# Digital Logic

CS207 2023 Fall Assignment 1

- Write neatly and submit an e-copy to Blackboard on time.
- Do write down all procedures. Only presenting the final answer will lead to a zero, even the answer is correct.
- Box answers when applicable.

1. (10 points) Convert the following numbers with the source bases to destination bases, retain maximum two digits after the radix point if necessary (no need to round):

a) $(234.5)_{10}$ = ( )$_3$

b) $(234.5)_{10}$ = ( )$_{12}$

c) $(435)_6$ = ( )$_{10}$

d) $(10110.0101)_2$ = ( )$_8$

2. (10 points) Each of the following arithmetic operations is correct in at least one number system. Determine possible radices of the numbers in each operation.

a) 1234 + 5432 = 6666

b) 302/20 = 12.1

3. (10 points) Simplify the following Boolean expressions to the **indicated** number of literals algebraically:

a) (a′+c)(a′+c′)(a+b+c′d) to 4 literals

b) abc'd + a'bd + abcd to 2 literals

4. (10 points) Simplify the following Boolean expressions to a **minimum** number of literals algebraically:

a) (a + c)(a′ + b + c)(a′ + b′ + c)

b) F(a,b,c) = ∑(0, 1, 2, 3, 5)

5. (10 points) Convert each of the following boolean functions into sum of minterm, and product of maxterm form algebracally.

a) F(a,b,c,d) = bd'+acd'+ab'c+a'c'

b) F(x,y,z) = (x'+z)(y+x')

6. (10 points) Simplify the following Boolean functions $F_1$(A,B,C) and $F_2$(A,B,C) to

a) Expressions having **3(for $F_1$) and 2(for $F_2$) literals** respectively using algebraic method.

b) and then by using K map in **sum of product** form:

| A | B | C | $F_1$ | $F_2$ |
|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 1 |
| 0 | 0 | 1 | 0 | 0 |
| 0 | 1 | 0 | 1 | 1 |
| 0 | 1 | 1 | 1 | 0 |
| 1 | 0 | 0 | 0 | 0 |
| 1 | 0 | 1 | 0 | 1 |
| 1 | 1 | 0 | 0 | 0 |
| 1 | 1 | 1 | 1 | 1 |

7. (10 points) Using K maps, find a simplest sum-of-products expression for each of the following logic functions.

a) $F(W,X,Y,Z) = \sum(0, 2, 3, 6, 7, 10, 11, 12, 13, 15)$

b) $F(A,B,C,D) = \prod(1, 3, 4, 5, 6, 7, 9, 12, 13, 14)$

8. (15 points) With the use of maps, find the simplest sum-of-products form of the function $F = fg$, where $f = abd' + c'd + a'cd' + b'cd'$ and $g = (a + b + d')(b' + c' + d)(a' + c + d')$.

9. (15 points) Obtain the simplest sum-of-products expression for $F(A, B, C, D) = \sum(1, 2, 4, 7, 8, 9, 11) + d(0, 3, 5)$ and implement it with

a) NAND gates only,

b) And NOR gates only.

c) Draw the two logic diagrams

1. a) $(234.5)_{10} = (22200.1)_3$.

| | | | | |
|---|---|---|---|---|
| $234/3 =$ | 78 | 0 | $0.5\times3=$ | 1.5 1 |
| $78/3 =$ | 26 | 0 | $0.5\times3=$ | 1.5 1 |
| $26/3 =$ | 8 | 2 | $0.5\times3=$ | 1.5 1 |
| $8/3 =$ | 2 | 2 | | |
| $2/3 =$ | 0 | 2 | | |

b) $(2345)_{10} = (176.6)_{12}$

| | | | |
|---|---|---|---|
| $234/12 =$ | 19 | 6 | $0.5\times12=$ 6.0 |
| $19/12 =$ | 1 | 7 | |
| $1/12 =$ | 0 | 1 | |

c) $(435)_6 = (167)_{10}$

$= 4\times6^2 + 3\times6+5 = 144+18+5 = 167$

d) $\underline{(10}_2\ \underline{110.}_6\ \underline{010}_2\ \underline{1)}_4{}_2 = (26.24)_8$.

2. a) $r \geq 7$.

b) $\frac{302}{20} = 12.1$

$3n^2+2 = 2n(n+2+\frac{1}{n})$

$3n^2+2 = 2n^2+4n+2$

$n^2 = 4n$

$n = 4$ 4进制.

3. (a) $(a'+c)(a'+c')(a+b+c'd)$

$= a'(a+b+c'd) = a'(b+c'd)$

(b) $abc'd + abcd + a'bd$

$= abd + a'bd = bd$.

4. a) $(a+c)(a'+b+c)(a'+b'+c)$

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

$= c$

b) $F(a,b,c) = \sum(0,1,2,3,5)$

$= a'b'c' + a'b'c + a'bc' + a'bc + ab'c$

$= a'b' + a'b + b'c$

$= a' + b'c$

5. a) $F(a,b,c,d) = abcd' + a'bcd' + ab'cd' + a'bc'd' + abcd' + ab'cd' + ab'cd + ab'cd' + a'bc'd + a'b'cd + abc'd' + a'b'c'd'$

$= \Sigma(0,1,4,5,7,8,11,14,15)$

$= \Pi(2,3,6,9,10,12,13)$

b) $F(x,y,z) = (x'+y+z)(x'+y'+z)(x'+y+z)(x'+y+z')$ (1 0 0 1 1 0 1 0 0 1 0 1)

$= \Pi(4,5,6) = \Sigma(0,1,2,3,7)$

6. a) $F_1 = A'BC' + A'BC + ABC$

$= BC + A'B$

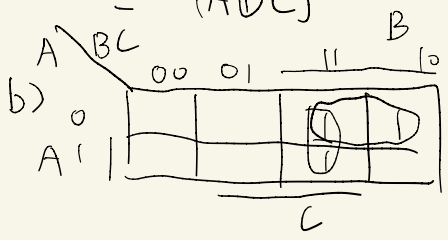
$= B(C + A')$

$F_2 = A'B'C' + A'BC' + AB'C + ABC$

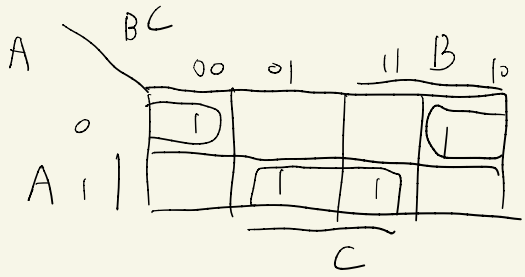
$= A'C' + AC$

$= (A \oplus C)'$

b)



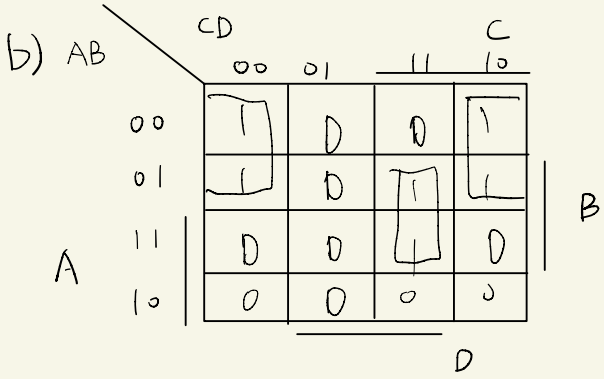

$F_1 = BC + A'B$



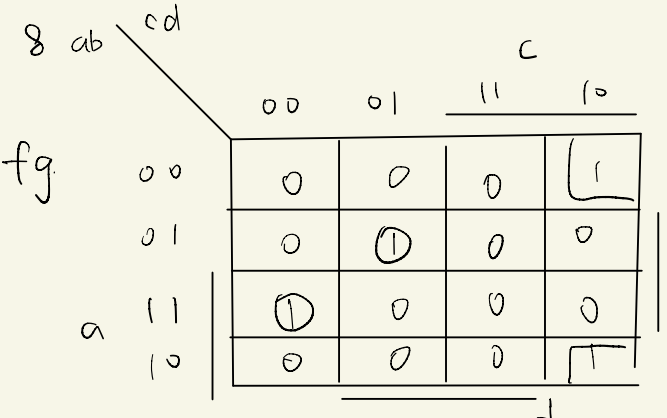

$F_2 = A'C' + AC$

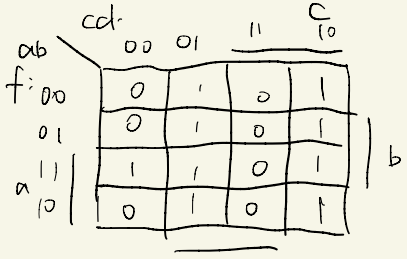
7. a) F(W, X, Y, Z)

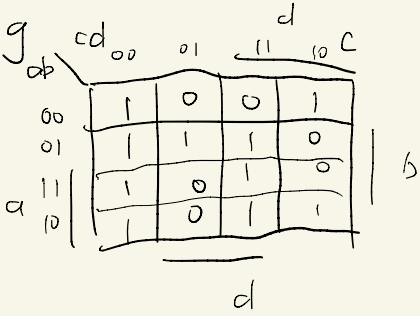

$$F(W, X, Y, Z) = W' X' Z' + W X Y' + W' Y + X' Y + Y Z$$

b) 


$$F(A, B, C, D) = A' D' + BCD$$

8 

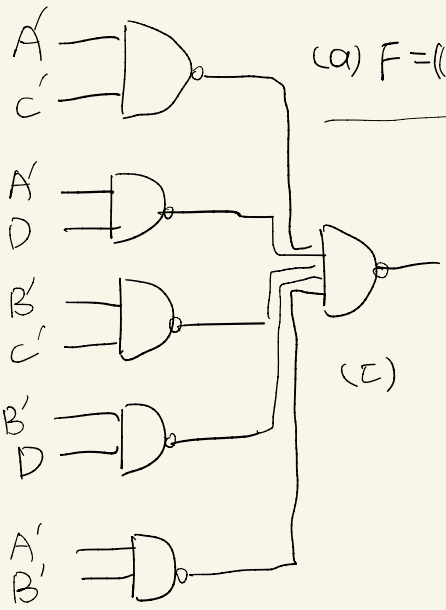
$F = b'cd' + a'bc'd + abc'd'$

9.

| AB \ CD | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 00 | X | 1 | X | 1 |
| 01 | 1 | X | 1 | |
| 11 | | | | |
| 10 | 1 | 1 | 1 | |

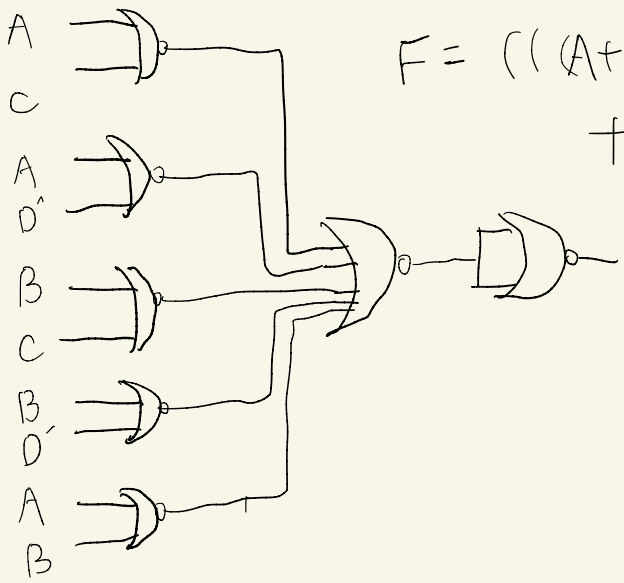
(A: 00, 01, 11, 10; B; C; D)

$F = A'C' + A'D + B'C' + B'D + A'B'$




(a) $F = ((A'C')'(A'D)'(B'C')'(B'D)'(A'B')')'$

b) $F = A'C' + A'D + B'C' + BD + A'B'$




$F = ((A+C)' + (A+D')' + (B+C)' + (B+D')' + (A+B')')'$