UNITED STATES AIR FORCE ACADEMY

ECE 281

Lesson 2 Notes

Objectives:

- Know the limitations of a number system (e.g. range)
- Demonstrate the ability to add or subtract binary numbers and correctly identify if there is a carry or overflow

Lesson Notes:

Terminology: Before we get started, let's review a few key terms that we discussed in CS 210.

Byte

Nibble

Word – a word is the most convenient size of data for the computer to work with and is highly variable from computer to computer. Common sizes are 16 to 64 bits.

LSB

MSB

Overflow – when adding two numbers together that can't be accurately represented in the available number of bits

Carry – A carry is when the **left most column** has a carry (internal carries do not result in setting the carry flag)

What are the rules for carry in integer (i.e. decimal) addition?

How does that relate to binary addition?

Ex – Unsigned binary addition works just like addition with decimal numbers, with the exception that each digit can only take on values of 0 or 1:

a.) 3 + 5

b.) 10 + 57

c.) 104 + 165

Which of the examples above result in overflow if we are using unsigned 8-bit integers

Binary Subtraction – The way you were taught with decimal is not efficient to implement in a digital logic device

Signed Magnitude –

2's Complement –

Unsigned Binary –

	1s complement	2s complement	Unsigned binary
Benefits			
Problems			
Range			
Range for N = 4			

Keypoints:

- Overflow will not occur with addition or subtraction of two numbers of opposite sign
    - If carry beyond number of bits occurs… it can be ignored
    - **Ex)** 4-bit 7-7

- If MSB differs from addition of two positive or negative numbers, overflow has occurred
    - **Ex)** 4-bit 7+3