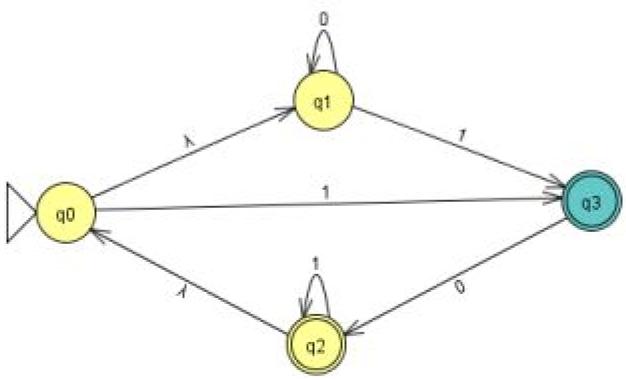
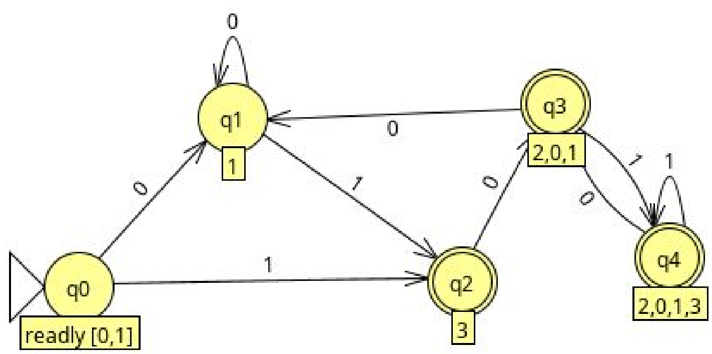
CS 321 HW2 - Lyell Read

Submit a pdf in Canvas. Use a word processor and/or JFLAP. (30 pts)

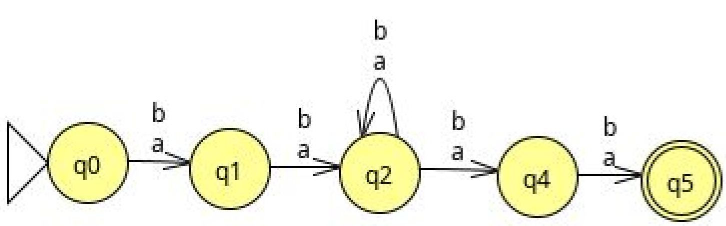
1) (4 pts) Convert the following NFA into an equivalent DFA





2) (3 pts) Show that the language L = { vwv : v, w {a,b}*, |v| = 2} is a regular language.

To prove L is a regular language, we must create an NFA or DFA that accepts L. Here is an acceptor for L:



Based on the assumption that this NFA properly accepts L, L can be concluded to be a regular language.

3) (4 pts) Prove that if L is a regular language then L^R is a regular language.

If Language L is regular, we have an NFA or DFA for language L, which accepts the language. Taking this DFA, and creating DFA^R by

1. Convert the DFA into an NFA or modify the NFA such that there is only one terminal state, which can be achieved with the lambda arrows.
2. Swapping the initial and final nodes
3. Reversing the direction of the arrows

This will create a DFA^R that will accept the reverse of language L, language L^R, proving language L^R is regular.

4) (9 pts) Give regular expressions for the following languages on Σ = {a, b}

a) L_1 = { w : n_a(w) mod 3 = 1}.

R = (((“b”)*(“a”)(“b”)*(“a”)(“b”)*(“a”)(“b”)*))*((“b”)*(“a”)(“b”)*)) + ((“b”)*(“a”)(“b”)*)

Explanation: Any number of sets of any string with three a’s, with one extra string containing exactly one a added to the end, making sure that each produced string is n*3*’a’ + ‘a’ (excluding ‘b’s) to create something that is guaranteed to leave 1 when the count of a’s is taken modulo 3. Single string included as it too will generate num_as % 3 = 1.

b) L_2 = { w : w ends in aa }.

R = (“a” + “b”)*”aa”

c) L_3 = all strings containing no more than three a’s.

R = ((“b”)*(“a”)(“b”)*(“a”)(“b”)*(“a”)(“b”)*) + ((“b”)*(“a”)(“b”)*(“a”)(“b”)*) + ((“b”)*(“a”)(“b”)*) + (“b”)*

Explanation: strings with <= 3 * ‘a’ can either be [b]a[b]a[b]a[b] (where [b] is optional & any quantity), [b]a[b]a[b] or [b]a[b], so these are ‘+’d together.

5) (4 pts) Consider a type of scientific notation for real numbers with the following rules:

a. A number can be preceded by a “+” or “-“ sign or the sign may be absent.

R = (“+” + “-” + λ)(0+1+2+3+4+5+6+7+8+9)*

b. Numeric values must be of the form $cb_1b_2…b_n$ where b_i is any digit, but c must be nonzero.

R = (1+2+3+4+5+6+7+8+9)(0+1+2+3+4+5+6+7+8+9)*

c. The number may be followed by an exponent field of the form e"+"y_1y_2 or e"-"y_1y_2, where y_i can be any digit {0, 1, 2, 3, 4, 5, 6, 7, 8, 9}.

R = ("+" + "-" + λ)(1+2+3+4+5+6+7+8+9)(0+1+2+3+4+5+6+7+8+9)*(("e"("+" + "-")(1+2+3+4+5+6+7+8+9)(0+1+2+3+4+5+6+7+8+9)*) + λ)

For example the strings -123e+10 and 257 represent real number in this scientific format. Give a regular expression for this scientific notation. Let = { 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, "+", "-", e} . (Note: With this convention "+" is the sign associated with the scientific number and + the operator of the regular expression.)

6) (6 pts) Find a regular grammars for the following languages on = {a, b}:

a) L_0 is all strings with exactly one a

S	$\rightarrow$	bS
S	$\rightarrow$	aA
A	$\rightarrow$	λ
A	$\rightarrow$	bA
A	$\rightarrow$	aA

b) L_1 = { w : $n_a(w)$ mod 3 = 1}.

S	$\rightarrow$	bS
S	$\rightarrow$	aD
D	$\rightarrow$	C
C	$\rightarrow$	λ
D	$\rightarrow$	aA
A	$\rightarrow$	aB
B	$\rightarrow$	aD
A	$\rightarrow$	bA
B	$\rightarrow$	bB
D	$\rightarrow$	bD