PCS 2 Course Project Report

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1. Networked Chat, File Transfer, and Quiz Application

❖ Introduction:

1. Project Overview:

- The project entails the development of a networked application in Python.
- It encompasses functionalities such as group chat, file transfer, and quiz administration over a network.

2. Objective:

- The primary goal is to create a versatile communication tool that facilitates real-time interaction among users.
- The application aims to provide a seamless experience for exchanging messages, transferring files, and conducting quizzes in a networked environment.

3. Scope:

- The project scope includes the development of server and client scripts capable of handling multiple concurrent connections.
- It encompasses features like authentication, message routing, file transmission, and quiz management.

- The application targets educational and collaborative settings where users can communicate, share resources, and engage in interactive quizzes remotely.

❖ Packet Encoding Protocol

- Packets are sent by encoding in the following way:
    - First two bytes contain the header length.
    - Then there is the message header.
    - Then the next four bytes contain payload length.
    - Then there is payload content.

❖ Message Protocols

- First there is a header then a colon and then other details in every message except when the server is sending text messages to all clients.

Actions	Message Protocol
client to server	**msg:your message**
client to another client	**to:recipient_name:your message**
server to clients	**Simply type the message and press enter.**
Sending file from client to server	**file_transfer:file_to_server:filename**
Sending file from client to another client	**file_transfer:file_to:recipient_name:filename**
Sending file from server to clients	**send_file:recipient:directory_name:file_name**
Initiating quiz on the server terminal	**Quiz:quiz_files_dir:quiz_ques.txt:quiz_ans.txt:quiz_score_file.csv**
Clients submitting answers to the server	**quiz_answer:<answer1> <answer2> <answer3>**

❖ Implementation Details

➢ server.py:

- **Threaded TCP Server:** Utilizes Python's socketserver module for concurrent client connections, ensuring efficient handling of multiple clients.
- **Authentication:** Users authenticate based on registration status, with registered users providing credentials and new users registering with unique username/password pairs.
- **Database Integration:** Utilizes SQLite3 for secure storage of user credentials, ensuring authentication and registration processes are database-backed.
- **Message Routing:** Routes messages according to predefined protocols, supporting various message types: normal messages, commands, file transfers, and quiz submissions.
- **File Transfer:** Enables clients to send and receive files with the server or other clients, supporting targeted transfers and broadcasts.
- **Quiz Administration:** Facilitates quiz management by the server, with clients receiving questions and submitting answers, and scores stored in a CSV file.
- **Server Operations:** Provides commands for server administrators via CLI, supporting file sending, quiz administration, and graceful server shutdown.
- **Multithreading:** Implements multithreading for efficient client handling, ensuring responsiveness without blocking the main server thread.
- **Error Handling:** Incorporates robust error handling mechanisms, providing informative error messages to clients for invalid requests or errors.

➢ server_utils.py:

- **Message Encoding/Decoding:** Provides functions for encoding and decoding messages with header and payload length.

- **Message Validation:** Validates the header of received messages.
- **Broadcasting Messages:** Broadcasts messages to all clients or sends messages to specific clients.
- **File Transfer:** Facilitates file transfer between clients and the server, supporting both sending and receiving files.
- **Quiz Management:** Handles reading quiz questions/options from files, starting quizzes by sending questions to clients, and evaluating quiz answers received from clients.
- **File Handling:** Manages file reading and writing operations, including file transfer and quiz-related files.
- **Error Handling:** Provides basic error handling mechanisms.

➢ client.py:

- **Socket Setup:** Initiates a socket for server communication.
- **Connection Handling:** Establishes connection with the specified host and port, handling connection failures gracefully.
- **Authentication:** Utilizes client_utils.authenticate to authenticate with the server.
- **Message Handling:** Concurrently receives messages from the server and sends various types of messages, including normal messages, commands, and file transfer requests.
- **Error Management:** Provides basic error handling mechanisms.
- **Client Shutdown:** Closes the socket and terminates the receive thread upon user request or interruption.

➢ client_utils.py:

- **Message Handling:** Encodes and decodes messages for network transmission, validates the header of received messages.
- **Authentication:** Facilitates client authentication with the server.
- **File Transfer:** Sends and receives files between client and server, processes incoming messages, including file transfer requests.
- **Error Management:** Provides basic error handling capabilities.

★ ***<u>Screenshots are attached at the end of report</u>***

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2. Packet Analysis Dashboard

Project Overview:

The project aims to provide a user-friendly web interface for analyzing network traffic in real-time, including features like traffic volume calculation, average packet size determination, abnormal packet detection, and protocol distribution visualization.

Project Components:

1. Python Script: The main script (packet_analysis_dashboard.py) integrates packet capture using Scapy, data analysis using Pandas, visualization using Matplotlib and Plotly via Dash, and anomaly detection using Scikit-learn.
2. Dashboard Interface: The web-based interface allows users to interactively explore and analyze network traffic. It includes features like applying filters based on source IP, destination IP, and protocol.
3. Anomaly Detection: Anomaly detection is performed using the Isolation Forest algorithm from Scikit-learn, which helps identify abnormal packets in the network traffic.

Installation and Requirements:

The project requires Python 3.x along with several Python packages including Scapy, Pandas, Matplotlib, Dash, Plotly, and Scikit-learn. Installation instructions are provided in the README file.

Usage:

To use the dashboard:

1. Run the Python script (packet_analysis_dashboard.py).
2. Access the dashboard by opening a web browser and navigating to http://127.0.0.1:8050/.

Features:

- Real-time packet capture and analysis.
- Visualization of packet size distribution by protocol.
- Detection of abnormal packets using the Isolation Forest algorithm.
- User-friendly web interface for interactive analysis.

Acknowledgments:

The project acknowledges the following libraries:

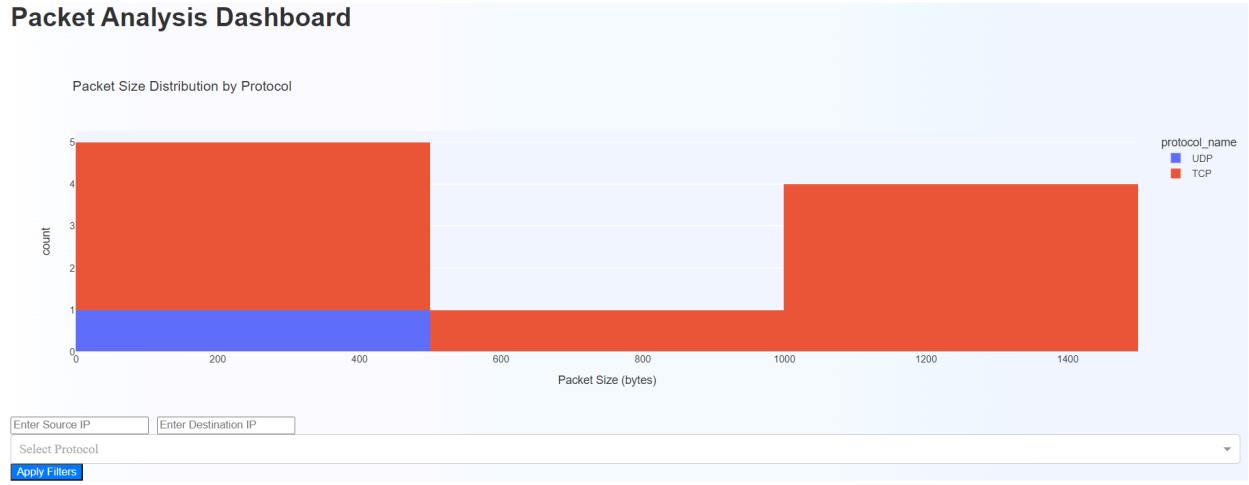
- Scapy: For packet manipulation and analysis.
- Dash: For building web applications with Python.
- Plotly: For interactive data visualization.
- Scikit-learn: For machine learning-based anomaly detection.

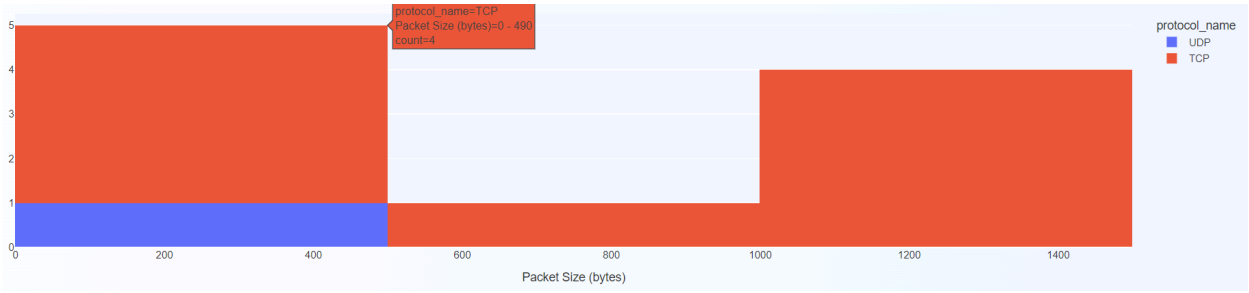
Conclusion:

The "Packet Analysis Dashboard" project provides a comprehensive solution for real-time network traffic analysis and anomaly detection, offering both functionality and usability through its intuitive web interface.

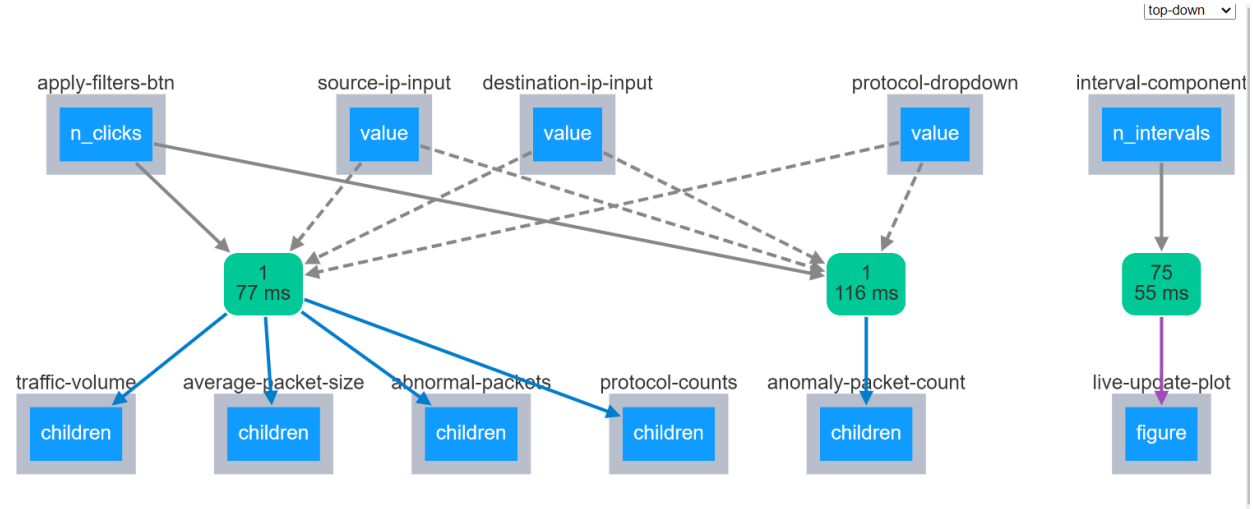
SOURCE CODE LINK

DASHBOARD SCREENSHOT -





Callback



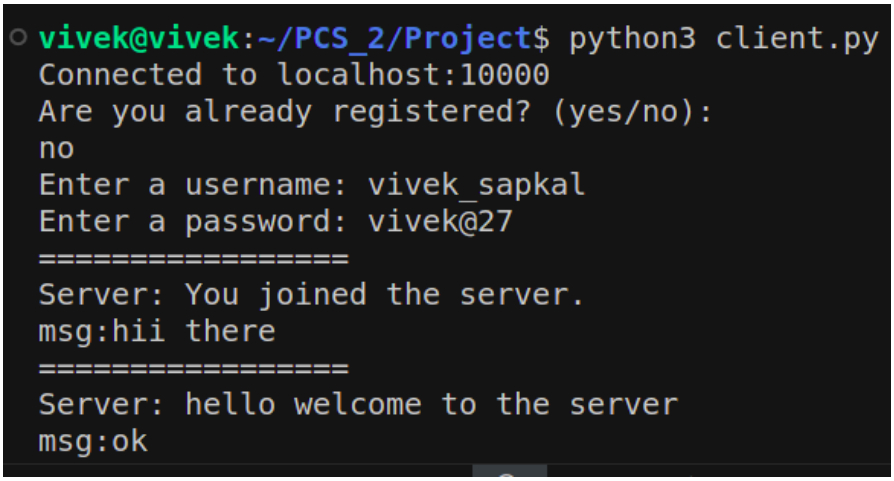
Contributions

1. Networked Chat, File Transfer, and Quiz Application: Vivek Sapkal (B22AI066)

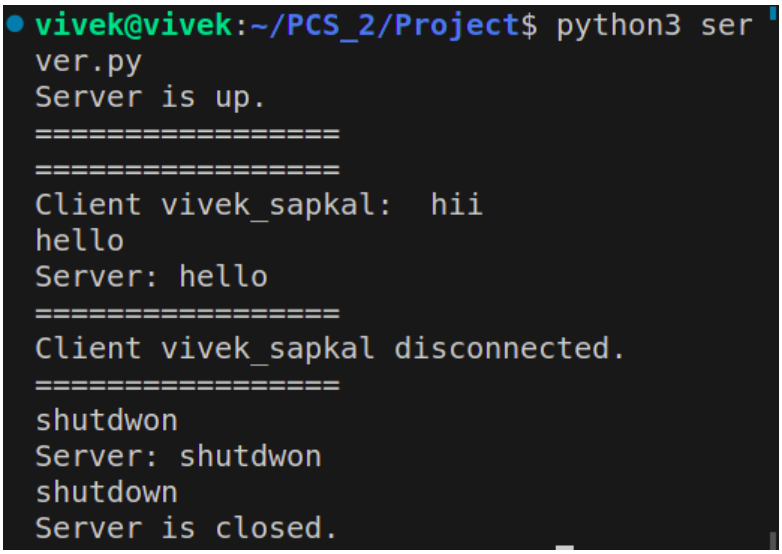
2. Packet Analysis Dashboard: Prem Kumar (B22AI031)

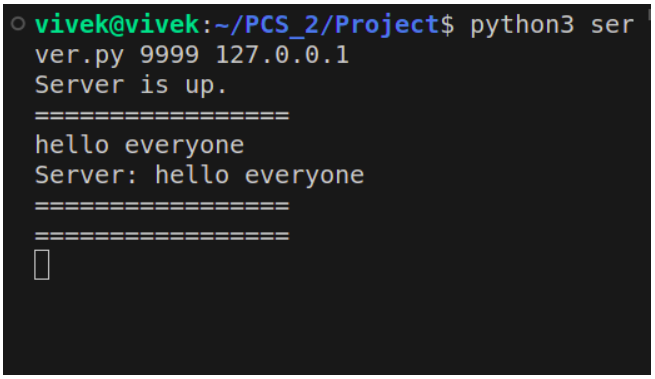
Presentation, Report, Readme File and Demo Video : Both

Screenshots of Networked Chat, File Transfer, and Quiz Application



- **Group chat**





- **Private chat**

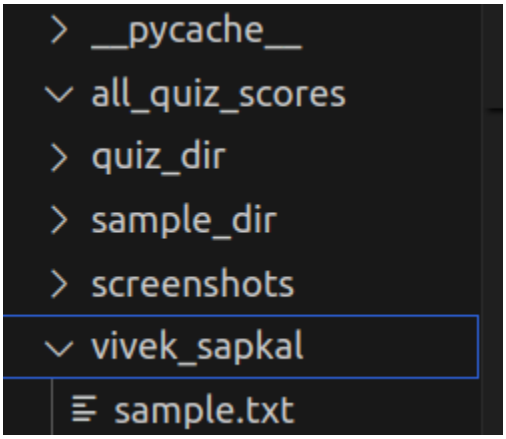
```
yes
Enter your username: vivek_sapkal
Enter your password: vivek@27
==================
Server: You joined the server.
==================
Server: Client kapil joined the server.
==================
Server: hello everyone
to:kapil: HI Kapil
==================
kapil (private):  Hi Vivek
```

```
vivek@vivek:~/PCS_2/Project$ python3 cl
ient.py 9999 127.0.0.1
Connected to 127.0.0.1:9999
Are you already registered? (yes/no):
yes
Enter your username: kapil
Enter your password: kapil@24
==================
Server: You joined the server.
==================
Server: hello everyone
==================
vivek_sapkal (private):  HI Kapil
to:vivek_sapkal: Hi Vivek
```

- **File Transfer**

```
vivek@vivek:~/PCS_2/Project$ python3 cli
ent.py
Connected to localhost:10000
Are you already registered? (yes/no):
yes
Enter your username: vivek_sapkal
Enter your password: vivek@27
==================
Server: You joined the server.
file_transfer:file_to_server:sample.txt
File 'sample.txt' sent to server.

==================
Server: File 'sample.txt' uploaded by vi
vek_sapkal
==================
Server: received file
```



- **Quiz**

```
vivek@vivek:~/PCS_2/Project$ python3 ser
ver.py
Server is up.
=================
Quiz:quiz_dir:quiz_ques.txt:quiz_ans.txt
:quiz_score.csv
=================
=================
```

```
Are you already registered? (yes/no):
yes
Enter your username: vivek_sapkal
Enter your password: vivek@27
=================
Server: You joined the server.
=================
Server: Client kapil joined the server.
=================
Question 1: What is the capital of Franc
e?

Options: a. Paris b. London c. Rome d. B
erlin

----------------------------

Question 2: Who wrote 'Romeo and Juliet'
?

Options: a. William Shakespeare b. Jane
Austen c. Charles Dickens d. Mark Twain

----------------------------

Question 3: What is the chemical symbol
for water?

Options: a. H2O b. CO2 c. O2 d. NaCl

----------------------------

quiz_answer:a b c
=================
Quiz is over. Thank you for participatin
g!
```

```
Connected to localhost:10000
Are you already registered? (yes/no):
yes
Enter your username: kapil
Enter your password: kapil@24
=================
Server: You joined the server.
=================
Question 1: What is the capital of Fran
ce?

Options: a. Paris b. London c. Rome d.
Berlin

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Question 2: Who wrote 'Romeo and Juliet
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Options: a. William Shakespeare b. Jane
 Austen c. Charles Dickens d. Mark Twai
n

----------------------------

Question 3: What is the chemical symbol
 for water?

Options: a. H2O b. CO2 c. O2 d. NaCl

----------------------------

quiz_answer:b b c
=================
Quiz is over. Thank you for participati
ng!
```

all_quiz_scores > quiz_score.csv

```
1   vivek_sapkal,3
2   kapil,2
3
```

End of Report
