

# Dictionaryes

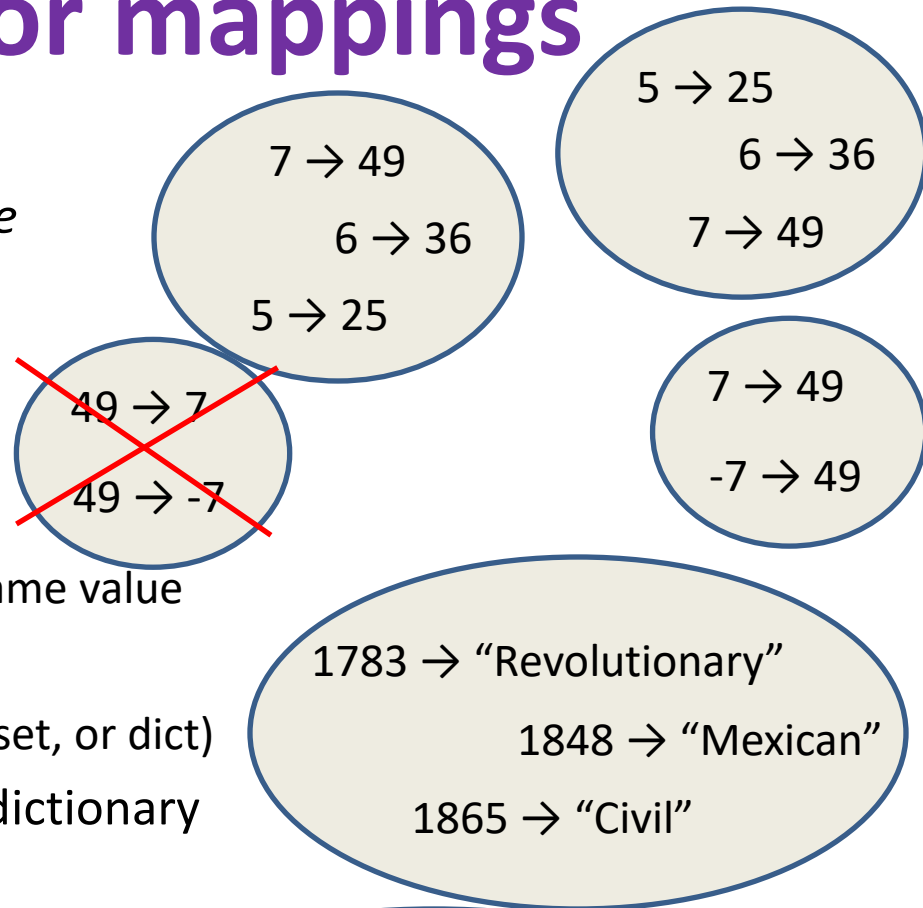
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# Dictionaries or mappings

- 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)



"Revolutionary" → 1775 | 1783

"Mexican" → 1846 | 1848

"Civil" → 1861 | 1865

add  
mapping

"WWI" → 1917 | 1918

"Revolutionary" → 1775 | 1783

"Mexican" → 1846 | 1848

"Civil" → 1861 | 1865

# 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 lists, for accessing and setting:

```
us_wars_by_end[1783] ⇒
```

```
us_wars_by_end[1783][1:10] ⇒
```

```
us_wars_by_name["WWI"] = [1917, 1918]
```

1783 → "Revolutionary"  
1848 → "Mexican"  
1865 → "Civil"

"Revolutionary" → 

1775	1783
------	------

  
"Mexican" → 

1846	1848
------	------

  
"Civil" → 

1861	1865
------	------

# Creating a dictionary

"GA" → "Atlanta"

"WA" → "Olympia"

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

```
>>> phonebook = dict()
```

```
>>> phonebook["Alice"] = "206-555-4455"
```

```
>>> phonebook["Bob"] = "212-555-2211"
```

"Alice" → "206-555-4455"

"Bob" → "212-555-1212"

```
>>> atomic_number = {}
```

```
>>> atomic_number["H"] = 1
```

```
>>> atomic_number["Fe"] = 26
```

```
>>> atomic_number["Au"] = 79
```

"H" → 1

"Fe" → 26

"Au" → 79

# Accessing a dictionary

```
>>> 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'**

```
>>> "Au" in atomic_number
```

**True**

```
>>> list(atomic_number.keys())
```

```
['H', 'Au', 'Fe']
```

```
>>> list(atomic_number.values())
```

```
[1, 79, 26]
```

```
>>> list(atomic_number.items())
```

```
[('H', 1), ('Au', 79), ('Fe', 26)]
```

"H" → 1

"Fe" → 26

"Au" → 79

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

```
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)
```

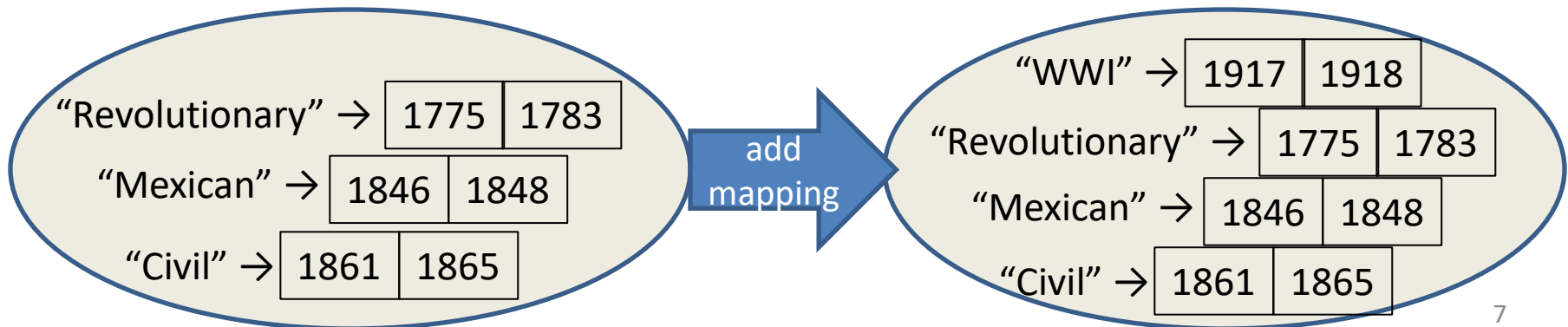
```
# Print out the keys and the values
```

```
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
```



# Dictionary Exercises

- 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]`
- 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}

```
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
```

# Aside: A list is like a dictionary

- A list maps an integer index 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 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)

# Not every value is allowed to be a key

- 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
- 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] ⇒ ???
```