ECE 20875

Python for Data Science

David Inouye and Qiang Qiu

(Adapted from material developed by Profs. Milind Kulkarni, Stanley Chan, Chris Brinton, David Inouye)

inheritance

reusing functionality

- We often want to reuse functionality from an existing class
  - When a new class that has some extra functionality compared to an old class
  - When a new class changes/overrides some functionality of an old class
- One option: Create a new class, and define all the necessary functions
  - This is done in the example on the right

```
class Person :
  def __init__(self, name) :
    self.name = name

  def getName(self) :
    return self.name

p = Person(“Bob”)
print(p.getName()) #prints “Bob”

#creating a new class that has a lot in
common with “Person”
class AgePerson :
  def __init__(self, name, age) :
    self.name = name
    self.age = age

  def getName(self) :
    return self.name

  def getAge(self) :
    return self.age
```

inheriting from parent class

- This is pretty inefficient if there is a lot of overlap
- Instead, we can use **inheritance**
  - Create a new **child** class that *inherits* the attributes of the **parent** class
  - Can then add new attributes to a class to define new functions and/or add new data
- Updated example using inheritance on the right:
  - `__init__` from `AgePerson` **overrides** `__init__` from `Person`
  - When we create a new `AgePerson`, we use the new version of `__init__`, but when we call `getName()`, we use the old version of `getName()`

```
class Person :
  def __init__(self, name) :
    self.name = name

  def getName(self) :
    return self.name

p = Person("Bob")
print(p.getName())

#we can instead let the AgePerson class
inherit from the parent class Person
class AgePerson(Person) :
  #overrides __init__ from parent
  def __init__(self, name, age) :
    self.name = name
    self.age = age

  def getAge(self) :
    return self.age
```

reusing when redefining

- Can reuse functionality even more by using the **`super()`** function within a child class
  - Tells the class to inherit this method/property from the parent, and allows further redefining
- Updated example on the right:
  - `super().__init__()` refers to `__init__()` of the parent class `Person`
  - This tells `AgePerson` to reuse `__init__` from `Person` in the redefinition, and then we can add additional functionality on top of it
- Can similarly reuse functionality when redefining other functions

```
class Person :
  def __init__(self, name) :
    self.name = name

  def getName(self) :
    return self.name

p = Person("Bob")
print(p.getName())

class AgePerson(Person) :
  def __init__(self, name, age) :
    #Tell AgePerson to inherit __init__
    from parent class
    super().__init__(name)

    #Then we can add additional
    functionality to the new init
    self.age = age

  def getAge(self) :
    return self.age
```

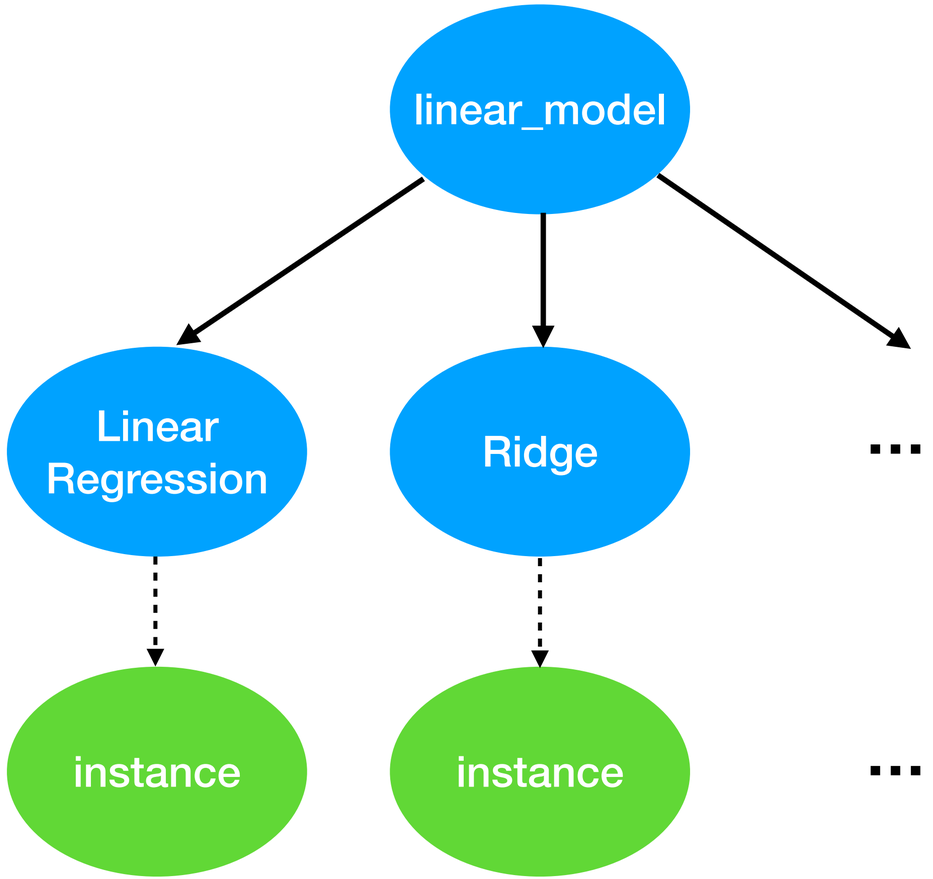
overriding default methods

- All classes inherit from the built-in basic class called **`object`** by default
  - Provides some default functionality like `__str__` and **`__repr__`** methods
  - **__repr__** is the “official” string representation of an object, more general than just printing, useful for debugging
  - `__str__` is the “informal” string representation of an object, used for creating readable end user output
- Overriding these gives us the ability to change how objects are represented (`__repr__`) or printed (`__str__` or `__repr__`)

```
class Person :
  def __init__(self, name) :
    self.name = name

  def getName(self) :
    return self.name

p = Person(“Bob”)
print(p.getName())

class AgePerson(Person) :
  def __init__(self, name, age) :
    super().__init__(name)
    self.age = age

  def getAge(self) :
    return self.age

  def __repr__(self) :
    return self.name + “, “ + str(self.age)

p = AgePerson(“Bob”, 33)
repr(p)   #prints ‘Bob, 33’
```

uses of inheritance we've seen

- We've seen inheritance used in many Python packages we have used in this class
- Distribution classes (normal, exponential, etc.) in `sklearn` all inherit from generic classes that provide some default functionality
  - These classes override key methods (like `pdf` and `cdf`) to provide distribution-specific implementations
- Several regression models in `sklearn` inherit functionality from `linear_model`



what about polymorphism or interfaces?

- You may have heard of **polymorphism** before
  - Call a function on an object, but invoke different functionality depending on exactly what class an object is
  - Can write very generic code since you do not have to know exactly what type of object you are working with
  - Used extensively in languages like Java and C++ through the inheritance mechanism
- Python gets you this “for free”:
  - Programs are not written with types
  - Invoke any method on any object if the object’s class has the method defined (called **duck typing**)
  - No need for any actual relationship between different classes that implement the same method(s)

```
class Animal :
  def __init__(self, name) :
    self.name = name

  def talk(self) :
    raise NotImplementedError(“Subclass
            must implement talk method”)

class Cat(Animal) :
  def talk(self):
     return ‘Meow!’

class Duck:  # Notice doesn’t inherit
  def __init__(self, name) :
     self.name = name # But has the right var.
  def talk(self): # And implements this method
     return ‘Quack! Quack!’

animals = [Cat(‘Missy’), Cat(‘Mr. Mistoffelees’),
                    Duck(‘Sammy’)]

for animal in animals:
        print(animal.name + ‘: ‘ + animal.talk())
```