

DIGITAL ELECTRONICS:
QUINE MCCCLUSKEY METHOD





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Quine-McCluskey Method

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Quine-McCluskey Method



Methods for minimizing Boolean functions:

1. Boolean Laws
2. K-Map
3. Quine –McCluskey Method (or) Tabular Method



Quine-McCluskey Method

Quine-McCluskey Method is used to simplify Boolean expressions with 6 or more variables.

Used to design complex digital systems.



Quine-McCluskey Method

Key Terms

Implicants: Group of ones

Prime Implicants: Largest possible Group of Ones

Essential Prime Implicants: This is Prime Implicants having atleast one minterm that cannot be combined in any other way.



Procedure of Quine-McCluskey Tabular Method



Steps for simplifying Boolean functions using Quine-McCluskey tabular method.

Step 1 – Arrange the given min terms in an **ascending order** and make the groups based on the number of ones present in their binary representations. So, there will be **at most 'n+1' groups** if there are 'n' Boolean variables in a Boolean function or 'n' bits in the binary equivalent of min terms.

Step 2 – Compare the min terms present in **successive groups**. If there is a change in only one-bit position, then take the pair of those two min terms. Place this symbol '_' in the differed bit position and keep the remaining bits as it is.

Step 3 – Repeat step2 with newly formed terms till we get all **prime implicants**.



Procedure of Quine-McCluskey Tabular Method



- **Step 4** – Formulate the **prime implicant table**. It consists of set of rows and columns. Prime implicants can be placed in row wise and min terms can be placed in column wise. Place '1' in the cells corresponding to the min terms that are covered in each prime implicant.
- **Step 5** – Find the essential prime implicants by observing each column. If the min term is covered only by one prime implicant, then it is **essential prime implicant**. Those essential prime implicants will be part of the simplified Boolean function.
- **Step 6** – Reduce the prime implicant table by removing the row of each essential prime implicant and the columns corresponding to the min terms that are covered in that essential prime implicant. Repeat step 5 for Reduced prime implicant table. Stop this process when all min terms of given Boolean function are over.



Example

Simplify: $F(V,W,X,Y,Z) = m(0,4,12,16,19,24,27,28,29,31)$

Step 1: (i) Write the Binary value for the corresponding decimal values

Decimal	Binary
0	00000
4	00100
12	01100
16	10000
19	10011
24	11000
27	11011
28	11100
29	11101
31	11111



Step 2: (ii) Make groups based on the number of ones present in their binary representations



Group	Minterms	V	W	X	Y	Z
1	0	0	0	0	0	0
2	4	0	0	1	0	0
	16	1	0	0	0	0
3	12	0	1	1	0	0
	24	1	1	0	0	0
4	19	1	0	0	1	1
	28	1	1	1	0	0
5	27	1	1	0	1	1
	29	1	1	1	0	1
6	31	1	1	1	1	1



Step 2:



The min terms, which are differed in only one-bit position from adjacent groups are merged. That differed bit is represented with this symbol, '-'. In this case, there are three groups and each group contains combinations of two min terms. The following table shows the possible **merging of min term pairs** from adjacent groups.

Group	Minterms	V	W	X	Y	Z
1	0,4	0	0	-	0	0
	0,16	-	0	0	0	0
2	4,12	0	-	1	0	0
	16,24	1	-	0	0	0
3	12,28	-	1	1	0	0
	24,28	1	1	-	0	0
4	19,27	1	-	0	1	1
	28,29	1	1	1	0	-
5	27,31	1	1	-	1	1
	29,31	1	1	1	-	1



Step 3:

The Prime Implicants that cannot be combined further



Minterms		V	W	X	Y	Z
0,4	$V'W'Y'Z'$	0	0	-	0	0
0,16	$W'X'Y'Z'$	-	0	0	0	0
4,12	$V'XY'Z'$	0	-	1	0	0
16,24	$VX'Y'Z'$	1	-	0	0	0
12,28	$WXY'Z'$	-	1	1	0	0
24,28	$VWY'Z'$	1	1	-	0	0
19,27	$VX'YZ$	1	-	0	1	1
28,29	$VWXY'$	1	1	1	0	-
27,31	$VWYZ$	1	1	-	1	1
29,31	$VWXZ$	1	1	1	-	1

Step 4: To find Essential Prime Implicants

Minterms		0	4	12	16	19	24	27	28	29	31
0,4	V'W'Y'Z'	X	X								
0,16	W'X'Y'Z'	X			X						
4,12	V'XY'Z'		X	X							
16,24	VX'Y'Z'				X		X				
12,28	WXY'Z'			X					X		
24,28	VWY'Z'						X		X		
19,27	VX'YZ					X		X			
28,29	VWXY'								X	X	
27,31	VWYZ							X			X
29,31	VWXZ									X	X

$$F(V,W,X,Y,Z) = V'W'Y'Z' + VX'Y'Z' + WXY'Z' + VX'YZ + VWXZ$$



Assessment

1. What is the advantage of Quine McCluskey Method?

2. List the techniques available to Simplify Boolean Expression.



*Thank
you*

