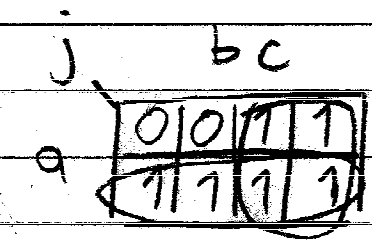
Spring '06

27 Apr 2006 EECS 303 midterm exam

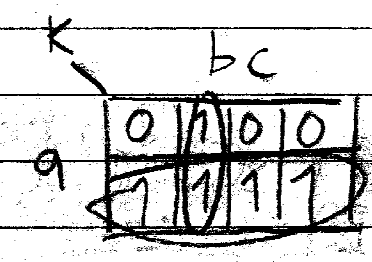
1)a) The Karnaugh map method does not specify how to select a minimal subset of primes that covers all ones.

1)b)

input	output
a b c	j k
0 0 0	0 0
0 0 1	0 1
0 1 0	1 0
0 1 1	1 0
1 0 0	1 1
1 0 1	1 1
1 1 0	1 1
1 1 1	1 1



$j = a + b$



$k = a + \bar{b}c$

2)a) The optimal solution may require more than two levels and the Quine-McCluskey method only produces two-level solutions.

2)b)

000	1
001	1
010	1
011	1
101	1
100	X

√000 √00X 0XX
√001 √0X0 X0X
√010 √X00
√100 √0X1
√011 √01X
√101 √X01
√10X

	0XX	X0X
000	1	1
001	1	1
010	1	
011	1	
101		1

$f = \overline{a} + \overline{b}$

$= \overline{\overline{a} + \overline{b}}$

$= \overline{ab}$

2)c) Unate covering problem

3)a) MIS can synthesize multi-level logic while Espresso is limited to two-level logic.

3)b)

XX01	1 R.E.	for XX01
11X1	1 P.R.	11XX
1X11	1 P.R.	unate, not T
X01X	X	XX01 R.E.

for 11X1

XX0X

XX1X

c̄ / T / c

T T

XXXX XXXX

not unate,

both T

11X1 not R.E.

for 1X11

X1XX

X0XX

b̄ / T / b

T T

XXXX XXXX

not unate

both T

1X11 not R.E.

Which R.E. covered by R.E. ∪ D.C.

$\begin{pmatrix} XX01 \\ X01X \end{pmatrix}_{11X1}$ = XX0X, not T, 11X1 P.R.

11X1 P.R.

$\begin{pmatrix} XX01 \\ X01X \end{pmatrix}_{1X11}$ = X0XX not T, 1X11 P.R.

3)b) ~~0001~~ ~~0101~~ ~~1001~~ ~~1011~~ 1111

Eliminate those covered by E.E. ∪ D.C.: XX01, X01X

11X1 1X11

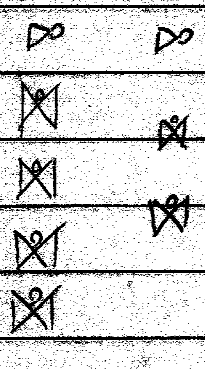
1111 1 1

1111 1

Either fine.

$f = \bar{c}d + abd$

4)a)



$5 \cdot 2 + 3 \cdot 2 = 10 \cdot 6 = 16$

4)b) n levels, each of which has 1 inverter and 2 TGs.

$$f = 2 \cdot n + 2\sum_{i=1}^{n} 2^i = 2n + 2(2^{n+1} - 2) = 2n + 2^{n+2} - 4$$

$$f = 2^{n+2} + 2n - 4$$

5)

ab \ cd	00	01	11	10
00	1	1	1	1
01	1	1	1	1
11	1	0	0	0
10	0	1	0	0

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

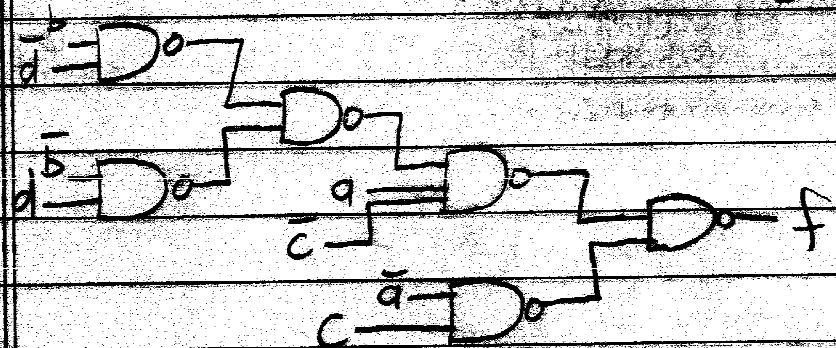
too many inputs

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

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

$f = \overline{\bar{a}c} \cdot \overline{a\bar{c}(b\bar{d} + \bar{b}d)}$

$b\bar{d} + \bar{b}d = \overline{\overline{b\bar{d}} \cdot \overline{\bar{b}d}}$



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