CS232 Week3 Q3

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1 Design of Four Bit Adder/Subtractor

In case of subtraction, we note the following:

$$\begin{aligned} & a - b \mod 2^n \\ & = a - b + 2^n \mod 2^n \\ & = a + (2^n - 1 - b) + 1 \mod 2^n \\ & = a + \bar{b} + 1 \mod 2^n \quad (*) \end{aligned}$$

where $\bar{b}$ is produced by inverting all bits of b. Thus for addition, we consider a signal $b_2 = b$ and for subtraction $b_2 = \bar{b}$. Thus,

$$b_2(i) = b(i) \oplus cin \quad \forall\ i$$

Now, we add b_2 and a using the Four Bit Ripple Adder, taking the carry bit as 0 for addition and 1 for subtraction, thus accounting for the $+1$ in $(*)$.

$$sum, cout = \text{FourBitRippleAdder}(a, b, cin)$$