TCP program in Python

Server:

```
/Users/ichimaru/Desktop/ComputerNetworking/TCP/venv/bin/python /Users/ichimaru/Desktop/ComputerNetworking/TCP/Server.py
Waiting for connection...
Connection from client:  ('192.168.1.101', 56309)
Connection closed

Process finished with exit code 0
```

Client:

```
/Users/ichimaru/Desktop/ComputerNetworking/TCP/venv/bin/python /Users/ichimaru/Desktop/ComputerNetworking/TCP/Client.py
Connect successfully
Please input the sending message: hello
From server:  Message received
Please input the sending message: quit
Connection closed

Process finished with exit code 0
```

Exercise

P3

UDP and TCP use 1s complement for their checksums. Suppose you have the following three 8-bit bytes: 01010011, 01100110, 01110100. What is the 1s complement of the sum of these 8-bit bytes? (Note that although UDP and TCP use 16-bit words in computing the checksum, for this problem you are being asked to consider 8-bit sums.) Show all work. Why is it that UDP takes the 1s complement of the sum; that is, why not just use the sum? With the 1s complement scheme, how does the receiver detect errors? Is it possible that a 1-bit error will go undetected? How about a 2-bit error?

Answer

01010011+01100110=10111001

10111001+01110100=00101110

1s complement of the sum=11010001

The receiver adds the three original 8-bit bytes and the checksum. If the result contains a 0, there will be an error. A 1-bit error will definitely be detected but a 2-bit error may go undetected.

P26

Consider transferring an enormous file of *L* bytes from Host A to Host B. Assume an MSS of 536 bytes.

a. What is the maximum value of *L* such that TCP sequence numbers are not exhausted? Recall that the TCP sequence number field has 4 bytes.

b. For the *L* you obtain in (a), find how long it takes to transmit the file. Assume that a total of 66 bytes of transport, network, and data-link header are added to each segment before the resulting packet is sent out over a 155 Mbps link. Ignore flow control and congestion control so A can pump out the segments back to back and continuously.

Answer

a. 4byte=32bits Lmax=2^32=4294967296 bytes

b. total segments=4294967296/536=8012999

total bytes=8012999*66+4294967296=4823825230

t=4823825230byte/155Mbps=248s

P37

Compare GBN, SR, and TCP (no delayed ACK). Assume that the timeout values for all three protocols are sufficiently long such that 5 consecutive data segments and their corresponding ACKs can be received (if not lost in the channel) by the receiving host (Host B) and the sending host (Host A) respectively. Suppose Host A sends 5 data segments to Host B, and the 2nd segment (sent from A) is lost. In the end, all 5 data segments have been cor- rectly received by Host B.

a. How many segments has Host A sent in total and how many ACKs has Host B sent in total? What are their sequence numbers? Answer this question for all three protocols.

b. If the timeout values for all three protocol are much longer than 5 RTT, then which protocol successfully delivers all five data segments in shortest time interval?

Answer

a.

GBN:

A sends 9 packets: 1,2,3,4,5,2,3,4,5

B sends 8 ACKs: 1,1,1,1,2,3,4,5

SR:

A sends 6 packets: 1,2,3,4,5,2

B sends 5 ACKs: 1,3,4,5,2

TCP:

A sends 6 packets: 1,2,3,4,5,2

B sends 6 ACKs: 2,2,2,2,6

b. TCP. Because TCP uses fast retransmit without waiting until time out.

P40

Consider Figure 3.58. Assuming TCP Reno is the protocol experiencing the behavior shown above, answer the following questions. In all cases, you should provide a short discussion justifying your answer.

a. Identify the intervals of time when TCP slow start is operating.

b. IdentifytheintervalsoftimewhenTCPcongestionavoidanceisoperating.

c. After the 16th transmission round, is segment loss detected by a triple duplicate ACK or by a timeout?

d. After the 22nd transmission round, is segment loss detected by a triple duplicate ACK or by a timeout?

e. What is the initial value of ssthresh at the first transmission round?

f. What is the value of ssthresh at the 18th transmission round?

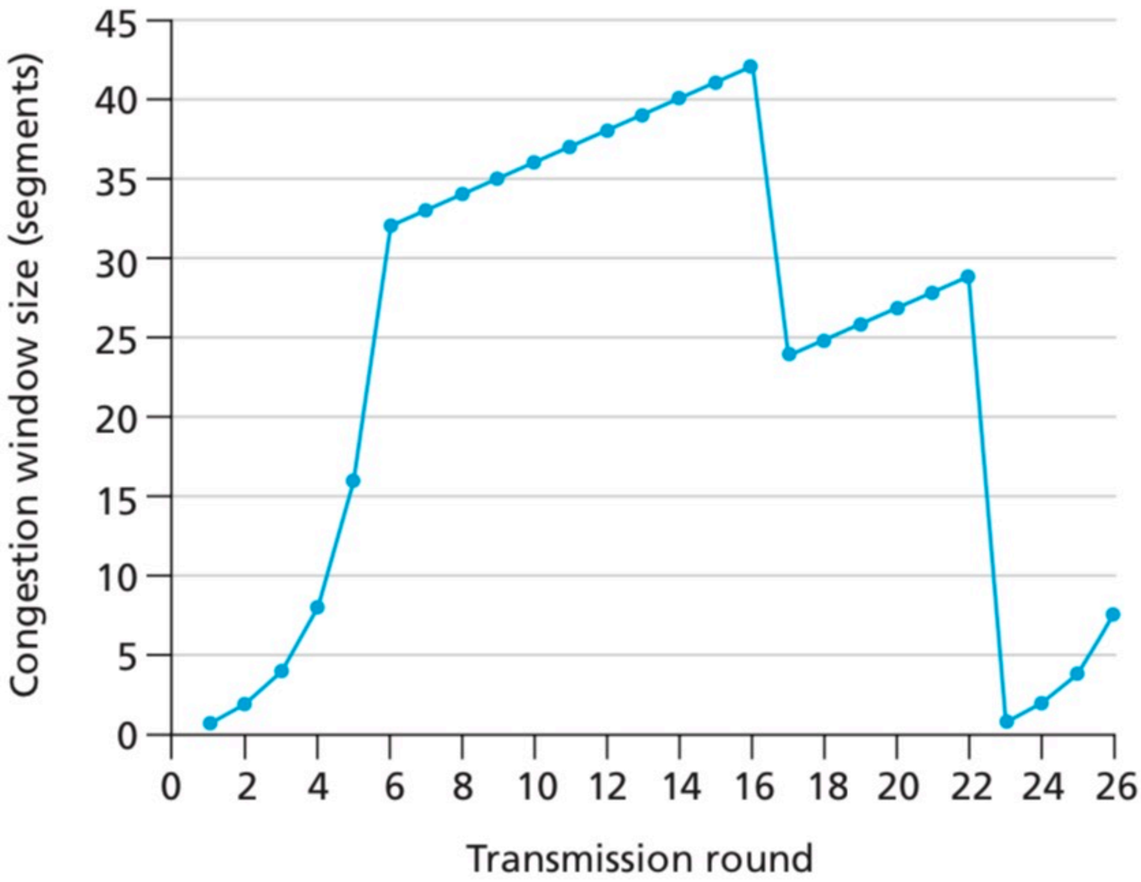
g. What is the value of ssthresh at the 24th transmission round?

h. During what transmission round is the 70th segment sent?

i. Assuming a packet loss is detected after the 26th round by the receipt of a triple duplicate ACK, what will be the values of the congestion window size and of ssthresh?

j. Suppose TCP Tahoe is used (instead of TCP Reno), and assume that triple duplicate ACKs are received at the 16th round. What are the ssthresh and the congestion window size at the 19th round?

k. Again suppose TCP Tahoe is used, and there is a timeout event at 22nd round. How many packets have been sent out from 17th round till 22nd round, inclusive?



Answer

a. [1,6] [23,26]

b. [6,16] [17,22]

c. Packet loss is detected by a triple duplicate ACK

d. Packet loss is detected by a timeout

e. The ssthresh is initially 32

f. The ssthresh is 42/2=21

g. The ssthresh is 29/2=15

h. 1+2+4+8+16+32=63 1+2+4+8+16+32+33=96. Thus packet 70 is sent in the 7th transmission round

i. cwnd=8/2=4, ssthresh=4+3=7

j. ssthresh=42/2=21, cwnd=4

k. 1+2+4+8+16+21=52

P44

Consider sending a large file from a host to another over a TCP connection that has no loss.

a. Suppose TCP uses AIMD for its congestion control without slow start. Assuming cwnd increases by 1 MSS every time a batch of ACKs is received and assuming approximately constant round-trip times, how long does it take for cwnd increase from 6 MSS to 12 MSS (assuming no loss events)?

b. What is the average throughout (in terms of MSS and RTT) for this con- nection up through time = 6 RTT?

Answer

a. 6MSS

b. (6+7+8+9+10+11)MSS/6RTT=8.5MMS/RRT