Real-Time Imaging and Control

Practice

MSCV/ESIREM

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Basics 1 - Boolean Logic

Problem 1

1. Give decimal values of those unsigned integers: 1001 1011 , 0011 1100 et 0101 0101.
2. Same question but with signed integers in two's complement.
3. Give binaries values of the decimal values -100, 83 et -29 (in two's complement).

Problem 2

Remark 1. *Some results We can define the dual of an expression e as the expression built with all the bits negated and with sums and products inverted.*
Example: $x\bar{y} + \bar{x}z \to (\bar{x} + y)(x + \bar{z})$
Notably, if two expressions e and f are equal, their dual are equal as well.

Simplify each expression with algebraic manipulation. when applicable, $f(a, b, c) = a + b + c$.

1. $a + 0$
2. $\bar{a} \cdot 0$
3. $a + \bar{a}$
4. $a + a$
5. $a + ab$
6. $a + \bar{a}b$
7. $a \cdot (\bar{a} + b)$
8. $ab + \bar{a}b$
9. $(\bar{a} + \bar{b}) \cdot (\bar{a} + b)$
10. $a \cdot (a + b + c + \cdots)$
11. $f(a, b, ab)$
12. $f(a, b, \bar{a}\bar{b})$
13. $f(a, b, \overline{ab})$
14. $a + a\bar{a}$

15. $ab + a\bar{b}$
16. $\bar{a} + \bar{a}b$
17. $(d + \bar{a} + b + \bar{c})b$
18. $(a + \bar{b})(a + b)$
19. $d + (d + da)$
20. $a(a + ab)$
21. $\overline{(\bar{a} + \bar{a})}$
22. $\overline{(a + \bar{a})}$
23. $d + d\bar{a}bc$
24. $\bar{d}\overline{(dabc)}$
25. $ac + \bar{a}b + bc$
26. $(a + c)(\bar{a} + b)(c + b)$
27. $\bar{a} + \bar{b} + ab\bar{c}$

Problem 3

Use De Morgan laws to simplify the following :

1. $\overline{\overline{(\bar{a} + c)} \cdot \overline{(b + c)}}$
2. $\overline{ab\bar{c}}$
3. $\overline{b + \bar{c}} \cdot \overline{c + \bar{a}} \cdot \overline{\bar{a} + \bar{b}}$

Problem 4

Remark 2. *In a Karnaugh map, there are two possible groupings :*

- *One with the 1, called "Minimum Sum of Products" (MSP)*
- *One with the 0, called "Minimum Product of Sums"(MPS)*

Note : in the slides, the notation was MSB in the rows and LSB in the columns. The other notation (with MSB and LSB transposed) exists and will be used in the following Karnaugh maps.

c \ ab	00	01	11	10
0	0	X	X	1
1	1	1	1	X

1. In the Karnaugh map above, find the MSP. A careful choice for the Do Not Care ("X") values is advised.

2. Same question with the MPS.

3. Are the equations equal ?

Problem 5

Find the logic equations described by the Karnaugh maps. Empty cells mean 0.

1.

cd \ ab	00	01	11	10
00	1	1	1	1
01	1	1	1	1
11		1	1	
10		1	1	

3.

cd \ ab	00	01	11	10
00			1	
01	1		1	1
11	1	1	1	1
10			1	

2.

cd \ ab	00	01	11	10
00	1			1
01		1	1	
11		1	1	
10	1			1

4.

cd \ ab	00	01	11	10
00		1		1
01	1		1	1
11		1		1
10	1	1	1	1