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Motilal Nehru National Institute of Technology Allahabad Prayagraj
Distributed System (CS17201)
B.Tech (CSE) – VII Sem Lab 5

Q1. Implement concurrent echo client---server application.
Code :

Client:

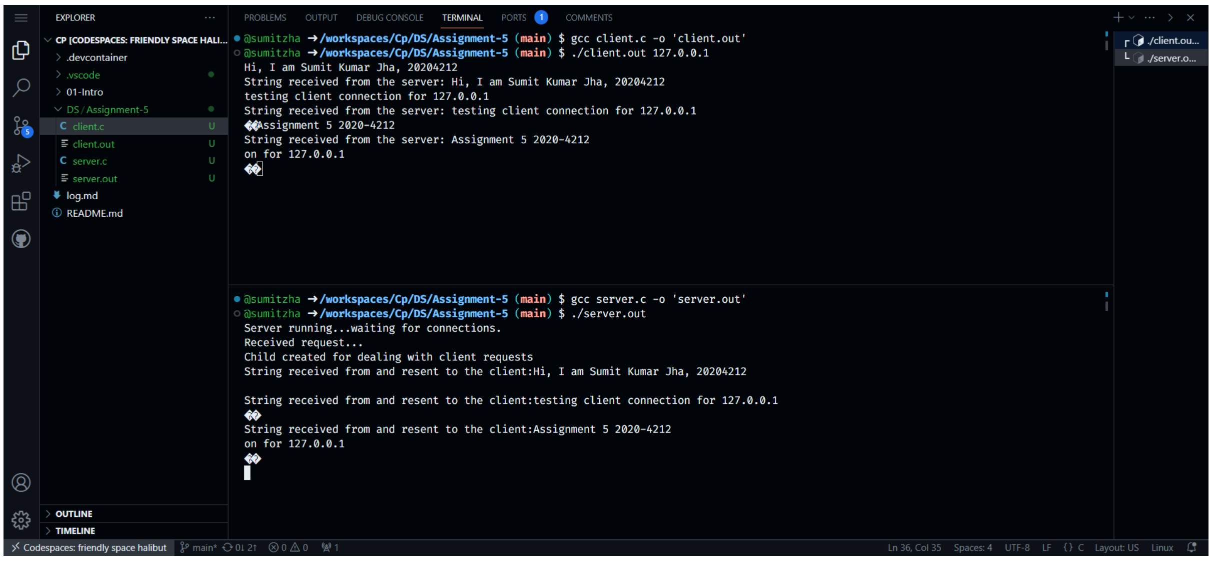
```c
#include <stdlib.h>
#include <stdio.h>
#include <sys/types.h>
#include <sys/socket.h>
#include <netinet/in.h>
#include <string.h>
#include <arpa/inet.h>

#define MAXLINE 4096   /*max text line length*/
#define SERV_PORT 3000 /*port*/

int main(int argc, char **argv)
{
    int sockfd;
    struct sockaddr_in servaddr;
    char sendline[MAXLINE], recvline[MAXLINE];
    // basic check of the arguments
    // additional checks can be inserted

    if (argc != 2)
    {
        perror("Usage: TCPClient <IP address of the server");
        exit(1);
    }

    // Create a socket for the client
    // If sockfd<0 there was an error in the creation of the socket
    if ((sockfd = socket(AF_INET, SOCK_STREAM, 0)) < 0)
    {
        perror("Problem in creating the socket");
        exit(2);
    }

    // Creation of the socket
    memset(&servaddr, 0, sizeof(servaddr));
    servaddr.sin_family = AF_INET;
    servaddr.sin_addr.s_addr = inet_addr(argv[1]);
    servaddr.sin_port = htons(SERV_PORT); // convert to big-endian order

    // Connection of the client to the socket
    if (connect(sockfd, (struct sockaddr *)&servaddr, sizeof(servaddr)) < 0)
    {
        perror("Problem in connecting to the server");
        exit(3);
    }
    while (fgets(sendline, MAXLINE, stdin) != NULL)
    {
        send(sockfd, sendline, strlen(sendline), 0);
        if (recv(sockfd, recvline, MAXLINE, 0) == 0)
        {
            // error: server terminated prematurely
            perror("The server terminated prematurely");
            exit(4);
        }
        printf("%s", "String received from the server: ");
        fputs(recvline, stdout);
    }
    exit(0);
}
```

Server:

```
#include <stdlib.h>
#include <stdio.h>
#include <sys/types.h>
#include <sys/socket.h>
#include <netinet/in.h>
#include <string.h>
#include <unistd.h>
#define MAXLINE 4096   /*max text line length*/
#define SERV_PORT 3000 /*port*/
#define LISTENQ 8      /*maximum number of client connections*/
int main(int argc, char **argv)
{
    int listenfd, connfd, n;
    pid_t childpid;
    socklen_t clilen;
    char buf[MAXLINE];
    struct sockaddr_in cliaddr, servaddr;
    // Create a socket for the soclet
    // If sockfd<0 there was an error in the creation of the socket
    if ((listenfd = socket(AF_INET, SOCK_STREAM, 0)) < 0)
    {
        perror("Problem in creating the socket");
        exit(2);
    }
    // preparation of the socket address
    servaddr.sin_family = AF_INET;
    servaddr.sin_addr.s_addr = htonl(INADDR_ANY);
    servaddr.sin_port = htons(SERV_PORT);
    // bind the socket
    bind(listenfd, (struct sockaddr *)&servaddr, sizeof(servaddr));
    // listen to the socket by creating a connection queue, then wait for
clients
    listen(listenfd, LISTENQ);
    printf("%s\n", "Server running...waiting for connections.");
    for (;;)
    {
        clilen = sizeof(cliaddr);
```

```c
        // accept a connection
        connfd = accept(listenfd, (struct sockaddr *)&cliaddr, &clilen);
        printf("%s\n", "Received request...");
        if ((childpid = fork()) == 0)
        { // if it’s 0, it’s child process
            printf("%s\n", "Child created for dealing with client requests");
            // close listening socket
            close(listenfd);
            while ((n = recv(connfd, buf, MAXLINE, 0)) > 0)
            {
                printf("%s", "String received from and resent to the client:");
                puts(buf);
                send(connfd, buf, n, 0);
            }
            if (n < 0)
                printf("%s\n", "Read error");
            exit(0);
        }
        // close socket of the server
        close(connfd);
    }
}
```

output:



```
@sumitzha ➜ /workspaces/Cp/DS/Assignment-5 (main) $ gcc client.c -o 'client.out'
@sumitzha ➜ /workspaces/Cp/DS/Assignment-5 (main) $ ./client.out 127.0.0.1
Hi, I am Sumit Kumar Jha, 20204212
String received from the server: Hi, I am Sumit Kumar Jha, 20204212
testing client connection for 127.0.0.1
String received from the server: testing client connection for 127.0.0.1
��Assignment 5 2020-4212
String received from the server: Assignment 5 2020-4212
on for 127.0.0.1
��
```

```
@sumitzha ➜ /workspaces/Cp/DS/Assignment-5 (main) $ gcc server.c -o 'server.out'
@sumitzha ➜ /workspaces/Cp/DS/Assignment-5 (main) $ ./server.out
Server running...waiting for connections.
Received request...
Child created for dealing with client requests
String received from and resent to the client:Hi, I am Sumit Kumar Jha, 20204212

String received from and resent to the client:testing client connection for 127.0.0.1
��
String received from and resent to the client:Assignment 5 2020-4212
on for 127.0.0.1
��
```

Q2. Implement a client---server program in which the server accepts a connection from a client and updates it own Master table by adding the client information and send the updated table to client, so client can update their own table.
Table format:

Node No	Ip Address	Port no
1.	172.31.100.36	2345
2.	172.31.100.40	3128
3.	172.31.100.52	2323

Client

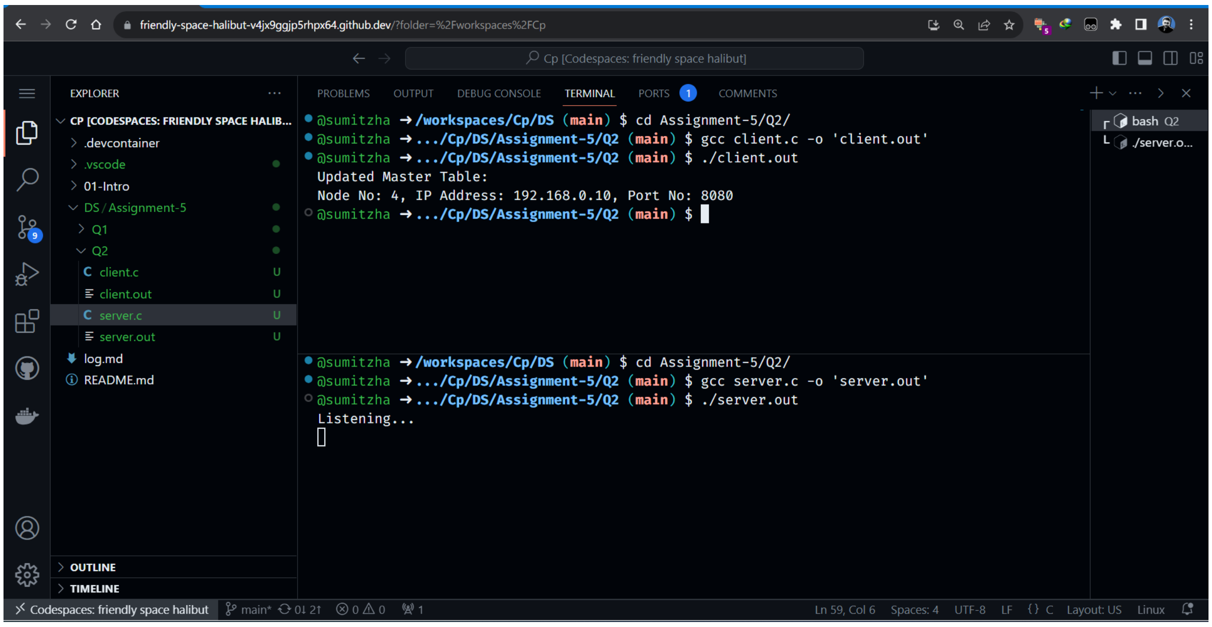
```c
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <arpa/inet.h>
#include <sys/socket.h>
#include <unistd.h>
#define MAX_CLIENTS 10
struct ClientInfo
{
    int node_no;
    char ip_address[20];
    int port_no;
};
int main()
{
    int client_socket;
    struct sockaddr_in server_addr;
    struct ClientInfo my_info;
    // Create a socket
    client_socket = socket(AF_INET, SOCK_STREAM, 0);
    if (client_socket < 0)
    {
        perror("Socket creation error");
        exit(1);
    }
    server_addr.sin_family = AF_INET;
    server_addr.sin_port = htons(12345);                  // Use the same port
as the server
    server_addr.sin_addr.s_addr = inet_addr("127.0.0.1"); // Use the server's
IP
```

```c
    // Connect to the server
    if (connect(client_socket, (struct sockaddr *)&server_addr,
                sizeof(server_addr)) < 0)
    {
        perror("Connection error");
        exit(1);
    }
    // Prepare and send client information to the server
    my_info.node_no = 4;                                          //
Change this to your node number
    strncpy(my_info.ip_address, "192.168.0.10", sizeof(my_info.ip_address)); //
Change to your IP
    my_info.port_no = 8080;                                       //
Change to your port
    send(client_socket, &my_info.node_no, sizeof(my_info.node_no), 0);
    send(client_socket, my_info.ip_address, sizeof(my_info.ip_address), 0);
    send(client_socket, &my_info.port_no, sizeof(my_info.port_no), 0);
    // Receive and update the client's master table
    struct ClientInfo updated_table[MAX_CLIENTS];
    recv(client_socket, updated_table, sizeof(updated_table), 0);
    printf("Updated Master Table:\n");
    for (int i = 0; i < MAX_CLIENTS; i++)
    {
        if (updated_table[i].node_no != 0)
        {
            printf("Node No: %d, IP Address: %s, Port No: %d\n",
                   updated_table[i].node_no, updated_table[i].ip_address,
updated_table[i].port_no);
        }
    }
    close(client_socket);
    return 0;
}
```

Server:

```c
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <arpa/inet.h>
#include <sys/socket.h>
#include <unistd.h>
#define MAX_CLIENTS 10
struct ClientInfo
{
    int node_no;
    char ip_address[20];
    int port_no;
};
struct ClientInfo master_table[MAX_CLIENTS];
int num_clients = 0;
void updateMasterTable(int node_no, char *ip_address, int port_no)
{
    if (num_clients < MAX_CLIENTS)
    {
        master_table[num_clients].node_no = node_no;
        strncpy(master_table[num_clients].ip_address, ip_address,
                sizeof(master_table[num_clients].ip_address));
        master_table[num_clients].port_no = port_no;
        num_clients++;
    }
    else
    {
        printf("Master table is full.\n");
    }
}
int main()
{
    int server_socket, client_socket;
    struct sockaddr_in server_addr, client_addr;
    socklen_t addr_size;
    int node_no;
    char client_ip[20];
    int client_port;
    // Initialize master table (you can pre-fill this with initial data)
    // Create a socket
    server_socket = socket(AF_INET, SOCK_STREAM, 0);
    if (server_socket < 0)
    {
        perror("Socket creation error");
        exit(1);
    }
    server_addr.sin_family = AF_INET;
    server_addr.sin_port = htons(12345); // Use your desired port
    server_addr.sin_addr.s_addr = INADDR_ANY;
    // Bind the socket
    if (bind(server_socket, (struct sockaddr *)&server_addr,
sizeof(server_addr)) <
        0)
    {
        perror("Binding error");
        exit(1);
    }
    // Listen for clients
    if (listen(server_socket, 10) == 0)
    {
        printf("Listening...\n");
    }
    else
    {
        perror("Listening error");
        exit(1);
    }
    // Accept client connections and update the master table
    addr_size = sizeof(client_addr);
    while (1)
    {
        client_socket = accept(server_socket, (struct sockaddr *)&client_addr,
                               &addr_size);
        // Receive client information
        recv(client_socket, &node_no, sizeof(node_no), 0);
        recv(client_socket, client_ip, sizeof(client_ip), 0);
        recv(client_socket, &client_port, sizeof(client_port), 0);
        // Update master table with client information
        updateMasterTable(node_no, client_ip, client_port);
        // Send the updated table back to the client
        send(client_socket, master_table, sizeof(master_table), 0);
        close(client_socket);
    }
    close(server_socket);
    return 0;
}
```

Output:



```
@sumitzha ➜ /workspaces/Cp/DS (main) $ cd Assignment-5/Q2/
@sumitzha ➜ .../Cp/DS/Assignment-5/Q2 (main) $ gcc client.c -o 'client.out'
@sumitzha ➜ .../Cp/DS/Assignment-5/Q2 (main) $ ./client.out
Updated Master Table:
Node No: 4, IP Address: 192.168.0.10, Port No: 8080
@sumitzha ➜ .../Cp/DS/Assignment-5/Q2 (main) $
```

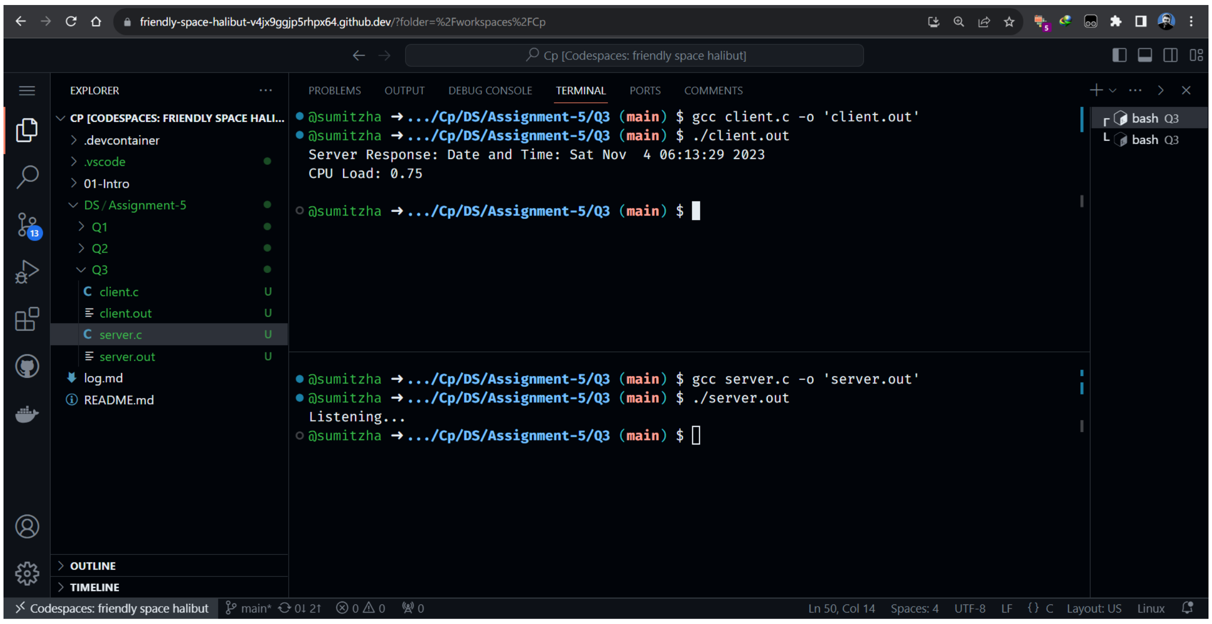
```
@sumitzha ➜ /workspaces/Cp/DS (main) $ cd Assignment-5/Q2/
@sumitzha ➜ .../Cp/DS/Assignment-5/Q2 (main) $ gcc server.c -o 'server.out'
@sumitzha ➜ .../Cp/DS/Assignment-5/Q2 (main) $ ./server.out
Listening...
```

Q3. Develop a client---server program to implement a date---time server and client. Upon connection establishment, the server should send its current date, time and CPU load information to its clients.
Client:

```c
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <unistd.h>
#include <sys/types.h>
#include <sys/socket.h>
#include <netinet/in.h>

#define PORT 8080
int main()
{
    int client_socket;
    struct sockaddr_in server_addr;
    char buffer[1024];
    client_socket = socket(AF_INET, SOCK_STREAM, 0);
    if (client_socket < 0)
    {
        perror("Error in socket");
        exit(1);
    }
    server_addr.sin_family = AF_INET;
    server_addr.sin_port = PORT;
    server_addr.sin_addr.s_addr = INADDR_ANY;
    if (connect(client_socket, (struct sockaddr *)&server_addr,
                sizeof(server_addr)) < 0)
    {
        perror("Error in connection");
        exit(1);
    }
    recv(client_socket, buffer, sizeof(buffer), 0);
    printf("Server Response: %s\n", buffer);
    close(client_socket);
    return 0;
}
```

Server:

```c
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <time.h>
#include <unistd.h>
#include <sys/types.h>
#include <sys/socket.h>
#include <netinet/in.h>
#define PORT 8080
int main()
{
    int server_fd, new_socket;
    struct sockaddr_in server_addr, new_addr;
    socklen_t addr_size;
    char buffer[1024];
    time_t rawtime;
    struct tm *info;
    server_fd = socket(AF_INET, SOCK_STREAM, 0);
    if (server_fd < 0)
    {
        perror("Error in socket");
        exit(1);
    }
    server_addr.sin_family = AF_INET;
    server_addr.sin_port = PORT;
    server_addr.sin_addr.s_addr = INADDR_ANY;
    if (bind(server_fd, (struct sockaddr *)&server_addr, sizeof(server_addr)) < 0)
    {
        perror("Error in bind");
        exit(1);
    }
    if (listen(server_fd, 10) == 0)
    {
        printf("Listening...\n");
    }
    else
    {
        perror("Error in listen");
        exit(1);
    }
    addr_size = sizeof(new_addr);
    new_socket = accept(server_fd, (struct sockaddr *)&new_addr, &addr_size);
    time(&rawtime);
    info = localtime(&rawtime);
    snprintf(buffer, sizeof(buffer), "Date and Time: %sCPU Load: 0.75\n",
             asctime(info));
    send(new_socket, buffer, strlen(buffer), 0);
    close(new_socket);
    close(server_fd);
    return 0;
}
```



```
@sumitzha ➜ .../Cp/DS/Assignment-5/Q3 (main) $ gcc client.c -o 'client.out'
@sumitzha ➜ .../Cp/DS/Assignment-5/Q3 (main) $ ./client.out
Server Response: Date and Time: Sat Nov  4 06:13:29 2023
CPU Load: 0.75

@sumitzha ➜ .../Cp/DS/Assignment-5/Q3 (main) $
```

```
@sumitzha ➜ .../Cp/DS/Assignment-5/Q3 (main) $ gcc server.c -o 'server.out'
@sumitzha ➜ .../Cp/DS/Assignment-5/Q3 (main) $ ./server.out
Listening...
@sumitzha ➜ .../Cp/DS/Assignment-5/Q3 (main) $
```