:00, 09:25:00) is 5
rank(09:10:25) is 7

```

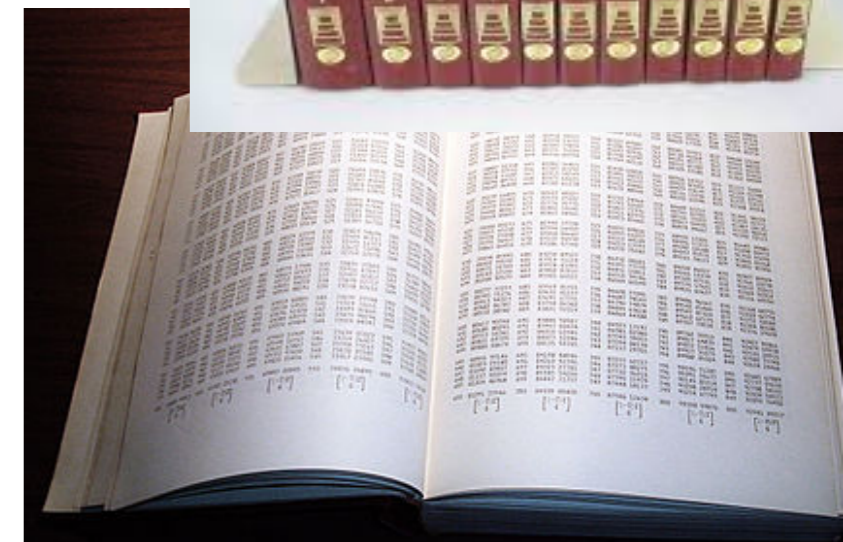
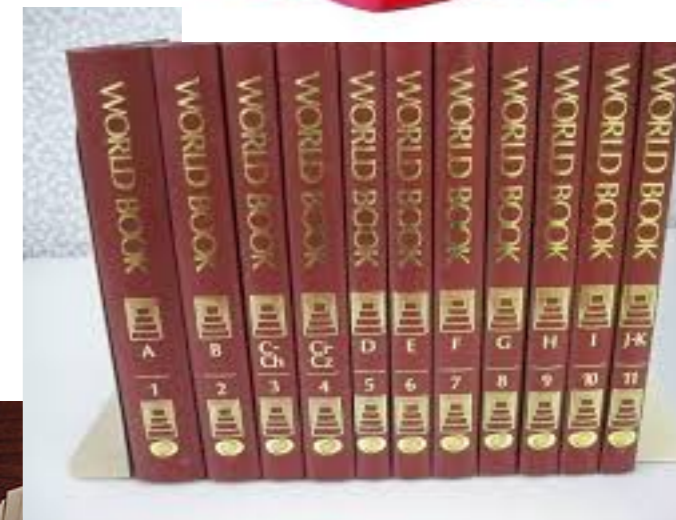
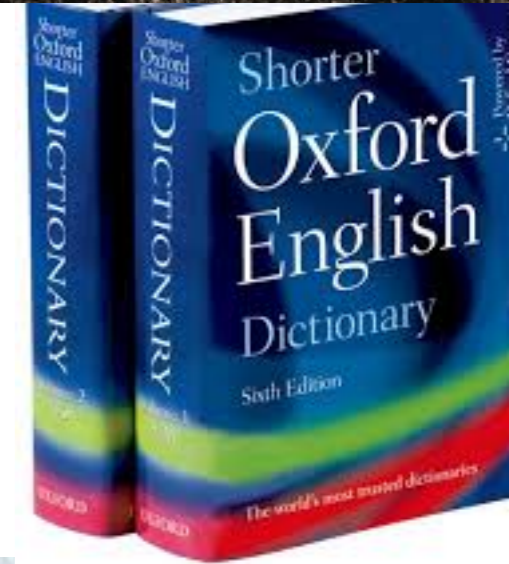
Ordered dictionary API

- ▶ `Key min()`: smallest key.
- ▶ `Key max()`: largest key.
- ▶ `Key floor(Key key)`: largest key less than or equal to given key.
- ▶ `Key ceiling(Key key)`: smallest key greater than or equal to given key.
- ▶ `int rank(Key key)`: number of keys less than given key.
- ▶ `Key select(int k)`: key with rank `k`.
- ▶ `Iterable keys()`: all keys in dictionary in sorted order.
- ▶ `Iterable keys(int lo, int hi)`: keys in `[lo, ..., hi]` in sorted order.

DICTIONARIES

Printed dictionaries are all around us

- ▶ **Dictionary:** key = word, value = definition.
- ▶ **Encyclopedia:** key = term, value = article.
- ▶ **Phonebook:** key = name, value = phone number.
- ▶ **Math table:** key = math functions and input, value = function output.
- ▶ **Unsupported operations:**
 - ▶ Add a new key and associated value.
 - ▶ Remove a given key and associated value.
 - ▶ Change value associated with a given key.



Readings:

- ▶ Recommended Textbook: Chapters 3.1 (Pages 362–386)
- ▶ Website:
 - ▶ <https://algs4.cs.princeton.edu/31elementary/>

Practice Problems:

- ▶ 3.1.1-3.1.6