CS 372 Introduction to Computer Networks
Self-Check Exercises: Lecture 32 **Solutions**

1) What is the motivation for Network Address Translation (NAT)
There are not enough IPv4 addresses to go around. NAT allows a sub-network of computers to use the same "global" IP address, but different "local" addresses (behind the NAT device).

2) What are some advantages NAT?
   - Multiple computers on the same IP address
   - Local addresses are inaccessible from the global network without any prior information. (good for privacy).
   - You can change ISPs without changing inner network structure.
   - Many other answers possible…

3) What are some disadvantages of NAT?
   - NAT translation adds some minor delay.
   - Local addresses are inaccessible from the global network without prior information. (bad for hosting servers)
   - NAT breaks some networking conventions, such as ports being used to specify processes (in NAT they also specify hosts). They also allow routers to modify data above layer 3.

4) Why does NAT have to translate port numbers?
Multiple devices in the local network might be attempting to access the same external address/port. These are necessary to keep the sockets straight.

5) The computers in your network have addresses of the form 10.0.0.x/8, and your network uses a NAPT device as an internet gateway. The NAPT box has external address 192.205.11.1, and internal address 10.0.0.1 . The next available port number on the NAPT device is 36409. Suppose that the original sender at computer 10.0.0.25 uses port 23000 to send a query to a remote host at 209.53.77.5 on port 80.

When the message from the original sender arrives at the NAPT device…

- What is the source address:port? **10.0.0.25:23000**
- What is the destination address:port? **209.53.77.5:80**

When the message is forwarded from the NAPT device to the remote host…

- What is the source address:port? **192.205.11.1:36409**
- What is the destination address:port? **209.53.77.5:80**

When a response from the remote host comes back to the NAPT device…

- What is the source address:port? **209.53.77.5:80**
- What is the destination address:port? **192.205.11.1:36409**

When the NAPT device relays the message to the original sender…

- What is the source address:port? **209.53.77.5:80**
- What is the destination address:port? **10.0.0.25:23000**

6) What does a NAPT device change in an outgoing TCP/IP datagram?
Source address, source port, checksum

7) What does a NAPT device change in an incoming TCP/IP datagram?
Destination address, destination port, checksum

8) What are some methods by which an outside host can contact a server running behind a NAPT device?
   - You can setup the NAPT device to forward from a specific port number to a specific host inside the network. You can then advertise this address:port combination outside the network to devices which want to treach the internal server (UPnP).
   - Have the NAPT device forward ALL packets for which there isn't a current mapping to the same server (Static NAT Traversal).
   - Have the internal host connect to an outside relay, and the remote host also connect to the relay. The relay then will establish the connection between the end hosts (NAT Traversal relaying).
   - The NAPT device provides DNS services for hosts within its network. These devices can then be accessed by name (Twice NAT – very similar to UPnP).