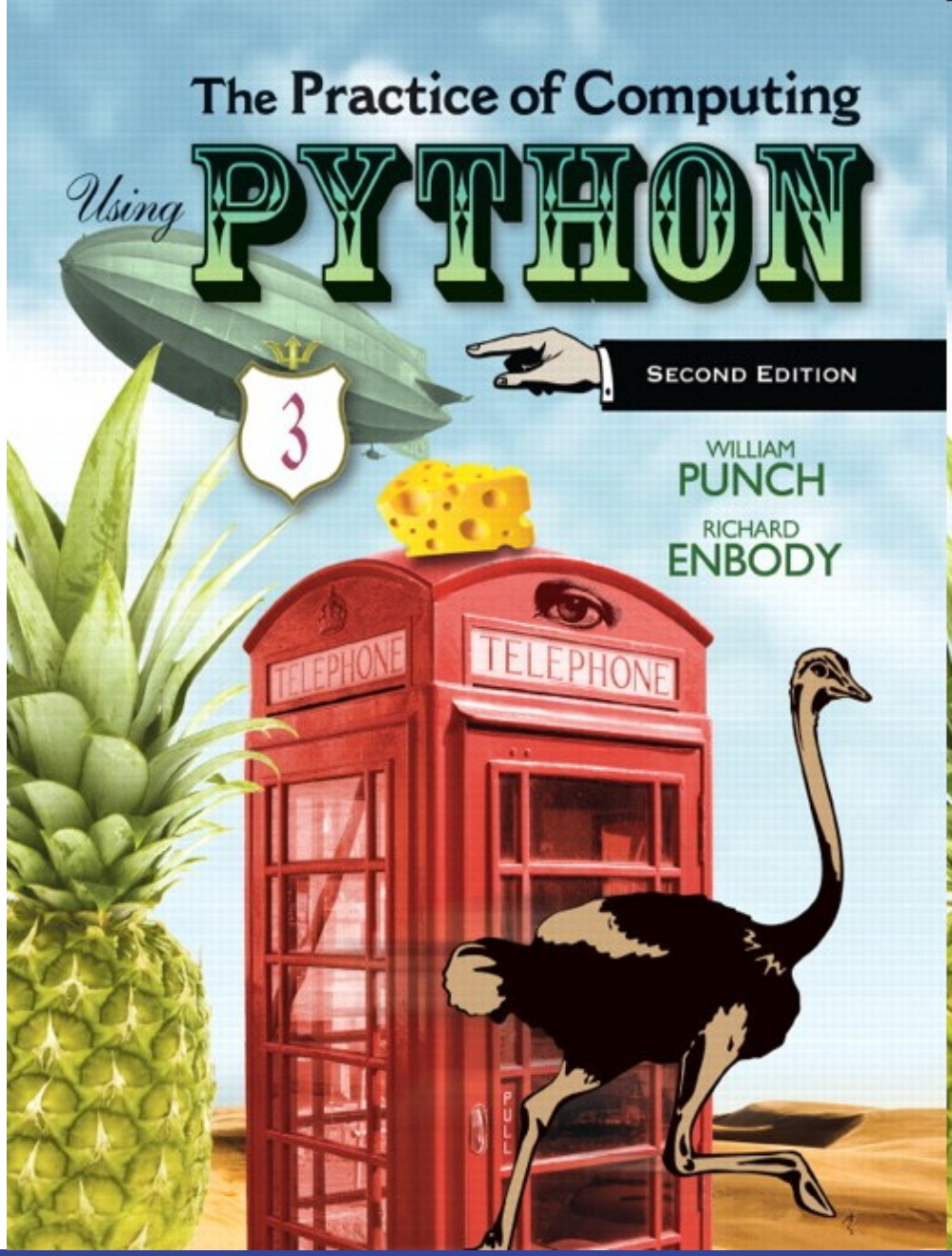
chapter 9

Dictionaries and Sets



More Data Structures

- We have seen the list data structure and what it can be used for
- We will now examine two more advanced data structures, the Set and the Dictionary
- In particular, the dictionary is an important, very useful part of python, as well as generally useful to solve many problems.

Dictionaries

What is a dictionary?

- In data structure terms, a dictionary is better termed an *associative array, associative list* or a *map*.
- You can think if it as a list of pairs, where the first element of the pair, the ***key***, is used to retrieve the second element, the ***value***.
- Thus we ***map a key to a value***

Key Value pairs

- The key acts as an index to find the associated value.
- Just like a dictionary, you look up a word by its spelling to find the associated definition
- A dictionary can be searched to locate the value associated with a key

Python Dictionary

- Use the { } marker to create a dictionary
- Use the : marker to indicate key:value pairs

```
contacts= {'bill': '353-1234',
 'rich': '269-1234', 'jane': '352-1234'}
print (contacts)
{'jane': '352-1234',
 'bill': '353-1234',
 'rich': '369-1234'}
```

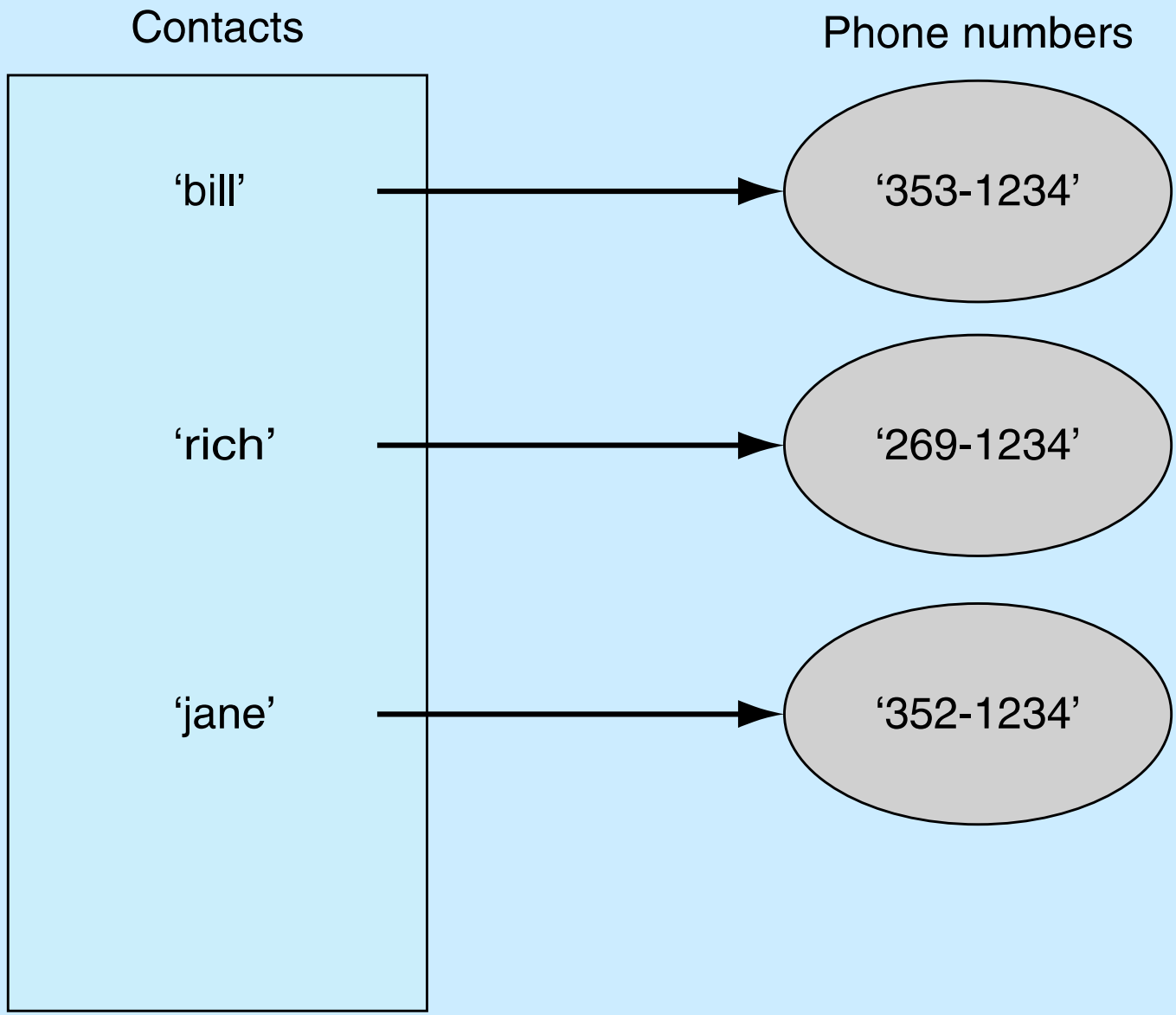
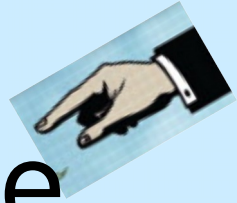


FIGURE 9.1 Phone contact list: names and phone numbers.

keys and values

- Key must be immutable
  - strings, integers, tuples are fine
  - lists are NOT
- Value can be anything



collections but not a sequence

- dictionaries are collections but they are not sequences such as lists, strings or tuples
  - there is no order to the elements of a dictionary
  - in fact, the order (for example, when printed) might change as elements are added or deleted.
- So how to access dictionary elements?

Access dictionary elements

Access requires `[ ]`, but the *key* is the index!

`my_dict={}`

- an empty dictionary

`my_dict['bill']=25`

- added the pair 'bill':25

`print(my_dict['bill'])`

- prints 25

Dictionaries are mutable

- Like lists, dictionaries are a mutable data structure
  - you can change the object via various operations, such as index assignment

```
my_dict = {'bill':3, 'rich':10}
print(my_dict['bill'])    # prints 3
my_dict['bill'] = 100
print(my_dict['bill'])    # prints 100
```

Dictionary keys can be any immutable object

```
demo = {2: ['a','b','c'], (2,4): 27, 'x': {1:2.5, 'a':3}}
demo
   {'x': {'a':3, 1:2.5}, 2: ['a','b','c'], (2,4): 27}
demo[2]
   ['a', 'b', 'c']
demo[(2,4)]
   27
demo ['x']
   {'a':3, 1: 2.5}
demo['x'][1]
   2.5
```

again, common operators

Like others, dictionaries respond to these

- `len(my_dict)`
  - number of key:value **pairs** in the dictionary
- `element in my_dict`
  - boolean, is `element` a **key** in the dictionary
- `for key in my_dict:`
  - iterates through the **keys** of a dictionary

fewer methods

Only 9 methods in total. Here are some

- `key in my_dict`

  does the key exist in the dictionary

- `my_dict.clear()` – empty the dictionary
- `my_dict.update(yourDict)` – for each key in `yourDict`, updates `my_dict` with that key/value pair
- `my_dict.copy` - shallow copy
- `my_dict.pop(key)`– remove key, return value

Dictionary content methods

- `my_dict.items()` – all the key/value pairs
- `my_dict.keys()` – all the keys
- `my_dict.values()` – all the values

There return what is called a *dictionary view*.

- the order of the views correspond
- are dynamically updated with changes
- are iterable

Views are iterable

```
for key in my_dict:
    print(key)
```

- prints all the keys

```
for key,value in my_dict.items():
    print (key,value)
```

- prints all the key/value pairs

```
for value in my_dict.values():
    print (value)
```

- prints all the values

```
my_dict = {'a':2, 3:['x', 'y'], 'joe':'smith'}
>>> dict_value_view = my_dict.values()
>>> dict_value_view                                    # a view
dict_values([2, ['x', 'y'], 'smith'])
>>> type(dict_value_view)                              # view type
<class 'dict_values'>
>>> for val in dict_value_view:                        # view iteration
        print(val)

2
['x', 'y']
smith
>>> my_dict['new_key'] = 'new_value'
>>> dict_value_view                                    # view updated
dict_values([2, 'new_value', ['x', 'y'], 'smith'])
>>> dict_key_view = my_dict.keys()
dict_keys(['a', 'new_key', 3, 'joe'])
>>> dict_value_view
dict_values([2, 'new_value', ['x', 'y'], 'smith']) # same order
>>>
```

Frequency of words in list 3 ways

membership test

```
count_dict = {}
for word in word_list:
    if word in count_dict:
        count_dict[word] += 1
    else:
        count_dict[word] = 1
```

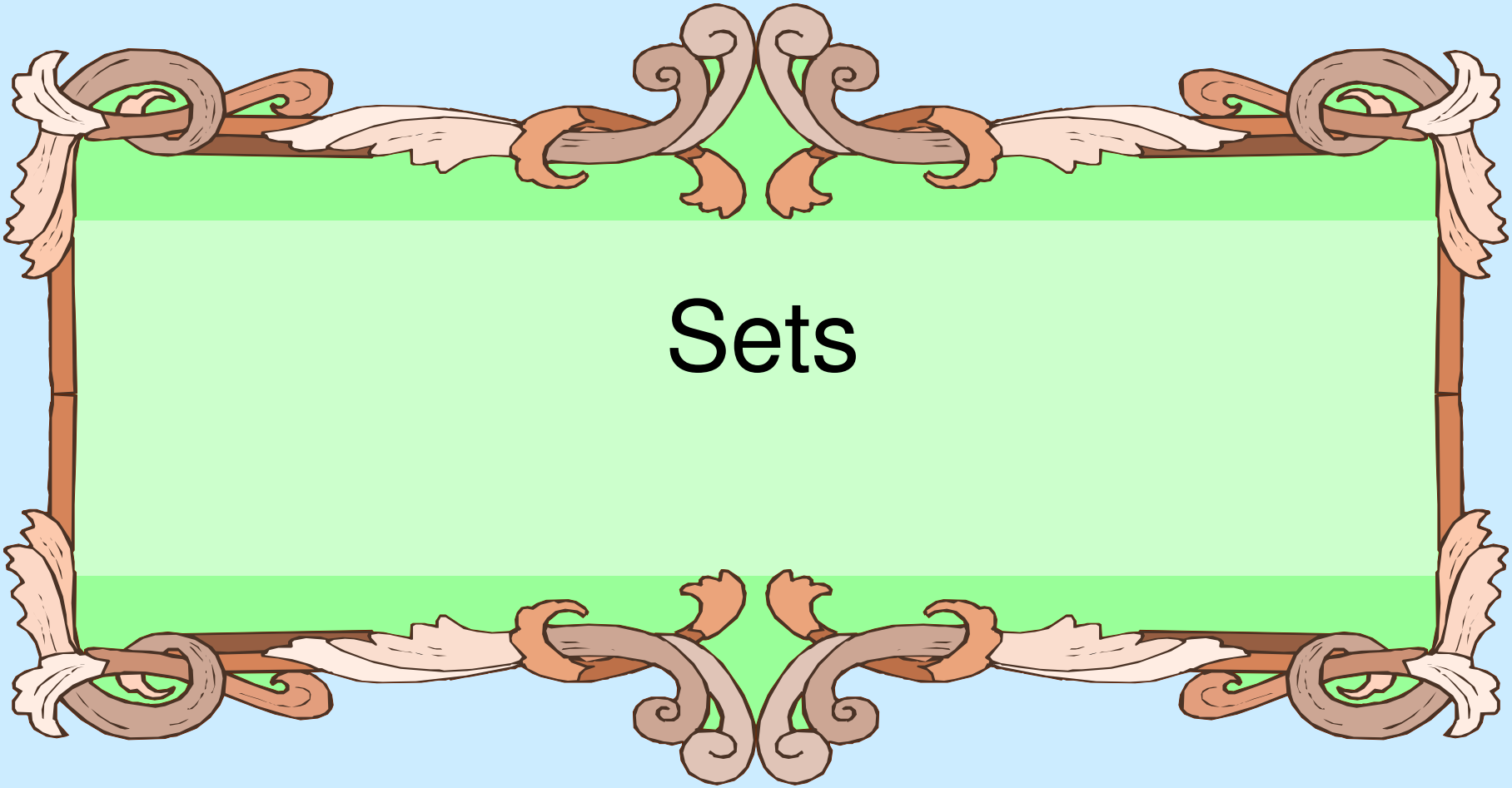
exceptions

```
count_dict = {}
for word in word_list:
    try:
        count_dict[word] += 1
    except KeyError:
        count_dict[word] = 1
```

get method

`get` method returns the value associated with a dict key or a default value provided as second argument. Below, the default is 0

```
count_dict = {}
for word in word_list:
    count_dict[word] = count_dict.get(word,0) + 1
```



Sets, as in Mathematical Sets

- in mathematics, a set is a collection of objects, potentially of many different types
- in a set, no two elements are identical. That is, a set consists of elements each of which is unique compared to the other elements
- there is no order to the elements of a set
- a set with no elements is the empty set

Creating a set

Set can be created in one of two ways:

- constructor: `set(iterable)` where the argument is iterable

```
my_set = set('abc')
my_set → {'a', 'b', 'c'}
```

- shortcut: `{}`, braces where the elements have no colons (to distinguish them from dicts)

```
my_set = {'a', 'b','c'}
```

Diverse elements

- A set can consist of a mixture of different types of elements

```
my_set = {'a',1,3.14159,True}
```

- as long as the single argument can be iterated through, you can make a set of it

no duplicates

- duplicates are automatically removed

```
my_set = set("aabbccdd")
print(my_set)
  → {'a', 'c', 'b', 'd'}
```

example

```
>>> null_set = set()          # set() creates the empty set
>>> null_set
set()
>>> a_set = {1,2,3,4}         # no colons means set
>>> a_set
{1, 2, 3, 4}
>>> b_set = {1,1,2,2,2}       # duplicates are ignored
>>> b_set
{1, 2}
>>> c_set = {'a', 1, 2.5, (5,6)} # different types is OK
>>> c_set
{(5, 6), 1, 2.5, 'a'}
>>> a_set = set("abcd")       # set constructed from iterable
>>> a_set
{'a', 'c', 'b', 'd'}          # order not maintained!
```

common operators

Most data structures respond to these:

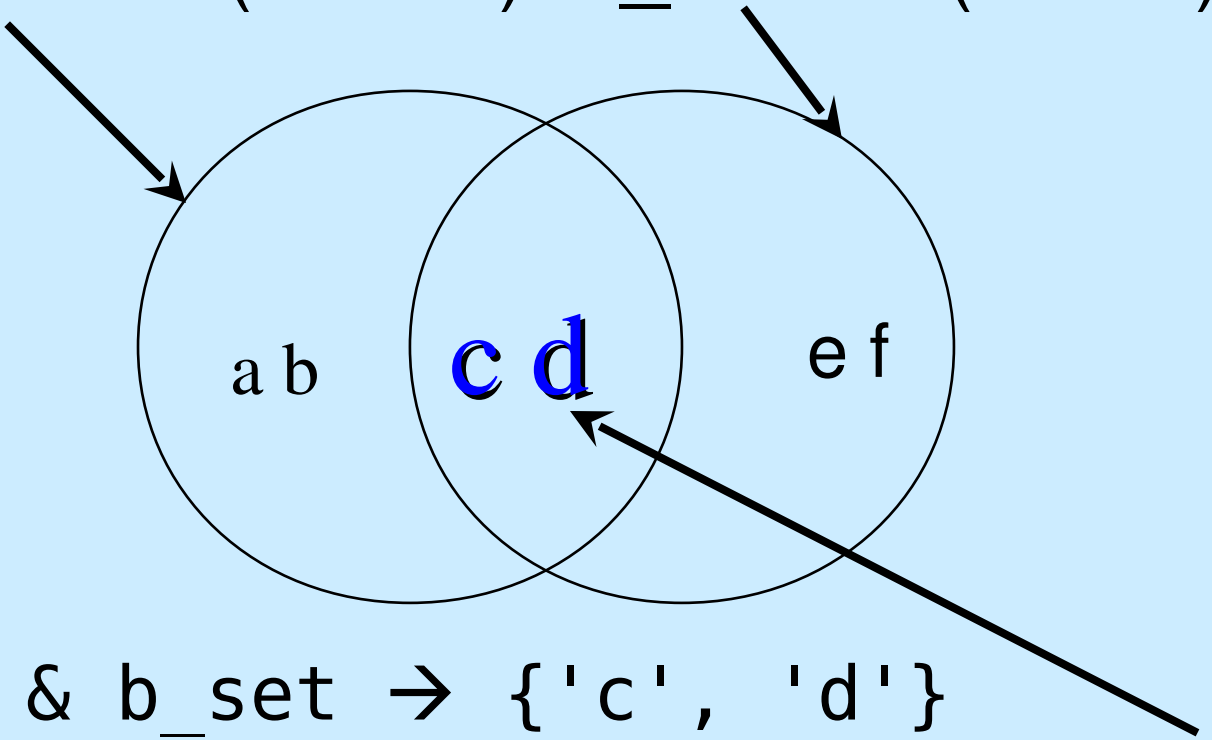
- `len(my_set)`
  - the number of elements in a set
- `element in my_set`
  - boolean indicating whether element is in the set
- `for element in my_set:`
  - iterate through the elements in `my_set`

Set operators

- The set data structure provides some special operators that correspond to the operators you learned in middle school.
- These are various combinations of set contents
- These operations have both a method name and a shortcut binary operator

method: intersection, op: &

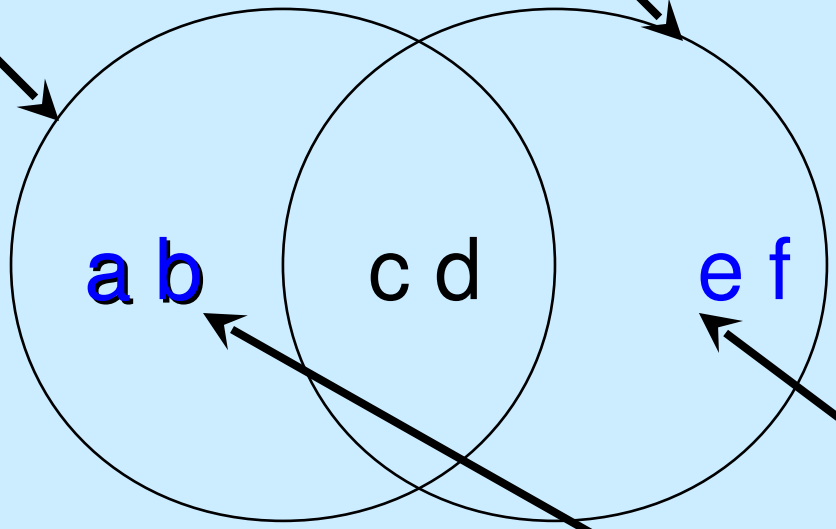
a_set=set("abcd") b_set=set("cdef")




```
a_set & b_set → {'c', 'd'}
b_set.intersection(a_set) → {'c', 'd'}
```

method:difference op: -

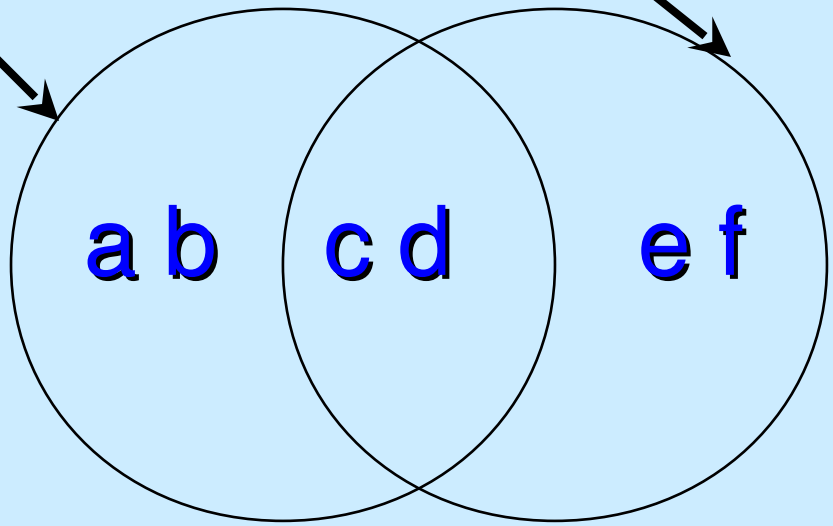
a_set=set("abcd") b_set=set("cdef")




```
a_set – b_set → {'a', 'b'}
b_set.difference(a_set) → {'e', 'f'}
```

method: union, op: |

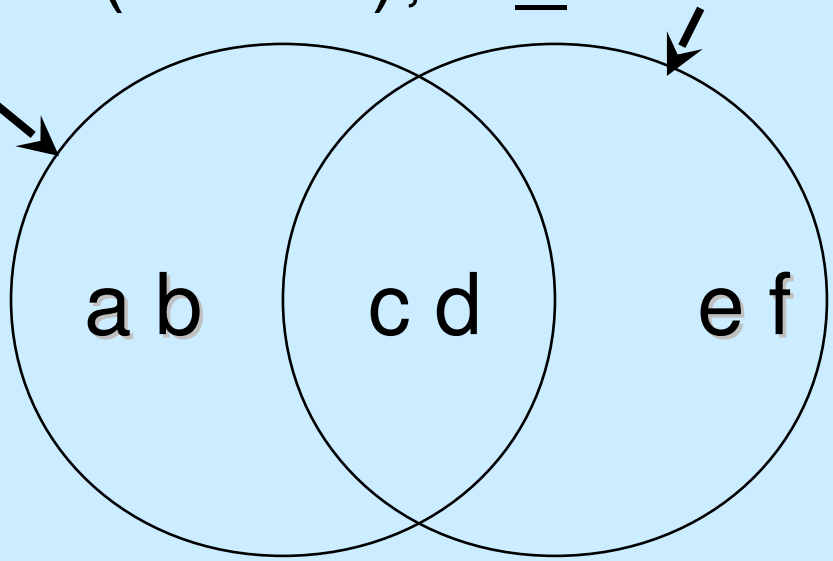
a_set=set("abcd") b_set=set("cdef")




```
a_set | b_set → {'a', 'b', 'c', 'd', 'e', 'f'}
b_set.union(a_set) → {'a', 'b', 'c', 'd', 'e',
'f'}
```

method:symmetric_difference, op: ^

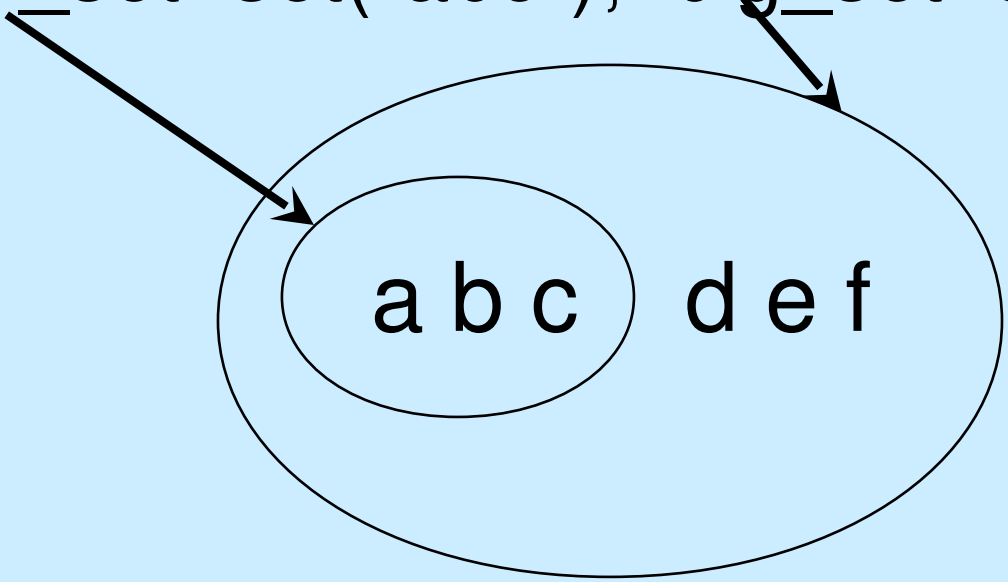
a_set=set("abcd"); b_set=set("cdef")




```
a_set ^ b_set → {'a', 'b', 'e', 'f'}
b_set.symmetric_difference(a_set) → {'a', 'b',
'e', 'f'}
```

method: issubset, op: <=
method: issuperset, op: >=

small_set=set("abc"); big_set=set("abcdef")




```
small_set <= big_set → True
big_set >= small_set → True
```

Other Set Ops

- `my_set.add("g")`
  - adds to the set, no effect if item is in set already
- `my_set.clear()`
  - empties the set
- `my_set.remove("g")` versus `my_set.discard("g")`
  - `remove` throws an error if "g" isn't there. `discard` doesn't care. Both remove "g" from the set
- `my_set.copy()`
  - returns a shallow copy of `my_set`

Copy vs. assignment

```
my_set=set {'a', 'b', 'c'}
my_copy=my_set.copy()
my_ref_copy=my_set
my_set.remove('b')
```