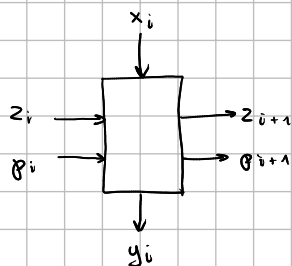


A1



z_i - same zero do tej pory

p_i - kolejny z grupy 1

nie może być jednocześnie $z_i = p_i$

x_i	z_i	p_i	y_i	z_{i+1}	p_{i+1}
0	0	0	0	0	0
0	0	1	0	0	0
0	1	0	0	1	0
0	1	1	-	-	-
1	0	0	0	0	0
1	0	1	1	0	1
1	1	0	1	0	1
1	1	1	-	-	-

x_i	$z_i p_i$	∞	01	11	10
0	0	0	0	-	0
1	0	1	0	1	0

y_i

x_i	$z_i p_i$	∞	01	11	10
0	0	0	0	1	0
1	0	0	0	-	0

z_{i+1}

x_i	$z_i p_i$	∞	01	11	10
0	0	0	0	-	0
1	0	0	1	-	1

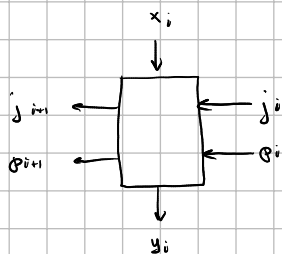
p_{i+1}

$$y_i = x_i p_i + x_i z_i = x_i (z_i + p_i)$$

$$z_{i+1} = \overline{x_i} z_i$$

$$p_{i+1} = x_i p_i + x_i z_i = y_i$$

A3



j_i - do tej pory same jednolite

p_i - kolejny '0' z pierwszej grupy

x_i	j_i	p_i	y_i	j_{i+1}	p_{i+1}
0	0	0	1	0	0
0	0	1	0	0	1
0	1	0	0	0	1
0	1	1	-	-	-
1	0	0	1	0	0
1	0	1	1	0	0
1	1	0	1	1	0
1	1	1	-	-	-

x_i	$j_i p_i$	∞	01	11	10
0	0	1	0	-	0
1	0	1	1	-	1

y_i

$$y_i = \overline{j_i} \overline{p_i} + x_i$$

x_i	$j_i p_i$	∞	01	11	10
0	0	0	0	-	0
1	0	0	0	1	0

j_{i+1}

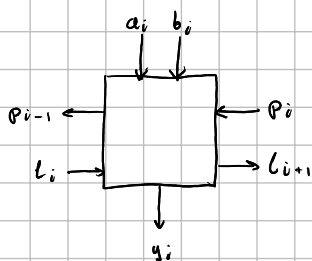
$$j_{i+1} = x_i j_i$$

x_i	$j_i p_i$	∞	01	11	10
0	0	0	1	0	1
1	0	0	0	-	0

p_{i+1}

$$p_{i+1} = \overline{x_i} p_i + \overline{x_i} j_i = \overline{x_i} (p_i + j_i)$$

A2



p_i - już była przerwana z prawej jednostka u A

l_i - już była przerwana z lewej jednostka u B

y_i - iloczyn bitów A i B między skrajnymi jednostkami

$l_i p_i$	$a_i b_i$	∞	01	11	10
∞	0	0	0	0	0
01	0	0	0	0	0
11	0	0	1	0	0
10	0	0	0	0	0

y_i

$$y_i = l_i p_i a_i b_i$$

$l_i p_i$	$a_i b_i$	∞	01	11	10
∞	0	1	1	0	0
01	0	1	1	0	0
11	1	1	1	1	1
10	1	1	1	1	1

l_{i+1}

$$l_{i+1} = l_i + b_i$$

$l_i p_i$	$a_i b_i$	∞	01	11	10
∞	0	0	1	1	1
01	1	1	1	1	1
11	1	1	1	1	1
10	0	0	1	1	1

p_{i-1}

$$p_{i-1} = p_i + a_i$$

$$y_1 = \sum (0, 1, 2, 3, 13, 15)$$

$$y_2 = \sum (0, 2, 5, 7, 8, 10, 13, 15)$$

$$y_3 = \sum (0, 2, 4, 5, 6, 7, 11, 13, 15)$$

$$y_1 y_2 = \sum (0, 2, 13, 15)$$

$$y_2 y_3 = \sum (0, 2, 5, 7, 13, 15)$$

$$y_1 y_3 = \sum (0, 2, 13, 15)$$

$$y_1 y_2 y_3 = \sum (0, 2, 13, 15)$$

$x_3 x_2$	$x_1 x_0$	00	01	11	10
00		1	1	1	1
01		0	0	0	0
11		0	1	0	0
10		0	0	0	0

y₁

$x_3 x_2$	$x_1 x_0$	00	01	11	10
00		1	0	0	1
01		0	1	1	0
11		0	1	1	0
10		1	0	0	1

y₂

$x_3 x_2$	$x_1 x_0$	00	01	11	10
00		1	0	0	1
01		1	1	1	1
11		0	1	1	0
10		0	0	1	0

y₃

$$y_1 = \overline{x_3} \overline{x_2} + x_3 x_2 x_0$$

$$y_2 = \overline{x_2} \overline{x_0} + x_2 x_0$$

$$y_3 = x_3 x_1 x_0 + \overline{x_3} \overline{x_0} + x_2 x_0$$

$$y_1 = \sum (0, 1, 2, 3) (13, 15)$$

$$y_2 = \sum (0, 2, 8, 10) (5, 7, 13, 15)$$

$$y_3 = \sum (11, 15) (0, 2, 4, 6) (5, 7, 13, 15)$$

$x_3 x_2$	$x_1 x_0$	00	01	11	10
00		1	0	0	1
01		0	0	0	0
11		0	1	0	0
10		0	0	0	0

y₁y₂

$x_3 x_2$	$x_1 x_0$	00	01	11	10
00		1	0	0	1
01		0	1	1	0
11		0	1	1	0
10		0	0	0	0

y₂y₃

$x_3 x_2$	$x_1 x_0$	00	01	11	10
00		1	0	0	1
01		0	0	0	0
11		0	1	1	0
10		0	0	0	0

y₁y₃

$$y_1 y_2 = \overline{x_3} \overline{x_2} \overline{x_0} + x_3 x_2 x_0$$

$$y_2 y_3 = \overline{x_3} \overline{x_2} \overline{x_0} + x_2 x_0$$

$$y_1 y_3 = \overline{x_3} \overline{x_2} \overline{x_0} + x_3 x_2 x_0$$

$$y_1 y_2 = \sum (0, 2) (13, 15)$$

$$y_2 y_3 = \sum (0, 2) (5, 7, 13, 15)$$

$$y_1 y_3 = \sum (0, 2) (13, 15)$$

$x_3 x_2$	$x_1 x_0$	00	01	11	10
00		1	0	0	1
01		0	0	0	0
11		0	1	1	0
10		0	0	0	0

$$y_1 y_2 y_3 = \overline{x_3} \overline{x_2} \overline{x_0} + x_3 x_2 x_0 = \sum (0, 2) (13, 15)$$

$$y_1 = \sum (0, 1, 2, 3) (13, 15)$$

$$y_2 = \sum (0, 2, 8, 10) (5, 7, 13, 15)$$

$$y_3 = \sum (11, 15) (0, 2, 4, 6) (5, 7, 13, 15)$$

$$y_1 y_2 = \sum (0, 2) (13, 15)$$

$$y_2 y_3 = \sum (0, 2) (5, 7, 13, 15)$$

$$y_1 y_3 = \sum (0, 2) (13, 15)$$

$$y_1 y_2 y_3 = \sum (0, 2) (13, 15)$$

		0	1	2	3	13	15	0	2	5	7	8	10	13	15	0	2	4	5	6	7	11	13	15	
0, 1, 2, 3	y ₁	x	x	x	x																				✓
13, 15	y ₁					x	x																		✓
0, 2, 8, 10	y ₂							x	x			x	x												✓
5, 7, 13, 15	y ₂									x	x			x	x										✓
11, 15	y ₃																				x		x		✓
0, 2, 4, 6	y ₃															x	x	x		x					✓
5, 7, 13, 15	y ₃																		x		x		x	x	✓
0, 2	y ₁ y ₂	x		x				x	x																✓
13, 15	y ₁ y ₂					x	x							x	x										✓
0, 2	y ₂ y ₃							x	x							x	x								✓
5, 7, 13, 15	y ₂ y ₃									x	x			x	x				x		x		x	x	✓
0, 2	y ₁ y ₃	x		x												x	x								✓
13, 15	y ₁ y ₃					x	x																x	x	✓
0, 2	y ₁ y ₂ y ₃	x		x				x	x							x	x								✓
13, 15	y ₁ y ₂ y ₃					x	x							x	x								x	x	✓

$$y_1 = \sum (0, 1, 2, 3) (13, 15)$$

$$y_2 = \sum (0, 2, 8, 10) (5, 7, 13, 15)$$

$$y_3 = \sum (11, 15) (0, 2, 4, 6) (5, 7, 13, 15)$$

B 3

$$y_1 = \sum (5, 7, 8, 9, 10, 11)$$

$$y_2 = \sum (1, 3, 5, 7, 8, 10, 12, 14)$$

$$y_3 = \sum (0, 1, 2, 3, 5, 7, 8, 10, 15)$$

$$y_1 y_2 = \sum (5, 7, 8, 10)$$

$$y_2 y_3 = \sum (1, 3, 5, 7, 8, 10)$$

$$y_1 y_3 = \sum (5, 7, 8, 10)$$

$$y_1 y_2 y_3 = \sum (5, 7, 8, 10)$$

$x_3 x_2$ \ $x_1 x_0$	00	01	11	10
00	0	0	0	0
01	0	1	1	0
11	0	1	0	0
10	1	1	0	1

y_1

$x_3 x_2$ \ $x_1 x_0$	00	01	11	10
00	0	1	1	0
01	0	1	1	0
11	1	0	0	1
10	1	0	0	1

y_2

$x_3 x_2$ \ $x_1 x_0$	00	01	11	10
00	1	1	1	1
01	0	1	1	0
11	0	0	1	0
10	1	0	0	1

y_3

$$y_1 = x_3 \bar{x}_2 \bar{x}_0 + x_3 \bar{x}_2 x_0 + \bar{x}_3 x_2 x_0$$

$$(8, 10) + (9, 11) + (5, 7)$$

$$y_2 = \bar{x}_3 x_0 + x_3 \bar{x}_0$$

$$(1, 3, 5, 7) + (8, 10, 12, 14)$$

$$y_3 = \bar{x}_2 \bar{x}_0 + \bar{x}_3 x_0 + x_2 x_1 x_0$$

$$(0, 2, 8, 10) + (1, 3, 5, 7) + (7, 15)$$

$x_3 x_2$ \ $x_1 x_0$	00	01	11	10
00	0	0	0	0
01	0	1	1	0
11	0	0	0	0
10	1	0	0	1

$y_1 y_2$

$$y_1 y_2 = x_3 \bar{x}_2 \bar{x}_0 + \bar{x}_3 x_2 x_0$$

$$(8, 10) + (5, 7)$$

$x_3 x_2$ \ $x_1 x_0$	00	01	11	10
00	0	1	1	0
01	0	1	1	0
11	0	0	0	0
10	1	0	0	1

$y_2 y_3$

$$y_2 y_3 = \bar{x}_3 x_0 + x_3 \bar{x}_2 \bar{x}_0$$

$$(1, 3, 5, 7) + (8, 10)$$

$x_3 x_2$ \ $x_1 x_0$	00	01	11	10
00	0	0	0	0
01	0	1	1	0
11	0	0	0	0
10	1	0	0	1

$y_1 y_3$

$$y_1 y_3 = x_3 \bar{x}_2 \bar{x}_0 + \bar{x}_3 x_2 x_0$$

$$(8, 10) + (5, 7)$$

$x_3 x_2$ \ $x_1 x_0$	00	01	11	10
00	0	0	0	0
01	0	1	1	0
11	0	0	0	0
10	1	0	0	1

$$y_1 y_2 y_3 = x_3 \bar{x}_2 \bar{x}_0 + \bar{x}_3 x_2 x_0$$

$$(8, 10) + (5, 7)$$

	y_1	5	7	8	9	10	11	1	3	5	7	8	10	12	14	0	1	2	3	5	7	8	10	15	
8, 10	1			X		X																			
9, 11	1				X		X																		✓
5, 7	1	X	X																						
1, 3, 5, 7	2							X	X	X	X														
8, 10, 12, 14	2											X	X	X	X										✓
0, 2, 8, 10	3															X		X					X	X	✓
1, 3, 5, 7	3																X		X	X	X				
7, 15	3																				X		X		✓
8, 10	12			X		X						X	X												
5, 7	12	X	X							X	X														
1, 3, 5, 7	23							X	X	X	X						X		X	X	X				✓
8, 10	23											X	X									X	X		
8, 10	13			X		X																X	X		
5, 7	13	X	X																	X	X				
8, 10	123			X		X						X	X									X	X		✓
5, 7	123	X	X							X	X								X	X					✓

$$y_1 = x_3 \bar{x}_2 \bar{x}_0 + x_3 \bar{x}_2 x_0 + \bar{x}_3 x_2 x_0$$

$$y_2 = \bar{x}_3 x_0 + x_3 \bar{x}_0$$

7 zumeist 8

$$y_3 = \bar{x}_2 \bar{x}_0 + \bar{x}_3 x_0 + x_2 x_1 x_0$$

C1

$$y = \sum (0, 2, 4, 5, 6, 7, 11, 13, 15)$$

$x_3 \backslash x_2$	00	01	11	10
00	1	0	0	1
01	1	1	1	1
11	0	1	1	0
10	0	0	1	0

$$y = \bar{x}_3 \bar{x}_0 + x_2 x_0 + x_3 x_1 x_0$$

 $x_3 \rightarrow 2$ raz

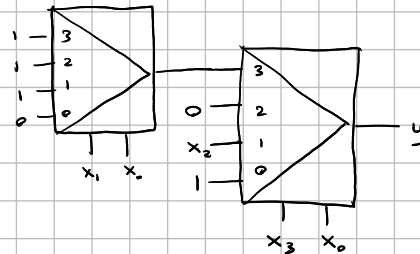
 x_3 i x_0 na
vejšću staviš

 $x_2 \rightarrow 1$ raz

 $x_1 \rightarrow 1$ raz

 $x_0 \rightarrow 3$ raz

$x_3 \ x_0$	y
0 0	$1 \cdot 1 + x_2 \cdot 0 + x_1 \cdot 0 = 1 + 0 = 1$
0 1	$1 \cdot 0 + x_2 \cdot 1 + 0 \cdot x_1 \cdot 1 = 0 + x_2 + 0 = x_2$
1 0	$0 \cdot 1 + x_2 \cdot 0 + 1 \cdot x_1 \cdot 0 = 0 + 0 + 0 = 0$
1 1	$0 \cdot 0 + x_2 \cdot 1 + 1 \cdot x_1 \cdot 1 = x_2 + x_1$



C2

$$y = \sum (0, 1, 3, 5, 7, 10, 11, 14, 15)$$

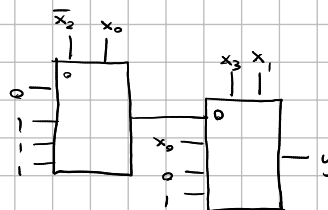
$x_3 \backslash x_2$	00	01	11	10
00	1	1	1	0
01	0	1	1	0
11	0	0	1	1
10	0	0	1	1

$$y = x_3 x_1 + \bar{x}_3 x_0 + \bar{x}_3 \bar{x}_2 \bar{x}_1$$

 $x_3 \rightarrow 3$
 $x_3 x_1$ na vejšću staviš

 $x_2 \rightarrow 1$
 $x_1 \rightarrow 2$
 $x_0 \rightarrow 1$

$x_3 \ x_1$	y
0 0	$0 \cdot 0 + 1 \cdot x_0 + 1 \cdot \bar{x}_2 \cdot 1 = x_0 + \bar{x}_2$
0 1	$0 \cdot 1 + 1 \cdot x_0 + 1 \cdot \bar{x}_2 \cdot 0 = x_0$
1 0	$1 \cdot 0 + 0 \cdot x_0 + 0 \cdot \bar{x}_2 \cdot 1 = 0$
1 1	$1 \cdot 1 + 0 \cdot x_0 + 0 \cdot \bar{x}_2 \cdot 0 = 1$



C3

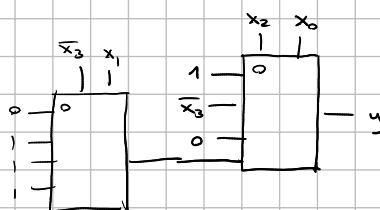
$$y = \sum (0, 1, 2, 3, 5, 7, 8, 10, 15)$$

$x_3 \backslash x_2$	00	01	11	10
00	1	1	1	1
01	0	1	1	0
11	0	0	1	0
10	1	0	0	1

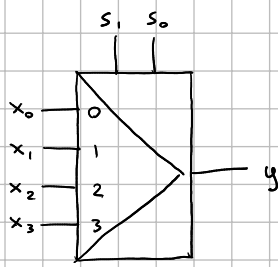
$$y = \bar{x}_2 \bar{x}_0 + \bar{x}_3 x_0 + x_2 x_1 x_0$$

 $x_3 \rightarrow 1$
 $x_2 \rightarrow 2$
 $x_1 \rightarrow 1$
 $x_0 \rightarrow 3$

$x_2 \ x_0$	y
0 0	$1 + 0 + 0 = 1$
0 1	$0 + \bar{x}_3 + 0 = \bar{x}_3$
1 0	$0 + 0 + 0 = 0$
1 1	$0 + \bar{x}_3 + x_1 = \bar{x}_3 + x_1$



Multiplexer 4-1



s_1	s_0	y
0	0	x_0
0	1	x_1
1	0	x_2
1	1	x_3

$$y = \bar{s}_1 \bar{s}_0 x_0 + \bar{s}_1 s_0 x_1 + s_1 \bar{s}_0 x_2 + s_1 s_0 x_3$$