

Internetworking Tutorial 2 – Solutions

Addressing and Subnetting

Remember:

IP Address Classes

Class A	1 – 127	(Network 127 is reserved for loopback and internal testing)		
		Leading bit pattern	0	00000000.00000000.00000000.00000000 <small>Network . Host . Host . Host</small>
Class B	128 – 191	Leading bit pattern	10	10000000.00000000.00000000.00000000 <small>Network . Network . Host . Host</small>
Class C	192 – 223	Leading bit pattern	110	11000000.00000000.00000000.00000000 <small>Network . Network . Network . Host</small>
Class D	224 – 239	(Reserved for multicast)		
Class E	240 – 255	(Reserved for experimental, used for research)		

Private Address Space

Class A	10.0.0.0 to 10.255.255.255
Class B	172.16.0.0 to 172.31.255.255
Class C	192.168.0.0 to 192.168.255.255

Default Subnet Masks

Class A	255.0.0.0
Class B	255.255.0.0
Class C	255.255.255.0

Exercise 1:

Convert the following binary numbers to decimal by using the provided table

Binary Value	$128 = 2^7$	$64 = 2^6$	$32 = 2^5$	$16 = 2^4$	$8 = 2^3$	$4 = 2^2$	$2 = 2^1$	$1 = 2^0$	Decimal Value
00011011	0	0	0	1	1	0	1	1	27
10101010	1	0	1	0	1	0	1	0	170
01101111	0	1	1	0	1	1	1	1	111
11111000	1	1	1	1	1	0	0	0	248
00100000	0	0	1	0	0	0	0	0	32
01010101	0	1	0	1	0	1	0	1	85
00111110	0	0	1	1	1	1	1	0	62
00000011	0	0	0	0	0	0	1	1	3
11101101	1	1	1	0	1	1	0	1	237
11000000	1	1	0	0	0	0	0	0	192

Exercise 2:

Convert the following decimal numbers to binary and complete the provided table.

Decimal Value	128	64	32	16	8	4	2	1
255	1	1	1	1	1	1	1	1
192	1	1	0	0	0	0	0	0
172	1	0	1	0	1	1	0	0
256	Needs 9 binary bits to be represented		None of the octets of an IPv4 address can have a decimal value of more than 255					
1	0	0	0	0	0	0	0	1
13	0	0	0	0	1	1	0	1
204	1	1	0	0	1	1	0	0
10	0	0	0	0	1	0	1	0
98	0	1	1	0	0	0	1	0
179	1	0	1	1	0	0	1	1
224	1	1	1	0	0	0	0	0
239	1	1	1	0	1	1	1	1

Exercise 3:

Identify the Class the following IP addresses belong to. Advise the provided information on the first page.

IP Address	Class
10.250.1.1	A
150.10.15.0	B
1492.14.2.0	Invalid IP
148.17.9.1	B
193.42.1.1	C
126.8.156.4	B
220.200.24.1	C
231.230.46.58	D
177.100.18.4	B
119.18.46.9	A
249.240.82.79	E
199.156.76.57	C
10.256.2.3	Invalid IP
95.0.21.90	A

IPv4 address can NOT hold a decimal value per octet (8 bits field) greater than 255. Check in Exercise 2, 255 is the largest decimal value that can be represented by using 8 binary bits.

Exercise 4:

Identify the network and host portions for the following IP addresses.

IP Address	Network address (network ID)	Host address (host ID)
10.250.1.1	10.0.0.0	0.250.1.1
150.10.15.0	150.10.0.0	0.0.15.0
1492.14.2.0	Invalid IP – it includes a value greater than 255	
148.17.9.1	148.17.0.0	0.0.9.1
193.42.1.1	193.42.0.0	0.0.0.1
126.8.156.4	126.0.0.0	0.8.156.4
220.200.24.1	220.200.24.0	0.0.0.1
231.230.46.58	Class D address – cannot be splitted	
177.100.18.4	177.100.0.0	0.0.18.4
119.18.46.9	119.0.0.0	0.18.46.9
249.240.82.79	Class E – cannot be splitted.	
199.156.76.57	199.156.76.0	0.0.0.57
10.256.2.3	Invalid IP – it includes a value greater than 255	
95.0.21.90	95.0.0.0	0.0.21.90

Exercise 5:

Calculate the network address and host address for the following IP addresses as defined by the provided custom subnet mask.

For example:

156.222.32.27 / 255.255.255.0 → 156.222.32.0 (network) and 0.0.0.27 (host)

IP Address / Subnet mask	Network Address (Network ID)	Host Address (Host ID)
188.11.18.3 / 255.255.0.0	188.11.0.0	0.0.18.3
10.11.48.81 / 255.255.255.0	10.11.48.0	0.0.0.81
192.168.23.185 / 255.255.255.0	192.168.23.0	0.0.0.185
150.203.23.19 / 255.255.0.0	150.203.0.0	0.0.23.19
10.11.12.13 / 255.0.0.0	10.0.0.0	0.11.12.13
186.14.25.114 / 255.255.255.0	186.14.25.0	0.0.0.114
199.21.201.152 / 255.0.0.0	199.0.0.0	0.21.201.152
191.55.168.123 / 255.255.255.0	191.55.168.0	0.0.0.123
28.252.250.254 / 255.255.0.0	28.252.0.0	0.0.250.254
192.168.254.254 / 255.255.0.0	192.168.0.0	0.0.254.254
10.1.5.254 / 255.255.255.0	10.1.5.0	0.0.0.254

Exercise 6:

For the following IP address and the provided subnet mask calculate the number of subnets and hosts you have for each subnet.

Scenario 1 - Default subnet mask

- IP address: 192.100.10.0
- Default subnet mask: 255.255.255.0
Convert the mask into binary – 11111111.11111111.11111111.00000000
- Number of subnets = 1 (There are no subnets, only the single class C network with address 192.100.10.0. as we are using the default mask.
- Number of hosts per subnet = Like every **Class C** network, it holds (2^8) 256 hosts **in total**. The usable host addresses are 254.

Scenario 2 – Custom subnet mask

- IP address: 192.100.10.0
- Custom Subnet mask: 255.255.255.240
Convert the mask into binary: 11111111.11111111.11111111.11110000
- Number of subnets = The custom subnet mask is different by **4 bits** from the default mask (255.255.255.0). These **4 different bits** can provide **16 (2^4) subnets**.
- Number of hosts per subnet = The **remaining 4 bits** from the Host ID will provide **16 addresses** (total) per subnet, of which 14 are usable.