Digital Design

Week 3: Combinational Logic
Part II

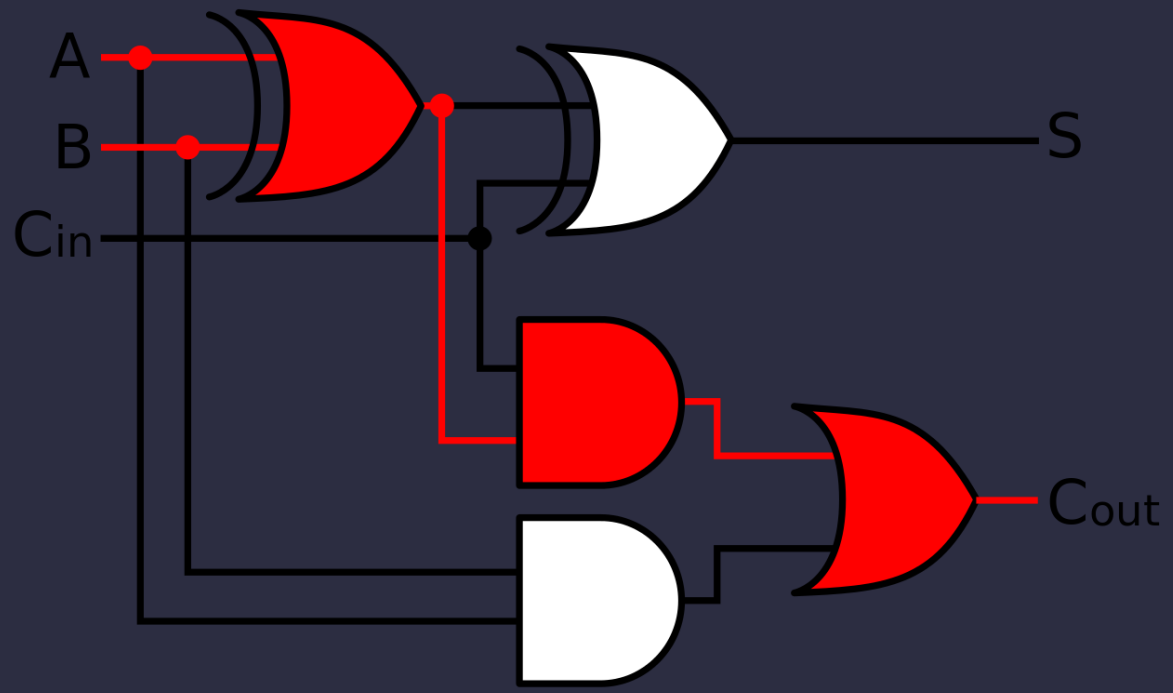
Fenerbahce University

Combinational Circuits

- Combinational Circuits
  - Decoder
  - Selective (Multiplexer)
  - Full Adder

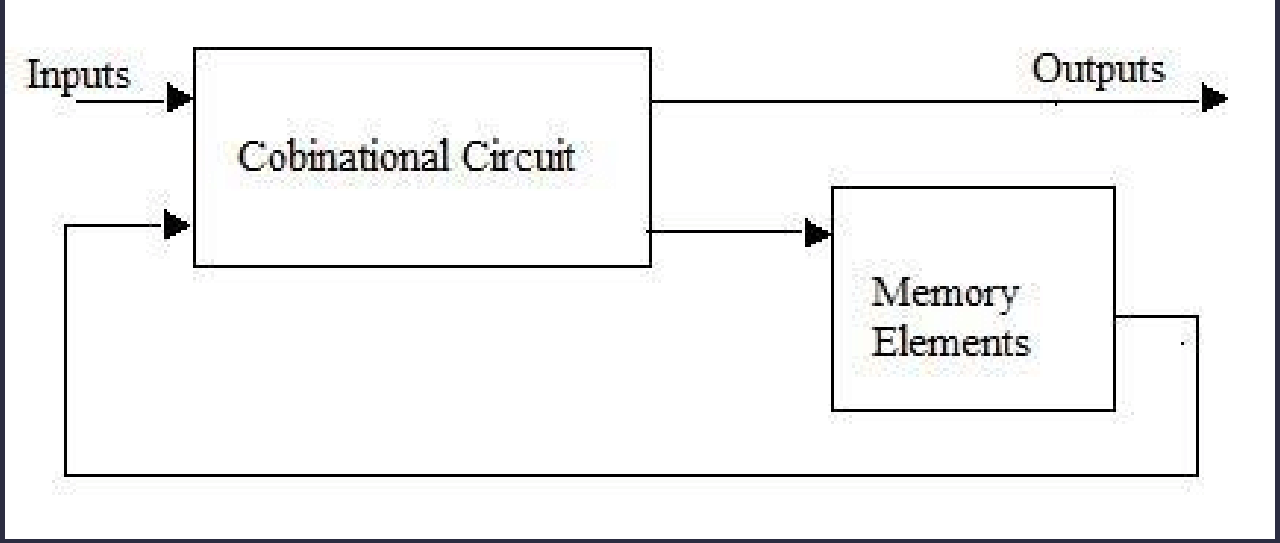
From Logic Gates to Control Units

- *Combinational Circuits*
  - The output of the circuit depends on the current input.
  - The output delay of the circuit depends on the longest path in the circuit.



From Logic Gates to Control Units

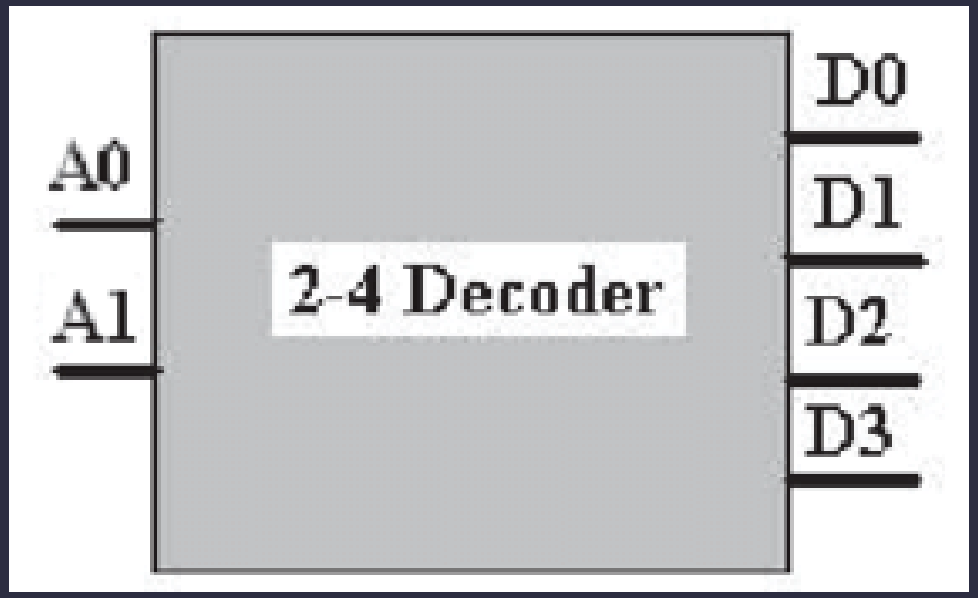
- *Sequential Circuits*
  - The output depends on both the current input and the values in memory.
  - Some outputs of the circuit are stored in memory and reused.
  - We'll get into the details next week.



Decoder

- *n* input , 2^n exit
  - Only one output can be one at same time

2-bit Decoder Example



Decoder

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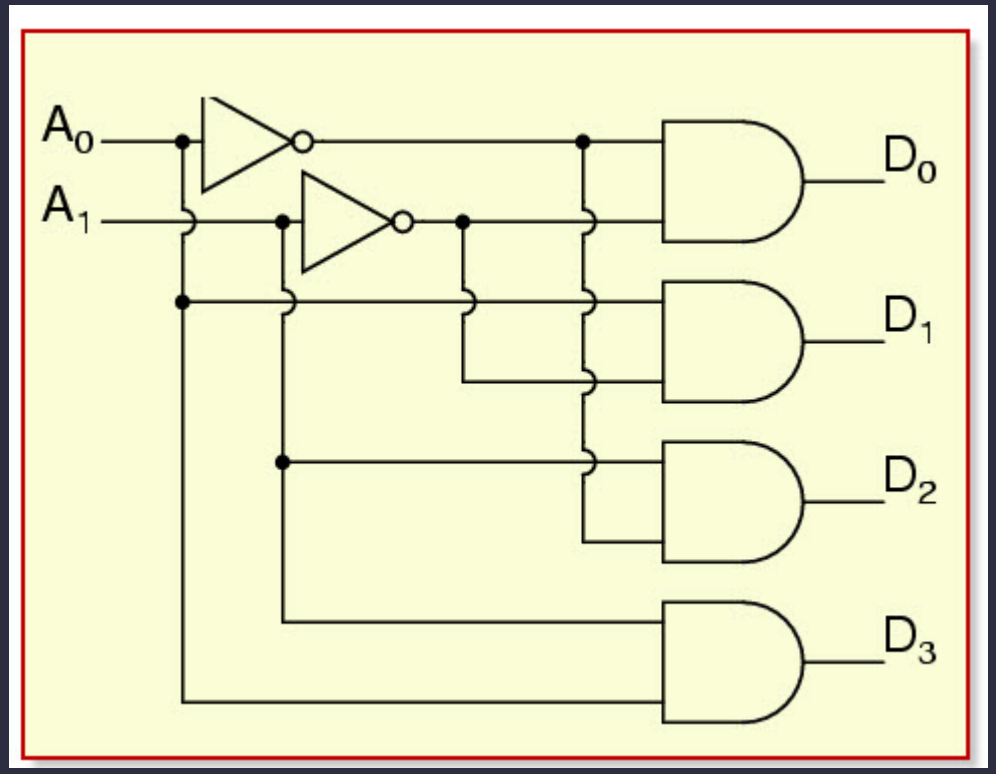
2-bit Decoder Example

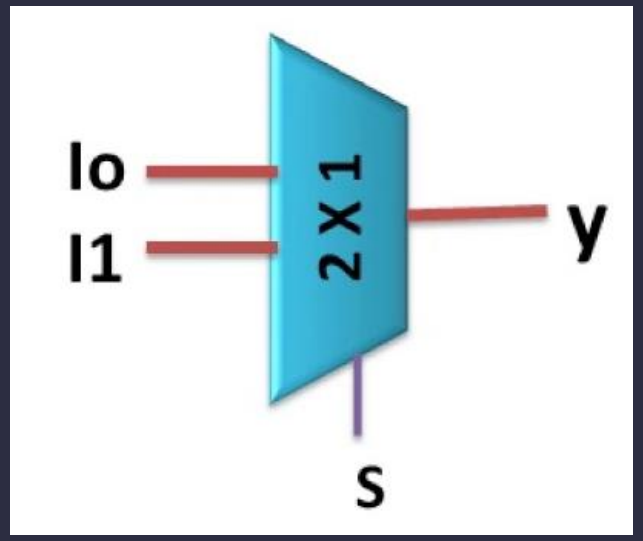


Truth Table

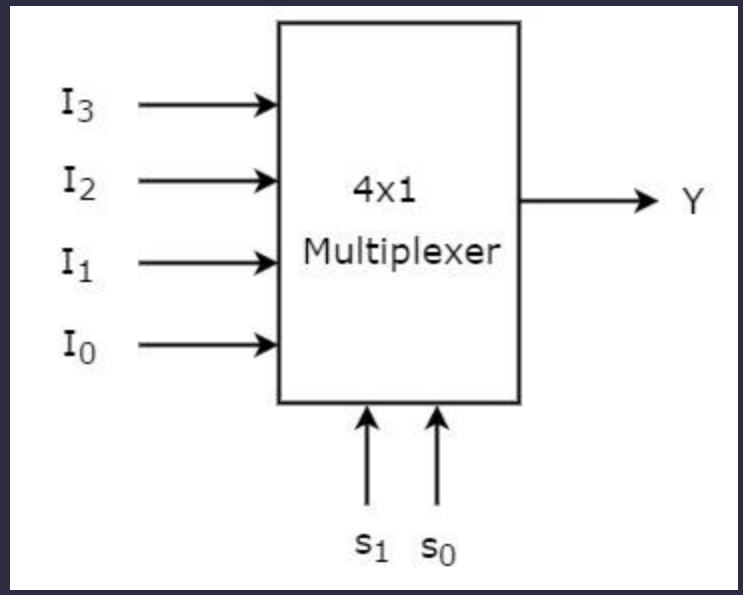
A_1	A_0	D_3	D_2	D_1	D_0
0	0	0	0	0	1
0	1	0	0	1	0
1	0	0	1	0	0
1	1	1	0	0	0

Multiplexer - MUX

- *n* - bit select, 2^n input and It has only one output.
  - According to the select bit, the value from the input is transferred to the output.



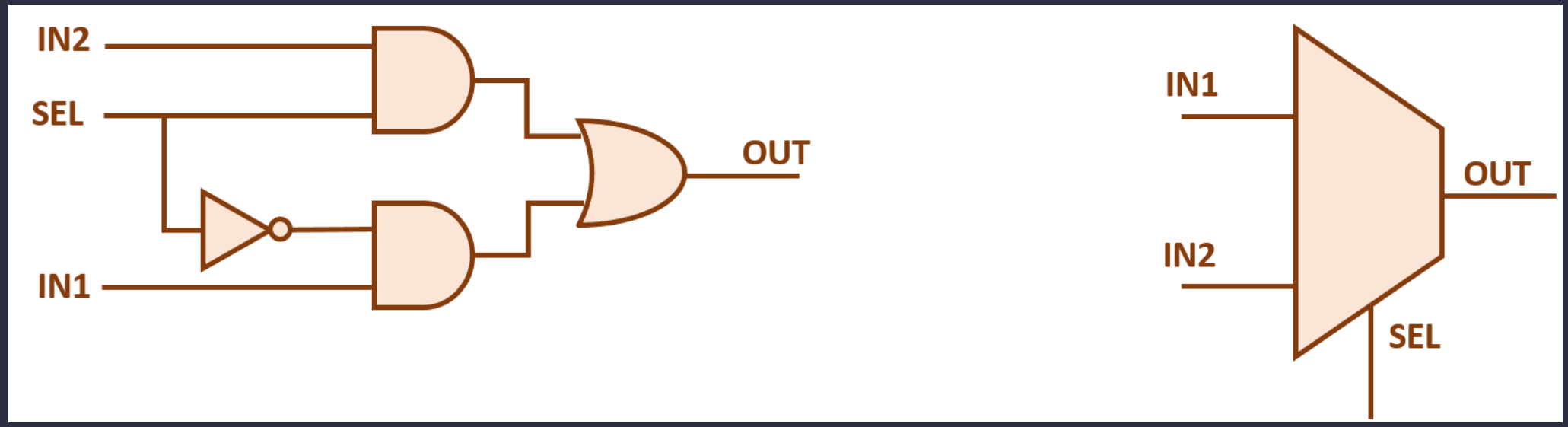
2 -1 MUX



4-1 MUX

Selector (Multiplexer - MUX)

- *n* - bit select, 2^n input and It has only one output.
  - According to the select bit, the value from the input is transferred to the output.



2 -1 MUX

Selector (Multiplexer - MUX)

- *n* - bit select, 2^n input and It has only one output.
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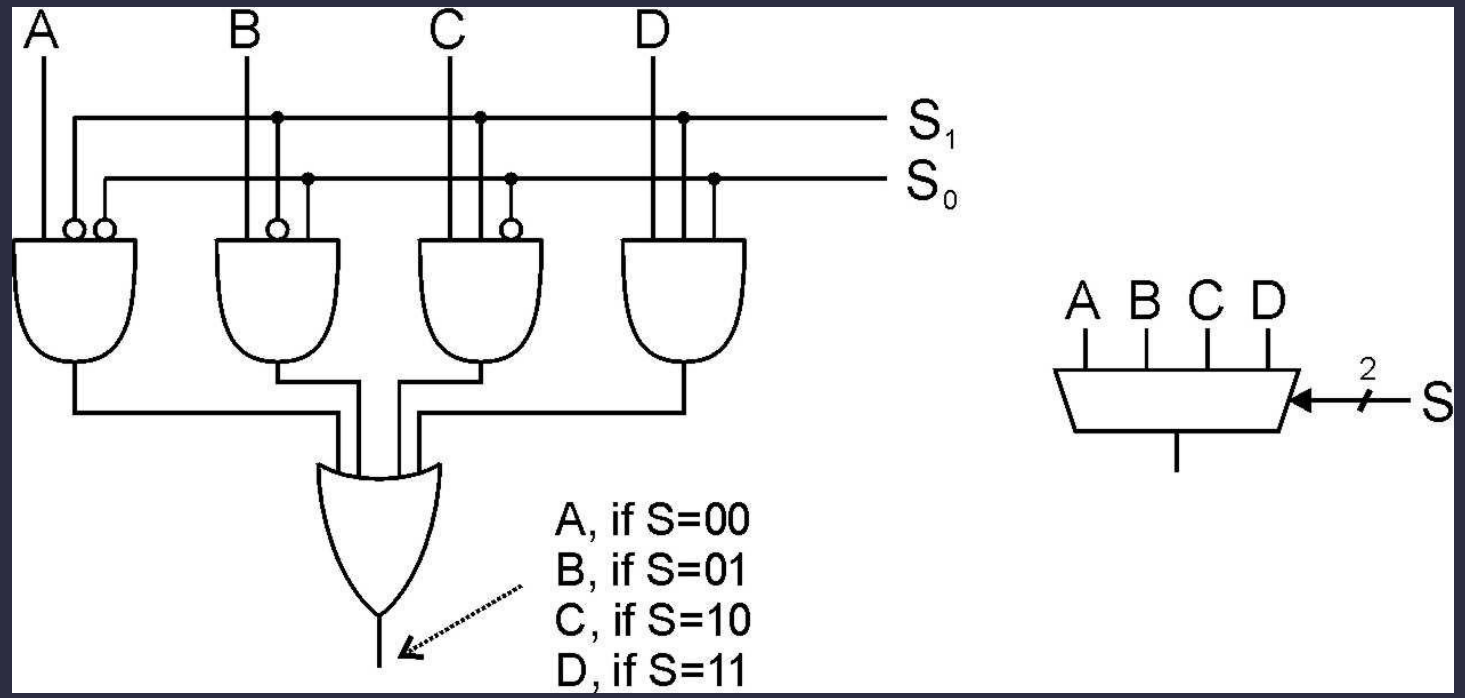
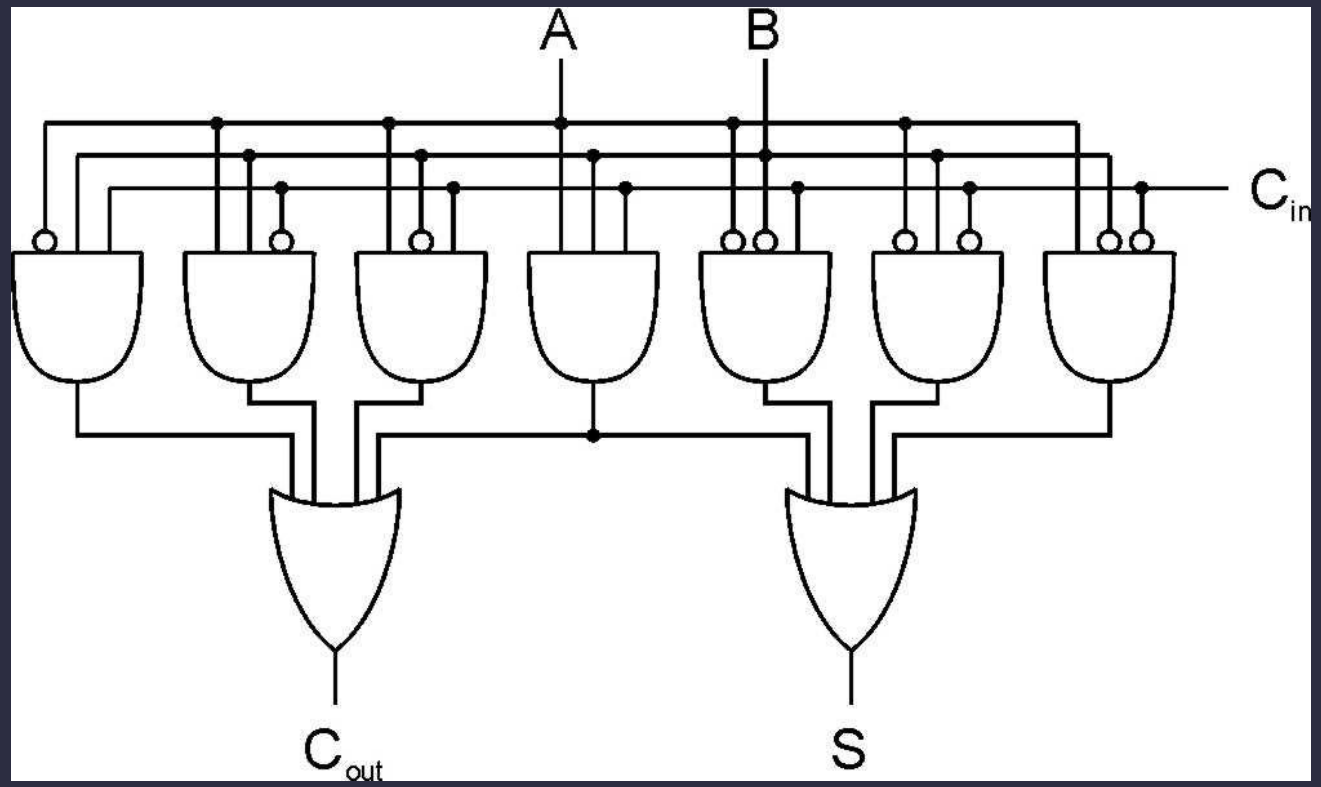


4 -1 MUX

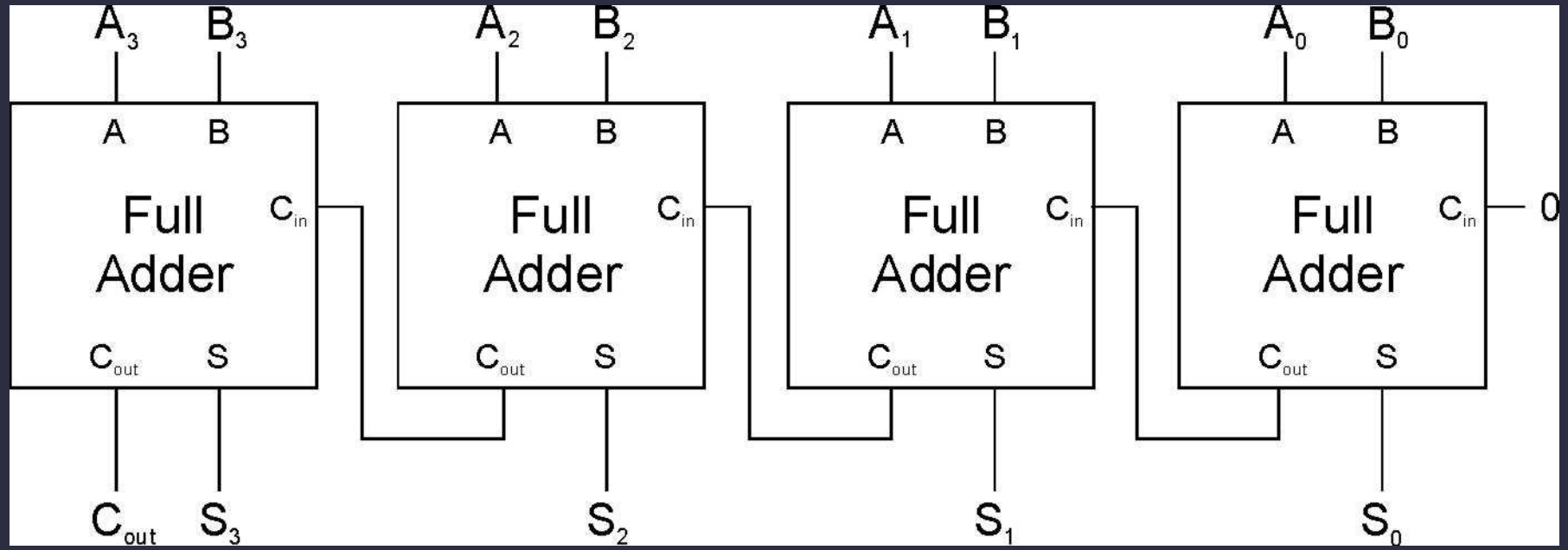
Full Adder

- Taking two bits (A and B) and a carry input (Cin), it produces a one-bit sum (S) and carry (Cout) .



A	B	C_{in}	S	C_{out}
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

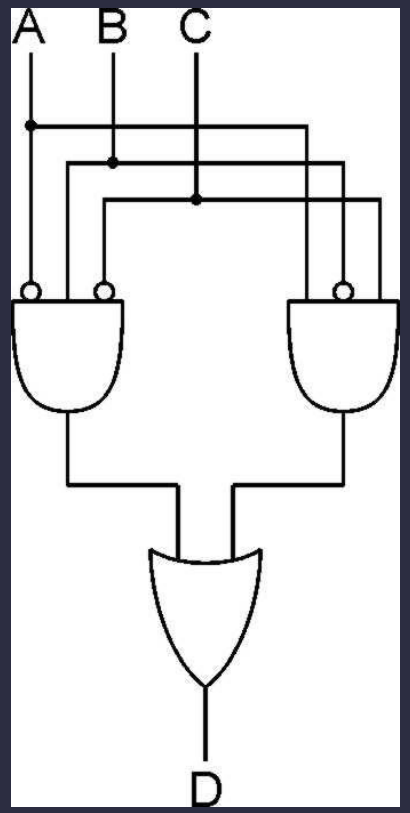
4-bit Adder



Other Circuits

- Any circuit can be expressed with And, Or and Not gates.

A	B	C	D
0	0	0	0
0	0	1	0
0	1	0	1
0	1	1	0
1	0	0	0
1	0	1	1
1	1	0	0
1	1	1	0



1. In the truth table, do and operation for 1 outputting rows

2. Combine these and gates with or gate