VE270 HW2 夏陶悦 518370910087.

1. Using the truth table to prove DeMorgan's law.

①

x	y	$(xy)'$	$x'+y'$
0	0	1	1
0	1	1	1
1	0	1	1
1	1	0	0

$\Rightarrow (xy)' = x'+y'$

②

x	y	$(x+y)'$	$x'y'$
0	0	1	1
0	1	0	0
1	0	0	0
1	1	0	0

$\Rightarrow (x+y)' = x'y'$

proved

2. $F = a'b(c+d') + a(b'+c) + a(b+d)c.$

$= a'bc + a'bd' + ab' + ac + abc + adc.$

$= (a'+a)bc + ac + a'bd' + ab' + abc$

$= bc + ac + a'bd' + a(b'+c)$

$= bc + ac + a'bd' + ab'$

3. $F = ac' + abd' + acd.$

$F' = (ac' + abd' + acd)' = (ac' + abd')'(acd)' = (ac')'(abd')'(acd)'$

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

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

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

$= a' + a'b'c + 0 + b'cd' + a'cd + 0 + 0$

$= a' + b'cd'$

So $F' = a' + b'cd'$

4.

a	b	c	F
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1

$\Rightarrow F = a'b'c + a'bc' + a'bc + ab'c + abc' + abc.$

$= m_1 + m_2 + m_3 + m_5 + m_6 + m_7$

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

5. $F = a'b'c + a'bc' + a'bc + ab'c + abc' + abc.$

$= \cancel{a'(b'c+bc)}$

$= a'c(b'+b) + bc'(a'+a) + ac(b'+b)$

$= a'c + bc' + ac$

$= c + bc' = b + c$

6. $F(a,b,c) = abc + ab + a + b + c = a + b + c$

a	b	c	F
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	1

$\Rightarrow F_1 = m_1 + m_2 + m_3 + m_4 + m_5 + m_6 + m_7$
$= \Sigma(1,2,3,4,5,6,7)$

7. (a) $F = ab + cd.$

$G = \cancel{(ab)' + (cd)'}\ ((ab)'(cd)')'$

$= (((a'+b')\cdot(c'+d'))')' = ((a'+b')' + (c'+d')')' = (ab + cd)' = (a'+b')(c'+d')$

so $F \neq G$ and $F' = G$.

(b)

a	b	c	d	F
0	0	0	0	0
0	0	0	1	0
0	0	1	0	0
0	0	1	1	1
0	1	0	0	0
0	1	0	1	0
0	1	1	0	0
0	1	1	1	1
1	0	0	0	0
1	0	0	1	0
1	0	1	0	0
1	0	1	1	1
1	1	0	0	1
1	1	0	1	1
1	1	1	0	1
1	1	1	1	1

a	b	c	d	G
0	0	0	0	1
0	0	0	1	1
0	0	1	0	1
0	0	1	1	0
0	1	0	0	1
0	1	0	1	1
0	1	1	0	1
0	1	1	1	0
1	0	0	0	1
1	0	0	1	1
1	0	1	0	1
1	0	1	1	0
1	1	0	0	0
1	1	0	1	0
1	1	1	0	0
1	1	1	1	0

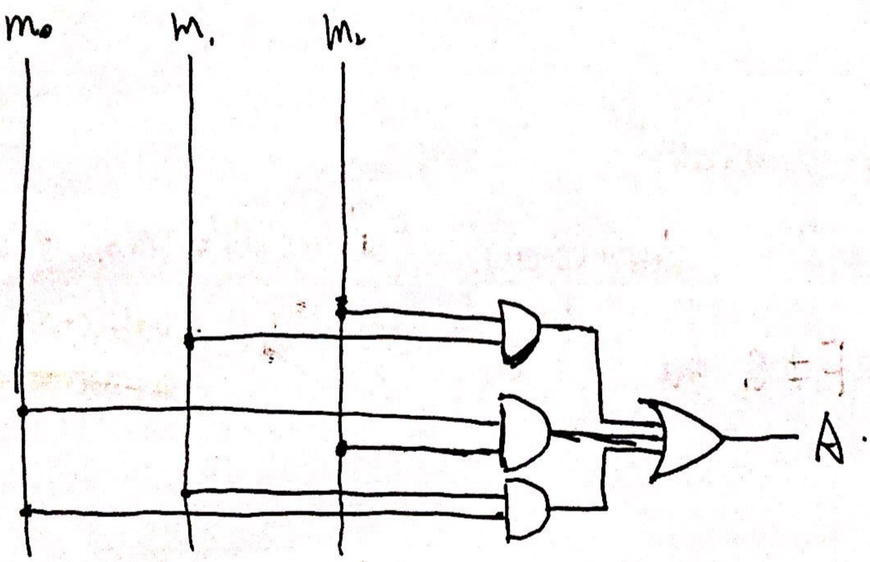
$\cancel{F \neq G}$, $F' = G$.

8.

m_0	m_1	m_2	A
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1

$$\Rightarrow A = m_0'm_1m_2 + m_0m_1'm_2 + m_0m_1m_2' + m_0m_1m_2$$
$$= m_1m_2 + m_0m_1'm_2 + m_0m_1m_2'$$
$$= m_1(m_2 + m_0m_2') + m_0m_1'm_2$$
$$= m_1(m_0+m_2) + m_0m_1'm_2$$
$$= m_0m_1 + m_1m_2 + m_0m_1'm_2$$
$$= m_0m_1 + m_2(m_0+m_1)$$
$$= m_0m_1 + m_0m_2 + m_1m_2.$$

Circuit:



9. (a) $F(a,b,c) = ab'c + abc + a'bc + abc'$

$= ac + a'bc + abc'$

$= c(a+b) + abc' = ac + b(a+c) = ab + ac + bc.$

(b) F

$a \backslash bc$	$b'c'$	$b'c$	bc	bc'
a'	0	0	1	0
a	0	1	1	1

$\Rightarrow F = bc + ac + ab.$

10. (a) algebraic method.

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

(b) K-map.

F

$ab \backslash cd$	$c'd'$	$c'd$	cd	cd'
$a'b'$	1	0	0	1
$a'b$	0	0	0	0
ab	1	1	1	1
ab'	0	0	0	0.

We can obviously find that F cannot be optimized.

11. Using K-map to derive $F(a,b,c,d) = a'bc'd + ab'cd'$

te.

F: ab \ cd	c'd'	c'd	cd	cd'
a'b'	0	0	X	0
a'b	0	1	X	0
ab	X	X	X	X
ab'	0	0	X	1

$\Rightarrow F = bd + ac.$

12. (a) $F = a'c + ac + a'b = c + a'b.$

F: c \ ab	00	01	10	11
0	0	1	0	0
1	1	1	1	1

prime implicants are c and a'b

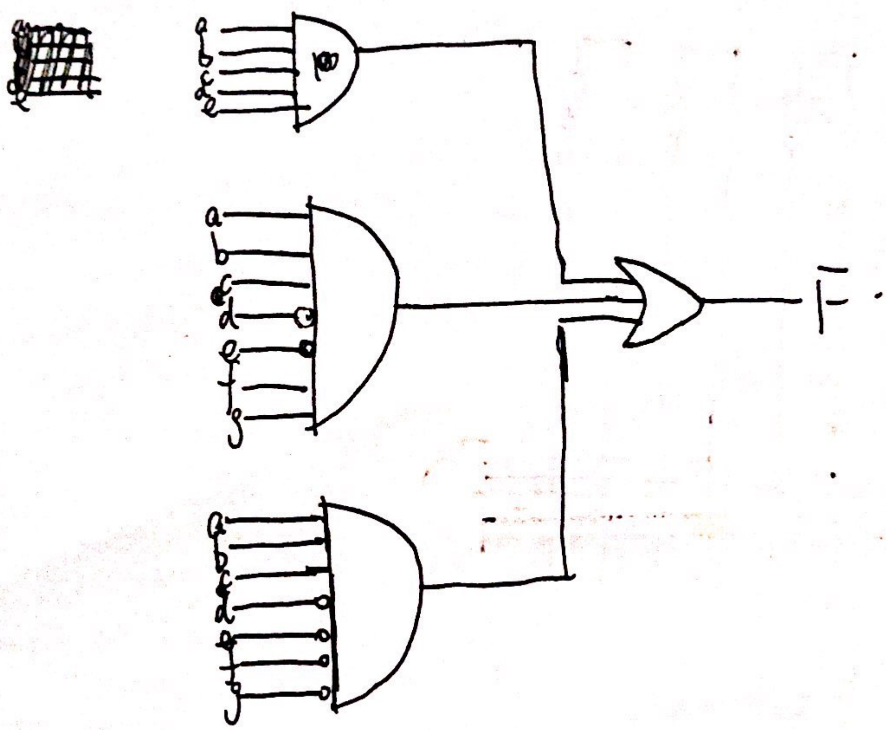
The essential prime implicants are also ~~b'c and a'bc~~. c and a'b.

13. $F = abcde + abcd'e'fg + abcd'e'f'g'$

$= abc(de + d'e'fg + d'e'f'g')$

$= abc(de + d'e'(fg + f'g'))$.

(1) original circuit.

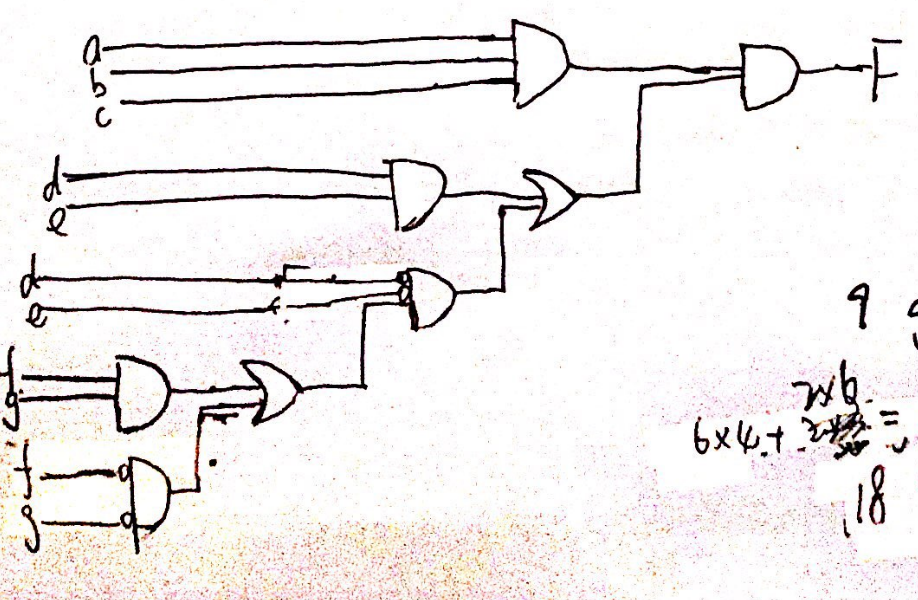


2 gate delays.

$10+14+14+6 = 44$ transistors

22 inputs.

(2) multilevel.



9 gate delays.

$6\times4 + 2\times6 = 36$ transistors.

18 inputs.