Melissa Gaines
Assignment 3 – Subnetting
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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 65,534
Subnet Mask	**255.255.255.0**
Number of Subnet Mask Bits Number of Usable Subnets Bits Maximum Subnets	24 8 255
Number of Host Bits per Subnet Number of Usable Hosts per Subnet	8 254
Subnet Address for this IP Address	172.30.1.0
IP Address of First Host on this Subnet	172.30.1.0
IP Address of Last Host on this Subnet	172.30.1.254
Broadcast Address for this Subnet	172.30.1.255

1. **Major (Base) Network Address**
   Host IP Address: 172.30.1.33 = 10101100 00011110 00000001 00100001
   Major Network Mask: 255.255.0.0 = 11111111 11111111 00000000 00000000
   Perform a bit-wise AND operation
   10101100 00011110 00000000 00000000 = 172.30.0.0
2. **Major Network Broadcast Address**
   a. **Add network mask bits (that have 1s) to the zero host bits**
   10101100 00011110 11111111 11111111 = 172.30.255.255
3. **Total number of host bits**
   a. Major Network Mask: 255.255.0.0 = 11111111 11111111 **00000000 00000000** => 16 bits
4. **Total number of hosts** = 2^(number of host bits) - 2 = 2^16 - 2 = 65,534 hosts
5. **Number of Subnet Mask Bits**
   a. Subnet Mask: 255.255.255.0 = **11111111 11111111 11111111** 00000000 => 24 bits
6. **Number of Usable Subnets Bits**
   a. Subnet Mask: 255.255.255.0 = 11111111 11111111 **11111111** 00000000 => 8 bits
7. **Max Subnets** = 2 ^ (number of subnet bits) = 2 ^ 8 = 256 subnets
8. **Number of Host Bits per Subnet**
   a. Subnet Mask: 255.255.255.0 = 11111111 11111111 11111111 **00000000** => 8 bits
9. **Usable Hosts per Subnet** = 2 ^ (host bits per subnet) - 2 = = 2 ^ 8 - 2 = 254 hosts per subnet
10. **Subnet Address**
    Host IP Address: 172.30.1.33 = 10101100 00011110 00000001 00100001
    Subnet Mask: 255.255.255.0 = 11111111 11111111 11111111 00000000
    Perform a bit-wise AND operation
    Subnet Address: 10101100 00011110 00000001 00000000 = 172.30.1.0

11. **IP Address of First Host on this Subnet**
    a. Change the last 8 bits of subnet address to the smallest value: 10101100 00011110 00000001 **00000000** = 172.30.1.0
12. **IP Address of Last Host on this Subnet**
    a. Change the last 8 bits of subnet address to the 2nd largest value: 10101100 00011110 00000001 **11111110** = 172.30.1.254
13. **Broadcast Address for this Subnet**
    a. First 24 bits from subnet address + Largest number from 8 bits = 10101100 00011110 00000001 **11111111** = 172.30.1.255

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	8 254
Subnet Mask	**255.255.255.252**
Number of Subnet Mask Bits Number of Usable Subnets Bits Maximum Subnets	30 6 64
Number of Host Bits per Subnet Number of Usable Hosts per Subnet	2 2
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

1. **Major (Base) Network Address**
   Host IP Address: 172.30.1.33 = 10101100 00011110 00000001 00100001
   Major Network Mask: 255.255.255.0 = 11111111 11111111 11111111 00000000
   Perform a bit-wise AND operation
   10101100 00011110 00000001 00000000 = 172.30.1.0
2. **Major Network Broadcast Address**
   a. **Add network mask bits (that have 1s) to the zero host bits**
   10101100 00011110 00000001 11111111 = 172.30.1.255
3. **Total number of host bits**
   a. Major Network Mask: 255.255.255.0 = 11111111 11111111 11111111 **00000000** => 8 bits
4. **Total number of hosts** = 2^(number of host bits) - 2 = 2^8 - 2 = 254 hosts
5. **Number of Subnet Mask Bits**
   a. Subnet Mask: 255.255.255.252 = **11111111 11111111 11111111 11111**00 => 30 bits
6. **Number of Usable Subnets Bits**
   a. Subnet Mask: 255.255.255.252 = 11111111 11111111 11111111 **111111**00 => 6 bits
7. **Max Subnets** = 2 ^ (number of subnet bits) = 2 ^ 6 = 64 subnets

8. **Number of Host Bits per Subnet**
    a. Subnet Mask: 255.255.255.252 = 11111111 11111111 11111111 11111**00** => 2 bits
9. **Usable Hosts per Subnet** = 2 ^ (host bits per subnet) - 2 = = 2 ^ 2 - 2 = 2 hosts per subnet
10. **Subnet Address**
    Host IP Address: 172.30.1.33 = 10101100 00011110 00000001 00100001
    Subnet Mask: 255.255.255.252 = 11111111 11111111 11111111 11111100
    Perform a bit-wise AND operation
    Subnet Address: 10101100 00011110 00000001 00100000 = 172.30.1.32
11. **IP Address of First Host on this Subnet**
    a. Change the last 2 bits of subnet address to the smallest value: 10101100 00011110 00000001 00100**01** = 172.30.1.33
12. **IP Address of Last Host on this Subnet**
    a. Change the last 2 bits of subnet address to the 2nd largest value: 10101100 00011110 00000001 00100**10** = 172.30.1.34
13. **Broadcast Address for this Subnet**
    a. Change the last 2 bits of subnet address to the largest value: 10101100 00011110 00000001 00100**11** = 172.30.1.35

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	8 254
Subnet Mask	**255.255.255.248**
Number of Subnet Bits Number of Usable Subnets Bits Maximum Subnets	29 5 32
Number of Host Bits per Subnet Number of Usable Hosts per Subnet	3 6
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

1. **Major (Base) Network Address**
    Host IP Address: 192.192.10.234 = 11000000 11000000 00001010 11101010
    Major Network Mask: 255.255.255.0 = 11111111 11111111 11111111 00000000
    Perform a bit-wise AND operation
    11000000 11000000 00001010 00000000 = 1192.192.10.0
2. **Major Network Broadcast Address**
    a. **Add network mask bits (that have 1s) to the zero host bits**
    11000000 11000000 00001010 11111111 = 192.192.10.255
3. **Total number of host bits**

   a. Major Network Mask: 255.255.255.0 = 11111111 11111111 11111111 **00000000** => 8 bits
4. **Total number of hosts** = 2^(number of host bits) - 2 = 2^8 - 2 = 254 hosts
5. **Number of Subnet Mask Bits**
   a. Subnet Mask: 255.255.255.248 = **11111111 11111111 11111111 11111**000 => 29 bits
6. **Number of Usable Subnets Bits**
   a. Subnet Mask: 255.255.255.248 = 11111111 11111111 11111111 **11111**000 => 5 bits
7. **Max Subnets** = 2 ^ (number of subnet bits) = 2 ^ 5 = 32 subnets
8. **Number of Host Bits per Subnet**
   a. Subnet Mask: 255.255.255.248 = 11111111 11111111 11111111 11111**000** => 3 bits
9. **Usable Hosts per Subnet** = 2 ^ (host bits per subnet) - 2 = = 2 ^ 3 - 2 = 6 hosts per subnet
10. **Subnet Address**
    Host IP Address: 192.192.10.234 = 11000000 11000000 00001010 11101010
    Subnet Mask: 255.255.255.248 = 11111111 11111111 11111111 11111000
    Perform a bit-wise AND operation
    Subnet Address: 11000000 11000000 00001010 11101000 = 192.192.10.232
11. **IP Address of First Host on this Subnet**
    a. Change the last 3 bits of subnet address to the smallest value: 11000000 11000000 00001010 11101**001** = 192.192.10.232
12. **IP Address of Last Host on this Subnet**
    a. Change the last 3 bits of subnet address to the 2nd largest value: 11000000 11000000 00001010 11101**110** = 192.192.10.238
13. **Broadcast Address for this Subnet**
    a. Change the last 3 bits of subnet address to the largest value: 11000000 11000000 00001010 11101**111** = 192.192.10.239

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 65,536 - 2 = 65,534
Subnet Mask	**255.255.240.0**
Number of Subnet Mask Bits Number of Usable Subnets Bits Maximum Subnets	20 4 16
Number of Host Bits per Subnet Number of Usable Hosts per Subnet	12 4,096 - 2 = 4094
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	171.68.111.255

1. **Major (Base) Network Address**
   Host IP Address: 171.68.99.71 = 10101011 01000100 01100011 01000111
   Major Network Mask: 255.255.0.0 = 11111111 11111111 00000000 00000000
   Perform a bit-wise AND operation
   10101011 01000100 00000000 00000000 = 171.68.0.0
2. **Major Network Broadcast Address**
   a. **Add network mask bits (that have 1s) to the zero host bits**
   10101011 01000100 11111111 11111111 = 171.68.255.255
3. **Total number of host bits**
   a. Major Network Mask: 255.255.0.0 = 11111111 11111111 **00000000 00000000** => 16 bits
4. **Total number of hosts** = 2^(number of host bits) - 2 = 2^16 - 2 = 65,534 hosts
5. **Number of Subnet Mask Bits**
   a. Subnet Mask: 255.255.240.0 = **11111111 11111111 1111**0000 00000000 => 20 bits
6. **Usable Subnets Bits**
   a. Subnet Mask: 255.255.240.0 = 11111111 11111111 **1111**0000 00000000 => 4 bits
7. **Max Subnets** = 2 ^ (number of subnet bits) = 2 ^ 4 = 16 subnets
8. **Number of Host Bits per Subnet**
   a. Subnet Mask: 255.255.240.0 = 11111111 11111111 1111**0000 00000000** => 12 bits
9. **Usable Hosts per Subnet** = 2 ^ (host bits - subnet bits) - 2 = 2 ^ (12) - 2 = 4094 hosts per subnet
10. **Subnet Address**
    Host IP Address: 171.68.99.71 = 10101011 01000100 01100011 01000111
    Subnet Mask: 255.255.240.0 = 11111111 11111111 11110000 00000000
    Perform a bit-wise AND operation
    Subnet Address: 10101011 01000100 01100011 00000000 = 171.68.96.0
11. **IP Address of First Host on this Subnet**
    a. Change the last 12 bits of subnet address to the smallest value: 10101011 01000100 0110**0011 00000001** = 171.68.96.1
12. **IP Address of Last Host on this Subnet**
    a. Change the last 12 bits of subnet address to the 2nd largest value: 10101011 01000100 0110**1111 11111110** = 171.68.111.254
13. **Broadcast Address for this Subnet**
    a. Change the last 12 bits of subnet address to the largest value: 10101011 01000100 0110**1111 11111111** = 171.68.111.255

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	8 254
Subnet Mask	**255.255.255.224**
Number of Subnet Mask Bits Number of Usable Subnets Bits Maximum Subnets	27 3 7

Number of Host Bits per Subnet Number of Usable Hosts per Subnet	5 30
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

1. **Major (Base) Network Address**
   Host IP Address: **217.200.3.219** = 11011001 11001000 00000011 11011011
   Major Network Mask: 255.255.255.0 = 11111111 11111111 11111111 00000000
   Perform a bit-wise AND operation
   11011001 11001000 00000011 00000000 = 217.200.3.0
2. **Major Network Broadcast Address**
   a. **Add network mask bits (that have 1s) to the zero host bits**
      11011001 11001000 00000011 11111111 = 217.200.3.255
3. **Total number of host bits**
   a. Major Network Mask: 255.255.255.0 = 11111111 11111111 11111111 **00000000** => 8 bits
4. **Total number of hosts** = 2^(number of host bits) - 2 = 2^8 - 2 = 254 hosts
5. **Number of Subnet Mask Bits**
   a. Subnet Mask: 255.255.255.224 = **11111111 11111111 11111111 111**00000 => 27 bits
6. **Number of Usable Subnets Bits**
   a. Subnet Mask: 255.255.255.224 = 11111111 11111111 11111111 **111**00000 => 3 bits
7. **Max Subnets** = 2 ^ (number of subnet bits) = 2 ^ 3 = 8 subnets
8. **Number of Host Bits per Subnet**
   a. Subnet Mask: 255.255.255.224 = 11111111 11111111 11111111 111**00000** => 5 bits
9. **Usable Hosts per Subnet** = 2 ^ (host bits per subnet) - 2 = 2 ^ 5 - 2 = 30 hosts per subnet
10. **Subnet Address**
    Host IP Address: 217.200.3.219 = 11011001 11001000 00000011 11011011
    Subnet Mask: 255.255.255.224 = 11111111 11111111 11111111 11100000
    Perform a bit-wise AND operation
    Subnet Address: 11011001 11001000 00000011 11000000 = 217.200.3.192
11. **IP Address of First Host on this Subnet**
    a. Change the last 5 bits of subnet address to the smallest value: 11011001 11001000 00000011 110**00001** = 217.200.3.193
12. **IP Address of Last Host on this Subnet**
    a. Change the last 3 bits of subnet address to the 2nd largest value: 11011001 11001000 00000011 110**11110** = 217.200.3.222
13. **Broadcast Address for this Subnet**
    a. Change the last 3 bits of subnet address to the largest value: 11011001 11001000 00000011 110**11111** = 217.200.3.223