61A Lecture 14

Wednesday, February 25

Announcements

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- Project 2 due Thursday 2/26 @ 11:59pm

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  - Extra office hours on Wednesday 2/25 4pm-6pm in Bechtel (Garbarini Lounge)

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  - Extra office hours on Wednesday 2/25 4pm-6pm in Bechtel (Garbarini Lounge)
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- Relocated office hours on Thursday 2/26: 380 Soda (11am-3pm) & 606 Soda (3pm-6pm)

Object-Oriented Programming

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A method for organizing programs

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- Data abstraction

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- Bundling together information and related behavior

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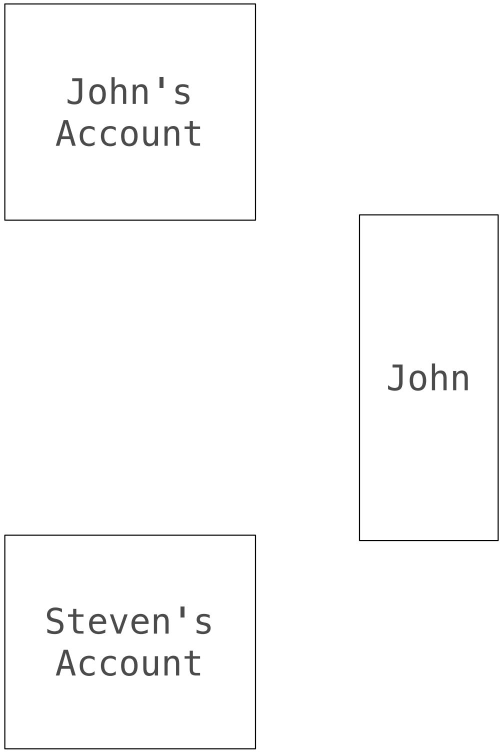

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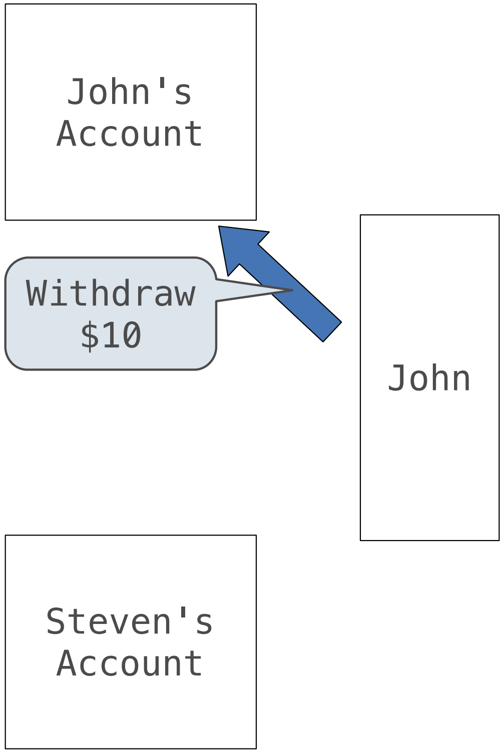

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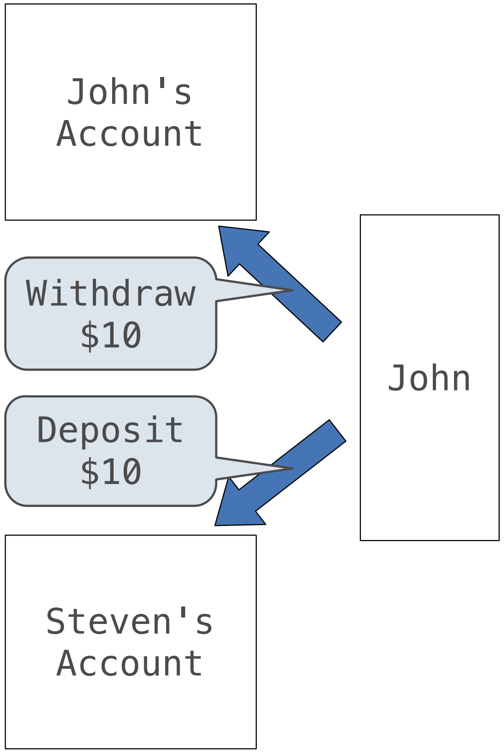

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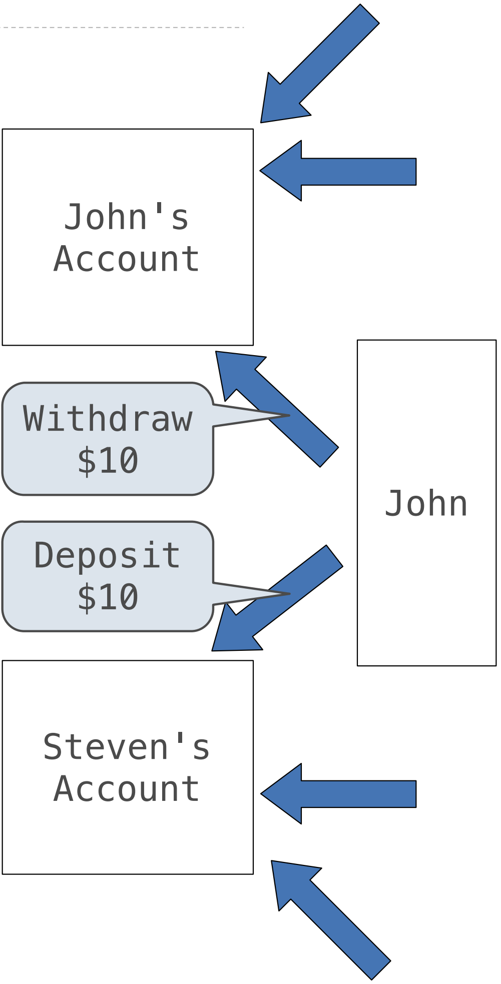

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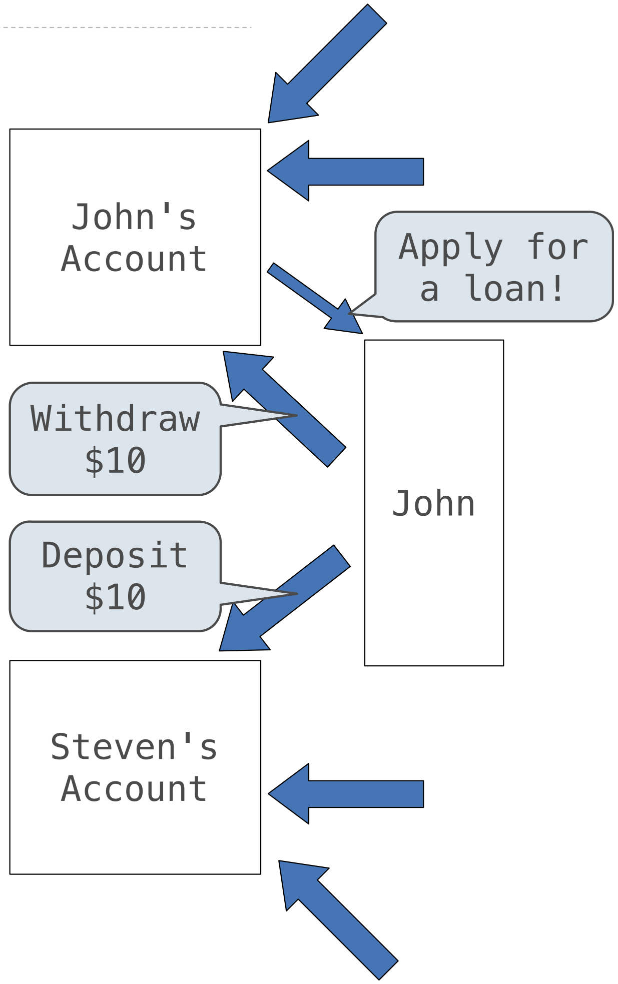

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```
>>> a = Account('Jim')
>>> a.holder
'Jim'
```

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>>> a = Account('Jim')
>>> a.holder
'Jim'
>>> a.balance
0
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>>> a.holder
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>>> 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.holder
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```
>>> a.deposit(15)
15
```

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

>>> a.deposit(15)
15
>>> a.withdraw(10)
5
```

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>>> a.balance
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```

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.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.

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

>>> a.deposit(15)
15
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>>> a.balance
5
>>> a.withdraw(10)
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```

Class Statements

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    <suite>
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>>> class Clown:
...     nose = 'big and red'
...     def dance():
...         return 'No thanks'
...
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>>> class Clown:
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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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        self.balance = 0
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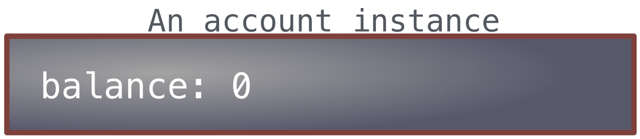
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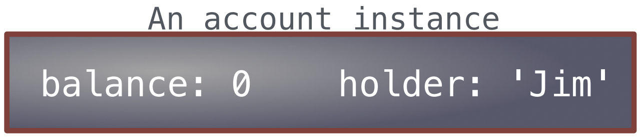

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__init__ is called a constructor

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>>> a.holder
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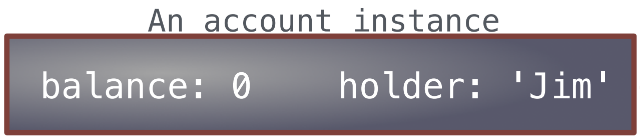

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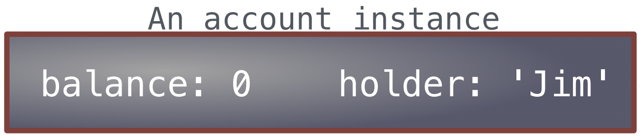
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Every call to Account creates a new Account instance. There is only one Account class.

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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
```

Methods

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```
class Account:
```

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            def __init__(self, account_holder):
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```
                self.balance = 0
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```
                    self.holder = account_holder
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```
        def deposit(self, amount):
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self should always be bound to an instance of the Account class

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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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Methods are functions defined in the suite of a class statement

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```
                return 'Insufficient funds'
```

Methods

Methods are functions defined in the suite of a class statement

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

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        return self.balance
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Defined with two parameters

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        self.balance = self.balance + amount
        return self.balance
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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.

Defined with two parameters

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

Invoked with one argument

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

Bound to self

Invoked with one argument

Dot Expressions

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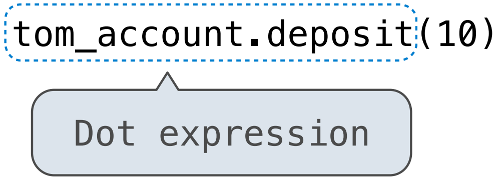

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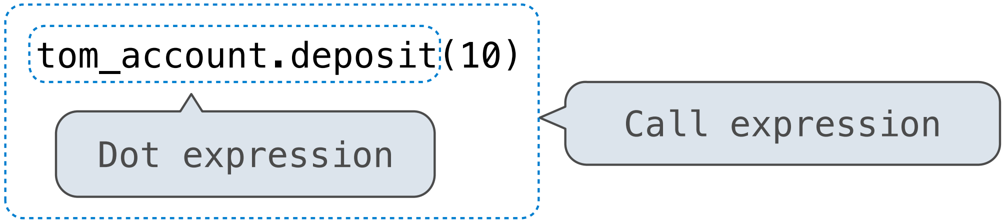

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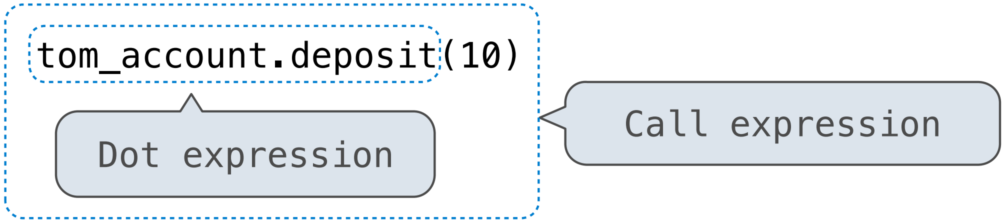

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(Demo)

Attributes

(Demo)

Accessing Attributes

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Methods and Functions

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```
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```

```
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1011
```

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

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

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>>> jim_account.interest
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Attribute Assignment

Assignment to Attributes

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```
tom_account.interest = 0.08
```

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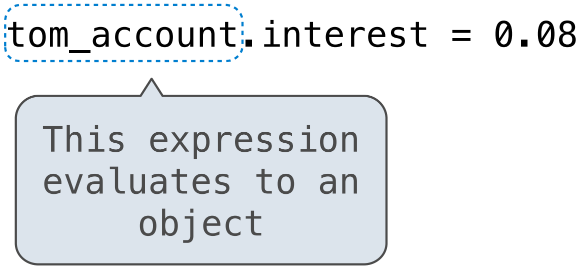
tom_account = Account('Tom')
```



```
tom_account.interest = 0.08
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This expression evaluates to an object

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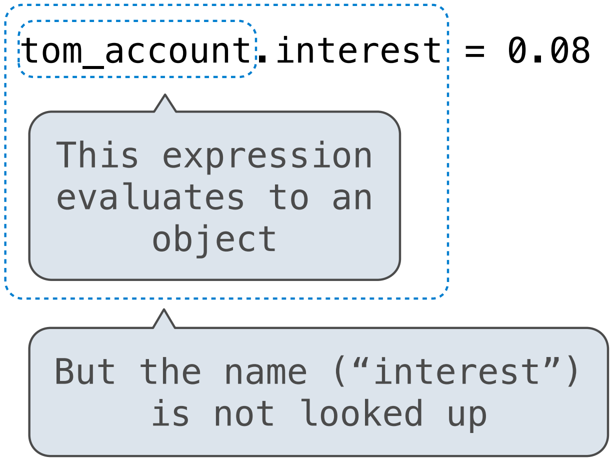
        self.holder = holder
        self.balance = 0
    ...

tom_account = Account('Tom')
```



tom_account.interest = 0.08

This expression evaluates to an object

But the name (“interest”) is not looked up

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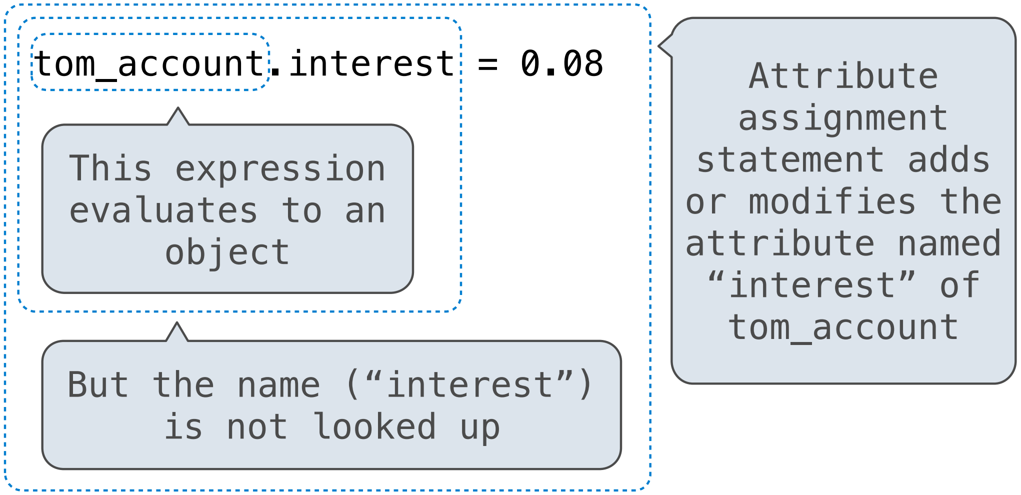

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tom_account.interest = 0.08
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Attribute assignment statement adds or modifies the attribute named "interest" of tom_account

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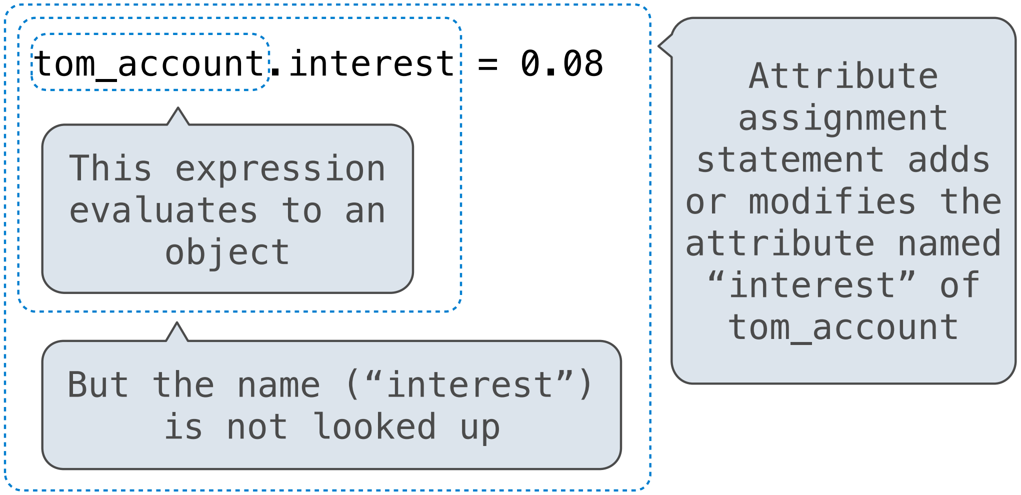
Instance Attribute Assignment :



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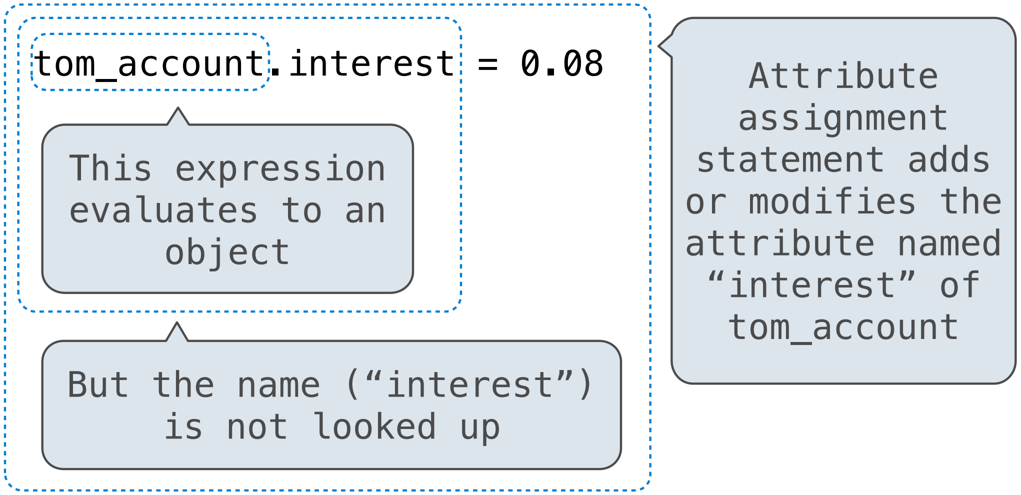

tom_account.interest = 0.08

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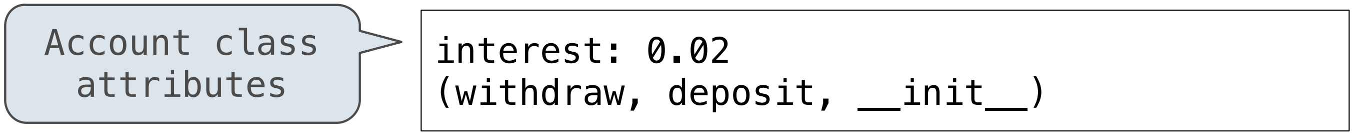
Attribute assignment statement adds or modifies the attribute named “interest” of tom_account

Class Attribute Assignment :

Account.interest = 0.04

Attribute Assignment Statements



Account class attributes

```
interest: 0.02
(withdraw, deposit, __init__)
```

Attribute Assignment Statements

Account class attributes

```
interest: 0.02
(withdraw, deposit, __init__)
```

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

Attribute Assignment Statements

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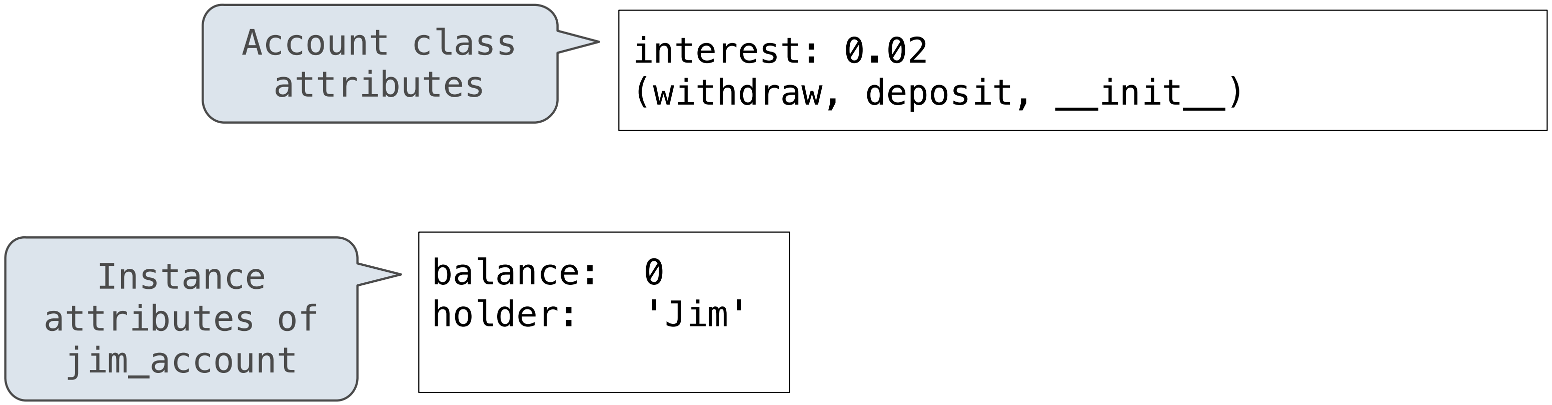
```

Instance attributes of jim_account

```
balance:   0
holder:    'Jim'
```

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

Attribute Assignment Statements



Account class attributes

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Instance attributes of jim_account

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```

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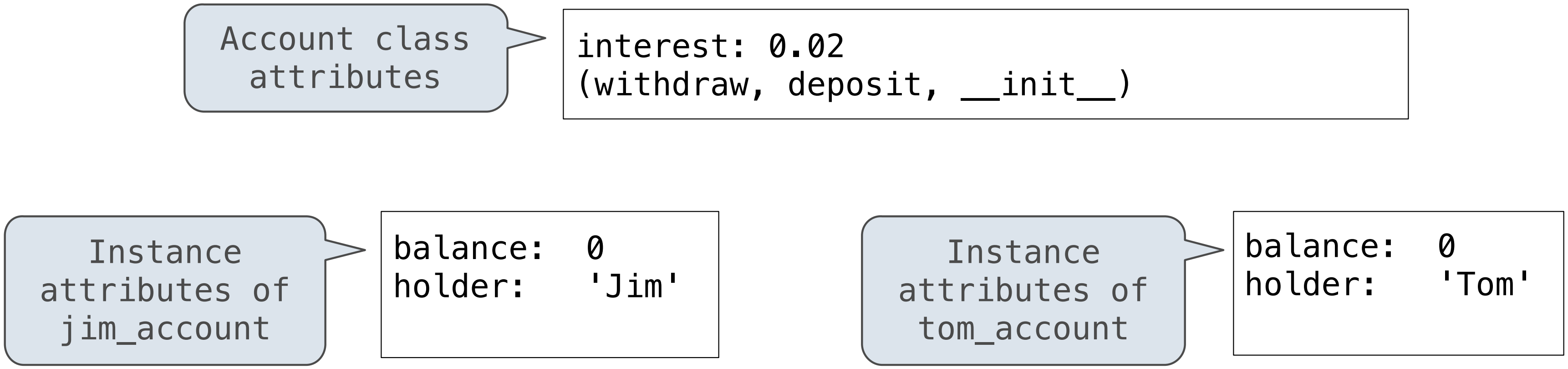
```

Attribute Assignment Statements



Account class attributes

```
interest: 0.02
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```

Instance attributes of jim_account

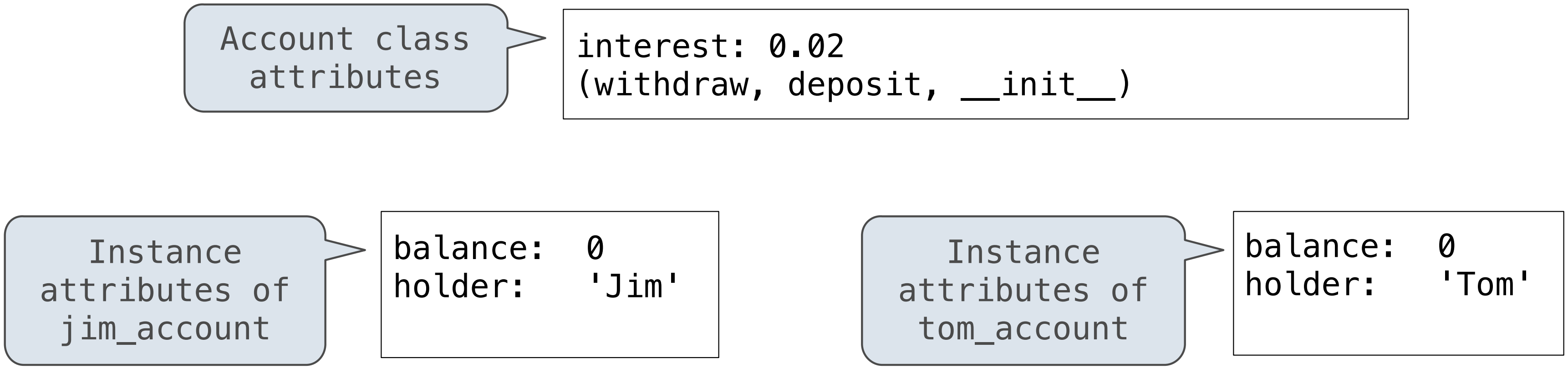
```
balance:  0
holder:   'Jim'
```

Instance attributes of tom_account

```
balance:  0
holder:   'Tom'
```

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

Attribute Assignment Statements



Account class attributes

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```

Instance attributes of jim_account

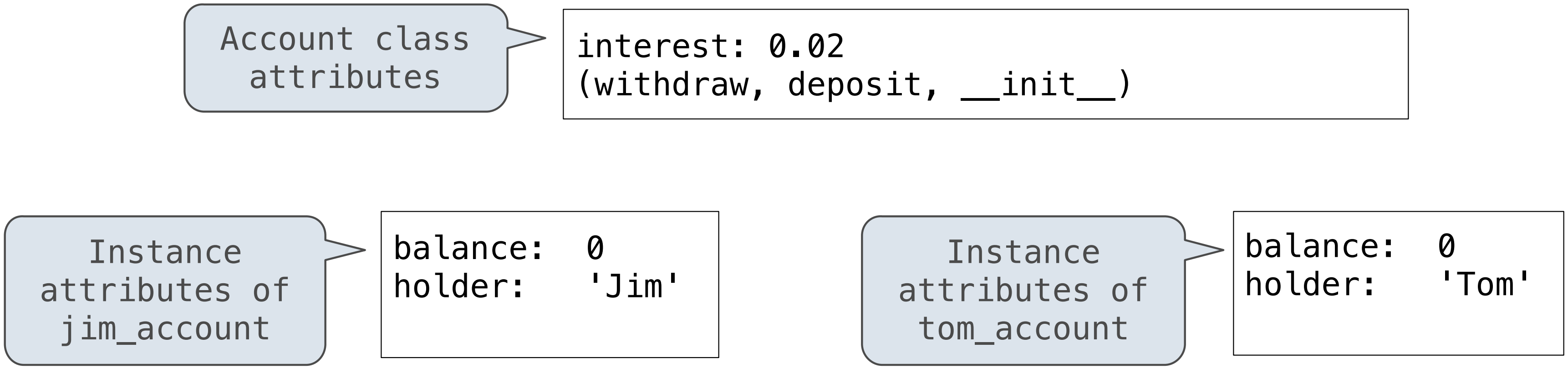
```
balance:  0
holder:   'Jim'
```

Instance attributes of tom_account

```
balance:  0
holder:   'Tom'
```

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

Attribute Assignment Statements



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>>> tom_account.interest
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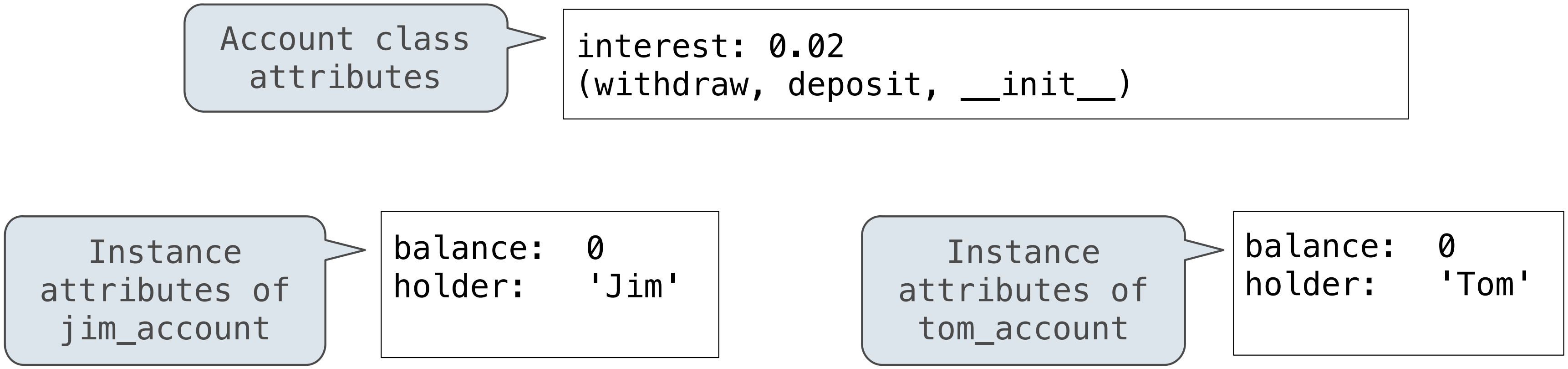

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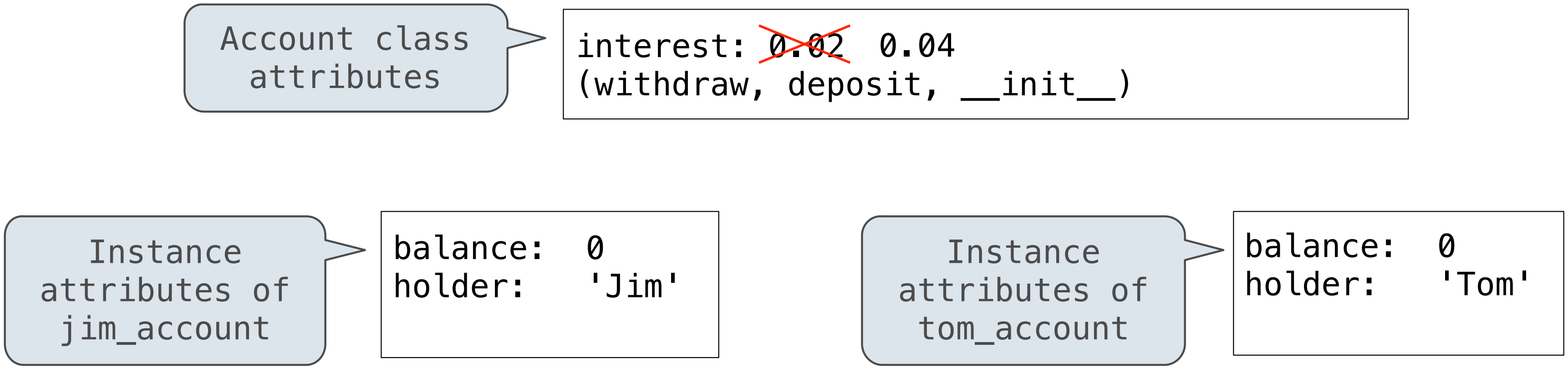
```
>>> jim_account = Account('Jim')
>>> tom_account = Account('Tom')
>>> tom_account.interest
0.02
>>> jim_account.interest
0.02
>>> Account.interest = 0.04
```

Attribute Assignment Statements



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Instance attributes of jim_account

balance: 0
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Instance attributes of tom_account

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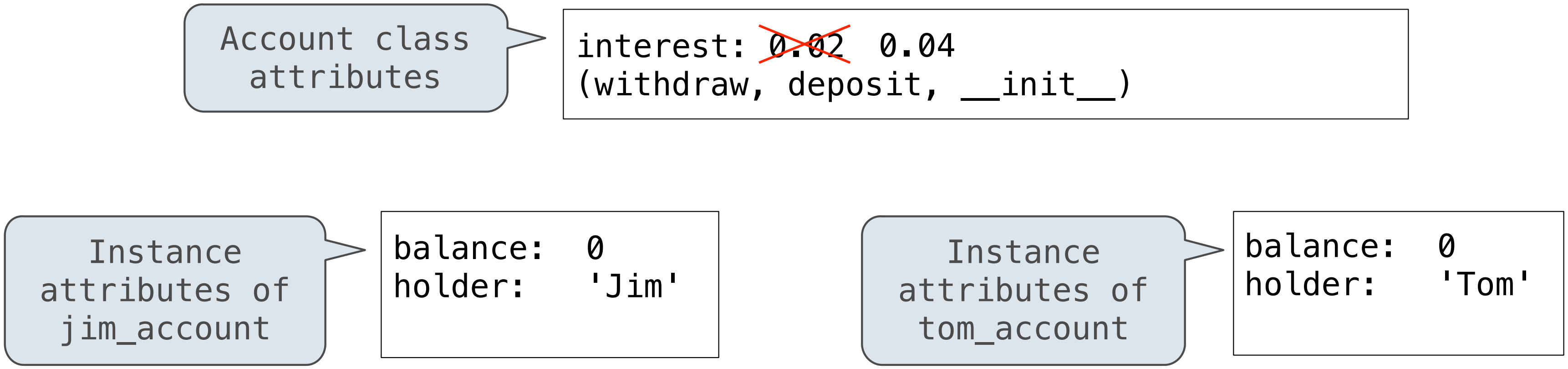

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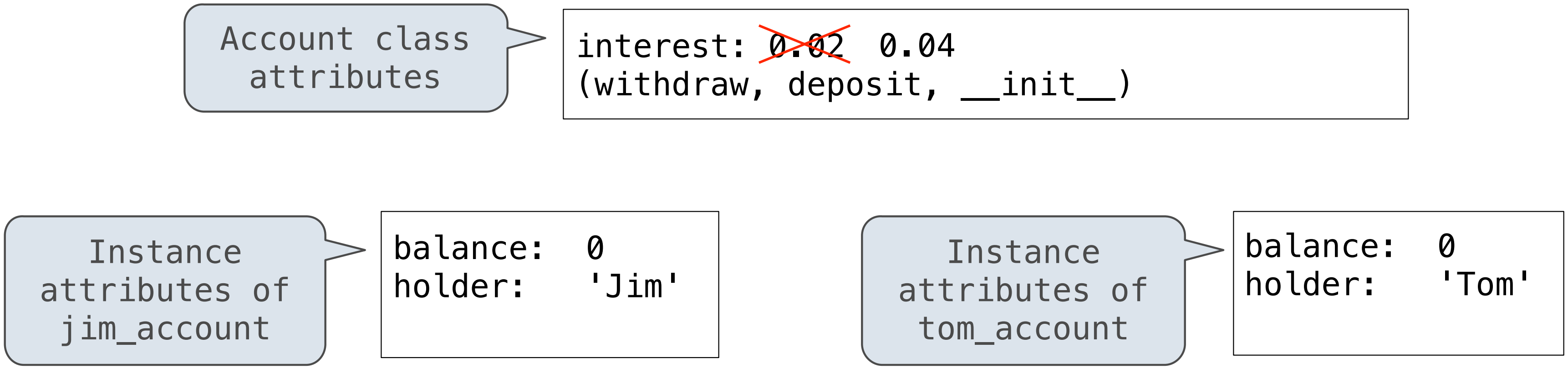
>>> tom_account.interest
0.02
>>> jim_account.interest
0.02
>>> Account.interest = 0.04
>>> tom_account.interest
0.04
```

Attribute Assignment Statements



Account class attributes

interest: ~~0.02~~ 0.04
(withdraw, deposit, __init__)

Instance attributes of jim_account

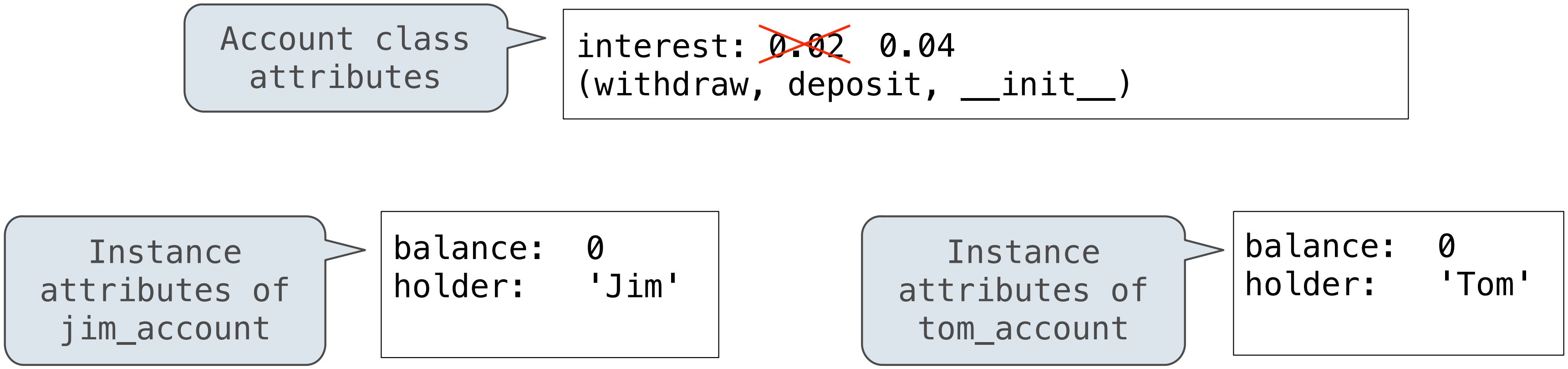
balance: 0
holder: 'Jim'

Instance attributes of tom_account

balance: 0
holder: 'Tom'

```
>>> 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
0.04
```

Attribute Assignment Statements



Account class attributes

interest: ~~0.02~~ 0.04
(withdraw, deposit, __init__)

Instance attributes of jim_account

balance: 0
holder: 'Jim'

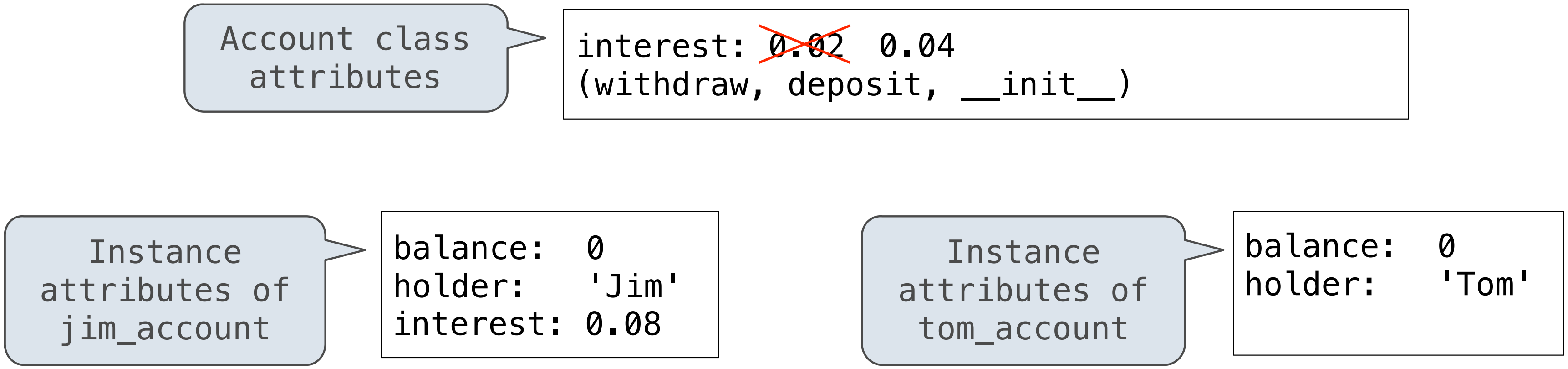
Instance attributes of tom_account

balance: 0
holder: 'Tom'

```
>>> 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
0.04
```

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

Attribute Assignment Statements



Account class attributes

interest: ~~0.02~~ 0.04
(withdraw, deposit, __init__)

Instance attributes of jim_account

balance: 0
holder: 'Jim'
interest: 0.08

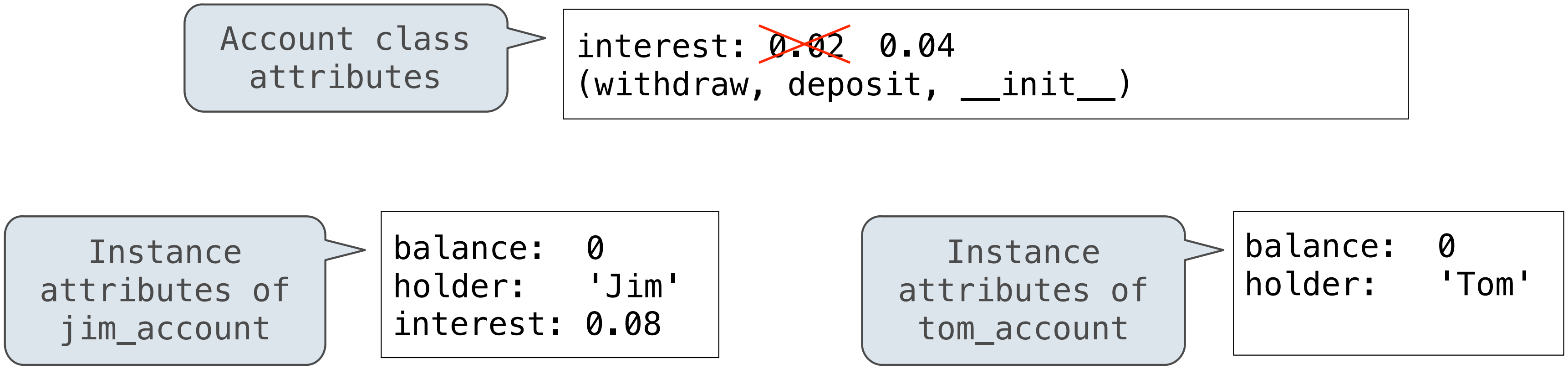
Instance attributes of tom_account

balance: 0
holder: 'Tom'

```
>>> 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
0.04
```

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

Attribute Assignment Statements



Account class attributes

interest: ~~0.02~~ 0.04
(withdraw, deposit, __init__)

Instance attributes of jim_account

```
balance:   0
holder:    'Jim'
interest: 0.08
```

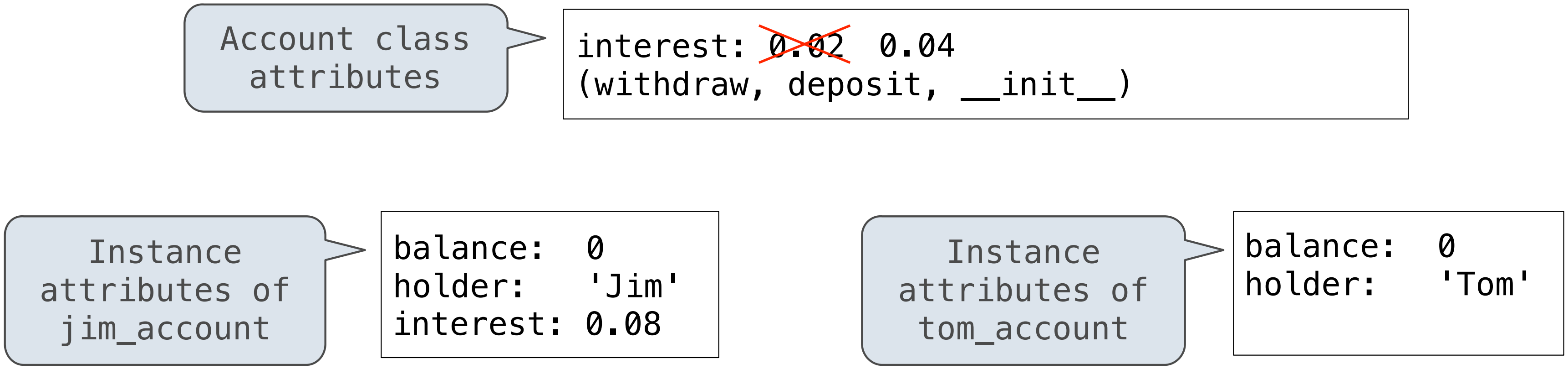
Instance attributes of tom_account

```
balance:   0
holder:    'Tom'
```

```
>>> 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
0.04
```

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

Attribute Assignment Statements



Account class attributes

interest: ~~0.02~~ 0.04
(withdraw, deposit, __init__)

Instance attributes of jim_account

balance: 0
holder: 'Jim'
interest: 0.08

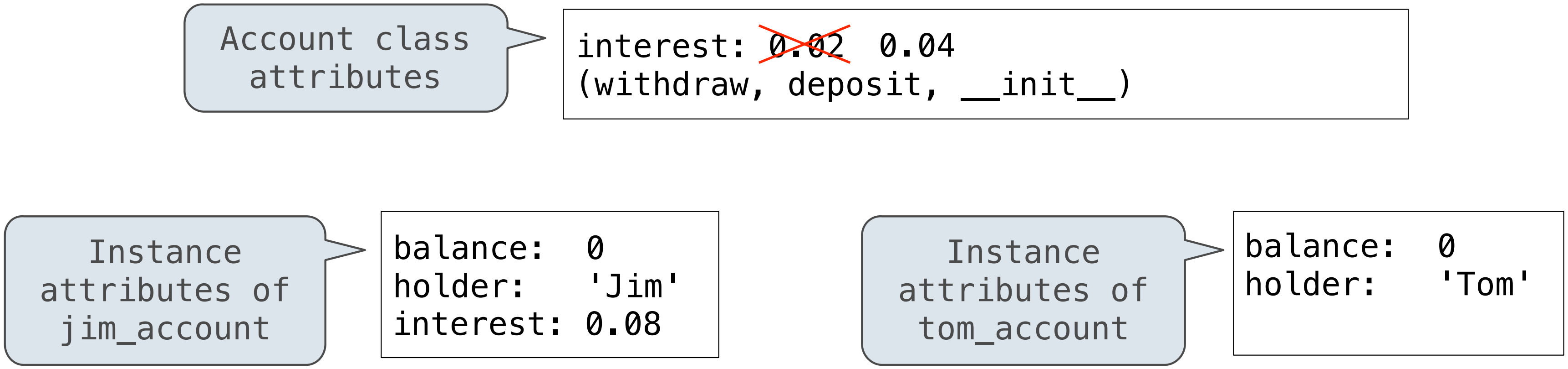
Instance attributes of tom_account

balance: 0
holder: 'Tom'

```
>>> 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
0.04
```

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

Attribute Assignment Statements



Account class attributes

interest: ~~0.02~~ 0.04
(withdraw, deposit, __init__)

Instance attributes of jim_account

balance: 0
holder: 'Jim'
interest: 0.08

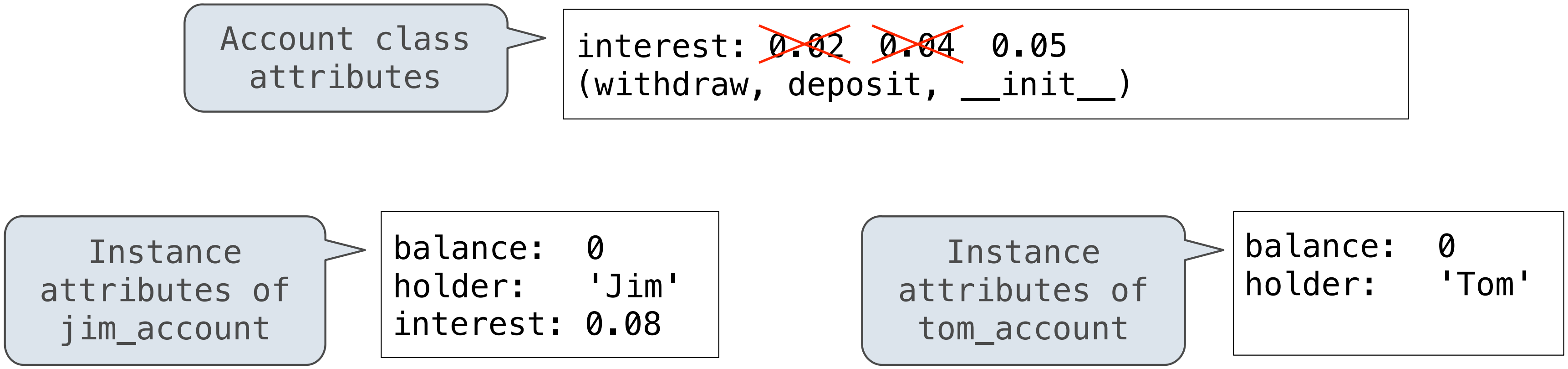
Instance attributes of tom_account

balance: 0
holder: 'Tom'

```
>>> 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
0.04
```

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

Attribute Assignment Statements



Account class attributes

interest: ~~0.02~~ ~~0.04~~ 0.05
(withdraw, deposit, __init__)

Instance attributes of jim_account

balance: 0
holder: 'Jim'
interest: 0.08

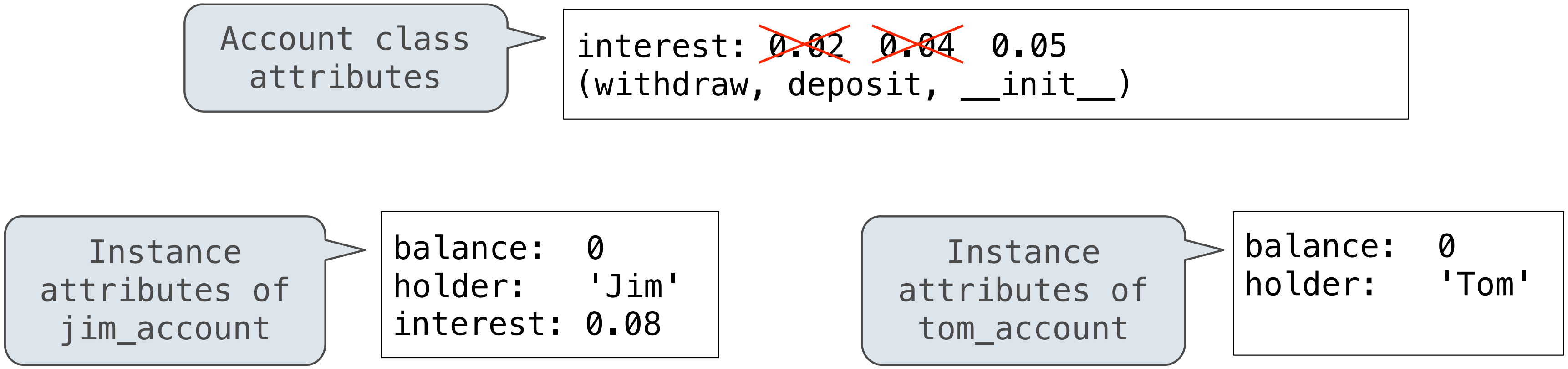
Instance attributes of tom_account

balance: 0
holder: 'Tom'

```
>>> 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
0.04
```

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

Attribute Assignment Statements



Account class attributes

interest: ~~0.02~~ ~~0.04~~ 0.05
(withdraw, deposit, __init__)

Instance attributes of jim_account

balance: 0
holder: 'Jim'
interest: 0.08

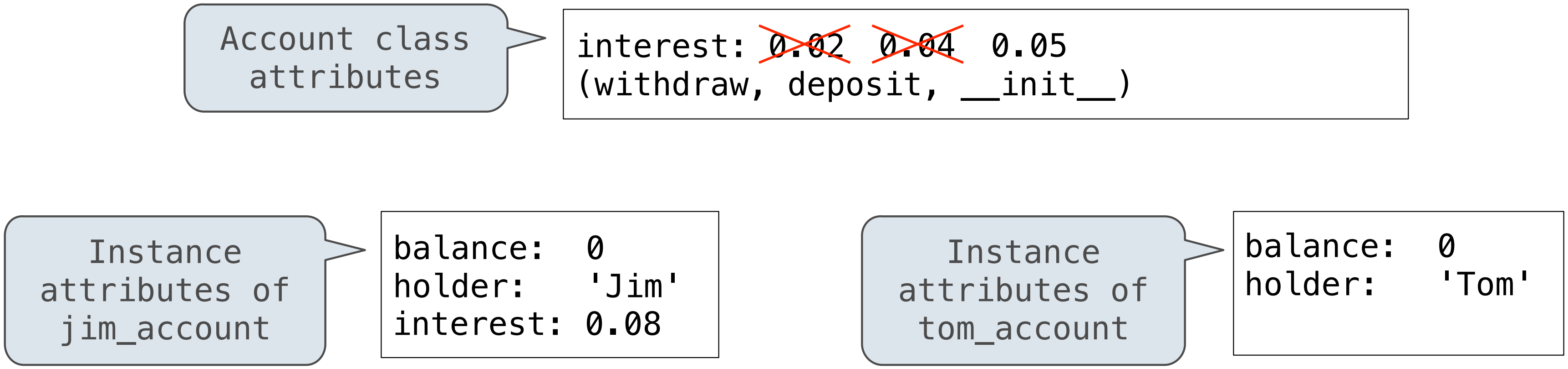
Instance attributes of tom_account

balance: 0
holder: 'Tom'

```
>>> 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
0.04
```

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

Attribute Assignment Statements



Account class attributes

```
interest: ~~0.02~~ ~~0.04~~ 0.05
(withdraw, deposit, __init__)
```

Instance attributes of jim_account

```
balance:   0
holder:    'Jim'
interest: 0.08
```

Instance attributes of tom_account

```
balance:   0
holder:    'Tom'
```

```
>>> 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
0.04
```

```
>>> 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
```