

ECEn/CS 224

Chapter 3 Homework Solutions

- 3.1 Draw the truth table for a 3-variable function whose output is TRUE any time an odd number of its inputs is TRUE.

A	B	C	F
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	0
1	1	1	1

- 3.2 Draw the truth table for a 4-variable function whose output is TRUE any time an even number of its inputs is TRUE.

A	B	C	D	F
0	0	0	0	1
0	0	0	1	0
0	0	1	0	0
0	0	1	1	1
0	1	0	0	0
0	1	0	1	1
0	1	1	0	1
0	1	1	1	0
1	0	0	0	0
1	0	0	1	1
1	0	1	0	1
1	0	1	1	0
1	1	0	0	1
1	1	0	1	0
1	1	1	0	0
1	1	1	1	1

- 3.3 Draw the truth table for a 4-variable function whose output is TRUE any time its inputs, when interpreted as the bits of a 4-bit unsigned binary number, is a multiple of 3 (consider 0 to be a multiple of 3).

A	B	C	D	F
0	0	0	0	1
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	1
0	1	1	1	0
1	0	0	0	0
1	0	0	1	1
1	0	1	0	0
1	0	1	1	0
1	1	0	0	1
1	1	0	1	0
1	1	1	0	0
1	1	1	1	1

- 3.4 For each of the problems above, write the boolean equation for the function by reading it off the truth table.

(3.1) $A'B'C + A'BC' + AB'C' + ABC$

(3.2) $A'B'C'D' + A'B'CD + A'BC'D + A'BCD' + AB'C'D + AB'CD' + ABC'D' + ABCD$

(3.2) $A'B'C'D' + A'B'CD + A'BCD' + AB'C'D + ABC'D' + ABCD$

- 3.5 Prove that the following identity is TRUE using a truth table: $AC + A'B + BC = AC + A'B$. This theorem has a name. What is its name?

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

Since the last two columns are the same, the two expressions are equivalent. This is called the “consensus theorem”.

- 3.6 Prove that the following is TRUE by *multiplying it out* and then simplifying:

$$\begin{aligned}
 (A+BC)(A+DE) &= AA + ADE + ABC + BCDE \\
 &= A(1 + DE + BC) + BCDE \\
 &= A + BCDE
 \end{aligned}$$

- 3.7 Write the dual for the equality in the previous problem.

$$A(B+C) + A(D+E) = A(B+C+D+E)$$