STUDENT PORTFOLIO

Insert Photo	Name: DIVYANSSH GAUR Register Number: RA2011027010090 Mail ID: dg8013@srmist.edu.in Department: Computer Science Engineering Specialization: Big Data Analytics Semester: 5

Subject Title: 18CSC301J Formal Language & Automata

Handled By: Sharanya S

Assignment – WorkSheet (Unit 1, 2, 3, 4, & 5)
(Write about the assignment questions and how you solved differently)

• Assignment questions were from all topics like Automata, Regular expressions, NFA,DFA,Pumping lemma,CFG,CNF,GNF, PDA,Turing machines. • Questions were of moderate difficulty which induced logical thinking.

• Solving questions was initially difficult. But, over a period it became comparatively easy.

• Overall,these assignment questions helped me to understand the subject better and it gave practice to different types of questions.

Assignment
(what is the most interesting part in the assignment)

• It made me think about how this could be used for real time problem solving.

• Most of the questions were based on the basic understanding which I found the most interesting.

• The questions were designed into the perfect way that tested our understanding and basic concepts in every topic covered in the offline/online classes.

HackerRank Achievements

- Problem Solving certificate Hackerrank
- Python (basic) certificate
- CCC Exit Test

Any other

(Write if you registered or practised apart from Codechef (ex. Hackerrank, Leetcode etc.)

- Hackerrank - registered and started working.
- Leetcode - registered and started working.
- Codechef - registered and started working.

Signature

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Note: Enclose the assignment and relevant certificates along with the profile

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WorkSheet-1

1)

Let $P(n)$ be $2^{2n} - 1$

Basic step: $P(1)$ = True

$LHS \rightarrow 2^{2(1)} - 1 = 3$

It is divisible by 3.

Inductive step

Assume that $P(k)$ is True

$2^{2k} - 1 = 3K$

we have to prove $P(K+1)$ is True

LHS :

$2^{2(K+1)} = 4(3K+1) - 1$

$\Rightarrow 12K + 3 = 3(4K+1)$

It is divisible by 3.

RHS

$3(K+1) = 3K + 3 = 3(K+1)$

It is divisible by 3.

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2) $a^2 = 3k$, a^2 is divisible by 3.

$a = (3k+1)$ or $3(k+2)$, a is divisible by 3.

a^2 is divisible by $3 \rightarrow a^2 = 3k$

a is divisible by $3 \rightarrow a = (3k+1)$ or $(3k+2)$

$a^2 = (3k+1)^2$ or $(3k+2)^2$

$\Rightarrow 3k+1$ or $3d+1$

3) let a & b be integers and assume that a+b is odd but a+b are both even sum of 2 even integer must be even therefore a+b is even

But then a+b both even and odd which is contradictory.

4) $P = 2n^2 - 16n + 31$ is always true for all n → taken

$n = 5$

$P(5) = 2 \times 5^5 - (6 \times 5 + 31) =$

$n = 4$

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1

$P(4) = 2 \times 16 - 16 \times 4 + 31 = 1$

5) let $p(n)$ for $n >= 5 \rightarrow 2^n > n^2$

Base steps :-

Assume $P(5)$

$2^5 > 5^2$

$32 > 25$

Hence, $P(5)$ is true

LHS

$2^{k+1} > (k+1)^2$

$2^k \cdot 2 > k^2 + 2k + 1$

$2(2^k) > 2 * k^2$

6) $1^2 + 2^2 + 3^2 \cdots k^2 = \frac{k(k+1)(2k+1)}{6}$

$\frac{k(k+1)(2k+1)(k+1)^2}{6} = \frac{k(k+1)(2k+3)}{6}$

$= \frac{k(k+1)(2k+3)}{6}$

It is true $P(k+1)$ =

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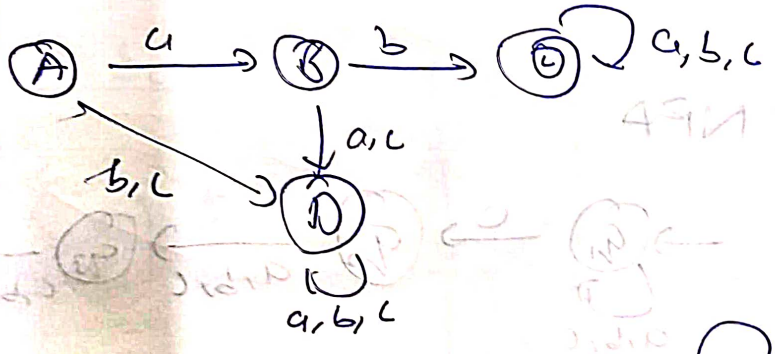
FLA Worksheet -3

1) 2(b)
2) h(a)
3) 15(c)
4) increase computation
5) 2n
6) I is false & II is true
7) DFA is more powerful
8) 5

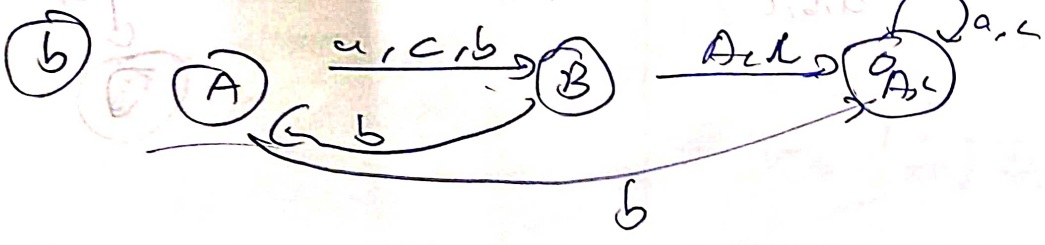
Part-B

1) Pass should start with 'ab'

a)



b)



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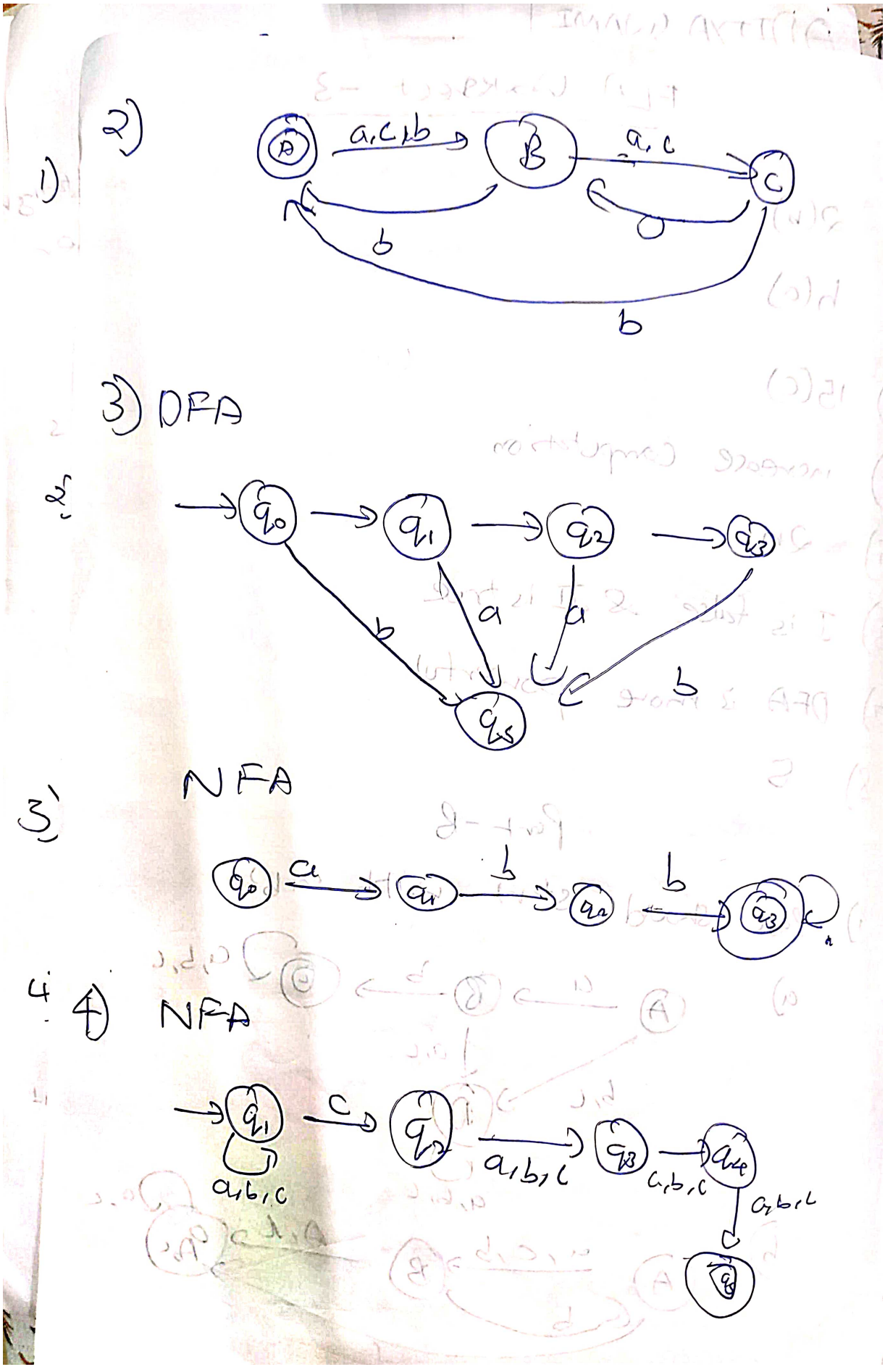

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Worksheet -4

(1) In NDFA we get multiple choices so if we have a language satisfying a DFA, it will also satisfy its equivalent NDFA.

(2) 2^n

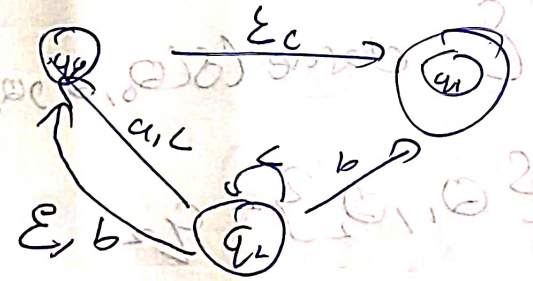
(3) $n \cdot 2^n$

(4) $\delta = Q \times (\Sigma \times \Sigma) = P(Q)$

(5) All the states can reach final states of ϵ-NFA only by reaching on ϵ.

Part-B

(1)



Transition table:-

	a	b	c
Q_0	ϕ	Q_2	Q_3
Q_1	ϕ	ϕ	ϕ
Q_2	Q_0	Q_1	Q_2

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ε -closure $(\phi_0) = \{\phi_0, \phi_1, \phi_2\} - q_0$

ε - closure $(Q_1) = \{Q_1, \}$

ε - closure $(Q_2) = \{Q_2\}$

$\delta'(q_0, a) = \varepsilon$-closure$(\delta(q_0, a))$

$= \{Q_0\} - q_2$

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

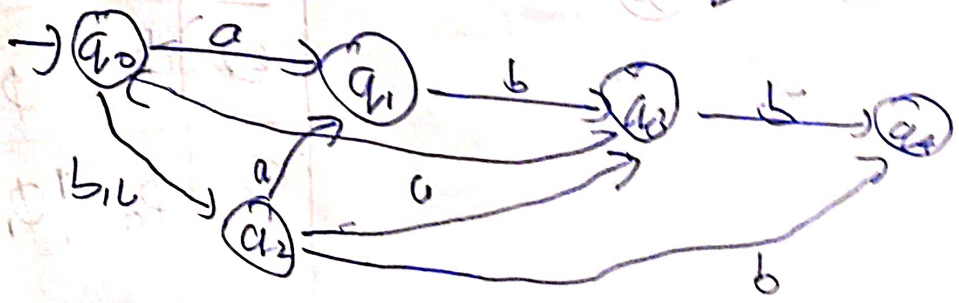
$= \varepsilon$-closure$(\delta(Q_0, Q_1, Q_2), b)$

$= \{Q_1, Q_2\} - q_3$

$\delta'(q_0, c) = \varepsilon$-closure$(\delta(q_0, c))$

$= \varepsilon$-closure$(\delta(Q_0, Q_1, Q_2), c)$

$= \{Q_1, Q_2\} - q_2$



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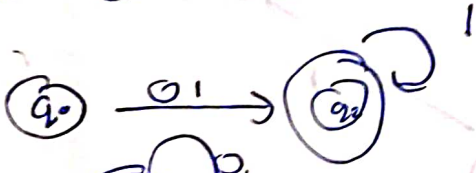
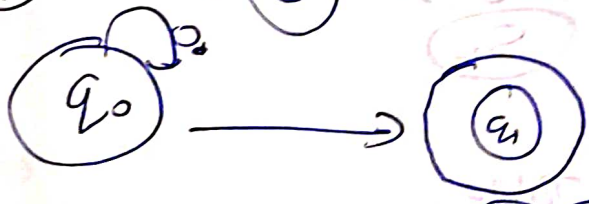
(2) $L_1 = 01^*$

$L_2 = 0^*1$

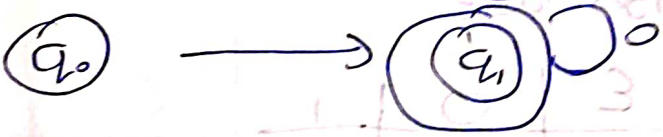
(i)



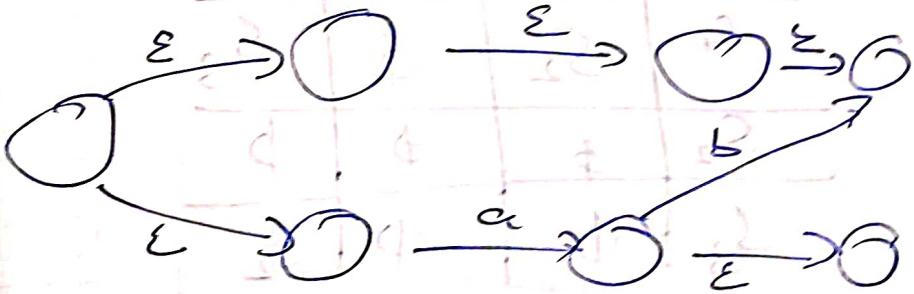
(ii)



(iii)



(3)



ε-closure(1) = {1, 2, 4, 6}

(2) = {2, 3, 6}

(3) = {3, 6}

(4) = {4}

(5) = {5, 7}

(6) = {6}

(7) = {7}

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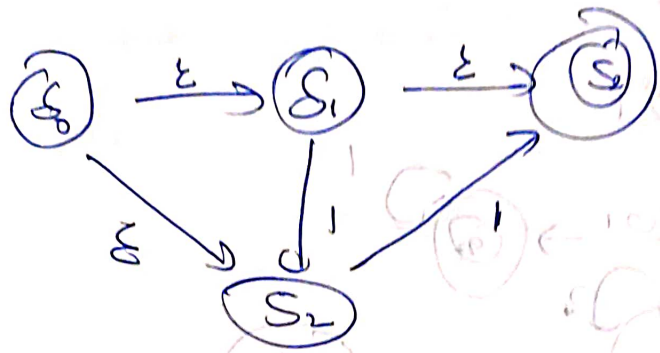
5)



Transition Table

	ε	0	1
S_0	S_3	S_0	ϕ
S_1	S_2	ϕ	S_3
S_2	ϕ	ϕ	ϕ
S_3	ϕ	ϕ	S_2

ε-closure $(S_0) = \{S_0, S_1, S_2, S_3\}$

$(S_1) = \{S_1, S_2\}$

$(S_2) = \{S_2\}$

$(S_3) = \{S_3\}$

$\delta'(S_0, 0) = \varepsilon$-closure $(\delta(\varepsilon\text{-closure}(S_0, 0))$

$= \varepsilon$-closure $(\delta(\{S_0, S_1, S_2, S_3\}, 0))$

$\Rightarrow \delta$-closure(δ_0)

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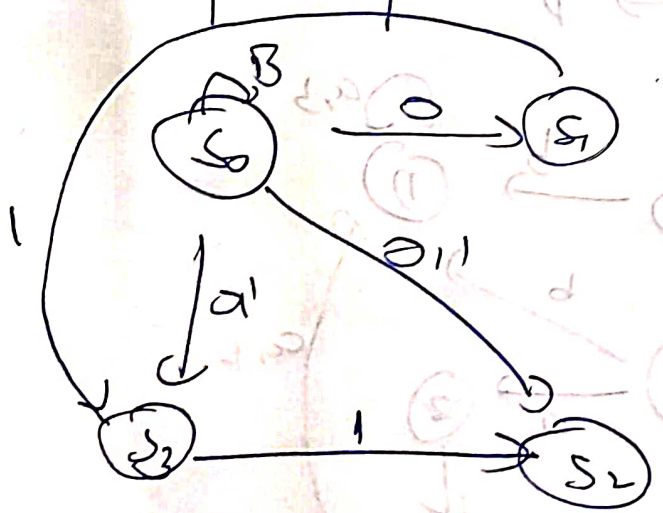
$\delta'(S_0, 1) = \varepsilon\text{-closure}(\delta(\varepsilon\text{-closure}(S_0, 1)))$

$= \varepsilon\text{-closure}(S_3, S_2)$

$= \{S_2, S_3\}$

Transition - Table

	0	1
$\rightarrow S_0$	$S_0\ S_1$ $S_3\ S_4$	S_2 S_3
S_1	ϕ	S_3
S_2	ϕ	ϕ
S_3	ϕ	S_2



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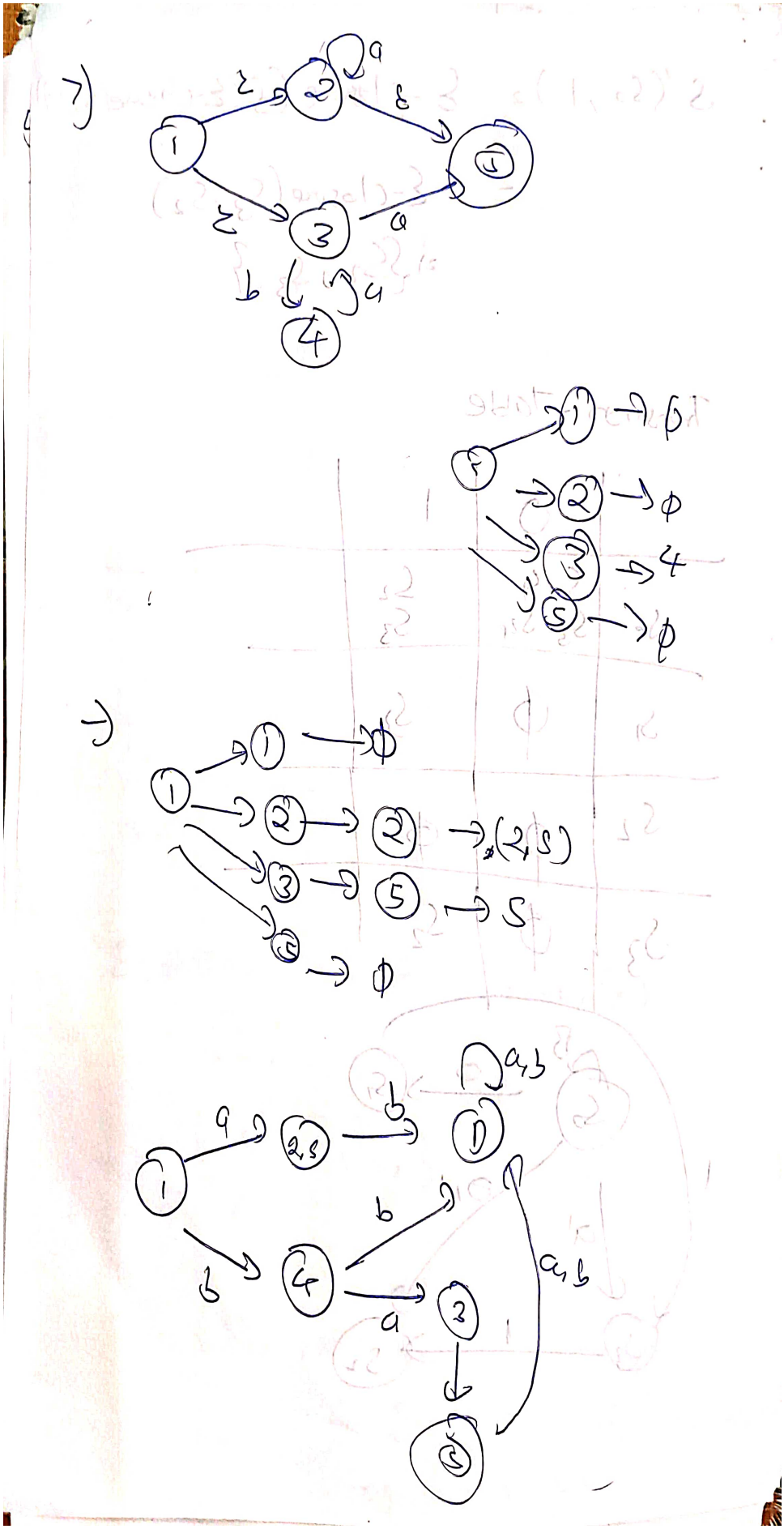

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FLA Worksheet - 5

1) Difference between DFA & NFA is that we get multiple choices in NFA so if we have a language satisfying this equivalent NDFA.

2) 2^n

3) $n, 2^n$

4) (d) $\delta = Q \times (\Sigma \cup \epsilon) = P(Q)$

5) (a) Some final states as ϵ - NFA.

Part-B

2) Given $L_1 = 01^*$ $L_2 = 0^*1$

Design Automata for → i) $(01^* + 0^*1)$

(ii) 0^*1

(iii) 10^*

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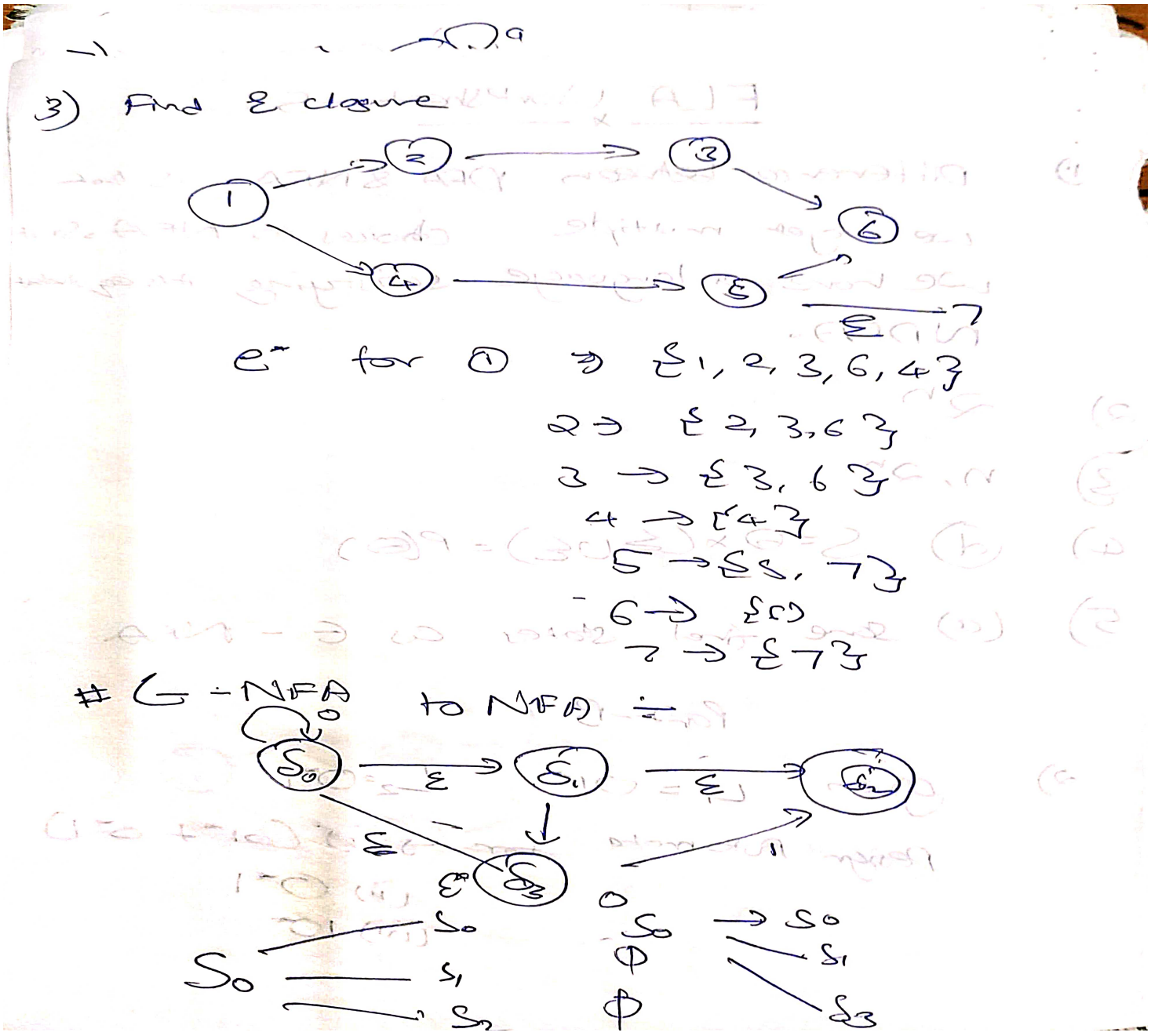

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Unit-4
Worksheet

Q-1 Storage capacity

2. Only reads input and two storage tapes.

3. Turing Machine with Stay option.

4. Non erasing turing machine.

5. Binary turing machine.

Q-6

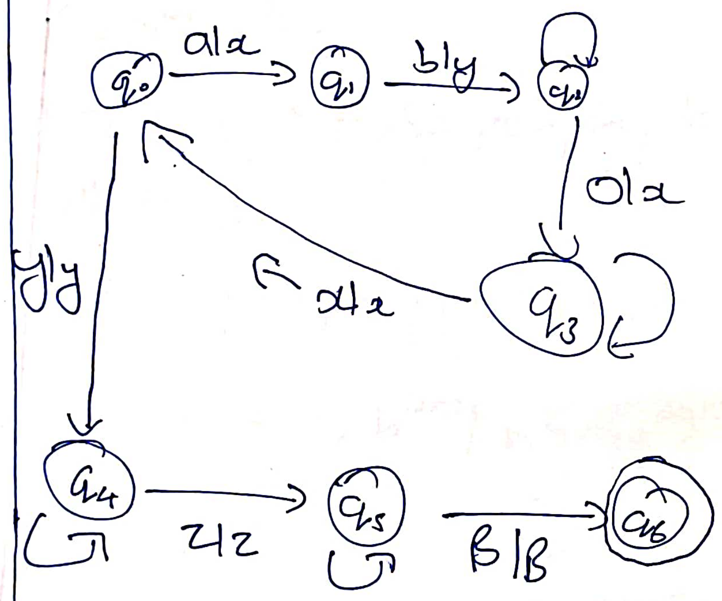
A standard turing machine is a machine which on providing an input, moves either to left or right, It may overwrite the existing symbol.

A standard TM is capable of accepting some of language called recursively enumerable language by doing some kind of rectification we can increase no. of language accepted by turing machine.

Q-7

Design T.M for

$L = a^m b^m c^m \mid m \geq 1$



b|b
y|y
a|a
z|z

Ans 1) True

2) True

3) 7

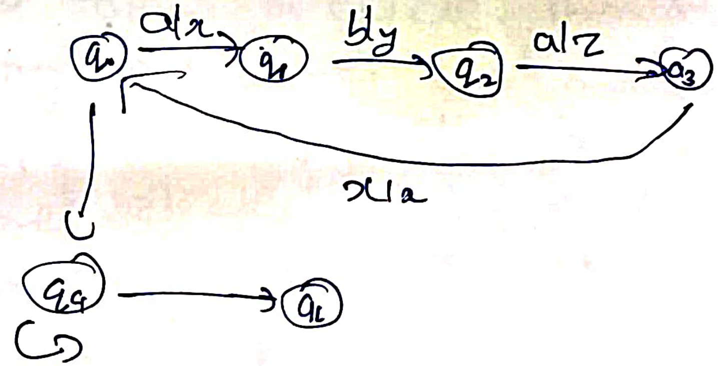
5) Both S_1 and S_2 are same

4) left

6) O^m, n

7) turing machine

$L = \{a^m, b^m, c^m\}$



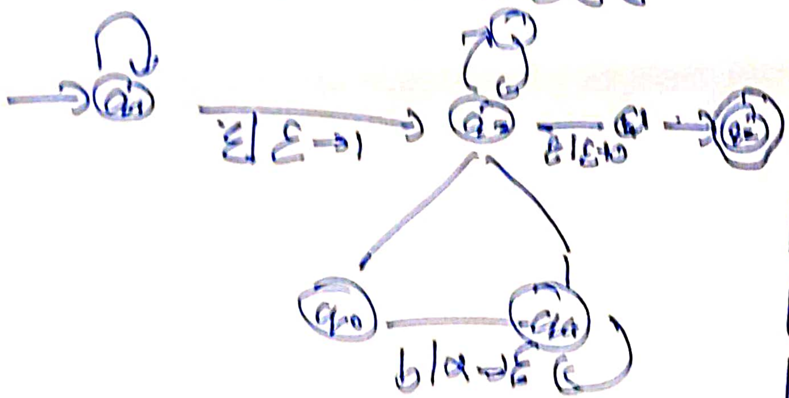
1) $A = \{0^{2n} 1^{3n} 0^n \mid n \geq 0\}$ is not context free language

Ans. let p be pumping lemma for CFL's and consider string $S = 0^{2p} 1^{3p} L$

$|S| = 6p > p$, so pumping lemma will hold.

Their crest, $x, y, z, xz, xz = 0$

$F = \{a^{2n}, b^{3m} \mid n > 0\}$



2) Kruskal Algorithm is in class P.

Kruskal Algorithm create a min. spanning tree by adding edges one at a time to T. It is built edge by edge, we start with the minimum cost if there are several pages with same min. cost, we select one of them and add it to minimum spanning tree provided the addition does not follow a cycle. Then add with exact lower cost and so on. Repeat the process until we have selected n edges to perform complete spanning tree

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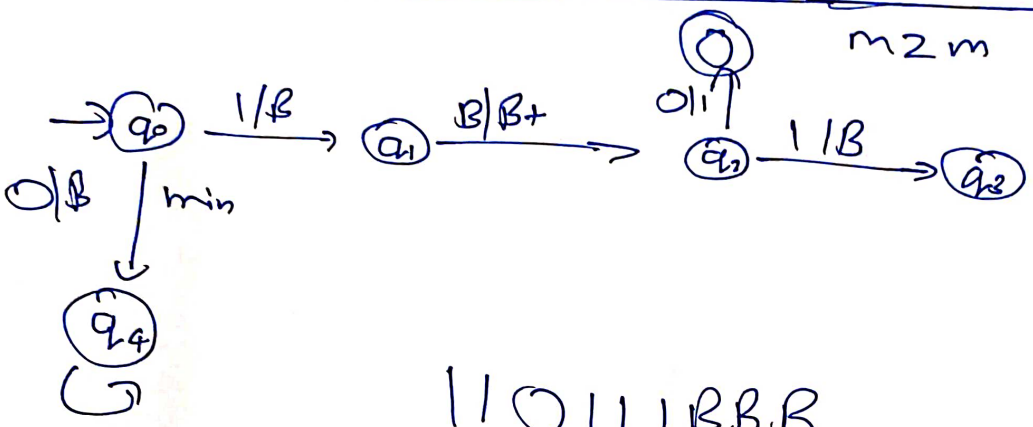
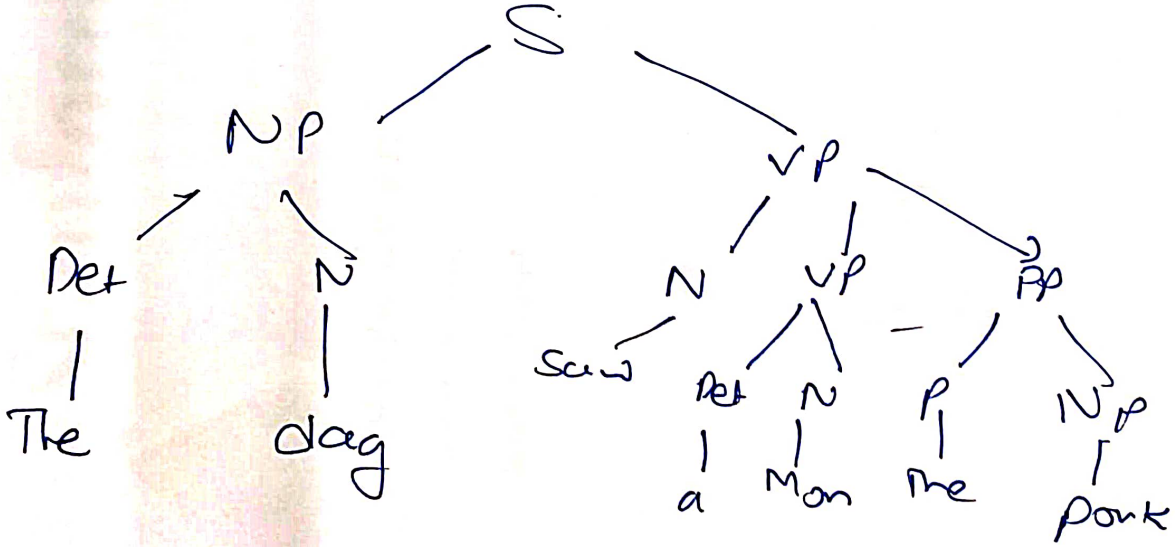
6)



11011BBB
B1011BBB
BB01BBB
BB1BBB

8) A dog saw a man on park



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HackerRank

Certificate

This is to certify that

DIVYANSH GAUR (RA2011027010090)

has successfully cleared the assessment for the skill

Python (Basic)

23 Jun, 2022

Date

Harishankaran K

CTO, HackerRank

ID: BC3C164D3A7D

HackerRank

Certificate

This is to certify that

DIVYANSH GAUR (RA2011027010090)

has successfully cleared the assessment for the skill

Problem Solving (Basic)

09 Dec, 2021

Date

Harishankaran K

CTO, HackerRank