Number Systems
Unsigned Binary

Last updated 8/20/20

Number Systems – unsigned binary

- Unsigned Binary (Binary)
  - All *n* bits used to represent the magnitude of the value
  - No negative values
  - Often used as absolute memory addresses, counts, …

4	→	00000100
32	→	00100000
16	→	00010000

50	→	?
10010110_b	→	?
0.625	→	?

Number Systems – unsigned binary

- Unsigned Binary (Binary)

  convert 50 decimal to 8 bit unsigned binary

  8 bits → bit values of 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1

  greatest bit value ≤ 50 = 32 — 0 0 1
  50 – 32 = 18

  greatest bit value ≤ 18 = 16 — 0 0 1 1
  18 – 16 = 2

  greatest bit value ≤ 2 = 2 — 0 0 1 1 0 0 1
  2 – 2 = 0

  no more left — 0 0 1 1 0 0 1 0

Number Systems – unsigned binary

- Unsigned Binary (Binary)

convert 10010110 unsigned binary to decimal

8 bits → bit values of 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1

1∗128 + 0∗64 + 0∗32 + 1∗16 + 0∗8 + 1∗4 + 1∗2 + 0∗1
128 + 16 + 4 + 2 = 150

10010110_b → 150

Number Systems – unsigned binary

- Unsigned Binary (Binary)

convert 0.625 decimal to unsigned binary

first few fractional bits → bit values of 1/2 | 1/4 | 1/8 | 1/16

0.5 0.25 0.125 0.0625

greatest bit value ≤ 0.625 = 1/2 . 1

0.625 - 0.5= 0.125

greatest bit value ≤ 0.125 = 1/8 . 1 0 1

0.125 – 0.125 = 0

no more left . 1 0 1 0 or 0.101

Number Systems – unsigned binary

- Unsigned Binary (Binary)
  - Maximum values: (non fractional)
    - 4 bits (1111) = 15
    - 8 bits (1111 1111) = 255
    - 16 bits (1111 1111 1111 1111) = 65,535
    - 32 bits (1111 1111 1111 1111 1111 1111 1111 1111) = 4,294,967,295

- Wait! 4 bits → 2^4 = 16, why is the maximum value 15

  8 bits → 2^8 = 256, why is the maximum value 255

  …

Number Systems – unsigned binary

- Unsigned Binary (Binary)
  - Wait! 4 bits → 2^4 = 16, why is the maximum value 15

    8 bits → 2^8 = 256, why is the maximum value 255

    …
  - Zero is one of our values, that only leaves 15 more …

decimal

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1111	1110	1101	1100	1011	1010	1001	1000	0111	0110	0101	0100	0011	0010	0001	0000

unsigned binary