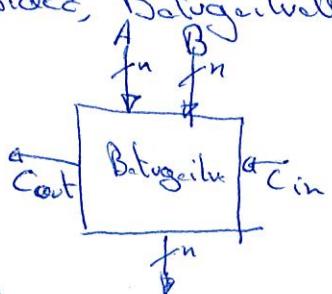


3. Gaia Blotte Kombinazionale

Kombinazionale: Irteerak, sarretakko balioen funtziotik sailkat dira. Ez dute memorierik, urola sarreren mende erosten dute irteera.

And, Or... ate logikak beraz, Kombinazionalek dira, urola sarreren mende erosten batzuk irteera, egia-tekuaren ogeri den legez.

Adibidez, Batugailuak (adders).

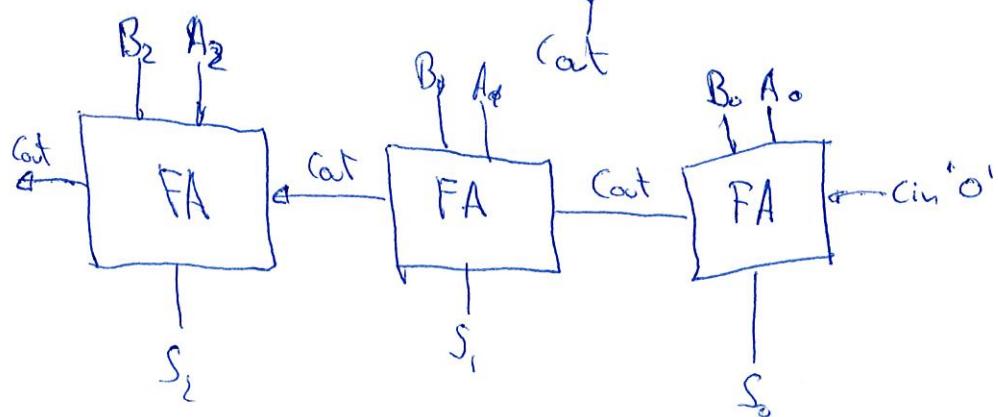
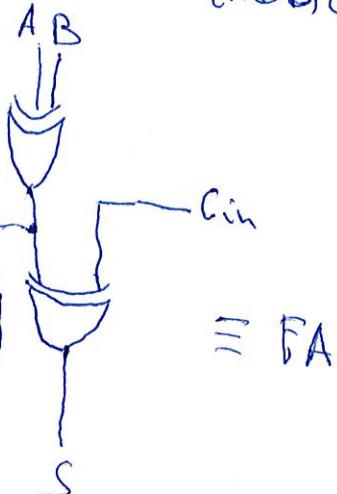


$n=1$ Jatorrian,

A	B	Cin	S	Cout
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

$$S = A \oplus B \oplus \text{Cin}$$

$$\text{Cout} = AB + (A \oplus B)\text{Cin}$$



2.Osas

$$101100 \rightarrow 44 - 64 = -20$$

$$011101 \rightarrow 29$$

0	0	1	0	0	1
---	---	---	---	---	---

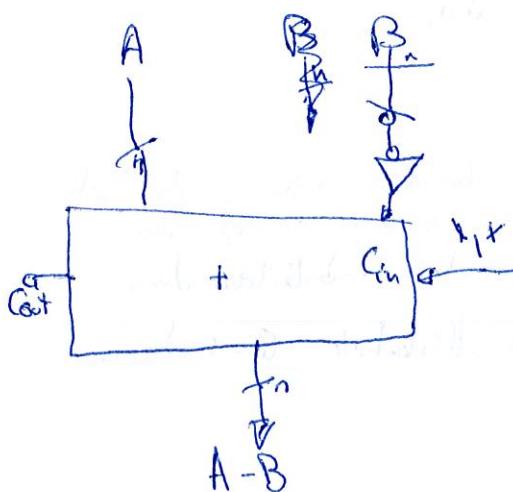
$$\rightarrow 9$$



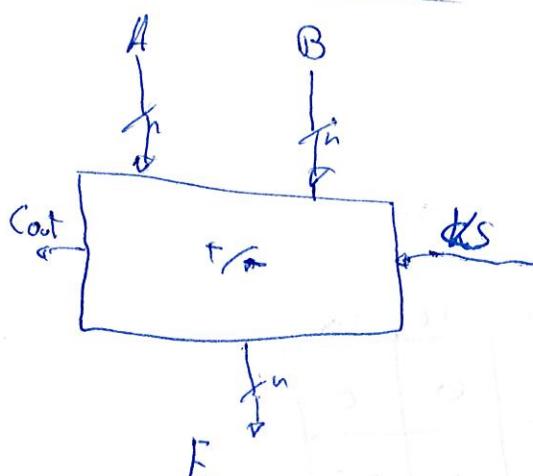
Kengilic

Zwei addierte sign beher. $L_{\text{Keng}}(-B)$ bedeutet Naturale

2.Osas $\bar{B}+1$ sign beher. Dazu berech. $A-B = A+\bar{B}+1$ sign beherkt. lalle.



Batugilic / Denggilic



$K_S \rightarrow$ Mantel seihele, ergo dig + edo - ergo due,

$$K_S = 0 \rightarrow A+B$$

$$K_S = 1 \rightarrow A-B = A+\bar{B}+1$$

$$Y \oplus 1 = Y$$

$$0 \oplus 1 = 1$$

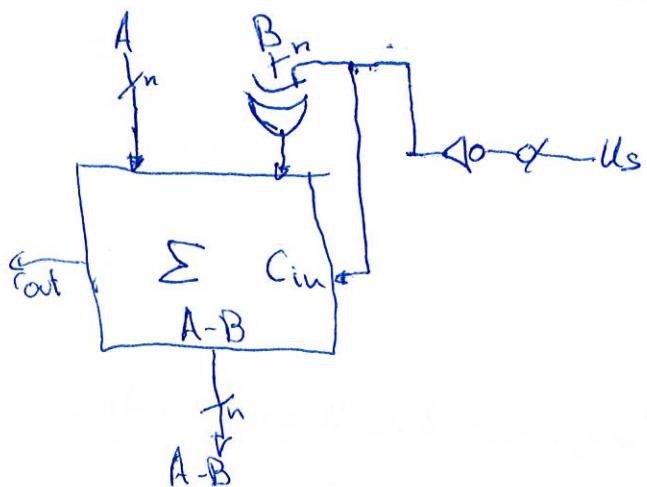
$$1 \oplus 1 = 0$$

$$Y \oplus 0 = Y$$

$$0 \oplus 0 = 0$$

$$1 \oplus 0 = 1$$

$\Rightarrow B$ erzählt weli degneen xor bat glio seihele ergo dig besteh zur zero Esiodarekin.



Multiplexoreakia

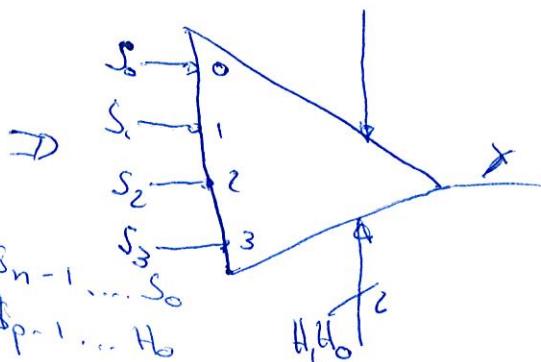
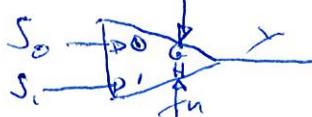
Hainbat sarrera izanik horietako bat aukeratuko du.

Datu sarrera S

Datu irteera Y

Hautzka-seinadek f_j zenagaren zindegia baliatu erabaltzen duen Gaizkintza-seinadea: $G=0$ denean multiplexora desaktibatuta $G=1$ denean aktibatuta.

Mux 2:1



$n = 2^p$ Pbit dagoenea

Sarrera
dagoenea

G	H	S_1	S_0	Y
0	-	-	-	0
1	0	0	0	0
1	0	0	1	1
1	0	1	0	0
1	0	1	1	1
1	1	0	0	0
1	1	0	1	0
1	1	1	0	1
1	1	1	1	1

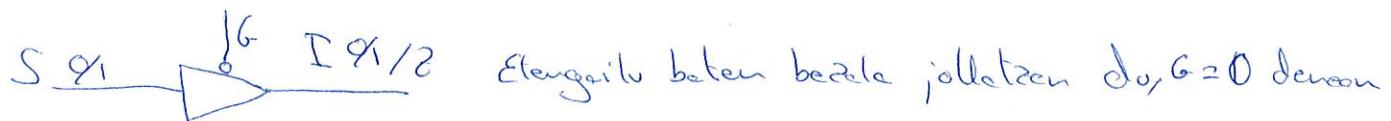
G	H	S_1	S_0	00	01	10	11
0	0	0	0	0	0	0	0
0	1	0	0	0	0	0	0
1	0	0	1	0	0	0	0
1	1	0	1	0	0	0	1
1	0	1	0	1	1	1	1
1	1	1	0	1	1	0	0
1	1	1	1	1	1	0	0

$$Y = GH\bar{S}_1 + G\bar{H}S_0 = G(H\bar{S}_1 + \bar{H}S_0)$$

Hiru egoerako gailurren

Datu asko prozesatu behar direnean multiplexoreak oso motetako dira, beraz ez dira egokiak:

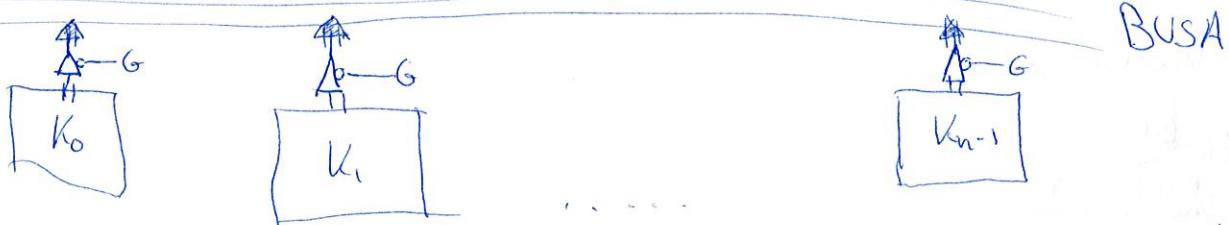
Honen ordez hiru egoerako gailua erabili daitelle. Honek hiru aukera ditu, H, L eta Z (Independentzia altua)



S01 → Z izango balitz bezala,

S	G	I
-	0	Z
0	1	0
1	1	1

Sren araberakoa izango da baldin $G=1$ badu, bestela $G>0$ izanile $I>2$ izango da.

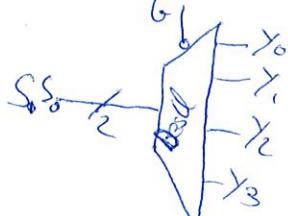


Ezer ezarrilla ez bezenezela da $K_0 = H$ eta $K_i = L$ izango balitz. Ez ditzakeen bitartez bat zortutako hitzak.

Deslodgegailuek

Informazioa deslodgeatzeko erabiltzen du. Kodifikatzeko mota asko daude, deslodgegailu mota asko izan ditzakete.

Bitartekoa hamarturako posizioa da simpleentzako bat.



Gailurriz - Seinalea multiplexorren eta deslode geiturun berdin jolatzen dute.

$G S_1 S_0$	X	Y_1	Y_2	Y_3
0 - -	0	0	0	0
1 0 0	1	0	0	0
1 0 1	0	1	0	0
1 1 0	0	0	1	0
1 1 1	0	0	0	1

$$Y_0 = G \bar{S}_1 \bar{S}_0, Y_1 = G \bar{S}_1 S_0, Y_2 = G S_1 \bar{S}_0, Y_3 = G S_1 S_0$$

Kodetzaileak (Encoders)

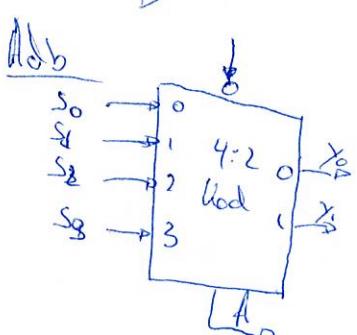
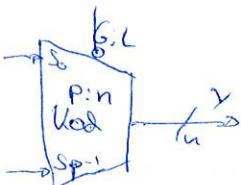
Kodetzaileak sarezko informazio kodatzera dute eta kodatzeko hosi isteetako erantzuz bezala emango du.

Ezabaliende sarezko hamartarrak bitarrera kodatzera izango da.

Sarezko S bitetako batello p sarezko klopurua izango da.

Isteera Y n bitello kodea, altibaritate dagokien edo sarezko degeltiora kode bitarriz emango du.

G kontrol seinalea,



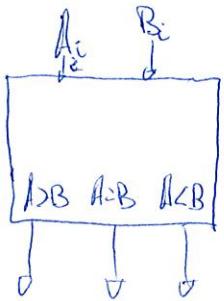
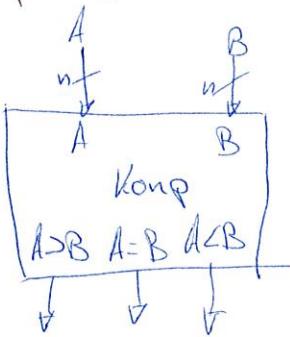
$G S_0 S_1 S_2 S_3$	X	Y_0	A
0 - - -	0	0	0
1 0 0 0	0	0	0
1 1 - -	-	0	1
1 0 1 -	-	0	1
1 0 0 1	-	1	0
1 0 0 0	1	1	1

$$A = G(S_0 + S_1 + S_2 + S_3)$$

$$Y_0 = G(\bar{S}_0 S_1 + \bar{S}_0 \bar{S}_1 \bar{S}_2 S_3) = G \bar{S}_0 (S_1 + \bar{S}_2 S_3)$$

$$Y_1 = G \bar{S}_1 (S_2 + S_3)$$

Komparagailvel (comparators)

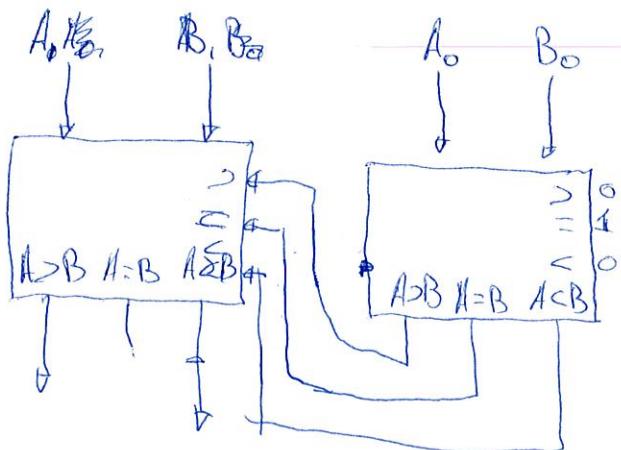


A _i	B _i	A > B	A = B	A < B
0	0	0	1	0
0	1	0	0	1
1	0	1	0	0
1	1	0	1	0

$$A = B : \bar{A}\bar{B} + A\bar{B} = A \oplus B$$

$$A > B : A\bar{B}$$

$$A < B : \bar{A}B$$



$$(A = B) = (A_1 \oplus B_1) \cdot (B_0 \oplus A_0) \quad A \bar{B}$$

$$A_o > B_o = A_1 \bar{B}_1 + A_1 \oplus B_1 \cdot (A_0 > B_0)$$

$$A_{10} < B_o = \bar{A}_1 B_1 + (A_1 \oplus B_1) \cdot \bar{A}_0 \cdot B_0$$

- 3.11.** Sistema digital jakin batean, 32 biteko 8 zenbaki ($Z_1 \dots Z_8$) batu behar dira. Diseinatu zirkuitu konbinazional bat, ahalik eta eraginkorrena, zenbaki horiek batzeko. Batugailu baten erantzun-denbora 2^n ns bada ($n =$ zenbakien bit kopurua), zenbat denbora behar da 8 zenbakiak batzeko? Nola detekta daiteke eragiketaren gainezkatzea (batugailuak 32 bitekoak dira)?

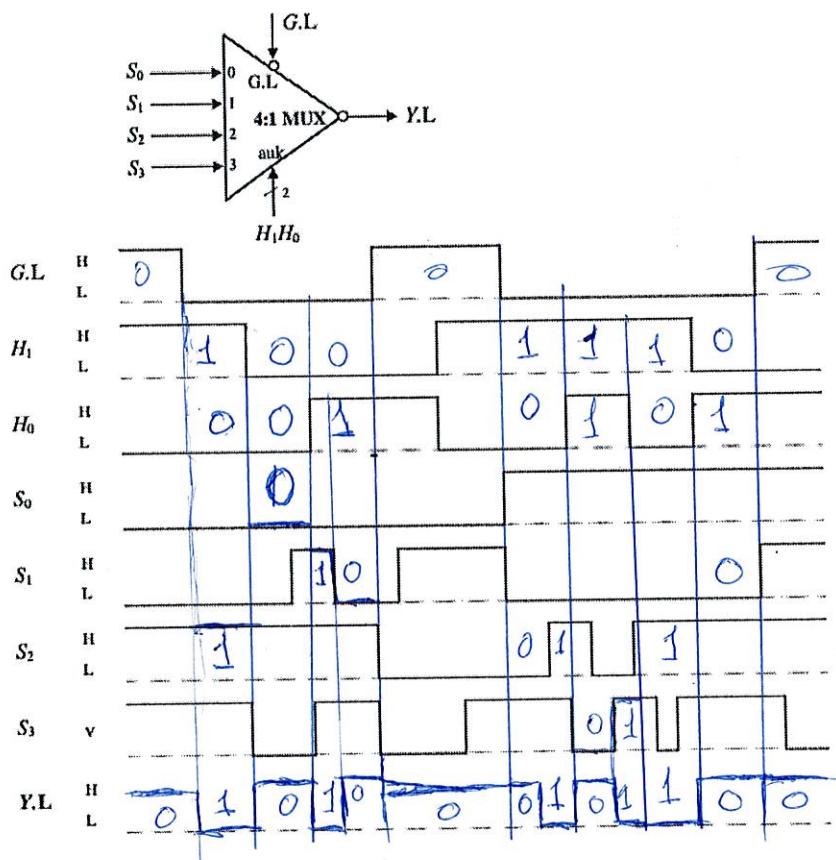
Liburuan ebatzitako ariketak

3.1. Eraiki ezazu 16 datu-sarrerako multiplexore bat, 4 datu-sarrerako multiplexoreak erabiliz.

3.2. Eraiki ezazu $f(d, c, b, a) = \Sigma (0, 3, 6, 7, 11, 14, 15)$ funtzioa hiru modu hauetan:

- (a) 16 datu-sarrerako multiplexorea erabiliz;
- (b) 8 datu-sarrerako multiplexorea eta behar diren atea erabiliz; eta
- (c) 4 datu-sarrerako multiplexorea eta behar diren atea erabiliz.

3.3. Lau sarrerako multiplexore baten datu-sarrerek eta gaikuntza-seimaleak kronograman ageri den portaera dute denboran zehar. Marraz ezazu, kronograman, multiplexoreak irteeran (Y.L) izango duen balioa. Adi! multiplexorearen irteera logika negatiboan dago.

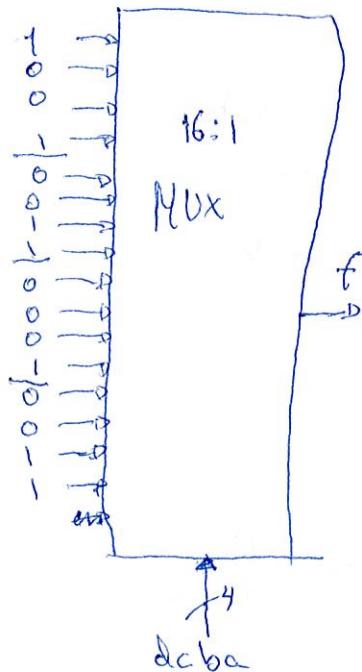


3.2

$$f(d, c, b, a) = \sum(0, 3, 6, 7, 11, 14, 15)$$

a)

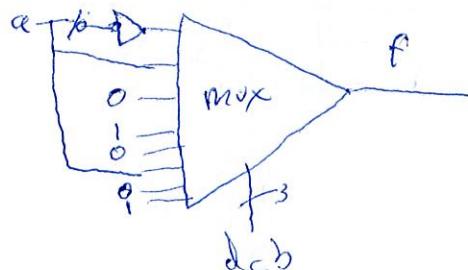
d	c	b	a	f
0	0	0	0	1
0	0	0	1	0
0	0	1	0	0
0	0	1	1	1
<hr/>				
0	1	0	0	0
0	1	0	1	0
0	1	1	0	1
0	1	1	1	1
<hr/>				
1	0	0	0	0
1	0	0	1	0
1	0	1	0	0
1	0	1	1	1
<hr/>				
1	1	0	0	0
1	1	0	1	0
1	1	1	0	1
1	1	1	1	1



b)

d	c	b	a	f	anmux
m ₀	0	0	0	1	
m ₁	0	0	1	0	\bar{a}
m ₂	0	0	10	0	
m ₃	0	0	11	1	a
m ₄	0	1	00	0	
m ₅	0	1	01	0	0
m ₆	0	1	10	1	
m ₇	0	1	11	1	1
m ₈	1	0	00	0	
m ₉	1	0	01	0	b
m ₁₀	1	0	10	0	a
m ₁₁	1	0	11	1	
m ₁₂	1	1	00	0	0
m ₁₃	1	1	01	1	

d	c	b	a	f	series multiplexor
0	0	0	0	0	
0	0	0	1	0	a
0	0	1	0	1	\bar{a}
0	0	1	1	0	
0	1	0	0	1	1



c)

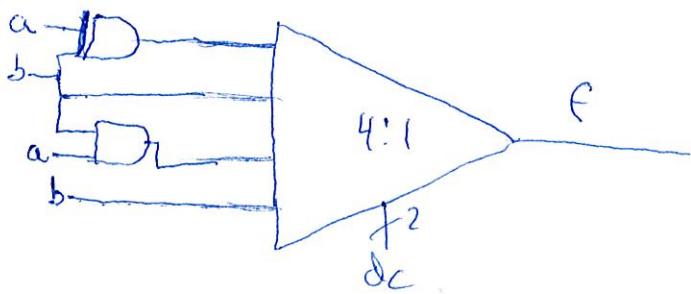
	d	c	b	a	f
m_0	0	0	0	0	1
	0	0	0	1	0
	0	0	1	0	0
	0	0	1	0	0
	0	0	1	1	1
m_1	0	1	0	0	0
	0	1	0	1	0
	0	1	1	0	1
	0	1	1	1	1
m_2	1	0	0	0	0
	1	0	0	1	0
	1	0	1	0	0
	1	0	1	1	1
m_3	1	1	0	0	0
	1	1	1	0	1
	1	1	1	1	1
	1	1	1	1	1

 $\frac{f}{f} = c$ $a \otimes b$

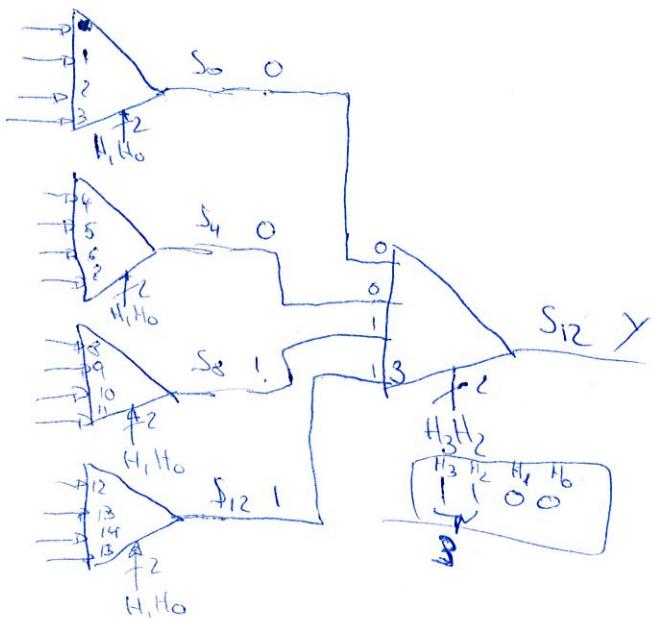
b

 $a \cdot b$

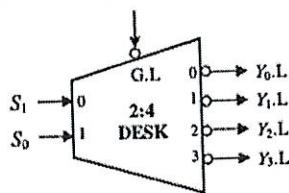
b



3.1

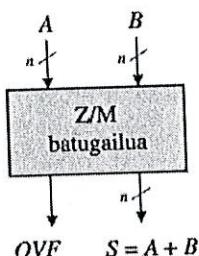


- 3.4.** Irudian, bi sarrerako eta lau irteerako deskodegailua ageri da. Bere portaera kronograma baten bidez azaldu nahi dugu. Kronograman adierazitza daude sarrerek hartzen dituzten balioak denboran zehar, eta irteeren balioak kalkulatu behar dira.



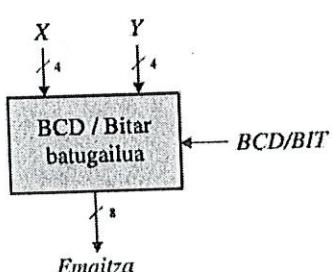
	G.L	H	L	H	L	H	L	H	L	H	L
	S ₁	0	1	0	1	0	1	0	1	0	1
	S ₀	0	0	0	1	1	0	1	0	1	0
	Y ₀ ,L	H	L	0	1	0	1	0	1	0	1
	Y ₁ ,L	H	L	0	1	1	0	1	0	1	0
	Y ₂ ,L	H	L	0	1	0	1	1	1	0	1
	Y ₃ ,L	H	L	0	1	0	1	1	1	0	1

- 3.5.** Zenbaki bitar arruntak zein birako osagarrian adierazitako osoak batzen dituen oinarritzko bloke konbinazionala aztertu dugu 3.5. atalean. Hainbat kasutan, hala ere, beste adierazpideak erabiliz kodetutako zenbakiak batu behar dira. Adibide gisa, zeinu/magnitudea adierazpideko zenbakien batugailua diseinatuko dugu ariketa honetan.



Sarreran, n biteko bi zenbaki hartzen ditu, eta, irteeran, haien batura eta eragiketaren balizko gainezkatzea (overflow) eskaintzen ditu.

- 3.6.** Batugailu bat diseinatu nahi dugu, BCD kodean zein bitar hutsez adierazitako zenbaki arruntak batzeko. Kontrol-seinale batek —BCD/BIT— datuen adierazpidea esango digu: $BCD/BIT = 1$ bada, batuketa BCDz egin beharko da; aldiz, $BCD/BIT = 0$ bada, batuketa bitarrez egingo da. Batugaiak 4 bitekoak dira eta emaitza, batura, 8 bitetan eman beharko da.



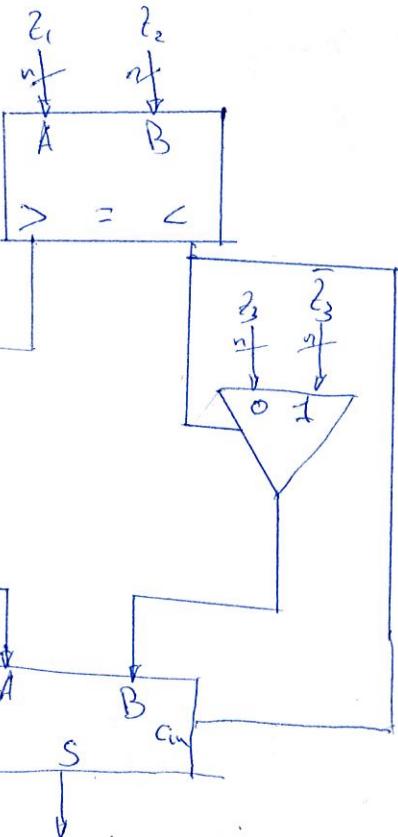


Ariketall

SDDO

3.5

a)



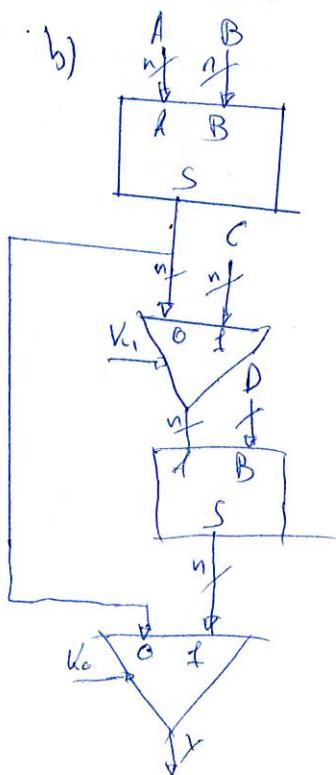
Baldin $Z_1 \geq Z_2$ ordvan $y := Z_2 + Z_3$

Bestele Baldin $Z_1 < Z_2$ $y := Z_1 + \bar{Z}_3 + 1 = Z_1 - Z_3$

Bestele $y := Z_1 + Z_3$
ambaldin

ambaldin.

b)



Baldin $K_0 = 0$ ordvan $y := A + B$

Bestele bldin $K_0 = 1$ ordvan ~~y :=~~

Baldin $K_1 = 0$ ordvan $y := A + B + D$

bestele $\neq K_1 = 1$ $y := C + D$

ambaldin

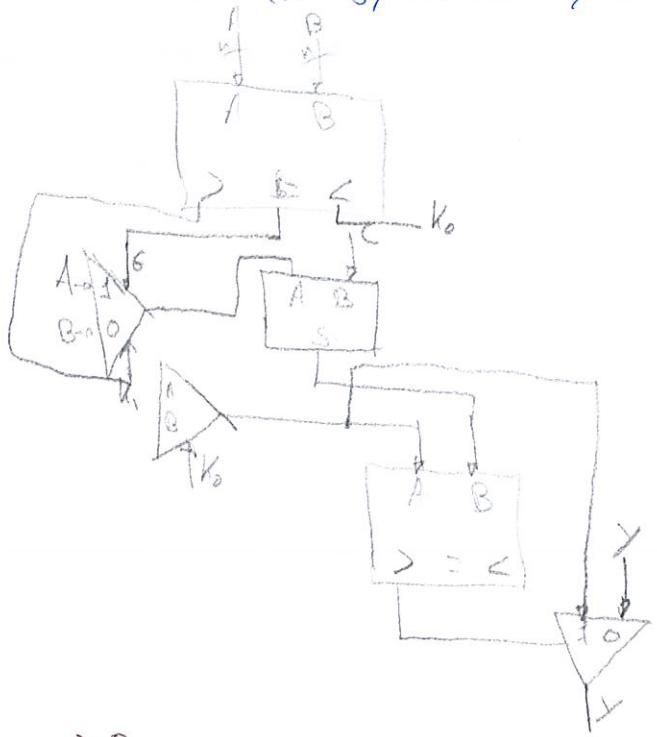
ambaldin
ambaldin

3.6

baldin ($A > B$) ordnen $y := \text{handigen}\{A, (B+C)\}$

baldin ($A < B$) ordnen $y := \text{handigen}\{B, (A+C)\}$

baldin ($A = B$) ordnen $y := \text{handigen}\{A, C\}$



	0	1	0	1	0	1
0	0	0	0	0	0	0
1	0	0	0	0	0	0
2	1	0	0	0	0	0
3	0	1	0	0	0	0
4	0	0	1	0	0	0
5	0	0	0	1	0	0
6	1	0	0	0	1	0
7	0	1	0	0	1	0
8	0	0	1	0	1	0
9	0	0	0	1	0	1

$$\Leftrightarrow A > B \oplus B < A + S(A=B)$$

3.7

$S=0$ deneen

baldin ($A = B$) ordnen $y := A$

bestele baldin ($A > B$) ordnen $y := A - B$

bestele

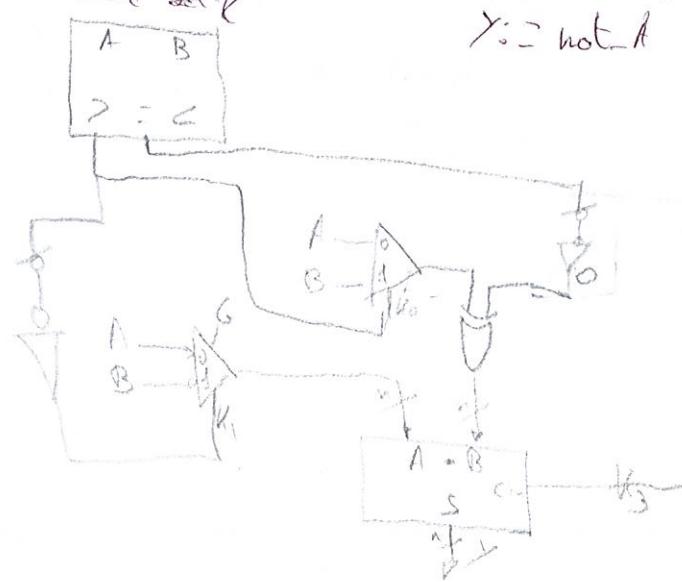
 $y := B - A$

$S=1$ deneen

Baldin ($A = B$) ordnen $y := A + B$

Bestele baldin ($A > B$) ordnen $y := \text{not}_2 B$

Bestele baldin

 $y := \text{not}_2 A$ 

	0	0	0	1	0	1	1
0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0
2	1	0	0	0	0	0	0
3	0	1	0	0	0	0	0
4	0	0	1	0	0	0	0
5	0	0	0	1	0	0	0
6	1	0	0	0	1	0	0
7	0	1	0	0	1	0	0
8	0	0	1	0	1	0	0
9	0	0	0	1	0	1	0
10	1	0	0	0	1	0	1
11	0	1	0	0	0	1	0
12	0	0	1	0	0	0	1
13	0	0	0	1	0	0	1

$$K_2 = \overline{A} = B$$

$$K_3 = \overline{A} \oplus B \oplus S$$

	0	0	1	1	0	0
0	0	0	0	1	1	0
1	0	0	1	0	0	0
2	1	0	0	0	0	0

Bloke Moubinzionaleit. Additieel

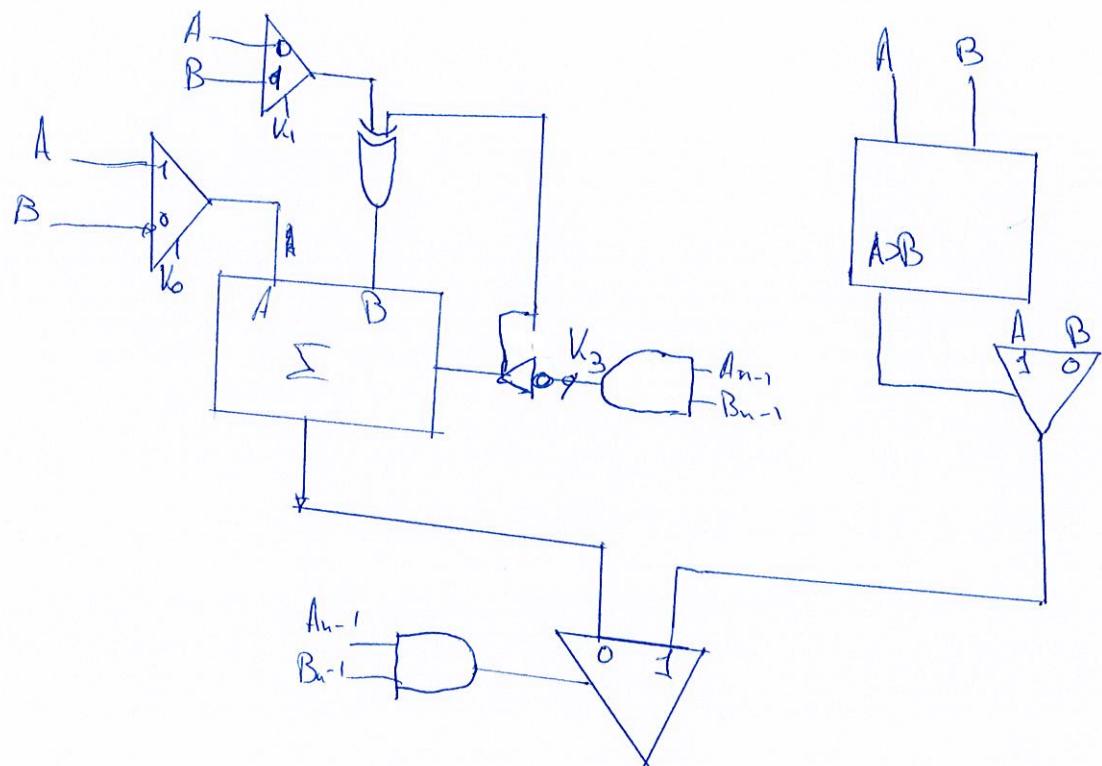
3.9

Baldin ($A \geq 0$) eta ($B \geq 0$) ordenen $y := A + B$

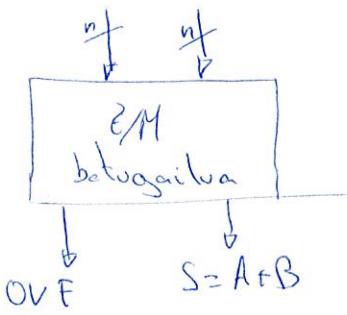
Bestele baldin ($A < 0$) eta ($B < 0$) ordenen $y :=$ handien $\{A, B\}$

Bestele

$$y^c = |A| + |B|$$



Arithmetische Ebettzung 3.5



$$\begin{array}{r} * \\ 1011 + 1001 = 1100 \\ \hline 0101 + 0001 = 0010 \\ \hline \end{array}$$

$$\begin{array}{r} * \\ 11001 + 0111 = \\ \hline 1111 + 1100 = 1011 \end{array}$$

$$S = A + B \rightarrow S_{(Z_S, M_S)} = A_{(Z_A, M_A)} + B_{(Z_B, M_B)}$$

$$Z_A = Z_B \quad M_A > M_B$$

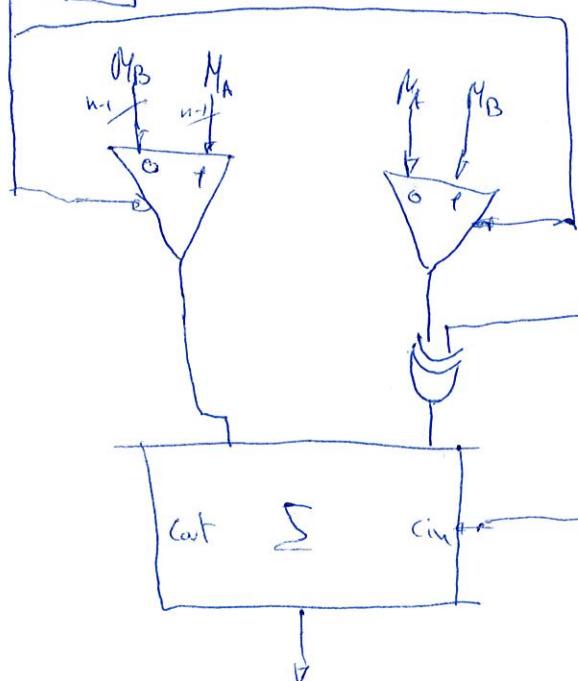
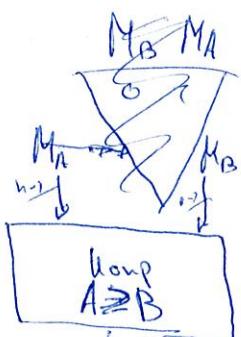
$$\begin{array}{cc} 1 & - \\ 0 & 1 \\ 0 & 0 \end{array}$$

ermitteln

$$Z_S = Z_A + Z_B \quad M_S = M_A + M_B$$

$$Z_S = Z_A \quad M_S = M_A - M_B$$

$$Z_S = Z_B \quad M_S = M_B - M_A$$



$$Z_A, Z_B$$

3.7

Blaue Kombinationell. Arbeitshk

$S=0$ denean

baldin ($A=B$) orduan $y_1 = A$

bestela baldin ($A>B$) $y_1 = A-B$

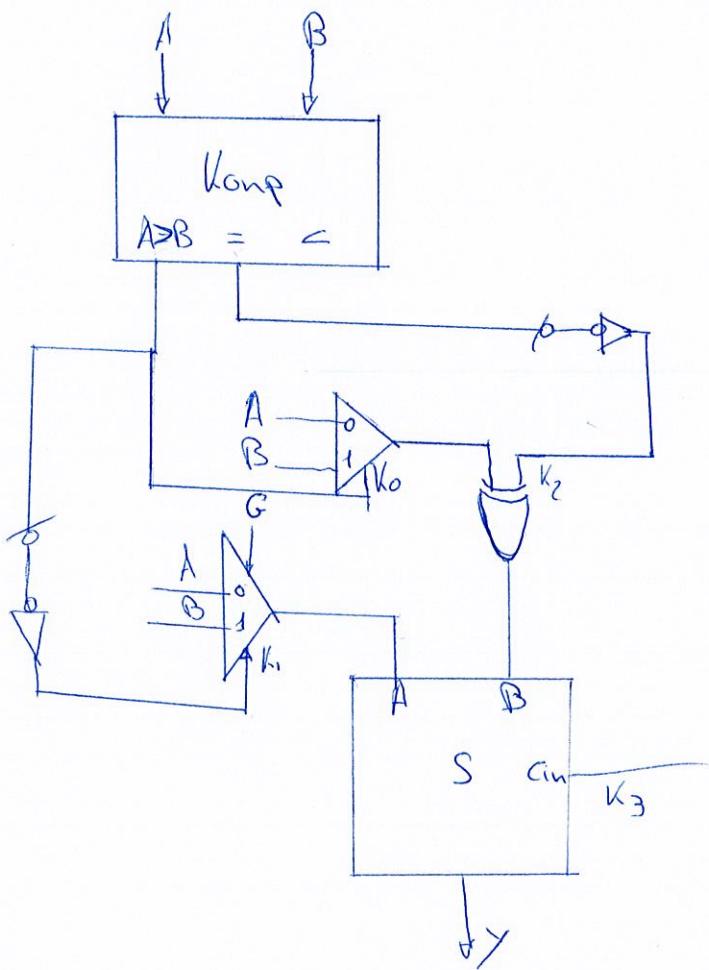
bestela $y_1 = B-A$

$S=1$ denean

Baldin ($A=B$) orduan $y_1 = A+B$

bestela baldin ($A>B$) $y_1 = \text{not } B$

bestela $y_1 = \text{not } A$



$A=B$	$A>B$	S	K_0	K_1	K_2	K_3	G
1	0	0	0	-	0	0	0
0	1	0	1	0	1	1	1
0	0	0	0	1	1	1	1
1	0	1	0	0	0	0	1
0	1	1	1	-	1	0	0
0	0	1	0	-	1	0	0

$$K_2 = \overline{A=B}$$

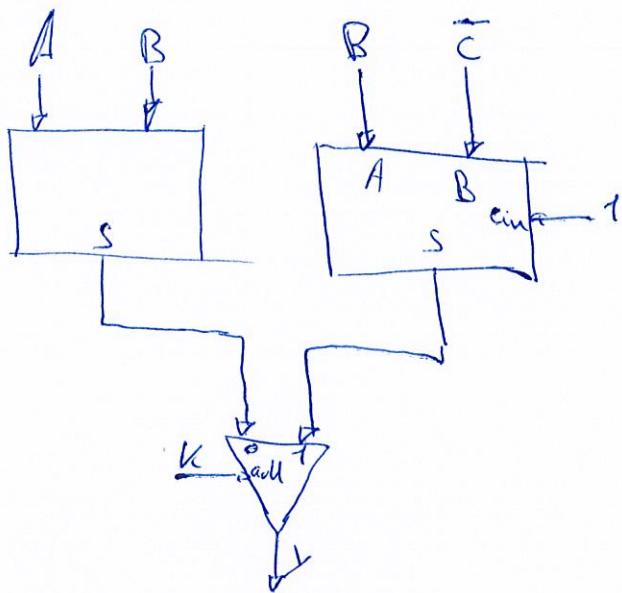
$$K_3 = \overline{A>B}S$$

K_Φ

$A=B$	$A>B$	S	K_0	K_1	K_2	K_3
0	1	0	1	\emptyset	1	0
1	-	0	-	-	0	0

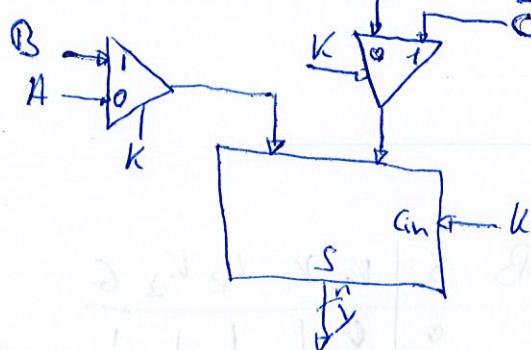
$$K_1 = \cancel{A=B} \cdot \overline{A>B}$$

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Bildlin $K=0$ ordnen $y := A+B$

Bestell. $K=1$ ordnen $y := B-C$



3.5

a)

Bildlin $z_1 > z_2$ ordnen $y := z_2 + z_3$

Bestell. Bildlin $z_1 = z_2$ ordnen $y := z_1 + z_3$

Bestell. $z_1 < z_2$ ordnen $y := z_2 - z_3$

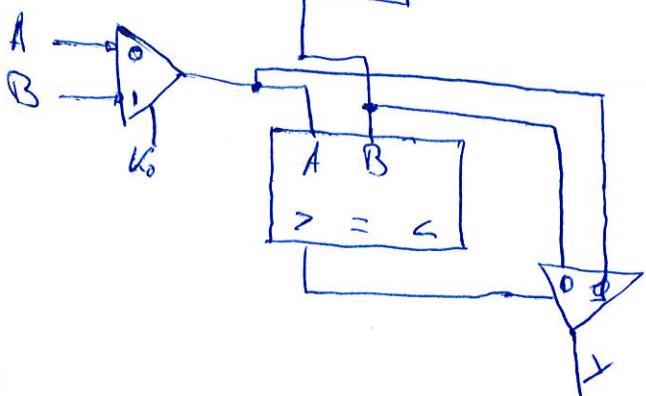
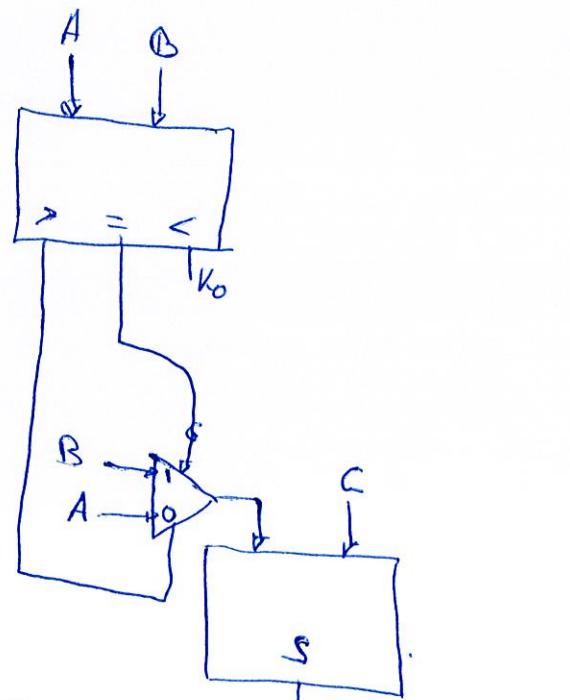
b)

Bildlin $K_0 = 0$ ordnen $y := A+B$

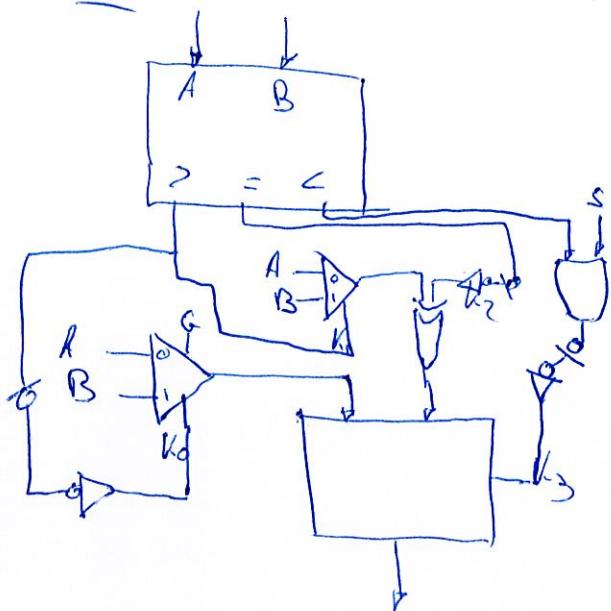
Bestell. Bildlin $K_1 = 0$ $y := A+B+D$

Bestell. $y := C+D$

3.6



3.7



$A > B$	$A = B$	S	K_0	K_1	K_2	K_3	G
1	0	0	0	1	1	1	1
0	1	0	-	0	0	0	0
0	0	0	1	0	1	1	1
<hr/>							
1	0	1	-	1	1	0	0
0	1	1	0	0	0	0	1
0	0	1	-	0	1	0	0

$$K_2 = \overline{A=B}$$