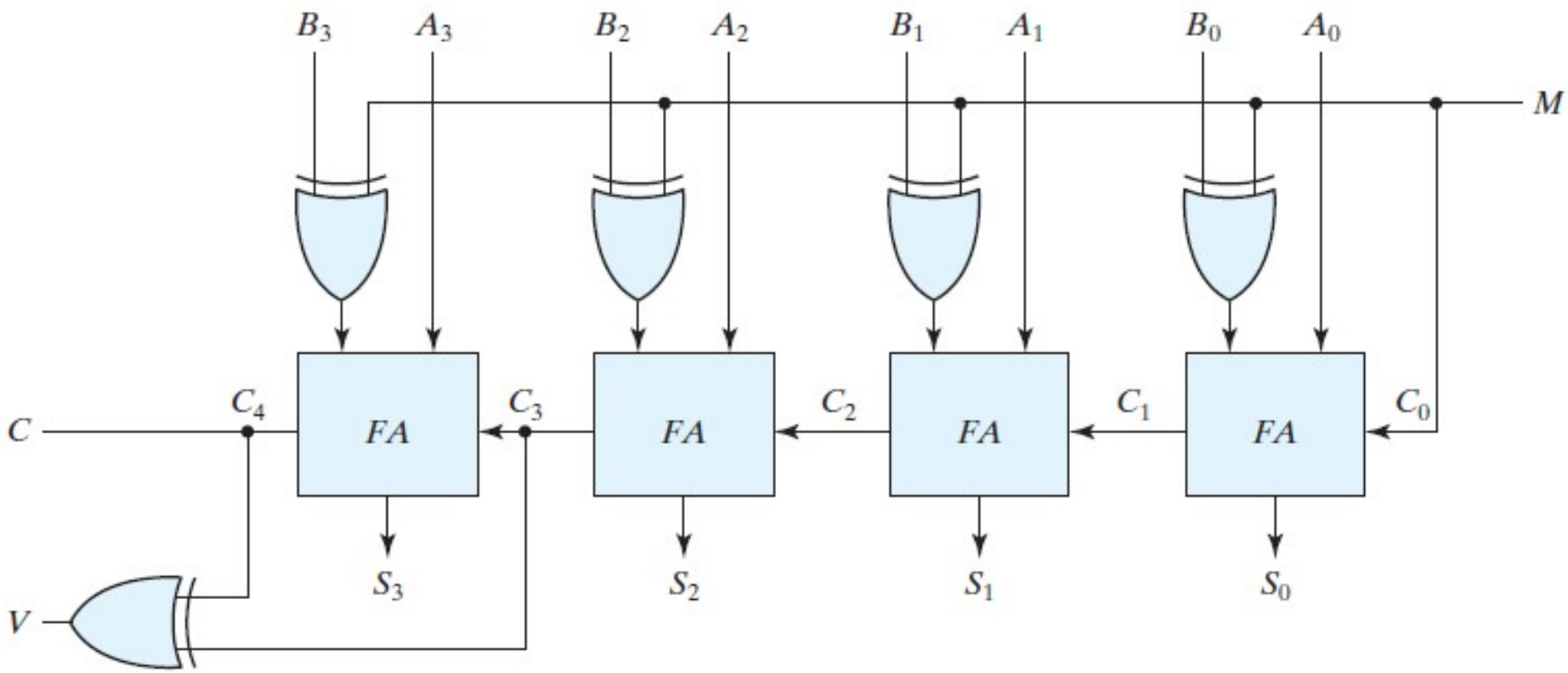
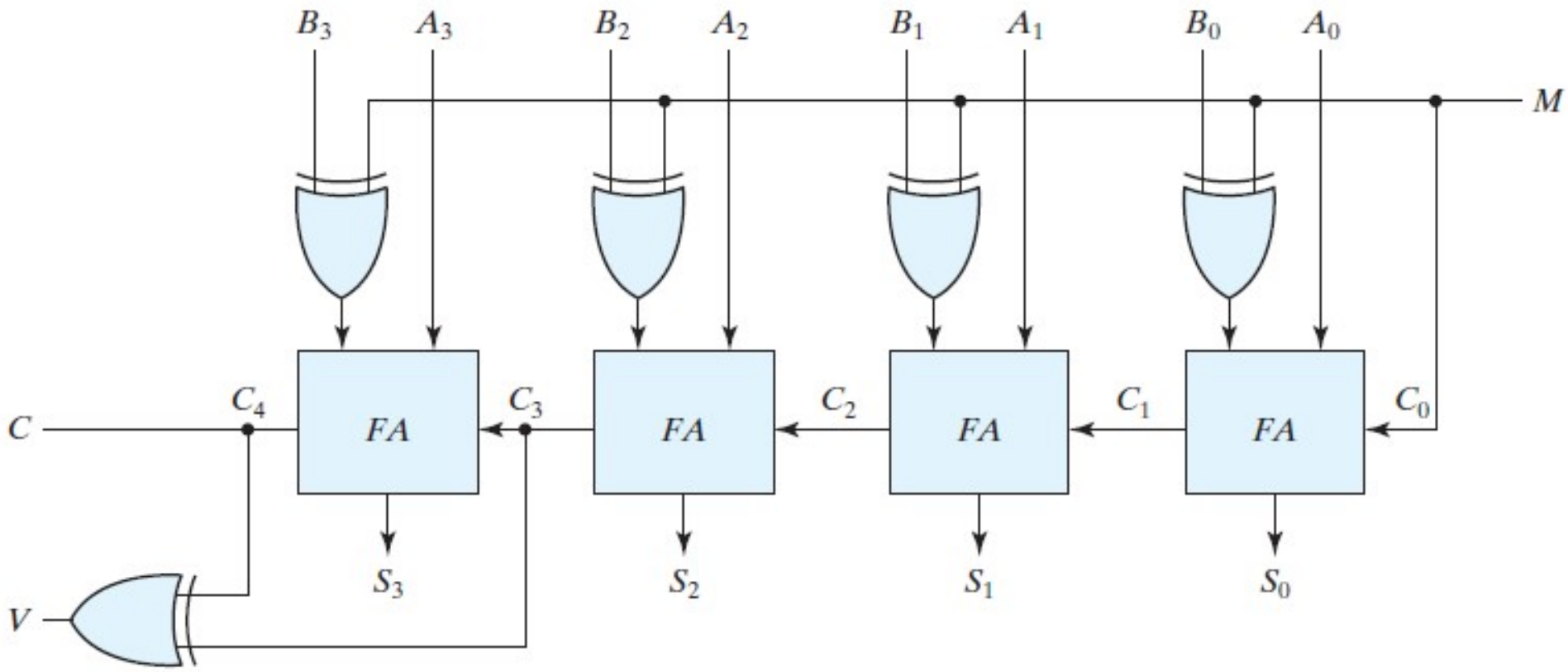
Four-Bit Adder–Subtractor

The addition and subtraction operations can be combined into one circuit with one common binary adder by including an exclusive-OR gate with each full adder. A four-bit adder–subtractor circuit is shown below:

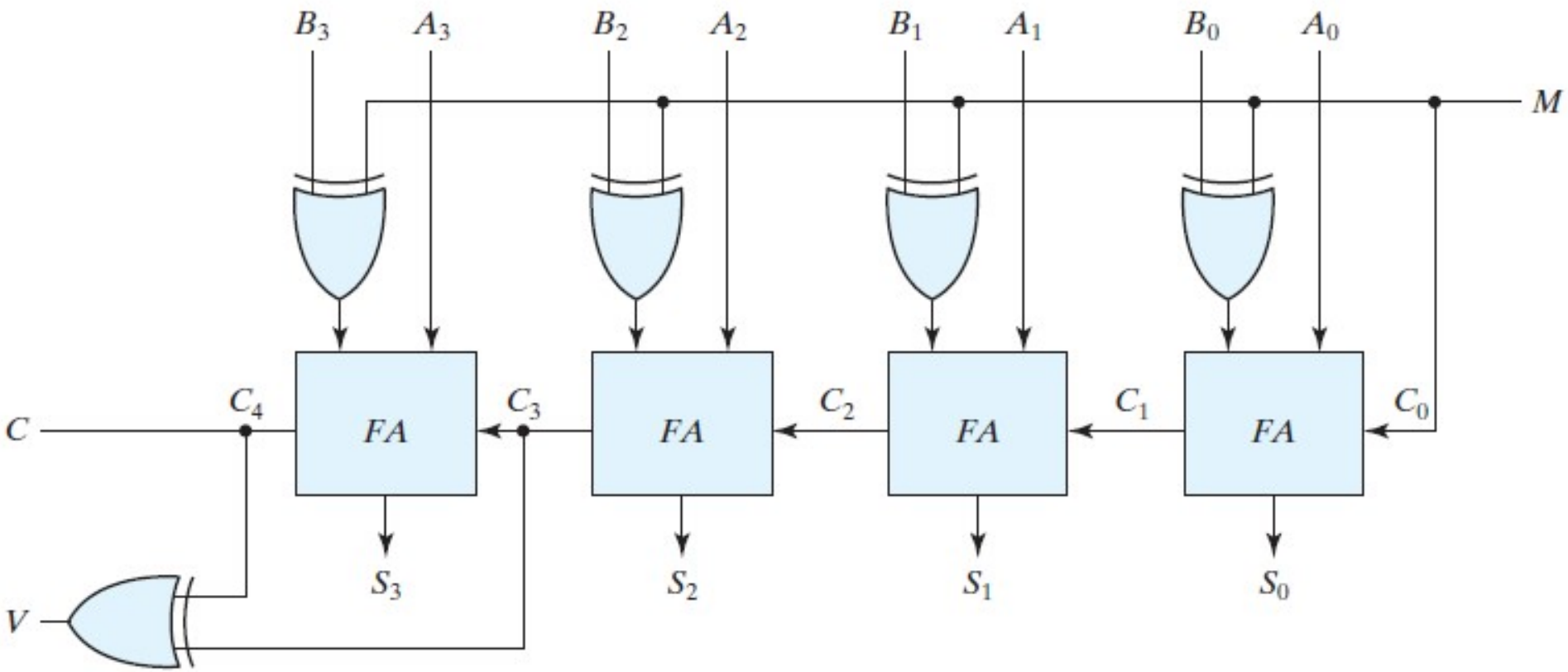


-The mode input M controls the operation. When M = 0, the circuit is an adder, and when M = 1, the circuit becomes a subtractor. Each exclusive-OR gate receives input M and one of the inputs of B.

- When M = 0, we have B ⊕ 0 = B. The full adders receive the value of B , the input carry is 0, and the circuit performs A plus B .



When M = 1, we have B $\oplus$ 1 = B' and C_0 = 1. The B inputs are all complemented and a 1 is added through the input carry. The circuit performs the operation A plus the 2's complement of B . (The exclusive-OR with output V is for detecting an overflow.)



It is worth noting that binary numbers in the signed-complement system are added and subtracted by the same basic addition and subtraction rules as are unsigned numbers. Therefore, computers need only one common hardware circuit to handle both types of arithmetic.