Homework #1 Suggested Solutions (Spring 2002)

1. (number systems) Problem 1–2, text book, p. 24
   Answer:
   (a) $48 \text{k bits} = 48 \times 2^{10} = 3 \times 2^{14} \text{ bits}$
   (b) $256 \text{M bits} = 256 \times 2^{20} = 2^{28} \text{ bits}$
   (c) $2 \text{G bits} = 2 \times 2^{30} = 2^{31} \text{ bits}$

2. (base conversion) *Problem 1–4, text book, p. 24
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   (1776)$_{10}$ to $(N)_{2}$. Answer: (11011110000)$_{2}$
   (1812)$_{10}$ to $(N)_{2}$. Answer: (11100010100)$_{2}$
   (1969)$_{10}$ to $(N)_{2}$. Answer: (11110110001)$_{2}$
   (2000)$_{10}$ to $(N)_{2}$. Answer: (11111010000)$_{2}$

   Solutions available in Prentice Hall companion Website Gallery.

5. (base conversion) Perform the following conversions without executing actual divisions and multiplications:
   (10110101.1101)$_{2}$ to $(N)_{8}$. Answer: (265.64)$_{8}$
   (27643.35)$_{8}$ to $(N)_{2}$. Answer: (010111111010011.0111101)$_{2}$
   (1010010110.101011)$_{2}$ to $(N)_{16}$. Answer: (296.AC)$_{16}$
   $(ABADABAD0)_{16}$ to $(N)_{2}$ to $(N)_{8}$. Answer:
   $(ABADABAD0)_{16} = (101010110110110101010011.110101)_{2} = (1256555272.64)_{8}$.  
   $(76421.65)_{8}$ to $(N)_{16}$. Answer: $(76421.65)_{8} = (111110100010001.110101)_{2} = (7D11.D4)_{16}$.

6. (base conversion) Find the base $r$ for which the following relationship holds:
   $(A1)_{r} \times (B2)_{r} = (8852)_{r}$
   where $A = (10)_{10}$ and $B = (11)_{10}$.
   Answer: $A1_{r} = 10r + 1$, $B2_{r} = 11r + 2$. Hence
   
   $$(10r + 1)(11r + 2) = 8r^3 + 8r^2 + 5r + 2$$
or, after simplification, \(8r^3 - 102r^2 - 26r = 0\). Or, \((4r + 1)(r - 13)r = 0\). Since \(r\) must be a positive integer, and in this problem, \(r > 11\) (why?), the only solution is \(r = 13\).


\[(3459)_{10} = (0011010001011001)_{BCD}\]

When a component of a BCD number is greater than 9(1001), 6(0110) is added to it to obtain the correct value with a carry of 1 always being generated.

So, subtract 6 from the rightmost position and the second from the leftmost position with the appended 1 that was carried. The results are the component sums of the BCD addition.

8. (binary code) Assuming A is a 32-bit unsigned binary number. How many different positive integers can be represented by A?

**Answer:** For a 32-bit unsigned binary numbers, there are \(2^{32} - 1\) different positive numbers can be represented (0 is not a positive number).

9. (binary code) Let B be encoded with 32 bit unsigned BCD code. How many different positive integers can be represented by B?

**Answer:** For unsigned BCD code, there are \(32/4 = 8\) BCD digits. Each BCD digits can take 10 different values. Thus the total number of positive integers can be represented by B is \(10^8 - 1\).

10. (binary code) Show the bit configuration that represents the decimal number 712\(_{10}\)

(a) in BCD code:
(b) in ASCII code:

**Answer:** (a) in BCD code: \(712_{10} = 011100010010\)
(b) in ASCII code: \(712_{10} = 01101111100010110010\)

11. (binary code) Calculate the even parity for the following binary numbers:

\[A = 10111000011, \ B = 111111111112\]

**Answer:** Even parity of \(A = 0\), of \(B = 1\).


**Answer:**

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<th>X+YZ</th>
<th>(X+Y)(X+Z)</th>
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   Solutions available in Prentice Hall companion Website Gallery.

14. (Boolean Algebra/Theorems) Problem 2–4, text book, pp. 84.
   Given: \( A.B = 0, \ A + B = 1 \)
   Prove: \( AC + \overline{A}B + BC = B + C \)
   \[
   AC + \overline{A}B + BC \\
   = C(A + B) + \overline{A}B \\
   = C(1) + \overline{A}B \\
   = C + \overline{A}B + 0 \\
   = C + \overline{A}B + AB \\
   = C + B(A + \overline{A}) \\
   = B + C
   \]

15. (Algebraic Simplification) Problem 2–6(b),(d), text book, pp. 84.
   (b) \((\overline{A} + B)(\overline{A} + \overline{B}) = \overline{A}\overline{B}(\overline{A} + \overline{B}) = \overline{A}\overline{B}\)
   (d) \(BC + B(AD + A\overline{D}) = BC + ABD + A\overline{B}\overline{D} = BC + AB(D + \overline{D}) = AB + BC\)

   Solutions available in Prentice Hall companion Website Gallery.

17. (Sum of Minterms, Product of Maxterms) Problem 2–10(b), text book, pp. 85.
   Solutions available in Prentice Hall companion Website Gallery.

18. (Sum of Products, Product of Sums) Book problem 2–11, page 85.
   (a) \( E = \sum m(0, 1, 2, 5), \Pi M(3, 4, 6, 7); \ F = \sum m(2, 3, 6, 7), \Pi M(0, 1, 4, 5) \)
   (b) \( \overline{E} = \sum m(3, 4, 6, 7), \overline{F} = \sum m(0, 1, 4, 5) \)
   (c) \( E + F = \sum m(0, 1, 2, 3, 5, 6, 7), \ E.F = \sum m(2) \)
   (d) \( E = \overline{X}\overline{Y}\overline{Z} + \overline{X}\overline{Y}Z + \overline{X}YZ + XYZ, \ F = XY\overline{Z} + \overline{X}YZ + XY\overline{Z} + XYZ \)
   (e) \( E = \overline{X}\overline{Z} + \overline{Y}Z, \ F = Y \)