01/27/2025.

example of RE.

ex1 identifier: starting with a letter. follow by mix of letters and nums.

$[a \cdots z]$ $[0 \cdots 9]$
$[A \cdots Z]$.

$$\left([A \cdots Z] \mid [a \cdots z]\right)\left([a \cdots z] \mid [0 \cdots 9] \mid [A \cdots Z]\right)^*$$

ex2. r: $0 \mid \left([1 \cdots 9][0 \cdots 9]^* . [0 \cdots 9]^*\right)$

L(r):

0 ✓
0.0 ✗
0.2 ✗
2. ✓
12. ✓
.1 ✗

12.0 ✓

00 ✗

ex: r: $0 \mid \cancel{[1 \cdots 9]^*[0 \cdots 9]^*}$ $\mid [1 \cdots 9][0 \cdots 9]^*$ $\mid (0 \mid [1 \cdots 9][0 \cdots 9]^*) . [0 \cdots 9]^*$

00 ✗ 01 ✗ 01.0 ✗

0. ✓ 0.0 ✓ 0.00 0.0010 ✓

1.01 ✓

Σ. $\hat{}c$: any alphabet in Σ other than c.

string literal in Java.

$"(\hat{}")^*"$

$/*\ (\hat{}*)^*\ */$

$/*\ (\hat{}* \mid **^*\hat{}/)^*\ */$

$/*\ (\hat{}* \mid *\hat{}/)^*\ */$

$/*\ T/**\ */$

r3, r30, r31

r3 | r30 | r31 r3(ε | 0 | 1)

r (1 | 2) ([0 ··· 9] | ε) r1, r2

r10, ··· r19

FA

r20, ··· r29.

2.2 RE ≡ FSM ≡ RL

Automata : abstract of computer.

classification : by memory

FSA	no memory.
PDA	stack.
TM.	tape.

by output — recognizer. — T/F, Y/N

transducer. — output

by behavior. — deterministic.

non-deterministic.

FSA: no memory $\begin{cases} \text{DFA} \\ \text{NDFA} \end{cases}$)))

~~sc~~ recognizer.

1. DFA. $M = (S, \Sigma, \delta, S_0, S_A)$

S: finite set of states.

Σ: finite alphabet.

δ: $S \times \Sigma \to S$ transition function

$\times$ $y = \pm\sqrt{x}$

$\times$ $\mathbb{R} \to \mathbb{R}$: $y = \sqrt{x}$

$\checkmark$ $\mathbb{R}_{\geq 0} \to \mathbb{R}$ $y = \sqrt{x}$

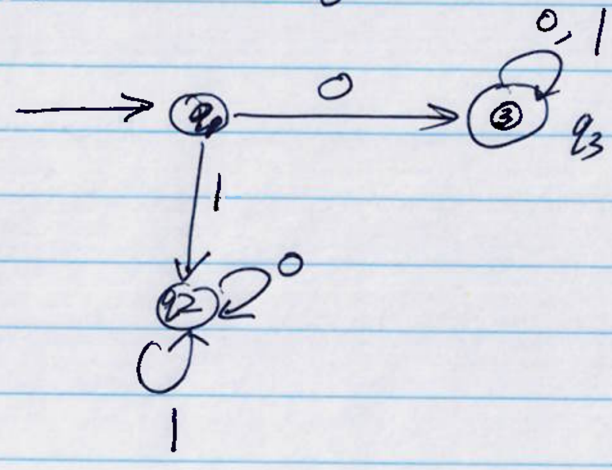
S_0 : initial state

$S_A \subseteq S$: accepting states

final states.

δ: transition diagram.

M:



$S = \{q_1, q_2, q_3\}$. ○ ◎

s_0 : q_1 → (s_0)

$S_A = \{q_3\}$ ◎

$\Sigma = \{\text{"0"}, \text{"1"}\}$.

δ :

$$\delta(q_1, 0) = q_3$$

$$\delta(q_1, 1) = q_2$$

$$\delta(q_2, 0) = \delta(q_2, 1) = q_2.$$

$$\delta(q_3, 0) = \delta(q_3, 1) = q_3.$$

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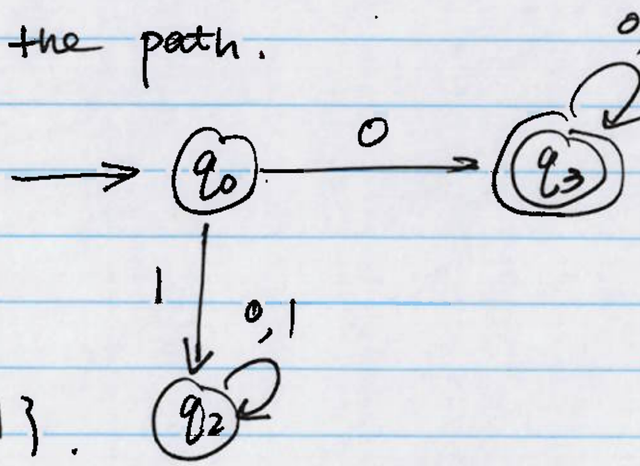
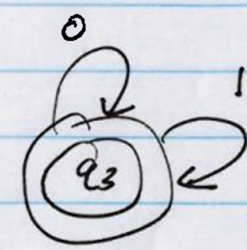
*. Group project.

$L(M) = \{$ set of strings accepted by $M \}$.

A string w is accept M. If there is a path from ~~start~~ state / initial state. to one of the accepting states with W as the label on the path.

M1





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

each state has 2 transitions. $\{\xrightarrow{1}, \xrightarrow{0}\}$

$0 \in L(M)$

$1 \notin L(M)$

$001 \in L(M)$.

$\varepsilon \notin L(M)$

$L(M1)$: any binary string starting with 0.

RE : $0(0|1)^*$

q_2 : dead state / trap / error.

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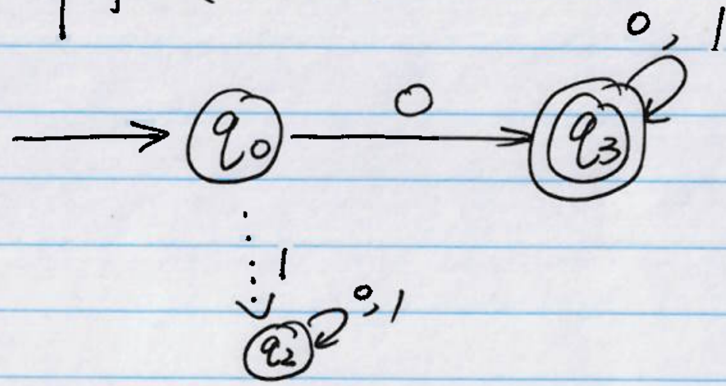
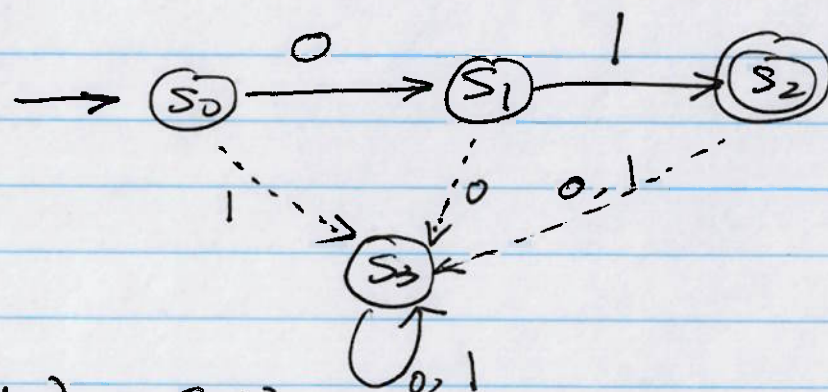
simplified (fi) representaton. omit the error state

simplified M1.



M2.



L(M2) = {01}.

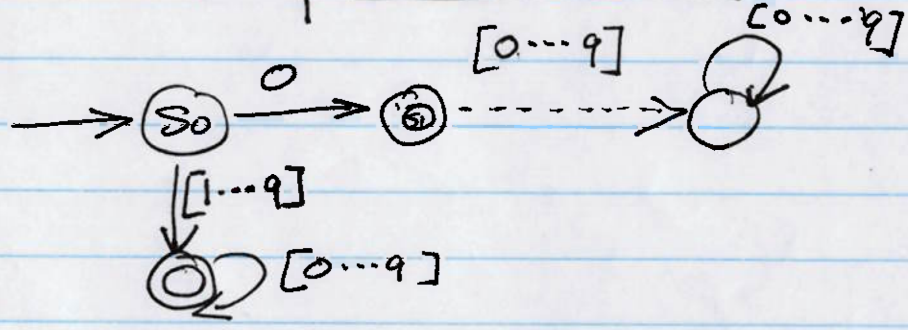
2. design DFA

① . non-negative int with no leading 0's.

RE : 0 | [1⋯9] [0⋯9]*

0 ✓

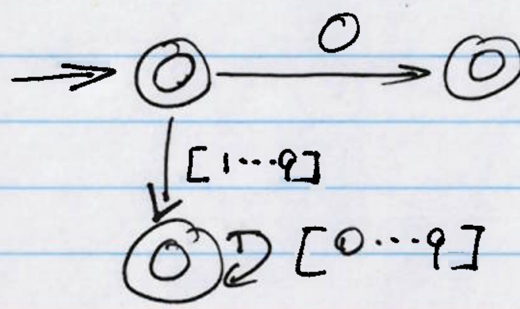
00 ✗



2 non-negative int. leading 0's allowed.

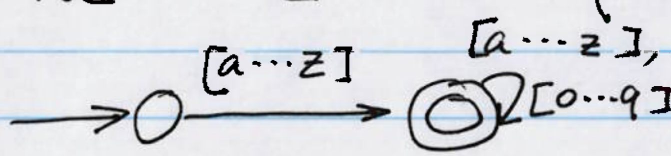
RE: $[0 \cdots 9]\,[0 \cdots 9]^*$ $\varepsilon \notin$.

3. non-negative int. including ε, with no leading 0's.



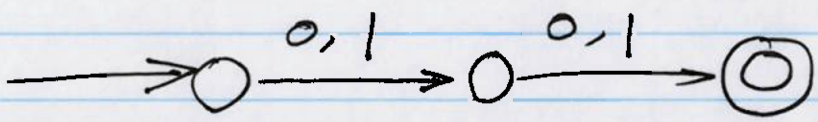
4. identifier.

RE: $[a \cdots z]\,\left([a \cdots z] \mid [0 \cdots 9]\right)^*$

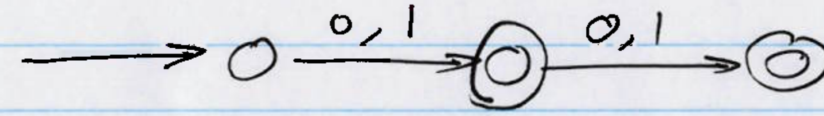


5 00 | 01 | 10 | 11 L = {00, 01, 10, 11}

(0 | 1) (0 | 1).



6 (0 | 1) (0 | 1 | ε) L = {0, 1, 00, 01, 10, 11}



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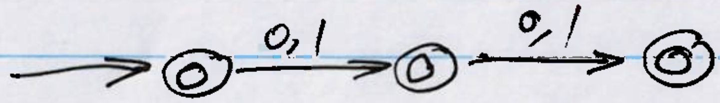
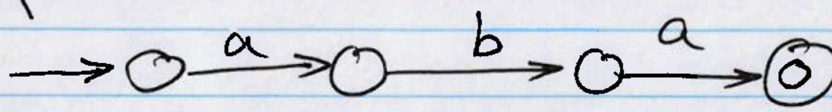
7 $(\varepsilon|0|1)(\varepsilon|0|1)$

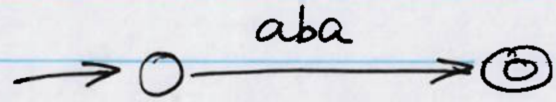
$L = \{\varepsilon, 0, 1, 00, 01, 10, 11\}$



8 $L = \{aba\}$.

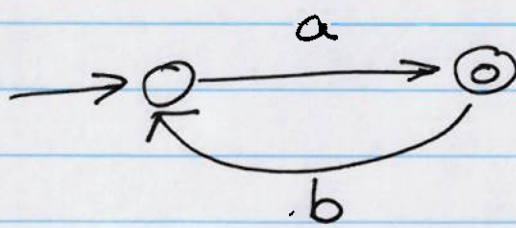


✓



X

M



$aba \in L(M)$

$a \in L(M)$.

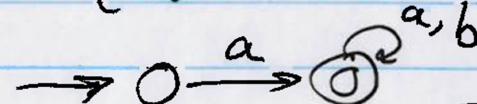
$a \notin L$

a
aba
ababa.
.

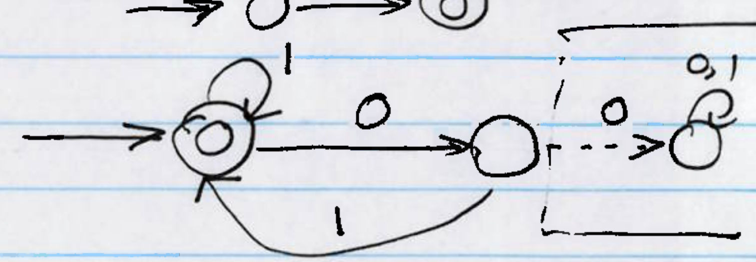
$a(ba)^*$

$(ab)^* a$

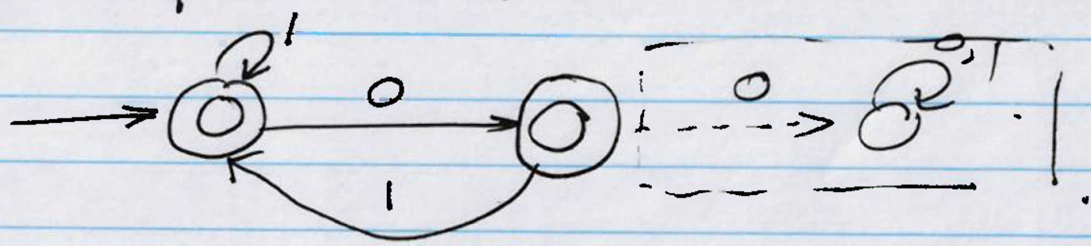
9. $a(a|b)^*$



10. $(1|01)^*$



11. $(1|01)^*(\varepsilon|0)$. no consecutive 0.

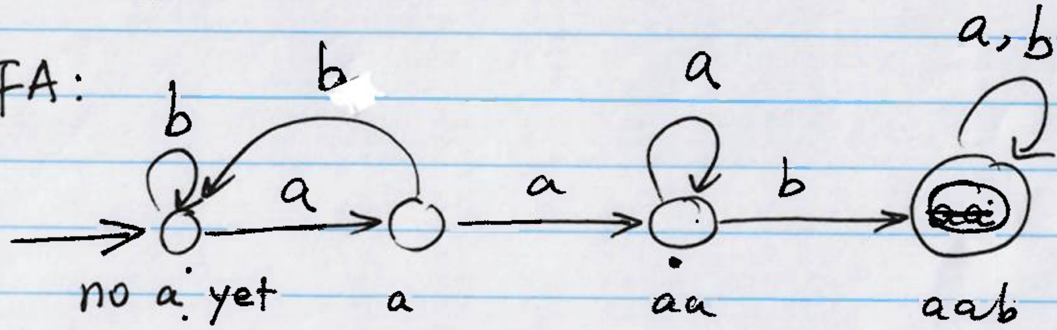


12. $L = \{ w \in \{a,b\}^* : w$ contains substring $aab \}$.

RE: aab

$(a|b)^* aab (a|b)^*$

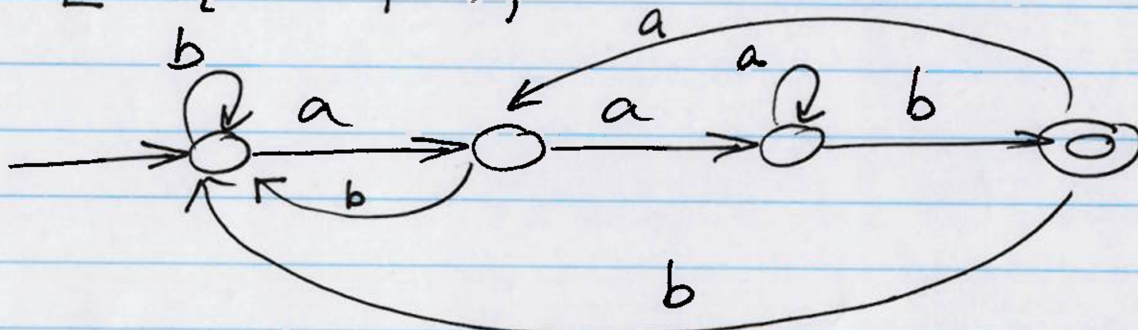
DFA:



state represents history

aab aab

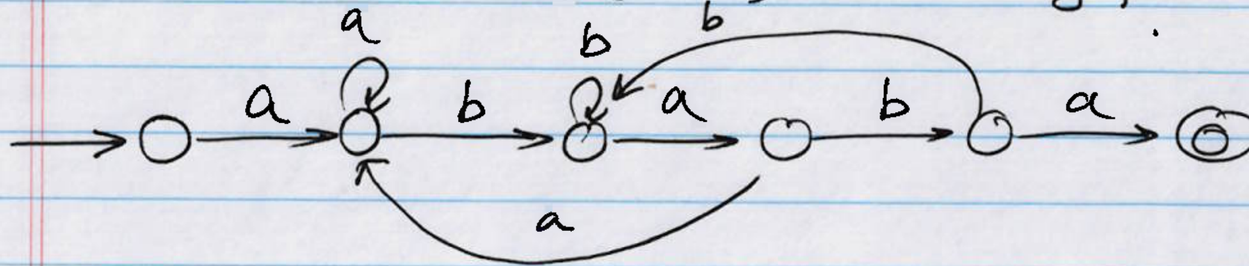
13. $L = \{ w \in \{a,b\}^* :$ W ends with aab $\}$



aabaab

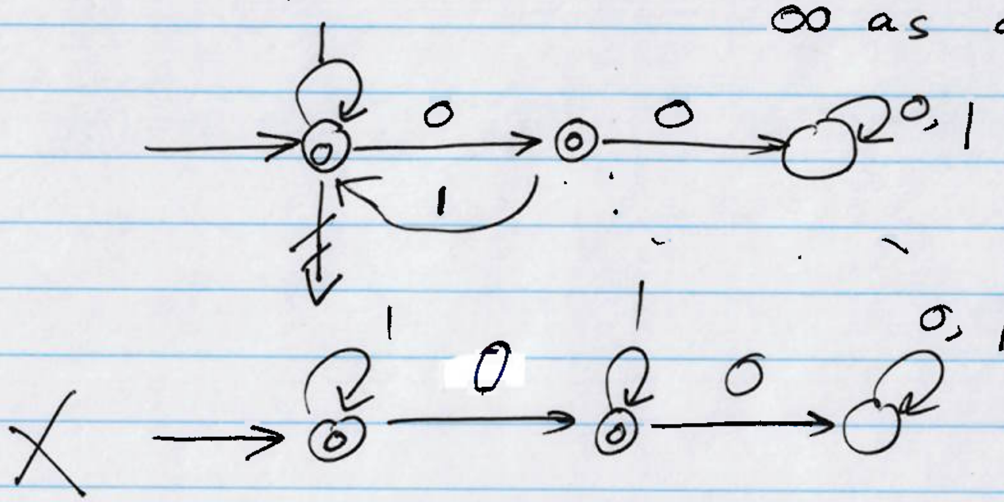
20

$L = \{ w \in \{a, b\}^* .$ w starts with a and contains baba as a substrng $\}$.



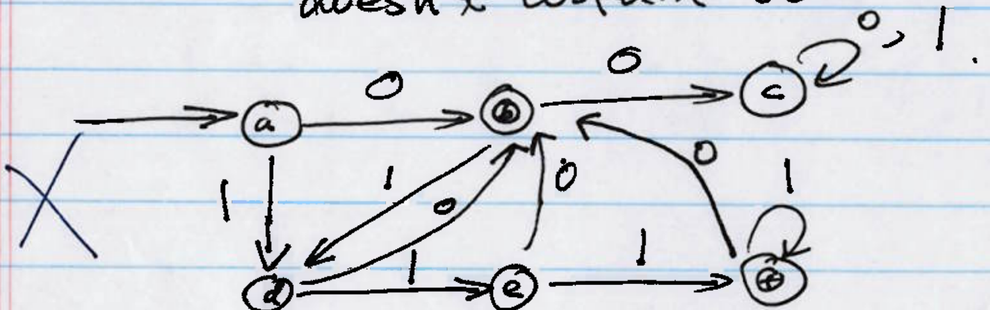
a . b ba bab baba

14: $L = \{ w \in \{0, 1\}^* .$ w doesn't contain 00 as a substrng $\}$.



0ø01

15. $L = \{ w \in \{0, 1\}^* .$ w contains '111' and doesn't contain 00



1110 1 X

10 X