

6.033
COMPUTER SYSTEMS ENGINEERING
HANDS ON 9: REPLICATED STATE MACHINE

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1. WARMUP

- (1) Yes, the balances in the temporary files are the same.
- (2) The error messages mean that the set of results from one pass over the set of servers produces more than one item. It prints this error message because you are connecting with two clients to the server, which means you will have two servers in the loop over the servers. Since both of these servers will respond with a result, you will have more than one pair of results in the results list, which will cause an error.
- (3) Completed by rerouting the client messages to the servers one message at a time, and only returning the first response.
- (4) Completed by sending the time from the coordinator, and having the servers update their time with the time sent over the socket, not their own local time.

2. SOURCE CODE FOR SRV.PY

```
#!/usr/bin/python

def xfer(a, b, amt):
    if state[a] > amt:
        state[a] -= amt
        state[b] += amt
    return (state[a], state[b])

import collections, sys, socket, os
from time import gmtime, strftime
state = None

cmd, datafile = sys.argv
def setup():
    try:
        os.remove(datafile)
    except OSError:
        pass
    s = socket.socket(socket.AF_INET, socket.SOCK_STREAM)
    s.setsockopt(socket.SOL_SOCKET, socket.SO_REUSEADDR, 1)
    s.bind(('', 0))
    s.listen(2)
    print "\nListening on port " + str(s.getsockname()[1]) + " ..."
    return s

def readfile(fn):
    s = collections.defaultdict(lambda: 100)
    if not os.path.exists(fn):
        open(fn, 'w').close()
    with open(fn) as f:
        for l in f.readlines():
            f = l.split(' ')
            if f[0] != "#":
                s[f[0]] = int(f[1])
    return s

def writefile(fn, s, time):
    with open(fn, 'w') as f:
        f.write(time)
        for k in sorted(s):
            f.write('%s %d\n' % (k, s[k]))

s = setup()
while True:
    conn, addr = s.accept()
    msg = conn.recv(4096)
    a = None
    try:
        msg, time = msg.split(";")
        a, b, amts = msg.split(' ')
        amt = int(amts)
    except:
        pass
    if a is not None:
        state = readfile(datafile)
        ra, rb = xfer(a, b, amt)
```

```
writefile(datafile, state, time)
# print '%s %s %d -> %d %d' % (a, b, amt, ra, rb)
conn.send("%d %d" % (ra, rb))
conn.close()
```

3. SOURCE CODE FOR COORDS.PY

```
#!/usr/bin/python

import sys, socket
from time import gmtime, strftime

replicas = map(int, sys.argv[1:])

s = socket.socket(socket.AF_INET, socket.SOCK_STREAM)
s.setsockopt(socket.SOL_SOCKET, socket.SO_REUSEADDR, 1)
s.bind(('', 0))
s.listen(4)
print "\nListening on port " + str(s.getsockname()[1]) + " ..."

while True:
    conn, addr = s.accept()
    msg = conn.recv(4096)
    mq = []

    # Below goes your code. You need to write between 5-10 lines of code.
    # If you are writing more, you are doing something wrong.
    # the variables replies and replicas should be used.

    replies = []
    time = strftime("# %a, %d %b %Y %H:%M:%S +0000\n", gmtime())
    for replica in replicas:
        connection = socket.create_connection(('localhost', replica))

        connection.send("%s;%s" % (msg, time))
        resp = connection.recv(4096)
        replies.append(resp)

    conn.send(replies[0])
    conn.close()
```