Recitation 3: Group exercises

1. General UDP questions:

- How will a host (Bob) know that he has received a UDP packet?
- Does a router (Fred) look at the UDP header when it forwards a packet from Alice to Bob? [With "router" we mean "router" and not a "NAT gateway".]
- Since both UDP and IP provides connectionless unreliable services, what functionality does UDP add? (What kind of multiplexing is done by IP and UDP respectively?)

2. UDP port numbers

- How long is a field containing a UDP port number?
- What is a "well-known" port number?
  Why do some ports need to be well-known?
- What is an "ephemeral" port number?
  Who decides which port number a "client" will use?
- On a UNIX system, what does the "/etc/services" file contain?
  Which service runs on UDP port 69?
  (What do you think the "getservbyname()" function does?)

3. UDP Checksum

- Both the IP header and the UDP header contain a checksum, but only one of "covers" the user data. Which?
- What happens if a Bob detects an error in the UDP checksum? Does he (a) silently discard the packet, (b) discard the packet and send back an ICMP error message to Alice, or (c) delivers it to the process associated with the socket, but marks it as "erroneous"?
- In addition to the UDP packet itself the UDP checksum covers part of the IP header, known as the "pseudo-header". What fields of the IP header are included in the pseudo-header?
- The UDP checksum is optional. How will Bob know if the packet from Alice includes a valid checksum or not?

4. Reliability

If a service which utilize UDP transport requires reliable delivery of packets that service needs to implement reliability itself.

- DHCP is an example of a protocol running on top of UDP. A DHCP client is able to acquire an IP address as well as other parameters from a DHCP server. A successful handshake contains 4 DHCP messages:
  "Discover" (C->S), "Offer" (S->C), "Request" (C->S) and "Ack" (S->C).
  How do you think DHCP implements reliability? E.g., what would happen if the "Offer" is lost?
- TFTP is a file transfer protocol running over UDP, and can be used for "bootstrapping" diskless client. Packet loss or reordering can not be tolerated by a file transfer protocol. How do you think TFTP handles reliability?
- In voice over IP (VoIP) Alice and Bob have voice (and video) calls to each other over the Internet. The media (voice/video) streams are encoded and put into RTP packets, which in turn are encapsulated in UDP packets. How do you think VoIP handles *reordering* of packets (i.e., what happens if packets arrive out of order)? How do you think VoIP handles *loss* of packets?

If there is time we will do some of the exercises in chapter 11 of the course book (e.g., 11.16) and/or look at some "socket programming" examples.