Overview

The two C programs, client.c and server.c, simulate the Go-Back-N (GBN) protocol to provide reliable data transfer over the unreliable UDP protocol. The simulation includes random packet loss and corruption to test the protocol's resilience.

Client.c - The Sender

The sender's goal is to transmit a set number of packets and ensure they are all acknowledged.

- **Sliding Window:** It sends a burst of packets up to a defined WINDOW_SIZE without waiting for individual ACKs.
- **Packet Loss Simulation**: It has a chance to randomly "drop" packets instead of sending them to simulate network loss.
- **Single Timer:** It uses one timer for the entire window of unacknowledged packets. It waits for a cumulative ACK using the select() function.
- **Receiving ACKs:** When a valid cumulative ACK arrives, it slides the window forward, allowing new packets to be sent.
- **Timeout & Retransmission:** If the timer expires before an ACK is received (a timeout), the sender retransmits all packets in the current window. This is the core "Go-Back-N" behavior.

Server.c - The Receiver

The receiver's role is to accept packets in the correct order and acknowledge them.

- **Packet Expectation:** It maintains a single state variable, expectedSeq, for the sequence number of the next packet it expects to receive.
- **Corruption Simulation:** It has a chance to randomly "corrupt" and discard incoming packets.
- I**n-Order vs. Out-of-Order:**
    - If a received packet's sequence number matches expectedSeq, it is accepted, and expectedSeq is incremented.
    - If a packet arrives out of order, it is discarded. The GBN receiver does not buffer out-of-order packets.
- **Cumulative ACKs:** After every packet arrival (whether accepted or discarded), the receiver sends an ACK for the last correctly received, in-order packet (expectedSeq - 1). This efficiently informs the sender of its progress.

Test Cases

Test Case 1: Perfect channel (no loss, no corruption)

- Expected: Packets 0 → 9 delivered in order, ACKs 0 → 9 sent.
- Not fully seen in this run (because I had losses + corruption).

Test Case 2: Packet loss

- Condition: Random packet loss simulated (rand()%10 < 2).

- Expected: Missing packet triggers timeout → retransmit full window.
- Matches expectation: packet loss triggered timeouts → sender resent entire window.

```
[Sender: Slide Window] base moved to 6
[Sender: Ready] Making packet 9
[Sender: Lost] Simulated loss for Packet 9
[Sender: ACK received] ackNo=6
[Sender: Slide Window] base moved to 7
[Sender: Timeout] Resending window...
[Sender: Resent] Packet 7
[Sender: Resent] Packet 8
[Sender: Resent] Packet 9
```

Test Case 3: Packet corruption

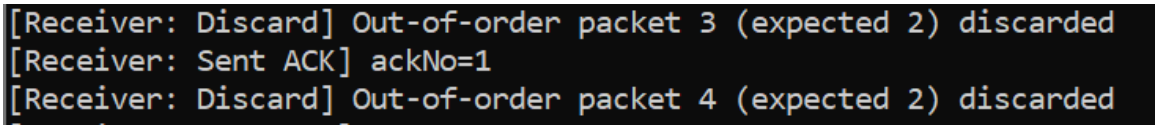
- Condition: Random corruption simulated (rand()%10 < 2).

- Expected: Corrupted packet discarded, receiver keeps ACKing last in-order. Sender retransmits after timeout.
- Matches expectation: corrupted packets discarded, receiver keeps ACKing last good packet (ackNo=6) until the missing ones were correctly received.

```
[Receiver: Corrupted] Packet 7 discarded
[Receiver: Corrupted] Packet 8 discarded
[Receiver: Corrupted] Packet 7 discarded
```

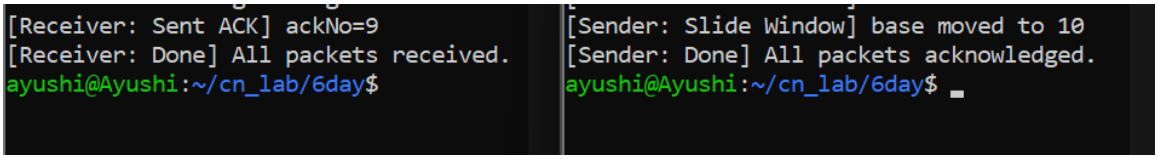
Test Case 4: Out-of-order arrival

- Condition: Receiver discards out-of-order packets.
- Expected: ACK stays at last correct packet. Sender retransmits missing one.
- Matches expectation: out-of-order packets discarded, receiver kept ACKing last in-order packet.



Test Case 5: Complete transmission

- Expected: All packets 0 → 9 delivered eventually, final ACK = 9.
- Seen at the end of both outputs:
- Matches expectation: all packets 0 → 9 eventually delivered, final ACK = 9.



SAMPLE OUTPUT: