

## Sets

## Introduction



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The world is *not* made of lists and arrays



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Mathematicians uses sets far more often



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An unordered collection of distinct items

Collection: contains zero or more items

Distinct: no item appears more than once

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



The world is *not* made of lists and arrays

Mathematicians uses *sets* far more often

An *unordered collection* of *distinct* items

Collection: contains zero or more items

Distinct: no item appears more than once

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

- This is the part people tend to trip over most





- But at least they're there...

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#### Python 2.6

```
primes = set([2, 3,
5])
```

- But at least they're there...

Python 2.6	Python 2.7
<pre>primes = set([2, 3, 5])</pre>	primes = {2, 3, 5}



- But at least they're there...

Python 2.6	Python 2.7
primes = set([2, 3,	primes = $\{2, 3, 5\}$
5])	empty = set()
empty = set()	



- But at least they're there...

Python 2.6	Python 2.7
<pre>primes = set([2, 3, 5])</pre>	primes = $\{2, 3, 5\}$
empty = set()	empty = set()
embry - ser()	

Because { } was already used for something else

Sets and Dictionaries



- But at least they're there...

Python 2.6	Python 3.1
<pre>primes = set([2, 3, 5])</pre>	$primes = {2, 3, 5}$
	empty = set()
empty = set()	

Because { } was already used for something else

We'll use Python 2.7 notation in this lecture

**Sets and Dictionaries** 



```
# 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'])
```



```
# 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'])
```

Not ordered alphabetically or by order of addition



```
# What letters are used?
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letters = set()
for char in 'ichthyosaur':
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```
set(['a', 'c', 'i', 'h', 'o', 's', 'r', 'u', 't', 'y'])
```

Not ordered alphabetically or by order of addition

Because set elements are not ordered



# What letters are used?

print set('ichthyosaur')

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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print set('ichthyosaur')

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

#### # 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\}
>>>  odds = \{1, 3, 5, 7, 9\}
# 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])

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

#### # intersection

```
>>> lows.intersection(odds)
set([1, 3])
```

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

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

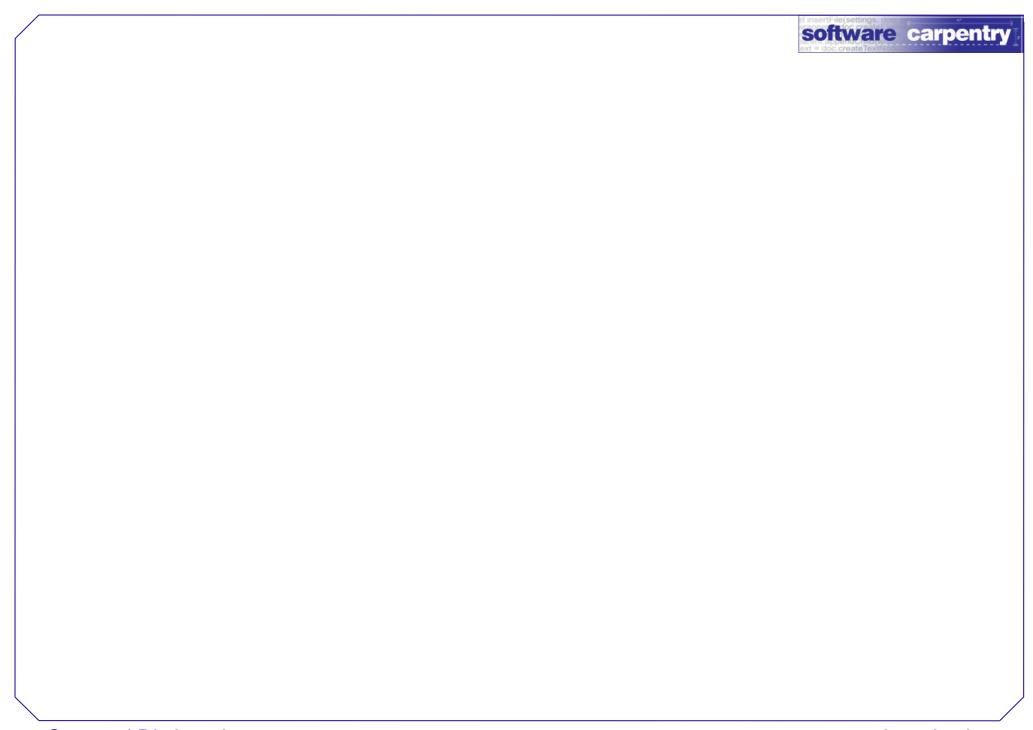
```
# union
>>> lows.union(odds)
set([1, 2, 3, 4, 5, 7, 9])
# size
>>> len(odds)
# membership
>>> 6 in odds
False
```

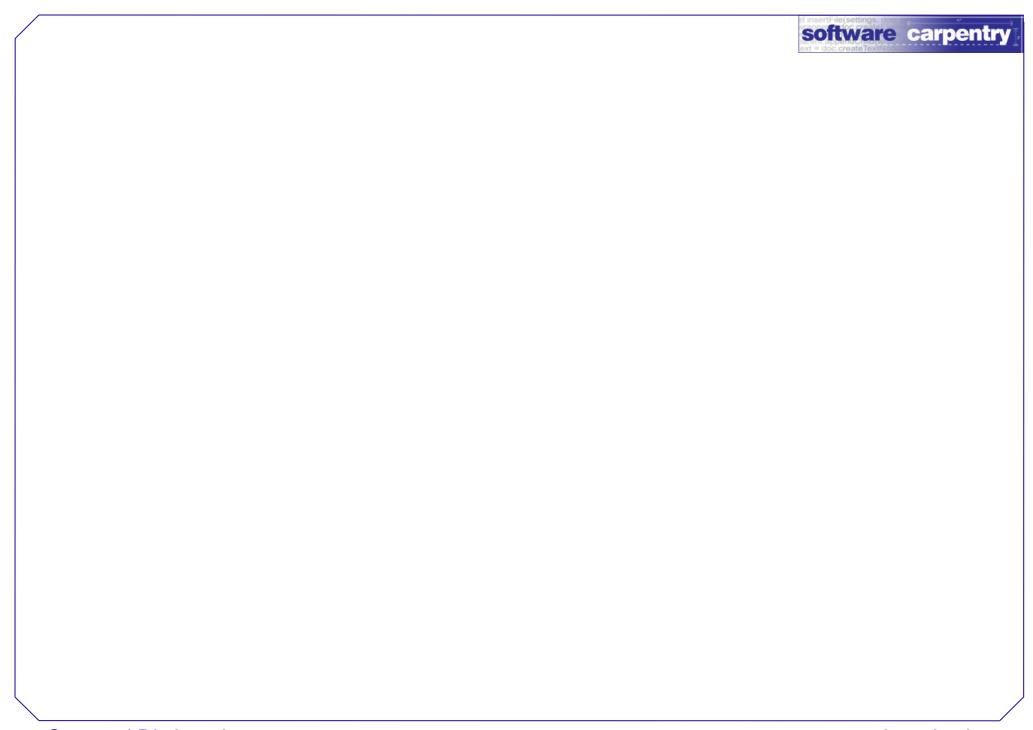


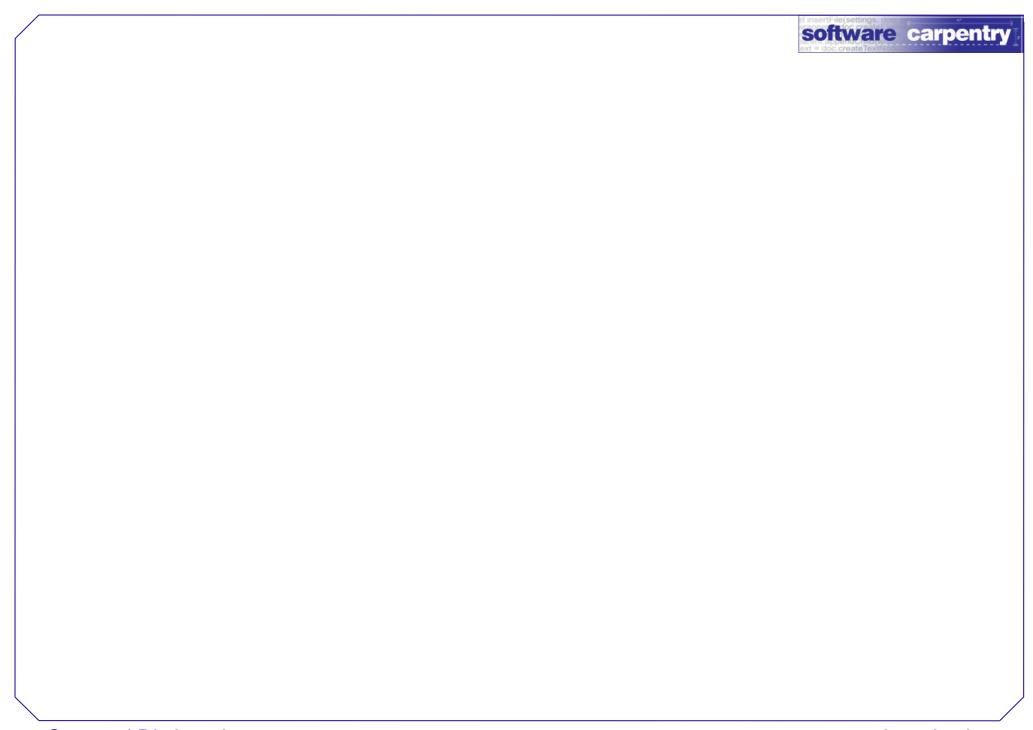
Methods	Operators
lows.difference(odds)	lows - odds
lows.intersection(odds)	lows & odds
lows.issubset(ten)	lows <= ten
	lows < ten
lows.issuperset(ten)	lows >= odds
	lows > odds
lows.symmetric_difference(odds)	lows ^ odds
lows.union(odds)	lows   odds

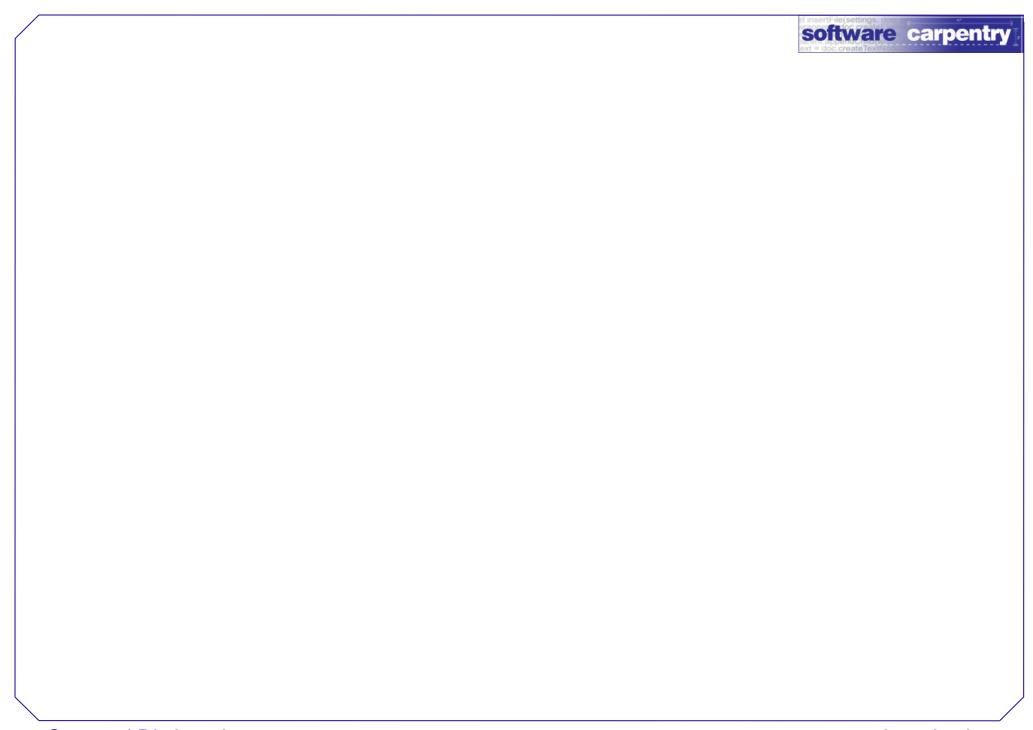


## STOP













Common in mathematics...



Common in mathematics...

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



Common in mathematics...

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

We'll solve this problem when we get to object-oriented programming



## Problem: cleaning up field observations



Problem: cleaning up field observations

One file has the names of birds our supervisor thinks are uninteresting.



Problem: cleaning up field observations

One file has the names of birds our supervisor thinks are uninteresting.

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



Problem: cleaning up field observations

One file has the names of birds our supervisor thinks are uninteresting.

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()
 writer.close()
```

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reader.close()

writer.close()

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 reader.close()
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"Copy file, removing items along the way." import sys
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**for** line **in** reader:

```
line = line.strip()
if line not in to_remove:
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reader.close()
writer.close()
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        if line not in to_remove:
            writer.write(line)
```

```
reader.close()
writer.close()
```

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"'Copy file, removing items along the way."'
import sys
```

```
if __name__ == '__main__':
    to_remove = read_set(sys.argv[1])
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    for line in reader:
        line = line.strip()
        if line not in to_remove:
            writer.write(line)
```

reader.close()
writer.close()

```
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
```

```
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)
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def read_set(filename):
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  line = line.strip()
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```
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 "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
```

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

result = set()

reader = open(filename, '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()

writer.close()

for line in result:

line = line.strip()

set.add(line)

reader.close()

return result



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	



created by

Greg Wilson

July 2010



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