INDEX

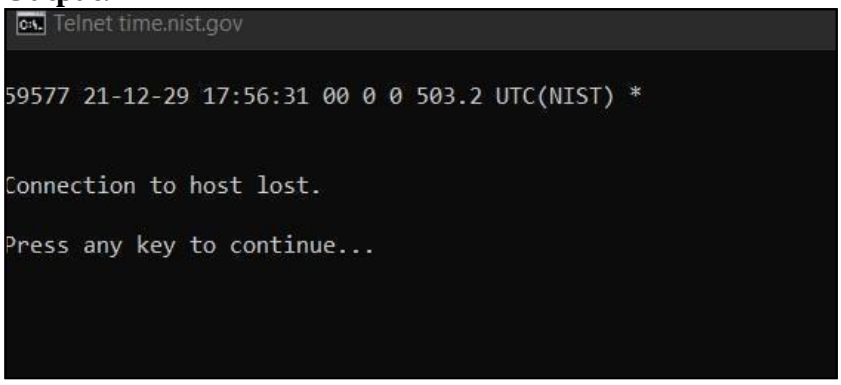
1. INTRODUCTION TO JAVA SOCKET PROGRAMMING

a) Using TELNET Client to Communicate with NIST Time

Code:

```
import java.io.IOException;
import java.net.Socket;
import java.util.Scanner;
public class hellosocketprogramming_q1 {
	public static void main(String args[]) throws IOException {
		Socket s = new Socket ("time.nist.gov", 13);
		Scanner ins = new Scanner (s.getInputStream());
		while (ins.hasNextLine()) {
			System.out.println (ins.nextLine());
		};
	}
}
```

Output:



b) Using Socket API to Implement Java Client to Communicate with NIST Time of the Day Service

Code:

```
import java.io.IOException;
import java.net.Socket;
import java.util.Scanner;
public class hellosocketprogramming_q1 {
	public static void main(String args[]) throws IOException {
		Socket s = new Socket ("time.nist.gov", 13);
		Scanner ins = new Scanner (s.getInputStream());
		while (ins.hasNextLine()) {
			System.out.println (ins.nextLine());
		};
	}
}
```

Output:

```
----------------------< com.mycompany:socketproj1 >-----------------------
] Building socketproj1 1.0-SNAPSHOT
--------------------------------[ jar ]---------------------------------

] --- exec-maven-plugin:3.0.0:exec (default-cli) @ socketproj1 ---

- 59577 21-12-29 17:56:00 00 0 0 784.8 UTC(NIST) *
------------------------------------------------------------------------
BUILD SUCCESS
------------------------------------------------------------------------
Total time:  2.130 s
Finished at: 2021-12-29T23:25:59+05:30
------------------------------------------------------------------------
```

c) Implementing a Java Program to Convert Between Domain Name and IP Address.

Code:

```
import java.net.InetAddress;
import java.io.IOException;
import java.net.UnknownHostException;
import java.util.Scanner;
public class socketprogram_q3 {
        /**
        * @param args the command line arguments
        */
        public static void main(String args[]) throws UnknownHostException {
                if (args.length > 0){
                String domainname = args[0];
                InetAddress[] inet = InetAddress.getAllByName(domainname);
                for(InetAddress addr : inet){
                        System.out.println(addr);
                }
                }else{
                        System.out.println(InetAddress.getLocalHost());
                }
                // TODO code application logic here
        }
}
```

Output:

```
--------------------< com.mycompany:socketproj1 >---------------------
Building socketproj1 1.0-SNAPSHOT
--------------------------------[ jar ]---------------------------------

--- exec-maven-plugin:3.0.0:exec (default-cli) @ socketproj1 ---
DESKTOP-MUK2EVO/192.168.49.1
------------------------------------------------------------------------
BUILD SUCCESS
------------------------------------------------------------------------
Total time:  1.252 s
Finished at: 2021-12-29T23:32:34+05:30
------------------------------------------------------------------------
```

2. IMPLEMENTING CLIENT-SERVER COMMUNICATION

a) Implementing a Simple Echo Chat Server Using Java Server Socket API

Code:

```
import java.io.*;
import java.net.*;
import java.util.*;
public class EchoServer {
	public static void main(String args[]) throws IOException {
		ServerSocket ss = new ServerSocket (8189);
		System.out.println("I am about to listen on 8189");
		Socket conn = ss.accept();
		InputStream inS = conn.getInputStream();
		OutputStream outS = conn.getOutputStream();
		Scanner in = new Scanner(inS);
		PrintWriter out = new PrintWriter(outS, true);
		out.println("Hello!.. I am the chat server. Let's Chat"+" Say BYE to
	disconnect");
		boolean bye = false;
		while(!bye && in.hasNextLine()){
			String cMsg = in.nextLine();
			out.println("Echo: " +cMsg);
			if (cMsg.trim().equals("BYE")) { bye= true;}
		}
		conn.close();
		ss.close();
	}
}
```

Output:

```
----------------------< com.mycompany:socketproj1 >-----------------------
Building socketproj1 1.0-SNAPSHOT
--------------------------------[ jar ]---------------------------------

--- exec-maven-plugin:3.0.0:exec (default-cli) @ socketproj1 ---
I am about to listen on 8189
```

```
Telnet localhost
Hello!.. I am the chat server. Let's Chat Say BYE to disconnect
hello
Echo: hello
how are you?
Echo: how are you?
BYE
Echo: BYE


Connection to host lost.

Press any key to continue...
```

b) Making the Echo Chat Server Multi-Threaded to Support Multiple Simultaneous Chatting Sessions

Code:

```
import java.io.IOException;
import java.net.ServerSocket;
import java.net.Socket;
public class MultiUserEchoChatServer {
	public static void main(String[] args) throws IOException{
		ServerSocket server = new ServerSocket (8189);
		System.out.println("I am about to listen on 8189");
		int userCnt =0;
		while (true){
			Socket userSocket = server.accept();
			userCnt++;
			EchoChatHandler echoChatter = new EchoChatHandler(userSocket,
	userCnt);
			Thread userChatThread = new Thread(echoChatter);
			System.out.println("Spawing a new chatting thread for user " +
	userCnt);
			userChatThread.start();
		}
	}
}
```

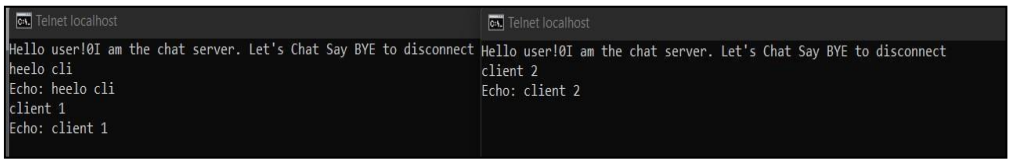
Code (Handler Class):

```
import java.io.IOException;
import java.io.InputStream;
import java.io.OutputStream;
import java.io.PrintWriter;
import java.net.Socket;
import java.util.Scanner;
class EchoChatHandler implements Runnable {
	private final Socket userSocket;
	private int userId;
	public EchoChatHandler(Socket userSocket, int userCnt){
		this.userSocket = userSocket;
		this.userId = userId;
	}
	@Override
	public void run(){
		try{
			InputStream inS = userSocket.getInputStream();
			OutputStream outS = userSocket.getOutputStream();
			Scanner in = new Scanner(inS);
			PrintWriter out = new PrintWriter(outS, true);
			out.println("Hello user!" + userId + "I am the chat server. Let's
			Chat"+" Say BYE to disconnect");
			boolean bye = false;
```

```
while(!bye && in.hasNextLine()){
```

```
                    String cMsg = in.nextLine();
                    out.println("Echo: " +cMsg);
                    if (cMsg.trim().equals("BYE")) { bye= true;}
                }
                userSocket.close();
            }
            catch(IOException ioEX){ ioEX.printStackTrace();}
        }
}
```

Output:




```
----------------------< com.mycompany:socketproj1 >----------------------
Building socketproj1 1.0-SNAPSHOT
--------------------------------[ jar ]---------------------------------

--- exec-maven-plugin:3.0.0:exec (default-cli) @ socketproj1 ---
I am about to listen on 8189
Spawing a new chatting thread for user 1
Spawing a new chatting thread for user 2
```

3. INTRODUCTION TO DATAGRAM SOCKET API

a) Using Datagram Socket API to Implement Number AdditionService
Code (Client):

```
import java.io.DataInputStream;
import java.io.DataOutputStream;
import java.io.IOException;
import java.io.InputStream;
import java.io.OutputStream;
import java.io.PrintWriter;
import java.net.DatagramPacket;
import java.net.DatagramSocket;
import java.net.InetAddress;
import java.net.ServerSocket;
import java.net.Socket;
import java.net.SocketException;
import java.net.UnknownHostException;
import java.util.Scanner;
public class AdditionClient {
	public static void main(String[] args){
		try{
			InetAddress addServiceIP = InetAddress.getLocalHost();
			int addServicePort = 8189;
			DatagramSocket clientSocket = new DatagramSocket();
			Scanner sc = new Scanner(System.in);
			System.out.println("Please enter the list of number: ");
			String numberList = sc.nextLine();
			DatagramPacket outDP = new DatagramPacket(numberList.getBytes
			(),numberList.length(),addServiceIP, addServicePort);
			clientSocket.send(outDP);
			System.out.println("Adding the number " + numberList + "
			together");
			byte[] buffer = new byte[256];
			DatagramPacket inDP = new DatagramPacket(buffer, buffer.length);
			clientSocket.receive(inDP);
			String servResp = new String(inDP.getData(),0,inDP.getLength());
			System.out.println(servResp);
			String stop = "STOP";
			outDP = new DatagramPacket(stop.getBytes(),stop.length
			(),addServiceIP, addServicePort);
			clientSocket.send(outDP);
			clientSocket.close();
		}
		catch(IOException ioEX){
			System.out.println(ioEX);
		}
```

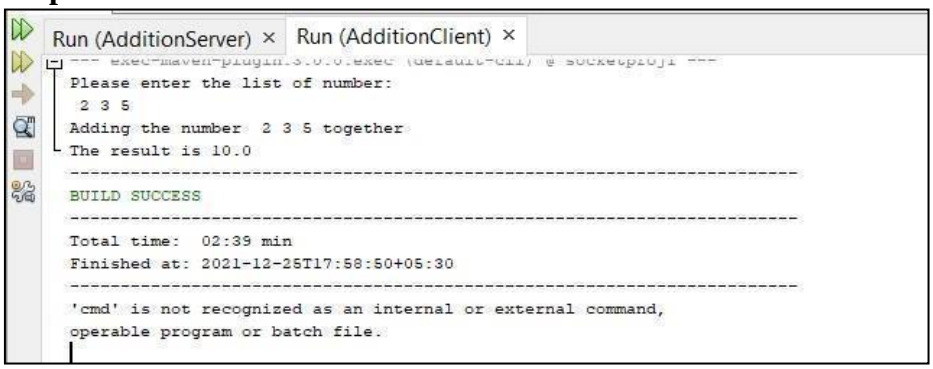
```
        }
}
```

Code (Server):

```
import java.io.IOException;
import java.net.DatagramPacket;
import java.net.DatagramSocket;
import java.net.InetAddress;
import java.net.SocketException;
import java.util.StringTokenizer;
public class AdditionServer {
        private int port = 8189;
        public static void main(String[] args){
                Datagramadditionserver addService = new Datagramadditionserver();
                addService.start();
        }
        public void start(){
        try{
                DatagramSocket serverConn = new DatagramSocket(port);
                byte[] buffer = new byte[256];
                DatagramPacket inDP = new DatagramPacket (buffer, buffer.length);
                String clientReq, serverResp;
                do{
                        serverConn.receive(inDP);
                        InetAddress clientAddress = inDP.getAddress();
                        int clientPort = inDP.getPort();
                        clientReq = new String(inDP.getData(), 0, inDP.getLength());
                        if(clientReq != null && !clientReq.trim().equals("STOP")){
                                double sumResult = 0;
                                StringTokenizer st = new StringTokenizer(clientReq);
                                try{
                                        while(st.hasMoreTokens()){
                                                Double d = new Double(st.nextToken());
                                                sumResult += d.doubleValue();
                                        }
                                        serverResp = "The result is " + sumResult;
                                }
                                catch(NumberFormatException nEx){
                                        serverResp = "Sorry, your list contains an invalid number";
                                }
                                DatagramPacket outDP = new
DatagramPacket(serverResp.getBytes(),serverResp.length(),
                                clientAddress, clientPort);
                                serverConn.send(outDP);
                        }
                }
```

```
                while(clientReq.trim().equals("STOP"));
                        serverConn.close();
            }catch(IOException ioex){ System.out.println(ioex);}
            }
}
```

Output:



4. IMPLEMENTING TOKEN-RING PROTOCOL FOR DISTRIBUTED MUTUAL-EXCLUSION

a) Using Datagram Socket API to Implement Token Ring Protocol to Enforce Distributed Mutual Exclusion

Code (Server):

```
import java.io.IOException;
import java.net.DatagramPacket;
import java.net.DatagramSocket;
import java.net.SocketException;
public class TokenChatServer {
	private static DatagramSocket ds;
	private static DatagramPacket dp;
	public static void main(String[] args) throws IOException{
	try{
		ds = new DatagramSocket(1000);
	}catch(SocketException ex){ ex.printStackTrace();}
	while(true){
		byte buff[] = new byte[1024];
		ds.receive(dp = new DatagramPacket (buff, buff.length));
		String str = new String(dp.getData(),0,dp.getLength());
		System.out.println("Message From: " + str);
	}
	}
}
```

Code (Client1):

```
import java.io.BufferedReader;
import java.io.IOException;
import java.io.InputStreamReader;
import java.net.DatagramPacket;
import java.net.DatagramSocket;
import java.net.InetAddress;
import java.net.SocketException;
import java.util.logging.Level;
import java.util.logging.Logger;
public class TokenClient1 {
	private static DatagramSocket ds;
	private static DatagramPacket dp;
	private static BufferedReader br;
	private static int cp=100;
	public static void main(String[] args) throws IOException{
		boolean hasToken = true;
		try{
			ds= new DatagramSocket(cp);
		}
		catch(SocketException ex){
		Logger.getLogger(TokenClient1.class.getName()).log(Level.SEVERE, null, ex);
```

```
                throw ex;
                }
                while(true){
                        if(hasToken){
                                System.out.println("Do you want to say Something"+"(i.e.,Send Data)to
Server?:"+"Type Y for Yes/N for No");
                                br=new BufferedReader(new InputStreamReader(System.in));
                                String userResp=        br.readLine();
                                if(userResp.equalsIgnoreCase("Y")){
                                        System.out.println("Enter what you want to send:");
                                        String userData="Client 1===>> "+br.readLine();
                                        System.out.println("Getting ready to send data ...");
                                        byte buff[]=userData.getBytes();
                                        System.out.println("Sending...");
                                        ds.send(new                     DatagramPacket(buff,buff.length,
InetAddress.getLocalHost(),1000));
                                        System.out.println("Data Sent.");
                                }else{
                                        System.out.println("Since I am in "+"busy state ... passing token to
client 2.");
                                        String tokenMsg = "Token";
                                        byte[] bf1 = new byte[1024];
                                        bf1 = tokenMsg.getBytes();
                                        ds.send(new
 DatagramPacket(bf1,bf1.length,InetAddress.getLocalHost(),200));
                                        hasToken= false;
                                }
                        }else{
                                System.out.println("Entering in the receiving mode ...");
                                byte bf[]=new byte[1024];
                                ds.receive(dp = new DatagramPacket(bf,bf.length));
                                String msgClient3= new String(dp.getData(),0,dp.getLength());
                                System.out.println("The data received from left neighbor :"+"client 3
is"+msgClient3);
                                if(msgClient3.equalsIgnoreCase("Token")){
                                        hasToken = true;
                                }

                        }
                }
        }
}
```

Code (Client2):

```
import java.io.BufferedReader;
import java.io.IOException;
import java.io.InputStreamReader;
```

```
import java.net.DatagramPacket;
import java.net.DatagramSocket;
import java.net.InetAddress;
import java.net.SocketException;
import java.util.logging.Level;
import java.util.logging.Logger;
public class TokenClient2 {
	private static DatagramSocket ds;
	private static DatagramPacket dp;
	private static BufferedReader br;
	private static int cp = 200;
	public static void main(String[] args) throws IOException{
		boolean hasToken = false;
		try{
			ds = new DatagramSocket(cp);
		}
		catch(SocketException ex){
			Logger.getLogger(TokenClient2.class.getName()).log(Level.SEVERE, null,ex);
			throw ex;
		}
		while(true){
			if(hasToken){
				System.out.println("Do you want to say something, " + "(i.e. Send Data) To
Server?: " + "Type Y for Yes/N for No");
				br = new BufferedReader(new InputStreamReader(System.in));
				String userResp = br.readLine();
				if(userResp.equalsIgnoreCase("Y")){
					System.out.println("Enter what you want to send: ");
					String userData = "Client 2 ===> "+br.readLine();
					System.out.println("Getting ready to send data ...");
					byte buff[] = userData.getBytes();
					System.out.println("Something...");
					ds.send(new DatagramPacket (buff,buff.length,
InetAddress.getLocalHost(),1000));
					System.out.println("Data Sent.");
				}else{
					System.out.println("Since I am in "+"busy state ... passing token to
client 3.");
					String tokenMsg = "Token";
					byte[] bf1 = new byte[1024];
					bf1 = tokenMsg.getBytes();
					ds.send(new
 DatagramPacket(bf1,bf1.length,InetAddress.getLocalHost(),300));
					hasToken= false;
				}
```

```
                        }else{
                        System.out.println("Entering in the receiving mode ...");
                        byte bf[]=new byte[1024];
                        ds.receive(dp = new DatagramPacket(bf,bf.length));
                        String msgClient3= new String(dp.getData(),0,dp.getLength());
                        System.out.println("The data received from left neighbor :"+"client 1
is"+msgClient3);
                        if(msgClient3.equalsIgnoreCase("Token")){
                                hasToken = true;
                        }

                }
        }
    }
}
```

Code (Client3):

```
import java.io.BufferedReader;
import java.io.IOException;
import java.io.InputStreamReader;
import java.net.DatagramPacket;
import java.net.DatagramSocket;
import java.net.InetAddress;
import java.net.SocketException;
import java.util.logging.Level;
import java.util.logging.Logger;
public class TokenClient3 {
        private static DatagramSocket ds;
        private static DatagramPacket dp;
        private static BufferedReader br;
        private static int cp = 300;
        public static void main(String[] args) throws IOException{
                boolean hasToken = false;
                try{
                        ds = new DatagramSocket(cp);
                }
                catch(SocketException ex){
                        Logger.getLogger(TokenClient3.class.getName()).log(Level.SEVERE, null,ex);
                        throw ex;
                }
                while(true){
                        if(hasToken){
                                System.out.println("Do you want to say something, " + "(i.e. Send Data) To
Server?: " + "Type Y for Yes/N for No");
                                br = new BufferedReader(new InputStreamReader(System.in));
                                String userResp = br.readLine();
```

```
                        if(userResp.equalsIgnoreCase("Y")){
                                System.out.println("Enter what you want to send: ");
                                String userData = "Client 3 ===> "+br.readLine();
                                System.out.println("Getting ready to send data ...");
                                byte buff[] = userData.getBytes();
                                System.out.println("Something...");
                                ds.send(new DatagramPacket (buff,buff.length,
 InetAddress.getLocalHost(),1000));
                                System.out.println("Data Sent.");
                        }else{
                                System.out.println("Since I am in "+"busy state ... passing token to
client 2.");
                                String tokenMsg = "Token";
                                byte[] bf1 = new byte[1024];
                                bf1 = tokenMsg.getBytes();
                                ds.send(new
 DatagramPacket(bf1,bf1.length,InetAddress.getLocalHost(),100));
                                hasToken= false;
                        }
                }else{
                        System.out.println("Entering in the receiving mode ...");
                        byte bf[]=new byte[1024];
                        ds.receive(dp = new DatagramPacket(bf,bf.length));
                        String msgClient3= new String(dp.getData(),0,dp.getLength());
                        System.out.println("The data received from left neighbor :"+"client 2
is"+msgClient3);
                        if(msgClient3.equalsIgnoreCase("Token"))
                        {
                                hasToken = true;
                        }
                }
        }
    }
}
```

Output:

```
Scanning for projects...

---------------------< com.mycompany:socketproj1 >----------------------
Building socketproj1 1.0-SNAPSHOT
--------------------------------[ jar ]---------------------------------

--- exec-maven-plugin:3.0.0:exec (default-cli) @ socketproj1 ---
Message From: Client 1===>> Hello
Message From: Client 2 ===> Hi
```

```
Do you want to say Something(i.e.,Send Data)to Server?:Type Y for Yes/N for No
Y
Enter what you want to send:
Hello
Getting ready to send data ...
Sending...
Data Sent.
Do you want to say Something(i.e.,Send Data)to Server?:Type Y for Yes/N for No
N
Since I am in busy state ... passing token to client 2.
Entering in the receiving mode ...
The data received from left neighbor :client 3 isToken
Do you want to say Something(i.e.,Send Data)to Server?:Type Y for Yes/N for No
```

```
--- exec-maven-plugin:3.0.0:exec (default-cli) @ socketproj1 ---
Entering in the receiving mode ...
The data received from left neighbor :client 1 isToken
Do you want to say something, (i.e. Send Data) To Server?: Type Y for Yes/N for No
Y
Enter what you want to send:
Hi
Getting ready to send data ...
Something...
Data Sent.
Do you want to say something, (i.e. Send Data) To Server?: Type Y for Yes/N for No
N
Since I am in busy state ... passing token to client 3.
Entering in the receiving mode ...
```

```
Running NetBeans Compile On Save execution. Phase execution is skipped and output directories
Scanning for projects...

---------------------< com.mycompany:socketproj1 >----------------------
Building socketproj1 1.0-SNAPSHOT
--------------------------------[ jar ]---------------------------------

--- exec-maven-plugin:3.0.0:exec (default-cli) @ socketproj1 ---
Entering in the receiving mode ...
The data received from left neighbor :client 2 isToken
Do you want to say something, (i.e. Send Data) To Server?: Type Y for Yes/N for No
Heya
Since I am in busy state ... passing token to client 2.
Entering in the receiving mode ...
```

5. Implement a simple client server chat application using Socket API

Code (Client):

```
import java.io.DataInputStream;
import java.io.DataOutputStream;
import java.io.IOException;
import static java.lang.System.out;
import java.net.Socket;
import java.net.UnknownHostException;
public class Client_Q1 {
	private Socket socket=null;
	private DataInputStream input =null;
	private DataOutputStream output =null;
	public Client_Q1(String address, int port) throws IOException{
		try{
			socket=new Socket(address, port);
			System.out.println("Connected");
			input=new DataInputStream(System.in);
			output=new DataOutputStream(socket.getOutputStream());
		}
		catch(UnknownHostException u){
			System.out.println(u);
		}
		catch(IOException i){
			System.out.println(i);
		}
		String line="";
		while(!line.equals("Over")){
			try{
				line=input.readLine();
				output.writeUTF(line);
			}
			catch(IOException i){
			System.out.println(i);
			}
		}
		try{
			input.close();
			output.close();
			socket.close();
		}
		catch(IOException i){
			System.out.println(i);
		}
	}
```

```
    public static void main(String args[]) throws IOException{
        Client_Q1 client=new Client_Q1("127.0.0.1",5000);
    }
}
```

Code (Server):

```
import com.sun.corba.se.spi.activation.Server;
import java.io.BufferedInputStream;
import java.io.DataInputStream;
import java.io.IOException;
import java.net.ServerSocket;
import java.net.Socket;
public class Server_Q1 {
    private Socket socket = null;
    private ServerSocket server = null;
    private DataInputStream in = null;
    public Server_Q1(int port) throws IOException{
        try{
            server = new ServerSocket(port);
            System.out.println("Server started");
            System.out.println("waiting for client");
            socket = server.accept();
            System.out.println("Client Accepted");
            in = new DataInputStream(new BufferedInputStream(socket.getInputStream()));
            String line = "";
            while(!line.equals("Over")){
                try{
                    line = in.readUTF();
                    System.out.println(line);
                }
                catch(IOException i){
                    System.out.println(i);
                }
            }
            System.out.println("Closing connection");
            socket.close();
            in.close();
        }
        catch(IOException i){
            System.out.println(i);
        }

    }
    public static void main(String args[]) throws IOException{
```

```
            Server_Q1 server = new Server_Q1(5000);
        }
}
```

Output:

```
---------------------< com.mycompany:socketproj2 >----------------------
Building socketproj2 1.0-SNAPSHOT
--------------------------------[ jar ]---------------------------------

--- exec-maven-plugin:3.0.0:exec (default-cli) @ socketproj2 ---
Server started
waiting for client
Client Accepted
Hello
Hii
Hi
Over
Closing connection
------------------------------------------------------------------------
BUILD SUCCESS
------------------------------------------------------------------------
Total time:  01:02 min
Finished at: 2021-12-30T12:40:49+05:30
------------------------------------------------------------------------
```

```
---------------------< com.mycompany:socketproj2 >----------------------
Building socketproj2 1.0-SNAPSHOT
--------------------------------[ jar ]---------------------------------

--- exec-maven-plugin:3.0.0:exec (default-cli) @ socketproj2 ---
Connected
Hello
Hi
Over
------------------------------------------------------------------------
BUILD SUCCESS
------------------------------------------------------------------------
Total time:  56.986 s
Finished at: 2021-12-30T12:40:49+05:30
------------------------------------------------------------------------
```

6. To develop a program for multi-client chat server.

Code (Client):

```
import java.io.*;
import java.net.*;
import java.util.Scanner;
public class MultiChatClient
{
	final static int ServerPort = 1234;
	public static void main(String args[]) throws UnknownHostException, IOException
	{
		Scanner scn = new Scanner(System.in);
		// getting localhost ip
		InetAddress ip = InetAddress.getByName("localhost");
		// establish the connection
		Socket s = new Socket(ip, ServerPort);
		// obtaining input and out streams
		DataInputStream dis = new DataInputStream(s.getInputStream());
		DataOutputStream dos = new DataOutputStream(s.getOutputStream());
		// sendMessage thread
		Thread sendMessage = new Thread(new Runnable()
		{
			@Override
			public void run() {
				while (true) {
				// read the message to deliver.
				String msg = scn.nextLine();
				try {
					dos.writeUTF(msg);
					// write on the output stream
				}
				catch (IOException e) {
					e.printStackTrace();
				}
				}
		}
	});
	// readMessage thread
	Thread readMessage = new Thread(new Runnable()
	{
		@Override
		public void run() {
			while (true) {
				try {
					// read the message sent to this client
					String msg = dis.readUTF();
					System.out.println(msg);
```

```
                        }
                        catch (IOException e) {
                                e.printStackTrace();
                        }
                }
        });
        }
        sendMessage.start();
        readMessage.start();
        }
}
```

Code (Server):

```
import java.io.*;
import java.util.*;
import java.net.*;
public class MultiChatServer
{
        // Vector to store active clients
        static Vector<ClientHandler> ar = new Vector<>();
        // counter for clients
        static int i = 0;
        public static void main(String[] args) throws IOException
        {
                // server is listening on port 1234
                ServerSocket ss = new ServerSocket(1234);
                Socket s;
                // running infinite loop for getting
                // client request
                while (true)
                {
                        // Accept the incoming
                        request s = ss.accept();
                        System.out.println("New client request received : " + s);
                        // obtain input and output streams
                        DataInputStream dis = new DataInputStream(s.getInputStream());
                        DataOutputStream dos = new DataOutputStream(s.getOutputStream());
                        System.out.println("Creating a new handler for this client...");
                        // Create a new handler object for handling this request.
                        ClientHandler mtch = new ClientHandler(s,"client " + i, dis, dos);
                        // Create a new Thread with this object.
                        Thread t = new Thread(mtch);
                        System.out.println("Adding this client to active client list");
                        // add this client to active clients
                        list ar.add(mtch);
                        // start the thread.
```

```
                    t.start();
                    // increment i for new client.
                    // i is used for naming only, and can be replaced
                    // by any naming scheme
                    i++;
                }
        }
}
// ClientHandler class
class ClientHandler implements Runnable {
        Scanner scn = new Scanner(System.in);
        private String name;
        final DataInputStream dis;
        final DataOutputStream dos;
        Socket s;
        boolean isloggedin;
        // constructor
        public ClientHandler(Socket s, String name,DataInputStream dis,DataOutputStream dos) {
                this.dis = dis;
                this.dos = dos;
                this.name = name;
                this.s = s;
                this.isloggedin=true;
        }
        @Override
        public void run() {
                String received;
                while (true)
                {
                        try
                        {
                                // receive the string
                                received = dis.readUTF();
                                System.out.println(received);
                                if(received.equals("logout")){
                                        this.isloggedin=false;
                                        this.s.close();
                                        break;
                                }
                                // break the string into message and recipient part
                                StringTokenizer st = new StringTokenizer(received, "#");
                                String MsgToSend = st.nextToken();
                                String recipient = st.nextToken();
                                // search for the recipient in the connected devices list.
                                // ar is the vector storing client of active users
```

```
                        for (ClientHandler mc : MultiChatServer.ar)
                        {
                                // if the recipient is found, write on its
                                // output stream
                                if (mc.name.equals(recipient) && mc.isloggedin==true)
                                {
                                        mc.dos.writeUTF(this.name+" : "+MsgToSend);
                                        break;
                                }
                        }
                catch (IOException e) {
                        e.printStackTrace();
                }

        }
        try
        {
                // closing resources
                this.dis.close();
                this.dos.close();
        }
        catch(IOException e){
                e.printStackTrace();
        }
    }
}
```

Output:

```
Building socketproj2 1.0-SNAPSHOT
--------------------------------[ jar ]---------------------------------

--- exec-maven-plugin:3.0.0:exec (default-cli) @ socketproj2 ---
New client request received : Socket[addr=/127.0.0.1,port=49479,localport=1234]
Creating a new handler for this client...
Adding this client to active client list
New client request received : Socket[addr=/127.0.0.1,port=49481,localport=1234]
Creating a new handler for this client...
Adding this client to active client list
hello#client 1
Hey#client 0
```

```
--------------------< com.mycompany:socketproj2 >--------------------
Building socketproj2 1.0-SNAPSHOT
--------------------------------[ jar ]---------------------------------

--- exec-maven-plugin:3.0.0:exec (default-cli) @ socketproj2 ---
hello#client 1
client 1 : Hey
```

```
---------------------< com.mycompany:socketproj2 >----------------------
[ Building socketproj2 1.0-SNAPSHOT
--------------------------------[ jar ]---------------------------------

[ --- exec-maven-plugin:3.0.0:exec (default-cli) @ socketproj2 ---
client 0 : hello
- Hey#client 0
```

7. To implement a Server calculator using RPC concept. (Make use of datagram)

Code (Client):

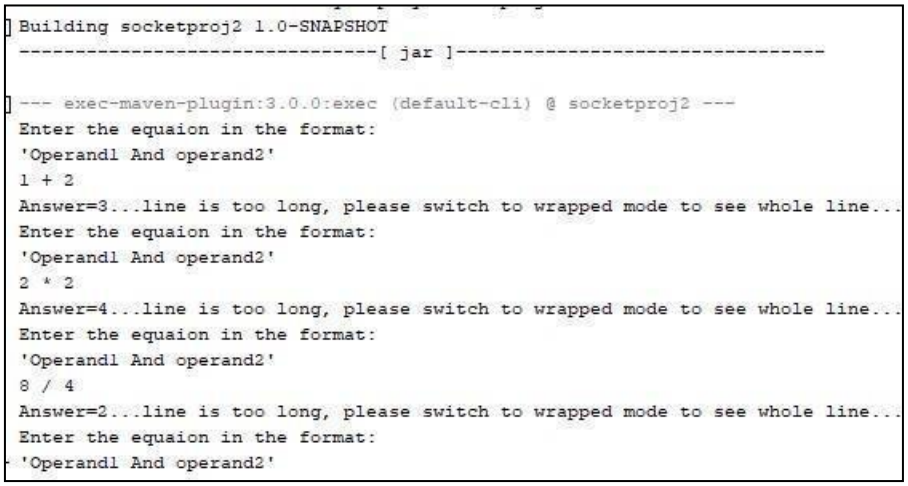
```
import java.io.IOException;
import java.net.DatagramPacket;
import java.net.DatagramSocket;
import java.net.InetAddress;
import java.util.Scanner;
public class Client {
	public static void main(String[] args)throws IOException {
		Scanner sc = new Scanner(System.in);
		DatagramSocket ds= new DatagramSocket();
		InetAddress ip=InetAddress.getLocalHost();
		byte buf[]=null;
		while(true){
			System.out.println("Enter the equaion in the format:");
			System.out.println("'Operand1 And operand2'");
			String inp=sc.nextLine();
			buf=new byte[65535];
			buf=inp.getBytes();
			DatagramPacket DpSend = new DatagramPacket(buf,buf.length, ip, 1234);
			ds.send(DpSend);
			if(inp.equals("Exit"))
				break;
			buf=new byte[65535];
			DatagramPacket DpReceive = new DatagramPacket(buf, buf.length);
			ds.receive(DpReceive);
			System.out.println("Answer="+ new String(buf,0, buf.length));
		}
	}
}
```

Code (Server):

```
import java.io.IOException;
import java.net.DatagramPacket;
import java.net.DatagramSocket;
import java.net.InetAddress;
import java.util.StringTokenizer;
public class Server {
	public static void main(String args[]) throws IOException{
		DatagramSocket ds=new DatagramSocket(1234);
		byte buf[]=null ;
		DatagramPacket DpSend=null;
		DatagramPacket DpReceive=null;
		while(true){
			buf=new byte[65535];
			DpReceive=new DatagramPacket(buf,buf.length);
```

```
                ds.receive(DpReceive);
                String inp=new String(buf, 0, buf.length);
                inp=inp.trim();
                System.out.println("Equaion Received:-"+inp);
                if(inp.equals("Exit")){
                        System.out.println("client Exiting");
                        break;
                }
                int result;
                StringTokenizer st=new StringTokenizer(inp);
                int op1=Integer.parseInt(st.nextToken());
                String operation=st.nextToken();
                int op2=Integer.parseInt(st.nextToken());
                if(operation.equals("+"))
                        result=op1+op2;
                else if(operation.equals("-"))
                        result=op1-op2;
                else if(operation.equals("*"))
                        result=op1*op2;
                else
                        result=op1/op2;
                System.out.println("Sending the result...");
                String res=Integer.toString(result);
                buf=res.getBytes();
                int port=DpReceive.getPort();
                DpSend =new DatagramPacket(buf, buf.length, InetAddress.getLocalHost(),port);
                ds.send(DpSend);
        }
    }
}
```

Output:



```
---------------------< com.mycompany:socketproj2 >----------------------
Building socketproj2 1.0-SNAPSHOT
--------------------------------[ jar ]---------------------------------

--- exec-maven-plugin:3.0.0:exec (default-cli) @ socketproj2 ---
Equaion Received:-1 + 2
Sending the result...
Equaion Received:-2 * 2
Sending the result...
Equaion Received:-8 / 4
Sending the result...
```

8. To implement a Date Time Server using RPC concept.

Code (Client):

```
import java.io.IOException;
import java.net.DatagramPacket;
import java.net.DatagramSocket;
import java.net.InetAddress;
import java.util.*;
public class UDP_Client {
	public static void main(String[] args) throws IOException {
		Scanner sc = new Scanner(System.in);
		DatagramSocket ds = new DatagramSocket();
		InetAddress ip= InetAddress.getLocalHost();
		byte buf[] = null;
		while(true){
			System.out.println("What do you want to know? Date / Time");
			String inp = sc.nextLine();
			buf = new byte[65535];
			buf = inp.getBytes();
			DatagramPacket DpSend = new DatagramPacket(buf, buf.length, ip, 1234);
			ds.send(DpSend);
			if(inp.equals("BYE"))
			break;
			buf = new byte[65535];
			DatagramPacket DpReceive = new DatagramPacket(buf,0, buf.length);
			ds.receive(DpReceive);
			System.out.println(inp+ ":" +new String(buf,0, buf.length));
		}
	}
}
```

Code (Server):

```
import java.io.IOException;
import java.net.DatagramPacket;
import java.net.DatagramSocket;
import java.net.InetAddress;
import java.util.*;
import java.text.*;
public class UDP_Server {
	public static void main(String[] args) throws IOException {
		DatagramSocket ds = new DatagramSocket(1234);
		System.out.println("the chat server is Listenting on the port 1234.  ");
		DateFormat forDate = new SimpleDateFormat("yyyy/mm/dd");
		DateFormat forTime = new SimpleDateFormat("hh:mm:ss");
		byte buf[]= null;
		DatagramPacket DpSend = null;
```

```
                DatagramPacket DpReceive = null;
                while(true){
                        String toReturn = "";
                        buf = new byte[65535];
                        DpReceive = new DatagramPacket(buf, buf.length);
                        ds.receive(DpReceive);
                        String inp = new String (buf,0 ,buf.length);
                        inp = inp.trim();
                        if(inp.equals("BYE")){
                                System.out.println("Client is saying Bye... exiting");
                                break;
                        }
                        Date date = new Date();
                        if(inp.equals("Date"))
                                toReturn = forDate.format(date);
                        else if(inp.equals("Time"))
                                toReturn = forTime.format(date);
                        System.out.println("Sending result ...");
                        buf = toReturn.getBytes();
                        int port = DpReceive.getPort();
                        DpSend = new DatagramPacket(buf, buf.length, InetAddress.getLocalHost(),port);
                        ds.send(DpSend);
                }
        }
}
```

Output:

```
--------------------< com.mycompany:socketproj2 >----------------------
Building socketproj2 1.0-SNAPSHOT
--------------------------------[ jar ]---------------------------------

--- exec-maven-plugin:3.0.0:exec (default-cli) @ socketproj2 ---
the chat server is Listenting on the port 1234.....
Sending result ...
Sending result ...
Client is saying Bye....exiting
------------------------------------------------------------------------
BUILD SUCCESS
------------------------------------------------------------------------
Total time:  24.878 s
Finished at: 2021-12-30T13:02:41+05:30
------------------------------------------------------------------------
```

```
----------------------< com.mycompany:socketproj2 >-----------------------
Building socketproj2 1.0-SNAPSHOT
--------------------------------[ jar ]---------------------------------

--- exec-maven-plugin:3.0.0:exec (default-cli) @ socketproj2 ---
What do you want to know? Date /  Time
Date
Date:2021/02/30...line is too long, please switch to wrapped mode to see whole line...
What do you want to know? Date /  Time
Time
Time:01:02:35...line is too long, please switch to wrapped mode to see whole line...
What do you want to know? Date /  Time
BYE
------------------------------------------------------------------------
BUILD SUCCESS
------------------------------------------------------------------------
Total time:  21.253 s
Finished at: 2021-12-30T13:02:41+05:30
------------------------------------------------------------------------
```

9. Using MySQL create Library database. Create table Book (Book_id, Book_name, Book_author) and retrieve the Book information from Library database using Remote Object Communication concept.

Code (Client):

```
import java.rmi.registry.LocateRegistry;
import java.rmi.registry.Registry;
import java.util.*;
public class Client {
	private Client() {}
	public static void main(String[] args)throws Exception {
		try {
			// Getting the registry
			Registry registry = LocateRegistry.getRegistry(null);
			// Looking up the registry for the remote object
			Hello stub = (Hello) registry.lookup("Hello");
			// Calling the remote method using the obtained object
			@SuppressWarnings("unchecked")
			List<Student> list = (List)stub.getStudents();
			for (Student s:list) {
				// System.out.println("bc "+s.getBranch());
				System.out.println("ID: " + s.getId());
				System.out.println("name: " + s.getName());
				System.out.println("branch: " + s.getBranch());
				System.out.println("percent: " + s.getPercent());
				System.out.println("email: " + s.getEmail());
			}
			// System.out.println(list);
		} catch (Exception e) {
			System.err.println("Client exception: " + e.toString());
			e.printStackTrace();
		}
	}
}
```

Code (Server):

```
import java.rmi.registry.Registry;
import java.rmi.registry.LocateRegistry;
import java.rmi.RemoteException;
import java.rmi.server.UnicastRemoteObject;
public class Server extends ImplExample {
	public Server() {}
```

```
	public static void main(String args[]) {
		try {
			// Instantiating the implementation class
			ImplExample obj = new ImplExample();
			// Exporting the object of implementation class (here we are exporting the remote
object to the stub)
			Hello stub = (Hello) UnicastRemoteObject.exportObject(obj, 0);
			// Binding the remote object (stub) in the registry
			Registry registry = LocateRegistry.getRegistry();
			registry.bind("Hello", stub);
			System.err.println("Server ready");
		} catch (Exception e) {
			System.err.println("Server exception: " + e.toString());
			e.printStackTrace();
		}
	}
}
```

Code (Hello):

```
import java.rmi.Remote;
import java.rmi.RemoteException;
import java.util.*;
// Creating Remote interface for our application
public interface Hello extends Remote {
	public List<Student> getStudents() throws Exception; }
```

Code (ImplExample):

```
import java.sql.*;
import java.util.*;
// Implementing the remote interface
public class ImplExample implements Hello {
	// Implementing the interface method
	`public List<Student> getStudents() throws Exception {
		List<Student> list = new ArrayList<Student>();
		// JDBC driver name and database URL
		String JDBC_DRIVER = "com.mysql.jdbc.Driver";
		String DB_URL = "jdbc:mysql://localhost:3306/details";
		// Database credentials
		String USER = "root";
		String PASS = "admin";
		Connection conn = null; Statement stmt = null;
		//Register JDBC driver
		Class.forName("com.mysql.jdbc.Driver");
		//Open a connection
```

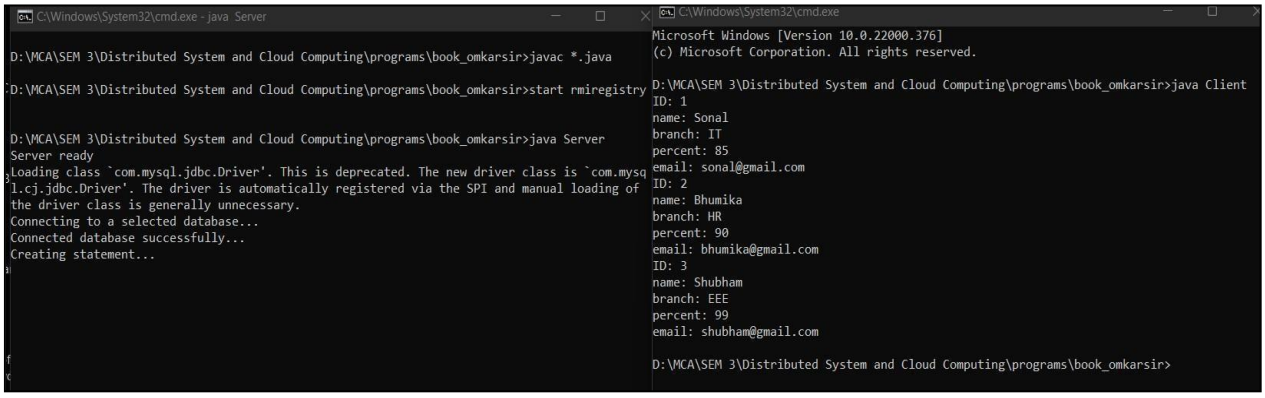
```
            System.out.println("Connecting to a selected database...");
            conn = DriverManager.getConnection(DB_URL, USER, PASS);
            System.out.println("Connected database successfully...");
            //Execute a query
            System.out.println("Creating statement...");
            stmt = conn.createStatement();
            String sql = "SELECT * FROM student_data";
            ResultSet rs = stmt.executeQuery(sql);
            //Extract data from result set
            while(rs.next()) {
                  // Retrieve by column name
                  int id = rs.getInt("id");
                  String name = rs.getString("name");
                  String branch = rs.getString("branch");
                  int percent = rs.getInt("percentage");
                  String email = rs.getString("email");
                  // Setting the values
                  Student student = new Student();
                  student.setID(id);
                  student.setName(name);
                  student.setBranch(branch);
                  student.setPercent(percent);
                  student.setEmail(email);
                  list.add(student);
            }
            rs.close();
            return list;
      }
}
```

Code (Student):

```
public class Student implements java.io.Serializable {
      private int id, percent;
      private String name, branch, email;
      public int getId() {
            return id;
      }
      public String getName() {
            return name;
      }
      public String getBranch() {
            return branch;
      }
```

```
    public int getPercent() {
        return percent;
    }
    public String getEmail() {
        return email;
    }
    public void setID(int id) {
        this.id = id;
    }
    public void setName(String name) {
        this.name = name;
    }
    public void setBranch(String branch) {
        this.branch = branch;
    }
    public void setPercent(int percent) {
        this.percent = percent;
    }
    public void setEmail(String email) {
        this.email = email;
    }
}
```

Output:



10. Using MySQL create Electric_Bill database. Create tableBill (consumer_name, bill_due_date, bill_amount) and retrieve the Bill information from the Elecrtic_Bill database using Remote Object Communication concept.

Code (Client):

```
import java.rmi.registry.LocateRegistry;
import java.rmi.registry.Registry;
import java.util.*;
public class Client {
	private Client() {}
	public static void main(String[] args)throws Exception {
		try {
			// Getting the registry
			Registry registry = LocateRegistry.getRegistry(null);
			// Looking up the registry for the remote object
			Hello stub = (Hello) registry.lookup("Hello");
			// Calling the remote method using the obtained object
			@SuppressWarnings("unchecked")
			List<Student> list = (List)stub.getStudents();
			for (Student s:list) {
			// System.out.println("bc "+s.getBranch());
			System.out.println("ID: " + s.getId());
			System.out.println("name: " + s.getName());
			System.out.println("branch: " + s.getBranch());
			//System.out.println("percent: " + s.getPercent());
			//System.out.println("email: " + s.getEmail());
		}
		// System.out.println(list);
		} catch (Exception e) {
			System.err.println("Client exception: " + e.toString());
			e.printStackTrace();
		}
	}
}
```

Code (Server):

```
import java.rmi.registry.Registry;
import java.rmi.registry.LocateRegistry;
import java.rmi.RemoteException;
import java.rmi.server.UnicastRemoteObject;
public class Server extends ImplExample {
```

```
	public Server() {}
	public static void main(String args[]) {
		try {
			// Instantiating the implementation class
			ImplExample obj = new ImplExample();
			// Exporting the object of implementation class (here we are exporting the remote
object to the stub)
			Hello stub = (Hello) UnicastRemoteObject.exportObject(obj, 0);
			// Binding the remote object (stub) in the registry
			Registry registry = LocateRegistry.getRegistry();
			registry.bind("Hello", stub);
			System.err.println("Server ready");
		} catch (Exception e) {
			System.err.println("Server exception: " + e.toString());
			e.printStackTrace();
		}
	}
}
```

Code (Hello):

```
import java.rmi.Remote;
import java.rmi.RemoteException;
import java.util.*;
// Creating Remote interface for our application
public interface Hello extends Remote {
public List<Student> getStudents() throws Exception; }
```

Code (Student):

```
public class Student implements java.io.Serializable {
	private int id, percent;
	private String name, branch, email;
	public int getId() {
		return id;
	}
	public String getName() {
		return name;
	}
	public String getBranch() {
		return branch;
	}
	public int getPercent() {
		return percent;
	}
```

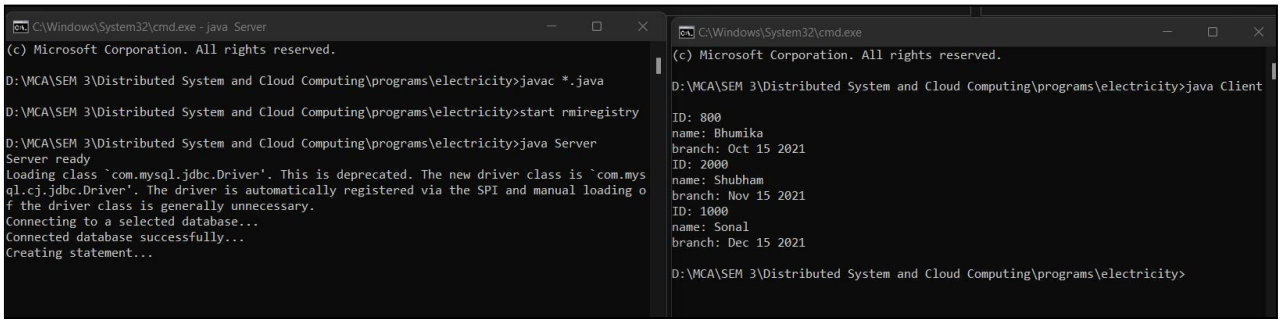
```
	public String getEmail() {
		return email;
	}
	public void setID(int id) {
		this.id = id;
	}
	public void setName(String name) {
		this.name = name;
	}
	public void setBranch(String branch) {
		this.branch = branch;
	}
	public void setPercent(int percent) {
		this.percent = percent;
	}
	public void setEmail(String email) {
		this.email = email;
	}
}
```

Code (ImplExample):

```
import java.sql.*;
import java.util.*;
// Implementing the remote interface
public class ImplExample implements Hello {
	// Implementing the interface method
	public List<Student> getStudents() throws Exception {
		List<Student> list = new ArrayList<Student>();
		// JDBC driver name and database URL
		String JDBC_DRIVER = "com.mysql.jdbc.Driver";
		String DB_URL = "jdbc:mysql://localhost:3306/details1";
		// Database credentials String USER = "root";
		String PASS = "admin";
		Connection conn = null;
		Statement stmt = null;
		//Register JDBC driver
		Class.forName("com.mysql.jdbc.Driver");
		//Open a connection
		System.out.println("Connecting to a selected database...");
		conn = DriverManager.getConnection(DB_URL, USER, PASS);
		System.out.println("Connected database successfully...");
		//Execute a query System.out.println("Creating statement...");
```

```
            stmt = conn.createStatement();
            String sql = "SELECT * FROM bill";
            ResultSet rs = stmt.executeQuery(sql);
            //Extract data from result set
            while(rs.next()) {
                  // Retrieve by column name
                  int id = rs.getInt("bill_amount");
                  String name = rs.getString("consumer_name");
                  String branch = rs.getString("bill_due_date");
                  //int percent = rs.getInt("percentage");
                  //String email = rs.getString("email");
                  // Setting the values
                  Student student = new Student();
                  student.setID(id);
                  student.setName(name);
                  student.setBranch(branch);
                  //student.setPercent(percent);
                  //student.setEmail(email);
                  list.add(student);
            }
            rs.close();
            return list;
      }
}
```

Output:



11. To develop applications using Google App Engine by using Eclipse IDE.

Steps:

1. Open any browser of your choice, go to cloud.google.com, login to your google account.
2. At the Top Right hand side click on Console, Click on Current Project -> Click on New Project.
3. Under Project Name -> Enter name of application -> Click on Create.
4. When the project is created, At top Right There is a icon of "Activate Cloud Shell" ->Click on it.
5. When the terminal is opened, Enter command "mkdir symca".
6. Click on Open Editor -> Click on New File - > Enter file name "demo.java" -> Then select our directory "symca" -> Click on OK.
7. When the file is created -> Enter the following code :

```
public class demo{
public static void main(String[] args) {
   System.out.println("Atharva Kale C22059 NMITD");
   }
}
```

8. Save the file "demo.java" -> Then click on Open Terminal
9. Enter command "cd symca" and press Enter
10. Enter command "javac demo.java" and press enter
11. Enter command "java demo" and press enter

Output:

```
atharvakale9@cloudshell:~/symca (javaproject-408608)$ javac demo.java
atharvakale9@cloudshell:~/symca (javaproject-408608)$ java demo
Atharva Kale C22059 NMITD
atharvakale9@cloudshell:~/symca (javaproject-408608)$
```