3.1 Design of logic functions

Basic structure of combinational logic
and sequential logic

Combinational Logic and Sequential Logic

- Combinational logic (組合せ回路)
  - The output value is a pure function of the present input only.
  - The function can be described by Boolean Expressions or a truth table.
  - The circuit is implemented by a wired logic or a LUT（Look-up Table）.
- Sequential logic (順序回路)
  - The output depends not only on the present value of its input signals but on the current state that is a result of the sequence of past input
  - The function can be described by a state transition diagram or a characteristic table.
  - The circuit is implemented by a combinational logic and registers (*).

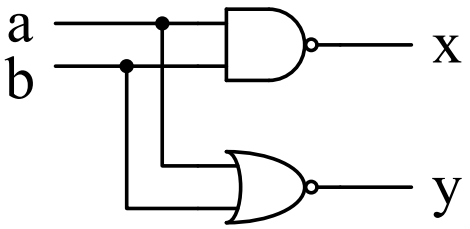
* Register: A register is a logic circuit to storages the data for a clock cycle.

Implementation of combinational logic

Boolean Expression ⟺ Wired logic

$x = \overline{a \cdot b}$

$y = \overline{a+b}$



⇕

||

LUT (Look-up Table)

Truth table

a	b	x	y
0	0	1	1
0	1	1	0
1	0	1	0
1	1	0	0

⟺

(ab) address

Memory

00	1	1	DC	DC	DC	DC	DC	DC
01	1	0	DC	DC	DC	DC	DC	DC
10	1	0	DC	DC	DC	DC	DC	DC
11	0	0	DC	DC	DC	DC	DC	DC

data (x y)

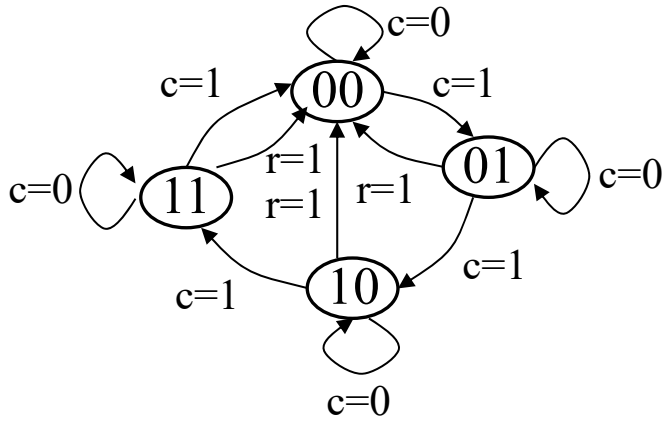
Unused

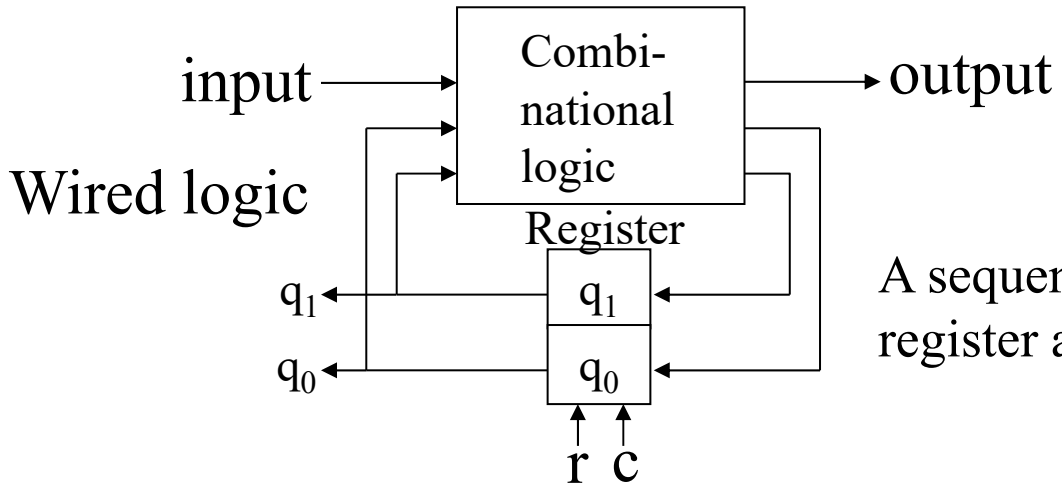
Implementation of sequential logic

Characteristic table
(特性表)

r	c	q_1q_0 (n + 1)
0	0	q_1q_0 (n)
0	1	q_1q_0 (n) + "01"
1	0	0 0
1	1	0 0

State Transition Diagram
(状態遷移図)





A sequential logic consists of a register and a combinational logic.