

Sets

BBM 101 - Introduction to Programming I

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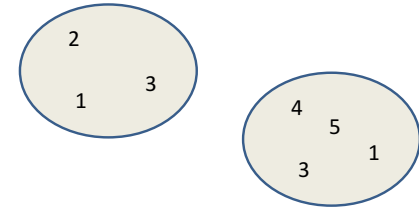
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Slides based on material prepared by Ruth Anderson, Michael Ernst and Bill Howe in the course CSE 140
University of Washington

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Sets

- Mathematical set: a collection of values, without duplicates or order
- Order does not matter
 $\{1, 2, 3\} == \{3, 2, 1\}$
- No duplicates
 $\{3, 1, 4, 1, 5\} == \{5, 4, 3, 1\}$
- For every data structure, ask:
 - How to create
 - How to query (look up) and perform other operations
 - (Can result in a new set, or in some other datatype)
 - How to modifyAnswer: <http://docs.python.org/2/library/stdtypes.html#set>



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Creating a Set

- Construct from a list:

```
odd = set([1, 3, 5])
prime = set([2, 3, 5])
empty = set([])
```

Python always prints using this syntax above

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Set Operations

```
odd = set([ 1, 3, 5 ])
prime = set([ 2, 3, 5 ])
```

- membership \in Python: `in` `4 in prime` \Rightarrow False
- union \cup Python: `|` `odd | prime` \Rightarrow {1, 2, 3, 5}
- intersection \cap Python: `&` `odd & prime` \Rightarrow {3, 5}
- difference \setminus or $-$ Python: `-` `odd - prime` \Rightarrow {1}

Think in terms of **set operations**,
not in terms of iteration and element operations
– Shorter, clearer, less error-prone, faster

Although we can do iteration over sets:

```
# iterates over items in arbitrary order
for item in myset:
```

...

But we cannot index into a set to access a specific element.

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Modifying a Set

- **Add** one element to a set:

```
myset.add(newelt)
myset = myset | set([newelt])
```

- **Remove** one element from a set:

```
myset.remove(elt) # elt must be in myset or raises err
myset.discard(elt) # never errs
```

What would this do?

```
myset = myset - set([newelt])
```

- Choose and remove some element from a set:

```
myset.pop()
```

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Practice with Sets

```
z = set([5,6,7,8])
y = set([1,2,3,"foo",1,5])
k = z & y
j = z | y
m = y - z
z.add(9)
```

```
z: {8, 9, 5, 6, 7}
y: {1, 2, 3, 5, 'foo'}
k: {5}
j: {1, 2, 3, 5, 6, 7, 8, 'foo'}
m: {1, 2, 3, 'foo'}
```

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List vs. Set Operations (1)

Find the common elements **in both** list1 and list2:

```
out1 = []
for i in list2:
    if i in list1:
        out1.append(i)
```

OR

```
out1 = [i for i in list2 if i in list1]
```

Find the common elements in both set1 and set2:

```
set1 & set2
```

Much shorter, clearer, easier to write!

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List vs. Set Operations (2)

Find the elements in **either** list1 or list2 (**or both**) (without duplicates):

```
out2 = list(list1) # make a copy
for i in list2:
    if i not in list1: # don't append elements
        out2.append(i) # already in out2
```

OR

```
out2 = list1+list2
for i in out1:
    out2.remove(i) # out1 (from previous example),
                 # common elements in both lists
                 # Remove common elements
```

Find the elements in either set1 or set2 (or both):

```
set1 | set2
```

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List vs. Set operations (3)

Find the elements in **either list but not in both**:

```
out3 = []
for i in list1+list2:
    if i not in list1 or i not in list2:
        out3.append(i)
```

Find the elements in either set but not in both:

```
set1 ^ set2          # symmetric difference
```

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Not Every Value may be Placed in a Set - 1

- Set elements must be immutable values
 - int, float, bool, string, *tuple*
 - *not*: list, set, dictionary
- Goal: only set operations change the set
 - after “`myset.add(x)`”, `x in myset` \Rightarrow True
 - `y in myset` always evaluates to the same valueBoth conditions should hold until `myset` itself is changed

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Not Every Value may be Placed in a Set - 2

- Mutable elements can violate these goals

```
list1 = ["a", "b"]
list2 = list1
list3 = ["a", "b"]
myset = { list1 }
list1 in myset  $\Rightarrow$  True
list3 in myset  $\Rightarrow$  True
list2.append("c")
list1 in myset  $\Rightarrow$  ???
list3 in myset  $\Rightarrow$  ???
```

\Leftarrow Hypothetical;
actually illegal in Python

\Leftarrow not modifying `myset` “directly”
modifying `myset` “indirectly” would
lead to different results

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