STUDENT NO.						
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EXAMINATION SCRIPT

DEPARTMENT:	
CSE	L-2 T-2

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY

COURSE NO.	CSE 211	DATE	16/1/2021
COURSE TITLE	Theory of Computation		

SECTION A

Declaration on the Online Course Conduct by Undergraduate Student of BUET for COVID-19 Situation

Please write the declaration (as per no. 2 of 'Instructions' given in the footer) below in your own handwriting and sign it.

On my honour, I bearing Student No. 1705045 hereby declare that,

I shall not misuse, in any form or method, the course materials, Audio and Video Records of the lectures of this course. I shall not adopt any unfair means during the Final examination and shall not receive any help or offer/provide help to anyone. I shall preserve hard copy and soft copies of the answer scripts and will not expose the the same to any person/party/media. I agree to accept any punitive measure taken by BUET authority if at any time during or after the completion of the course it is revealed/violated otherwise

Signature: Ifte Khair Hakim Kaosar Date: 16/1/2021

Instructions

1. Clearly enter your Student ID, Course Number, Course Title, and Date in the space provided. *Complete the declaration exactly as below with your signature and date.* You can also insert the scanned image of your handwritten declaration in this box.
2. Declaration: I shall not misuse, in any form or method, the course materials including Lecture Notes, Reading Materials, Audio and Video Records of the lectures of this course. I shall not adopt any unfair means during the Final Examination and shall not receive any help or offer/ provide help to anyone. I shall preserve hard copy and soft copies of the answer scripts and will not expose the same to any person/party/media. I agree to accept any punitive measure taken by BUET Authority if at any time during or after the completion of the course it is revealed/ violated otherwise.
3. Do not put your name or any other form of identification except the Student No. anywhere in the answer script.
4. Use offset/normal white paper of A4 size for writing the answer. Use only one side of the paper for writing. On each page, clearly write your Student ID and Page numbers.

Ans. q. no – 2(a)

By evaluating the DFA, we see that it recognizes all strings of length at least 2 whose last 2 characters are same.

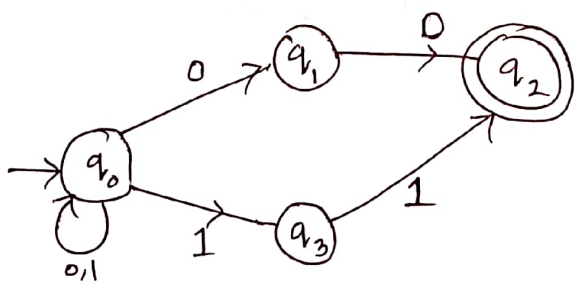
If the automaton is M, the language,

$$L(M) = \{ w \mid w \in \{0,1\}^*, |w| \geq 2 \text{ and last two characters are same} \}$$

Ans. to q. – 2(b)

We see that if we directly copy the DFA and state it as NFA, it will work. Because every DFA is an NFA too.

However we will make an easier (apparently) NFA.



We say the NFA, $N = (Q, \Sigma, \delta, q_0, \{q_2\})$

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

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

$\delta(q_0, 0) = \{q_0, q_1\}$

$\delta(q_0, 1) = \{q_0, q_3\}$

$\delta(q_1, 0) = \{q_2\}$

$\delta(q_3, 1) = \{q_2\}$

And, $F = \{q_2\}$

Ans. to q. no- 2(c)

The corresponding language L in question 2(a) includes all strings of length at least 2 and last two characters are same.

Let's say the strings not in L makes another language L'.

Its regular expression will be,

$$0 \cup 1 \cup \in \cup \Sigma^*01 \cup \Sigma^*10$$

Ans. to q no. — 3(a).

i) We know, φ^* means ϵ.
Concatenating 4 empty string yields just an empty string ϵ.

So, $\varphi^* \varphi^* \varphi^* \varphi^* = \epsilon$

ii) $\varphi^* \cup \{\epsilon\}$.

Again, as φ^* means ϵ,

$\varphi^* \cup \{\epsilon\} = \{\epsilon\} \cup \{\epsilon\} = \{\epsilon\}$

iii)

$(\varphi^* \cup 1)\{0,1\}$

$= (\epsilon \cup 1)\{0,1\}$

$= (0) \cup (1) \cup (10) \cup (11)$

$= \{0, 1, 10, 11\}$

iv) $(11)^* \varphi (00)^* = \varphi$

Where whatever is in left or right, as we are concatenating φ, it yields φ or null set.
Because, we cannot concatenate a null set.

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v) $(\phi^* \cup 0)\{0, 1, 11\}$

$= (\epsilon \cup 0)\{0, 1, 11\}$

$= \{0, 1, 11, 00, 01, 011\}$

Ans. q. no - 3 (b)

In this procedure we are designing NFA N ~~given~~ to recognize L_1^*, given NFA N_1 to recognize L_1.

Here, in the question, a valid mating of δ for N is given. Explanation ~~of~~ by sequence as in question —

i) $\delta(q, a) = \delta_1(q, a)$ where $q \in Q_1$ and $q \notin F_1$

For states q which are member of Q_1 ~~and~~ but not member of ~~final~~ accepting states of N_1, they will have ~~same~~ transition functions in N similar to their respective transition functions in N_1. Their arcs are as same as in N_1.

2) $\delta_1(q,a)$ where $q \in F_1$ and $a \neq \epsilon$

States which are ~~in~~ ~~in~~ accepting states for N_1 ~~what~~ will have ~~same~~ transition functions similar to their respective transition functions in N_1 given that the input symbol is not ϵ.

It means for accepting states and non-empty input symbol, we add arcs from them as they were in N_1.

3) $\delta(q,a) = \delta_1(q,a) \cup \{q_1\}$ where $q \in F_1$ and $a = \epsilon$.

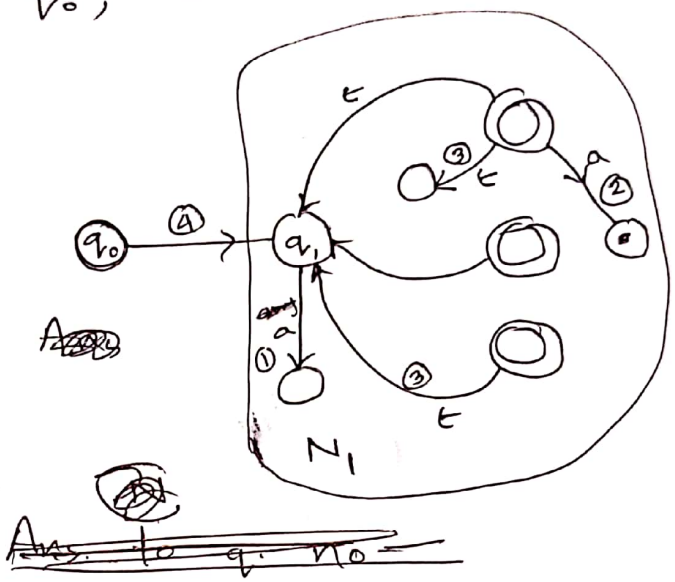
For accepting states and empty input symbol ϵ, we add all the arcs as they were in N_1. But, we add ~~some~~ arcs from each of them to q_1 (starting state of N_1) with ϵ.

4) $\delta(q,a) = \{q_1\}$ where $q = q_0$ and $a = \epsilon$

In N_1 we added a new state q_0, and it is the new start state. We add an arc from it to q_1 (starting state of N_1) through ϵ or empty string.

5) $\delta(q,a) = \phi$, $q = q_0$ and $a \neq \epsilon$

For q_0 (a new starting state) and non-empty input symbol, we do not add any arc from q_0, i.e. no-transition from them.



N

Here we ~~make~~ marked arc/transition for 1-4. (Here a is some element belongs to Σ)

Ans. to - 4 (a)

By observing the given regular expression, we see that it puts at least one 0 between any two ~~adjac~~ 1's.

So, its language ~~recognizes~~ includes, all strings whose do not have adjacent 1's. It is notable that it includes empty string or any string of length one or any string consisting of all 0's too.

So,

$L = \{ w \mid w \in (0,1)^* \text{ and } w \text{ does not have consecutive } 1\text{'s} \}$

Ans. to qno – 4(b)

Converting NFA to DFA:–

Here

$E(\{q_0\}) = \{q_0, q_1, q_2, q_4, q_7\}$

$E(\{q_1\}) = \{q_1, q_2, q_4\}$

$E(\{q_2\}) = \{q_2\}$

$E(\{q_3\}) = \{q_1, q_2, q_3, q_4, q_6, q_7\}$

$E(\{q_4\}) = \{q_4\}$

$E(\{q_5\}) = \{q_1, q_2, q_4, q_5, q_6, q_7\}$

$E(\{q_7\}) = \{q_7\}$

$E(\{q_8\}) = \{q_8\}$

$E(\{q_9\}) = \{q_9\}$

$E(\{q_{10}\}) = \{q_{10}\}$

So,
starting state is $\{q_0, q_1, q_2, q_4, q_7\}$

state / Σ	0	1
→ $\{q_0, q_1, q_2, q_4, q_7\}$ or A	$\{q_1, q_2, q_3, q_4, q_6, q_7, q_8\}$ or B	$\{q_1, q_2, q_4, q_5, q_6, q_7\}$ or C
$\{q_1, q_2, q_3, q_4, q_6, q_7, q_8\}$ or B	$\{q_1, q_2, q_3, q_4, q_6, q_7, q_8\}$ or B	$\{q_1, q_2, q_4, q_5, q_6, q_7, q_9\}$ or D
$\{q_1, q_2, q_4, q_5, q_6, q_7\}$ or C	$\{q_1, q_2, q_3, q_4, q_6, q_7, q_8\}$ or B	$\{q_1, q_2, q_4, q_5, q_6, q_7\}$ or C
$\{q_1, q_2, q_4, q_5, q_6, q_7, q_9\}$ or D	$\{q_1, q_2, q_3, q_4, q_6, q_7, q_8\}$ or B	$\{q_1, q_2, q_4, q_5, q_6, q_7, q_{10}\}$ or E
~~$\{q_1, q_2, q_3, q_4, q_6, q_7, q_8\}$ or E~~	~~$\{q_1, q_2, q_3, q_4, q_6, q_7, q_8\}$~~	~~$\{q_1, q_2, q_4, q_5, q_6, q_7, q_9\}$~~
* $\{q_1, q_2, q_4, q_5, q_6, q_7, q_{10}\}$ or E	$\{q_1, q_2, q_3, q_4, q_6, q_7, q_8\}$ or B	$\{q_1, q_2, q_4, q_5, q_6, q_7\}$ or C

So, DFA