DEPARTMENT OF COMPUTER ENGINEERING
Computer Network Lab

Semester	T.E. Semester V – Computer Engineering
Subject	Computer Network
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Title: **Two-Way Chat Application with TCP and UDP**

Explanation:

Server-side:

- The server offers the user a choice between TCP and UDP.
- For TCP, it establishes a server socket, accepts client connections, and handles two-way communication.
- For UDP, it creates a datagram socket, receives messages from clients, and sends responses back.

Client-side:

- The client prompts the user to choose between TCP and UDP.
- For TCP, it connects to the server, spawns a thread to continuously receive messages, and allows the user to send messages.
- For UDP, it creates a datagram socket, spawns a thread to continuously receive messages, and allows the user to send messages.

The main differences between TCP (Transmission Control Protocol) and UDP (User Datagram Protocol) chats in the provided code lie in the characteristics of these protocols:

- **Connection-oriented vs. Connectionless:**
- **TCP:** It is a connection-oriented protocol. The server and client establish a connection before exchanging data. This ensures reliable, ordered, and error-checked delivery of information. The **ServerSocket** and **Socket** classes are used in Java for TCP communication.
- **UDP:** It is a connectionless protocol. Communication is achieved by sending independent packets, known as datagrams, to each other. UDP is faster but doesn't guarantee delivery, order, or error checking. The **DatagramSocket** and **DatagramPacket** classes are used in Java for UDP communication.
- **Reliability:**
- **TCP:** Reliable and ensures that data is received in the order it was sent. It also handles retransmission of lost packets and error detection.
- **UDP:** Unreliable, as it doesn't guarantee delivery, order, or error checking. It's often used in scenarios where a small amount of data loss is acceptable, such as real-time applications.
- **Overhead:**
- **TCP:** Higher overhead due to its reliability features and the need to establish and maintain a connection.
- **UDP:** Lower overhead since it's connectionless and doesn't include mechanisms for reliability.
- **Usage:**
- **TCP:** Suitable for applications where accurate and ordered delivery of data is crucial, such as file transfers, email, and web browsing.
- **UDP:** Used in scenarios where low latency and high-speed data transmission are more critical, such as video streaming, online gaming, and real-time communication.

Implementation:

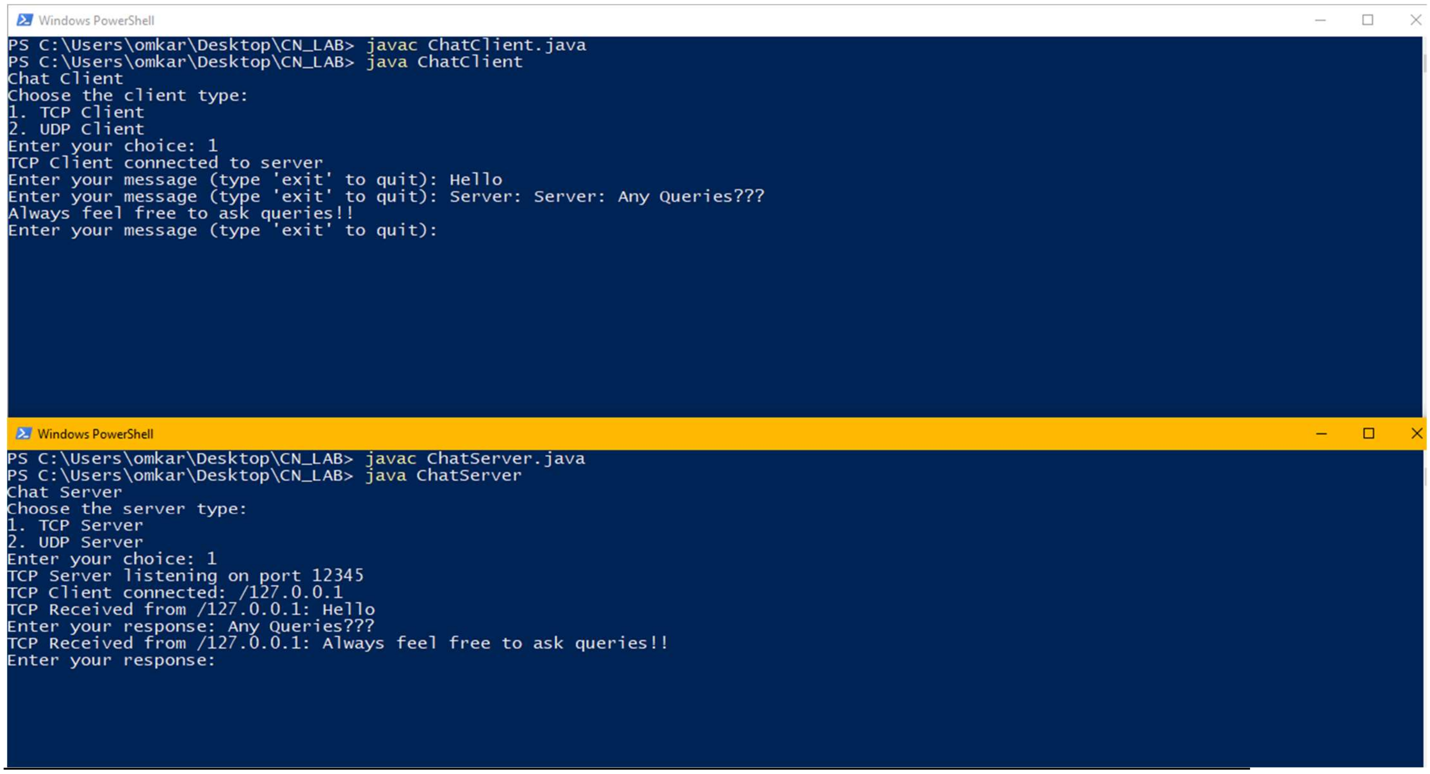
Server-side:-

```
import java.io.*;
import java.net.*;

public class ChatServer {
    private static final int TCP_PORT = 12345;
    private static final int UDP_PORT = 12346;

    public static void main(String[] args) {
        System.out.println("Chat Server");

        try {
            BufferedReader reader = new BufferedReader(new InputStreamReader(System.in));

            System.out.println("Choose the server type:");
            System.out.println("1. TCP Server");
            System.out.println("2. UDP Server");
            System.out.print("Enter your choice: ");

            int choice = Integer.parseInt(reader.readLine());

            switch (choice) {
                case 1:
                    startTCPServer();
                    break;
                case 2:
                    startUDPServer();
                    break;
                default:
                    System.out.println("Invalid choice. Please enter 1 or 2.");
            }
        } catch (IOException e) {
            e.printStackTrace();
        }
    }
    private static void startTCPServer() {
        try {
            ServerSocket serverSocket = new ServerSocket(TCP_PORT);
            System.out.println("TCP Server listening on port " + TCP_PORT);

            while (true) {
                Socket clientSocket = serverSocket.accept();
                System.out.println("TCP Client connected: " + clientSocket.getInetAddress());

                Thread clientThread = new Thread(() -> handleTCPClient(clientSocket));
                clientThread.start();
            }
        } catch (IOException e) {
            e.printStackTrace();
        }
    }

    private static void handleTCPClient(Socket clientSocket) {
        try {
            BufferedReader reader = new BufferedReader(new
InputStreamReader(clientSocket.getInputStream()));
            PrintWriter writer = new PrintWriter(clientSocket.getOutputStream(), true);

            BufferedReader consoleReader = new BufferedReader(new InputStreamReader(System.in));

            while (true) {
                String message = reader.readLine();
                if (message == null || message.equals("exit")) {
                    System.out.println("TCP Client disconnected: " + clientSocket.getInetAddress());
                    break;
                }

                System.out.println("TCP Received from " + clientSocket.getInetAddress() + ": " + message);

                System.out.print("Enter your response: ");
                String response = consoleReader.readLine();

                writer.println("Server: " + response);
            }

            clientSocket.close();
        } catch (IOException e) {
            e.printStackTrace();
        }
    }
    private static void startUDPServer() {
        try {
            DatagramSocket serverSocket = new DatagramSocket(UDP_PORT);
            System.out.println("UDP Server listening on port " + UDP_PORT);

            while (true) {
                byte[] receiveData = new byte[1024];
                DatagramPacket receivePacket = new DatagramPacket(receiveData, receiveData.length);
                serverSocket.receive(receivePacket);

                InetAddress clientAddress = receivePacket.getAddress();
                int clientPort = receivePacket.getPort();

                String message = new String(receivePacket.getData(), 0, receivePacket.getLength());
                System.out.println("UDP Received from " + clientAddress + ":" + clientPort + ": " + message);

                if (message.equals("exit")) {
                    System.out.println("UDP Client disconnected: " + clientAddress + ":" + clientPort);
                    continue;
                }

                String replyMessage = "Server: " + message;
                byte[] sendData = replyMessage.getBytes();
                DatagramPacket sendPacket = new DatagramPacket(sendData, sendData.length, clientAddress,
clientPort);
                serverSocket.send(sendPacket);
            }
        } catch (IOException e) {
            e.printStackTrace();
        }
    }
}
```

Client-side:-

```
import java.io.*;
import java.net.*;

public class ChatClient {
    private static final int TCP_PORT = 12345;
    private static final int UDP_PORT = 12346;

    public static void main(String[] args) {
        System.out.println("Chat Client");

        try {
            BufferedReader reader = new BufferedReader(new InputStreamReader(System.in));

            System.out.println("Choose the client type:");
            System.out.println("1. TCP Client");
            System.out.println("2. UDP Client");
            System.out.print("Enter your choice: ");

            int choice = Integer.parseInt(reader.readLine());

            switch (choice) {
                case 1:
                    startTCPClient();
                    break;
                case 2:
                    startUDPClient();
                    break;
                default:
                    System.out.println("Invalid choice. Please enter 1 or 2.");
            }
        } catch (IOException e) {
            e.printStackTrace();
        }
    }

    private static void startTCPClient() {
        try {
            Socket socket = new Socket("localhost", TCP_PORT);
            System.out.println("TCP Client connected to server");

            BufferedReader serverReader = new BufferedReader(new
InputStreamReader(socket.getInputStream()));
            PrintWriter writer = new PrintWriter(socket.getOutputStream(), true);
            BufferedReader consoleReader = new BufferedReader(new InputStreamReader(System.in));

            new Thread(() -> {
                try {
                    while (true) {
                        String response = serverReader.readLine();
                        System.out.println("Server: " + response);
                    }
                } catch (IOException e) {
                    e.printStackTrace();
                }
            }).start();

            while (true) {
                System.out.print("Enter your message (type 'exit' to quit): ");
                String message = consoleReader.readLine();

                writer.println(message);

                if (message.equals("exit")) {
                    break;
                }
            }

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

    private static void startUDPClient() {
        try {
            DatagramSocket socket = new DatagramSocket();
            InetAddress serverAddress = InetAddress.getByName("localhost");

            BufferedReader consoleReader = new BufferedReader(new InputStreamReader(System.in));

            new Thread(() -> {
                try {
                    while (true) {
                        byte[] receiveData = new byte[1024];
                        DatagramPacket receivePacket = new DatagramPacket(receiveData, receiveData.length);
                        socket.receive(receivePacket);

                        String response = new String(receivePacket.getData(), 0, receivePacket.getLength());
                        System.out.println("Server: " + response);
                    }
                } catch (IOException e) {
                    e.printStackTrace();
                }
            }).start();

            while (true) {
                System.out.print("Enter your message (type 'exit' to quit): ");
                String message = consoleReader.readLine();

                byte[] sendData = message.getBytes();
                DatagramPacket sendPacket = new DatagramPacket(sendData, sendData.length, serverAddress,
UDP_PORT);
                socket.send(sendPacket);
                if (message.equals("exit")) {
                    break;
                }
            }

            socket.close();
        } catch (IOException e) {
            e.printStackTrace();
        }
    }
}
```

End Result:



```
PS C:\Users\omkar\Desktop\CN_LAB> javac ChatClient.java
PS C:\Users\omkar\Desktop\CN_LAB> java ChatClient
Chat Client
Choose the client type:
1. TCP Client
2. UDP Client
Enter your choice: 1
TCP Client connected to server
Enter your message (type 'exit' to quit): Hello
Enter your message (type 'exit' to quit): Server: Server: Any Queries???
Always feel free to ask queries!!
Enter your message (type 'exit' to quit):
```

```
PS C:\Users\omkar\Desktop\CN_LAB> javac ChatServer.java
PS C:\Users\omkar\Desktop\CN_LAB> java ChatServer
Chat Server
Choose the server type:
1. TCP Server
2. UDP Server
Enter your choice: 1
TCP Server listening on port 12345
TCP Client connected: /127.0.0.1
TCP Received from /127.0.0.1: Hello
Enter your response: Any Queries???
TCP Received from /127.0.0.1: Always feel free to ask queries!!
Enter your response:
```

Conclusion:

The TCP chat implementation in the provided code showcases a reliable and connection-oriented communication model, ensuring ordered and error-checked message exchange. This makes it suitable for applications prioritizing data integrity, such as file transfers or text-based communication. In contrast, the UDP chat leverages a connectionless, low-overhead approach, offering faster data transmission but without guarantees of reliability or ordered delivery. The choice between TCP and UDP in a chat application depends on the specific requirements, balancing factors like message integrity and real-time responsiveness. The code provides a practical illustration of these fundamental differences in socket-based communication.