Unsigned Binary

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These slides introduce unsigned binary number concepts

Unsigned Binary

- Unsigned Binary
  - Binary representation for a number that is ALWAYS positive
    - Memory addresses
    - Counters
    - Populations
  - Often just called “binary”
  - Characterized by n-bits
    - Use a 16 bit unsigned binary number

Unsigned Binary

- Bit Values
  - All *n* bits used to represent the magnitude of the value
  - No negative values

4	→	00000100
32	→	00100000
16	→	00010000

50	→	?
10010110_b	→	?
0.625	→	?

Unsigned Binary

- Convert Decimal to Unsigned Binary

convert 50 decimal to 8 bit unsigned binary

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

50	How many 128s	→ 0	0
50	How many 64s	→ 0	00
50	How many 32s	→ 1 r 18	001
18	How many 16s	→ 1 r 2	0011
2	How many 8s	→ 0	0011 0
2	How many 4s	→ 0	0011 00
2	How many 2s	→ 1 r 0	0011 001
0	How many 1s	→ 0	0011 0010
0			0011 0010

Unsigned Binary

- Convert Unsigned Binary to Decimal

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

Unsigned Binary

- Convert Fractions to Unsigned 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

0.625	How many 1/2s	→ 1 r 0.125	.1
0.125	How many 1/4s	→ 0	.10
0.125	How many 1/8s	→ 1 r 0	.101
0.0			.101

Note: while it is possible to represent fractional numbers in binary, it is rarely done due to its inherent inaccuracy (try 1/3)

Unsigned Binary

- Limits
  - 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

    …

Unsigned Binary

- Limits
  - 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