SUNWAY

INT'L BUSINESS SCHOOL

Programme Name: **BCS HONS**

Course Code: **CSC 2624**

Course Name: **Distributed And Parallel Computing**

Assignment / Lab Sheet / Project / Case Study No. **2**

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1. **Develop a java RMI Client and server program to compute the power of a number such that the client will call the RemoteCalcObject.computerPower(num) object method to compute the power of number and print the result in the screen.**

Answer: As we know, we need 2 folders (client and server) to run the above program. In given folder it will have its own files which will help them to connect with each other. Folder client will have 3 files named as Client.java, Number.java and RemoteCalcObject.java whereas Folder server will have Server.java, Number.java and NumberImpl.java. Therefore, Code for above program is given below:

Folder Client

Client.java

```
import java.rmi.*;
import java.rmi.registry.*;

public class Client {
    public static void main(String[] args) throws RemoteException, NotBoundExcept
ion {
     try {
        Registry remoteRegistry = LocateRegistry.getRegistry("127.0.0.1", 9300);
         Number numm = (Number) remoteRegistry.lookup("number");
         RemoteCalcObject remoteCalcObject = new RemoteCalcObject();
         double finalnum = remoteCalcObject.computerPower(numm.getNum());
          System.out.println("The power of " + numm.getNum() + " by 2 is " + fina
lnum);
        } catch (Exception e) {
            System.out.println("Clinet error occoured " + e.toString());
        }

    }
}
```

Number.java

```
import java.rmi.*;

public interface Number extends Remote {
    public double getNum() throws RemoteException;
}
```

RemoteCalcObject.java

```java
import java.lang.Math;

class RemoteCalcObject {
    RemoteCalcObject() {

    }

    public double computerPower(double num) {
        return Math.pow(num, 2);
    }
}
```

Folder Server

Server.java

```java
import java.rmi.server.UnicastRemoteObject;
import java.rmi.registry.LocateRegistry;
import java.rmi.registry.Registry;

public class Server {
    public static void main(String[] args) {
        try {
            NumberImpl n1 = new NumberImpl(4);
            Number stub1 = (Number) UnicastRemoteObject.exportObject(n1, 0);
            Registry registry = LocateRegistry.getRegistry("127.0.0.1", 9300);
            registry.bind("number", stub1);
        } catch (Exception e) {
            System.out.println("Error :" + e);
        }

    }
}
```

Number.java

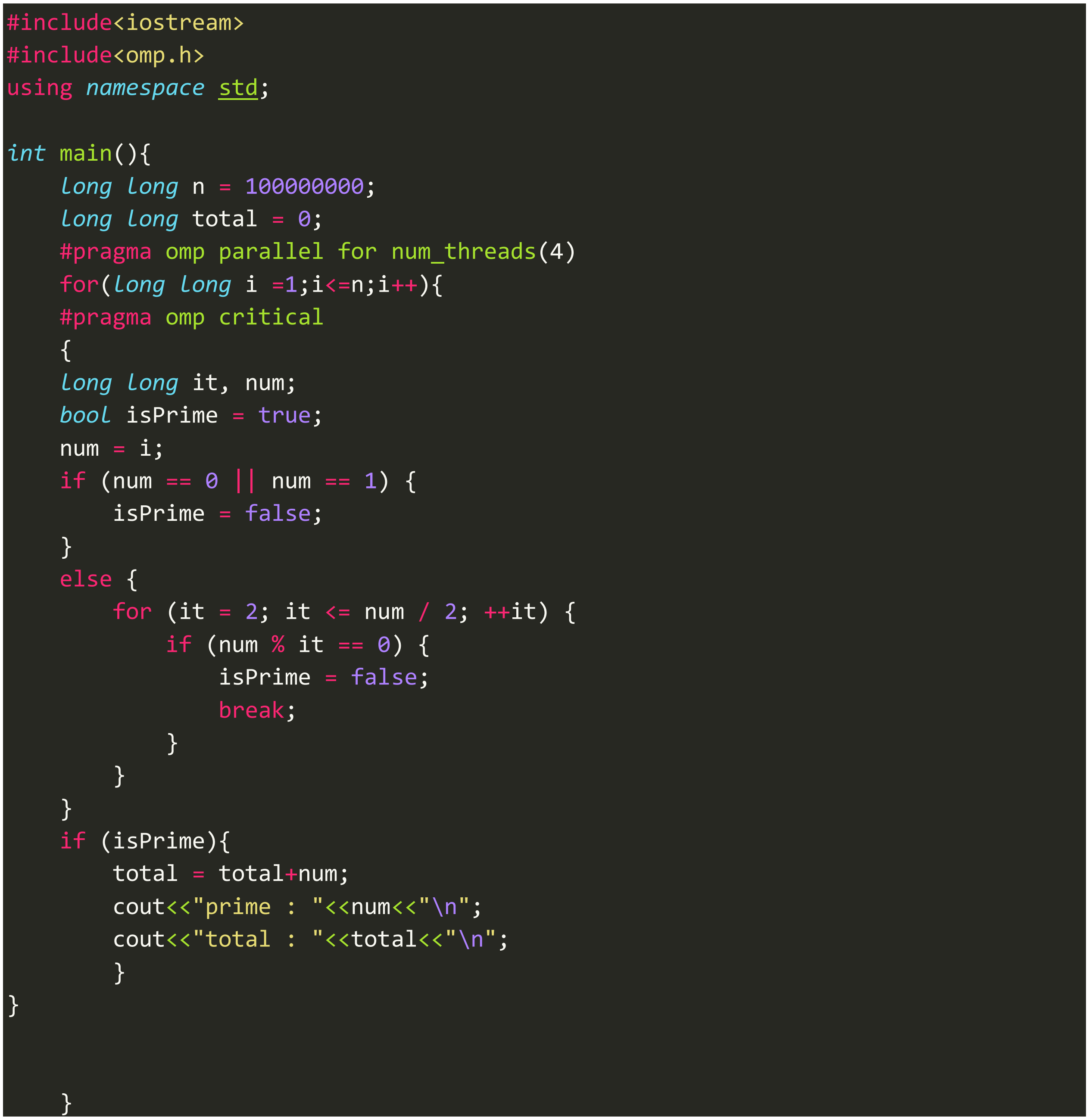
```java
import java.rmi.*;

public interface Number extends Remote {
    public double getNum() throws RemoteException;
}
```

NumberImpl.java

```java
import java.rmi.*;
import java.rmi.server.*;

public class NumberImpl implements Number{

    double numm;

    NumberImpl(double newnumm) throws RemoteException{
        this.numm = newnumm;
    }
    public double getNum() throws RemoteException{
        return this.numm;
    }
}
```

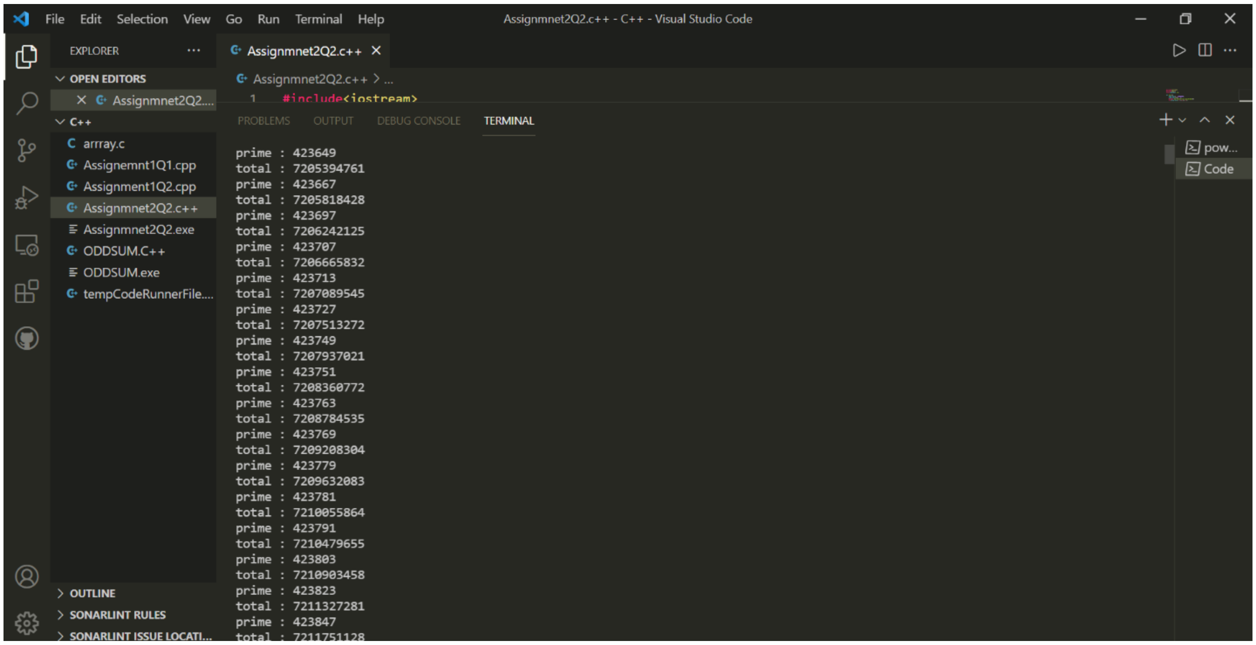
2. **Write an OpenMP C++ program to implement FOUR (4) parallel section clause by setting the number of threads to 4 and compute the sum of prime numbers up to (100 billion) using 4 threads.**

Answer: An OpenMP C++ program to implement FOUR (4) parallel section clause by setting the number of threads to 4 and compute the sum of prime numbers up to (100 billion) using 4 threads is given below:



```
#include<iostream>
#include<omp.h>
using namespace std;

int main(){
    long long n = 100000000;
    long long total = 0;
    #pragma omp parallel for num_threads(4)
    for(long long i =1;i<=n;i++){
    #pragma omp critical
    {
    long long it, num;
    bool isPrime = true;
    num = i;
    if (num == 0 || num == 1) {
        isPrime = false;
    }
    else {
        for (it = 2; it <= num / 2; ++it) {
            if (num % it == 0) {
                isPrime = false;
                break;
            }
        }
    }
    if (isPrime){
        total = total+num;
        cout<<"prime : "<<num<<"\n";
        cout<<"total : "<<total<<"\n";
        }
}


    }
cout<<"Total sum of prime number up to "<<n<<" is "<<total<<"\n";


    return EXIT_SUCCESS;
}
```

It may take a lot of time to compute the sum of prime numbers up to (100 billion) using 4 threads, so here is the output of the process:



```
#include<iostream>
```

```
prime : 423649
total : 7205394761
prime : 423667
total : 7205818428
prime : 423697
total : 7206242125
prime : 423707
total : 7206665832
prime : 423713
total : 7207089545
prime : 423727
total : 7207513272
prime : 423749
total : 7207937021
prime : 423751
total : 7208360772
prime : 423763
total : 7208784535
prime : 423769
total : 7209208304
prime : 423779
total : 7209632083
prime : 423781
total : 7210055864
prime : 423791
total : 7210479655
prime : 423803
total : 7210903458
prime : 423823
total : 7211327281
prime : 423847
total : 7211751128
```

3. **Develop a multi-threaded web server that receive the file name from the client such that serverinfo.txt and return the file that resides in server to the client. Client will parse the file content and display it on the screen.**

Answer:

We are developing a multi-threaded web server that receive the file name from the client such that serverinfo.txt and return the file that resides in server to the client.

Client-Side Program: A client can communicate with a server using this code. This involves
Establish a Socket Connection
Communication

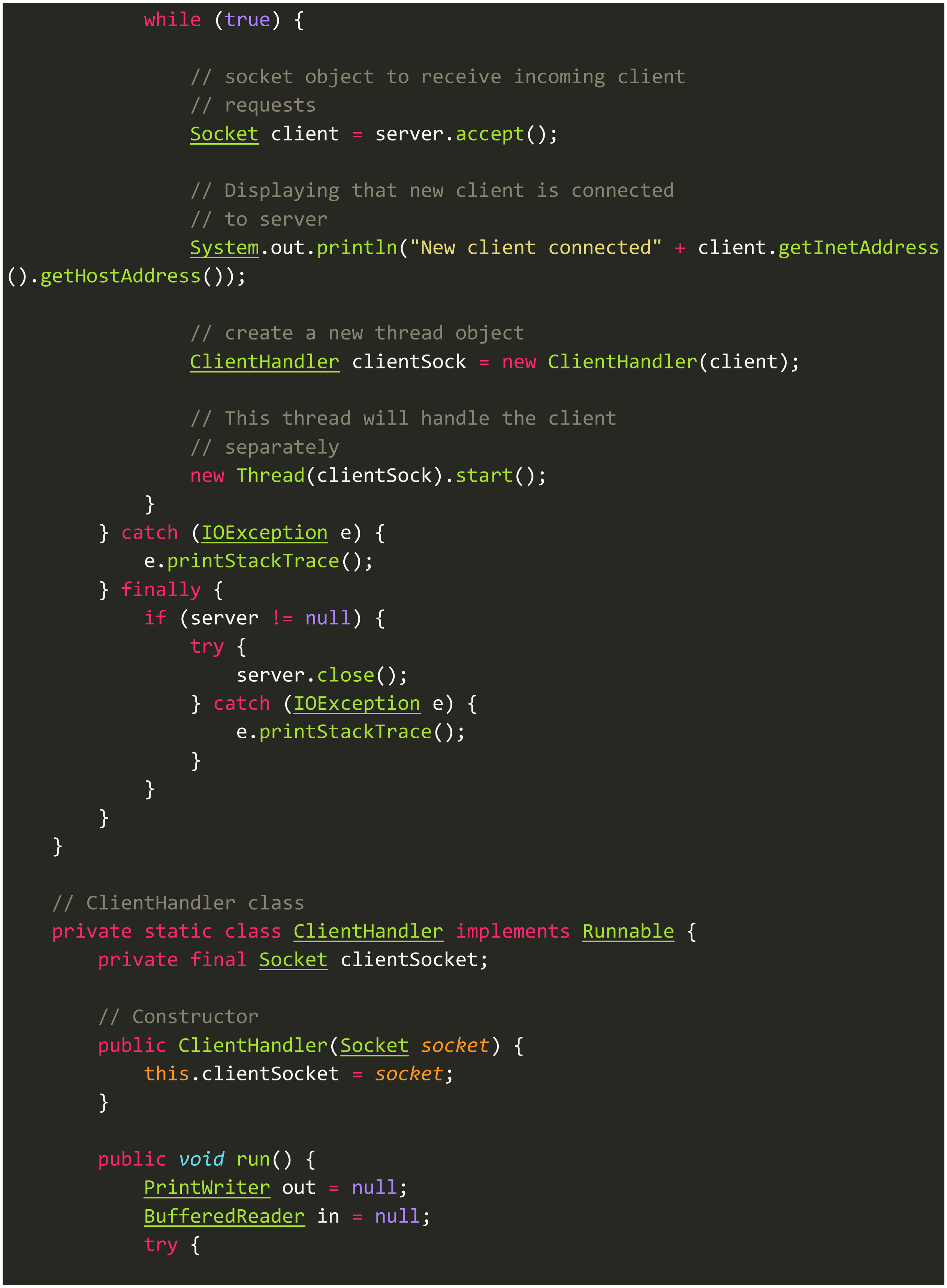
```
import java.io.*;
import java.net.*;
import java.util.*;

// Client class
class Client {

    // driver code
    public static void main(String[] args) {
        // establish a connection by providing host and port
        // number
        try (Socket socket = new Socket("localhost", 1234)) {

            // writing to server
            PrintWriter out = new PrintWriter(socket.getOutputStream(), true);

            // reading from server
            BufferedReader in = new BufferedReader(new InputStreamReader(socket.getInputStream()));

            // object of scanner class
            Scanner sc = new Scanner(System.in);
            String line = null;

            while (!"exit".equalsIgnoreCase(line)) {

                // reading from user
                line = sc.nextLine();

                // sending the user input to server
                out.println(line);
                out.flush();
                // displaying server reply
                System.out.println("Server replied " + in.readLine());
            }

            // closing the scanner object
            sc.close();
        } catch (IOException e) {
            e.printStackTrace();
        }
    }
}
```

Server-Side Program: When a new client is connected, and he sends the message to the server.
Server class: The steps involved on the server side are similar to the article Socket Programming in Java with a slight change to create the thread object after obtaining the streams and port number.

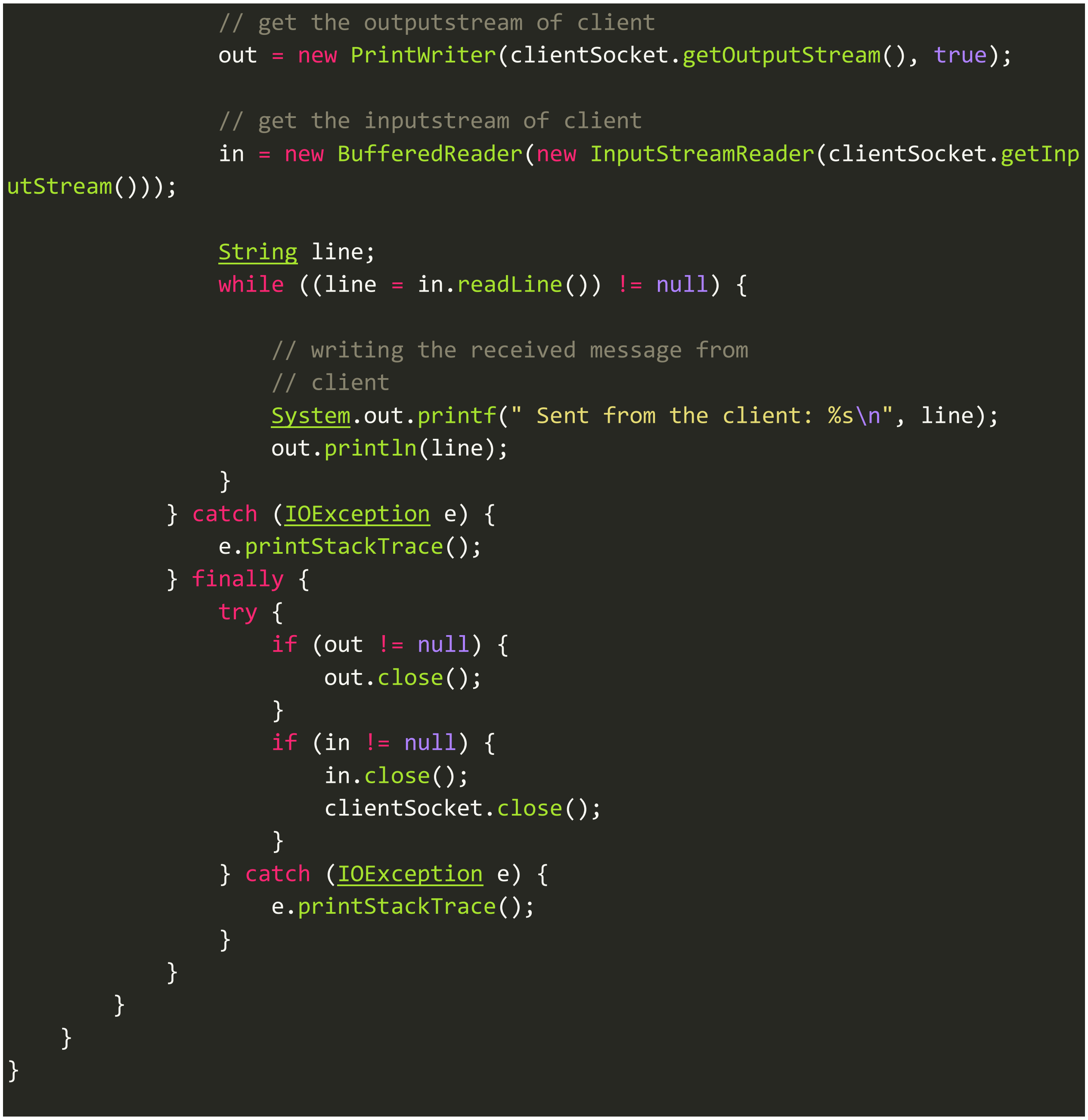
- Establishing the Connection: Server socket object is initialized and inside a while loop a socket object continuously accepts an incoming connection.
- Obtaining the Streams: The inputstream object and outputstream object is extracted from the current requests' socket object.
- Creating a handler object: After obtaining the streams and port number, a new clientHandler object (the above class) is created with these parameters.
- Invoking the start() method: The start() method is invoked on this newly created thread object.

Code:

```
import java.io.*;
import java.net.*;

// Server class
class Server {
    public static void main(String[] args) {
        ServerSocket server = null;

        try {

            // server is listening on port 1234
            server = new ServerSocket(1234);
            server.setReuseAddress(true);

            // running infinite loop for getting
            // client request
```



```
            while (true) {

                // socket object to receive incoming client
                // requests
                Socket client = server.accept();

                // Displaying that new client is connected
                // to server
                System.out.println("New client connected" + client.getInetAddress
().getHostAddress());

                // create a new thread object
                ClientHandler clientSock = new ClientHandler(client);

                // This thread will handle the client
                // separately
                new Thread(clientSock).start();
            }
        } catch (IOException e) {
            e.printStackTrace();
        } finally {
            if (server != null) {
                try {
                    server.close();
                } catch (IOException e) {
                    e.printStackTrace();
                }
            }
        }
    }

    // ClientHandler class
    private static class ClientHandler implements Runnable {
        private final Socket clientSocket;

        // Constructor
        public ClientHandler(Socket socket) {
            this.clientSocket = socket;
        }

        public void run() {
            PrintWriter out = null;
            BufferedReader in = null;
            try {
```



```
                // get the outputstream of client
                out = new PrintWriter(clientSocket.getOutputStream(), true);

                // get the inputstream of client
                in = new BufferedReader(new InputStreamReader(clientSocket.getInp
utStream()));

                String line;
                while ((line = in.readLine()) != null) {

                    // writing the received message from
                    // client
                    System.out.printf(" Sent from the client: %s\n", line);
                    out.println(line);
                }
            } catch (IOException e) {
                e.printStackTrace();
            } finally {
                try {
                    if (out != null) {
                        out.close();
                    }
                    if (in != null) {
                        in.close();
                        clientSocket.close();
                    }
                } catch (IOException e) {
                    e.printStackTrace();
                }
            }
        }
    }
}
```