Theory of Comp.

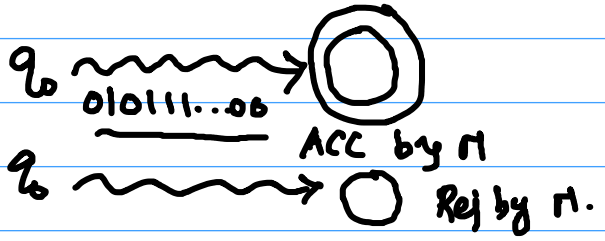
$L_1 = \{ x \mid x \in \{0,1\}^* \; x \text{ ends with } 01 \}$

$L_2 = \{ x \mid x \in \{0,1\}^* \; x \text{ begins with } 10 \}$

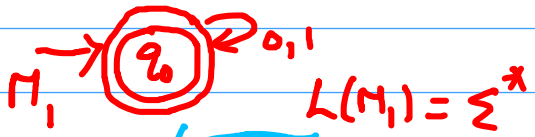
$\Sigma = \{0,1\}$

Σ^* = Set of all strings over $\{0,1\}$

↳ $\{ \epsilon, 0, 1, 00, 01, \ldots \}$



① ? FSA Accepting Σ^*



Set of all strings Acc by M_1

M_1 — Must Accept L

— Must Reject $\Sigma^* \setminus L$

$\Sigma^* = \{ \epsilon, 0, 1, 00, 01, \ldots \}$

$L(M)$: The language Acc by FSA 'M'

↳ The set of strings x

$$L(M) = \{ x \mid \delta(q_0, x) = q_f \in F \}$$

M: Set of strings ending with 01

$L(M) = \{ 01, 001, 101, 1101, 0101, \ldots \}$

Identically: $L(M) \subseteq \Sigma^*$ ← a subset

① Given an arbitrary subset $S \subseteq \Sigma^*$,
Does ∃ FSA M' accepting S.

1) ... 01

2) 10 ...

$\delta: Q \times \Sigma \to Q$

$\delta(q, \underline{0}) = q'$

$\delta(q_0, 1100) =$

$\delta(\delta(\delta(\delta(q_0,1),1),0),0 \ldots$

$\delta(q_0, 0) = q_0$

$\delta(q_0, \overbrace{010011}^{x})$

$= \delta(\delta(q_0, 0), 10011)$

$= \delta(\delta(\delta(q_0,0),1),0) \ldots$

$\delta(q, 0)$

$\hat{\delta}(q, x)$ ↳ $x \in \Sigma^*$

δ: Simulation on a Symbol

$\hat{\delta}$: " a String

$\hat{\delta}(q, x)$ $\qquad x = x_1 x_2 x_3 \ldots$

$:= \delta(\delta(q, x_1), x_2), \ldots)$

$L = \{ x \mid x \in \{0,1\}^* \; x$ contains 101 as a substring $\}$.

Text Books :

① Class notes

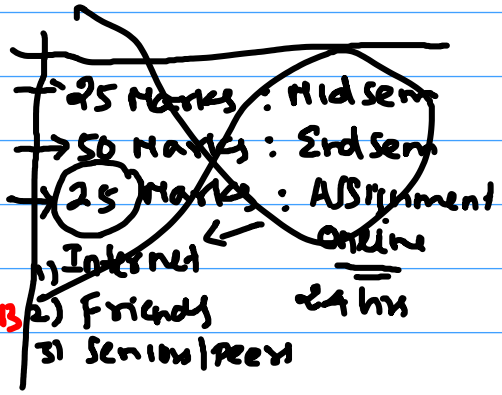
② Hopcroft & Ullman
- DS
- Algo
- OS, CN, DB, Ai, Orgn

③ Peter Linz

Theory & Comp.

Lang, Machines, Computation

Automaton theory



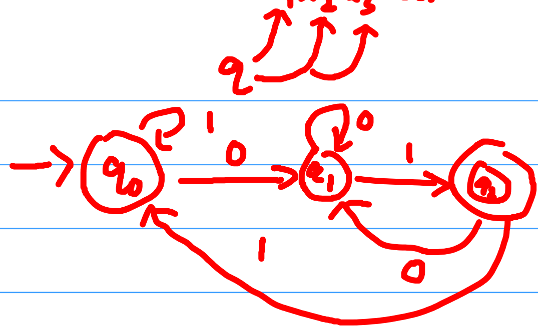
δ : $\delta(q, \underline{a}) = q' \in Q$

$\quad\quad a \in \Sigma$

$\hat{\delta}$: $\hat{\delta}(q, x)$

$\quad\quad x \in \Sigma^*$

$x = x_1 x_2 x_3 \ldots$



$\hat{\delta}(\delta(q_1, 1), 1001)$

$\hat{\delta}(q_2, 1001)$

$\hat{\delta}(\delta(q_2, 1), 001)$

$\vdots$

$x = 011001$

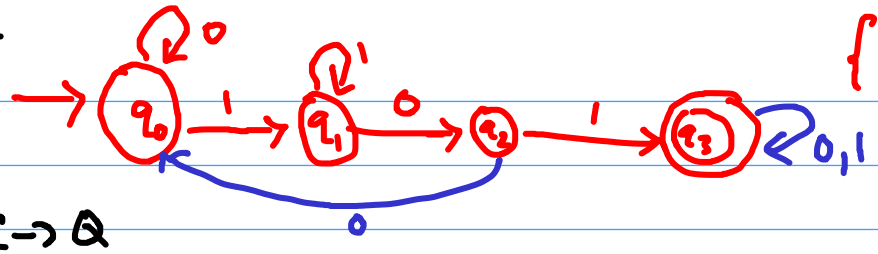
$\delta(q_0, 0) = q_1$

$\hat{\delta}(q_0, 011001)$

$= \hat{\delta}(\delta(q_0, 0), 11001)$

$= \hat{\delta}(q_1, 11001)$

$L_3 = \{ x \mid x \in \{0,1\}^* \quad x \text{ contains } 101 \text{ as a substring} \}$.



{ 101, 0101, 1101, 10100, ... }

$\delta : Q \times \Sigma \to Q$

$\{q_0, q_1, q_2, q_3\} \times \{0,1\} \to$

$q_0, 0 \longrightarrow ?\ q_0$

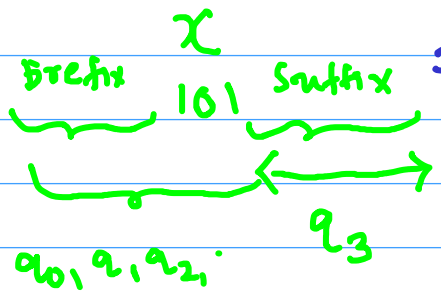
$q_0, 1 \longrightarrow q_1$

$q_1, 0 \longrightarrow q_2$

$q_1, 1 \longrightarrow q_1$

$q_2, 1 \longrightarrow q_3$

$q_2, 0 \longrightarrow ?$.



000111101

If $\delta(q_2, 0) = q_2$ then 011001 is Acc by M

Incorrect

If $\delta(q_2, 0) = q_1$ then 10001 is Acc by M

Incorr

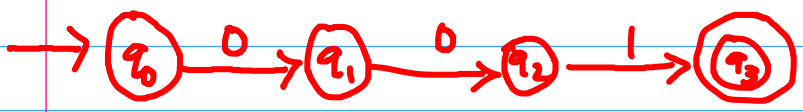
$\delta(q_2, 0) = q_0$

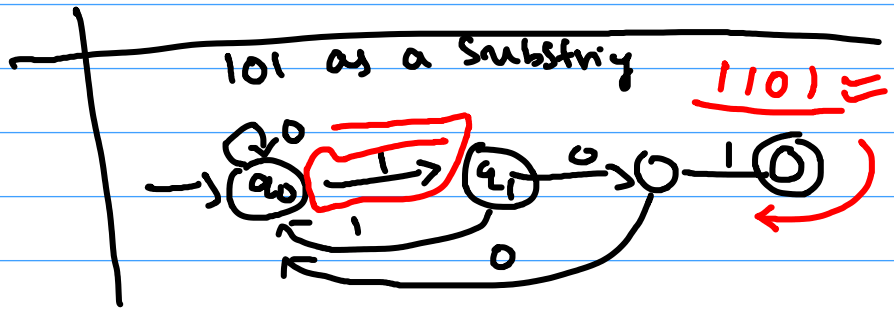
$L_4 = \{ x \mid x \in \{0,1\}^* \text{ begins with 00 ends with 01} \}$

Einstein ? A Good Q
- Q_1 really Q
- Q_2 ⋮ coolest Q.
- ⋮

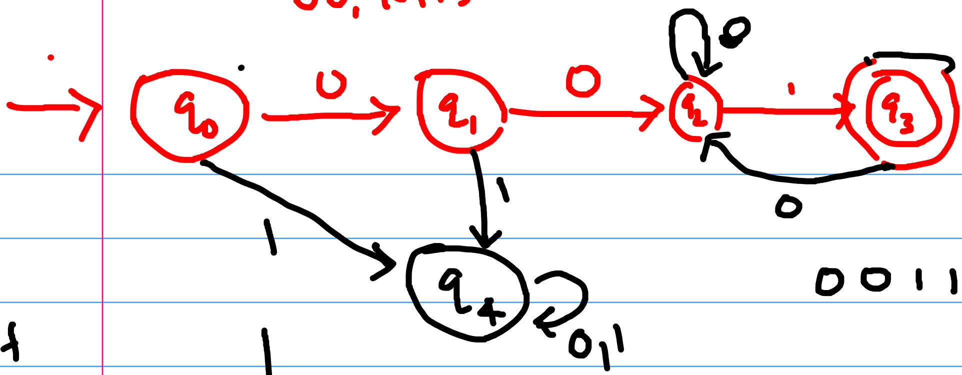
001 , 0001 , 00 1100 0110 01

00 Any string of 0,1 01





00, {0,1}*



001101

0011 is Acc ×

00111 is Acc ×

0011101 — q_4

If

$\delta(q_3, 1) = q_3$

$\delta(q_3, 0) = q_1$

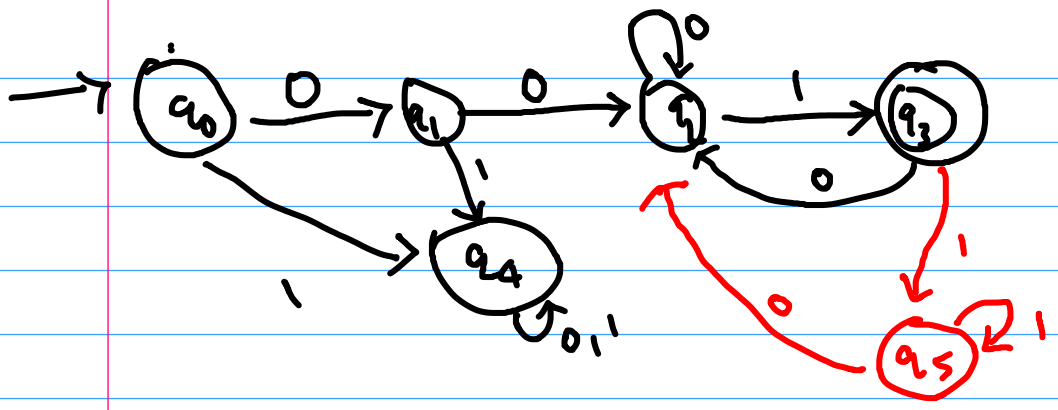
0010 ∈ L(M) - Incorrect.

$\hat{\delta}(q_1, 00101) = q_4 \notin L(M)$

Invalid st

1	{0,1}*
01	{0,1}*
11	
10	

begins with 00 ... ends with 01

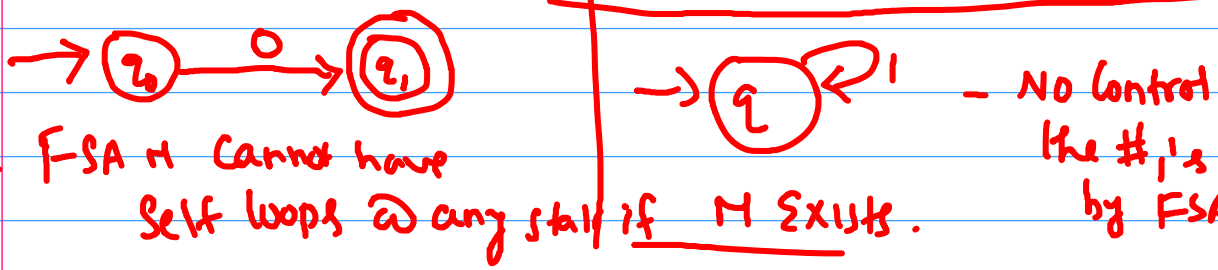


$L_5 = \{ x \mid x \in \{0,1\}^* \;\; x$ contains odd no. of 0's and Even no. of 1's $\}$.

$L_5 = \{ x \mid x \in \{0,1\}^* \text{ s.t } \#_0(x) : \text{ODD} \wedge \#_1(x) : \text{Even} \}$.

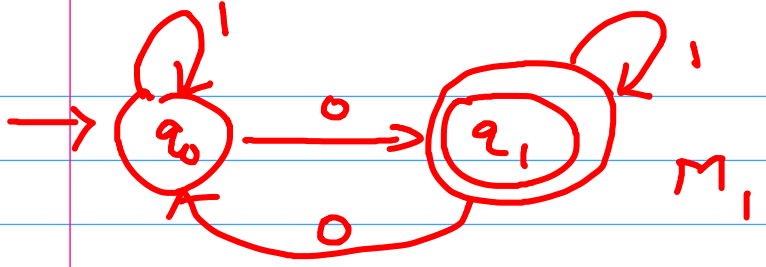
ODD $\#_0$ — No. of 0's Even $\#_1$

$L_5 = \{ 0, 011, 101, 110, 000, 00011, 10100, \ldots \}$



The FSA M cannot have self loops @ any state if M exists.

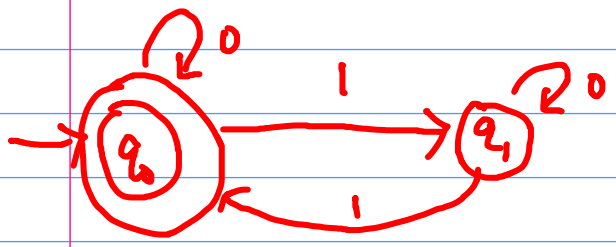
- No control over the $\#_1$'s read by FSA.



M_1

L_1 ODD no. of 0's

No constraint on #1's



M_2

L_2 Even no. of 1's

No Const on #0's

L_5: ODD $\#_0 \wedge$ Even $\#_1$

$= L_1 \cap L_2$