Python Objects

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http://en.wikipedia.org/wiki/Object-oriented_programming

Warning

- This lecture is very much about definitions and mechanics for objects
- This lecture is a lot more about “how it works” and less about “how you use it”
- You won’t get the entire picture until this is all looked at in the context of a real problem
- So please suspend disbelief and learn technique for the next 50 or so slides..

5.1. More on Lists

The list data type has some more methods. Here are all of the methods of list objects:

`list.`**`append`**`(x)`
Add an item to the end of the list; equivalent to `a[len(a):] = [x]`.

`list.`**`extend`**`(L)`
Extend the list by appending all the items in the given list; equivalent to `a[len(a):] = L`.

`list.`**`insert`**`(i, x)`
Insert an item at a given position. The first argument is the index of the element before which to insert, so `a.insert(0, x)` inserts at the front of the list, and `a.insert(len(a), x)` is equivalent to `a.append(x)`.

`list.`**`remove`**`(x)`
Remove the first item from the list whose value is *x*. It is an error if there is no such item.

`list.`**`pop`**`([i])`
Remove the item at the given position in the list, and return it. If no index is specified, `a.pop()` removes and returns the last item in the list. (The square brackets around the *i* in the method signature denote that the parameter is optional, not that you should type square brackets at that position. You will see this notation frequently in the Python Library Reference.)

`list.`**`index`**`(x)`
Return the index in the list of the first item whose value is *x*. It is an error if there is no such item.

`list.`**`count`**`(x)`
Return the number of times *x* appears in the list.

https://docs.python.org/2/tutorial/datastructures.html

11.13. `sqlite3` — DB-API 2.0 interface for SQLite databases

New in version 2.5.

SQLite is a C library that provides a lightweight disk-based database that doesn't require a separate server process and allows accessing the database using a nonstandard variant of the SQL query language. Some applications can use SQLite for internal data storage. It's also possible to prototype an application using SQLite and then port the code to a larger database such as PostgreSQL or Oracle.

The sqlite3 module was written by Gerhard Häring. It provides a SQL interface compliant with the DB-API 2.0 specification described by **PEP 249**.

To use the module, you must first create a `Connection` object that represents the database. Here the data will be stored in the `example.db` file:

```
import sqlite3
conn = sqlite3.connect('example.db')
```

You can also supply the special name `:memory:` to create a database in RAM.

Once you have a `Connection`, you can create a `Cursor` object and call its `execute()` method to perform SQL commands:

```
c = conn.cursor()

# Create table
c.execute('''CREATE TABLE stocks
             (date text, trans text, symbol text, qty real, price real)''')

# Insert a row of data
c.execute("INSERT INTO stocks VALUES ('2006-01-05','BUY','RHAT',100,35.14)")

# Save (commit) the changes
conn.commit()

# We can also close the connection if we are done with it.
# Just be sure any changes have been committed or they will be lost.
conn.close()
```

https://docs.python.org/2/library/sqlite3.html

Object Oriented

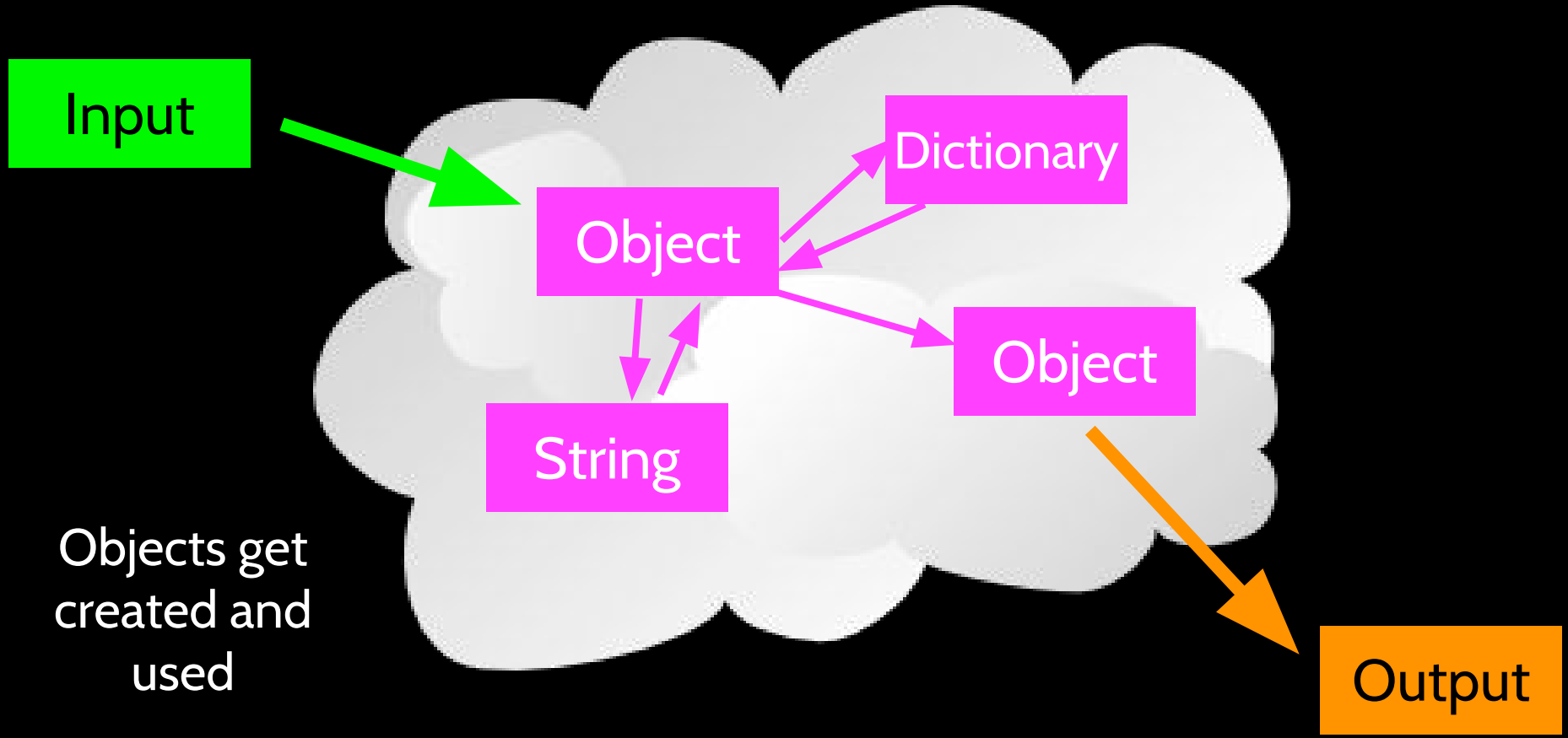
- A program is made up of many cooperating objects
- Instead of being the “whole program” - each object is a little “island” within the program and cooperatively working with other objects.
- A program is made up of one or more objects working together - objects make use of each other’s capabilities

Object

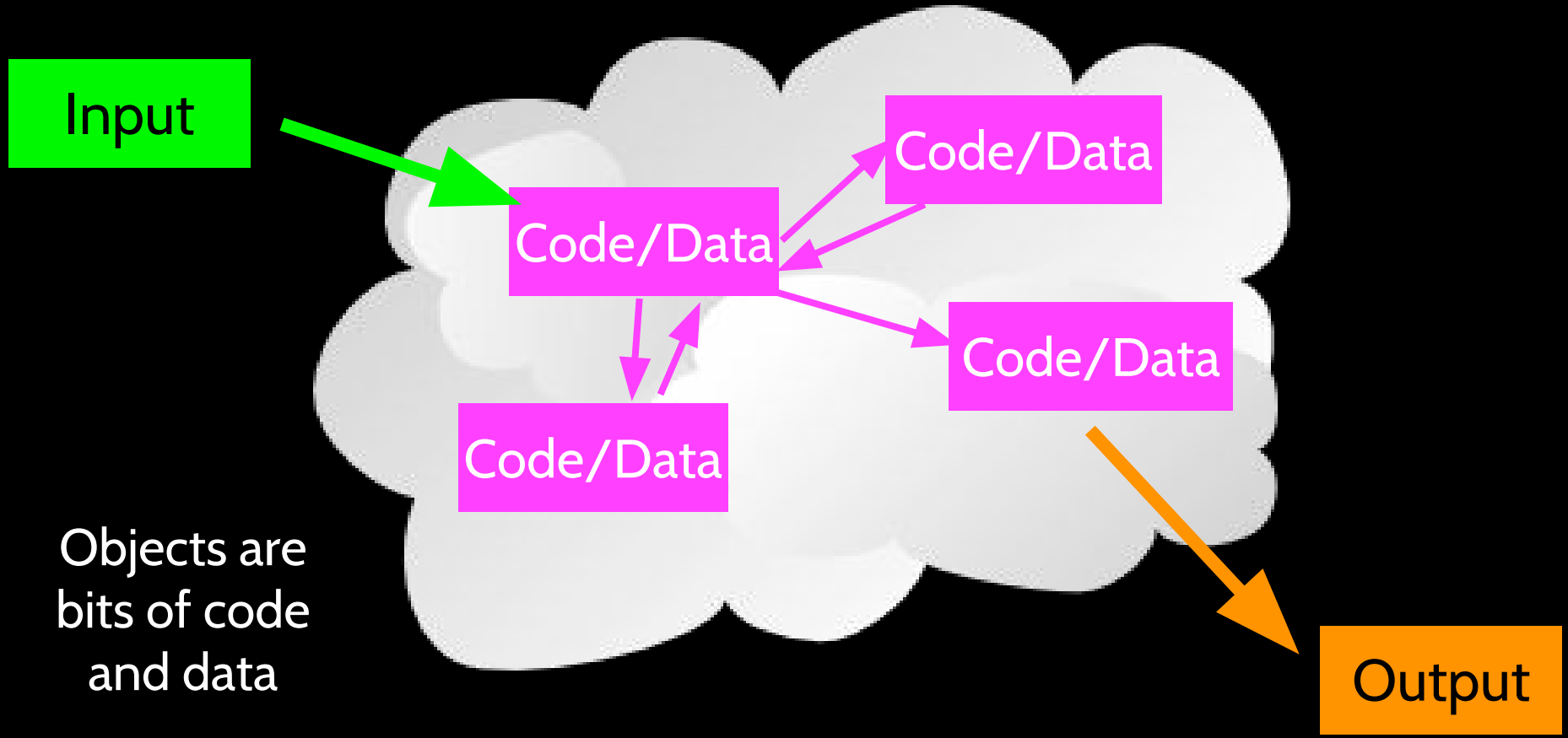
- An Object is a bit of self-contained Code and Data
- A key aspect of the Object approach is to break the problem into smaller understandable parts (divide and conquer)
- Objects have boundaries that allow us to ignore un-needed detail
- We have been using objects all along: String Objects, Integer Objects, Dictionary Objects, List Objects...

```
movies = list()
movie1 = dict()
movie1['Director'] = 'James Cameron'
movie1['Title'] = 'Avatar'
movie1['Release Date'] = '18 December
2009'
movie1['Running Time'] = '162 minutes'
movie1['Rating'] = 'PG-13'
movies.append(movie1)
movie2 = dict()
movie2['Director'] = 'David Fincher'
movie2['Title'] = 'The Social Network'
movie2['Release Date'] = '01 October 2010'
movie2['Running Time'] = '120 min'
movie2['Rating'] = 'PG-13'
movies.append(movie2)
```

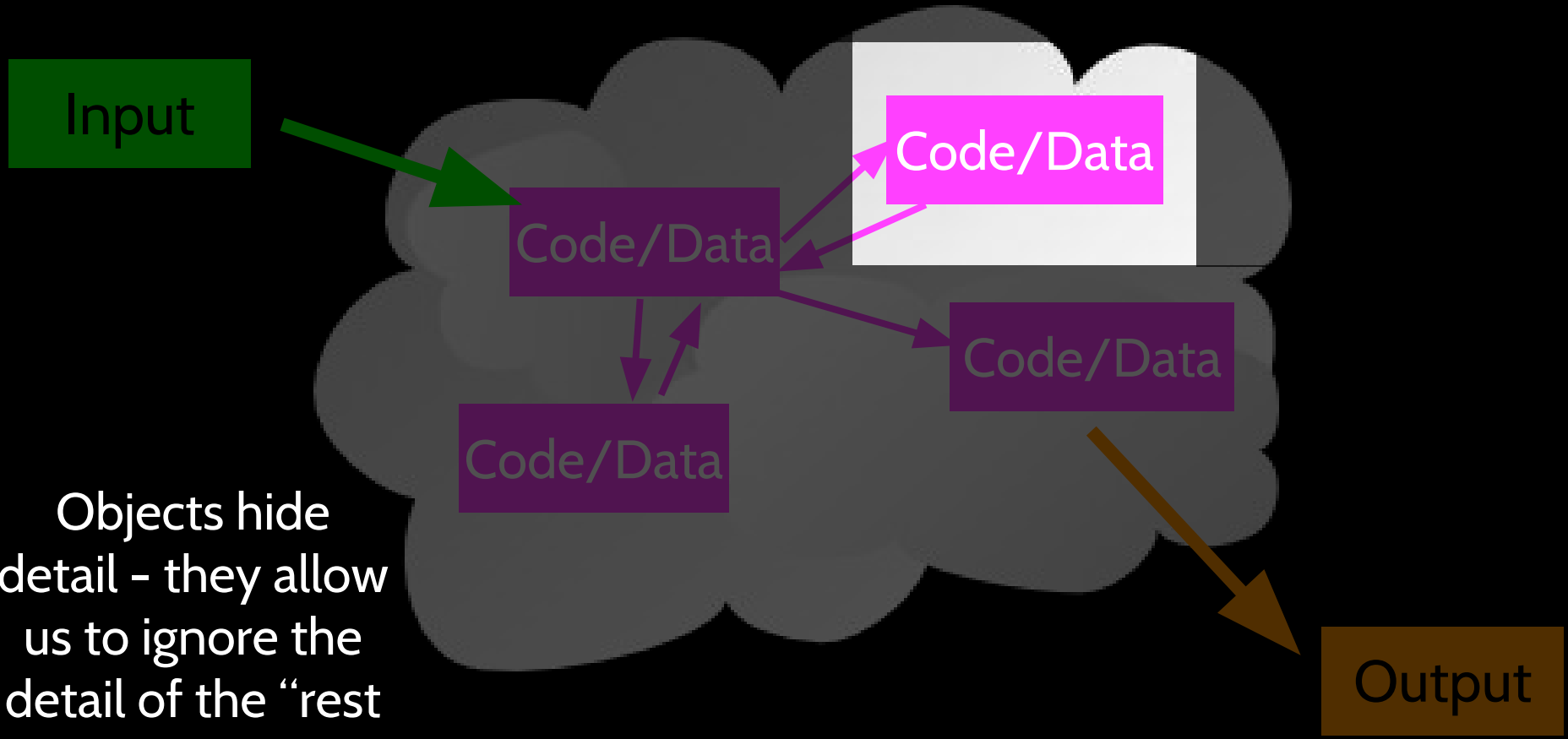
```
keys = ['Title', 'Director', 'Rating',
'Running Time']

print '----------'
print movies
print '----------'
print keys

for item in movies:
    print '----------'
    for key in keys:
        print key,': ', item[key]

print '----------'
```



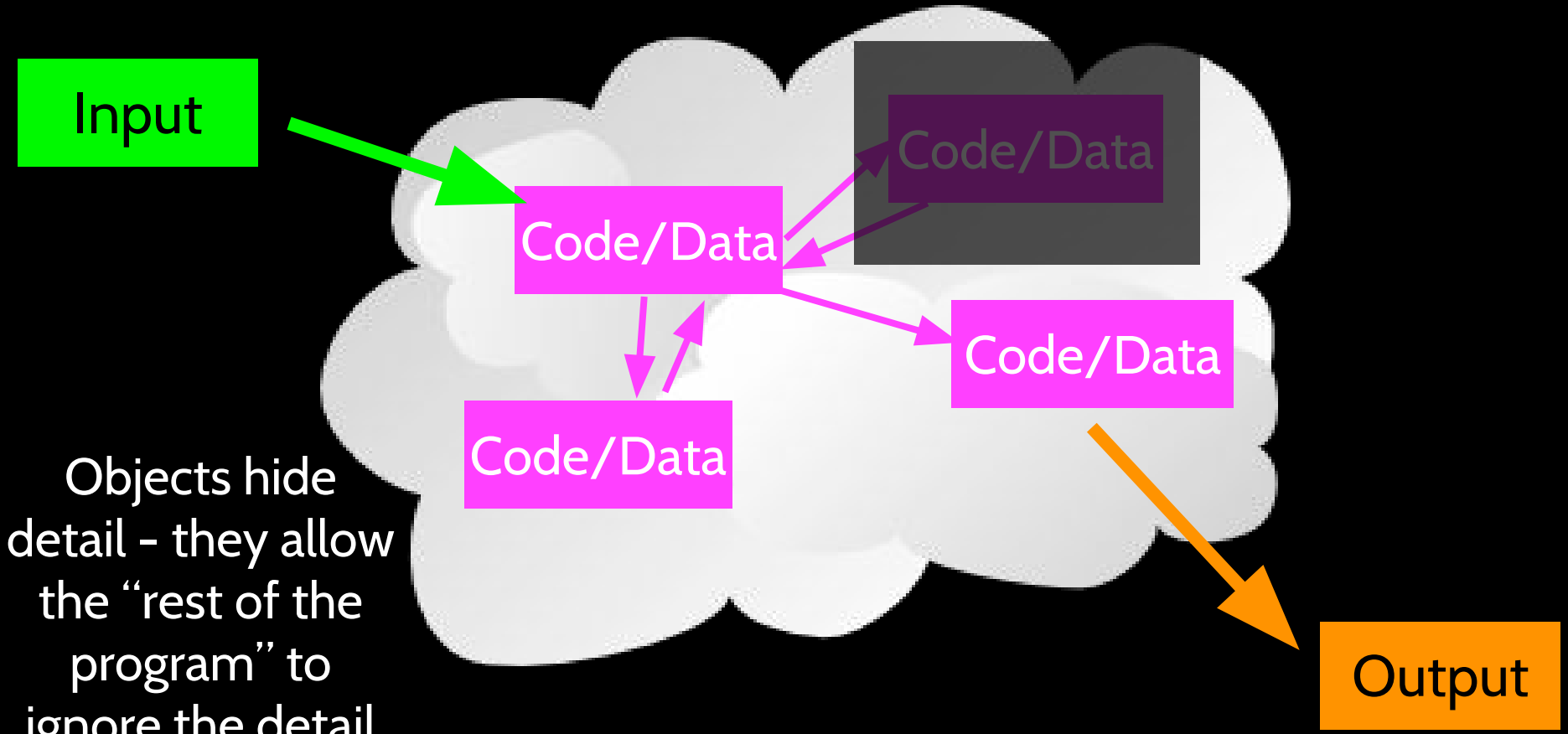
Objects get created and used



Objects are bits of code and data



Objects hide detail - they allow us to ignore the detail of the "rest of the program".



Objects hide detail – they allow the "rest of the program" to ignore the detail about "us".

Definitions

- Class - a template - Dog
- Method or Message - A defined capability of a class - bark()
- Field or attribute- A bit of data in a class - length
- Object or Instance - A particular instance of a class - Lassie

Terminology: Class

Defines the abstract characteristics of a thing (object), including the thing's characteristics (its attributes, fields or properties) and the thing's behaviors (the things it can do, or methods, operations or features). One might say that a class is a blueprint or factory that describes the nature of something. For example, the class Dog would consist of traits shared by all dogs, such as breed and fur color (characteristics), and the ability to bark and sit (behaviors).

http://en.wikipedia.org/wiki/Object-oriented_programming

class is a reserved word.

Each PartyAnimal object has a bit of code.

Tell the object to run the party() code.

```
class PartyAnimal:
  x = 0

  def party(self) :
    self.x = self.x + 1
    print "So far",self.x

an = PartyAnimal()

an.party()
an.party()
an.party()
```

This is the template for making PartyAnimal objects.

Each PartyAnimal object has a bit of data.

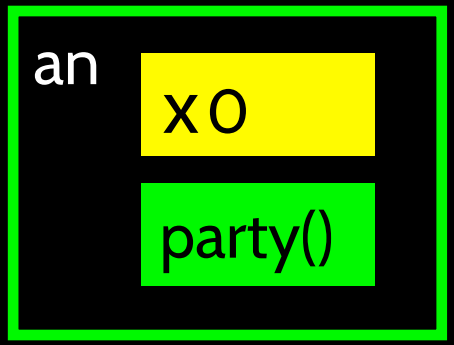
Create a PartyAnimal object.

PartyAnimal.party(an)

run party() *within* the object an

```
class PartyAnimal:
  x = 0

  def party(self) :
    self.x = self.x + 1
    print "So far",self.x

an = PartyAnimal()

an.party()
an.party()
an.party()
```

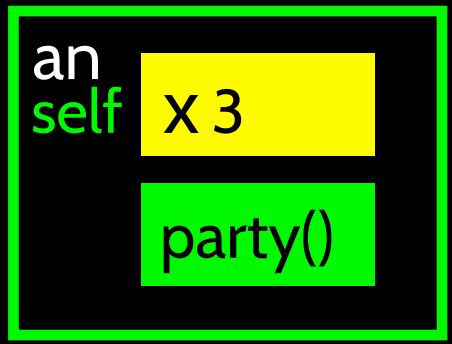
$ python party1.py



```
class PartyAnimal:
  x = 0

  def party(self) :
    self.x = self.x + 1
    print "So far",self.x

an = PartyAnimal()

an.party()
an.party()
an.party()
```

"self" is a formal argument that refers to the object itself.

self.x is saying "x within self"



self is "global within this object"

A Nerdy Way to Find Capabilities

- The dir() command lists capabilities
- Ignore the ones with underscores - these are used by Python itself
- The rest are real operations that the object can perform
- It is like type() - it tells us something *about* a variable

```
>>> x = list()
>>> type(x)
<type 'list'>
>>> dir(x)
['__add__', '__class__',
'__contains__', '__delattr__',
'__delitem__', '__delslice__',
'__doc__', '__eq__', '__setitem__',
'__setslice__', '__str__',
'append', 'count', 'extend',
'index', 'insert', 'pop', 'remove',
'reverse', 'sort']
>>>
```

Try dir() with a String

```
>>> y = “Hello there”
>>> dir(y)
['__add__', '__class__', '__contains__', '__delattr__', '__doc__',
'__eq__', '__ge__', '__getattribute__', '__getitem__',
'__getnewargs__', '__getslice__', '__gt__', '__hash__', '__init__',
'__le__', '__len__', '__lt__', '__repr__', '__rmod__', '__rmul__',
'__setattr__', '__str__', 'capitalize', 'center', 'count', 'decode',
'encode', 'endswith', 'expandtabs', 'find', 'index', 'isalnum',
'isalpha', 'isdigit', 'islower', 'isspace', 'istitle', 'isupper',
'join', 'ljust', 'lower', 'lstrip', 'partition', 'replace', 'rfind',
'rindex', 'rjust', 'rpartition', 'rsplit', 'rstrip', 'split',
'splitlines', 'startswith', 'strip', 'swapcase', 'title',
'translate', 'upper', 'zfill']
```

```
class PartyAnimal:
    x = 0

    def party(self) :
      self.x = self.x + 1
      print "So far",self.x

an = PartyAnimal()

print "Type", type(an)
print "Dir ", dir(an)
```

We can use dir() to find the "capabilities" of *our* newly created class.

```
$ python party2.py
Type <type 'instance'>
Dir  ['__doc__',
'__module__', 'party', 'x']
```

Object Lifecycle

- Objects are created, used and discarded
- We have special blocks of code (methods) that get called
  - At the moment of creation (constructor)
  - At the moment of destruction (destructor)
- Constructors are used a lot
- Destructors are seldom used

```
class PartyAnimal:
   x = 0

   def __init__(self):
     print "I am constructed"

   def party(self) :
     self.x = self.x + 1
     print "So far",self.x

   def __del__(self):
     print "I am destructed",
self.x

an = PartyAnimal()
an.party()
an.party()
an.party()
```

```
$ python party2.py
I am constructed
So far 1
So far 2
So far 3
I am destructed 3
```

The constructor and destructor are optional. The constructor is typically used to set up variables. The destructor is seldom used.

Constructor

- In object oriented programming, a constructor in a class is a special block of statements called when an object is created

http://en.wikipedia.org/wiki/Constructor_(computer_science)

```
class PartyAnimal:
    x = 0
    name = ""
    def __init__(self, nam):
      self.name = nam
      print self.name,"constructed"

    def party(self) :
      self.x = self.x + 1
      print self.name,"party count",self.x

s = PartyAnimal("Sally")
s.party()

j = PartyAnimal("Jim")
j.party()
s.party()
```

Constructors can have additional parameters. These can be used to set up instance variables for the particular instance of the class (i.e., for the particular object).

```
class PartyAnimal:
    x = 0
    name = ""
    def __init__(self, z):
      self.name = z
      print self.name,"constructed"

    def party(self) :
      self.x = self.x + 1
      print self.name,"party count",self.x

s = PartyAnimal("Sally")
s.party()

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j.party()
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```

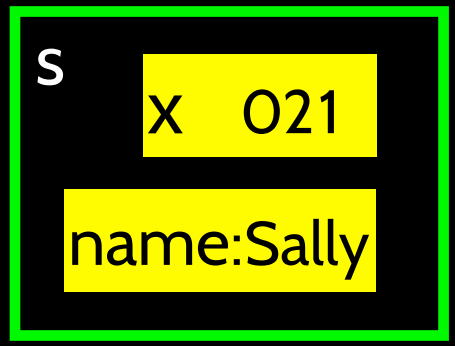

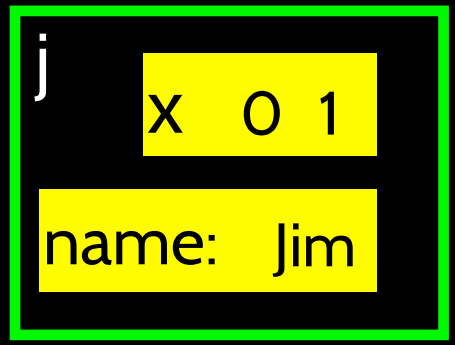

We have two independent instances.

PartyAnimal.party(j)

Inheritance

- When we make a new class - we can reuse an existing class and inherit all the capabilities of an existing class and then add our own little bit to make our new class
- Another form of store and reuse
- Write once - reuse many times
- The new class (child) has all the capabilities of the old class (parent) - and then some more

Terminology: Inheritance

‘Subclasses’ are more specialized versions of a class, which inherit attributes and behaviors from their parent classes, and can introduce their own.

http://en.wikipedia.org/wiki/Object-oriented_programming

```
class PartyAnimal:
   x = 0
   name = ""
   def __init__(self, nam):
     self.name = nam
     print self.name,"constructed"

   def party(self) :
     self.x = self.x + 1
     print self.name,"party count",self.x

class FootballFan(PartyAnimal):
   points = 0
   def touchdown(self):
      self.points = self.points + 7
      self.party()
      print self.name,"points",self.points
```

```
s = PartyAnimal("Sally")
s.party()

j = FootballFan("Jim")
j.party()
j.touchdown()
```

FootballFan is a class which extends PartyAnimal. It has all the capabilities of PartyAnimal and more.

```
class PartyAnimal:
   x = 0
   name = ""
   def __init__(self, nam):
     self.name = nam
     print self.name,"constructed"

   def party(self) :
     self.x = self.x + 1
     print self.name,"party count",self.x

class FootballFan(PartyAnimal):
   points = 0
   def touchdown(self):
      self.points = self.points + 7
      self.party()
      print self.name,"points",self.points
```

```
s = PartyAnimal("Sally")
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```
class PartyAnimal:
   x = 0
   name = ""
   def __init__(self, nam):
     self.name = nam
     print self.name,"constructed"

   def party(self) :
     self.x = self.x + 1
     print self.name,"party count",self.x

class FootballFan(PartyAnimal):
   points = 0
   def touchdown(self):
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      print self.name,"points",self.points
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```
s = PartyAnimal("Sally")
s.party()

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j.party()
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```

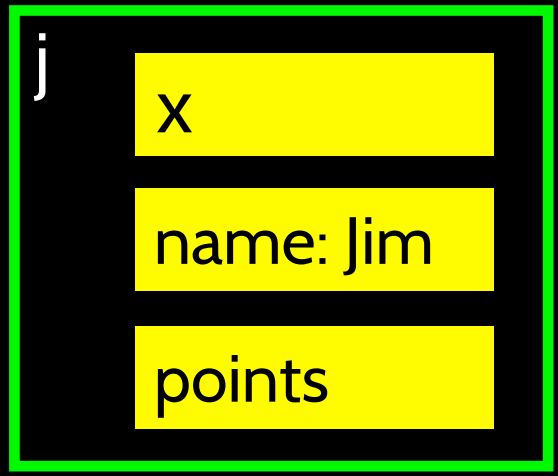

Summary

- Object Oriented programming is a very structured approach to code reuse.
- We can group data and functionality together and create many independent instances of a class

Acknowledgements / Contributions

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