**Lab 6: IP Addressing [60 points]**

Due: 4/6/2022

**Objectives:** Gain a hands-on understanding of IP addressing by:

1. Creating a subnet calculator program that will output information about an IP address in CIDR notation
2. Creating a supernet calculator program that will output an aggregated route for a list of IP addresses in CIDR notation
3. Completing some IP subnetting word problems

**Note:** For this lab you can write your programs in either Java or Python (your choice). Both languages have networking helper libraries that could be used to calculate some of these values for you. DO NOT use these libraries in your submitted files. You should calculate the values yourself. There are several subnet and supernet calculators online, feel free to use these to validate your answers but write the programs yourself.

# Subnetting

1. Write a program (with comments) that will calculate the following values given a user-provided IP address in CIDR notation: network ID, subnet mask, total number of hosts in the subnet, number of usable hosts in the subnet, range of usable hosts and the broadcast address. [25 points]  
     
   Your program should also do basic error checking on the input – for example no octet should be larger than 255, the CIDR number (after the slash) should not be less than 1 or greater than 32.  
     
   Recall:  
   IPv4 addresses are 32 bits.  
   The **subnet mask** can be derived from the CIDR number, using the number as the number of most significant bits set to 1, then subtracting from 32 and setting the remaining bits to 0 and converting each octet back to decimal.  
   The **network ID** can be derived by logically ANDing the IP address and subnet mask in binary and converting the result back to decimal.  
   The **broadcast address** can be derived by setting all the host bits to 1.  
   The **total number of hosts** is where *n* is the number of host bits.  
   The number of **usable hosts** is -2 where *n* is the number of host bits.  
   The **range of hosts** starts at one above the network ID and ends at one below the broadcast address.  
     
     
   **Sample output:**  
   Enter an IP address in CIDR notation (x.x.x.x/y): 160.70.17.50/27  
   Network ID: 160.70.17.32  
   Subnet mask: 255.255.255.224  
   Broadcast address: 160.70.17.63  
   Total hosts: 32  
   Usable hosts: 30  
   Host range: 160.70.17.33 - 160.70.17.62
2. Consider a subnet with prefix 128.119.40.128/26. What is one host IP address on this network? [5 points]
3. Suppose an ISP owns the block of addresses 128.119.40.64/26 and they want to create 4 subnets from this block with the same number of IP addresses. What are the prefixes (of the form x.x.x.x/y) for the 4 subnets? [5 points]  
     
   **Hint:** To determine the size of each network figure out the total number of hosts in the network we’re subnetting and divide it by 4. You can then determine how many network bits you need by solving for .

# Supernetting

We discussed in class that one of the benefits of CIDR addressing is route aggregation. The process of aggregating routes into one larger route is called **supernetting**.

1. Write a program (with comments) that will calculate the supernet of a set of user-provided IP addresses in CIDR notation. You will need some of the code from the previous program so you may choose to add this as an additional option in your first program, if you prefer. [25 points]  
     
   **Hint:** To determine a supernet you should convert each provided IP address to binary and find the longest string of consecutive most-significant binary digits. The number of matching digits will by the CIDR number (after the slash), setting the remaining binary digits to 0 and converting to decimal will provide the network ID.  
     
   **Sample output:**  
   Enter IP addresses in CIDR notation, one per line. Press ENTER on a blank line when done:  
   176.16.150.40/16

172.16.148.30/16

172.16.148.15/16

172.16.149.20/20  
  
The supernet for these addresses is: 160.0.0.0/3