ASSIGNMENT/ASSESSMENT ITEM COVER SHEET

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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: assignment 1   Due Date/Time: 28/03/21

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

Lecturer/Tutor Name: Nasimul

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THE UNIVERSITY OF NEWCASTLE AUSTRALIA

c3349828

Comp2270 Assignment 1

1, if n is a positive integer then n^3+3n^2+2n is divisible by 6

let $n=1$

$(1)^3+3(1)^2+2(1)=6$

$\therefore$ 6 is divisible by 6 ✓ true

assume true for $n=k$

k^3+3k^2+2k

proof for $n=k+1$

$(k+1)^3+3(k+1)^2+2(k+1)$

$(k+1)\times((k+1)^2+3(k+1)+2)$

$(k+1)\times(k^2+2k+1+3k+3+2)$

$(k+1)\times(k^2+5k+6)$

$(k+1)\times(k(k+3)+2(k+3))$

$(k+1)\times(k+2)\times(k+3)$

The above is three consecutive numbers, so we know that one of the numbers must be divisible by 2 and another; or the same, must be divisible by 3. Thus multiplying a multiple of 2 and 3 gives us a multiple of 6, which will be divisible by 6.

For example, $7\times8\times9$, 8 is divisible by 2 and 9 is divisible by 3. The result is 504 and $504 \% 6=0$.

2,

a) Closed, because concatenating two even numbers will always result in an even number

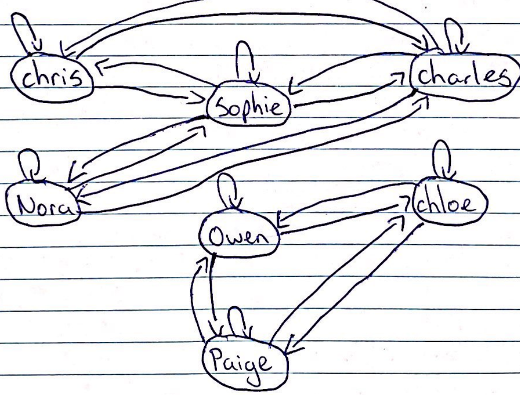
b) Closed, a palindrome reversed is the same as the original and concatenating a palindrome with a palindrome is essentially reflecting the same word where they join so it will always remain a palindrome

3,

a) - It lacks reflexivity
- It lacks symmetry
- It lacks transitivity

b) {(chris, chris), (Sophie, sophie), (charles, charles), (Nora, Nora), (Owen, Owen), (Chloe, chloe), (Paige, Paige), (charles, sophie), (chloe, Owen), (Sophie, chris), (Nora, charles), (Paige, chloe), (Sophie, Nora), (owen, paige), (chris, charles), (charles, chris), (Nora, sophie), (Paige, owen)

c)



d) 2 equivalence classes here.

4,

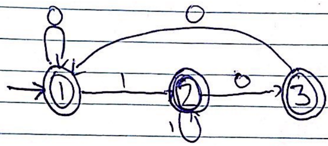
a) False, L_2 may have an infinite number of strings that are not included in L, via a different alphabet.

b) False, you can get "aaba" in $((L_1^* \cup L_2^*)^*)$ but not in $(L_1^* \cup L_2^*)$ if $L_1 = \{a\}$ and $L_2 = \{b\}$

c)

5,

a)



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

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

$\delta =$

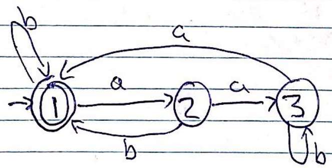
K \ Σ	0	1
1	1	2
2	3	1
3	1	—

transitions

$S = 1$

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

b)



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

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

$\delta =$

	a	b
1	2	1
2	3	1
3	1	3

transitions

$S = 1$

$A = 1$

6.

Initially, classes = {[3,5], [1,2,4,6]}

At step 1:

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

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

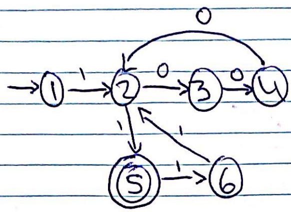
These split into 3 groups [1,4], [2], [6]
So, the classes are: {[3,5], [1,4], [2], [6]}

At step 2 we must consider [1,4]:

((1,a), [2]) ((4,a), [2])
((1,b), [3]) ((4,b), [3])

No further splitting required. The minimal machine has states {[3,5], [1,4], [2], [6]} Q 7,

a)



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

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

$\Delta =$

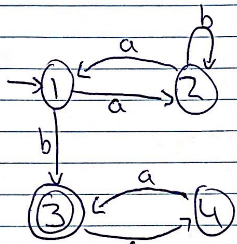
	0	1
1	-	2
2	3	5
3	4	-
4	2	-
5	-	6
6	-	2

transitions

$S = 1$

$A = 5$

b)



$K = \{1, 2, 3, 4\}$

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

$\Delta =$

	a	b
1	2	3
2	1	2
3	4	-
4	3	-

transitions

$S = 1$

$A = 3$

8.

1. compute eps(q) for each state q

$eps(1) = \{1\}$

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

$eps(3) = \{3\}$

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

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

2. start state $s' = eps(s) = eps(1) = \{1\}$

3. Active states: $\{\{1\}\}$ consider $\{1\}$

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

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

Active states: $\{\{1\}, \{1,5\}, \{2,3,4\}\}$ consider $\{1,5\}$

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

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

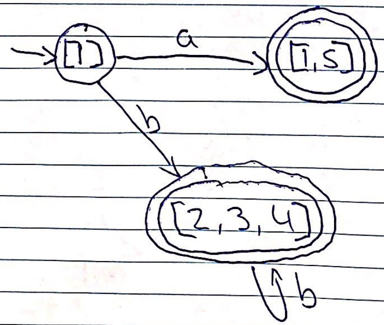
Active states: $\{\{1\}, \{1,5\}, \{2,3,4\}\}$ consider $\{2,3,4\}$

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

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

$K' = (\{1\}, \{1,5\}, \{2,3,4\})$

$A' = \{\{1,5\}, \{2,3,4\}\}$



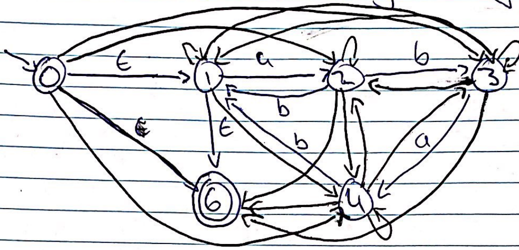
9,

a)

Note: All Black pen represents ϕ transitions

Step 1, - create new start state & accepting state and get rid of redundant (5)

- add ϕ to every necessary transition



Rip 3, $R' = R(p,q) \cup R(p,rip), R(rip,rip)^*, R(rip,q)$

$R'(2,4) = R(2,4) \cup R(2,3), R(3,3)^*, R(3,4)$

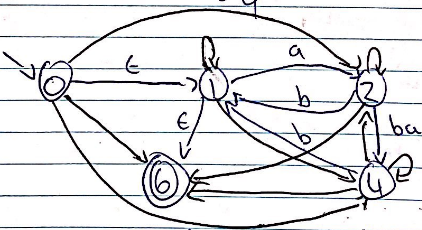
$= \phi \cup b\,\phi^* a$

$= ba$

$R'(4,2) = R(4,2) \cup R(4,3), R(3,3)^*, R(3,2)$

$= \phi \cup \phi\,\phi\,\phi$

$= \phi$



Rip 4, $R'(2,6) = R(2,6) \cup R(2,4) R(4,4)^* R(4,6)$

$= \phi \cup ba\,\phi^* \phi$

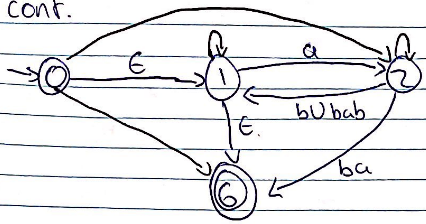
$= ba$

$R'(2,1) = R(2,1) \cup R(2,4) R(4,4) R(4,1)$

$= b \cup ba\,\phi\, b$

$= b \cup bab$

9a) cont.



Rip 2, $R(1,6) = R(1,6) \cup R(1,2)\, R(2,2),\, R(2,6)$

$= \epsilon \cup a\, \phi\, ba$

$= aba$

$R(0,1) = R(0,1) \cup R(0,2)\, R(2,2) \cdot R(2,1)$

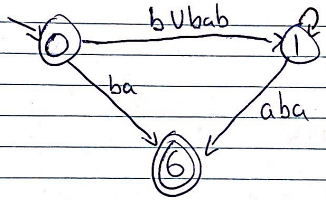
$= \epsilon \cup \phi \phi\, b \cup bab$

$= b \cup bab$

$R(0,6) = R(0,6) \cup R(0,2)\, R(2,2)\, R(2,6)$

$= \phi \cup \phi\, \phi\, ba$

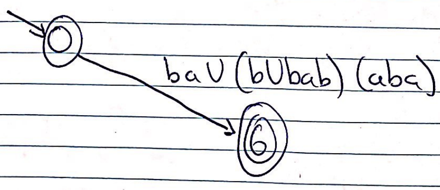
$= ba$



Rip 1, $R(0,6) = R(0,6) \cup R(0,1)\, R(1,1)^{*}\, R(1,6)$

$= ba \cup (b \cup bab)\, \phi^{*}\, (aba)$

$= ba \cup (b \cup bab)(aba)$



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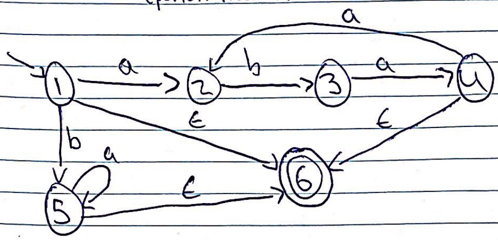
/ /

9,

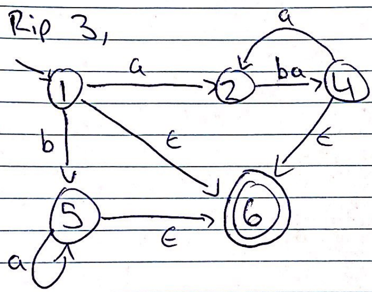
b)

Initialise diagram

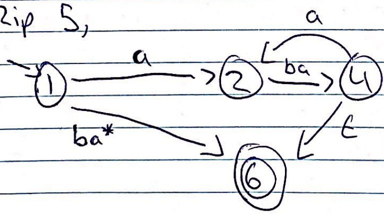
-add another final state instead of others with epsilon transition



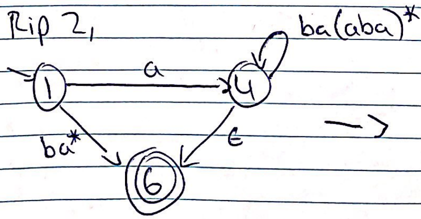
Rip 3,



Rip 5,

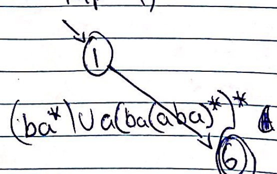


Rip 2,



$\longrightarrow$

Rip 4,



$(ba^*) \cup a(ba(aba)^*)^*$

10,

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

no, it does not correctly describe L because if you wanted to have abbbbaaa it is not possible as you cannot have more than 1 a's after the b's

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

Yes, it does correctly describe L because $(a^* b^* \cup b^* a^*)^*$ essentially means you can have any possible combination of any a or b's and it must end in a to satisfy condition it works.

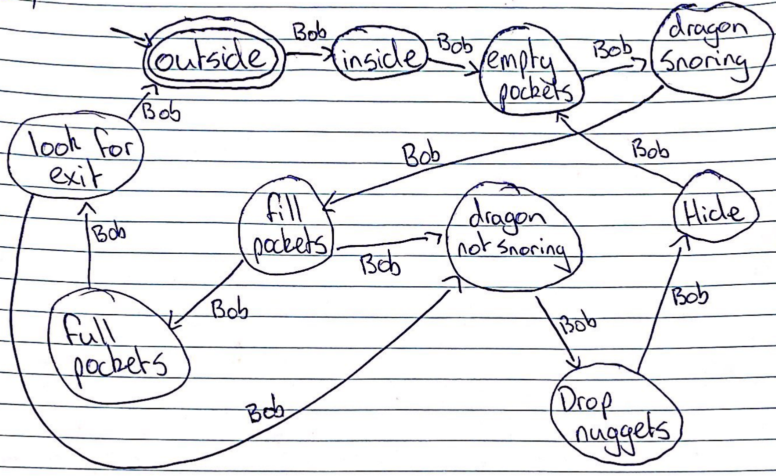
c) $(b^* a^* b^*)^* a \rightarrow (a^* b^*)^* a$

Yes, it does correctly describe L but the extra b^* is redundant and $(a^* b^*)^* a$ is a better representation the $(a^* b^*)^*$ essentialy means any combination of a's or/and b's and it must be followed by an a in a.

d) $(b^* a)^* b^* a^*$

No, it does not correctly describe L because the "a^*" at the end indicates that the string can end in a b which is not meant to happen.

11,



K = {outside, inside, empty pockets, dragon snoring, fill pockets, dragon not snoring, drop nuggets, Hide, full pockets, look for exit}

Σ = {Bob}

Δ = transitions

	Bob
- outside	inside
- inside	empty pockets
- empty pockets	dragon snoring
- dragon snoring	fill pockets
- fill pockets	full pockets, dragon not snoring
- dragon not snoring	drop nuggets
- drop nuggets	Hide
- Hide	empty pockets
- full pockets	look for exit
- look for exit	outside, dragon not snoring

S = outside

A = outside.