

9/17/2009 outline

- 1) Sum of Products / Truth Tables
- 2) Smallest SOP - simplify ~~code~~ sequence
- 3) Karnaugh Maps (k-map)
- 4) More Gates
 - NAND - Not And
 - NOR - Not or
 - XOR - Exclusive OR - 1 when only 1 input = 1
 - XNOR - Equal OR - 1 when both inputs are same
- 5) NAND → NOT
completeness → OR
→ NOR
etc...
- 6) Possible Boolean Functions
 - N inputs
 - 2^N rows
 - $2^{(2^N)}$ possible functions
- 7) Decoders
- 9) MUXES

$$f(a, b, c) = m \Sigma(1, 2, 5, 7)$$

inputs = 3

Truth Tables = $2^3 = 8$

| | a | b | c | f | $\bar{b}c$ | $a\bar{c}$ | $\bar{a}b\bar{c}$ | f' |
|---|---|---|---|---|------------|------------|-------------------|----|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 1 |
| 2 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 |
| 3 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |
| 4 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 |
| 6 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 |

↑ SAME ↑

Sum of Products

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

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

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

$$f = \bar{b}c(1) + \bar{a}b\bar{c} + abc$$

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

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

$$c(\bar{b}(1+a) + ab) + \bar{a}b\bar{c}$$

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

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

$$c(\bar{b} + a(1)) + \bar{a}b\bar{c}$$

- 1) Dist.
- 2) Comp
- 3) Id

- 4) Dist
- 5) Null
- 6) Dist
- 7) Dist
- 8) Comp

a > a-1

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

$$\bar{b}c + ac + \bar{a}b\bar{c}$$

9) 10

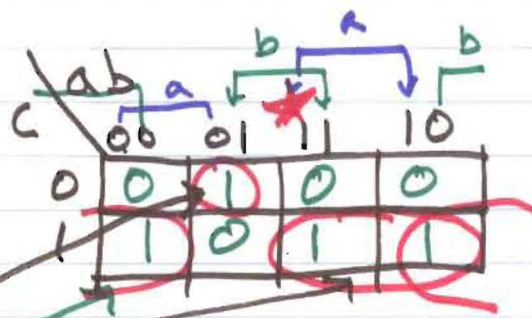
10) Dist.

| a | b | c | f |
|---|---|---|---|
| 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 1 |
| 0 | 1 | 0 | 1 |
| 0 | 1 | 1 | 0 |
| 1 | 0 | 0 | 0 |
| 1 | 0 | 1 | 1 |
| 1 | 1 | 0 | 0 |
| 1 | 1 | 1 | 1 |

Smallest SOP w Simplification

Karnaugh map - (Kmap)

- 1) Convert to a truth Table
- 2) Draw empty kmap



- 3) Fill in Kmap w F value

- 4) Group 1s in a power of 2 grouping
Horizontal
Vertical
edges

5) $F = \bar{a}b\bar{c} + ac + \bar{b}c$

Reduce input that change in the kmap

| | | | |
|---|----|----|----|
| | ab | | |
| c | 00 | 01 | 11 |
| 0 | 1 | 1 | 1 |
| 1 | 1 | 0 | 1 |

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

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

| a | b | c | f |
|---|---|---|---|
| 0 | 0 | 0 | 1 |
| 0 | 0 | 1 | 1 |
| 0 | 1 | 0 | 1 |
| 0 | 1 | 1 | 0 |
| 1 | 0 | 0 | 0 |
| 1 | 0 | 1 | 0 |
| 1 | 1 | 0 | 1 |
| 1 | 1 | 1 | 1 |

| | | | |
|---|----|----|----|
| | ab | | |
| c | 00 | 01 | 11 |
| 0 | 1 | 0 | 0 |
| 1 | 1 | 1 | 1 |

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

| | | | |
|----|----|----|----|
| | ab | | |
| cd | 00 | 01 | 11 |
| 00 | 1 | 1 | 0 |
| 01 | 0 | 1 | 1 |
| 11 | 0 | 1 | 0 |
| 10 | 1 | 1 | 1 |

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

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

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