Solutions
Exercises 1: Computer architecture

1) **Write the disjunctive normal form for the following value table. Simplify it by using the mathematical and the Karnaugh-Veitch-Methode.**

A	B	C	Q
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	0
1	0	1	0
1	1	0	1
1	1	1	1

$$(\overline{A} \wedge \overline{B} \wedge C) \vee (\overline{A} \wedge B \wedge \overline{C}) \vee (\overline{A} \wedge B \wedge C) \vee (A \wedge B \wedge \overline{C}) \vee (A \wedge B \wedge C)$$

with the + for $\vee$ and · for $\wedge$ its easier to deal

$$\overline{A}\,\overline{B}\,C + \overline{A}\,B\,\overline{C} + \overline{A}\,B\,C + A\,B\,\overline{C} + A\,B\,C$$

$$\overline{A}\,\overline{B}\,C + \overline{A}\,B\,(\overline{C} + C) + A\,B\,(\overline{C} + C)$$

$$\overline{A}\,\overline{B}\,C + \overline{A}\,B\,(1) + A\,B\,(1)$$

$$\overline{A}\,\overline{B}\,C + \overline{A}\,B + A\,B$$

$$\overline{A}\,\overline{B}\,C + (\overline{A} + A)\,B$$

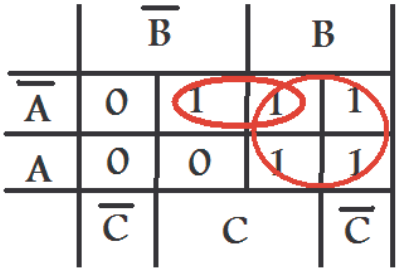
$$\overline{A}\,\overline{B}\,C + (1)\,B$$

$$\overline{A}\,\overline{B}\,C + B$$

$$(\overline{A}\,C + B)(\overline{B} + B)$$

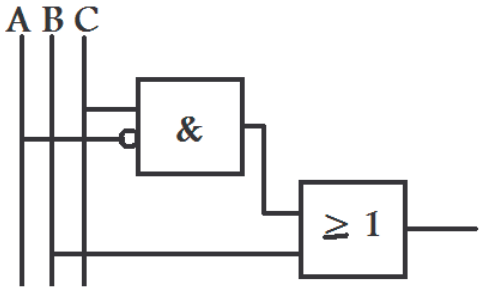
$$(\overline{A}\,C + B)\,1$$

$$\overline{A}\,C + B$$



$$B \vee (\overline{A} \wedge C)$$

2) **Draw the logic gate for above table.**



3) **Simplify the following term**

$$x_1x_2\bar{x}_3\bar{x}_4+\bar{x}_1x_2\bar{x}_3\bar{x}_4+\bar{x}_1\bar{x}_2\bar{x}_3x_4+\bar{x}_1\bar{x}_2x_3x_4+\bar{x}_1x_2x_3\bar{x}_4+x_1x_2x_3\bar{x}_4$$

$$x_2\bar{x}_3\bar{x}_4 \quad + \quad \bar{x}_1\bar{x}_2x_4 \quad + \quad x_2x_3\bar{x}_4$$

$$x_2\bar{x}_4 \quad + \quad \bar{x}_1\bar{x}_2x_4$$

Quine-McCluskey-Algorithm

4) **The standard Boolean algebra uses the element set of 0 and 1 and the operations AND, OR and NOT on it. Show that at least the operations AND ond NOT or OR and NOT are enough to construct the algebra.**

$$A \wedge B = \overline{\overline{A \wedge B}} = \overline{\overline{A} \vee \overline{B}}$$

Involution DeMorgan

5) **Calculate the binary representation of 2303?**

2303 / 2 = 1151 R = 1
1151 / 2 = 575 R = 1
575 / 2 = 287 R = 1
287 / 2 = 143 R = 1
143 / 2 = 71 R = 1
71 / 2 = 35 R = 1
35 / 2 = 17 R = 1
17 / 2 = 8 R = 1
8 / 2 = 4 R = 0
4 / 2 = 2 R = 0
2 / 2 = 1 R = 0
1 / 2 = 0 R = 1
=> 100011111111

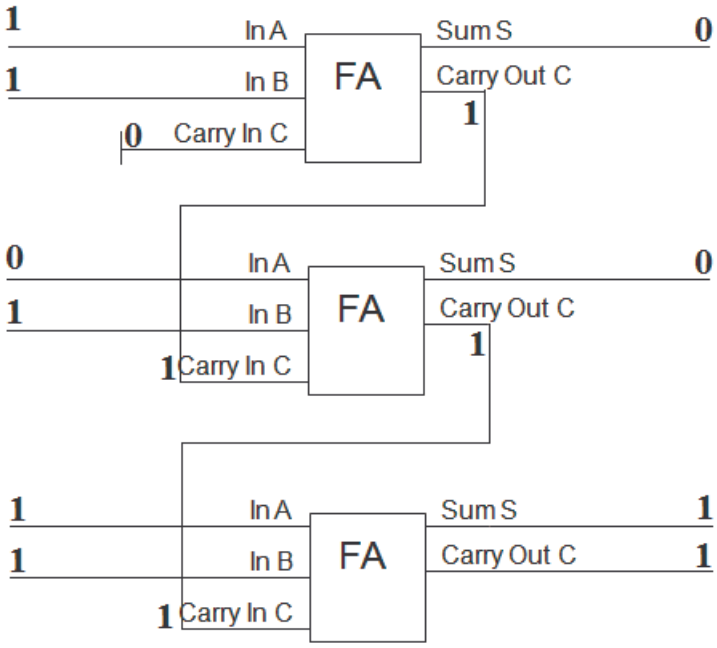
6) **How many Bytes do you need to represent 1023?**

10 Bits are needed => 2 Bytes

7) **Which decimal number is coded with 10101010**

1 * 2 + 1 * 8 + 1 * 32 + 1 * 128 = 170

8) Draw the gate-combination to add 101 and 111 with full-adder and give the states at each input/output?



=> 1100

9) Give the value table for XOR with two inputs?

A	B	OUT
0	0	0
0	1	1
1	0	1
1	1	0