

Discussion 01

Number Representation

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About Me

- Grade: Junior
- # Teaching Sem: 4
 - 61a: 3
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- Hobbies:
 - Reading, Gymming, Bouldering (?)



Announcements

Agenda

- Intro
- Unsigned
- Sign-Magnitude
- 2's Complement
- Q & A

Number Representation

- Everything is bits!
- Numbers
 - 19 -> 0b00001011
- ASCII Characters
 - Even letters and punctuation can be represented with bits
 - a -> 0b110001
- Computer Instructions
 - 3 + 0 -> 0b00000000000110000000000000010010011

Conversions between Representations

- Base a to decimal

- $\overline{a^7 \ a^6 \ a^5 \ a^4 \ a^3 \ a^2 \ a^1 \ a^0}$

- Example: 61

- Binary: 0b0111101

- Octal (Base 8): 75

- Hex (Base 16): 3D

- Binary to Hex

- Convert groups of 4 bits at a time

- Example: 0b00111100

- What if length is not multiple of 4 ?

Speedy Conversions

- $2^n \rightarrow$ n+1 bit is 1 , rest are 0
 - $64 = 2^6 = 0b01000000$
- $2^n - 1 \rightarrow$ n-1 bits that are all 1
 - $63 = 2^6 - 1 = 0b00111111$

Unsigned

- Range: $[0, 2^{n-1} - 1]$
-  $2^7 \ 2^6 \ 2^5 \ 2^4 \ 2^3 \ 2^2 \ 2^1 \ 2^0$

Sign-Magnitude Notation

- Range: $[-(2^{n-1} - 1), 2^{n-1} - 1]$
- _____
sign $2^6 \ 2^5 \ 2^4 \ 2^3 \ 2^2 \ 2^1 \ 2^0$
- $-1^{\text{sign}} * \text{magnitude}$ (convert normally)
- Pros
- Cons
 - $+0$ and -0
 - addition?

Two's Complement

- Range: $[-2^{n-1}, 2^{n-1} - 1]$
- _____
 $-2^7 \ 2^6 \ 2^5 \ 2^4 \ 2^3 \ 2^2 \ 2^1 \ 2^0$
- $-1^{\text{sign}} * \text{magnitude}$ (convert normally)
- Positive: same as unsigned
- Negative: $\sim(\text{positive}) + 1$

Bias Notation

- Range: $[\text{bias}, 255 + \text{bias}]$
- Applying a shift to the unsigned interpretation of number
- Bias is typically negative
 - Standard bias: $-(2^{n-1} - 1)$
- Converting to bias notation
 - $x + b = n$
 - x = binary in bias notation
 - b = chosen bias
 - n = number want to represent
- When is bias notation useful?

Thank you!

Feedback