Object-Oriented Programming

Slides adapted from Berkeley cs61a

- OOP
- Classes and Objects
- Methods and Attributes
- Lookup up Attributes by Name

OOP, an example

Object-Oriented Programming

A method for organizing programs

- Data abstraction
- Bundling together information and related behavior

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- 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 method calls
- Method calls are messages passed between objects
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- Different types may relate to each other

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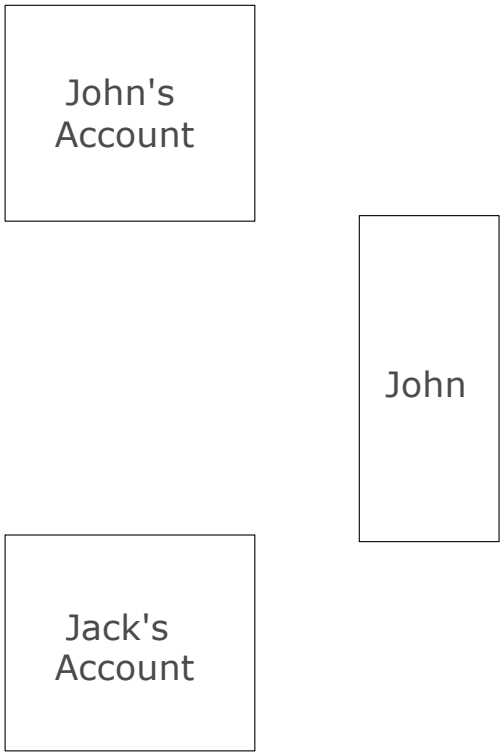

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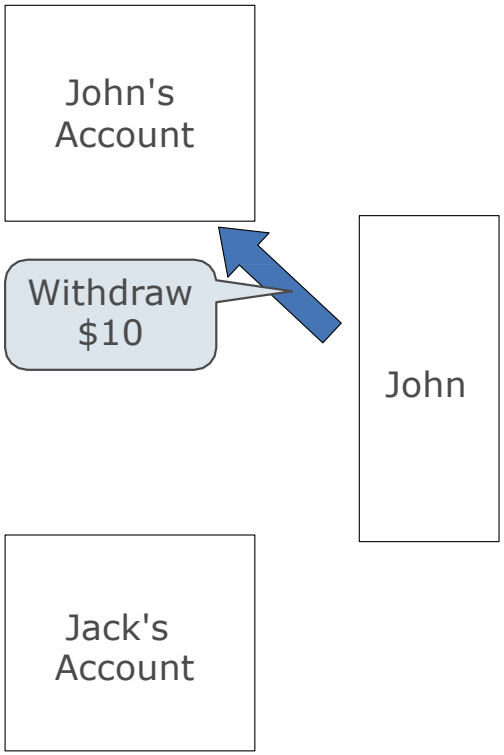

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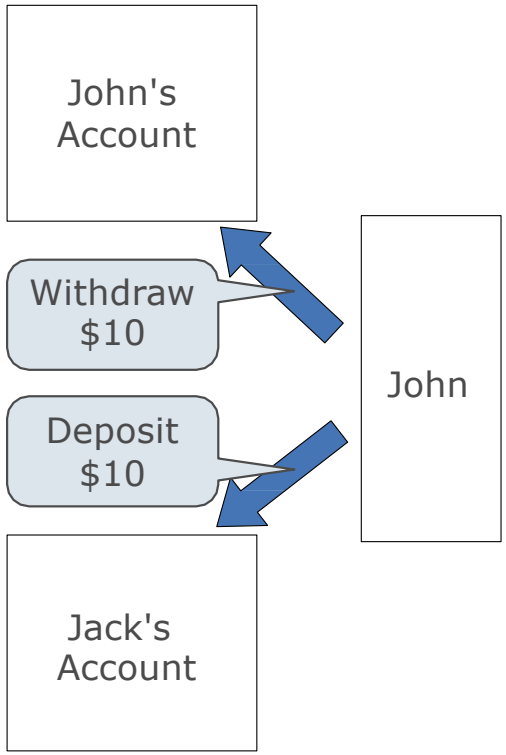

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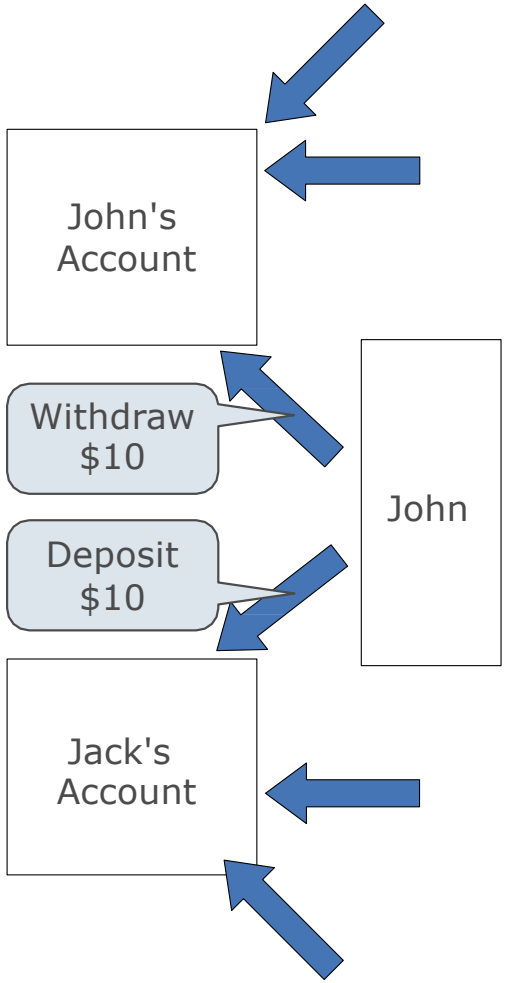

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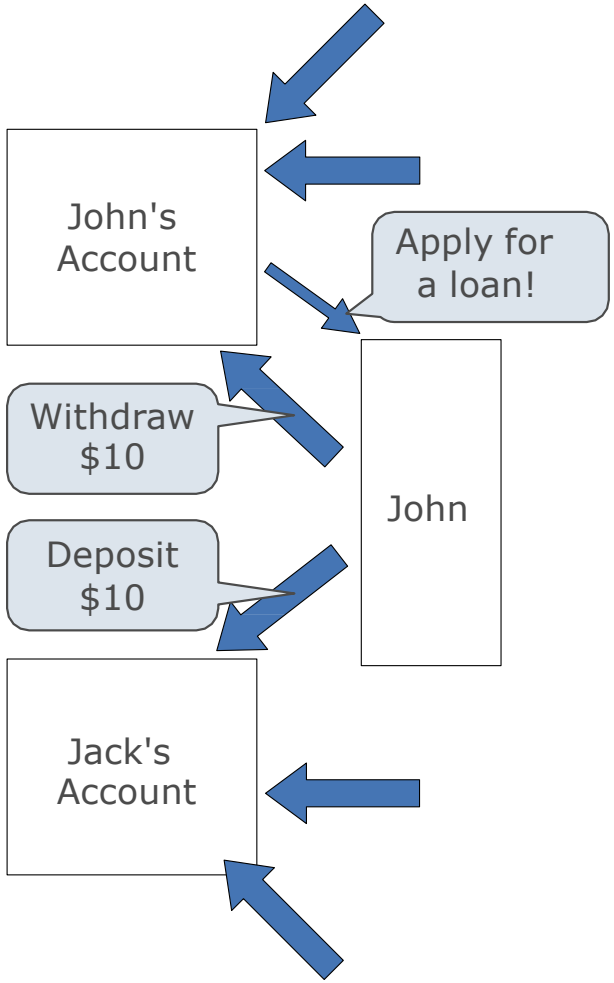

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>>> a.holder
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>>> a.balance
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Idea: All bank accounts should have withdraw and deposit behaviors that all work in the same way

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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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Class Statements

The Class Statement

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    <suite>
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>>> Clown.nose
'big and red'
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>>> Clown
<class '__main__.Clown'>
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Idea: All bank accounts have a **balance** and an account **holder**;
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self should always be bound to an instance of the Account class

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    def withdraw(self, amount):
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        if amount > self.balance:
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These def statements create function objects as always, but their names are bound as attributes of the class (not bound to the particular frame)

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100
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Bound to self

Invoked with one argument

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

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

Defined with two parameters

Dot notation automatically supplies the first argument to a method

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

Bound to self

Invoked with one argument

(demo_1)

Attributes

Class Attributes

Class attributes are "shared" across all instances of a class
because they are attributes of the class, not the instance (**Instance attributes?**)

```
class Account:

    interest = 0.02 # A class attribute

    def __init__(self, account_holder):
        self.balance = 0
        self.holder = account_holder
```

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

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

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

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```

Methods are also considered as the attributes of the class

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

Accessing Attributes

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

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

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

Looking up an attribute name in an object may return:

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

(We will examine this in details later)

Methods and Functions

Python distinguishes between:

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

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>>> Account.deposit(tom_account, 1000)
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```

Function: all arguments within parentheses

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>>> type(tom_account.deposit)
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1000
>>> tom_account.deposit(1021)
2021
```

Function: all arguments within parentheses

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

All objects have attributes, which are name-value pairs

Classes are objects too, so they have attributes

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>>> type(tom_account)
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MyClass = MetaClass()
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?

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type is the metaclass in Python

```
ACGN = type('ACGN',
      (tuple for parent classes),
      {dic for attribute pairs})
print(ACGN)
type(ACGN)
```

As classes are objects in Python,
what we use to define "class objects"?

We use **metaclass** to define classes:
type(MyClass) -> MetaClass

```
my_object = MyClass()
MyClass = MetaClass()
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Looking Up Attributes by Name

```
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```

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(demo: lls.balance)

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(demo: lls.interest,
lls.noSuchAttribute)

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

(demo_2)

The X You Need To Understand In This Lecture

- The basic idea of OOP
- Classes vs. Objects

  What happens when instantiating an object from a class (object + __init__)
- Functions vs. Methods

  Understanding the 'self' keyword
- Instance attributes vs. Class attributes
- The rules for looking up attributes