UC Berkeley
EECS
Lecturer
Michael Ball

Computational Structures in Data Science

Object-Oriented Programming

Announcements

UC Berkeley
EECS
Lecturer
Michael Ball

Computational Structures in Data Science

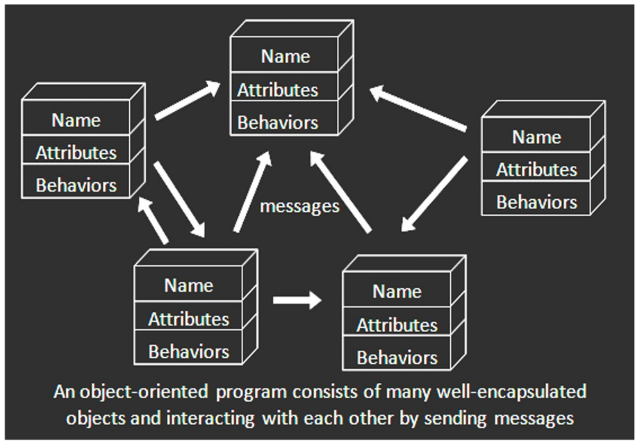
Object-Oriented Programming

Learning Objectives

- Learn how to make a class in Python
  - `class` keyword
  - `__init__` method
  - `self`

Object-Oriented Programming (OOP)

- **<u>Objects</u>** as data structures
  - With <u>methods</u> you ask of them
    - »These are the behaviors
  - With <u>local state</u>, to remember
    - »These are the attributes
- **<u>Classes</u>** & **<u>Instances</u>**
  - Instance an example of class
  - E.g., Fluffy is instance of Dog
- **<u>Inheritance</u>** saves code
  - Hierarchical classes
  - e.g., a Tesla is a special case of an Electric Vehicle, which is a special cade of a car
- Other Examples (though not pure)
  - Java (CS61B), C++

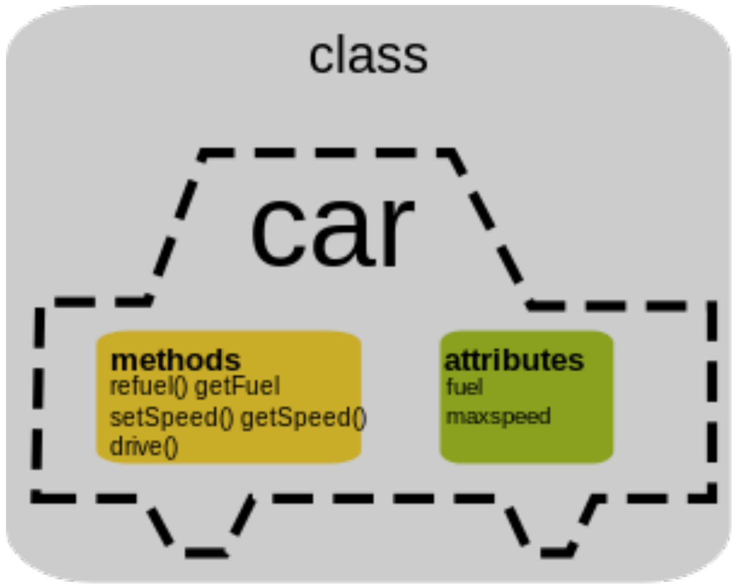

Name
Attributes
Behaviors
messages
An object-oriented program consists of many well-encapsulated objects and interacting with each other by sending messages

www3.ntu.edu.sg/home/ehchua/programming /java/images/OOP-Objects.gif

Classes

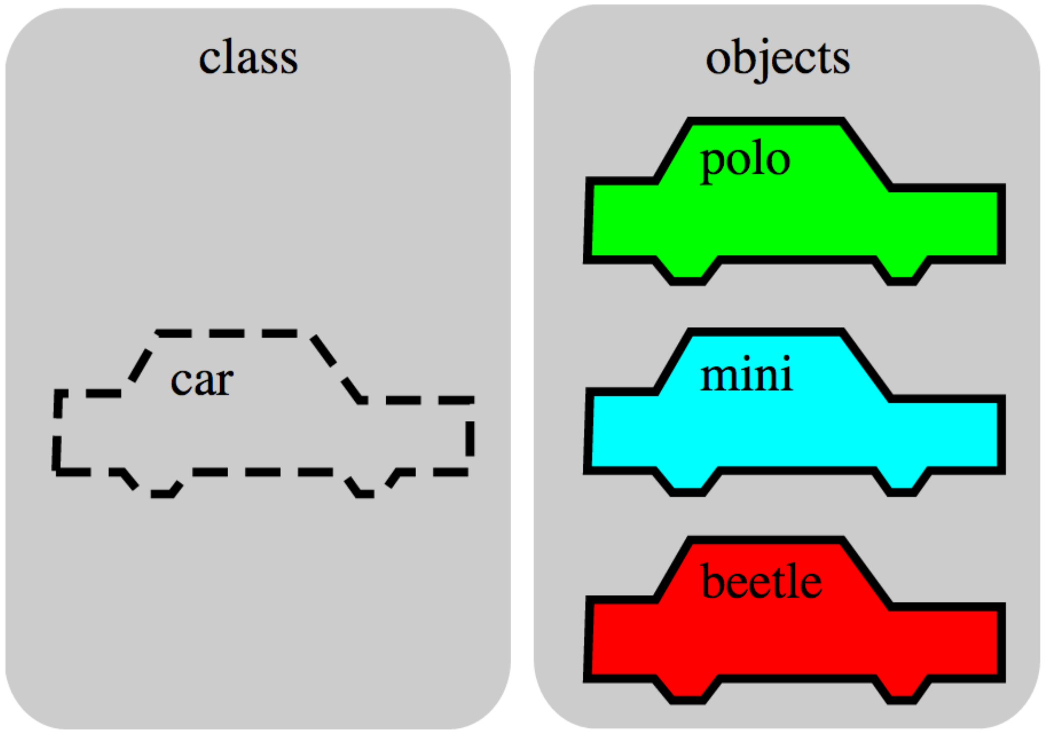
- Consist of data and behavior, bundled together to create abstractions
  - Abstract Data Types use functions to create abstractions
  - Classes extend this idea to a feature of the programming language.
    - » They make the "abstract" data type concrete.
- A class has
  - –attributes (variables)
  - –methods (functions)

  that define its behavior.



Objects

- An object is the instance of a class.



Objects

- Objects are concrete instances of classes in memory.

- They can have state
  - mutable vs immutable (lists vs tuples)

- Functions do one thing (well)
  - Objects do a collection of related things

- In Python, everything is an object
  - All objects have attributes
  - Manipulation happens through methods

Python class statement

```
class ClassName:
    <statement-1>
    .
    .
    .
    <statement-N>


class ClassName ( inherits ):
    <statement-1>
    .
    .
    .
    <statement-N>
```

Example: Account

```
class BaseAccount:

    def __init__(self, name, initial_deposit):
        self.name = name
        self.balance = initial_deposit

    def account_name(self):
        return self.name

    def balance(self):
        return self.balance

    def withdraw(self, amount):
        self.balance -= amount
        return self.balance
```

new namespace

attributes

The object

dot

methods

Creating an object, invoking a method

The Class Constructor

```
my_acct = BaseAccount("John Doe", 93)
my_acct.withdraw(42)
```

dot

Special Initialization Method

```
class BaseAccount:

    def __init__(self, name, initial_deposit):
        self.name = name
        self.balance = initial_deposit

    def account_name(self):
        return self.name

    def balance(self):
        return self.balance

    def withdraw(self, amount):
        self.balance -= amount
        return self.balance
```

return None

More on Attributes

- Attributes of an object accessible with 'dot' notation

```
obj.attr
```

- You can distinguish between "public" and "private" data.
  - Used to clarify to programmers how you class should be used.
  - In Python an _ prefix means "this thing is private"
  - `_foo` and `__foo` do different things inside a class.
  - More for the curious.
- Class variables vs Instance variables:
  - Class variable set for all instances at once
  - Instance variables per instance value

Example

```
class BaseAccount:

    def __init__(self, name, initial_deposit):
        self.name = name
        self.balance = initial_deposit

    def name(self):
        return self.name

    def balance(self):
        return self.balance

    def withdraw(self, amount):
        self.balance -= amount
        return self.balance
```

Example: “private” attributes

```
class BaseAccount:

    def __init__(self, name, initial_deposit):
        self._name = name
        self._balance = initial_deposit

    def name(self):
        return self._name

    def balance(self):
        return self._balance

    def withdraw(self, amount):
        self._balance -= amount
        return self._balance
```

Example: class attribute

```
class BaseAccount:
    account_number_seed = 1000

    def __init__(self, name, initial_deposit):
        self._name = name
        self._balance = initial_deposit
        self._acct_no = BaseAccount.account_number_seed
        BaseAccount.account_number_seed += 1

    def name(self):
        return self._name

    def balance(self):
        return self._balance

    def withdraw(self, amount):
        self._balance -= amount
        return self._balance
```

More class attributes

```
class BaseAccount:
    account_number_seed = 1000
    accounts = []
    def __init__(self, name, initial_deposit):
        self._name = name
        self._balance = initial_deposit
        self._acct_no = BaseAccount.account_number_seed
        BaseAccount.account_number_seed += 1
        BaseAccount.accounts.append(self)

    def name(self):
        ...

    def show_accounts():
        for account in BaseAccount.accounts:
            print(account.name(),
                  account.account_no(),account.balance())
```