Walter Cazzola

Home Page
ADAPT Lab.
Curriculum Vitae
Research Topic

Didactics

Publications

Funded Projects

Research Projects

Related Events

Exam of Advance in Programming

4 June 2012

Disclaimer. Note that to have a running solution for an exercise is not enough: you need a well-cooked solution that proves your ability to use what explained during the classes. The marks for the first exercise is 16 the marks for the remaining two is 8 each. To pass the exam you have to do, at least, the first exercise and one of the other; submissions without a working solution for the first exercise will not be evaluated at all.

Exercise 1: Deep vs Shallow Copy.

Traditionally object-oriented programming provides two different modes for cloning an instance or a structured data type: **shallow** and **deep** copy. The former has the effect to clone exclusively the external shell and not its content originating a quite fastidious **aliasing** effect. The latter, instead, copies the shell and its content recursively creating two completely separate copies of the instance.

As you know, Python's programs suffer of the aliasing effect when you copy an instance of a class or a structured type (e.g., a list) with the = operator. As showed in the following example:

```
[21:21]cazzola@surtur:~/pa>python3
>>> l=[1,2,3]
>>> l1=l
>>> l1[2] = 'β'
>>> l1
[1, 2, 'β']
>>> l
```

The exercise consists of defining a meta-class which implements the deep copy (the use of the `copy` module is forbidden) on the assignment operator and binding this to the standard class `list` (note the deep copy is limited to instances of the `list` class). Such that the following behavior can be yielded

```
from antialiasing import *

if __name__ == '__main__':
  l0=list()
  l1=list()
  l0.append(1)
  l0.append(2)
  l0.append(3)
  print("l0 :- {}".format(l0))
  l1 = l0
  print("l1 :- {}".format(l1))
  l1[0] = 'α'
  print("l0 :- {}".format(l0))
  print("l1 :- {}".format(l1))
  another_list = list()
  another_list = l1
  l1.append('Ω')
  print("l0 :- {}".format(l0))
  print("l1 :- {}".format(l1))
  print("another_list :- {}".format(another_list))
  l2 = list()
  l2.append(l0)
  l2.append(l1)
  l2.append('ζ')
  l2.append(another_list)
  print("l2 :- {}".format(l2))
  l3 = list()
  l3 = l2
  print("l3 :- {}".format(l3))
  l3[0][1] = 3.14
  del l3[3][2]
  print("l0 :- {}".format(l0))
  print("l1 :- {}".format(l1))
  print("another_list :- {}".format(another_list))
```

```
[9:44]cazzola@surtur:~/pa>python3 main-antialiasing.py
l0 :- [1, 2, 3]
l1 :- [1, 2, 3]
l0 :- [1, 2, 3]
l1 :- ['α', 2, 3]
l0 :- [1, 2, 3]
l1 :- ['α', 2, 3, 'Ω']
another_list :- ['α', 2, 3]
l2 :- [[1, 2, 3], ['α', 2, 3, 'Ω'], 'ξ', ['α', 2, 3]]
l3 :- [[1, 2, 3], ['α', 2, 3, 'Ω'], 'ξ', ['α', 2, 3]]
l0 :- [1, 2, 3]
l1 :- ['α', 2, 3, 'Ω']
another_list :- ['α', 2, 3]
l2 :- [[1, 2, 3], ['α', 2, 3, 'Ω'], 'ξ', ['α', 2, 3]]
```

Note, please remember we are in a virtual machine so everything is there and in some way accessible.

Exercise 2: Alternade.

An **alternade** is a word in which its letters, taken alternatively in a strict sequence, and used in the same order as the original word, make up as many **real** words as the alternade length. All letters must be used, but the smaller words are not necessarily of the same length. For example, a word with seven letters where every second letter is used will produce a four-letter word and a three-letter word.

In the majority of alternades, every second letter is used to make two smaller words, but in some cases, every third letter is used to make three smaller words and so on. Theoretically, a very long word could use every fourth/fifth/... letter to make four/five/... smaller words; e.g., «partitioned» is an alternade for «pin», «ate», «rid», and «to».

In this exercise is required to implement a generator, named `alternade_generator`, parametric on a dictionary filename and on the number of the alternades you need for each word. At each step the generator has to generate an alternade, i.e., a couple word and a list of its spawns (spawned as for the rules above) checked into the dictionary that the all the spawns are real words. As a dictionary please use the following file (it is already sorted do not change it).

The following is an example of the expected behavior.

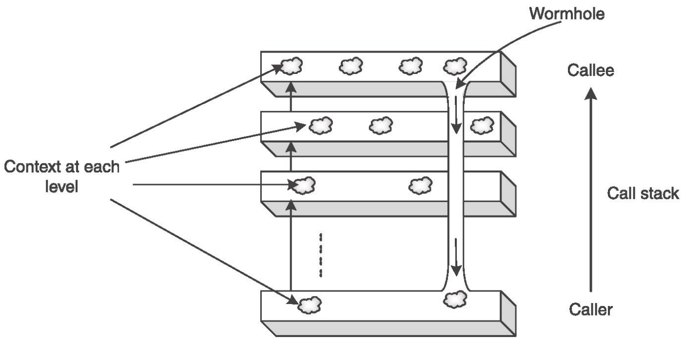
```
from alternade import *

if __name__ == "__main__":
  for i in range(2,5):
    tot = 0
    var_format = "«{0}» is an alternade for "+
        ("«{{{}}}», "*(i-1)).format(*range(1,i))+"and «{{{}}}»".format(i)
    for w, a in alternade_generator("dictionary.txt", i):
       tot+=1
       print(var_format.format(w,*a))
    print("There are {0} alternade of lenght {1} in this dictionary\n"
```

```
[12:18]cazzola@surtur:~/pa>python3 main-alternade.py
«aids» is an alternade for «ad», and «is»
«aims» is an alternade for «am», and «is»
«allied» is an alternade for «ale», and «lid»
                 ...
«wooded» is an alternade for «woe», and «odd»
«worry» is an alternade for «wry», and «or»
There are 235 alternade of lenght 2 in this dictionary

«abacuses» is an alternade for «ace», «bus», and «as»
«abased» is an alternade for «as», «be», and «ad»
                 ...
«womanised» is an alternade for «was», «one», and «mid»
There are 83 alternade of lenght 3 in this dictionary

«ballyhoo» is an alternade for «by», «ah», «lo», and «lo»
«corporeal» is an alternade for «col», «or», «re», and «pa»
                 ...
«violations» is an alternade for «van», «its», «oi», and «lo»
```

Exercise 3: Wormhole Pattern.

Often a called method has to know the context of the invocation. As an example, let us consider an authorization system where methods has to know who called them in order to establish if the request is allowable.

This particular behavior is realized by the **wormhole pattern** that allows the called method to directly access to its invoking context. This is realized by establishing a hidden and direct connection, called **wormhole**, between two levels in the call stack (as showed in the picture).



This technique does not require to modify the API in order to pass the callee context to the called method nor to introduce new calls into the existing sequence of calls. With traditional programming techniques you have just two mechanisms to realize the wormhole pattern: to add some parameters to the methods (i.e., by polluting the API) or to exploit a shared memory to store the context (i.e., by tightly coupling the program to the presence of that area). In python, it is possible to avoid this problems by exploiting meta-classes and decorators.

Let us consider the classic example of the bank account as depicted in the following code.

account.py

```
class Account:
  def __init__(self, number, owner):
    self.tot = 0
    self.number = number
    self.owner = owner
  def deposit(self, amount):
    self.tot += amount
  def withdraw(self, amount):
    self.tot -= amount
  def balance(self):
```

ATM.py

```
from wormhole import *

accounts = {
     11: Account(11, 'Walter'),
     12: Account(12, 'Cazzola'),
     13: Account(13, 'WCazzola')
   }

class ATM:
  def __init__(self, idn):
    self.idn = idn
  def deposit(self, accnumber, amount):
    accounts[accnumber].deposit(amount)
  def withdraw(self, accnumber, amount):
    accounts[accnumber].withdraw(amount)
  def balance(self, accnumber):
```

In this example would be nice to have the `Account` class to log all the `deposit` and `withdraw` operations when they are done. To have a complete picture of the situation the log entry should contain the id of the ATM used, the kind of operation, the number of the account interested by the operation, its owner and of course the amount of the operation. Unfortunately, some of these data are not known to the `Account` instances, e.g., the ATM's id and this is logically correct. So implement some meta-classes and decorators combination (stored in the `wormhole.py` file) that realizes the wormhole pattern without changing the API and without using a shared memory. At the end, the following is the expected behavior (**note** that the code provided **CAN'T** be changed).

```
from ATM import *

if __name__ == '__main__':
  atm1 = ATM(1)
  atm2 = ATM(2)
  atm3 = ATM(3)

  atm1.deposit(11, 2500)
  atm2.withdraw(12, 1000)
  atm3.deposit(12, 7000)
  atm3.deposit(13, 1500)
  atm1.withdraw(11, 500)
  atm2.withdraw(13, 1500)
  atm2.deposit(11, 7000)
  atm1.deposit(13, 3500)

  for number in accounts.keys():
```

```
[12:24]cazzola@surtur:~/pa>python3 main-wormhole.py
## At the ATM1 Has been requested a «deposit» on the
          account 11 owned by Walter for 2500€.
## At the ATM2 Has been requested a «withdraw» on the
          account 12 owned by Cazzola for 1000€.
## At the ATM3 Has been requested a «deposit» on the
          account 12 owned by Cazzola for 7000€.
## At the ATM3 Has been requested a «deposit» on the
          account 13 owned by WCazzola for 1500€.
## At the ATM1 Has been requested a «withdraw» on the
          account 11 owned by Walter for 500€.
## At the ATM2 Has been requested a «withdraw» on the
          account 13 owned by WCazzola for 1500€.
## At the ATM2 Has been requested a «deposit» on the
          account 11 owned by Walter for 7000€.
## At the ATM1 Has been requested a «deposit» on the
          account 13 owned by WCazzola for 3500€.
the account #11 contains 9000€
the account #12 contains 6000€
```

Last Modified: Fri, 08 Jun 2012 14:02:52 ADAPT Lab.