Python Objects

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

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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..

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5. Data Structures

This chapter describes some things you've learned about already in more d

5.1. More on Lists

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

`list.`**`append`**`(x)`

Add an item to the end of the list. Equivalent to `a[len(a):] = [x]`.

`list.`**`extend`**`(iterable)`

Extend the list by appending all the items from the iterable. Equivalent

`list.`**`insert`**`(i, x)`

Insert an item at a given position. The first argument is the index o `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 the

https://docs.python.org/3/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()
```

Review of Programs

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```
usf = input('Enter the US Floor Number: ')
wf = usf - 1
print('Non-US Floor Number is', wf)
```

```
python elev.py
Enter the US Floor Number: 2
Non-US Floor Number is 1
```

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('-----------')
```


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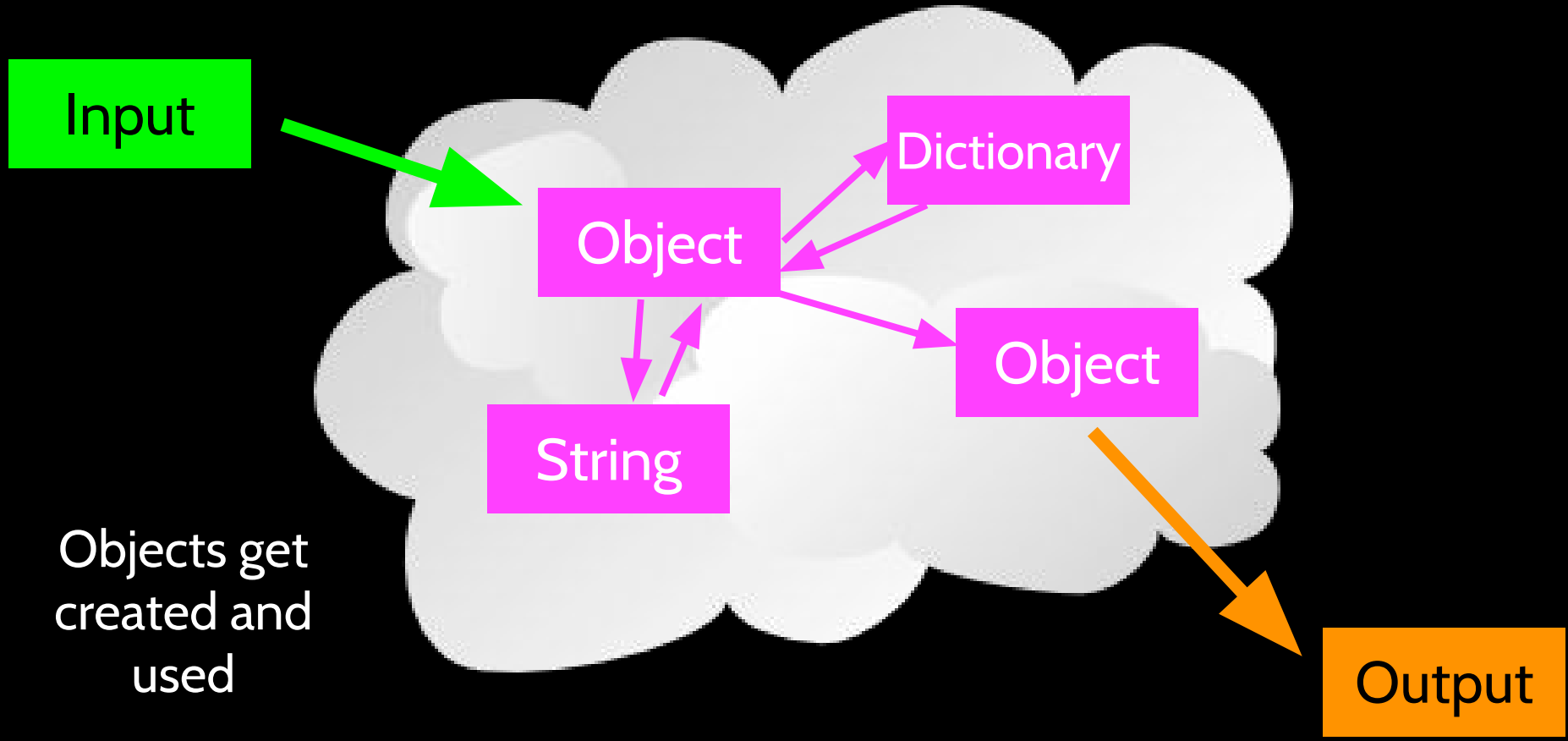

Objects get created and used

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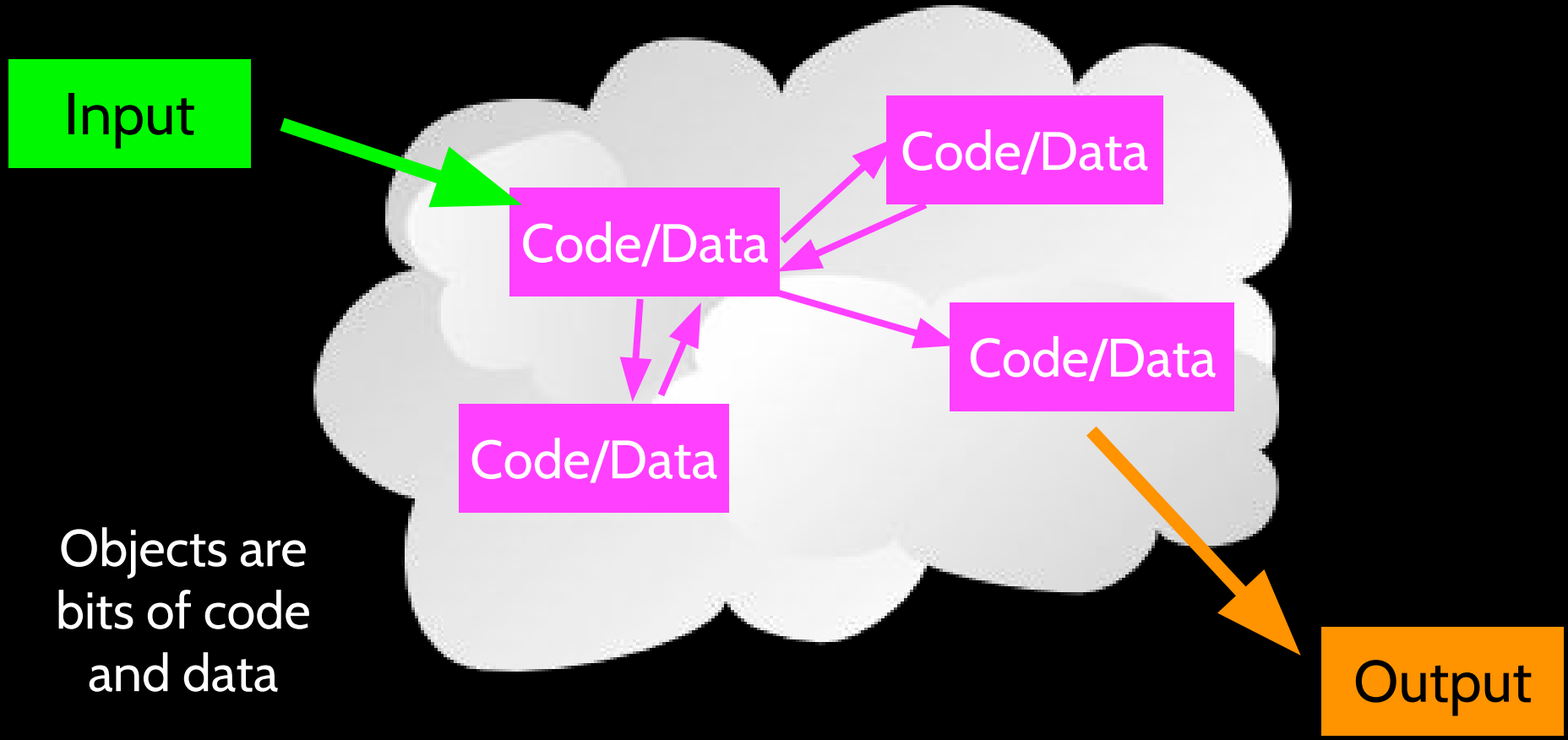

Objects are bits of code and data

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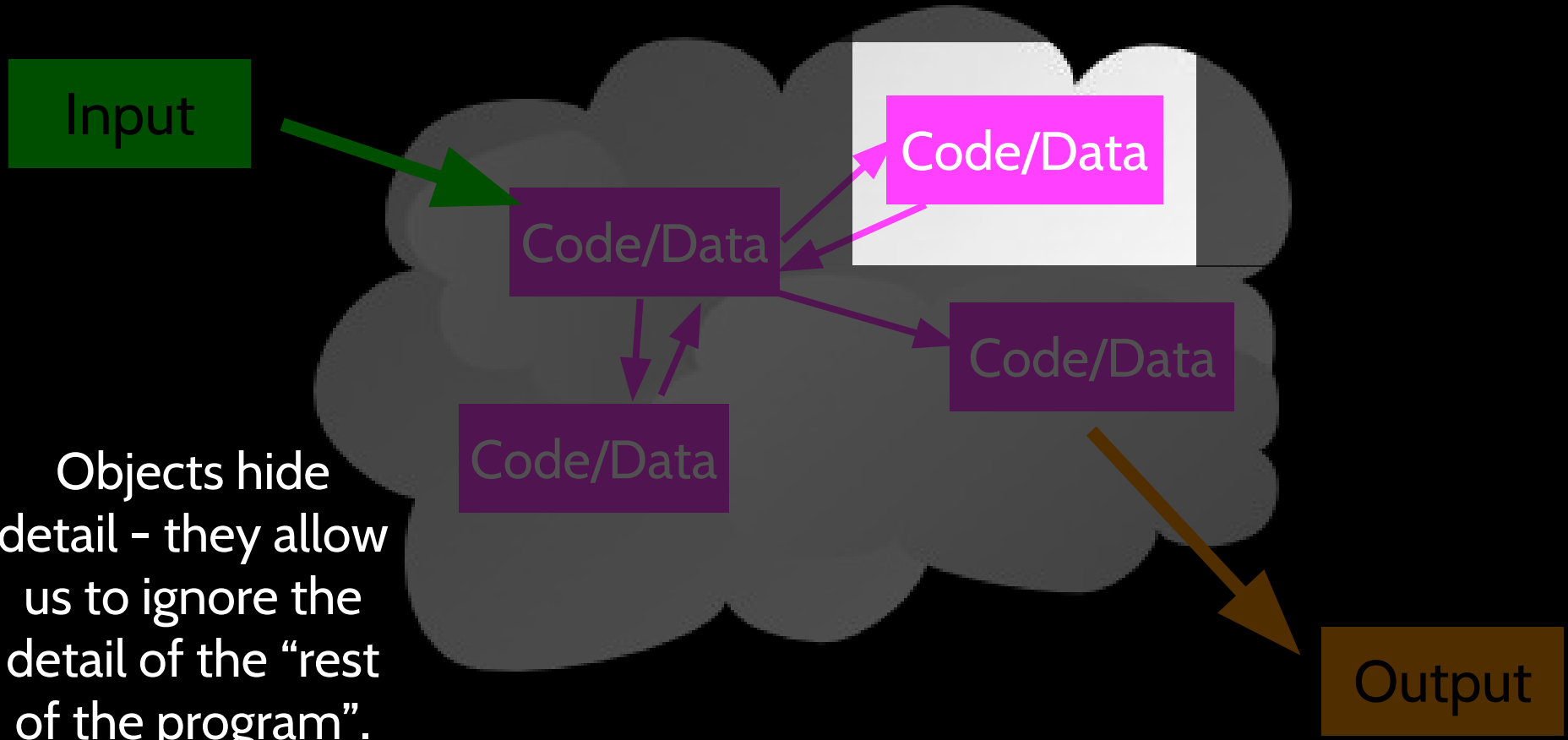
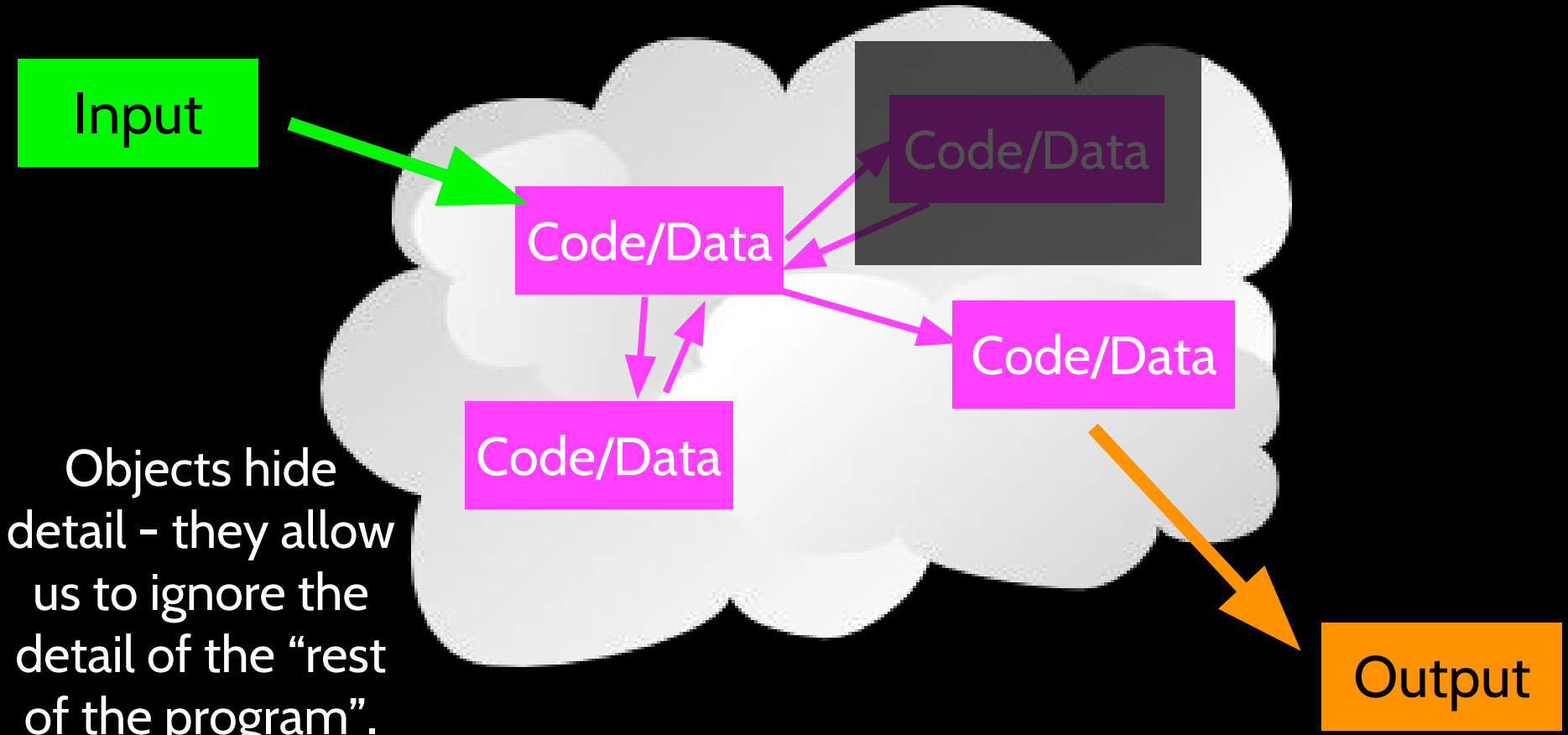


Objects hide detail - they allow us to ignore the detail of the “rest of the program”.



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

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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

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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

Terminology: Class

A pattern (exemplar) of a class. The class of Dog defines all possible dogs by listing the characteristics and behaviors they can have; the object Lassie is one particular dog, with particular versions of the characteristics. A Dog has fur; Lassie has brown-and-white fur.

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

Terminology: Instance

One can have an instance of a class or a particular object. The instance is the actual object created at runtime. In programmer jargon, the Lassie object is an instance of the Dog class. The set of values of the attributes of a particular object is called its state. The object consists of state and the behavior that's defined in the object's class.

Object and Instance are often used interchangeably.

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

Terminology: Method

An object's abilities. In language, methods are verbs. Lassie, being a Dog, has the ability to bark. So bark() is one of Lassie's methods. She may have other methods as well, for example sit() or eat() or walk() or save_timmy(). Within the program, using a method usually affects only one particular object; all Dogs can bark, but you need only one particular dog to do the barking

Method and Message are often used interchangeably.

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

A Sample Class

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

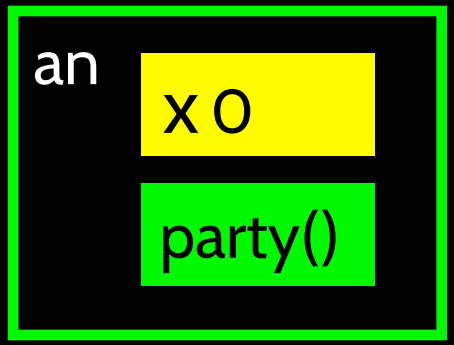
```
class PartyAnimal:
  x = 0

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

an = PartyAnimal()

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

$ python party1.py



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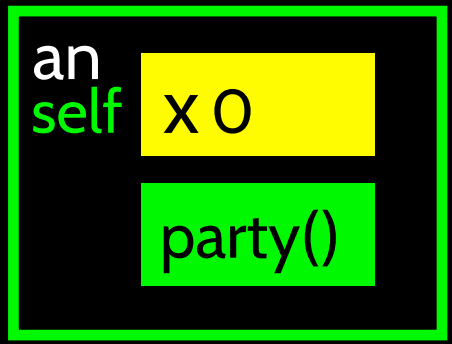
```
class PartyAnimal:
  x = 0

  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"

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Definitions Review

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Playing with dir() and type()

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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']
>>>
```


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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']
```


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```
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']
```


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Object Lifecycle

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

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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

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Constructor

- The primary purpose of the constructor is to set up some instance variables to have the proper initial values when the object is created

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```
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.

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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)

Many Instances

- We can create lots of objects - the class is the template for the object
- We can store each distinct object in its own variable
- We call this having multiple instances of the same class
- Each instance has its own copy of the instance variables

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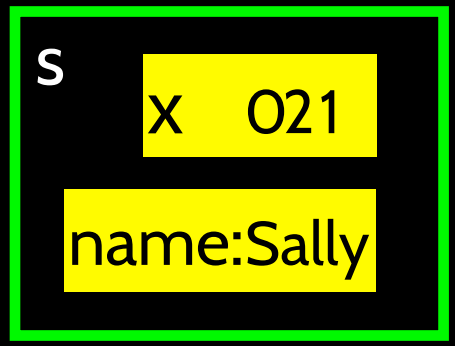
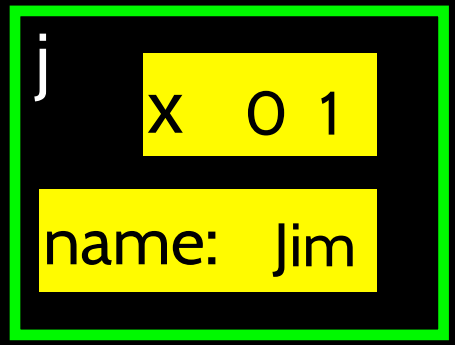
```
class PartyAnimal:
    x = 0
    name = ""
    def __init__(self, nam):
      self.name = nam
      print(self.name,"constructed")

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

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()

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

We have two independent instances.





PartyAnimal.party(j)

Definitions

- Class - a template - Dog
- Method or Message - A defined capability of a class - bark()
- Object or Instance - A particular instance of a class - Lassie
- Constructor - A method which is called when the instance / object is created

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Inheritance

http://www.python.org/doc/2.5.2/tut/node11.html
http://www.ibiblio.org/g2swap/byteofpython/read/inheritance.html

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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

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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

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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):
      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):
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```
class PartyAnimal:
   x = 0
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     self.name = nam
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   def party(self) :
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class FootballFan(PartyAnimal):
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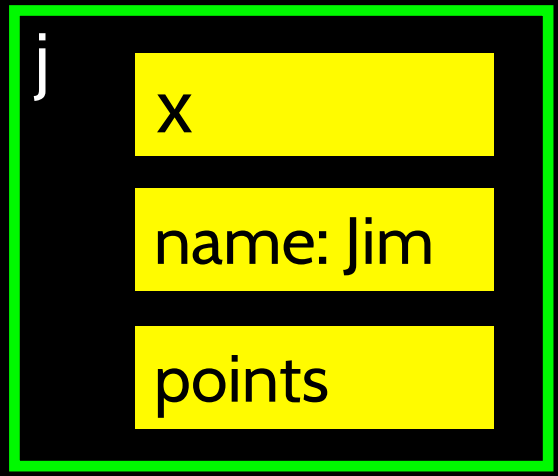

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Definitions

- Class - a template - Dog
- Method or Message - A defined capability of a class - bark()
- Object or Instance - A particular instance of a class - Lassie
- Constructor - A method which is called when the instance / object is created
- Inheritance - the ability to take a class and extend it to make a new class.

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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

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Acknowledgements / Contributions

Initial Development: Charles Severance, University of Michigan School of Information

... Insert new Contributors here

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