ASSIGNMENT/ASSESSMENT ITEM COVER SHEET

Student Name: Nabeel | **Majid**

FIRST NAME | **FAMILY / LAST NAME**

Student Number: 3 2 8 7 0 6 0 Email: c3287060@uon.edu.au

Course Code	**Course Title**
c o m p 2 2 7 0	**Theory of Computation**
(Example) A B C D 1 2 3 4	*(Example)* Intro to University

Campus of Study: Callaghan (eg Callaghan, Ourimbah, Port Macquarie)

Assessment Item Title: assignment1 Due Date/Time: 26/03/23

Tutorial Group (If applicable): Word Count (If applicable):

Lecturer/Tutor Name: Nasim

Extension Granted: ○ Yes ○ No Granted Until: 29/03/23

Please attach a copy of your extension approval

NB: STUDENTS MAY EXPECT THAT THIS ASSIGNMENT WILL BE RETURNED WITHIN 3 WEEKS OF THE DUE DATE OF SUBMISSION

Please tick box if applicable

☐ *Students within the Faculty of Business and Law, Faculty of Science and Information Technology, Faculty of Engineering and Built Environment and the School of Nursing and Midwifery:*
I verify that I have completed the online Academic Integrity Module and adhered to its principles

☐ *Students within the School of Education:*
"I understand that a minimum standard of correct referencing and academic literacy is required to pass all written assignments in the School of Education; and I have read and understood the School of Education *Course Outline Policy Supplement,* which includes important information related to assessment policies and procedures.

I declare that this assessment item is my own work unless otherwise acknowledged and is in accordance with the University's academic integrity policy available from the Policy Library on the web at http://www.newcastle.edu.au/policylibrary/000608.html
I certify that this assessment item has not been submitted previously for academic credit in this or any other course. I certify that I have not given a copy or have shown a copy of this assessment item to another student enrolled in the course.

I acknowledge that the assessor of this assignment may, for the purpose of assessing this assignment:
- Reproduce this assessment item and provide a copy to another member of the Faculty; and/or
- Communicate a copy of this assessment item to a plagiarism checking service (which may then retain a copy of the item on its database for the purpose of future plagiarism checking).
- Submit the assessment item to other forms of plagiarism checking.

I certify that any electronic version of this assessment item that I have submitted or will submit is identical to this paper version.

DATE STAMP HERE

Turnitin ID:
(if applicable)

Insert this way

Signature: ______________________ Date: 29/03/23

To copy and paste the completed form into another document use the `snapshot' tool.

Print Form

THE UNIVERSITY OF NEWCASTLE AUSTRALIA

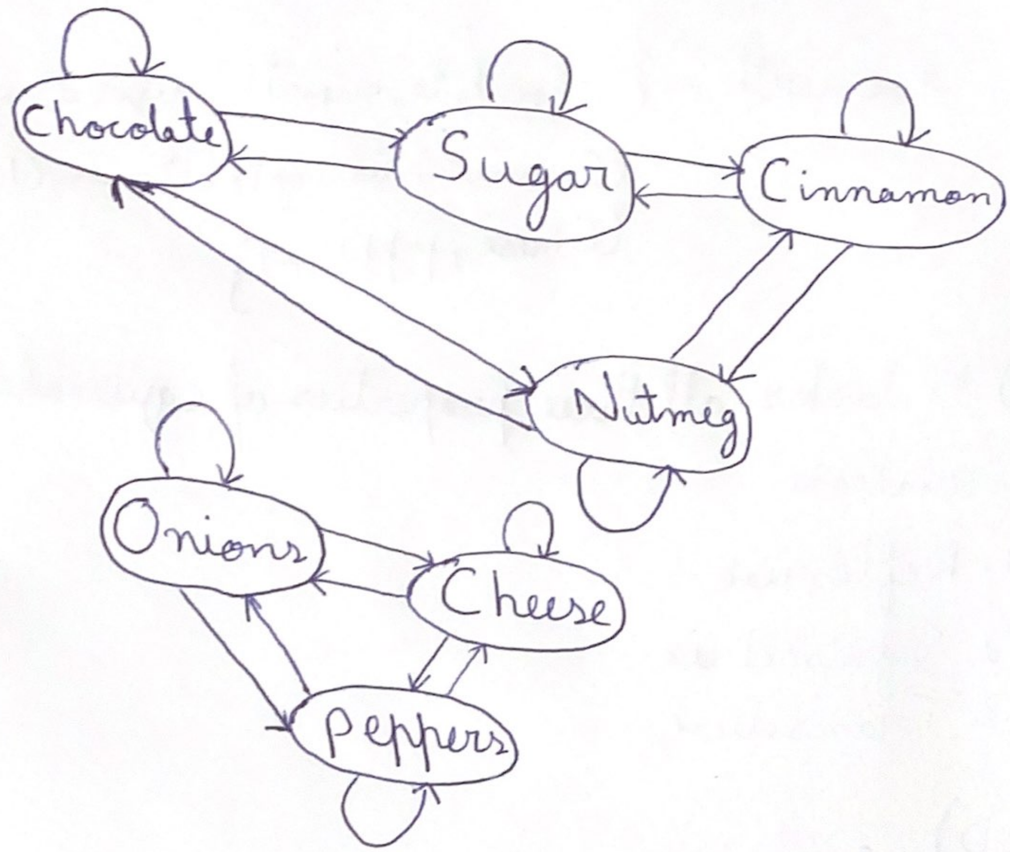
1) Goeswith = {(chocolate, sugar), (Sugar, Cinnamon), (Cinnamon, nutmeg), (Onion, Cheese), (Cheese, peppers)}

a) It lacks all three properties of equivalence relation

1. Reflexive
2. Symmetric
3. Transitive

(b) $ Goeswith = {(Chocolate, Sugar), (Sugar, Cinnamon), (Cinnamon, Nutmeg), (Onion, Cheese), (Cheese, peppers), (Nutmeg, Chocolate), (Chocolate, Nutmeg), (Nutmeg, Cinnamon), (Cinnamon, Sugar), (Sugar, Chocolate), (Pepper, Onion), (Onion, pepper), (Pepper, Cheese), (Cheese, Onion), (Chocolate, Chocolate), (Sugar, Sugar), (Cinnamon, Cinnamon), (Nutmeg, Nutmeg), (Onion, Onion), (Cheese, Cheese), (Peppers, Peppers).

(c)



(d) There are 2 equivalence classes in that closure.

2)

a) Yes, the set of binary strings representing odd number is closed under concatenation

e.g Let $w = \{1, 11, 101, 1011, 1101\}$

concatenation of two string will always ~~its~~ result in another binary number.

So, $5 = 101$ $13 = 1101$

Concatenating $= 1011101 \rightarrow$ which is 93.

(b) $L = \{w \in \{\alpha, B\}^*$ starts and ends with $B\}$

Yes, It is closed under reverse Concatenation.

Suppose $w_1 = \{B\alpha B\}$, $w_2^R = \{B\alpha B\}$

$w_1 w^R = \{B\alpha B B\alpha B\}$

3)

3a) False, if you have $L_1 = \{a\}^*$, $L_2 = \{b\}^*$

$L_1 - L_2 = \{\varepsilon\}$

Epsilon in $L_1 - L_2$ is finite set but L_1 and L_2 are not.

3b False, Counterexample.

Let $L_1 = \{a\}, L_2 = \{b\}, L_3 = \{c\}$

So, $(L_1 L_2 L_3)^* = (abc)^*$

and $L_1^* L_2^* L_3^* = a^* b^* c^*$ -> which are not equal.

3c True, $L\emptyset = \emptyset$ and we know

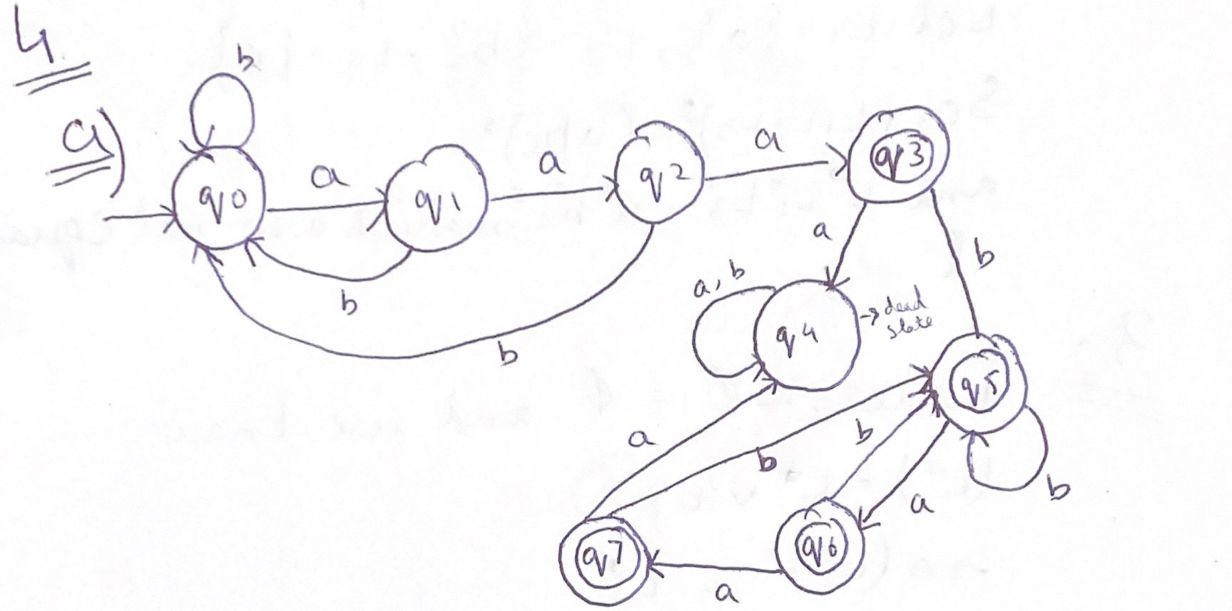
$(L^*) = L^+ \cup \{\varepsilon\}$

so $(L^*)^+ = L^*$

and $(L \cup L\emptyset)^* = L^*$. -> so it is true for L.

4

a)



Quintuple relationship:

$K = \{q_0, q_1, q_2, q_3, q_4, q_5, q_6, q_7\}$ | $S = q_0$

$\Sigma = \{a, b\}$ | $A = q_3, q_5, q_6, q_7$

$\delta = \{(q_0, a) = q_1, (q_0, b) = q_0, (q_1, a) = q_2, (q_1, b) = q_0,$

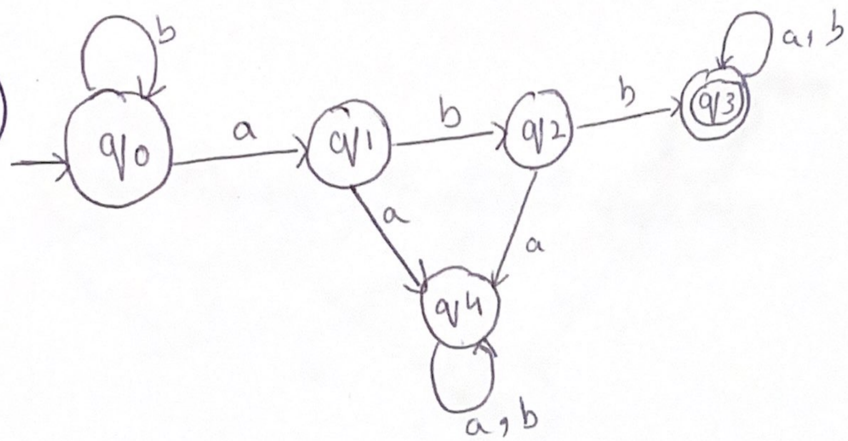
$(q_2, a) = q_3, (q_2, b) = q_0, (q_3, a) = q_4, (q_3, b) = q_5,$

$(q_4, a) = q_4, (q_4, b) = q_4, (q_5, a) = q_6, (q_5, b) = q_5$

$(q_6, a) = q_7, (q_6, b) = q_5, (q_7, a) = q_4, (q_7, b) = q_5$

4

b)



$K = q_0, q_1, q_2, q_3, q_4$

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

$\delta = \{(q_0, a) = q_1, (q_0, b) = q_0, (q_1, a) = q_4, (q_1, b) = q_2,$
$(q_2, a) = q_4, (q_2, b) = q_3, (q_3, a) = q_3, (q_3, b) = q_3,$
$(q_4, a) = q_4, (q_4, b) = q_4.\}$

$S = q_0$

$A = q_3$

5

Initial class {[5] [1, 2, 3, 4, 6, 7, 8]}

Step 1.

Let [5] = A and [1, 2, 3, 4, 6, 7, 8) = B

~~((1, a), B)~~
~~((1, B), B)~~
~~(2, a), [5]~~

Splitting

((1, a), [1, 2, 3, 4, 6, 7, 8]) ((2, a), [5])
(1, b), [1, 2, 3, 4, 6, 7, 8]) ((2, b), [1, 2, 3, 4, 6, 7, 8])
((3, a), [1, 2, 3, 4, 6, 7, 8)) ((4, a), [1, 2, 3, 4, 6, 7, 8])
((3, b), [1, 2, 3, 4, 6, 7, 8]) ((4, b), [5]))
(6, a), [5])
(6, b), [1, 2, 3, 4, 6, 7, 8] ((7, a), [1, 2, 3, 4, 6, 7, 8])
((7, b), [1, 2, 3, 4, 6, 7, 8]))
((8, a), [5])
((8, b), [1, 2, 3, 4, 6, 7, 8]

Classes : [5] [1, 3, 7] [2, 6, 8] [4]

Step 2

splitting

((1, a), [2, 6, 8]) ((3, a), [2, 6, 8] ((7, a), [2, 6, 8]
((1, b), [1, 3, 7]) ((3, b), [1, 3, 7] ((7, b), [1, 3, 7]
((2, a), [5]) (6, a), [5] (8, a), [5]
((2, b), [4]) (6, b), [1, 3, 7] (8, b), [1, 3, 7]

Classes = [5] [1, 3, 7] [2] [6, 8] [4]

Step 3

[1,3,7] ,[6,8) -> checking them

((1,a),[2]) ((3,a),[6,8]))

((1,b),[1,3,7]) ((3,b),[1,3,7]) -> splitting

(7,a),[6,8]

(7,b),[1,3,7]

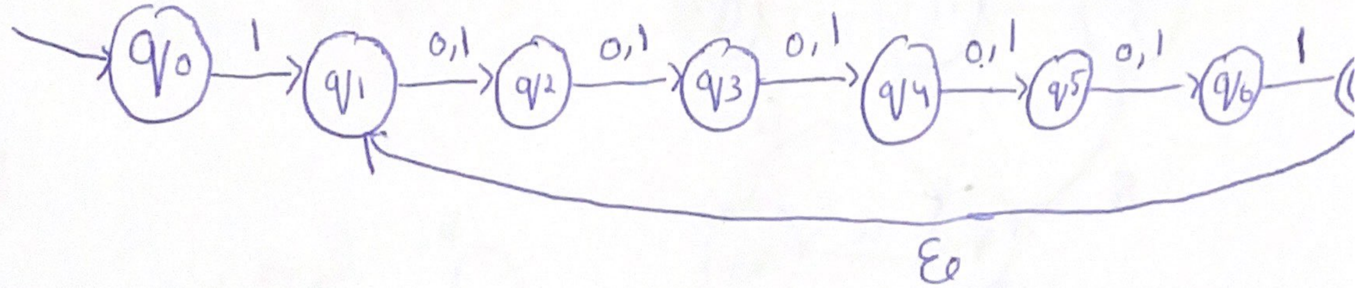
(6,a),[5] (8,a),[5]

(6,b),[1,3,7] (8,b),[1,3,7}

Classes: [5] [1] [3,7] [2] [6,8] [4]

No Further splitting required this is the minimal states for this machine.

Q6(a)



$K = \{q_0, q_1, q_2, q_3, q_4, q_5, q_6, q_7\}$

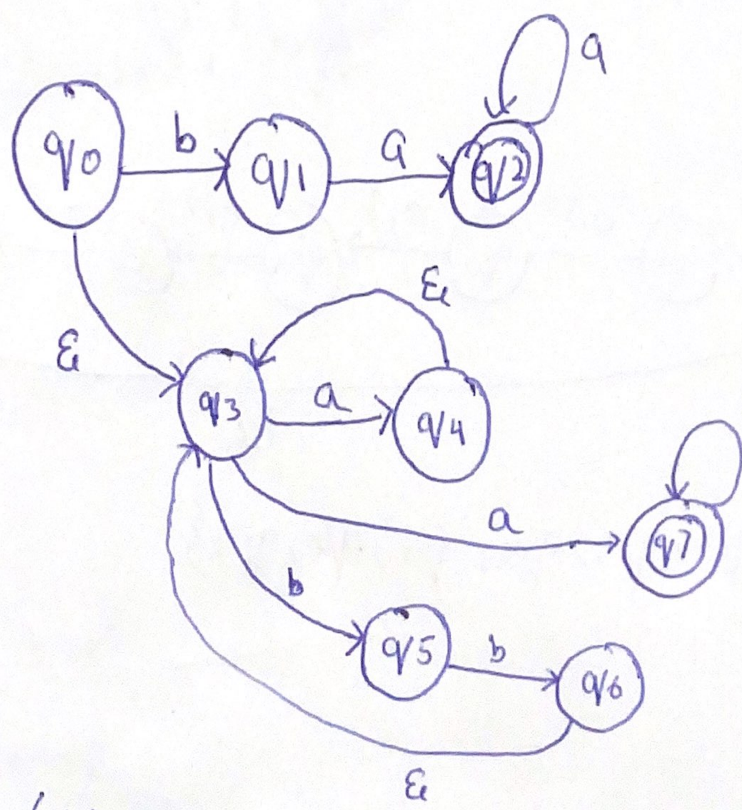
$\Sigma = \{0, 1\}$

$S = q_0$

$A = q_7$

$\Delta = \{(q_0,1) = q_1,\ (q_1,0) = q_2,\ (q_1,1) = q_2,$
$(q_2,0) = q_3,\ (q_2,1) = q_3,\ (q_3,0) = q_4,$
$(q_3,1) = q_4,\ (q_4,0) = q_5,\ (q_4,1) = q_5,$
$(q_5,0) = q_6,\ (q_5,1) = q_6,\ (q_6,1) = q_7$
$(q_7,\varepsilon) = q_1\}.$

6 b)



$M = (K, \Sigma, \Delta, s, F)$

$K = \{q_0, q_1, q_2, q_3, q_4, q_5, q_6, q_7\}$

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

$s = q_0$

$F = \{q_2, q_7\}$

$$\Delta = \{ (q_0, b) = q_1, (q_0, \varepsilon) = q_3, (q_1, a) = q_2,$$
$$(q_2, a) = q_2, (q_3, a) = q_4, q_7, (q_3, b) = q_5,$$
$$(q_4, \varepsilon) = q_3, (q_5, b) = q_6, (q_6, \varepsilon) = q_3$$
$$(q_7, b) = q_7 \}.$$

7)

1. Compute eps(q) for each state

$eps(1) = \{1,2,3\}$

$eps(2) = \{2,3,1\}$

$eps(3) = \{3,1,2\}$

$eps(4) = \{4,3,1,2\}$

$eps(5) = \{5\}$

$eps(6) = \{6\}$

2. Start state $s' = eps = eps(1) = \{1,2,3\}$

3. δ' $eps(\{1,2,3\},a) = eps\{1,4,5\}$

$eps(1) \cup eps(4)\ eps\{5\} = \{1,2,3,4,5\}$

$eps(\{1,2,3\},b) = eps\{3,6\} = \{1,2,3,6\}$

Active states $= \{1,2,3,4,5\}\ \{1,2,3,6\}$

$eps(\{1,2,3,4,5\},a) = \{1,2,3,4,5\}$

$eps(\{1,2,3,4,5\},b) = eps\{3,5,6\} = eps\{3\} \cup eps\{5\} \cup eps\{6\}$

$= eps\{1,2,3,5,6\}$

Active states $= \{1,2,3\}\ \{1,2,3,4,5\}\ \{1,2,3,6\}\ \{1,2,3,5,6\}$

$eps(\{1,2,3,6\},a) = \{\cancel{1,2,3}, eps\{3,5\} = eps\{3\} \cup eps\{5\}$

$= \{1,2,3,5\}$

eps({1,2,3,6},b) = eps{1,3} = {1,2,3}

Active states

{1,2,3} {1,2,3,4,5} {1,2,3,6} {1,2,3,5,6}

{1,2,3,5}

eps({1,2,3,5,6},a) = eps{1,4,5} = eps{1} ∪ eps{4} ∪ eps{5}

= {1,2,3,4,5}

eps({1,2,3,5,6},b) = eps{1,3,5,6} = eps{1} ∪ eps{3} ∪ eps{5} ∪ eps{6}

= {1,2,3,5,6}

Active state

{1,2,3} {1,2,3,4,5} {1,2,3,6} {1,2,3,5,6}

{1,2,3,5}

eps({1,2,3,5},a) = ~~{1,2,3~~, {1,3,4,5}

= eps{1} ∪ eps{3} ∪ eps{4} ∪ eps{5}

= {1,2,3,4,5}

eps({1,2,3,5},b) = eps(3,6) = eps{3} ∪ eps{6}

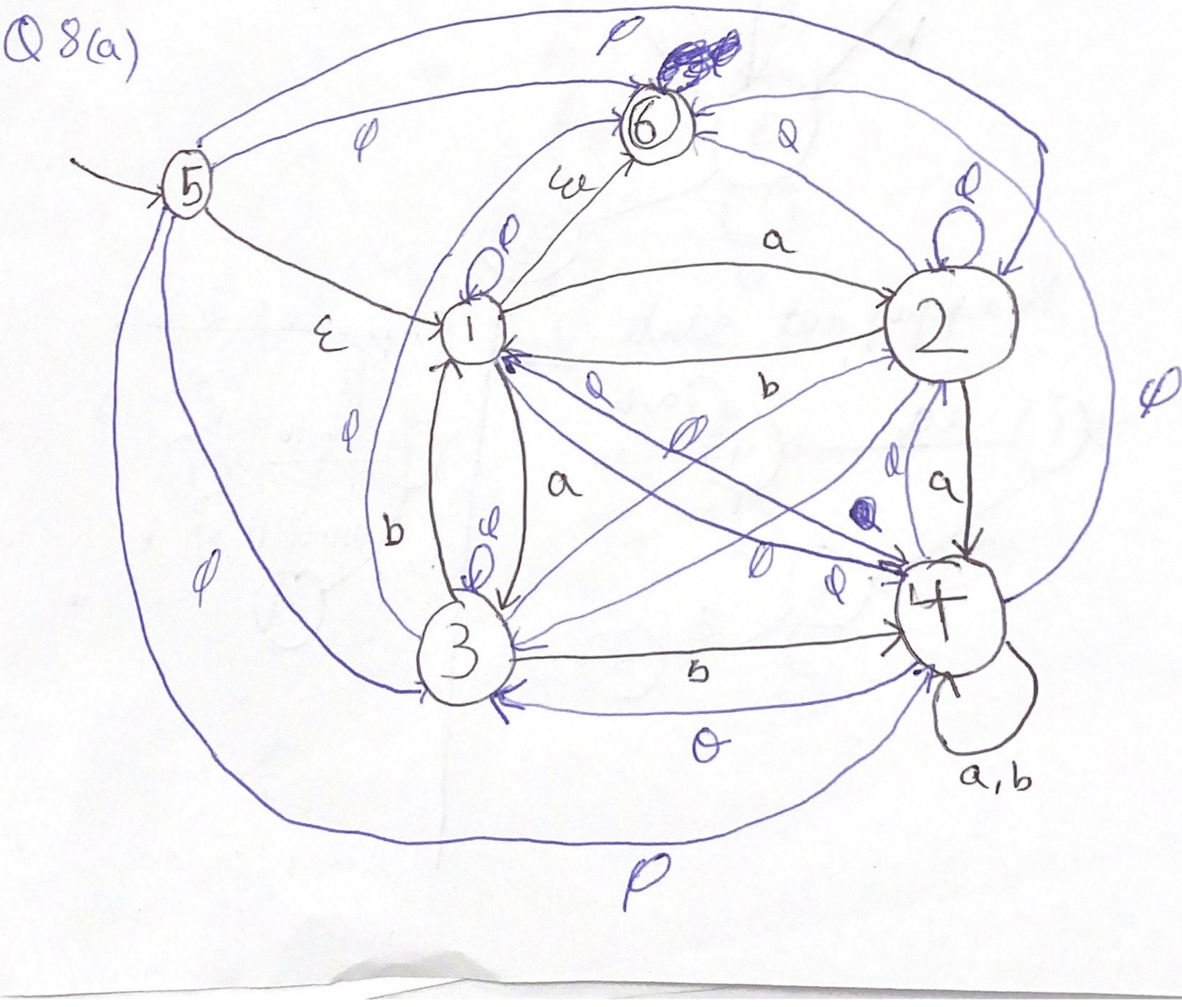
= {1,2,3,6}

No more active states

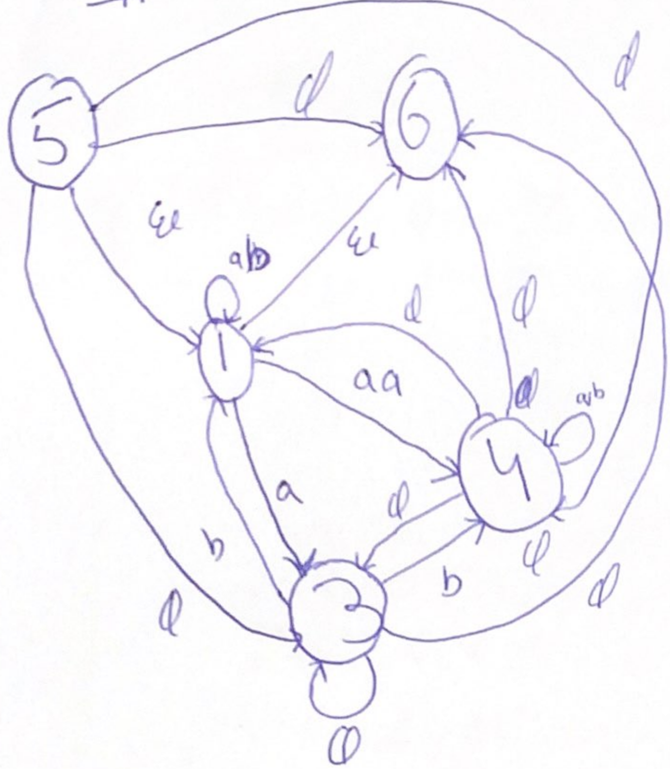
4. Q' = {1,2,3} {1,2,3,4,5} {1,2,3,6} {1,2,3,5,6} {1,2,3,5}

5. A' = {1,2,3,4,5} {1,2,3,5,6} {1,2,3,5}

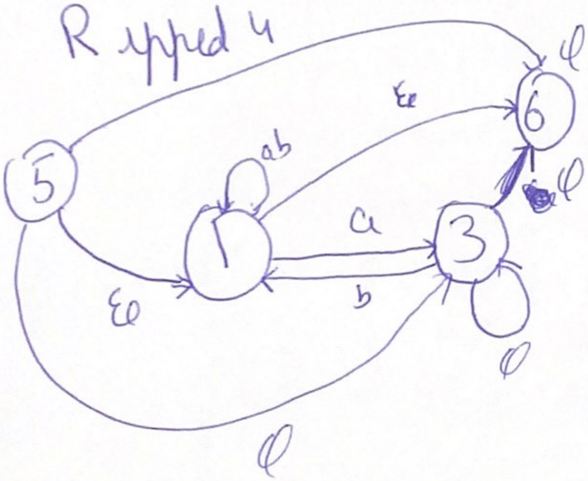
Q 8(a)



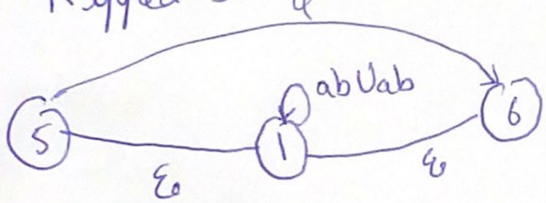
Ripped 2



Ripped 4



Ripped 3



Ripping 2

$(1,4) = \phi \cup a\phi^* a = aa$

$(1,1) = \phi \cup a\phi^* b = ab$

$(1,3) = a \cup a\phi^*\phi = a$

$(1,6) = \varepsilon \cup a\phi^*\phi = \varepsilon$

$(3,1) = b \cup \phi\phi^* a = b$

$(3,3) = \phi \cup \phi\phi^*\phi = \phi$

$(3,4) = b \cup \phi\phi^* a = b$

$(3,6) = \phi \cup \phi\phi^*\phi = \phi$

$(4,1) = \phi \cup \phi\phi^* b = \phi.$

$(4,3) = \phi \cup \phi\phi^*\phi = \phi$

$(4,4) = a^*b^* \cup \phi\phi^* a = a^*b^*$

$(4,6) = \phi \cup \phi\phi^*\phi = \phi$

$(5,1) = \varepsilon \cup \phi\phi^* b = \varepsilon$

$(5,3) = \phi \cup \phi\phi^*\phi = \phi$

$(5,4) = \phi \cup \phi\phi^* a = \phi$

$(5,6) = \phi \cup \phi\phi^*\phi^* = \phi$

Ripping 4

$(1,1) = ab \cup aaa^*b^*\phi = ab$

$(1,3) = a \cup aaa^*b^*\phi = a.$

$(1,6) = \varepsilon \cup aaa^*b^*\phi = \varepsilon$

$(3,1) = b \cup ba^*b^*\phi = b$

$(3,3) = \phi \cup ba^*b^*\phi = \phi$

$(3,6) = \phi \cup ba^*b^*\phi = \phi.$

$(5,1) = \varepsilon \cup \phi a^*b^*\phi = \varepsilon$

$(5,3) = \phi \cup \phi a^*b^*\phi = \phi$

$(5,6) = \phi \cup \phi a^*b^*\phi = \phi$

Ripping 3

$\cancel{(1,1) = ab \cup a\phi^*\phi = ab}$

$(1,1) = ab \cup a\phi^* b = ab \cup ab$

$(1,6) = \varepsilon \cup a\phi^*\phi = \varepsilon$

$(5,1) = \cancel{\phi \cup}\ \varepsilon \cup \phi\phi^* b = \varepsilon$

$(5,6) = \phi \cup \phi\phi^*\phi = \phi.$

Ripping 1

$(5,6) = \phi \cup = \varepsilon (ab \cup ab)^* \varepsilon$

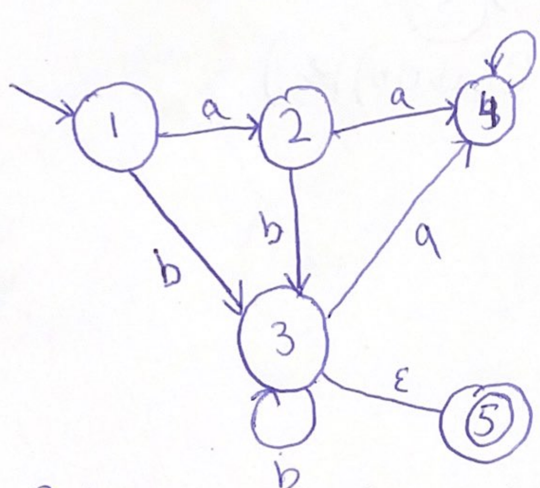
$= (ab \cup ab)^*$

8 b

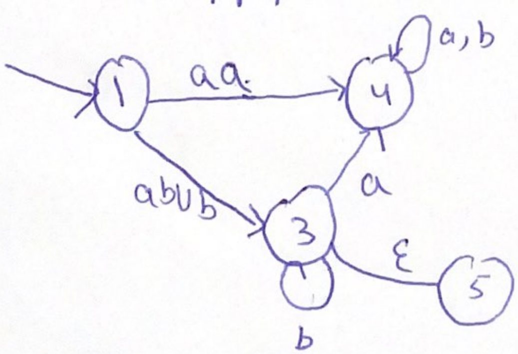
~~FSMtoregixH~~

fsmtoregix heuristic:

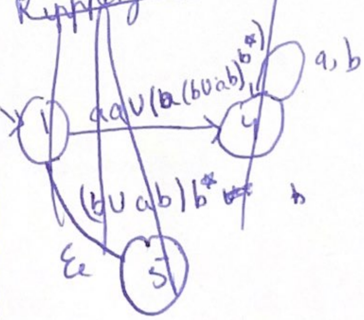
1. There is a transition out of Accepting state so creating a new accepting state 5.



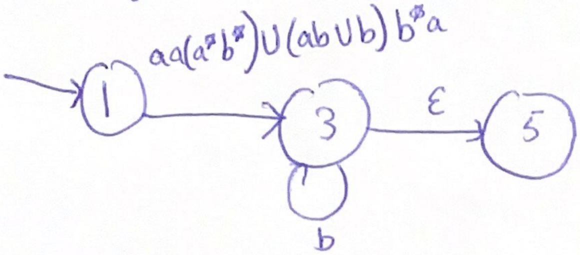
Ripping out state 2



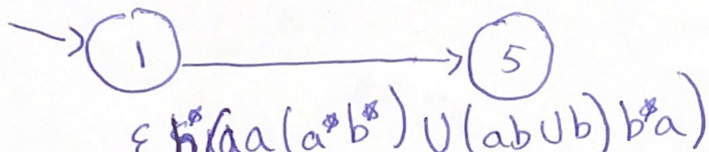
~~Ripping out state 3~~



Ripping out 4



Ripping out 3.



9
(a)
(i) $\rightarrow$ ε (empty ~~s~~string) cannot be generated because there is no rule in grammer $S \rightarrow \varepsilon$ to generate empty string.

(ii) yyy

This string canbe generated by grammer rule.

$S \rightarrow y\cancel{U}$
$y\cancel{y}U$
yyy

(iii) yyyz

This ~~s~~string cannot be generated. cannot generate a single z after y.

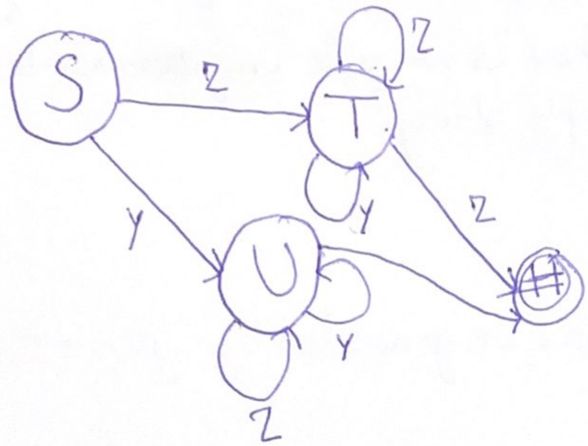
(iv) zyzz

This string canbe generated

$S \rightarrow z\bar{X}$
$zy\bar{X}$
$zyy\bar{X}$
$zyyz\bar{X}$
$zyyzz$.

FS

9b) Grammer to FSM



9c) In Plain English.

if the string is starting with alphabet 'y' then it also finish with 'y'.
and if the string is starting with alphabet 'z' it should end with 'z' as well.

10.

a) We can reduce them to smaller set classes ~~using equ~~

Rude: "Talk to hand", "Thumbs down"

Success: 'fist pump', 'high five', 'Toss coin', 'Victory sign'

Weakness: 'Face palm', 'hand, Kissing'

friendly: 'hand-heart', 'highfive', 'Victory sign'

$\Sigma = \{$Rude, Success, Weakness, friendly$\}$

$\Sigma = \{R, S, W, f\}$

b)

1. Neutral
2. Attack
3. opportunistic
4. forgive