EXPERIMENT 14

IMPLEMENTING TCP CLIENT/SERVER APPLICATION IN SOCKET PROGRAMMING

OBJECTIVE:

- Make a simple Client- Server Application using Socket API

Example TCP Server

The following is an example of a networked TCP server and associated client. The server opens a passive socket and listens for connection requests from clients. This is a very simple server: it accepts at most one connection request. Once a client connects, the server sends the message "Hello there!" to the client and shuts down.The client is not expected to send anything to the server. It simply connects, reads the server's "reply," and prints it out.

```
#include <stdlib.h>
#include <sys/socket.h>
#include <arpa/inet.h>
#include <unistd.h>
#include <string.h>
#include      <iostream>
#include <stdio.h> using
namespace std;
int main(int argc, char** argv)
{            int
server_sock; int
client_sock; int
error;


//create the server socket
server_sock = socket(PF_INET, SOCK_STREAM, 0);


// Need an address to bind the server socket to struct
sockaddr_in server_address;
memset(&server_address,    '\0',    sizeof(server_address));
server_address.sin_addr.s_addr   =   inet_addr("127.0.0.1");
server_address.sin_family = PF_INET; server_address.sin_port
= htons(2222);


// bind the server socket to a local address
error = bind(server_sock,(struct sockaddr *)&server_address,
sizeof(server_address)); if (error == -1)
{  perror("bind  failed.");  return
1;
}
```

```
// listen for a connection error
= listen(server_sock, 10); if
(error == -1)
{ perror("listen failed."); return
3; }
cerr << "Now listening for connections...\n" ;


// accept a connection struct sockaddr_in client_address;
socklen_t   client_addr_len;   error   =   client_sock   =
accept(server_sock,(struct sockaddr *)
&client_address, &client_addr_len); if
(error == -1)
{ perror("accept failed."); return
0; }
cerr << "Connection request received.\n";

write(client_sock, "hello there!", 12); close(client_sock);
close(server_sock);
return  0;
}
```

TCP Client

This is the client to go along with the server just shown.

```
#include <stdlib.h>
#include <sys/socket.h>
#include <arpa/inet.h>
#include <unistd.h>
#include <string.h>
#include    <iostream>
#include<stdio.h> using
namespace std;
int main(int argc, char** argv)
{           int
client_sock; int
error;


//create the client socket
client_sock = socket(PF_INET, SOCK_STREAM, 0);


// Need the address of the server to connect to struct
sockaddr_in server_address; memset(&server_address, 0,
sizeof(server_address));
server_address.sin_addr.s_addr =
inet_addr("127.0.0.1"); server_address.sin_family
= PF_INET; server_address.sin_port = htons(2222);
```

```
//connect to the server error = connect(client_sock, (struct
sockaddr *)&server_address, sizeof(server_address)); if (error
== -1)
{perror("Failed to connect.");
return 1; } cout << "Here is the message from the
server:\n "; char ch; while (read(client_sock,
&ch, 1) > 0)
{
write(1, &ch, 1);
}
close(client_sock);
return 0; }
```

This server and client use 127.0.0.1 for the IP address of the server, and both assume that the server is running at port 2222.

TASK

Modify the server and client above so that server computes and sends back to the client the square of any integer that the client sends. The protocol is binary, and is as follows:

1. Client connects and sends a single integer in binary form.
2. Server reads the integer and sends back a single integer, the square of the received integer, also in binary form.
3. The server closes the connection to the client.

The server will be a single-threaded server that serializes service to its clients. The server will stay in a loop in which it accepts a connection, reads the integer sent through the connection, and sends back the integer square through the same connection. After that, the server closes the connection and goes back to wait for another connection.

The client should ask the user for an integer, read the integer, open a connection to the server, and send the integer. Then it should read the reply and print it (the square) to the screen.

Test your server and client on your own machine by using two different terminals and paste your modified code along with screenshot of your output in the space provided below.

Server

```
#include <stdlib.h>
#include <sys/socket.h>
```

```
#include <arpa/inet.h>
#include <unistd.h>
#include <string.h>
#include <iostream>
using namespace std;

int main() {
    int server_sock, client_sock, error;

    // Create server socket
    server_sock = socket(PF_INET, SOCK_STREAM, 0);

    struct sockaddr_in server_address;
    memset(&server_address, 0, sizeof(server_address));

    server_address.sin_addr.s_addr = inet_addr("127.0.0.1");
    server_address.sin_family = PF_INET;
    server_address.sin_port = htons(2222);

    // Bind socket
    error = bind(server_sock, (struct sockaddr *)&server_address,
                 sizeof(server_address));
    if (error == -1) {
        perror("Bind failed");
        return 1;
    }

    // Listen
    error = listen(server_sock, 10);
    if (error == -1) {
        perror("Listen failed");
        return 2;
    }

    cout << "Server is running. Waiting for connections...\n";

    // Server loop
    while (1) {
        struct sockaddr_in client_address;
        socklen_t client_len = sizeof(client_address);

        // Accept connection
        client_sock = accept(server_sock,
                             (struct sockaddr*)&client_address,
                             &client_len);

        if (client_sock < 0) {
            perror("Accept failed");
            continue;
        }

        cout << "Client connected.\n";
```

```
        // Receive integer
        int number;
        read(client_sock, &number, sizeof(number));

        cout << "Received number: " << number << endl;

        // Compute square
        int result = number * number;

        // Send result back
        write(client_sock, &result, sizeof(result));

        close(client_sock);
        cout << "Connection closed.\n\n";
    }

    close(server_sock);
    return 0;
}
```

Clinet

```
#include <stdlib.h>
#include <sys/socket.h>
#include <arpa/inet.h>
#include <unistd.h>
#include <string.h>
#include <iostream>
using namespace std;

int main() {
    int client_sock, error;
    int number, result;

    // Ask user for integer
    cout << "Enter an integer: ";
    cin >> number;

    // Create client socket
    client_sock = socket(PF_INET, SOCK_STREAM, 0);

    struct sockaddr_in server_address;
    memset(&server_address, 0, sizeof(server_address));

    server_address.sin_addr.s_addr = inet_addr("127.0.0.1");
    server_address.sin_family = PF_INET;
    server_address.sin_port = htons(2222);

    // Connect to server
    error = connect(client_sock, (struct sockaddr*)&server_address,
```

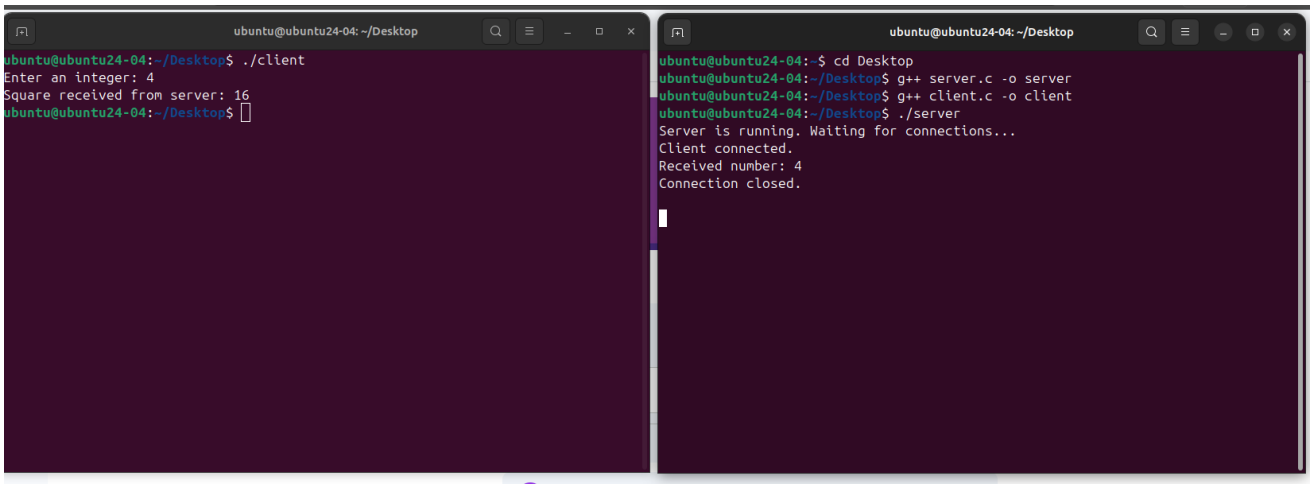
```
                sizeof(server_address));
    if (error == -1) {
        perror("Connection failed");
        return 1;
    }

    // Send integer to server
    write(client_sock, &number, sizeof(number));

    // Receive squared result
    read(client_sock, &result, sizeof(result));

    cout << "Square received from server: " << result << endl;

    close(client_sock);
    return 0;
}
```



POST LAB QUESTION:

Modify the server and client of part 1 so that the client can ask the server to compute either a square or a cube. Use a binary protocol as follows. To request computation of the square of *x*, the client sends

<integer 6><string square><integer x>

That is, it sends an integer in binary form for the length of a string, then sends the characters of the string, and then sends the integer argument in binary form. Requesting computation of a cube is similar: the client sends

<integer 4><string cube><integer x>

These are the length of the string "cube", the string "cube" itself, and then the argument in binary form.