# 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 method for organizing programs

- Data abstraction
- 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 method calls
- Method calls are messages passed between objects
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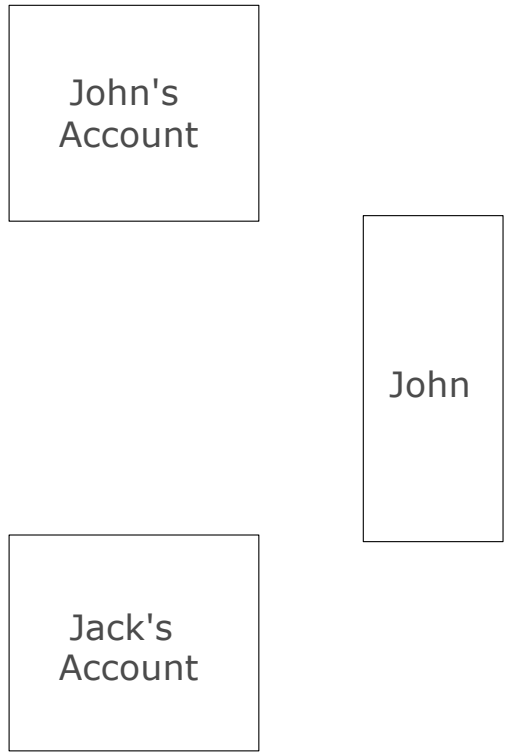


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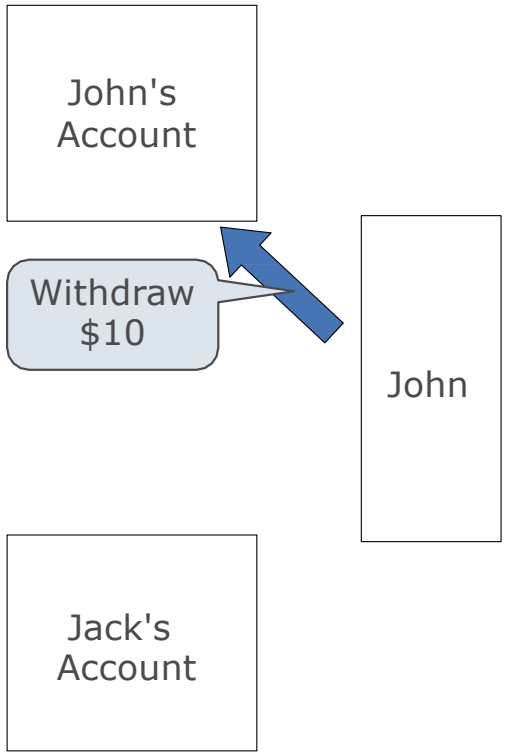


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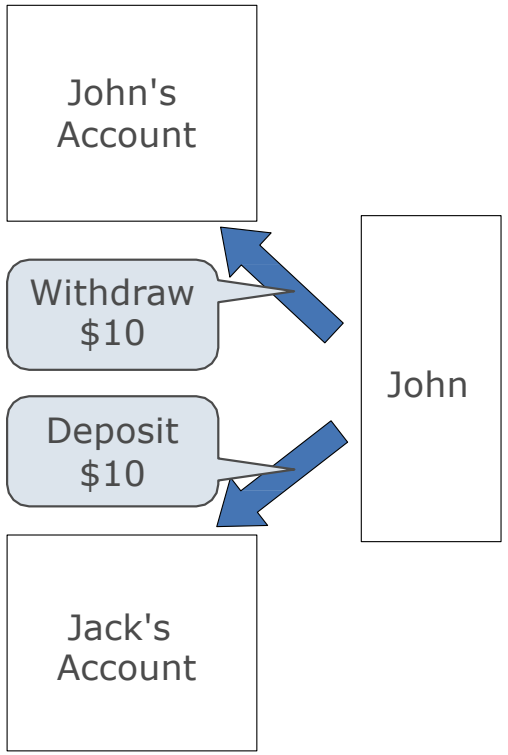


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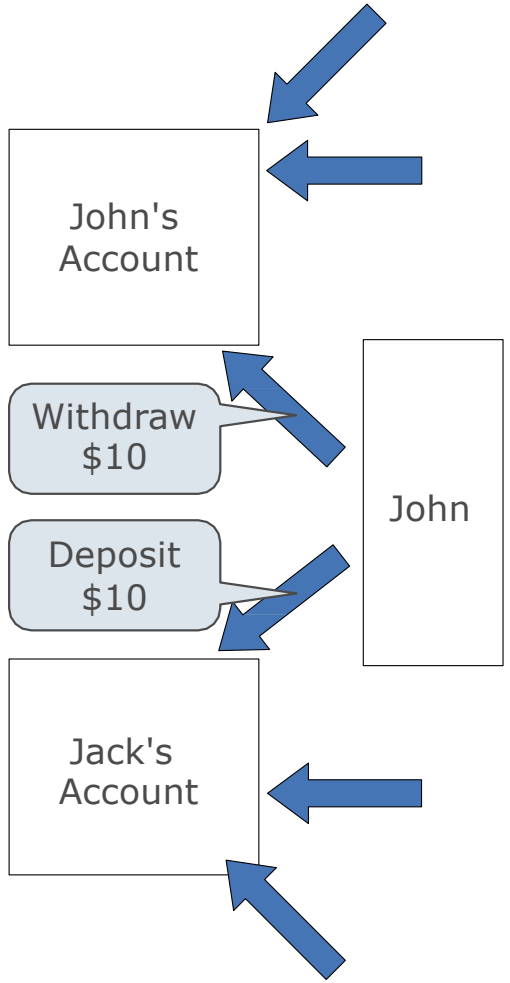


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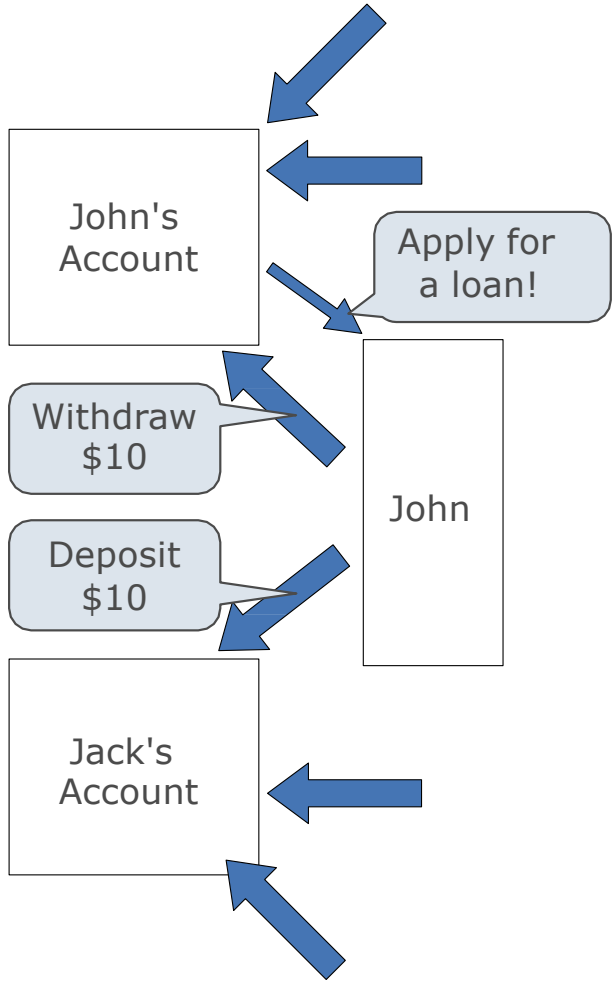


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**Better idea**: All bank accounts share a withdraw method and a deposit method

# Class Statements

# The Class Statement

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'big and red'
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>>> Clown
<class '__main__.Clown'>
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self should always be bound to an instance of the Account class

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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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Invoked with one argument

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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')
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>>> tom_account.interest
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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

```
>>> 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!

# 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
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```

**Function**: all arguments within parentheses

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

**Function**: all arguments within parentheses

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

# Terminology: Attributes, Functions, and Methods

All objects have attributes, which are name-value pairs

Classes are objects too, so they have attributes

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type(my_object) -> MyClass

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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)
```

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what we use to define "class objects"?

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type(MyClass) -> MetaClass

```
my_object = MyClass()
MyClass = MetaClass()
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# Terminology: Attributes, Functions, and Methods

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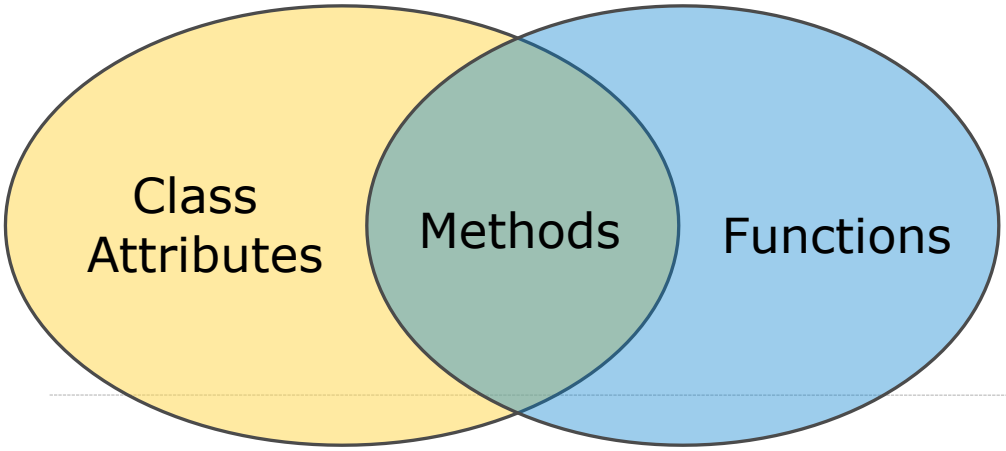
**Classes are objects** too, so they have attributes

**Instance attribute**: attribute of an instance

**Class attribute**: attribute of the class

**Terminology:**




**Python object system:**

Functions are objects

Bound methods are also objects: a function that has its first parameter "self" already bound to an instance

Dot expressions evaluate to bound methods for class attributes that are functions

<instance>.<method_name>

# Looking Up Attributes by Name

<expression> . <name>

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2. <name> is matched against the instance attributes of that object; if an attribute with that name exists, its value is returned

(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