Ayden Khairis – C3282229

ASSIGNMENT/ASSESSMENT ITEM COVER SHEET

Student Name: Ayden (FIRST NAME) Khairis (FAMILY / LAST NAME)

Student Number: 3 2 8 2 2 2 9 Email: Khairis

Course Code	Course Title
COMP2270	Theory of Computation
(Example) ABCD1234	*(Example)* Intro to University

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

Assessment Item Title: Assignment 1 Due Date/Time: 27/03/20

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

Lecturer/Tutor Name: Nasimul Noman

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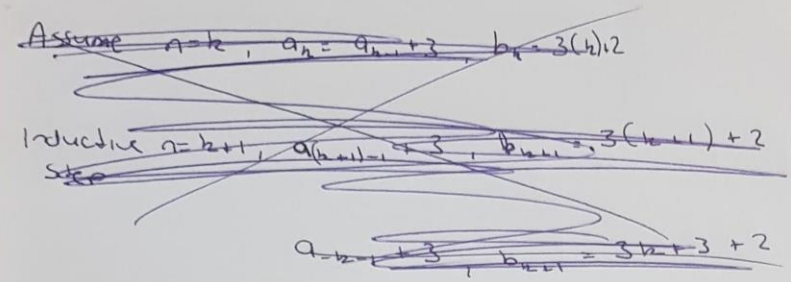
$a_0 = 2,\ a_n = a_{n-1} + 3,\ b_n = 3n + 2$

Base Case: $n = 1$, $a_1 = a_{1-1} + 3 = 5 \quad \therefore a_1 = b_1$

$b_1 = 3(1) + 2 = 5$



Assume, assume that for some arbitary value of n that $b_n = a_{n-1} + 3$, $a_n = 3n + 2$

Induction Step, we want to show that $b_{(n+1)} = a_{(n+1)-1} + 3$

$a_{(n+1)} = 3(n+1) + 2$

$b_{(n+1)} = 3(n+1) + 2$

$= 3n + 3 + 2$

$= (a_n) + 3$

$= a_n + 3$

$a_{(n+1)} = a_{(n+1)-1} + 3$

$= a_n + 3$

Conclusion: therefore $\{a_n = b_n\}$ iff $a_n = b_n,\ n \in \mathbb{N}_0$

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2A) No, because if 2 odd length strings are concatenated, they will be even in length. The closure is all non-empty strings drawn from the alphabet given

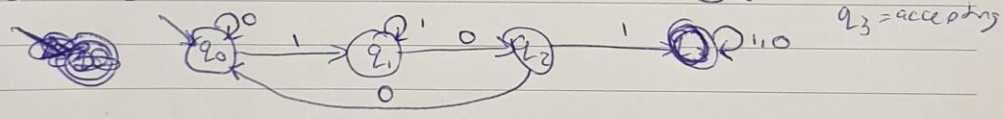
B) Yes, it is closed. It doesn't matter if ϵ doesn't end in β because it is no strings. Every string ending in β will be closed by Kleene Star

4A) False. If you have $L_1 = \{a\}$, $L_2 = \{a\}^*$, then $L_1L_2 = L_2L_1$ and $L_1 \neq L_2$.
Eg: $L_1L_2 = \{\epsilon, a, aa, \ldots\}$, $L_2L_1 = \{\epsilon, a, aa, \ldots\}$

B) False. If you have $L_1 = \{a\}$, $L_2 = \{a\}^+$, then $L_1^+ = L_2^+ = \{a\}^+ \neq \{a\}$. Therefore, false.

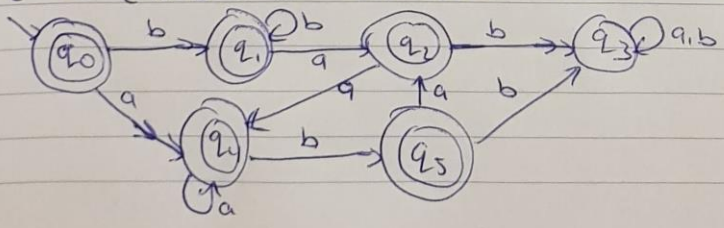
C) False.
$L_1 = \{a\}^*$, $L_2 = \{b\}^*$, $L_1 - L_2 = \{\epsilon\}$
Epsilon in $L_1 - L_2$ is finite but the languages L_1 and L_2 are not. Therefore, false.

5A) $\{w \in \{0,1\}^* : w$ has 101 as substring$\}$



$K = \{q_0, q_1, q_2, q_3\}$ $S = q_0$
$\Sigma = \{0, 1\}$ $A = q_3$
$\delta = \{(q_0,0) = q_0, (q_0,1) = q_1, (q_1,0) = q_2, (q_1,1) = q_1,$
$(q_2,0) = q_0, (q_2,1) = q_3, (q_3,0) = q_3, (q_3,1) = q_3$

B) $\{w \in \{a,b\}^* : w$ has neither bab or abb as substrings$\}$



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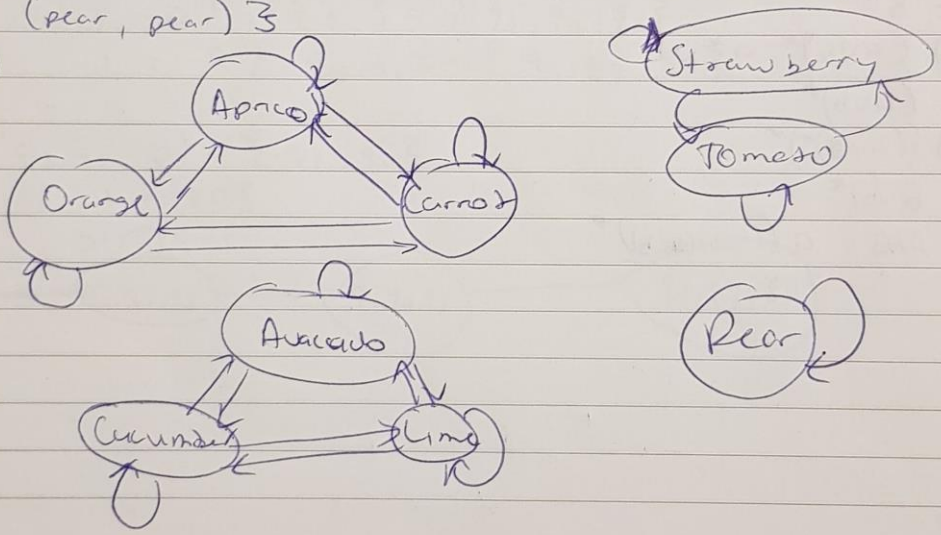
3) Same colour = { (apricot, orange), (avocado, lime), (lime, cucumber), (strawberry, tomato), (carrot, orange) }

a) Lacks all properties, e.g. it isn't reflexive, symmetric or transitive

b) { (apricot, orange), (avocado, lime), (lime, cucumber), (strawberry, tomato), (carrot, orange), (apricot, apricot), (orange, orange), (lime, lime), (cucumber, cucumber), (strawberry, strawberry), (tomato, tomato), (carrot, carrot), (orange, orange), (orange, apricot), (lime, avocado), (cucumber, lime), (tomato, strawberry), (orange, carrot), (avocado, cucumber), (cucumber, avocado), (apricot, carrot), (carrot, apricot), (pear, pear) }

c)



d) 4

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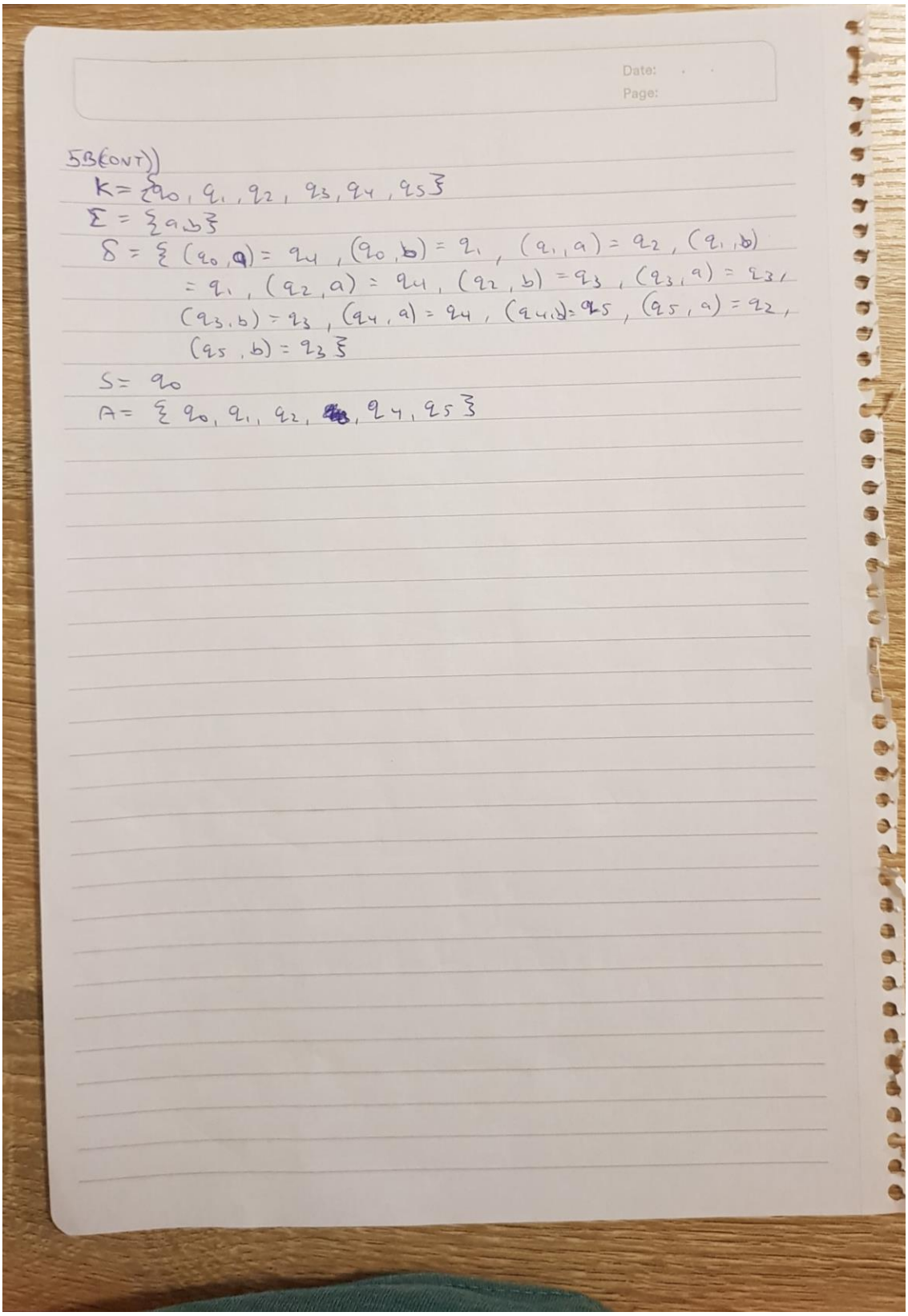

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5B(CONT))

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

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

$\delta = \{(q_0, a) = q_4, (q_0, b) = q_1, (q_1, a) = q_2, (q_1, b) = q_1, (q_2, a) = q_4, (q_2, b) = q_3, (q_3, a) = q_3, (q_3, b) = q_3, (q_4, a) = q_4, (q_4, b) = q_5, (q_5, a) = q_2, (q_5, b) = q_3\}$

$S = q_0$

$A = \{q_0, q_1, q_2, q_4, q_5\}$

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6) Initial classes = {[6,7], [1,2,3,4,5]}

Step 1:

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

~~SPLIT 6 and 7~~ DON'T SPLIT

Classes = {~~[6,7]~~ [6,7], [1,2,3,4,5]}

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

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

((5,a), [6,7] SPLIT INTO NEW CLASSES
(5,b), [1,2,3,4,5]

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

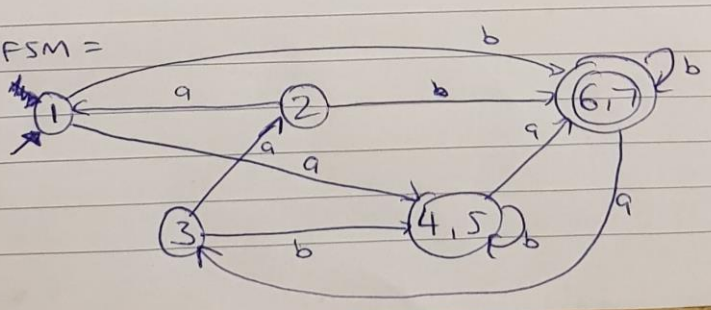
((6,a), [3]) ((7,a), [3]) DON'T SPLIT
((6,b), [6,7] ((7,b, [6,7])

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

((4,a), [6,7] ((5,a), [6,7]) DON'T SPLIT
((4,b), [4,5] ((5,b), [4,5])

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

MINDFSM =



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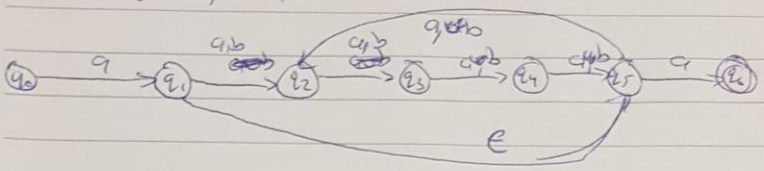
7a) $(a \cup b)^*$: two a's seperated by whose string is length is $4i$, for some $i \geq 0$

$a\,(a \cup b)^* a$



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

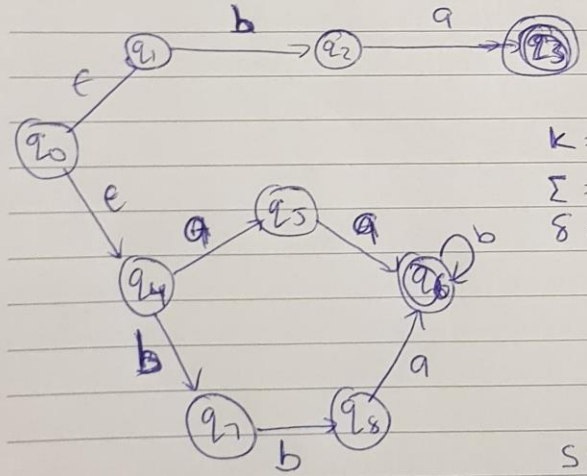
$\Sigma = \{a, b\}$

$\delta = \{(q_0, a) = q_1, (q_1, \epsilon) = q_5, (q_1, a, b) = q_2, (q_2, a, b) = q_3, (q_3, a, b) = q_4), (q_4, a, b) = \{q_5,$
$(q_5, a) = q_6\}$

$S = q_0$

$A = q_6$

7b) $L = \{w \in \{a, b\}^* ; w = (ba \cup ((a \cup bb)\, ab^*))\}$



$K = \{q_0, q_1, q_2, q_3, q_4, q_5, q_6, q_7, q_8\}$

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

$\delta = \{(q_0, \epsilon) = q_1, q_4, (q_1, b) = q_2, (q_2, a) = q_3, (q_4, a) = q_5, (q_4, b) = q_7, (q_5, a) = q_6, (q_7, b) = q_8, (q_8, a) = q_6, (q_6, b) = q_6\}$

$S = q_0$

$A = \{q_3, q_6$

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Q8)

Step 1: eps(1) = {1,2} eps(4) = {4}
eps(2) = {2} eps(5) = {4,5}
eps(3) = {3} eps(6) = {5,6}

~~Step 2: Start state = eps(1) = {1,2}~~

~~Step 3: δ' Active states: {{1,2}}. Consider {1,2}~~
~~eps({1,2}, a) = {3}~~
~~eps({1,2}, b) = {5,6}~~
~~Active states: {{1}, {2,3}, {5,6}}. Consider {3}.~~
~~eps({3}, a) =~~
~~eps({3}, b) =~~

Step 2: Start state = eps(5) = eps(1) = {1,2}
Step 3: δ' Active = {{1,2}}. Consider {1,2}
eps({1,2}, a) = {3,4}
eps({1,2}, b) = {4,5,6}
Active states: {{1,2}, {3,4}, {4,5,6}} Consider {3,4}
eps({3,4}, a) = {2}
eps({3,4}, b) = {4,5}
Active states: {{1,2}, {3,4}, {4,5,6}, {2}, {4,5}}
eps({4,5,6}, a) = {2,4,5}
eps({4,5,6}, b) = {4,5,6}
Active states = {{1,2}, {3,4}, {4,5,6}, {2}, {4,5}, {2,4,5}}
eps({2}, a) = {4}
eps({2}, b) = {}
Active states = {{1,2}, {3,4}, {4,5,6}, {2}, {4,5}, {2,4,5}, {4}}
eps({4,5}, a) = {2,4,5}
eps({4,5}, b) = {4,5,6}
Active = {{1,2}, {3,4}, {4,5,6}, {2}, {4,5}, {2,4,5}, {4}}
eps({2,4,5}, a) = {2,4,5}
eps({2,4,5}, b) = {4,5,6}
Active = Consider {4}
eps({4}, a) = {2}
eps({4}, b) = {4,5} DONE

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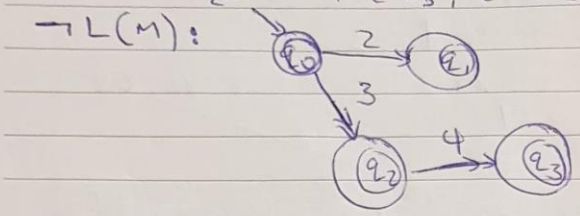
Q8(Cont)

$K' = \{\{1,2\},\{3,4\},\{4,5,6\},\{2\},\{4,5\},\{2,4,5\},\{4\},\emptyset\}$

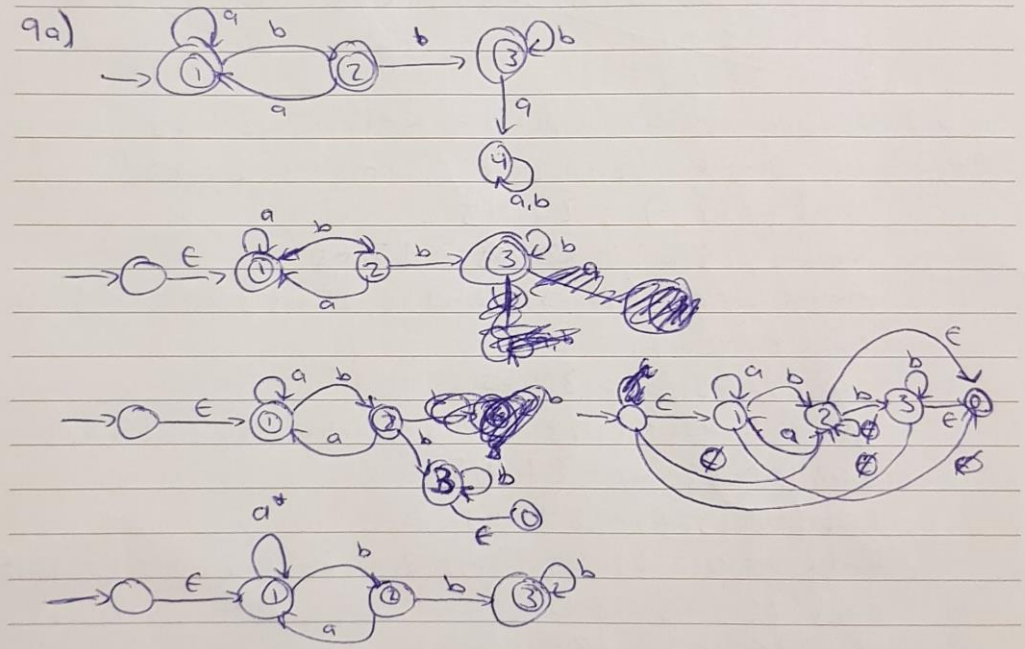
$A' = \{\{1,2\},\{4,5,6\},\{2\},\{4,5\},\{2,4,5\}\}$

$\neg L(M) = \{\{3,4\},\{2\},\{4\}\}$

$\neg L(M)$:



9a)



$a^* \quad ba \cup bb^* \quad b^*$

$a^*(a^*ba \cup bb)b^*$

$a^* \cup a^*(ba^* \cup bb^*)^*b^*$

ANS = $a^* \cup a^*(ba^* \cup bb) \cup a^*(ba^* \cup bb)b^*$

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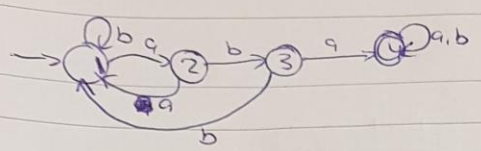
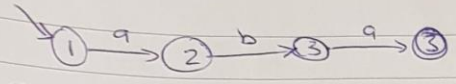
9b)



Get rid of majority of 1, 2, 3 transitions you get:



regex = aba

10a) ~~Σ =~~ { 16, 26, 36, 46, 56, 66,
15, 25, 35, 45, 55, 65,
14, 24, 34, 44, 45, 46,
13, 23, 33, 34, 35, 36,
12, 22, 23, 24, 25, 26,
11, 12, 13, 14, 15, 16

10a) Σ = { 11, 21, 31, 41, 51, 61
12, 22, 32, 42, 52, 62
13, 23, 33, 43, 53, 63
14, 24, 34, 44, 54, 64
15, 25, 35, 45, 55, 65
16, 26, 36, 46, 56 66 }

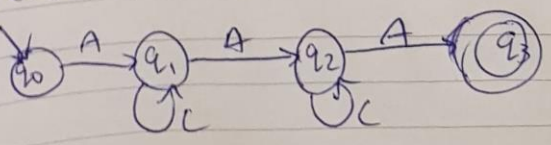
Encoding technique would be substituting winning P, winning Q and drawing PQ for letters, Eg.

A = P(w) = { 21, 31, 32, 41, 42, 43, 51, 52, 53, 54, 61, 62, 63, 64, 65 }

B = Q(w) = { 12, 13, 23, 14, 24, 34, 15, 25, 35, 45, 16, 26, 36, 46, 56 }

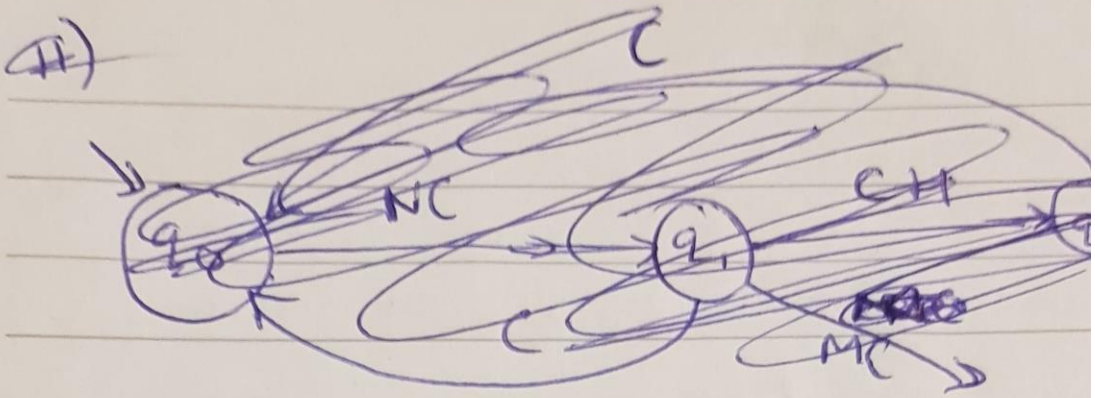
C = PQ(D) = { 11, 22, 33, 44, 55, 66 }

10b)

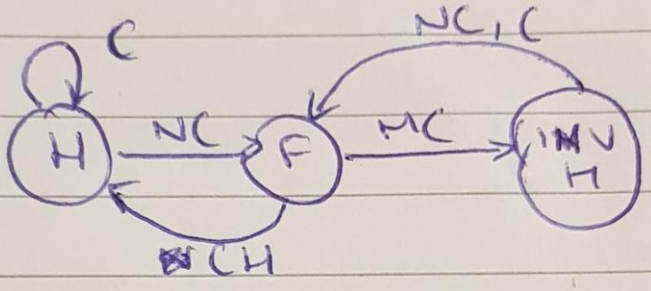


$q_1 = (1,0)$
$q_2 = (2,0)$
$q_3 = (3,0)$

II)



II)



H= in hole

F= finding cheese

INV H= invisible in hole