CS 131 Discussion 8

Winter 2015

Announcements

Project

o Thursday, March 05, 23:55

Midterm

- Please see CCLE announcement for details
- I graded: questions 1, 3, 4
- Prof. Eggert graded: questions 2, 5

Python

Variables & Printing

```
Variables do not have to be declared before assignment, and can be rebound
>>> x = 1 + 2
>>> X
3
>>> x = "foo"
>>> X
'foo'
Strings can be enclosed in single, double, or triple (""") quotes (which can span across multiple lines)
>>> print "Mary's car"
Mary's car
>>> print("""Mary's "beautiful" car
was worth %s dollars""" % (x))
Mary's "beautiful" car
was worth 3 dollars
```

Dictionaries, List, Tuple

[2, 'baz']

'baz'

>>> y.get("bar")[2]

```
Dictionary elements can be added easily
>>> w = \{"Mary" : 1, "George" : 2, "
"Martin" : 3}
>>> W
{'Martin': 3, 'Mary': 1, 'George': 2}
>>> w.get("Martin")
>>> w["Betty"] = 4
>>> w.get("Betty")
```

```
You can use anything as key/value, as long as the key is hashable (eg. a list is not)

>>> y = {x : 1, "bar" : [1, 2, "baz"], 42 : (1,1)}

>>> y

{42: (1, 1), 3: 1, 'bar': [1, 2, 'baz']}

>>> z = y.get(42)

>>> z.count(1)

2

Both list and tuple can have any elements inside

>>> y.get("bar")[1:3]
```

Control Flow Statements

```
Empty lists & tuples, or null objects are false
                                               >>> if 3 != 4:
>>> if ([] or () or None):
                                                  x = "foo"
     print "() or [] or None is true"
                                               else:
else:
                                                    x = "bar"
     print "() and [] and None are false"
                                               >>> X
                                               'foo'
() and [] and None are false
>>> z = [1,2,3]
                                     >>> for j in y.iteritems():
>>> for i in z:
                                          print j
     print i
                                     (42, (1, 1))
                                                                        Note: Indenting is crucial! All
                                     ('foo', 1)
                                                                        statements in the same level
                                     ('bar', [1, 2, 'baz'])
                                                                        must have the same
>>> i
                                                                        indentation
```

Functions

```
You can return different values, or no value
>>> def inverse(x):
     if x == 0:
          print "Oops!"
          return
     if x == 1:
          return "It's the same!"
     print "the answer is:"
     return 1./x
>>> inverse(0)
Oops!
>>> inverse(1)
"It's the same!"
>>> inverse(2)
the answer is:
0.5
```

```
Nameless functions are also possible, if the
function body is to return a single expression
>>> (lambda x:x*x)(3)
>>> def applyTwice(f, x):
     return f(f(x))
>>> applyTwice((lambda x: x*x), 2)
16
>>> f = lambda x:x*x
>>> applyTwice(f, 2)
16
```

Classes

```
>>> class BaseClass(object):
     def __init__(self, argx):
           self.x = argx
>>> foo = BaseClass(3)
>>> foo.x
Class members are always accessible
>>> foo.x = 5
You can also add members to an instance
>>> foo.y = 6
>>> bar = BaseClass(8)
>>> bar.y #This results in a error!
```

```
>>> class ChildClass(BaseClass):
    def __init__(self, argx, argy):
        super(ChildClass,self).__init__(argx)
        self.y = argy
    def getX(self):
        return self.x
    def getY(self):
        return self.y

>>> baz = ChildClass(1,2)
>>> baz. dict
```

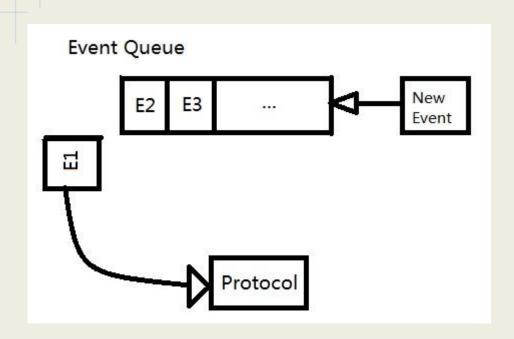
{'y': 2, 'x': 1}

>>> baz.getX()

Twisted



Event-Driven Architecture



- Events can enter the event queue
- The event in the front of the queue is pass to a protocol, which processes the event

Reactor, Protocol, Factory, Transport

Reactor event loop

Waits on and dispatches events to event handlers

Protocol

 Must handle these events: makeConnection, connectionMade, dataReceived, connectionLost

Protocol Factory

- Builds new instances of protocols (for each new connection)
- Saves persistent information

Transport

- Represents the connection between two endpoints
- Has following methods, which can be called by a protocol: write, writeSequence, loseConnection, getPeer, getHost

Example: chatserver.py

```
from twisted.internet.protocol import Factory
                                                                                def handle CHAT(self. message):
from twisted.protocols.basic import LineReceiver
                                                                                    message = "<%s> %s" % (self.name, message)
from twisted.internet import reactor
                                                                                    self.broadcastMessage(message)
class ChatProtocol(LineReceiver):
   def init (self. factory):
                                                                                def broadcastMessage(self, message):
       self.factory = factory
                                                                                    for name, protocol in self.factory.users.iteritems():
       self.name = None
                                                                                        if protocol != self:
       self.state = "REGISTER"
                                                                                             protocol.sendLine(message)
    def connectionMade(self):
                                                                           class ChatFactory(Factory):
       self.sendLine("What's your name?")
                                                                                def __init__(self):
   def connectionLost(self, reason):
                                                                                    self.users = {}
       if self.name in self.factorv.users:
                                                                                def buildProtocol(self, addr):
           del self.factory.users[self.name]
           self.broadcastMessage("%s has left the channel." % (self.name,))
                                                                                    return ChatProtocol(self)
   def lineReceived(self, line)
                                                                           reactor.listenTCP(8000, ChatFactory())
        if self.state == "REGISTER":
           self.handle REGISTER(line)
                                                                           reactor.run()
       else:
           self.handle CHAT(line)
    def handle REGISTER(self, name):
       if name in self.factory.users:
                                                                                                 port #
           self.sendLine("Name taken, please choose another.")
           return
       self.sendLine("Welcome, %s!" % (name,))
       self.broadcastMessage("%s has joined the channel." % (name,))
       self.name = name
       self.factory.users[name] = self
       self.state = "CHAT"
```

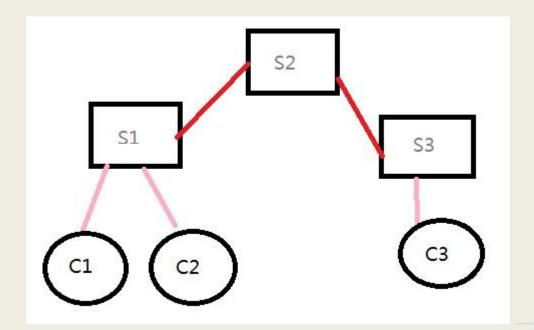
Project

Your task

- Investigate Twisted
- Build prototype of an event-driven application with an "application server herd" architecture. Five servers and non-predetermined number of clients
- Make comment on Twisted's usefulness and compare to Node.js (Javascript, also event-driven)

Application Server Herd

Example with 3 servers and 3 clients:



Your Prototype

- 5 servers: 'Alford', 'Bolden', 'Hamilton', 'Parker', 'Powell'
 - Alford talks with Parker and Powell
 - Bolden talks with Parker and Powell
 - Hamilton talks with Parker
- Each server should accept TCP connections from clients (eg. via telnet)

Client

• A client can send its location to the server:

IAMAT kiwi.cs.ucla.edu +34.068930-118.445127 1400794645.392014450

• Or it can query for places near a client's location:

WHATSAT kiwi.cs.ucla.edu 10 5

Server

 Upon receiving an IAMAT from client C, the server sends C, and the server's neighbours:

AT Alford +0.563873386 kiwi.cs.ucla.edu +34.068930-118.445127 1400794699.108893381

- Upon receiving an WHATSAT from client C, the server queries Google Places and returns the location of the queried client (via AT), followed by the JSON returned by Google Places
- Upon receiving an AT from another server S, this server must check the timestamp of the AT, before storing the new location information and relaying the message to its neighbours

Painfully-Detailed Step by Step Tutorial to Run the Example in the Spec

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                                              up: Permission denied
                                                                                         * For assistance please contact help@seas
2015-02-25 00:27:48-0800 [-] ServerFactory st bash-4.1$ telnet lnxsrv.seas.ucla.edu 120🕻 *
arting on 12000
                                             Trying 164.67.100.234...
                                                                                         [yunl@lnxsrv01 ~]$ bash
2015-02-25 00:27:48-0800 [-] Starting factory telnet: connect to address 164.67.100.234: bash: /u/cs/class/cs111/cbin/share/shells
<twisted.internet.protocol.ServerFactory ins Connection refused</pre>
                                                                                          Permission denied
tance at 0x1133128>
                                             Trving 164.67.100.231...
                                                                                         bash-4.1$ telnet lnxsrv.seas.ucla.edu 120
2015-02-25 00:29:49-0800 [twisted.internet.pr telnet: connect to address 164.67.100.231: Trying 164.67.100.231...
otocol.ServerFactory] Got new client!
                                              Connection refused
                                                                                         telnet: connect to address 164.67.100.231
2015-02-25 00:30:30-0800 [MyChat,0,164.67.100 Trying 164.67.100.232...
                                                                                         nection refused
.234] received 'Hello World!'
                                             Connected to lnxsrv.seas.ucla.edu.
                                                                                         Trying 164.67.100.232...
2015-02-25 00:31:37-0800 [twisted.internet.pr Escape character is '^]'.
                                                                                         Connected to lnxsrv.seas.ucla.edu.
otocol.ServerFactory] Got new client!
                                             Hello World!
                                                                                         Escape character is '^l'.
2015-02-25 00:32:31-0800 [MyChat,1,164.67.100 Hello World!
                                                                                         Hello Everyone!
.231] received 'Hello Everyone!'
                                             Hello Everyone!
                                                                                         Hello Everyone!
```

```
bash-4.1$ export PATH=/usr/local/cs/bin:$PAT
                                                * User processes older than 36 hours
                                                                                           * User processes older than 36 hours was
                                                * You can run graphical applications
                                                                                           * You can run graphical applications :
                                                                                           !! Please see http://www.seasnet.ucla
bash-4.1$ sed 's/1025/12000/' /u/cs/fac/egge
                                                 !! Please see http://www.seasnet.ucla
rt/src/Twisted-14.0.0/doc/ downloads/chatser
ver.pv >chatserver.pv
bash-4.1$ vi chatserver.pv
                                                                                      * SEASnet Computing Access
bash-4.1$ vi chatserver.py
                                             * SEASnet Computing Access
bash-4.1$ twistd -n -y chatserver.py
2015-02-25 00:27:46-0800 [-] Log opened.
                                           * Priority is given both on the servers a * Priority is given both on the servers a
2015-02-25 00:27:48-0800 [-] twistd 14.0.0 (/ * students doing coursework. Computing su * students doing coursework. Computing su
                                                                                      * each department.
usr/local/cs/Python-2.7.6/bin/python 2.7.6) s * each department.
tarting up.
2015-02-25 00:27:48-0800 [-] reactor class: t * For assistance please contact help@seas * For assistance please contact help@seas
wisted.internet.epollreactor.EPollReactor.
2015-02-25 00:27:48-0800 [-] ServerFactory st [yunl@lnxsrv04 ~]$ bash
                                                                                      [yunl@lnxsrv01 ~]$ bash
arting on 12000
                                            bash: /u/cs/class/cs111/cbin/share/shellse bash: /u/cs/class/cs111/cbin/share/shellse
2015-02-25 00:27:48-0800 [-] Starting factory up: Permission denied
                                                                                        Permission denied
<twisted.internet.protocol.ServerFactory ins bash-4.15 telnet lnxsrv.seas.ucla.edu 1200 bash-4.15 telnet lnxsrv.seas.ucla.edu 1200</p>
tance at 0x1133128>
                                            Trying 164.67.100.234...
                                                                                      Trying 164.67.100.231...
2015-02-25 00:29:49-0800 [twisted.internet.pr telnet: connect to address 164.67.100.234: telnet: connect to address 164.67.100.231
otocol.ServerFactory] Got new client!
                                            Connection refused
                                                                                      nection refused
2015-02-25 00:30:30-0800 [MyChat, 0, 164.67.100 Trying 164.67.100.231...
                                                                                      Trying 164.67.100.232...
.234] received 'Hello World!'
                                           telnet: connect to address 164.67.100.231: Connected to lnxsrv.seas.ucla.edu.
2015-02-25 00:31:37-0800 [twisted.internet.pr Connection refused
                                                                                       Escape character is '^l'.
otocol.ServerFactory| Got new client! Trying 164.67.100.232...
                                                                                       Hello Evervone!
2015-02-25 00:32:31-0800 [MyChat,1,164.67.100 Connected to lnxsrv.seas.ucla.edu.
                                                                                       Hello Everyone!
.231] received 'Hello Everyone!'
                                           Escape character is '^]'.
                                                                                       Say goodbye by typing ctrl-1
2015-02-25 00:33:41-0800 [MyChat,1,164.67.100 Hello World!
                                                                                       Say goodbye by typing ctrl-]
.231] received 'Say goodbye by typing ctrl-]' Hello World!
2015-02-25 00:34:03-0800 [MyChat,1,164.67.100 Hello Everyone!
                                                                                       telnet> quit
                                                                                       Connection closed.
.2311 Lost a client!
                                            Sav goodbye by typing ctrl-1
                                                                                       bash-4.1$
```

```
wisted.internet.epollreactor.EPollReactor.
                                                  * User processes older than 36 hours
                                                                                             * Please use "lnxsrv.seas.ucla.edu" to
2015-02-25 00:27:48-0800 [-] ServerFactory st
                                                  * You can run graphical applications
                                                                                             * User processes older than 36 hours w
arting on 12000
                                                  !! Please see http://www.seasnet.ucla
                                                                                             * You can run graphical applications fr
2015-02-25 00:27:48-0800 [-] Starting factory
                                                                                             !! Please see http://www.seasnet.ucla.e
<twisted.internet.protocol.ServerFactory ins
tance at 0x1133128>
2015-02-25 00:29:49-0800 [twisted.internet.pr
                                               SEASnet Computing Access
otocol.ServerFactory] Got new client!
                                                                                         * SEASnet Computing Access
2015-02-25 00:30:30-0800 [MyChat, 0, 164.67.100
                                               Priority is given both on the servers a
.2341 received 'Hello World!'
                                               students doing coursework. Computing su * Priority is given both on the servers and
2015-02-25 00:31:37-0800 [twisted.internet.pr
                                               each department.
                                                                                         * students doing coursework. Computing supp
otocol.ServerFactory] Got new client!
                                                                                          each department.
2015-02-25 00:32:31-0800 [MyChat,1,164.67.100
                                               For assistance please contact help@seas
.2311 received 'Hello Everyone!'
                                                                                        * For assistance please contact help@seas.
2015-02-25 00:33:41-0800 [MyChat, 1, 164.67.100
                                               unl@lnxsrv04 ~]$ bash
.231] received 'Say goodbye by typing ctrl-]'
                                               sh: /u/cs/class/cs111/cbin/share/shellse[yunl@lnxsrv01 ~]$ bash
2015-02-25 00:34:03-0800 [MyChat,1,164.67.100]
                                               : Permission denied
                                                                                        bash: /u/cs/class/cs111/cbin/share/shellset
.231| Lost a client!
                                               sh-4.1$ telnet lnxsrv.seas.ucla.edu 120( Permission denied
^C2015-02-25 00:34:36-0800 [-] Received SIGIN
                                                                                        bash-4.1$ telnet lnxsrv.seas.ucla.edu 12000
                                               ying 164.67.100.234...
I, shutting down.
                                               Inet: connect to address 164.67.100.234: Trying 164.67.100.231...
2015-02-25 00:34:36-0800 [-] (TCP Port 12000
                                               nnection refused
                                                                                        telnet: connect to address 164.67.100.231:
Closed)
                                               ying 164.67.100.231...
                                                                                        nection refused
2015-02-25 00:34:36-0800 [-] Stopping factory
                                               lnet: connect to address 164.67.100.231: Trying 164.67.100.232...
<twisted.internet.protocol.ServerFactory ins
                                               nnection refused
                                                                                        Connected to lnxsrv.seas.ucla.edu.
tance at 0x1133128>
                                               ving 164.67.100.232...
                                                                                        Escape character is '^]'.
2015-02-25 00:34:36-0800 [MyChat, 0, 164.67.100
                                               nnected to lnxsrv.seas.ucla.edu.
                                                                                        Hello Everyone!
.234] Lost a client!
                                               cape character is '^]'.
                                                                                        Hello Everyone!
2015-02-25 00:34:36-0800 [-] Main loop termin
                                               llo World!
                                                                                        Say goodbye by typing ctrl-]
                                               llo World!
                                                                                        Say goodbye by typing ctrl-1
ated.
2015-02-25 00:34:36-0800 [-] Server Shut Down
                                               llo Everyone!
                                               y goodbye by typing ctrl-]
                                                                                        telnet> quit
bash-4.1$ ...Type ctrl-C to terminate server
                                               nnection closed by foreign host.
                                                                                        Connection closed.
                                             ∨ sh-4.1$
                                                                                        bash-4.1$
```