Chapter 2: InetAddress

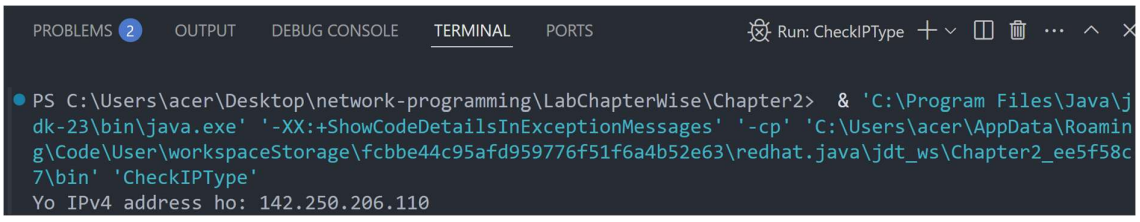
Lab 1

Objective: To check whether address is IPv4 or IPv6.

Source Code:

```
import java.net.*;


public class CheckIPType {
   public static void main(String[] args) {
      try {
        // InetAddress object banaune (example: google.com ko lagi)
         InetAddress address = InetAddress.getByName("google.com");


        // Address ko type check garne
         if (address instanceof Inet4Address) {
            System.out.println("Yo IPv4 address ho: " + address.getHostAddress());
         } else if (address instanceof Inet6Address) {
            System.out.println("Yo IPv6 address ho: " + address.getHostAddress());
         } else {
            System.out.println("Unknown address type: " + address.getHostAddress());
         }
      } catch (Exception e) {
         System.out.println("Error aayo: " + e.getMessage());
      }
   }
}
```

Output:



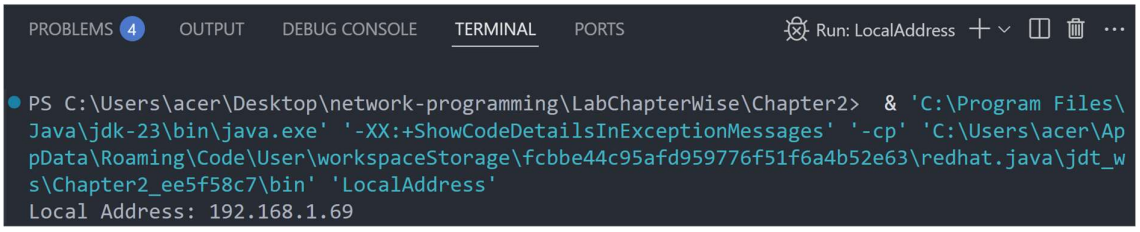
Lab 2

Objective: To find the address of local machine.

Source Code:

```
import java.net.*;


public class LocalAddress {
   public static void main(String[] args) {
      try {
        // Local machine ko address lina
         InetAddress local = InetAddress.getLocalHost();
         System.out.println("Local Address: " + local.getHostAddress());
      } catch (Exception e) {
         System.out.println("Error aayo: " + e.getMessage());
      }
   }
}
```

Output:



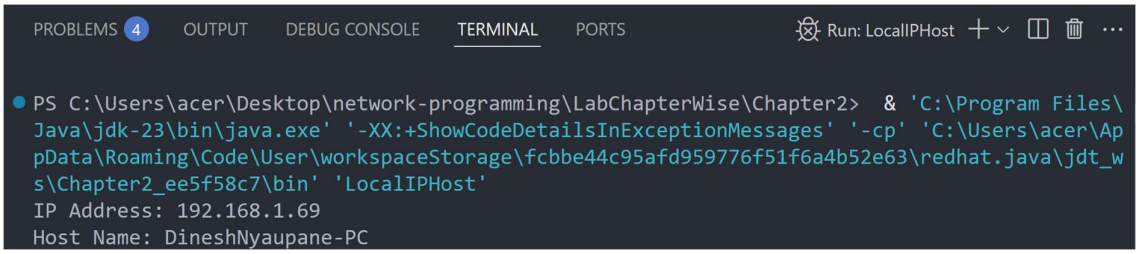
Lab 3

Objective: To find the IP Address and host name of local machine.

Source Code:

```
import java.net.*;


public class LocalIPHost {
   public static void main(String[] args) {
      try {
        // Local machine ko IP ra Hostname print garne
         InetAddress local = InetAddress.getLocalHost();
         System.out.println("IP Address: " + local.getHostAddress());
         System.out.println("Host Name: " + local.getHostName());
      } catch (Exception e) {
         System.out.println("Error aayo: " + e.getMessage());
      }
   }
}
```

Output:



Lab 4

Objective: To demonstrate the SpamCheck.

Source Code:

```
import java.net.*;


public class SpamCheck {
   public static void main(String[] args) {
      try {
        // Domain name ko address khojne
         InetAddress address = InetAddress.getByName("www.google.com");


        // Hostname spam chaina bhane reply garne
         if (!address.isAnyLocalAddress()) {
            System.out.println("Yo spam address huna sakcha!");
         } else {
            System.out.println("Yo safe address ho.");
         }
      } catch (Exception e) {
         System.out.println("Error aayo: " + e.getMessage());
      }
   }
}
```

Output:

Lab 5

Objective: To compare the domain names "*www.ibiblio.org*" and "*helios.ibiblio.org*".

Source Code:

```
import java.net.*;
public class CompareDomain {
   public static void main(String[] args) {
      try {
        // Duita domain ko IP address khojne
         InetAddress addr1 = InetAddress.getByName("www.ibiblio.org");
         InetAddress addr2 = InetAddress.getByName("helios.ibiblio.org");
        // Address compare garne
         if (addr1.equals(addr2)) {
            System.out.println("Domain haru same address ma point garcha.");
         } else {
            System.out.println("Domain haru different address ma chha.");
         }
      } catch (Exception e) {
         System.out.println("Error aayo: " + e.getMessage());
      }
   }
}
```

Output:

```
PROBLEMS 6   OUTPUT   DEBUG CONSOLE   TERMINAL   PORTS   Run: CompareDomain

PS C:\Users\acer\Desktop\network-programming\LabChapterWise\Chapter2>  & 'C:\Program Files\
Java\jdk-23\bin\java.exe' '-XX:+ShowCodeDetailsInExceptionMessages' '-cp' 'C:\Users\acer\Ap
pData\Roaming\Code\User\workspaceStorage\fcbbe44c95afd959776f51f6a4b52e63\redhat.java\jdt_w
s\Chapter2_ee5f58c7\bin' 'CompareDomain'
Error aayo: No such host is known (helios.ibiblio.org)
```

If we check www.google.com and www.youtube.com :

```
r\Desktop\network-programming\LabChapterWise\Chapter2'; & 'C:\Program Files\Java\jdk-23\bin
\java.exe' '-XX:+ShowCodeDetailsInExceptionMessages' '-cp' 'C:\Users\acer\AppData\Roaming\C
ode\User\workspaceStorage\fcbbe44c95afd959776f51f6a4b52e63\redhat.java\jdt_ws\Chapter2_ee5f
58c7\bin' 'CompareDomain'
Domain haru different address ma chha.
```

Chapter 3: URLs and URIs

Lab 6

Objective: To write a program that splits the parts of a URL [Splitting URL into pieces information]

Source Code:

```
import java.net.URL;


public class SplitURL {
   public static void main(String[] args) {
      try {
         URL url = new
         URL("https://www.example.com:8080/path/to/resource?query=nepal#section");
         System.out.println("Protocol: " + url.getProtocol());
         System.out.println("Host: " + url.getHost());
         System.out.println("Port: " + url.getPort());
         System.out.println("Path: " + url.getPath());
         System.out.println("Query: " + url.getQuery());
         System.out.println("Reference: " + url.getRef());
      } catch (Exception e) {
         System.out.println("URL ko parts split garna error: " + e);
      }
   }
}
```

Output:

Lab 7

Objective: To write a program that checks the which protocols does a virtual machine support or not?

Source Code:

```
import java.net.URLConnection;

import java.util.Arrays;

import java.util.List;


public class CheckProtocols {

   public static void main(String[] args) {

      List<String> protocols = Arrays.asList("http", "https", "ftp", "file", "mailto");


      for (String protocol : protocols) {

         try {

            URLConnection connection = new java.net.URL(protocol +
"://test.com").openConnection();

            System.out.println(protocol + " is supported.");

         } catch (Exception e) {

            System.out.println(protocol + " is NOT supported.");

         }

      }

   }

}
```

Output:

Lab 8

Objective: To write a program to download a web page of a given web address.

Source Code:

```
import java.io.BufferedReader;
import java.io.InputStreamReader;
import java.net.URL;
public class DownloadWebPage {
   public static void main(String[] args) {
      try {
         URL url = new URL("https://example.com");
         BufferedReader reader = new BufferedReader(new
InputStreamReader(url.openStream()));
         String line;
         while ((line = reader.readLine()) != null) {
            System.out.println(line);
         }
         reader.close();
      } catch (Exception e) {
         System.out.println("Webpage download garna error: " + e);
      } } }
```

Output:

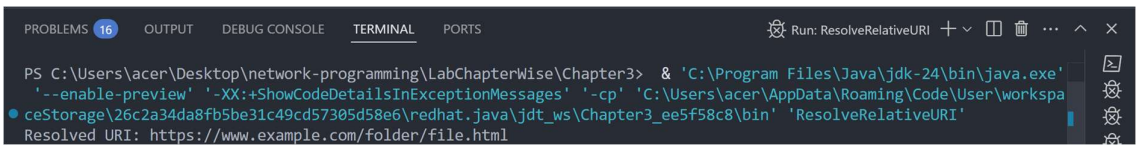
Lab 9

Objective: To write a program for resolving relatives URI

Source Code:

```
import java.net.URI;


public class ResolveRelativeURI {
   public static void main(String[] args) {
      try {
         URI base = new URI("https://www.example.com/folder/");
         URI relative = new URI("file.html");
         URI resolved = base.resolve(relative);


         System.out.println("Resolved URI: " + resolved.toString());
      } catch (Exception e) {
         System.out.println("Relative URI resolve garna error: " + e);
      }
   }
}
```

Output:



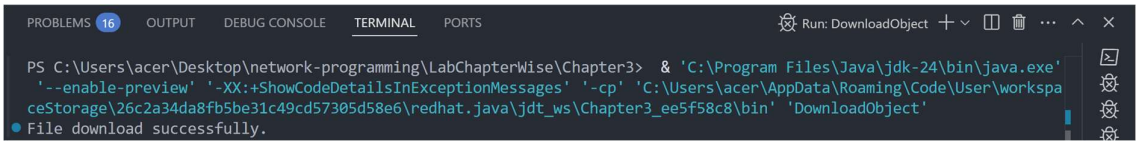
Lab 10

Objective: To write a program to download an object.

Source Code:

```
import java.io.FileOutputStream;
import java.io.InputStream;
import java.net.URL;

public class DownloadObject {
   public static void main(String[] args) {
      try {
         URL url = new URL("https://www.example.com");
         InputStream input = url.openStream();
         FileOutputStream output = new FileOutputStream("downloaded_sample.pdf");

         byte[] buffer = new byte[2048];
         int bytesRead;

         while ((bytesRead = input.read(buffer)) != -1) {
            output.write(buffer, 0, bytesRead);
         }

         input.close();
         output.close();
         System.out.println("File download successfully.");
      } catch (Exception e) {
         System.out.println("File download garna error: " + e);
      }
   }
}
```

Output:



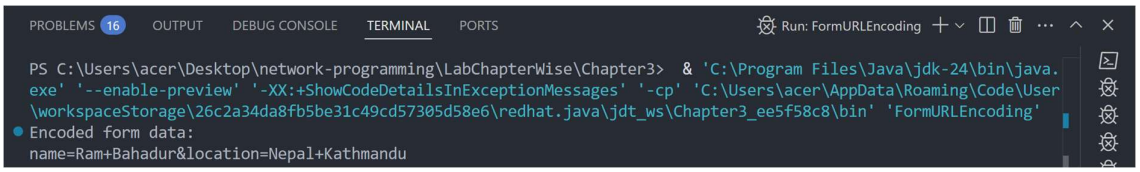
Lab 11

Objective: To write a program to demonstrate the x-www-form-URL encoded strings.

Source Code:

```
import java.net.URLEncoder;
import java.nio.charset.StandardCharsets;

public class FormURLEncoding {
    public static void main(String[] args) {
        try {
            String name = "Ram Bahadur";
            String location = "Nepal Kathmandu";

            String encodedName = URLEncoder.encode(name, StandardCharsets.UTF_8);
            String encodedLocation = URLEncoder.encode(location, StandardCharsets.UTF_8);

            System.out.println("Encoded form data:");
            System.out.println("name=" + encodedName + "&location=" + encodedLocation);
        } catch (Exception e) {
            System.out.println("Form URL encoding garna error: " + e);
        }
    }
}
```

Output:



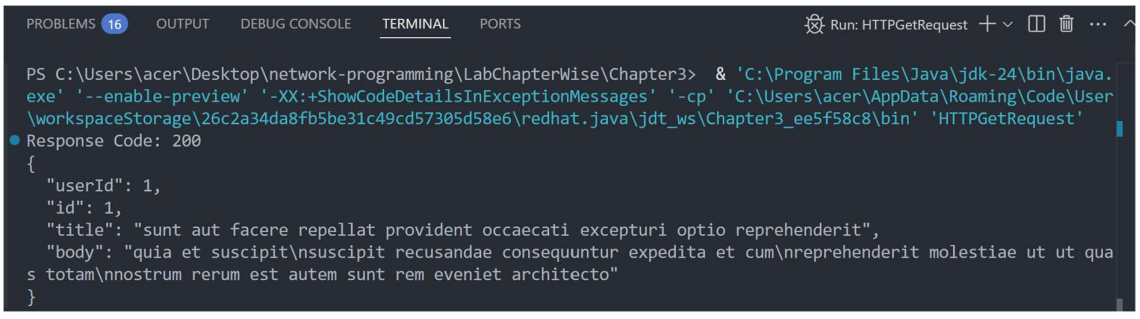
Lab 12

Objective: To write a program that communicating with Server-Side Programs Through GET.

Source Code:

```
import java.io.BufferedReader;
import java.io.InputStreamReader;
import java.net.HttpURLConnection;
import java.net.URL;

public class HTTPGetRequest {
   public static void main(String[] args) {
      try {
         URL url = new URL("https://jsonplaceholder.typicode.com/posts/1");
         HttpURLConnection conn = (HttpURLConnection) url.openConnection();

         conn.setRequestMethod("GET");
         int responseCode = conn.getResponseCode();

         System.out.println("Response Code: " + responseCode);

         BufferedReader reader = new BufferedReader(new
InputStreamReader(conn.getInputStream()));
         String line;

         while ((line = reader.readLine()) != null) {
            System.out.println(line);
         }

         reader.close();
      } catch (Exception e) {
         System.out.println("Server sanga GET communication garna error: " + e);
      }
   }
}
```

Output:



Chapter 4: HTTP

Lab 13

Objective: To write a program that shows a simple CookiePolicy that blocks cookies from .gov domains, but allows others.

Source Code:

```
import java.net.*;

public class CookiePolicyExample {
   public static void main(String[] args) throws Exception {
      CookiePolicy policy = new CookiePolicy() {
         @Override
         public boolean shouldAccept(URI uri, HttpCookie cookie) {
            String host = uri.getHost();
            return !host.endsWith(".gov.np");
         }
      };

      CookieManager manager = new CookieManager();
      manager.setCookiePolicy(policy);
      CookieHandler.setDefault(manager);

      URI govUri = new URI("http://mofaga.gov.np"); // blocked
      URI eduUri = new URI("http://nepathya.edu.np"); // allowed

      HttpCookie govCookie = new HttpCookie("session", "gov_cookie");
      HttpCookie eduCookie = new HttpCookie("session", "edu_cookie");

      boolean isGovAccepted = policy.shouldAccept(govUri, govCookie);
      boolean isEduAccepted = policy.shouldAccept(eduUri, eduCookie);

      System.out.println("mofaga.gov.np cookie accepted? " + isGovAccepted);
      System.out.println("nepathya.edu.np cookie accepted? " + isEduAccepted);
   }
}
```

Output:

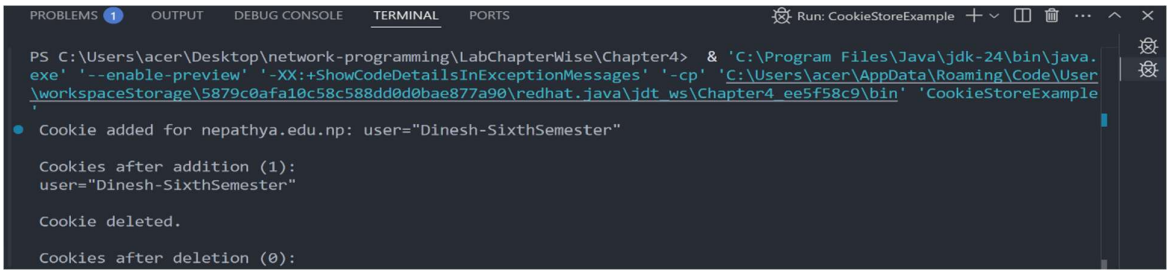
Lab 14

Objective: To implement the CookieStore Methods (add, read, delete) cookies.

Source Code:

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

public class CookieStoreExample {
   public static void main(String[] args) throws Exception {
      CookieManager manager = new CookieManager();
      CookieHandler.setDefault(manager);
      CookieStore store = manager.getCookieStore();

      URI nepUri = new URI("http://nepathya.edu.np");

      // Add a cookie
      HttpCookie cookie = new HttpCookie("user", "Dinesh-SixthSemester");
      store.add(nepUri, cookie);

      System.out.println(" Cookie added for nepathya.edu.np: " + cookie);
      System.out.println("\n Cookies after addition (" + store.getCookies().size() + "):");
      for (HttpCookie c : store.getCookies()) {
         System.out.println(" " + c);
      }

      // Delete cookie
      store.remove(nepUri, cookie);
      System.out.println("\n Cookie deleted.");

      // Verify deletion
      List<HttpCookie> cookies = store.getCookies();
      System.out.println("\n Cookies after deletion (" + cookies.size() + "):");
      for (HttpCookie c : cookies) {
         System.out.println("➞ " + c);
      }
   }
}
```

Output:



Chapter 5: URL Connections

Lab 15

Objective: To write a program to download a web page using URLConnection.

Source Code:

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

public class DOwnloadWebPage {
   public static void main(String[] args) {
      String website = "http://nepathyacollege.edu.np";

      try {
         URL url = new URL(website);
         URLConnection connection = url.openConnection();

         BufferedReader reader = new BufferedReader(
               new InputStreamReader(connection.getInputStream()));
         BufferedWriter writer = new BufferedWriter(
               new FileWriter("DownloadedPage.html"));

         String line;
         while ((line = reader.readLine()) != null) {
            writer.write(line);
            writer.newLine();
         }

         reader.close();
         writer.close();

         System.out.println("Web page downloaded successfully as 'DownloadedPage.html'");
} catch (Exception e) {
         System.out.println("Error: " + e.getMessage());
      }
   }
}
```

Output:

Lab 16

Objective: To write a program to read value of HTTP Header fields.

Source Code:

```
import java.net.*;


public class ReadHTTPHeaderFields {
    public static void main(String[] args) {
        try {
            URL url = new URL("http://nepathyacollege.edu.np");
            URLConnection connection = url.openConnection();


            String contentType = connection.getHeaderField("Content-Type");
            String server = connection.getHeaderField("Server");


            System.out.println("Content-Type: " + contentType);
            System.out.println("Server: " + server);
        } catch (Exception e) {
            System.out.println("Error: " + e.getMessage());
        }
    }
}
```

Output:

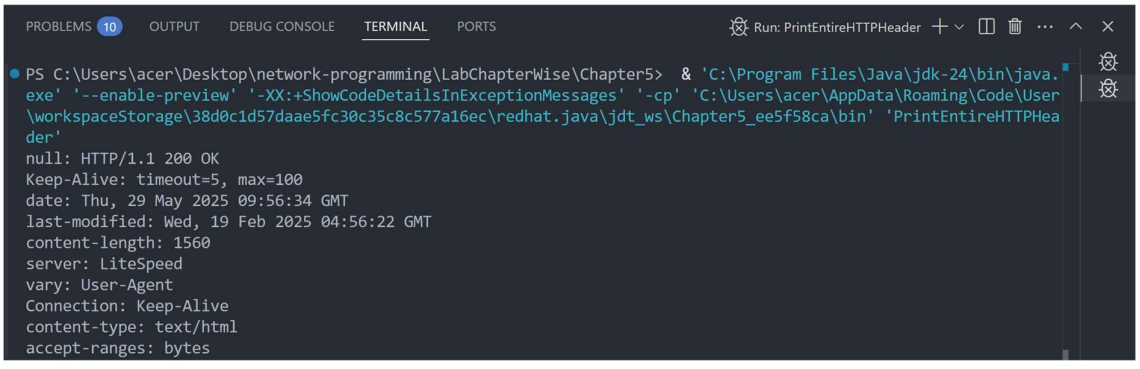
Lab 17

Objective: To write a program to print the entire HTTP header

Source Code:

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

public class PrintEntireHTTPHeader {
   public static void main(String[] args) {
      try {
         URL url = new URL("http://nepathyacollege.edu.np");
         URLConnection connection = url.openConnection();

         Map<String, List<String>> headers = connection.getHeaderFields();

         for (Map.Entry<String, List<String>> entry : headers.entrySet()) {
            String key = entry.getKey();
            List<String> values = entry.getValue();
            System.out.println(key + ": " + String.join(", ", values));
         }
      } catch (Exception e) {
         System.out.println("Error: " + e.getMessage());
      }
   }
}
```

Output:



Lab 18

Objective: To write a program for HTTP Request Method.

Source Code:

```
import java.net.*;


public class HTTPRequestMethod {
   public static void main(String[] args) {
      try {
         URL url = new URL("http://nepathyacollege.edu.np");
         HttpURLConnection connection = (HttpURLConnection) url.openConnection();


         connection.setRequestMethod("GET");  // You can try "POST", "HEAD" etc.


         System.out.println("HTTP Request Method: " + connection.getRequestMethod());
      } catch (Exception e) {
         System.out.println("Error: " + e.getMessage());
      }
   }
}
```

Output:

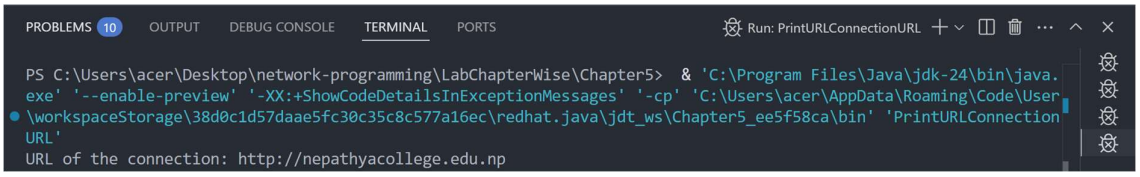
Lab 19

Objective: To write a program to print the URL of a URL Connection to "nepathyacollege.edu.np"

Source Code:

```
import java.net.*;


public class PrintURLConnectionURL {
   public static void main(String[] args) {
      try {
         URL url = new URL("http://nepathyacollege.edu.np");
         URLConnection connection = url.openConnection();


         System.out.println("URL of the connection: " + connection.getURL());
      } catch (Exception e) {
         System.out.println("Error: " + e.getMessage());
      }
   }
}
```

Output:



Lab 20

Objective: To write a program to get the time when a URL was last changed.

Source Code:

```
import java.net.*;
import java.text.SimpleDateFormat;
import java.util.Date;

public class URLLastModifiedTime {
    public static void main(String[] args) {
        try {
            URL url = new URL("http://nepathyacollege.edu.np");
            URLConnection connection = url.openConnection();

            long lastModified = connection.getLastModified();
            if (lastModified == 0) {
                System.out.println("No Last-Modified information.");
            } else {
                Date date = new Date(lastModified);
                SimpleDateFormat sdf = new SimpleDateFormat("dd MMM yyyy HH:mm:ss");
                System.out.println("Last Modified: " + sdf.format(date));
            }
        } catch (Exception e) {
            System.out.println("Error: " + e.getMessage());
        }
    }
}
```

Output:

Chapter 6: Socket for Clients

Lab 21

Objective: To write a program socket to client.

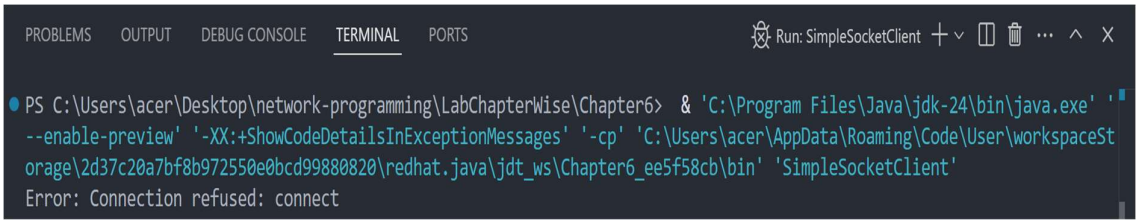
Source Code:

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

public class SimpleSocketClient {
    public static void main(String[] args) {
        String serverAddress = "localhost"; // or IP address of the server
        int port = 5000;  // port number the server is listening on

        try (Socket socket = new Socket(serverAddress, port);
             PrintWriter out = new PrintWriter(socket.getOutputStream(), true);
             BufferedReader in = new BufferedReader(new
InputStreamReader(socket.getInputStream()));
             BufferedReader userInput = new BufferedReader(new
InputStreamReader(System.in))) {

            System.out.println("Connected to server at " + serverAddress + ":" + port);

            // Read user input and send to server
            System.out.print("Enter message to send: ");
            String message = userInput.readLine();
            out.println(message);

           // Read and print server response
            String response = in.readLine();
            System.out.println("Server response: " + response);

        } catch (IOException e) {
            System.err.println("Error: " + e.getMessage());
        }
```

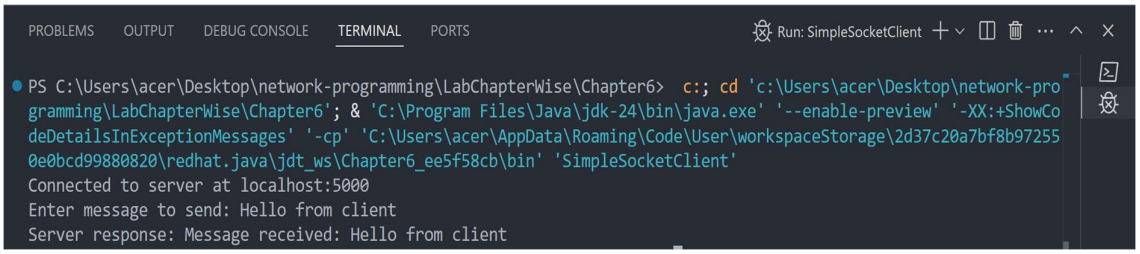
```
    }
}
```

Output:

(before connecting to server)



(after connecting to server)



Chapter 7: Socket for Server

Lab 22

Objective: To write a program socket to server.

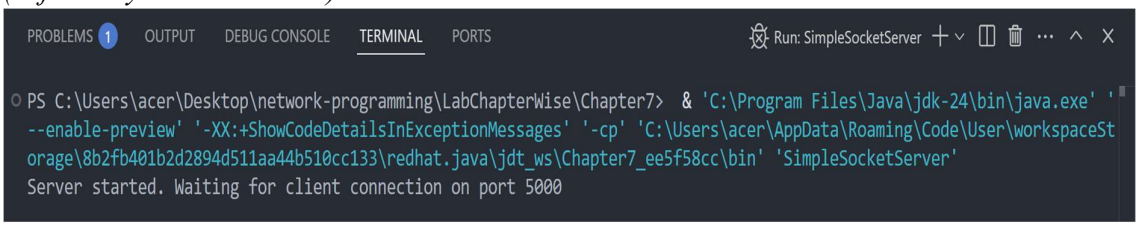
Source Code:

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

public class SimpleSocketServer {
   public static void main(String[] args) {
      int port = 5000;  // Server will listen on this port

      try (ServerSocket serverSocket = new ServerSocket(port)) {
         System.out.println("Server started. Waiting for client connection on port " + port);

         Socket clientSocket = serverSocket.accept(); // Accept client connection
         System.out.println("Client connected: " + clientSocket.getInetAddress());

         BufferedReader in = new BufferedReader(
               new InputStreamReader(clientSocket.getInputStream()));
         PrintWriter out = new PrintWriter(clientSocket.getOutputStream(), true);

        // Read message from client
         String message = in.readLine();
         System.out.println("Received from client: " + message);

         // Send response to client
         out.println("Message received: " + message);

        // Close client connection
         clientSocket.close();
         System.out.println("Client connection closed.");
      } catch (IOException e) {
         System.err.println("Error: " + e.getMessage());
```

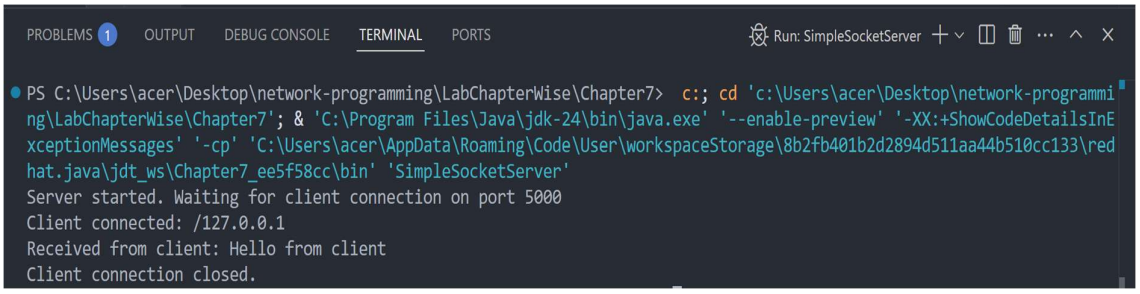
```
        }
    }
}
```

Output:

(before any client connects)



(after client connects)



Chapter 8: Secure Sockets

Lab 23

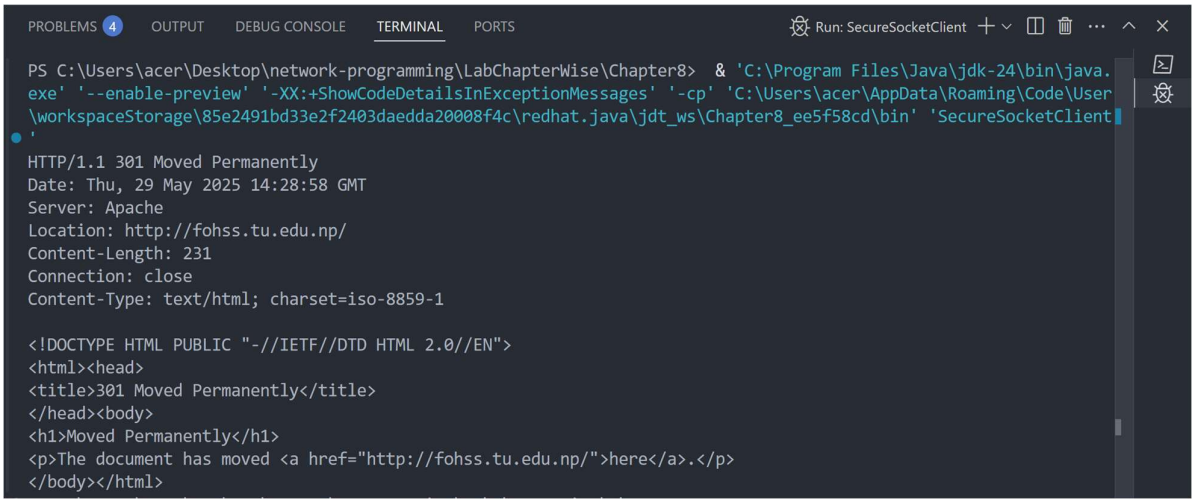
Objective: To write a program for Creating Secure Sockets with tufohss.edu.np.

Source Code:

```
import java.io.*;
import javax.net.ssl.SSLSocket;
import javax.net.ssl.SSLSocketFactory;

public class SecureSocketClient {
   public static void main(String[] args) {
      String host = "tufohss.edu.np";
      int port = 443; // HTTPS default port

      try {
        // Create SSL socket factory and socket
         SSLSocketFactory factory = (SSLSocketFactory) SSLSocketFactory.getDefault();
         SSLSocket sslSocket = (SSLSocket) factory.createSocket(host, port);

        // Start handshake (optional, but recommended)
         sslSocket.startHandshake();

        // Output stream to send data to server
         PrintWriter out = new PrintWriter(new BufferedWriter(
               new OutputStreamWriter(sslSocket.getOutputStream())));

        // Input stream to read server response
         BufferedReader in = new BufferedReader(
               new InputStreamReader(sslSocket.getInputStream()));

        // Send HTTP GET request
         out.println("GET / HTTP/1.1");
         out.println("Host: " + host);
         out.println("Connection: Close");
```

```
            out.println(); // blank line to end request headers
            out.flush();

            // Read and print the response line by line
            String line;
            while ((line = in.readLine()) != null) {
                System.out.println(line);
            }

            // Close streams and socket
            in.close();
            out.close();
            sslSocket.close();

        } catch (Exception e) {
            System.err.println("Error: " + e.getMessage());
            e.printStackTrace();
        }
    }
}
```

Output:



Lab 24

Objective: To write a program for Creating Secure Server Sockets and Client Sockets.

Source Code:

SecureClient.java

```
import java.io.*;
import java.security.KeyStore;
import javax.net.ssl.*;

public class SecureClient {
   public static void main(String[] args) throws Exception {
      char[] password = "password".toCharArray();

      // Set system properties to point to the truststore file containing server cert or CA cert
      System.setProperty("javax.net.ssl.trustStore", "clienttruststore.jks");
      System.setProperty("javax.net.ssl.trustStorePassword", "password");

      // Load the truststore file (this step is optional if you want to create SSLContext manually)
      KeyStore ts = KeyStore.getInstance("JKS");
      try (FileInputStream fis = new FileInputStream("clienttruststore.jks")) {
         ts.load(fis, password);
      }

      // Initialize TrustManagerFactory with the truststore
      TrustManagerFactory tmf = TrustManagerFactory.getInstance("SunX509");
      tmf.init(ts);

      // Set up SSL context using the trust managers from the truststore
      SSLContext sc = SSLContext.getInstance("TLS");
      sc.init(null, tmf.getTrustManagers(), null);

      // Create SSLSocketFactory from SSL context
```

```
        SSLSocketFactory ssf = sc.getSocketFactory();

        // Create an SSL socket connected to the server
        try (SSLSocket socket = (SSLSocket) ssf.createSocket("localhost", 12345);
             BufferedReader in = new BufferedReader(new
InputStreamReader(socket.getInputStream()))) {

            // Read response from server
            String response = in.readLine();
            System.out.println("Message from Server: " + response);
        }
    }
}
```

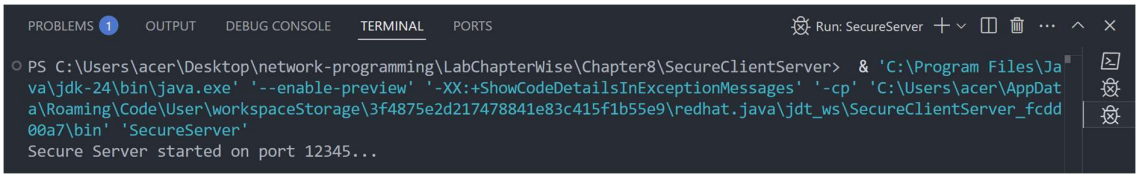
SecureServer.java

```
import java.io.*;
import java.security.KeyStore;
import javax.net.ssl.*;

public class SecureServer {
    public static void main(String[] args) throws Exception {
        char[] password = "password".toCharArray();

        // Load keystore
        KeyStore ks = KeyStore.getInstance("JKS");
        ks.load(new FileInputStream("serverkeystore.jks"), password);

        // Initialize KeyManagerFactory
        KeyManagerFactory kmf = KeyManagerFactory.getInstance("SunX509");
        kmf.init(ks, password);
```

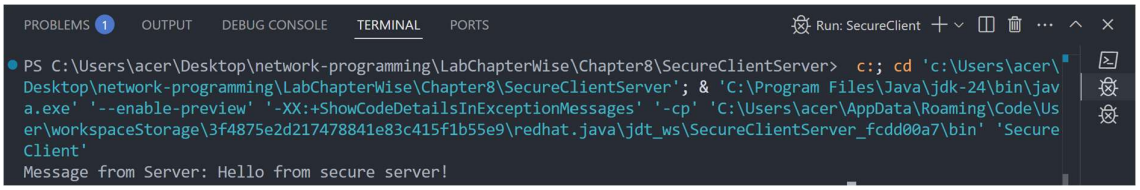
```
        // Set up SSL context
        SSLContext sc = SSLContext.getInstance("TLS");
        sc.init(kmf.getKeyManagers(), null, null);

        SSLServerSocketFactory ssf = sc.getServerSocketFactory();
        SSLServerSocket serverSocket = (SSLServerSocket) ssf.createServerSocket(12345);

        System.out.println("Secure Server started on port 12345...");

        while (true) {
            SSLSocket socket = (SSLSocket) serverSocket.accept();
            PrintWriter out = new PrintWriter(socket.getOutputStream(), true);
            out.println("Hello from secure server!");
            socket.close();
        }
    }
}
```

Output:

(SecureServer.java)



(SecureClient.java)



Chapter 9: Non Blocking I/O

Lab 25

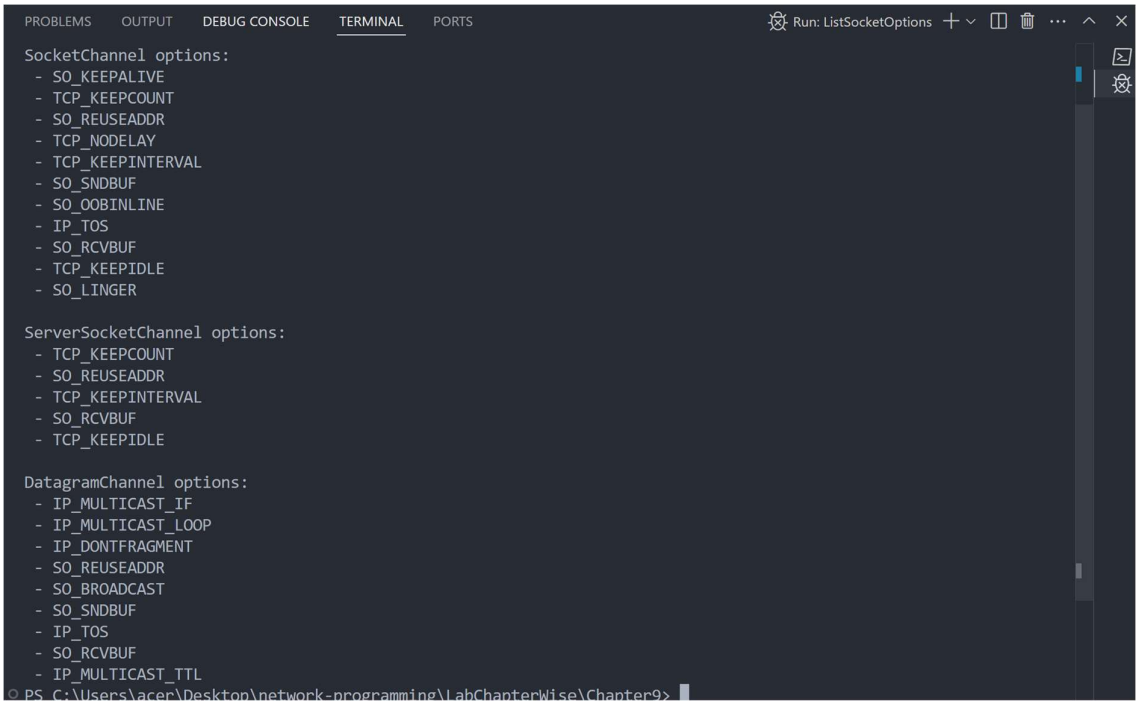
Objective: To write program to list all supported socket options for the different types of network channels

Source Code:

```
import java.net.*;

import java.nio.channels.*;

import java.util.Set;


public class ListSocketOptions {

   public static void main(String[] args) throws Exception {

      System.out.println("SocketChannel options:");

      SocketChannel socketChannel = SocketChannel.open();

      Set<SocketOption<?>> socketOptions = socketChannel.supportedOptions();

      for (SocketOption<?> option : socketOptions) {

         System.out.println(" - " + option.name());

      }


      System.out.println("\nServerSocketChannel options:");

      ServerSocketChannel serverSocketChannel = ServerSocketChannel.open();

      Set<SocketOption<?>> serverSocketOptions =

serverSocketChannel.supportedOptions();

      for (SocketOption<?> option : serverSocketOptions) {

         System.out.println(" - " + option.name());

      }
```

```
        System.out.println("\nDatagramChannel options:");
        DatagramChannel datagramChannel = DatagramChannel.open();
        Set<SocketOption<?>> datagramOptions = datagramChannel.supportedOptions();
        for (SocketOption<?> option : datagramOptions) {
            System.out.println(" - " + option.name());
        }
    }
}
```

Output:



Lab 26

Objective: To write program to implement the concept on Filling and Draining buffer, duplicating buffer, Slicing buffer, Compact buffer.

Source Code:

```
import java.nio.ByteBuffer;
public class BufferOperations {
   public static void main(String[] args) {
      // Fill buffer
      ByteBuffer buffer = ByteBuffer.allocate(10);
      for (byte i = 0; i < 10; i++) {
         buffer.put(i);
      }

      // Flip (prepare for reading)
      buffer.flip();

      // Drain buffer
      System.out.print("Draining buffer: ");
      while (buffer.hasRemaining()) {
         System.out.print(buffer.get() + " ");
      }

      // Refill
      buffer.clear();
      for (byte i = 10; i < 20; i++) {
         buffer.put(i);
      }

      // Duplicate
      ByteBuffer duplicate = buffer.duplicate();
      duplicate.flip();
      System.out.print("\nDuplicate buffer: ");
      while (duplicate.hasRemaining()) {
         System.out.print(duplicate.get() + " ");
```

```
        }

        // Slice buffer
        buffer.position(2);
        buffer.limit(6);
        ByteBuffer slice = buffer.slice();
        System.out.print("\nSliced buffer: ");
        for (int i = 0; i < slice.capacity(); i++) {
            System.out.print(slice.get(i) + " ");
        }

        //compact
        buffer.clear();
        buffer.put((byte) 1);
        buffer.put((byte) 2);
        buffer.put((byte) 3);
        buffer.flip();
        buffer.get(); // read one byte
        buffer.compact(); // move remaining bytes to beginning
        buffer.put((byte) 4); // add more
        buffer.flip();
        System.out.print("\nCompact buffer: ");
        while (buffer.hasRemaining()) {
            System.out.print(buffer.get() + " ");
        }
    }
}
```

Output:

Lab 27

Objective: To write a program to implement the concept on Data Conversion

Source Code:

```
import java.nio.ByteBuffer;
import java.nio.CharBuffer;
import java.nio.charset.Charset;
import java.nio.charset.StandardCharsets;

public class DataConversion {
    public static void main(String[] args) {
        String input = "Hello, buffer world!";
        System.out.println("Original String: " + input);

        Charset charset = StandardCharsets.UTF_8;
        ByteBuffer byteBuffer = charset.encode(input);

        System.out.print("Encoded Bytes: ");
        while (byteBuffer.hasRemaining()) {
            System.out.print(byteBuffer.get() + " ");
        }

        byteBuffer.rewind();
        CharBuffer decoded = charset.decode(byteBuffer);
        System.out.println("\nDecoded String: " + decoded.toString());
    }
}
```

Output:

Chapter 10: UDP

Lab 28

Objective: To write a program for UDP Client

Source Code:

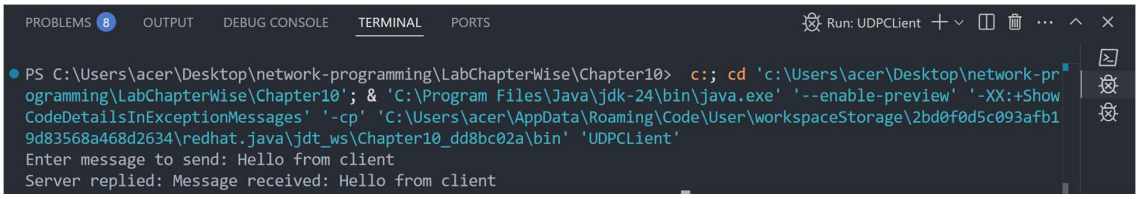
```
import java.net.DatagramPacket;
import java.net.DatagramSocket;
import java.net.InetAddress;
import java.util.Scanner;

public class UDPCLient {
   public static void main(String[] args) {
      try {
         DatagramSocket clientSocket = new DatagramSocket();
         InetAddress serverAddress = InetAddress.getByName("localhost");
         Scanner scanner = new Scanner(System.in);

         System.out.print("Enter message to send: ");
         String message = scanner.nextLine();
         byte[] sendBuffer = message.getBytes();

         DatagramPacket sendPacket = new DatagramPacket(sendBuffer, sendBuffer.length,
serverAddress, 9876);
         clientSocket.send(sendPacket);

        // Receive response
         byte[] receiveBuffer = new byte[1024];
         DatagramPacket receivePacket = new DatagramPacket(receiveBuffer,
receiveBuffer.length);
         clientSocket.receive(receivePacket);

         String response = new String(receivePacket.getData(), 0, receivePacket.getLength());
```

```
            System.out.println("Server replied: " + response);

            clientSocket.close();
            scanner.close();
        } catch (Exception e) {
            e.printStackTrace();
        }
    }
}
```

Output:

(before connecting to server)

(after connecting to server)



Lab 29

Objective: To write a program for UDP Server.

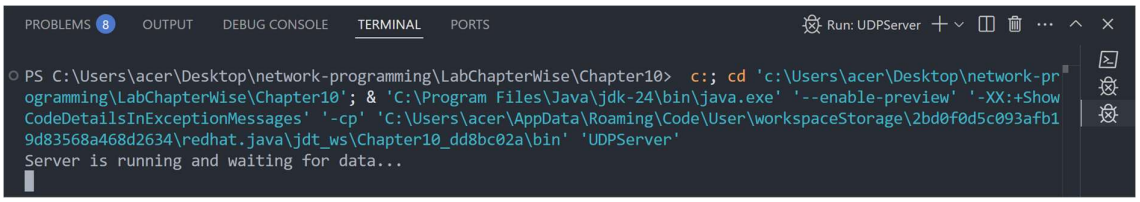
Source Code:

```
import java.net.DatagramPacket;
import java.net.DatagramSocket;


public class UDPServer {
   public static void main(String[] args) {
      try {
         DatagramSocket serverSocket = new DatagramSocket(9876);
         byte[] receiveBuffer = new byte[1024];


         System.out.println("Server is running and waiting for data...");


        // Receive packet
         DatagramPacket receivePacket = new DatagramPacket(receiveBuffer,
receiveBuffer.length);
         serverSocket.receive(receivePacket);
         String clientMessage = new String(receivePacket.getData(), 0,
receivePacket.getLength());
         System.out.println("Client says: " + clientMessage);


        // Send response
         String reply = "Message received: " + clientMessage;
         byte[] sendBuffer = reply.getBytes();


         DatagramPacket sendPacket = new DatagramPacket(
            sendBuffer,
            sendBuffer.length,
            receivePacket.getAddress(),
            receivePacket.getPort()
```

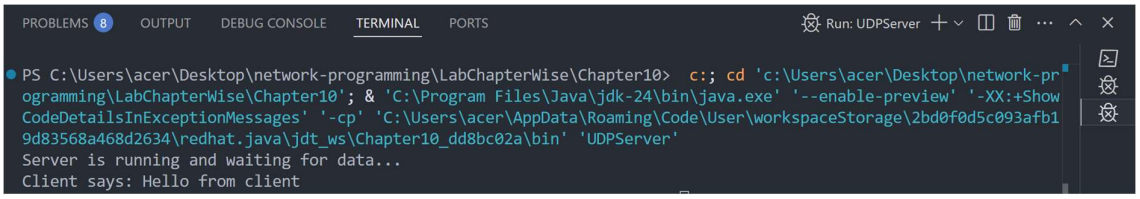
```
            );
            serverSocket.send(sendPacket);

            serverSocket.close();
        } catch (Exception e) {
            e.printStackTrace();
        }
    }
}
```

Output:

(before any client connects)



(after client connects)



Chapter 11: IP Multicast

Lab 30

Objective: To verify that you are receiving multicast data at a particular host.

Source Code:

```
import java.io.IOException;

import java.net.DatagramPacket;

import java.net.InetAddress;

import java.net.MulticastSocket;


public class MulticastReceiver {

   public static void main(String[] args) {

      final int PORT = 4446; // Use the same port as sender

      final String MULTICAST_GROUP = "230.0.0.0"; // A valid multicast IP


      try {

         MulticastSocket socket = new MulticastSocket(PORT);

         InetAddress group = InetAddress.getByName(MULTICAST_GROUP);


         socket.joinGroup(group);

         System.out.println("Joined multicast group. Listening for messages...");


         byte[] buffer = new byte[1024];

         DatagramPacket packet = new DatagramPacket(buffer, buffer.length);


         socket.receive(packet);

         String received = new String(packet.getData(), 0, packet.getLength());
```

```
            System.out.println("Received multicast message: " + received);


            socket.leaveGroup(group);
            socket.close();
        } catch (IOException e) {
            e.printStackTrace();
        }
    }
}
```

Output:

Chapter 12: RMI

Lab 31

Objective: To add two numbers using RMI

Source Code:

Calculator.java

```
import java.rmi.Remote;
import java.rmi.RemoteException;

public interface Calculator extends Remote{
   int add(int a, int b) throws RemoteException;
}
```

CalculatorRemote.java

```
import java.rmi.RemoteException;
import java.rmi.server.UnicastRemoteObject;

public class CalculatorRemote extends UnicastRemoteObject implements Calculator{
   //constructor
   public CalculatorRemote() throws RemoteException {
      super();
   }

   @Override
   public int add(int a, int b){
      return a + b;
   }
}
```

Server.java

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

public class Server {
   public static void main(String[] args) {
      try{
         CalculatorRemote objCalculatorRemote = new CalculatorRemote();
         Registry registry = LocateRegistry.createRegistry(9000);
         registry.bind("Multiply", objCalculatorRemote);
         System.out.println("Server is ready to accept requests...");
      }catch (Exception e) {
         System.out.println("Server exception: " + e.getMessage());
         e.printStackTrace();
      }
   }
}
```

Client.java

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

public class Client {
   public static void main(String[] args) {
      try {
       Registry registry = LocateRegistry.getRegistry("localhost", 9000);
       Calculator calculator = (Calculator) registry.lookup("Multiply");
       int value = calculator.add(60, 10);
       System.out.println("Result is: "+value);
```

```
        } catch (Exception e) {
            System.out.println("Client exception: " + e.getMessage());
            e.printStackTrace();
        }
    }
}
```

Output:

(server)

(client)