Name ONLY: _____

CS4392/5376: Computer Networks/ Communication Networks

Summer II 2021

Midterm Exam Solution

(14 problems & 20 total pts)

July 20th (Tuesday), 2021

Show ALL your work,
Open books and notes

1. [ ] define format, order of messages sent and received among network entities, and actions taken on message transmission and receipt.

[1 pt]

- Protocols (or communication protocols)

2. 2 GHz clock rate is what PICO clock cycle? Show all your work. Here, clock cycle = 1 / clock rate

[1 pt]

- clock cycle = 1 / clock rate = 1 / (2 x 10^(9)) = 0.5 x 10^(-9) = 500 x 10^(-12) = 500 psec

3. [True or False]: Network core devices (e.g., router and switch) can run a user application code.

[1 pt]

- False

4. Suppose users share a 3 Mbps link. Also suppose each user requires 150 kbps when transmitting, but each user transmits only 10 percent of the time. When circuit switching is used, how many users can be supported?

[1 pt]

- 3 x 10^6 bps/ 150 x 10^3 bps → 20 users

5. [True or False] In DNS, the iterated query operation puts burden of name resolution on contacted name server, resulting in heavy workload at upper levels of hierarchy.

[1 pt]

- False

6. Suppose Host A wants to send a large file to Host B. The path from Host A to Host B has three links with rates R1 = 500 kbps, R2 = 2 Mbps, and R3 = 1 Mbps.

(a) Assuming no other traffic in the network, what is the throughput for the file transfer?

[1 pt]

- 500 kbps

(b) Now R2 reduced to 100 kbps. Then assuming no other traffic in the network, what is the throughput for the file transfer?

[1 pt]

- 100 kbps

7. [True or False]: With nonpersistent connections between browser and origin server, it is possible for a single TCP segment to carry two distinct HTTP request messages.

[1 pt]

- False

8. [True or False] The *alternating-bit* protocol is the same as the *SR* protocol with a sender and receiver window size of 1.

[1 pt]

- True
- Note that with a window size of 1, SR, GBN, and the alternating bit protocol are functionally equivalent. The window size of 1 precludes the possibility of out-of-order packets (within the window). A cumulative ACK is just an ordinary ACK in this situation, since it can only refer to the single packet within the window.

9. [True or False] In reliable data transfer, a negative-acknowledgment message (NAK) can be replaced by a sequence number, if no acknowledgment (ACK) and NAK will be lost.

[1 pt]

- True

10. [True or False]: Suppose Host A is sending Host B a large file over a TCP connection. The number of unacknowledged bytes that A sends can exceed the size of the receive buffer.

[1 pt]

- False

11. Suppose within your Web browser you click on a link to obtain a Web page. The IP address for the associated URL is not cached in your local host, so a DNS lookup is necessary to obtain the IP address. Suppose that n DNS servers are visited before your host receives the IP address from DNS; the successive visits incur an RTT of `RTT1`, `RTT2`, …, `RTTn`. Further suppose that the Web page associated with the link contains exactly one object, consisting of a small amount of HTML text. Let `RTT0` denote the RTT between the local host and the server containing the object. Assume that zero transmission time of the object, how much time elapse from when the client clicks on the link until the client receives the object? [Hint]: A TCP connection should be setup.

[2 pts]

- The total amount of time to get the IP address is RTT1 + RTT2 + … + RTTn. Once the IP address is known, RTT0 elapses to set up the TCP connection and another RTT0 elapses to request and receive the small object. The total response time is 2RTT0 + RTT1 + RTT2 + … + RTTn.

12. Suppose you have the following two sample 8-bit data: `0101 0001` and `1101 0100`. What is the checksum? (Note that UDP and TCP use 16-bit in computing the checksum but this problem you are being asked to consider 8-bit checksum).

[2 pts]

-

```
0 1 0 1  0 0 0 1
1 1 0 1  0 1 0 0
-----------------
0 0 1 0  0 1 0 1
              1 (carry out)
-----------------
0 0 1 0  0 1 1 0 (sum)
1 1 0 1  1 0 0 1 (1's complement)
```

Thus, the checksum is 1 1 0 1 1 0 0 1

13. In TCP (no delay ACK), assume that the timeout value is 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 correctly received by Host B.

(a) (i) How many segments has Host A sent in total and (ii) what are their sequence numbers?

[1 pt]

(i) Host A sends 6 segments in total. (ii) They are initially sent segments 1, 2, 3, 4, 5 and later re-sent segments 2.

(b) (i) How many ACKs has Host B sent in total and (ii) what are their sequence numbers?

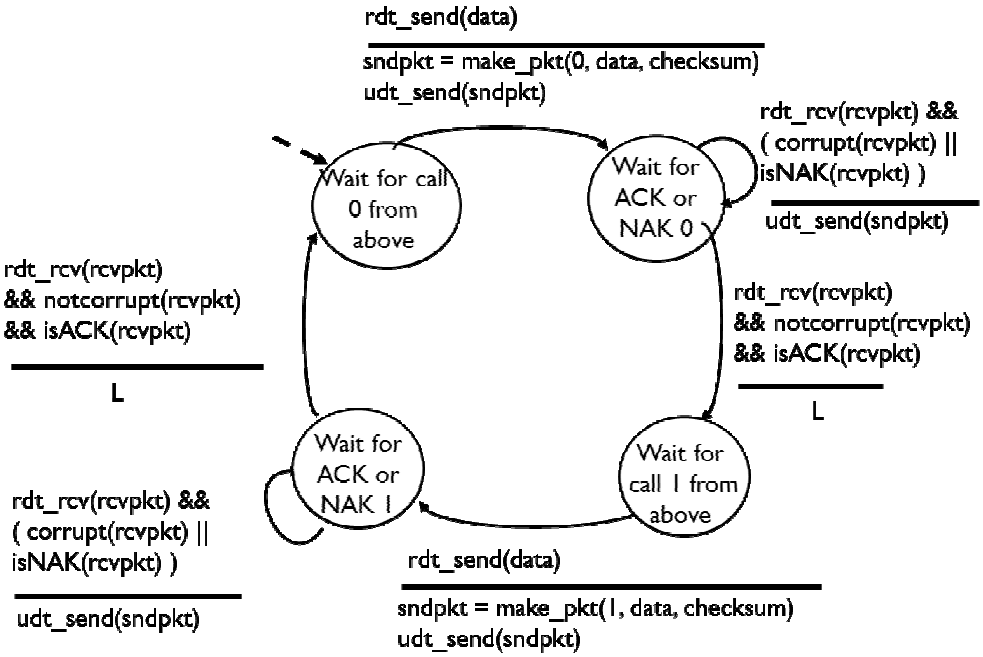
[1 pt]

(i) Host B sends 5 ACKs. (ii) They are 4 ACKS with sequence number 2. There is one ACK with sequence numbers 6. Note that TCP always send an ACK with expected sequence number.

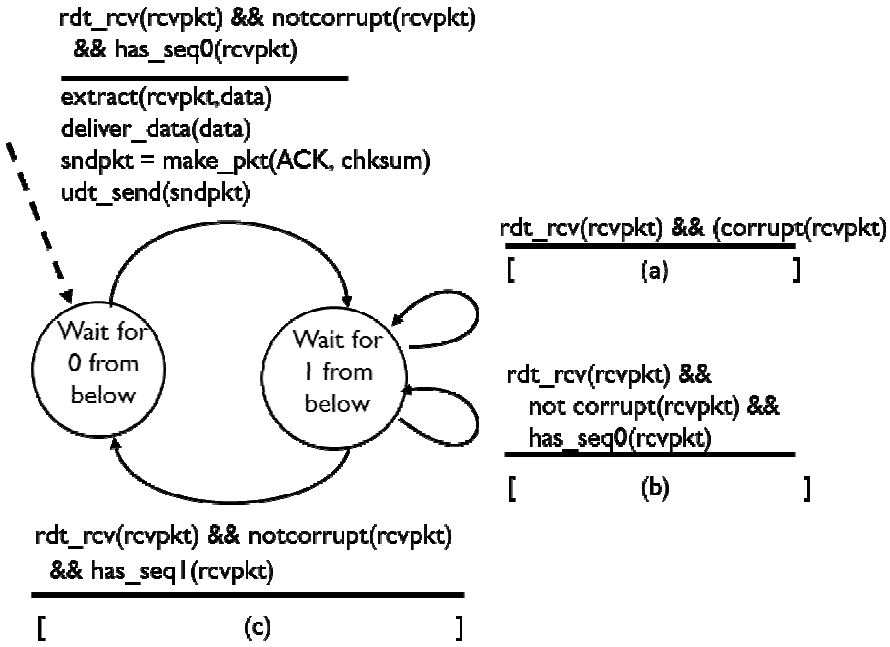
14. In reliable data transfer protocol, we consider that both sender and receiver can handle garbled ACK/NAKs. Here, the sender adds checksum and sequence number (e.g., 0 or 1). Describe the required action(s) at the receiver, (a), (b), and (c). Use the notations and be specific.

[3 pts]

- Sender:



- Receiver:



- (a) sndpkt = make_pkt(NAK, chksum); udt_send(sndpkt)
- (b) sndpkt = make_pkt(ACK, chksum); udt_send(sndpkt);
- (c) extract(rcvpkt,data); deliver_data(data); sndpkt = make_pkt(ACK, chksum); udt_send(sndpkt)