

61A Lecture 15

Monday, October 1

Dispatch Dictionaries

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Demo

The Story So Far About Data

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Message passing: We can organize large programs by building components that relate to each other by passing messages.

Dispatch functions/dictionaries: A single object can include many different (but related) behaviors that all manipulate the same local state.

(All of these techniques can be implemented using only functions and assignment.)

Object-Oriented Programming

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Specialized syntax & vocabulary to support this metaphor

Classes

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>>> a.holder  
'Jim'
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Idea: All bank accounts have a balance and an account holder; the Account class should add those attributes to each newly created instance.

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>>> a = Account('Jim')
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'Jim'
>>> a.balance
0
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>>> a.deposit(15)
15
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>>> a.deposit(15)
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>>> a.withdraw(10)
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Idea: All bank accounts should have "withdraw" and "deposit" behaviors that all work in the same way.

Better idea: All bank accounts share a "withdraw" method.

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5
>>> a.balance
5
>>> a.withdraw(10)
'Insufficient funds'
```

The Class Statement

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class <name>(<base class>):  
    <suite>
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class Account(object):  
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class Account(object):  
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Binding an object to a new name using assignment **does not** create a new object:

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Binding an object to a new name using assignment **does not** create a new object:

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>>> c is a
True
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        self.balance = self.balance + amount  
        return self.balance
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    def withdraw(self, amount):  
        if amount > self.balance:  
            return 'Insufficient funds'  
        self.balance = self.balance - amount  
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        if amount > self.balance:  
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        self.balance = self.balance - amount  
        return self.balance
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These def statements create function objects as always, but their names are bound as attributes of the class.

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Called with two arguments

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Dot notation automatically supplies the first argument to a method.

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```
>>> tom_account = Account('Tom')  
>>> tom_account.deposit(100)  
100
```

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>>> tom_account.deposit(100)  
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```

Invoked with one argument

Dot Expressions

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tom_account.deposit(10)
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Dot expression

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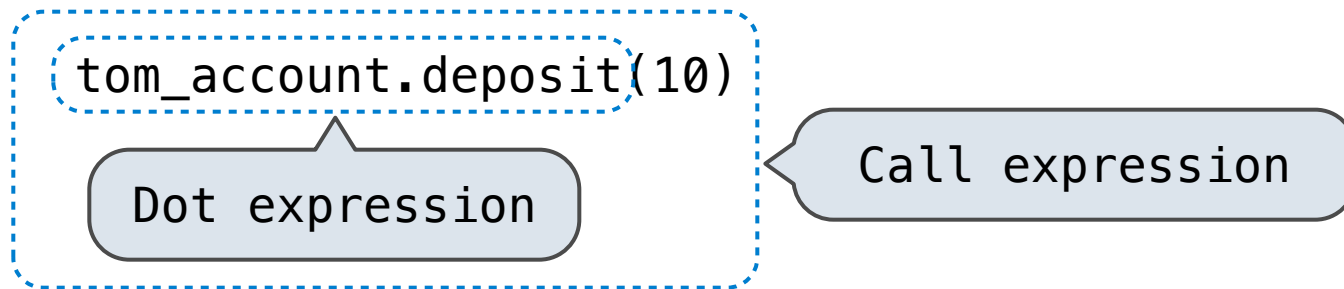
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10
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```
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True
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Looking up an attribute name in an object may return:

- One of its instance attributes, **or**
- One of the attributes of its class

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```
>>> type(Account.deposit)
```

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```
>>> Account.deposit(tom_account, 1001)
1011
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3. If not, `<name>` is looked up in the class, which yields a class attribute value.

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To evaluate a dot expression:

1. Evaluate the `<expression>` to the left of the dot, which yields the object of the dot expression.
2. `<name>` is matched against the instance attributes of that object; **if an attribute with that name exists**, its value is returned.
3. If not, `<name>` is looked up in the class, which yields a class attribute value.
4. That value is returned **unless it is a function**, in which case a *bound method* is returned instead.

Class Attributes

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```
class Account(object):  
    interest = 0.02    # A class attribute  
  
    def __init__(self, account_holder):  
        self.balance = 0  
        self.holder = account_holder  
  
    # Additional methods would be defined here
```


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        self.balance = 0  
        self.holder = account_holder  
  
    # Additional methods would be defined here  
  
>>> tom_account = Account('Tom')
```

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class Account(object):  
    interest = 0.02    # A class attribute  
  
    def __init__(self, account_holder):  
        self.balance = 0  
        self.holder = account_holder  
  
    # Additional methods would be defined here  
  
>>> tom_account = Account('Tom')  
>>> jim_account = Account('Jim')
```

Class Attributes

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```
class Account(object):  
    interest = 0.02    # A class attribute  
  
    def __init__(self, account_holder):  
        self.balance = 0  
        self.holder = account_holder  
  
    # Additional methods would be defined here  
  
>>> tom_account = Account('Tom')  
>>> jim_account = Account('Jim')  
>>> tom_account.interest  
0.02
```

Class Attributes

Class attributes are "shared" across all instances of a class because they are attributes of the class, not the instance.

```
class Account(object):  
    interest = 0.02    # A class attribute  
  
    def __init__(self, account_holder):  
        self.balance = 0  
        self.holder = account_holder  
  
    # Additional methods would be defined here  
  
>>> tom_account = Account('Tom')  
>>> jim_account = Account('Jim')  
>>> tom_account.interest  
0.02  
>>> jim_account.interest  
0.02
```

Class Attributes

Class attributes are "shared" across all instances of a class because they are attributes of the class, not the instance.

```
class Account(object):  
    interest = 0.02    # A class attribute  
  
    def __init__(self, account_holder):  
        self.balance = 0  
        self.holder = account_holder  
  
    # Additional methods would be defined here
```

```
>>> tom_account = Account('Tom')  
>>> jim_account = Account('Jim')  
>>> tom_account.interest  
0.02  
>>> jim_account.interest  
0.02
```

interest is not part of the instance that was somehow copied from the class!

Assignment Statements and Attributes

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Assignment statements with a dot expression on their left-hand side affect attributes for the object of that dot expression

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```
>>> jim_account = Account('Jim')
```

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```
>>> jim_account = Account('Jim')  
>>> tom_account = Account('Tom')
```

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- If the object is an instance, then assignment sets an instance attribute
- If the object is a class, then assignment sets a class attribute

```
>>> jim_account = Account('Jim')
>>> tom_account = Account('Tom')
>>> tom_account.interest
0.02
```

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Assignment statements with a dot expression on their left-hand side affect attributes for the object of that dot expression

- If the object is an instance, then assignment sets an instance attribute
- If the object is a class, then assignment sets a class attribute

```
>>> jim_account = Account('Jim')
>>> tom_account = Account('Tom')
>>> tom_account.interest
0.02
>>> jim_account.interest
0.02
```

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Assignment statements with a dot expression on their left-hand side affect attributes for the object of that dot expression

- If the object is an instance, then assignment sets an instance attribute
- If the object is a class, then assignment sets a class attribute

```
>>> jim_account = Account('Jim')
>>> tom_account = Account('Tom')
>>> tom_account.interest
0.02
>>> jim_account.interest
0.02
>>> tom_account.interest
```

Assignment Statements and Attributes

Assignment statements with a dot expression on their left-hand side affect attributes for the object of that dot expression

- If the object is an instance, then assignment sets an instance attribute
- If the object is a class, then assignment sets a class attribute

```
>>> jim_account = Account('Jim')
>>> tom_account = Account('Tom')
>>> tom_account.interest
0.02
>>> jim_account.interest
0.02
>>> tom_account.interest
0.02
>>> Account.interest = 0.04
```

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Assignment statements with a dot expression on their left-hand side affect attributes for the object of that dot expression

- If the object is an instance, then assignment sets an instance attribute
- If the object is a class, then assignment sets a class attribute

```
>>> jim_account = Account('Jim')
>>> tom_account = Account('Tom')
>>> tom_account.interest
0.02
>>> jim_account.interest
0.02
>>> tom_account.interest
0.02
>>> Account.interest = 0.04
>>> tom_account.interest
```


Assignment Statements and Attributes

Assignment statements with a dot expression on their left-hand side affect attributes for the object of that dot expression

- If the object is an instance, then assignment sets an instance attribute
- If the object is a class, then assignment sets a class attribute

```
>>> jim_account = Account('Jim')
>>> tom_account = Account('Tom')
>>> tom_account.interest
0.02
>>> jim_account.interest
0.02
>>> tom_account.interest
0.02
>>> Account.interest = 0.04
>>> tom_account.interest
0.04
```

Assignment Statements and Attributes

Assignment statements with a dot expression on their left-hand side affect attributes for the object of that dot expression

- If the object is an instance, then assignment sets an instance attribute
- If the object is a class, then assignment sets a class attribute

```
>>> jim_account = Account('Jim')
>>> tom_account = Account('Tom')
>>> tom_account.interest
0.02
>>> jim_account.interest
0.02
>>> tom_account.interest
0.02
>>> Account.interest = 0.04
>>> tom_account.interest
0.04
```

Assignment Statements and Attributes

Assignment statements with a dot expression on their left-hand side affect attributes for the object of that dot expression

- If the object is an instance, then assignment sets an instance attribute
- If the object is a class, then assignment sets a class attribute

```
>>> jim_account = Account('Jim')
>>> tom_account = Account('Tom')
>>> tom_account.interest
0.02
>>> jim_account.interest
0.02
>>> tom_account.interest
0.02
>>> Account.interest = 0.04
>>> tom_account.interest
0.04
```

```
>>> jim_account.interest = 0.08
```

Assignment Statements and Attributes

Assignment statements with a dot expression on their left-hand side affect attributes for the object of that dot expression

- If the object is an instance, then assignment sets an instance attribute
- If the object is a class, then assignment sets a class attribute

```
>>> jim_account = Account('Jim')
>>> tom_account = Account('Tom')
>>> tom_account.interest
0.02
>>> jim_account.interest
0.02
>>> tom_account.interest
0.02
>>> Account.interest = 0.04
>>> tom_account.interest
0.04
```

```
>>> jim_account.interest = 0.08
>>> jim_account.interest
0.08
```

Assignment Statements and Attributes

Assignment statements with a dot expression on their left-hand side affect attributes for the object of that dot expression

- If the object is an instance, then assignment sets an instance attribute
- If the object is a class, then assignment sets a class attribute

```
>>> jim_account = Account('Jim')
>>> tom_account = Account('Tom')
>>> tom_account.interest
0.02
>>> jim_account.interest
0.02
>>> tom_account.interest
0.02
>>> Account.interest = 0.04
>>> tom_account.interest
0.04
```

```
>>> jim_account.interest = 0.08
>>> jim_account.interest
0.08
>>> tom_account.interest
0.04
```

Assignment Statements and Attributes

Assignment statements with a dot expression on their left-hand side affect attributes for the object of that dot expression

- If the object is an instance, then assignment sets an instance attribute
- If the object is a class, then assignment sets a class attribute

```
>>> jim_account = Account('Jim')
>>> tom_account = Account('Tom')
>>> tom_account.interest
0.02
>>> jim_account.interest
0.02
>>> tom_account.interest
0.02
>>> Account.interest = 0.04
>>> tom_account.interest
0.04
```

```
>>> jim_account.interest = 0.08
>>> jim_account.interest
0.08
>>> tom_account.interest
0.04
>>> Account.interest = 0.05
```

Assignment Statements and Attributes

Assignment statements with a dot expression on their left-hand side affect attributes for the object of that dot expression

- If the object is an instance, then assignment sets an instance attribute
- If the object is a class, then assignment sets a class attribute

```
>>> jim_account = Account('Jim')
>>> tom_account = Account('Tom')
>>> tom_account.interest
0.02
>>> jim_account.interest
0.02
>>> tom_account.interest
0.02
>>> Account.interest = 0.04
>>> tom_account.interest
0.04
```

```
>>> jim_account.interest = 0.08
>>> jim_account.interest
0.08
>>> tom_account.interest
0.04
>>> Account.interest = 0.05
>>> tom_account.interest
0.05
```

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Assignment statements with a dot expression on their left-hand side affect attributes for the object of that dot expression

- If the object is an instance, then assignment sets an instance attribute
- If the object is a class, then assignment sets a class attribute

```
>>> jim_account = Account('Jim')
>>> tom_account = Account('Tom')
>>> tom_account.interest
0.02
>>> jim_account.interest
0.02
>>> tom_account.interest
0.02
>>> Account.interest = 0.04
>>> tom_account.interest
0.04
```

```
>>> jim_account.interest = 0.08
>>> jim_account.interest
0.08
>>> tom_account.interest
0.04
>>> Account.interest = 0.05
>>> tom_account.interest
0.05
>>> jim_account.interest
0.08
```