Topic 4

Converting Number Systems
Binary, Decimal, and Hexadecimal

Objectives:

The objective of this lab is to help you become familiar with different number formats and the methods used to convert them into data that is used by a computer.

After performing this lab, you should be able to convert**:**

- Decimal numbers into hexadecimals and binary numbers
- Hexadecimal numbers into binary and decimal numbers
- Binary numbers into hexadecimal and decimal numbers

Required Materials:

- CIST 1001 Lab Manual
- Paper and Pen/Pencil

Background Information:

Computers understand 0's and 1's, people understand 0 – 9.

A computer uses Binary to communicate internally. It is the only "language" a computer understands, called machine language. Number systems like decimal and hexadecimal are used to make it easier for users to interpret numbers being used within a computer. However, the computer can not read nor translate these other number systems. When a program that was written in a language other than a machine language, the computer has to use a compiler or an interpreter to convert it into machine language before the program can be executed.

Binary Number System

Basepower	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Positional Value	128	64	32	16	8	4	2	1

Table 4.1

Steps for converting a Binary number to a Decimal number:

1. When converting the Binary number 10100110 into a Decimal number, place the binary number into Example 4.1 as shown below. Place one number in each of the columns starting on the right side of the table.

2. Find the number that is in the ***Positional Value*** row that correlates to the "1"s (ones) in the ***Binary Number*** row below it.

3. Take the numbers you found in step 2 and add them together. The sum is the equivalent Decimal number for the Binary number 10100110. See example 4.1.

Positional Value	128	64	32	16	8	4	2	1
Binary Number	1	0	1	0	0	1	1	0
Add these numbers	**128**	-	**32**	-	-	**4**	**2**	-

128 + 32 + 4 + 2 = 166 **1 0 1 0 0 1 1 0 = 166 in Decimal**

Example 4.1

Decimal Number System

	Column^4	Column^3	Column^2	Column^1
Base^{power}	10^3	10^2	10^1	10^0
Positional Value	1000	100	10	1

Table 4.2

Steps for converting a Decimal Number to a Binary Number:

1. When converting a Decimal number (166) into a Binary number, subtract the number in the ***Positional Value*** row shown in Table 4.1, the ***Binary Number*** table.
2. Choose the largest number that is less than or equal to the Decimal number you are converting. Follow this process until the answer equals "0".
3. Place a "1" under each of the ***Positional Values*** that were used in the subtraction in step 2. A "0" is placed in all the columns that were not used in the subtraction.

Positional Value	**128**	64	**32**	16	8	**4**	**2**	1
Binary Number	1	0	1	0	0	1	1	0

166-**128** = 38
38-**32** = 6
6-**4** = 2
2-**2** = 0
166 = 1 0 1 0 0 1 1 0 Binary

Example 4.2

Hexadecimal Number System

Basepower	16^2	16^1	16^0
Positional Value	256	16	1

Table 4.3

Steps for converting a Hexadecimal Number to a Decimal Number:

Positional Value	128	64	32	16	8	4	2	1
Binary Number	1	0	1	0	0	1	1	0
Hexadecimal Conversion	**8**	4	**2**	1	8	**4**	**2**	1

Table 4.4

Exercises

1. Convert the binary number to a decimal number.

   a) 10101101 = _____

   b) 00001101 = _____

   c) 11100010 = _____

   d) 10101010 = _____

   e) 11011000 = _____

2. Convert the decimal number to a binary number.

   a) 148 = _____

   b) 563 = _____

   c) 1005 = _____

   d) 352 = _____

   e) 889 = _____

3. Convert the hexadecimal number to a decimal number.

   a) 17h= _____

   b) FBh= _____

   c) 43h= _____

   d) DEh= _____

   e) D4h= _____

4. Convert the decimal numbers to hexadecimal numbers.

   a) 15= _____

   b) 157= _____

   c) 225= _____

   d) 1552= _____

   e) 564= _____

5. Convert the hexadecimal numbers to binary numbers.

NOTE: Hexadecimal numbers are followed by the letter "h" so they do not get confused as being a decimal number.

a) 13h= _____

b) 2Fh= _____

c) AAh= _____

d) AFh= _____

e) BEh= _____

6. Convert the binary numbers to hexadecimal numbers.

a) 110= _____

b) 1101= _____

c) 100110= _____

d) 1101110= _____

e) 11100010= _____

7. Click ***Start*** on the taskbar, point to ***All Programs***, point to ***Accessories***, and click on ***Command Prompt***. At the command prompt type: ***ipconfig /all*** (there is a space between the g and the /). This should bring you to the physical address of the network card.

a) MAC address (physical address) in hexadecimal:

_____

b) IPv4 address (logical address) in decimal:

_____

8. Click ***Start*** on the taskbar, point to ***Control Panel***, click on the ***System*** icon, click on ***Hardware*** tab, click on ***Device Manager***, click on the [**+**] sign located by ***Network Adapters***, double click on ***Intel® PRO/100 VE Network Connection***, (in Clegg 224B), click on ***Resources*** tab. Look at the Resource type and the Setting. They are shown in hexadecimal numbers. Convert the settings to a decimal number and determine the number of bytes used by each resource.

   a) Input/Output Range=

   _____

   b) Memory Range=

   _____

   c) Interrupt Request=

   _____

CLOSE ALL WINDOWS AND SHUT DOWN COMPUTER

Review Questions

1) Which number system does a computer actually use?

_____

2) Hexadecimal numbers usually are seen with a suffix, what is the suffix?

_____

3) Why were Decimal and Hexadecimal chosen as alternate numbering schemes to use when writing computer language?

_____

4) Binary uses base: _____

Decimal uses base: _____

Hexadecimal uses base: _____

5) Give an example of where a hexadecimal number is used in a computer.

_____

Reflection

(Include the following: How did this assignment connected to what has already been discussed? Give an example of how this material is relevant to you. Which part of this assignment made you think about the topic differently? What did you learn from doing this assignment?)