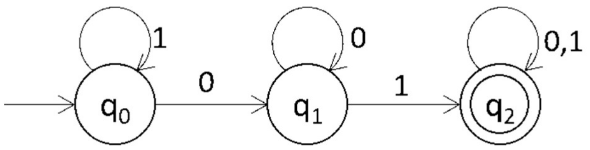
Techniques for DFA

1. If the L is equal to a finite value, if possible, draw that base condition state flow, figure out all the possible transitions for each state.
2. If L is not equal to a finite value, draw that base condition flow, and mark the initial ones as final but not the last state. Figure out all the possible transitions for each state.

1. Design a DFA which accepts all strings with a substring 01.

L = {01, 001, 101, 010, 011, 0001, 0010, 0100 ...}



A = {Q, Σ, δ, q_0, F}

Q = {q_0, q_1, q_2}

Σ = {0, 1}

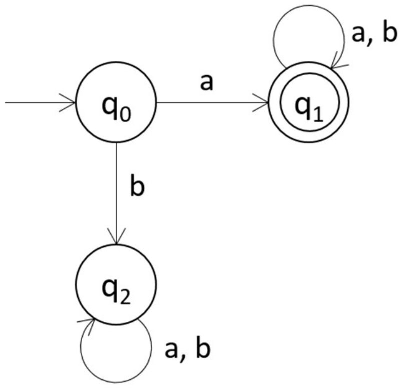
q_0 = q_0 (start state)

F = {q_2}

δ	0	1
→q_0	q_1	q_0
q_1	q_1	q_2
*q_2	q_2	q_2

2. Construct a DFA over {a, b} which accepts language for all strings starting with symbol 'a'.

L = {a, aa, ab, aaa, aab, aba, abb ...}



A = {Q, Σ, δ, q_0, F}

Q = {q_0, q_1, q_2}

Σ = {a, b}

q_0 = q_0 (start state)

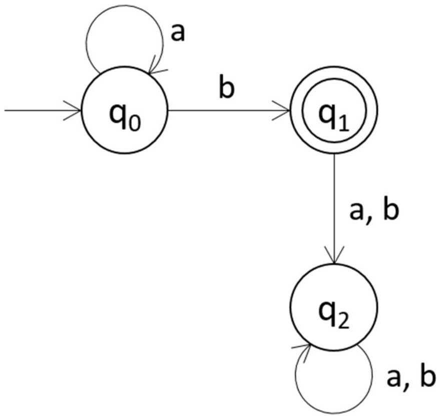
F = {q_1}

δ	a	b
→q_0	q_1	q_2
*q_1	q_1	q_1
q_2	q_2	q_2

NOTE: q_2 is trap state or sink state.

3. Construct DFA to accept all strings with arbitrary no. of a's followed by a single b.

L = {b, ab, aab, aaab …}



A = {Q, Σ, δ, q_0, F}

Q = {q_0, q_1, q_2}

Σ = {a, b}

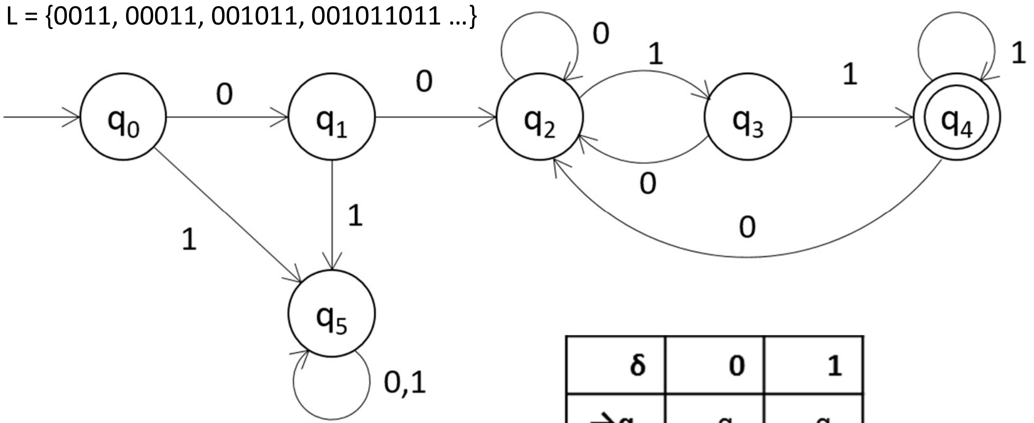
q_0 = q_0 (start state)

F = {q_1}

δ	a	b
→q_0	q_0	q_1
***q_1**	q_2	q_2
q_2	q_2	q_2

4. Construct DFA for Σ = {0, 1} which accepts strings starting with 2 0's & ending with 2 1's.

L = {0011, 00011, 001011, 001011011 …}



A = {Q, Σ, δ, q_0, F}

Q = {q_0, q_1, q_2, q_3, q_4, q_5}

Σ = {0, 1}

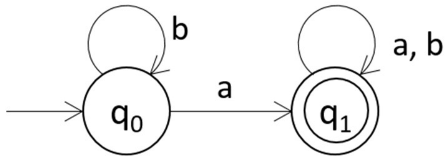
q_0 = q_0 (start state)

F = {q_4}

δ	0	1
→q_0	q_1	q_5
q_1	q_2	q_5
q_2	q_2	q_3
q_3	q_2	q_4
***q_4**	q_2	q_4
q_5	q_5	q_5

5. Design automata for $\Sigma = \{a, b\}$ strings with at least one 'a'.

$L = \{a, aa, ab, ba, aaa, aab, baa, abb \ldots\}$



$A = \{Q, \Sigma, \delta, q_0, F\}$

$Q = \{q_0, q_1\}$

$\Sigma = \{a, b\}$

$q_0 = q_0$ (start state)

$F = \{q_1\}$

δ	**a**	**b**
→q_0	q_1	q_0
***q_1**	q_1	q_1

Extending the transition function to strings (δ^*):-

Example: 1) baab

$\delta^*(q_0, \epsilon) = q_0$

$\delta^*(q_0, b) = \delta(\delta^*(q_0, \epsilon), b)$
$= \delta(q_0, b)$
$= q_0$

$\delta^*(q_0, ba) = \delta(\delta^*(q_0, b), a)$
$= \delta(q_0, a)$
$= q_1$

$\delta^*(q_0, baa) = \delta(\delta^*(q_0, ba), a)$
$= \delta(q_1, a)$
$= q_1$

$\delta^*(q_0, baab) = \delta(\delta^*(q_0, baa), b)$
$= \delta(q_1, b)$
$= q_1$

Since $q_1 \in F$, baab is valid.

Example: 2) bbb

$\delta^*(q_0, \epsilon) = q_0$

$\delta^*(q_0, \epsilon) = \delta(\delta^*(q_0, \epsilon), b)$
$= \delta(q_0, b)$
$= q_0$

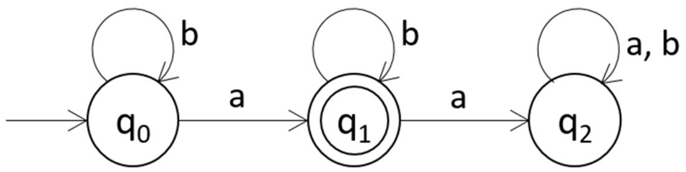
$\delta^*(q_0, b) = \delta(\delta^*(q_0, b), b)$
$= \delta(q_0, b)$
$= q_0$

$\delta^*(q_0, bbb) = \delta(\delta^*(q_0, bb), b)$
$= \delta(q_0, b)$
$= q_0$

Since $q_0 \notin F$, bbb is invalid.

6. Design an automata with Σ = {a, b} that accepts string with exactly one ‘a’.

L = {a, ab, ba, abb, bab, bba …}



A = {Q, Σ, δ, q_0, F}

Q = {q_0, q_1, q_2}

Σ = {a, b}

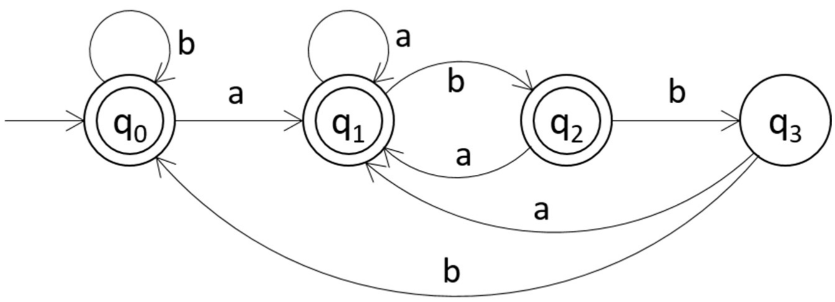
q_0 = q_0 (start state)

F = {q_1}

δ	a	b
→q_0	q_1	q_0
*q_1	q_2	q_1
q_2	q_2	q_2

7. Design an automata with Σ = {a, b} such that it accepts all strings except those which end with abb.

L = {ϵ, a, b, aa, ab, ba, bb, aaa, aab, aba, abba …}



A = {Q, Σ, δ, q_0, F}

Q = {q_0, q_1, q_2, q_3}

Σ = {a, b}

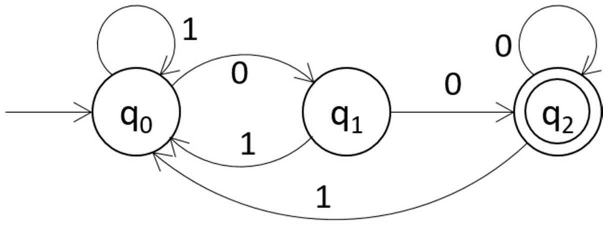
q_0 = q_0 (start state)

F = {q_0, q_1, q_2}

δ	a	b
→*q_0	q_1	q_0
*q_1	q_1	q_2
*q_2	q_1	q_3
q_3	q_1	q_0

8. Design an automata with $\Sigma = \{0, 1\}$ that accepts set of all strings ending with 00.

L = {00, 000, 100, 1000, 0100, 0000, 1100 …}



$A = \{Q, \Sigma, \delta, q_0, F\}$

$Q = \{q_0, q_1, q_2\}$

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

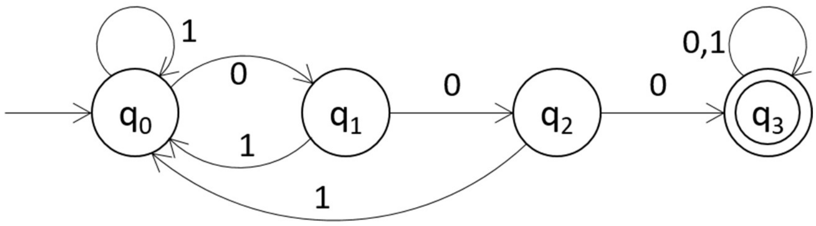
$q_0 = q_0$ (start state)

$F = \{q_2\}$

δ	**0**	**1**
→q_0	q_1	q_0
q_1	q_2	q_0
$*q_2$	q_2	q_0

9. Draw an automata with $\Sigma = \{0, 1\}$ that accepts set of all strings with 3 consecutive 0's.

L = {000, 1000, 0000, 0001, 101000, 00010001 …}



$A = \{Q, \Sigma, \delta, q_0, F\}$

$Q = \{q_0, q_1, q_2, q_3\}$

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

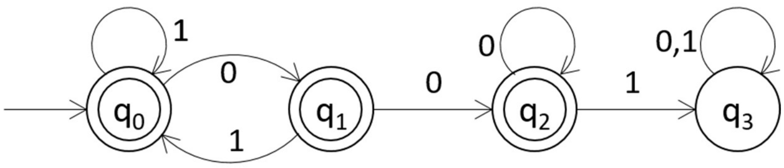
$q_0 = q_0$ (start state)

$F = \{q_3\}$

δ	**0**	**1**
→q_0	q_1	q_0
q_1	q_2	q_0
q_2	q_3	q_0
$*q_3$	q_3	q_3

10. Design an automata with Σ = {0, 1} that accepts set of all strings except those containing substring 001.

L = {ϵ, 0, 1, 00, 11, 01, 10, 101, 011, 010, 010100 …}



A = {Q, Σ, δ, q_0, F}

Q = {q_0, q_1, q_2, q_3}

Σ = {0, 1}

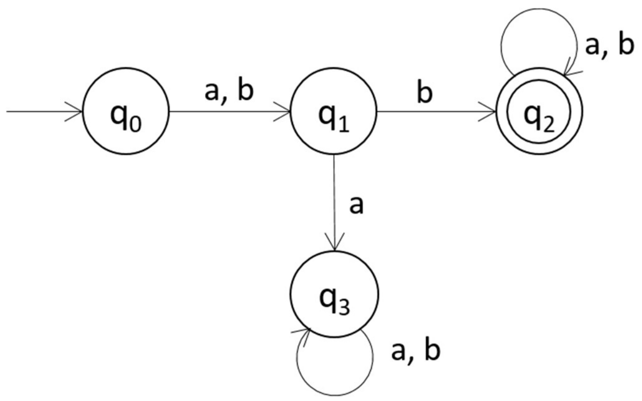
q_0 = q_0 (start state)

F = {q_0, q_1, q_2}

δ	0	1
→*q_0	q_1	q_0
*q_1	q_2	q_0
*q_2	q_2	q_3
q_3	q_3	q_3

11. Design an automata with Σ = {a, b} that accepts set of all strings with b as second letter.

L = { ab, bb, aba, abb, bba, bbb, abbabab …}



A = {Q, Σ, δ, q_0, F}

Q = {q_0, q_1, q_2, q_3}

Σ = {a, b}

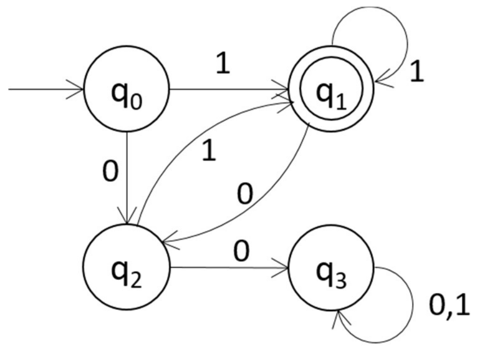
q_0 = q_0 (start state)

F = {q_2}

δ	a	b
→q_0	q_1	q_1
q_1	q_3	q_2
*q_2	q_2	q_2
q_3	q_3	q_3

12. Obtain DFA that accepts all strings on $\Sigma = \{0, 1\}$ that ends with 1 and do not contain 00.

$L = \{1, 01, 011, 0101, 101, 111 \ldots\}$



$A = \{Q, \Sigma, \delta, q_0, F\}$

$Q = \{q_0, q_1, q_2, q_3\}$

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

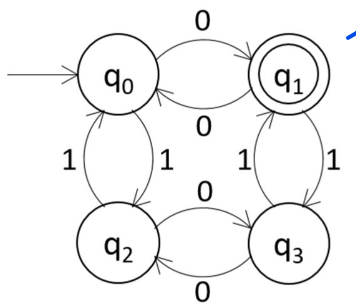
$q_0 = q_0$ (start state)

$F = \{q_1\}$

δ	**0**	**1**
→q_0	q_2	q_1
***q_1**	q_2	q_1
q_2	q_3	q_1
q_3	q_3	q_3

13. Obtain DFA to accept the language $L = \{w \mid n_0(w)$ is odd and $n_1(w)$ is even$\}$.

$L = \{0, 011, 101, 110, 000, 00011, 01010 \ldots\}$



$A = \{Q, \Sigma, \delta, q_0, F\}$

$Q = \{q_0, q_1, q_2, q_3\}$

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

$q_0 = q_0$ (start state)

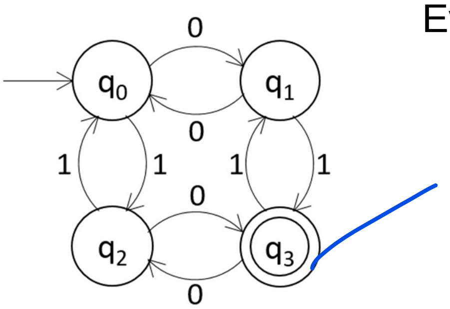
$F = \{q_1\}$

δ	**0**	**1**
→q_0	q_1	q_2
***q_1**	q_0	q_3
q_2	q_3	q_0
q_3	q_2	q_1

0	0	Position
Even -	Even	1
Odd -	Even	2
Odd -	Odd	3
Even -	Odd	4

14. L = {w | $n_0(w)$ is odd and $n_1(w)$ is odd}

L = {01, 10, 0010, 1000, 010101 …}



A = {Q, Σ, δ, q_0, F}

Q = {q_0, q_1, q_2, q_3}

Σ = {0, 1}

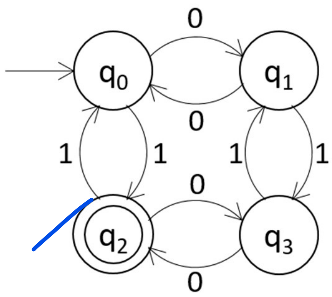
q_0 = q_0 (start state)

F = {q_3}

δ	0	1
→q_0	q_1	q_2
q_1	q_0	q_3
q_2	q_3	q_0
*q_3	q_2	q_1

15. L = {w | $n_0(w)$ is even and $n_1(w)$ is odd}

L = {1, 100, 010, 001, 111, 00111 …}



A = {Q, Σ, δ, q_0, F}

Q = {q_0, q_1, q_2, q_3}

Σ = {0, 1}

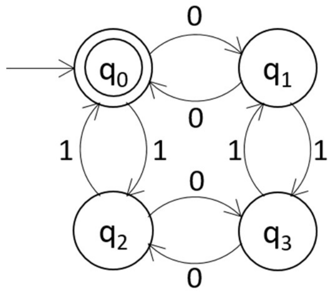
q_0 = q_0 (start state)

F = {q_2}

δ	0	1
→q_0	q_1	q_2
q_1	q_0	q_3
*q_2	q_3	q_0
q_3	q_2	q_1

16. L = {w | $n_0(w)$ is even and $n_1(w)$ is even}

L = {ϵ, 11, 00, 0101, 01011010 …}



A = {Q, Σ, δ, q_0, F}

Q = {q_0, q_1, q_2, q_3}

Σ = {0, 1}

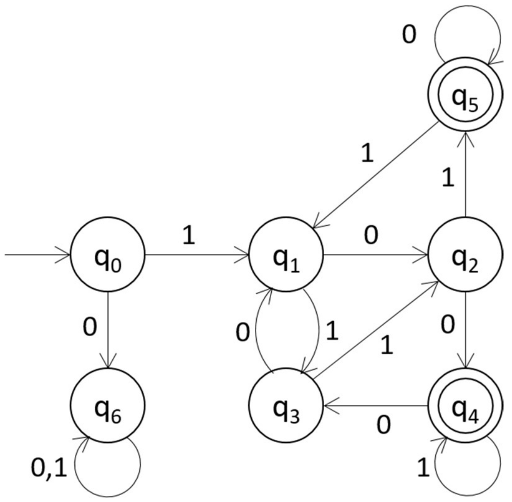
q_0 = q_0 (start state)

F = {q_0}

δ	**0**	**1**
→*q_0	q_1	q_2
q_1	q_0	q_3
q_2	q_3	q_0
q_3	q_2	q_1

17. DFA to accept binary numbers that are divisible by 5 and start with 1.

L = {101, 1010, 1111, 10100, 11001, 11110 …}



A = {Q, Σ, δ, q_0, F}

Q = {q_0, q_1, q_2, q_3, q_4, q_5, q_6}

Σ = {0, 1}

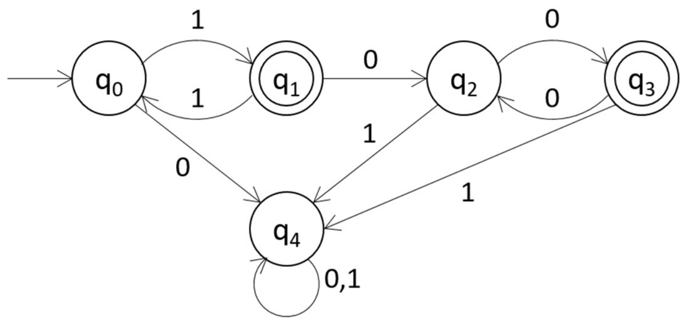
q_0 = q_0 (start state)

F = {q_4, q_5}

δ	**0**	**1**
→q_0	q_6	q_1
q_1	q_2	q_3
q_2	q_4	q_5
q_3	q_1	q_2
***q_4**	q_3	q_4
***q_5**	q_5	q_1
q_6	q_6	q_6

18. DFA for L = {w | w has odd no of 1's followed by even no of 0's}

L = {1, 100, 111, 1110000 ...}



A = {Q, Σ, δ, q_0, F}

Q = {q_0, q_1, q_2, q_3, q_4}

Σ = {0, 1}

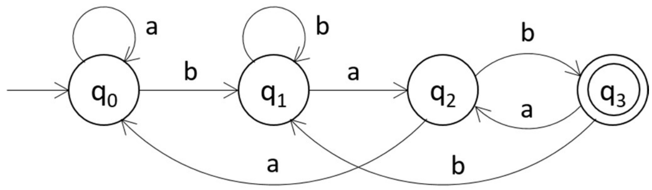
q_0 = q_0 (start state)

F = {q_1, q_3}

δ	**0**	**1**
→q_0	q_4	q_1
***q_1**	q_2	q_0
q_2	q_3	q_4
***q_3**	q_2	q_4
q_4	q_4	q_4

19. DFA for L = {wbab | w ∈ {a, b}*}

L = {bab, abab, bbab, aabab, abbab, abbbababbab ...}



A = {Q, Σ, δ, q_0, F}

Q = {q_0, q_1, q_2, q_3}

Σ = {a, b}

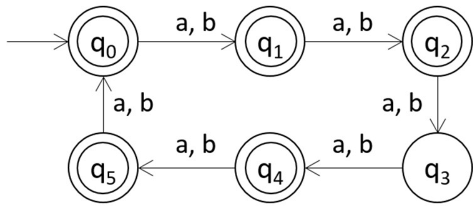
q_0 = q_0 (start state)

F = {q_3}

δ	**a**	**b**
→q_0	q_0	q_1
q_1	q_2	q_1
q_2	q_0	q_3
***q_3**	q_2	q_1

20. DFA for L = {w| |w| mod 3 >= |w| mod 2} where w ∈ Σ* and Σ = {a, b}.

L = {|w| = 1, |w| = 2, |w| = 4, |w| = 5, |w| = 6, |w| = 7 ...}



A = {Q, Σ, δ, q_0, F}

Q = {q_0, q_1, q_2, q_3, q_4, q_5}

Σ = {a, b}

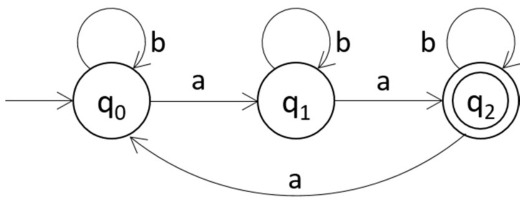
q_0 = q_0 (start state)

F = {q_0, q_1, q_2, q_4, q_5}

δ	a	b
→*q_0	q_1	q_1
***q_1**	q_2	q_2
***q_2**	q_3	q_3
q_3	q_4	q_4
***q_4**	q_5	q_5
***q_5**	q_0	q_0

21. L = {w | n(a) mod 3 > 1} for Σ = {a, b}.

L = {aa, aab, baa, babab, abba, ababaabba ...}



A = {Q, Σ, δ, q_0, F}

Q = {q_0, q_1, q_2}

Σ = {a, b}

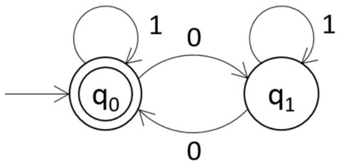
q_0 = q_0 (start state)

F = {q_2}

δ	a	b
→q_0	q_1	q_0
q_1	q_2	q_1
***q_2**	q_0	q_2

22. Detect even number of 0's for Σ = {0, 1}.

L = {ϵ, 1, 00, 0000, 010, 100, 1001, 110010101 …}



A = {Q, Σ, δ, q_0, F}

Q = {q_0, q_1}

Σ = {0, 1}

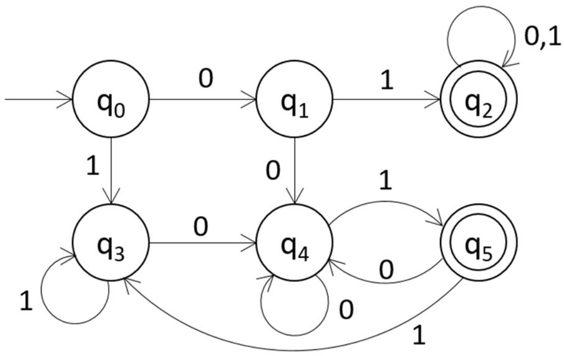
q_0 = q_0 (start state)

F = {q_0}

δ	0	1
→*q_0	q_1	q_0
q_1	q_0	q_1

23. Accept all strings that either begin or end or both with 01.

L = {01, 010, 011, 001, 101, 1001, 0111 …}



A = {Q, Σ, δ, q_0, F}

Q = {q_0, q_1, q_2, q_3, q_4, q_5}

Σ = {0, 1}

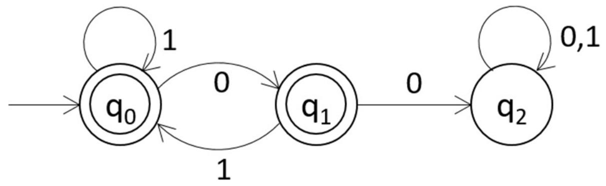
q_0 = q_0 (start state)

F = {q_2, q_5}

δ	0	1
→q_0	q_1	q_3
q_1	q_4	q_2
***q_2**	q_2	q_2
q_3	q_4	q_3
q_4	q_4	q_5
***q_5**	q_4	q_3

24. Accept strings that doesn't contain two consecutive 0's.

L = {ϵ, 0, 1, 01, 10, 11, 010, 101, 011, 110, 0110101101 ...}



A = {Q, Σ, δ, q_0, F}

Q = {q_0, q_1, q_2}

Σ = {0, 1}

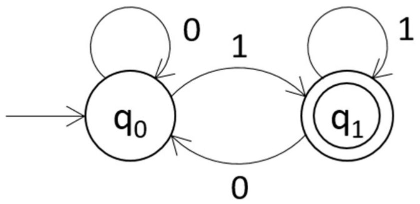
q_0 = q_0 (start state)

F = {q_0, q_1}

δ	0	1
→*q_0	q_1	q_0
***q_1**	q_2	q_0
q_2	q_2	q_2

25. Detect odd binary numbers.

L = {1, 01, 11, 101, 001, 011, 111, 00101011 ...}



A = {Q, Σ, δ, q_0, F}

Q = {q_0, q_1}

Σ = {0, 1}

q_0 = q_0 (start state)

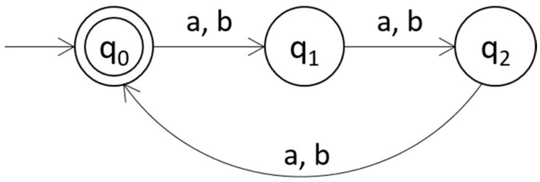
F = {q_1}

δ	0	1
→q_0	q_0	q_1
***q_1**	q_0	q_1

n Mod length is basically a circle with n states

26. L = {w | |w| mod 3 = 0} for Σ = {a, b}

L = {aaa, aab, aba, abb, baa, bab, bba, bbb, abaaba …}



A = {Q, Σ, δ, q_0, F}

Q = {q_0, q_1, q_2}

Σ = {a, b}

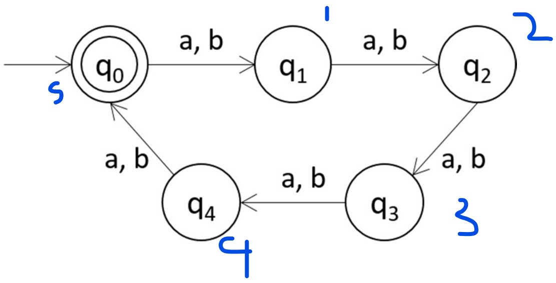
q_0 = q_0 (start state)

F = {q_0}

δ	**a**	**b**
→*q_0	q_1	q_1
q_1	q_2	q_2
q_2	q_0	q_0

27. L = {w | |w| mod 5 =0} for Σ = {a, b}

L = {aaaaa, bbbbb, ababa, abbaa, baabb, babba, aababbaabb …}



A = {Q, Σ, δ, q_0, F}

Q = {q_0, q_1, q_2, q_3, q_4}

Σ = {a, b}

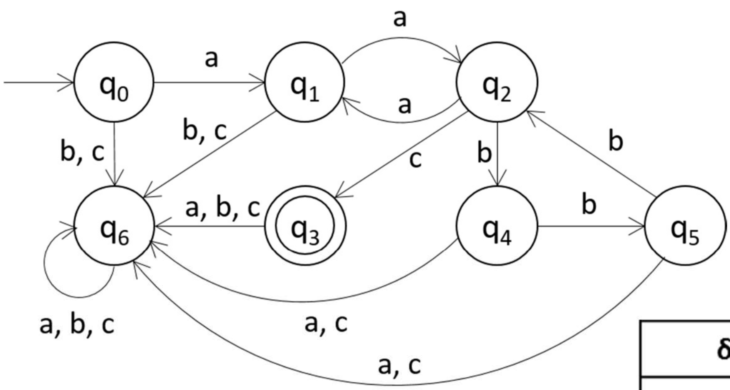
q_0 = q_0 (start state)

F = {q_0}

δ	**a**	**b**
→*q_0	q_1	q_1
q_1	q_2	q_2
q_2	q_3	q_3
q_3	q_4	q_4
q_4	q_0	q_0

28. $L = \{a^{2n}b^{3m}c \mid n \geq 1 \text{ and } m \geq 0\}$

L = {aac, aabbbc, aaaac, aaaabbbc, aabbbbbbc …}



δ	a	b	c
→q_0	q_1	q_6	q_6
q_1	q_2	q_6	q_6
q_2	q_1	q_4	q_3
*q_3	q_6	q_6	q_6
q_4	q_6	q_5	q_6
q_5	q_6	q_2	q_6
q_6	q_6	q_6	q_6

$A = \{Q, \Sigma, \delta, q_0, F\}$

$Q = \{q_0, q_1, q_2, q_3, q_4, q_5, q_6\}$

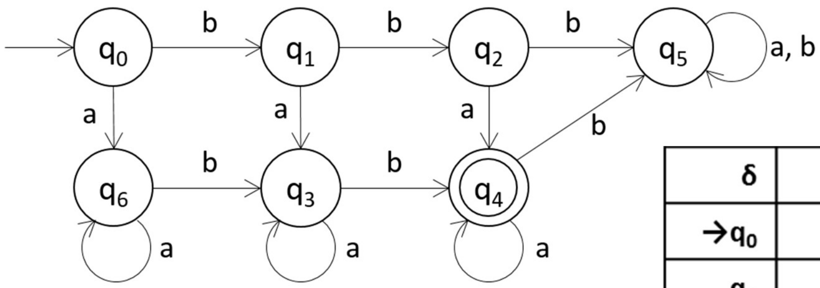
$\Sigma = \{a, b\}$

$q_0 = q_0$ (start state)

$F = \{q_3\}$

29. At least one 'a' and exactly two b's.

L = {abb, bab, bba, abab, aabb, aabaabaa …}



δ	a	b
→q_0	q_6	q_1
q_1	q_3	q_2
q_2	q_4	q_5
q_3	q_3	q_4
*q_4	q_4	q_5
q_5	q_5	q_5
q_6	q_6	q_3

$A = \{Q, \Sigma, \delta, q_0, F\}$

$Q = \{q_0, q_1, q_2, q_3, q_4, q_5, q_6\}$

$\Sigma = \{a, b\}$

$q_0 = q_0$ (start state)

$F = \{q_4\}$