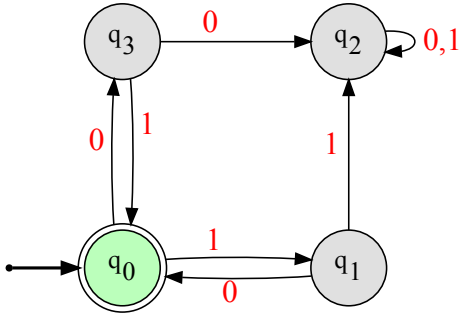
Deterministic Finite Automata (DFAs): Examples

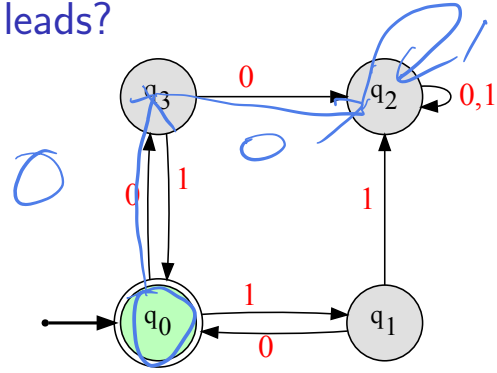
Lecture 3
Tuesday, August 30, 2022

LaTeXed: August 30, 2022 10:25

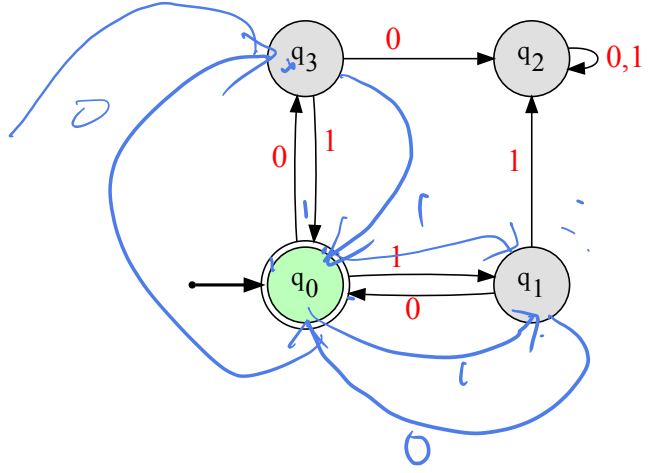
Graphical Representation/State Machine



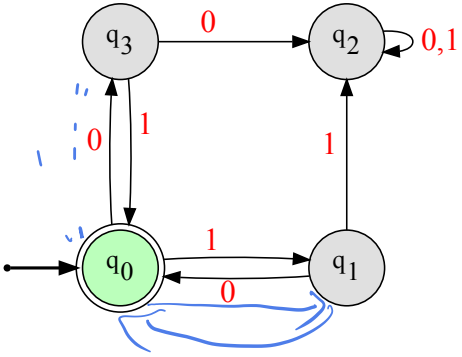
Where does **001** leads?



Where does **10010** leads?



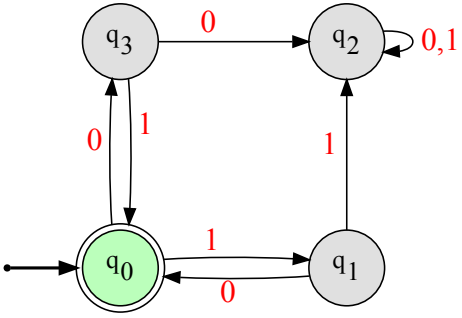
Which strings end up in an accepting state?



ε
01
0101
$(01)^*$
$(10)^*$

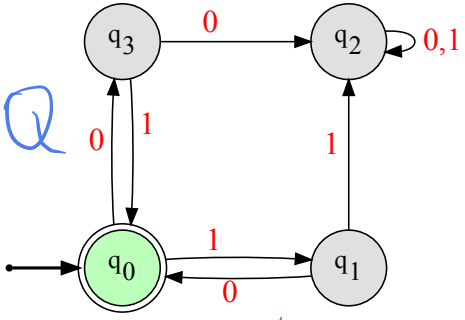
$(01+10)^*$

Which strings end up in an accepting state?



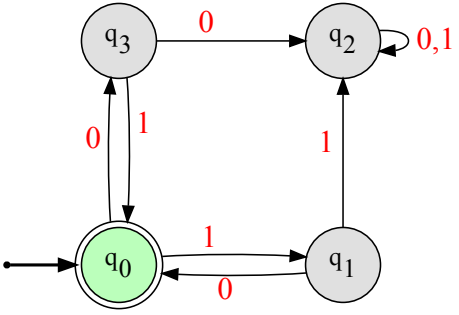
Example

$f : Q \times \Sigma \to Q$



- $Q = \{q_0, q_1, q_1, q_3\}$ ~ set of states
- $\Sigma = \{0, 1\}$ ← input alphabet
- δ
- $s = q_0$
- $A = \{q_0\}$ ~ set of accepting states in Q

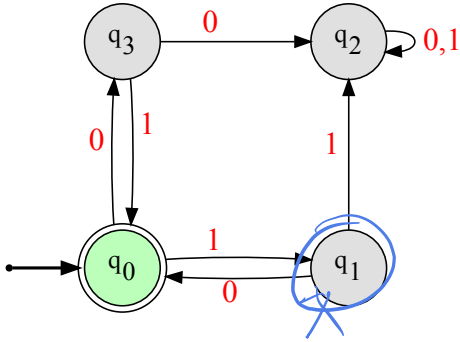
Example: The transition function



δ :

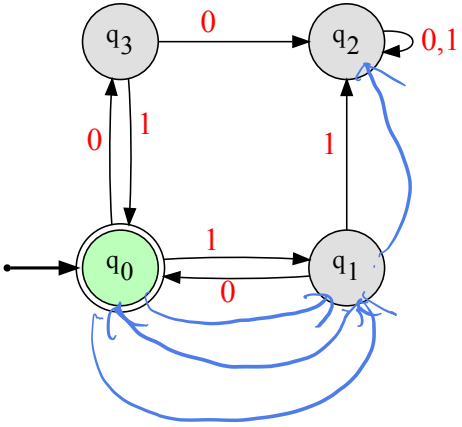
state $q \in Q$	input $c \in \Sigma$	result $\delta(q, c) \in Q$
q_0	0	q_3
q_0	1	q_1
q_1	0	q_0
q_1	1	q_2
q_2	0	q_2
q_2	1	q_3
q_3	0	q_2
q_3	1	q_0

What is $\delta^*(q_1, \epsilon)$?

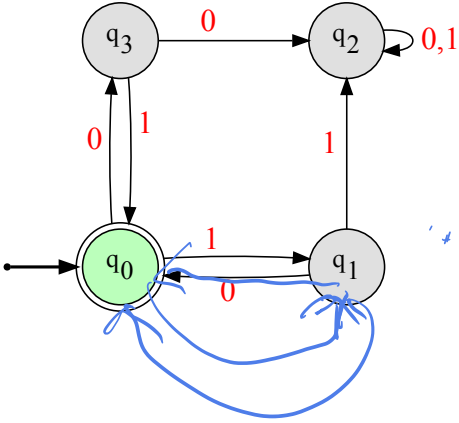


What is $\delta^*(q_0, 1011)$?

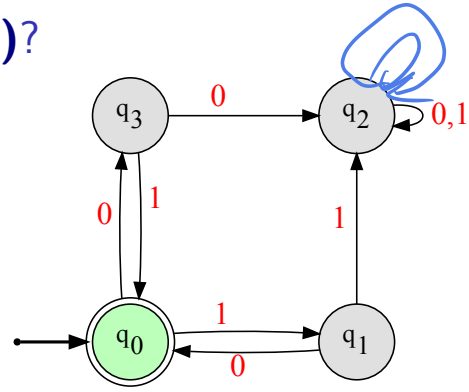
11
q_2



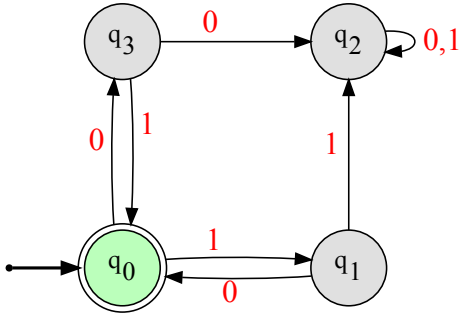
What is $\delta^*(q_1, 010)$?



What is $\delta^*(q_0, 10)$?

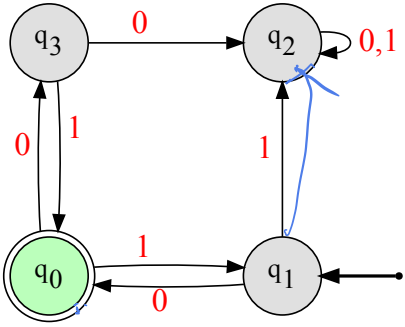


What is $L(M)$?



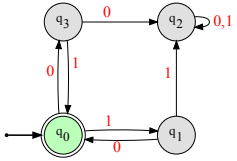
$(01+10)^*$

What is $L(M)$ if start state is changed to q_1?

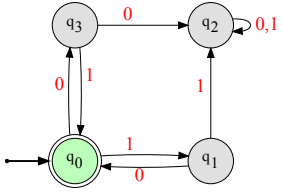


$0(01+10)^*$

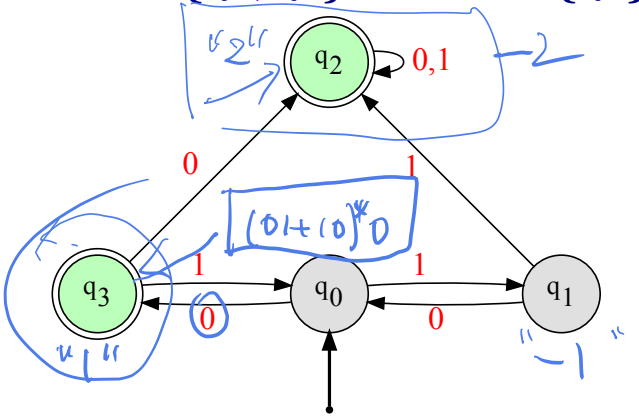
Old:



$L(M)$ if final/accept states are $\{q_2, q_3\}$ instead of $\{q_0\}$?



Old version:



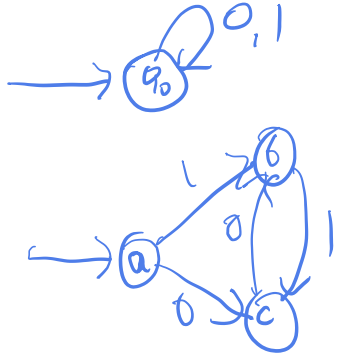
Redraw

$L(Q_2)$ = all binary strings with a prefix with balance 2 or −2

$\#_0(w) - \#_1(w) = 0$

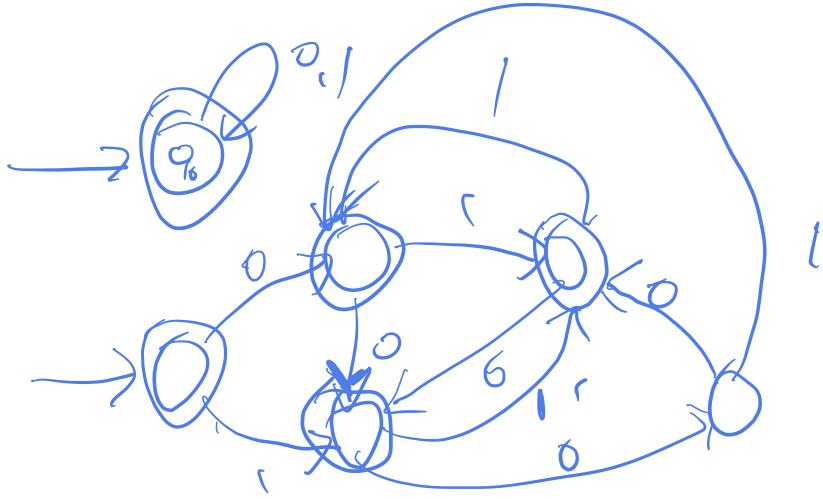
DFA example: $L = \emptyset$

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



DFA example: $L = \Sigma^*$

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

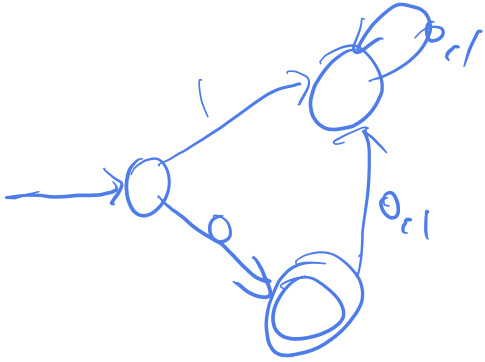


DFA example: $L = \{\epsilon\}$

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

DFA example: $L = \{0\}$

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

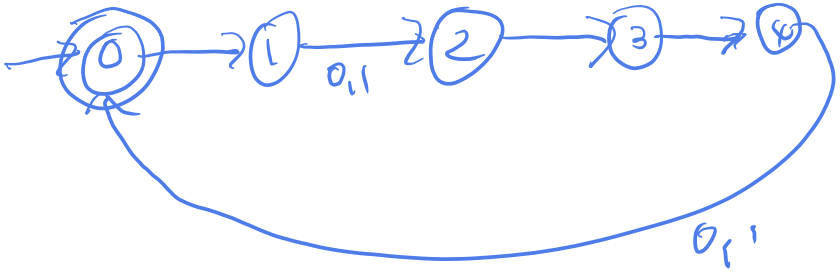


DFA Construction: Examples

Example II: Length divisible by 5

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

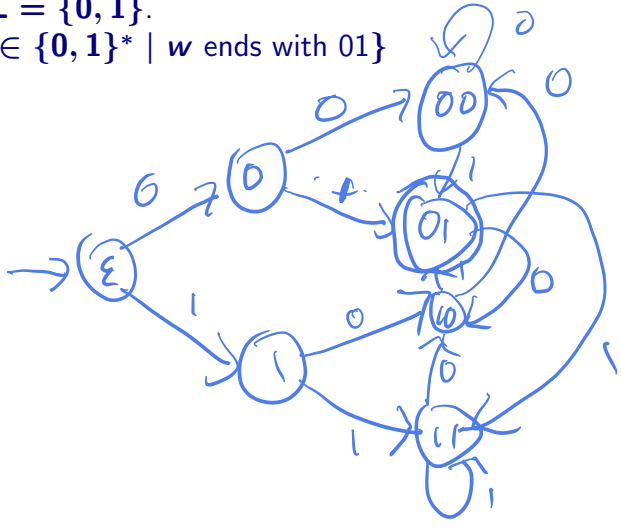
$L = \{w \in \{0, 1\}^* \mid |w| \text{ is divisible by } 5\}$



DFA Construction: examples

Example III: Ends with 01

Assume $\Sigma = \{0, 1\}$.
$L = \{w \in \{0, 1\}^* \mid w \text{ ends with } 01\}$

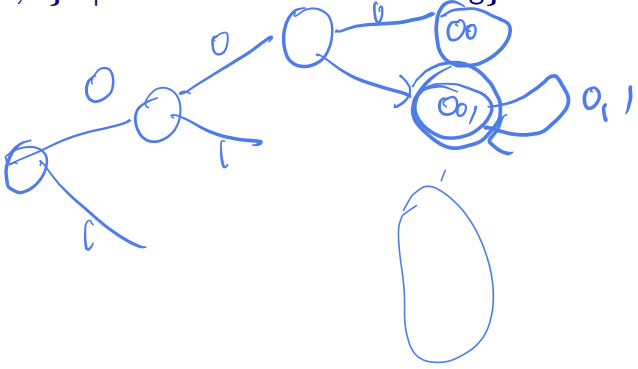


DFA Construction: examples

Example IV: Contains 001

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

$L = \{w \in \{0, 1\}^* \mid w \text{ contains } 001 \text{ as substring}\}$

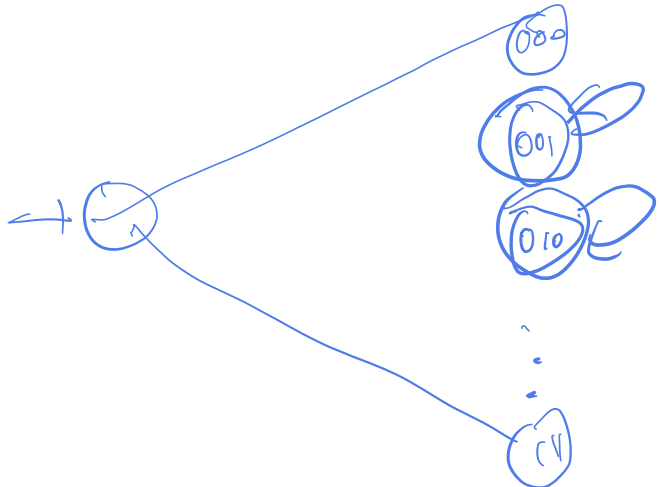


DFA Construction: examples

Example V: Contains 001 or 010

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

$L = \{w \in \{0, 1\}^* \mid w \text{ contains } \mathbf{001} \text{ or } \mathbf{010} \text{ as substring}\}$

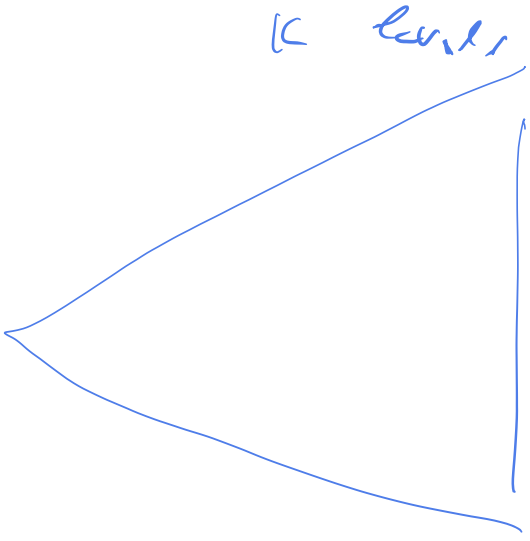


DFA construction examples

Example VI: Has a **1** exactly **k** positions from end

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

$L = \{w \in \Sigma^* \mid w$ has a 1 located k positions from the end of $w\}$.



Example: $L = \{\text{Binary numbers congruent to } \mathbf{0} \mod \mathbf{5}\}$