05/10/2021

ESERCIZIO 1

Sintetizzare con Quine-McCluskey la funzione avente:

ON set = { 0, 1, 2, 4, 5, 9, 10, 11, 13, 15 }

0 0 0 0	0 ✓
0 0 0 1	1 ✓
0 0 1 0	2 ✓
0 1 0 0	4 ✓
0 1 0 1	5 ✓
1 0 0 1	9 ✓
1 0 1 0	10 ✓
1 0 1 1	11 ✓
1 1 0 1	13 ✓
1 1 1 1	15 ✓

0 0 0 -	0,1 ✓
0 0 - 0	0,2 A
0 - 0 0	0,4 ✓
0 - 0 1	1,5 ✓
- 0 0 1	1,9 ✓
- 0 1 0	2,10 B
0 1 0 -	4,5 ✓
- 1 0 1	5,13 ✓
1 0 - 1	9,11 ✓
1 - 0 1	9,13 ✓
1 0 1 -	10,11 C
1 - 1 1	11,15 ✓
1 1 - 1	13,15 ✓

0 - 0 -	0,1,4,5 D
~~- - 0 1~~	~~1,5,9,13~~
- - 0 1	1,5,9,13 E
~~1 - - 1~~	~~9,13,11,15~~
1 - - 1	9,13,11,15 F

	0	1	2	4	5	9	10	11	13	15	COSTO
A	x		x								3
B			x				x				3
C							x	x			3
D	x	x		x	x						2
E		x			x	x			x		2
F						x		x	x	x	2

→ numero letterali

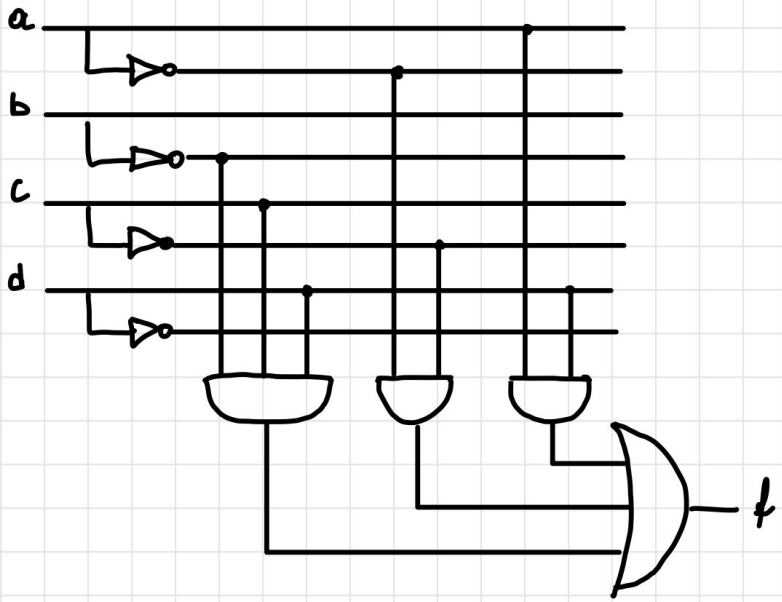
C = { F, D, B }

primari ↓ secondari

	2	10	
A	x		3
B	x		3
C		x	3

DOMINA

→ $f = B + D + F = \bar{b}c\bar{d} + \overline{ac} + ad$



ESERCIZIO 2

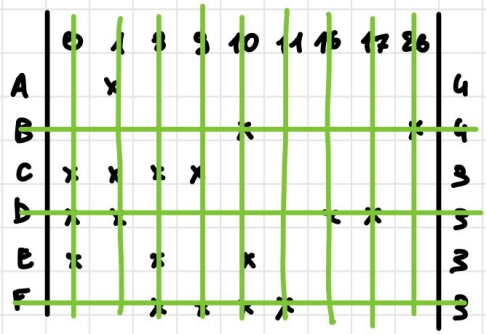
Sintetizza ... con:

ONset: { 0, 1, 8, 9, 10, 11, 16, 17, 26 }
DCset: { 2, 5 }

0 0 0 0 0	0 V
0 0 0 0 1	1 V
0 0 0 1 0	2 V
0 1 0 0 0	8 V
1 0 0 0 0	16 V
0 0 1 0 1	5 V
0 1 0 0 1	9 V
0 1 0 1 0	10 V
1 0 0 0 1	17 V
0 1 0 1 1	11 V
1 1 0 1 0	26 V

0 0 0 0 -	0, 1 V
0 0 0 - 0	0, 2 V
0 - 0 0 0	0, 8 V
- 0 0 0 0	0, 16 V
0 0 - 0 1	1, 5 A
0 - 0 0 1	1, 9 V
- 0 0 0 1	1, 17 V
0 - 0 1 0	2, 10 V
0 1 0 - 0	8, 10 V
1 0 0 0 -	16, 17 V
0 1 0 0 -	8, 9 V
0 1 0 - 1	9, 11 V
0 1 0 1 -	10, 11 V
- 1 0 1 0	10, 26 B

C D 0 - 0 0 -	0, 1, 8, 9
- 0 0 0 -	0, 1, 16, 17
E 0 - 0 - 0	0, 2, 8, 10
F 0 1 0 - -	8, 9, 10, 11



$C = \{B, D, F\}$

12/10/2021

ESERCIZIO 1

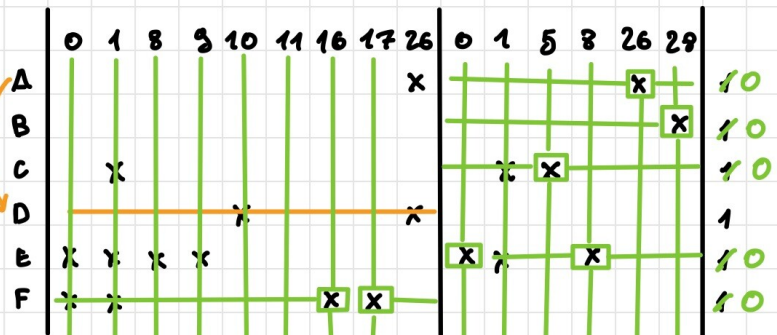
$f_1(a,b,c,d,e)$: ONset(0, 1, 8, 9, 10, 11, 16, 17, 26), DCset(2, 5)

$f_2(a,b,c,d,e)$: ONset(0, 1, 5, 8, 26, 28), DCset(9)

00000	11	0 X
00001	11	1 X
00010	10	2 X
01000	11	8 X
10000	10	16 X
00101	11	5 X
01001	11	9 X
01010	10	10 X
10001	10	17 X
01011	10	11 X
11010	11	26 A
11100	01	28 B

0000-	11	0,1 X
000-0	10	0,2 X
0-000	11	0,8 X
-0000	10	0,16 X
00-01	11	1,5 C
0-001	11	1,9 X
-0001	10	1,17 X
0-010	10	2,10 X
0100-	11	8,9 X
010-0	10	8,10 X
1000-	10	16,17 X
010-1	10	9,11 X
0101-	10	10,11 X
-1010	10	10,26 D

0-00-	11	0,1,8,9 E
-000-	10	0,1,16,17 F
0-0-0	10	0,2,8,10 G
010--	10	8,9,10,11 H



$f_1 = F + H + A$

$f_2 = A + B + C + E$

$\Rightarrow f_1 = b'c'd' + a'bc' + abc'de'$

$\Rightarrow f_2 = abc'de' \; abcd'e' + a'b'd'e + a'c'd'$

VHDL

```
entity fun in
  port(a, b, c, d, e : in std_logic;
       f1, f1 : out std_logic);
end entity

architecture arch of fun is
  signal(f_in : std_logic_vector(4 downto 1)
begin
  f_in <= a & b & c & d & e;
  with f_in select
    f1 <= '1' when …ONset
          '_' when …DCset
          '0' when others
  with f_in select
    f2 <= '1' when …ONset
          '_' when …DCset
          '0' when others
end
```

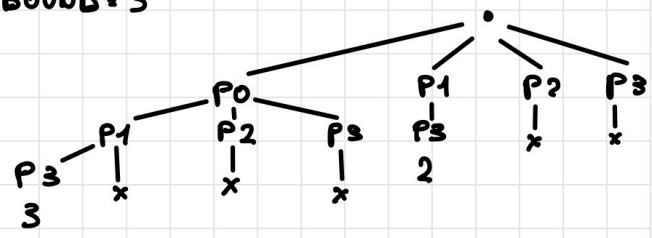
ESERCIZIO 2

BRANCH & BOUND:

	1	2	3	4	5	
P0	x	x				1
P1		x	x		x	1
P2			x	x		1
P3	x			x	x	1

↳ ciclica!

BOUND = 3



⇓ ottimale {P1, P3}

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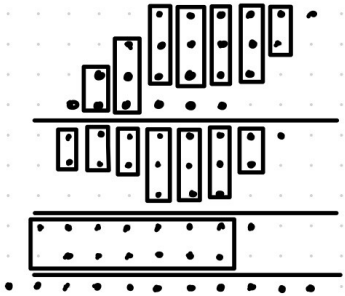
ESERCIZIO 1

Progettare un moltiplicatore di Wallace 6×4 e dire il numero di FA e HA e il numero di bit del sommatore finale



FA: 8
HA: 6

nbit: 7 bit

ESERCIZIO 2

Codificare A = 64 e B = -102 su 8 bit usando:

- Booth radix 2
- Booth radix 4

1) A = 0 1 0 0 0 0 0 0 =>
B = 1 0 0 1 1 0 1 0

$-q_i + q_{i-1}$ →	
0 0	0
0 1	1
1 0	-1
1 1	0

B = 1 0 0 1 1 0 1 0 0
-1 0 1 0 -1 1 -1 0

```
                    0 1 0 0 0 0 0 0
1           1 1 1  -1 0 1 0 -1 1 -1 0
1 1 1 1 1 1 1 1 1 0 0 0 0 0
0 0 0 0 0 0 0 1 0 0 0 0 0 0
1 1 1 1 1 1 1 0 0 0 0 0 0 0
0 0 0 0 1 0 0 0 0 0 0 0 0 0
1 1 1 0 0 0 0 0 0 0
1 1 1 0 0 1 1 0 1 0 0 0 0 0 0 0
```

b) $-2q_{i+1} + q_i + q_{i-1}$ =>

0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	2
1	0	0	-2
1	0	1	-1
1	1	0	-1
1	1	1	0

B = 1 0 0 1 1 0 1 0 0
-2 2 -1 -2

```
1 1 1                0 1 0 0 0 0 0 0
1 1 1   1 1 1          -2  2 -1 -2
1 1 1 1 1 1 1 1 1 0 0 0 0 0 0 .
1 1 1 1 1 1 1 1 1 0 0 0 0 0 0
0 0 0 0 1 0 0 0 0 0 0 .
1 1 1 0 0 0 0 0 0 .
```

1 1 1 0 0 1 1 0 1 0 0 0 0 0 0 0

ESERCIZIO 3

Codificare A = -27,75 e B = 7,6875 in IEEE 753 ed eseguirne la somma

$11011.11 \Rightarrow 1.101111 \cdot 2^4 \Rightarrow EXP = 127 + 4 = 131$

27	
13	1
6	1
3	0
1	1
0	

$0,75 \rightarrow 1,5 \rightarrow 1$

$\Rightarrow$ 1 | 1 0 0 0 0 0 0 1 1 | 1 0 1 1 1 1 0 — 0 |

$\cdots 1.1101101 \cdot 2^2 \rightarrow EXP = 127 + 2 = 129$

$\Rightarrow$ 0 | 1 0 0 0 0 0 0 0 1 | 1 1 0 1 1 0 — 0 |

$A + B =$

$$\begin{array}{r} 1.1011110000 \text{ — } 0 \\ 0.0111101100 \text{ — } 0 \\ \hline 1.0100001000 \text{ — } 0 \end{array} \quad \begin{matrix} -1 \\ \\ \\ \end{matrix} \quad \begin{matrix} -1\ -1 \\ = \\ \end{matrix}$$

$\Rightarrow$ 1 | 1 0 0 0 0 0 1 1 | 0 1 0 0 0 0 0 1 0 — 0 |

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ESERCIZIO 1

macchina di Mealy, completa

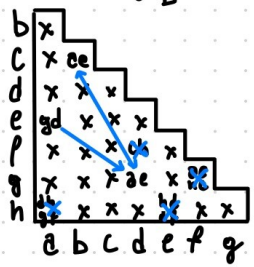
	0	1
→ a	h/0	g/1
b	c/0	e/0
c	b/0	a/0
d	e/1	c/0
e	h/0	d/1
f	e/1	h/0
g	a/1	c/0
h	d/0	f/1

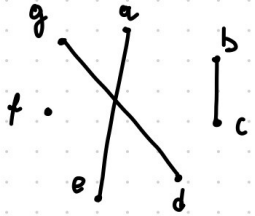
1) RAGGIUNGIBILITÀ

- a
- h
- g
- d
- f
- c
- e
- b

→ a, b, c, d, e, f, g, h raggiungibili

2) EQUIVALENZA





=> $\alpha = \{a,e\}$, $\beta = \{b,c\}$, $\gamma = \{d,g\}$

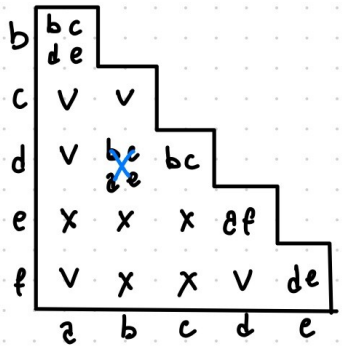
=>

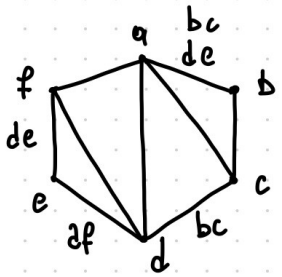
	0	1
α	h/0	γ/1
β	β/0	α/0
γ	α/1	β/0
g	α/1	h/0
h	γ/0	f/0

ESERCIZIO 2

	00	01	11	10
a	b/01	d/10	-/--	-/--
b	c/01	e/-0	-100	-/--
c	b/0-	-/10	-10-	b/0-
d	b/0-	a/1-	-/--	c/-1
e	b/-0	f/1-	d/1-	-/--
f	-/--	-/--	e/11	-/--

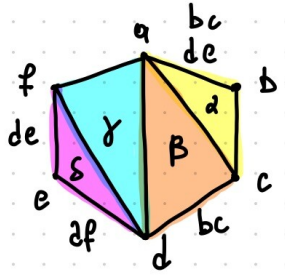
← niente analisi di raggiungib. perché non concorso lo stato iniziale!

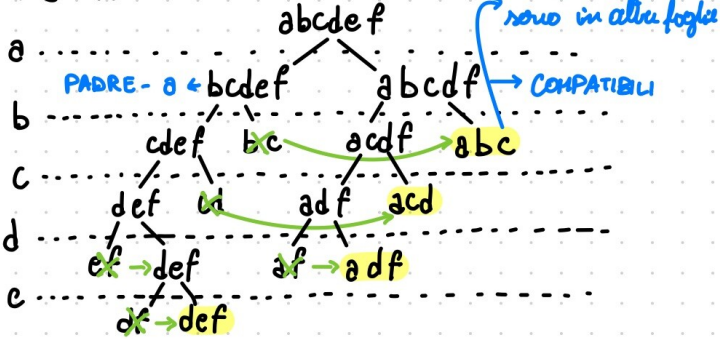




Usiamo 2 euristiche per scegliere:

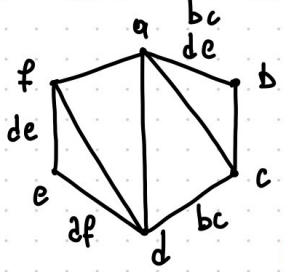
1) CLASSI DI MASSIMA COMPATIBILITÀ





NODO FOGLIA
Compare da stati già considerati tranne al più l'ultimo che non sono in altre foglie

2) CLASSI DI COMPATIBILITÀ PRIME



STATI VINCOLI

~~{e}: ∅~~	~~{ab}: {bc}, {dc}~~	~~{abc}: {bc}~~, {de}
~~{b}: ∅~~	{ac}: ∅	{acd}: {bc}
~~{c}: ∅~~	~~{cd}: ∅~~	{adf}: ∅
~~{d}: ∅~~	~~{af}: ∅~~	{def}: ~~{bc}~~, {af}
{f}: ∅	{bc}: ∅	
~~{f}: ∅~~	~~{cd}: {bc}~~	
	~~{df}: ∅~~	
	~~{dc}: {af}~~	
	{ef}: {de}	

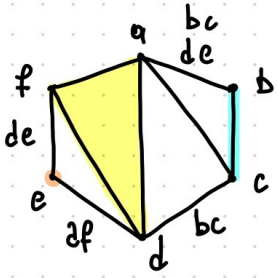
incluse in {ac} con meno vincoli

{ n. stati aggiunti +
n. vincoli risolti −
n. vincoli aggiunti ↑

{abc}: {de}	3+0-1=2	2+0-1=1	0+0-1=-1
{acd}: {bc}	3+0-1=2	1+0-1=0	0+0-1=-1
{adf}: ∅	3+0-0=3	—	—
{def}: {af}	3+0-1=2	1+0-1=0	1+0-1=0
{ac}: ∅	2+0-0=2	1+0-0=1	0+0+0=0
{bc}: ∅	2+0-0=2	2+0-0=2	—
{ef}: {de}	2+0-1=1	1+0-1=0	1+0-1=0
{f}: ∅	1+0-0=0	1+0-0=0	1+0+0=1

CS: {adf}, {bc}, {e}
VI: ∅

=> migliore dell'algoritmo precedente, prendiamo questo



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ESERCIZIO 1

Ottimizzare in SOP $f(x,y,z,w) = \bar{x}y\bar{z} + \bar{x}zw + yz + xz$ con QMC

$\bar{x}y\bar{z} = 010-$
$\bar{x}zw = 0-11$
$yz = -11-$
$xz = 1-1-$

→

0100 4
0101 5
0011 3
0111 7
0110 6
0111 7
1110 14
1111 15
1010 10
1011 11
1110 14
1111 15

→ ON(3,4,5,6,7,10,11,14,15)

0 1 0 0	4 x
0 0 1 1	3 x
0 1 0 1	5 x
0 1 1 0	6 x
1 0 1 0	10 x
0 1 1 1	7 x
1 0 1 1	11 x
1 1 1 0	14 x
1 1 1 1	15 x

0 1 0 -	4,5 x
0 1 - 0	4,6 x
0 - 1 1	3,7 x
- 0 1 1	3,11 x
0 1 - 1	5,7 x
0 1 1 -	6,7 x
- 1 1 0	6,14 x
1 0 1 -	10,11 x
1 - 1 0	10,14 x
- 1 1 1	7,15 x
1 - 1 1	11,15 x
1 1 1 -	14,15 x

0 1 - -	4,5,6,7	A
- - 1 1	3,7,11,15	B
- 1 1 -	6,7,14,15	C
1 - 1 -	10,11,14,15	D

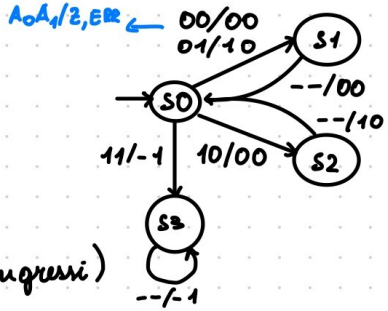
	3	4	5	6	7	10	11	14	15	
A		x	x							1
B	x									1
C				x	x			x	x	1
D						x				1

A + B + D → $\bar{x}y + zw + xz$

ESERCIZIO 2

Progettare FSN con ingresso a 2 bit (A_0, A_1) e due uscite z, ERR da un bit ciascuna. Legge ogni 2 cicli di clock A e li fornisce seriamente su z. Se due bit di A non possono essere 1 contemporaneamente. In caso di errore ERR=1 fino a RESET.

R								
A_0	1	-	-	0	-	0	-	1	-
A_1	1	-	-	1	-	0	-	0	-
Z	-	-	-	1	0	0	0	0	1
ERR	1	1	1	0	0	0	0	0	0

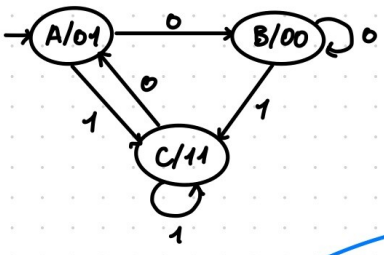


Macchina di Mealy

(l'uscita deve dipendere dagli ingressi)

ESERCIZIO 3

Sintetizzare FSA con FF T



FF:

Q	Q^+	T
0	0	0
0	1	1
1	0	1
1	1	0

	0	1	
A	B	C	01
B	B	C	00
C	A	C	11

POSSO FARLO!

Q_0 Q_1	Q_0^+ Q_1^+ 0	Q_0^+ Q_1^+ 1	
0 1	0 0	1 1	01
0 0	0 0	1 1	00
1 1	0 1	1 1	11

Q_0 Q_1	0 T_0 T_1	1 T_0 T_1	
0 1	0 1	1 0	01
0 0	0 0	1 1	00
1 1	1 0	0 0	11

Q_0 Q_1	0 T_0 T_1	1 T_0 T_1	U_0 U_1
0 0	0 0	1 1	00
0 1	0 1	1 0	01
1 1	1 0	0 0	11
1 0	-	-	--

$T_0 = Q_0 I + Q_0 \bar{I}$

$T_1 = Q_0 Q_1 \bar{I} + \bar{Q}_1 I$

$U_0 = Q_0$

$U_1 = Q_1$

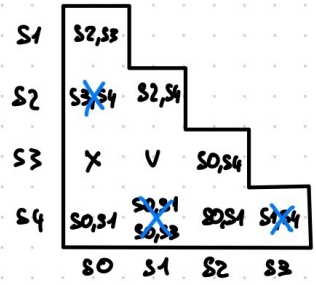
DISEGNO FSA

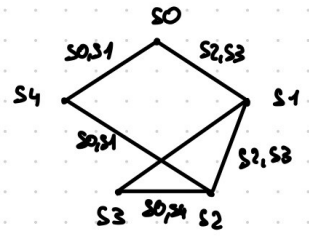
ESERCIZIO 4

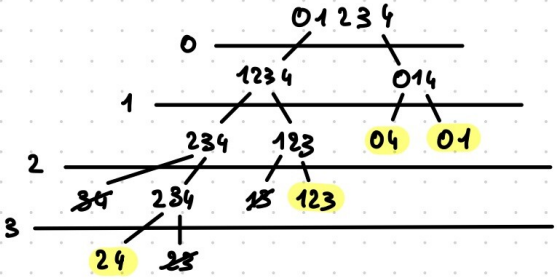
Minimizzare la FSA

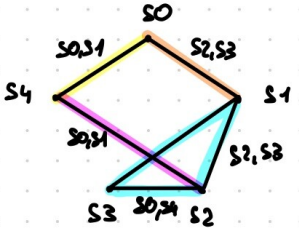
	00	01	11	10
S0	S3/1	S0/0	S1/0	-/-
S1	S2/1	-/-	S1/0	S3/0
S2	S4/1	S0/-	-/-	-/-
S3	-/-	S4/1	-/-	-/-
S4	-/-	S1/-	S0/0	S0/0

Mealy, niente analisi di raggiungibilità









0 : ∅
~~1 : ∅~~
2 : ∅
~~3 : ∅~~
4 : ∅

01 : 23
04 : 01
12 : 24
13 : ∅
23 : 04
24 : 01

123 : 04, 24

1	2	3	04, ~~24~~	1	2	3
	0	1	23	3+0-2=1	1+0-2=-1	0+0-1=-1
	0	4	01	2+0-1=1	1+0-1=0	1+1-1=0
	1	2	~~24~~	2+0-1=1	2+0-1=1	1+0+0=1
	1	3	∅	2+0-0=2	1+0-1=0	0+0+0=0
	2	3	04	2+0-1=1	———	———
	2	4	01	2+0-1=1	1+0-1=0	0+0-1=-1
	0		∅	1+0=1	2+0-1=1	———
	2		∅	1+0=1	1	1
	4		∅	1+0=1	1	1
					1	1

C: 13, 24, 04
V: 01
S: 1, 3, 2, 4, 0

X

posso scegliere

$\alpha = 01$ $\beta = 04$ $\gamma = 24$ $\delta = 123$

	00	01	11	10
α	δ/1	α/0	α/0	-/-
β	δ/1	α/0	α/0	α/0
γ	β/1	α/-	α/0	α/0
δ	γ/1	β/1	α/0	δ/0