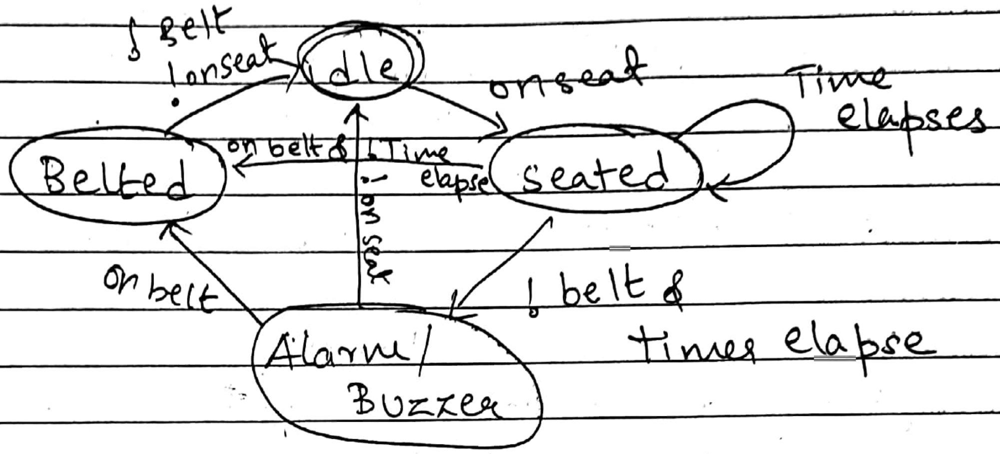
7/2/2020

Formal language of Automate theory

* Seat - Belt Controller (Transition diagram)



'intialy idle & end also idle.'
to check person is there or not if there check he/she has ~~bite~~ belt or not. if belt no there alarm will be on. ~~to~~ off it wear a belt.

* State: ① idle ③ Alarm / Buzzer
  ② Seated ④ Belted

* Actions: ① on seat ③ on belt
  ② !on seat ④ !on belt
  ⑤ Time elapse ⑥ !Time Elapses

* Start state :- idle state
  Finish state :- idle state
  Transition function :-

* Rules :- ① (idle, on seat) → seated
  Format $\boxed{\text{(currentstate, input)} \rightarrow \text{next state}}$

  ② (Seated, !belt & Time elapse) → Alram / Buzzer

→ 2 circles means finial state

classmate

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9/1/2020

1. Language
2. Grammer
3. Machine

Grammer

Rules:

start symbol → Sentence → <noun phrose> <predicate>

noun phrase → Article noun

Predicate → Verb <predicatephras>

(1) Article → a, an, the → its called Non terminal

Terminal

* a grammer is having set of Non terminal ~~which are not~~, set of terminal, set of rules and start symbol

* Grammer [4-Tuples]

1. Set of Terminals (T) → small letters
2. Set of Non Terminals (V) → Capital symbols.
3. Production rules (P)
4. Start symbol (S)

$$G = (V, T, P, S)$$

5 mks

Q1 Given G: Find out the language generated by Grammar (G)

$G = (V, T, P, S)$

$V = \{S\}$ $T = \{a, b, \lambda\}$

$P: S \rightarrow aSb$ (rule 1)

$S \rightarrow \lambda$ (rule 2)

Start sysbol (S): S

L = {atleast one 'a' or at least one 'b'}

$\boxed{or}$ $L\{b^p a^q : p \geq 0, q > 0$ or $p > 0, q \geq 0\}$

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7 - strings $\in$ language.

Ans $S \rightarrow \lambda$ (rule 2)

$S \rightarrow aSb$ (rule 1)

$S \rightarrow a \lambda b$ by rule 2)

$\rightarrow ab$

$S \rightarrow aSb$ rule 1

$\rightarrow aaSbb$ rule 1

$\rightarrow aa \lambda bb$ rule 2

$\rightarrow aabb$

$S \rightarrow aSb$ rule 1

$\rightarrow aaSbb$ rule 1

$\rightarrow aaaSbbb$ rule 1

$\rightarrow aaa\lambda bbb$ rule 2

$\rightarrow aaabbb$

$L = \{a^n b^n : n \geq 0\}$

1. λ
2. ab
3. aa bb
4. aaa bbb
5. aaaa bbbb
6. aaaaa bbbbb
7. aaaaaa bbbbbb

no of a	no of b
0	0
1	1
2	2
3	3
4	4
5	5
6	6

10/1/2020

Q. (2) $S \rightarrow a$ rule 1

$S \rightarrow b$ rule 2

$S \rightarrow aS$ rule 3

$S \rightarrow bS$ rule 4

$G = (V, T, P, S)$

Find out the language (L) generated by the given grammer

$V = \{S\}$ Start symbol $= S$

$T = \{a, b\}$

7 strings	no of a	no of b
(1) a	1	0
(2) b	0	1
(3) aa	2	0
(4) ab	1	1
(5) ba	1	1
(6) bb	0	2
(7) aaa	3	0

(1) $S \rightarrow a$ rule 1

(2) $S \rightarrow b$ rule 2

(3) $S \rightarrow aS$ rule 3

aa rule 1

(4) $S \rightarrow aS$ rule 3

ab rule 2

(5) $S \rightarrow bS$ rule 4

ba rule 1

(6) $S \rightarrow bS$ rule 4

(7) $S \rightarrow aS$ rule 3

$\rightarrow aaS$ rule 3

$\rightarrow aaa$ rule 1

be $L = \{a^n b^m : n \geq 0, m > 0\}$

$n > 0, m \geq 0$ or b

Q3. P:- $S \to Ab$ rule 1
$A = aAb$ rule 2
$A = \lambda$ rule 3

$V = \{S, A\}$ no teminals
$T = \{a, b, \lambda\}$ teminals
Starting Point = S

Strings

		a	b
1	b	0	1
2	abb	1	2
3	aa bbb	2	3
4	aaa bbbb	3	4
5	aaaa bbbbb	4	5
6	aaaaa bbbbbb	5	6
7	aaaaaa bbbbbbb	6	7

~~$L = \{a^n b^m : n \geq 0, m \geq 0\}$~~

$L = \{a^n b^{n+1} : n \geq 0\}$

$L = \{$no of b's = no of a's $+1\}$

$S \to Ab$ rule 1
λb rule 3
$S \to b$

$S \to Ab$ rule 1
$aAbb$ rule 2
$a\lambda bb$ rule 3
abb

$S \to Ab$ rule 1
$aAbb$ rule 2
$aaAbbb$ rule 2
$aa\lambda bbb$ rule 3
$aabbb$

$S \to Ab$ rule 1
$aAbb$ rule 2
$aaAbbb$ rule 2
$aaaAbbbb$ rule 2
$aaa\lambda bbbb$ rule 3
$aaabbbb$

$S \to Ab$ rule 1
$aAbb$
$aaAbbb$
$aaaAbbbb$ rule 2
$aaaaAbbbbb$
$aaaa\lambda bbbbb$ rule 3
$aaaa\lambda bbbbb$

Q4 P: $S \to aS$ rule 1
$S \to aA$ rule 2
$S \to a$ rule 3
$A \to aAb$ rule 4
$A \to ab$ rule 5

$V = \{S, A\}$
$T = \{a, b\}$
Start symbl = S

$S \to a$ rule 3

$S \to aS$ rule 1
aa rule 3

$S \to aA$ rule 2
aab rule 5

$S \to aA$ rule 2
$aaAb$ rule 4
$aaabb$ rule 5

$S \to aS$ rule 1
aaA rule 2
$aaab$ rule 5

$S \to aS$ rule 1
aaA rule 2
$aaaAb$ rule 4
$aaaabb$ rule 5

Strings

		a	b
1	a	1	0
2	aa	2	0
3	aab	2	1
4	aaa bb	3	2
5	aaa b	3	1
6	aaaa bb	4	2
7	aaaaa bbb	5	3

$S \to aS$ rule 1
aaA rule 2
$aaaAb$ rule 4
$aaaaAbb$ rule 4
$aaaaabbb$ rule 5

$L = \{a^n b^m : n \geq 0, m \geq 0\}$

Q5 Find out the language (L) generated by Grammer (G)

P:
$S \to aSb$ (rule 1)
$S \to bSa$ (rule 2)
$S \to a$ (rule 3)

$V = \{S\}$
$T = \{a, b\}$
Start point $\to$ S

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	String	no of a	no of b
1	a	1	0
2	aab	2	1
3	abaab	3	2
4	baa	2	1
5	aaabb	3	2
6	bbaaa	3	2
7	bbbaaaa	4	3

$L = \{a^{n+1} b^n : n \geq 0\}$

or

$L = \{b^n a^{n+1} : n \geq 0\}$

S → a rule 3

S → aSb rule 1
aab rule 3

S → aSb rule 1
abSab rule 2
abaab rule 3

S → bSa rule 2
baa rule 3

S → aSb rule 1
aaSbb rule 1
aaabb rule 3

S → bSa rule 2
bbSaa rule 2
bbaaa rule 3

S → bSa rule 2
bbSaa rule 2
bbbSaaa rule 2
bbbaaaa rule 3

(Q 6) P: S → aA 1
A → bS 2
S → ab 3

G = (V, T, P, S)
V = {S, A}
T = {a, b}
Starting Point = S

	Strings	no of a	no of b
1	ab	1	1
2	abab	2	2
3	ababab	3	3
4	abababab	4	4
5	5a 5b	5	5
6	6a 6b	6	6
7	7a 7b	7	7

$L = \{(ab)^n : n \geq 1\}$

S → ab rule 3

S → aA 1
abS 2
abab 3

S → aA 1
abS 2
abaA 1
ababS 2
ababab

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Q7) P: $S \to aSb$ 1 $V = \{S\}$
$S \to ab$ 2 $T = \{a, b, \lambda\}$
$S \to \lambda$ 3 Start Syomble = S

String	no of a	no of b	
① λ	0	0	$S \to \lambda$ rul 3
② ab	1	1	$S \to ab$ rul 2
③ aabb	2	2	$S \to aSb$ rul 1
④ aaabbb	3	3	$a\lambda b$ rul 3
⑤ aaaa bbbb	4	4	ab
⑥ aaaaa bbbbb	5	5	$S \to aSb$ rul 1
⑦ aaaaaa bbbbbb	6	6	aabb rul 2

$S \to aSb$ 1
aaSbb 1
aaabbb 2

$L = \{a^n b^{\cancel{m}} : n \geq 0\} \cancel{m \geq 0}$

Q8) P: $S \to aAb$ rule 1 $G = (V, T, P, S)$
$S \to ab$ rule 2 $V = \{S, A\}$
$A \to aAb$ rule 3 $T = \{a, b, \lambda\}$
$A \to \lambda$ rule 4 Start Symb = S

String	no of a	no of b	
① ab	1	1	$S \to ab$ rule 2
② aabb	2	2	$S \to aAb$ rul 1
③ aaa bbb	3	3	aaAbb rul 3
④ aaaa bbbb	4	4	$S \to aAb$ 1
⑤ aaaaa bbbbb	5	5	aaAbb 3
⑥ aaaaaa bbbbbb	6	6	aaaAbbb 3
⑦ aaaaaaa bbbbbbb	7	7	aaabbb 4

$L = \{a^n b^n : n \geq 1\}$

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Q9 P: $E \to E \cup E$ 1   Start Symbl = E
$E \to E \cap E$ 2 $V = \{E\}$
$E \to \neg E$ 3 $T = \{\cup, \cap, a, \neg\}$
$E \to a$ 4

String ~~not a~~ not b

1. a
2. $\neg a$
3. $a \cup a$
4. $a \cap a$
5. $\neg a \cap a$
6.
7.

$L = \{a * a : * \in \{\cup, \cap\}\}$
or
$L = \{\neg a * a : * \in \{\cup, \cap\}\}$
or
$L = \{$perform set operation$\}$

$E \to a$ 4

$E \to \neg E$ 3
$\neg a$ 4

$E \to E \cup E$ 1
$a \cup E$ 4
$a \cup a$ 4

$E \to E \cap E$ 2
$a \cap E$ 4
$a \cap a$ 4

$E \to \neg E$ 3
~~$\neg(E \cap E)$ 2~~
~~$\neg E \cup \neg E$~~
$\neg E \cap E$ 2
$\neg a \cap E$ 4
$\neg a \cap a$ 4

10 P. $S \to SS$ rule 1
$S \to SSS$ rule 2 $V = \{S\}$
$S \to aSb$ rule 3 $T = \{a, b\}$
$S \to bSa$ rule 4
$S \to \lambda$ rule 5

String
1. λ $L = \{b^n a^n : n \geq 0\}$ $S \to aSb$
2. ab or $absab$
3. ba $L = \{(ab)^n : n \geq 0\}$ $abab$
4. $abab$ or $S \to bSa$
5. $baba$ $L = \{a^n b^m : n \geq 0\}$ $basba$
6. $ababab$ or $baba$
7. $bababa$ $L \{(ba)^n : n \geq 0\}$

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16/1/2020

① Find out the Grammer (G) for the given language (L)

$L = \{a^n : n \text{ is even}\}$
$G = (V, T, P, S)$

P:

Strings
n
$0 \rightarrow a^0 \rightarrow \lambda$
$2 \rightarrow a^2 \rightarrow aa$
$4 \rightarrow a^4 \rightarrow aaaa$
$6 \rightarrow a^6 \rightarrow aaaaaa$

$S \rightarrow \lambda$ rule 1
$S \rightarrow aaS$ rule 2

$V = \{S\}$
$T = \{a, \lambda\}$
Start symbol = S

② $L = \{a^n : n \text{ is even } \& \ n > 3\}$

Strings
n
4 $a^4 \rightarrow aaaa$
6 $a^6 \rightarrow aaaaaa$
Start symbol = S

$S \rightarrow aaaaA$
$A \rightarrow aAa \mid Aaa \mid aaA$
$A \rightarrow \lambda$
$V = \{S, A\}$
$T = \{a, \lambda\}$

③ L = {all strings with exactly 2a's}
$\Sigma = \{a, b\}$
Strings
① aa
② aab
③ baa
④ aba

$S \rightarrow aaA \mid Aaa \mid aAa$
$A \rightarrow bA$
$A \rightarrow \lambda$
$V = \{S, A\}$

$T = \{a, b\}$

Start symbol = S

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(4) L = {all strings starts with a & end with b} $\Sigma = \{a, b\}$.

String
(1) ab
(2) aaab
(3) abb

$S \to ab$ [useless production]
$S \to aAb$
$A \to aA \mid bA$
$A \Rightarrow \lambda$

(5) L = {all strings ~~start~~ with equal no of a's & b's} $\Sigma = (a, b)$

String
(1) ab
(2) aabb
(3) abab
(4) bbaa

$S \to aSb$
$S \to bSa$
$S \to ab$
$S \to ba$
$S \to \lambda$

(6) L = {contains the integer}
~~strings~~ digit → 0|1|2|3|4|5|6|7|8|9 rule 1

0
1
2
.
.
.
9

integer → digit rest rule 2
rest → digit rest rule 3
rest → λ rule 4
start symbol = {integer}
V = {integer, digit, rest}
T = {0 - 9}

789

integer → digit rest rule 2
→ 7 rest rule 1
→ 7 digit rest rule 3
→ 7 8 rest rule 1
→ 7 8 digit rest rule 3
→ 7 8 9 rest rule 1

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(7) L = { contains even numbers }
digit → 0|1|2|3|4|5|6|7|8|9 1
~~Digit~~ digit even → 0|2|4|6|8 rule 2
Even-number → rest digit-even 3
rest → digit rest 4
rest → λ 5
Start ~~symbol~~ → even number.
Non terminal
(1) Even-number (2) rest (3) digit
(4) digit even

Terminal { 0, 1, 2, 3, 4, 5, 6, 7, 8, 9 }

(8) L = { contains odd numbers }
digit → 0|1|2|3|4|5|6|7|8|9
digit-odd → 1|3|5|7|9
Odd-number → rest digit odd
rest → digit rest
rest → λ or digit-odd.

(9) L = { to represent variable
variable should contain only
alphabet }

Alphabets = a|b|c ... z|A|B|C ... Z
Varaiable → rest Alphabet.
rest → Alphabet rest
rest → λ

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21/1/2020

Q: Find the grammer (G) for the given Constraint Password can be of any length, but it should Start with an alphabet. Constants atleast one digit, Number of digits in Password should not be more than three, It can have any number of letters?

Sol: $G = (V, T, P, S)$

Alphabet → a|b|c|d ··· z|A|B|C|···|Z|
digit → 0|1|2|·····|9|
Password → Alphabet digit rest
Password → Alpha digit digit rest
" → Alpha dig dig dig rest
Password → Alpha rest dig
" → Alph dig rest dig
" → Alph dig dig rest dig
rest → Alpha rest
rest → λ

it is a lengthy process.

Password → Alpha rest digit rest
Password → Alpha rest digit rest digit rest
Password → Alpha rest digit rest digit rest digit rest
rest → Alphabet rest
rest → λ.

S2 .

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* Rules for variables in C :-

1. Variable name is a sequence of Letters, digit, underscore.
2. Start with Letters / undersore.
3. Letters Can be upper | lower case.
4. (— –) is not permitted.

Alphabets → a|b|c . . |z|A|B|C . . |Z|
digits → 0|1|2| . . . |9|
undersone → _

Variable name = Alphabet rest | underscor rest
rest → Alphabet rest | digit rest | λ
rest → Alph undersorce rest
rest → digit undersone rest
rest → Alph. rest
rest → digit rest
rest → λ

Variable name → Alphabet rest | underscon rest
rest → Undersone rest / Aphabet rest
digit rest
rest → λ
rest → Alphabet rest | digit rest | rest Undersone | ~~Alphab digit~~

P TO

23/1/2020

Automata → It is an abstract model of a computer that has set of states, set of actions, transition function, start state and final state.

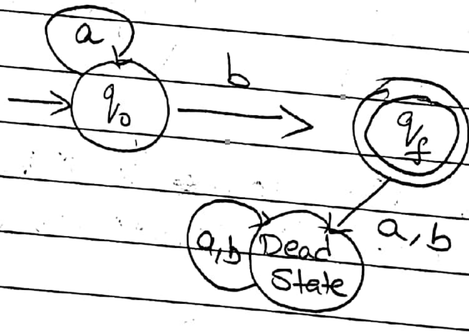
Regular language
Regular Grammer
Finite Automate

all i/p should be consider for dead state

(i) Deterministic Finite automata (DFA)
or
(ii) Deterministic Finite State Automate (DFA)
(iii) Non Deterministic Finite Automate NFA

Q1 construct DFA for the given language (L)
L = {$a^n b$ and end with b}
& has any no of a's
$\Sigma = \{a, b\}$

strings
1. ab
2. aab
3. aaab
4. b

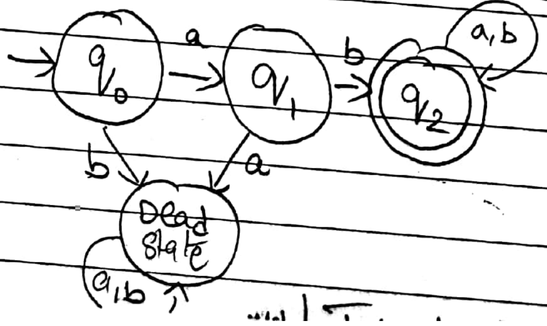


Q2 construct DFA for given language (L)
L = {set of all strings start with ab}
$\Sigma = \{a, b\}$

String
1. ab
2. abab
3. ababab
4. abb

Start st = q_0
final st = q_2

self loop



States: q_0, q_1, q_2, dead state
Input: a, b

$\delta(ds, a) = ds$

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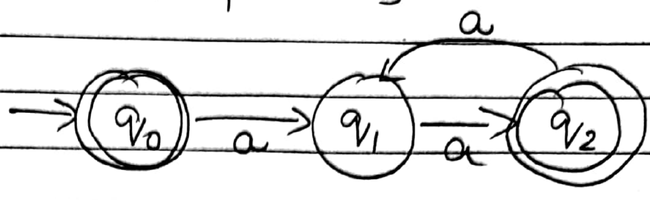
Q3 L = {even no of a's} $\Sigma = \{a\}$

String
1. λ
2. aa
3. aaaa



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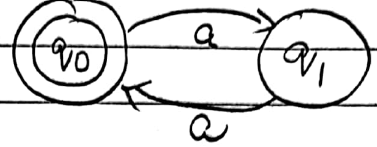
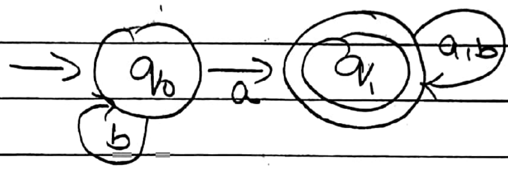


Q4 L = {atleast one a's} $\Sigma = \{a, b\}$

Strings
1. a
2. ab
3. abb
4. ba
5. bbab

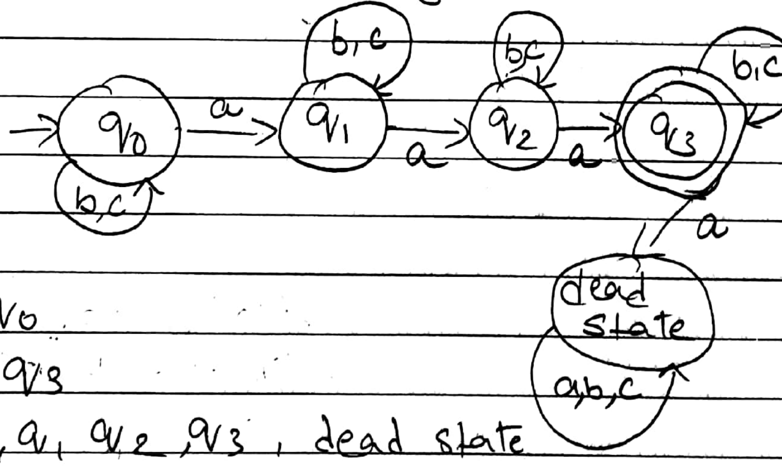


Start state q_0
finial state q_1

States :- q_0, q_1 Tranqution fuction
Input ⇒ a, b $\delta(q_0, a) = q_1$
$\delta(q_1, a) = q_1$, $\delta(q_0, b) = q_0$
$\delta(q_1, b) = q_1$

Q5) L = {Strings with exactly 3 a's} $\Sigma = \{a, b, c\}$

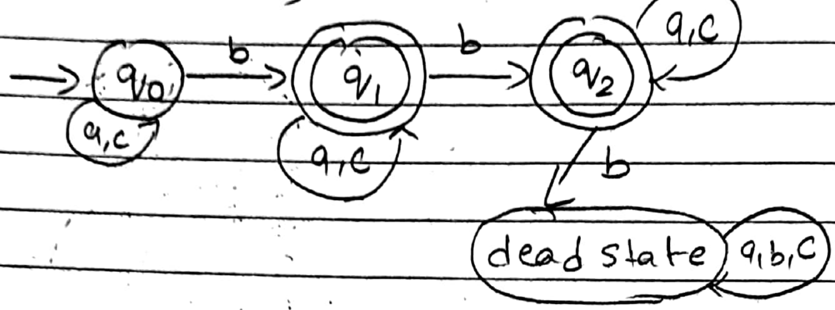
Strings
1. aaa
2. aaabc
3. babaca



Start state : q_0
finial state : q_3
States = q_0, q_1, q_2, q_3, dead state
input = a, b, c
Transition state = $\delta(q_0, a) = q_1$

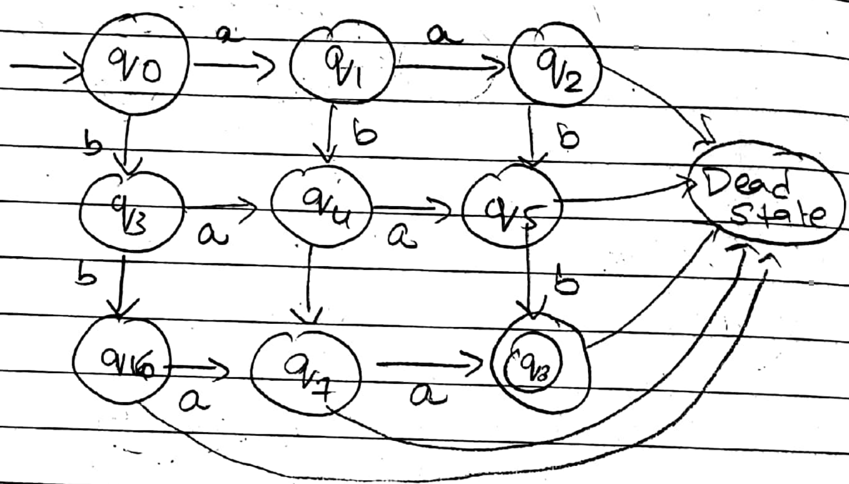
write every detal in all questions.

Q6) L = { Strings with one b or two b's }
Σ = { a, b, c }

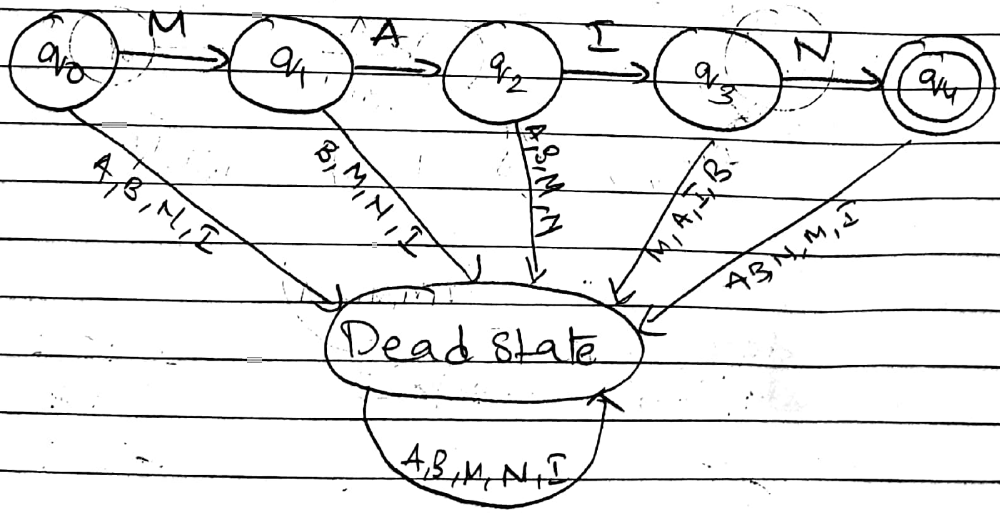


Q7 = L = { String with 2a's & 2b's }
Σ { a, b }

String
1) abab
2) baba
3) baab
4) aabb



Q8) L = { accept only 'MAIN' }
Σ = { A, B, M, N, I }

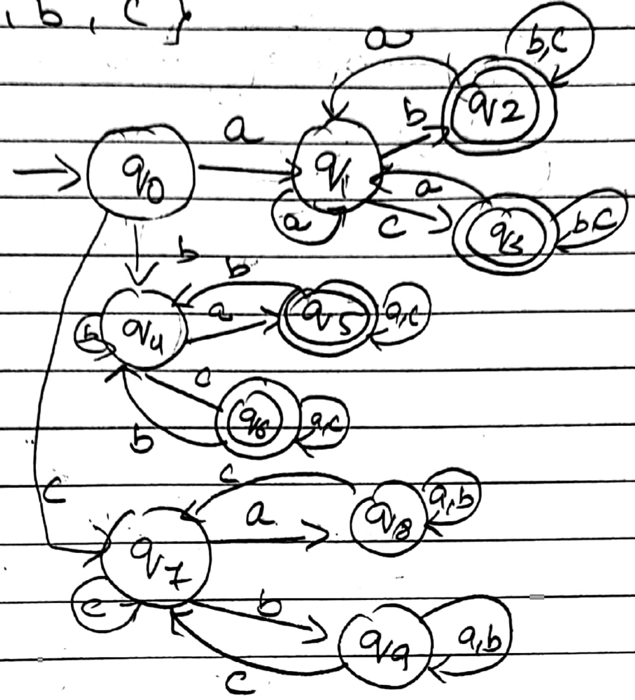


Q9) L = { start and end character should not be the same }

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

⇒ strings

1. abcab
2. abcac
3. baaaa
4. bcabc
5. a x a
not possible



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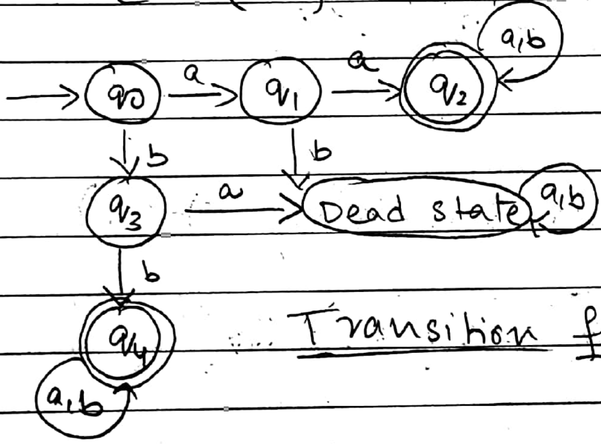
Q10) construct dFA for the given language (L) L = { string start with aa or bb }

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



start state : q0

final " : q_2, q_4

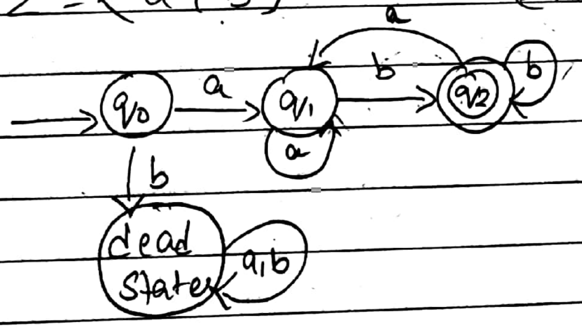
input : a, b

states : q0, q1, q2, q3, q4, dead S

Transition fu^n →

Q11 Construct (L) = { String starts with 'a' & end with b }

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



strings

1. ab
2. ababb
3. aaaab

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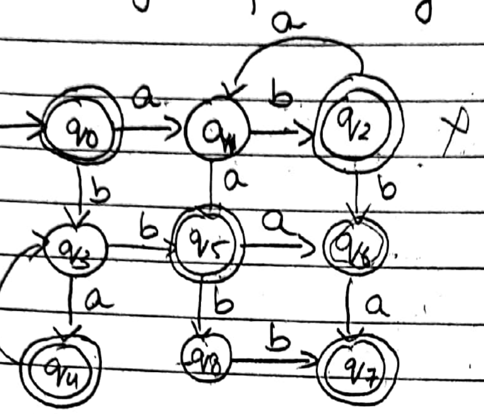
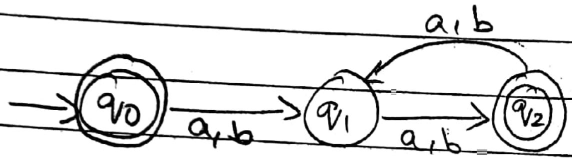
Q12 L = {length of string is even} Σ = {a,b}



string
(1) λ
(2) ab
(3) ba
(4) abab | baba
(5) aabb | bbaa



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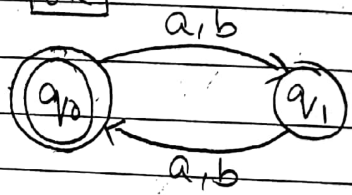
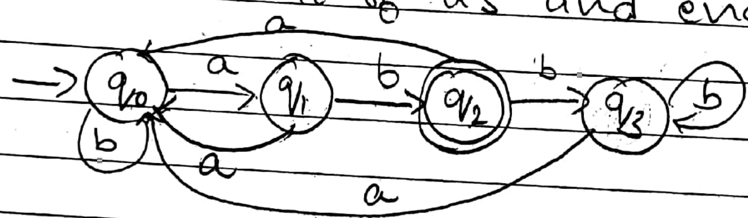
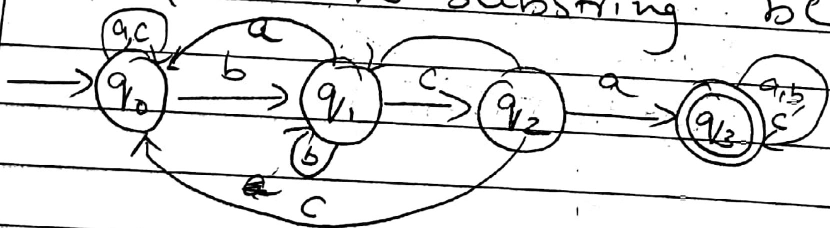


Q13 L = {odd no of a's and end with ab} Σ = {a

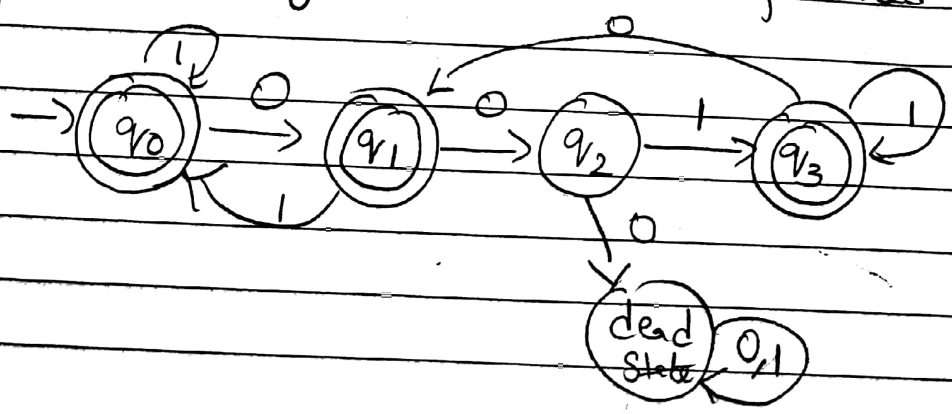


construct

Q14 L: {contains substring bca} Σ = {a,b,c}



Q15 L: {every 00 should be followed by 1}



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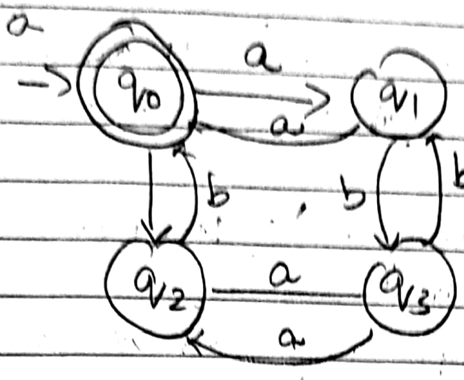
Q6 L = { even no of a's and even no of b's }



a^n	b^n	final
even	even	q0
odd	odd	q3
even	odd	q2
odd	even	q1

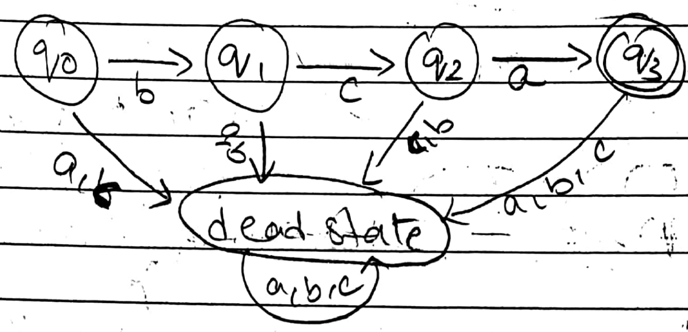
4/2/2020 DFA

(1) δ(current state, current input) = only one next state

(2) δ(current state, ∀ input) = one next state

(3) on input state transition happens
δ(current state, current input) = next state

Eg:- L = { bca as a string } Σ = {a, b, c}



P.T.O..

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4/2/2020

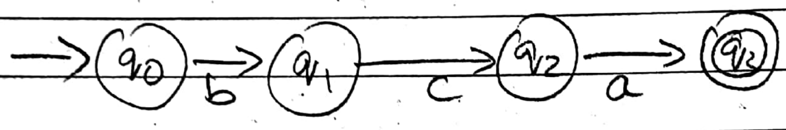
Non Deterministic Finite Automata (NFA)

δ(current state, current input) = more than one next state.

δ(current state, current input) = no next state

without reading any input state transition happens.

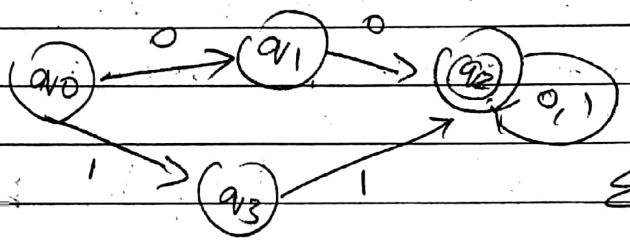
Eg: L = {bca as a string}



no dead state show.

DFA without dead state is called NFA

Eg 1)

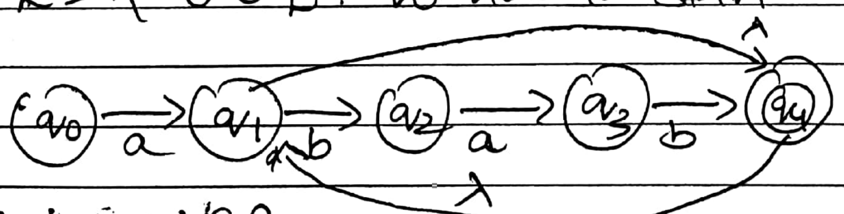


$\Sigma = \{0, 1\}$

{q0, 0} = q1
(q0, 1) = q3 ∴ it is NFA
(q1, 0) = q2
(q1, ϕ) = — L = {string starts with 00 or 11}

L = {w ∈ L : w has to start with 00 (or) 11}

Q2)



Ans it is NFA
$\Sigma = \{a, b\}$

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strings

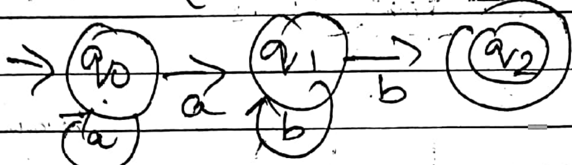
1. $q_0 \xrightarrow{a} q_1 \xrightarrow{\lambda} q_4$ $a \in L$

2. $q_0 \xrightarrow{a} q_1 \xrightarrow{b} q_2 \xrightarrow{a} q_3 \xrightarrow{b} q_4$ $abab \in L$

3. a bab bab $\in L$

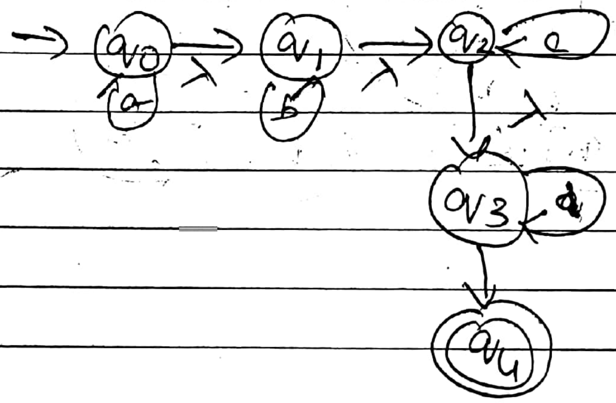
4. a bab bab bab $\in L$

$$L = \{ a(bab)^n : n \geq 0 \}$$

Q3  find languge.

$\Sigma = \{a, b\}$ $L = \{ a^n b^m : n, m \geq 1 \}$

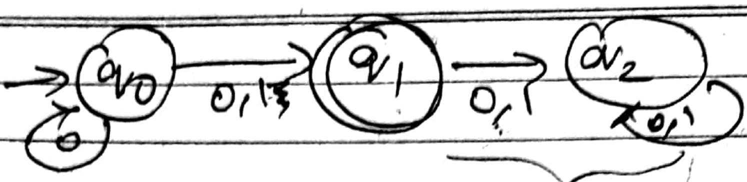
1. $q_0 \xrightarrow{a} q_1 \xrightarrow{b} q_2$

Q4  $\Sigma = \{a, b, c, d\}$

$q_0 \xrightarrow{\lambda} q_4$

$$L = \{ a^n b^m c^p d^q : n, m, p, q \geq 0 \}$$

Q5



dead state

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

(1) $q_0 \xrightarrow{0} q_1$

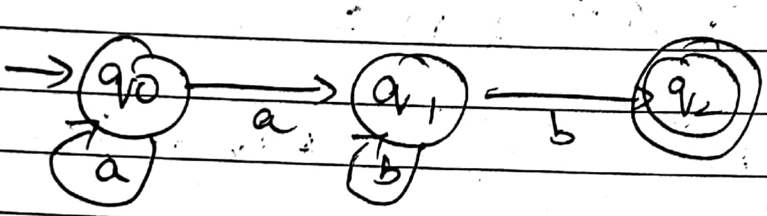
(2) $q_0 \xrightarrow{1} q_1$

$L = \left\{ \begin{array}{l} \cancel{0^n : n >= 1} \\ 0^n 1 : n >= 0 \end{array} \right\}$

$L = \{ 0^m 1^n : m \geq 0 ; n \leq 1 \}$

6/2/2020

Q6 Convert NFA to DFA



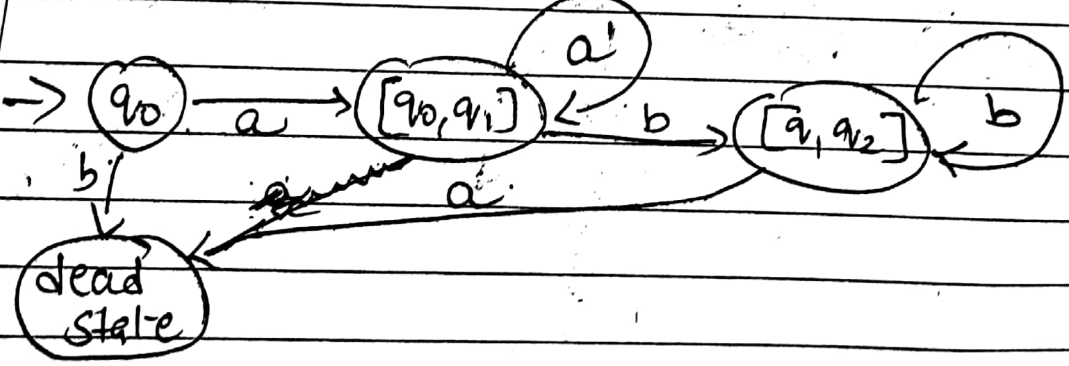
$\Sigma = \{a, b\}$

single state [ ]

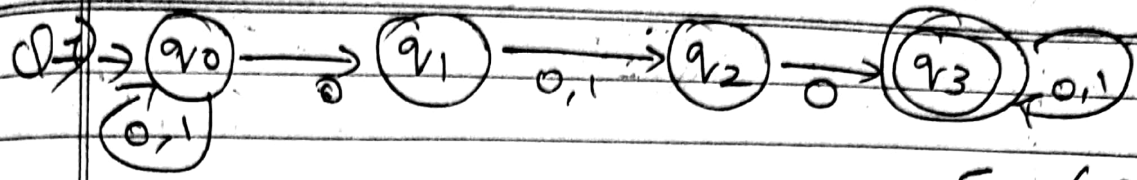
set { }

	a	b
q_0	$[q_0, q_1]$	— or ϕ
$[q_0, q_1]$	$[q_0, q_1]$	$[q_1, q_2]$
$[q_1, q_2]$	ϕ	$[q_1, q_2]$

final state

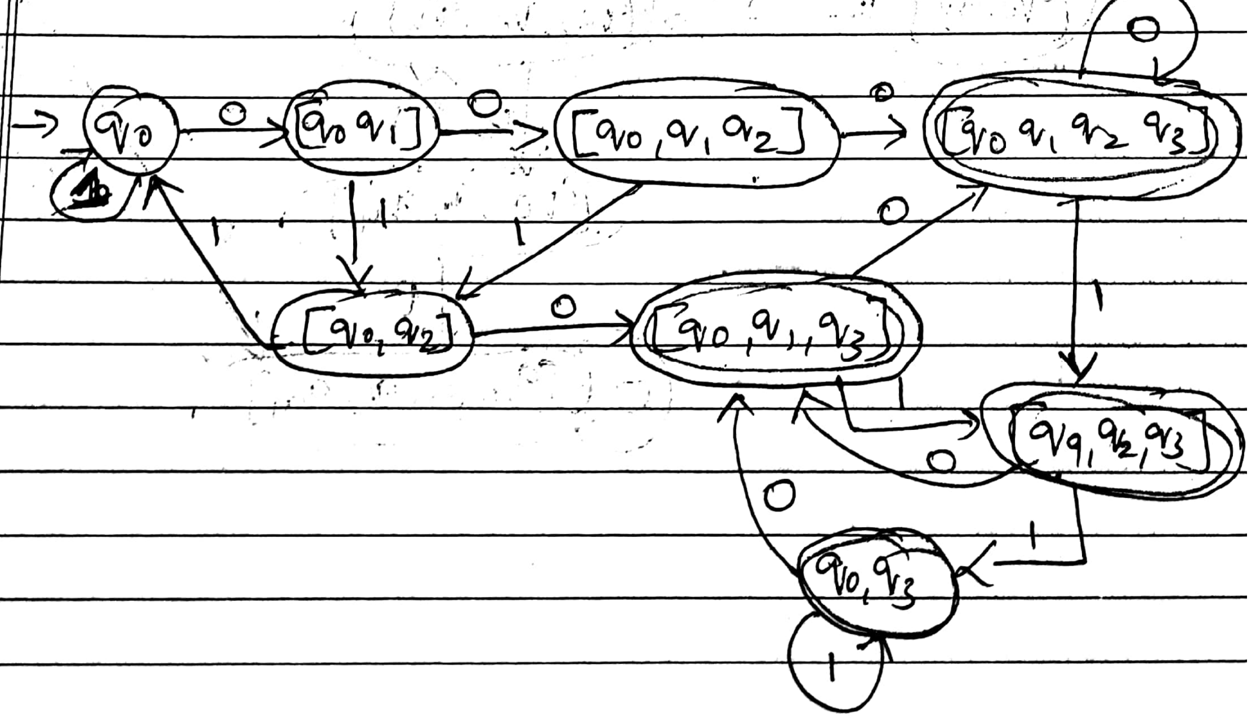


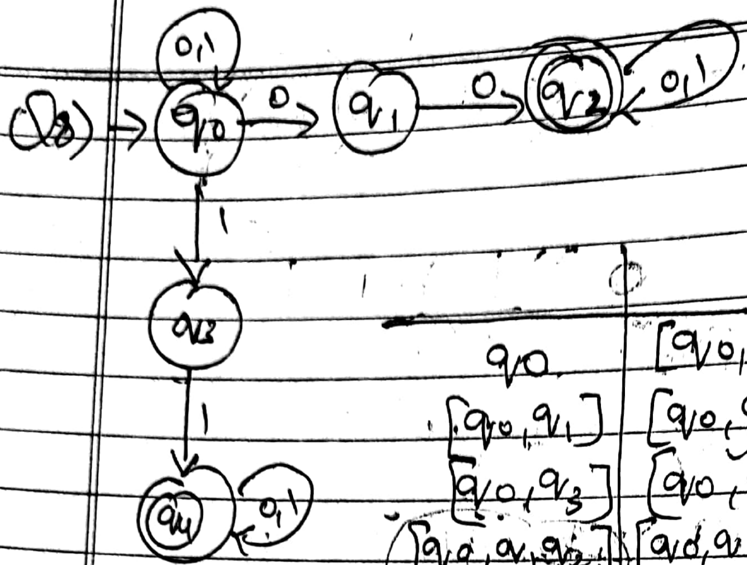
Q1)



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

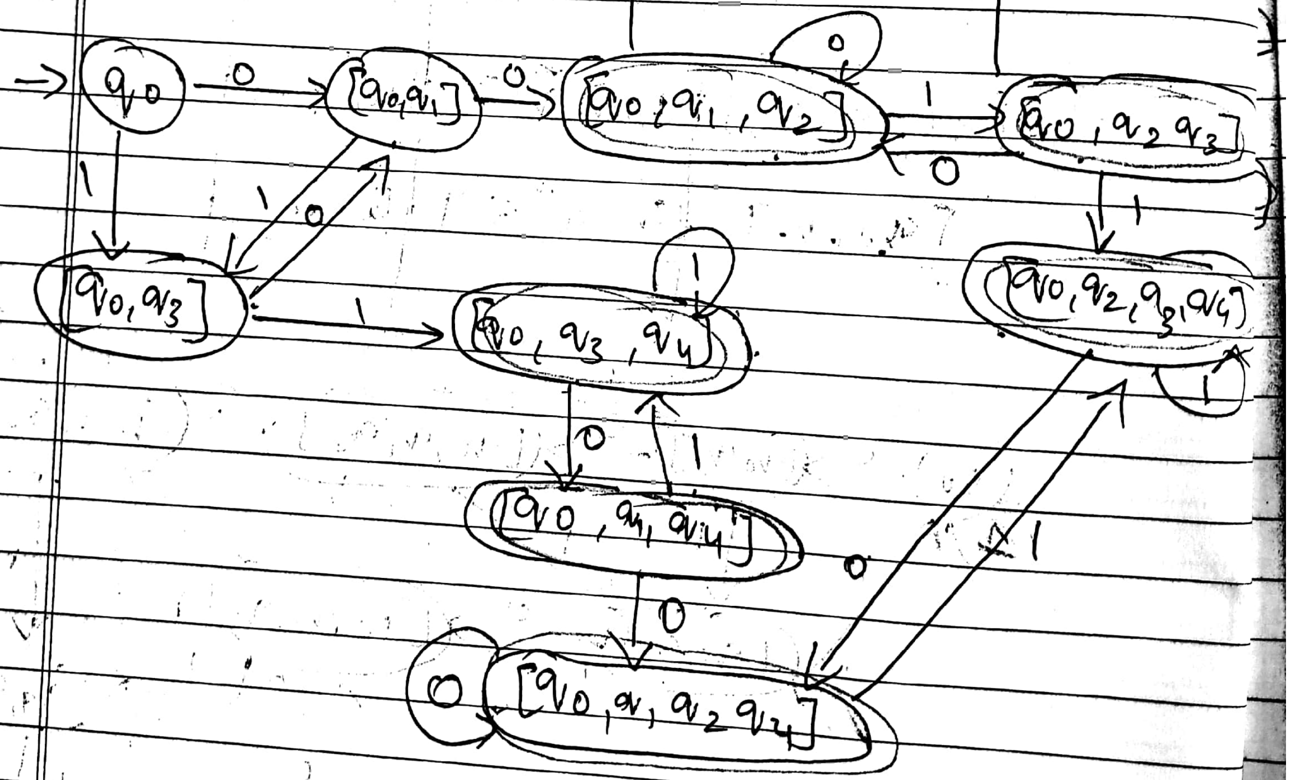
	0	1
q_0	$[q_0, q_1]$	q_0
$[q_0, q_1]$	$[q_0, q_1, q_2]$	$[q_0, q_2]$
$[q_0, q_1, q_2]$	$[q_0, q_1, q_2, q_3]$	$[q_0, q_2]$
$[q_0, q_2]$	$[q_0, q_1, q_3]$	q_0
$[q_0, q_1, q_2, q_3]$	$[q_0, q_1, q_2, q_3]$	$[q_0, q_2, q_3]$
$[q_0, q_1, q_3]$	$[q_0, q_1, q_2, q_3]$	$[q_0, q_2, q_3]$
$[q_0, q_2, q_3]$	$[q_0, q_1, q_3]$	$[q_0, q_3]$
$[q_0, q_3]$	$[q_0, q_1, q_3]$	$[q_0, q_3]$





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

	0	1
q_0	$[q_0, q_1]$	$[q_0, q_3]$
$[q_0, q_1]$	$[q_0, q_1, q_2]$	$[q_0, q_3]$
$[q_0, q_3]$	$[q_0, q_1]$	$[q_0, q_3, q_4]$
$[q_0, q_1, q_2]$	$[q_0, q_1, q_2]$	$[q_0, q_2, q_3]$
$[q_0, q_3, q_4]$	$[q_0, q_1, q_4]$	$[q_0, q_3, q_4]$
$[q_0, q_2, q_3]$	$[q_0, q_1, q_2]$	$[q_0, q_2, q_3, q_4]$
$[q_0, q_1, q_4]$	$[q_0, q_1, q_2, q_4]$	$[q_0, q_3, q_4]$
$[q_0, q_2, q_3, q_4]$	$[q_0, q_1, q_2, q_4]$	$[q_0, q_2, q_3, q_4]$
$[q_0, q_1, q_2, q_4]$	$[q_0, q_1, q_2, q_4]$	$[q_0, q_2, q_3, q_4]$

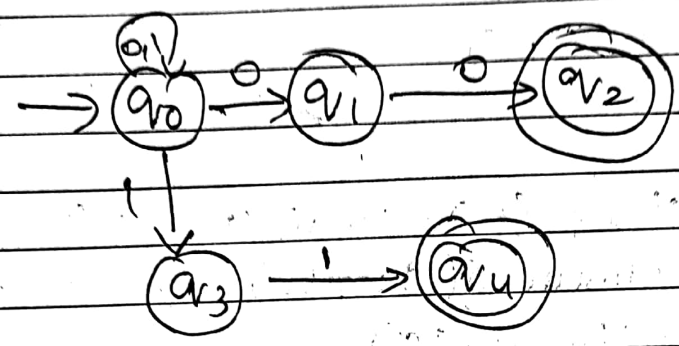


Q9) Transition table of NFA

Given.

	0	1
q_0	$\{q_0, q_1\}$	$\{q_0, q_3\}$
q_1	q_2	ϕ
q_2	ϕ	ϕ
q_3	ϕ	q_4
q_4	ϕ	ϕ

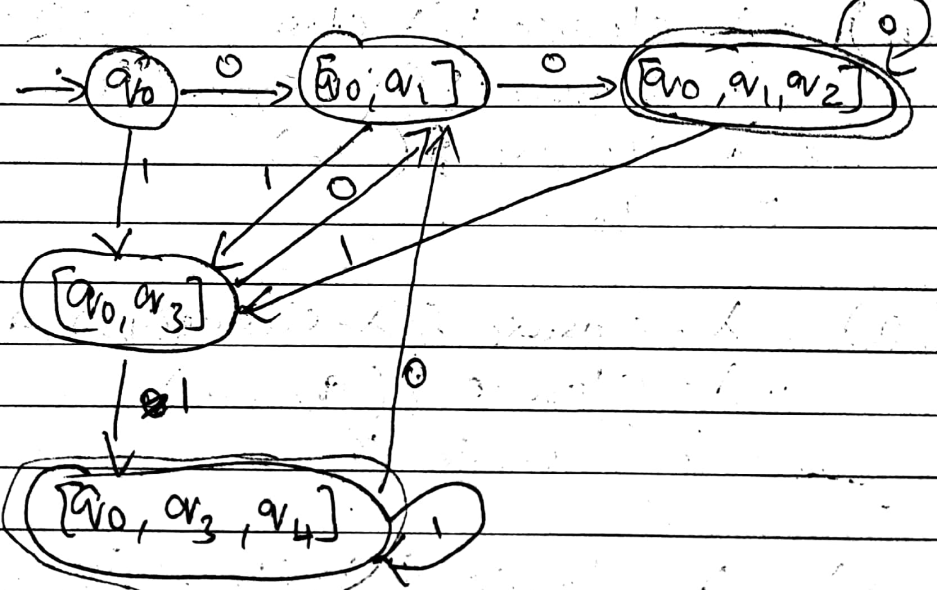
solve



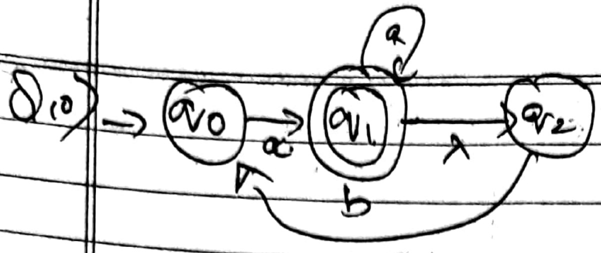
NFA.

	0	1
q_0	$[q_0, q_1]$	$[q_0, q_3]$
$[q_0, q_1]$	$[q_0, q_1, q_2]$	$[q_0, q_3]$
$[q_0, q_3]$	$[q_0, q_1]$	$[q_0, q_3, q_4]$
F = $[q_0, q_1, q_2]$	$[q_0, q_1, q_2]$	$[q_0, q_3]$
F = $[q_0, q_3, q_4]$	$[q_0, q_1]$	$[q_0, q_3, q_4]$

table.



NFA with λ to NFA without λ



$\delta(q_1, b) = ?$

$\delta(q_1, b) = \cancel{\emptyset}$ Can't pass

$\delta(q_1, b) = q_0$ ✓

λ - closure $(q_0) = q_0$

λ - closure $(q_1) = \{q_1, q_2\}$

λ - closure $(q_2) = q_2$

~~$\delta(q_0, a) = q_1$~~

$\delta(q_0, a) = \lambda$ - closure $\delta(\lambda\text{-closure}(q_0), a)$

$= \lambda$ - closure $\delta(q_0, a)$

$= \lambda$ - closure (q_1)

$= \{q_1, q_2\}$

$\delta(q_0, b) = \lambda$ - closure $\delta(\lambda\text{-closure}(q_0), b)$

$= \lambda$ - closure $\delta(q_0, b)$

$= \lambda$ - closure $(\emptyset)$

$= \emptyset$

$\delta(q_1, a) = \lambda$ - closure $\delta(\lambda\text{-closure}(q_1), a)$

$= \lambda$ - closure $\delta(\{q_1, q_2\}, a)$

$= \lambda$ - closure $\cancel{\delta}(q_1)$

$= \{q_1, q_2\}$

$\delta(q_1, b) = \lambda$ - closure $\delta(\lambda\text{-closure}(q_1), b)$

$= \lambda$ - closure $\delta(\{q_1 q_2\}, b)$

$= \lambda$ - closure $\cancel{\delta}(q_0)$

$= q_0$

$\delta(q_2, a) = \lambda$ - closure $\delta(\lambda\text{-closure}(q_2), a)$

$= \lambda$ - closure $\delta(q_2, a)$

$= \lambda$ - closure $\emptyset$

$= \emptyset$

$\delta(q_2, b) = \lambda$ - closure $\delta(\lambda\text{-closure}(q_2), b)$

$= \lambda$ - closure $\delta(q_2, b)$

$= \lambda$ - closure (q_0)

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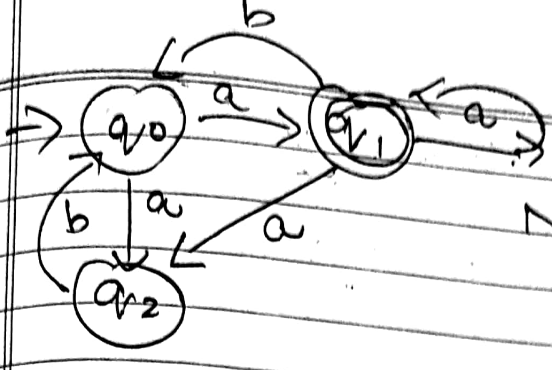
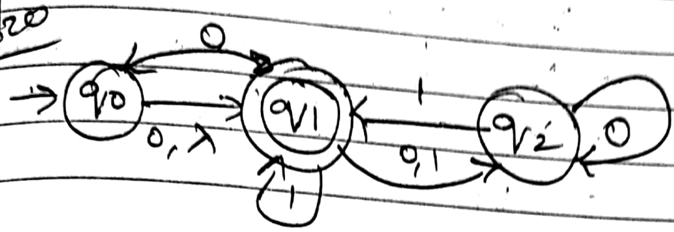


NFA without λ trasition

7/2/2020



λ - closure $(q_0) = \{q_0, q_1\}$
λ - closure $(q_1) = q_1$
λ - closure $(q_2) = q_2$

$\delta(q_0, 0) = \lambda\text{-closure } \delta(\lambda\text{-closure}(q_0), 0)$
$= \lambda\text{-closure } \delta(\{q_0, q_1\}, 0)$
$= \lambda\text{-closure } (q_1, q_2, q_0)$
$= \{q_0, q_1, q_2\}$

$\delta(q_0, 1) = \lambda\text{-closure } \delta(\lambda\text{-closure}(q_0), 1)$
$= \lambda\text{-closure } \delta(\{q_0, q_1\}, 1)$
$= \lambda\text{-closure } (q_1, q_2)$
$= \{q_1, q_2\}$

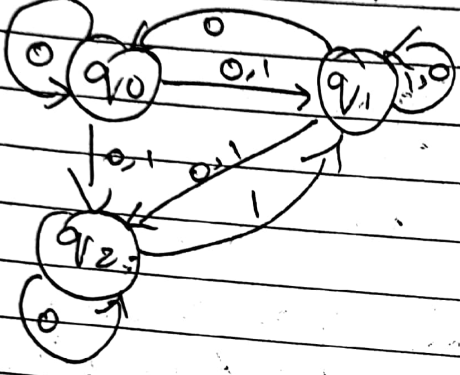
$\delta(q_1, 0) = \lambda\text{-closure } \delta(\lambda\text{-closure}(q_1), 0)$
$= \lambda\text{-closure } \delta(q_1, 0)$
$= \lambda\text{-closure } (q_2, q_0, q_1)$
$= \{q_2, q_0, q_1\}$

$\delta(q_1, 1) = \lambda\text{-closure } \delta(\lambda\text{-close}(q_1), 1)$
$= \lambda\text{-closure } \delta(q_1, 1)$
$= \lambda\text{-closure } (q_1, q_2)$
$= \{q_1, q_2\}$

Scanned by CamScanner

$\delta(q_2, 0) = \lambda\text{-closure}\,\delta(\lambda\text{-closure}(q_2), 0)$
$= \lambda\text{-closure}\,\delta(q_2, 0)$
$= \lambda\text{-closure}(q_2)$
$= q_2$

$\delta(q_2, 1) = \lambda\text{-closure}\,\delta(\lambda\text{-closure}(q_2), 1)$
$= \lambda\text{-closure}\,\delta(q_2, 1)$
$= \lambda\text{-closure}(q_1)$
$= q_1$



NFA without λ.

7/12/2020

* Regular Language ↓ ↑ Regular Grammer ↓ ↑ Finite Automate

Regular Expression [REX]

* Find out the Regular Expression for given language (L)

L = {set of strings ∈ L, either end with pair of a's or pair of b's}

Ans Regular Expression [REX]

$(a+b)^*(aa+bb)$

$*$ → 0 ... ∞ times
$+$ → (or)

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Q L = {set of String ∈ L, starts with 0}
$\Sigma = \{0,1\}$

Ans $0(0+1)^*$

or

$0(1+0)^*$

Q L = {set of string ∈ L, end with 111}
$\Sigma = \{0,1\}$

Ans $(0+1)^*111$

Q L = {set of string ∈ L, having atleast one 1}
$\Sigma = \{0,1\}$

Ans $0^*1(0+1)^*$

Q L = {set of string ∈ L, with even no of 1}
$\Sigma = \{1\}$

Ans $(11)^*$

ϵ
11
1111
111111.

Q. L = {with even no of 1's & odd no of 0's}
$\Sigma = \{0,1\}$

Ans $(11)^*$ ~~$0(00)^*$~~ $0(00)^*(11)^*$ ✗

$\boxed{\text{Or}}$

$(11)^*0(00)^*$

$1(11)^*0(00)^*1(11)^*$
$+$
$0(11)^*1(00)^*1(11)^*$

Q L = {having b as a second letter}

$(a+b+c+d)^* b (a+b+c+d)^*$

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Q L = {having fifth symbol from last is c};
$\Sigma = \{a, b, c, d\}$

~~(a+b+c+d)* (a+b+c+d) (a+b+c+d)~~ (a+b+c+d)*

$(a+b+c+d)^* \, c \, (a+b+c+d) (a+b+c+d) (a+b+c+d) (a+b+c+d)$

11/2/2020 L = {set of strings having even no of 1's followed by odd no of 0's

i.e

$(aa)^* (bb)^* b$ $\quad$ $(11)^* (00)^* 0$

Sol Correct ans

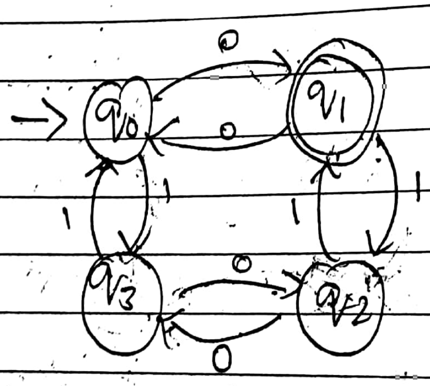
$[(11+00)^* 0 (00)^* (11+00)^*$ or

$+$

$1(11)^* 0(00)^* 1(11)^*$ or

$1(11)^* (00)^* 1 (11)^* 0 (00)^*] = Y$

$Y (YY)^*$



0101011

$0(00)^* (11)^* (1001)^*$

$+$

$(101)(1001)^* (101101)^*$

$+$

$(110)(0110)^*$

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Q $L = \{$ set of strings not ending with 10 $\}$
$\Sigma = \{0, 1\}$

sol $(0+1)^* \underbrace{(00 + 11 + 01)}$

start case not given it can start with 0(or)1
end case given.

Q $L = \{$ Length of strings is even $\}$
$\Sigma = \{a, b, c\}$

sol $((a+b+c)(a+b+c))^*$

$\cancel{a(aa)^* \; b(bb)^* \; c(cc)^*}$

if odd no of string.
$((a+b+c)(a+b+c))^*(a+b+c)$

Q $L = \{a^n b^m : n \geq 3, m \text{ is odd}\}$

$\cancel{a^3 b^1}$ $\underset{3}{aaa}(a)^* \underset{1}{b}(bb)^*$

Q $L = \{a^n b^m : n \geq 2, m \geq 1, nm \geq 3\}$

$(aaa)(a)^* \; b \; (b)^*$ ~~(aa)(bb)(ab)~~
$+$
$aa(a)^* \; bb \; (b)^*$

13/2/2020 Set of rules the language has to follow

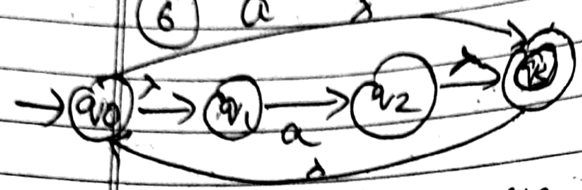
Regular expression

Regular language

① Rex generates Regular language

① $L = (0+01)$

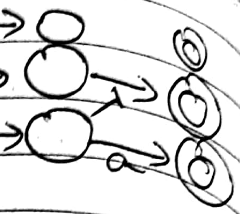
⑥ a^*



① $\phi \rightarrow$

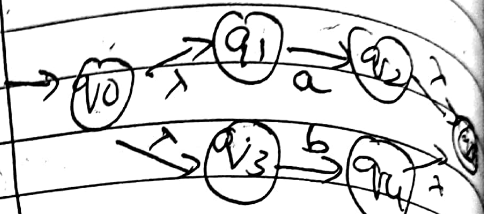
② $\lambda \rightarrow$

③ $a \rightarrow$



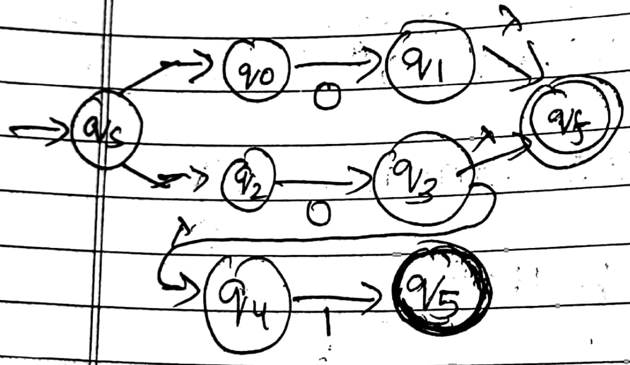
④ +

$a+b$

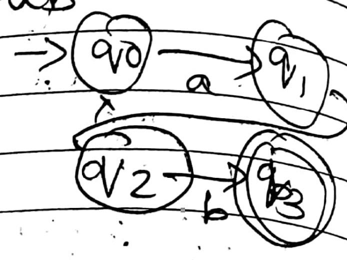


Q Prove that given Rex generates Reg Lang

① $L = (0+01)$

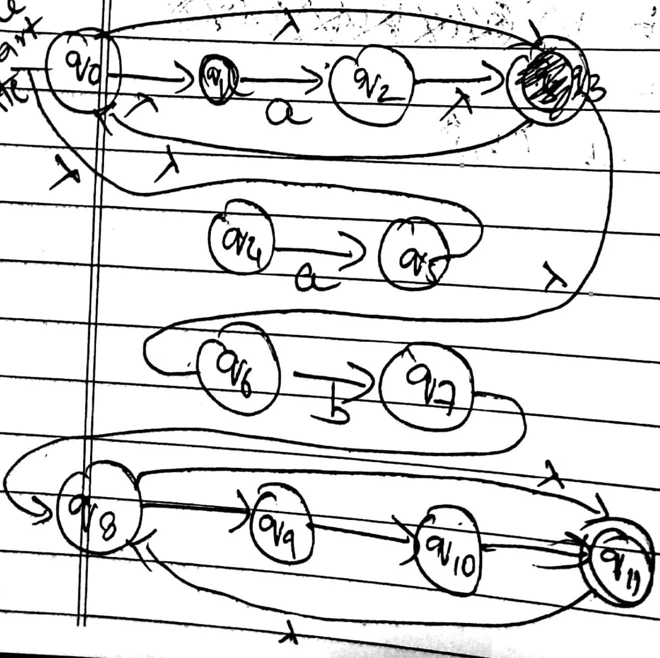


⑤ ab



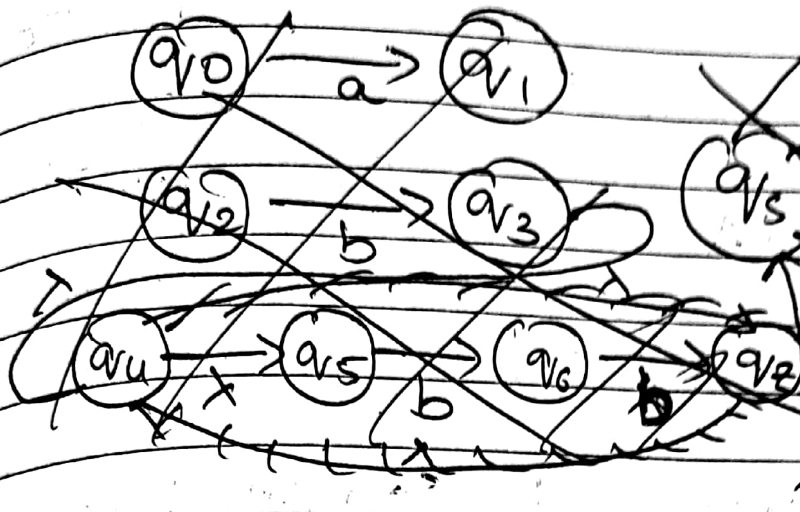
② aa^*bb^*

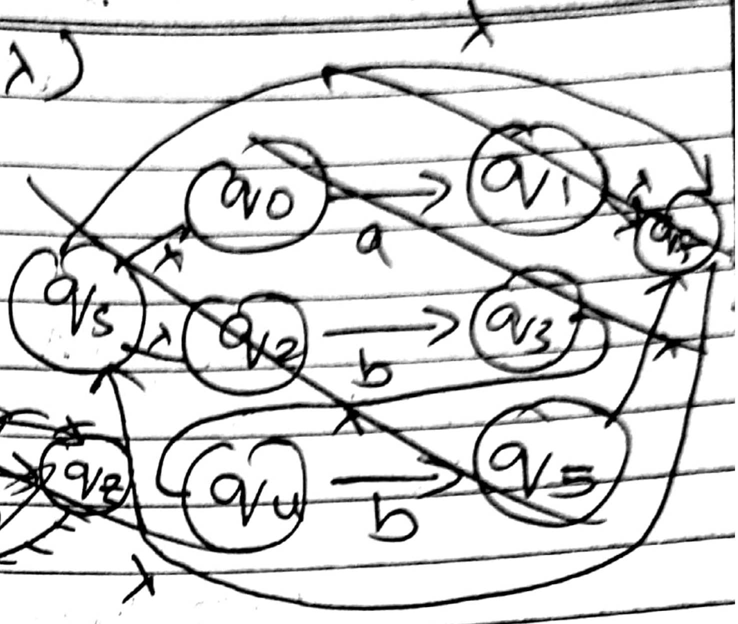
one start state

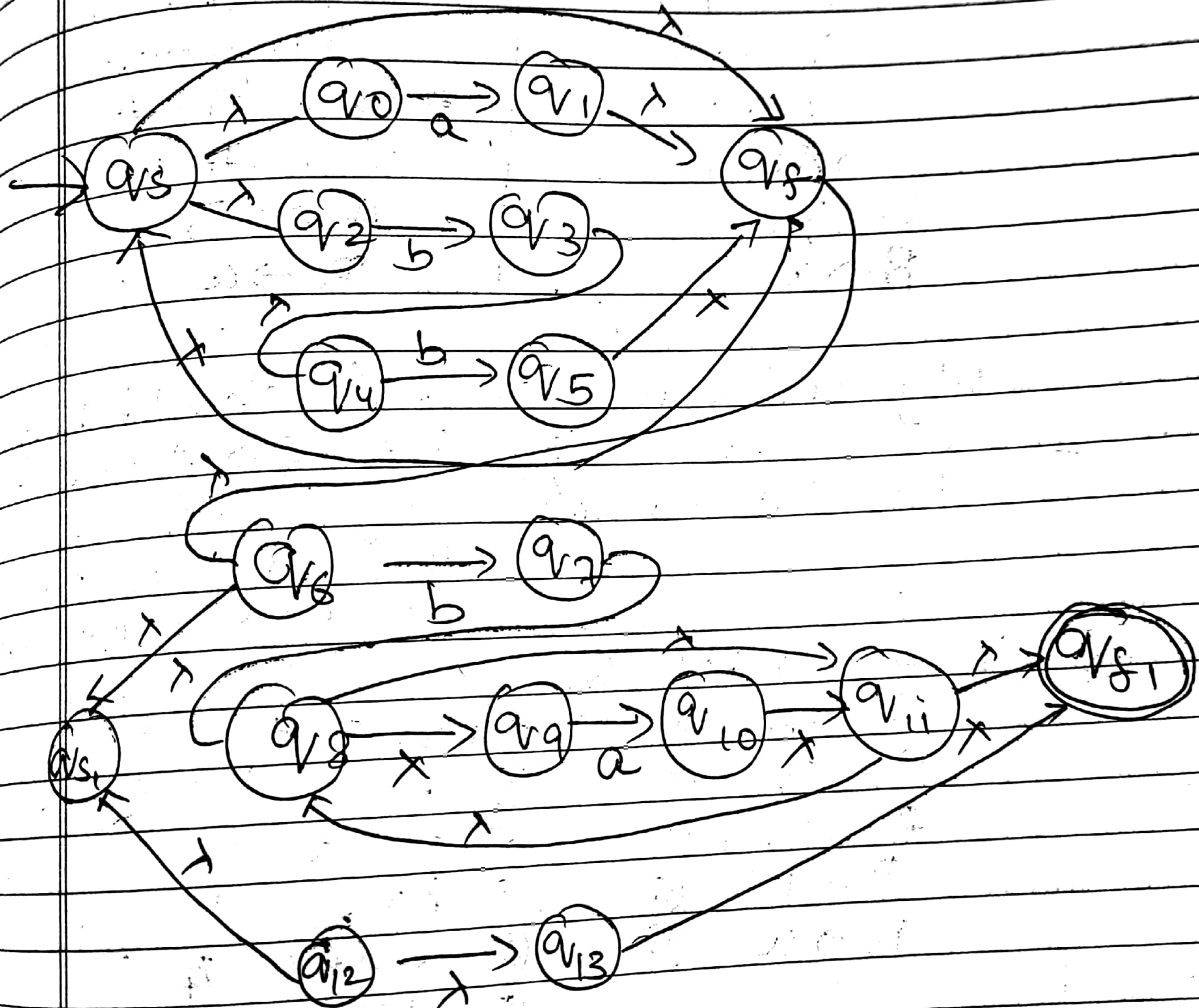


one finial state

3) $(a + bb)^*(ba^+ + \lambda)$







Set of rules the languey has to follow

Regular language → Regular Grammer → Finite Automata

Regular Grammer

No two i/p at a same time.

$S \to Aw \mid wA$

$S \to w$

$w \in T^*$, $S, A \in V$

Left linear Gramer.	Right Linear Grammer
$S \to Aabc$	$S \to abcA$
$S \to Aa$	$S \to aA$
$S \to Ba$	$A \to aB$
$B \to a$	$B \to a$

Only on non-terminal should be there in a Grammer i.e $S \to Aabe$

terminal can be (0 - ∞) one non ternal

it can be on left corner or on the right corner

Q (L) generated by

$S \to aA$ ①

$S \to B$ ②

$A \to aaB$ ③

$B \to bB$ ④

$B \to a$ ⑤

string		a	b
1	a	1	0
2	aaaa	4	0
3	ba	1	1
4	aaaba	~~4~~	1
5	aaabba		

$S \to aA$

$S \to aaaB$

aaaba

$S \to B$ ②

$S \to a$ ⑤

$S \to aA$ ①

$S \to aA$

aaaB

aaabB

aaabbB

$S \to aaaB$ ③

$S \to aaaa$

$S \to B$ ②

$S \to bB$ ④

$L = \{a^n b^m a : n, m \geq 0\}$

$\{n \geq 0 \;\&\; n \leq 3, m \geq 0\}$

or

L = { String should end with a }

or

$L = \{b^n a^m ; n \geq 0, m \geq 1\}$

Q $L = \{a^n b^m : n \geq 3, m \geq 2\}$ Regular Gramer.

Strings

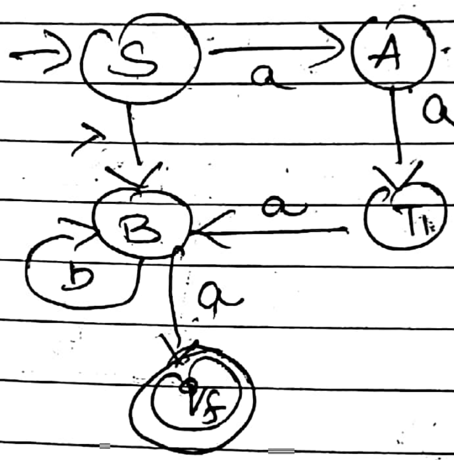
1. aaabb
2. aaabbb
3. aaaabb

$S \to aaabbA$.
$S \to aaaBbbb$
$A \to b$
$B \to aA$

$S \to aaaA$
$A \to aA$
$A \to bbB$
$B \to bB$
$B \to \lambda$

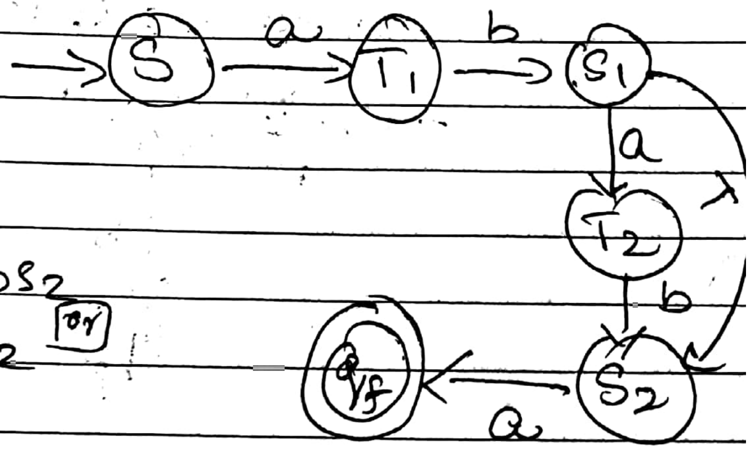
14/2/19
question

(1)
$S \to aA$
$S \to B$
$A \to aaB$
$B \to bB$
$B \to a$ → finial state



(2)
$S \to abS_1$
$S_1 \to abS_2 \mid S_2$
$S_2 \to a$

$S_1 \to abS_2$ $\boxed{or}$
$S_1 \to S_2$



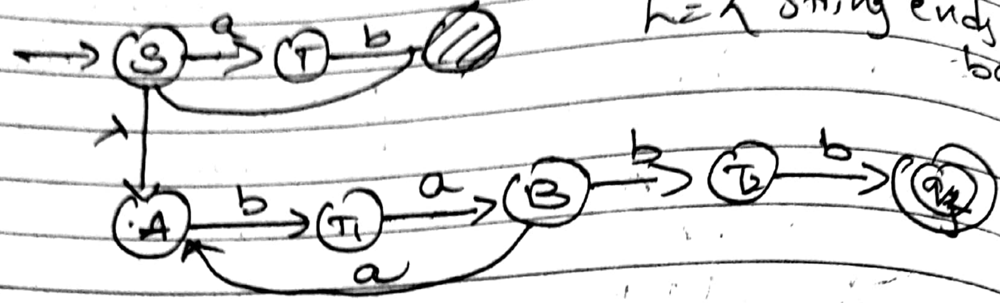
The Lanagu is

$L = \{ aba + ababa$

Q5 $S \to abS \mid A$
$A \to baB$
$B \to aA \mid bb$

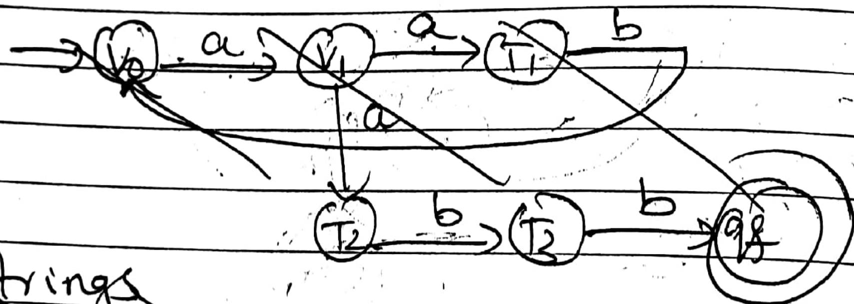
ab
abba
abbaabba
abbabb

L = { string ends with babb



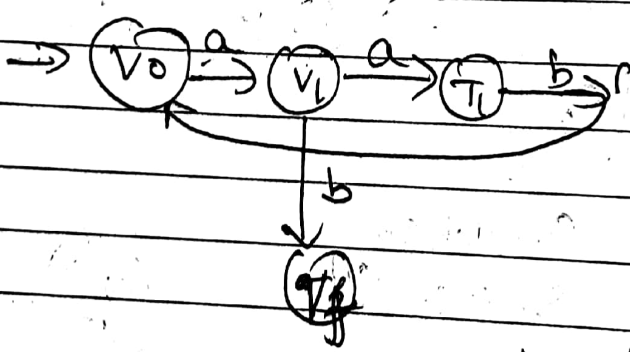
$L = \{ (ab)^* ba (aba)^* bb \}$
L = { it has a substring ba and ends with bb }

Q4 $V_0 \to aV_1$
$V_1 \to abV_0 \mid b$



$V_1 \to b$
~~$V_1 \to abb$~~

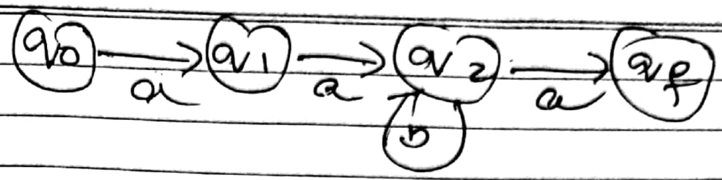
Strings
~~aaba aabb~~

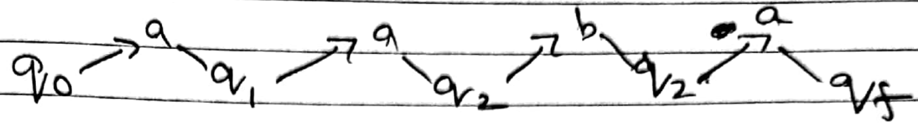


Strings.
aab aab
ab

$L = \{ (aab)^* ab \}$

$L = \{ a (aba)^* b \}$

Q5  find language



$L = \{ aa(b)^* a \}$

$aa(b)^* a$ //

Q Prove that given Reg exp Reg langu.

$aa^* (ab + a)^*$

Pone Reg Exp to language then Constict NFA