

---

# Switching Circuit & Logic Design

Lecture 15 : Quinn-McCluskey Method

---

# What we learned ?

---

Fundamental :  $PA + PA' = P(A+A') = P$

$$\Sigma_m(0,1,4,5) = A'B'C' + A'B'C + AB'C' + AB'C$$

$$= A'B' (C' + C) + AB' (C'+C) = (A'+A)B' = B'$$

Step 1 : Combined two pairs of adjacent terms

Step 2 : Two terms combined again

---

# Which terms can be paired ?

---

If the terms differ in one position

$$AB'C + ABC = A(B'+B)C = AC$$

$$AB'CD' + AB'CD = AB'C(D'+D) = AB'C$$

Etc.

---

# Quine-McCluskey

---

List all minterms

Arrange all minterms in groups of same numbers of 1's

Compare each term of the lower index group with every term in the succeeding group.

Combined terms : Original fixed representation with the differing one replaced by a dash (-).

Combine the terms generated in Step 3 in the same fashion.

---

# Example

---

$$F = \Sigma_m (0, 1, 6, 7, 8, 9, 13, 14, 15)$$

Index	MinTerm	Binary
Index 0	0	0000
Index 1	1 8	0001 1000
Index 2	6 9	0110 1001
Index 3	7 13 14	0111 1101 1110
Index 4	15	1111

---

# Example

---

Column 1		
Index	MinTerm	Binary
Index 0	0	0000
Index 1	1	0001
	8	1000
Index 2	6	0110
	9	1001
Index 3	7	0111
	13	1101
	14	1110
Index 4	15	1111

Column 2				
Pairs	A	B	C	D
0,1 0,8	0	0	0	-
	-	0	0	0
1,9 8,9	-	0	0	1
	1	0	0	-
6,7 6,14 9,13	0	1	1	-
	-	1	1	0
	1	-	0	1
7,15 14,15	-	1	1	1
	1	1	1	-

---

Column 2				
Pairs	A	B	C	D
0,1	0	0	0	-
0,8	-	0	0	0
1,9	-	0	0	1
8,9	1	0	0	-
6,7	0	1	1	-
6,14	-	1	1	0
9,13	1	-	0	1
7,15	-	1	1	1
14,15	1	1	1	-

---

Column 3				
Quads	A	B	C	D
0,8,1,9	-	0	0	-
6,14,7,15	-	1	1	-

---

---

Column 2				
Pairs	A	B	C	D
0,1	0	0	0	-
0,8	-	0	0	0
1,9	-	0	0	1
8,9	1	0	0	-
6,7	0	1	1	-
6,14	1	1	1	0
9,13	1	-	0	1
7,15	-	1	1	1
14,15	1	1	1	-

---

Column 3				
Quads	A	B	C	D
0,8,1,9	-	0	0	-
6,14,7,15	-	1	1	-

---



# With K-Map

$$F = \Sigma_m(0, 1, 6, 7, 8, 9, 13, 14, 15)$$

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

The Karnaugh map shows the function F with 1s in the following cells: (0,0), (0,1), (1,2), (1,3), (2,2), (2,3), (3,2), (3,3), (4,0), and (4,1). The groupings are as follows:

- A red L-shaped group covers cells (0,0), (0,1), (1,0), and (1,1).
- A blue vertical oval group covers cells (2,2) and (3,2).
- A yellow circle group covers cells (2,2), (2,3), (3,2), and (3,3).

# Minimise with QM

---

$$\Sigma_m(6,7,8,9) \\ + d(10,11,12,13,14,15)$$

Index 1	8	1	0	0	0
Index 2	6	0	1	1	0
	9	1	0	0	1
	10	1	0	1	0
	12	1	1	0	0
Index 3	7	0	1	1	1
	11	1	0	1	1
	13	1	1	0	1
	14	1	1	1	0
Index 4	15	1	1	1	1

---

# Minimise with QM

Index 1	8	1	0	0	0
Index 2	6	0	1	1	0
	9	1	0	0	1
	10	1	0	1	0
	12	1	1	0	0
Index 3	7	0	1	1	1
	11	1	0	1	1
	13	1	1	0	1
	14	1	1	1	0
Index 4	15	1	1	1	1

[illegible]