Joseph Hyatt
CSE 3100-01

Homework 1

Chapter 1

1.7) Convert the hexadecimal number DB4F to binary, and then convert it from binary to octal.

In order to convert the hexadecimal number to its binary equivalent, you must replace each digit of the hexadecimal number by its 4 digit equivalent binary number. Then you must finally combine all those binary numbers to represent the binary equivalent of the hexadecimal number.

hexadecimal	6	4	C	D
binary	0110	0100	1100	1101

$(0110\ 0100\ 1100\ 1101)_2$

When you want to convert a number from binary to octal, first divide the binary into a group of three digits, starting from right to left, then assign the corresponding octal digit to each group.

binary	0	110	010	011	001	101
octal	0	6	2	3	1	5

$(62315)_8$

1.3) Convert the following numbers with the indicated bases to decimal:

(a)* (4310)5

The number uses base value 5 for the decimal conversion. The place value of the digits of a binary number corresponds to the powers of 5.

$0 \cdot 5^0 = 0$

$1 \cdot 5^1 = 5$

$3 \cdot 5^2 = 75$

$4 \cdot 5^3 = 500$

$= 580$

$(4310)_5 = (580)_{10}$

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

To find 1's complement of a binary number you simply add the binary number with all 1's or just replace the 0 with 1's with 0.

To find 2's complement of a binary number you have to find 1's complement first. Then simply add 1 to the 1's complement.

(a) 10010000

10010000 = 01101111 (1's complement)
01101111 + 1 = 01110000 (2's complement)

(e) 10100101

10100101 = 01011010 (1's complement)
01011010 = 01011011 (2's complement)

1.18) Perform subtraction on the given unsigned binary numbers using the 2's complement of the subtrahend. Where the result should be negative, find its 2's complement and affix a minus sign.

(a) 10011−10010

10011 - 10010

Minuend (M)	10011
Subtrahend (N)	10010
2's complement of subtrahend (N')	01110

Add N' with M (sum)	100001

There is an end carry, apply Case 1, and discard the end carry 1. Final answer 00001 or 1.

(b) 100010−100110

100010 - 100110

Minuend (M)	10010
Subtrahend (N)	100110
2's complement of subtrahend (N')	0110010
Add N' with M (sum)	111100
2's complement of the sum	000100

There is no end carry, apply Case 2 to obtain the final answer by appending a negative sign in front of the final answer obtained. The final answer is -100.

1.25) Represent the decimal number 6,428 in (a) BCD, (b) excess-3 code, (c) 2421 code, and (d) 6311 code.

Decimal	6	2	4	8
BDC code	0110	0010	0100	1000
Excess-3 code	1001	0101	0111	1011
2421 code	1100	0010	0100	1110
6311 code	1000	0011	0101	1011

a) BDC code for the decimal number 6248 is 0110 0010 0100 1000.
b) Excess-3 code for the decimal number 6248 is 1001 0101 0111 1011.
c) 2421 code for the decimal number 6248 is 1100 0010 0100 1110.
d) 6311 code for the decimal number 6248 is 1000 0011 0101 1011.

Chapter 2

2.2) Simplify the following Boolean expressions to a minimum number of literals:

c) xyz + x ' y + xyz '

$$
\begin{aligned}
xyz + x'y + xyz' &= xy(z + z') + x'y \\
&= xy(1) + x'y \\
&= y(x + x') \\
&= y(1) \\
&= y
\end{aligned}
$$

The simplified boolean expression to the minimum number of literals is y.

f) a ' bc + abc ' + abc + a ' bc '

$$
\begin{aligned}
(a + b + c')(a'b' + c) &= a(a'b' + c) + b(a'b' + c) + c'(a'b' + c) \\
&= aa'b' + ac + a'bb' + bc + a'b'c' + cc' \\
&= 0 + ac + 0 + bc + a'b'c + 0 \\
&= (a + b)c + a'b'c'
\end{aligned}
$$

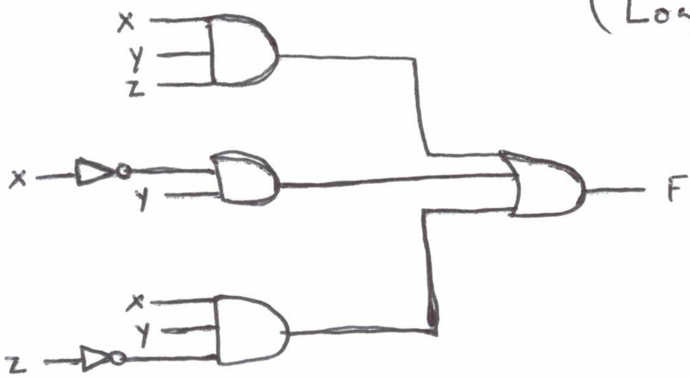
The simplified boolean expression to the minimum number of literals is $(a + b)c + a'b'c'$

2.5) Draw logic diagrams of the circuits that implement the original and simplified expressions in Problem 2.2 (c) and (f).

c) xyz + x ' y + xyz '

$$
\begin{aligned}
F &= xyz + x'y + xyz' \\
&= xy(z + z') + x'y \\
&= xy(1) + x'y \\
&= xy + x'y \\
&= y(x + x') \\
&= y(1) \\
F &= y
\end{aligned}
$$

The simplified expression is F = y



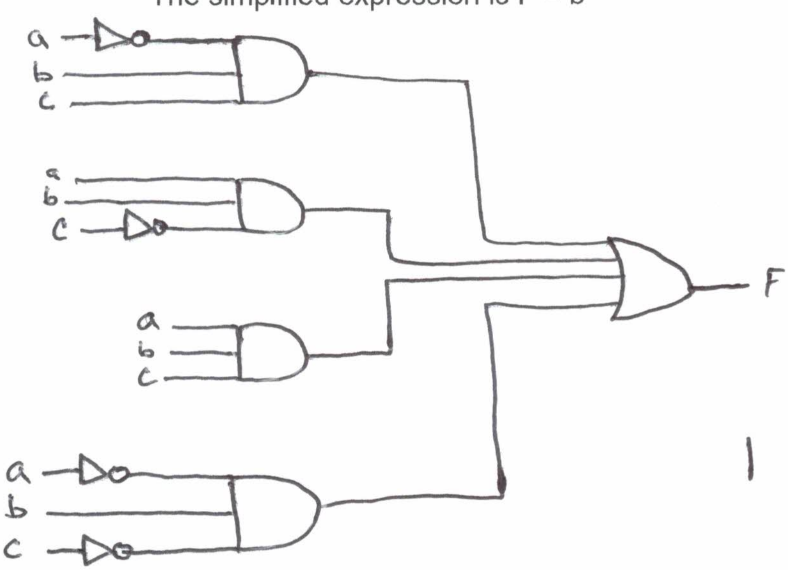
(Logic diagram)

(Simplified)

f) a ' bc + abc ' + abc + a ' bc '

$$
\begin{aligned}
F &= a'bc + abc' + abc + a'bc' \\
&= a'b(c + c') + ab(c + c') \\
&= a'b(1) + ab(1) \\
&= a'b + ab \\
&= b(a' + a) \\
&= b(1) \\
F &= b
\end{aligned}
$$

The simplified expression is F = b



(Logic diagram)

(Simplified)

2.9) Find the complement of the following expressions:

1. * xy ' + x ' y

$$F' = (xy')' \cdot (x'y)'$$
$$= (x' + y) \cdot (x + y')$$
$$= x'x + x'y' + yx + yy'$$
$$= xy + x'y'$$

The complement of $xy' + x'y$ *is* $xy + x'y'$

2. (a + c) (a + b ') (a ' + b + c ')

$$F' = (a + c)' + (a + b')' + (a' + b + c')'$$
$$= a'c' + a'b + ab'c$$

The complement of $(a + c)(a + b')(a' + b + c')$ *is* $a'c' + a'b + ab'c$

3. z + z ' (v ' w + xy)

$$F' = (z') \cdot \left[z'(v'w + xy)\right]'$$
$$= (z') \cdot \left[z + (v'w + xy)'\right]$$
$$= (z') \cdot \left[z + (v'w)' \cdot (xy)'\right]$$
$$= (z') \cdot \left[z + (v + w') \cdot (x' + y')\right]$$
$$F' = z'z + z'(v + w')(x' + y')$$
$$= z'(v + w')(x' + y')$$

The complement of $z + z'(v'w + xy)$ *is* $z'(v + w')(x' + y')$

2.17) Obtain the truth table for the following functions, and express each function in sum-of-minterms and product-of-maxterms form:

C. (c ' + d) (b + c ')

Sum of minterms:

$$F = (c' + d)(b + c')$$
$$= c'(n + c') + d(b + c')$$
$$= bc' + c'c' + bd + c'd$$
$$= bc' + bd + c'd + c'$$
$$F = bc' + bd + c'(d + 1)$$
$$= bc' + bd + c'$$
$$= bc'(d + d') + bd(c + c') + c'(b + b')(d + d')$$
$$= bc'd + bc'd' + bcd + bc'd + (bc' + b'c')(d + d')$$

$$x \cdot x = x, \; x + x' = 1$$
$$F = bc'd + bc'd' + bcd + bc'd + bc'd + bc'd' + b'c'd + b'c'd'$$
$$= bc'd + bc'd' + bcd + b'c'd + b'c'd'$$
$$= b'c'd' + b'c'd + bc'd' + bc'd + bcd$$
$$= m_0 + m_1 + m_4 + m_5 + m_7$$
$$F = \sum (0, 1, 4, 5, 7)$$

The function $(c' + d)(b + c')$ can be expressed in sum of minterms as
$$F = \sum (0, 1, 4, 5, 7)$$

Product of maxterms:

$$F = (c' + d)(b + c')$$
$$= (c' + d + bb')(b + c' + dd')$$
$$= (c' + d + b)(c' + d + b')(b + c' + d)(b + c' + d')$$
$$= (b + c' + d)(b + c' + d')(b' + c' + d)$$

$$x \cdot x = x \;\; and \;\; x \cdot x' = 0$$
$$F = M_1 M_3 M_6$$
$$= \pi(2, 3, 6)$$

The function $F = (c' + d)(b + c')$ can be expressed in product of maxterms as
$F = \pi(2, 3, 6)$

D. b d ' + a c d ' + a b ' c + a ' c '

Sum of minterms:

$$F = bd' + acd' + ab'c + a'c'$$
$$= bd'(a + a')(c + c') + acd'(b + b') + ab'c(d + d') + a'c'(b + b')(d + d')$$
$$= (abd' + a'bd')(c + c') + abcd' + ab'cd' + ab'cd + ab'cd' + (a'bc' + a'b'c')(d + d')$$
$$= abcd' + abc'd' + a'bcd' + a'bc'd' + abcd' + ab'cd' + ab'cd + ab'cd' + a'bc'd + a'bc'd' + a'b'c'd + a'b'c'd$$
$$= a'b'c'd' + a'b'c'd + a'bc'd' + a'bc'd + a'bcd' + ab'cd' + ab'cd + abc'd' + abcd'$$

$$= m_0 + m_1 + m_4 + m_5 + m_6 + m_{10} + m_{11} + m_{12} + m_{14}$$

$$F = \sum(0, 1, 4, 5, 6, 10, 11, 12, 14)$$

$x \cdot x = x \quad and \quad x + x' = 1$

The function $bd' + acd' + ab'c + a'c'$ can be expressed in sum of minterms as
$F = \sum(0, 1, 4, 5, 6, 10, 11, 12, 14)$

Sum of maxterms:

$F = \pi(2, 3, 7, 8, 9, 13, 15)$

The function $bd' + acd' + ab'c + a'c'$ can be expressed in the product of maxterms as
$F = \pi(2, 3, 7, 8, 9, 13, 15)$

2.22) Convert each of the following expressions into sum of products and product of sums:

1. (u + x w) (x + u ' v)

$$F = (u + xw)(x + u'v)$$
$$= ux + uu'v + xxw + u'vwx$$
$$= ux + (0)v + (x)w + u'vwx$$
$$= ux + wx\, u'vwx$$
$$= ux + wx(1 + u'v)$$
$$= ux + wx$$
$$= (u + w)x$$

The product of sums form of the expression is $F = (u + w)x$

2. x ' + x (x + y ') (y + z ')

$$F = x' + x(x + y')(y + z')$$
$$= (x' + x)\left[x' + (x + y')\right]\left[x' + (y + z')\right]$$
$$= \left[(x' + x) + y'\right]\left[x' + y + z'\right]$$
$$= \left[1 + y'\right]\left[x' + y + z'\right]$$
$$= \left[1\right]\left[x' + y + z'\right]$$
$$= x' + y + z'$$
$$F = x' + y + z'$$

The product of sums form of the expression is $F = (x' + y + z')$