Lab 1.2.8 Hexadecimal Conversions – Instructor Version

Objective

- Learn the process to convert hexadecimal values to decimal and binary values.
- Learn the process to convert decimal and binary values to hexadecimal values.
- Practice converting between decimal, binary and hexadecimal values.

Background / Preparation

The Hexadecimal (Hex) number system is used to refer to the binary numbers in a NIC or IPv6 address. The word hexadecimal comes from the Greek word for 16. Hexadecimal is often abbreviated "0x", zero and lower case x. Hex numbers use 16 unique digits to display any combination of eight binary digits as only two hexadecimal digits.

A Byte, or 8 bits, can range from 00000000 to 11111111. A Byte can create 256 combinations with decimal values ranging from 0 to 255 or Hex values 0 to FF. Each Hex value represents only four binary bits. The alpha (A-F) values are not case sensitive.

A tool that makes the conversion of hexadecimal to decimal values simple is the following table. Use the same techniques as covered in binary to decimal conversions. The first row is the two Hex positions. The value row starts as 1 and 16, base 16, for each position to the left.

Position	**2**	**1**
Value	16	1

Note: Steps are provided at the end of this lab in the use of the Windows Scientific Calculator to check the work.

Dec	Hex	Binary
0	0	0000
1	1	0001
2	2	0010
3	3	0011
4	4	0100
5	5	0101
6	6	0110
7	7	0111
8	8	1000
9	9	1001
10	A	1010
11	B	1011
12	C	1100
13	D	1101
14	E	1110
15	F	1111

Steps for Hex to decimal conversion

1. Break the Hex value into pairs. Start at the right side. For example 77CE becomes 77 and CE. Insert a zero in the first position if necessary to complete the first pair.
2. Put each Hex pair in row three. The value in parenthesis is the decimal value of A-F.
3. To get the decimal values in row four, multiply the row two values by row three.

4. Now just add row four across.

Position Value	**2**	**1**	
	16	1	
	7	7	
	112	7	= 119

Position Value	**2**	**1**	
	16	1	
	C(12)	E(14)	
	192	14	= 206

Steps for decimal to Hex conversion

1. To be valid for the purpose of this lab, the decimal value will be between 0 and 256. The first Hex value is derived by dividing the decimal value by 16. If the value is greater than 9 it will need to be put in Hex form A-F.
2. The second value is the remainder from step 1. If the value is greater than 9 it will need to be put in Hex form A-F.
3. For example, 209 divided by 16 is 13 with a remainder of 1. 13 equals D in Hex. Therefore, 209 equals D1.

Steps for Hex to binary conversion

1. This is the easiest conversion. Remember that each Hex value converts to four binary bits, so work right to left.
2. For example, to convert **77AE** to binary. Start with E. Use the table at the beginning of this lab to go directly to binary. The other alternative is to convert the value to decimal, E = 14, and then use the last four positions of the table used in the decimal to binary conversions.

   14 divided by 8 is 1 with a remainder of 6.
   6 divided by 4 is 1 with a remainder of 2.
   2 divided by 2 is 1 with no remainder.
   Add zeros if necessary to end up with four bits.

Position Value	4	3	2	1	
	8	4	2	1	
	1	1	1	0	
	8	4	2		= 14

3. Using the same technique, A becomes 1010 and the total so far is 10101110.

Position Value	4	3	2	1	
	8	4	2	1	
	1	0	1	0	
	8		2		= 10

4. Using the same technique, the two 7s each become 0111 and the total is 01110111.10101110.

Position Value				
	4	3	2	1
	8	4	2	1
	0	1	1	1
		4	2	1

= 7

Steps for binary to Hex conversion

1. Each Hex value equals four binary bits. Start by breaking the binary value into 4-bit units from right to left. Add any leading zeros required to end up with all 4-bit values. 01101110. 11101100 would become 0110 1110 1110 1100.
2. Use the table at the beginning of this lab to go directly to Hex. The other alternative is to convert each 4-bit binary value to decimal, 0-15. Then convert the decimal to Hex, 0-F.

Position Value				
	4	3	2	1
	8	4	2	1
	1	1	0	0
	8	4		

= 12 or C

Position Value				
	4	3	2	1
	8	4	2	1
	1	1	1	0
	8	4	2	

= 14 or E

3. The result is 6E-EC.

Practice

Convert the following values to the other two forms:

	Decimal	Hex	Binary
1	169	a9	10101001
2	255	FF	11111111
3	186-209	Bad1	10111010-11010001
4	231-99-28	E7-63-1C	11100111-01100011-00011100
5	53	35	00110101
6	115	73	01110011
7	19	13	00010011
8	212.65.119.45	D4.41.77.2D	11010100. 01000001. 01110111. 00101101
9	170	AA	10101010

10	6	6	110
11	252.60	FC.3C	11111100.00111100
12	12.128.240.255	0C.80.F0.FF	00001100.10000000.11110000.11111111

Checking conversions with the Windows Calculator
It is important to be able to perform the previous calculations manually. However, to check the work using the Windows Calculator applet, access the Calculator. Click **Start > Programs > Accessories** and then **Calculator**. Click on the **View** menu to make sure that the calculator is in **Scientific** mode. Click on the button for the type of number to be entered, Hex, Dec or Bin. Enter the number in that form. To convert from one form to another, click on one of the alternate buttons.

