There will be another assignment soon.

Equations from Truth Tables

Example 1:

Suppose we have 3 inputs (A, B, C) and 1 output F that corresponds to each of the input combinations according to the following truth table:

A	B	C	F	Minterms
0	0	0	0	m_0
0	0	1	0	m_1
0	1	0	1	m_2
0	1	1	1	m_3
1	0	0	0	m_4
1	0	1	0	m_5
1	1	0	1	m_6
1	1	1	1	m_7

Note F is chosen to reflect our requirements—the values for F come from what we're trying to do/solve.

We can get an equation by ORing m_2, m_3, m_6, and m_7 together:

F = (A′.B.C′) + (A′.B.C) + (A.B.C′) + (A.B.C)

We can optimise this to use fewer gates:

F = A′.B.(C′ + C) + A.B.(C′ + C)

F = A′.B + A.B

F = B(A′ + A)

F = B

You can see this is clear if you look at the table. We have now gone from 12 gates to 0 gates required.

Example 2:

Derive the equation from the following truth table, simplify if possible, and draw the corresponding circuit.

This is how he may write a question in an exam.

A	B	C	F	Minterms
0	0	0	0	m0
0	0	1	1	m1
0	1	0	0	m2
0	1	1	1	m3
1	0	0	1	m4
1	0	1	0	m5
1	1	0	1	m6
1	1	1	0	m7

$F = m1 + m3 + m4 + m6$

$F = A'.B'.C + A'.B.C + A.B'.C' + A.B.C'$

$F = A'.C.(B' + B) + A.C'.(B' + B)$

$F = A'.C + A.C' = A \oplus C$

Example 3: Nightclub Bouncer Circuit

Inputs:

1. >= 18? (call this A for age)
2. Drunk? (call this D for drunk)
3. Male/female? (call this G for gender)
4. Well-dressed? (call this C for clothes)

So if A = 1, then you're >= 18.

D = 1, then you're drunk.

G = 1, you're female; G = 0, you're male.

C = 1, you're well-dressed.

A	D	G	C	Door
0	0	0	0	0
0	0	0	1	0
0	0	1	0	0
0	0	1	1	1
0	1	0	0	0
0	1	0	1	0
0	1	1	0	0
0	1	1	1	0
1	0	0	0	0
1	0	0	1	1
1	0	1	0	1
1	0	1	1	1
1	1	0	0	0
1	1	0	1	1
1	1	1	0	0
1	1	1	1	1

$Door = m_3 + m_9 + m_{10} + m_{11} + m_{13} + m_{15}$

$Door = A'.D'.G.C + A.D'.G'.C' + A.D'.G.C' + A.D'.G.C + A.D.G'.C +$ A.D.G.C

Optimise:

$Door = D'.G.C.(A' + A) + A.D.C.(G + G') + A.D'.(G'.C + G.C')$

$Door = D'.G.C + A.D.C + A.D'.(G \oplus C)$