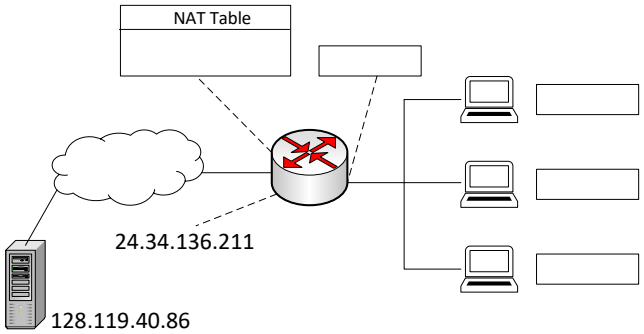
Assignment 4: IP and Network Routing[1]

Please submit your answers in a single PDF file.

1. (2 points) Suppose IPv4 datagrams are limited to 1,500 bytes (including header) between source Host A and destination Host B. Host A needs to send an MP3 consisting of 5 million bytes over TCP. Assuming only mandatory TCP and IPv4 headers are used and no fragmentation is allowed for IPv4, how many datagrams would be required to send the entire file? Explain how you computed your answer.

2. (5 points) Consider the network setup in the following figure. Suppose that the ISP assigns the router the address 24.34.136.211 and that the network prefix of the home network is 192.168.1.0/24.



   a. Assign addresses to all 3 interfaces in the home network and the network interface of the router connected to the home network.
   b. Suppose each host has 2 ongoing TCP connections, all to port 80 at host 128.119.40.86. Provide the 6 corresponding entries in the NAT translation table. You can make reasonable assumptions on the port numbers allocated by the local hosts. Note that there can be different correct answers.

NAT Translation Table	
WAN Side	LAN Side

[1] Some questions are adapted from textbooks “Computer Networking: A Top-Down Approach" by James Kurose & Keith Ross and resources provided with the textbooks. They can only be used by students who registered for this course. Reproduction outside of this course use is prohibited.

3. (1 point) We made a distinction between the forwarding function and the routing function performed in the network layer. What are the key differences between routing and forwarding?

4. (4 points) Consider a datagram network using 32-bit host addresses. Suppose a router has five links, numbered 0 through 4, and packets are to be forwarded to the link interfaces as follows:

Destination Address Range	Link Interface
11100000 00000000 00000000 00000000 through 11100000 00111111 11111111 11111111	0
11100000 01000000 00000000 00000000 through 11100000 01000000 11111111 11111111	1
11100000 01110000 00000000 00000000 through 11100000 01111111 11111111 11111111	2
11100001 10110000 00000000 00000000 through 11100001 10111111 11111111 11111111	3
11100010 10000000 00000000 00000000 through 11100010 11111111 11111111 11111111	4

   a. Complete the following forwarding table according to the above setting, assuming longest prefix matching is used to decide where to forward a packet to the correct link interface. Note that the column of network prefix should be presented in the decimal form of a.b.c.d/x.

Network Prefix (Decimal)	Output Link Interface

b. According to the above forwarding table, give the output link interface for each datagram with the following destination addresses:

   225.180.128.1, 224.125.1.2, 224.64.120.1

5. (3 points) Consider a router that interconnects three subnets: Subnet 1, Subnet 2, and Subnet 3. Suppose all of the interfaces in each of these three subnets should use addresses in a large block defined by prefix 128.16.0.0/12. You need to further divide this large address block into three smaller **non-overlapping** address blocks for these three subnets. They need to further meet the following conditions:

   a. Subnet 1 is required to support at least 300 interfaces, and the last address for this subnet is 128.31.255.255.
   b. Subnet 2 is to support at least 120 interfaces, and the last address for this subnet is 128.16.1.127.
   c. Subnet 3 is to support at least 400 interfaces, and the last address for this subnet is 128.17.7.255.

   Provide three network prefixes (of the form a.b.c.d/x) for the three subnets that satisfy the above constraints and also minimize the numbers of addresses for these subnets.