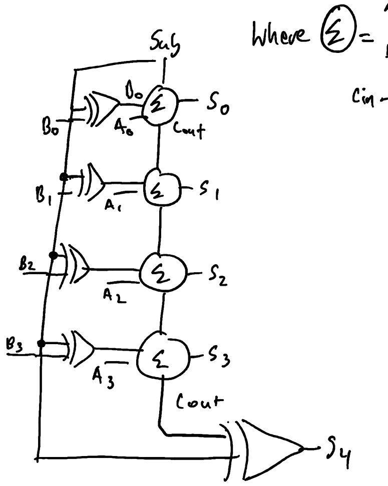
EE10 HW4

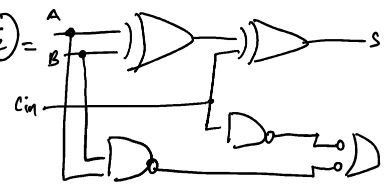
Friday, February 3, 2023 4:35 PM

4bit Adder:



Corrects Cout signal Bout

Where Σ =



Add/Sub Equation

$S_0 = [(B_0 \oplus Sub) \oplus A_0] \oplus (Sub)$ $\quad Cout_0 = A_0(B_0 \oplus Sub) + (A_0 \oplus (B_0 \oplus Sub))\,Sub$

$S_1 = ((B_1 \oplus Sub) \oplus A_1) \oplus Cout_0$ $\quad Cout_1 = A_1(B_1 \oplus Sub) + (A_1 \oplus (B_1 \oplus Sub))\,Cout_0$

$S_2 = ((B_2 \oplus Sub) \oplus A_2) \oplus Cout_1$ $\quad Cout_2 = A_2(B_2 \oplus Sub) + (A_2 \oplus (B_2 \oplus Sub))\,Cout_1$

$S_3 = ((B_3 \oplus Sub) \oplus A_3) \oplus Cout_2$

$S_4 = (A_3(B_3 \oplus Sub) + A_3 \oplus (B_3 \oplus Sub))\,Cout_2$ $\quad Cout_3 = (S_4 \oplus Sub)$

$\boxed{Zero = \overline{S_3}\,\overline{S_2}\,\overline{S_1}\,\overline{S_0}}$

Overflow: Only for signed

Subtraction can be treated as addition:

0111	Case 1:			Case 2:		
0000	+ Positive	0111	+7	+Negative	1011	-5
	+ Positive	00111	+7	+Negative	11011	-5
0111	Negative	01110	-2	Positive	10110	-6

$Cout_2\overline{S_4} + \overline{Cout_2}S_4 = \boxed{Cout_2 \oplus S_4}$

Sign $= S_3$

1 → Unsigned ⇒ S_3

1 → Signed ⇒ S_3

Carry $= S_4$

1 → Unsigned ⇒ S_4

Signed ⇒ S_4

2's complement

0 min ⟶ 7 max | -8 ⟶ min → -1 max

Unsign Comparisons

1010 = 1010 → $\boxed{Zero = UnSignEq}$

1010 > 1001 C: 0
10 - 9 S: X – Shouldn't matter
Cannot overflow 0: X
Z: 0

1010 > 0001 C: 0
S: X
O: X
Z: 0

$\boxed{C\,\overline{Z} = \text{Unsigned GT}}$

$\boxed{\text{Unsign LT} = \overline{(\text{UnsignEq} + \text{UnsignGT})}}$

Sign Comparisons

1001 - 1001 = $\boxed{Zero = SignEq}$

+A > +B

C: 0
S: 0
Z: 0
O: 0

+A > -B

C: Always 1
S: Could be negative or not depending on overflow
Z: 0
O: Could overflow or not
(7 - (-5)) (6 - (-7))

COS+

Since |A| < |B|, then -A-(-B) > 0

-A > -B

C: 0
S: 0
Z: 0
O: 0

		A>B		A<B	
-5	:	1011		1011	-5
-6		1010		0100	-(+4)
	Cout=1	0001		1111	
	Bout=0			Cout=0	
				Bout=1	

Carry for Subtraction: Bout

	5	0101	Cout=0	0101	5
+	-(-2)	0010	Bout=1	0100	+(-(-4))
		0111		1001	
				Cout=0 Bout=1	Overflow: 1 Sign: 1

$\hookrightarrow \overline{Z}(\overline{C}\,\overline{O}\,\overline{S} + C(OS + \overline{O}\,\overline{S}))$

$\boxed{\overline{Z}(\overline{C}\,\overline{O}\,\overline{S} + C(\overline{O \oplus S})) = \text{Signed GT}}$

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

= $\overline{\text{XOR}}$

Signed LT = ‾‾‾‾

Carry

for subtraction: Bout

0 0 1

$$\boxed{\text{SignedLT} = \overline{(\text{SignedGT}) + \text{Zero}}}$$