

COMPUTER ENGINEERING DEPARTMENT

ASSIGNMENT NO-02

Sub: Theory of Computer Science

COURSE: T.E.

Year: 2020-2021

Semester: V

DEPT: Computer Engineering

SUBJECT CODE: CSC504

DUE DATE: 05/11/2020

=====

Roll No. 50


Name: Amey Thakur

Class: TE-Comps B

Date of Submission: 04/11/2020

Tutorial 2

1. Construct DFA equivalent to NFA $(\{p,q,r,s\}, \{0,1\}, \delta, p, \{q,s\})$ and minimize the given DFA where δ is

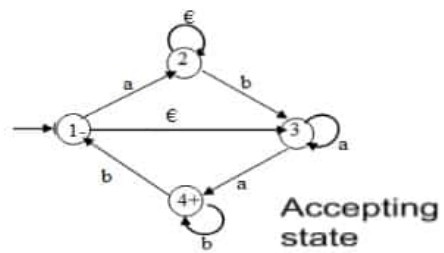
Σ	0	1
Q		
	q,r	q
*q	r	q,r
r	s	p
*s	-	p

2.

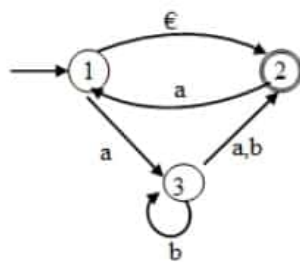
Convert the following NFA to an equivalent DFA

State	a	b	ϵ
$\rightarrow q_0$	$\{q_0, q_1\}$	$\{q_1\}$	$\{\}$
q_1	$\{q_2\}$	$\{q_1, q_2\}$	$\{\}$
* q_2	$\{q_0\}$	$\{q_2\}$	$\{q_1\}$

3. Convert the full NFA with ϵ to a complete DFA.



4. Convert the full NFA with ϵ to a complete DFA.



Q.1. Construct DFA equivalent to NFA $(\{p, q, r, s\}, \{0, 1\}, \delta, p, \{q, s\})$ and minimize the given DFA where s is

Σ	0	1
$\rightarrow p$	qr	q
q^*	r	qs
r	s	p
s^*	$-$	p

Ans:

$$\delta(p, 0) = qr - (N)$$

$$\delta(r, 0) = s$$

$$\delta(p, 1) = q$$

$$\delta(r, 1) = p$$

$$\delta(q, 0) = r$$

$$\delta(s, 0) = \emptyset$$

$$\delta(q, 1) = qr$$

$$\delta(s, 1) = p$$

$$\delta(qr, 0) = \delta(q, 0) \cup \delta(r, 0) = r \cup s$$

$$\delta(qr, 0) = rs - (N)$$

$$\delta(qr, 1) = \delta(q, 1) \cup \delta(r, 1) = qr \cup p$$

$$\delta(qr, 1) = pqr - (N)$$

$$\delta(rs, 0) = \delta(r, 0) \cup \delta(s, 0) = s \cup \emptyset$$

$$\delta(rs, 0) = s$$

$$\delta(rs, 1) = \delta(r, 1) \cup \delta(s, 1) = p \cup p$$

$$\delta(rs, 1) = p$$

$$\delta(pqr, 0) = \delta(p, 0) \cup \delta(q, 0) \cup \delta(r, 0) = qr \cup r \cup s$$

$$\delta(pqr, 0) = qrs - (N)$$

$$\delta(pqr, 1) = \delta(p, 1) \cup \delta(q, 1) \cup \delta(r, 1) = q \cup qr \cup p$$

$$\delta(pqr, 1) = pqr$$

$$\delta(qrs, 0) = \delta(q, 0) \cup \delta(r, 0) \cup \delta(s, 0) = r \cup s \cup \phi$$

$$\delta(qrs, 0) = rs$$

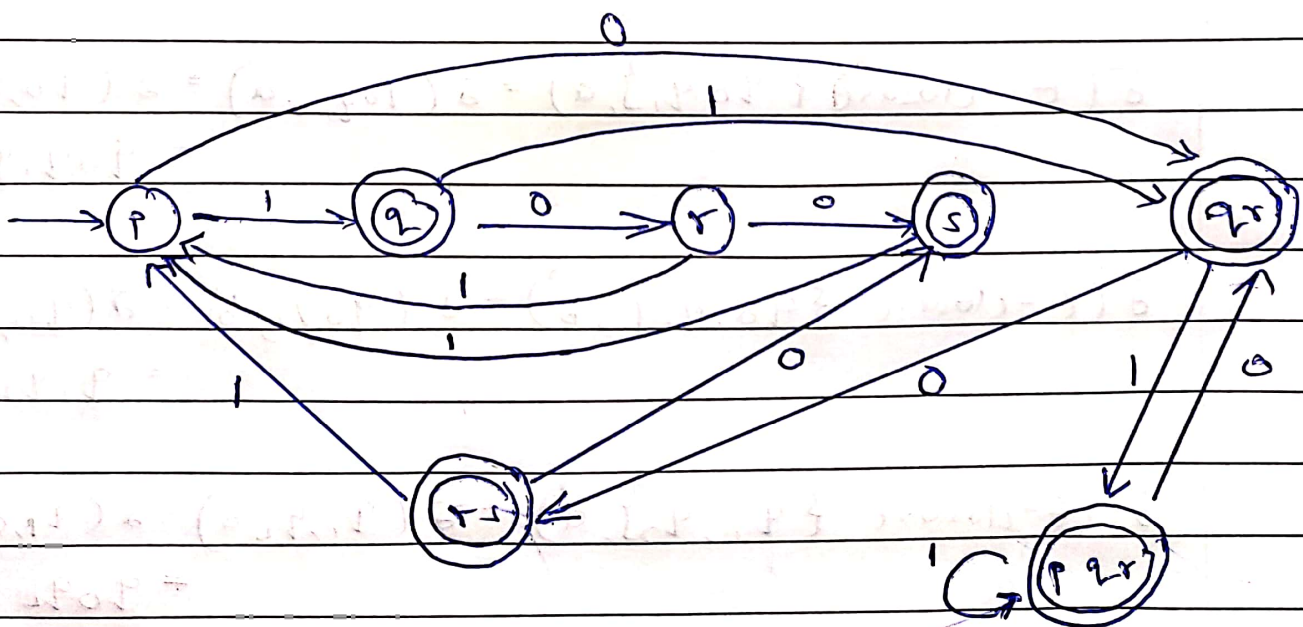
$$\delta(qrs, 1) = \delta(q, 1) \cup \delta(r, 1) \cup \delta(s, 1) = qr \cup p \cup p$$

$$\delta(qrs, 1) = pqr$$

\therefore New transition table for DFA is

Q \ Σ	0	1		Q \ Σ	0	1
$\rightarrow p$	qr	q		p	qr	q
q^*	r	qr		q^*	r	qr
r	s	p		r	s	p
s^*	-	p	\Rightarrow	s^*	-	p
qrs^*	rs	pqr	\swarrow	qrs^*	rs	pqr
rs^*	s	p		rs^*	s	p
pqr^*	qrs	pqr		pqr^*	qr	pqr
qrs^*	rs	pqr	\searrow			

Equivalent DFA:



Q.2. Convert the following NFA to equivalent DFA

state	a	b	c
$\rightarrow q_0$	$\{q_0, q_1\}$	$\{q_1\}$	$\{\}$
q_1	$\{q_2\}$	$\{q_1, q_2\}$	$\{\}$
q_2^*	$\{q_0\}$	$\{q_2\}$	$\{q_1\}$

Ans:

$$\epsilon\text{-closure}(q_0) = \{q_0\}$$

$$\epsilon\text{-closure}(q_1) = \{q_1\}$$

$$\epsilon\text{-closure}(q_2) = \{q_1, q_2\}$$

$$\delta(\epsilon\text{-closure}\{q_0\}, a) = \delta(q_0, a) = q_0, q_1 - (N)$$

$$\delta(\epsilon\text{-closure}\{q_0\}, b) = \delta(q_0, b) = q_1$$

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

$$\delta(\epsilon\text{-closure}\{q_1\}, b) = \delta(q_1, b) = q_1, q_2 - (N)$$

$$\begin{aligned} \delta(\epsilon\text{-closure}\{q_2\}, a) &= \delta(q_1, q_2, a) = \delta(q_1, a) \cup \delta(q_2, a) \\ &= q_0, q_2 - (N) \end{aligned}$$

$$\begin{aligned} \delta(\epsilon\text{-closure}\{q_0, q_1\}, b) &= \delta(q_0, q_1, b) = \delta(q_0, b) \cup \delta(q_1, b) \\ &= q_1, q_2 \end{aligned}$$

$$\begin{aligned} \delta(\epsilon\text{-closure}\{q_0, q_1\}, a) &= \delta(q_0, q_1, a) = \delta(q_0, a) \cup \delta(q_1, a) \\ &= q_0, q_1, q_2 - (N) \end{aligned}$$

$$\begin{aligned} \delta(\epsilon\text{-closure}\{q_0, q_1\}, b) &= \delta(q_0, q_1, b) = \delta(q_0, b) \cup \delta(q_1, b) \\ &= q_1, q_2 \end{aligned}$$

$$\begin{aligned} \delta(\epsilon\text{-closure}\{q_1, q_2\}, a) &= \delta(q_1, q_2, a) = \delta(q_1, a) \cup \delta(q_2, a) \\ &= q_0, q_2 \end{aligned}$$

$$\delta(\epsilon\text{-closure}\{q_1, q_2\}, b) = \delta(q_1, q_2, b) = \delta(q_1, b) \cup \delta(q_2, b) \\ = q_1, q_2$$

$$\delta(\epsilon\text{-closure}\{q_0, q_2\}, a) = \delta(q_0, q_2, a) = \delta(q_0, a) \cup \delta(q_2, a) \cup \delta(q_0, q_2) \\ = q_0, q_2, q_1$$

$$\delta(\epsilon\text{-closure}\{q_0, q_2\}, b) = \delta(q_0, q_2, b) = \delta(q_0, b) \cup \delta(q_2, b) \cup \delta(q_0, q_2) \\ = q_1, q_2$$

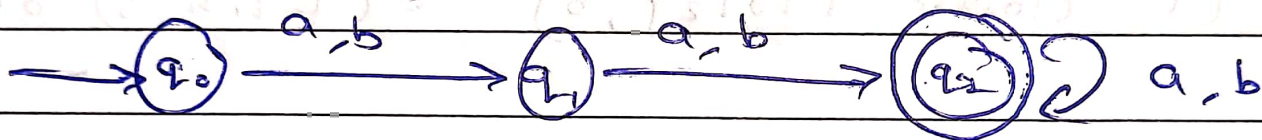
$$\delta(\epsilon\text{-closure}\{q_0, q_1, q_2\}, a) = \delta(q_0, q_1, q_2, a) = \delta(q_0, a) \cup \delta(q_1, a) \cup \delta(q_2, a) \\ = q_0, q_1, q_2$$

$$\delta(\epsilon\text{-closure}\{q_0, q_1, q_2\}, b) = \delta(q_0, q_1, q_2, b) = \delta(q_0, b) \cup \delta(q_1, b) \cup \delta(q_2, b) \\ = q_1, q_2$$

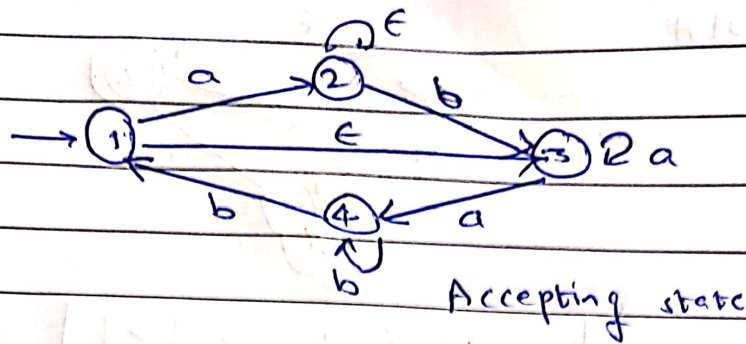
New Transition Table for equivalent DFA is

Q \ Σ	a	b		Q \ Σ	a	b
$\rightarrow q_0$	q_0, q_1	q_1		$\rightarrow q_0$	q_0, q_1	q_1
q_1	q_2	q_0, q_2		q_1	q_2	q_1, q_2
q_2^*	q_0, q_2	q_1, q_2		$\rightarrow q_2^*$	q_0, q_2	q_1, q_2
q_0, q_1	q_0, q_1, q_2	q_1, q_2	\Rightarrow	q_0, q_1	q_0, q_2	q_1, q_2
q_1, q_2^*	q_0, q_2	q_1, q_2		q_1, q_2^*	q_0, q_2	q_1, q_2
q_0, q_2^*	q_0, q_1, q_2	q_1, q_2	\leftarrow	q_0, q_2^*	q_0, q_2	q_1, q_2
q_0, q_1, q_2^*	q_0, q_1, q_2	q_1, q_2	\leftarrow			

$Q \backslash \Sigma$	a	b		$Q \backslash \Sigma$	a	b
$\rightarrow q_0$	$q_0 q_1$	q_1		$\rightarrow q_0$	q_1	q_1
q_1	q_2	q_2	\Rightarrow	q_1	q_2	q_2
q_2^*	q_2	q_2		q_2^*	q_2	q_2
$q_0 q_1$	q_2	q_2				



Q.3. Convert the Full NFA with ϵ to complete DFA



Ans:

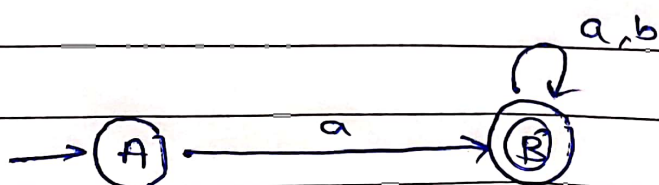
x	$Y = \epsilon\text{-closure}[x]$	$\delta(Y, a)$	$\delta(Y, b)$
A $\rightarrow \{1\}$	$\{1, 3\}$	$\{2, 3, 4\}$	-
B $\{2, 3, 4\}$	$\{2, 3, 4\}$	$\{3, 4\}$	$\{3, 4, 1\}$
C $\{3, 4\}$	$\{3, 4\}$	$\{3, 4\}$	$\{4, 1\}$
D $\{3, 4, 1\}$	$\{1, 3, 4\}$	$\{2, 3, 4\}$	$\{4, 1\}$
E $\{4, 1\}$	$\{1, 3, 4\}$	$\{2, 3, 4\}$	$\{4, 1\}$

Transition Table of DFA

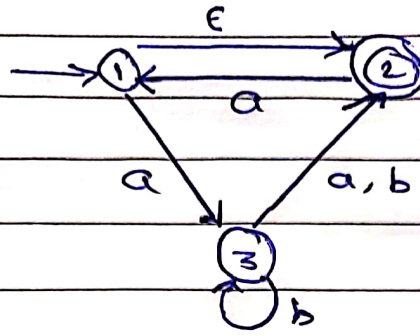
$Q \backslash \Sigma$	a	b		$Q \backslash \Sigma$	a	b
$\rightarrow A$	B	-		$\rightarrow A$	B	-
B^*	C	D		B^*	C	D
C^*	C	E	\Rightarrow	C^*	C	D
D^*	B	E	\leftarrow	D^*	B	D
E^*	B	E	\downarrow			

$Q \backslash \Sigma$	a	b		$Q \backslash \Sigma$	a	b
$\rightarrow A$	B	-		$\rightarrow A$	B	-
B^*	B	D	\leftarrow	B	B	B
D^*	B	D	\downarrow			

Transition Diagram



Q.4. Convert the full NFA with ϵ to a complete DFA



	x	$y = \epsilon\text{-closure}[x]$	$\delta(y, a)$	$\delta(y, b)$
$\rightarrow A$	$\{1\}$	$\{1, 2\}$	$\{3, 1\}$	-
B	$\{3, 1\}$	$\{1, 3, 2\}$	$\{1, 2, 3\}$	$\{2, 3\}$
C^*	$\{1, 2, 3\}$	$\{1, 2, 3\}$	$\{1, 2, 3\}$	$\{2, 3\}$
D^*	$\{2, 3\}$	$\{2, 3\}$	$\{1, 2\}$	$\{3, 2\}$
E^*	$\{1, 2\}$	$\{1, 2\}$	$\{1, 3\}$	-

	a	b
A	B	-
B	C	D
C^*	C	D
D^*	E	D
E^*	B	-

State transition diagram of DFA

