Homework 2

Name: Danyal Falsafi

(1)

a) $Y_1 = [A \cdot B' (C + B \cdot D) + A' \cdot B'] C$

$= [A \cdot B' \cdot C + A \cdot B' \cdot B \cdot D + A' \cdot B'] \cdot C$

$= A \cdot B' \cdot C \cdot C + A \cdot \underbrace{B \cdot B'}_{0} \cdot C \cdot D + A' \cdot B' \cdot C$

$= A \cdot B' \cdot C + A' \cdot B' \cdot C = B' \cdot C (A + A') = \boxed{B' \cdot C}$

b) $Y_2 = (A + B') \cdot (A' + B' + D) \cdot (B' + C + D')$

$= (A \cdot A' + A \cdot B' + A \cdot D + B' \cdot A' + B' \cdot B' + B' D) \cdot (B' + C + D')$

$= (0 + A \cdot B' + AD + A' \cdot B' + B' + B' D) \cdot (B' + C + D')$

$= (B' \cdot (A + A') + A \cdot D + B' + B' \cdot D) \cdot (B' + C + D')$

$= (B' + A \cdot D + B' + B' \cdot D) \cdot (B' + C + D')$

$= (A \cdot D + B' (D + 1 + 1)) \cdot (B' + C + D')$

$= (A \cdot D + B') \cdot (B' + C + D') = A \cdot B' \cdot D + A \cdot C \cdot D + \underbrace{A \cdot D \cdot D'}_{0} + \underbrace{B' \cdot B'}_{B'} + B' \cdot C + B' \cdot D'$

$= A \cdot C \cdot D + B' (A \cdot D + C + D' + 1) = \boxed{ADC + B'}$

C) $Y_3 = AB\,CD' + A'B'CD + CD'$

$= A'B'CD + CD'(AB + 1) = A'B'CD + CD'$

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

$= \boxed{A'B'C + CD'}$

(2)

$$f = \overline{\left(\overline{(a \oplus b)} + \overline{(c \oplus d)}\right)}$$

$$f = \overline{\left((a \odot b) \cdot (c \odot d)\right)} = \overline{(a \odot b)} \cdot \overline{(c \odot d)}$$

$$\boxed{f = (a \oplus b) \cdot (c \oplus d)}$$

a)

$$f = (a \oplus b) \cdot (c \oplus d)$$

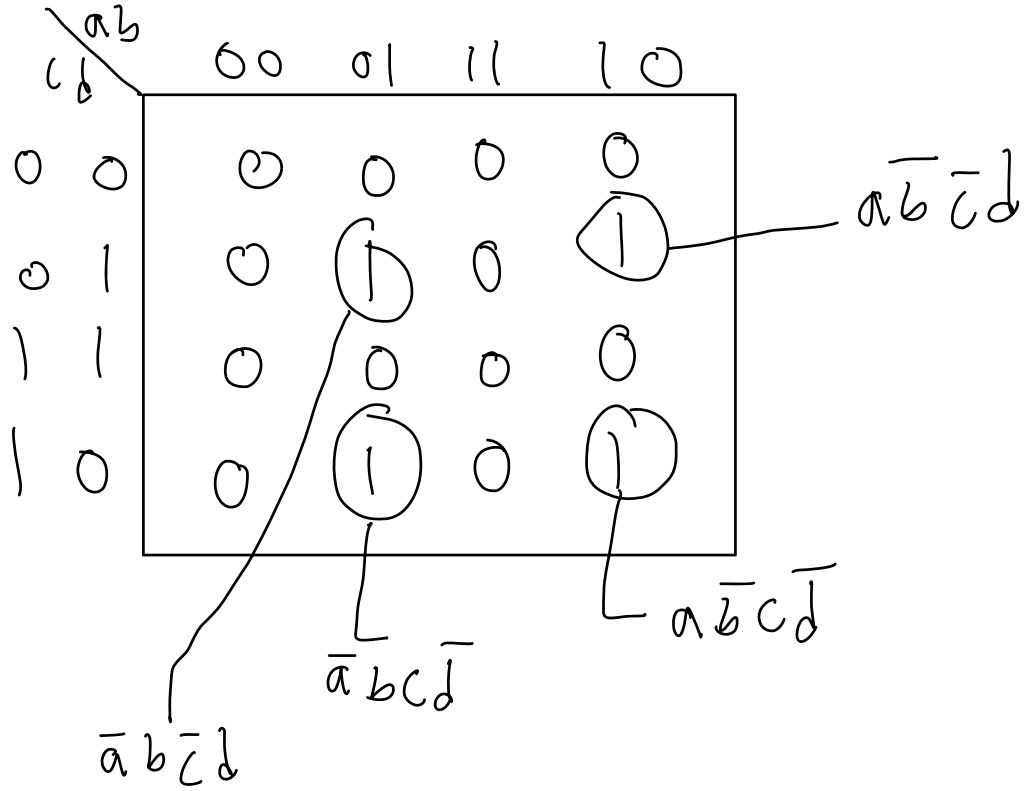
	a	b	c	d	f	
0	0	0	0	0	0	$(0\oplus0)\cdot(0\oplus0) = 0\cdot0 = 0$
1	0	0	0	1	0	$(0\oplus0)\cdot(0\oplus1) = 0\cdot1 = 0$
2	0	0	1	0	0	$(0\oplus0)\cdot(1\oplus0) = 0\cdot1 = 0$
3	0	0	1	1	0	$(0\oplus0)\cdot(1\oplus1) = 0\cdot0 = 0$
4	0	1	0	0	0	$(0\oplus1)\cdot(0\oplus0) = 1\cdot0 = 0$
5	0	1	0	1	1	$(0\oplus1)\cdot(0\oplus1) = 1\cdot1 = 1$
6	0	1	1	0	1	$(0\oplus1)\cdot(1\oplus0) = 1\cdot1 = 1$
7	0	1	1	1	0	$(0\oplus1)\cdot(1\oplus1) = 1\cdot0 = 0$
8	1	0	0	0	0	$(1\oplus0)\cdot(0\oplus0) = 1\cdot0 = 0$
9	1	0	0	1	1	$(1\oplus0)\cdot(0\oplus1) = 1\cdot1 = 1$
10	1	0	1	0	1	$(1\oplus0)\cdot(1\oplus0) = 1\cdot1 = 1$
11	1	0	1	1	0	$(1\oplus0)\cdot(1\oplus1) = 1\cdot0 = 0$
12	1	1	0	0	0	$(1\oplus1)\cdot(0\oplus0) = 0\cdot0 = 0$
13	1	1	0	1	0	$(1\oplus1)\cdot(0\oplus1) = 0\cdot1 = 0$
14	1	1	1	0	0	$(1\oplus1)\cdot(1\oplus0) = 0\cdot1 = 0$
15	1	1	1	1	0	$(1\oplus1)\cdot(1\oplus1) = 0\cdot0 = 0$

b)

(1's) SOP: $f(a,b,c,d) = \Sigma m(5,6,9,10)$

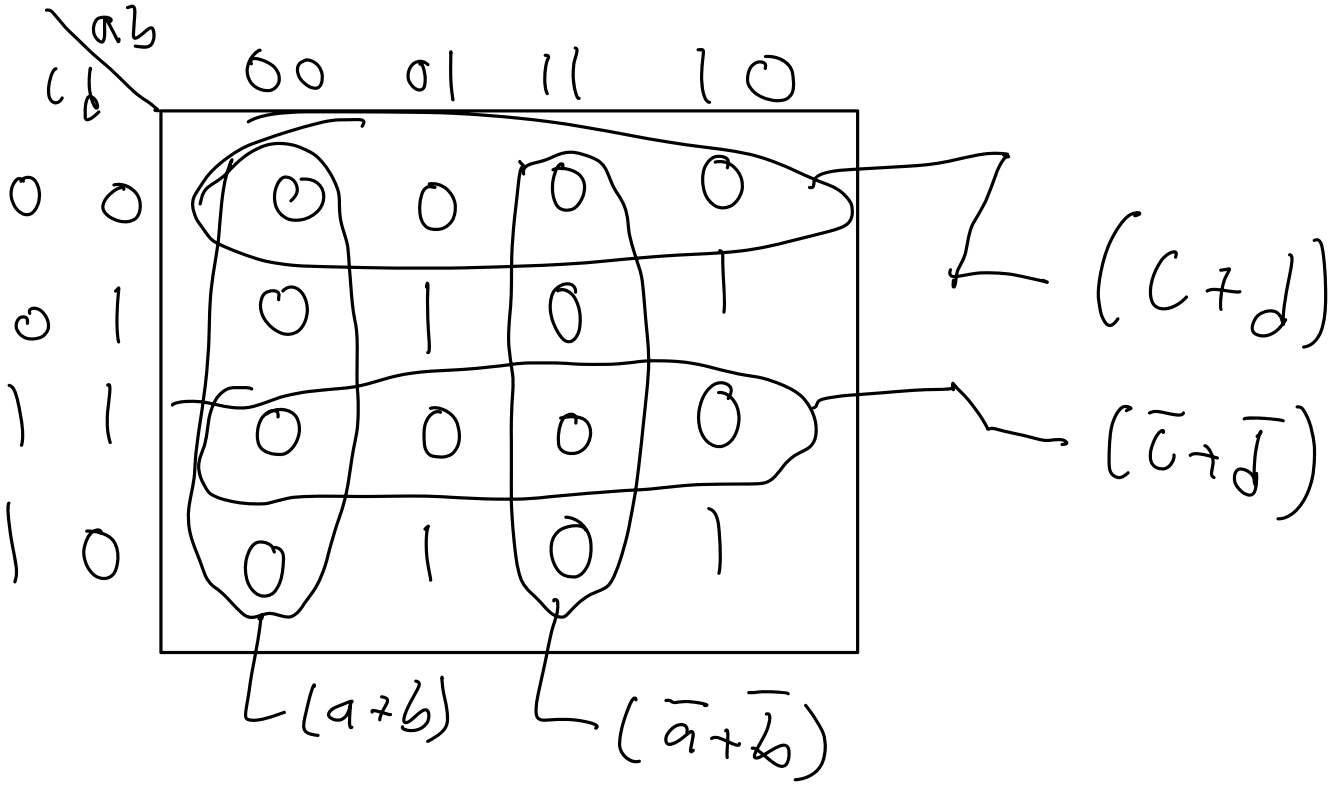
(0's) POS: $f(a,b,c,d) = \Pi M(1,2,3,4,7,8,11,12,13,14,15)$

SOP: 0101, 0110, 1001, 1010



SOP: $\bar{a}b\bar{c}d + \bar{a}bc\bar{d} + a\bar{b}c\bar{d} + a\bar{b}\bar{c}d$

Answer

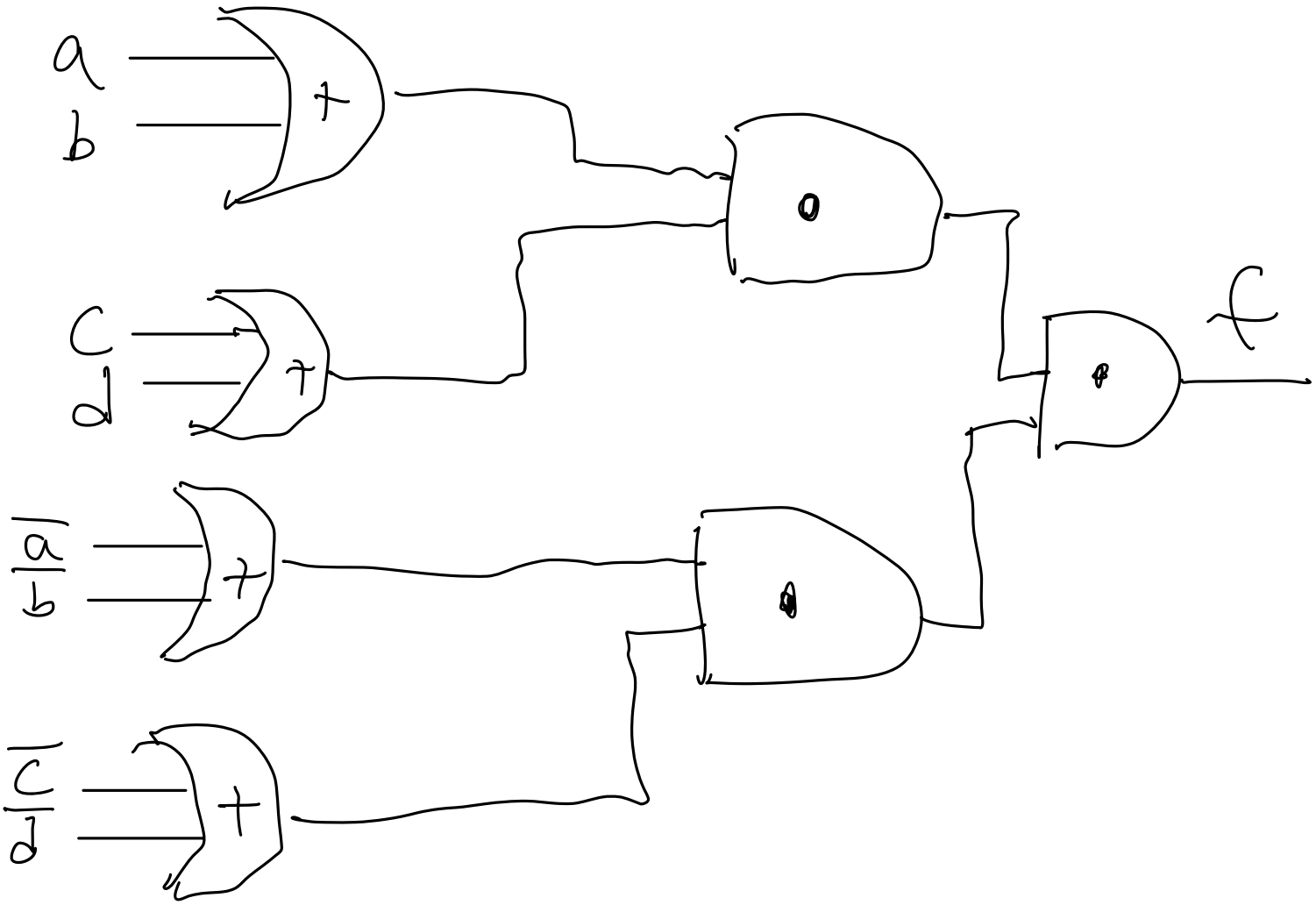


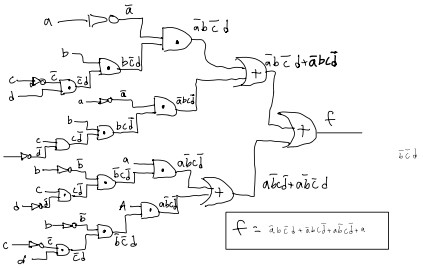
POS: $(a+b)\cdot(c+d)\cdot(\bar{a}+\bar{b})\cdot(\bar{c}+\bar{d})$

Answer

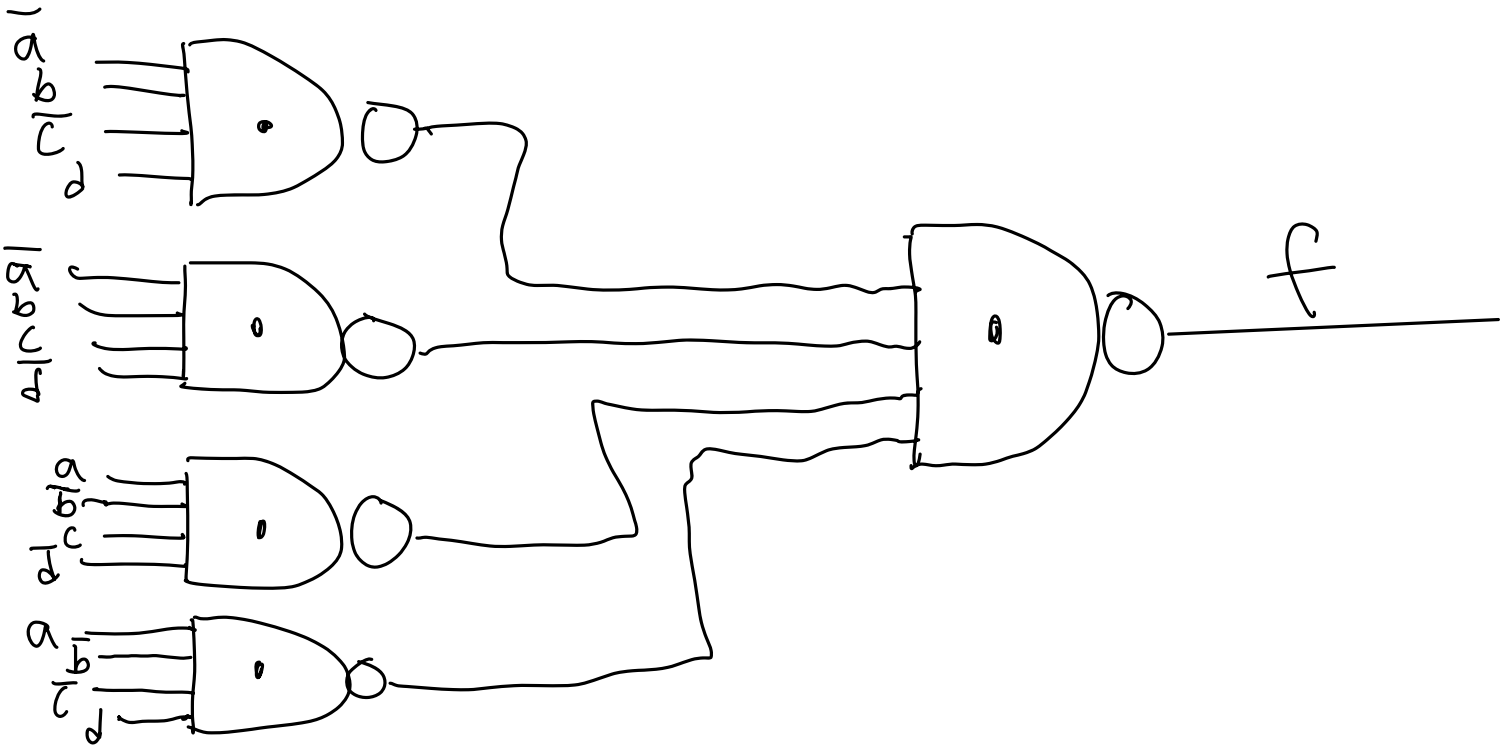
3

c)

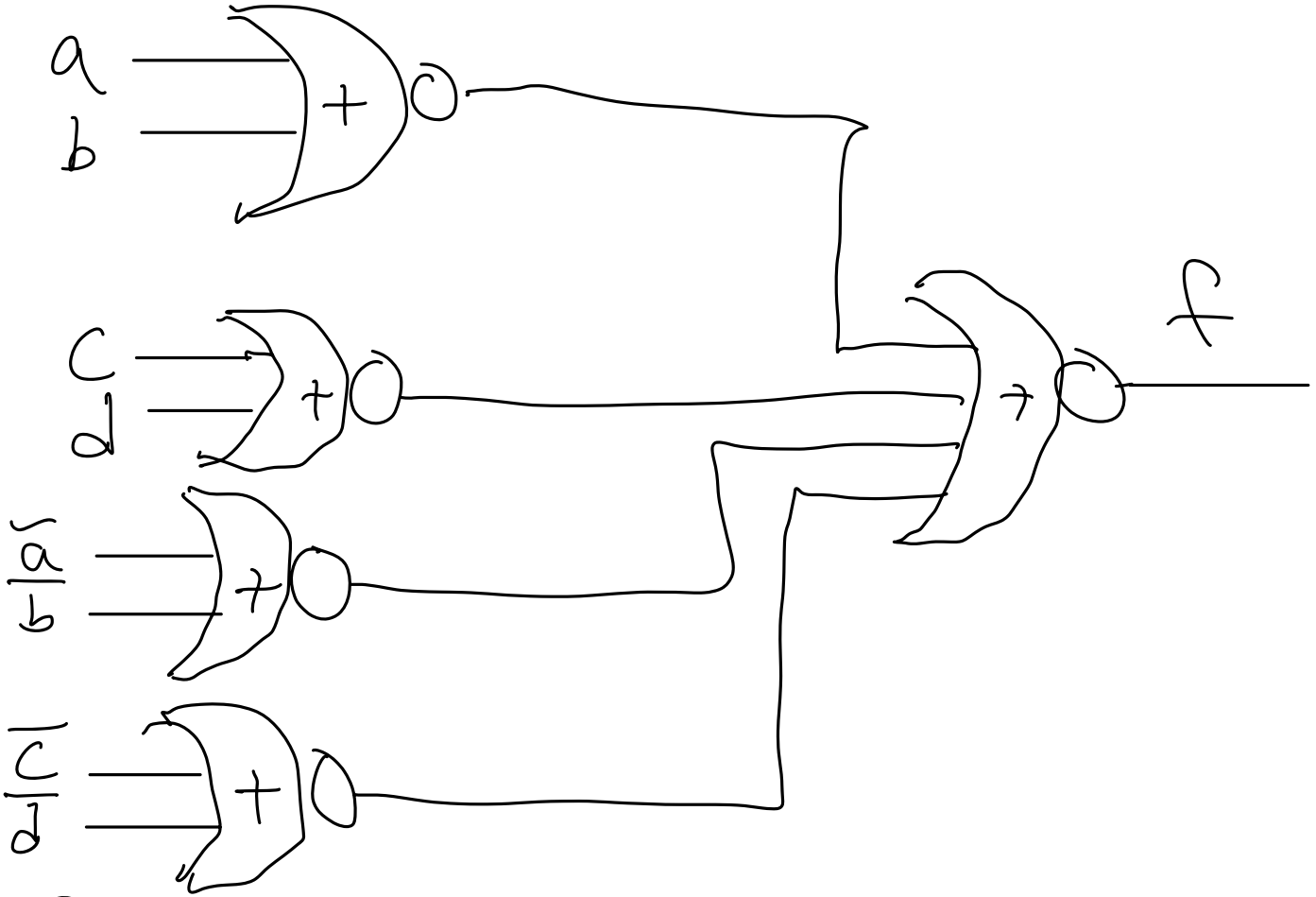

a
b
c
d
$\bar{a}$
$\bar{b}$
$\bar{c}$
$\bar{d}$
f


$f = \bar{a}b\bar{c}\bar{d} + \bar{a}b\bar{c}\bar{d} + a\bar{b}\bar{c}\bar{d} + a\bar{b}\bar{c}\bar{d} + a$

d) $f = \bar{a}b\bar{c}d + \bar{a}bc\bar{d} + a\bar{b}c\bar{d} + a\bar{b}\bar{c}d$



c)



(4) $f(a,b,c,d) = acd + bd' + a'c'd + ab'cd + a'b'cd'$

$1X11 \quad X1X0 \quad 0X01 \quad 1011 \quad 0010$

$1011 \quad 1110 \quad 0001$

$1 \quad 0100 \quad 0101$

1111

	a	b	c	d	f	f'
0	0	0	0	0	0	1
1	0	0	0	1	1	0
2	0	0	1	0	1	0
3	0	0	1	1	0	1
4	0	1	0	0	1	0
5	0	1	0	1	1	0
6	0	1	1	0	1	0
7	0	1	1	1	0	1
8	1	0	0	0	0	1
9	1	0	0	1	0	1
10	1	0	1	0	0	1
11	1	0	1	1	1	0
12	1	1	0	0	1	0
13	1	1	0	1	0	1
14	1	1	1	0	1	0
15	1	1	1	1	1	0

a)

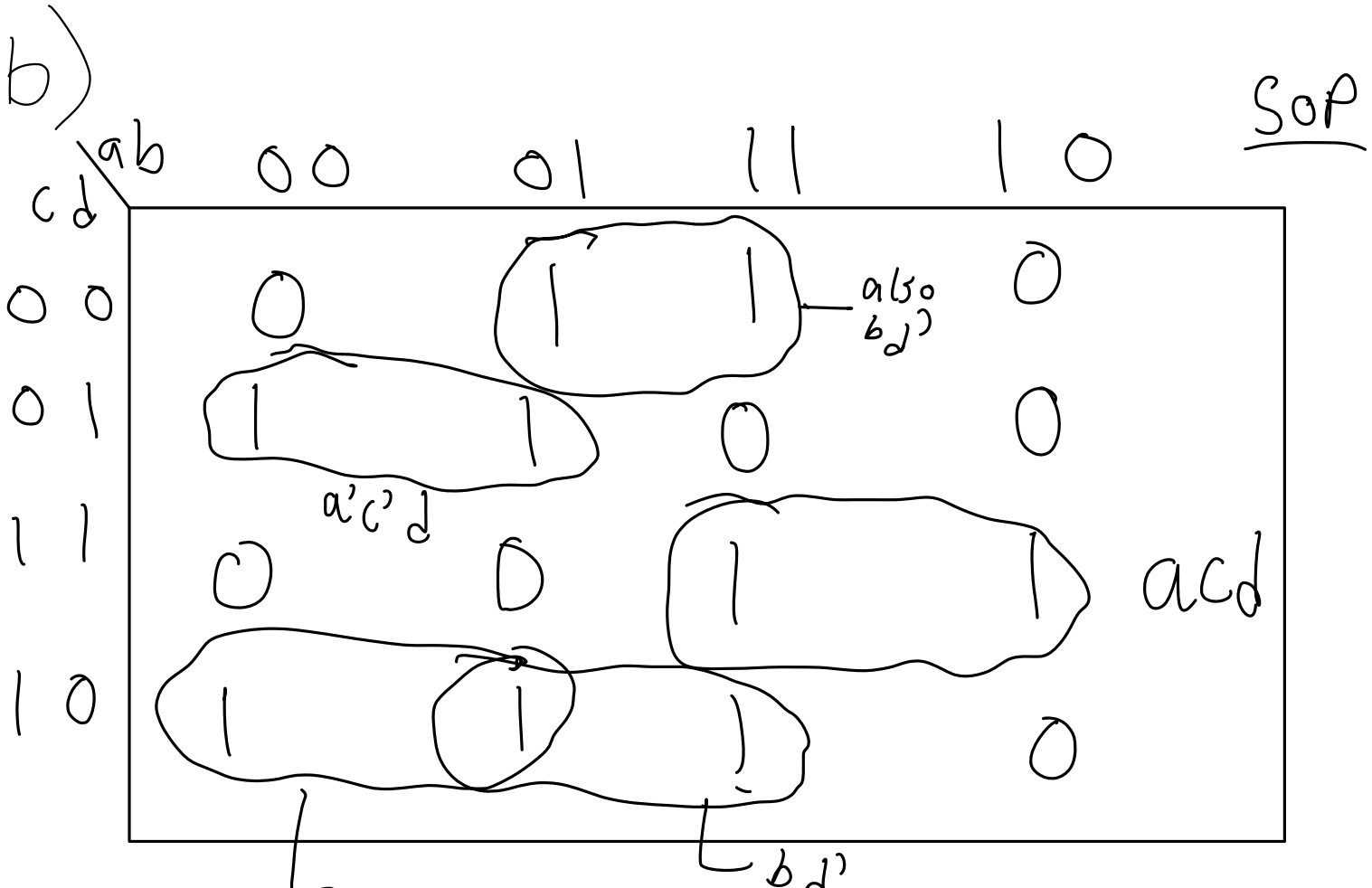
f minterm: $\sum m(1,2,4,5,6,11,12,14,15)$

f' minterm: $\sum m(0,3,7,8,9,10,13)$

f maxterm: $\prod M(0,3,7,8,9,10,13)$

f' max term: $\prod M(1,2,4,5,6,11,12,14,15)$

b)



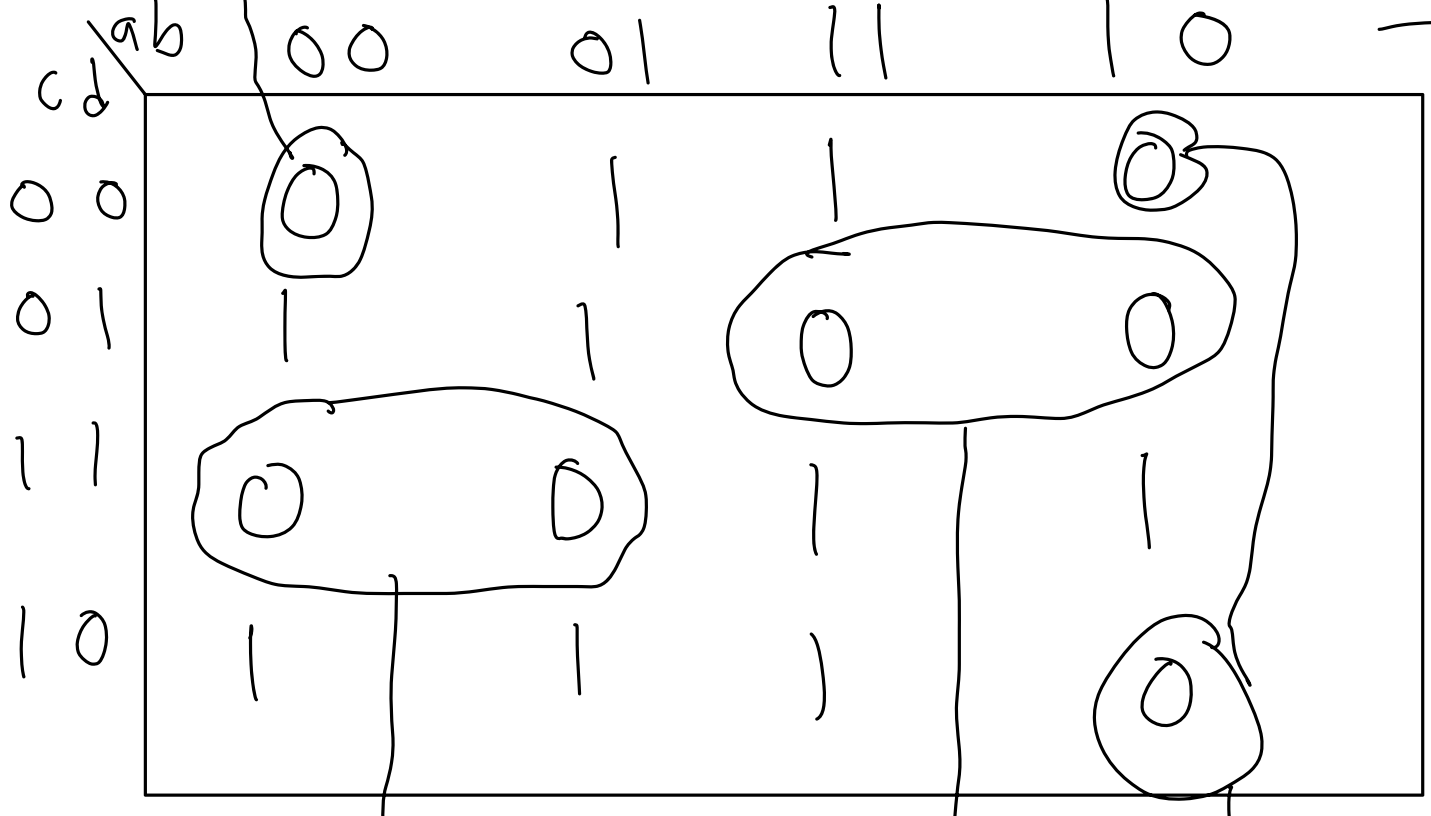
$a'c'd'$

FOR f ↴

SOP ⇒ $bd' + a'c'd + acd + a'cd'$

$(b+c+d)$

POS



$(a+c+\bar{d})$ $(\bar{a}+c+\bar{d})$ $(\bar{a}+b+d)$

FOR f ↴

POS ⇒ $(b+c+d)\cdot(a+\bar{c}+\bar{d})\cdot(\bar{a}+c+\bar{d})\cdot(\bar{a}+b+d)$

For f' ↓

SOP: $\bar{b}\bar{c}\bar{d} + \bar{a}cd + a\bar{c}d + a\bar{b}\bar{d}$

For f' ↓

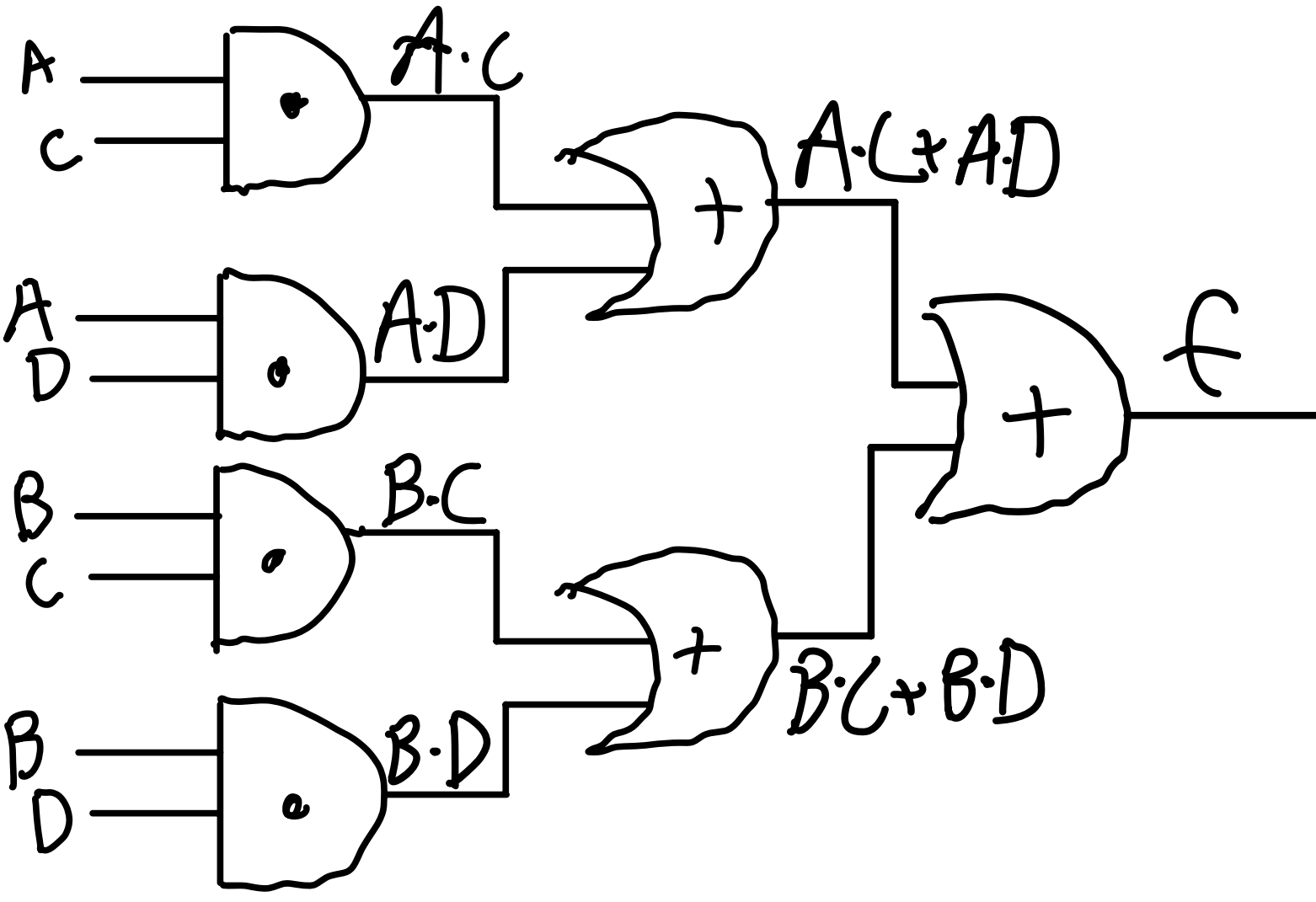
POS: $(\bar{b}+d)\cdot(a+c+\bar{d})\cdot(\bar{a}+\bar{c}+\bar{d})\cdot(a+\bar{c}+d)$

(5)

a) And-OR SoP

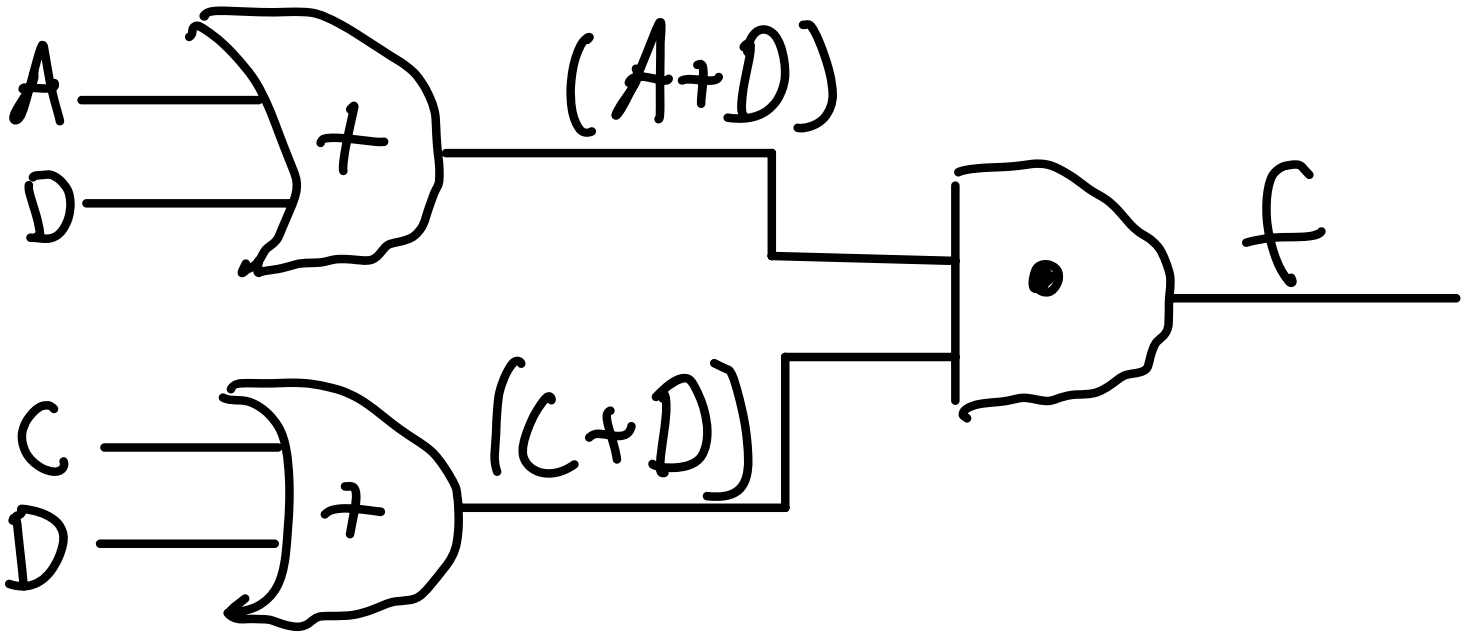
$f = (A+B)(C+D)$

$= AC + AD + BC + BD$

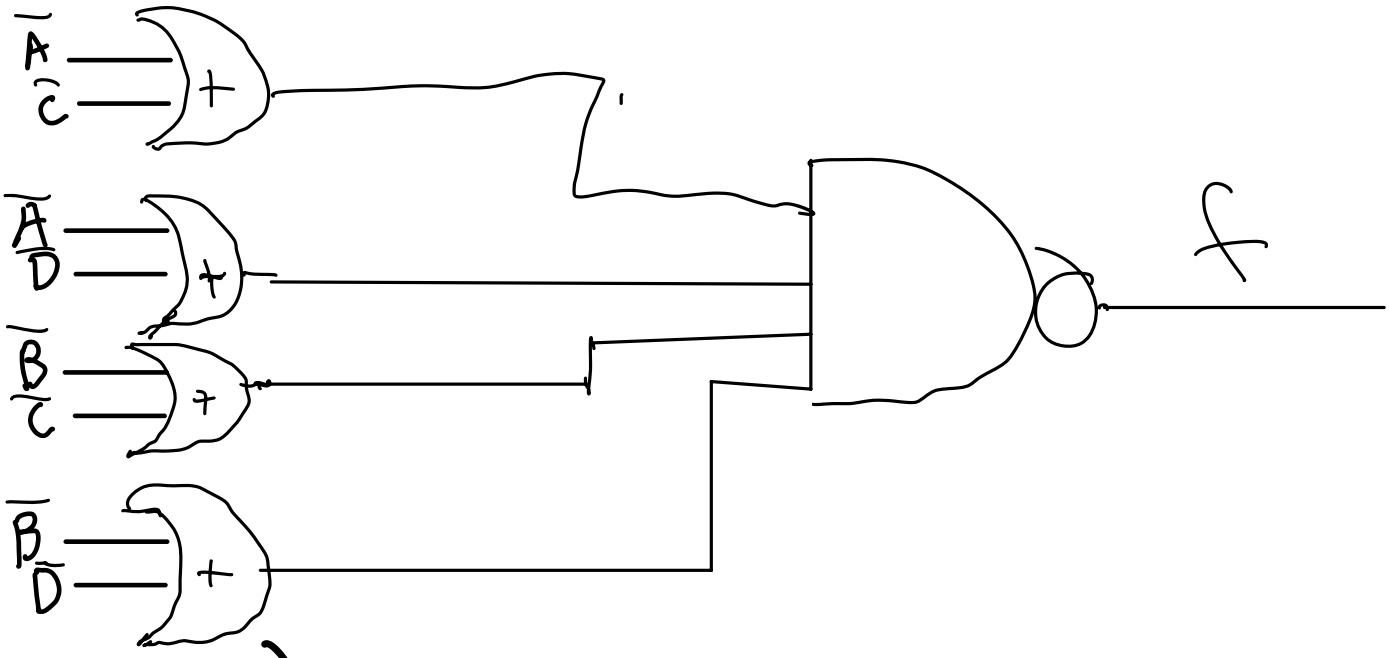


b) $f = (A+D)\cdot(C+D)$

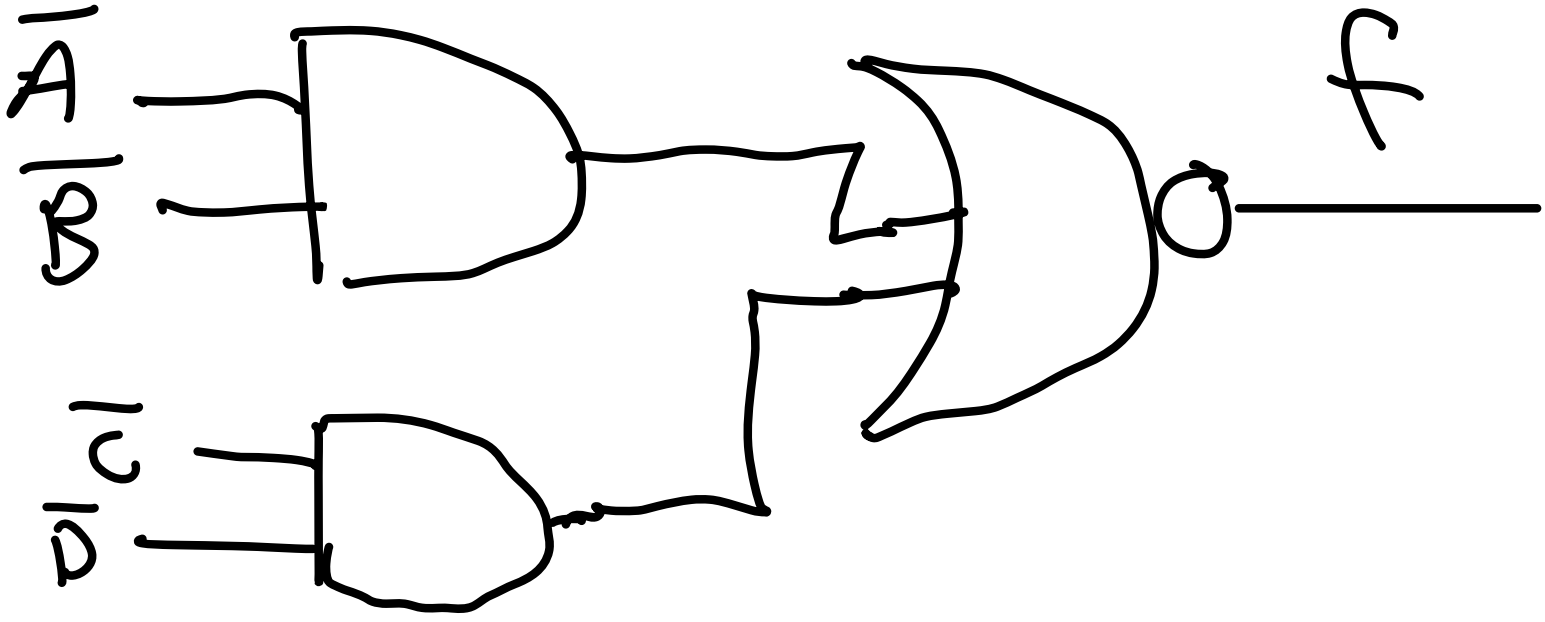
OR - AND



c) OR-NAND



d) AND-NOR



e) NOR-OR