

ECE-223, Solutions for Assignment #1

Chapter 1, Digital Design, M. Mano, 3rd Edition

1.4)

Convert the following numbers with the indicated bases to decimal:

$(4310)_5$, and $(198)_{12}$.

$$(4310)_5 = 4 \cdot 5^3 + 3 \cdot 5^2 + 5^1 + 0 = 500 + 75 + 5 = 580$$

$$(198)_{12} = 1 \cdot 12^2 + 9 \cdot 12 + 8 \cdot 12^0 = 144 + 108 + 8 = 260$$

1.7)

Express the following numbers in decimal: $(10110.0101)_2$, $(16.5)_{16}$, and $(26.24)_8$

$$(10110.0101)_2 = 16 + 4 + 2 + 1/4 + 1/16 = 22 + 5/16 = 22.3125$$

$$(16.5)_{16} = 16 + 6 + 5/16 = 22 + 5/16 = 22.3125$$

$$(26.24)_8 = 16 + 6 + 2/8 + 4/64 = 20 + 20/64 = 22 + 5/16 = 22.3125$$

1.8) Convert the following numbers to hexadecimal and to decimal

a) 1.11010

b) 1110.10

Explain why the decimal answer in (b) is 8 times that of (a).

$$(a) 1.11010 = 0001.1101 = 1.D = 1 + 13/16 = 1.8125$$

$$(b) 1110.10 = 1110.1000 = E.8 = 14 + 8/16 = 14.5$$

(14.5 = 8 * 1.8125, Reason is that 1110.10 is the same as 1.11010 shifted left 3 times; i.e. multiplies by 8.)

1.9) Convert the hexadecimal number 68BE to binary and then from binary convert it to octal.

$$68BE = 0110\ 1000\ 1011\ 1110 = 110\ 100\ 010\ 111\ 110 = 64276 \text{ (octal)}$$

1.10) Convert the decimal number 345 to binary in two ways: (a) convert directly to binary; (b) convert first to hexadecimal, then from hexadecimal to binary, Which method is faster?

Results of repeated division by 2: quotients are followed by remainders:

a) $345/2 = 172(1); 86(0); 43(0); 21(1); 10(1); 5(0); 2(1); 1(0); 0(1)$

Answer 101011001.

b) Results of repeated by division by 16(much shorter):

$345/16 = 21(9); 1(5); 0(1)$ answer = 159 (hex) = 0001 0101 1001 = 101011001 (bin)

1.16) Obtain the 1's and 2's complements of the following binary numbers:

- a) 11101010
- b) 01111110
- c) 00000001
- d) 10000000
- e) 00000000

- a) 1' comp. = 00010101; 2's comp. = 00010110
 - b) 1' comp. = 10000001; 2's comp. = 10000010
 - c) 1' comp. = 11111110; 2's comp. = 11111111
 - d) 1' comp. = 01111111; 2's comp. = 10000000
 - e) 1' comp. = 11111111; 2's comp. = 00000000
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1.18) Perform subtraction on the following unsigned binary number using 2's-complement of the subtrahend. Where the result should be negative, 2's complement it and affix a minus sign.

- a) $11011 - 11001$
- b) $110100 - 10101$
- c) $1011 - 110000$
- d) $101010 - 101011$

- a) $11011 - 11001 = 11011 + 00111 = 00010$ ($27 - 25 = 2$)
 - b) $110100 - 10101 = 110100 + 101011 = 011111$ ($52 - 21 = 31$)
 - c) $1011 - 110000 = 011011 \rightarrow 100101$ ($11 - 48 = -37$) (No Carry implies negative.)
 - d) $101010 - 101011 = 111111 \rightarrow -000001$ ($42 - 43 = -1$)
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1.24) Represent decimal number 6027 in (a) BCD (b) excess-3 code, (c) 2421 code.

a) BCD	0110	0000	0010	0111
b) EXCESS-3	1001	0011	0101	1010
c) 2421	1100	0000	0010	1101