ENEL 353 Section 02 Lecture - Mon Sept 16 2019

Labs start this week - be sure to do the pre-lab work!

Rooms ENA 301 and ENA 305 are both available for lab work.

Tutorials start tomorrow

Quiz #1 is in the tutorial Tue Sept 24.

Set 1, Slide 57 (continued)

greatest n-bit 2's complement number

bit pattern: $\underbrace{011\ldots111}_{n\text{ bits}}$ value: $2^{n-1}-1$

least n-bit 2's complement number ("weird number")

bit pattern: $\underbrace{100\ldots000}_{n\text{ bits}}$ value: -2^{n-1}

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width n	min value	max value
8	$-2^7 = -128$	$2^7-1 = 127$
16	$-2^{15} = -32768$	$2^{15}-1 = 32767$

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Slide 59 – Example of signed overflow in addition

Max number $2^5 - 1 = 31$

Addition

$$\begin{array}{rr} 0 & 101110 \leftarrow \text{carry in bits} \\ & 010111 \\ & 010111 \\ \hline & 101110 \end{array}$$

overall carry out

Apparently $23_{10} + 23_{10}$ is a negative number!

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$$\begin{array}{rr} \text{carries } 1 & 1000 \\ & 1100 \\ + & 1101 \\ \hline & 1001 \end{array}$$

unsigned overflow? YES

signed overflow? NO – the sign of the sum is correct.

addition	unsigned overflow	signed overflow
1100 + 1010	YES	YES – sign of sum is wrong
1111 + 0001	YES	NO – adding opposite signs
0110 + 0011	NO	YES – sign of sum is wrong

BCD example

16-bit BCD for 1985

0001 1001 1000 0101

Note: Unsigned binary rep. of 1985, using 16 bits, is 0000 0111 1100 0011 ← totally different from BCD

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Slide 71 - 3-bit Gray code

2-bit Gray

number	Gray code
0	00
1	01
2	11
3	10

Duplicate in reverse order

number	complete Gray code
0	00
1	01
2	11
3	10
4	10
5	11
6	01
7	00

1st half: leading 0
2nd half: leading 1

number	Gray code
0	0 00
1	0 01
2	0 11
3	0 10
4	1 10
5	1 11
6	1 01
7	1 00

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Binary-to-Gray example

4-bit Gray code

0 1 0 1

0 0 1 1 0

4-bit binary code

Gray code is 0101

Remark: You can find the Gray code bits in any order you choose.

Gray-to-binary example

6-bit Gray code

1 0 1 1 1 0

0 1 1 0 1 0 0

6-bit unsigned binary

Answer: 110100

Remark: Here you must work left-to-right

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Here the sensors will report 0000.

Slide 78

Here the sensors will report 0001