Number Systems

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1 Administrivia

Announcements

Assignment

Read 1.3 of Mano.

Outline

1. Number systems: decimal, binary, hexadecimal.
2. Number ranges.

Coming Up

Base conversion and character representation.

2 Number Systems

Positional, weighted number systems. Example of a non-weighted number system: Roman numerals. Example of non-positional non-weighted number system: unary.

Radix, digit set.

2.1 Decimal Numbers

1. Radix 10, digit set 0–9.
2. $402.5 = 4 \times 10^2 + 0 \times 10^1 + 2 \times 10^0 + 5 \times 10^{-1}$.

   Radix point.
3. General case: $d_{n-1}d_{n-2}\ldots d_0.d_{-1}\ldots d_m = d_{n-1} \times 10^{n-1} + \cdots + d_m \times 10^{-m}$

   We can substitute any radix and digit set we want.

2.2 Binary Numbers

1. Radix 2, digit set: 0, 1.
2. Decimal values of $(110011)_2$, $(1010)_2$, and $(1011.01)_2$?

   Binary point
3. Powers of two. K, M, and G.

2.3 Hexadecimal Numbers

(Octal is similar — study on your own.)

1. Radix 16, digit set: 0–9, A–F.
2. Generally used as compact binary form.

   How? — Powers of two.
3. C Constants: `0XFE23`, `0x89ab`. (`0567`).
4. Relationship to binary and decimal.

Hex	Binary	Decimal
0	0	0
1	1	1
2	10	2
...	...	...
7	111	7
8	1000	8
9	1001	9
a	1010	10
b	1011	11
c	1100	12
d	1101	13
e	1110	14
f	1111	15

$(1101001010011)_2 = (1a53)_{16}$.

2.4 Number Ranges

1. Range of values which can be represented.

   Meaning of *unsigned*.

2. Consider an n-bit number. How many values can be represented? What is the range of values for an n-bit unsigned number?

3. What is the range of values of an 8-bit unsigned number?

3 Exercises

Convert the following binary numbers to hexadecimal and decimal:

1. 11100111

2. 00111010

3. 11000111

4. 00011111

5. 11101110