Course title: Computer Networks
Course code: CS461/ SE321
Assignment: Subnetting IP Addresses
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Due date: Monday, ***August 25***, 2025
(Please bring and submit the assignment when you come to attend the lecture)

Subnetting IP Addresses

There are five different address classes: A, B, C, D, and E. The first three classes A through C, each use a different size for the network ID and host ID portion of the address. Class D is for special type of address called a Multicast Address. Class E is an experimental address class that is not used.

Class A, B, and C Address

Class	Address Number Range	Starting Bits	Length of Network ID	Number of Networks	Host
A	1 – 126.x.y.z	0	8	126	16,777,214
B	128 – 191.x.y.z	10	16	16, 384	65,534
C	192 – 223.x.y.z	110	24	2,097,152	254

Default subnet masks (in bits / in decimal) of Class A, B and C IP addresses (32 bits long)

Address Class	Default Subnet Mask (in bits)	Default Subnet Mask (in decimal)	Network Prefix
Class A	11111111 00000000 00000000 00000000	255.0.0.0	/8
Class B	11111111 11111111 00000000 00000000	255.255.0.0	/16
Class C	11111111 11111111 11111111 00000000	255.255.255.0	/24

The first four bits of the IP address are used to determine into which class a particular address fit.

- If the first bit is a **0** (zero), the address is Class A address.
- If the first two bits are **10**, the address is a Class B address.
- If the first three bits are **110**, the address is a Class C address.
- If the first four bits are **1110**, the address is a Class D address.
- If the first four bits are **1111**, the address is a Class E address

To determine the network ID of an IP address, the device (router) must have both the IP address and the subnet mask.

Since all hosts on the same network must be using the same network ID, the ID must be defined by the same subnet mask.

For example, 157.55.0.0/16 is not the same network ID as 157.55.0.0/24.

The network ID 157.55.0.0/16 implies a range of valid host IP addresses from 157.55.0.1 to 157.55.255.254.

The network ID 157.55.0.0/24 implies a range of valid host IP addresses from 157.55.0.1 to 157.55.0.254.

(1) Subnetting Class C address: 1 – 126.x.y.z

Scenario 1

Consider the following class C network address of 206.168.1.0 with binary representation and with the default subnet mask of 255.255.255.0.

IP address (in decimal)	206	168	1	0
IP address (in binary)	11001110	10101000	00000001	00000000
Default Subnet mask (in decimal)	255	255	255	0
Default Subnet mask (in binary)	11111111	11111111	11111111	00000000

The 1's (dark red) in the default subnet mask indicates the network address portion, and the 0's indicates the host address portion.

Thus, the default subnet mask tells that the first 24 bits (206.168.1) are for the network portion and the remaining 8 bits (.0) are for the host portion.

When converting the binary to decimal, the values of each of the 8 host bits is as follows:

128, 64, 32, 16, 8, 4, 2, 1.

Based on scenario 1, answer the following questions.

Question 1-1: What is the highest decimal value that we can create with the 8 host bits? (Hint: assign 1 to all the host bits)

Answer: 254

Question 1-2: What is the network address of 206.168.1.0?

Answer: 206.168.1.0

Question 1-3: What is the broadcast address of 206.168.1.0?

Answer: 206.168.1.255

We can use address range from 206.168.1.1 – 206.168.1.254 as IP addresses for the 254 hosts in this Class C network.

Rather than having a single network with 254 host, for instance, it is possible to have two networks by implementing the subnetting process - dividing the Class C network into two subnetworks. The subnet mask tells the size of the network. When we want to create two or more subnets, we need to borrow (use) the bits from the host portion. For instance, by taking 1 bit from the host portion, we can create 2 subnets (2^1) from a single network, and only 7 bits are remaining for the host portion.

Question 1-4: When creating 2 subnets from a single network (class C address of 206.168.1.0), what will be the new subnet mask? Write your answer in both decimal and binary values.

Answer: /25

Subnet mask (in decimal)	255	255	255	128
Subnet mask (in binary)	11111111	11111111	11111111	10000000

Question 1-5: Based on Question 1-4, What is the highest decimal value that we can create with the host bits? (Hint: assign 1 to all the host bit)

Answer: 127

Questions regarding Subnet-1

Question 1-6: What is the IP address and subnet masks of Subnet-1? Write your answer in both decimal and binary representation.

Answer:

IP address	206 11001110	168 10101000	1 00000001	0 0000000(
Subnet mask	255 11111111	255 11111111	255 11111111	128 10000000

Question 1-7: What is the network address of Subnet-1? Hint: set all the host bits to 0 (zero).

Answer: 206.168.1.0/25

Question 1-8: What is the first valid host IP address of Subnet-1? Hint: it is the address that comes immediately after the network address

Answer: 206.168.1.1

Question 1-9: What is the broadcast address of Subnet-1? Hint: set all the host bits to 1.

Answer: 206.168.1.127

Question 1-10: What is the last valid host IP address of Subnet-1? Hint: it is the address immediately before the broadcast address.

Answer: 206.168.1.126

Questions regarding Subnet-2

Question 1-11: What is the IP address and subnet masks of Subnet-2? Write your answer in both decimal and binary representation.

Answer:

IP address	206 11001110	168 10101000	1 00000001	128 10000000
Subnet mask	255 11111111	255 11111111	255 11111111	128 10000000

Question 1-12: What is the network address of Subnet-2?

Answer: 206.168.1.128/25

Question 1-13: What is the first valid host IP address of Subnet-2?

Answer: 206.168.1.129

Question 1-14: What is the broadcast address of Subnet-2?

Answer: 206.168.1.255

Question 1-15: What is the last valid host IP address of Subnet-2?

Answer: 206.168.1.254

Scenario 2

By taking the Class C address 206.168.1.0, please create 4 subnets (subnetworks) and for each subnet compute the subnet mask, the network address, the broadcast address, the first and last valid host addresses. The address should be represented in both decimal and binary format.

Questions regarding Subnet-1

Question 1-16: What is the IP address and subnet masks of Subnet-1?

Answer:

IP address	206 11001110	168 10101000	1 00000001	0 00000000
Subnet mask	255 11111111	255 11111111	255 11111111	192 11000000

Question 1-17: What is the network address of Subnet-1? Hint: set all the host bits to 0 (zero).

Answer:

206	168	1	0
11001110	1010100(	00000001	0000000

Question 1-18: What is the first valid host IP address of Subnet-1? Hint: it is the address that comes immediately after the network address

Answer:

206	168	1	1
11001110	1010100(	00000001	00000001

Question 1-19: What is the broadcast address of Subnet-1? Hint: set all the host bits to 1.

Answer:

206	168	1	63
11001110	10101000	00000001	00111111

Question 1-20: What is the last valid host IP address of Subnet-1? Hint: it is the address immediately before the broadcast address.

Answer:

206	168	1	62
11001110	10101000	00000001	00111110

Questions regarding Subnet-2

Question 1-21: What is the IP address and subnet masks of Subnet-2?

Answer:

IP address	206 11001110	168 10101000	1 00000001	64 01000000
Subnet mask	255 11111111	255 11111111	255 11111111	192 11000000

Question 1-22: What is the network address of Subnet-2? Hint: set all the host bits to 0 (zero).

Answer:

206	168	1	64
11001110	10101000	00000001	01000000

Question 1-23: What is the first valid host IP address of Subnet-2?

Answer:

206	168	1	65
11001110	10101000	00000001	01000001

Question 1-24: What is the broadcast address of Subnet-2?

Answer:

206	168	1	127
11001110	10101000	00000001	01111111

Question 1-25: What is the last valid host IP address of Subnet-2?

Answer: 206.168.1.127

206	168	1	126
11001110	10101000	00000001	01111110

Questions regarding Subnet-3

Question 1-27: What is the IP address and subnet masks of Subnet-3?

Answer:

IP address	206 11001110	168 10101000	1 00000001	128 10000000
Subnet mask	255 11111111	255 11111111	255 11111111	192 11000000

Question 1-28: What is the network address of Subnet-3?

Answer:

206	168	1	128
11001110	10101000	00000001	10000000

Question 1-29: What is the first valid host IP address of Subnet-3?

Answer:

206	168	1	129
11001110	10101000	00000001	10000001

Question 1-30: What is the broadcast address of Subnet-3?

Answer:

206	168	1	191
11001110	10101000	00000001	10111111

Question 1-31: What is the last valid host IP address of Subnet-3?

Answer:

206	168	1	190
11001110	10101000	00000001	10111110

Questions regarding Subnet-4

Question 1-32: What is the IP address and subnet masks of Subnet-4?.

Answer:

IP address	206 11001110	168 10101000	1 00000001	192 11000000
Subnet mask	255 1111111	255 1111111	255 11111111	192 11000000

Question 1-33: What is the network address of Subnet-4?

Answer:

206	168	1	192
11001110	1010100(	00000001	11000000

Question 1-34: What is the first valid host IP address of Subnet-4?

Answer:

206	168	1	193
11001110	10101000	00000001	11000001

Question 1-35: What is the broadcast address of Subnet-4?

Answer:

206	168	1	255
11001110	1010100(	00000001	11111111

Question 1-36: What is the last valid host IP address of Subnet-4?

Answer:

206	168	1	254
11001110	10101000	00000001	11111110

(2) Subnetting Class B address: 128 – 191.x.y.z

Consider the following class B network address of 186.32.0.0/17 with binary representation and with the default subnet mask of 255.255.0.0.

IP address (in decimal)	186	32	0	0
IP address (in binary)	10111100	00100000	00000000	00000000
Default Subnet mask (in decimal)	255	255	0	0
Default Subnet mask (in binary)	11111111	11111111	00000000	00000000

Create two subnets (Subnet-1 and Subnet-2) out of the class B network address 186.32.0.0/17. By taking one bit from the host portion, you can create two subnets. Here you have 7 + 8 = 15 host bits to be used for subnetting, which is more than the host bits of Class C address.

For each subnet compute the subnet mask, the network address, the broadcast address, the first and last valid host addresses. The address should be represented in both decimal and binary format.

Block size of each subnet: 256 - 128 = 128
For /17 mask, you get 2 subnets, each with 32,766 hosts.
Subnet-1: 186.32.0.0/17
Subnet-2: 186.32.128.0/17

Questions regarding Subnet-1

Question 2-37: What is the IP address and subnet masks of Subnet-1?

Answer:

IP address	186 10111010	32 00100000	0 0000000	0 0000000
Subnet mask	255 11111111	255 11111111	128 10000000	0 00000000

Question 2-38: What is the network address of Subnet-1?

Answer:

186	32	0	0
10111010	00100000	00000000	00000000

Question 2-39: What is the first valid host IP address of Subnet-1?

Answer:

186	32	0	1
10111010	00100000	00000000	00000001

Question 2-40: What is the broadcast address of Subnet-1?

186	32	127	255
10111010	00100000	01111111	11111111

Question 2-41: What is the last valid host IP address of Subnet-1?

186	32	127	254
10111010	00100000	01111111	11111110

Questions regarding Subnet-2

Question 2-42: What is the IP address and subnet masks of Subnet-2?

Answer:

IP address	186 10111010	32 00100000	128 10000000	0 00000000
Subnet mask	255 11111111	255 11111111	128 10000000	0 00000000

Question 2-43: What is the network address of Subnet-2?

Answer:

186	32	128	0
10111010	00100000	10000000	00000000

Question 2-44: What is the first valid host IP address of Subnet-2?

Answer:

186	32	128	1
10111010	00100000	10000000	00000001

Question 2-45: What is the broadcast IP address of Subnet-2?

Answer:

186	32	255	255
10111010	00100000	11111111	11111111

Question 2-46: What is the last valid host IP address of Subnet-2?

Answer:

186	32	255	254
10111010	00100000	11111111	11111110