

Practical Computing for Scientists

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Python

Sets and Dictionaries

Introduction

The world is *not* made of lists and arrays

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Mathematicians uses sets far more often

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Unordered: no such thing as "first" or "last"

- This is the part people tend to trip over most

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Python 2.6

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primes = set([2, 3, 5])
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Python 2.7

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primes = {2, 3, 5}
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Because {} was already used for something else

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Because {} was already used for something else

We'll use Python 2.7 notation in this lecture

Naturally used to find unique items in a collection

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```
# What letters are used?
```

```
letters = set()
```

```
for char in 'ichthyosaur':
```

```
    letters.add(char)
```

```
print(letters)
```

```
set(['a', 'c', 'i', 'h', 'o', 's', 'r', 'u', 't', 'y'])
```

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Not ordered alphabetically or by order of addition

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Not ordered alphabetically or by order of addition

Because set elements are *not ordered*

A much shorter way to accomplish the same goal

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set(['a', 'c', 'i', 'h', 'o', 's', 'r', 'u', 't', 'y'])
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If you can loop over it, you can build a set from it

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Can *not* build a set from several separate items

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set(['a', 'c', 'i', 'h', 'o', 's', 'r', 'u', 't', 'y'])
```

If you can loop over it, you can build a set from it

Can *not* build a set from several separate items

```
set('a', 'e', 'i', 'o', 'u')
```

```
TypeError: set expected at most 1 arguments, got 5
```

```
>>> ten = set(range(10))      # {0...9}
>>> lows = {0, 1, 2, 3, 4}
>>> odds = {1, 3, 5, 7, 9}
```

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```

```
>>> lows = {0, 1, 2, 3, 4}
```

```
>>> odds = {1, 3, 5, 7, 9}
```

```
# add an element
```

```
>>> lows.add(9)
```

```
>>> lows
```

```
set([0, 1, 2, 3, 4, 9])
```

```
>>> ten = set(range(10))      # {0...9}
```

```
>>> lows = {0, 1, 2, 3, 4}
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```
# add an element
```

```
>>> lows.add(9)
```

```
>>> lows
```

```
set([0, 1, 2, 3, 4, 9])
```

```
# remove all elements
```

```
>>> lows.clear()
```

```
>>> lows
```

```
set()
```

```
# difference  
>>> lows.difference(odds)  
set([0, 2, 4])
```

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```
# intersection  
>>> lows.intersection(odds)  
set([1, 3])
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# difference
>>> lows.difference(odds)
set([0, 2, 4])
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```
# intersection
>>> lows.intersection(odds)
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```

```
# subset
>>> lows.issubset(ten)
True
```

```
# superset  
>>> lows.issuperset(odds)  
False
```



```
# superset  
>>> lows.issuperset(odds)  
False
```

```
# remove an element  
>>> lows.remove(0)  
>>> lows  
set([1, 2, 3, 4])
```

```
# superset
>>> lows.issuperset(odds)
False
```

```
# remove an element
>>> lows.remove(0)
>>> lows
set([1, 2, 3, 4])
```

```
# symmetric difference (also called "exclusive or")
>>> lows.symmetric_difference(odds)
set([2, 4, 5, 7, 9])
```

```
# union  
>>> lows.union(odds)  
set([1, 2, 3, 4, 5, 7, 9])
```

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>>> lows.union(odds)  
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```

```
# size  
>>> len(odds)  
7
```

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>>> lows.union(odds)  
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```
# size  
>>> len(odds)  
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```
# membership  
>>> 6 in odds  
False
```

Methods

`lows.difference(odds)`

`lows.intersection(odds)`

`lows.issubset(ten)`

`lows.issuperset(ten)`

`lows.symmetric_difference(odds)`

`lows.union(odds)`

Operators

`lows - odds`

`lows & odds`

`lows <= ten`

`lows < ten`

`lows >= odds`

`lows > odds`

`lows ^ odds`

`lows | odds`

Cannot *negate* a set

Cannot *negate* a set

Common in mathematics...

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Common in mathematics...

...but what's the negation of $\{1, 2\}$ in a program?

Problem: cleaning up field observations

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Another contains the names of all birds observed during a three-week period in a mosquito-infested hellhole in northern Ontario.

Copy the observation file, removing uninteresting birds along the way.

```
'''Copy file, removing items along the way.'''
```

```
import sys
```

```
if __name__ == '__main__':
```

```
    to_remove = read_set(sys.argv[1])
```

```
    reader = open(sys.argv[2], 'r')
```

```
    writer = open(sys.argv[3], 'w')
```

```
    for line in reader:
```

```
        line = line.strip()
```

```
        if line not in to_remove:
```

```
            writer.write(line)
```

```
    reader.close()
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def read_set(filename):  
    '''Read set elements from a file.'''  
  
    result = set()  
    reader = open(filename, 'r')  
    for line in result:  
        line = line.strip()  
        set.add(line)  
    reader.close()  
    return result
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| removals.txt | observations.txt | result.txt |
|-------------------------|---|---|
| | loon duck loon ostrich loon | loon duck loon ostrich loon |
| ostrich | loon duck loon ostrich loon | loon duck loon loon |
| duck loon ostrich | loon duck loon ostrich loon | |