KOLT Python

Containers, Aliasing & Mutability

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Monday 18th March, 2019

KOLT

Agenda

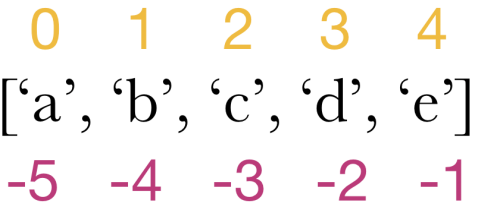
1. Recap
2. Lists
3. Mutability
4. Aliasing & Cloning
5. Tuples
6. Sets
7. Dictionaries

Lists

- Group values together. `my_values = [1, 'a', None]`
- You can think of each element as a variable, accessed by **indexing**
- You can do everything you do to variables to list elements:
  - Assign new values: `my_values[0] = 3`
  - Use shorthand assignment operators: `my_values[1] += 'bc'`
  - Learn their type: `type(my_values[2]) # => <class 'NoneType'>`
  - Change their type: `my_values[2] = True`
  - Compare their value: `if my_values[0] == my_values[1]: ...`
- What happens when we call `my_values[3] = 3`? `# =>` **`IndexError`**

Indexing

Access elements at a particular index




```
x = [1, 2, 'a', 'hello']
x[0] # => 1
x[1] # => 2
x[2] # => 'a'
x[3] # => 'hello'
x[-1] # => 'hello'
x[-2] # => 'a'
x[-3] # => 2
```

Slicing

Access collection of elements by specifying **`[start:stop:step]`**
Gives a list, even when number of elements is not bigger than 1.

```
numbers = [0, 1, 2, 3, 4, 5]
"""
ASCII art analogy :)
 +---+---+---+---+---+---+
 | 0 | 1 | 2 | 3 | 4 | 5 | => Indices
 +---+---+---+---+---+---+
 0   1   2   3   4   5   6 => Borders
-6  -5  -4  -3  -2  -1
"""
```

```
numbers[0::2]   # => [0, 2, 4]
numbers[:]   # => [0, 1, 2, 3, 4, 5]
numbers[1:]   # => [1, 2, 3, 4, 5]
numbers[-2:]   # => [4, 5]
numbers[1:4]   # => [1, 2, 3]
numbers[1:1]   # => []
numbers[-99:99]   # => [0, 1, 2, 3, 4, 5]
numbers[::-1]   # => [5, 4, 3, 2, 1, 0]
numbers[::-2]   # => [5, 3, 1]
```

Slices with `step` = 1 are called **Basic Slice**.
Slices with `step != 1` are called **Extended Slice**.

Strings

Special kind of **lists**! `name = 'Ahmet'`
You can do:

- Indexing: `name[2]` ⇒ 'm'
- Slicing: `name[::-1]` ⇒ 'temhA'
- Search by `in` operator: `'hm'in name` ⇒ `True`

You can not do:

- String mutation: name[2]='H' ⇒ **`TypeError`**

Special functions about strings: `str.isnumeric()`, `str.capitalize()`, `str.format(...)`, `str.find()` ...

Loops

Do something for many elements or based on a condition.

```
while <condition>:
    <expression>
    <expression>
    ...
```

Similar to simple if blocks, but runs again and again until condition check fails.

```
for <item> in <iterable>:
    <expression>
    <expression>
    ...
```

Iterable: collection of **ordered** elements.
What is next after this item?

For Loops

What is next after this item?
numbers[1] is after numbers[0] $\neq$ **numbers[1]** $>$ **numbers[0]**
Examples of iterables: lists, strings, ranges

Ranges

`range(start, stop, step)`: creates a sequence of integers from start (inclusive) to stop (exclusive) by step.
Can be **indexed** and **sliced**
`len()` and `in` operator can be used

Break, Continue

Break terminates the closest for or while loop

```
for i in range(0, 5):
    if i % 2 == 1:
        break
    print(i)
```

```
x = 1
while x < 100:
    x *= 2
    if (x+1) % 3 == 0:
        break
    print(x)
```

Continue continues with the next iteration of the loop

```
for i in range(0, 5):
    if i % 2 == 1:
        continue
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x = 1
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List Mutation

`list.append(x)`: Append x to end of the sequence
`list.insert(i, x)`: Insert x to index i
`list.pop(i=-1)`: Remove and return element at index i
`list.remove(x)`: Remove first occurrence of x
`list.extend(iterable)`: Add all elements in iterable to end of list
`list[i] = new_value`: Update value of index i with new value
`list[basic_slice] = iterable`: Change elements in basic slice with elements in iterable, sizes can be different: `numbers[:] = []`
`list[extended_slice] = iterable`: Change elements in extended slice with elements in iterable 1-1, sizes must be equal.

Some Other List Operations

`in` operator: Check whether an element is in list. `3 in numbers` ⇒ `True`
`len(list)`: Returns the length of list(and other collections).
`list.index(value, start=0, stop=len(list))`: Return first index of value.
`list.count(value)`: Count number of occurrences of value in list.
`list.reverse()`: Reverse the list (in-place)
`list.sort()`: Sort list elements (in-place)
For more, type `help(list)` in your interactive interpreter.

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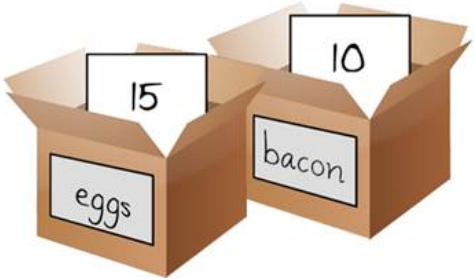

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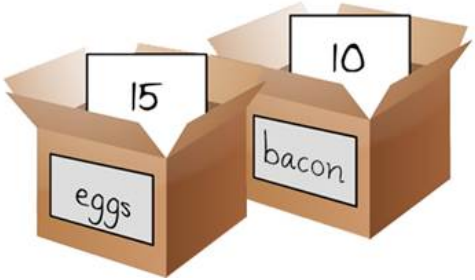

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other_box = my_secret_box
other_box.remove(2)
print(my_secret_box)   # => [0, 1]
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Did we just changed inside of a closed box? Box analogy **does not** work!

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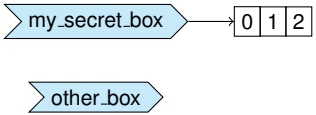

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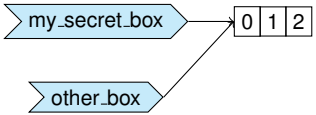

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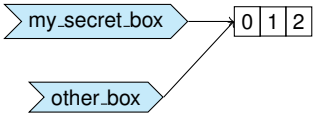

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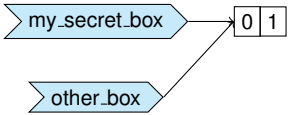

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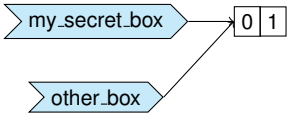

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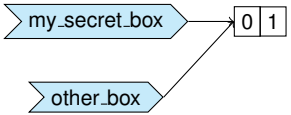

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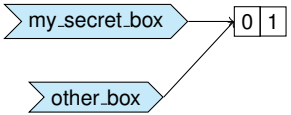

Variables are more like **labels** pointing to **values**!
Assignment links **variables** to **values**!

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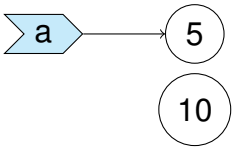

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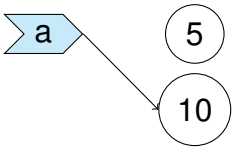

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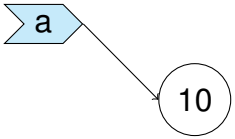

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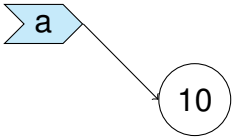

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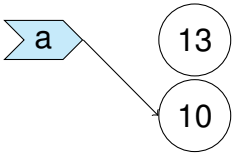

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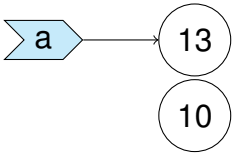

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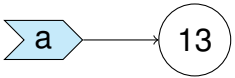

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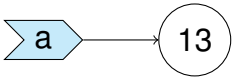

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a = 1000
b = 1000
a == b   # => True
a is b   # => False
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`==` operator compares values, **`is`** operator compares identities.

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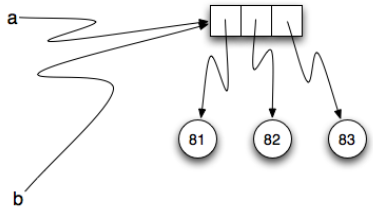
Almost always use **`==`** to compare values!

Aliasing & Cloning

- More than one variables can refer to **same object**!
- What if we want to clone/copy instead of aliasing?
- For lists, `list.copy()` $\Rightarrow$ returns a shallow copy of the list.
- Shallow: only copy the references, not inner values.



- `>>> import copy`

`copy.copy(x)`: shallow copy, `copy.deepcopy(x)`: deepcopy

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- **`len(my_tuple)`** $\Rightarrow$ 3
- **`my_tuple.append(3)`** $\Rightarrow$ **`AttributeError:`** `'tuple' object has no attribute 'append'`

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my_list = [1, 2, 3]
my_tuple = ('a', my_list)
my_list.append(4)
print(my_tuple)
my_list += [5, 6, 7]   # my_list.extend(...)
print(my_tuple)
my_tuple += (1, 2)   # my_tuple = my_tuple + (1, 2)
print(my_tuple)
```

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- **Mutable**, `add(element)`, `remove(element)` methods.
- Python also has **immutable** sets: `frozenset`

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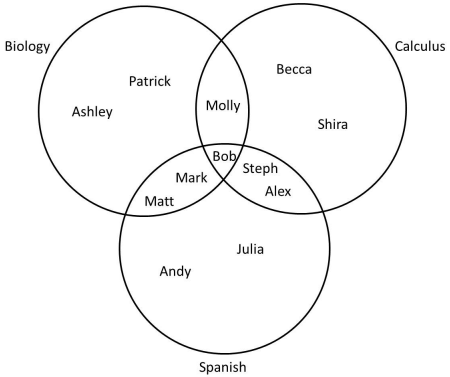
- Can compute set operations: **union**, **intersection**, **difference**, **symmetric difference**.

Sets


Biology
Calculus
Spanish
Patrick
Ashley
Molly
Becca
Shira
Bob
Steph
Mark
Alex
Matt
Julia
Andy

Sets

```
biology = {'Ashley', 'Patrick', 'Molly', 'Bob',
           'Mark', 'Matt'}
calculus = {'Becca', 'Shira', 'Alex', 'Molly', 'Bob', 'Steph'}
spanish = {'Matt', 'Mark', 'Bob', 'Alex', 'Steph', 'Julia', 'Andy'}
# intersection &
print(biology.intersection(calculus))  # => {'Molly', 'Bob'}
print(calculus & spanish)  # => {'Bob', 'Alex', 'Steph'}
# union |
print(biology.union(calculus))  # => all names except andy and julia
print(calculus | spanish | biology)  # => all names
# difference -
print((biology - calculus).intersection(spanish))  # => {'Mark', 'Matt'}
# symmetric_difference ^
print(biology.symmetric_difference(spanish))
# => {'Molly', 'Julia', 'Ashley', 'Alex', 'Steph', 'Andy', 'Patrick'}
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- How to access values? `print(d['one'])` # ⇒ 1

Dictionaries

```
d = {'x': 1, 'y': 2, 'z': 3}
for key, value in d.items():
    print(f'value {value} is associated with key: {key}')

for key in d:
    print(f'value {d[key]} is associated with key: {key}')

# Add new pairs
d['a'] = 15
# Change value of key
d['x'] = 1
# Remove pairs
y_value = d.pop('y')
```