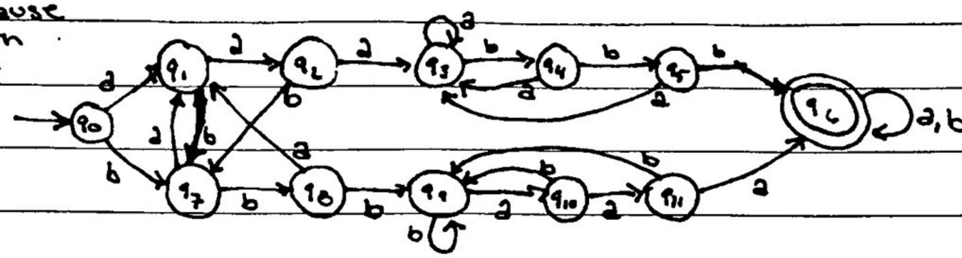
Julia Nelson Problem Set 1. solo work

"I pledge my honor that I have abided by the Stevens Honor System."

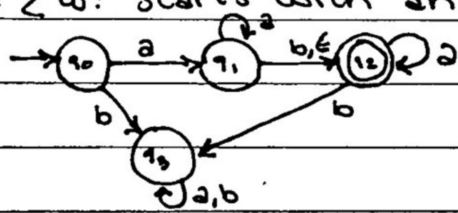
Problem 1:

1. $L_1 = \{w : w \text{ contains string } aaa \text{ and string } bbb\}$

This is correct because it accepts any length string whether aaa comes before or after bbb. Each state has transition for each symbol.

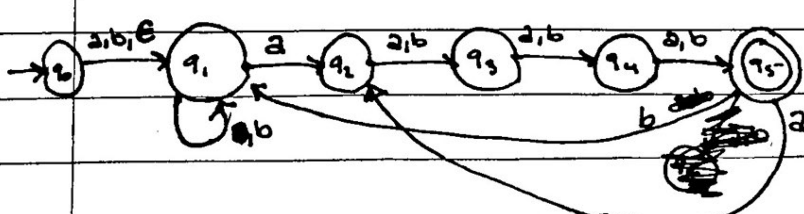


2. $L_2 = \{w : \text{starts with an } a \text{ and has at most 1 } b\}$



This is correct because it can only accept when input starts with a. If 1st input is b it goes to a dead state. It also only allows 1 b in the string ~~as~~ none and any more goes to dead state. ~~ε also allows no b's~~

3. $L_3 = \{w : 4^{th} \text{ from end is } a\}$



This is correct because it accounts for every symbol/transition. The string can start with any symbol (or if only 4 ~~sy~~ symbol input, uses ε to transition) If more symbols appear after entering accept state, b goes back to q_1 to try again and a goes to q_2 potentiall the 4^{th} to last symbol.

Problem 2: Pledge Jnelson

$M_1 = (Q_1, \Sigma_1, \delta_1, q_1, F_1)$
$M_2 = (Q_2, \Sigma_2, \delta_2, q_2, F_2)$

I believe to modify this proof's transitions and Σ must be changed.

Let M_1 recognize alphabet Σ_1
and M_2 recognize alphabet Σ_2

Let M recognize $\Sigma = \Sigma_1 \cup \Sigma_2$

$M = (Q, \Sigma, \delta, q_0, F)$

$Q = \{(r_1, r_2) | r_1 \in Q_1 \text{ and } r_2 \in Q_2\}$

$\Sigma = \Sigma_1 \cup \Sigma_2$

$\delta = Q \times \Sigma \longrightarrow Q$

For $(r_1, r_2) \in Q$ and $a \in \Sigma_1 \cup \Sigma_2 \rightarrow$ $\delta((r_1, r_2), a) = (\delta_1(r_1, a), \delta_2(r_2, a))$

if $a \in \Sigma_1$ but $a \notin \Sigma_2$
$\delta((r_1, r_2), a) = (\delta_1(r_1, a), r_2)$

if $a \in \Sigma_2$ but $a \notin \Sigma_1$
$\delta((r_1, r_2), a) = (r_1, \delta_2(r_2, a))$

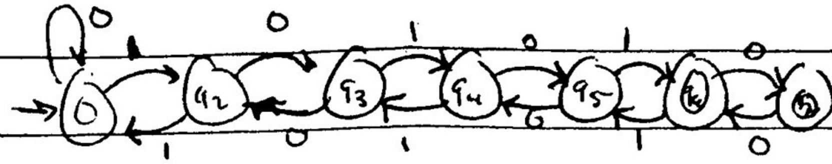
$q_0 = (q_1, q_2)$

$F = \{(r_1, r_2) | r_1 \in F_1 \text{ or } r_2 \in F_2\}$

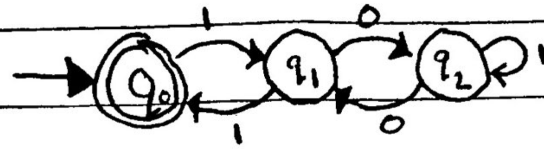
Pledge Jnelson

Problem 3

1.



Simplified



$0 = 00$ ✓

$3 = 11$ Accept ✓	$4 = 100$ Reject X
$9 = 1001$ ✓	$11 = 1011$ X
$15 = 1111$ ✓	$35 = 100011$ X
$33 = 100001$ ✓	$226 = 11100010$ X
$1014 = 1111110110$ ✓	$1015 = 1111110111$ X

Started by trying to use the diffences of the binary strings rather than the remainder of input / 3. This caused the longer FSA. After simplifing and adjusting to the remainders the DFA accepts the language D_3

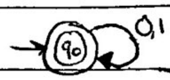
Pledge Jnelson

Problem 3 (cont.)

2. Prove D_k is regular for every $k \geq 1$

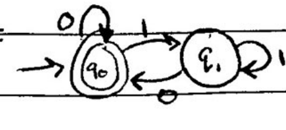
A language is regular if FSA recognizes it.

D_1



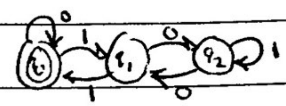
	0	1
$\rightarrow q_0$	q_0	q_0

D_2



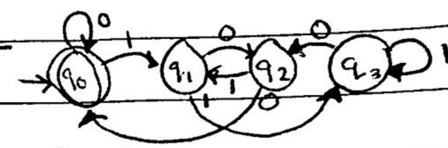
	0	1
$\rightarrow q_0$	q_0	q_1
q_1	q_0	q_1

D_3



	0	1
$\rightarrow q_0$	q_0	q_1
q_1	q_2	q_0
q_2	q_1	q_2

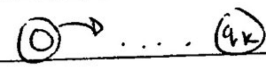
D_4



	0	1
$\rightarrow q_0$	q_0	q_1
q_1	q_2	q_3
q_2	q_0	q_1
q_3	q_2	q_3

states = k

D_k



	0	1
$\rightarrow q_0$	q_0	q_1
q_1	q_2	q_3
$\vdots$	$\vdots$	$\vdots$
q_{k-1}	q_{k-2}	q_{k-1}

D_k is regular for $k \geq 1$