

Dave's CPSC 121 Tutorial Notes – Week Six

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Formula Sheet Tips

- **Binary Representations**

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

- **Powers of 2**

1 2 4 8 16 32 64 128 256 512 1024 2048 4096 8192 16384 32768 65536

- **Taking the 2's Compliment**

Step Zero: Always check the width (number of bits) of your “system”

Step One: Flip the bits

Step Two: Add One (ignore overflow)

Sample Problems

1. A Little Humour

Because the topic this week is straightforward and there are lots of samples in the textbooks for converting between binary numbers and decimal and Hex, I thought I'd just share two lame jokes:

Why is Halloween = Christmas?

Because $31_{OCT} = 25_{DEC}$

There are 10 kinds of people in the world:

Those who get binary jokes, and those who don't.

2. A Few Tips on dealing with Binary Representations

All of the following assume that you have an n -bit system, and I provide an example with a 4-bit system [$n = 4$].

- UNsigned values range from $(0 \dots 2^n - 1)$ [$0 \dots 15$]
- Signed values range from $(-2^{n-1} \dots 2^{n-1} - 1)$ [$-8 \dots 7$]
- Because there is an “extra” negative number, you can't take 2's compliment of the smallest negative number
[the 2's compliment of 1000 is 1000, or $-(-8) = -8$]
- The 2's compliment of zero is zero.
- Wrap-around (overflow) occurs when you add one to the largest number and get the smallest unsigned: [$15 + 1 = 0$] signed: [$7 + 1 = -8$]
- To interpret the decimal value of a negative signed binary value, there are two methods:
 - Find the 2's compliment of the number and negate it
[2's compliment of 1101 is $(0010 + 1) = 0011_2 = 3_{10} \rightarrow -3$]
 - Ignore the first bit and then add -2^{n-1}
[$1101 \rightarrow 101_2 = 5_{10} \rightarrow 5 + (-2^3) = 5 + (-8) = -3$]
- To convert between Binary \Leftrightarrow Hex, align in groups of 4 and zero-pad on the *left* if necessary
[$11011101010111110_2 \rightarrow 1\ 1011\ 1010\ 1011\ 1110_2 \rightarrow 1B A B E_{16}$]