Basics of Information Systems

Winter Semester 2022–23

For discussion on Wednesday, November 2, 2022

1. Prove the following statements, referring to the axioms of Boolean algebra and, if applicable, elementary theorems from class:

   (a) $(a \wedge b) \vee (a \wedge b') = a$

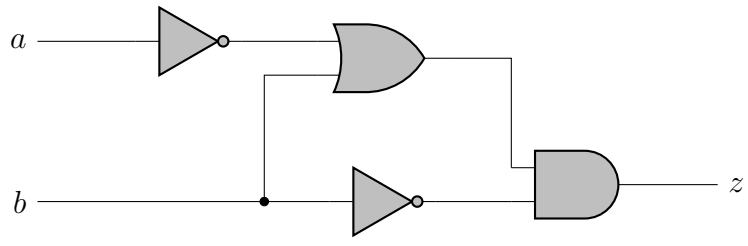
   (b) $(a \wedge b') \vee b = a \vee b$

   (c) $(a \vee b) \wedge (b \vee c) \wedge (a' \vee c) = (a \vee b) \wedge (a' \vee c)$

2. Derive and simplify a Boolean algebra expression for the following binary truth table:

a	b	c	z
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	1
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	0

3. (a) Convert the following circuit diagram into a Boolean expression and simplify, if possible:



   (b) Draw a circuit diagram implementing the following Boolean expression:

$$z = (a \wedge b' \wedge c) \vee (a' \wedge b) \vee (a \wedge c)'$$

4. Change the following decimal numbers to 8-bit two's complement integers, then express the binary numbers in hexadecimal:

   (a) -12

   (b) 56

   (c) -128

   (d) 148

5. Change sign of the following 8-bit two's complement numbers, then convert to decimal:

   (a) 01110111

   (b) 01110100

   (c) 11111100

   (d) 11001110