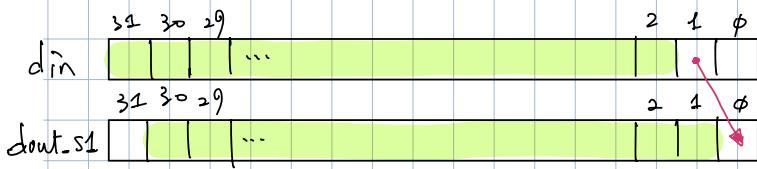


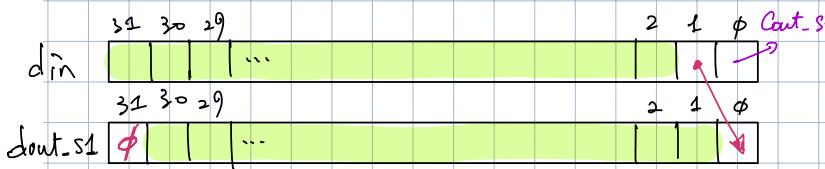
Shift 1



00 CSR
01 ASR
10 ROR

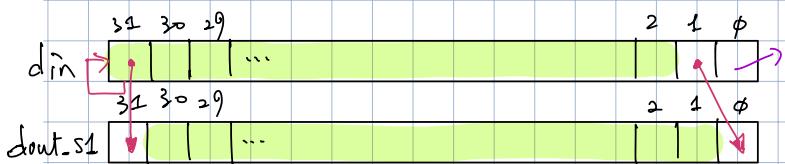
carry: parity nb, etc.

LSL, ASR, ROR, shift_val(φ) = 1.
 $dout_{s1}(30 \text{ down to } 1) \Leftarrow din(31 \text{ down to } 2)$
 $dout_{s1}(\phi) \Leftarrow din(1)$



LSL, ASR, ROR, shift_val(φ) = 1.

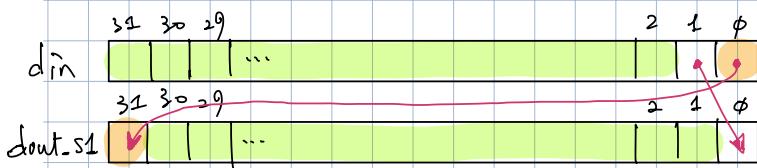
[- idem -]
 $dout_{s1}(31) \Leftarrow '0'$
 $Carry_{s1} \Leftarrow din(\phi)$



ASR, shift_val(φ) = 1.

[- idem -]

$dout_{s1}(31) \Leftarrow din(31)$
 $Carry_{s1} \Leftarrow din(\phi)$ last bit shifted out of the Register



ROR, shift_val(φ) = 1.

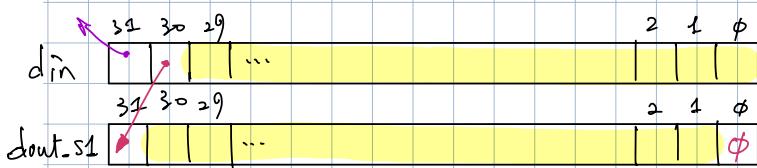
[- idem -]

$dout_{s1}(31) \Leftarrow din(\phi)$

$Carry_{s1} \Leftarrow din(1)$!!

* For rotate-without-carry (ROR) operations, the carry flag mirrors the LSB after rotation

Count_{s1}



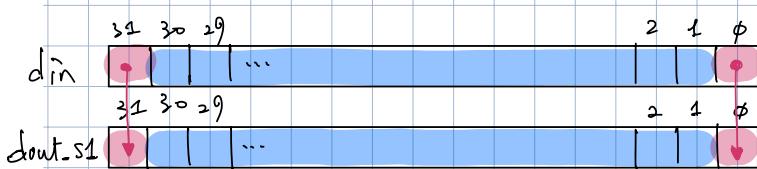
LSL, shift_val(φ) = 1

$dout_{s1}(30 \text{ down to } 1) \Leftarrow din(29 \text{ down to } \phi)$

$dout_{s1}(\phi) \Leftarrow '0'$

$dout_{s1}(31) \Leftarrow din(30)$

$Carry_{s1} \Leftarrow din(31)$



shift_val(φ) = φ

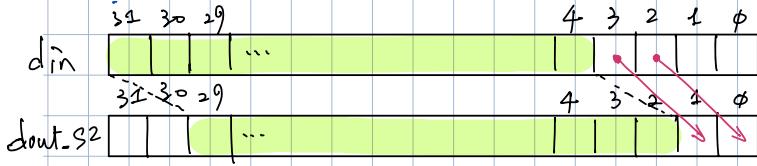
$dout_{s1}(30 \text{ down to } 1) \Leftarrow din(30 \text{ down to } 1)$

$dout_{s1}(\phi) \Leftarrow din(\phi)$

$dout_{s1}(31) \Leftarrow din(31)$

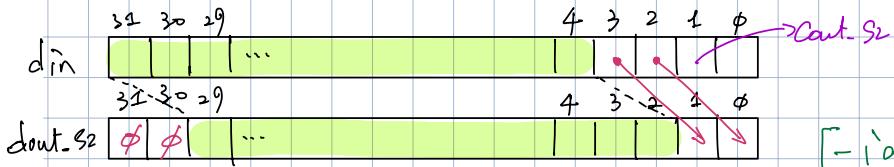
$Carry_{s1} \Leftarrow Cin$

Shift 2



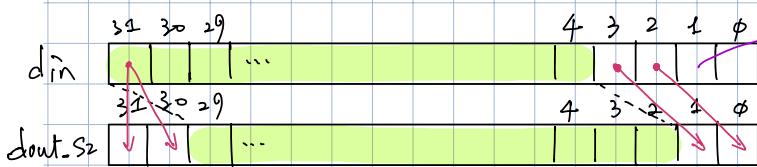
LSR, ASR, ROR, shift_val(1) = 1

dout_S2 (29 downto 2) \Leftarrow din (31 downto 4)
dout_S2 (1 downto φ) \Leftarrow din (3 downto 2)



LSR, shift_val(1) = 1

[- idem -]



dout_S2 (31 downto 30) \Leftarrow "φφ"

Cout_S2 \Leftarrow din(1)

ASR, shift_val(1) = 1

[- idem -]

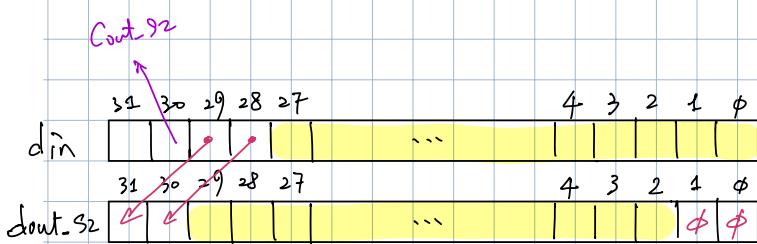


dout_S2 (31 downto 30) \Leftarrow din(31) & din(32)

Cout_S2 = din(31)

ROR, shift_val(1) = 1

[- idem -]



dout_S2 (31 downto 30) \Leftarrow din (1 downto φ)

Cout_S2 \Leftarrow din(2)



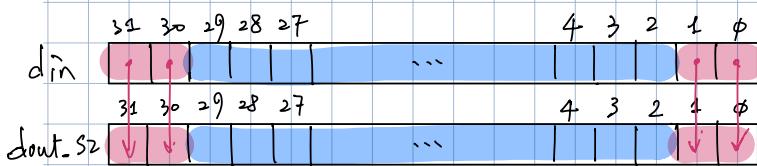
LSL, shift_val(1) = 1

dout_S2 (29 downto 2) \Leftarrow din (27 downto φ)

dout_S2 (1 downto φ) \Leftarrow "φφ"

dout_S2 (31 downto 30) \Leftarrow din (29 downto 28)

Cout_S2 \Leftarrow din(30)



/, shift_val(1) = φ

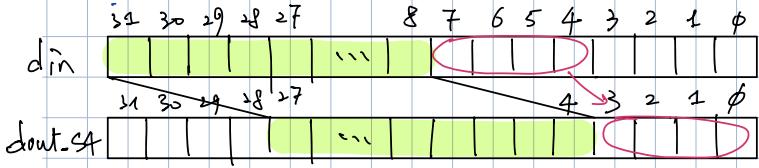
dout_S2 (29 downto 2) \Leftarrow din (29 downto 2)

dout_S2 (31 downto 30) \Leftarrow din (31 downto 30)

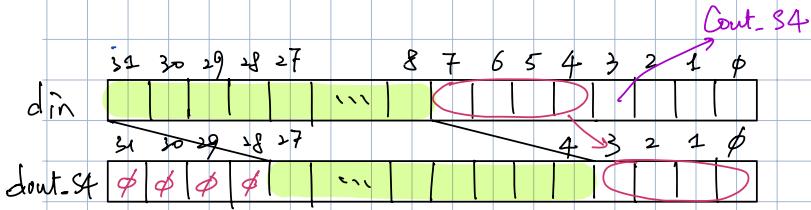
dout_S2 (1 downto φ) \Leftarrow din (1 downto φ)

Cout_S2 \Leftarrow Cin.

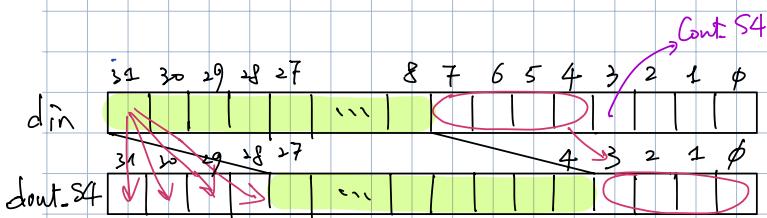
Shift 4



$\text{LSR, ASR, ROR, shift_val}(2) = 1$
 $\text{dout_S4}(27 \text{ down to } 4) \Leftarrow \text{din}(31 \text{ down to } 8)$
 $\text{dout_S4}(3 \text{ down to } \phi) \Leftarrow \text{din}(7 \text{ down to } 4)$



$\text{LSR, shift_val}(2) = 1$
[- idem -]

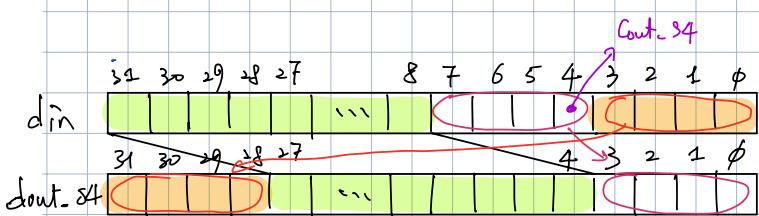


$\text{dout_S4}(31 \text{ down to } 8) \Leftarrow "φφφφ"$
 $\text{Cout_S4} \Leftarrow \text{din}(3)$

$\text{ASR, shift_val}(2) = 1$
[- idem -]

$\text{dout_S4}(31 \text{ dt } 8) \Leftarrow \text{din}(31) \& \text{din}(31)$
 $\text{Cout_S4} \Leftarrow \text{din}(3) \quad \& \text{din}(31) \& \text{din}(31)$

$\text{ROR, shift_val}(2) = 1$
[- idem -]



$\text{dout_S4}(31 \text{ dt } 8) \Leftarrow \text{din}(3 \text{ dt } \phi)$
 $\text{Cout_S4} \Leftarrow \text{din}(4)$

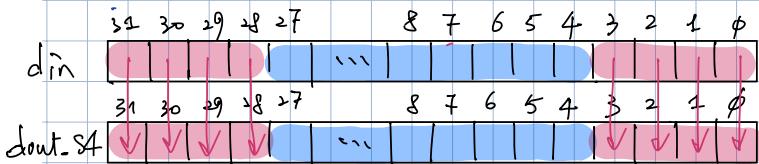
$\text{LSL, shift_val}(2) = 1$

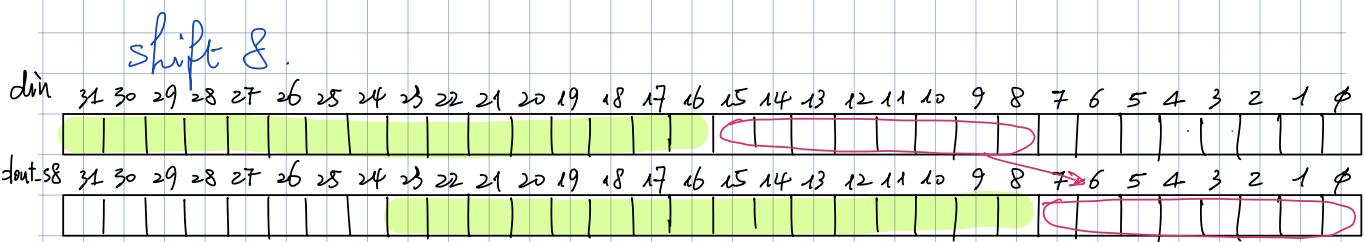
$\text{dout_S4}(27 \text{ down to } 4) \Leftarrow \text{din}(23 \text{ down to } \phi)$
 $\text{dout_S4}(3 \text{ down to } \phi) \Leftarrow "φφφφ"$
 $\text{dout_S4}(31 \text{ dt } 28) \Leftarrow \text{din}(27 \text{ dt } 24)$
 $\text{Cout_S4} \Leftarrow \text{din}(28)$

✓ $\text{shift_val}(2) = \phi$



$\text{dout_S4}(27 \text{ down to } 4) \Leftarrow \text{din}(27 \text{ dt } 4)$
 $\text{dout_S4}(3 \text{ dt } \phi) \Leftarrow \text{din}(3 \text{ dt } \phi)$
 $\text{dout_S4}(31 \text{ dt } 28) \Leftarrow \text{din}(31 \text{ dt } 28)$
 $\text{Cout_S4} \Leftarrow \text{din}$



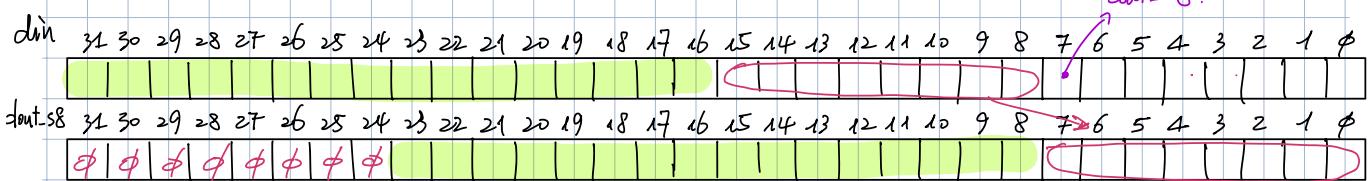


LSR, ASR, ROR. shift_val(3) = 1.

$$\text{dout_58 (23 downto 0)} \Leftarrow \text{din(31 downto 26)}$$

$$\text{dout_8 (7 downto } \phi\text{)} \Leftarrow \text{din(15 downto 8)}$$

Cout-58.



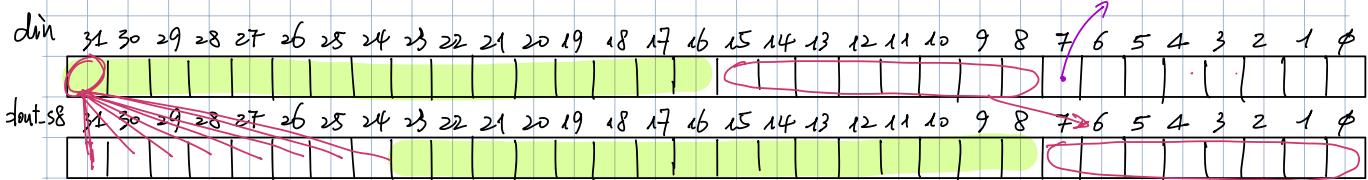
LSR, shift_val(3) = 1

[- idem -]

$$\text{dout_58 (31 downto 24)} \Leftarrow "φφφφφφφφ"$$

$$\text{Cout-58} \Leftarrow \text{din}(7)$$

Cout-58



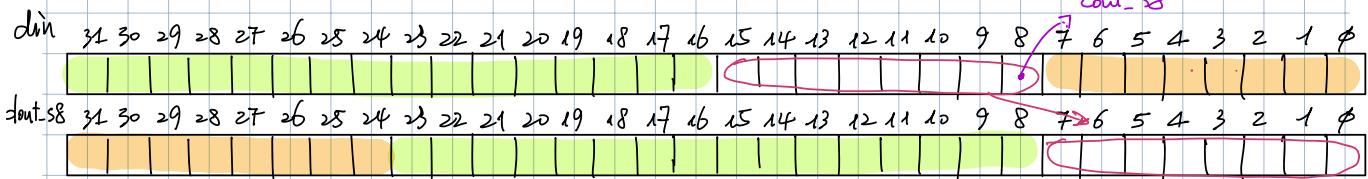
ASR Shift_val(3) = 1

[- idem -]

$$\text{dout_58 (31 downto 24)} \Leftarrow \text{din(31) \& din(31) \& din(31) \& din(31) \&}$$

$$\text{Cout-58} \Leftarrow \text{din(7)}$$

Cout-58



ROR Shift_val(3)=1

[- idem -]

$$\text{dout_58 (31 downto 24)} \Leftarrow \text{din(7) downto } \phi$$

$$\text{Cout-58} \Leftarrow \text{din(8)}$$

Δ

$$\begin{aligned} \text{dout_s8 (23 downto 8)} &\Leftarrow \text{din (15 downto } \phi) \\ \text{dout_s8 (31 downto 24)} &\Leftarrow \text{din (27 downto 16)} \\ \text{dout_s8 (7 downto } \phi) &\Leftarrow \text{"}\phi\phi\phi\phi\phi\phi\phi\phi\phi\text{"} \\ \text{Cont_s8} &\Leftarrow \text{din (24)} \end{aligned}$$

$$\begin{array}{l}
 \text{shift_val}(3) = \phi \\
 \text{dout_s8} \quad (23 \text{ downto } 8) \Leftarrow \text{din} (23 \text{ downto } 8) \\
 \text{dout_s8} \quad (31 \text{ downto } 24) \Leftarrow \text{din} (31 \text{ downto } 24) \\
 \text{dout_s8} \quad (7 \text{ downto } \phi) \Leftarrow \text{din} (7 \text{ downto } \phi) \\
 \text{Cout_s8} \quad \Leftarrow \text{Cin}.
 \end{array}$$

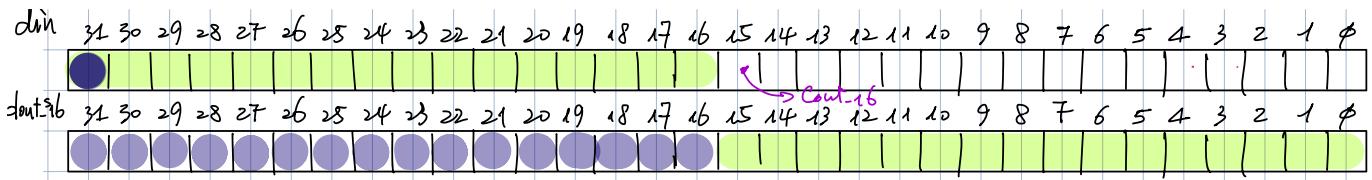
Shift 16.

LSR, ASR, RoR. shift_val(4) = 1

dout_s16 (15 downto 0) <= din (31 downto 16)

LSR shift_val(4) = 1
F- [idem-]

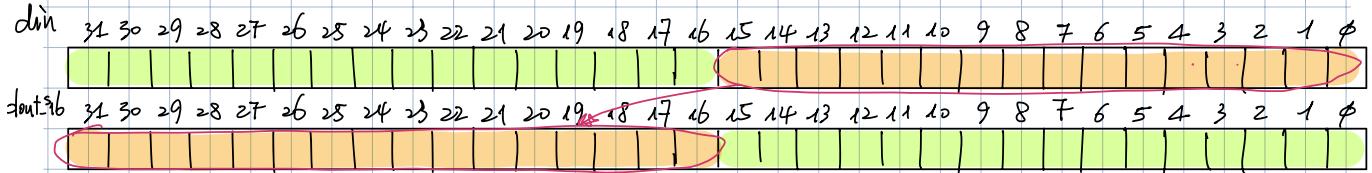
`down_s16(31 downto 16) <= "00000000000000000000000000000000"`
`out_16 <= din(15)`



$$ASR \quad \text{shift val}(4) = 1$$

[- idem -]

$$\text{dout_sub}(31 \text{ downto } 16) \Leftarrow \text{din}(31) \& \text{din}(30) \& \dots \& \text{din}(15).$$

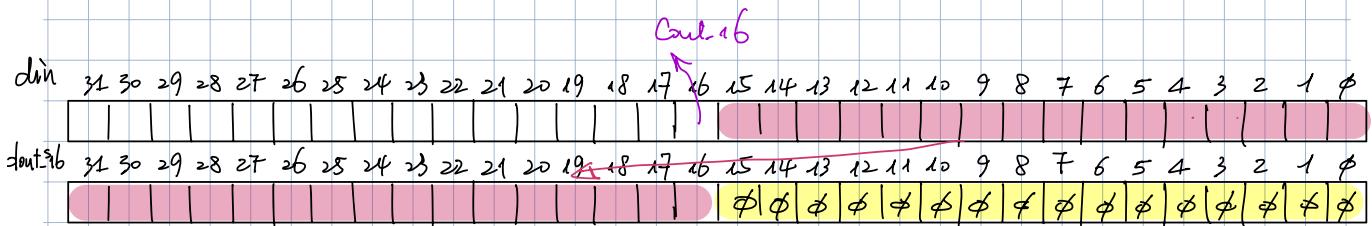


ROR shift_val(4) = 1

[- idem -]

$$\text{dout_16} \leftarrow (\text{31 downto } 16) \Leftarrow \text{din} \left(15 \text{ down to } \phi \right)$$

$$\text{cout_16} \Leftarrow \text{din}(16)$$

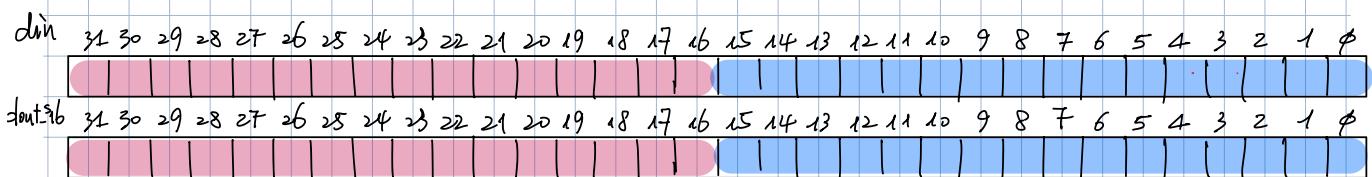


LSL shift_val(4) = 1.

dout. set (15 domínio φ) ⊂ "φ φ φ φ φ φ φ φ φ φ φ φ φ"

dout_ sib (31 douts 16) <= din (15 douts φ)

$$\text{Count}_{-16} \leq \text{dim}(16)$$



$$\text{shift_val} = \phi$$

dout-s16 (15 doutos #) = din (15 douts #)

dout_s6 (31 douto 16) C= din (31 duto 16)

$$\text{Cont_16} \leftarrow \text{Cin}$$