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 | m0 |
| 0 | 0 | 1 | 0 | m1 |
| 0 | 1 | 0 | 1 | m2 |
| 0 | 1 | 1 | 1 | m3 |
| 1 | 0 | 0 | 0 | m4 |
| 1 | 0 | 1 | 0 | m5 |
| 1 | 1 | 0 | 1 | m6 |
| 1 | 1 | 1 | 1 | m7 |

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 m2, m3, m6, and m7 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⊕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 = m3 + m9 + m10 + m11 + m13 + m15

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⊕C)