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	

```
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 = {"123123131231241234567890981312312313123131311313111313113131131313113131131"
            + "313113131131131131131131131131131131131131131131131131131131131131131131131131131131131131131131"
            + "131311313113131131131131131131131131131131131131131131131131131131131131131131131131131131131131"
            + "131311313113131131131131131131131131131131131131131131131131131131131131131131131131131131131131"};

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

Client (servers.num)		
Config File	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	
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	

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	

```
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

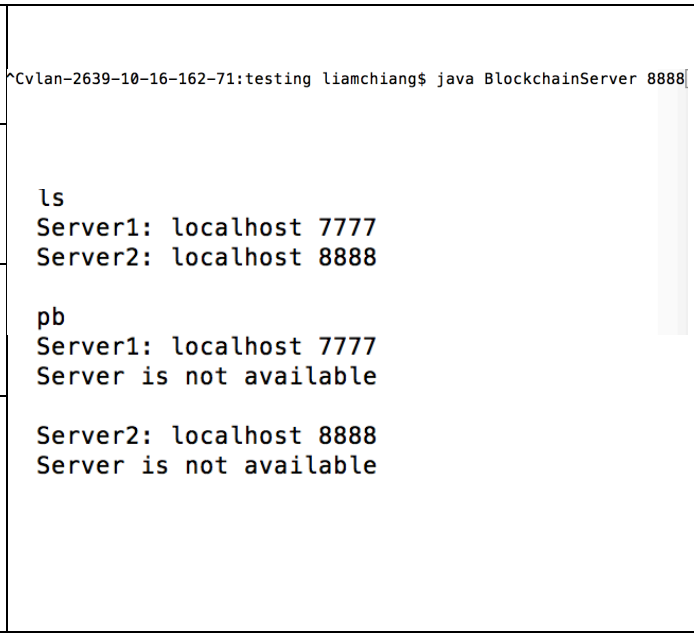
6. FileNotFound Exception / and IOException

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	

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
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.

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: The last part of the data :

```
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
```

+

```
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
```