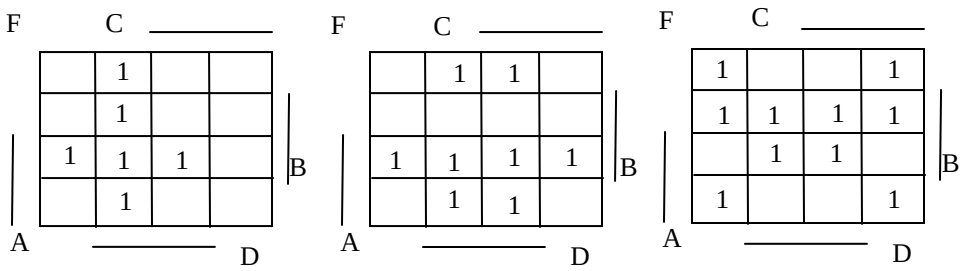
Hand-in assignments (Thursday, week 1)

Exercise 1 a) b) c)



a) F = $\overline{C}$.D + A.B.$\overline{C}$ + A.B.D

b) F = A.B + $\overline{B}$.D

c) F = B.D + $\overline{B}$.$\overline{D}$ + $\overline{A}$.B
or
F = B.D + $\overline{B}$.$\overline{D}$ + $\overline{A}$.$\overline{D}$

Exercise 2

a)

AB \ CD	00	01	11	10
00	1	0	0	1
01	0	0	0	0
11	0	0	-	0
10	-	0	-	-

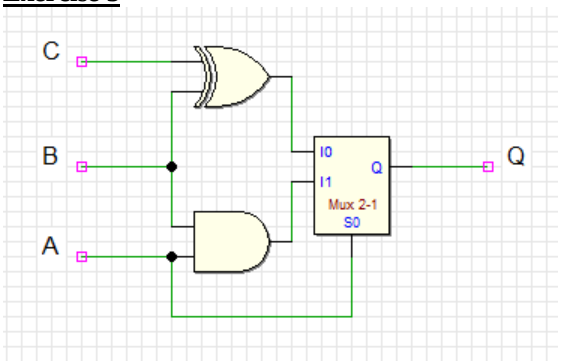
SOP: $F = \overline{B} \bullet \overline{D}$

b)

AB \ CD	00	01	11	10
00	-	0	0	-
01	0	-	1	-
11	0	1	-	1
10	-	1	-	-

SOP: $F = B \bullet C + A \bullet D$

Exercise 3



Truth table

a	b	c	q
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	1
1	1	1	1

Next use a Karnaugh map to find minimum SOP form.

$$q = \bar{a} \bullet \bar{b} \bullet c + a \bullet b + b \bullet \bar{c}$$

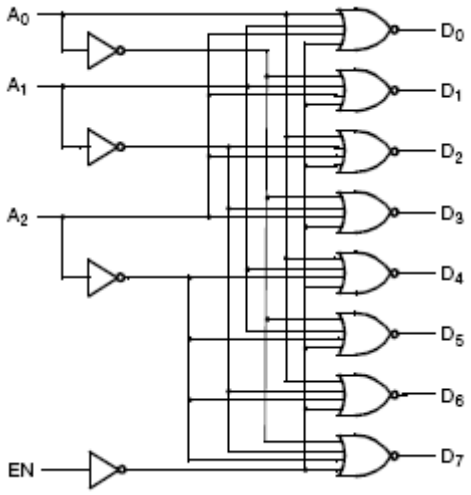
Exercise 4

16 cells →2^{16}= 65536 different patterns→65536 combinational functions are possible. This includes the trivial function, e.g. always 0 independent of the address.

Exercise 5

F=X.Z + X.Y + Y.Z
(e.g. using Karnaugh)

Exercise 6



Equation for output D0

$$D0 = \overline{A2} \bullet \overline{A1} \bullet \overline{A0} \bullet E \quad \text{with DeMorgan}$$

$$D0 = \overline{A2 + A1 + A0 + \bar{E}}$$

Exercise 7

Q2	Q1	Q0	Q2+	Q1+	Q0+
0	0	0	0	0	1
0	0	1	0	1	0
0	1	0	0	1	1
0	1	1	1	0	0
1	0	0	1	0	1
1	0	1	1	1	0
1	1	0	1	1	1
1	1	1	0	0	0

Since D flip-flop is chosen, the D input must have the value of Q+.
Solution in SOP-form for the combinational logic:

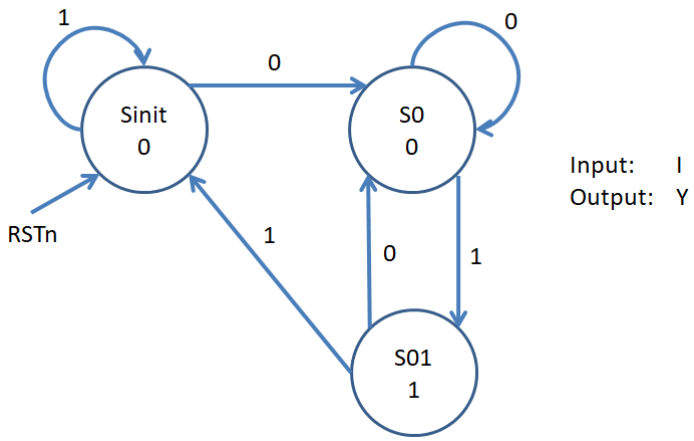
$$D0 = \overline{Q0}$$

$$D1 = Q1 \bullet \overline{Q0} + \overline{Q1} \bullet Q0$$

$$D2 = Q2 \bullet \overline{Q1} + Q2 \bullet \overline{Q0} + \overline{Q2} \bullet Q1 \bullet Q0$$

Exercise 8

a) FSM



S_{init} means: nothing detected
S_0 means: 0 is detected
S_{01} means: 1 is detected and on the previous active edge of the clock the input was 0.
It is a MOORE machine and only in state S_{01} the output is 1 (output in state)

	I=0	I=1	
Present state	Next state	Next state	Y
Sinit	S0	Sinit	0
S0	S0	S01	0
S01	S0	Sinit	1

Binary encoding of the states:

	F1	F0
Sinit	0	0
S0	0	1
S01	1	0

Note: other encoding of the states is also correct as long as the bit patterns are different for each state.

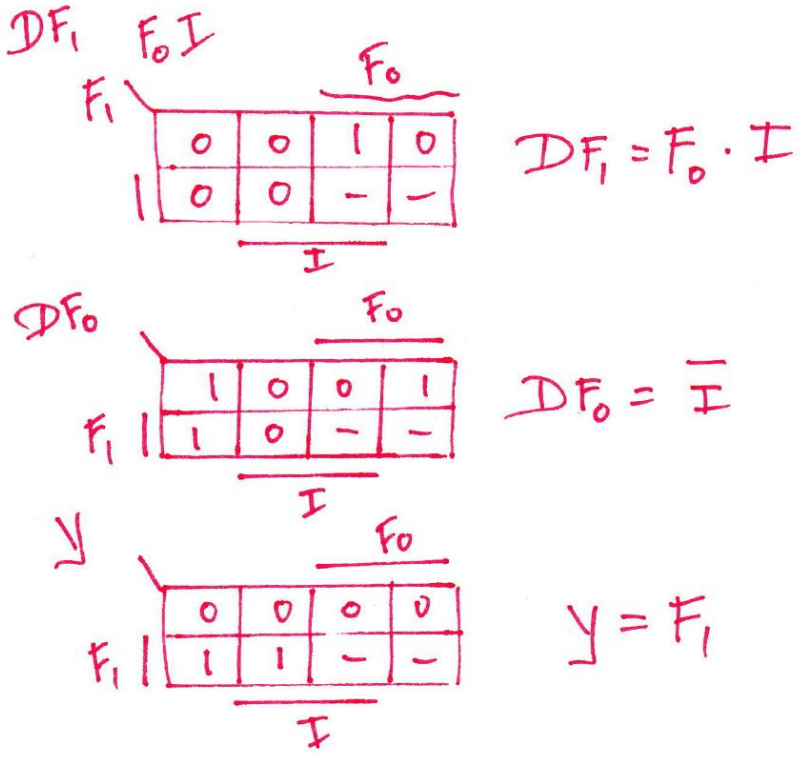
2-dimensional state table

		I=0		I=1		
F1	F0	F1+	F0+	F1+	F0+	Y
0	0	0	1	0	0	0
0	1	0	1	1	0	0
1	0	0	1	0	0	1

1-dimensional state table

F1	F1	I	F1+	F0+	Y
0	0	0	0	1	0
0	0	1	0	0	0
0	1	0	0	1	0
0	1	1	1	0	0
1	0	0	0	1	1
1	0	1	0	0	1

Karnaugh & Boolean equations



Schematic