Leonardo Fusser (1946995) April 3rd, 2021

PART A: *For each of the following case of find the requested info.*

**Note: red indicates number of bits borrowed. Orange indicates host bits.*

a. Number of needed subnets: 5 Network address: 218.35.50.0

1. Address class: class C
2. Default subnet mask: 255.255.255.0
3. Number of bits borrowed: 3 $bits\ borrowed\ (since\ 2^n\ != 5,\ we\ use\ closest\ value: 2^3 = 8)$
4. Custom subnet mask: 255.255.255.224 /27 (255.255.255.1110 0000)
5. Total number of subnets: 8 $(2^{number\ of\ bits\ borrowed} = 2^3 = 8)$
6. Number of bits left for hosts: 5
7. Total number of host addresses: 32 $per\ subnet\ (2^{number\ of\ bits\ left\ for\ host} = 2^5 = 32)$
8. Number of assignable host addresses: 30 $per\ subnet\ (2^{number\ of\ bits\ left\ for\ host} - 2 = 2^5 - 2 = 30)$

b. Number of needed usable hosts: 50 Network address: 179.80.0.0

1. Address class: class B
2. Default subnet mask: 255.255.0.0
3. Number of bits borrowed: 10 $bits\ borrowed$
4. Custom subnet mask: 255.255.255.192 /26 (255.255.255.1100 0000)
5. Total number of subnets: 1′024 $(2^{number\ of\ bits\ borrowed} = 2^{10} = 1'024)$
6. Number of bits left for hosts: 6
7. Total number of host addresses: 64 $per\ subnet\ (2^{number\ of\ bits\ left\ for\ host} = 2^6 = 64)$
8. Number of assignable host addresses: 62 $per\ subnet\ (2^{number\ of\ bits\ left\ for\ host} - 2 = 2^6 - 2 = 62)$

c. Number of needed usable hosts: 29 Network address: 23.0.0.0

1. Address class: class A
2. Default subnet mask: 255.0.0.0
3. Number of bits borrowed: 19 $bits\ borrowed$
4. Custom subnet mask: 255.255.255. 224 /27 (255.255.255.1110 0000)
5. Total number of subnets: 524′288 $(2^{number\ of\ bits\ borrowed} = 2^{19} = 524'288)$
6. Number of bits left for hosts: 5
7. Total number of host addresses: 32 $per\ subnet\ (2^{number\ of\ bits\ left\ for\ host} = 2^5 = 32)$
8. Number of assignable host addresses: 30 $per\ subnet\ (2^{number\ of\ bits\ left\ for\ host} - 2 = 2^5 - 2 = 30)$

d. Number of needed subnets: 60 Network address: 128.77.0.0

1. Address class: class B
2. Default subnet mask: 255.255.0.0
3. Number of bits borrowed: 6 $bits\ borrowed\ (since\ 2^n\ != 60,\ we\ use\ closest\ value: 2^6 = 64)$
4. Custom subnet mask: 255.255.252.0 /22 (255.255.1111 1100.0000 0000)
5. Total number of subnets: 64 $(2^{number\ of\ bits\ borrowed} = 2^6 = 64)$
6. Number of bits left for hosts: 10
7. Total number of host addresses: 1′024 $per\ subnet\ (2^{number\ of\ bits\ left\ for\ host} = 2^{10} = 1'024)$
8. Number of assignable host addresses: 1′022 $per\ subnet\ (2^{number\ of\ bits\ left\ for\ host} - 2 = 2^{10} - 2 = 1'022)$

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PART B: *Going a little further.*

a. Number of needed subnets: 45
Network address: 220.100.100.0

*Note: red indicates number of bits borrowed. Orange indicates host bits.

1. Address class: class C
2. Default subnet mask: 255.255.255.0
3. Custom subnet mask: 255.255.255. 252 /30 (255.255.255.1111 1100)
4. Number of bits borrowed: $6\ bits\ borrowed\ (since\ 2^n\ ! = 45,\ we\ use\ closest\ value{:}\ 2^6 = 64)$
5. Total number of subnets: $64\ (2^{number\ of\ bits\ borrowed} = 2^6 = 64)$
6. Total number of host addresses: $4\ per\ subnet\ (2^{number\ of\ bits\ left\ for\ host} = 2^2 = 4)$
7. Number of assignable host addresses: $2\ per\ subnet\ (2^{number\ of\ bits\ left\ for\ host} - 2 = 2^2 - 2 = 2)$
8. What is the 5th subnet range?

   255.255.255.252 -> 1111 1111.1111 1111.1111 1111.1111 1100

   220.100.100.0 -> 1101 1100.0110 0100.0110 0100.0000 0000

Subnet Number	Subnet Address *4 = 0100	Usable Host Range	Broadcast Address
4 (5th subnet)	(1101 1100.0110 0100.0110 0100.0001 0000) 220.100.100.16	220.100.100.17 to 220.100.100.18	(1101 1100.0110 0100.0110 0100.0001 0011) 220.100.100.19

9. What is the subnet number (ID) for the 4th subnet?

   255.255.255.252 -> 1111 1111.1111 1111.1111 1111.1111 1100

   220.100.100.0 -> 1101 1100.0110 0100.0110 0100.0000 0000

Subnet Number	Subnet Address *3 = 0011	Usable Host Range	Broadcast Address
3 (4th subnet)	(1101 1100.0110 0100.0110 0100.0000 1100) 220.100.100.12	220.100.100.13 to 220.100.100.14	(1101 1100.0110 0100.0110 0100.0000 1111) 220.100.100.15

10. What is the subnet ID and broadcast address for the 13th subnet?

    255.255.255.252 -> 1111 1111.1111 1111.1111 1111.1111 1100

    220.100.100.0 -> 1101 1100.0110 0100.0110 0100.0000 0000

Subnet Number	Subnet Address *12 = 1100	Usable Host Range	Broadcast Address
12 (13th subnet)	(1101 1100.0110 0100. 0110 0100.0011 0000) 220.100.100.48	220.100.100.49 to 220.100.100.50	(1101 1100.0110 0100. 0110 0100.0011 0011) 220.100.100.51

11. What are the assignable addresses for the 12th subnet?

    255.255.255.252 -> 1111 1111.1111 1111.1111 1111.1111 1100

    220.100.100.0 -> 1101 1100.0110 0100.0110 0100.0000 0000

Subnet Number	Subnet Address *11 = 1011	Usable Host Range	Broadcast Address
11 (12th subnet)	(1101 1100.0110 0100. 0110 0100.0010 1100) 220.100.100.44	220.100.100.45 to 220.100.100.46	(1101 1100.0110 0100. 0110 0100.0010 1111) 220.100.100.47

b. Number of usable hosts: 8,000
Network address: 137.70.0.0

*Note: red indicates number of bits borrowed. Orange indicates host bits.

1. Address class: class B
2. Default subnet mask: 255.255.0.0
3. Custom subnet mask: 255.255.224.0 /19 (255.255.1110 0000.0000 0000)
4. Number of bits borrowed: $3\ bits\ borrowed$
5. Total number of subnets: 8 ($2^{number\ of\ bits\ borrowed} = 2^3 = 8$)
6. Total number of host addresses: $8'192\ per\ subnet$ ($2^{number\ of\ bits\ left\ for\ host} = 2^{13} = 8'192$)
7. Number of assignable host addresses: $8'190\ per\ subnet$ ($2^{number\ of\ bits\ left\ for\ host} - 2 = 2^{13} - 2 = 8'190$)
8. What is the 6th subnet range?

   255.255.224.0 -> 1111 1111.1111 1111.1110 0000.0000 0000

   137.70.0.0 -> 1000 1001.0100 0110.0000 0000.0000 0000

Subnet Number	Subnet Address *5 = 0101	Usable Host Range	Broadcast Address
5 (6th subnet)	(1000 1001.0100 0110.1010 0000.0000 0000) 137.70.160.0	137.70.160.1 to 137.70.191.254	(1000 1001.0100 0110.1011 1111.1111 1111) 137.70.191.255

9. What is the subnet ID for the 7th subnet?

   255.255.224.0 -> 1111 1111.1111 1111.1110 0000.0000 0000

   137.70.0.0 -> 1000 1001.0100 0110.0000 0000.0000 0000

Subnet Number	Subnet Address *6 = 0110	Usable Host Range	Broadcast Address
6 (7th subnet)	(1000 1001.0100 0110.1100 0000.0000 0000) 137.70.192.0	137.70.192.1 to 137.70.223.254	(1000 1001.0100 0110.1101 1111.1111 1111) 137.70.223.255

10. What is the subnet broadcast address for the 3rd subnet?

    255.255.224.0 -> 1111 1111.1111 1111.1110 0000.0000 0000

    137.70.0.0 -> 1000 1001.0100 0110.0000 0000.0000 0000

Subnet Number	Subnet Address *2 = 0010	Usable Host Range	Broadcast Address
2 (3rd subnet)	(1000 1001.0100 0110.0100 0000.0000 0000) 137.70.64.0	137.70.64.1 to 137.70.95.254	(1000 1001.0100 0110.0101 1111.1111 1111) 137.70.95.255

11. What are the assignable addresses for the 5th subnet?

    255.255.224.0 -> 1111 1111.1111 1111.1110 0000.0000 0000

    137.70.0.0 -> 1000 1001.0100 0110.0000 0000.0000 0000

Subnet Number	Subnet Address *4 = 0100	Usable Host Range	Broadcast Address
4 (5th subnet)	(1000 1001.0100 0110.1000 0000.0000 0000) 137.70.128.0	137.70.128.1 to 137.70.159.254	(1000 1001.0100 0110.1001 1111.1111 1111) 137.70.159.255

c. Network address: 165.200.0.0 /26

*Note: red indicates number of bits borrowed. Orange indicates host bits.

1. Address class: class B
2. Default subnet mask: 255.255.0.0
3. Custom subnet mask: 255.255.255.192 /26 (255.255.255.1100 0000)
4. Number of bits borrowed: 10 *bits borrowed*
5. Total number of subnets: 1'024 ($2^{number\ of\ bits\ borrowed} = 2^{10} = 1'024$)
6. Total number of host addresses: 64 *per subnet* ($2^{number\ of\ bits\ left\ for\ host} = 2^6 = 64$)
7. Number of assignable host addresses: 62 *per subnet* ($2^{number\ of\ bits\ left\ for\ host} - 2 = 2^6 - 2 = 62$)
8. What is the 10th subnet range?

   255.255.255.192 -> 1111 1111.1111 1111.1111 1111.1100 0000

   165.200.0.0 -> 1010 0101.1100 1000.0000 0000.0000 0000

Subnet Number	Subnet Address *9= 1001	Usable Host Range	Broadcast Address
9 (10th subnet)	(1010 0101.1100 1000.0000 0010.0100 0000) 165.200.2.64	165.200.2.65 to 165.200.2.126	(1010 0101.1100 1000.0000 0010.0111 1111) 165.200.2.127

9. What is the subnet ID for the 12th subnet?

   255.255.255.192 -> 1111 1111.1111 1111.1111 1111.1100 0000

   165.200.0.0 -> 1010 0101.1100 1000.0000 0000.0000 0000

Subnet Number	Subnet Address *11 = 1011	Usable Host Range	Broadcast Address
11 (12th subnet)	(1010 0101.1100 1000.0000 0010.1100 0000) 165.200.2.192	165.200.2.193 to 165.200.2.254	(1010 0101.1100 1000.0000 0010.1111 1111) 165.200.2.255

10. What is the subnet broadcast address for the 1023rd subnet?

    255.255.255.192 -> 1111 1111.1111 1111.1111 1111.1100 0000

    165.200.0.0 -> 1010 0101.1100 1000.0000 0000.0000 0000

Subnet	Subnet Address *1022 = 0011 1111 1110	Usable Host Range	Broadcast Address
1022 (1023rd subnet)	(1010 0101.1100 1000.1111 1111.1000 0000) 165.200.255.128	165.200.255.129 to 165.200.255.190	(1010 0101.1100 1000.1111 1111.1011 1111) 165.200.255.191

11. What are the assignable addresses for the 1021nd subnet?

    255.255.255.192 -> 1111 1111.1111 1111.1111 1111.1100 0000

    165.200.0.0 -> 1010 0101.1100 1000.0000 0000.0000 0000

Subnet	Subnet Address *1020 = 0011 1111 1100	Usable Host Range	Broadcast Address
1020	(1010 0101.1100 1000.1111 1111.0000 0000) 165.200.255.0	165.200.255.1 to 165.200.255.62	(1010 0101.1100 1000.1111 1111.0011 1111) 165.200.255.63

d. Network address: 93.0.0.0 /19

Note: red indicates number of bits borrowed. Orange indicates host bits.

1. Address class: class A
2. Default subnet mask: 255.0.0.0
3. Custom subnet mask: 255.255.224.0 /19 (255.255.1110 0000.0000 0000)
4. Number of bits borrowed: 11 $bits\ borrowed$
5. Total number of subnets: 2'048 ($2^{number\ of\ bits\ borrowed} = 2^{11} = 2'048$)
6. Total number of host addresses: 8'192 $per\ subnet$ ($2^{number\ of\ bits\ left\ for\ host} = 2^{13} = 8'192$)
7. Number of assignable host addresses: 8'190 $per\ subnet$ ($2^{number\ of\ bits\ left\ for\ host} - 2 = 2^{13} - 2 = 8'190$)
8. What is the 15th subnet range?

   255.255.224.0 -> 1111 1111.1111 1111.1110 0000.0000 0000

   93.0.0.0 -> 0101 1101.0000 0000.0000 0000.0000 0000

Subnet Number	Subnet Address *14 = 1110	Usable Host Range	Broadcast Address
14 (15th subnet)	(0101 1101.0000 0001.1100 0000.0000 0000) 93.1.192.0	93.1.192.1 to 93.1.223.254	(0101 1101.0000 0001.1101 1111.1111 1111) 93.1.223.255

9. What is the subnet ID for the 8th subnet?

   255.255.224.0 -> 1111 1111.1111 1111.1110 0000.0000 0000

   93.0.0.0 -> 0101 1101.0000 0000.0000 0000.0000 0000

Subnet Number	Subnet Address *7 = 0111	Usable Host Range	Broadcast Address
7 (8th subnet)	(0101 1101.0000 0000.1110 0000.0000 0000) 93.0.224.0	93.0.224.1 to 93.0.255.254	(0101 1101.0000 0000.1111 1111.1111 1111) 93.0.255.255

10. What is the subnet broadcast address for the 10th subnet?

    255.255.224.0 -> 1111 1111.1111 1111.1110 0000.0000 0000

    93.0.0.0 -> 0101 1101.0000 0000.0000 0000.0000 0000

Subnet Number	Subnet Address *9 = 1001	Usable Host Range	Broadcast Address
9 (10th subnet)	(0101 1101.0000 0001.0010 0000.0000 0000) 93.1.32.0	93.1.32.1 to 93.1.63.254	(0101 1101.0000 0001.0011 1111.1111 1111) 93.1.63.255

11. What are the assignable addresses for the 21st subnet?

    255.255.224.0 -> 1111 1111.1111 1111.1110 0000.0000 0000

    93.0.0.0 -> 0101 1101.0000 0000.0000 0000.0000 0000

Subnet Number	Subnet Address *20 = 0001 0100	Usable Host Range	Broadcast Address
20 (21st subnet)	(0101 1101.0000 0010.1000 0000.0000 0000) 93.2.128.0	93.2.128.1 to 93.2.159.254	(0101 1101.0000 0010.1001 1111.1111 1111) 93.2.159.255