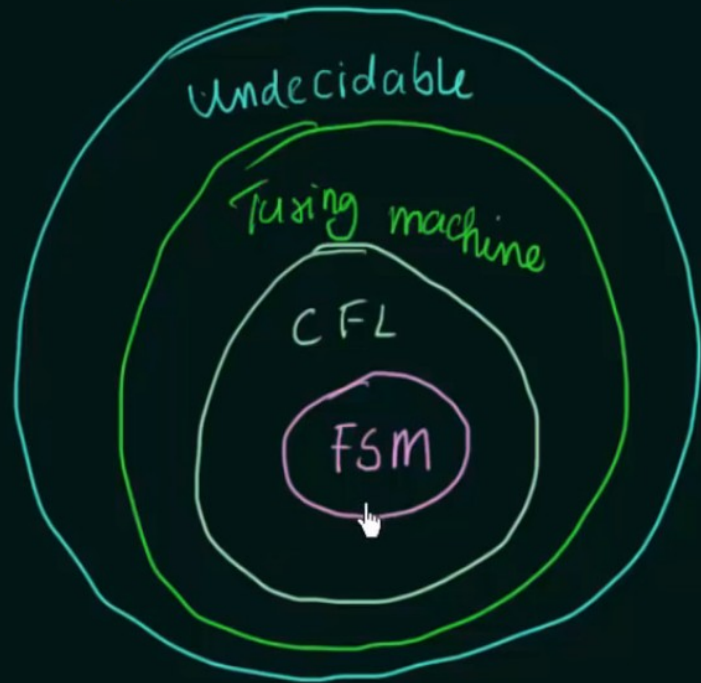
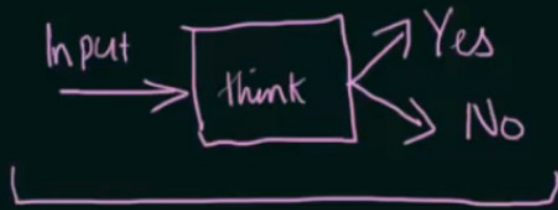


Finite State Machines

Eg. Compilers

valid &
invalid



FSM - Finite State Machine

CFL - Context Free Language
↓
Set of strings



Finite State Machine (Prerequisites)

Symbol - $a, b, c, 0, 1, 2, 3, \dots$

Alphabet - Σ - collection of symbols - Eg. $\{a, b\}, \{d, e, f, g\}$

String - sequence of symbols. Eg. $\{0, 1, 2\}, \dots$

Language - set of strings. Eg. $a, b, 0, 1, aa, bb, ab, 01, \dots$

Eg. $\Sigma = \{0, 1\}$

$L_1 =$ set of all strings of length 2
 $= \{00, 01, 10, 11\}$



String - Sequence of symbols. Eg. $\{0, 1, 2\}$
Language - set of strings. Eg. $a, b, 0, 1, aa, bb, ab, 01, \dots$

Eg. $\Sigma = \{0, 1\}$

$L_1 =$ set of all strings of length 2.
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$L_2 =$ set of all strings of length 3
 $= \{000, 001, 010, 011, 100, 101, 110, 111\}$

L_3



String - Sequence of symbols. Eg. $\{0, 1, 2\}$
Language - Set of strings. Eg. $a, b, 0, 1, aa, bb, ab, 01, \dots$

Eg. $\Sigma = \{0, 1\}$

$L_1 =$ set of all strings of length 2.
 $= \{00, 01, 10, 11\}$

$L_2 =$ set of all strings of length 3
 $= \{000, 001, 010, 011, 100, 101, 110, 111\}$

finite

$L_3 =$ set of all strings that begin with 0
 $= \{0, 00, 01, 000, 001, 010, 011, 0000, \dots\}$

infinite



$= \{000, 001, 010, 011, 100, 101, 110, 111\}$
finite

$\{010, 011, 0000, \dots\}$
infinite

Powers of Σ : $\Sigma = \{0, 1\}$

Σ^0 = set of all strings of length 0 : $\Sigma^0 = \{\epsilon\}$

Σ^1 = set of all strings of length 1 : $\Sigma^1 = \{0, 1\}$

Σ^2 = set of all strings of length 2 : $\Sigma^2 = \{00, 01, 10, 11\}$

Σ^3 = set of all strings of length 3 : $\Sigma^3 = \{000, 001, 010, 011, 100, 101, 110, 111\}$

Σ = set of all strings of length 1 : $\Sigma = \{0, 1\}$

Σ^2 = set of all strings of length 2 : $\Sigma^2 = \{00, 01, 10, 11\}$

Σ^3 = set of all strings of length 3 : $\Sigma^3 = \{000, 001, 010, 011, 100, 101, 110, 111\}$

Σ^n = set of all strings of length n .

Cardinality



Σ^1 = set of all strings of length 1 : $\Sigma^1 = \{0, 1\}$

Σ^2 = set of all strings of length 2 : $\Sigma^2 = \{00, 01, 10, 11\}$

Σ^3 = set of all strings of length 3 : $\Sigma^3 = \{000, 001, 010, 011, 100, 101, 110, 111\}$

Σ^n = set of all strings of length n .



Cardinality - number of elements in a set

$\hookrightarrow \Sigma^n = 2^n$



Σ^3 = set of all strings of length 3 : $\Sigma^3 = \{000, 001, 010, 011, 100, 101, 110, 111\}$

Σ^n = set of all strings of length n .

Cardinality - number of elements in a set

$$\hookrightarrow \Sigma^n = 2^n$$

$$\Sigma^* = \Sigma^0 \cup \Sigma^1 \cup \Sigma^2 \cup \Sigma^3 \dots$$

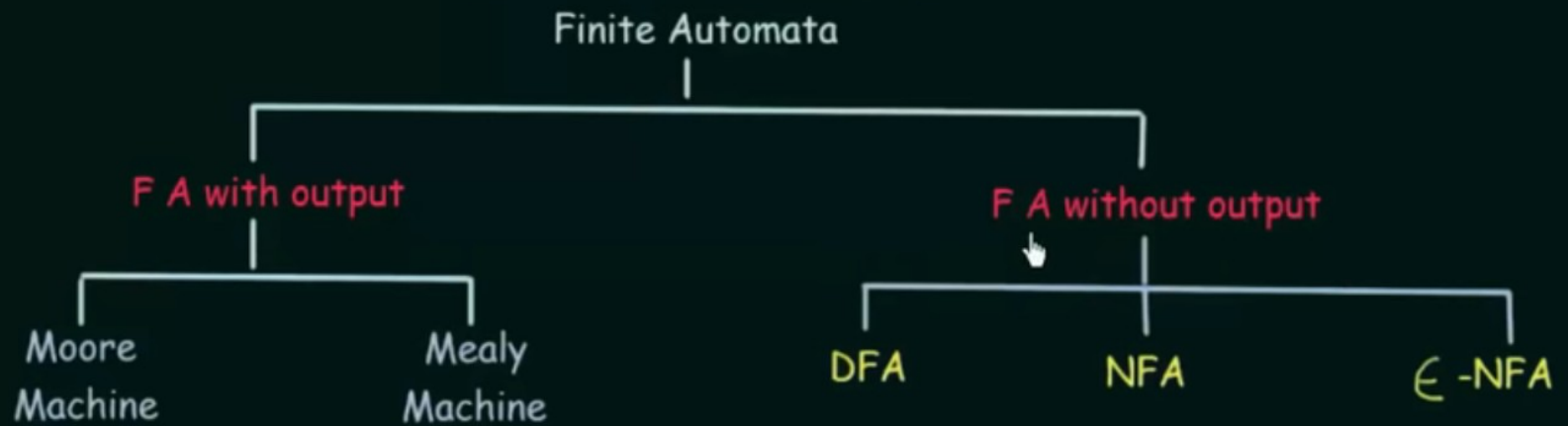
$$= \{\epsilon\} \cup \{0, 1\} \cup \{00, 01, 10, 11\} \cup \dots$$

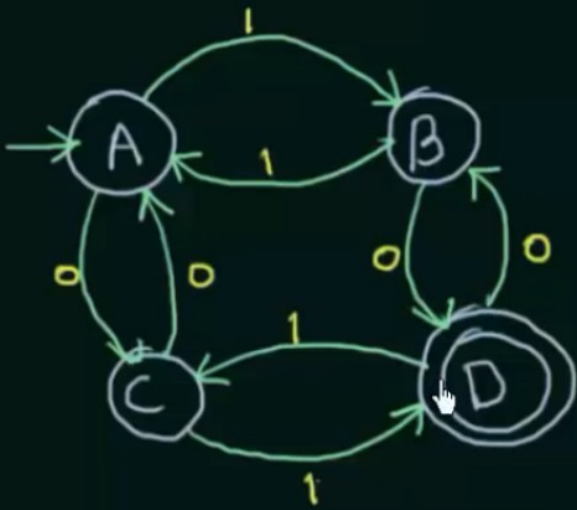
= set of all possible strings of all lengths over $\{0, 1\}$

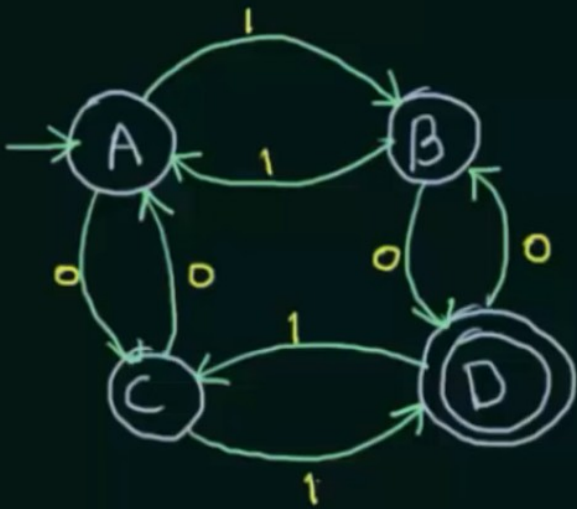
\hookrightarrow infinite.



Finite State Machine

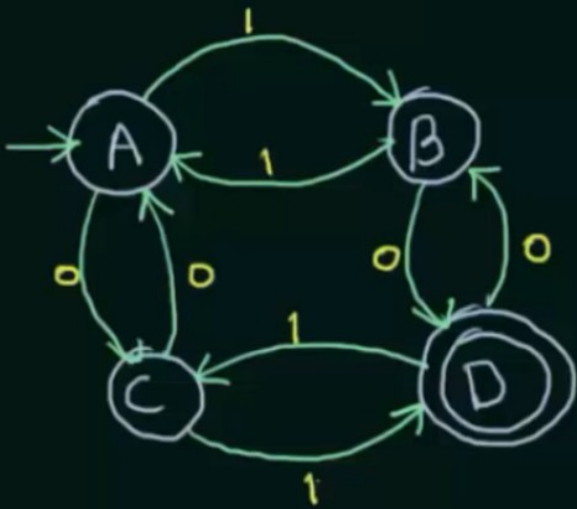






$(Q, \Sigma, q_0, F, \delta)$





$(Q, \Sigma, q_0, F, \delta)$

Q = set of all states

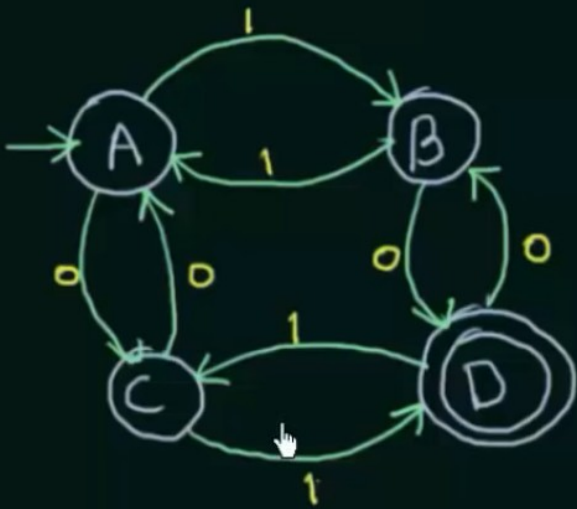
Σ = inputs

q_0 = start state / initial state

F = set of final states.

δ transition function from $Q \times \Sigma \rightarrow Q$





$(Q, \Sigma, q_0, F, \delta)$

Q = set of all states

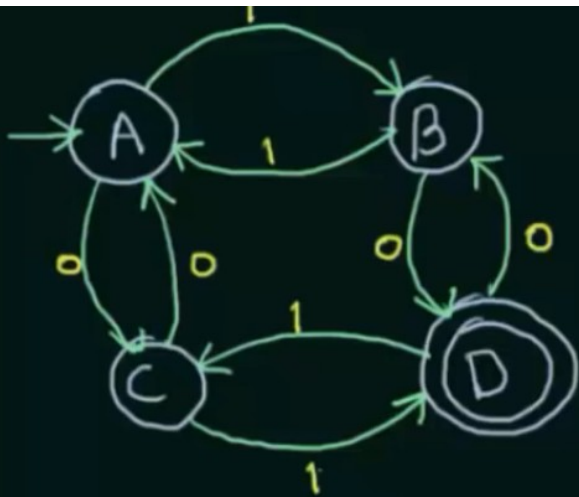
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$(Q, \Sigma, q_0, F, \delta)$

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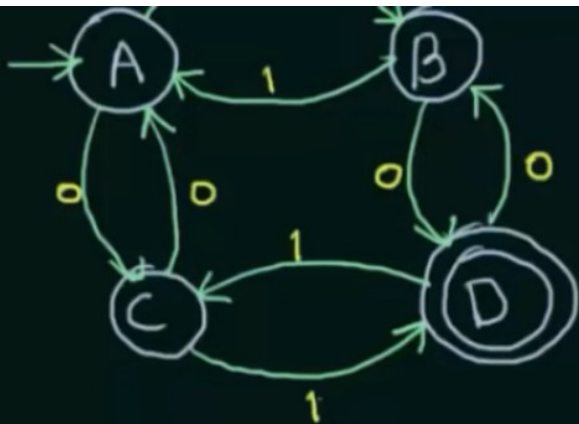
$Q = \{A, B, C, D\}$

$\Sigma = \{0, 1\}$

$q_0 = A$

$F = \{D\}$





$(Q, \Sigma, q_0, F, \delta)$

Q = set of all states

Σ = inputs

q_0 = start state / initial state

F = set of final states.

δ = transition function from $Q \times \Sigma \rightarrow Q$

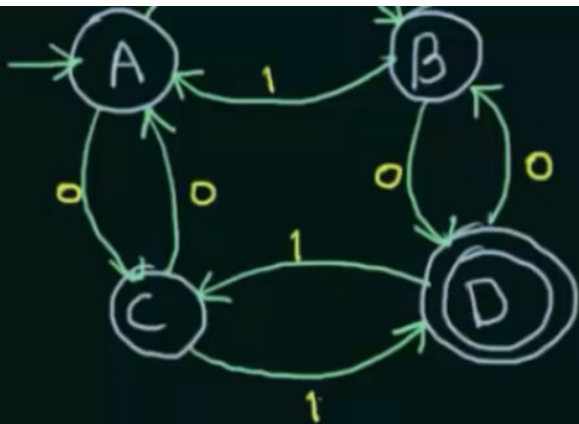
$Q = \{A, B, C, D\}$

$\Sigma = \{0, 1\}$

$q_0 = A$

$F = \{D\}$





$(Q, \Sigma, q_0, F, \delta)$

Q = set of all states

Σ = inputs

q_0 = start state / initial state

F = set of final states.

δ = transition function from $Q \times \Sigma \rightarrow Q$

$Q = \{A, B, C, D\}$

$\Sigma = \{0, 1\}$

$q_0 = A$

$F = \{D\}$

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



Deterministic Finite Automata (Example-2)



Deterministic Finite Automata (Example-2)

Construct a DFA that accepts sets of all strings over $\{0,1\}$ of length 2.

$$\Sigma = \{0,1\}$$

$$L = \{00, 01, 10, 11\}$$



Deterministic Finite Automata (Example-2)



Construct a DFA that accepts sets of all strings over $\{0,1\}$ of length 2.

$\Sigma =$ 



0:43 / 11:20

Scroll for details

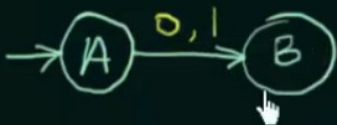


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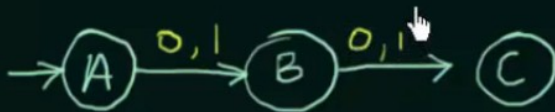


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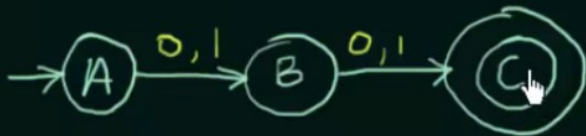


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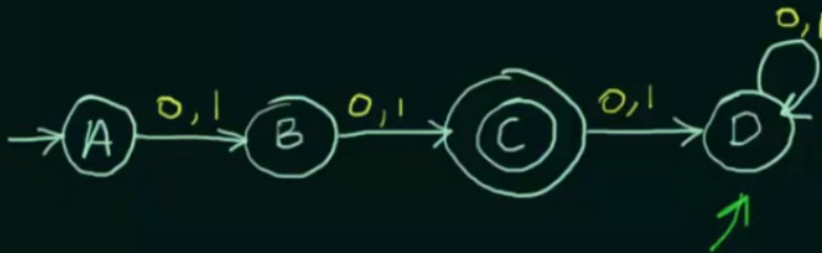


Deterministic Finite Automata (Example-2)

Construct a DFA that accepts sets of all strings over $\{0,1\}$ of length 2.

$$\Sigma = \{0,1\}$$

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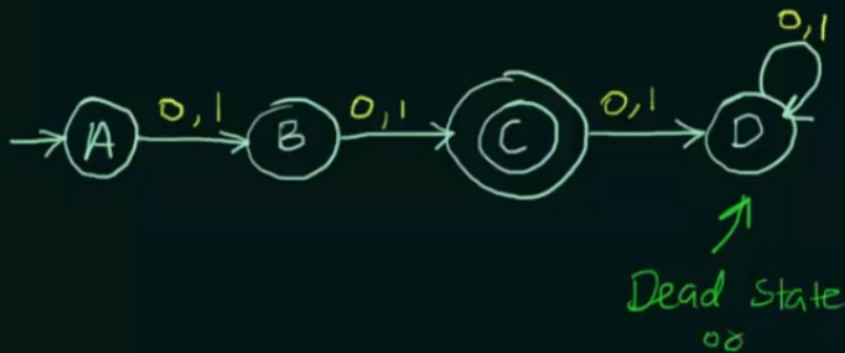


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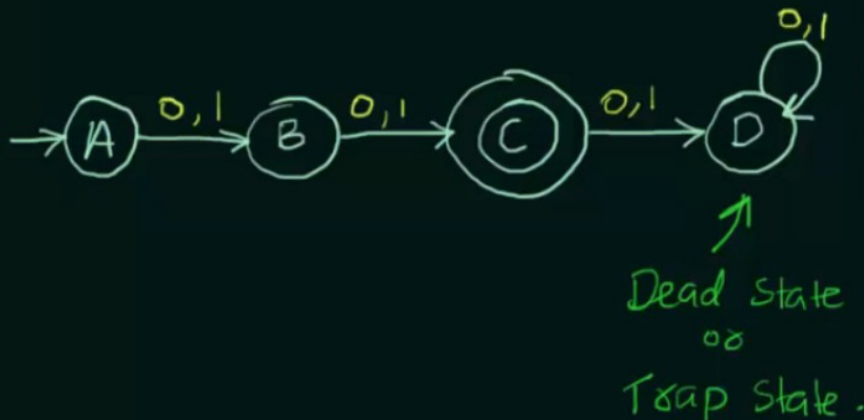


Deterministic Finite Automata (Example-2)

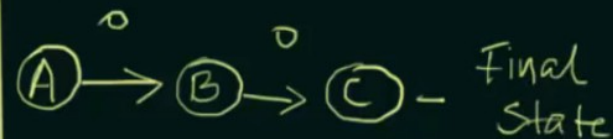
Construct a DFA that accepts sets of all strings over $\{0,1\}$ of length 2.

$$\Sigma = \{0,1\}$$

$$L = \{00, 01, 10, 11\}$$



Eg. $\begin{matrix} \circ & \circ \\ \uparrow & \uparrow \end{matrix}$ ✓

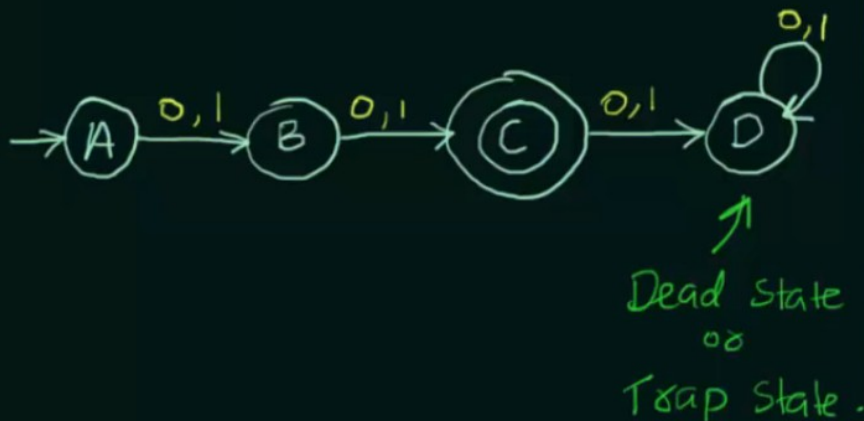


Deterministic Finite Automata (Example-2)

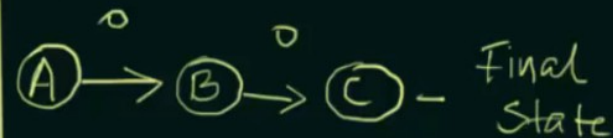
Construct a DFA that accepts sets of all strings over $\{0,1\}$ of length 2.

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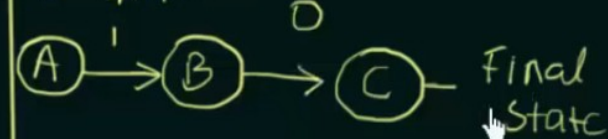
$$L = \{00, 01, 10, 11\}$$



Eg. 00 ✓



Eg. 10 ✓

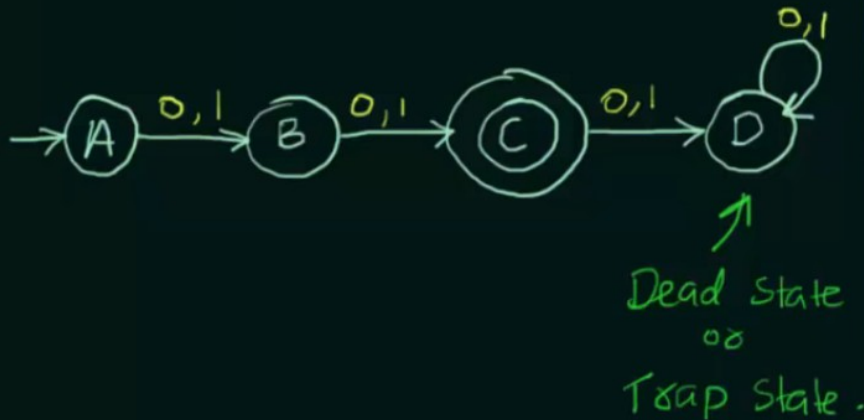


Deterministic Finite Automata (Example-2)

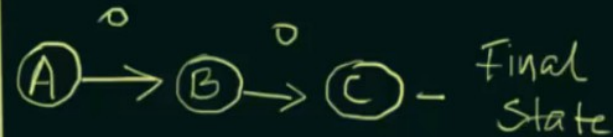
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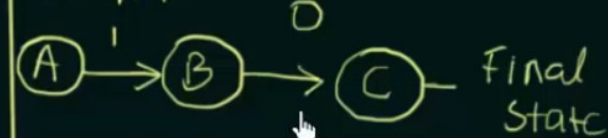
$$L = \{00, 01, 10, 11\}$$



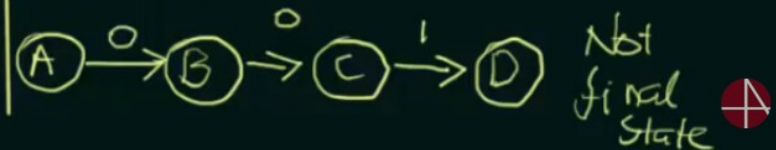
Eg. 00 ✓



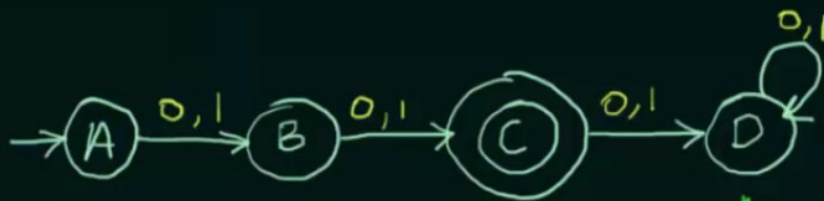
Eg. 10 ✓



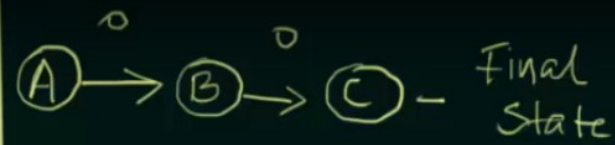
Eg. 001 X



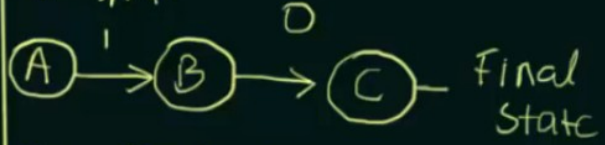
Deterministic Finite Automata (Example -2)



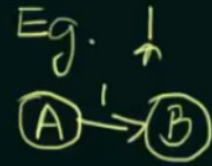
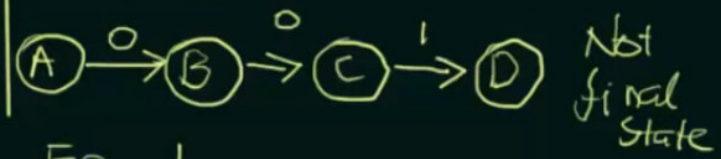
↑
Dead state
00
Trap state.



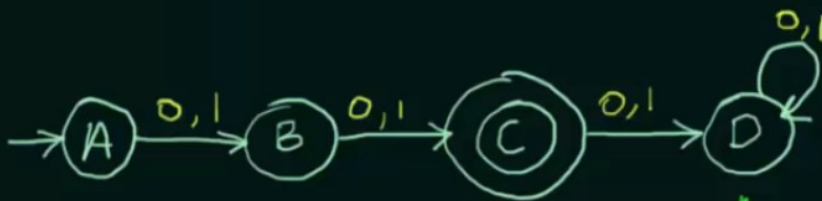
Eg. 10 ✓
↑ ↑



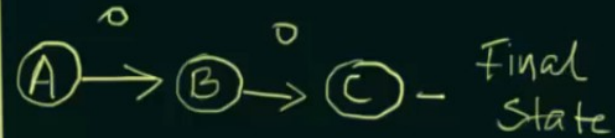
Eg. 001 X
↑ ↑ ↑



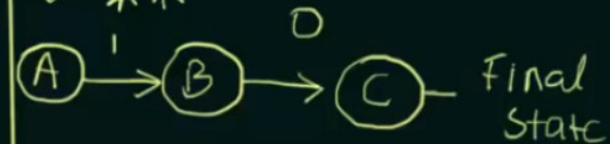
$L = \{00, 01, 10, 11\}$



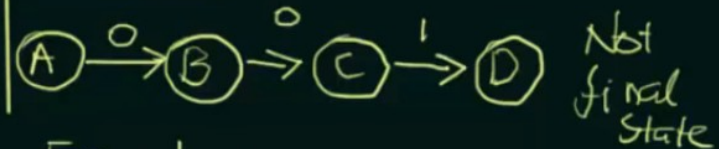
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Dead state
00
Trap state.



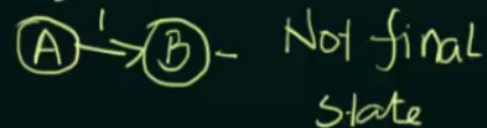
Eg. 10 ✓
↑ ↑



Eg. 001 X
↑ ↑ ↑



Eg. 1 ↓



• **Questions????**