Dictionaries

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UW CSE 160

Spring 2018
Dictionaries or mappings

- A dictionary maps each key to a value
- Order does not matter
- Given a key, can look up a value
  - Given a value, cannot look up its key
- No duplicate keys
  - Two or more keys may map to the same value
- Keys and values are Python values
  - Keys must be immutable (not a list, set, or dict)
- Can add key → value mappings to a dictionary
  - Can also remove (less common)
Dictionary syntax in Python

```python
# Two different ways to create an empty dictionary

d = {}  # First way

d = dict()  # Second way

us_wars_by_end = {
    1783: "Revolutionary",
    1848: "Mexican",
    1865: "Civil"
}

us_wars_by_name = {
    "Civil": [1861, 1865],
    "Mexican": [1846, 1848],
    "Revolutionary": [1775, 1783]
}

• Syntax just like lists, for accessing and setting:

us_wars_by_end[1783] => 1783 → “Revolutionary”
us_wars_by_end[1783][1:10] => 1848 → “Mexican”
us_wars_by_name["WWI"] = [1917, 1918] => 1865 → “Civil”
```

See in python tutor
Creating a dictionary

```python
>>> state_capitals = {"GA" : "Atlanta", "WA": "Olympia" }

>>> phonebook = dict()
>>> phonebook["Alice"] = "206-555-4455"
>>> phonebook["Bob"] = "212-555-2211"

>>> atomic_number = {}
>>> atomic_number["H"] = 1
>>> atomic_number["Fe"] = 26
>>> atomic_number["Au"] = 79
```

“GA” → “Atlanta”
“WA” → “Olympia”
“Alice” → “206-555-4455”
“Bob” → “212-555-2211”
“H” → 1
“Fe” → 26
“Au” → 79
Accessing a dictionary

```python
>>> atomic_number = {"H":1, "Fe":26, "Au":79}
>>> atomic_number["Au"]
79
>>> atomic_number["B"]
Traceback (most recent call last):
  File "<pyshell#102>", line 1, in <module>
    atomic_number["B"]
KeyError: 'B'
>>> atomic_number.has_key("B")
False
>>> atomic_number.keys()
['H', 'Au', 'Fe']
>>> atomic_number.values()
[1, 79, 26]
>>> atomic_number.items()
[('H', 1), ('Au', 79), ('Fe', 26)]
```

"H" → 1
"Fe" → 26
"Au" → 79

Good for iteration (for loops)

```python
for key in mymap.keys():
    val = mymap[key]
    ... use key and val

for key in mymap:
    val = mymap[key]
    ... use key and val

for (key,val) in mymap.items():
    ... use key and val
```
Iterating through a dictionary

```python
atomic_number = {"H":1, "Fe":26, "Au":79}

# Print out all the keys:
for element_name in atomic_number.keys():
    print element_name

# Another way to print out all the keys:
for element_name in atomic_number:
    print element_name

# Print out all the values:
for element_number in atomic_number.values():
    print element_number

# Print out the keys and the values
for (element_name, element_number) in atomic_number.items():
    print "name:“, element_name, "number:“, element_number
```
Modifying a dictionary

us_wars1 = {
    "Revolutionary" : [1775, 1783],
    "Mexican" : [1846, 1848],
    "Civil" : [1861, 1865] }

us_wars1["WWI"] = [1917, 1918]  # add mapping
del us_wars1["Civil"]  # remove mapping

See in python tutor
Dictionary Exercises

• What does this do?

  squares = { 1:1, 2:4, 3:9, 4:16 }
  squares[3 + 3]
  squares[2 + 2]

• Convert a list to a dictionary:
  • Given [5, 6, 7], produce {5:25, 6:36, 7:49}

• Reverse key with value in a dictionary:
  – Given {5:25, 6:36, 7:49}, produce {25:5, 36:6, 49:7}
Dictionary Exercise (Answers)

• Convert a list to a dictionary:
  – E.g. Given [5, 6, 7], produce {5:25, 6:36, 7:49}
  
    ```python
    d = {}
    for i in [5, 6, 7]:  # or range(5, 8)
        d[i] = i * i
    ```

• Reverse key with value in a dictionary:
  – E.g. Given {5:25, 6:36, 7:49}, produce {25:5, 36:6, 49:7}
  
    ```python
    k ={}
    for i in d.keys():
        k[d[i]] = i
    ```
A list is like a dictionary

• A list maps an integer to a value
  – The integers must be a continuous range 0..i

```python
mylist = ['a', 'b', 'c']
mylist[1] => 'b'
mylist[3] = 'c'  # error!
```

• In what ways is a list more convenient than a dictionary?
• In what ways is a list less convenient than a dictionary?
Not every value is allowed to be a key in a dictionary

• Keys must be immutable values
  – int, float, bool, string, tuple of immutable types
  – not: list, set, dictionary

• The dictionary itself is mutable (e.g. we can add and remove elements)

• Goal: only dictionary operations change the keyset
  – after “mydict[x] = y”, mydict[x] ⇒ y
  – if a == b, then mydict[a] == mydict[b]

These conditions should hold until mydict is changed

• Mutable keys can violate these goals