

Fundamentos de Programação

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Summary

- Sets

Sets

Data Types

Simple types
(bool, int, float, complex)

Compound types (collections)

Sequences:
(list, tuple, str)

Sets:
(set, frozenset)

Mappings:
(dict)

Set types

- A **set** is an *unordered collection* of *unique* elements.
 - **Collection** because it may contain zero or more elements.
 - **Unordered** because elements are not in sequence.
 - **Unique** because elements cannot be repeated!
- Sets are a fundamental data type in Math and computing.
- In Python, a set may be created using braces.

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```
fruits = {'pear', 'apple', 'banana', 'orange'}  
S = { x for x in fruits if x < 'c' }      # (by comprehension)
```

- The `set` constructor converts from other types.

```
numbers = set([3, 1, 3])    #-> {1, 3}
```

- The empty set must be created with `set()`, because `{ }` creates a dictionary.

```
empty = set()
```

Elements in a set are unique

- An object either is or is not in a set. It cannot be in the set more than once!

```
{1, 2, 1} == {1, 2}      #-> True  
len({4, 5, 4, 5, 5})    #-> 2
```

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- Like *keys* in a dictionary.
- Unlike sequences.

```
[1, 2, 1] == [1, 2]      #-> False
```

- A common application of sets is for eliminating duplicate elements in sequences.

```
set([1, 2, 2, 2, 1])     #-> {1, 2}  
set('banana')            #-> {'a', 'b', 'n'}
```

- This eliminates order, too.

Elements in a set are unordered

- Sets don't recall the position or order of entry of elements.

```
s = {3, 1, 2}
print(s)           # {1, 2, 3}, {2, 3, 1} or ...
s == {2, 3, 1} == {1, 2, 3}  #-> True
```

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- So, indexing, slicing, and concatenation are not allowed!

```
s[0]           # TypeError
s[0:2]         # TypeError
s + {4}        # TypeError
```

Elements in a set must be hashable

- A set may contain elements of various types, but only *hashable* types are allowed.
- Just like dictionary keys.
- Simple immutable types (like numbers) are OK.
- Strings are OK.
- Tuples are OK, *if their elements are hashable*.

```
{ 23, 'eggs', (1997, 10, 23) }
```

- Lists, dictionaries, sets and other mutable types are not allowed!

```
{ [1, 2] }          # TypeError
```

```
{ {1}, {1, 2} }    # TypeError
```

- What are hashable types? (Read this description.)

Operations on sets

- Sets have a length and support the membership operator.

```
S = {23, 5, 12}
```

```
len(S)      # 3
```

```
5 in S      # True (This is a fast operation!)
```

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- Sets support union, intersection, and differences.

```
{3,4,5} | {1,2,3}    #-> {1,2,3,4,5} (set.union)
```

```
{3,4,5} & {1,2,3}    #-> {3}         (set.intersection)
```

```
{3,4,5} - {1,2,3}    #-> {4,5}       (set.difference)
```

```
{3,4,5} ^ {1,2,3}    #-> {1,2,4,5}   (set.symmetric_difference)
```


Operations on sets (2)

- Sets may be compared for equality.

```
S = {1, 2}
{2, 2, 1} == S    # True
```

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- We may test subset or superset relations.

```
S <= {1, 2}        # True = S.issubset({1, 2})
S < {1, 2, 3}       # True
S >= {1, 2}         # True = S.issuperset({1, 2})
S > {2}             # True
```

- But this is not a *total ordering* relation! You can have two sets A and B such that:

```
A < B, A == B, A > B    # All are False!
```

Sets are mutable

- We can add or remove elements in sets.

```
S = {1, 2, 3}
S.add(4)          # S -> {1, 2, 3, 4}
S.remove(2)       # S -> {1, 3, 4}
S.discard(7)      # No error!
```

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- We can update the set by union, intersection or differences.

```
S |= {3, 5, 7}     # S.update({3, 5, 7})
S &= {1, 2, 3, 4}  # S.intersection_update({1, 2, 3, 4})
S -= {4, 5, 6}     # S.difference_update({4, 5, 6})
S ^= {1, 2, 4}     # S.symmetric_difference_update({1, 2, 4})
```

- Python also has immutable sets: the `frozenset` type.

```
T = frozenset({1, 2, 3})
```

How to select the proper data type?

- Choosing the right type to store your data is very important.
- First, consider the different characteristics of the types.

Type	Type identifier	Collection?	Sequence?	Mutable?	Element type
Simple types	<code>bool, int, float, complex</code>	No (scalar)	---	No	---
String	<code>str</code>	Yes	Yes	No	Character
Tuple	<code>tuple</code>	Yes	Yes	No	Any type
List	<code>list</code>	Yes	Yes	Yes	Any type
Dictionary	<code>dict</code>	Yes	No (unorderable)	Yes	Key: Hashable Value: Any type
Set	<code>set</code>	Yes	No (unorderable)	Yes	Hashable
Immutable set	<code>frozenset</code>	Yes	No (unorderable)	No	Hashable

Some questions to help deciding

- Are the data simple (scalar) or compound (several elements)?
 - Compound => collection.
- Does element order/position matter?
 - Yes => sequence.
- Will the contents grow, shrink or change?
 - Yes => mutable.
- Need to quickly map a key to a value?
 - Yes => dictionary.