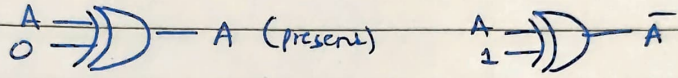
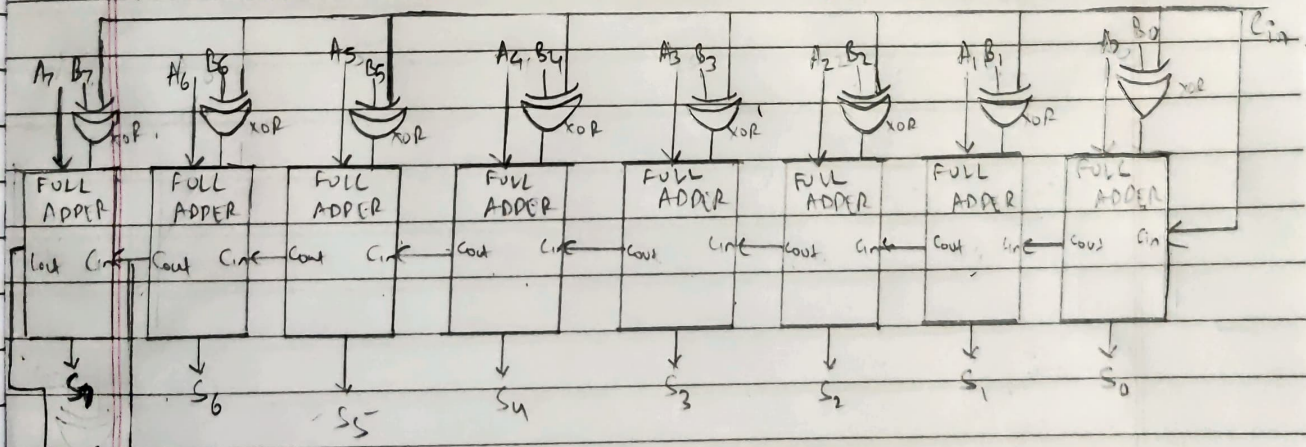
Eight bit adder/subtractor.

To add the functionality of subtraction to the eight bit adder, we use the concept that the addition of the 2's complement of a number is equivalent to subtraction. Additionally, we know that the 2's complement of a number is obtained by flipping all of its bits and adding 1.

~~To~~ Another ~~opera~~ observation: XOR gate can preserve or invert a boolean bit depending on the input at the other terminal, i.e.



The below given circuit diagram works as an adder for $C_{in} = 0$ and subtracter for $C_{in} = 1$ (Notice when $C_{in} = 1$ each bit of B will be inverted and we add 1 to A+ 1's complement of B, which is A − B). when $C_{in} = 0$, each bit of B is preserved, there is no carry in, and the result obtained is A + B as required.



Since we follow 2's complement notation, if S_7 is 0, then the obtained number is positive, else it is negative. Additionally, if the carry in to the last (MS) bit is not equal to the carry out of the last adder, then there is overflow. If the output of XOR gate V is 0, there is no overflow. If 1, there is overflow.