

ASSIGNMENT 4

Set: \_\_\_\_\_ C \_\_\_\_\_

Due: October 15th at 11:59 PM (for all three sets)

Answer all questions on this handout.

1. [5 marks] Use truth tables to prove or disprove the following Boolean statement:

$$x(y \oplus z) + x'y'z = ((x + z) \uparrow y) \odot z$$

$$x(y \oplus z) + x'y'z$$

$$y \oplus z$$

$$y'z + yz'$$

x	y	z	x'	y'	z'	y'z	y'z'	y'z + yz'	x(y'z + yz')	x'y'z	x(y \oplus z) + x'y'z
0	0	0	1	1	1	0	0	0	0	0	0
0	0	1	1	1	0	0	1	1	0	1	1
0	1	0	1	0	1	1	0	1	0	0	0
0	1	1	1	0	0	0	0	0	0	0	0
1	0	0	0	1	1	0	0	0	0	0	0
1	0	1	0	1	0	0	1	1	1	0	1
1	1	0	0	0	1	1	0	1	1	0	1
1	1	1	0	0	0	0	0	0	0	0	0

$$\text{let } a = x + z$$

$$((x + z) \uparrow y) \odot z$$

$$a \uparrow y = (ay)'$$

$$= a' + y'$$

$$\text{let } b = a' + y'$$

$$= b \odot z$$

$$= b'z + b'z'$$

x	y	z	x'	y'	z'	x+z=a	a'	a'+y'=b	b'	b'z	b'z'	b'z + b'z'
0	0	0	1	1	1	0	1	1	0	0	0	0
0	0	1	1	1	0	1	0	1	0	1	0	1
0	1	0	1	0	1	0	1	1	0	0	0	0
0	1	1	1	0	0	1	0	0	1	0	0	0
1	0	0	0	1	1	1	0	1	0	0	0	0
1	0	1	0	1	0	1	0	1	0	1	0	1
1	1	0	0	0	1	1	0	0	1	0	1	1
1	1	1	0	0	0	1	0	0	1	1	0	0

equal  $\therefore$  proved

2. [15 marks] Use Boolean algebra to prove or disprove the following Boolean statements. Circle the correct answer in each case and also show your work.

a)  $(a' + c')(ac + b')(a + b + c') = (ac)'b$  Proved Disproved

$$(a' + c')(ac + b')(a + b + c') = (ac)'b$$

$$(ac)'((ac)' \cdot b')(a + b + c') \quad T15a$$

$$(ac)'((ac)'b)(a + b + c') \quad T13$$

$$(ac)'((ac)'ba + (ac)'b + (ac)'bc') \quad L8a$$

$$(ac)'((a' + c')ba + (a' + c')b + (a' + c')bc') \quad T15a$$

$$(ac)'(a'a'b + c'ba) + (a'b + c'b) + (a'bc' + c'b) \quad L8a$$

$$(ac)'((0 + c'ba) + (a'b + c'b) + a'bc' + c'b) \quad T11a, T9a$$

$$(ac)'(c'ba + a'b + c'b + a'bc' + c'b)$$

$$(ac)'b(c'a + a' + \underline{c'} + a'c' + \underline{c'}) \quad L8a$$

$$(ac)'b(c'a + a' + a'c' + c') \quad T11b$$

$$(ac)'b(c'a + a'c' + a' + c')$$

$$(ac)'b(c'(a + a')' + a' + c') \quad T8a, T12b$$

$$(ac)'b(\underline{c'} + a' + \underline{c'}) \quad T11b$$

$$(ac)'b(a' + c')$$

$$\underline{(a' + c')}(b)\underline{(a' + c')} \quad T15a$$

$$(a' + c')(b) \quad T11a$$

$$(ac)'b \quad T15a$$

$$(ac)'b = (ac)'b \therefore \text{proved}$$

b)  $a'(a+b) + (b+aa)(a+b') = (a+b)$

Proved

Disproved

$$a'(a+b) + (b+aa)(a+b') = (a+b)$$

$$(a'a + a'b) + (b+a)(a+b') \quad L8a$$

$$(0 + a'b) + (b+a)(a+b') \quad T12a$$

$$a'b + ba + bb' + aa + ab' \quad L8a$$

$$a'b + ba + 0 + a + ab'$$

$$a'b + a(b + 1 + b') \quad L8a$$

$$a'b + a(\underline{b+b'} + 1) \quad T12b$$

$$a'b + a(1+1)$$

$$a'b + a(1)$$

$$a'b + a$$

$$a + b \quad T14d$$

$$a+b = a+b \therefore \text{proven}$$

c)  $((abc')' + a'c'd' + (a'b'c'd)')' = 1$       Proved

Disproved

$$((abc')' + a'c'd' + (a'b'c'd)')' \neq 1$$

$$(a' + b' + c' + a'c'd' + a'' + b'' + c'' + d')' \quad T15a$$

$$(a' + b' + c + a'c'd' + a + b + c + d') \quad T13$$

$$(\underline{a' + a} + \underline{b' + b} + \underline{c + c} + a'c'd' + d') \quad T12b, T11b$$

$$(1 + 1 + 1 + c + a'c'd' + d')'$$

$$(1 + c + a'c'd' + d')'$$

$$(1' \cdot c' \cdot (a'c'd')' \cdot d'')$$

$$\underline{0} \cdot c' \cdot (a'c'd')' \cdot d''$$

$$= 0 \quad T9a$$

$$0 \neq 1 \therefore \text{disproved}$$

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3. [15 marks] Simplify the following expressions as much as possible. Box your final answer.

a)  $(yz + y' + z')x$

$$(yz + y' + z')x$$

$$(y' + z + z')x \quad T14d$$

$$(y' + 1)x \quad T12b$$

$$(1)x \quad T9b$$

$$\boxed{= x}$$

b)  $pq + q + p(q + r) + qr$

$$pq + q + p(q + r) + qr$$

$$pq + q + pq + pr + qr \quad L8a$$

$$pq + q + pr + qr \quad T11b$$

$$q(\cancel{p+1}) + pr + qr \quad L8a$$

$$q + pr + qr \quad T9b$$

$$pr + q + qr$$

$$pr + q(\cancel{1+r})$$

$$\boxed{pr + q} \quad T9b$$

c)  $(x + y)' * (x' + y')$

$$(x + y)' = (x' + y')$$

$$(x' y') \cdot (x' + y') \quad T15b$$

$$x' y' x' + x' y' y' \quad L8a$$

$$x' y' + x' y' \quad T11a$$

$$\boxed{x' y'} \quad T11b$$