61A Lecture 16

Wednesday, October 8

Announcements

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- Project 2 due Thursday 10/9 @ 11:59pm

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  - Suggest questions and vote for your favorites at http://goo.gl/HtkXFf or on Piazza

Object-Oriented Programming

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A method for organizing modular programs

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- Data abstraction

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- Bundling together information and related behavior

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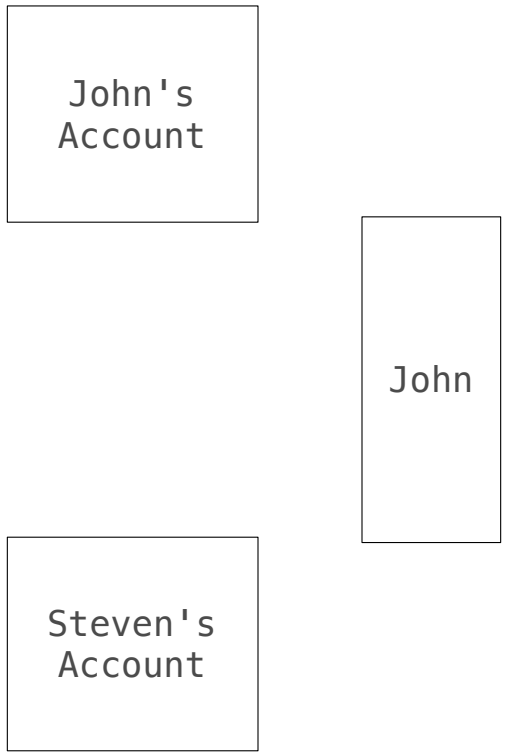

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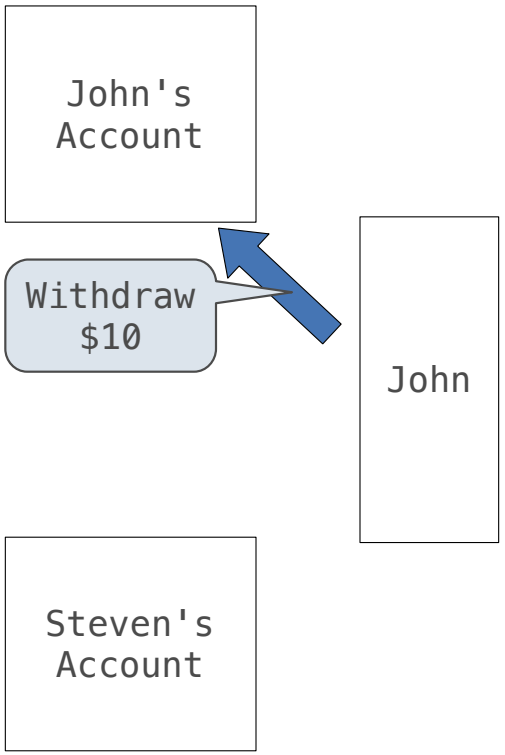

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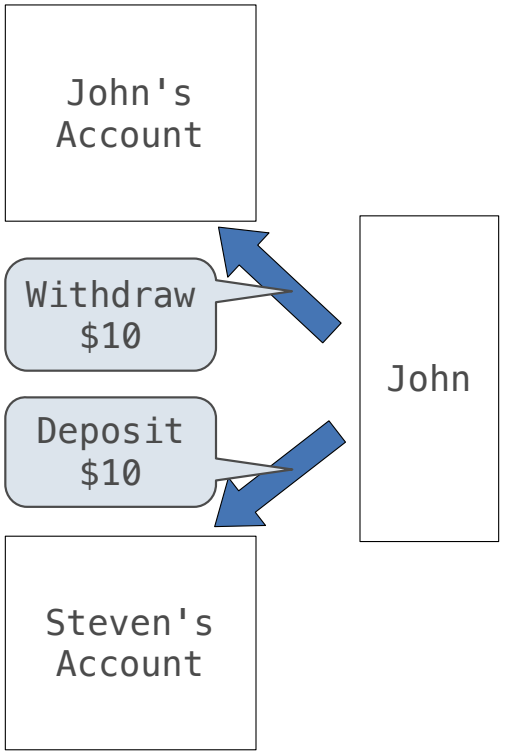

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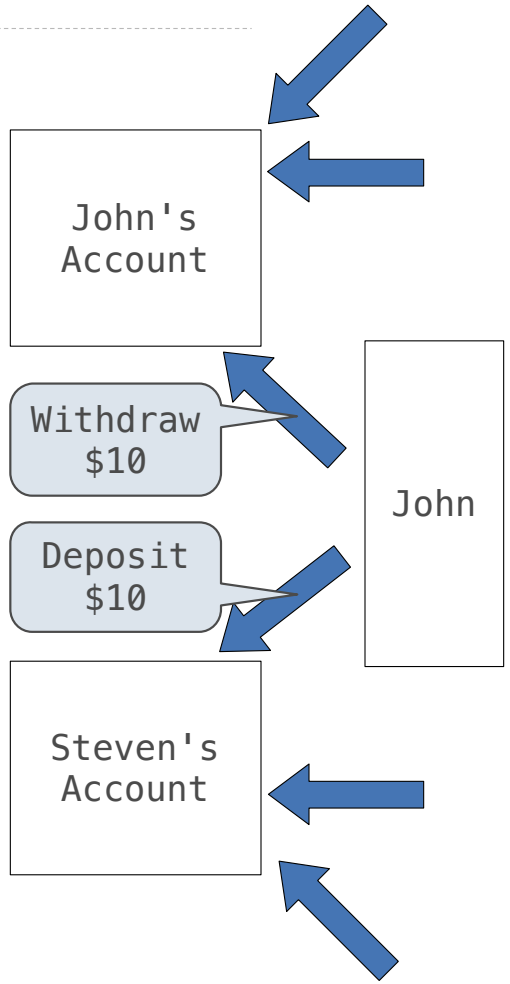

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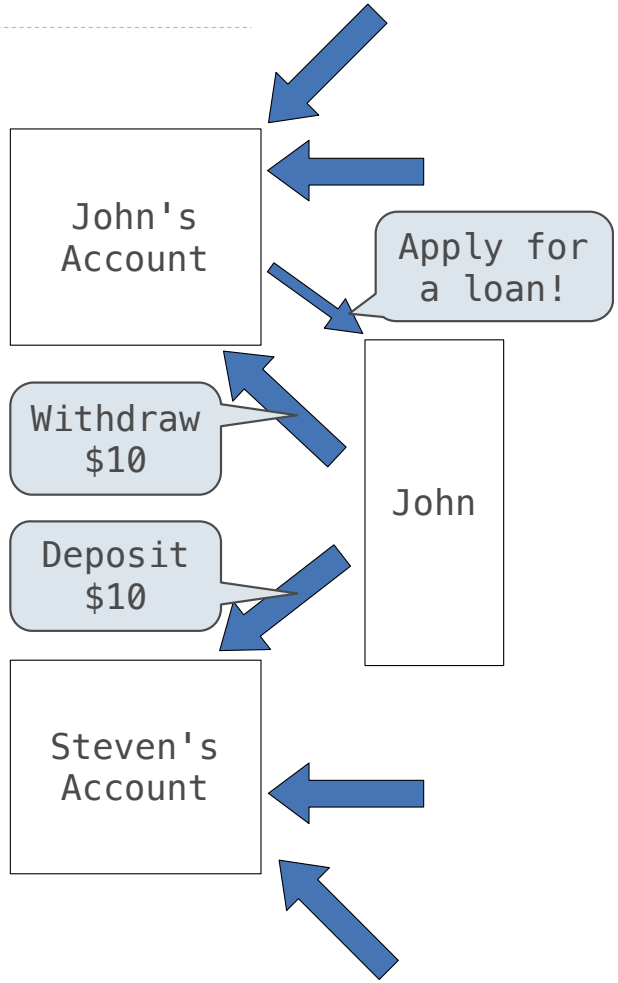

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>>> a.holder
'Jim'
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>>> a.holder
'Jim'
>>> a.balance
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Idea: All bank accounts should have "withdraw" and "deposit" behaviors that all work in the same way.

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```
>>> a.deposit(15)
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```
>>> a.deposit(15)
15
>>> a.withdraw(10)
5
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5
>>> a.balance
5
>>> a.withdraw(10)
'Insufficient funds'
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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 and a "deposit" method.

```
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>>> a.holder
'Jim'
>>> a.balance
0

>>> a.deposit(15)
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5
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'Insufficient funds'
```

Class Statements

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...     nose = 'big and red'
...     def dance():
...         return 'No thanks'
...
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>>> Clown.nose
'big and red'
```

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>>> Clown.dance()
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'No thanks'
>>> Clown
<class '__main__.Clown'>
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>>> a.balance
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Every call to Account creates a new Account instance. There is only one Account class.

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Identity operators "is" and "is not" test if two expressions evaluate to the same object:

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True
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>>> c = a
>>> c is a
True
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```
        self.holder = account_holder
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        self.balance = self.balance + amount
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```
        return self.balance
```

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```
    def withdraw(self, amount):
```

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```
        if amount > self.balance:
```

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```
            return 'Insufficient funds'
```

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```
        self.balance = self.balance - amount
```

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

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Defined with two arguments

Dot notation automatically supplies the first argument to a method.

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

Invoked with one argument

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

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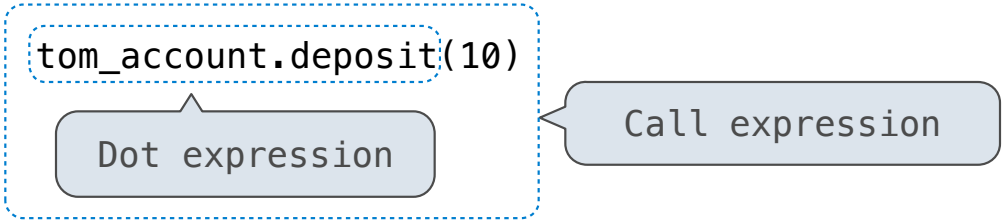

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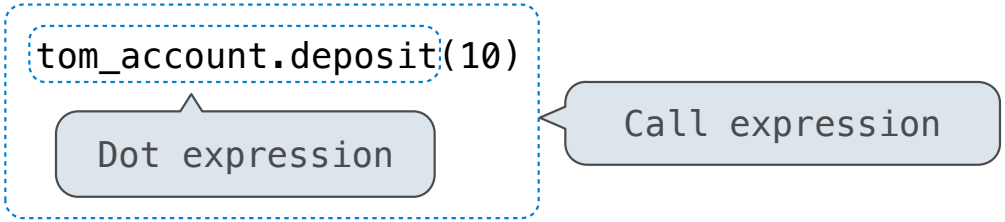

(Demo)

Attributes

Accessing Attributes

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Using getattr, we can look up an attribute using a string

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

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- One of its instance attributes, or

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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

Methods and Functions

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

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

```
>>> Account.deposit(tom_account, 1001)
1011
```

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```

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1011
>>> tom_account.deposit(1003)
2014
```

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Function: all arguments within parentheses

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2014
```

Function: all arguments within parentheses

Method: One object before the dot and other arguments within parentheses

Looking Up Attributes by Name

```
<expression> . <name>
```

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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:
    interest = 0.02   # A class attribute
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        self.balance = 0
        self.holder = account_holder
    # Additional methods would be defined here
```

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

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

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```

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

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        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
```

The **interest** attribute is ***not*** part of the instance; it's part of the class!

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    # Additional methods would be defined here
```

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

The **interest** attribute is ***not*** part of the instance; it's part of the class!

Attribute Assignment

Assignment Statements and Attributes

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```

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```
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>>> tom_account = Account('Tom')
>>> tom_account.interest
```

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

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

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

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- 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
>>> Account.interest = 0.04
```

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```
>>> 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
```

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- 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
>>> Account.interest = 0.04
>>> tom_account.interest
0.04
```

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```
>>> 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
```

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```
>>> 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
```

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

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

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

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

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

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>>> tom_account.interest
0.02
>>> jim_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
```

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

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

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

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0.02
>>> jim_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
```

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0.02
>>> jim_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
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>>> tom_account.interest
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```

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

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0.02
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```

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>>> 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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0.08
```