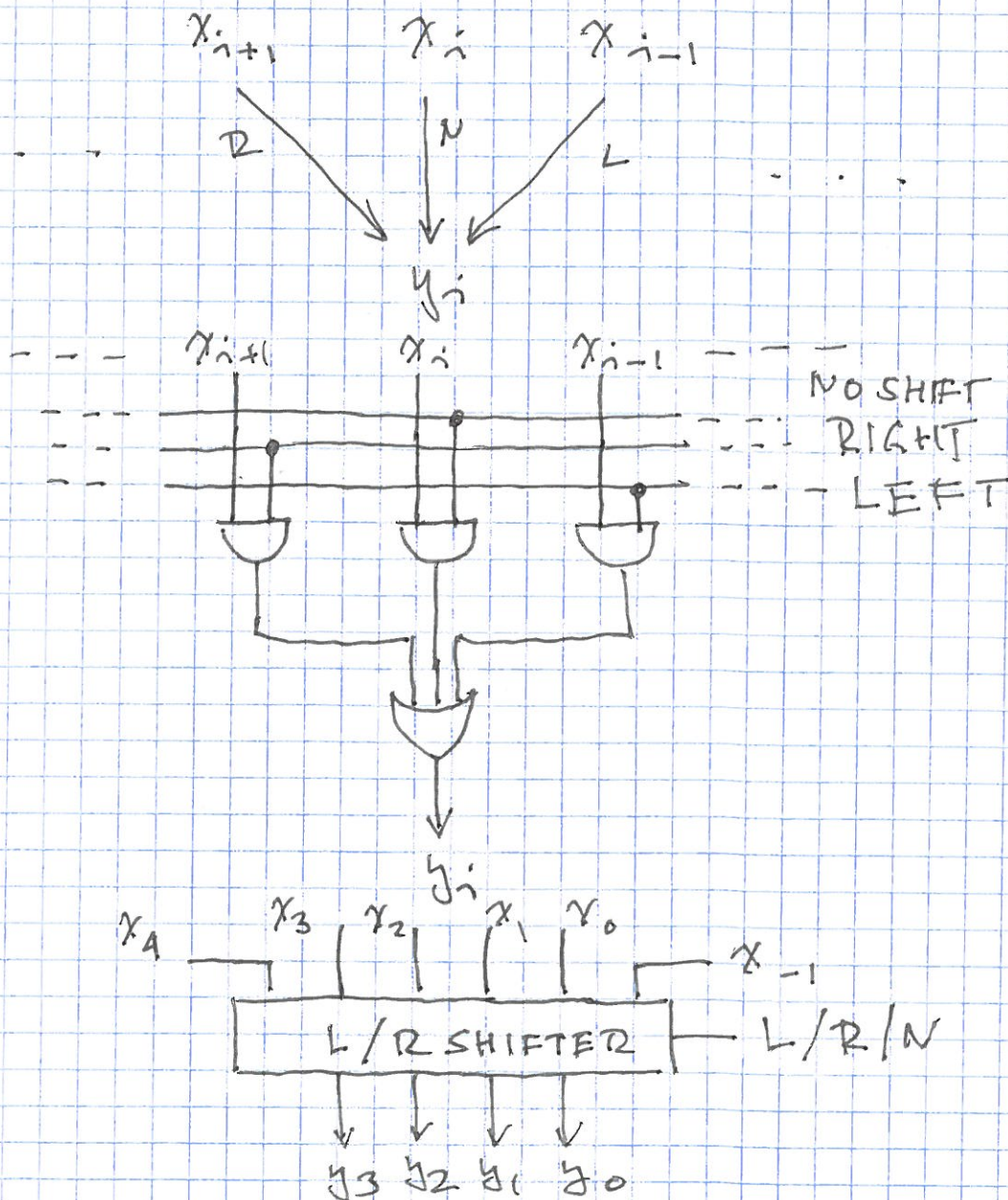
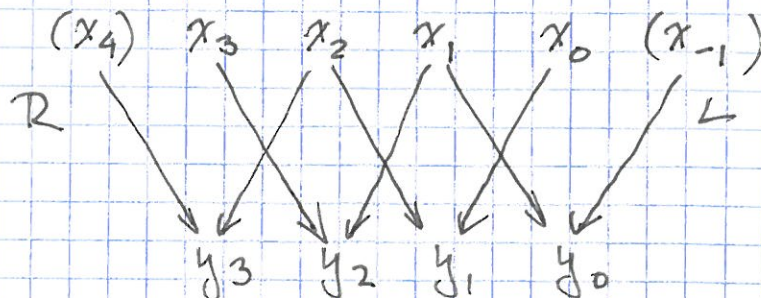


NOTES ON SHIFTERS

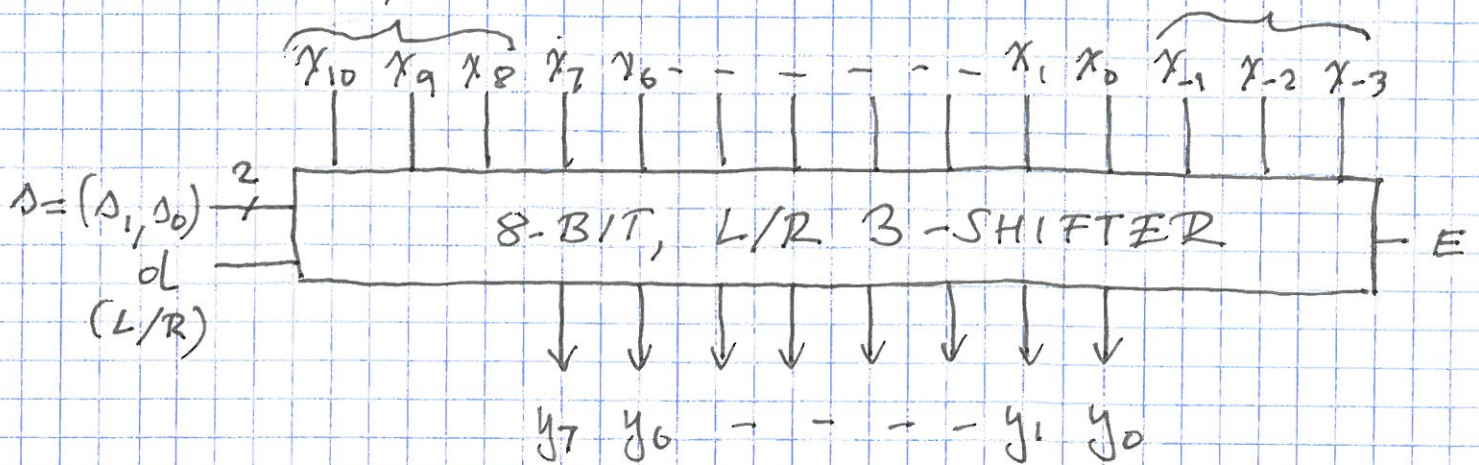
— FOR UNIFORM BIT-VECTOR MOVEMENTS;
LEFT / RIGHT; 1, 2, 3 ..., p POSITIONS

INPUT:



D-SHIFTER, BIDIRECTIONAL (UNIDIRECTIONAL)

8-BIT, 3-SHIFTER:

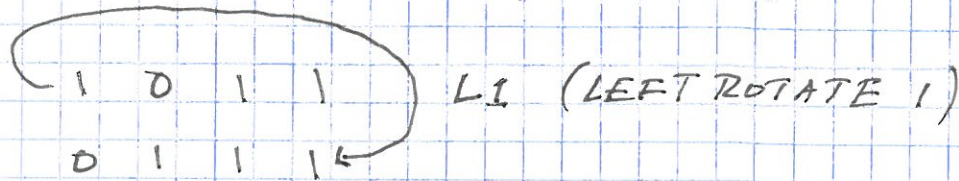


EXAMPLE:

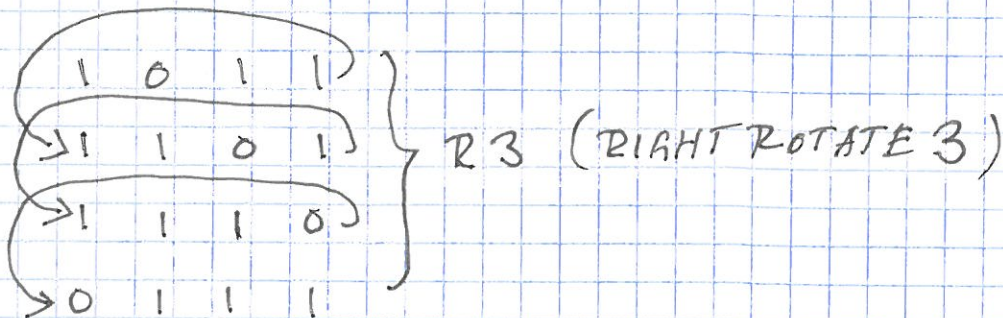


ROTATOR (LEFT/RIGHT)

$n=4$



$L1$ (LEFT ROTATE 1)



$R3$ (RIGHT ROTATE 3)

$$La = R(n-a)$$

LEFT ROTATE BARREL SHIFTER

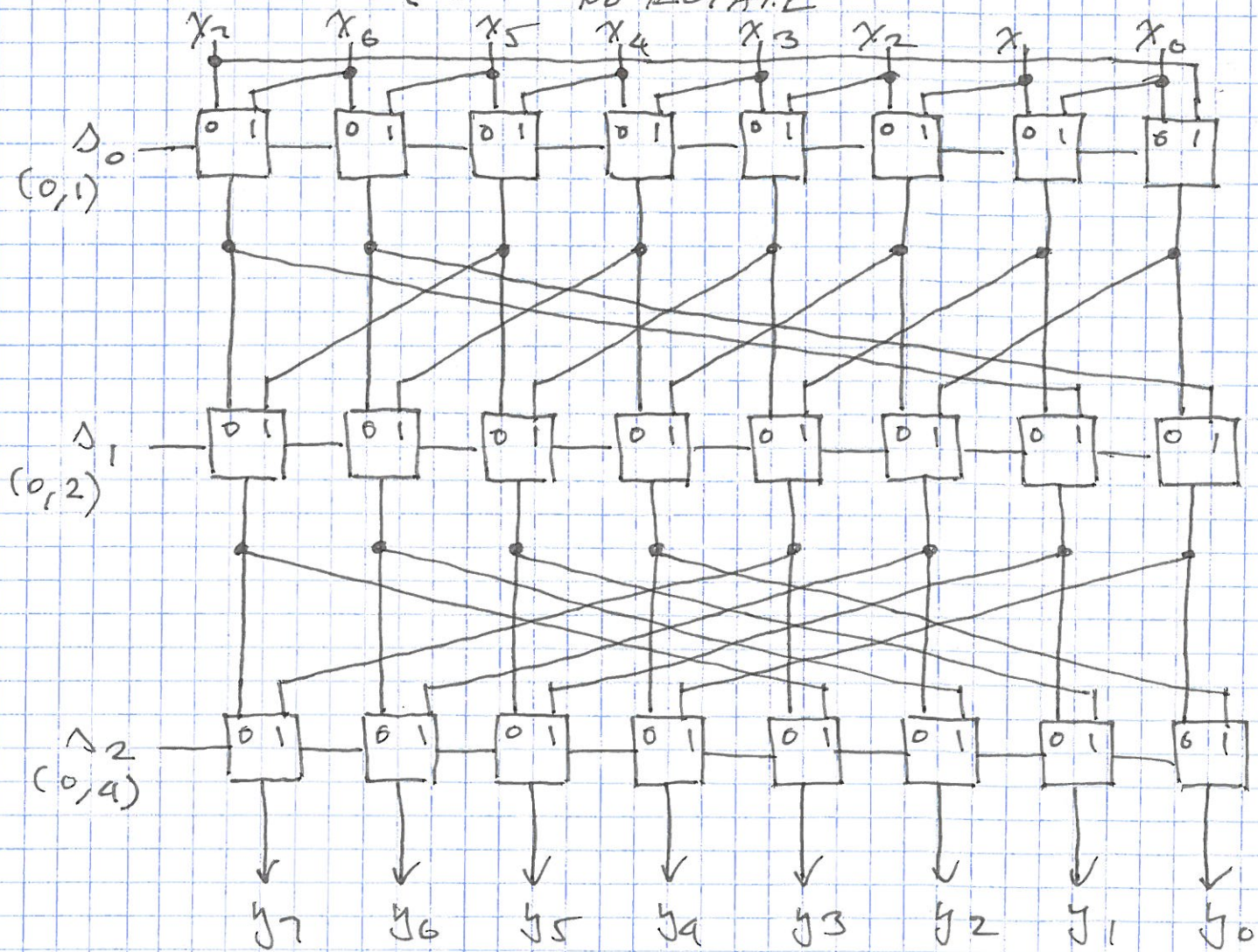
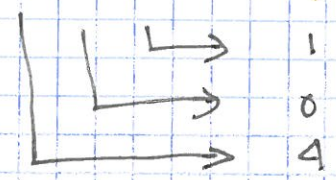
ROTATE DISTANCE $\Delta = \sum_{i=0}^n \Delta_i 2^i$

$\Delta_0 = \begin{cases} 1 & \text{ROTATE 1} \\ 0 & \text{NO ROTATE} \end{cases}$

$\Delta_1 = \begin{cases} 1 & \text{ROTATE 2} \\ 0 & \text{NO ROTATE} \end{cases}$

$\Delta_2 = \begin{cases} 1 & \text{ROTATE 4} \\ 0 & \text{NO ROTATE} \end{cases}$

$\Delta = 5$
 $= 101$ ROTATE



RL2 \equiv RL6 x5 x4 x3 x2 x1 x0 x7 x6
 RL1 \equiv RL7 x0 x7 x6 x5 x4 x3 x2 x1

EXAMPLES OF ROTATIONS:

④

IN $x_7 \ x_6 \ x_5 \ x_4 \ x_3 \ x_2 \ x_1 \ x_0$

RR6
≡ RL2

$\Delta = (010)$

	x_7	x_6	x_5	x_4	x_3	x_2	x_1	x_0	ROTATE
STAGE 1	x_7	x_6	x_5	x_4	x_3	x_2	x_1	x_0	0
STAGE 2	x_5	x_4	x_3	x_2	x_1	x_0	x_7	x_6	2
STAGE 3 (OUT)	x_5	x_4	x_3	x_2	x_1	x_0	x_7	x_6	0

RL7

$\Delta = (111)$

	x_6	x_5	x_4	x_3	x_2	x_1	x_0	x_7	ROTATE
STAGE 1	x_6	x_5	x_4	x_3	x_2	x_1	x_0	x_7	1
STAGE 2	x_4	x_3	x_2	x_1	x_0	x_7	x_6	x_5	2
STAGE 3 (OUT)	x_0	x_7	x_6	x_5	x_4	x_3	x_2	x_1	4

P-SHIFTER CAN BE USED TO
MULTIPLY AND DIVIDE BY POWERS
OF 2.

$$(L) \quad y = x \cdot 2^{\Delta} \quad \Delta = \{0, 1, 2, \dots, p\}$$

$$(R) \quad z = \left\lfloor \frac{x}{2^{\Delta}} \right\rfloor$$

$$x = 0 \ 0 \ 0 \ 0 \ 0 \ 1 \ 0 \ 1 = 5$$

$$L3(x) = 0 \ 0 \ 1 \ 0 \ 1 \ 0 \ 0 \ 0 = 40 = 5 \times 2^3$$

$$x = 0 \ 0 \ 0 \ 0 \ 1 \ 1 \ 0 \ 1 = 13$$

$$R2(x) = 0 \ 0 \ 0 \ 0 \ 0 \ 0 \ 1 \ 1 = 3 = \left\lfloor 13 \cdot 2^{-2} \right\rfloor$$