

## Textbook problems

Simplify the following Boolean Functions using three-variable maps.

### 1. Problem 1-8(b)

b.  $F(x, y, z) = E(1, 2, 3, 6, 7)$

x\yz	00	01	11	10
0	0	1	1	1
1	0	0	1	1

$$F(x, y, z) = x'z + y$$

### 2. Problem 1-8(c)

c.  $F(x, y, z) = E(3, 5, 6, 7)$

x\yz	00	01	11	10
0	0	0	1	0
1	0	1	1	1

$$F(x, y, z) = xy + yz + xy$$

Simplify The following Boolean Functions Using four-variable maps.

### 3. Problem 1-9(b)

b.  $F(A, B, C, D) = E(3, 7, 11, 13, 14, 15)$

AB\CD	00	01	11	10
00	0	0	1	0
01	0	0	1	0
11	0	1	1	1
10	0	0	1	0

$$F(A, B, C, D) = ABD + CD + ABC$$

### 4. Problem 1-9(d)

d.  $F(A, B, C, D) = E(0, 2, 4, 5, 6, 7, 8, 10, 13, 15)$

AB\CD	00	01	11	10
00	1	0	0	1
01	1	1	1	1
11	0	1	1	0
10	1	0	0	1

$$F(A, B, C, D) = B'D' + A'B + BD$$

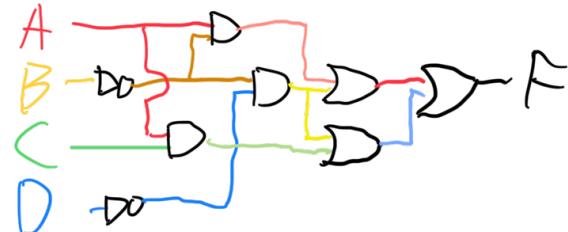
5. Problem 1-11

Simplify The following Boolean function in sum-of-products form by means of a four-variable map. Draw the logic diagram with (a) AND-OR gates; (b) NAND gates.

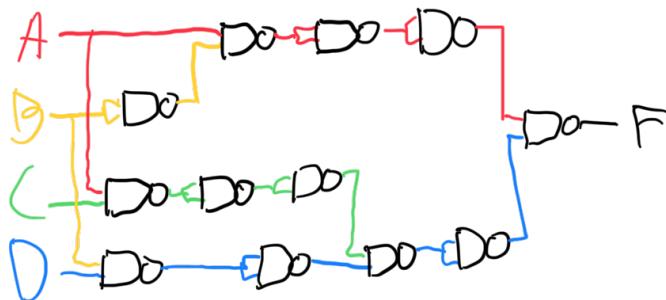
$$F(A, B, C, D) = E(0, 2, 8, 9, 10, 11, 14, 15)$$

AB\CD	00	01	11	10
00	1	0	0	1
01	0	0	0	0
11	0	0	1	1
10	1	1	1	1

$$F(A, B, C, D) = B'D' + AB' + AC$$



(b)



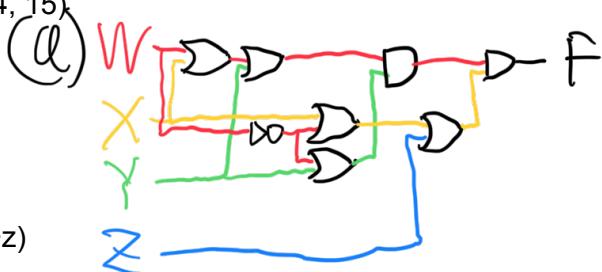
6. Problem 1-12

Simplify the following Boolean function in product-of-sums form by means of a four-variable map. Draw the logic diagram with (a) OR-AND gates; (b) NOR gates.

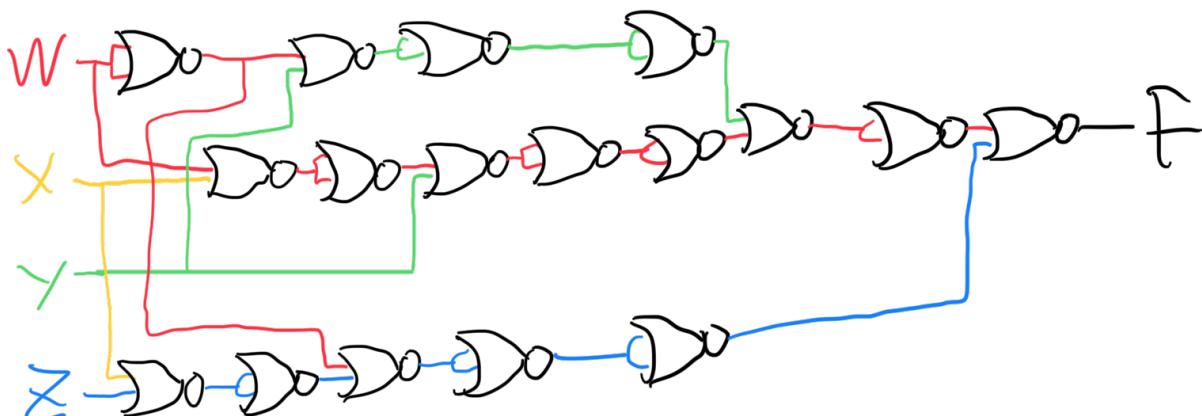
$$F(w, x, y, z) = E(2, 3, 4, 5, 6, 7, 11, 14, 15)$$

wx\yz	00	01	11	10
00	0	0	1	1
01	1	1	1	1
11	0	0	1	1
10	0	0	1	0

$$F(A, B, C, D) = (w+x+y)(w'+y)(w'+x+z)$$



(b)



### 7. Problem 1-13

Simplify The Boolean function Together with the don't-care conditions d in (1) sum-of-products form and (2) product-of-sums form.

$$F(w, x, y, z) = E(0, 1, 2, 3, 7, 8, 10)$$

$$d(w, x, y, z) = E(5, 6, 11, 15)$$

AB\CD	00	01	11	10
00	1	1	1	1
01	0	X	1	X
11	0	0	X	1
10	1	0	X	0

$$(1) F(w, x, y, z) = A'B' + CD + B'C'D' + BC$$

$$(2) F(w, x, y, z) = (B'+C)(A'+D')(A'+B+C')$$

### Boolean expression simplify

8. Simplify the following Boolean expression using two-variable Karnaugh maps:

(Hint: Write a truth table for the function and then use Karnaugh map to simplify)

$$a. F(x, y) = x'y' + yy + x'yy'$$

x	y	x'y'	yy	x'yy'	x'y' + yy + x'yy'
0	0	1	0	0	1
0	1	0	1	1	1
1	0	0	0	0	0
1	1	0	1	0	1

x\y	0	1
0	1	1
1	0	1

$$F(x, y) = x'y + y$$

$$b. F(x, y) = xy + x'y'y' + x'yy'$$

x	y	xy	x'y'y'	x'yy'	xy + x'y'y' + x'yy'
0	0	0	1	0	1
0	1	0	0	1	1
1	0	0	0	0	0
1	1	1	0	0	1

x\y	0	1
0	1	1
1	0	1

$$F(x, y) = x'y + y$$

9. Simplify the following Boolean expression using three-variable Karnaugh maps:  
 (Hint: Write a truth table for the function and then use Karnaugh map to simplify)

a.  $F(A, B, C) = A'BC + A'BC' + AB'C' + AB'C$

A	B	C	$A'BC$	$A'BC'$	$AB'C'$	$AB'C$	$A'BC + A'BC' + AB'C' + AB'C$
0	0	0	0	0	0	0	0
0	0	1	0	0	0	0	0
0	1	0	0	1	0	0	1
0	1	1	1	0	0	0	1
1	0	0	0	0	1	0	1
1	0	1	0	0	0	1	1
1	1	0	0	0	0	0	0
1	1	1	0	0	0	0	0

A\BC 00 01 11 10

0 0 0 1 1

1 1 1 0 0

$F(x, y) = AB' + A'B$

b.  $F(A, B, C) = A'B + BC' + B'C'$

A	B	C	$A'B$	$BC'$	$B'C'$	$A'B + BC' + B'C'$
0	0	0	0	0	1	1
0	0	1	0	0	0	0
0	1	0	1	1	0	1
0	1	1	1	0	0	1
1	0	0	0	0	1	1
1	0	1	0	0	0	0
1	1	0	0	1	0	1
1	1	1	0	0	0	0

A\BC 00 01 11 10

0 1 0 1 1

1 1 0 1 0

$F(x, y) = B'C' + BC + A'B$

10. Simplify the following Boolean expression using four-variable Karnaugh maps:

$$F(A, B, C, D) =$$

$$A'B'C'D' + A'B'C'D + A'B'CD + A'BC'D' + A'BC'D + A'BCD + ABC'D' + ABC'D + ABCD$$

0000	0001	0011	0100	0101	0111	1100	1101	1111
AB\CD	00	01	11	10				
00	1	1	1	0				
01	1	1	1	0				
11	1	1	1	0				
10	0	0	0	0				

$$F(A, B, C, D) = A'C' + A'D + BC' + BD$$

11. Simplify the following Boolean functions using Karnaugh map

a.  $F(X, Y, Z) = \sum m(3, 4, 6, 7)$

X\YZ	00	01	11	10
0	0	0	1	0
1	1	0	1	1

$$F(X, Y, Z) = XZ' + YZ$$

b.  $F(X, Y, Z) = \sum m(0, 2, 4, 5, 6)$

X\YZ	00	01	11	10
0	1	0	0	1
1	1	1	0	1

$$F(X, Y, Z) = Z' + XY'$$

c.  $F(W, X, Y, Z) = \sum m(0, 1, 2, 4, 5, 6, 8, 9, 12, 13, 14)$

WX\YZ	00	01	11	10
00	1	1	0	1
01	1	1	0	1
11	1	1	0	1
10	1	1	0	0

$$F(W, X, Y, Z) = Y' + W'Z' + XZ'$$

d.  $F(A, B, C, D) = \sum m(1, 3, 7, 11, 15)$  and  $d(A, B, C, D) = \sum m(0, 2, 5)$

AB\CD	00	01	11	10
00	X	1	1	X
01	0	X	1	0
11	0	0	1	0
10	0	0	1	0

$$F(A, B, C, D) = A'B' + CD$$

$$e. F(w, x, y, z) = \Sigma m(1, 4, 5, 6, 12, 14, 15)$$

wx\yz	00	01	11	10
00	0	1	0	0
01	1	1	0	1
11	1	0	1	1
10	0	0	0	0

$$F(w, x, y, z) = xy'z' + w'y'z + wxy + xyz'$$

12. Simplify the following expressions in (1) sum of products and (2) product of sums:

(Hint: Write a truth table for the function and then use Karnaugh map to simplify)

$$a. F(x, y) = x'y' + y'y' + yy' + xy$$

x\y	00	00	x	11
0	0	1		
1	1	0		

$$(1) F(x, y) = x'y' + xy$$

$$(2) F(x, y) = (x+y)(x+y')$$

$$b. F(A, B, C, D) = (A' + B' + D') (A + B' + C') (A' + B + D') (B + C' + D')$$

A	B	C	D	1	2	3	4	F
0	0	0	0	1	1	1	1	1
0	0	0	1	1	1	1	1	1
0	0	1	0	1	1	1	1	1
0	0	1	1	1	1	1	0	0
0	1	0	0	1	1	1	1	1
0	1	0	1	1	1	1	1	1
0	1	1	0	1	0	1	1	0
0	1	1	1	1	0	1	1	0
1	0	0	0	1	1	1	1	1
1	0	0	1	1	1	0	1	0
1	0	1	0	1	1	1	1	1
1	0	1	1	1	1	0	0	0
1	1	0	0	1	1	1	1	1
1	1	0	1	0	1	1	1	0
1	1	1	0	1	1	1	1	1
1	1	1	1	0	1	1	1	0
AB\CD	00	01	11	10				
00	1	1	0	1				
01	1	1	0	0				
11	1	0	0	1				
10	0	1	0	1				

$$(1) F(A, B, C, D) = A'C' + ABD' + B'CD' + ABD + B'C'D$$

$$(2) F(A, B, C, D) = (C'+D')(A'+B+C+D)(A'+B'+D')(AB'C)$$