Number Systems
One's Compliment

Last updated 8/20/20

Number Systems

- One's Complement
  - Negative numbers are formed by flipping all bits
  - Most Significant Bit (MSB) represents the sign
    (but it is NOT a sign bit)
    - MSB = 0 → positive
    - MSB = 1 → negative
  - All bits are used to represent the magnitude of the value
  - Not widely used anymore – but a stepping stone to 2's complement

50 → 0011 0010

-50 → 1100 1101

-37 →

10010110_b 1's comp →

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Number Systems

- One's Complement

convert -37 decimal to one's complement

8 bits → positive bit values of x | 64 | 32 | 16 | 8 | 4 | 2 | 1

s = negative → flip all bits at end

|-37| = 37

greatest bit value ≤ 37 = 32 — 0 0 1

37 – 32 = 5

greatest bit value ≤ 5 = 4 — 0 0 1 0 0 1

5 – 4 = 1

greatest bit value ≤ 1 = 1 — 0 0 1 0 0 1 0 1

1 – 1 = 0

Continued

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Number Systems

- One's Complement

convert -37 decimal to one's complement – cont'd

s = negative → flip all bits at end

0 0 1 0 0 1 0 1 → 1 1 0 1 1 0 1 0

-37 → 1 1 0 1 1 0 1 0 one's complement

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Number Systems

- One's Complement

convert 10010110 one's complement to decimal

MSB is 1 (negative) → remember this for the end → flip the bits

10010110 → 01101001

8 bits → positive bit values of x | 64 | 32 | 16 | 8 | 4 | 2 | 1

1*64 + 1*32 + 0*16 + 1*8 + 0*4 + 0*2 + 1*1
64 + 32 + 8 + 1 = 105

MSB = 1 = negative → -105

10010110_b 1's comp → -105

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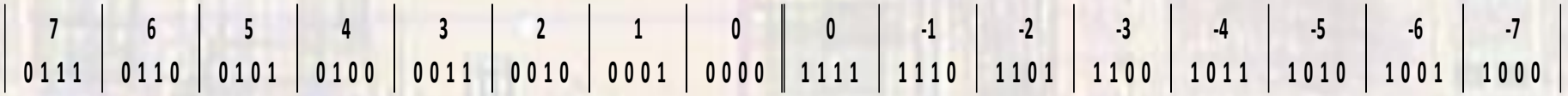
Number Systems

- One's Complement
  - Maximum values:
    - 4 bits = ± 7 = $\pm (2^3-1)$
    - 8 bits = ± 127 = $\pm (2^7-1)$
    - 16 bits = $\pm 32{,}767$ = $\pm(2^{15}-1)$



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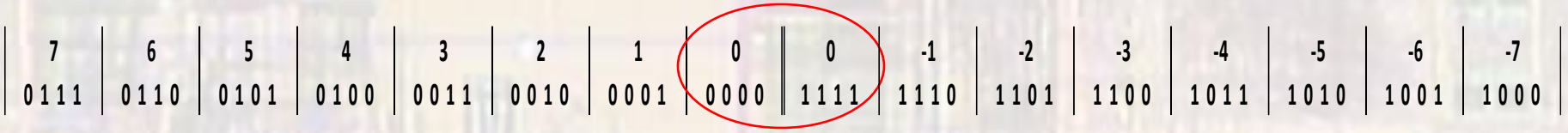
Number Systems

- One's Complement
  - Issues
    - 2 zeros really causes a lot of problems



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