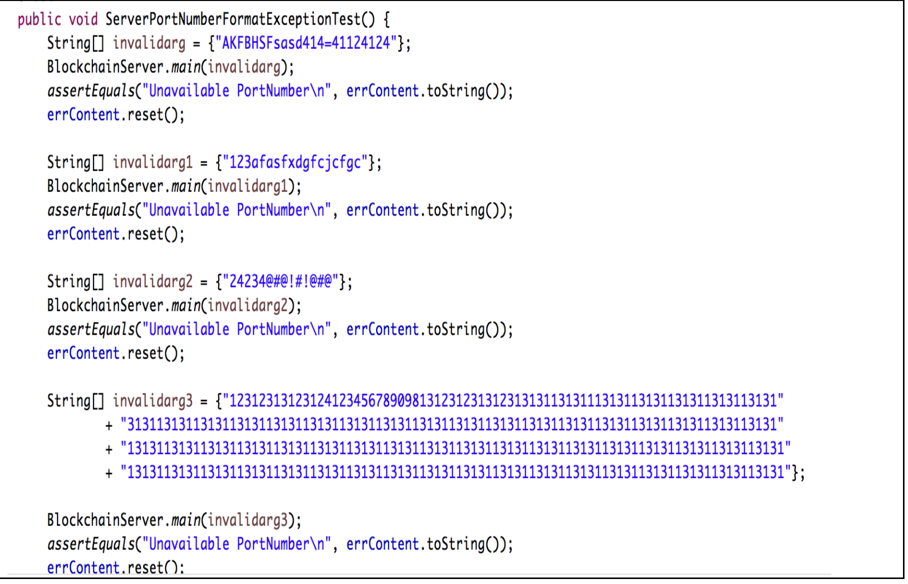
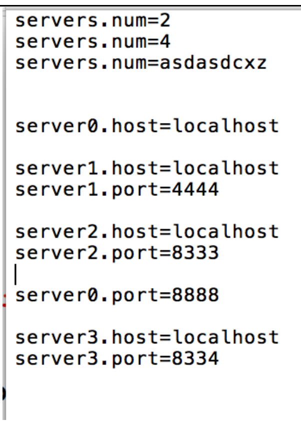
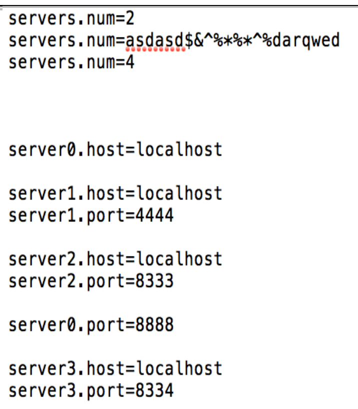
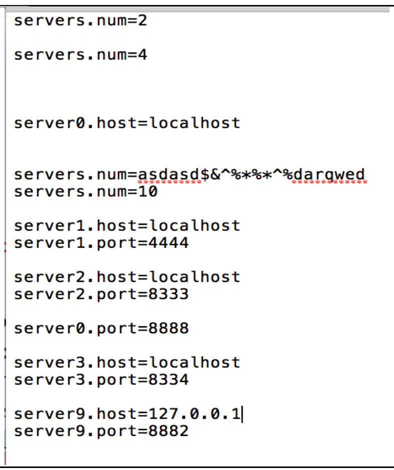
White boxing test:
Exception Type Testing

1. Number Format Exception

Server		
Inputs:	Random characters without number	
Expected output:	“Unavailable Port number” message	
Actual output:	“Unavailable Port number” message	

```java
public void ServerPortNumberFormatExceptionTest() {
    String[] invalidarg = {"AKFBHSFsasd414=41124124"};
    BlockchainServer.main(invalidarg);
    assertEquals("Unavailable PortNumber\n", errContent.toString());
    errContent.reset();

    String[] invalidarg1 = {"123afasfxdgfcjcfgc"};
    BlockchainServer.main(invalidarg1);
    assertEquals("Unavailable PortNumber\n", errContent.toString());
    errContent.reset();

    String[] invalidarg2 = {"24234@#@!#!@#@"};
    BlockchainServer.main(invalidarg2);
    assertEquals("Unavailable PortNumber\n", errContent.toString());
    errContent.reset();

    String[] invalidarg3 = {"123123131231241234567890981312312313123131311313111313113131131311313113131131311313113131"
            + "3131131311313113131131311313113131131311313113131131311313113131131311313113131"
            + "1313113131131311313113131131311313113131131311313113131131311313113131131311313113131"
            + "1313113131131311313113131131311313113131131311313113131131311313113131131311313113131"};

    BlockchainServer.main(invalidarg3);
    assertEquals("Unavailable PortNumber\n", errContent.toString());
    errContent.reset();
```

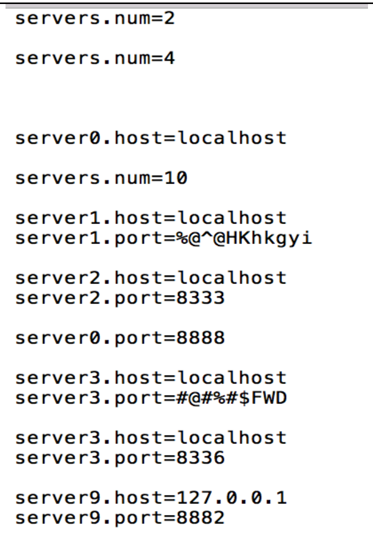
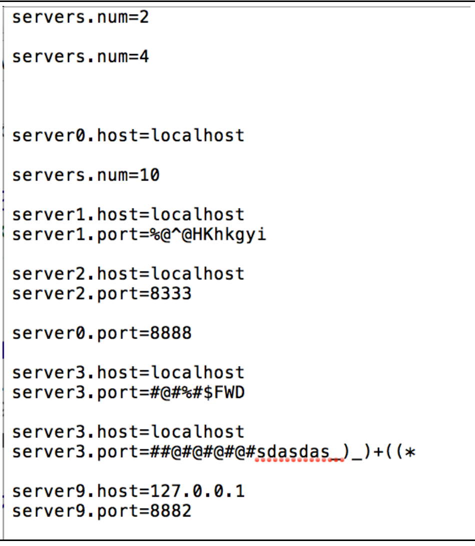
Client (servers.num)			
Config File			
Inputs:	Random characters without number as the value		
Expected Output:	Ignore the invalid value and access the largest valid value		
Actual Output:	The same as the expected output		

```
servers.num=2
servers.num=4
servers.num=asdasdcxz


server0.host=localhost

server1.host=localhost
server1.port=4444

server2.host=localhost
server2.port=8333

server0.port=8888

server3.host=localhost
server3.port=8334
```

```
servers.num=2
servers.num=asdasd$&^%*%*^%darqwed
servers.num=4


server0.host=localhost

server1.host=localhost
server1.port=4444

server2.host=localhost
server2.port=8333

server0.port=8888

server3.host=localhost
server3.port=8334
```

```
servers.num=2

servers.num=4


server0.host=localhost

servers.num=asdasd$&^%*%*^%darqwed
servers.num=10

server1.host=localhost
server1.port=4444

server2.host=localhost
server2.port=8333

server0.port=8888

server3.host=localhost
server3.port=8334

server9.host=127.0.0.1
server9.port=8882
```

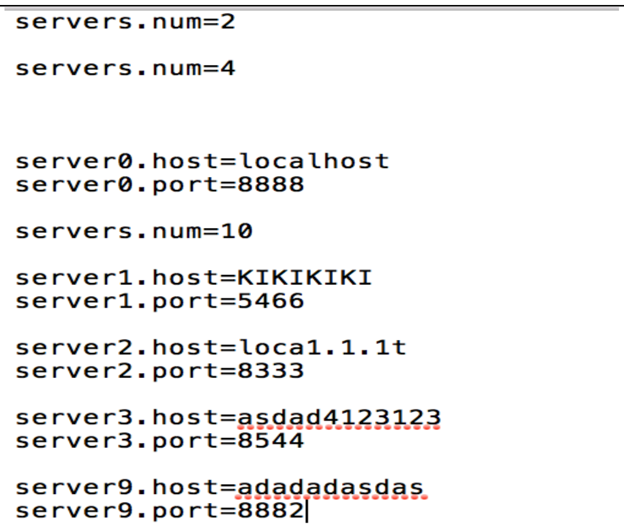
Client(server.port)	

Config File	 servers.num=2
	servers.num=4
	
	server0.host=localhost
	servers.num=10
	server1.host=localhost
	server1.port=%@^@HKhkgyi
	server2.host=localhost
	server2.port=8333
	server0.port=8888
	server3.host=localhost
	server3.port=#@#%#$FWD
	server3.host=localhost
	server3.port=8336
	server9.host=127.0.0.1
	server9.port=8882
	
	 servers.num=2
	servers.num=4
	
	server0.host=localhost
	servers.num=10
	server1.host=localhost
	server1.port=%@^@HKhkgyi
	server2.host=localhost
	server2.port=8333
	server0.port=8888
	server3.host=localhost
	server3.port=#@#%#$FWD
	server3.host=localhost
	server3.port=##@#@#@#@#sdasdas_)_)+((*
	server9.host=127.0.0.1
	server9.port=8882

Inputs:	Random characters as the port
Expected Output:	“Server <index> has an unavailable port” message
Actual Output:	“Server <index> has an unavailable port” message

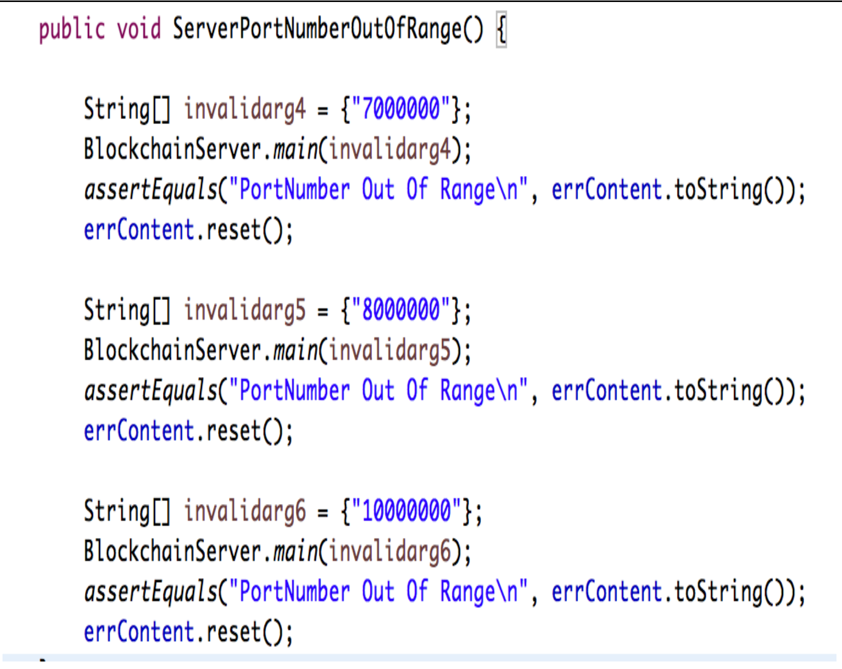
2. Unknown Host Exception

Client (server.host)	

Config. File	 `servers.num=2`
	
	`servers.num=4`
	
	`server0.host=localhost`
	`server0.port=8888`
	
	`servers.num=10`
	
	`server1.host=KIKIKIKI`
	`server1.port=5466`
	
	`server2.host=loca1.1.1t`
	`server2.port=8333`
	
	`server3.host=asdad4123123`
	`server3.port=8544`
	
	`server9.host=adadadasdas`
	`server9.port=8882`

Input:	A series of invalid format hostname.
Expected Output:	Set the invalid server as null and access the valid server
Actual Output:	The whole server information become null when keep verifying invalid hostname
Reason:	The whole data has been reset after the newest data size is set up Therefore, the output is still the expected since the invalid hostname would not be allowed to add into the server data list

3. Illegal Argument Exception

Server (port out of range)		
Input:	Exceeded range of port number	
Expected Output:	“Port Number Out of Range” message	
Actual Output:	“Port Number Out of Range” message	

```java
public void ServerPortNumberOutOfRange() {

    String[] invalidarg4 = {"7000000"};
    BlockchainServer.main(invalidarg4);
    assertEquals("PortNumber Out Of Range\n", errContent.toString());
    errContent.reset();

    String[] invalidarg5 = {"8000000"};
    BlockchainServer.main(invalidarg5);
    assertEquals("PortNumber Out Of Range\n", errContent.toString());
    errContent.reset();

    String[] invalidarg6 = {"10000000"};
    BlockchainServer.main(invalidarg6);
    assertEquals("PortNumber Out Of Range\n", errContent.toString());
    errContent.reset();
```

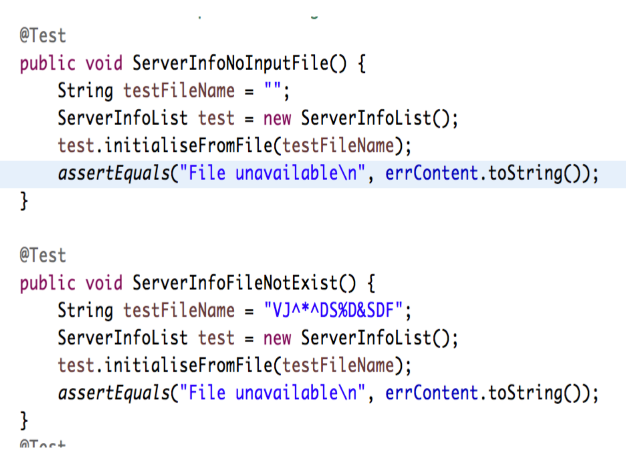
4. (Socket Time Out Exception)/ Socket Exception

Client (Communication to the server with socket) Connection + send message + receive response	
Input:	1. The connection is more than 2 seconds 2. The sending message is more than 2 seconds 3. the receiving message is more than s seconds
Expected Output:	“Server is not available” message
Actual Output:	“Server is not available” message

5. Interrupted Exception

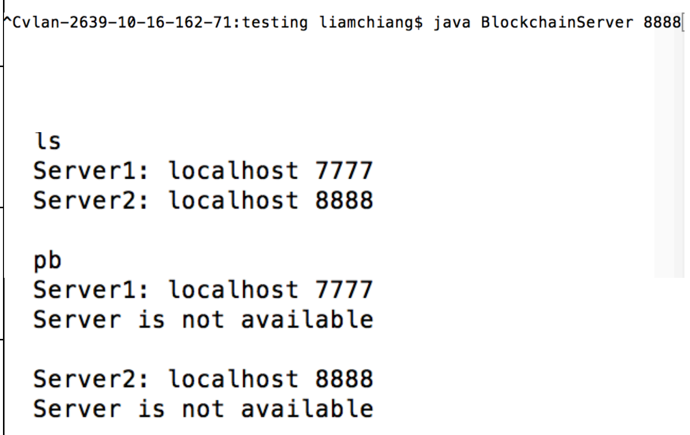
Client (cast)	
Input:	Interrupt threads by calling “thread.interrupt()”
Expected Output:	“Unavailable thread” message
Actual Output:	“Unavailable thread” message

6. FileNotFound Exception / and IOException

Client		
Inputs:	input without any config. File input Non-exist File	
Expected Output:	“file unavailable” message and then quit the client	
Actual Output:	No file inputed would be the same output as the expected, but input non-exist file would shows “file unavailable” message and continue the client	
Reason:	Since the file does not exist, the client system just initialize a new empty server information list for user to store the server data in. Therefore, the Output is totally fine since we can run the system perfectly	

```
@Test
public void ServerInfoNoInputFile() {
    String testFileName = "";
    ServerInfoList test = new ServerInfoList();
    test.initialiseFromFile(testFileName);
    assertEquals("File unavailable\n", errContent.toString());
}

@Test
public void ServerInfoFileNotExist() {
    String testFileName = "VJ^*^DS%D&SDF";
    ServerInfoList test = new ServerInfoList();
    test.initialiseFromFile(testFileName);
    assertEquals("File unavailable\n", errContent.toString());
}
```

7. Socket Refuse Connection Exception/ Socket Connection reset Exception:

Server		
Inputs:	Running the client and send request to a non available server	
Expected Output:	"Server is not available" message	
Actual Output:	"Server is not available" message	
Reason:	The Server is not listening to the socket connection since the server is not available, or the firewall blocking the socket connection	

```
^Cvlan-2639-10-16-162-71:testing liamchiang$ java BlockchainServer 8888
```

```
ls
Server1: localhost 7777
Server2: localhost 8888

pb
Server1: localhost 7777
Server is not available

Server2: localhost 8888
Server is not available
```

Grey boxing test:
Server/Client attacked by other users
Server:

Sending 10 thousand "tx" tansaction commands to attack the server system	
Inputs:	10 thousand "tx" transaction commands
Expected Output:	Server strongly handles the 10 thousand commands and still run and print out the result perfectly
Actual Output:	The same as the expected output

Sending the package, which contains 10 million random command data to attack the server	
Inputs:	The package contains 10 million random command data
Expected Output:	"Scoket Connection reset" message Attacker's client system would be forced quit
Actual Output:	The server system refuse to connect with the hacker's client and force hacker to quit the client system.

Continuously sending 10 thousand "tx" tansaction and "pb" commands to attack the server system (DOS attack)	
Inputs:	The 10 thousand "tx" transaction and "pb" commands
Expected Output:	The server would response all of the "pb" and "tx" requests and send the responses back to client immediately
Actual Output:	The server is freezing once client send 10 thousands pb and tx requests concurrently.
Reason:	In the java socket connection, the maximum queue length for incoming connection indications is set to 50. Therefore, the threads can not handle more than 50 concurrent clients. Once the connection indication arrives if the queue length is too full, the server system would refuse the connection or taking too long to produce responses for the large amount of requests.
Solutions:	There is no right solution for preventing DOS attack since there might be more than 10 million clients connect to the same server. The server would directly cause extremely slow response or just directly freezing in the worst case. The only way to prevent from DOS attack is to make server allow to handle huge amount of requests concurrently

Client:

Initializing a huge duplicated server data to attack the client	
Input:	Huge amount of duplicated server information
Expected Output:	Initialize the config. File in the normal flow
Actual Output:	The system takes longer to initialize the config. data
Reason:	The System needs to verify each of the server data line by line. Since we input a huge duplicated server information into the system, the system would take longer time to initialize the data, but it would still working in the normal flow.

The attacking config. File:

This part has been duplicated 10 times:

```
servers.num=0
servers.num=0
servers.num=0servers.num=0

servers.num=0
servers.num=1
servers.num=2


server0.host=localhost
servers.num=0

servers.num=0
servers.num=0
server1.host=localhost

servers.num=10

servers.num=012213123
server2.host=localhost

servers.num=022servers.num=0
server3.host=127.0.0.1
1
server0.host=localhost
servers.num=10

server0.host=localhost
servers.num=0

servers.num=0
servers.num=0
server1.host=localhost

servers.num=10

servers.num=012213123
server2.host=localhost

servers.num=022servers.num=0
server3.host=127.0.0.1
1
server0.host=localhost
servers.num=10



server0.host=localhost
servers.num=0

servers.num=0
servers.num=0
server1.host=localhost

servers.num=10

servers.num=012213123
```

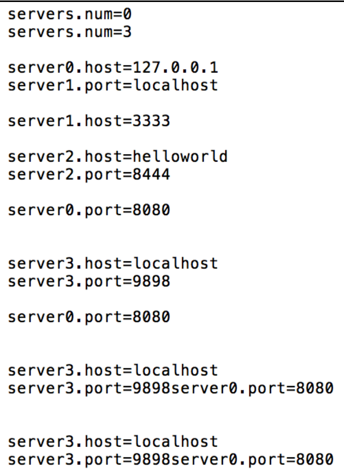
+

The last part of the data :

```
server0.host=localhost
servers.num=0

servers.num=0
servers.num=0
server1.host=localhost

servers.num=10

servers.num=012213123
server2.host=localhost

servers.num=022servers.num=0
server3.host=127.0.0.1
1
server0.host=localhost
servers.num=10

server0.host=123f12312313212
server0.port=123123123^&^@^#(@^#&@^%*@

server1.host=99999999999
server1.host=localhost
server1.port=9999

server100.host=127.0.0.1
server200.port=2333
server100.port=9000

server2.host=localhost
server2.port=4959

servers.num=2

server1.host=localhost
server1.port=7777

server3.host=localhost
server3.port=4444
```

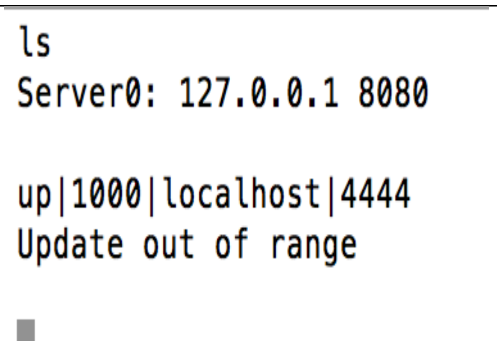
Black boxing test:
Random Users testing:

User A:

Server data verification in config. file in BlockchainClient.java		
Inputs:	1. Unknown hostname (not in any format) 2. Duplicated the server data.	
Expected Output:	1. Catch "unknownhostname" Exception and set the value as null at the server key. 2. Verify all of the data sets and successfully store the valid server information	
Actual Output:	The same as the expected output	
Reason:	Catching the exception by using InetAddress.getbyName("hostname") to check the format of ipv4, ipv6 and IP address.	duplicated more than 10 times (The config. File created by UserA)

```
servers.num=0
servers.num=3

server0.host=127.0.0.1
server1.port=localhost

server1.host=3333

server2.host=helloworld
server2.port=8444

server0.port=8080


server3.host=localhost
server3.port=9898

server0.port=8080


server3.host=localhost
server3.port=9898server0.port=8080


server3.host=localhost
server3.port=9898server0.port=8080
```

User B:

Update the server value at the key which is out of the range of the server list. (In the BlockchainClient.java)		
Inputs:	Update the server data at the key which is out of range of the server list Example: list.size() = 3, but do "up|10|localhost|5444"	 (The command is tested by User B)
Expected Output:	Ignore the requested update value and shows "update out of range" message	
Actual Output:	The same as the expected output	
Reason:	Since the server data set list's size has been limited, the system would catch "Index out of Bound" exception once add the value at the out-of-range index	

```
ls
Server0: 127.0.0.1 8080

up|1000|localhost|4444
Update out of range

█
```