4.1 Rita in funktionen i ett Karnaughdiagram och minimera

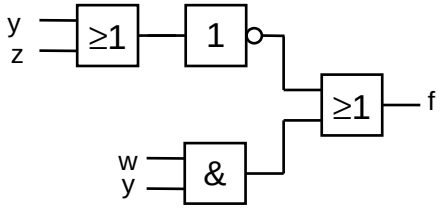
för disjunktiv form

wx \ yz	00	01	11	10
00	1			
01	1			
11	1		1	1
10	1		1	1

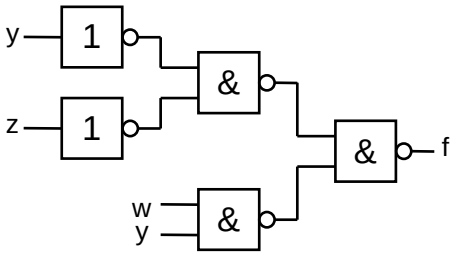
för konjunktiv form

wx \ yz	00	01	11	10
00		0	0	0
01		0	0	0
11		0		
10		0		

a) f = y'z' + wy

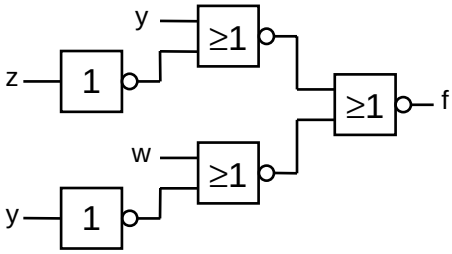


b) f = y'z' + wy = (de Morgan) = ((y'z')'(wy)')'



c) f = (y + z')(w + y') = (de Morgan)

= ((y + z')' + (w + y')')'



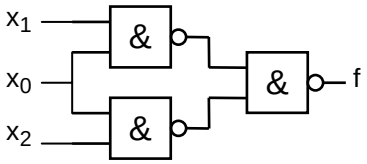
4.2 **Funktionsbeskrivning** och **lösning/förenkling** via funktionstabell och Karnaughdiagram

	x_2 x_1 x_0	f
0	0 0 0	0
1	0 0 1	0
2	0 1 0	0
3	0 1 1	1
4	1 0 0	0
5	1 0 1	1
6	1 1 0	0
7	1 1 1	1

x_2 \ x_1x_0	00	01	11	10
0			1	
1		1	1	

$f = x_2x_0 + x_1x_0 = (x_2 + x_1)x_0$

Realisering

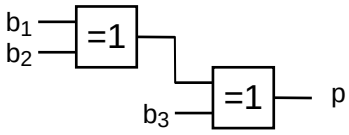


4.3 **Funktionsbeskrivning** och **lösning/förenkling** via Karnaughdiagram

b_3 \ b_2b_1	00	01	11	10
0		1		1
1	1		1	

$$p = b_3 \oplus b_2 \oplus b_1$$

Realisering



4.4 **Funktionsbeskrivning**: Nätet utför paritetskontroll för ord med jämn paritet. Om antalet ettor är udda så är ordet felaktigt och detta skall f indikera. I funktionstabell sätts f = 1 när ett udda antal invariabler är "1".

b_3 b_2 b_1 b_0	f
0 0 0 0	0
0 0 0 1	1
0 0 1 0	1
0 0 1 1	0
0 1 0 0	1
0 1 0 1	0
0 1 1 0	0
0 1 1 1	1
1 0 0 0	1
1 0 0 1	0
1 0 1 0	0
1 0 1 1	1
1 1 0 0	0
1 1 0 1	1
1 1 1 0	1
1 1 1 1	0

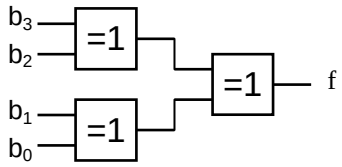
b_3b_2 \ b_1b_0	00	01	11	10
00		1		1
01	1		1	
11		1		1
10	1		1	

Lösning: För att skapa ett förenklat funktionsuttryck omsätts funktionstabellen i ett Karnaughdiagram. I detta ser man en diagonal struktur som indikerar att funktionen bör beskrivas med XOR-uttryck.

$$f = (b_3'b_2' + b_3b_2)(b_1'b_0 + b_1b_0') + (b_3'b_2 + b_3b_2')(b_1'b_0' + b_1b_0)$$

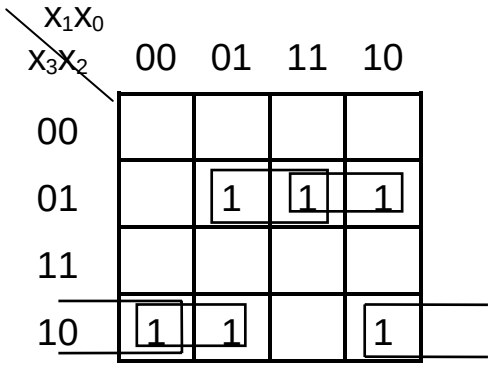
$$= (b_3 \oplus b_2)'(b_1 \oplus b_0) + (b_3 \oplus b_2)(b_1 \oplus b_0)' = [(b_3 \oplus b_2) \oplus (b_1 \oplus b_0)]$$

Realisering: Kan ske med 3 st XOR på följande sätt



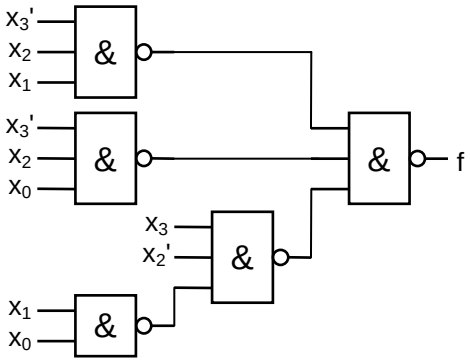
4.5 **Funktionsbeskrivning** och **lösning/förenkling** via Karnaughdiagram

f = 1 $\Rightarrow$ Siffran tillhör ej 2421-koden.



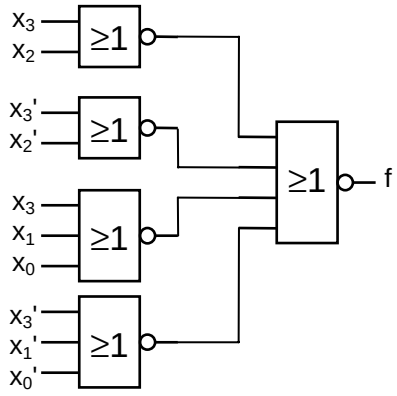
a) $f = x_3'x_2x_1 + x_3'x_2x_0 + x_3x_2'x_1' + x_3x_2'x_0' = x_3'x_2x_1 + x_3'x_2x_0 + x_3x_2'(x_1x_0)'$

Realisering



b) $f = (x_3 + x_2)(x_3' + x_2')(x_3 + x_1 + x_0)(x_3' + x_1' + x_0')$

Realisering

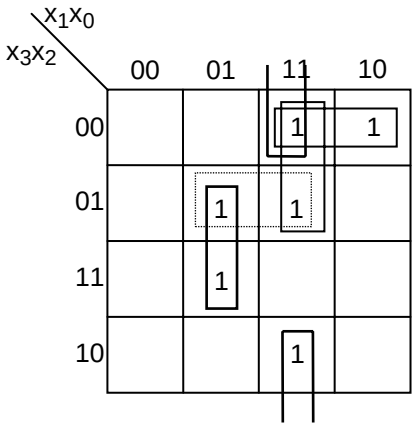


4.6 **Funktionsbeskrivning** **Lösning/förenkling**

Funktionstabell

	x_3 x_2 x_1 x_0	f
0	0 0 0 0	0
1	0 0 0 1	0
2	0 0 1 0	1
3	0 0 1 1	1
4	0 1 0 0	0
5	0 1 0 1	1
6	0 1 1 0	0
7	0 1 1 1	1
8	1 0 0 0	0
9	1 0 0 1	0
10	1 0 1 0	0
11	1 0 1 1	1
12	1 1 0 0	0
13	1 1 0 1	1
14	1 1 1 0	0
15	1 1 1 1	0

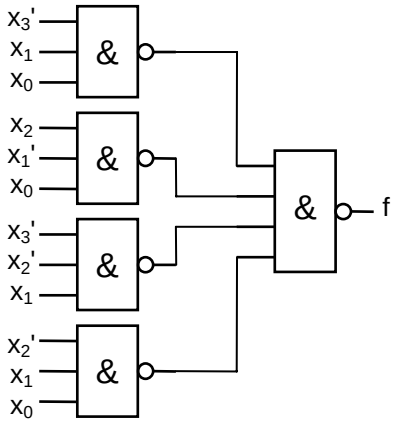
Karnaughdiagram



$f = x_3'x_1x_0 + x_2x_1'x_0 + x_3'x_2'x_1 + x_2'x_1x_0$

Realisering:

3 st INVERTERARE
4 st tre-ingångars NAND
1 st fyra-ingångars NAND



4.7 **Funktionsbeskrivning** via funktionstabell:

x_1 x_0	y_1 y_0	f_0 f_1 f_2 f_3 f_4 f_5 f_6
0 0	0 0	1 0 0 0 0 0 0
0 0	0 1	0 1 0 0 0 0 0
0 0	1 0	0 0 1 0 0 0 0
0 0	1 1	0 0 0 1 0 0 0
0 1	0 0	0 1 0 0 0 0 0
0 1	0 1	0 0 1 0 0 0 0
0 1	1 0	0 0 0 1 0 0 0
0 1	1 1	0 0 0 0 1 0 0
1 0	0 0	0 0 1 0 0 0 0
1 0	0 1	0 0 0 1 0 0 0
1 0	1 0	0 0 0 0 1 0 0
1 0	1 1	0 0 0 0 0 1 0
1 1	0 0	0 0 0 1 0 0 0
1 1	0 1	0 0 0 0 1 0 0
1 1	1 0	0 0 0 0 0 1 0
1 1	1 1	0 0 0 0 0 0 1

Lösning/förenkling via funktionstabellen och Karnaughdiagram när så behövs:

$f_0 = x_1'x_0'y_1'y_0'$

$f_1 = x_1'x_0'y_1'y_0 + x_1'x_0\, y_1'y_0' = x_1'y_1'(x_0 \oplus y_0)$

x_1x_0 \ y_1y_0	00	01	11	10
00				1
01		1		
11				
10	1			

$f_2 = x_1'x_0'y_1y_0' + x_1'x_0y_1'y_0 + x_1x_0'y_1'y_0' = x_0'y_0'(x_1 \oplus y_1) + x_1'x_0y_1'y_0$

x_1x_0 \ y_1y_0	00	01	11	10
00			1	
01				1
11	1			
10		1		

$f_3 = x_1'x_0'y_1y_0 + x_1'x_0\, y_1\, y_0' + x_1x_0'y_1'y_0 + x_1\, x_0\, y_1'y_0' = (x_1 \oplus y_1)(x_0 \oplus y_0)$

x_1x_0 \ y_1y_0	00	01	11	10
00				
01			1	
11		1		
10				1

$f_4 = x_1'x_0y_1y_0 + x_1x_0'y_1y_0' + x_1x_0y_1'y_0 = x_0y_0(x_1 \oplus y_1) + x_1x_0'y_1y_0'$

$f_5 = x_1x_0'y_1y_0 + x_1x_0y_1y_0' = x_1y_1(x_0 \oplus y_0)$

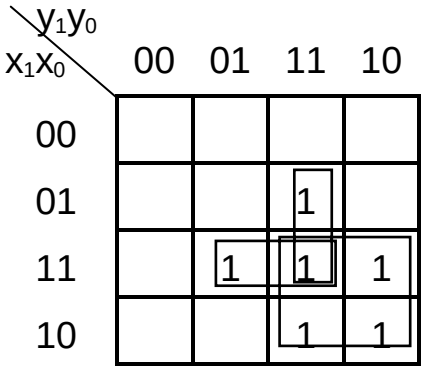
$f_6 = x_1x_0y_1y_0$

Realisering: Ur dessa uttryck görs en realisering.

4.8 **Funktionsbeskrivning** via funktionstabell:

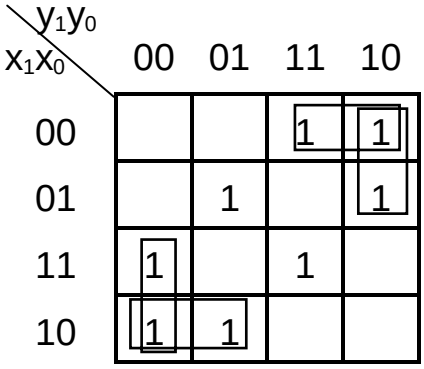
x_1 x_0	y_1 y_0	s_2 s_1 s_0
0 0	0 0	0 0 0
0 0	0 1	0 0 1
0 0	1 0	0 1 0
0 0	1 1	0 1 1
0 1	0 0	0 0 1
0 1	0 1	0 1 0
0 1	1 0	0 1 1
0 1	1 1	1 0 0
1 0	0 0	0 1 0
1 0	0 1	0 1 1
1 0	1 0	1 0 0
1 0	1 1	1 0 1
1 1	0 0	0 1 1
1 1	0 1	1 0 0
1 1	1 0	1 0 1
1 1	1 1	1 1 0

Lösning/förenkling



$s_2 = x_0y_1y_0 + x_1x_0y_0 + x_1y_1$

$= (x_1 + y_1)x_0y_0 + x_1y_1$

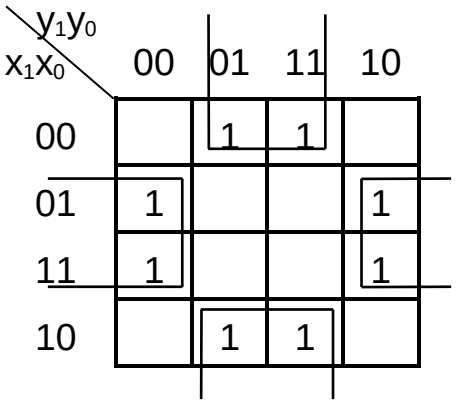


$s_1 = x_1'x_0'y_1 + x_1'y_1y_0' + x_1y_1'y_0' + x_1x_0'y_1' + x_1'x_0y_1'y_0 + x_1x_0y_1y_0$

$= x_1'y_1(x_0' + y_0') + x_1y_1'(y_0' + x_0') + x_0y_0(x_1'y_1' + x_1y_1)$

$= (x_0' + y_0')(x_1'y_1 + x_1y_1') + x_0y_0(x_1'y_1' + x_1y_1)$

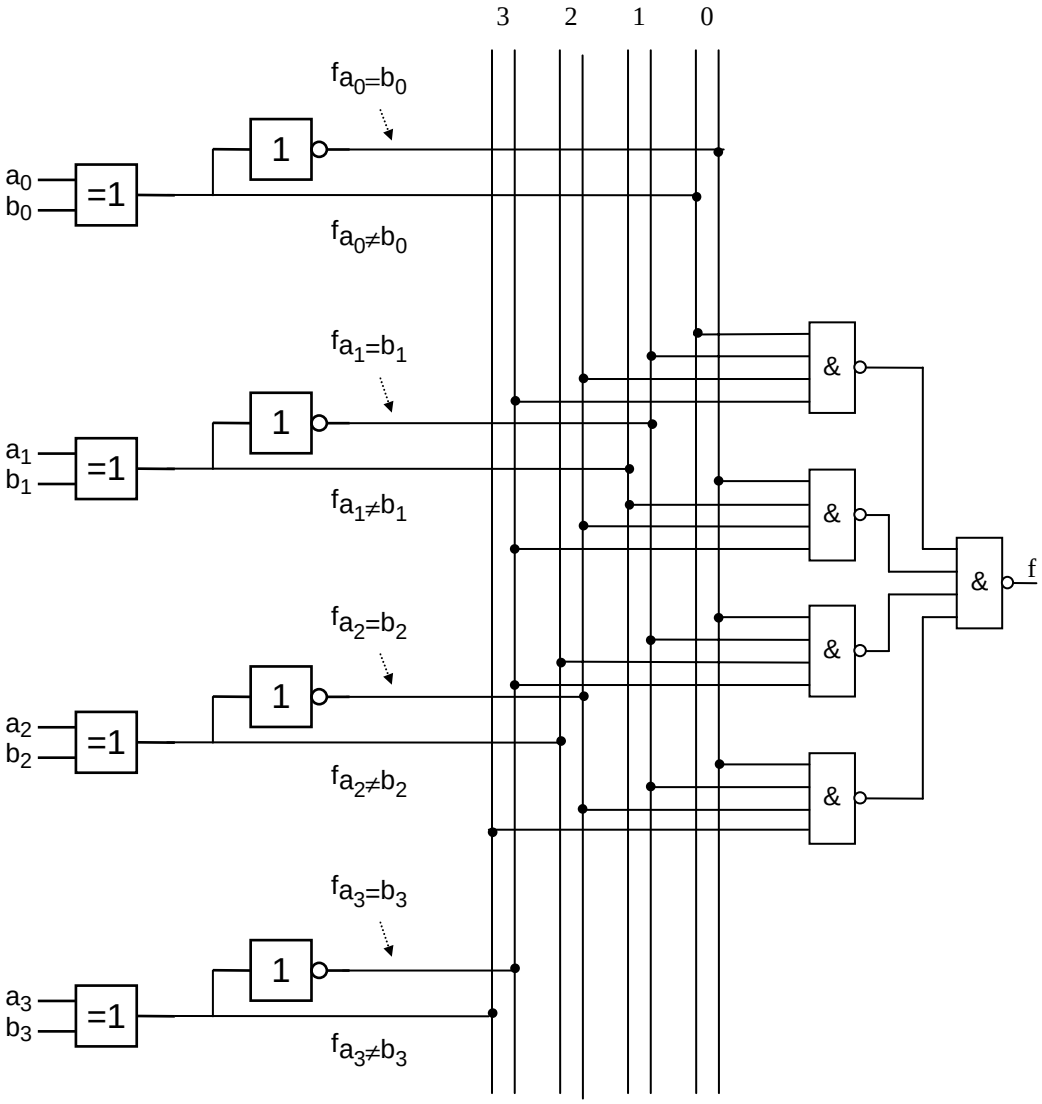
$= (x_0y_0)'(x_1 \oplus y_1) + (x_0y_0)(x_1 \oplus y_1)' = (x_0y_0) \oplus (x_1 \oplus y_1)$



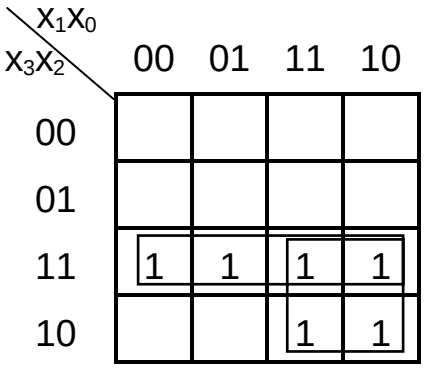
$s_0 = x_0'y_0 + x_0y_0' = x_0 \oplus y_0$

Realisering: Ur dessa uttryck görs en realisering.

4.9 **Realisering**:

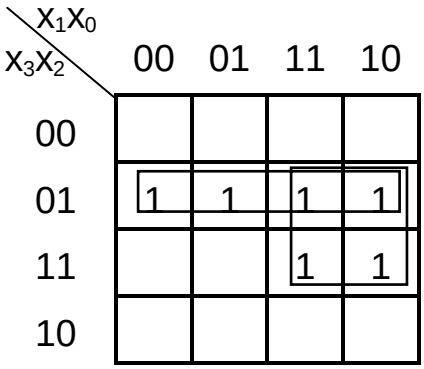


4.10 **Lösning/förenkling:** via Karnaughdiagram

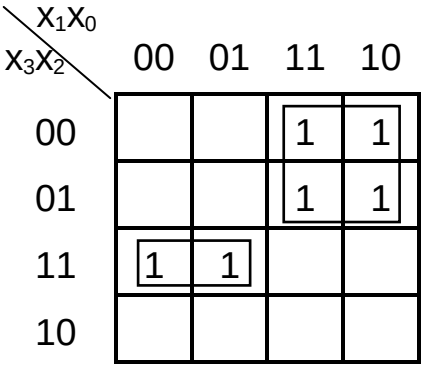


$d_4 = x_3x_2 + x_3x_1$

$d_3 = x_3x_2'x_1'$ eller $d_3 = d_4'x_3$



$d_2 = x_3'x_2 + x_2x_1$ eller $d_2 = d_4'x_2 + d_4x_2x_1$

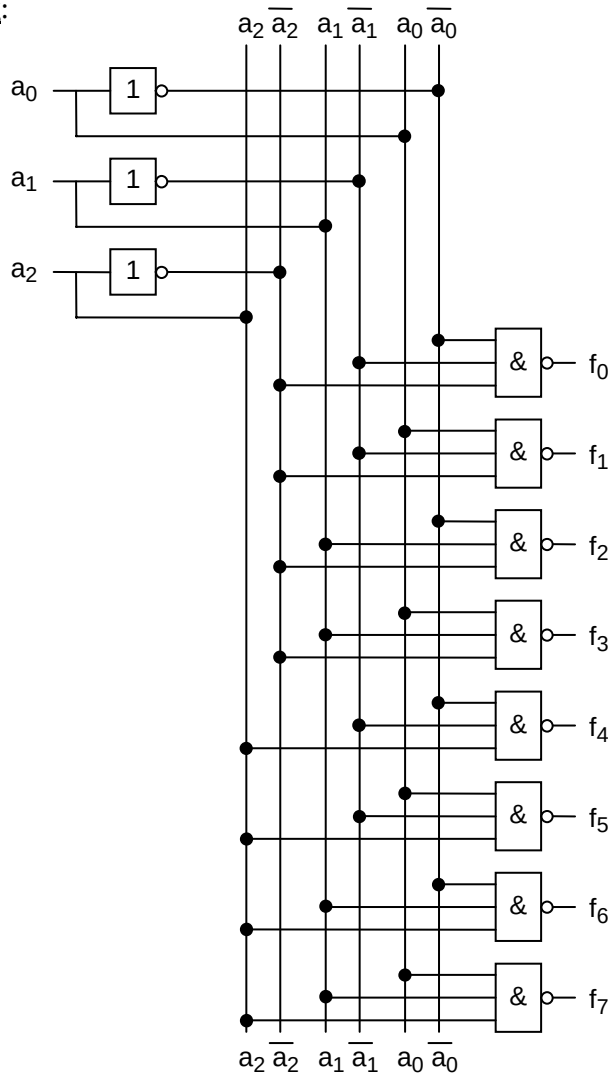


$d_1 = x_3'x_1 + x_3x_2x_1'$ eller $d_1 = d_4'x_1 + d_4x_1'$

$d_0 = x_0$

Realisering: Ur dessa uttryck görs en realisering.

4.11 **Realisering**:



4.12 **a)** f = w'xz + xyz **b)** f = y'z' **c)** f = x'y + x'z

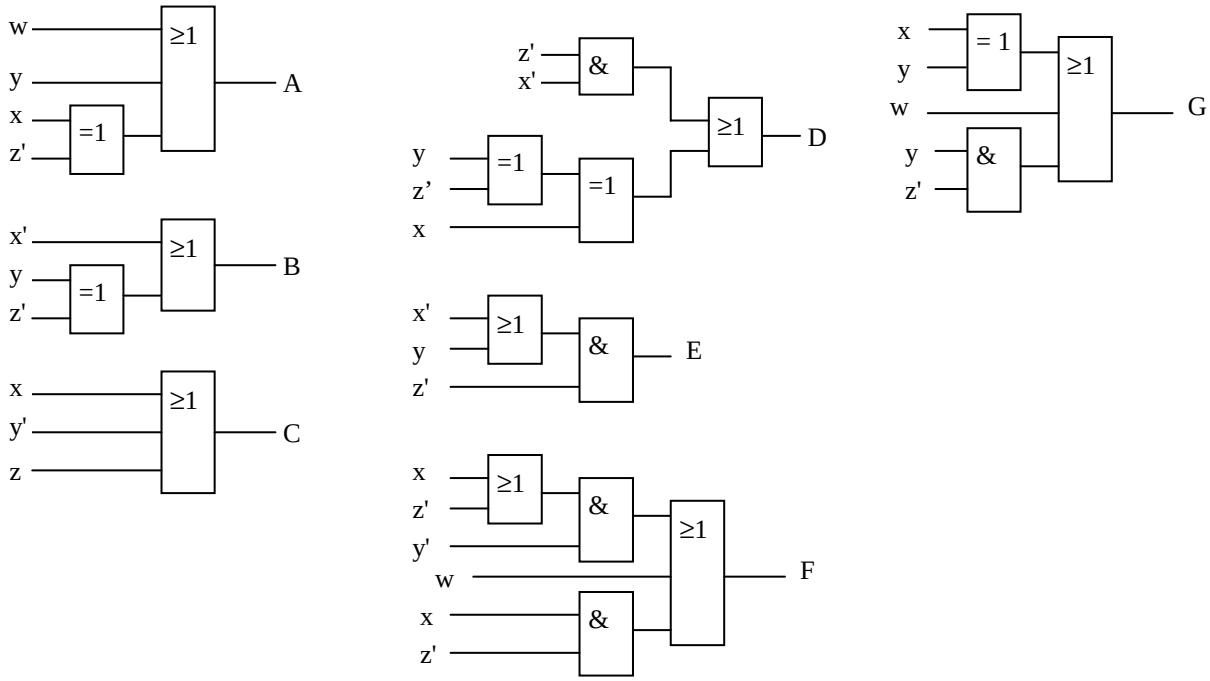
d) f = x'y' + x'z' **e)** f = w'x'y + x'yz + xy'z **f)** f = x'y' + x'z'

g) f = w'x'y'z + xy'z' + wyz + xyz **h)** f = z'

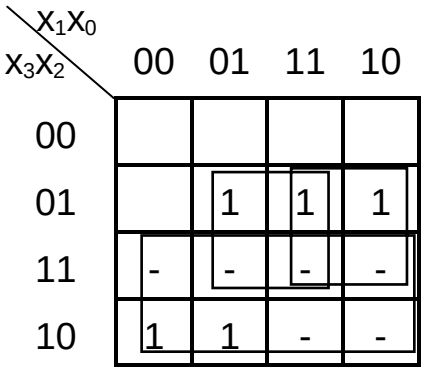
4.13 Funktionsbeskrivning

w	x	y	z	dec	A	B	C	D	E	F	G
0	0	0	0	0	1	1	1	1	1	1	0
0	0	0	1	1	0	1	1	0	0	0	0
0	0	1	0	2	1	1	0	1	1	0	1
0	0	1	1	3	1	1	1	1	0	0	1
0	1	0	0	4	0	1	1	0	0	1	1
0	1	0	1	5	1	0	1	1	0	1	1
0	1	1	0	6	1	0	1	1	1	1	1
0	1	1	1	7	1	1	1	0	0	0	0
1	0	0	0	8	1	1	1	1	1	1	1
1	0	0	1	9	1	1	1	0	0	1	1
1	0	1	0	-	-	-	-	-	-	-	-
1	0	1	1	-	-	-	-	-	-	-	-
1	1	0	0	-	-	-	-	-	-	-	-
1	1	0	1	-	-	-	-	-	-	-	-
1	1	1	0	-	-	-	-	-	-	-	-
1	1	1	1	-	-	-	-	-	-	-	-

Realisering:



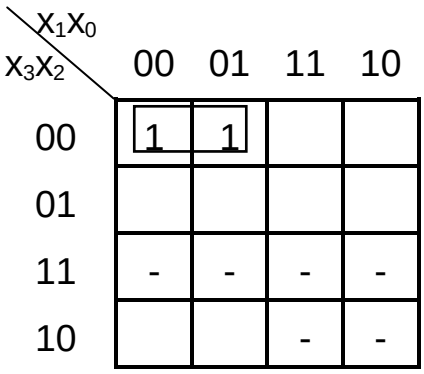
4.14 **Lösning/förenkling:** via Karnaughdiagram



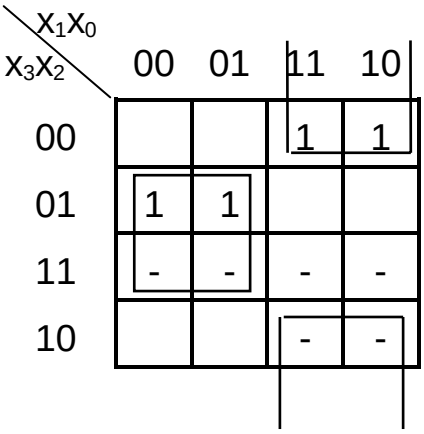
$f = x_3 + x_2x_0 + x_2x_1$

Realisering: Ur dessa uttryck görs en realisering.

4.15 **Lösning/förenkling:** via Karnaughdiagram



$y_3 = x_3'x_2'x_1'$



$y_2 = x_2x_1' + x_2'x_1 = x_2 \oplus x_1$

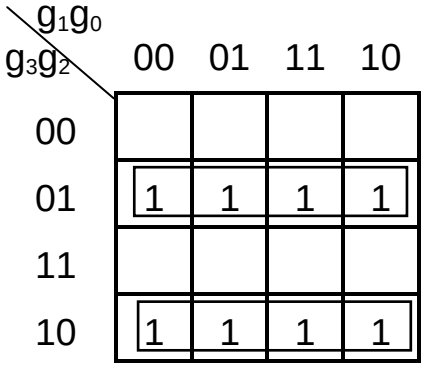
$y_1 = x_1$

$y_0 = x_0'$

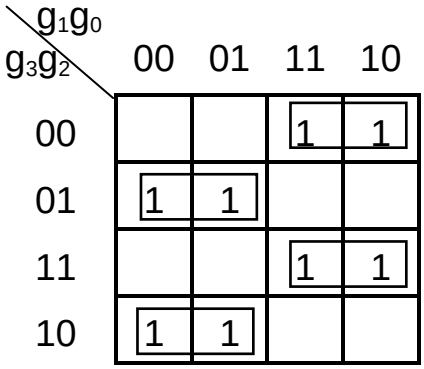
Realisering: Ur dessa uttryck görs en realisering.

4.16 **Lösning/förenkling:** via Karnaughdiagram

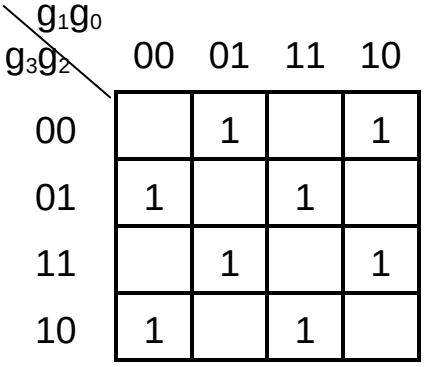
$x_3 = g_3$



$x_2 = g_3'g_2 + g_3g_2' = g_3 \oplus g_2$



$x_1 = g_3'g_2'g_1 + g_3'g_2g_1' + g_3g_2g_1 + g_3g_2'g_1' = g_3 \oplus g_2 \oplus g_1$



$x_0 = g_3'g_2'g_1g_0' + g_3'g_2'g_1'g_0 + g_3'g_2g_1'g_0' + g_3'g_2g_1g_0 +$

$+ g_3g_2g_1'g_0 + g_3g_2g_1g_0' + g_3g_2'g_1'g_0' + g_3g_2'g_1g_0 =$

$= g_3 \oplus g_2 \oplus g_1 \oplus g_0$

Realisering: Ur dessa uttryck görs en realisering.

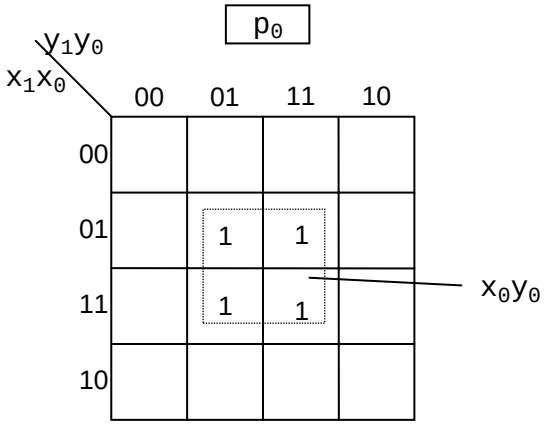
4.17 Studentens egen lösning skall diskuteras!

4.18 Studentens egen lösning skall diskuteras!

4.19 **Funktionsbeskrivning**: **Lösning/förenkling**

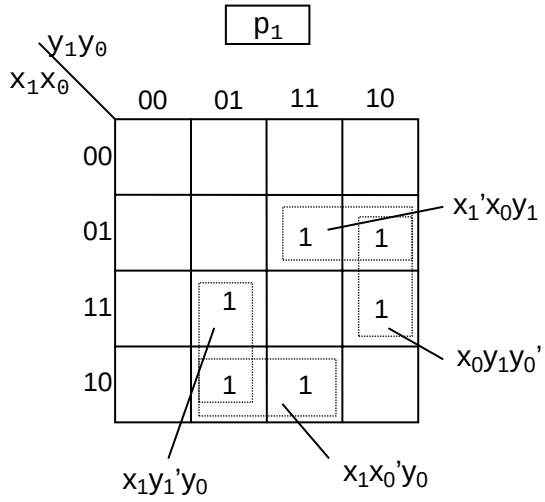
via funktionstabell via Karnaughdiagram

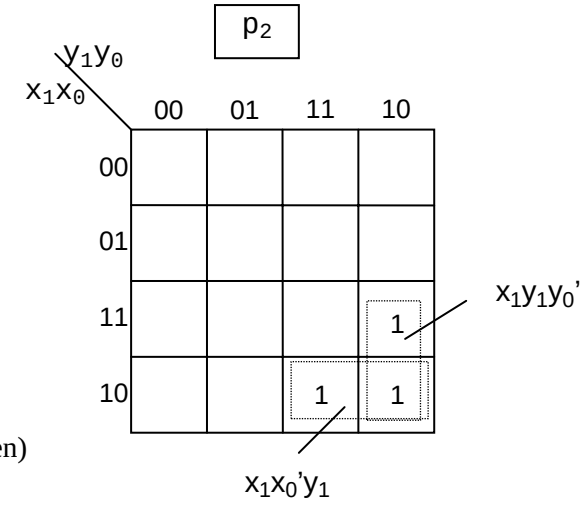
x_1x_0 y_1y_0	$p_3p_2p_1p_0$
00 00	0 0 0 0
00 01	0 0 0 0
00 10	0 0 0 0
00 11	0 0 0 0
01 00	0 0 0 0
01 01	0 0 0 1
01 10	0 0 1 0
01 11	0 0 1 1
10 00	0 0 0 0
10 01	0 0 1 0
10 10	0 1 0 0
10 11	0 1 1 0
11 00	0 0 0 0
11 01	0 0 1 1
11 10	0 1 1 0
11 11	1 0 0 1



$p_0 = x_0y_0$

$p_1 = x_1'x_0y_1 + x_0y_1y_0' + x_1x_0'y_0 + x_1y_1'y_0$
$= x_0y_1(x_1' + y_0') + x_1y_0(x_0' + y_1')$
$= x_0y_1(x_1y_0)' + x_1y_0(x_0y_1)'$
$= x_0y_1 \oplus x_1y_0$



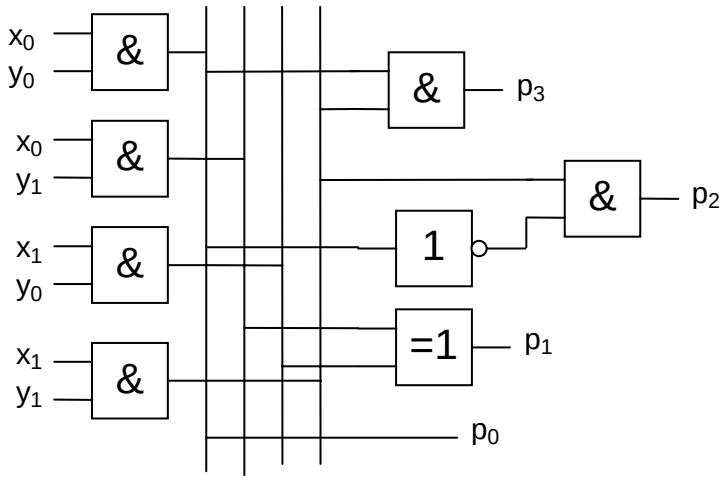


$p_2 = x_1y_1y_0' + x_1x_0'y_1$
$= x_1y_1(y_0' + x_0')$
$= x_1y_1(y_0x_0)'$

$p_3 = x_1x_0y_1y_0$ (tas direkt ur funktionstabellen)

Realisering:

- med inverterare, OCH- och och XOR-grindar realiseras uttrycken för produktbitarna på följande sätt



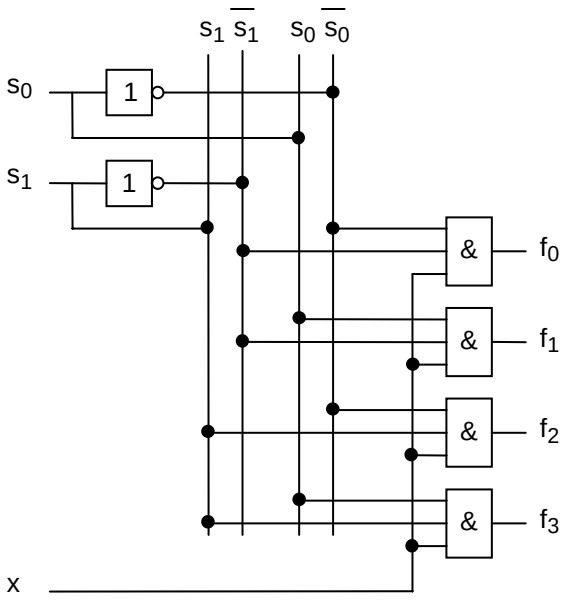
4.20 **a)** f = x·z·(w'+y) **b)** f = y'·z' **c)** f = (y+z) x'

d) f = (y'+z') ·x' **e)** f = (x'+y')·(x+y)·(w'+z) **f)** f = x'·(y'+ z')

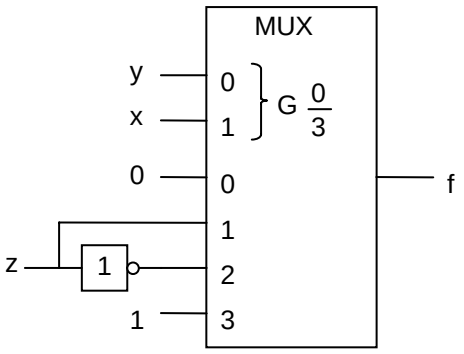
g) f = (y'+z) (x'+y+z')·(w'+y)·(x+z)·(w+x+y') **h)** f = z'

4.21 Studentens egen lösning skall diskuteras!

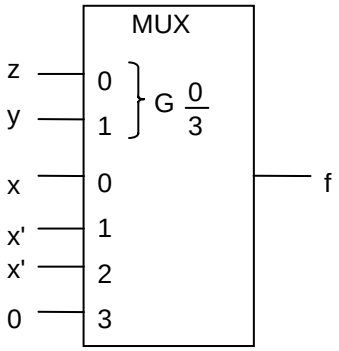
4.22 **Realisering**:



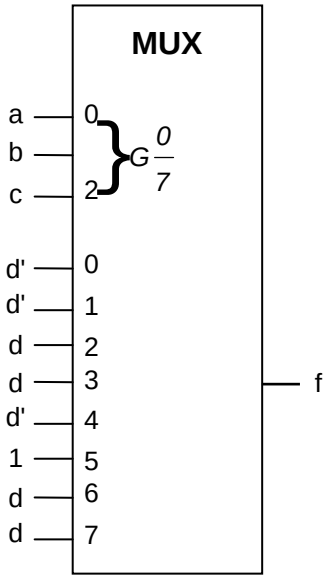
4.23 **Realisering**:



4.24 **Realisering**:



4.25 **Realisering**:



4.26 <u>Realisering</u>: