

Introduction to Networks and Distributed Computing
CECS 327 Section 01
Spring 2021
Due Date: Tuesday, March 23, 2021 @ 10:00 PM PST

Assignment 3: Subnetting

Instructions For all problems:

- This is a team assignment
- Use the Subnetting Worksheet to show and record all work for each problem.
- The all 0's subnet is a usable subnet and the all 1's subnet is not a usable subnet.

Problem 1

Host IP Address	172.30.1.33
Major Network Mask	255.255.0.0
Major (Base) Network Address	172.30.0.0
Major Network Broadcast Address	172.30.255.255
Total Number of Host Bits Number of Hosts	16 host bits $2^{16} = 65,536 - 2 = 65,534$ usable hosts
Subnet Mask	255.255.255.0
Number of Subnet Mask Bits Number of Usable Subnets Bits Maximum Subnets	24 subnet bits 8 usable bits $2^8 = 256$ subnets
Number of Host Bits per Subnet Number of Usable Hosts per Subnet	8 bits (32 - number of subnet mask bits) $2^8 - 2 = 254$ usable hosts/subnet
Subnet Address for this IP Address	172.30.1.0
IP Address of First Host on this Subnet	172.30.1.1
IP Address of Last Host on this Subnet	172.30.1.254
Broadcast Address for this Subnet	172.30.1.255

Problem 1 Work:

Step 1: Convert IP Address and Major Network Mask to Binary

Given:

IP Address: 172.30.1.33

IP Address in Binary: 10101100. 011110. 1. 0100001

Major Network Mask: 255.255.0.0 (/16)

Major Network Mask in Binary: 11111111.11111111.00000000.00000000

Step 2: Major Network Address Bitwise the IP and the Major Network Mask via the AND Operator (Binary)

IP Address in Binary: 10101010. 00011110. 1. 0100001

Major Network Mask in Binary: 11111111.11111111.00000000.00000000

Network Address: 10101100.11110.0.0 (Major Network Address)
172.30.0.0 (Decimal form of Major Network Address)

Step 3: Broadcast Address for the Major Network Address

	Network Portion		Host Portion	
Network Address	10101100 (172)	0011110 (30)	00000000 (0)	00000000 (0)
Major mask	11111111 (255)	11111111 (255)	00000000 (0)	00000000 (0)
Broadcast	10101100 (172)	0011110 (30)	11111111 (255)	11111111 (255)

NOTE: Broadcast = first half of major network address and the second half is all 1's. Decimal number will be in parentheses.

Host bits represent the host portion which is the second half of the ip addresses

Host bits = 8 + 8 = 16

2^{16} = 65,536 total number of hosts(the 2 came from binary: YES OR NO)

65,536 - 2 = 65,534 usable hosts(Not allowed to use the all 0's ip address, network address, or all the 1's ip address, broadcast address).

Part 2:

Step 1: Translate Host IP Address and Subnet Mask into binary notation

IP Address: 172.30.1.33

IP Address in Binary: 10101100. 00011110. 00000001. 0100001

Subnet

Mask: 255.255.255.0 (/24)

Subnet Mask in Binary: 11111111.11111111.11111111.00000000

Step 2: Determine the Network (or Subnet) where this Host address lives Perform a Bitwise Operator on the IP Address and Subnet Mask via the AND Operator

IP Address in Binary: 10101100. 00011110. 00000001. 00100001

Subnet Mask in Binary: 11111111.11111111.11111111.00000000

10101100 11110 1 0
172 30 1 0

Subnet Address in Decimal: 172.30.1.0

Step 3: Determine which bits in the address contain Network information and which contain Host information:

1. Draw the “**Major Divide**” (M.D) as a wavy line where the 1’s in the Major (Base) Network Mask ends (also the mask if there was no subnetting).
2. Draw the “**Subnet Divide**” (S.D.) as a straight line where the 1’s in the given Subnet Mask ends. The network information ends where the 1’s in the mask end.

	Subnet Counting Range	Host Counting Range
IP Address	00000001 00	100001
Subnet Mask	11111111 00	000000
Subnet Add	00000001(1) 00 (0)	000000 (0)
First host	1	00000001(1)
Last host	1	00111110 (254)
broadcast	1	00111111 (255)

Step 5: Determine the range of host addresses available on this subnet, and the broadcast address on this subnet:

1. Copy down all of the network/subnet bits of the Network Address(i.e. all bits before the S.D.)
2. In the host portion (to the right of the S.D.) make the host bits all 0's except for the right most bit (or least significant bit), which you make a 1. This gives you the first Host IP Address on this subnet, which is the first part of the result for "Range of Host Addresses for This Subnet,"
3. Now, in the host portion (to the right of the S.D.) make the host bits all 1's except for the right most bit (or least significant bit), which you make a 0. This gives you the last Host IP Address on this subnet, which is the last part of the result for "Range of Host Addresses for This Subnet,"
4. In the host portion (to the right of the S.D.) make the host bits all 1's. This gives you the Broadcast IP Address on this subnet. This is the result for "Broadcast Address of This Subnet,"

Step 6: Determine the number of usable subnets

The way to look for the usable subnet bits is to look at the last number of the Subnet mask address. By looking at the last number of the Subnet mask address, you can determine how many bits are being borrowed to add up to that number. Ex: 0 has 0 subnet bits because its not borrowing any bits

(Last number of subnet mask) Number of Subnet bits = 128 64 32 16 8 4 2 1 = 0
0 0 0 0 0 0 0 0

NOTE:

The number of subnet bits are the 1's = 0

The number of host bits per Subnet are the 0's = 8

Step 7: Determine the number usable hosts per subnet

The number of hosts per subnet is determined by the number of host bits (in this example, 8 bits) minus 2 (1 for the subnet address and 1 for the broadcast address of the subnet).

$$2^8 - 2 = 256 - 2 = 254 \text{ hosts/subnet}$$

Problem 2

Host IP Address	172.30.1.33
Major Network Mask	255.255.255.0
Major (Base) Network Address	172.30.1.0
Major Network Broadcast Address	172.30.1.255
Total Number of Host Bits Number of Hosts	8 bits $2^8 = 256 - 2 = 254$ usable hosts
Subnet Mask	255.255.255.252
Number of Subnet Mask Bits Number of Usable Subnets Bits Maximum Subnets	30 subnet bits 6 bits $2^6 = 64$ maximum subnets
Number of Host Bits per Subnet Number of Usable Hosts per Subnet	2 host bits/subnet (32 - number of subnet mask bits) $2^2 - 2 = 2$ usable hosts/subnet
Subnet Address for this IP Address	172.30.1.32
IP Address of First Host on this Subnet	172.30.1.33
IP Address of Last Host on this Subnet	172.30.1.34
Broadcast Address for this Subnet	172.30.1.35

(Last number of subnet mask) Number of Subnet bits = 128 64 32 16 8 4 2 1 = 252
 1 1 1 1 1 1 0 0

NOTE:

To KNOW THE LAST NUMBER of subnet mask, convert the decimal to binary and look at and add the number of 1's

The number of subnet bits are the 1's = 6

The number of host bits per Subnet are the 0's = 2

Problem 3

Host IP Address	192.192.10.234
Major Network Mask	255.255.255.0
Major (Base) Network Address	192.192.10.0
Major Network Broadcast Address	192.192.10.255
Total Number of Host Bits Number of Hosts	8 bits $2^8 - 2 = 256 - 2 = 254$ usable hosts
Subnet Mask	255.255.255.248
Number of Subnet Bits Number of Usable Subnets (zero subnet used) Maximum Subnets	29 subnet bits 5 bits $2^5 = 32$ usable bits
Number of Host Bits per Subnet Number of Usable Hosts per Subnet	3 host bits/subnet (32 - number of subnet mask bits) $2^3 - 2 = 6$ usable hosts/subnet
Subnet Address for this IP Address	192.192.10.232
IP Address of First Host on this Subnet	192.192.10.233
IP Address of Last Host on this Subnet	192.192.10.238
Broadcast Address for this Subnet	192.192.10.239

(Last number of subnet mask) Number of Subnet bits = 128 64 32 16 8 4 2 1 = 248

1 1 1 1 1 0 0 0

NOTE:

TO KNOW THE LAST NUMBER of subnet mask, convert the decimal to binary and look at and add the number of 1's

The number of subnet bits are the 1's = 5

The number of host bits per Subnet are the 0's = 3

Problem 4

Host IP Address	171.68.99.71
Major Network Mask	255.255.0.0
Major (Base) Network Address	171.68.0.0
Major Network Broadcast Address	171.68.255.255
Total Number of Host Bits Number of Hosts	16 host bits $2^{16} = 65,536$ total number of hosts $65,536 - 2 = 65,534$ usable hosts
Subnet Mask	255.255.240.0
Number of Subnet Bits Number of Usable Subnets (zero subnet used) Maximum Subnets	20 bits 4 bits $2^4 = 16$ bits
Number of Host Bits per Subnet Number of Usable Hosts per Subnet	12 host bits/subnet $2^{12} - 2 = 4094$ usable hosts/subnet
Subnet Address for this IP Address	171.68.96.0
IP Address of First Host on this Subnet	171.68.96.1
IP Address of Last Host on this Subnet	171.68.111.254
Broadcast Address for this Subnet	171.68.11.255

Number of Subnet bits = 128 64 32 16 8 4 2 1 = 240
1 1 1 1 0 0 0 0

0 = 00000000

NOTE:

To KNOW THE LAST NUMBER of subnet mask, convert the decimal to binary and look at and add the number of 1's

Because the subnet mask ends with a 0, you have to add the last 2 numbers

The number of host bits per Subnet are the 0's = 12 because 4 + 8

Problem 5

Host IP Address	217.200.3.219
Major Network Mask	255.255.255.0
Major (Base) Network Address	217.200.3.0
Major Network Broadcast Address	217.200.3.255
Total Number of Host Bits Number of Hosts	8 bits $2^8 - 2 = 256 - 2 = 254$ usable hosts
Subnet Mask	255.255.255.224
Number of Subnet Bits Number of Usable Subnets (zero subnet used) Maximum Subnets	27 subnet bits 3 bits $2^3 = 8$ usable bits
Number of Host Bits per Subnet Number of Usable Hosts per Subnet	5 host bits/subnet (32 - number of subnet bits) $2^5 - 2 = 30$ usable hosts/subnet
Subnet Address for this IP Address	217.200.3.192
IP Address of First Host on this Subnet	217.200.3.193
IP Address of Last Host on this Subnet	217.200.3.222
Broadcast Address for this Subnet	217.200.3.223

Number of Subnet bits = 128 64 32 16 8 4 2 1 = 224
1 1 1 0 0 0 0 0

NOTE:

To KNOW THE LAST NUMBER of subnet mask, convert the decimal to binary and look at and add the number of 1's

The number of subnet bits are the 1's = 3

The number of host bits per Subnet are the 0's = 5