Dictionaries

BBM 101 - Introduction to Programming I

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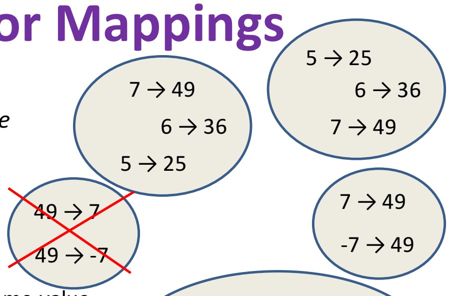
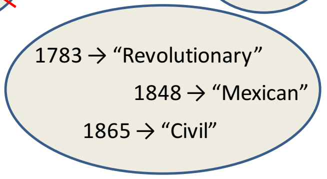
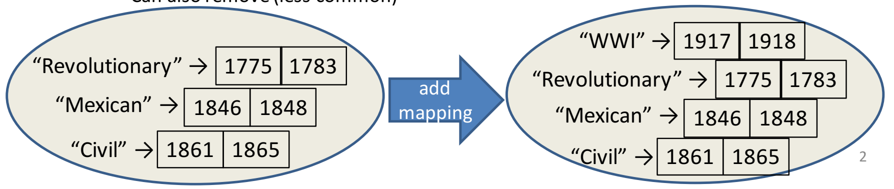
Slides based on material prepared by Ruth Anderson, Michael Ernst and Bill Howe in the course CSE 140 University of Washington

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)







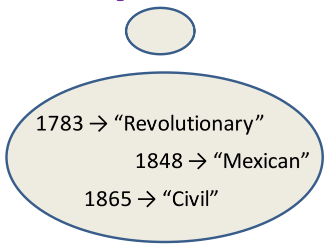
Dictionary Syntax in Python

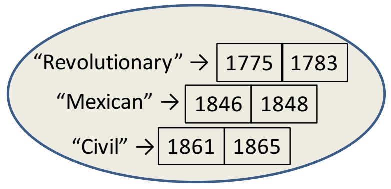
```
d = { }
d = dict()
```

Two different ways to create an empty dictionary

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

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



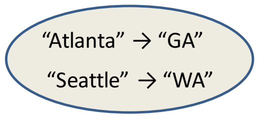


Syntax just like arrays, for accessing and setting:

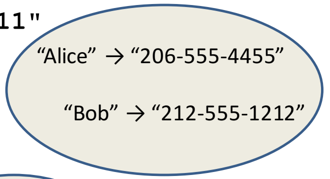
```
us_wars_by_end[1783]       ⇒
us_wars_by_end[1783][1:10]    ⇒
us_wars_by_name["WWI"] = [1917, 1918]
```

Creating a Dictionary

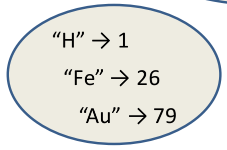
```
>>> state = {"Atlanta" : "GA", "Seattle" : "WA"}
```



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

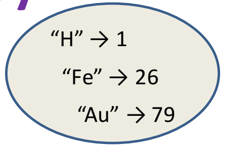


```
>>> atomicnumber = {}
>>> atomicnumber["H"] = 1
>>> atomicnumber["Fe"] = 26
>>> atomicnumber["Au"] = 79
```



Accessing a Dictionary

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



Good for iteration (for loops)

```
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

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

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

```
H
Fe
Au
```

```
# Another way to print out all the keys:
for element_name in atomicnumber:
    print(element_name)
```

```
H
Fe
Au
```

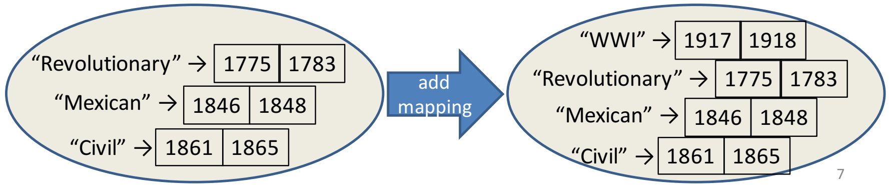
```
# Print out the keys and the values
for (element_name, element_number) in atomicnumber.items():
    print("name:",element_name, "number:",element_number)
```

```
name:  H number:  1
name:  Fe number:  26
name:  Au number:  79
```

Modifying a Dictionary

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

us_wars1["WWI"] = [1917, 1918]    # add mapping
us_wars1.pop("Mexican”)           # remove mapping
```



Dictionary Exercises

- 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}
- What does this do?

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

Dictionary Exercise Solutions

- Convert a list to a dictionary:
  - E.g. Given [5, 6, 7], produce {5:25, 6:36, 7:49}

```
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}

```
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*

```
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 - 1

- Keys must be immutable values
  - int, float, bool, string, *tuple*
  - *not*: list, set, dictionary
- 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** itself is changed

Not Every Value is Allowed to be a Key - 2

- Mutable keys can violate these goals

```
list1 = ["a", "b"]
list2 = list1
list3 = ["a", "b"]
mydict = {}
mydict[list1] = "z"      ⇐ Hypothetical; actually illegal in Python
mydict[list3]  ⇒ "z"
list2.append("c")
mydict[list1]  ⇒ ???
mydict[list3]  ⇒ ???
```