# KOLT Python

## File I/O, Testing & Debugging

Ahmet Uysal

Monday 25th March, 2019

# Agenda

1. Recap
2. Sets
3. Dictionaries
4. File Input/Output
5. Error/Exception Handling
6. Debugging

# Mutability

## Immutable:

An `object` with a fixed value. Immutable objects include **numbers**, **strings** and **tuples**. Such an object cannot be altered. A new object has to be created if a different value has to be stored. They play an important role in places where a constant **hash value** is needed, for example as a **key** in a `dictionary`.

```
a = 5
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a += 3
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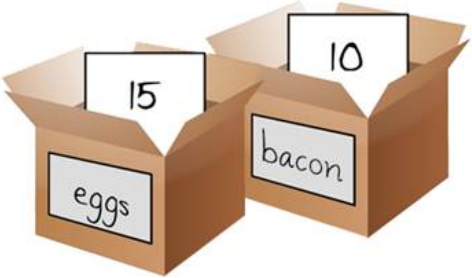
# Python Data Model

How did we represent data in Python? **Variables!**
How do they work? Do they store the data themselves?



# Box Analogy

```
my_fav_number = 13
other_number = my_fav_number
other_number += 3
print(my_fav_number)   # => 13
```

```
my_secret_box = [0, 1, 2]
other_box = my_secret_box
other_box.remove(2)
print(my_secret_box)   # => [0, 1]
```

Did we just changed inside of a closed box? Box analogy **does not** work!

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| | | |
|---|---|---|
| 0 | 1 | 2 |

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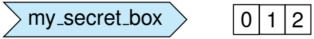

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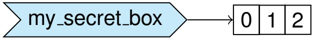

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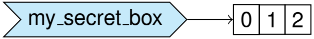

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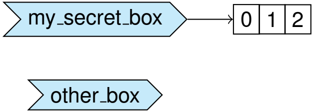

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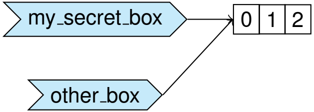

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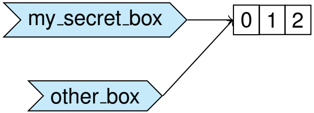

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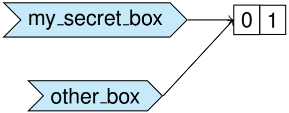

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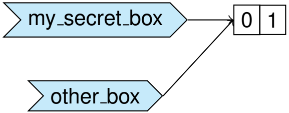

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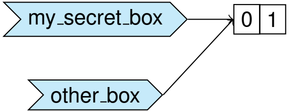

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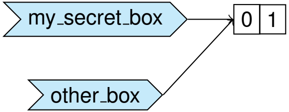

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**Assignment** links **variables** to **values**!

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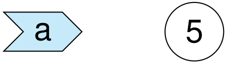

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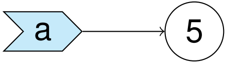

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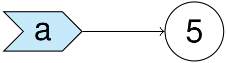

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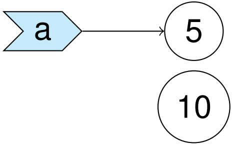

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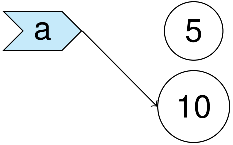

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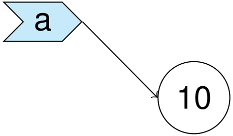

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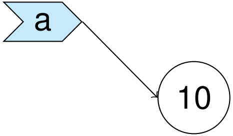

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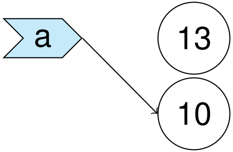

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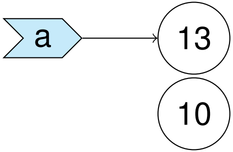

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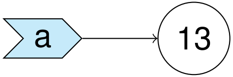

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a += 3
print(a)
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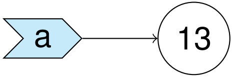


a

13

# Object

Each object has an `identity`, this value can be obtained by using **`id()`** function.

**`==`** operator compares values, **`is`** operator compares identities.

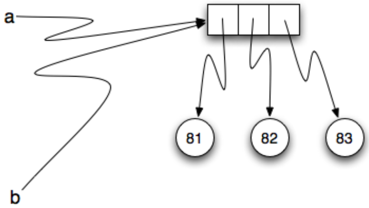
```
a = 1000
b = 1000
a == b   # => True
a is b   # => False
```

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()` ⇒ 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



# Tuples

- **Immutable** sequence(ordered) of elements.
- Similar to `lists`, you can use **indexing**, **slicing**, and iterate over using `for` loops.
- Elements cannot be added/removed/changed once the tuple is created.
- How to create tuples? **`my_tuple = (1, [1, 2], 'a')`**
- **`len(my_tuple)`** ⇒ 3
- **`my_tuple.append(3)`** ⇒ **`AttributeError:`** `'tuple' object has no attribute 'append'`

# Tuples

`()` / `tuple()`: empty tuple, `(3)`: `int` 3, `(3,)`: `tuple` containing 3

```
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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- How to create empty sets? `set()` ({ } is reserved for `dict`)
- Can compute set operations: **union**, **intersection**, **difference**, **symmetric difference**.

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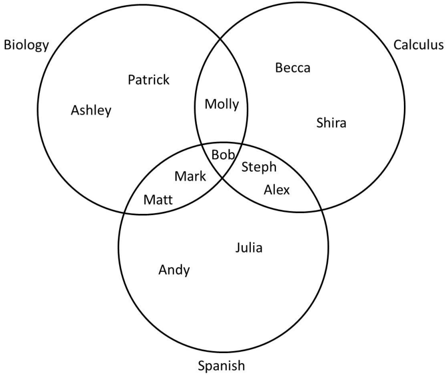
Biology
Calculus
Patrick
Ashley
Molly
Becca
Shira
Bob
Mark
Matt
Steph
Alex
Julia
Andy
Spanish

# 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

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```python
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')
```

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  - 'r': read mode, default
  - 'w': write mode, overrides the file contents if it already exists
  - 'x': create & write mode, similar to write mode gives error if file already exists

# Files In Python

Access to a `file object` using **`open(filename, mode='r')`** function

- **`filename`**: File name including the **file extension.** Ex: 'data.txt'
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  - 'a': append mode, adds content to the end of file

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- **Always** close the file when you are done: `f.close()`

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- `file.write()` method **only** takes **`str`** values!
- Close the file when you are done.
- `f.close()`

# Context Managers

What if something bad happens before we close the file?

```
f = open('my_file.txt', 'r') as f:
    # Content of my_file.txt: '1,0,2'
values = f.read().split(',')
# What happens
result = int(values[0]) / int(values[1]) + int(values[2])
f.close()
```

```
# Safer approach, file is closed
# even when we encounter an exception
with open('my_file.txt', 'w') as f:
    f.write('Hello, world!')
```

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# SyntaxError: invalid syntax
```

```
while True:
print('Hello')
# IndentationError: expected an indented block
```

Easy to detect: Your code will not work :)

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- Put `if` checks everywhere?

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How to be safe in these situations?

- Put `if` checks everywhere?
- Too much effort, and probably we cannot list every condition.
- Solution is `try-except-finally` blocks.

# Try Except Blocks

```
try:
    <risky-statements >
    <risky-statements >
    <risky-statements >
    ...
except ValueError as valError:
    print('value error', valError)
except (RuntimeError, TypeError, NameError):
    print('One of the above errors, but not ValueError')
else:
    print('No errors')
finally:
    print('This always runs')
```

# Try Except Blocks

```
def divide(x, y):
    try:
        result = x / y
    except ZeroDivisionError:
        print("division by zero!")
    else:
        print("result is", result)
    finally:
        print("executing finally clause")
```

# Debugging in VS Code

## In-class Demo

Refer to *VSCode Python Tutorial* if you have missed the class.