CS3205 - Introduction To Computer Networks
Assignment - 3

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After running the sender and receiver code we have observed the download times for different values of losses (0.1%,0.5%,1%,1.5%,2%,5%) and different latencies (50ms, 100ms, 150ms, 200ms, 250ms and 500ms) for 3 different protocols namely, Stop and Wait, Go Back N, Selective Repeat.
Bandwidth was fixed at 200MBps and RTO at 1s, with packet size of 25KB and window size of 5 packets. We have increased the bandwidth and RTO than the mentioned ones for better demonstration.

- Impact of Loss Percentage on Time Delay:
    - As the loss percentage increases, the time delay also tends to increase. This is evident from the fact that for a fixed latency, higher loss percentages generally result in higher time delays.
    - This suggests that higher loss percentages lead to more retransmissions and longer time to send a complete file.
- Effect of Latency on Time Delay:
    - Generally, higher latencies lead to higher time delays. This is observed across different loss percentages. [Check the heat maps provided]
- Non-linear Relationship between Parameters and Time Delay:
    - The relationship between loss percentage, latency, and time delay is **not** strictly linear. There might be cases where increasing one parameter (e.g., loss percentage) might not proportionally increase the time delay due to interactions with other parameters (e.g., latency).
- Trade-offs in Network Performance:
    - Network designers must balance the trade-offs between loss percentage and latency. Lower loss percentages might be desirable for data integrity, but they can lead to longer time delays, especially with higher latencies. Conversely, reducing latency might improve responsiveness, but it could increase the impact of packet loss on overall performance.
- Protocols
    - It can be observed from the heatmaps that Selective Repeat works best, then Go Back N, then Stop and Wait from the values of the times for downloading the image.
        - Selective Repeat performs better in high-loss or delay scenarios, as it retransmits only lost packets.
        - Go-Back-N is efficient in low-error environments but struggles with higher losses or delays.
        - Stop-and-Wait is simple but inefficient, especially with high losses or delays.
    - The download time increases too much for Stop and Wait in adverse conditions, while the Go back N and Selective Repeat protocols offer much less increase in download time for higher losses and latancies.

The heatmaps, spreadsheets, and bash file are attached in the given zip.
README.txt has been provided with instructions to run the codes.