

**CS 428/528**  
**Instructor: Anand Seetharam**  
**Homework 3: Transport Layer**

**Problem 1 (40 points)**

a) Consider the two 16-bit words (shown in binary) below. Compute the Internet checksum value for these two 16-bit words:

```
11101110 01111001
10010000 11110001
-----
Wrap around: 10111111 01101010
Sum: 01111111 01101011
Checksum: 10000000 10010100
```

b) For the bytes in part (a), give an example where one bit is flipped in each of the 2 bytes and yet the 1s complement doesn't change.

```
11101110 01110001
10010000 11111001
```

**Problem 2 (20 points)**

Suppose that the UDP receiver computes the Internet checksum for the received UDP segment and finds that it matches the value carried in the checksum field. Can the receiver be absolutely certain that no bit errors have occurred? Explain.

False, as shown in 1.b based on the way that the checksum is calculated even if there was transmission error and 1 bit in each was flipped in each of the two 16 bit words, then we could still end up with the correct checksum. This is because when added if one bit in byte one is 1 and the corresponding bit in byte 2 is 0 or vice versa, if both of those bits get flipped, when added together you still get a result of 1. Thus, the receiver cannot be sure that UDP segment is absolutely correct.

**Problem 3 (40 points)**

a) In our rdt protocols, why did we need to introduce sequence numbers?

We use sequence numbers in order to keep track of the order for which the packets are obtained. Say you got two packets at the same time without sequence numbers, how would you know which one came first?

b) In our rdt protocols, why did we need to introduce timers?

We introduced timers in order to account for possible acknowledgment or packet loss. With timers you can assume that a packet didn't arrive, or the acknowledgment got lost, if you don't get an acknowledgment in a timely manner.

c) Suppose that the round-trip delay between sender and receiver is constant and known to the sender. Would a timer still be necessary in protocol rdt 3.0, assuming that packets can be lost? Explain.

Yes, a timer would still be necessary. In this scenario the timer could be set to the constant time that the roundtrip takes. That way if the timer were to expire then we would know for sure that the packet was lost and not delayed. This timer is essential in determining if packets were lost and require retransmission.

Submit a single pdf file with answers to the above questions. The naming convention of the file should be HW3\_yourlastname.pdf