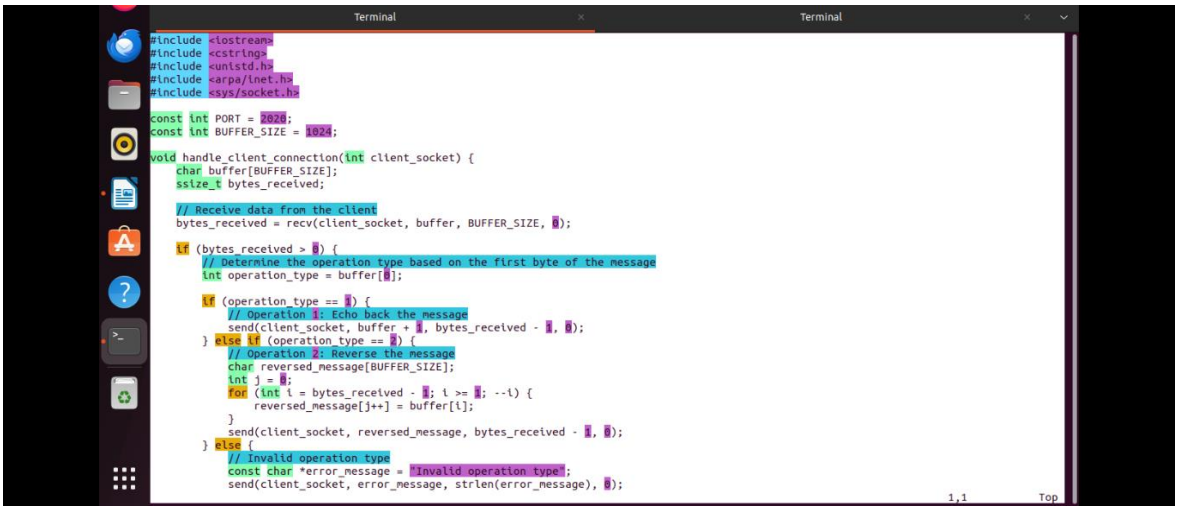
Day – 6 LSP : Test

Assignment Task -1

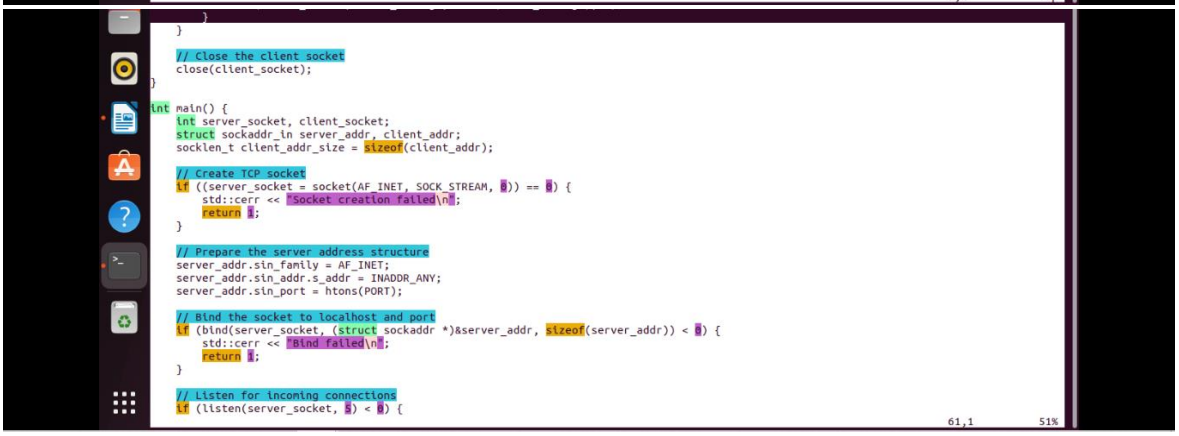
1. TCP Server with Custom Protocol:

Implement a TCP server that:
Binds to port 2020. Listens for incoming connections.
Implements a simple custom protocol where:
The first byte of the message indicates the type of operation (e.g., 1 for echo, 2 for reverse).
For operation type 1, the server echoes the message back.
For operation type 2, the server sends back the reversed message.
Closes the connection and terminates.

Tcp client



```
#include <iostream>
#include <cstring>
#include <unistd.h>
#include <arpa/inet.h>
#include <sys/socket.h>

const int PORT = 2020;
const int BUFFER_SIZE = 1024;

void handle_client_connection(int client_socket) {
    char buffer[BUFFER_SIZE];
    ssize_t bytes_received;

    // Receive data from the client
    bytes_received = recv(client_socket, buffer, BUFFER_SIZE, 0);

    if (bytes_received > 0) {
        // Determine the operation type based on the first byte of the message
        int operation_type = buffer[0];

        if (operation_type == 1) {
            // Operation 1: Echo back the message
            send(client_socket, buffer + 1, bytes_received - 1, 0);
        } else if (operation_type == 2) {
            // Operation 2: Reverse the message
            char reversed_message[BUFFER_SIZE];
            int j = 0;
            for (int i = bytes_received - 1; i >= 1; --i) {
                reversed_message[j++] = buffer[i];
            }
            send(client_socket, reversed_message, bytes_received - 1, 0);
        } else {
            // Invalid operation type
            const char *error_message = "Invalid operation type";
            send(client_socket, error_message, strlen(error_message), 0);
```



```
    }

    // Close the client socket
    close(client_socket);
}

int main() {
    int server_socket, client_socket;
    struct sockaddr_in server_addr, client_addr;
    socklen_t client_addr_size = sizeof(client_addr);

    // Create TCP socket
    if ((server_socket = socket(AF_INET, SOCK_STREAM, 0)) == 0) {
        std::cerr << "Socket creation failed\n";
        return 1;
    }

    // Prepare the server address structure
    server_addr.sin_family = AF_INET;
    server_addr.sin_addr.s_addr = INADDR_ANY;
    server_addr.sin_port = htons(PORT);

    // Bind the socket to localhost and port
    if (bind(server_socket, (struct sockaddr *)&server_addr, sizeof(server_addr)) < 0) {
        std::cerr << "Bind failed\n";
        return 1;
    }

    // Listen for incoming connections
    if (listen(server_socket, 5) < 0) {
```

```
    if (listen(server_socket, 5) < 0) {
        std::cerr << "Listen failed\n";
        return 1;
    }

    std::cout << "Server listening on port " << PORT << "...\n";

    while (true) {
        // Accept incoming connection
        if ((client_socket = accept(server_socket, (struct sockaddr *)&client_addr, &client_addr_size)) < 0) {
            std::cerr << "Accept failed\n";
            return 1;
        }

        char client_ip[INET_ADDRSTRLEN];
        inet_ntop(AF_INET, &client_addr.sin_addr, client_ip, INET_ADDRSTRLEN);
        std::cout << "Accepted connection from " << client_ip << ":" << ntohs(client_addr.sin_port) << std::endl;

        // Handle client connection
        handle_client_connection(client_socket);

        std::cout << "Connection from " << client_ip << ":" << ntohs(client_addr.sin_port) << " closed.\n";
    }

    // Close the server socket
                                                                                    85,1          91%
```

Tcp_client

```
Activities   Terminal                                   Jul 25  15:06
Terminal
Terminal                                                Terminal
#include <iostream>
#include <sys/types.h>
#include <sys/socket.h>
#include <netinet/in.h>
#include <arpa/inet.h>
#include <unistd.h>
#include <cstring>

#define PORT 8080

int main() {
    int sock = 0, valread;
    struct sockaddr_in serv_addr;
    const char *hello = "Hello from client";
    char buffer[1024] = {0};

    // Creating socket file descriptor
    if ((sock = socket(AF_INET, SOCK_STREAM, 0)) < 0) {
        std::cerr << "Socket creation error" << std::endl;
        return -1;
    }

    // Set server address information
    serv_addr.sin_family = AF_INET;
    serv_addr.sin_port = htons(PORT);

    // Convert IPv4 address from text to binary form
    if (inet_pton(AF_INET, "127.0.0.1", &serv_addr.sin_addr) <= 0) {
        std::cerr << "Invalid address/ Address not supported" << std::endl;
        return -1;
    }

    // Connect to server
    if (connect(sock, (struct sockaddr *)&serv_addr, sizeof(serv_addr)) < 0) {
        std::cerr << "Connection Failed" << std::endl;
"socket_client.cpp" 51L, 1343B                                                      6,1           Top
```

Execution :

```
-rwxrwxr-x 1 rps rps 16976 Jul 25 14:47 socket_sig_client
rps@rps-virtual-machine:~/socket$ vim echo_response.cpp
rps@rps-virtual-machine:~/socket$ mv echo_response.cpp tcp_server.cpp
rps@rps-virtual-machine:~/socket$ g++ -o tcp_server tcp_server.cpp
/usr/bin/ld: /usr/lib/gcc/x86_64-linux-gnu/11/../../../x86_64-linux-gnu/Scrt1.o: in function `_start':
(.text+0x1b): undefined reference to `main'
collect2: error: ld returned 1 exit status
rps@rps-virtual-machine:~/socket$ vim tcp_server.cpp
rps@rps-virtual-machine:~/socket$ g++ -o tcp_server tcp_server.cpp
rps@rps-virtual-machine:~/socket$ ./tcp_server
Server listening on port 2020...
hello
Accepted connection from 127.0.0.1:34046
Connection from 127.0.0.1:34046 closed.
```

```
Terminal                                                Terminal
rps@rps-virtual-machine:~/socket$ vim tcp_client.cpp
rps@rps-virtual-machine:~/socket$ g++ -o tcp_client tcp_client.cpp
rps@rps-virtual-machine:~/socket$ ./tcp_client
Connected to server 127.0.0.1:2020
Enter message: Hello How are you ?
Enter operation type (1 for echo, 2 for reverse): 1
Server response: Hello How are you ??
                                                        r
rps@rps-virtual-machine:~/socket$
```

Assignment Task -2

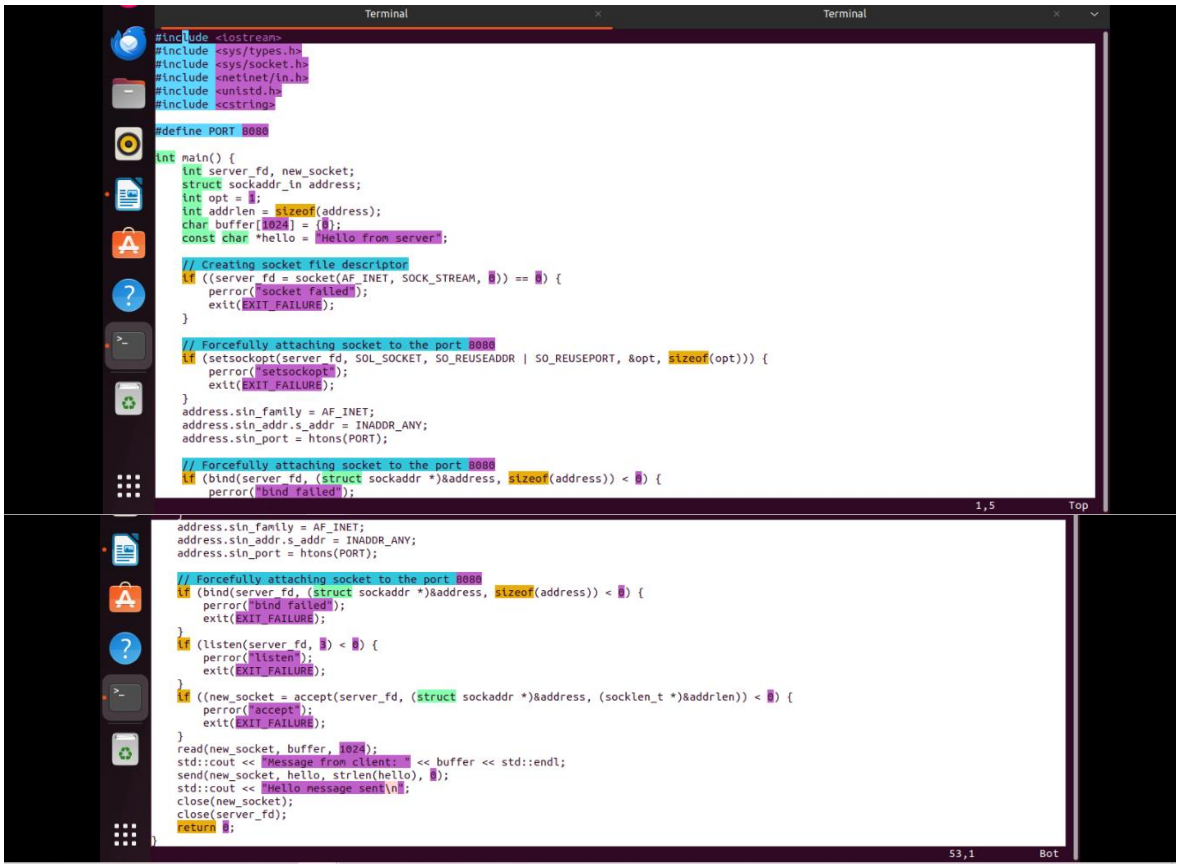
Objective:

Create a C++ application that combines signal handling and socket programming to manage network communication while gracefully handling interruptions (e.g., SIGINT for program termination). The application should be capable of sending and receiving messages over a network while responding appropriately to system signals.

Requirements:

1. **Socket Programming:**
   Implement a TCP server that listens for incoming connections on a specified port.
   Implement a TCP client that connects to the server and exchanges messages.

   a. **TCP Server**



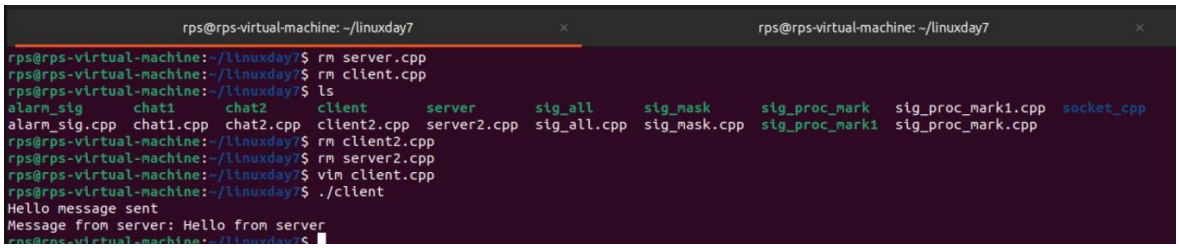
```
#include <iostream>
#include <sys/types.h>
#include <sys/socket.h>
#include <netinet/in.h>
#include <unistd.h>
#include <cstring>

#define PORT 8080

int main() {
    int server_fd, new_socket;
    struct sockaddr_in address;
    int opt = 1;
    int addrlen = sizeof(address);
    char buffer[1024] = {0};
    const char *hello = "Hello from server";

    // Creating socket file descriptor
    if ((server_fd = socket(AF_INET, SOCK_STREAM, 0)) == 0) {
        perror("socket failed");
        exit(EXIT_FAILURE);
    }

    // Forcefully attaching socket to the port 8080
    if (setsockopt(server_fd, SOL_SOCKET, SO_REUSEADDR | SO_REUSEPORT, &opt, sizeof(opt))) {
        perror("setsockopt");
        exit(EXIT_FAILURE);
    }
    address.sin_family = AF_INET;
    address.sin_addr.s_addr = INADDR_ANY;
    address.sin_port = htons(PORT);

    // Forcefully attaching socket to the port 8080
    if (bind(server_fd, (struct sockaddr *)&address, sizeof(address)) < 0) {
        perror("bind failed");
```

```
    address.sin_family = AF_INET;
    address.sin_addr.s_addr = INADDR_ANY;
    address.sin_port = htons(PORT);

    // Forcefully attaching socket to the port 8080
    if (bind(server_fd, (struct sockaddr *)&address, sizeof(address)) < 0) {
        perror("bind failed");
        exit(EXIT_FAILURE);
    }
    if (listen(server_fd, 3) < 0) {
        perror("listen");
        exit(EXIT_FAILURE);
    }
    if ((new_socket = accept(server_fd, (struct sockaddr *)&address, (socklen_t *)&addrlen)) < 0) {
        perror("accept");
        exit(EXIT_FAILURE);
    }
    read(new_socket, buffer, 1024);
    std::cout << "Message from client: " << buffer << std::endl;
    send(new_socket, hello, strlen(hello), 0);
    std::cout << "Hello message sent\n";
    close(new_socket);
    close(server_fd);
    return 0;
}
```

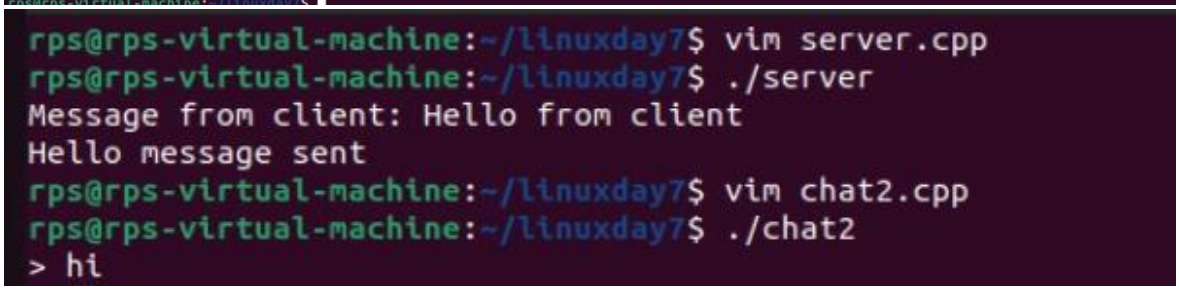
b. TCP Client

```
#include <iostream>
#include <sys/types.h>
#include <sys/socket.h>
#include <netinet/in.h>
#include <arpa/inet.h>
#include <unistd.h>
#include <cstring>

#define PORT 8080

int main() {
    int sock = 0, valread;
    struct sockaddr_in serv_addr;
    const char *hello = "Hello from client";
    char buffer[1024] = {0};

    // Creating socket file descriptor
    if ((sock = socket(AF_INET, SOCK_STREAM, 0)) < 0) {
        std::cerr << "Socket creation error" << std::endl;
        return -1;
    }

    // Set server address information
    serv_addr.sin_family = AF_INET;
    serv_addr.sin_port = htons(PORT);

    // Convert IPv4 address from text to binary form
    if (inet_pton(AF_INET, "127.0.0.1", &serv_addr.sin_addr) <= 0) {
        std::cerr << "Invalid address/ Address not supported" << std::endl;
        return -1;
    }

    // Connect to server
    if (connect(sock, (struct sockaddr *)&serv_addr, sizeof(serv_addr)) < 0) {
        std::cerr << "Connection Failed" << std::endl;
"socket_client.cpp" 51L, 1343B                                          6,1          Top
```

Execution :



```
rps@rps-virtual-machine: ~/linuxday7        rps@rps-virtual-machine: ~/linuxday7
rps@rps-virtual-machine:~/linuxday7$ rm server.cpp
rps@rps-virtual-machine:~/linuxday7$ rm client.cpp
rps@rps-virtual-machine:~/linuxday7$ ls
alarm_sig      chat1      chat2      client      server      sig_all      sig_mask      sig_proc_mark   sig_proc_mark1.cpp  socket_cpp
alarm_sig.cpp  chat1.cpp  chat2.cpp  client2.cpp server2.cpp sig_all.cpp sig_mask.cpp sig_proc_mark1  sig_proc_mark.cpp
rps@rps-virtual-machine:~/linuxday7$ rm client2.cpp
rps@rps-virtual-machine:~/linuxday7$ rm server2.cpp
rps@rps-virtual-machine:~/linuxday7$ vim client.cpp
rps@rps-virtual-machine:~/linuxday7$ ./client
Hello message sent
Message from server: Hello from server
```



```
rps@rps-virtual-machine:~/linuxday7$ vim server.cpp
rps@rps-virtual-machine:~/linuxday7$ ./server
Message from client: Hello from client
Hello message sent
rps@rps-virtual-machine:~/linuxday7$ vim chat2.cpp
rps@rps-virtual-machine:~/linuxday7$ ./chat2
> hi
```

2. **Signal Handling:**

Implement signal handlers for SIGINT (Ctrl+C) and SIGTERM to gracefully shut down the server and client. Ensure that the program can handle interruptions without crashing : or leaving resources unfreed.

i. Data Exchange

The client should be able to send a message to the server. The server should echo the received message back to the client.

ii. **Graceful Shutdown:**

When the server receives a SIGINT or SIGTERM signal, it should close all active connections and free resources before terminating. When the client receives a SIGINT or SIGTERM signal, it should inform the server before terminating.

Server side :

```
#include <iostream>
#include <cstring>
#include <cstdlib>
#include <unistd.h>
#include <arpa/inet.h>
#include <sys/socket.h>
#include <signal.h>

#define PORT 8080

volatile sig_atomic_t Sendflag = 0;

void signalHandler(int signal) {
    Sendflag = 1;
}

int main() {
    int server_fd, new_socket;
    struct sockaddr_in address;
    int opt = 1;
    int addrlen = sizeof(address);
    char buffer[1024] = {0};
    const char *hello = "Hello from server";

    // Register SIGINT signal handler
    signal(SIGINT, signalHandler);

    // Creating socket file descriptor
    if ((server_fd = socket(AF_INET, SOCK_STREAM, 0)) == 0) {
        perror("socket failed");
        exit(EXIT_FAILURE);
    }

    // Forcefully attaching socket to the port 8080
    if (setsockopt(server_fd, SOL_SOCKET, SO_REUSEADDR | SO_REUSEPORT, &opt, sizeof(opt))) {
"socket_sig_server.cpp" 68L, 1788B                                                    1,3           Top
```

Client side :

```
#include <iostream>
#include <sys/socket.h>
#include <arpa/inet.h>
#include <unistd.h>
#include <cstring>
#include <cstdlib>

#define PORT 8080

int main() {
    int sock = 0, valread;
    struct sockaddr_in serv_addr;
    const char *hello = "Hello from client";
    char buffer[1024] = {0};

    // Creating socket file descriptor
    if ((sock = socket(AF_INET, SOCK_STREAM, 0)) < 0) {
        perror("Socket creation error");
        return -1;
    }

    serv_addr.sin_family = AF_INET;
    serv_addr.sin_port = htons(PORT);

    // Convert IPv4 and IPv6 addresses from text to binary form
    if (inet_pton(AF_INET, "127.0.0.1", &serv_addr.sin_addr) <= 0) {
        perror("Invalid address/ Address not supported");
        return -1;
    }

    // Connect to server
    if (connect(sock, (struct sockaddr *)&serv_addr, sizeof(serv_addr)) < 0) {
        perror("Connection Failed");
        return -1;
    }

    // Send message to server
    send(sock, hello, strlen(hello), 0);
    std::cout << "Hello message sent to server\n";

    // Read server response
    valread = read(sock, buffer, 1024);
    std::cout << "Message from server: " << buffer << std::endl;

    close(sock);
    return 0;
}
                                                                                      48,0-1        Bot
```

```
rps@rps-virtual-machine:~/socket$ vim socket_sig_server.cpp
rps@rps-virtual-machine:~/socket$ vim socket_sig_client.cpp
rps@rps-virtual-machine:~/socket$ make socket_sig_server
g++     socket_sig_server.cpp   -o socket_sig_server
rps@rps-virtual-machine:~/socket$ make socket_sig_client
g++     socket_sig_client.cpp   -o socket_sig_client
rps@rps-virtual-machine:~/socket$
```

```
rps@rps-virtual-machine:~/socket$ make socket_sig_client
g++     socket_sig_client.cpp   -o socket_sig_client
rps@rps-virtual-machine:~/socket$ ./socket_sig_client
Hello message sent to server
```

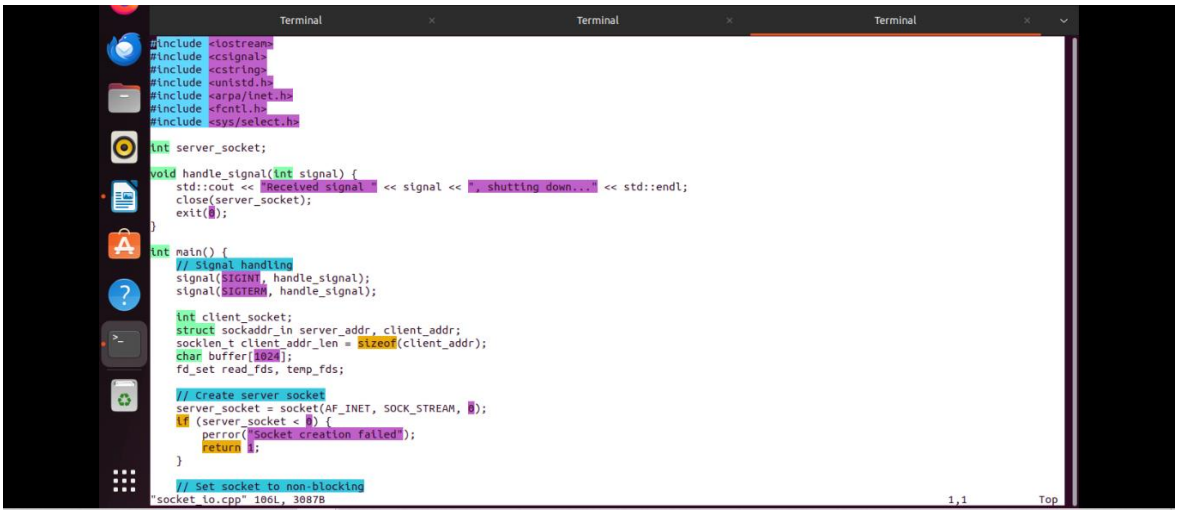
```
[2]+  Stopped                 ./socket_sig_client
rps@rps-virtual-machine:~/socket$ ./socket_sig_server
bind failed: Address already in use
rps@rps-virtual-machine:~/socket$
```

```
rps@rps-virtual-machine:~/socket$ ./socket_sig_client
Hello message sent to server
^Z
[1]+  Stopped                 ./socket_sig_client
rps@rps-virtual-machine:~/socket$ ./socket_sig_client
Hello message sent to server
```

Problem 3: Asynchronous I/O with Signals

Create a C++ program that uses asynchronous I/O operations for reading from and writing to a socket. Implement signal handling to manage program interruptions and ensure that all pending I/O operations are completed or properly canceled before the program exits.

a. Server-side



```
#include <iostream>
#include <csignal>
#include <cstring>
#include <unistd.h>
#include <arpa/inet.h>
#include <fcntl.h>
#include <sys/select.h>

int server_socket;

void handle_signal(int signal) {
    std::cout << "Received signal " << signal << ", shutting down..." << std::endl;
    close(server_socket);
    exit(0);
}

int main() {
    // Signal handling
    signal(SIGINT, handle_signal);
    signal(SIGTERM, handle_signal);

    int client_socket;
    struct sockaddr_in server_addr, client_addr;
    socklen_t client_addr_len = sizeof(client_addr);
    char buffer[1024];
    fd_set read_fds, temp_fds;

    // Create server socket
    server_socket = socket(AF_INET, SOCK_STREAM, 0);
    if (server_socket < 0) {
        perror("Socket creation failed");
        return 1;
    }

    // Set socket to non-blocking
"socket_io.cpp" 106L, 3087B                                   1,1           Top
```

b. Client – side

```
#include <iostream>
#include <csignal>
#include <cstring>
#include <unistd.h>
#include <arpa/inet.h>
#include <fcntl.h>
#include <sys/select.h>

int client_socket;

void handle_signal(int signal) {
    std::cout << "Received signal " << signal << ", shutting down..." << std::endl;
    close(client_socket);
    exit(0);
}

int main() {
    // Signal handling
    signal(SIGINT, handle_signal);
    signal(SIGTERM, handle_signal);

    struct sockaddr_in server_addr;
    char buffer[1024];

    // Create client socket
    client_socket = socket(AF_INET, SOCK_STREAM, 0);
    if (client_socket < 0) {
        perror("Socket creation failed");
        return 1;
    }

    // Set socket to non-blocking
    int flags = fcntl(client_socket, F_GETFL, 0);
    fcntl(client_socket, F_SETFL, flags | O_NONBLOCK);
                                                              1,1           Top
```

```
    // Server address details
    server_addr.sin_family = AF_INET;
    server_addr.sin_port = htons(8080);
    if (inet_pton(AF_INET, "127.0.0.1", &server_addr.sin_addr) <= 0) {
        perror("Invalid address");
        close(client_socket);
        return 1;
    }

    // Connect to server
    if (connect(client_socket, (struct sockaddr*)&server_addr, sizeof(server_addr)) < 0) {
        if (errno != EINPROGRESS) {
            perror("Connection failed");
            close(client_socket);
            return 1;
        }
    }

    std::cout << "Connected to server" << std::endl;

    while (true) {
        // Handle asynchronous I/O operations (e.g., using select(), poll(), epoll())
        fd_set read_fds, temp_fds;
        FD_ZERO(&read_fds);
        FD_SET(client_socket, &read_fds);
        int max_sd = client_socket;

        temp_fds = read_fds;
        int activity = select(max_sd + 1, &temp_fds, NULL, NULL, NULL);
        if (activity < 0 && errno != EINTR) {
            perror("Select error");
            break;
        }

        if (FD_ISSET(client_socket, &temp_fds)) {
            std::cout << "Enter message: ";
            std::string message;
            std::getline(std::cin, message);

            ssize_t bytes_sent = send(client_socket, message.c_str(), message.length(), 0);
            if (bytes_sent < 0) {
                perror("Send failed");
                break;
            }

            ssize_t bytes_received = recv(client_socket, buffer, sizeof(buffer) - 1, 0);
            if (bytes_received < 0) {
                perror("Receive failed");
                break;
            } else if (bytes_received == 0) {
                std::cout << "Server disconnected" << std::endl;
                break;
            } else {
                buffer[bytes_received] = '\0';
                std::cout << "Server response: " << buffer << std::endl;
            }
        }
    }

    close(client_socket);
    std::cout << "Client shutdown gracefully.\n";

    return 0;
}
                                                                    97,0-1        Bot
```

Execution :

```
rps@rps-virtual-machine:~/socket$ g++ -o socket_server socket_server.cpp
rps@rps-virtual-machine:~/socket$ ./socket_server
bind failed: Address already in use
rps@rps-virtual-machine:~/socket$ vim socket_io.cpp
rps@rps-virtual-machine:~/socket$ vim socket_io_client.cpp
rps@rps-virtual-machine:~/socket$ g++ -o socket_io socket_io.cpp
rps@rps-virtual-machine:~/socket$ ./socket_io
Bind failed: Address already in use
rps@rps-virtual-machine:~/socket$
```

```
socket_client       socket_clientA.cpp  socket_io.cpp         socket_serverA      socket_sig_client.cpp  tcp_client.cpp
socket_client1      socket_client.cpp   socket_server         socket_serverA.cpp  socket_sig_server      tcp_server
socket_client1.cpp  socket_io           socket_server1        socket_server.cpp   socket_sig_server.cpp  tcp_server.cpp
rps@rps-virtual-machine:~/socket$ g++ -o socket_io_client socket_io_client.cpp
rps@rps-virtual-machine:~/socket$ ./socket_io_client
Connected to server
```

Assignment Task – 3

1. **Implement a TCP server that:**

   Binds to port 9090.

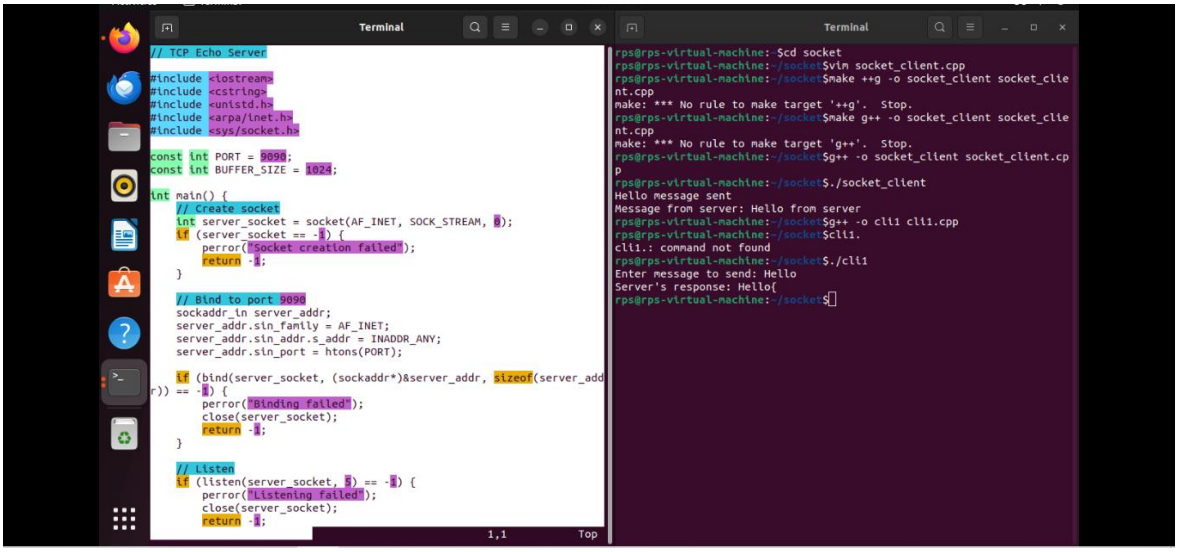
   Listens for incoming connections.

   Accepts a connection from a client.

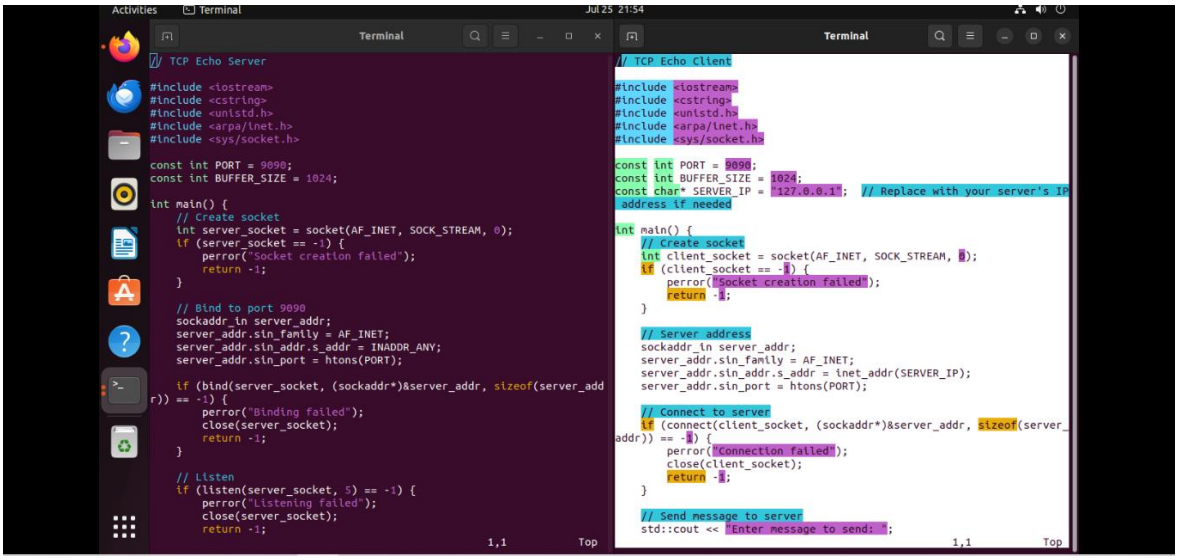
   Receives a message from the client and echoes the same message back to the client.

   Closes the connection and terminates.

a. Server - side



b. Client - side

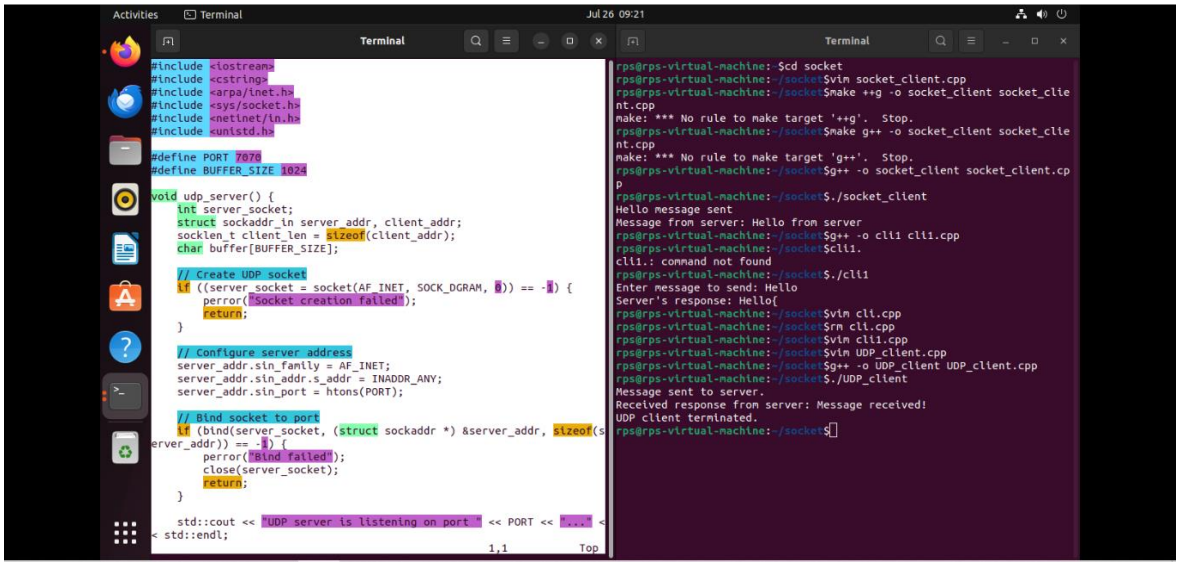


Execution :

2. UDP Client-Server Communication:

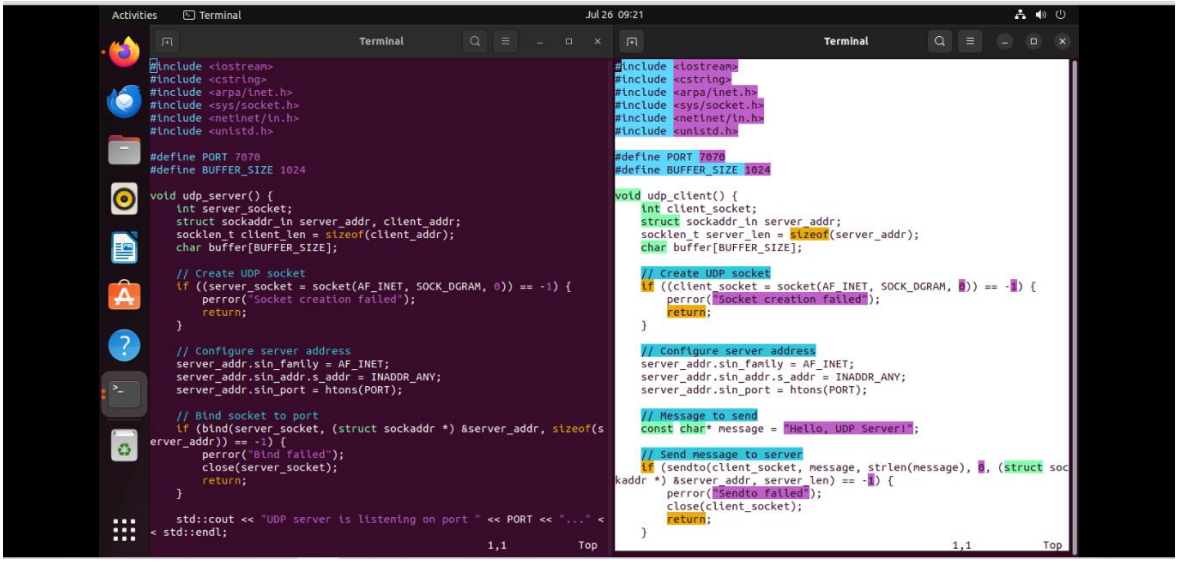
i. Create a UDP server that:

Binds to port 7070.
Receives a message from a client.
Sends a response message back to the client.
Closes the socket and terminates.

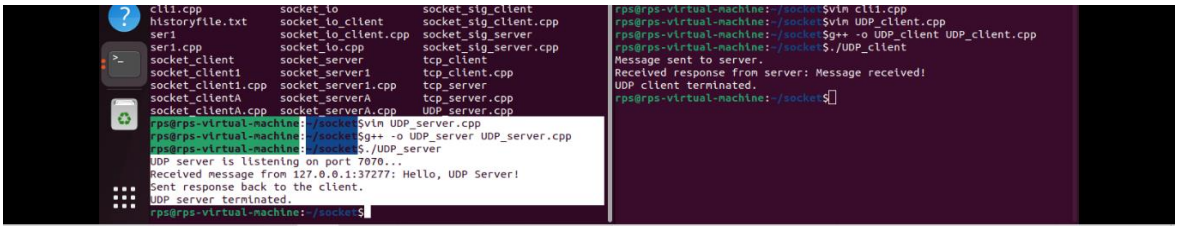


ii. Create a UDP client that:

Sends a message to the server on port 7070.
Receives and prints the response message from the server.
Closes the socket and terminates.



Execution :



3. Multi-Client TCP Server:

i. Implement a TCP server that:

Binds to port 6060.

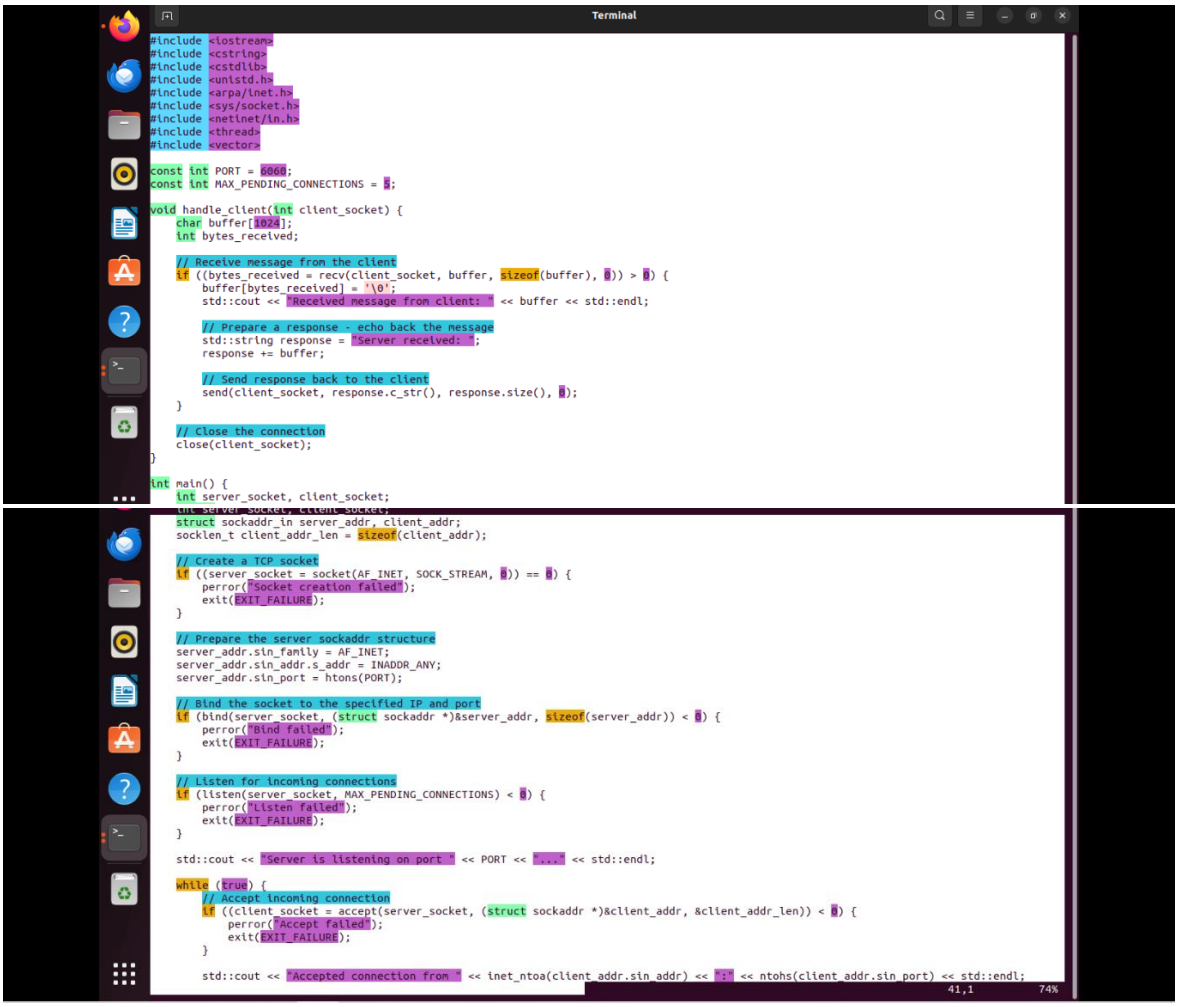
Listens for incoming connections.

Accepts multiple client connections concurrently.

Receives a message from each client and sends a unique response back.

Closes the connections and terminates after handling all clients.

a. Server - side



```
        // Create a new thread to handle the client
        std::thread client_thread(handle_client, client_socket);
        client_thread.detach(); // Detach the thread to run independently
    }

    // Close the server socket
    close(server_socket);

    return 0;
}
```

b. Client - side

```
#include <iostream>
#include <cstring>
#include <cstdlib>
#include <unistd.h>
#include <arpa/inet.h>
#include <sys/socket.h>
#include <netinet/in.h>

const int PORT = 6060;
const char *SERVER_IP = "127.0.0.1";

int main() {
    int client_socket;
    struct sockaddr_in server_addr;
    char buffer[1024] = {0};

    // Create a TCP socket
    if ((client_socket = socket(AF_INET, SOCK_STREAM, 0)) < 0) {
        perror("Socket creation failed");
        exit(EXIT_FAILURE);
    }

    // Prepare the server sockaddr_structure
    server_addr.sin_family = AF_INET;
    server_addr.sin_port = htons(PORT);

    // Convert IPv4 and IPv6 addresses from text to binary form
    if (inet_pton(AF_INET, SERVER_IP, &server_addr.sin_addr) <= 0) {
        perror("Invalid address/ Address not supported");
        exit(EXIT_FAILURE);
    }

    // Connect to the server
    if (connect(client_socket, (struct sockaddr *)&server_addr, sizeof(server_addr)) < 0) {
        perror("Connection failed");
        exit(EXIT_FAILURE);
    }
                                                                    1,1           Top
```

Execution :

```
rps@rps-virtual-machine:~/socket$vim UDP_server.cpp
rps@rps-virtual-machine:~/socket$vim TCP_server.cpp
rps@rps-virtual-machine:~/socket$g++ -o TCP_server TCP_server.cpp
rps@rps-virtual-machine:~/socket$
rps@rps-virtual-machine:~/socket$./TCP_server
Server is listening on port 6060...
Accepted connection from 127.0.0.1:41674
Received message from client: Hello, TCP Server!
```

```
rps@rps-virtual-machine:~/socket$vim UDP_client.cpp
rps@rps-virtual-machine:~/socket$vim TCP_client.cpp
rps@rps-virtual-machine:~/socket$g++ -o TCP_client TCP_client.cpp
rps@rps-virtual-machine:~/socket$./TCP_client
Message sent to server: Hello, TCP Server!
Server response: Server received: Hello, TCP Server!
rps@rps-virtual-machine:~/socket$vim TCP_client.cpp
rps@rps-virtual-machine:~/socket$
```

4. TCP Client with Error Handling:

Create a TCP client that:
Connects to a server at port 5050.
Sends a message to the server.
Handles and displays error messages for common issues such as connection failure or data transmission errors.
Receives and prints the response message from the server.
Closes the socket and terminates.

a. Server – side

```
#include <iostream>
#include <cstring>
#include <cstdlib>
#include <unistd.h>
#include <arpa/inet.h>
#include <sys/socket.h>
#include <netinet/in.h>

const int PORT = 6060;
const char *SERVER_IP = "127.0.0.1";

int main() {
    int client_socket;
    struct sockaddr_in server_addr;
    char buffer[1024] = {0};

    // Create a TCP socket
    if ((client_socket = socket(AF_INET, SOCK_STREAM, 0)) < 0) {
        perror("Socket creation failed");
        exit(EXIT_FAILURE);
    }

    // Prepare the server sockaddr structure
    server_addr.sin_family = AF_INET;
    server_addr.sin_port = htons(PORT);

    // Convert IPv4 and IPv6 addresses from text to binary form
    if (inet_pton(AF_INET, SERVER_IP, &server_addr.sin_addr) <= 0) {
        perror("Invalid address/ Address not supported");
        exit(EXIT_FAILURE);
    }

    // Connect to the server
    if (connect(client_socket, (struct sockaddr *)&server_addr, sizeof(server_addr)) < 0) {
        perror("Connection failed");
        exit(EXIT_FAILURE);
    }
                                                                    1,1           Top
```

b. Client – side

```
#include <iostream>
#include <cstring>
#include <cstdlib>
#include <unistd.h>
#include <arpa/inet.h>
#include <sys/socket.h>
#include <netinet/in.h>

const int PORT = 6060;

int main() {
    int server_socket, client_socket;
    struct sockaddr_in server_addr, client_addr;
    char buffer[1024] = {0};
    int opt = 0;
    int addrlen = sizeof(server_addr);

    // Creating socket file descriptor
    if ((server_socket = socket(AF_INET, SOCK_STREAM, 0)) == 0) {
        perror("Socket creation failed");
        exit(EXIT_FAILURE);
    }

    // Forcefully attaching socket to the port 6060
    if (setsockopt(server_socket, SOL_SOCKET, SO_REUSEADDR | SO_REUSEPORT, &opt, sizeof(opt))) {
        perror("Setsockopt failed");
        exit(EXIT_FAILURE);
    }
    server_addr.sin_family = AF_INET;
    server_addr.sin_addr.s_addr = INADDR_ANY;
    server_addr.sin_port = htons(PORT);

    // Bind the socket to localhost port 6060
    if (bind(server_socket, (struct sockaddr *)&server_addr, sizeof(server_addr)) < 0) {
        perror("Bind failed");
        exit(EXIT_FAILURE);
    }
"TCP_server1.cpp" 71L, 2075B                                        1,1           Top
```

Execution :

```
rps@rps-virtual-machine:~/socket$vim TCP_client.cpp
rps@rps-virtual-machine:~/socket$vim TCP_client1.cpp
rps@rps-virtual-machine:~/socket$g++ -o TCP_client TCP_client1.cpp
rps@rps-virtual-machine:~/socket$./TCP_client1
bash: ./TCP_client1: No such file or directory
rps@rps-virtual-machine:~/socket$g++ -o TCP_client1 TCP_client1.cpp
rps@rps-virtual-machine:~/socket$./TCP_client1
Message sent to server: Hello, TCP Server!
^Z
[1]+  Stopped                 ./TCP_client1
rps@rps-virtual-machine:~/socket$vim TCP_client1.cpp
rps@rps-virtual-machine:~/socket$
```

```
rps@rps-virtual-machine:~/socket$vim TCP_server.cpp
rps@rps-virtual-machine:~/socket$vim TCP_server1.cpp
rps@rps-virtual-machine:~/socket$g++ -o TCP_server TCP_server1.cpp
rps@rps-virtual-machine:~/socket$./TCP_server
Bind failed: Address already in use
rps@rps-virtual-machine:~/socket$vim TCP_server1.cpp
rps@rps-virtual-machine:~/socket$./TCP_server
Bind failed: Address already in use
rps@rps-virtual-machine:~/socket$vim TCP_server1.cpp
rps@rps-virtual-machine:~/socket$
```

5. Server and Client Chat Bot (Important)

a. server - side

```
#include <iostream>
#include <cstdlib>
#include <cstring>
#include <unistd.h>
#include <arpa/inet.h>
#include <sys/socket.h>
#include <netinet/in.h>
#include <netdb.h>

#define PORT 12345
#define MAX_MSG_LEN 1024

void error(const char *msg) {
    perror(msg);
    exit(0);
}

int main() {
    int client_socket;
    struct sockaddr_in server_addr;
    struct hostent *server;
    char buffer[MAX_MSG_LEN];

    // Get server IP address
    server = gethostbyname("127.0.0.1");
    if (server == NULL) {
        fprintf(stderr, "ERROR, no such host\n");
        exit(0);
    }

    // Create socket
    client_socket = socket(AF_INET, SOCK_STREAM, 0);
    if (client_socket < 0)
        error("ERROR opening socket");

    // Initialize server address
    memset(&server_addr, 0, sizeof(server_addr));
                                                                    1,1           Top
    server_addr.sin_family = AF_INET;
    memcpy(&server_addr.sin_addr.s_addr, server->h_addr, server->h_length);
    server_addr.sin_port = htons(PORT);

    // Connect to server
    if (connect(client_socket, (struct sockaddr *) &server_addr, sizeof(server_addr)) < 0)
        error("ERROR connecting");

    std::cout << "[CONNECTED] Connected to server on 127.0.0.1:" << PORT << std::endl;

    // Handle communication
    while (true) {
        // Prompt user for message
        std::cout << "Enter message: ";
        memset(buffer, 0, MAX_MSG_LEN);
        std::cin.getline(buffer, MAX_MSG_LEN);

        // Send message to server
        int bytes_sent = send(client_socket, buffer, strlen(buffer), 0);
        if (bytes_sent < 0)
            error("ERROR writing to socket");

        // Receive response from server
        memset(buffer, 0, MAX_MSG_LEN);
        int bytes_received = recv(client_socket, buffer, sizeof(buffer), 0);
        if (bytes_received < 0)
            error("ERROR reading from socket");

        std::cout << "[RECEIVED] Echo from server: " << buffer << std::endl;
    }

    // Close socket
    close(client_socket);
                                                                    65,0-1        89%
```

```
    // Close socket
    close(client_socket);

    return 0;
}
                                                                    74,0-1        Bot
```

b. client – side

```
#include <iostream>
#include <cstdlib>
#include <cstring>
#include <unistd.h>
#include <arpa/inet.h>
#include <sys/socket.h>
#include <netinet/in.h>

#define PORT 12345
#define MAX_MSG_LEN 1024

void error(const char *msg) {
    perror(msg);
    exit(0);
}

int main() {
    int server_socket, client_socket;
    struct sockaddr_in server_addr, client_addr;
    socklen_t client_len;
    char buffer[MAX_MSG_LEN];

    // Create socket
    server_socket = socket(AF_INET, SOCK_STREAM, 0);
    if (server_socket < 0)
        error("ERROR opening socket");

    // Initialize server address
    memset(&server_addr, 0, sizeof(server_addr));
    server_addr.sin_family = AF_INET;
    server_addr.sin_addr.s_addr = INADDR_ANY;
    server_addr.sin_port = htons(PORT);

    // Bind socket to server address
    if (bind(server_socket, (struct sockaddr *) &server_addr, sizeof(server_addr)) < 0)
        error("ERROR on binding");
                                                                    1,1           Top
```

```
    // Listen for incoming connections
    listen(server_socket, 5);
    std::cout << "[LISTENING] Server is listening on 127.0.0.1:" << PORT << std::endl;

    // Accept connections and handle communication
    while (true) {
        // Accept connection
        client_len = sizeof(client_addr);
        client_socket = accept(server_socket, (struct sockaddr *) &client_addr, &client_len);
        if (client_socket < 0)
            error("ERROR on accept");

        std::cout << "[NEW CONNECTION] Client connected: " << inet_ntoa(client_addr.sin_addr) << std::endl;

        // Handle communication
        while (true) {
            // Receive message from client
            memset(buffer, 0, MAX_MSG_LEN);
            int bytes_received = recv(client_socket, buffer, sizeof(buffer), 0);
            if (bytes_received < 0)
                error("ERROR reading from socket");
            if (bytes_received == 0) {
                std::cout << "[DISCONNECTED] Client disconnected." << std::endl;
                break;
            }

            std::cout << "[RECEIVED] Message from client: " << buffer << std::endl;

            // Echo message back to client
            int bytes_sent = send(client_socket, buffer, bytes_received, 0);
            if (bytes_sent < 0)
                                                                    37,0-1        70%
```

```
        // Close client socket
        close(client_socket);
    }

    // Close server socket
    close(server_socket);

    return 0;
}
                                                                    81,0-1        Bot
```

Execution :

```
rps@rps-virtual-machine:~/socket$vim TCP_server1.cpp
rps@rps-virtual-machine:~/socket$vim server_chat.cpp
rps@rps-virtual-machine:~/socket$g++ server_chat server_chat.cpp
/usr/bin/ld: cannot find server_chat: No such file or directory
collect2: error: ld returned 1 exit status
rps@rps-virtual-machine:~/socket$ls
cli1                socket_io_client       TCP_client
cli1.cpp            socket_io_client.cpp   TCP_client1
client_chat.cpp     socket_io.cpp          TCP_client1.cpp
historyfile.txt     socket_server          tcp_client.cpp
ser1                socket_server1         TCP_client.cpp
ser1.cpp            socket_server1.cpp     tcp_server
server_chat.cpp     socket_serverA         TCP_server
socket_client       socket_serverA.cpp     TCP_server1.cpp
socket_client1      socket_server.cpp      tcp_server.cpp
socket_client1.cpp  socket_sig_client      TCP_server.cpp
socket_clientA      socket_sig_client.cpp  UDP_client
socket_clientA.cpp  socket_sig_server      UDP_client.cpp
socket_client.cpp   socket_sig_server.cpp  UDP_server
socket_io           tcp_client             UDP_server.cpp
rps@rps-virtual-machine:~/socket$make server_chat
g++     server_chat.cpp   -o server_chat
rps@rps-virtual-machine:~/socket$./server_chat
[LISTENING] Server is listening on 127.0.0.1:12345
[NEW CONNECTION] Client connected: 127.0.0.1
[RECEIVED] Message from client: Hello !
[RECEIVED] Message from client: How is the machine working ?
[RECEIVED] Message from client: Nice.
[RECEIVED] Message from client: What's your IP ?
[RECEIVED] Message from client: Mine is 127.0.0.1
[RECEIVED] Message from client: Ok.
^Z
[2]+  Stopped                 ./server_chat
rps@rps-virtual-machine:~/socket$vim server_chat.cpp
rps@rps-virtual-machine:~/socket$
```

```
rps@rps-virtual-machine:~/socket$vim TCP_client1.cpp
rps@rps-virtual-machine:~/socket$vim client_chat.cpp
rps@rps-virtual-machine:~/socket$make client_chat
g++     client_chat.cpp   -o client_chat
rps@rps-virtual-machine:~/socket$./client_chat
[CONNECTED] Connected to server on 127.0.0.1:12345
Enter message: Hello !
[RECEIVED] Echo from server: Hello !
Enter message: How is the machine working ?
[RECEIVED] Echo from server: How is the machine working ?
Enter message: Nice.
[RECEIVED] Echo from server: Nice.
Enter message: What's your IP ?
[RECEIVED] Echo from server: What's your IP ?
Enter message: Mine is 127.0.0.1
[RECEIVED] Echo from server: Mine is 127.0.0.1
Enter message: Ok.
[RECEIVED] Echo from server: Ok.
Enter message: ^Z
[2]+  Stopped                 ./client_chat
rps@rps-virtual-machine:~/socket$vim client_chat.cpp
rps@rps-virtual-machine:~/socket$
```