Protocol Specification

Transport Layer

- **Protocol**: TCP
- **Default Port**: 1337
- **Encoding**: UTF-8
- **Message Format**: Newline-terminated (\n) text messages

Protocol Flow

1. Connection Phase

- **Client connects to server**
- **Server sends: "Welcome! Please log in.\n"**

2. Authentication Phase

Step 1: Username

- **User types: "User: <username>\n"**
- **Server validates format**
- **If invalid: server sends "error: invalid input\n" and closes connection**
- **If valid: server stores username and expects password**

Step 2: Password

- **User types: "Password: <password>\n"**
- **Server validates format and checks credentials**
- **If invalid format: server sends "error: invalid input\n" and closes connection**
- **If wrong credentials: server sends "Failed to login\n" and resets to username step**
- **If correct: server sends "Hi <username>, good to see you.\n" and proceeds to command phase**

3. Command Phase

After successful login, user can send these following commands:

a) Parentheses Check

- User types: "parentheses: <expression>\n"
- Expression must contain only (and) characters
- Server response: "the parentheses are balanced: yes\n" or "the parentheses are balanced: no\n"
- Error: "error: invalid input\n" (if expression contains invalid characters)

b) LCM (Least Common Multiple)

- User types: "lcm: <num1> <num2>\n"
- Server response: "the lcm is: <result>\n"
- Error: "error: invalid input\n" (if not exactly 2 integers)

c) Caesar Cipher

- User types: "caesar: <text> <shift>\n"
- Text must contain only letters (A-Z, a-z) and spaces
- Server response: "the ciphertext is: <encrypted_text>\n"
- Error: "error: invalid input\n" (if invalid characters or format)

d) Quit

- User types: "quit\n"
- Server closes connection (no response)

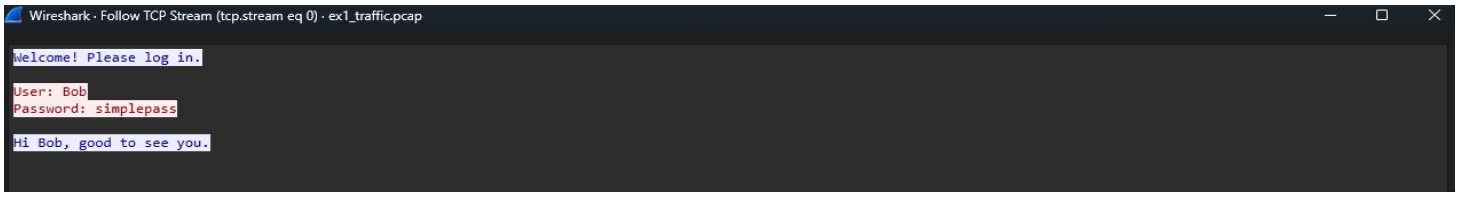
e) Invalid Command

- Any other command format
- Server response: "error: invalid input\n"
- Connection remains open

```
Welcome! Please log in.
User: alice
Password: secret123
Hi alice, good to see you.
parentheses: (()())
the parentheses are balanced: yes
lcm: 12 18
Server: the lcm is: 36
caesar: hello world 3
the ciphertext is: khoor zruog
quit
[Connection closed]
```

Blue represents Server's output

Yellow represents Client's input.



Wireshark · Follow TCP Stream (tcp.stream eq 0) · ex1_traffic.pcap

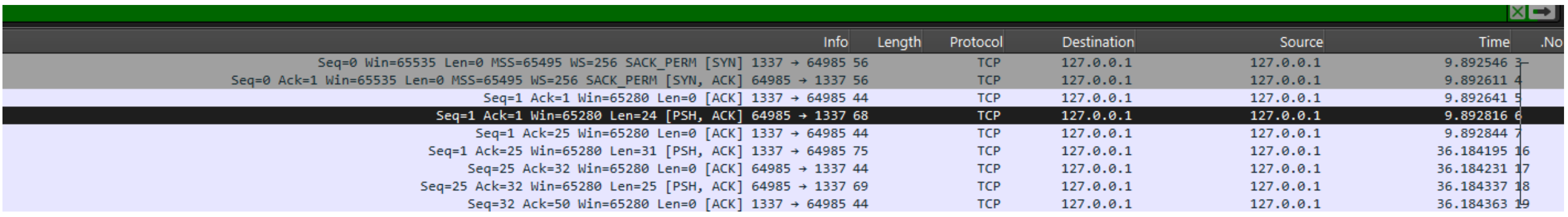
```
Welcome! Please log in.

User: Bob
Password: simplepass

Hi Bob, good to see you.
```

In generally: The screenshot shows the application protocol flow. The server sends a welcome message (Blue), the client sends the username 'Bob' (Red), and the server validates it

More specifically:



Info	Length	Protocol	Destination	Source	Time	.No
Seq=0 Win=65535 Len=0 MSS=65495 WS=256 SACK_PERM [SYN] 1337 → 64985	56	TCP	127.0.0.1	127.0.0.1	9.892546	3
Seq=0 Ack=1 Win=65535 Len=0 MSS=65495 WS=256 SACK_PERM [SYN, ACK] 64985 → 1337	56	TCP	127.0.0.1	127.0.0.1	9.892611	4
Seq=1 Ack=1 Win=65280 Len=0 [ACK] 1337 → 64985	44	TCP	127.0.0.1	127.0.0.1	9.892641	5
Seq=1 Ack=1 Win=65280 Len=24 [PSH, ACK] 64985 → 1337	68	TCP	127.0.0.1	127.0.0.1	9.892816	6
Seq=1 Ack=25 Win=65280 Len=0 [ACK] 1337 → 64985	44	TCP	127.0.0.1	127.0.0.1	9.892844	7
Seq=1 Ack=25 Win=65280 Len=31 [PSH, ACK] 1337 → 64985	75	TCP	127.0.0.1	127.0.0.1	36.184195	16
Seq=25 Ack=32 Win=65280 Len=0 [ACK] 64985 → 1337	44	TCP	127.0.0.1	127.0.0.1	36.184231	17
Seq=25 Ack=32 Win=65280 Len=25 [PSH, ACK] 64985 → 1337	69	TCP	127.0.0.1	127.0.0.1	36.184337	18
Seq=32 Ack=50 Win=65280 Len=0 [ACK] 1337 → 64985	44	TCP	127.0.0.1	127.0.0.1	36.184363	19

Lines 1-3- the packets are SYN, SYN-ACK, ACK and thus, these three packets show the TCP 3-Way Handshake establishing the connection between the client and server.

Line 4 (PSH, ACK packet)- means the server pushes (PSH) data to the client (the 'Welcome' message)

Line 5 (ACK packet): The client acknowledges receiving the message.

Line 6 (PSH, ACK packet)- the client pushes (PSH) data to the server (his username and password)

Line 7 (ACK packet): The server acknowledges receiving the message.

Line 8 (PSH, ACK packet)- the server sends the "... good to see you" message.

Line 9 (ACK packet): The client acknowledges receiving the message.