ECE 20875
Python for Data Science
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(Adapted from material developed by Profs. Milind Kulkarni, Stanley Chan, Chris Brinton, David Inouye)
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()

```python
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

```python
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)

```python
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:
    def __init__(self, name):
        self.name = name

    def talk(self):
        return 'Quack! Quack!'  

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

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

**IF IT LOOKS LIKE A DUCK, AND QUACKS LIKE A DUCK, IT'S A DUCK.**