Homework #1 Suggested Solutions (Fall 2000)

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

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   (10110101.1101)_{2} to (N)_{8}. **Answer:** (265.64)_{8}
   (27643.35)_{8} to (N)_{2}. **Answer:** (01011110100011.011101)_{2}
   (1010010110.101011)_{2} to (N)_{16}. **Answer:** (296.AC)_{16}.
   (ABADABAD0)_{16} to (N)_{2} to (N)_{8}. **Answer:**
   (ABADABAD0)_{16} = (10101011011011010110110111011011)_{2} =
   (1256555272.64)_{8}.
   (76421.65)_{8} to (N)_{16}. **Answer:** (76421.65)_{8} =
   (111110100011.110101)_{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 \(r = 13\).


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

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

**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). 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 \(10^{8} - 1\).

9. (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: \(712_{10} = 011011101100010110010\)

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

\(A = 10111000111_{2}, B = 1111111111_{2}\]

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


**Answer:**

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<th>Y</th>
<th>Z</th>
<th>X+YZ</th>
<th>(X+Y)(X+Z)</th>
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13. (Boolean Algebra/Theorems) Problem 2–4, text book, pp. 84.
   Given: $A.B = 0, A + B = 1$
   Prove: $AC + \bar{A}B + BC = B + C$
   
   $AC + \bar{A}B + BC$
   $= C(A + B) + \bar{A}B$
   $= C(1) + \bar{A}B$
   $= C + \bar{A}B + 0$
   $= C + \bar{A}B + AB$
   $= C + B(A + \bar{A})$
   $= B + C$

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

15. (Complement of Boolean Function) *Problem 2–9(c), text book, pp. 85.
   Solutions available in Prentice Hall companion Website Gallery.

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

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19. (Logic realization from Boolean Expression) Book problem 2-13(b), page 85.
   Refer Figure 1

20. (K-Map, three variables) Book problem 2-15(c), page 86.
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21. (K-Map, four variables) Book problem 2-16(c), page 86.
    **Answer:** $B\bar{D} + \bar{B}\bar{D} + \bar{A}\bar{D} \text{(or) } B\bar{D} + \bar{B}\bar{D} + \bar{A}\bar{B}$ (refer Figure 2)

22. (Equation directly to K-Map) Book problem 2-18(b), page 86.
    Solutions available in Prentice Hall companion Website Gallery.
Figure 1: Problem 19

Figure 2: Problem 21