61A Lecture 14

Friday, September 30
The Story So Far About Data
The Story So Far About Data

**Data abstraction**: Enforce a separation between how data values are represented and how they are used.
The Story So Far About Data

**Data abstraction:** Enforce a separation between how data values are represented and how they are used.

**Abstract data types:** A representation of a data type is valid if it satisfies certain behavior conditions.
The Story So Far About Data

**Data abstraction**: Enforce a separation between how data values are represented and how they are used.

**Abstract data types**: A representation of a data type is valid if it satisfies certain behavior conditions.

**Message passing**: We can organize large programs by building components that relate to each other by passing messages.
The Story So Far About Data

**Data abstraction:** Enforce a separation between how data values are represented and how they are used.

**Abstract data types:** A representation of a data type is valid if it satisfies certain behavior conditions.

**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.
The Story So Far About Data

**Data abstraction:** Enforce a separation between how data values are represented and how they are used.

**Abstract data types:** A representation of a data type is valid if it satisfies certain behavior conditions.

**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

A method for organizing modular programs
Object-Oriented Programming

A method for organizing modular programs

• Abstraction barriers
Object-Oriented Programming

A method for organizing modular programs

• Abstraction barriers
• Message passing
Object-Oriented Programming

A method for organizing modular programs

• Abstraction barriers
• Message passing
• Bundling together information and related behavior
Object-Oriented Programming

A method for organizing modular programs

- Abstraction barriers
- Message passing
- Bundling together information and related behavior

A metaphor for computation using distributed state
Object-Oriented Programming

A method for organizing modular programs

- Abstraction barriers
- Message passing
- Bundling together information and related behavior

A metaphor for computation using distributed state

- Each *object* has its own local state.
Object-Oriented Programming

A method for organizing modular programs
• Abstraction barriers
• Message passing
• Bundling together information and related behavior

A metaphor for computation using distributed state
• Each object has its own local state.
• Each object also knows how to manage its own local state, based on the messages it receives.
Object-Oriented Programming

A method for organizing modular programs

- Abstraction barriers
- Message passing
- Bundling together information and related behavior

A metaphor for computation using distributed state

- Each *object* has its own local state.
- Each object also knows how to manage its own local state, based on the messages it receives.
- Several objects may all be instances of a common type.
Object-Oriented Programming

A method for organizing modular programs

• Abstraction barriers
• Message passing
• Bundling together information and related behavior

A metaphor for computation using distributed state

• Each *object* has its own local state.
• Each object also knows how to manage its own local state, based on the messages it receives.
• Several objects may all be instances of a common type.
• Different types may relate to each other as well.
Object-Oriented Programming

A method for organizing modular programs

- Abstraction barriers
- Message passing
- Bundling together information and related behavior

A metaphor for computation using distributed state

- Each object has its own local state.
- Each object also knows how to manage its own local state, based on the messages it receives.
- Several objects may all be instances of a common type.
- Different types may relate to each other as well.

Specialized syntax & vocabulary to support this metaphor
Classes

A class serves as a template for its instances.
Classes

A class serves as a template for its instances.

**Idea:** All bank accounts have a balance and an account holder; the Account class should add those attributes to each newly created instance.
A class serves as a template for its instances.

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

```python
>>> a = Account('Jim')
```
A class serves as a template for its instances.

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

```python
>>> a = Account('Jim')
>>> a.holder
'Jim'
```
A class serves as a template for its instances.

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

```python
>>> a = Account('Jim')
>>> a.holder
'Jim'
>>> a.balance
0
```
Classes

A class serves as a template for its instances.

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

```python
>>> a = Account('Jim')
>>> a.holder
'Jim'
>>> a.balance
0
```

Idea: All bank accounts should have "withdraw" and "deposit" behaviors that all work in the same way.
A class serves as a template for its instances.

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

```python
>>> a = Account('Jim')
>>> a.holder
'Jim'
>>> a.balance
0
```

Idea: All bank accounts should have "withdraw" and "deposit" behaviors that all work in the same way.

```python
>>> a.deposit(15)
15
```
Classes

A class serves as a template for its instances.

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

>>> a = Account('Jim')
>>> a.holder
'Jim'
>>> a.balance
0

Idea: All bank accounts should have "withdraw" and "deposit" behaviors that all work in the same way.

>>> a.deposit(15)
15
>>> a.withdraw(10)
5
A class serves as a template for its instances.

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

```python
>>> a = Account('Jim')
>>> a.holder
'Jim'
>>> a.balance
0
```

**Idea:** All bank accounts should have "withdraw" and "deposit" behaviors that all work in the same way.

```python
>>> a.deposit(15)
15
>>> a.withdraw(10)
5
>>> a.balance
5
```
A class serves as a template for its instances.

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

```python
>>> a = Account('Jim')
>>> a.holder
'Jim'
>>> a.balance
0
```

**Idea:** All bank accounts should have "withdraw" and "deposit" behaviors that all work in the same way.

```python
>>> a.deposit(15)
15
>>> a.withdraw(10)
5
>>> a.balance
5
>>> a.withdraw(10)
'Insufficient funds'
```
A class serves as a template for its instances.

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

```python
>>> a = Account('Jim')
>>> a.holder
'Jim'
>>> a.balance
0
```

**Idea:** All bank accounts should have "withdraw" and "deposit" behaviors that all work in the same way.

```python
>>> a.deposit(15)
15
>>> a.withdraw(10)
5
>>> a.balance
5
>>> a.withdraw(10)
'Insufficient funds'
```

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

```python
```
The Class Statement
The Class Statement

class <name>(<base class>):
  <suite>
The Class Statement

class <name>(<base class>):
<suite>

Next lecture
The Class Statement

A class statement **creates** a new class and **binds** that class to `<name>` in the first frame of the current environment.
The Class Statement

A class statement **creates** a new class and **binds** that class to `<name>` in the first frame of the current environment.

Statements in the `<suite>` create attributes of the class.
A class statement **creates** a new class and **binds** that class to `<name>` in the first frame of the current environment.

Statements in the `<suite>` create attributes of the class.

As soon as an instance is created, it is passed to `__init__`, which is an attribute of the class.
A class statement creates a new class and binds that class to \texttt{<name>} in the first frame of the current environment.

Statements in the \texttt{<suite>} create attributes of the class.

As soon as an instance is created, it is passed to \texttt{__init__}, which is an attribute of the class.

\begin{verbatim}
class Account(object):
\end{verbatim}
A class statement creates a new class and binds that class to <name> in the first frame of the current environment.

Statements in the <suite> create attributes of the class.

As soon as an instance is created, it is passed to __init__, which is an attribute of the class.

```python
class Account(object):
    def __init__(self, account_holder):
```
A class statement **creates** a new class and **binds** that class to `<name>` in the first frame of the current environment.

Statements in the `<suite>` create attributes of the class.

As soon as an instance is created, it is passed to `__init__`, which is an attribute of the class.

```python
class Account(object):
    def __init__(self, account_holder):
        self.balance = 0
```
The Class Statement

A class statement **creates** a new class and **binds** that class to `<name>` in the first frame of the current environment.

Statements in the `<suite>` create attributes of the class.

As soon as an instance is created, it is passed to `__init__`, which is an attribute of the class.

```python
class Account(object):
    def __init__(self, account_holder):
        self.balance = 0
        self.holder = account_holder
```
Initialization
Initialization

**Idea:** All bank accounts have a balance and an account holder; the Account class should add those attributes.

```python
>>> a = Account('Jim')
>>> a.holder
'Jim'
>>> a.balance
0
```
**Initialization**

**Idea:** All bank accounts have a balance and an account holder; the Account class should add those attributes.

```python
>>> a = Account('Jim')
>>> a.holder
'Jim'
>>> a.balance
0
```

Classes are "called" to construct instances.
Initialization

**Idea:** All bank accounts have a balance and an account holder; the Account class should add those attributes.

```python
>>> a = Account('Jim')
>>> a.holder
'Jim'
>>> a.balance
0
```

Classes are "called" to construct instances.

The constructor `__init__` is called on newly created instances.
Initialization

**Idea:** All bank accounts have a balance and an account holder; the Account class should add those attributes.

```python
>>> a = Account('Jim')
>>> a.holder
'Jim'
>>> a.balance
0
```

Classes are "called" to construct instances.

The constructor `__init__` is called on newly created instances.

The object is bound to `__init__`'s first parameter, `self`.

```python
class Account(object):
    def __init__(self, account_holder):
        self.balance = 0
        self.holder = account_holder
```
Object Identity
Object Identity

Every object that is an instance of a user-defined class has a unique identity:
Object Identity

Every object that is an instance of a user-defined class has a unique identity:

```python
>>> a = Account('Jim')
>>> b = Account('Jack')
```
Every object that is an instance of a user-defined class has a unique identity:

```python
>>> a = Account('Jim')
>>> b = Account('Jack')
```

Identity testing is performed by "is" and "is not" operators:
Every object that is an instance of a user-defined class has a unique identity:

```python
>>> a = Account('Jim')
>>> b = Account('Jack')
```

Identity testing is performed by "is" and "is not" operators:

```python
>>> a is a
True
>>> a is not b
True
```
Object Identity

Every object that is an instance of a user-defined class has a unique identity:

```python
>>> a = Account('Jim')
>>> b = Account('Jack')
```

Identity testing is performed by "is" and "is not" operators:

```python
>>> a is a
True
>>> a is not b
True
```

Binding an object to a new name using assignment does not create a new object:
Every object that is an instance of a user-defined class has a unique identity:

```python
>>> a = Account('Jim')
>>> b = Account('Jack')
```

Identity testing is performed by "is" and "is not" operators:

```python
>>> a is a
True
>>> a is not b
True
```

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

```python
>>> c = a
>>> c is a
True
```
Methods
Methods

Methods are defined in the suite of a class statement
Methods

Methods are defined in the suite of a class statement

```python
class Account(object):
```

Friday, September 30, 2011
Methods

Methods are defined in the suite of a class statement

```python
class Account(object):
    def __init__(self, account_holder):
        self.balance = 0
        self.holder = account_holder
```
Methods

Methods are defined in the suite of a class statement

```python
class Account(object):
    def __init__(self, account_holder):
        self.balance = 0
        self.holder = account_holder

    def deposit(self, amount):
        self.balance = self.balance + amount
        return self.balance
```
Methods

Methods are defined in the suite of a class statement

class Account(object):
    
def __init__(self, account_holder):
        self.balance = 0
        self.holder = account_holder
    
def deposit(self, amount):
        self.balance = self.balance + amount
        return self.balance
    
def withdraw(self, amount):
        if amount > self.balance:
            return 'Insufficient funds'
        self.balance = self.balance - amount
        return self.balance
Methods

Methods are defined in the suite of a class statement

```python
class Account(object):
    def __init__(self, account_holder):
        self.balance = 0
        self.holder = account_holder

    def deposit(self, amount):
        self.balance = self.balance + amount
        return self.balance

    def withdraw(self, amount):
        if amount > self.balance:
            return 'Insufficient funds'
        self.balance = self.balance - amount
        return self.balance
```

These `def` statements create function objects as always, but their names are bound as attributes of the class.
Invoking Methods

All invoked methods have access to the object via the `self` parameter, and so they can all access and manipulate the object's state.
Invoking Methods

All invoked methods have access to the object via the self parameter, and so they can all access and manipulate the object's state.

```python
class Account(object):
    ...

    def deposit(self, amount):
        self.balance = self.balance + amount
        return self.balance
```
Invoking Methods

All invoked methods have access to the object via the `self` parameter, and so they can all access and manipulate the object's state.

```python
class Account(object):
    ...

def deposit(self, amount):
    self.balance = self.balance + amount
    return self.balance
```

Called with two arguments
Invoking Methods

All invoked methods have access to the object via the `self` parameter, and so they can all access and manipulate the object's state.

```python
class Account(object):
    ...
    def deposit(self, amount):
        self.balance = self.balance + amount
        return self.balance
```

Dot notation automatically supplies the first argument to a method.
Invoking Methods

All invoked methods have access to the object via the self parameter, and so they can all access and manipulate the object's state.

```python
class Account(object):
    ...

    def deposit(self, amount):
        self.balance = self.balance + amount
        return self.balance
```

dot notation automatically supplies the first argument to a method.

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

All invoked methods have access to the object via the `self` parameter, and so they can all access and manipulate the object's state.

```python
class Account(object):
    ...

    def deposit(self, amount):
        self.balance = self.balance + amount
        return self.balance
```

Dot notation automatically supplies the first argument to a method.

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

Objects receive messages via dot notation
Dot Expressions

Objects receive messages via dot notation

Dot notation accesses attributes of the instance or its class
Dot Expressions

Objects receive messages via dot notation

Dot notation accesses attributes of the instance or its class

<expression> . <name>
Dot Expressions

Objects receive messages via dot notation

Dot notation accesses attributes of the instance or its class

<expression> . <name>

The <expression> can be any valid Python expression
Dot Expressions

Objects receive messages via dot notation

Dot notation accesses attributes of the instance or its class

<expression> . <name>

The <expression> can be any valid Python expression

The <name> must be a simple name
Dot Expressions

Objects receive messages via dot notation

Dot notation accesses attributes of the instance or its class

<expression> . <name>

The <expression> can be any valid Python expression

The <name> must be a simple name

Evaluates to the value of the attribute looked up by <name> on the object that is the value of the <expression>
Dot Expressions

Objects receive messages via dot notation

Dot notation accesses attributes of the instance or its class

<expression> . <name>

The <expression> can be any valid Python expression

The <name> must be a simple name

Evaluates to the value of the attribute looked up by <name> on the object that is the value of the <expression>

```python
tom_account.deposit(10)
```
Dot Expressions

Objects receive messages via dot notation

Dot notation accesses attributes of the instance or its class

\(<expression>\. <name>\)

The <expression> can be any valid Python expression

The <name> must be a simple name

Evaluates to the value of the attribute looked up by <name> on the object that is the value of the <expression>

```
> tom_account.deposit(10)
```
Dot Expressions

Objects receive messages via dot notation

Dot notation accesses attributes of the instance or its class

<expression> . <name>

The <expression> can be any valid Python expression

The <name> must be a simple name

Evaluates to the value of the attribute looked up by <name> on the object that is the value of the <expression>

```python
tom_account.deposit(10)
```

Dot expression

Call expression
Accessing Attributes
Accessing Attributes

Using `getattr`, we can look up an attribute using a string, just as we did with a dispatch function/dictionary.
Accessing Attributes

Using `getattr`, we can look up an attribute using a string, just as we did with a dispatch function/dictionary

```python
>>>getattr(tom_account, 'balance')
10
```
Accessing Attributes

Using `getattr`, we can look up an attribute using a string, just as we did with a dispatch function/dictionary.

```python
>>> getattr(tom_account, 'balance')
10
```
```
>>> hasattr(tom_account, 'deposit')
True
```
Accessing Attributes

Using `getattr`, we can look up an attribute using a string, just as we did with a dispatch function/dictionary.

```python
>>> getattr(tom_account, 'balance')
10
```

```python
>>> hasattr(tom_account, 'deposit')
True
```

global `getattr` and dot expressions look up a name in the same way.
Accessing Attributes

Using getattr, we can look up an attribute using a string, just as we did with a dispatch function/dictionary

```python
>>> getattr(tom_account, 'balance')
10

>>> hasattr(tom_account, 'deposit')
True
```

getattr and dot expressions look up a name in the same way

Looking up a named attribute on an object may return:
Accessing Attributes

Using getattr, we can look up an attribute using a string, just as we did with a dispatch function/dictionary

```python
>>> getattr(tom_account, 'balance')
10

>>> hasattr(tom_account, 'deposit')
True
```

ggetattr and dot expressions look up a name in the same way

Looking up a named attribute on an object may return:

• One of its instance attributes
Accessing Attributes

Using `getattr`, we can look up an attribute using a string, just as we did with a dispatch function/dictionary:

```python
>>> getattr(tom_account, 'balance')
10

>>> hasattr(tom_account, 'deposit')
True
```

global attr and dot expressions look up a name in the same way.

Looking up a named attribute on an object may return:

- One of its instance attributes
- One of the attributes (including a method) of its class
Methods and Functions
Methods and Functions

Python distinguishes between:
Methods and Functions

Python distinguishes between:

• *function objects*, which we have been creating since the beginning of the course, and
Methods and Functions

Python distinguishes between:

- *function objects*, which we have been creating since the beginning of the course, and

- *bound method objects*, which couple together a function and the object on which that method will be invoked
Methods and Functions

Python distinguishes between:

- *function objects*, which we have been creating since the beginning of the course, and
- *bound method objects*, which couple together a function and the object on which that method will be invoked

\[
\text{Object} + \text{Function Object} = \text{Bound Method Object}
\]
Methods and Functions

Python distinguishes between:

- *function objects*, which we have been creating since the beginning of the course, and
- *bound method objects*, which couple together a function and the object on which that method will be invoked

\[
\text{Object} + \text{Function Object} = \text{Bound Method Object}
\]

```python
g>>> type(Account.deposit)
<class 'function'>
g>>> type(tom_account.deposit)
<class 'method'>
```
Methods and Functions

Python distinguishes between:

- **function objects**, which we have been creating since the beginning of the course, and
- **bound method objects**, which couple together a function and the object on which that method will be invoked

```
Object + Function Object = Bound Method Object
```

```
>>> type(Account.deposit)
class 'function'

>>> type(tom_account.deposit)
class 'method'

>>> Account.deposit(tom_account, 1001)
1011
```
Methods and Functions

Python distinguishes between:

- *function objects*, which we have been creating since the beginning of the course, and

- *bound method objects*, which couple together a function and the object on which that method will be invoked

\[
\text{Object} + \text{ Function Object} = \text{ Bound Method Object}
\]

```python
>>> type(Account.deposit)
<class 'function'>
>>> type(tom_account.deposit)
<class 'method'>

>>> Account.deposit(tom_account, 1001)
1011
>>> tom_account.deposit(1000)
2011
```
Looking Up Attributes by Name

<expression> . <name>
Looking Up Attributes by Name

To evaluate a dot expression:

<expression> . <name>
Looking Up Attributes by Name

To evaluate a dot expression:

1. Evaluate the `<expression>` to the left of the dot, which yields the object of the dot expression.
Looking Up Attributes by Name

<expression> . <name>

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.
Looking Up Attributes by Name

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 `<name>` does not appear among instance attributes, it is looked up in the class, which yields a class attribute value.
Looking Up Attributes by Name

<expression> . <name>

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 <name> does not appear among instance attributes, it is looked up in the class, which yields a class attribute value.

4. That value is returned unless it is a function value, in which case a bound method value is returned instead.
Class Attributes
Class Attributes

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

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

```python
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

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

```python
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
Assignment Statements and Attributes

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

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

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

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

```python
>>> 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

```python
>>> 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
```
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

```python
>>> 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

```python
>>> 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

```python
>>> 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

```python
>>> 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

```python
>>> 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
```

```python
>>> 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

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

```python
>>> 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

```python
>>> 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
```

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

Friday, September 30, 2011
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

```python
>>> 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
>>> jim_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
```