CSC 2204 Finite Automata Theory and Formal Languages

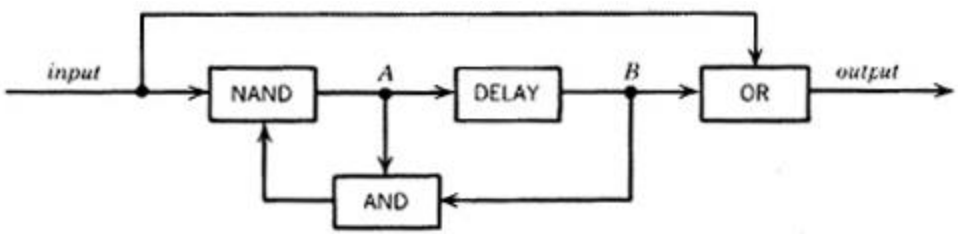
Department of Computer Science
SZABIST (Islamabad Campus)

Week 9 (Lecture 1)

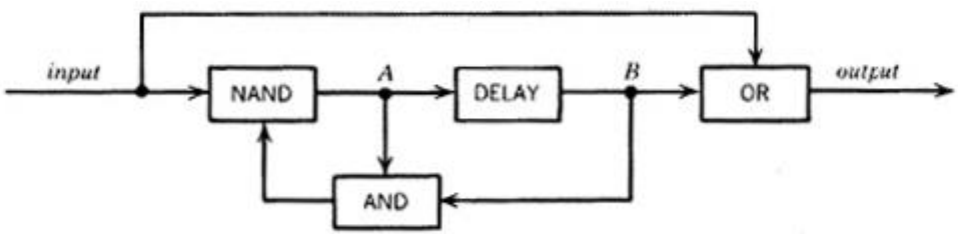
Transducers as Models of Sequential Circuits

- Automata with input and output are sometimes called “Transducers” because of their connection to electronics.

Example 1



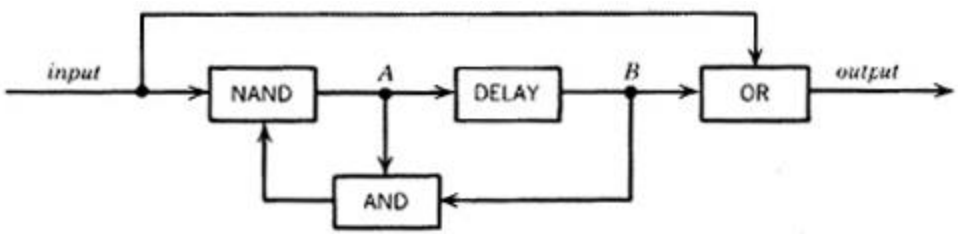
Example 1



The following four types of boxes are used in this circuit

1. <u>**NAND box (NOT AND)**</u>: For the given input, it provides the complement of Boolean AND output.
2. <u>**DELAY box (Flip Flop box)**</u>: It delays the transmission of signal along the wire by one step (clock pulse).
3. <u>**OR box**</u>: For the given input, it provides the Boolean OR output.
4. <u>**AND box**</u>: For the given input, it provides the Boolean AND output.

Example 1



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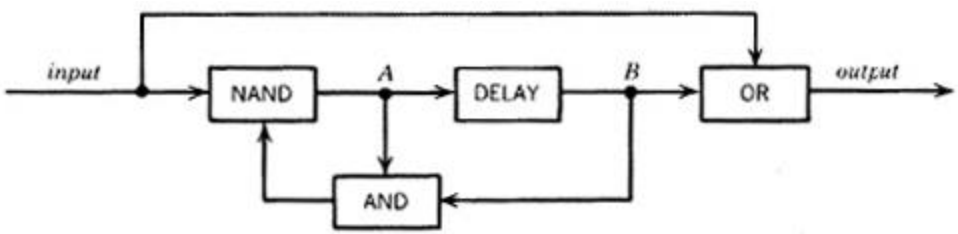
4. **AND box**: For the given input, it provides the Boolean AND output.

There are two points A and B w.r.t. to which following four states of the machine are identified according to the presence and absence of current at these points *i.e.*

1) q_0(A=0, B=0) ≡ (0,0)
2) q_1 (A=0, B=1) ≡ (0,1)
3) q_2 (A=1, B=0) ≡ (1,0)
4) q_3 (A=1, B=1) ≡ (1,1)

Example 1



The operation of the circuit is such that the machine changes its state after reading 0 or 1. The transitions are determined using the following relations

new B = old A
new A = (input) **NAND** (old A **AND** old B)
output = (input) **OR** (old B)

It is to be noted that old A and old B indicate the presence or absence of current at A and B before inputting any letter. Similarly new A and new B indicate the presence or absence of current after reading certain letter.
At various discrete pulses of a time clock, input is received by the machine and the corresponding output string is generated.

Example 1

The transition at the state q_0 after reading the letter 0, can be determined, along with the corresponding output character as under

new B = old A = 0
new A = (input) **NAND** (old A **AND** old B)
= 0 **NAND** (0 **AND** 0) = 0 **NAND** 0
= 1
output = (input) **OR** (old B) = 0 **OR** 0 = 0

Thus after reading 0 at q_0 new B is 0 and new A is 1 i.e.machine will be at state (1,0) $\equiv q_2$ and during this process it's output character will be 0.

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Thus after reading 0 at q_0 new B is 0 and new A is 1 i.e.machine will be at state (1,0) $\equiv q_2$ and during this process it's output character will be 0.

Old state	Inputting 0		Inputting 1	
	State	Output	State	Output
$q_0 \equiv (0,0)$	$(1,0) \equiv q_2$	0	$(1,0) \equiv q_2$	1

Example 1

Old state	Inputting 0		Inputting 1	
	State	Output	State	Output
$q_0 \equiv (0,0)$	$(1,0) \equiv q_2$	0	$(1,0) \equiv q_2$	1
$q_1 \equiv (0,1)$	$(1,0) \equiv q_2$	1	$(1,0) \equiv q_2$	1

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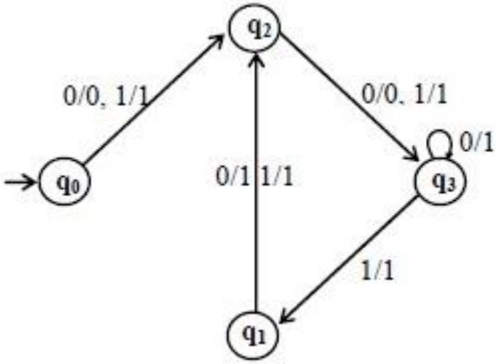

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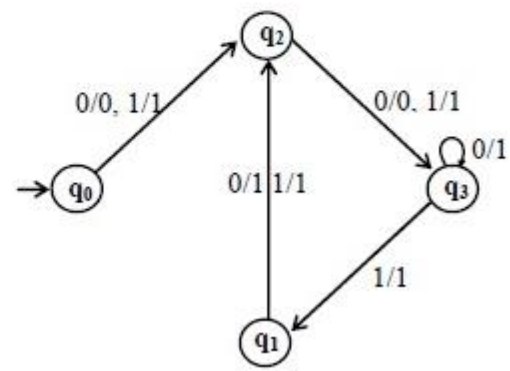

Input		0	1	1	0	1	1	1	0
States	q_0	q_2	q_3	q_1	q_2	q_3	q_1	q_2	q_3
output		0	1	1	1	1	1	1	0