CS 301 Homework 1

Ryan Magdaleno

TOTAL POINTS

36 / 40

QUESTION 1

1 DFAs **15 / 15**

✓ **- 0 pts** *Correct*

  - 1 pts Start state missing

  - 1 pts Final state missing

  - 2 pts Missing transition(s) for each character and every state, or extra transition(s) were given.

  - 1 pts Missing a garbage state

  - 1 pts Does not go to garbage state on '00'

  - 1 pts Does not go to new non-garbage state on '1'

  - 1 pts Rejected '01'. Should Accept

  - 1 pts Final state has self loops. Should not have self loops

  - 1 pts All transitions to final state must be on '1'. Missing or wrong transition(s) to final state.

  - 1 pts Q is not a set, or set of states in Q is incorrect.

  - 1 pts Σ or alphabet is not a set, or wrong alphabet is given

  - 1 pts Transitions(δ) are not present as a table or list of tuples, or the transitions for the DFA are wrong

  - 1 pts The initial state($$q_0$$) is a set, or wrong initial state is given

  - 1 pts F is not a set, or wrong final states are given

QUESTION 2

2 NFAs **15 / 15**

Valid NFA

✓ **+ 1 pts** *Start state indicator*

✓ **+ 1 pts** *At least one final state*

(010)*

✓ **+ 1 pts** *Accepts empty string*

✓ **+ 1 pts** *Accepts (010)(010)*

✓ **+ 1 pts** *Rejects (01)**

1*(00)*

✓ **+ 1 pts** *Accepts empty string*

✓ **+ 1 pts** *No 0s come before 1s*

✓ **+ 1 pts** *No odd # of 0s*

✓ **+ 2 pts** *Union*

5-tuple

✓ **+ 1 pts** *$$Q$$ (set)*

✓ **+ 1 pts** *$$Σ$$ (set)*

✓ **+ 1 pts** *$$δ$$ (elements are sets, epsilon column)*

✓ **+ 1 pts** *$$q_0$$ not a set*

✓ **+ 1 pts** *$$F$$ (set)*

  + 0 pts No submission

QUESTION 3

3 Closure **6 / 10**

  + 2 pts $$Q_{R}$$

✓ **+ 1 pts** *$$Q_{R}$$ partially correct*

✓ **+ 2 pts** *$$\sum_{R}$$*

+ 2 pts $$\delta_{R}$$

✓ **+ 1 pts** *$$\delta_{R}$$ partially correct*

+ 2 pts $$q_{0R}$$

✓ **+ 1 pts** *$$q_{0R}$$ partially correct*

+ 2 pts $$F_{R}$$

✓ **+ 1 pts** *$$F_{R}$$ partially correct*

+ 0 pts no submission or no correct part

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1 DFAs

a) Generate the state diagram for a DFA which decides the following language L. $\Sigma = \{0, 1\}$.

$L = \{w \in \Sigma^* : w \text{ does not start with '00' and } w \text{ ends with '01' }\}$
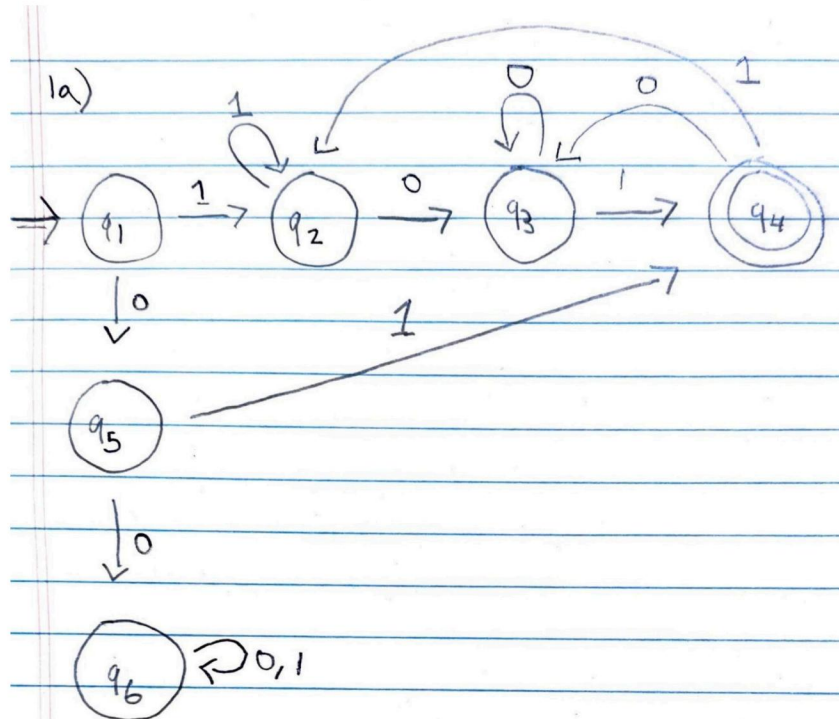
b) Give the 5-tuple which represents the the transition function (δ)

1b) $Q = \{q_1, q_2, q_3, q_4, q_5, q_6\}$

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

$q_0 = q_1$

$F = \{q_4\}$

$\delta =$

	0	1
q_1	q_5	q_2
q_2	q_3	q_2
q_3	q_3	q_4
q_4	q_3	q_2
q_5	q_6	q_4
q_6	q_6	q_6

1 DFAs **15 / 15**

**✓ - 0 pts** *Correct*

    - 1 pts Start state missing

    - 1 pts Final state missing

    - 2 pts Missing transition(s) for each character and every state, or extra transition(s) were given.

    - 1 pts Missing a garbage state

    - 1 pts Does not go to garbage state on '00'

    - 1 pts Does not go to new non-garbage state on a '1'

    - 1 pts Rejected '01'. Should Accept

    - 1 pts Final state has self loops. Should not have self loops

    - 1 pts All transitions to final state must be on '1'. Missing or wrong transition(s) to final state.

    - 1 pts Q is not a set, or set of states in Q is incorrect.

    - 1 pts Σ or alphabet is not a set, or wrong alphabet is given

    - 1 pts Transitions(δ) are not present as a table or list of tuples, or the transitions for the DFA are wrong

    - 1 pts The initial state(q_0) is a set, or wrong initial state is given

    - 1 pts F is not a set, or wrong final states are given

2 NFAs

a) Generate the state-diagram for an NFA which decides the following language L. $\Sigma = \{0, 1\}$.

$$L = (010)^* \cup 1^*(00)^*$$

2a)
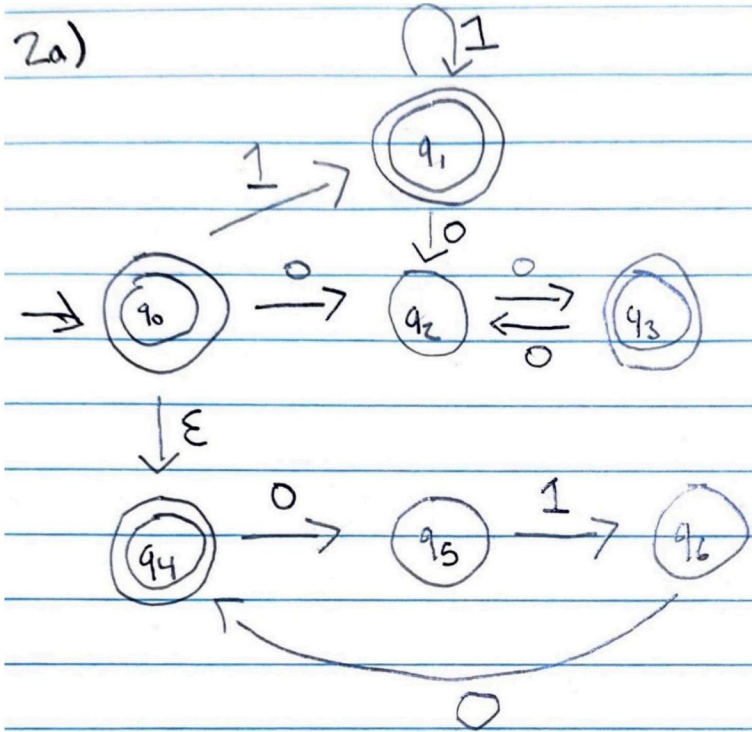
b) Give the 5-tuple which represents the transition function (δ)

2b) $Q = \{q_0, q_1, q_2, q_3, q_4, q_5, q_6\}$

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

$q_0 = q_0$

$F = \{q_0, q_1, q_3, q_4\}$

$\delta =$	0	1	ε
q_0	$\{q_2\}$	$\{q_1\}$	$\{q_4\}$
q_1	$\{q_2\}$	$\{q_1\}$	$\emptyset$
q_2	$\{q_3\}$	$\emptyset$	$\emptyset$
q_3	$\{q_2\}$	$\emptyset$	$\emptyset$
q_4	$\{q_5\}$	$\emptyset$	$\emptyset$
q_5	$\emptyset$	$\{q_6\}$	$\emptyset$
q_6	$\{q_4\}$	$\emptyset$	$\emptyset$

Valid NFA

✓ **+ 1 pts** *Start state indicator*

✓ **+ 1 pts** *At least one final state*

(010)*

✓ **+ 1 pts** *Accepts empty string*

✓ **+ 1 pts** *Accepts (010)(010)*

✓ **+ 1 pts** *Rejects (01)**

1*(00)*

✓ **+ 1 pts** *Accepts empty string*

✓ **+ 1 pts** *No 0s come before 1s*

✓ **+ 1 pts** *No odd # of 0s*

✓ **+ 2 pts** *Union*

5-tuple

✓ **+ 1 pts** *Q (set)*

✓ **+ 1 pts** *Σ (set)*

✓ **+ 1 pts** *δ (elements are sets, epsilon column)*

✓ **+ 1 pts** *q_0 not a set*

✓ **+ 1 pts** *F (set)*

+ 0 pts No submission

3 Closure

Given the 5-tuple for an NFA $M_L = (Q, \Sigma, \delta, q_0, F)$ which decides, L, describe how to produce the 5-tuple for an NFA $M_{L^R} = (Q_R, \Sigma, \delta_R, q_{0_R}, F_R)$ which decides L^R, the reverse of L.

*The reverse, L^R is the recursive operation given below which gives the reverse of a string. e.g. $(110)^R = 011$*

- $\epsilon^R = \epsilon$

- For string w and character a, $(wa)^R = a(w^R)$

Given L, to get L^R or revered L we can manipulate the L NFA's 5 tuple like so:

Q^R = Q set
Σ^R = Σ set
Q0^R = F /Final state of of L
F^R = Q0/Starting state of L

For the transition function let's use the following string example:
L = {1011}, L^R should become {1101}.
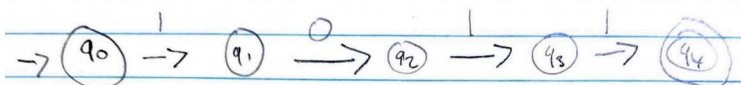
x = empty set (wrong encoding on phi)
L transition function δ:
```
     1    0
q0 | q1 |  x |
q1 |  x | q2 |
q2 | q3 |  x |
q3 | q4 |  x |
q4 |  x |  x |
```

To retrieve the string we need to invert the starting and final state.
(As noted with Q0^R=F, F^R=Q0).
After that we must reverse the transition function of L; δ.

One method to reverse the transition would be to enter the original starting state, in this example q0, and enter each state sort of recursively, so we go q0 -> q1 -> q2 -> q3 and stop until the next state only has the empty set on all transitions, this would be our base case.

In this example we would stop at q3 because q4 terminates fully. We can now reverse by swapping the transition from:
```
     1   0                        1    0
q3 | q4 | x | to become => q4 | q3 |  x  |
```

Then like we're returning from a recursive function, we then would reverse:
```
     1   0                        1    0
q2 | q3 | x | to become => q3 | q2 |  x  |
q1 |  x |q2 | to become => q2 | x  | q1  |
```

Eventually returning back to q0 which should now terminate all transitions:
```
     1   0                        1    0
q0 | q1 | x | to become => q0 | x  |  x  |
```

In the end the L^R transition function δ^R should look like this:
```
     1   0
q0 | x  | x  |
q1 | q0 | x  |
q2 | x  | q1 |
q3 | q2 | x  |
q4 | q3 | x  |
```

And the final NFA L^R should now be reversed in all string cases like so:
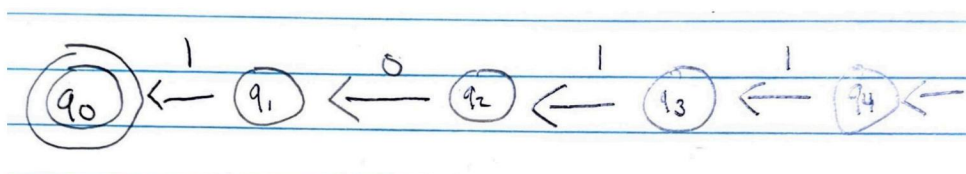
Extra note: Doing the steps listed above again should result in the original L, that is:
L = (L^R)^R

3 Closure **6 / 10**

    + 2 pts $$Q_{R}$$

✓ **+ 1 pts** *$$Q_{R}$$ partially correct*

✓ **+ 2 pts** *$$\sum_{R}$$*

    + 2 pts $$\delta_{R}$$

✓ **+ 1 pts** *$$\delta_{R}$$ partially correct*

    + 2 pts $$q_{0R}$$

✓ **+ 1 pts** *$$q_{0R}$$ partially correct*

    + 2 pts $$F_{R}$$

✓ **+ 1 pts** *$$F_{R}$$ partially correct*

    + 0 pts no submission or no correct part

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