

This homework is due in class on Monday, October 15. You can discuss homework exercises with other people in the class, but you should write up your own answers in your own words. The exercises on this homework are adaptations of problems from the textbook, starting with the very first problem in the book. Your responses should be generous.

Exercise 1. (From Problem P1 in Chapter 1.) Design and describe an application level protocol to be used between an automatic teller machine and a bank's centralized computer. Your protocol should allow a user's card and pin number to be verified, the account balance to be queried, and an account withdrawal to be made. Your protocol should be able to handle the case where there is not enough money in the account to cover the withdrawal. Specify your protocol by listing the messages exchanged and the actions taken on transmission or receipt of messages. What transport layer protocol does your application layer protocol use? Why?

Exercise 2. (Problem P14 in Chapter 2.) How does SMTP mark the end of a message body? How about HTTP? Could HTTP use the same method as SMTP to mark the end of a message body? Explain.

Exercise 3. (From Problem P19 in Chapter 2.) In this problem, we use the *dig* tool that is available on Mac OS and Linux to explore the hierarchy of DNS servers. First, consult the man page for *dig* (with the command `man dig`, or just google "man dig" to find the man page on line). Also, review the format for DNS query and response messages.

Use *dig* to explore the hierarchy of DNS servers. Start by using the *dig* command with no arguments to find the root servers. Then use *dig* to send a series of queries for *math.hws.edu*, first to a root server, then to a TLD server, etc., until you get an IP address for *math.hws.edu*. Report the names of the servers to which you send queries.

Repeat the exercise for *www.ox.ac.uk* and for at least one popular web site such as *google.com*.

Finally, write a short essay discussing the format of the output from a *dig* command and how it corresponds to the format of DNS responses.

Exercise 4. (From Problem P24 in Chapter 3.) Answer the following questions, and **justify your answers**.

- a) With a Selective Repeat protocol, is it possible for a sender to receive an ACK for a packet that falls outside its current window?
- b) With a Go-Back-N protocol, is it possible for a sender to receive an ACK for a packet that falls outside its current window?

Exercise 5. (Problem P28 in Chapter 3.) Host A and Host B are directly connected by a 100 Mbps link. There is one TCP connection between the two hosts, and Host A is sending to Host B an enormous file over this connection. Host A can send its application data into its TCP socket at a rate as high as 120 Mbps, but Host B can read out its TCP socket at a maximum rate of 50 Mbps. Describe the effect of TCP flow control.