Vidyalankar Institute of Technology — Accredited A+ by NAAC	**DEPARTMENT OF COMPUTER ENGINEERING**

Experiment No. 10

Semester	B.E. Semester VIII – Computer Engineering
Subject	Distributed Computing Lab
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Title: Multi-Threaded Distributed Application in Java

1. Introduction

A distributed application is a system where multiple clients interact with a server over a network. In this lab, we develop a multi-threaded client-server application using Java, where the server handles multiple clients concurrently.

2. Objectives

- To understand the concept of distributed computing.
- To implement a multi-threaded server that can handle multiple clients.
- To develop a client program that communicates with the server.

3. Theory

3.1 Distributed Computing

Distributed computing involves multiple computers working together to solve a problem or provide a service. In a client-server model, clients request services from a central server, which processes these requests and sends responses.

3.2 Multi-Threading in Java

Multi-threading allows a program to execute multiple tasks concurrently. In a multi-threaded server, each client connection is handled in a separate thread, ensuring simultaneous communication with multiple clients.

3.3 Sockets in Java

Sockets enable network communication between processes. Java provides ServerSocket for creating server connections and Socket for client connections. The server listens on a port and accepts incoming connections.

4. Implementation Details

4.1 Server Implementation

- A ServerSocket is created to listen for incoming client connections.
- When a client connects, a new thread (ClientHandler) is spawned to handle communication.
- The server echoes messages received from the client.

4.2 Client Implementation

- A Socket is used to connect to the server.
- The client sends messages to the server and receives responses.
- The client terminates communication when the user types "exit".

5. Execution Steps

1. **Compile the Java Files**

```
javac MultiThreadedServer.java Client.java
```

2. **Run the Server**

```
java MultiThreadedServer
```

3. **Run Multiple Clients**

```
java Client
```

4. **Interact with the Server**
    - Clients can send messages.

- The server responds with an echo message.
- Typing "exit" disconnects the client.

6. Observations and Results

- The server successfully handles multiple clients simultaneously.
- Each client receives responses independently.
- Communication is maintained until the client chooses to disconnect.

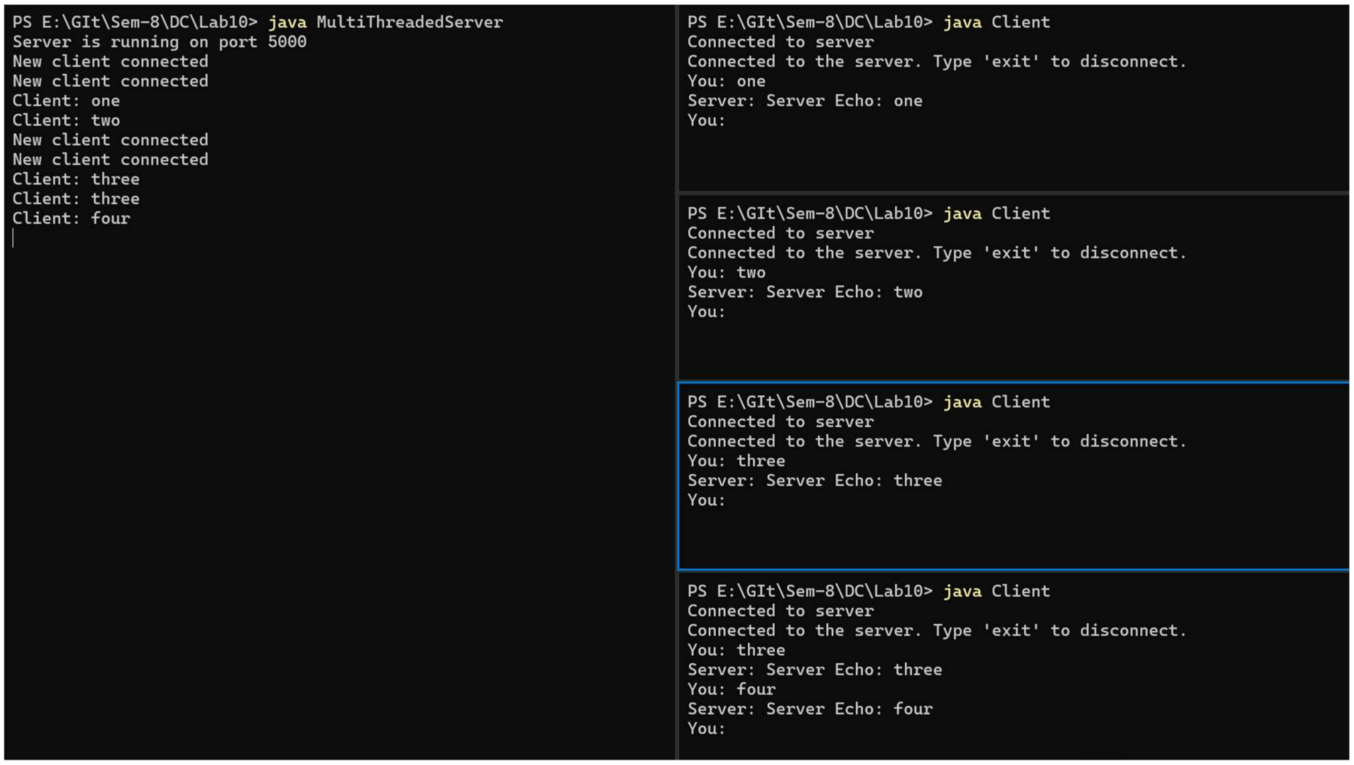
7. Conclusion

This lab demonstrates the implementation of a distributed application using Java sockets and multi-threading. The server efficiently manages multiple clients using separate threads, showcasing the power of concurrent programming.

Code:

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

class ClientHandler extends Thread {
    private Socket socket;

    public ClientHandler(Socket socket) {
        this.socket = socket;
    }

    @Override
    public void run() {
        try (BufferedReader in = new BufferedReader(new
InputStreamReader(socket.getInputStream()));
             PrintWriter out = new PrintWriter(socket.getOutputStream(), true)) {

            out.println("Connected to the server. Type 'exit' to disconnect.");
            String message;
            while ((message = in.readLine()) != null) {
                if ("exit".equalsIgnoreCase(message)) {
                    out.println("Goodbye!");
                    break;
                }
                System.out.println("Client: " + message);
                out.println("Server Echo: " + message);
            }
        } catch (IOException e) {
            System.out.println("Client disconnected.");
        } finally {
            try {
                socket.close();
            } catch (IOException e) {
                e.printStackTrace();
            }
        }
    }
}

public class MultiThreadedServer {
    public static void main(String[] args) {
        int port = 5000;
        try (ServerSocket serverSocket = new ServerSocket(port)) {
            System.out.println("Server is running on port " + port);
            while (true) {
                Socket clientSocket = serverSocket.accept();
                System.out.println("New client connected");
                new ClientHandler(clientSocket).start();
            }
        } catch (IOException e) {
            e.printStackTrace();
        }
    }
}


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

public class Client {
    public static void main(String[] args) {
        String host = "localhost";
        int port = 5000;

        try (Socket socket = new Socket(host, port);
             BufferedReader in = new BufferedReader(new
InputStreamReader(socket.getInputStream()));
             PrintWriter out = new PrintWriter(socket.getOutputStream(), true);
             BufferedReader userInput = new BufferedReader(new
InputStreamReader(System.in))) {

            System.out.println("Connected to server");
            System.out.println(in.readLine());

            String message;
            while (true) {
                System.out.print("You: ");
                message = userInput.readLine();
                out.println(message);
                if ("exit".equalsIgnoreCase(message)) break;
                System.out.println("Server: " + in.readLine());
            }
        } catch (IOException e) {
            e.printStackTrace();
        }
    }
}
```

Output:



```
PS E:\GIt\Sem-8\DC\Lab10> java MultiThreadedServer
Server is running on port 5000
New client connected
New client connected
Client: one
Client: two
New client connected
New client connected
Client: three
Client: three
Client: four
```

```
PS E:\GIt\Sem-8\DC\Lab10> java Client
Connected to server
Connected to the server. Type 'exit' to disconnect.
You: one
Server: Server Echo: one
You:
```

```
PS E:\GIt\Sem-8\DC\Lab10> java Client
Connected to server
Connected to the server. Type 'exit' to disconnect.
You: two
Server: Server Echo: two
You:
```

```
PS E:\GIt\Sem-8\DC\Lab10> java Client
Connected to server
Connected to the server. Type 'exit' to disconnect.
You: three
Server: Server Echo: three
You:
```

```
PS E:\GIt\Sem-8\DC\Lab10> java Client
Connected to server
Connected to the server. Type 'exit' to disconnect.
You: three
Server: Server Echo: three
You: four
Server: Server Echo: four
You:
```