Computer Science CSCI 355

Digital Logic and Computer Organization

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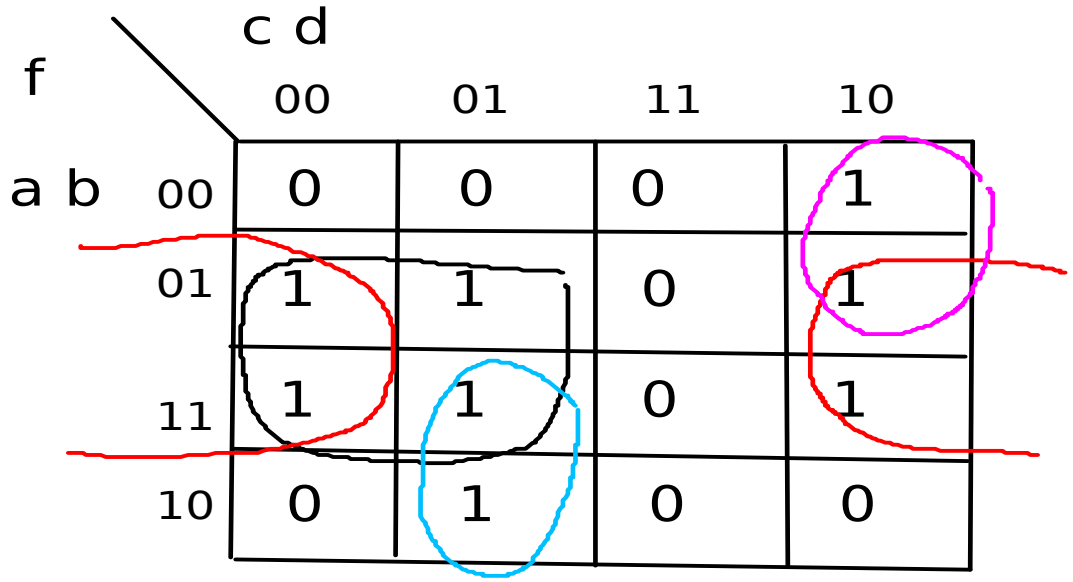
Minimal SOP/POS

- DeMorgan's Theorem
  - $\overline{AB} = \overline{A} + \overline{B}$
  - $\overline{A + B} = \overline{A}.\overline{B}$

$$minimal\ POS\ for\ f = \overline{minimal\ SOP\ for\ \overline{f}}$$

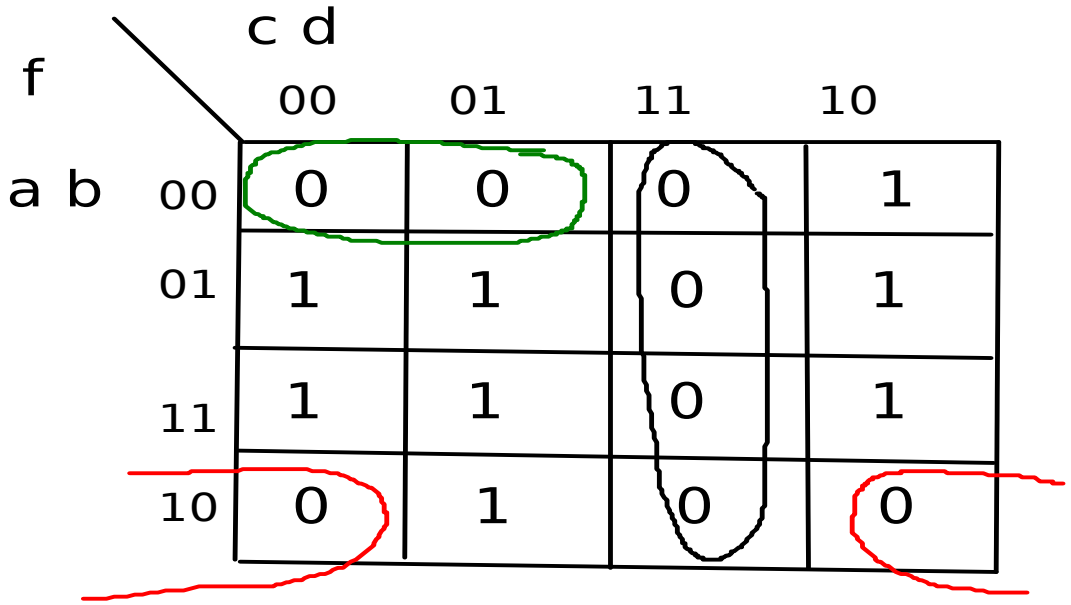
$$minimal\ SOP\ for\ f = \overline{minimal\ POS\ for\ \overline{f}}$$

Example



f = bc' + bd' + ac'd + a'cd'

Example cont.



f' = cd + ab'd' + a'b'c'

Example cont.

$$\overline{f} = cd + \overline{a}\,\overline{b}\,\overline{c} + a\,\overline{b}\,\overline{d}$$

$$\Rightarrow\ \overline{\overline{f}} = \overline{cd + \overline{a}\,\overline{b}\,\overline{c} + a\,\overline{b}\,\overline{d}}$$

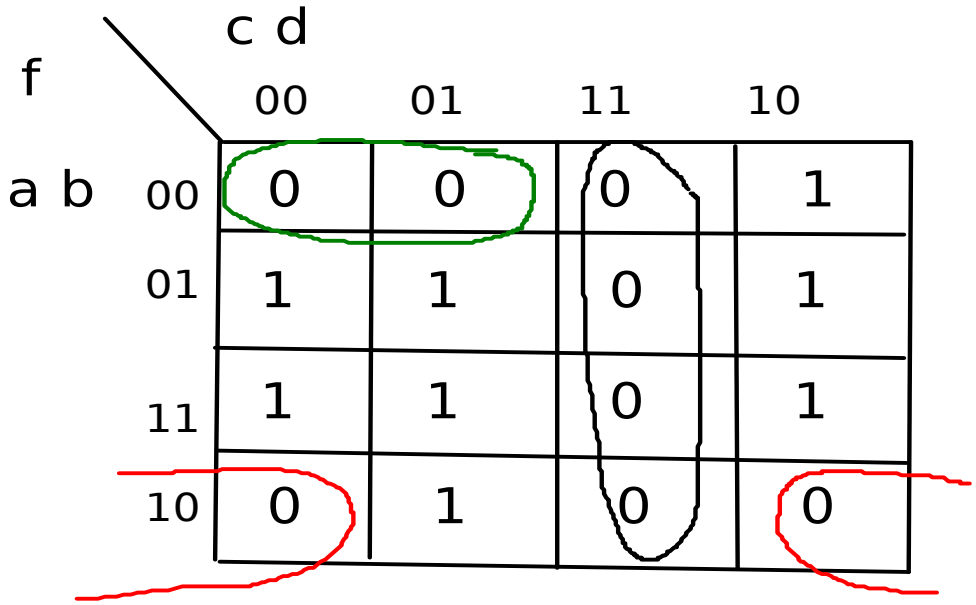
$$\Rightarrow\ f = (\overline{cd})(\overline{\overline{a}\,\overline{b}\,\overline{c}})(\overline{a\,\overline{b}\,\overline{d}})$$

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

Example cont.

a	b	c	d	m	M
0	0	0	0	a'b'c'd'	a+b+c+d
0	0	0	1	a'b'c'd	a+b+c+d'
0	0	1	0	a'b'cd'	a +b+c'+d

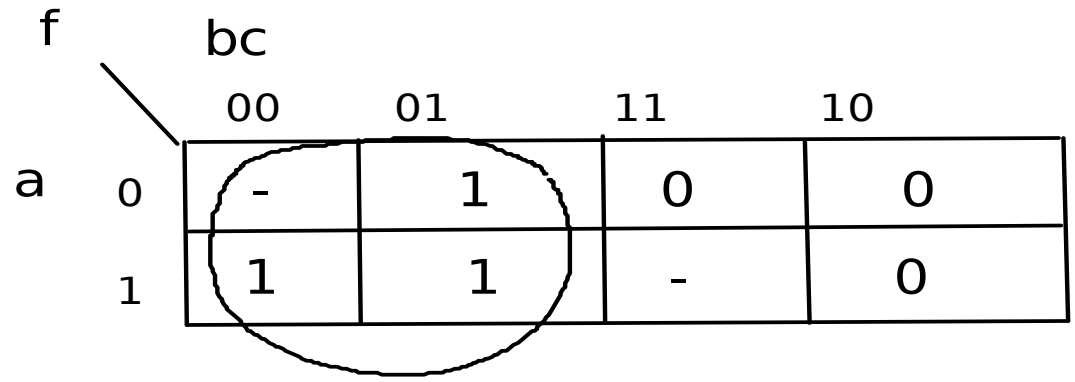
Example cont.



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

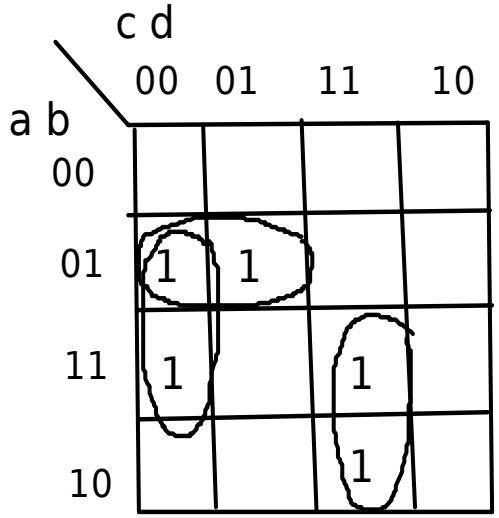
Don't Cares

- e.g. $f = \Sigma m(1,4,5) + \Sigma md(0,7)$

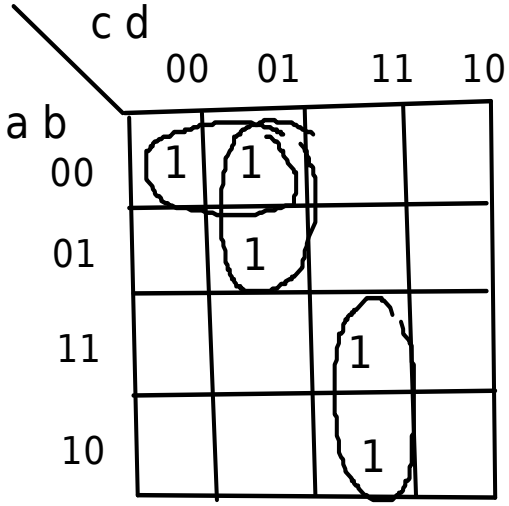


f = b'

Multiple Outputs



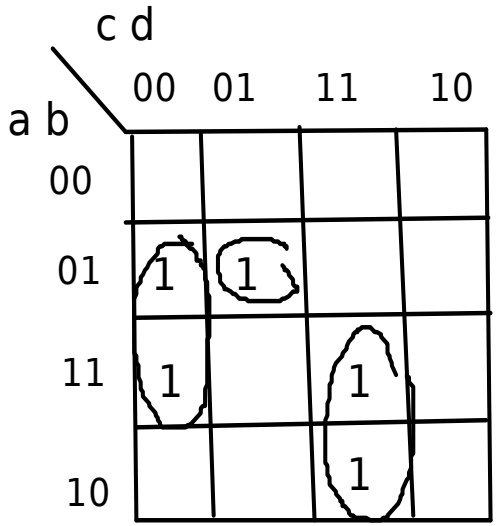
f1



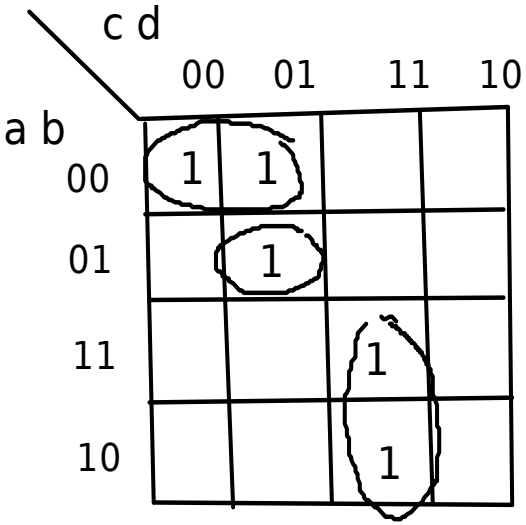
f2

f1 = bc'd' + a'bc' + acd
f2 = a'b'c' + a'c'd + acd

Multiple Outputs (Target Sharing)



g1



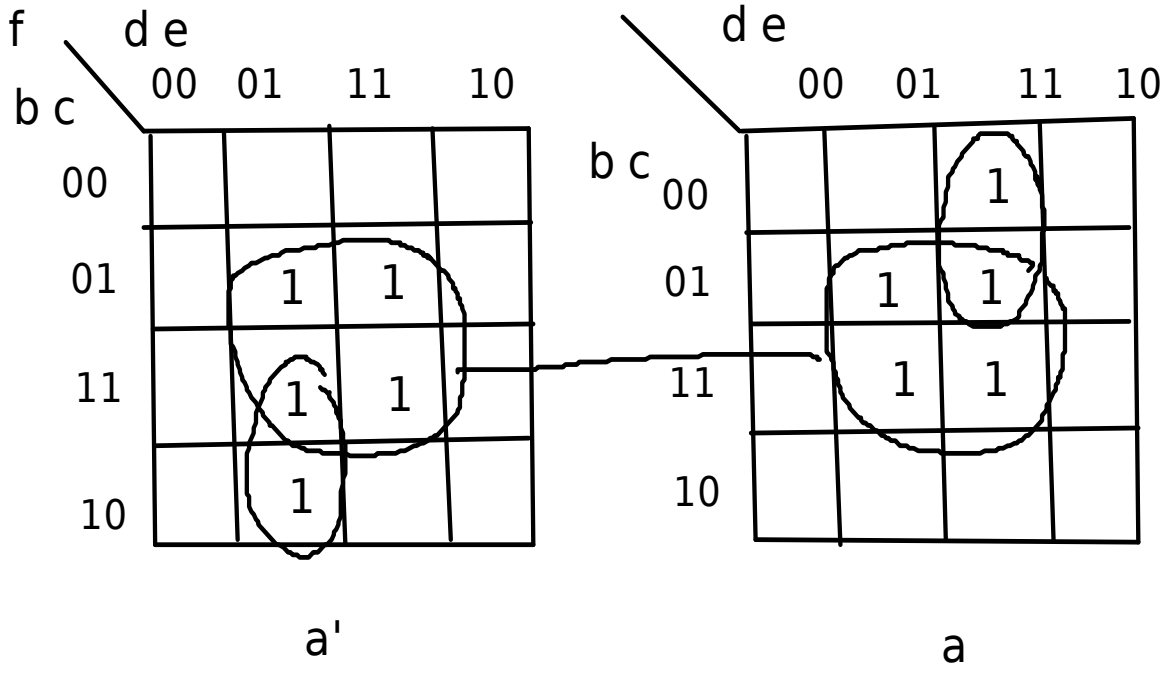
g2

g1 = bc'd' + a'bc'd + acd
g2 = a'b'c' + a'bc'd + acd

Realization Cost

- TTL ($f1$ $f2$)
  - 5 3-input AND gates
  - 2 3-input OR gates
  - 9 1-input NOT gates
- TTL ($g1$ $g2$)
  - 3 3-input AND gates
  - 1 4-input AND gates
  - 2 3-input OR gates
  - 7 1-input NOT gates
- PLA ($f1$ $f2$)
  - 5 product terms
- PLA ($g1$ $g2$)
  - 4 product terms

Example (5 Variables)



$$f = ce + a'bd'e + ab'de$$