Additional Object-Oriented Techniques

olsen software

Contents

1. A closer look at attributes
2. Implementing magic methods
3. Inheritance

Demo folder: **`07-MoreOOP`**

1. A Closer Look at Attributes

- Determining an object's attributes
- Adding and removing object attributes
- Built-in class attributes

Managing an Object's Attributes

- Python provides several global functions that allow you to manage attributes on an object

```
from accounting import BankAccount

acc1 = BankAccount("Fred")

setattr(acc1, "bonus", 2000)

if hasattr(acc1, "bonus"):
    print("acc1.bonus is %d" % acc1.bonus)

delattr(acc1, "bonus")
```

manageattributes.py

Adding and Removing Object Attributes

- You can also add and remove attributes on an object directly, as follows:

```
from accounting import BankAccount

acc1 = BankAccount("Fred")

# Add an attribute to an object.
acc1.flag = "Whao watch this guy"
print("acc1.flag is %s" % acc1.flag)

# Remove an attribute from an object.
del acc1.flag
```

addremoveattributes.py

Built-In Class Attributes

- Every class provides metadata via the following built-in attributes
  - You can also get metadata about an object too

```
from accounting import BankAccount

print("BankAccount.__doc__:",    BankAccount.__doc__)
print("BankAccount.__name__:",   BankAccount.__name__)
print("BankAccount.__module__:", BankAccount.__module__)
print("BankAccount.__bases__:",  BankAccount.__bases__)
print("BankAccount.__dict__:",   BankAccount.__dict__)

acc1 = BankAccount("Ola")
print("acc1.__dict__:", acc1.__dict__)
```

builtinattributes.py

2. Implementing Special Methods

- Overview
- Implementing constructors and destructors
- Implementing stringify methods
- Implementing operator methods

Overview

- There are various "special" methods you can implement in your Python classes
  - These methods allow your class objects to take advantage of standard Python idioms

- It's good practice to implement these methods where relevant
  - Python programmers will recognise these methods immediately
  - Makes your classes easier to maintain

Implementing Constructors and Destructors

- Constructor
  - `__init__(self, *otherArgs*)`

- Destructor
  - `__del__(self)`

- Example

```
class Person:

    def __init__(self, name, age):
        self.name = name
        self.age = age
        print("In __init__() for %s and %d" % (self.name, self.age))

    def __del__(self):
        print("In __del__() for %s and %d" % (self.name, self.age))
```

```
p1 = Person("Bill", 23)
p2 = Person("Ben", 25)
…
del p1, p2
```

magicmethods.py

Implementing Stringify Methods

- Return a machine-readable representation of an object
  - `__repr__(self)`

- Return a human-readable representation of an object
  - `__str__(self)`

- Example

```
class Person:

    def __repr__(self):
        return "{0} instance, name: {1}, age: {2}".format( \
                                                      self.__class__.__name__,\
                                                      self.name, self.age)
    def __str__(self):
        return "{0} is {1}.".format(self.name, self.age)
    …
```

```
…

print(repr(p1))
print(str(p2))
```

magicmethods.py

Implementing Operator Methods

- There are a large number of method that represent standard operators, including:
  - `__eq__(self, other)`
  - `__ne__(self, other)`
  - Etc…

- Example

```
class Person:

    def __eq__(self, other):
        return self.age == other.age

    def __ne__(self, other):
        return self.age != other.age

    …
```

```
…

print("p1 == p2 gives %s" % (p1 == p2))
print("p1 != p2 gives %s" % (p1 != p2))
```

magicmethods.py

3. Inheritance

- Overview of inheritance
- Superclasses and subclasses
- Sample hierarchy
- Defining a subclass
- Adding new members
- Defining constructors
- Overriding methods
- Multiple inheritance

Overview of Inheritance

- Inheritance is a very important part of object-oriented development
  - Allows you to define a new class based on an existing class
  - You just specify how the new class differs from the existing class

- Terminology:

For the "existing class":	Base class, superclass, parent class
For the "new class":	Derived class, subclass, child class

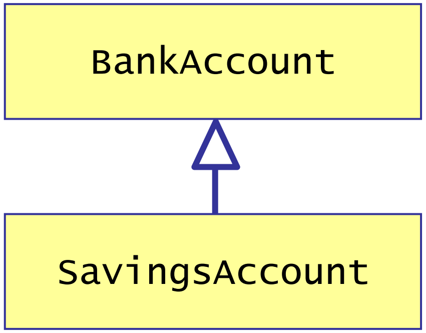
- Potential benefits of inheritance:
  - Improved OO model
  - Faster development
  - Smaller code base

Superclasses and Subclasses

- The subclass inherits everything from the superclass (except constructors)
  - You can define additional variables and methods
  - You can override existing methods from the superclass
  - You typically have to define constructors too
  - Note: You can't cherry pick or "blank off" superclass members

Sample Hierarchy

- We'll see how to implement the following simple hierarchy:



- Note:
  - `BankAccount` defines common state and behaviour that is relevant for all kinds of account
  - `SavingsAccount` "is a kind of" `BankAccount` that earns interest

- We might define additional subclasses in the future…
  - E.g. `CurrentAccount`, a kind of `BankAccount` that has cheques

Defining a Subclass

- To define a subclass, use the following syntax
  - Note that a Python class can inherit from multiple superclasses
  - We'll discuss multiple inheritance later in this chapter

```
class Subclass(Superclass1, Superclass2, …) :

    # Additional attributes and methods …

    # Constructor(s) …

    # Overrides for superclass methods, if necessary …
```

- Example:

```
class SavingsAccount(BankAccount):
    …
    …
    …                                                         accounting.py
```

Adding New Members

- The subclass inherits everything from the superclass
  - (Except for constructors)
  - The subclass can define additional members if it needs to …

- Example:

```
class SavingsAccount(BankAccount):

    __DEFAULT_INTEREST_RATE = 1.5


    def earnInterest(self):
        self.balance *= (1 + self.interestRate)
        return self.balance

    …
```

Additional class-wide variables

Additional methods
(instance / class-wide methods)

accounting.py

Defining Constructors

- A subclass doesn't inherit the constructor from superclass
  - So, define a constructor in the subclass, to initialize subclass state

- The subclass constructor should invoke the superclass constructor, to initialize superclass data
  - Call `super().__init__(`*`params`*`)`

- Example:

```
class SavingsAccount(BankAccount):

    def __init__(self, accountHolder="Anonymous", interestRate=None):

        super().__init__(accountHolder)

        if interestRate is None:
            self.interestRate = SavingsAccount.__DEFAULT_INTEREST_RATE
        else:
            self.interestRate = interestRate
    …
```

accounting.py

Overriding Methods

- The subclass can override superclass instance methods
  - To provide a different (or supplementary) implementation
  - No obligation ☺

- An override can call the original superclass method, to leverage existing functionality
  - Call super().*methodName*(*params*)

- Example:

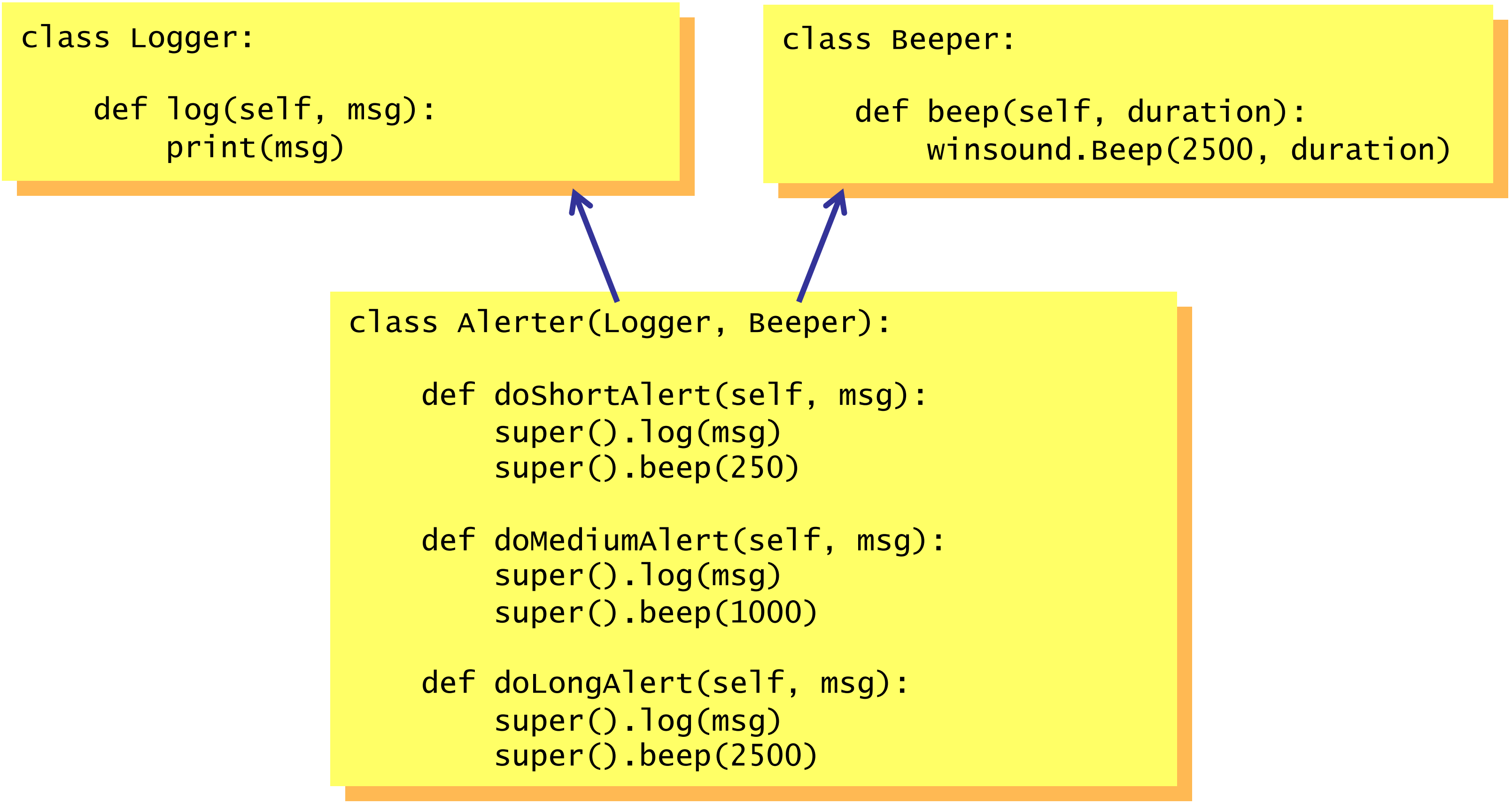
```
class SavingsAccount(BankAccount):

    def withdraw(self, amount):
        if amount > self.balance:
            print("You can't go overdrawn in a savings account!")
        else:
            super().withdraw(amount)
        return self.balance
    …
```

accounting.py

Multiple Inheritance (1 of 2)

- Python supports multiple inheritance



```
class Logger:

    def log(self, msg):
        print(msg)
```

```
class Beeper:

    def beep(self, duration):
        winsound.Beep(2500, duration)
```

```
class Alerter(Logger, Beeper):

    def doShortAlert(self, msg):
        super().log(msg)
        super().beep(250)

    def doMediumAlert(self, msg):
        super().log(msg)
        super().beep(1000)

    def doLongAlert(self, msg):
        super().log(msg)
        super().beep(2500)
```

`multipleinheritance.py`

Multiple Inheritance (2 of 2)

- Client code can access public members in the subclass or in any superclass

```
alerter = Alerter()

alerter.log("Wakey wakey!")
for i in range(30):
    alerter.beep(50)

msg = input("Enter an alert message: ")
alerter.doShortAlert(msg)

msg = input("Enter another alert message: ")
alerter.doMediumAlert(msg)

msg = input("And another: ")
alerter.doLongAlert(msg)
```

`multipleinheritance.py`

Any Questions?