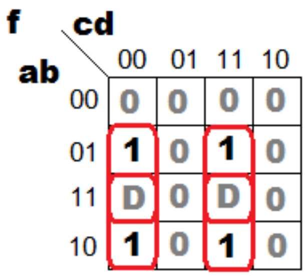
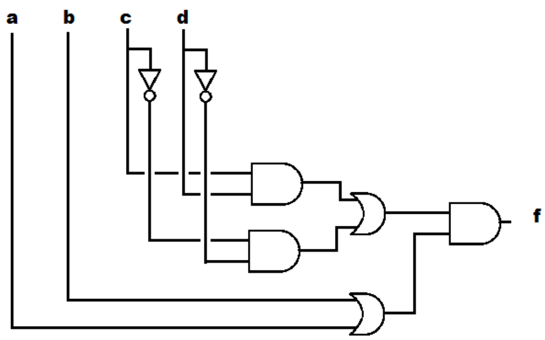
Recitation Solutions for the week of the MiniProject

1.



This expression contains two NOT gates (for c and d), four AND gates, and one OR gate. (7 gates)
Each NOT gate has one input, each AND gate has three inputs, and the OR gate has four inputs (2 + 4*3 + 4 = 18 inputs). The total cost is 7 gates + 18 inputs = 25.
$f = b\bar{c}\bar{d} + a\bar{c}\bar{d} + bcd + acd = (b + a)\bar{c}\bar{d} + (b + a)cd = (b + a)(\bar{c}\bar{d} + cd)$.



2. To uniquely represent n values, you need at least $Ceiling(log_2(n))$ bits. This then indicates that 24 values will require at least 5 bits.

3.
- a. 85_{10}
- b. 10001011_2
- c. $16E_{16}$
- d. $1010\ 1011\ 1100_2$
- e. 177105_8
- f. 522_6
- g. 111001_2 (S&M)
- h. 100110_2 (1's comp)
- i. 100111_2 (2's comp)
- j. 11001_2 (1's comp)
- k. 11010_2 (2's comp)
- l. 10010_2 (S&M)
- m. 11110_2 (2's comp)
- n. 110010_2 (S&M)
- o. 101101_2 (1's comp)
- p. 010101_2 (positive number is identical for all negative number schemes)

4. a. 110110_2 b. 001101_2 c. 101011_2 d. 001000_2

5. Substitute each existing numeral for its equivalent value in an unknown base b:
$6_b x^2 - 55_b x + 105_b = 0 \Longrightarrow 6x^2 - (5b + 5)x + (b^2 + 5) = 0$
Let x = 3 and solve for b. $\Longrightarrow 54 - 15b - 15 + b^2 + 5 = 0 \Longrightarrow b^2 - 15b + 44 = 0$
Use quadratic equation with S = 1, L = -15, and C = 44

$$\frac{-L \pm \sqrt{L^2 - 4SC}}{2S} = \frac{15 \pm 7}{2}$$

Which leaves the result as 4 xor 11. Since the unknown base b has a numeral 6, b > 6, therefore b = 11.

6.
- a. 100101_2 with overflow
- b. 101111_2
- c. 001100_2
- d. 110111_2