An Application

- **Goal**: Presentation program (e.g. PowerPoint)
- **Problem**: There are many types of content
  - **Examples**: text box, rectangle, image, etc.
  - Have to write code to display each one
- **Solution**: Use object oriented features
  - Define class for every type of content
  - Make sure each has a `draw` method:

```
for x in slide[i].contents:
    x.draw(window)
```

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Defining a Subclass

Abbreviate as SC to right

```
class SlideContent(object):
    """Any object on a slide."""
    def __init__(self, x, y, w, h): ...
    def draw_frame(self): ...
    def select(self): ...
```

Superclass / Parent class / Base class → SlideContent

Subclass / Child class / Derived class → TextBox   Image

SC
__init__(self,x,y,w,h)
draw_frame(self)
select(self)

```
class TextBox(SlideContent):
    """An object containing text."""
    def __init__(self, x, y, text): ...
    def draw(self): ...
```

TextBox(SC)
__init__(self,x,y,text)
draw(self)

Image(SC)
__init__(self,x,y,img_f)
draw(self)

```
class Image(SlideContent):
    """An image."""
    def __init__(self, x, y, image_file): ...
    def draw(self): ...
```

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Class Definition: Revisited

class *<name>*(<superclass>):

```
    """Class specification"""

    getters and setters

    initializer (__init__)

    definition of operators

    definition of methods

    anything else
```

Class type to extend (may need module name)

- Every class must extend *something*
- Previous classes all extended object

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object and the Subclass Hierarcy

- Subclassing creates a **hierarchy** of classes
  - Each class has its own super class or parent
  - Until object at the "top"
- object has many features
  - Special built-in fields: `__class__`, `__dict__`
  - Default operators: `__str__`, `__repr__`

Kivy Example

object

kivy.uix.widge.WidgetBase

kivy.uix.widget.Widget

kivy.uix.label.Label

kivy.uix.button Button

Module   Class

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Name Resolution Revisited

- To look up attribute/method name
  1. Look first in instance (object folder)
  2. Then look in the class (folder)
- Subclasses add two more rules:
  3. Look in the superclass
  4. Repeat 3. until reach object

object
????

p.select()

SC(object)
__init__(self,x,y,w,h)
draw_frame(self)
select(self)

id3
p.text
TextBox
text 'Hi!'

p.draw()

TextBox(SC)
__init__(self,x,y,text)
draw(self)

p → id3

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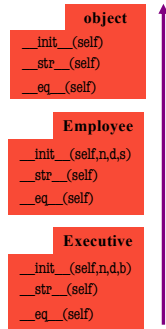---

A Simpler Example

```
class Employee(object):
    """Instance is salaried worker"""
    # INSTANCE ATTRIBUTES:
    # _name:  full name, a string
    # _start:  first year hired,
    #    an int ≥ -1, -1 if unknown
    # _salary: yearly wage, a float

class Executive(Employee):
    """An Employee with a bonus"""
    # INSTANCE ATTRIBUTES:
    #_bonus: annual bonus, a float
```

object
__init__(self)
__str__(self)
__eq__(self)

Employee
__init__(self,n,d,s)
__str__(self)
__eq__(self)

Executive
__init__(self,n,d,b)
__str__(self)
__eq__(self)

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Method Overriding

- Which __str__ do we use?
  - Start at bottom class folder
  - Find first method with name
  - Use that definition
- New method definitions **override** those of parent
  - Access to old version is **lost**
  - New version used instead
  - **Example**: __init__

```
              object
__init__(self)
__str__(self)
__eq__(self)

              Employee
__init__(self,n,d,s)
__str__(self)
__eq__(self)

              Executive
__init__(self,n,d,b)
__str__(self)
__eq__(self)
```

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Accessing the "Previous" Method

- What if you want to use the original version method?
  - New method = original+more
  - Do not want to repeat code from the original version
- Use the function super()
  - "Converts" type to parent class
  - Now methods go to the class
- **Example**:
  super().__str__()

  In Python 2 self goes here
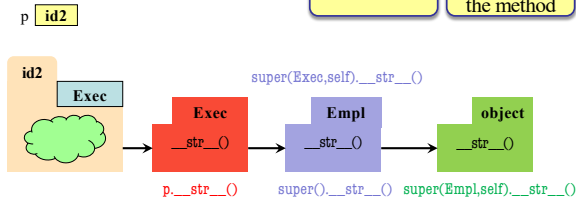
```python
class Employee(object):
    """An Employee with a salary"""
    ...
    def __str__(self):
        return (self._name +
                ', year ' + str(self._start) +
                ', salary ' + str(self._salary))


class Executive(Employee):
    """An Employee with a bonus."""
    ...
    def __str__(self):
        return (super().__str__()
                + ', bonus ' + str(self._bonus) )
```

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About super()

- super() is very limited
  - Can only go one level
  - **BAD**: super().super()

  p [id2]

- Need arguments for more
  - super(class,self)

  The **subclass**   Object in the method

```
id2
  Exec
                    super(Exec,self).__str__()

         Exec          Empl           object
       __str__()     __str__()      __str__()

     p.__str__()  super().__str__()  super(Empl,self).__str__()
```
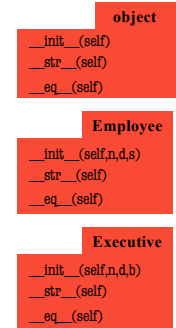
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Primary Application: Initializers

```python
class Employee(object):
    ...
    def __init__(self,n,d,s=50000.0):
        self._name = n
        self._start = d
        self._salary = s


class Executive(Employee):
    ...
    def __init__(self,n,d,b=0.0):
        super().__init__(n,d)
        self._bonus = b
```
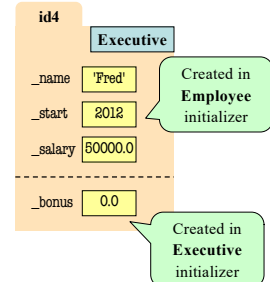
```
              object
__init__(self)
__str__(self)
__eq__(self)

              Employee
__init__(self,n,d,s)
__str__(self)
__eq__(self)

              Executive
__init__(self,n,d,b)
__str__(self)
__eq__(self)
```

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Instance Attributes are (Often) Inherited

```python
class Employee(object):
    ...
    def __init__(self,n,d,s=50000.0):
        self._name = n
        self._start = d
        self._salary = s


class Executive(Employee):
    ...
    def __init__(self,n,d,b=0.0):
        super().__init__(n,d)
        self._bonus = b
```
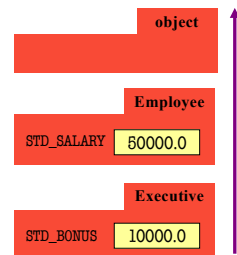
```
id4
         Executive
_name    'Fred'      Created in
                     Employee
_start   2012        initializer
_salary  50000.0
- - - - - - - - -
_bonus   0.0
                     Created in
                     Executive
                     initializer
```

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Also Works With Class Attributes

Class Attribute: Assigned outside of any method definition

```python
class Employee(object):
    """Instance is salaried worker"""
    # Class Attribute
    STD_SALARY = 50000.0


class Executive(Employee):
    """An Employee with a bonus."""
    # Class Attribute
    STD_BONUS = 10000.0
```

```
              object


              Employee
STD_SALARY   50000.0

              Executive
STD_BONUS    10000.0
```

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