1) Remote Simple Calculator – The server was created using the Server Socket Class in Java.

Server.java

```
import java.io.IOException;
import java.net.ServerSocket;
import java.net.Socket;
import java.util.Scanner;
import java.lang.*;
import java.io.*;

public class Server{
   public static void main(String[] args){
    try{
      ServerSocket serverSocket = new ServerSocket(4444);
      System.out.println("Server Started...");
      while(true){
        new Thread(new ClientConnectionThread(serverSocket.accept())).start();
      }

    }catch(IOException e) {e.printStackTrace();}

   }

}
class ClientConnectionThread implements Runnable{
   private Socket socket;
   public ClientConnectionThread(Socket socket){
      this.socket = socket;
   }
   @Override
   public void run(){
      try{
          DataInputStream dIn = new DataInputStream(socket.getInputStream());
          DataOutputStream dOut = new DataOutputStream(socket.getOutputStream());
          String message = dIn.readUTF();

          System.out.println("Client Request : " + message);
          String[] input = message.split(" ");
          String result = input[0] + " " + input[2] + " " + input[1] + " = " +
calculate(Integer.parseInt(input[0]), Integer.parseInt(input[1]), input[2]);
          System.out.println("Server Response : " + result);

          dOut.writeUTF(result);
          dOut.flush();
          dOut.close();
          socket.close();
      }catch(IOException e) {e.printStackTrace();}
   }

   public static String calculate (int num1, int num2, String operator) {
      Integer result = 0;
      switch (operator.charAt(0)){
         case '+':
            result = num1 + num2;
            break;
         case '-':
            result = num1 - num2;
            break;
         case '*':
            result = num1 * num2;
            break;
         case '/':
            result = num1 / num2;
            break;
      }
      return Integer.toString(result);

   }
}
```

Android Client App: We had to make changes to the Manifest File → AndroidManifest.xml

```xml
<?xml version="1.0" encoding="utf-8"?>
<manifest xmlns:android="http://schemas.android.com/apk/res/android"
    package="example.rndnumberclient">
    <uses-permission android:name="android.permission.INTERNET"/>
    <uses-permission android:name="android.permission.ACCESS_NETWORK_STATE"/>
    <uses-permission android:name="android.permission.ACCESS_WIFI_STATE"/>
    <uses-permission android:name="android.permission.CHANGE_WIFI_STATE"/>

    <application
        android:allowBackup="true"
        android:icon="@mipmap/ic_launcher"
        android:label="@string/app_name"
        android:roundIcon="@mipmap/ic_launcher_round"
        android:supportsRtl="true"
        android:theme="@style/AppTheme">
        <activity android:name=".MainActivity">
            <intent-filter>
                <action android:name="android.intent.action.MAIN" />

                <category android:name="android.intent.category.LAUNCHER" />
            </intent-filter>
        </activity>
    </application>

</manifest>
```

MainActivity.java

```java
package example.rndnumberclient;

import android.support.v7.app.AppCompatActivity;
import android.os.Bundle;
import android.text.TextUtils;
import android.view.View;
import android.widget.EditText;
import android.widget.Button;
import android.widget.TextView;
import java.io.IOException;
import java.net.Socket;
import java.io.*;
import java.net.UnknownHostException;
import java.lang.*;

public class MainActivity extends AppCompatActivity implements View.OnClickListener {

    EditText n;
    EditText max;
    EditText min;
    TextView displayResult;
    Button submit;
    MainActivity activity;
    Socket socket;
    String response = "";

    /** Called when first created. */

    @Override
    public void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.activity_main);
```

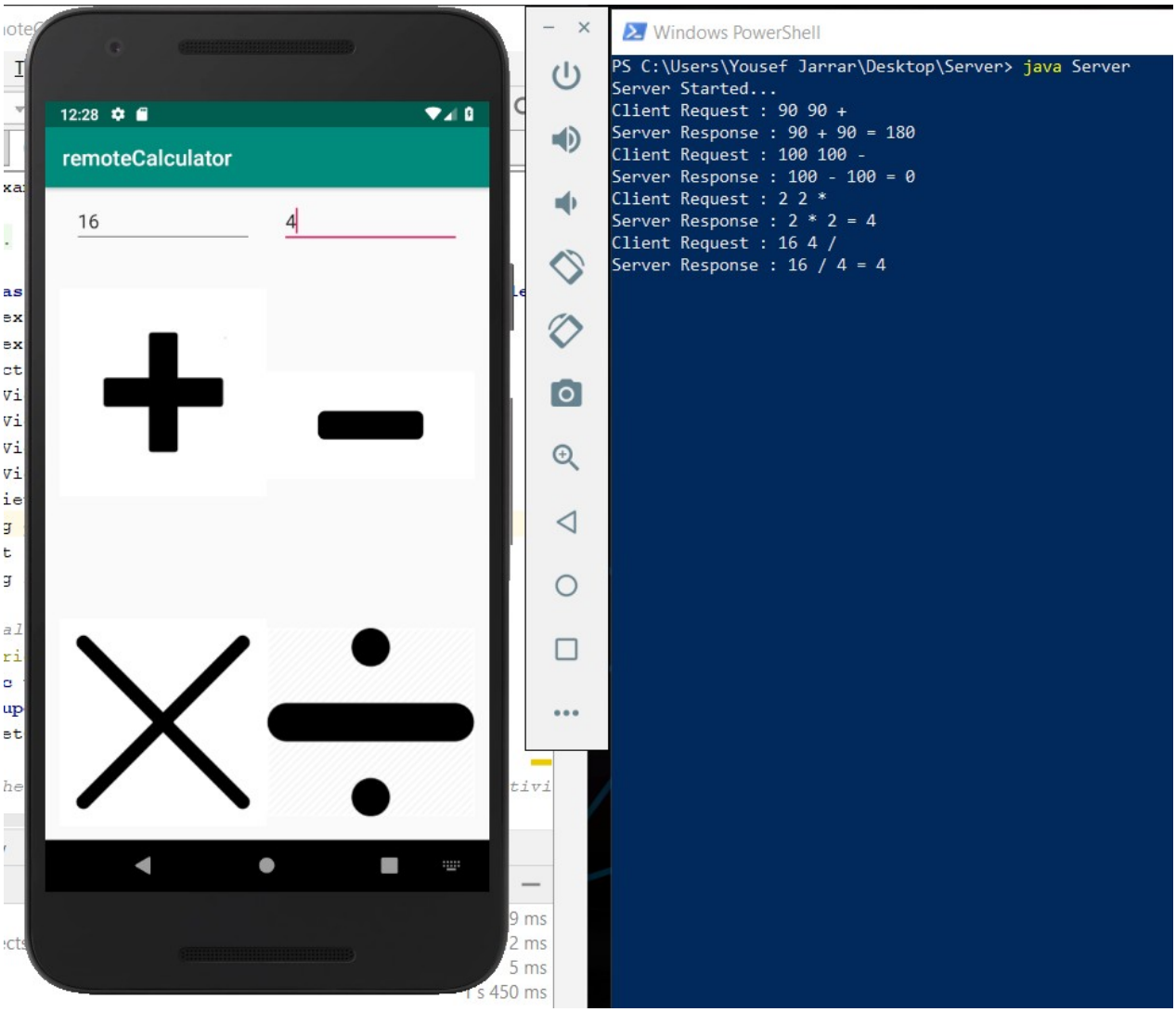
```
        // find the EditText elements (defined in res/layout/activity_main.xml

        n = (EditText) findViewById(R.id.editText);
        min = (EditText) findViewById(R.id.editText2);
        max = (EditText) findViewById(R.id.editText3);
        submit = (Button) findViewById(R.id.button);
        displayResult = (TextView) findViewById(R.id.displayResult);
        // set listeners
        submit.setOnClickListener(this);
    }
    // @Override
    public void onClick( View view ) {
        // check if the fields are empty
        if (TextUtils.isEmpty(n.getText().toString())
                || TextUtils.isEmpty(min.getText().toString()) ||
                TextUtils.isEmpty(max.getText().toString())) {
            return;
        }
        new Thread(new Runnable() {
            @Override
            public void run() {
                try {
                    response = "";
                    socket = new Socket("10.0.2.2", 4455);
                    DataOutputStream dOut = new
                            DataOutputStream(socket.getOutputStream());
                    DataInputStream dIn = new
                            DataInputStream(socket.getInputStream());
                    dOut.writeUTF(n.getText() + " " + min.getText() +
                            " " + max.getText());
                    dOut.flush();
                    response = dIn.readUTF();
                    runOnUiThread(new Runnable() {
                        @Override
                        public void run() {
                            displayResult.setText(response);
                        }
                    });
                    dIn.close();
                    dOut.close();
                    socket.close();
                }
                catch (UnknownHostException e) {
                    e.printStackTrace();
                    displayResult.setText("UnknownHostException: " + e.toString());
                } catch (IOException e) {
                    e.printStackTrace();
                    displayResult.setText("IOException: " + e.toString());
                }
            }
        }).start();
    }

}
```

Activity_Main.xml

```
<?xml version="1.0" encoding="utf-8"?>
<LinearLayout
    xmlns:android="http://schemas.android.com/apk/res/android"
            android:orientation="vertical"
            android:layout_width="fill_parent"
            android:layout_height="fill_parent">
<LinearLayout
        android:layout_width="match_parent"
                android:layout_height="match_parent"
                android:orientation="vertical">
<EditText
            android:id="@+id/editText"
                    android:layout_width="match_parent"
                    android:layout_height="wrap_content"
                    android:layout_weight="0.99"
                    android:ems="10"
                    android:inputType="textPersonName"
                    android:text="Enter Number" />
<EditText
            android:id="@+id/editText2"
```

```
                    android:layout_width="match_parent"
                    android:layout_height="wrap_content"
                    android:layout_weight="1"
                    android:ems="10"
                    android:inputType="textPersonName"
                    android:text="LowerBound" />
<EditText
            android:id="@+id/editText3"
                    android:layout_width="match_parent"
                    android:layout_height="wrap_content"
                    android:layout_weight="1"
                    android:ems="10"
                    android:inputType="textPersonName"
                    android:text="UpperBound" />
<Button
            android:id="@+id/button"
                    android:layout_width="match_parent"
                    android:layout_height="46dp"
                    android:layout_weight="1"
                    android:backgroundTint="@android:color/holo_blue_dark"
                    android:text="Submit" />
<TextView
            android:id="@+id/displayResult"

                    android:layout_width="match_parent"
                    android:layout_height="116dp"
                    android:layout_weight="1"
                    android:text="TextView" />
</LinearLayout>
</LinearLayout>
```

Output:



Learning:

In section one of the lab we learned how to create a simple calculator and a server to communicate with the application. We were able to implement a basic calculator with its functions. Using remote java server program we successfully implemented RMI. Above is a sample of how the application contacted the server.

2) Remote Random Number Generator

RandomNumberServer.java

```
import java.io.IOException;
import java.net.ServerSocket;
import java.net.Socket;
import java.util.Scanner;
import java.lang.*;
import java.io.*;
import java.util.Random;
import java.util.Arrays;

public class RandomNumberServer {
    public static void main(String[] args) {
        try{
            ServerSocket serverSocket = new ServerSocket(4444);
            System.out.println("Server Started...");
            while(true){
                new Thread(new ClientConnection(serverSocket.accept())).start();
            }
        }catch(IOException e){e.printStackTrace();}
    }
}
class ClientConnection implements Runnable{
    private Socket socket;
    public ClientConnection(Socket socket){
        this.socket = socket;
    }
    @Override
    public void run(){
        try{
            DataInputStream dIn = new DataInputStream(socket.getInputStream());
            DataOutputStream dOut = new DataOutputStream(socket.getOutputStream());
            String message = dIn.readUTF();
            System.out.println("Client Request : " + message);
            String[] input = message.split(" ");
            String result = generateRandom(Integer.parseInt(input[0]),Integer.parseInt(input[1]),
Integer.parseInt(input[2]));
            System.out.println("Server Response : " + result);
            dOut.writeUTF(result);
            dOut.flush();
            dOut.close();
            socket.close();
        }catch(IOException e){e.printStackTrace();}
    }
    public static String generateRandom(int num, int min, int max ) {
        int range = (max - min) + 1;
        String response ="";
        for(int i=0;i<num;i++) {
            response += Integer.toString((int)(Math.random() * range) + min) + " ";
        }
        return response;
    }
}
```

Client:

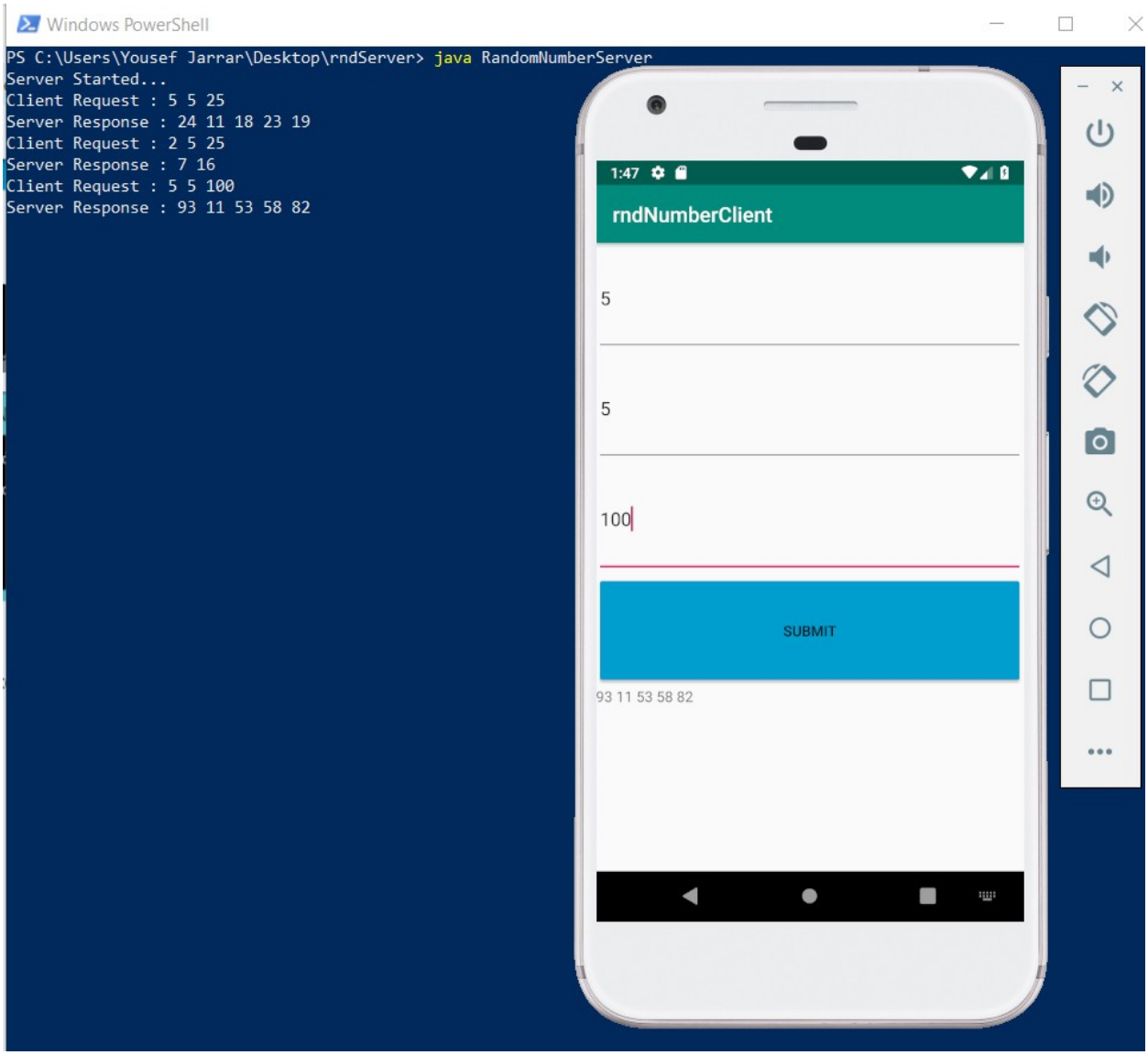
```
package example.rndnumberclient;

import android.support.v7.app.AppCompatActivity;
import android.os.Bundle;
import android.text.TextUtils;
import android.view.View;
import android.widget.EditText;
import android.widget.Button;
import android.widget.TextView;
import java.io.IOException;
import java.net.Socket;
import java.io.*;
import java.net.UnknownHostException;
import java.lang.*;

public class MainActivity extends AppCompatActivity implements View.OnClickListener {

    EditText n;
```

```
    EditText max;
    EditText min;
    TextView displayResult;
    Button submit;
    MainActivity activity;
    Socket socket;
    String response = "";

    /** Called when first created. */

    @Override
    public void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.activity_main);

        // find the EditText elements (defined in res/layout/activity_main.xml

        n = (EditText) findViewById(R.id.editText);
        min = (EditText) findViewById(R.id.editText2);
        max = (EditText) findViewById(R.id.editText3);
        submit = (Button) findViewById(R.id.button);
        displayResult = (TextView) findViewById(R.id.displayResult);
        // set listeners
        submit.setOnClickListener(this);
    }
    // @Override
    public void onClick( View view ) {
        // check if the fields are empty
        if (TextUtils.isEmpty(n.getText().toString())
                || TextUtils.isEmpty(min.getText().toString()) ||
                TextUtils.isEmpty(max.getText().toString())) {
            return;
        }
        new Thread(new Runnable() {
            @Override
            public void run() {
                try {
                    response = "";
                    socket = new Socket("10.0.2.2", 4455);
                    DataOutputStream dOut = new
                            DataOutputStream(socket.getOutputStream());
                    DataInputStream dIn = new
                            DataInputStream(socket.getInputStream());
                    dOut.writeUTF(n.getText() + " " + min.getText() +
                            " " + max.getText());
                    dOut.flush();
                    response = dIn.readUTF();
                    runOnUiThread(new Runnable() {
                        @Override
                        public void run() {
                            displayResult.setText(response);
                        }
                    });
                    dIn.close();
                    dOut.close();
                    socket.close();
                }
                catch (UnknownHostException e) {
                    e.printStackTrace();
                    displayResult.setText("UnknownHostException: " + e.toString());
                } catch (IOException e) {
                    e.printStackTrace();
                    displayResult.setText("IOException: " + e.toString());
                }
            }
        }).start();
    }

}
```

UI.xml

```
<?xml version="1.0" encoding="utf-8"?>
<LinearLayout
    xmlns:android="http://schemas.android.com/apk/res/android"
    android:orientation="vertical"
    android:layout_width="fill_parent"
    android:layout_height="fill_parent">
```

```
    <LinearLayout
        android:layout_width="match_parent"
        android:layout_height="match_parent"
        android:orientation="vertical">
        <EditText
            android:id="@+id/editText"
            android:layout_width="match_parent"
            android:layout_height="wrap_content"
            android:layout_weight="0.99"
            android:ems="10"
            android:inputType="textPersonName"
            android:text="Enter Number" />
        <EditText
            android:id="@+id/editText2"
            android:layout_width="match_parent"
            android:layout_height="wrap_content"
            android:layout_weight="1"
            android:ems="10"
            android:inputType="textPersonName"
            android:text="LowerBound" />
        <EditText
            android:id="@+id/editText3"
            android:layout_width="match_parent"
            android:layout_height="wrap_content"
            android:layout_weight="1"
            android:ems="10"
            android:inputType="textPersonName"
            android:text="UpperBound" />
        <Button
            android:id="@+id/button"
            android:layout_width="match_parent"
            android:layout_height="46dp"
            android:layout_weight="1"
            android:backgroundTint="@android:color/holo_blue_dark"
            android:text="Submit" />
        <TextView
            android:id="@+id/displayResult"

            android:layout_width="match_parent"
            android:layout_height="116dp"
            android:layout_weight="1"
            android:text="TextView" />
    </LinearLayout>
</LinearLayout>
```



Outcome:

Jose and I were able to accomplish both sections of the lab. Our biggest difficulty was being able to understand how the client communicates with the server. We had to understand that the manifest of the app had to be changed, in order for it to communicate with the server. We also had to understand that based on RPC/RMI calls we had to include IP:PORT to it. Developing the application was not as hard as the last. I think we deserve full points on this lab. 20/20