Recitation 2: Group exercises

1. What fields should go into a network layer header?
2. IP routing exercise
3. Explain how IP fragmentation/reassembly works!
4. Avoiding fragmentation by use of Path MTU discovery
5. Explain why the ARP is needed and how it works?
6. ICMP questions

1. What fields should go into a network layer header?

   Hints:
   - In order for the packet to reach Bob, what address information must Alice put in the network layer header?
   - How can a final destination know if an IP packet carries an UDP packet, a TCP packet or some other kind of payload?
   - How can one avoid packets looping around in the network during periods of routing failures?
   - Should your network protocol be able to handle fragmentation?
   - Other fields? Error detection? Options? QoS?

2. Alice (at 192.168.0.10) would like to send a packet to Bob (at 192.168.1.2). Her routing table looks as follows:

Destination	Mask	Gateway	Interface
192.168.0.0	255.255.255.0	-	eth0
192.168.1.0	255.255.255.0	192.168.0.2	eth0
0.0.0.0	0.0.0.0	192.168.0.1	eth0

To which node will Alice forward the packet?
(That is, which node will be the next hop?)
Additional questions:

- What if Alice would like to send a packet to Charlie at 192.168.0.45?
- If she likes to send a packet to Fred at 130.235.8.9?

3. Explain how IP fragmentation/reassembly works!
   - Where and why can fragmentation occur?
   - Does every fragment contain an IP header?
   - Which node(s) reassembles a fragmented IP packet, the final destination, or an intermediate node (i.e., a router), or both?
   - How is a node able to reassemble a packet?
     - How does it know which fragments belong together? (which fields in the IP header does it look at?)
     - How is it able to put the fragments in the right order? (which fields does it look at?)
     - What happens if one of the fragments are missing?

4. Avoiding IP fragmentation:
   Path MTU discovery techniques can be used to avoid IP fragmentation. Try to come up with such a mechanism!
   Hint: Could you use the Don't Fragment (DF) flag and probe with different packet sizes? How will you know if your packet got through or not?
   Additional questions if there is time:
   Try to think about different probing algorithms?
   What happens if packets go along different paths with different path MTUs, e.g., due to load balancing routers or because some link becomes broken?

5. Explain why the address resolution protocol is needed and how it works?
   - Is ARP needed on LANs? Is ARP needed on point-to-point links?
   - What would an ARP query look like? “Who has IP=192.168.3.2?” or “Who has MAC=00:56:34:12:45?”
   - If Alice would like to send a packet to Bob residing on another subnet, will she use ARP to resolve the MAC address of Bob or the MAC address of her (next-hop) router along the path to Bob?

6. ICMP questions:
   - Explain how the “ping” program works! What ICMP messages does it use?
   - Explain how the “traceroute” program works!
   - (What would happen if you send a packet to a host which “is down”? What kind of message (if any) will the “last hop router” send back to you? See pages 214-216)