61A Lecture 16

Friday, October 11

Announcements

Announcements

- Homework 5 is due Tuesday 10/15 @ 11:59pm
- Project 3 is due Thursday 10/24 @ 11:59pm
- Midterm 2 is on Monday 10/28 7pm–9pm

Attributes

Terminology: Attributes, Functions, and Methods

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All objects have attributes, which are name-value pairs
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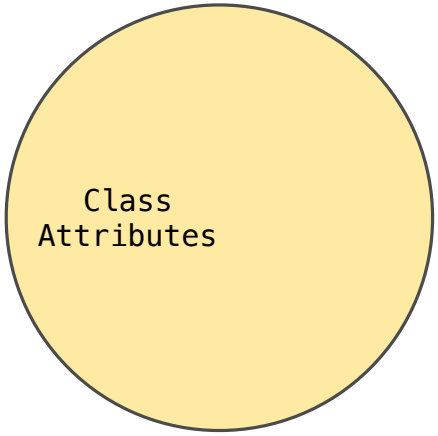

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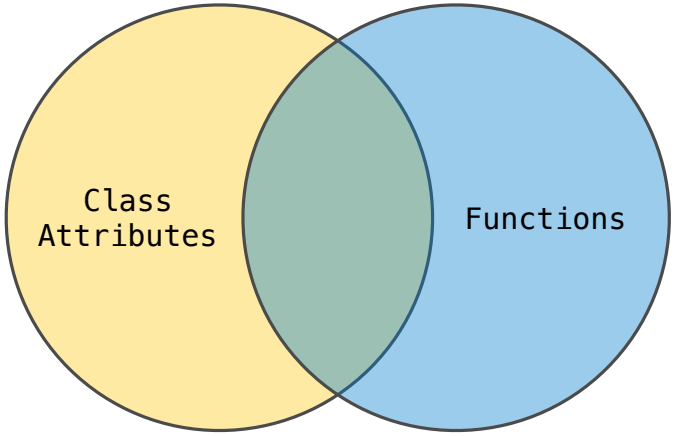

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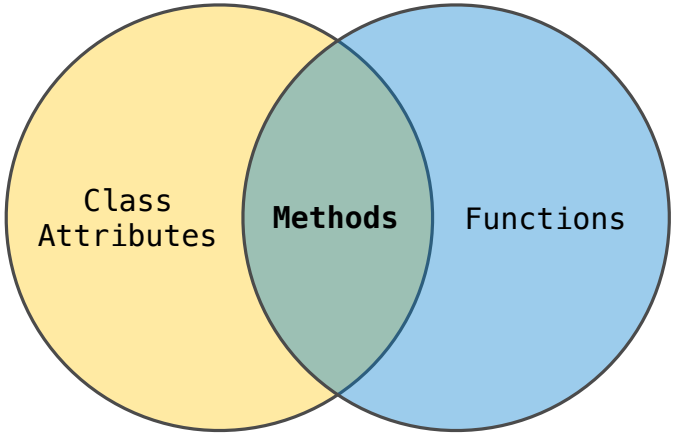

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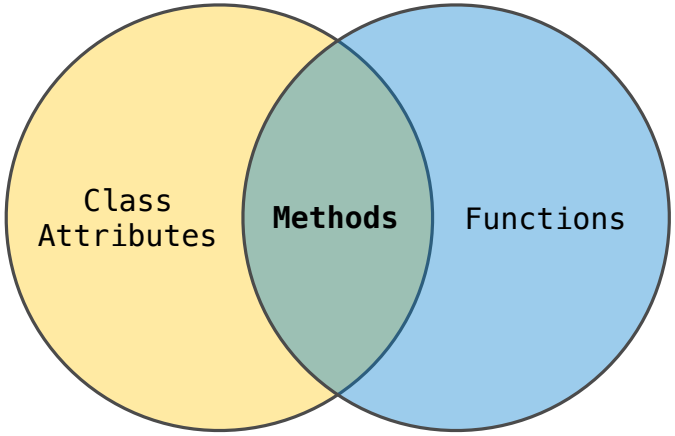

Python object system:

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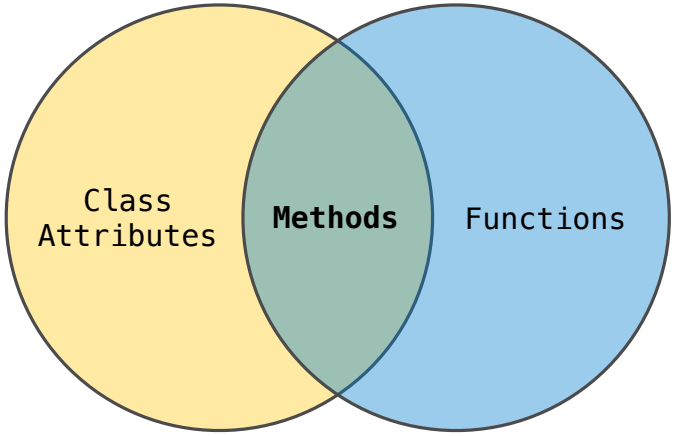

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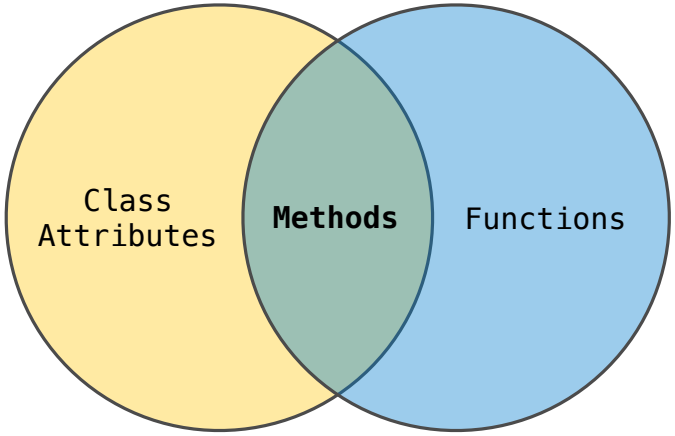

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Bound methods are also objects: a function that has its first parameter "self" already bound to an instance.

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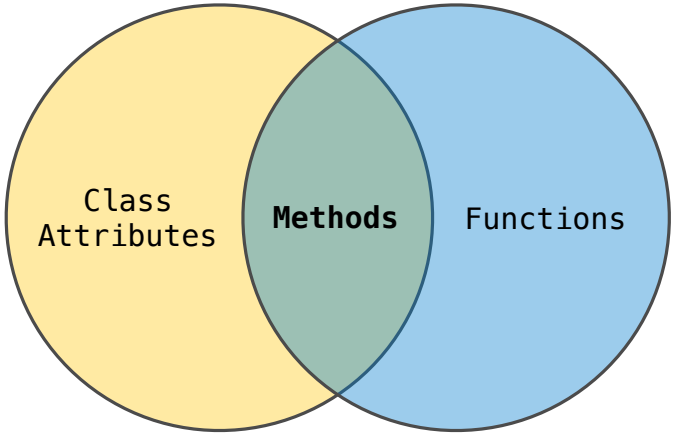

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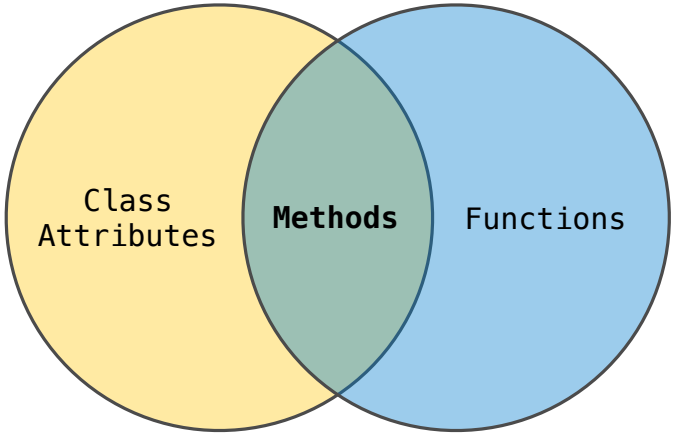

Python object system:

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 of an Object

```
<expression> . <name>
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To evaluate a dot expression:

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1. Evaluate the <expression>.

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

Looking Up Attributes of an Object

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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

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- If the object is an instance, then assignment sets an instance attribute
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Instance Attribute Assignment :

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Assignment to 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
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Instance Attribute Assignment :

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tom_account.interest = 0.08
```

This expression evaluates to an object

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

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
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```

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

Attribute Assignment Statements

Account class attributes

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

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

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

Attribute Assignment Statements

Account class attributes

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interest: 0.02
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Instance attributes of jim_account

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Attribute Assignment Statements

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>>> tom_account = Account('Tom')
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Attribute Assignment Statements

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Instance attributes of jim_account

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balance:  0
holder:   'Jim'
```

Instance attributes of tom_account

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balance:  0
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```
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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

Account class attributes

```
interest: 0.02
(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
```

Attribute Assignment Statements

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Instance attributes of jim_account

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

Instance attributes of tom_account

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```

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

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>>> 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
```

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

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balance: 0
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Instance attributes of tom_account

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0.02
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>>> tom_account.interest
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>>> Account.interest = 0.04
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>>> Account.interest = 0.04
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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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>>> tom_account.interest
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>>> tom_account.interest
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>>> Account.interest = 0.05
>>> tom_account.interest
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```

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class <name>(<base class>):
    <suite>
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Conceptually, the new *subclass* "shares" attributes with its base class.

The subclass may *override* certain inherited attributes.

Using inheritance, we implement a subclass by specifying its differences from the the base class.

Inheritance Example

```
A CheckingAccount is a specialized type of Account.
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>>> ch = CheckingAccount('Tom')
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```
>>> ch = CheckingAccount('Tom')
>>> ch.interest     # Lower interest rate for checking accounts
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>>> ch.deposit(20)  # Deposits are the same
20
```

Inheritance Example

A CheckingAccount is a specialized type of Account.

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>>> ch = CheckingAccount('Tom')
>>> ch.interest     # Lower interest rate for checking accounts
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>>> ch.withdraw(5)  # Withdrawals incur a $1 fee
14
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Inheritance Example

A CheckingAccount is a specialized type of Account.

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Most behavior is shared with the base class Account

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```
class CheckingAccount(Account):
```

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```
class CheckingAccount(Account):
    """A bank account that charges for withdrawals."""
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Most behavior is shared with the base class Account

```
class CheckingAccount(Account):
    """A bank account that charges for withdrawals."""
    withdraw_fee = 1
    interest = 0.01
```

Inheritance Example

A CheckingAccount is a specialized type of Account.

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>>> ch = CheckingAccount('Tom')
>>> ch.interest     # Lower interest rate for checking accounts
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Most behavior is shared with the base class Account

```
class CheckingAccount(Account):
    """A bank account that charges for withdrawals."""
    withdraw_fee = 1
    interest = 0.01
    def withdraw(self, amount):
```

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Inheritance Example

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(Demo)

Object-Oriented Design

Designing for Inheritance

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Attribute look-up on base class

Preferred to CheckingAccount.withdraw_fee to allow for specialized accounts

Inheritance and Composition

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(Demo)

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Resolving Ambiguous Class Attribute Names

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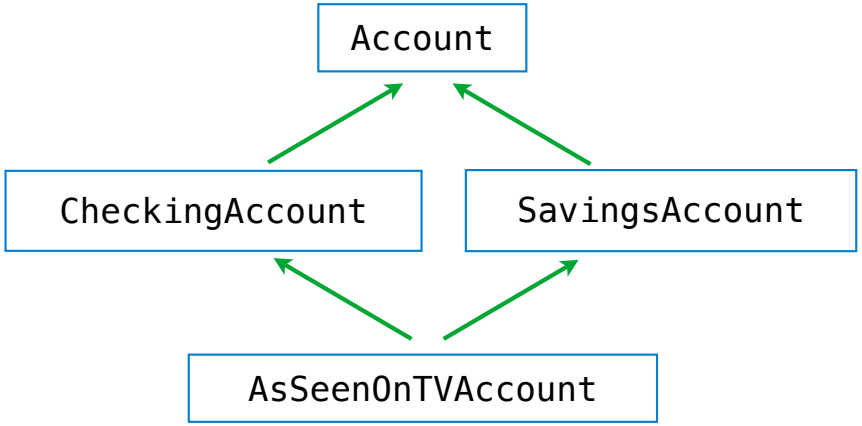

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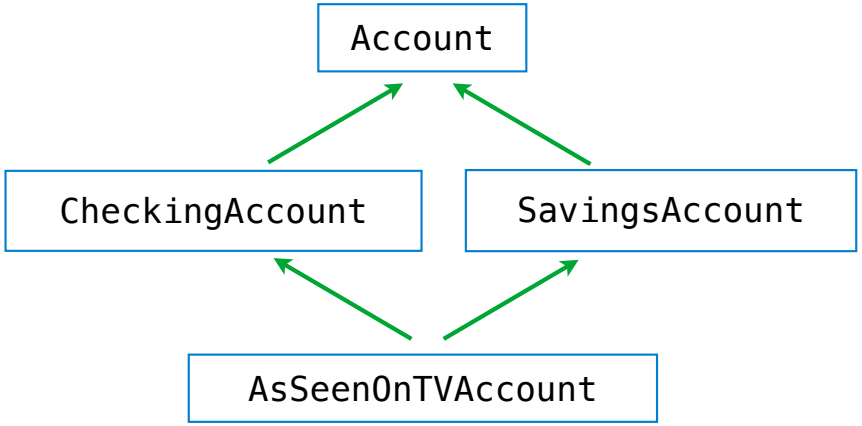


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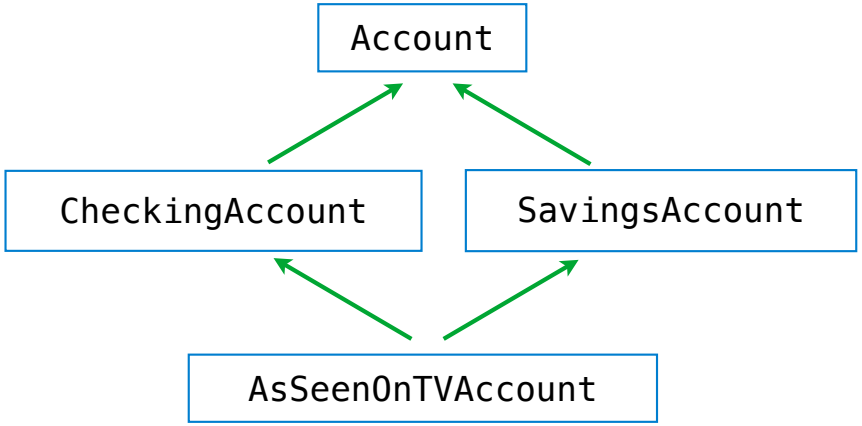


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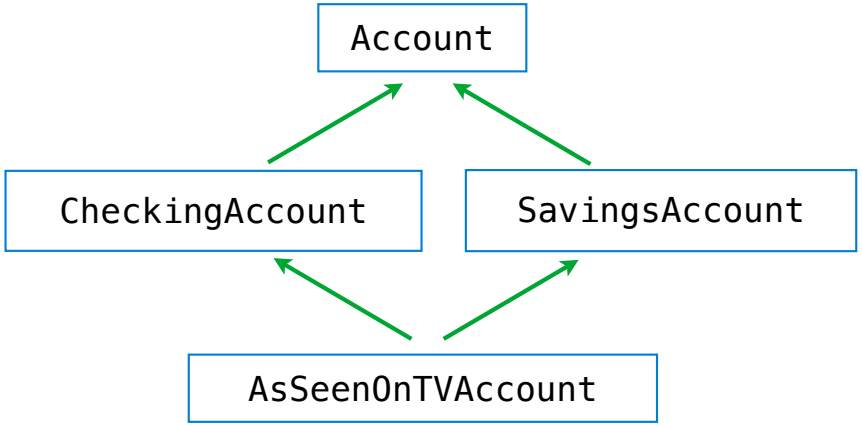

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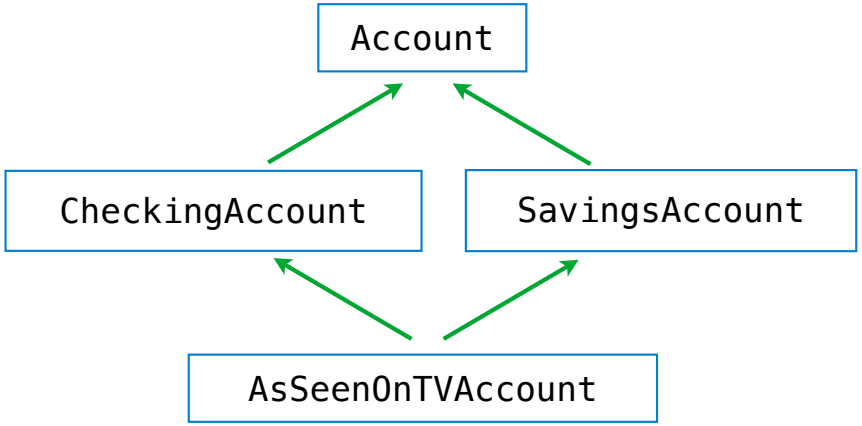

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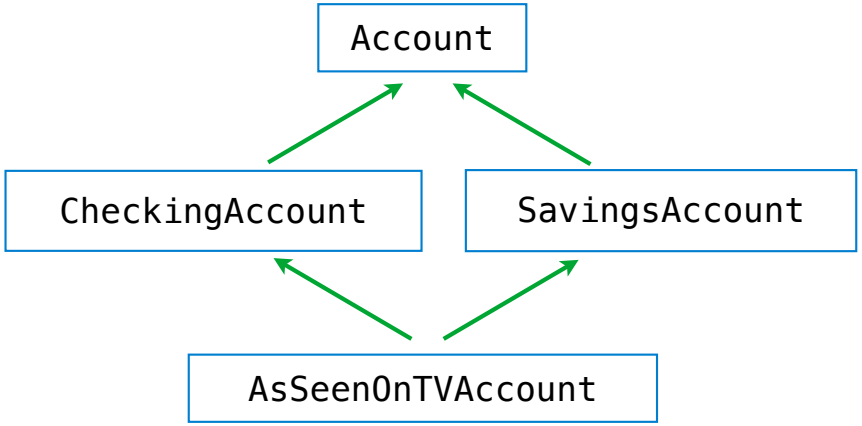

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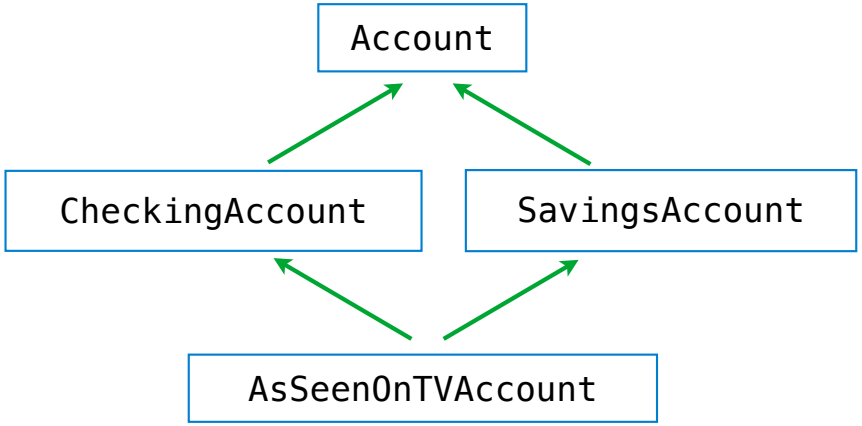

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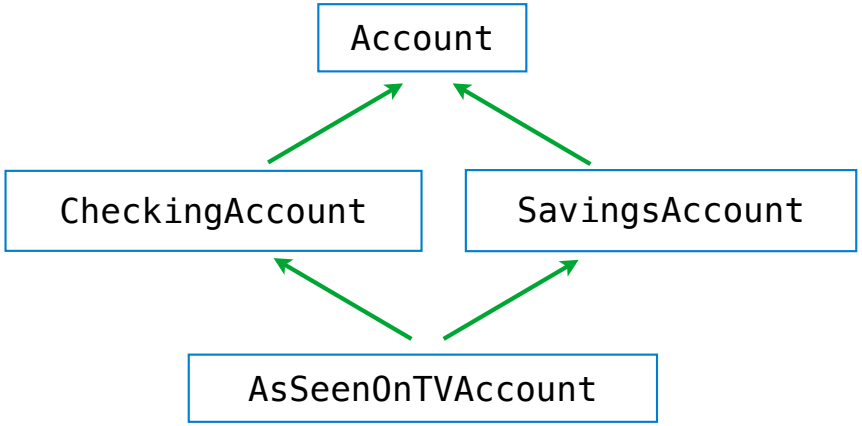

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Complicated Inheritance

Biological Inheritance

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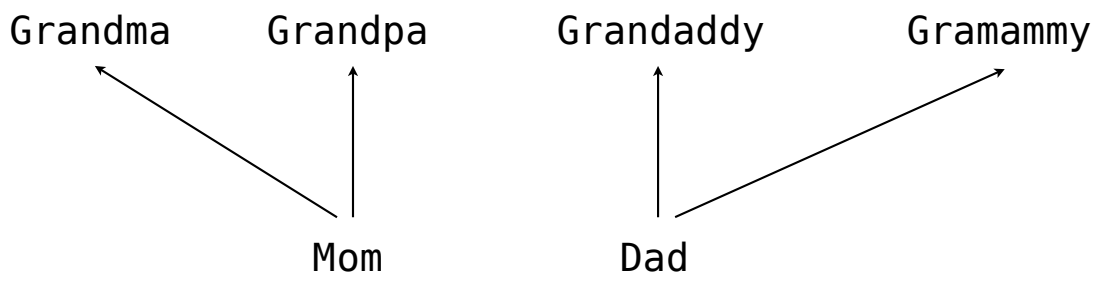
Grandma Grandpa Grandaddy Gramammy

Biological Inheritance



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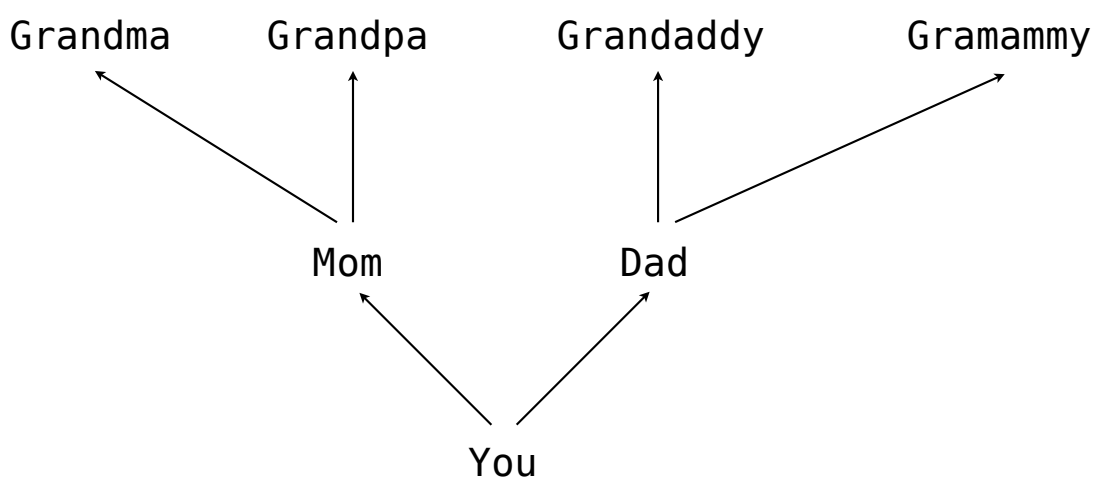

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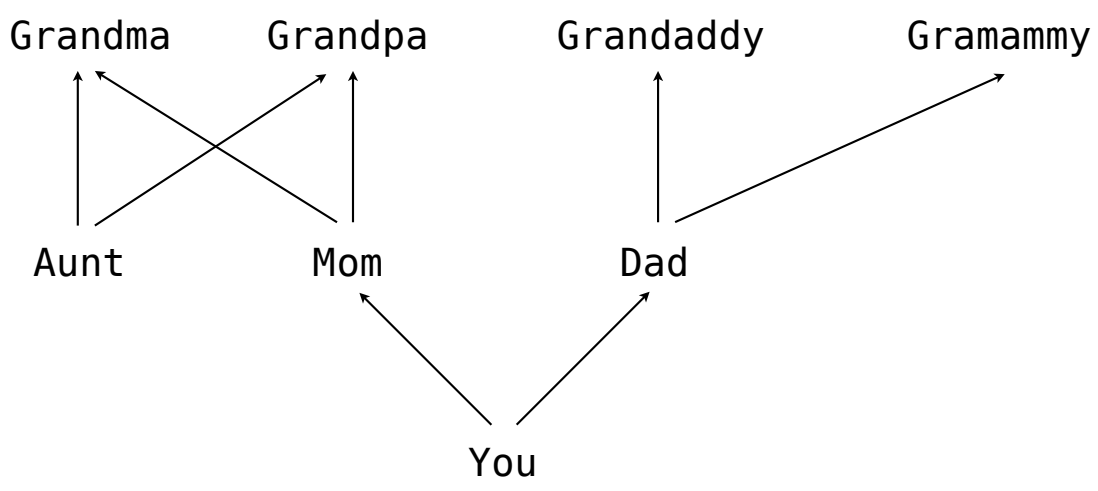

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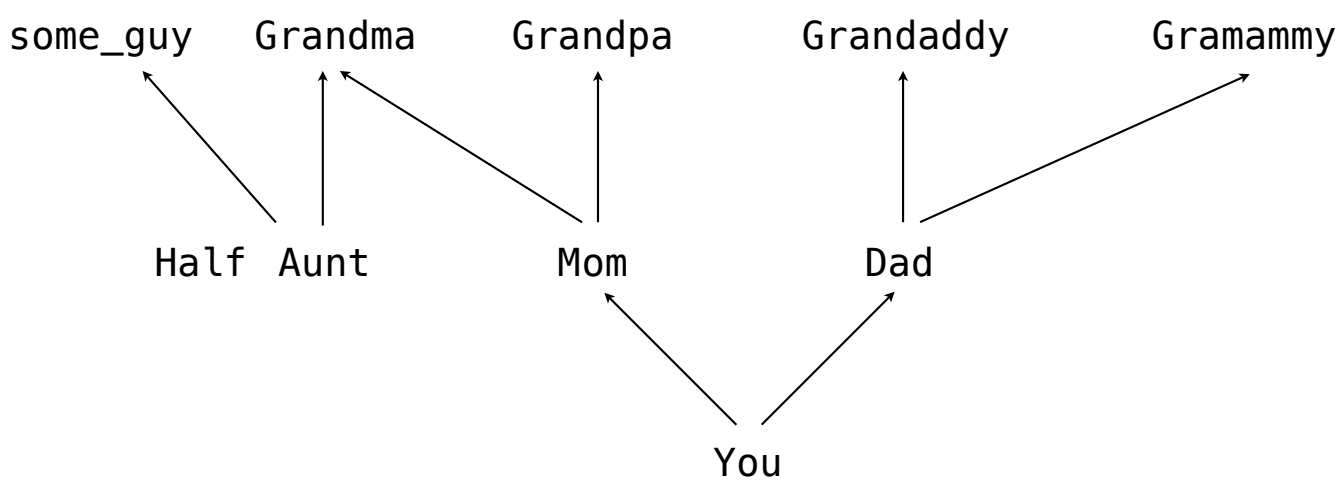

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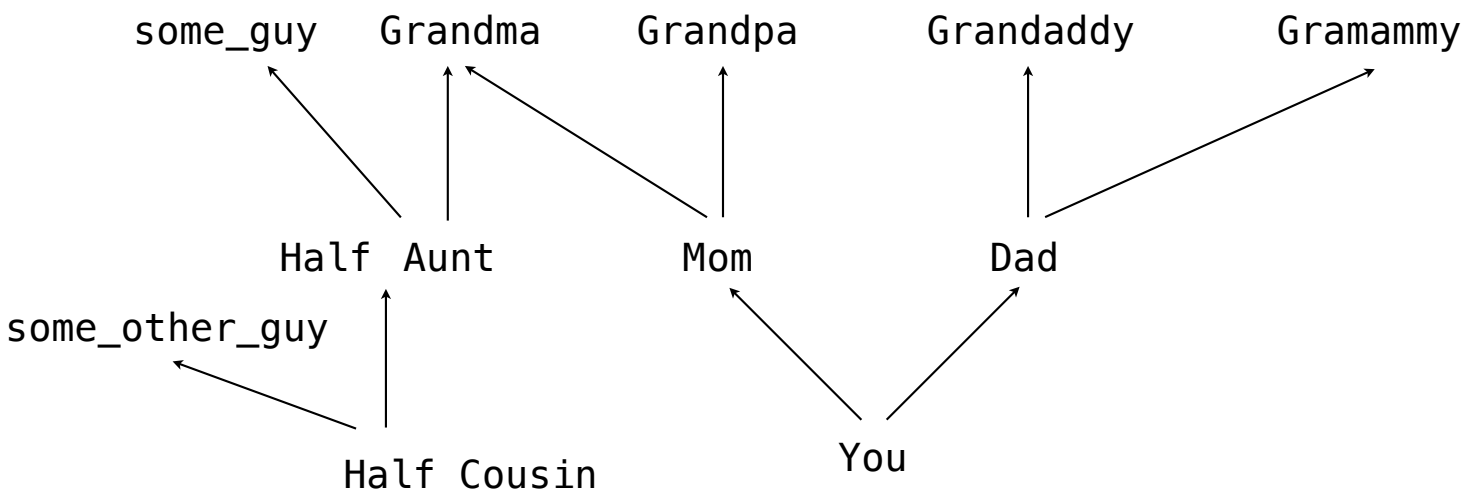

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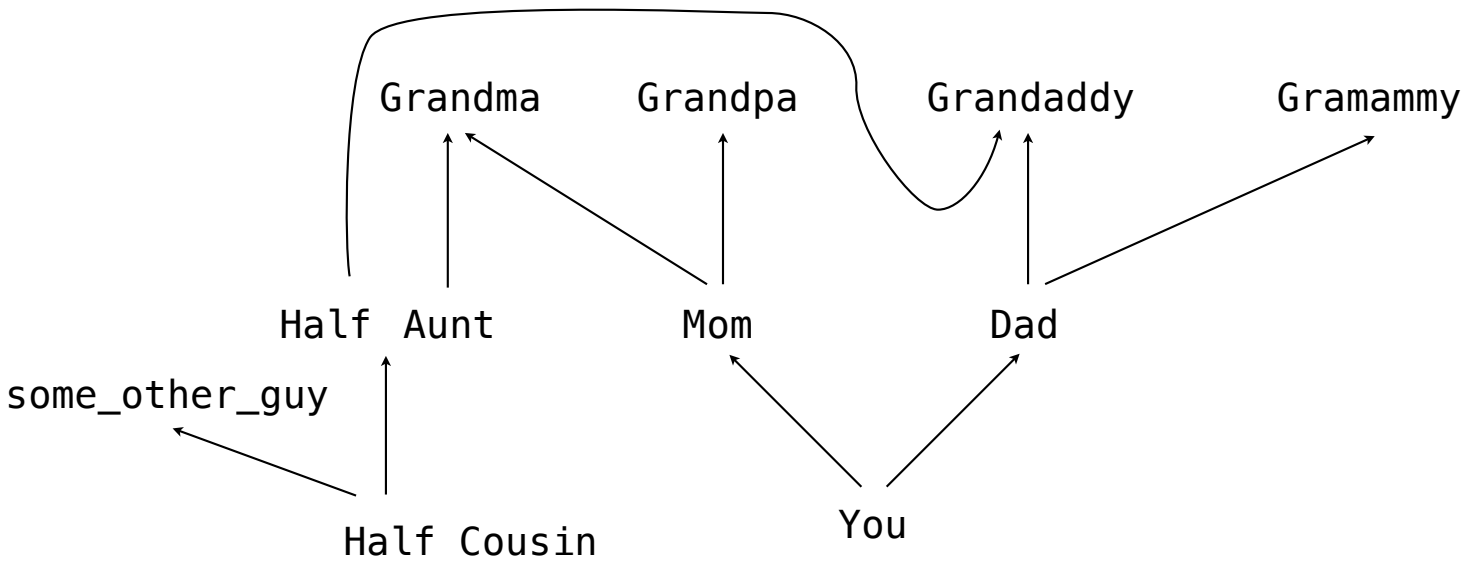

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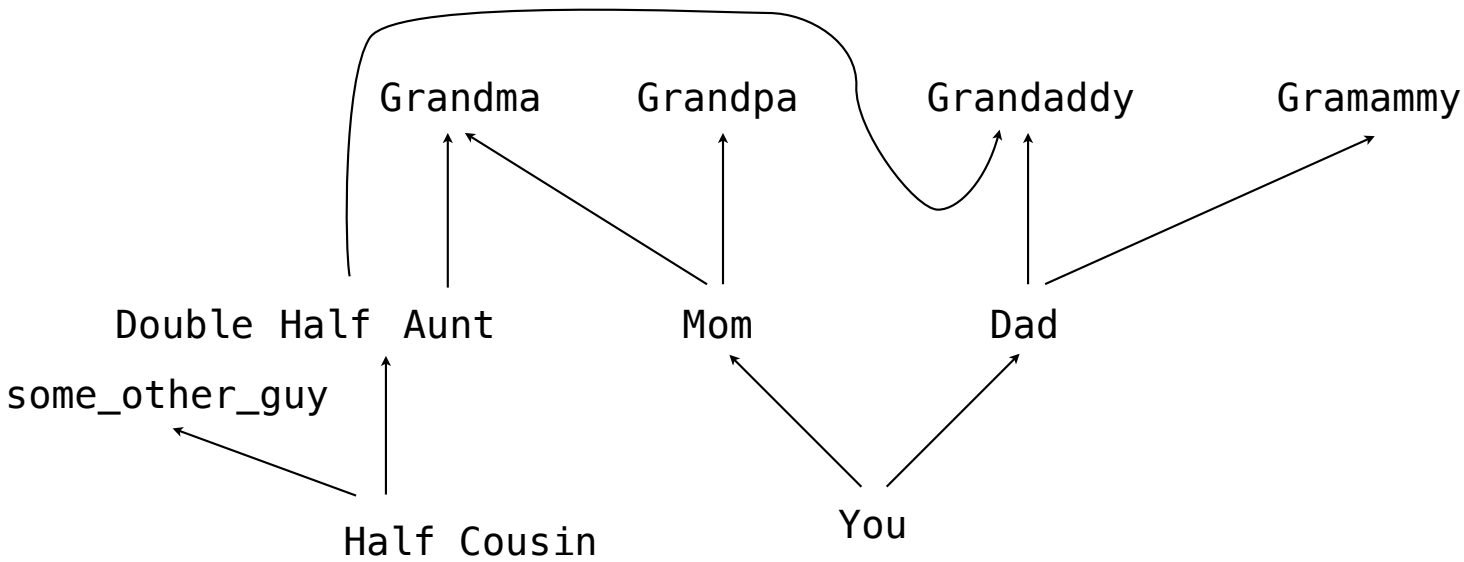

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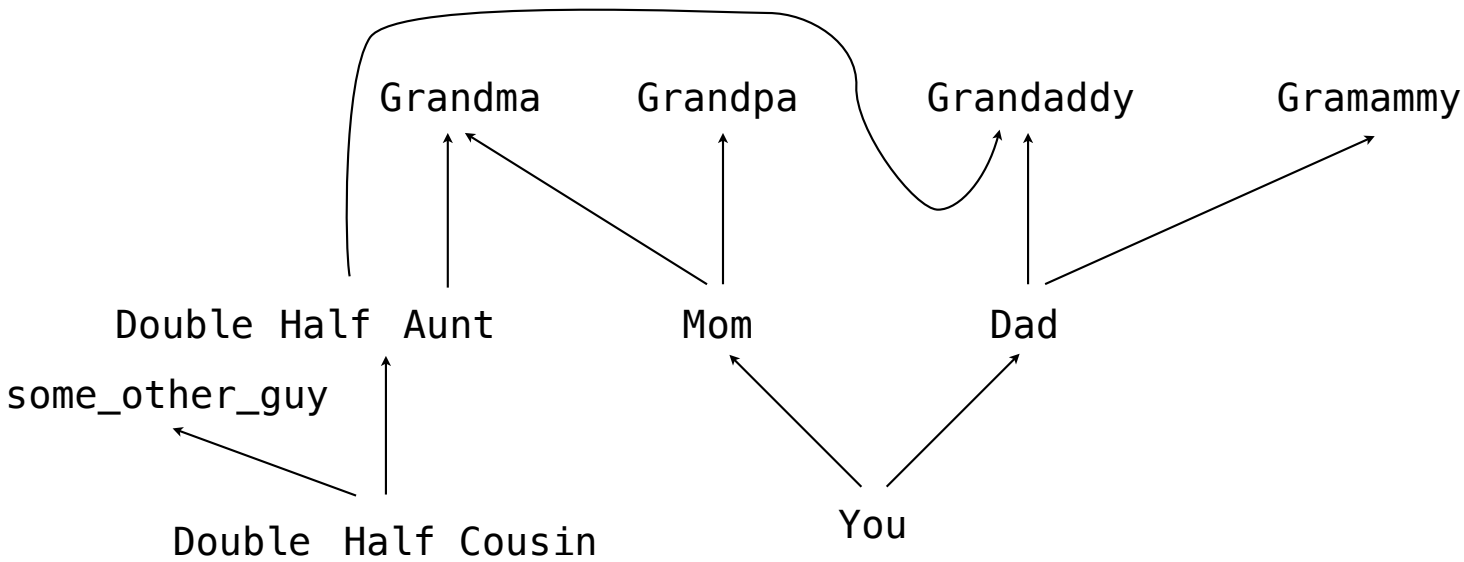

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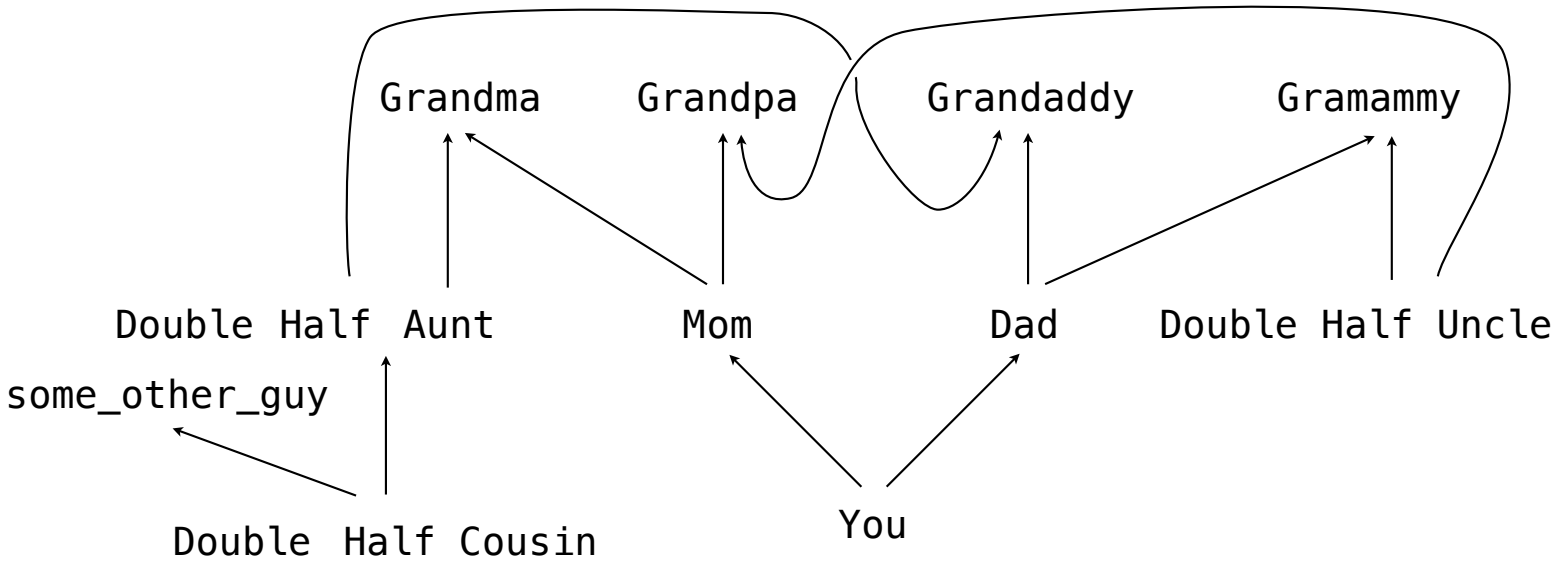

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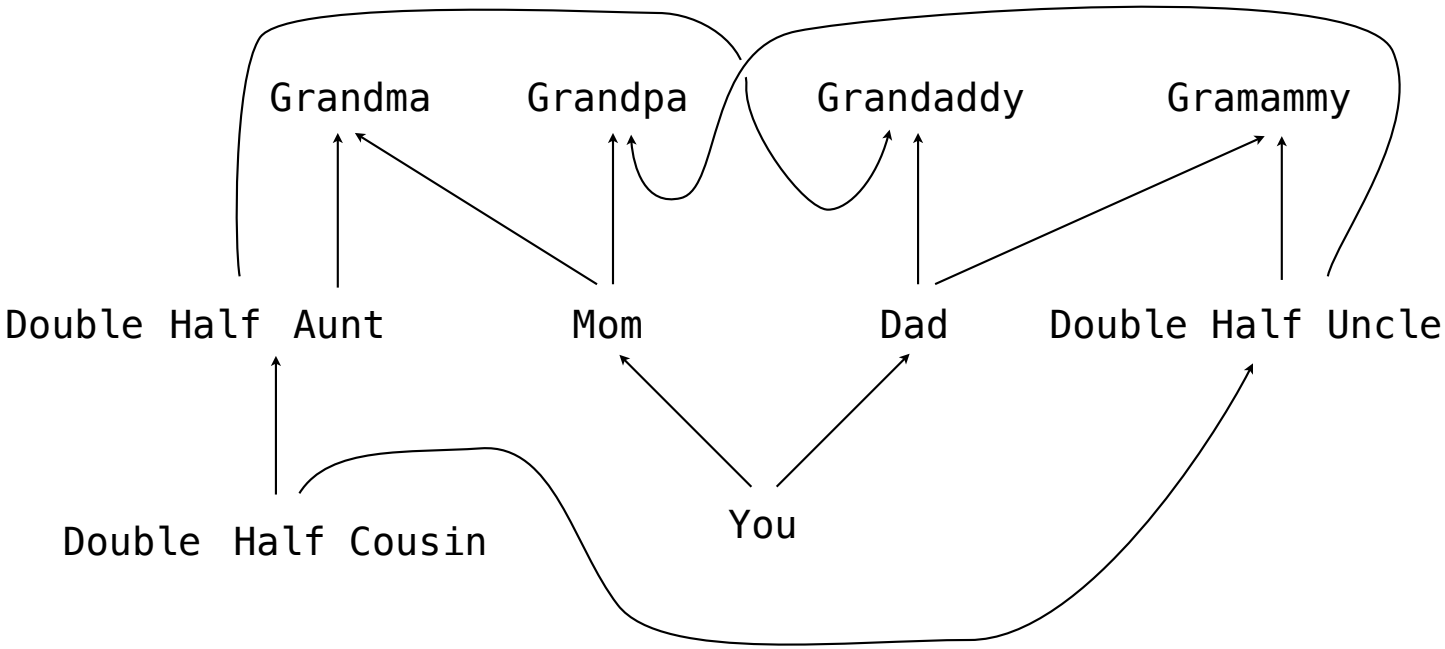

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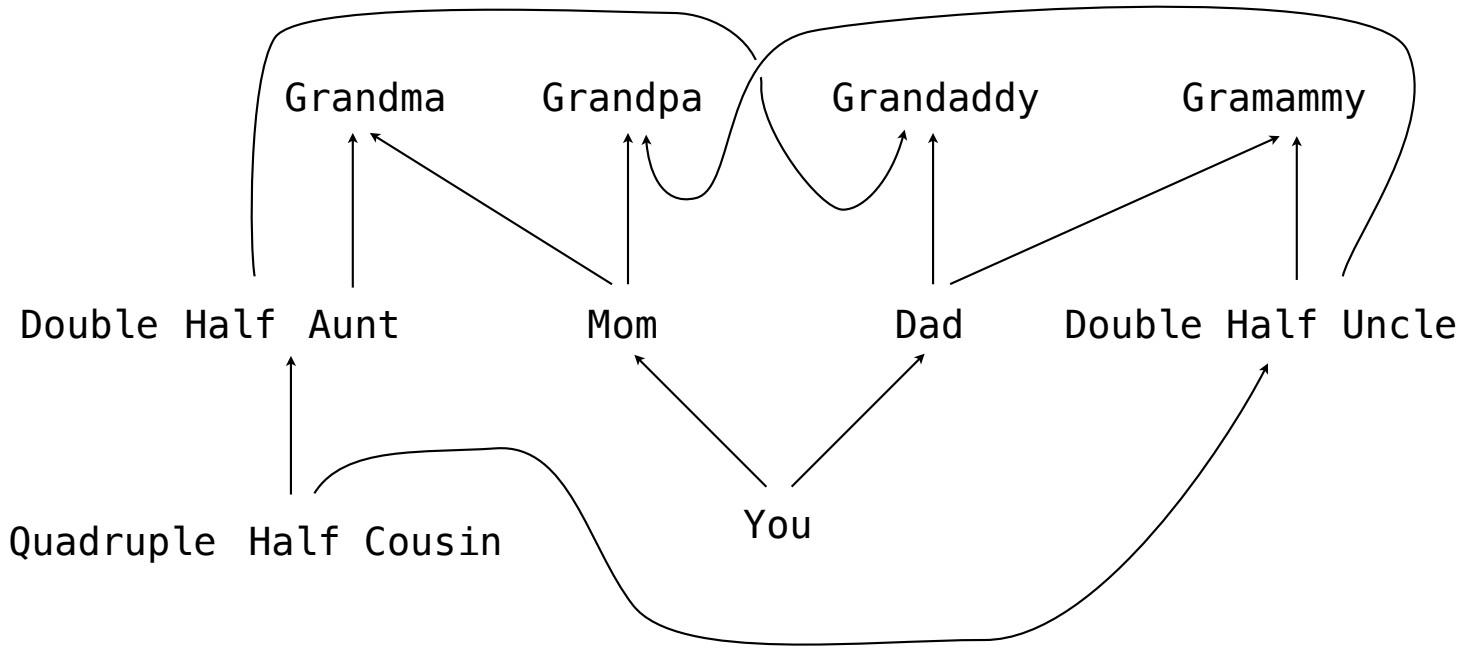

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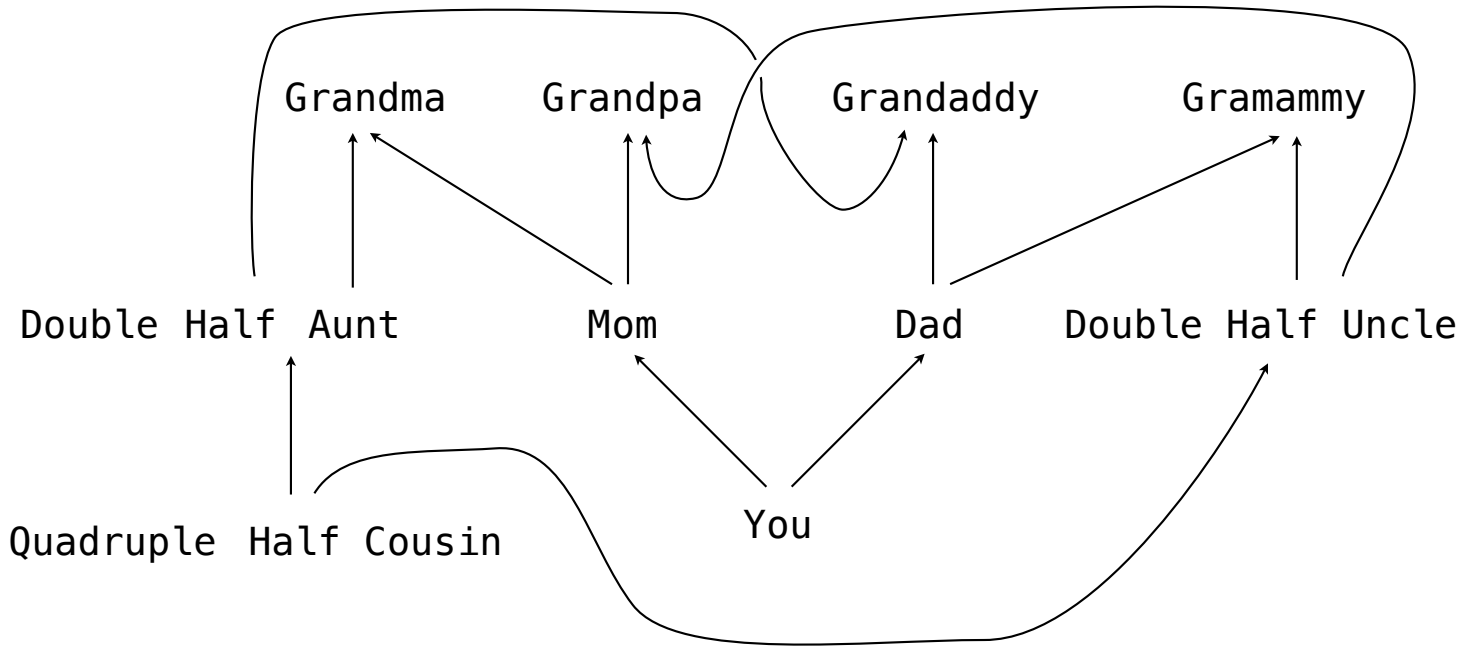

Moral of the story: Inheritance can be complicated, so don't overuse it!