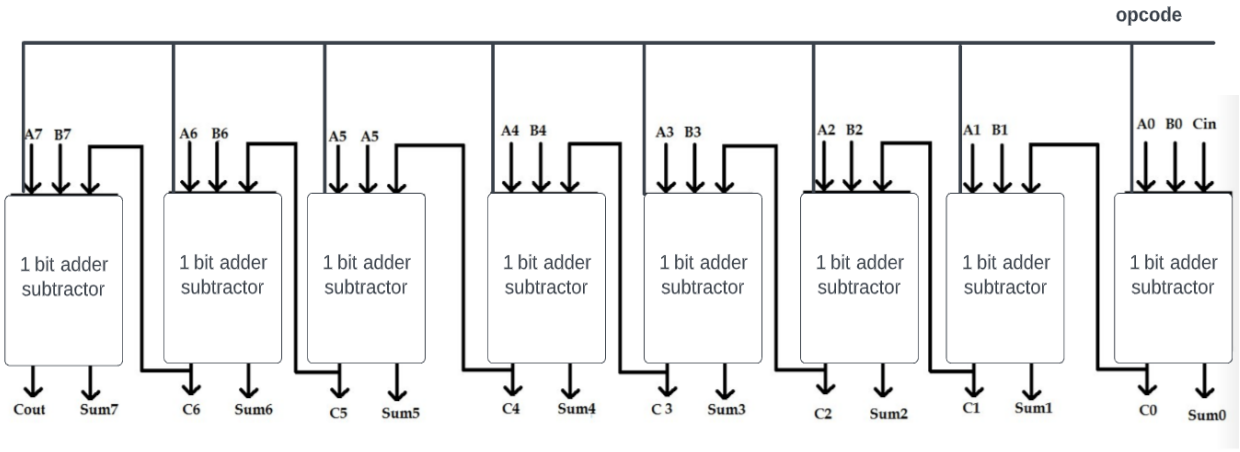
8-bit adder-subtractor circuit



(Circuit Diagram)

- The 8-bit adder-subtractor takes input 2 numbers A0 and B0 along with opcode and cin and outputs the result, i.e., addition of the numbers if opcode is 0 and their subtraction otherwise.
- If the opcode is 0, direct addition of the two numbers takes place and processing of the bits takes place as shown in the diagram above, taking the cin value as 0.
- Now, if the opcode is 1, we need to take the 2's complement of the second number and then add it to the 1st number.
- For taking the 2's complement, we just invert the bits and add 1'b1 to the number.
- To achieve this in our circuit, while processing each bit, we just invert the bit of the second number and for adding the 1'b1 to the second number, we just take the cin value while processing the 1st bit to be 1.
- By this, the subtraction operation can be reduced to a normal addition operation only.

- But, it has also to be ensured that the result obtained is correct or not, i.e., to check if there is an overflow or not.
- For this, we compare cout and c6 from the above circuit diagram, and if the come out to be different, there is an overflow and the result obtained is not correct.
- The addition operation processes one bit at a time from the inputs and ouputs the sum and the carry and then moves on to the next bit.
- It can be clearly figured out that

$$\text{Sum} = (\text{In1}) \wedge (\text{In2}) \wedge (\text{Cin})$$
$$\text{Carry} = (\text{In1}\&\text{In2}) \mid (\text{In1}\&\text{Cin}) \mid (\text{In2}\&\text{Cin})$$

- So. by this way finally, we get the sum and the carry-out as the outputs of the 8-bit adder-subtractor circuit.