通过checkpoint展示

cp1


```
shenzhengyu@shenzhengyu-VirtualBox:~/计算机网络/project/cp1$ ruby checkpoint1.rb
starting SPIFFY on port 15441
starting tests
Spiffy local stuff:  0100007f:1111
Spiffy setup complete.  127.0.0.1:15441
Delete this line after testing.
Listening on 15441...
15-441 PROJECT 2 PEER

chunk-file:      C.chunks
has-chunk-file: B.chunks
max-conn:        4
peer-identity:  2
peer-list-file: nodes.map
  peer 2: 127.0.0.1:2222
  peer 1: 127.0.0.1:1111
Spiffy local stuff:  00000000:2222
Spiffy setup complete.  127.0.0.1:15441
Delete this line after testing.
verifying packet sanity
########### Test 1 Passed! ###########
15-441 PROJECT 2 PEER

chunk-file:      C.chunks
has-chunk-file: A.chunks
max-conn:        4
peer-identity:  2
peer-list-file: nodes.map
  peer 2: 127.0.0.1:2222
  peer 1: 127.0.0.1:1111
Spiffy local stuff:  00000000:2222
Spiffy setup complete.  127.0.0.1:15441
Delete this line after testing.
Spiffy local stuff:  0100007f:1111
Spiffy setup complete.  127.0.0.1:15441
Delete this line after testing.
creating Control packet of type 0 with 2 chunks
verifying packet sanity
########### Test 2 Passed! ###########
15-441 PROJECT 2 PEER

chunk-file:      C.chunks
has-chunk-file: A.chunks
max-conn:        4
peer-identity:  2
peer-list-file: nodes.map
  peer 2: 127.0.0.1:2222
  peer 1: 127.0.0.1:1111
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  peer 2: 127.0.0.1:2222
  peer 1: 127.0.0.1:1111
Spiffy local stuff:  00000000:2222
Spiffy setup complete.  127.0.0.1:15441
Delete this line after testing.
Spiffy local stuff:  0100007f:1111
Spiffy setup complete.  127.0.0.1:15441
Delete this line after testing.
creating Control packet of type 0 with 2 chunks
Good, went ten seconds without receiving IHAVE
########### Test 3 Passed! ###########
done with tests
killing spiffy
shenzhengyu@shenzhengyu-VirtualBox:~/计算机网络/project/cp1$
```

cp2

```
shenzhengyu@shenzhengyu-VirtualBox:~/计算机网络/project/cp2$ ruby checkpoint2.rb
starting SPIFFY on port 15442
starting tests
Spiffy local stuff:  0100007f:1111
Spiffy setup complete.  127.0.0.1:15442
Delete this line after testing.
Spiffy local stuff:  00000000:2222
Spiffy setup complete.  127.0.0.1:15442
Delete this line after testing.
Couldn't open socket:  Address already in use at ./hupsim.pl line 395.
id = 0, hash = 6acfce07d222d400ce900d918306c6664501b33f
continue GET task
id = 1, hash = af91dbd47aac60e980e0369df68271ca52de11a8
write data to the target file
******** ref_peer exiting after 2 connections, as specified by -x flag ********
########### Test 1 Passed! ###########
Spiffy local stuff:  00000000:1111
Spiffy setup complete.  127.0.0.1:15442
Delete this line after testing.
Spiffy local stuff:  0100007f:2222
Spiffy setup complete.  127.0.0.1:15442
Delete this line after testing.
id = 0, hash = 3b9f916bbf59021ab781c9f2456df90a0102079f
id = 0, hash = 3b9f916bbf59021ab781c9f2456df90a0102079f
id = 0, hash = 3b9f916bbf59021ab781c9f2456df90a0102079f
id = 1, hash = 78585121ee33fbb6666bc4bf1a8498c04b2758e8
id = 1, hash = 78585121ee33fbb6666bc4bf1a8498c04b2758e8
id = 1, hash = 78585121ee33fbb6666bc4bf1a8498c04b2758e8
GOT test2.tar
******** ref_peer exiting after 2 connections, as specified by -x flag ***********
########### Test 2 Passed! ###########
done with tests
killing spiffy
shenzhengyu@shenzhengyu-VirtualBox:~/计算机网络/project/cp2$
```

cp3

```
shenzhengyu@shenzhengyu-VirtualBox:~/计算机网络/project/cp3$ ruby checkpoint3.rb
starting SPIFFY on port 15443
drop rate = 0.10

droptimes str = 60:69:90
key = 127.0.0.1:1111,127.0.0.1:2222 droptimes = 60 69 90
Listening on 15443...
starting tests
Spiffy local stuff:  0100007f:1111
Spiffy setup complete.  127.0.0.1:15443
Delete this line after testing.
15-441 PROJECT 2 PEER

chunk-file:      C.chunks
has-chunk-file: B.chunks
max-conn:        4
peer-identity:   2
peer-list-file: nodes.map
  peer 2: 127.0.0.1:2222
  peer 1: 127.0.0.1:1111
Spiffy local stuff:  00000000:2222
Spiffy setup complete.  127.0.0.1:15443
Delete this line after testing.
starting flow 127.0.0.1:2222,127.0.0.1:1111 at 1608358145452.86
Peer 1 received WHO_HAS with 2 hashes
id = -1, hash = 6acfce07d222d400ce900d918306c6664501b33f
id = -1, hash = af91dbd47aac60e980e0369df68271ca52de11a8
found 2 matches:
id = 0, hash = 6acfce07d222d400ce900d918306c6664501b33f
id = 1, hash = af91dbd47aac60e980e0369df68271ca52de11a8
creating Control packet of type 1 with 2 chunks
Peer 1 Sending IHAVE of size 60 to 0.0.0.0:2222
Peer 1 received GET from peer 2:
id = 0, hash = 6acfce07d222d400ce900d918306c6664501b33f
Data Transfer May take a few minutes
Dropping packet seq = 4, ack = 0 len = 1432 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 44
Dropping packet seq = 7, ack = 0 len = 1432 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 57
Dropping packet seq = 14, ack = 0 len = 1432 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 1124
Dropping packet seq = 0, ack = 13 len = 2048 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 1131
Dropping packet seq = 0, ack = 13 len = 2048 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 1160
Dropping packet seq = 0, ack = 17 len = 2048 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 2174
Dropping packet seq = 23, ack = 0 len = 1432 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 2200
Dropping packet seq = 0, ack = 22 len = 2048 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 2238
Dropping packet seq = 0, ack = 31 len = 2048 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 3300
Dropping packet seq = 0, ack = 44 len = 2048 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 3373
Dropping packet seq = 0, ack = 45 len = 2048 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 3380
Dropping packet seq = 47, ack = 0 len = 1432 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 3380
Dropping packet seq = 53, ack = 0 len = 1432 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 3405
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Dropping packet seq = 261, ack = 0 len = 1432 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 47415
Dropping packet seq = 267, ack = 0 len = 1432 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 48463
Dropping packet seq = 271, ack = 0 len = 1432 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 49513
Dropping packet seq = 0, ack = 270 len = 2048 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 49528
Dropping packet seq = 294, ack = 0 len = 1432 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 50666
Dropping packet seq = 0, ack = 293 len = 2048 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 50690
Dropping packet seq = 297, ack = 0 len = 1432 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 50690
Dropping packet seq = 0, ack = 293 len = 2048 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 50709
Dropping packet seq = 0, ack = 298 len = 2048 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 51733
Dropping packet seq = 305, ack = 0 len = 1432 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 51768
Dropping packet seq = 0, ack = 304 len = 2048 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 51782
Dropping packet seq = 310, ack = 0 len = 1432 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 52827
Dropping packet seq = 0, ack = 313 len = 2048 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 53881
Dropping packet seq = 0, ack = 315 len = 2048 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 53892
Dropping packet seq = 0, ack = 316 len = 2048 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 53907
Dropping packet seq = 0, ack = 322 len = 2048 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 53948
Dropping packet seq = 335, ack = 0 len = 1432 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 54008
Dropping packet seq = 0, ack = 334 len = 2048 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 54045
Dropping packet seq = 0, ack = 343 len = 2048 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 55132
Dropping packet seq = 0, ack = 347 len = 2048 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 55156
Dropping packet seq = 0, ack = 355 len = 2048 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 55195
Dropping packet seq = 0, ack = 357 len = 2048 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 55212
Dropping packet seq = 375, ack = 0 len = 720 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 55292
continue GET task
Peer 1 received GET from peer 2:
id = 1, hash = af91dbd47aac60e980e0369df68271ca52de11a8
Data Transfer May take a few minutes
Dropping packet seq = 11, ack = 0 len = 1432 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 56407
Dropping packet seq = 14, ack = 0 len = 1432 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 56420
Dropping packet seq = 19, ack = 0 len = 1432 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 56433
Dropping packet seq = 0, ack = 10 len = 2048 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 56449
Dropping packet seq = 0, ack = 10 len = 2048 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 56453
Dropping packet seq = 0, ack = 14 len = 2048 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 57467
Dropping packet seq = 21, ack = 0 len = 1432 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 57492
Dropping packet seq = 0, ack = 20 len = 2048 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 57500
Dropping packet seq = 0, ack = 24 len = 2048 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 58561
Dropping packet seq = 27, ack = 0 len = 1432 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 58576
Dropping packet seq = 35, ack = 0 len = 1432 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 59648
Dropping packet seq = 0, ack = 34 len = 2048 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 59656
Dropping packet seq = 36, ack = 0 len = 1432 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 60686
Dropping packet seq = 37, ack = 0 len = 1432 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 60686
Dropping packet seq = 0, ack = 38 len = 2048 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 61705
Dropping packet seq = 39, ack = 0 len = 1432 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 61707
Dropping packet seq = 40, ack = 0 len = 1432 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 62722
Dropping packet seq = 0, ack = 41 len = 2048 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 63760
Dropping packet seq = 0, ack = 42 len = 2048 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 63760
Dropping packet seq = 56, ack = 0 len = 1432 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 64844
Dropping packet seq = 57, ack = 0 len = 1432 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 64852
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Dropping packet seq = 178, ack = 0 len = 1432 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 84988
Dropping packet seq = 0, ack = 177 len = 2048 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 85020
Dropping packet seq = 189, ack = 0 len = 1432 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 86089
Dropping packet seq = 197, ack = 0 len = 1432 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 87175
Dropping packet seq = 199, ack = 0 len = 1432 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 87182
Dropping packet seq = 0, ack = 198 len = 2048 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 88215
Dropping packet seq = 211, ack = 0 len = 1432 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 88296
Dropping packet seq = 212, ack = 0 len = 1432 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 88297
Dropping packet seq = 212, ack = 0 len = 1432 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 89337
Dropping packet seq = 213, ack = 0 len = 1432 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 90350
Dropping packet seq = 0, ack = 212 len = 2048 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 90359
Dropping packet seq = 0, ack = 213 len = 2048 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 91355
Dropping packet seq = 0, ack = 237 len = 2048 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 92499
Dropping packet seq = 251, ack = 0 len = 1432 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 92568
Dropping packet seq = 0, ack = 250 len = 2048 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 92576
Dropping packet seq = 261, ack = 0 len = 1432 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 93690
Dropping packet seq = 265, ack = 0 len = 1432 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 94749
Dropping packet seq = 0, ack = 272 len = 2048 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 95824
Dropping packet seq = 0, ack = 273 len = 2048 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 95832
Dropping packet seq = 276, ack = 0 len = 1432 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 95844
Dropping packet seq = 296, ack = 0 len = 1432 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 96970
Dropping packet seq = 0, ack = 295 len = 2048 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 96975
Dropping packet seq = 301, ack = 0 len = 1432 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 97000
Dropping packet seq = 307, ack = 0 len = 1432 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 98069
Dropping packet seq = 0, ack = 306 len = 2048 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 98092
Dropping packet seq = 311, ack = 0 len = 1432 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 98092
Dropping packet seq = 0, ack = 312 len = 2048 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 99137
Dropping packet seq = 0, ack = 316 len = 2048 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 99168
Dropping packet seq = 0, ack = 328 len = 2048 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 99238
Dropping packet seq = 0, ack = 329 len = 2048 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 99238
Dropping packet seq = 333, ack = 0 len = 1432 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 99250
Dropping packet seq = 0, ack = 333 len = 2048 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 100283
Dropping packet seq = 336, ack = 0 len = 1432 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 101312
Dropping packet seq = 337, ack = 0 len = 1432 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 101318
Dropping packet seq = 336, ack = 0 len = 1432 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 102320
Dropping packet seq = 341, ack = 0 len = 1432 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 103350
Dropping packet seq = 342, ack = 0 len = 1432 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 103357
Dropping packet seq = 343, ack = 0 len = 1432 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 104378
Dropping packet seq = 347, ack = 0 len = 1432 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 105423
Dropping packet seq = 0, ack = 346 len = 2048 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 105425
Dropping packet seq = 0, ack = 349 len = 2048 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 106466
Dropping packet seq = 0, ack = 350 len = 2048 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 106472
Dropping packet seq = 0, ack = 353 len = 2048 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 107510
write data to the target file
******** ref_peer exiting after 2 connections, as specified by -x flag ********
########## Test 1 Passed! ##########
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15-441 PROJECT 2 PEER

chunk-file:       C.chunks
has-chunk-file: B.chunks
max-conn:         4
peer-identity:  1
peer-list-file: nodes.map
  peer 2: 127.0.0.1:2222
  peer 1: 127.0.0.1:1111
Spiffy local stuff:  00000000:1111
Spiffy setup complete.  127.0.0.1:15443
Delete this line after testing.
Spiffy local stuff:  0100007f:2222
Spiffy setup complete.  127.0.0.1:15443
Delete this line after testing.
Handling user GET for (test2.chunks, test2.tar)
user requested the following 2 chunks:
id = 0, hash = 3b9f916bbf59021ab781c9f2456df90a0102079f
id = 1, hash = 78585121ee33fbb6666bc4bf1a8498c04b2758e8
creating Control packet of type 0 with 2 chunks
Peer 2 received I_HAVE with 2 hashes
id = -1, hash = 3b9f916bbf59021ab781c9f2456df90a0102079f
id = -1, hash = 78585121ee33fbb6666bc4bf1a8498c04b2758e8
id = 0, hash = 3b9f916bbf59021ab781c9f2456df90a0102079f
Peer 2 sending GET to peer 127.0.0.1 : 1111 for:
id = 0, hash = 3b9f916bbf59021ab781c9f2456df90a0102079f
Data Transfer May take a few minutes
Dropping packet seq = 1, ack = 0 len = 2048 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 114766
Dropping packet seq = 5, ack = 0 len = 2048 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 116794
Dropping packet seq = 0, ack = 4 len = 32 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 116812
Dropping packet seq = 13, ack = 0 len = 2048 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 118824
Dropping packet seq = 13, ack = 0 len = 2048 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 118861
Dropping packet seq = 0, ack = 23 len = 32 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 120902
Dropping packet seq = 0, ack = 27 len = 32 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 120929
Dropping packet seq = 0, ack = 31 len = 32 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 120955
Dropping packet seq = 0, ack = 32 len = 32 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 120970
Dropping packet seq = 43, ack = 0 len = 2048 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 120976
Dropping packet seq = 46, ack = 0 len = 2048 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 121001
Dropping packet seq = 0, ack = 42 len = 32 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 121023
Dropping packet seq = 47, ack = 0 len = 2048 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 121061
Dropping packet seq = 0, ack = 51 len = 32 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 121086
Dropping packet seq = 0, ack = 56 len = 32 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 121120
Dropping packet seq = 0, ack = 58 len = 32 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 121129
Dropping packet seq = 65, ack = 0 len = 2048 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 121141
Dropping packet seq = 67, ack = 0 len = 2048 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 121141
Dropping packet seq = 70, ack = 0 len = 2048 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 121156
Dropping packet seq = 73, ack = 0 len = 2048 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 121207
Dropping packet seq = 79, ack = 0 len = 2048 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 121271
```

```
Dropping packet seq = 459, ack = 0 len = 2048 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 149777
Dropping packet seq = 462, ack = 0 len = 2048 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 149777
Dropping packet seq = 0, ack = 461 len = 32 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 149824
Dropping packet seq = 464, ack = 0 len = 2048 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 151819
Dropping packet seq = 0, ack = 466 len = 32 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 151852
Dropping packet seq = 472, ack = 0 len = 2048 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 151853
Dropping packet seq = 0, ack = 471 len = 32 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 151882
Dropping packet seq = 472, ack = 0 len = 2048 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 151896
Dropping packet seq = 480, ack = 0 len = 2048 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 153908
Dropping packet seq = 481, ack = 0 len = 2048 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 153909
Dropping packet seq = 0, ack = 479 len = 32 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 153956
Dropping packet seq = 0, ack = 494 len = 32 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 154027
Dropping packet seq = 0, ack = 497 len = 32 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 154044
Dropping packet seq = 0, ack = 498 len = 32 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 154048
Dropping packet seq = 512, ack = 0 len = 2048 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 154077
Dropping packet seq = 0, ack = 512 len = 32 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 156131
Successfully Downloaded: id = 0, hash = 3b9f916bbf59021ab781c9f2456df90a0102079f
id = 1, hash = 78585121ee33fbb6666bc4bf1a8498c04b2758e8
Peer 2 sending GET to peer 127.0.0.1 : 1111 for:
id = 1, hash = 78585121ee33fbb6666bc4bf1a8498c04b2758e8
Data Transfer May take a few minutes
Dropping packet seq = 0, ack = 1 len = 32 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 156173
Dropping packet seq = 7, ack = 0 len = 2048 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 158198
Dropping packet seq = 0, ack = 6 len = 32 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 158207
Dropping packet seq = 0, ack = 6 len = 32 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 158224
Dropping packet seq = 14, ack = 0 len = 2048 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 160222
Dropping packet seq = 0, ack = 13 len = 32 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 160267
Dropping packet seq = 25, ack = 0 len = 2048 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 160292
Dropping packet seq = 27, ack = 0 len = 2048 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 160306
Dropping packet seq = 0, ack = 33 len = 32 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 160400
Dropping packet seq = 0, ack = 35 len = 32 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 160408
Dropping packet seq = 46, ack = 0 len = 2048 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 160447
Dropping packet seq = 48, ack = 0 len = 2048 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 160448
Dropping packet seq = 0, ack = 45 len = 32 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 160496
Dropping packet seq = 0, ack = 53 len = 32 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 160536
Dropping packet seq = 59, ack = 0 len = 2048 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 160545
Dropping packet seq = 81, ack = 0 len = 2048 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 160675
Dropping packet seq = 0, ack = 79 len = 32 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 160708
Dropping packet seq = 97, ack = 0 len = 2048 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 160754
Dropping packet seq = 0, ack = 88 len = 32 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 160772
Dropping packet seq = 101, ack = 0 len = 2048 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 160785
Dropping packet seq = 103, ack = 0 len = 2048 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 160800
Dropping packet seq = 101, ack = 0 len = 2048 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 160852
Dropping packet seq = 0, ack = 100 len = 32 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 160871
Dropping packet seq = 0, ack = 105 len = 32 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 160888
Dropping packet seq = 118, ack = 0 len = 2048 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 162925
Dropping packet seq = 303, ack = 0 len = 2048 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 178055
Dropping packet seq = 0, ack = 369 len = 32 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 178682
Dropping packet seq = 374, ack = 0 len = 2048 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 178692
Dropping packet seq = 378, ack = 0 len = 2048 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 178717
Dropping packet seq = 379, ack = 0 len = 2048 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 178748
Dropping packet seq = 0, ack = 383 len = 32 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 178784
Dropping packet seq = 387, ack = 0 len = 2048 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 180778
Dropping packet seq = 391, ack = 0 len = 2048 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 180794
Dropping packet seq = 392, ack = 0 len = 2048 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 180796
Dropping packet seq = 0, ack = 390 len = 32 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 180819
Dropping packet seq = 392, ack = 0 len = 2048 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 182825
Dropping packet seq = 396, ack = 0 len = 2048 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 182833
Dropping packet seq = 403, ack = 0 len = 2048 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 182893
Dropping packet seq = 404, ack = 0 len = 2048 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 182906
Dropping packet seq = 420, ack = 0 len = 2048 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 182992
Dropping packet seq = 423, ack = 0 len = 2048 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 183008
Dropping packet seq = 420, ack = 0 len = 2048 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 183064
Dropping packet seq = 428, ack = 0 len = 2048 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 183088
Dropping packet seq = 429, ack = 0 len = 2048 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 183095
Dropping packet seq = 432, ack = 0 len = 2048 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 183095
Dropping packet seq = 0, ack = 427 len = 32 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 183095
Dropping packet seq = 0, ack = 427 len = 32 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 183108
Dropping packet seq = 0, ack = 431 len = 32 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 183135
Dropping packet seq = 0, ack = 431 len = 32 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 183144
Dropping packet seq = 437, ack = 0 len = 2048 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 185148
Dropping packet seq = 0, ack = 436 len = 32 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 185180
Dropping packet seq = 447, ack = 0 len = 2048 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 185197
Dropping packet seq = 452, ack = 0 len = 2048 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 185233
Dropping packet seq = 467, ack = 0 len = 2048 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 185317
Dropping packet seq = 0, ack = 461 len = 32 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 185324
Dropping packet seq = 0, ack = 474 len = 32 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 185404
Dropping packet seq = 491, ack = 0 len = 2048 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 185464
Dropping packet seq = 0, ack = 483 len = 32 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 185464
Dropping packet seq = 496, ack = 0 len = 2048 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 185483
Dropping packet seq = 0, ack = 487 len = 32 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 185493
Dropping packet seq = 0, ack = 490 len = 32 (from,to) = (127.0.0.1:2222,127.0.0.1:1111) at time = 185536
Dropping packet seq = 499, ack = 0 len = 2048 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 185565
Dropping packet seq = 503, ack = 0 len = 2048 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 185581
Dropping packet seq = 504, ack = 0 len = 2048 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 185582
Dropping packet seq = 505, ack = 0 len = 2048 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 185582
Dropping packet seq = 505, ack = 0 len = 2048 (from,to) = (127.0.0.1:1111,127.0.0.1:2222) at time = 185605
Successfully Downloaded: id = 1, hash = 78585121ee33fbb6666bc4bf1a8498c04b2758e8
GOT test2.tar
********* ref_peer exiting after 2 connections, as specified by -x flag ***********
########### Test 2 Passed! ###########
done with tests
killing spiffy
shenzhengyu@shenzhengyu-VirtualBox:~/计算机网络/project/cp3$
```

并发测试

```
shenzhengyu@shenzhengyu-VirtualBox:~/计算机网络/project/concurrenttest$ ruby concurrenttest.rb
starting SPIFFY on port 15444
drop rate = 0.00

droptimes str = 60
key = 127.0.0.1:1111,127.0.0.1:2222 droptimes = 60
Listening on 15444...
starting test
Spiffy local stuff:  0100007f:1111
Spiffy setup complete.  127.0.0.1:15444
Delete this line after testing.
Spiffy local stuff:  0100007f:2222
Spiffy setup complete.  127.0.0.1:15444
Delete this line after testing.
15-441 PROJECT 2 PEER

chunk-file:      ./C.chunks
has-chunk-file: B.chunks
max-conn:        4
peer-identity:  3
peer-list-file: nodes.map
  peer 3: 127.0.0.1:3333
  peer 2: 127.0.0.1:2222
  peer 1: 127.0.0.1:1111
Spiffy local stuff:  00000000:3333
Spiffy setup complete.  127.0.0.1:15444
Delete this line after testing.
starting flow 127.0.0.1:3333,127.0.0.1:2222 at 1608358900637.78
Peer 2 received WHO_HAS with 2 hashes
id = -1, hash = 6acfce07d222d400ce900d918306c6664501b33f
id = -1, hash = af91dbd47aac60e980e0369df68271ca52de11a8
found 2 matches:
id = 0, hash = 6acfce07d222d400ce900d918306c6664501b33f
id = 1, hash = af91dbd47aac60e980e0369df68271ca52de11a8
creating Control packet of type 1 with 2 chunks
Peer 2 Sending IHAVE of size 60 to 0.0.0.0:3333
Peer 1 received WHO_HAS with 2 hashes
id = -1, hash = 6acfce07d222d400ce900d918306c6664501b33f
id = -1, hash = af91dbd47aac60e980e0369df68271ca52de11a8
found 2 matches:
id = 0, hash = 6acfce07d222d400ce900d918306c6664501b33f
id = 1, hash = af91dbd47aac60e980e0369df68271ca52de11a8
creating Control packet of type 1 with 2 chunks
Peer 1 Sending IHAVE of size 60 to 0.0.0.0:3333
Peer 2 received GET from peer 3:
id = 0, hash = 6acfce07d222d400ce900d918306c6664501b33f
```

```
id = -1, hash = 6acfce07d222d400ce900d918306c6664501b33f
id = -1, hash = af91dbd47aac60e980e0369df68271ca52de11a8
found 2 matches:
id = 0, hash = 6acfce07d222d400ce900d918306c6664501b33f
id = 1, hash = af91dbd47aac60e980e0369df68271ca52de11a8
creating Control packet of type 1 with 2 chunks
Peer 1 Sending IHAVE of size 60 to 0.0.0.0:3333
Peer 2 received GET from peer 3:
id = 0, hash = 6acfce07d222d400ce900d918306c6664501b33f
Data Transfer May take a few minutes
Peer 1 received GET from peer 3:
id = 1, hash = af91dbd47aac60e980e0369df68271ca52de11a8
Data Transfer May take a few minutes
continue GET task
******** ref_peer exiting after 1 connections, as specified by -x flag ********
write data to the target file
******** ref_peer exiting after 1 connections, as specified by -x flag ********
########## Test 1 Data is Correct ##########
killing spiffy after test1
done with test
shenzhengyu@shenzhengyu-VirtualBox:~/计算机网络/project/concurrenttest$
```