COMPUTER MATH- BRIDGE EXERCISE

Name:

This activity will provide an overview of media access control and numbering systems.

1. Binary Numbers
2. Hexadecimal Numbers
3. Number System Conversions
4. MAC Addresses Lookup
5. IP Addressing Classes

TASK ONE – BINARY NUMBER SYSTEM

Binary means *composed of two pieces or two parts* or two digits. The binary numeral system, or base-2 number system, represents numeric values using two symbols: “0” and “1”. In our standard system, based on powers of 10, we use the numbers 0 through 9 in each space. When I say a number like "1,302", I'm actually speaking of 1 one-thousand, plus 3 hundreds, plus 0 tens, plus 2 ones. Think of 1,302 our regular base 10 number system like this:

Decimal System (Base-10)			
1000s	100s	10s	1s
1	3	0	2

In the binary system, only the numbers 0 and 1 are used in each space. The places themselves, instead of being powers of 10, as above, are powers of 2. Just like our base 10 number system above, we start with a 1s place at the rightmost place. Just like our own 10s system, the places can go as high as is needed. If we're given the binary number 11001010, we break it down like this:

Binary Numbers (Base-2)							
128	64	32	16	8	4	2	1
1	1	0	0	1	0	1	0

128 + 64 + 8 + 2 = 202

Now try converting binary numbers to decimal numbers:

128	64	32	16	8	4	2	1	EQUALS
1	0	1	1	0	0	1	1	

0	1	1	0	0	1	0	1	
1	1	1	1	0	0	0	0	
1	1	0	0	1	1	0	0	
0	0	1	1	1	1	1	0	
0	1	0	1	1	1	1	1	
1	0	0	1	1	0	0	1	
1	1	1	1	1	1	0	0	

Check your answers: http://acc6.its.brooklyn.cuny.edu/~gurwitz/core5/nav2tool.html

Decimal To Binary Conversion

To convert a decimal number to binary, first subtract the largest possible power of two, and keep subtracting the next largest possible power form the remainder, marking 1s in each column where this is possible and 0s where it is not.

<table>
<tr>
<td>Example 1 - (Convert Decimal 55 to Binary)

55 – 64 = N/A 0
55 – 32 = 23 1
23 – 16 = 7 1
7 – 8 = N/A 0
7 – 4 = 3 1
3 – 2 = 1 1
1 – 1 = 0 1

55 = 0110111</td>
<td>Example 2 - (Convert Decimal 106 to Binary)

106 – 128 = N/A 0
106 – 64 = 42 1
42 – 32 = 10 1
10 – 16 = N/A 0
10 – 8 = 2 1
2 – 4 = N/A 0
2 – 2 = 0 1
0 – 1 = N/A 0

106 = 01101010</td>
</tr>
<tr>
<td>Example 3 - (Convert Decimal 119 to Binary)

119 – 128 = N/A 0
119 – 64 = N/A 1
55 – 32 = 23 1
23 – 16 = 7 1
7 – 8 = N/A 0
7 – 4 = 3 1
3 – 2 = 1 1
1 – 1 = 0 1

119 = 01110111</td>
<td>Example 4 - (Convert Decimal 189 to Binary)

189 – 128 = 61 1
61 – 64 = N/A 0
61 – 32 = 29 1
29 – 16 = 13 1
13 – 8 = 5 1
5 – 4 = 1 1
1 – 2 = N/A 0
1 – 1 = 0 1

189 = 10111101</td>
</tr>
</table>

Now you try it:

Decimal	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	Binary Number
	256	128	64	32	16	8	4	2	1	
37	0	0	0	1	0	0	1	0	1	100101
73										
98										
108										
128										
147										
174										
197										
220										
246										
453										

Play the Binary Game: http://forums.cisco.com/CertCom/game/binary_game_page.htm

TASK – 2 HEXADECIMAL NUMBERS

Hexadecimal Numbers

The one main disadvantage of Binary Numbers is that the binary equivalent of a large decimal number can be quite long, which makes it difficult to both read or write without producing errors especially when working with 16 or 32-bit numbers. One common way of overcoming this problem is to arrange the binary numbers into groups of four as Hexadecimal Numbers, starting with the least significant digit at the right hand side. This Hexadecimal or simply "Hex" numbering system uses the Base of 16 system. Hence, it uses 16 (sixteen) different digits with a combination of numbers from 0 to 9 and the capital letters A to F to represent its Binary or Decimal equivalent.

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

CONVERTING HEXADECIMAL TO DECIMAL

Steps to convert Hexadecimal to Decimal:

- Get the last digit of the hex number, call this digit the current Digit.
- Make a variable, let's call it power. Set the value to 0.
- Multiply the current digit with (16^power), store the result.
- Increment power by 1.
- Set the current Digit to the previous digit of the hex number.
- Repeat from step 3 until all digits have been multiplied.
- Sum the result of step 3 to get the answer number.

16^3=4096	16^2=256	16^1=16	16^0 = 1

Example:

2E58 (Hex) = 11864 (Dec) (2) 2 * 4096 = 8192 (E) 14 * 256 = 3584 (5) 5 * 16 = 80 (8) 8 * 1 = 8	A0F7= (A) 10 * 4096 = 40960 (0) 0 * 256 = 0 (F) 15 * 16 = (7) 7 * 1 = 7
5D3C (hex) =	44DD (hex) =
12EA (hex) =	AABB (hex) =

Decimal to Hexadecimal

Multiplier	16^3=4096	16^2=256	16^1=16	16^0=1	Example
x1	4096	256	16	1	50100 – (12 x 16^3) or 49152 = 948
x2	8192	512	32	2	
x3	12288	768	48	3	12 = C
x4	16384	1024	64	4	
x5	20480	1280	80	5	948 – (3 x 16^2) or 768 = 180
x6	24576	1536	96	6	
x7	28672	1792	112	7	3 = 3
x8	32768	2048	128	8	
x9	36864	2304	144	9	180 – (11 x 16^1) or 176 = 4
x10 (a)	40960	2560	160	10	
x11 (b)	45056	2816	176	11	11 = B
x12 (c)	49152	3072	192	12	
x13 (d)	53248	3328	208	13	4 – (4 x 16^0) or 4 = 0
x14 (e)	57344	3584	224	14	
x15 (f)	61440	3840	240	15	4 = 4
	C	3	B	4	Answer = C3B4 Hex

Now it is your turn:

Decimal	Hexadecimal
23,999	
9,090	
17,300	
54,232	
62,200	

TASK 3 - NUMBER SYSTEM CONVERSIONS

Convert the following Binary numbers to Hexadecimal (left two columns) then Hexadecimal to Binary.

Binary Code	Hexadecimal	Hexadecimal	Binary Code
1010 1100 0010 1110		**5ED**	
0111 1001 0111 0001		**A0B**	
1011 1101 1010 1111		**3ED**	
1110 0111 0101 1001		**EA2**	
1101 0101 1010 1111		**25A5**	
1010 0101 1010 0101		**30D2**	
1100 0011 1001 0110		**A034**	
1110 0111 1100 0011		**CC81**	

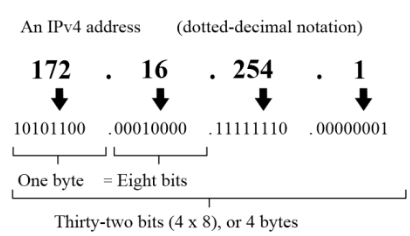
STEP 4 - MAC ADDRESSES LOOKUP

Find as much information that you can about the following MAC address.

MAC Address	Vendor
00-90-6d-09-21-00	
00-90-69-00-23-c9	
60-fb-42-00-32-d3	
64-31-50-00-19-e3	
8c-a9-82-01-90-3f	
90-b1-34-00-98-cd	
D0-c1-b1-23-09-cd	
D4-28-b2-78-90-cd	

STEP 5 - IP ADDRESSING CLASSES

Short for Internet Protocol, IP is an address of a computer or other network device on a network using IP or TCP/IP. For example, the number "166.70.10.23" is an example of such an address. These addresses are similar to an addresses used on a house and is what allows data to reach the appropriate destination on a network. There are five classes of available IP ranges: Class A, Class B, Class C, Class D and Class E, while only A, B, and C are commonly used. Each class allows for a range of valid IP addresses. Below is a table of these addresses.



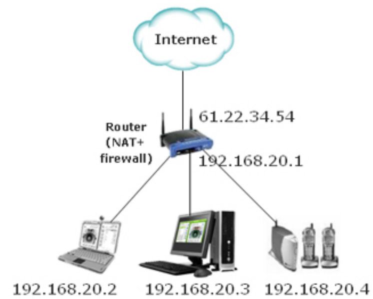
Class	1st Octet Decimal Range	1st Octet High Order Bits	Network/Host ID (N=Network, H=Host)	Default Subnet Mask	Number of Networks	Hosts per Network (Usable Addresses)
A	**1 – 126***	**0**	**N.H.H.H**	**255.0.0.0**	**126 ($2^7 - 2$)**	**16,777,214 ($2^{24} - 2$)**
B	**128-191**	**10**	**N.N.H.H**	**255.255.0.0**	**16,382 ($2^{14} - 2$)**	**65,534 ($2^{16} - 2$)**
C	**192-223**	**110**	**N.N.N.H**	**255.255.255.0**	**2,097,150 ($2^{21} - 2$)**	**254 ($2^8 - 2$)**
D	**224-239**	**1110**	**Reserved for multicast**			
E	**240-254**	**1111**	**Experimental, used for research**			

Ranges 127.x.x.x are reserved for the loopback or localhost, for example, 127.0.0.1 is the common loopback address. Range 255.255.255.255 broadcasts to all hosts on the local network.

IP PRIVATE ADDRESSES

Early network design, when global end-to-end connectivity was envisioned for communications with all Internet hosts, intended that IP addresses be uniquely assigned to a particular computer or device. However, it was found that this was not always necessary as private networks developed and public address space needed to be conserved.

Computers not connected to the Internet, such as factory machines that communicate only with each other via TCP/IP, need not have globally unique IP addresses. Three ranges of IPv4 addresses for private networks were reserved in RFC 1918. These addresses are not routed on the Internet and thus their use need not be coordinated with an IP address registry. Today, when needed, such private networks typically connect to the Internet through network address translation (NAT).



Private IP Addresses

Class	Private Networks	Subnet Mask
A	**10.0.0.0**	**255.0.0.0**
B	**172.16.x.x-172.16.31.x.x**	**255.255.0.0**
C	**192.168.x.x**	**255.255.255.0**

Match the following IP addresses to the proper IP classes:

IP Address	Default Subnet Mask	Class (A-B-C-D)	Private Public
23.90.123.56	255.0.0.0		Public
10.10.23.22		A	Private
123.23.1.56			
224.23.23.10			
190.23.45.190			
201.20.100.12			
78.90.101.102			
192.168.34.45			
172.16.78.200			
143.50.78.200			

Why do we need private IP addresses?

Another source for more detailed information on subnet masking is:

http://www.scribd.com/doc/2158504/IP-Addressing-Subnetting-Workbook