COMS 3261 Review Handout 3B
Practice Questions: Finite Automata

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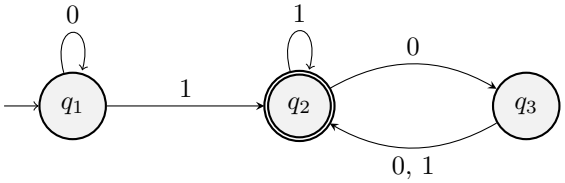
1 DFA Exercises

1. Determine which of ε, 11, 010, 10, 0101 is accepted by this DFA.



ε – Not accepted

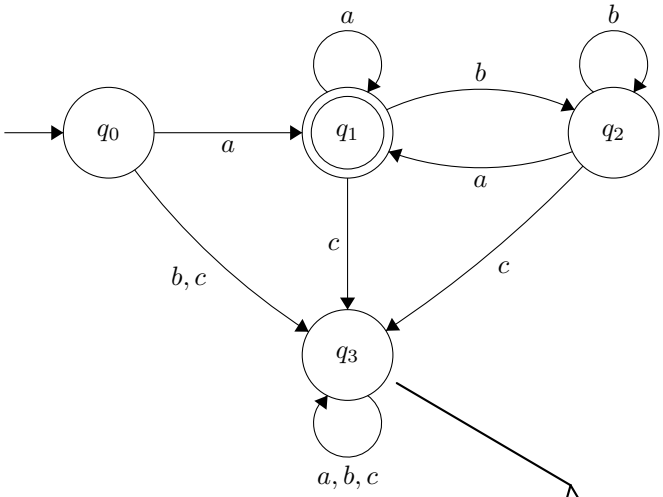
11 – Accepted

010 – Not accepted

10 – Not accepted

0101 – Accepted

2. The DFA state diagram below is defined on the alphabet $\Sigma = \{a, b, c\}$. Write out its formal definition (as a 5-tuple). When specifying the transition function δ, draw a table.



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

$Q = \{q_0, q_1, q_2, q_3\}$

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

δ:

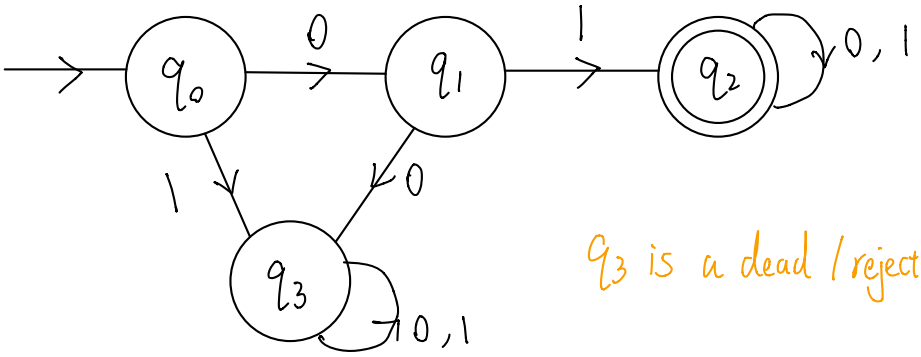
	a	b	c
q_0	q_1	q_3	q_3
q_1	q_1	q_2	q_3
q_2	q_1	q_2	q_3
q_3	q_3	q_3	q_3

$F = \{q_1\}$

dead / reject / bad state :
We could also not draw this because for DFAs we have a convention that when there are missing transitions, it means that they all go to the dead / reject / bad state.

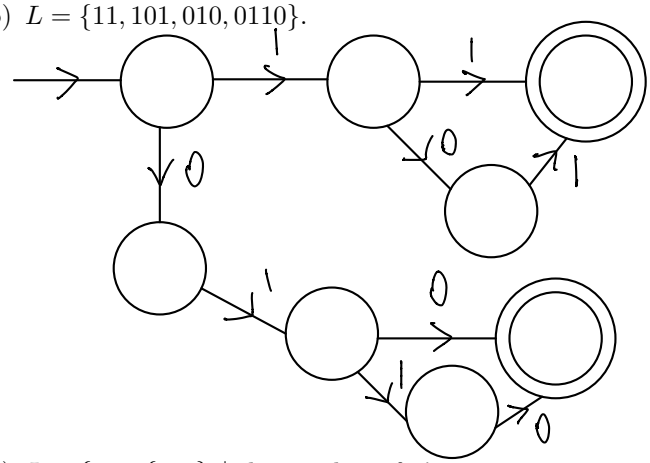
3. Draw a DFA that recognizes:

(a) All strings with the prefix 01.



q_3 is a dead / reject / bad state.

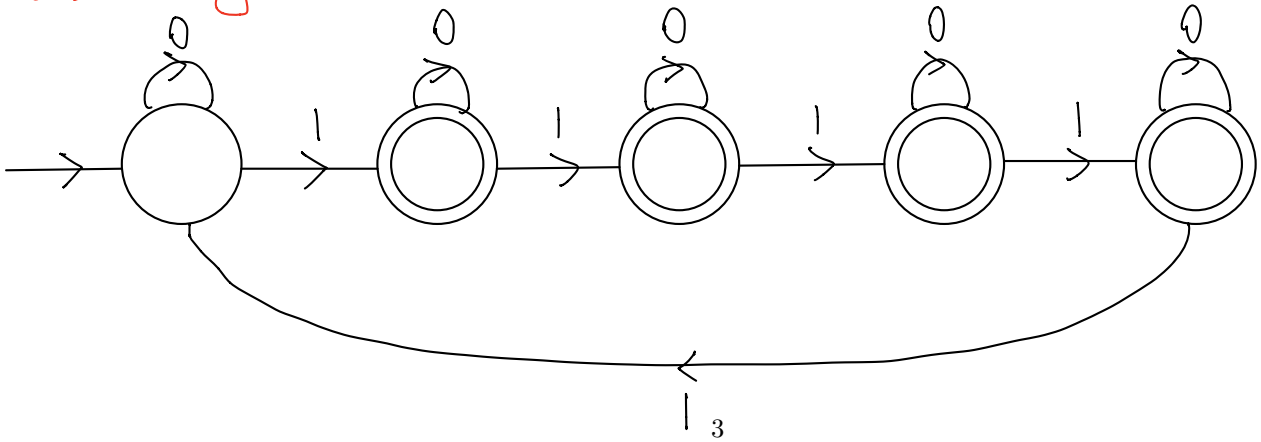
(b) $L = \{11, 101, 010, 0110\}$.



The dead / reject / bad state can be omitted. In this graph, we just omitted it to avoid making the graph messy.

(c) $L = \{w \in \{0,1\}^* |$ the number of 1's in w is not an integer multiple of 5$\}$.

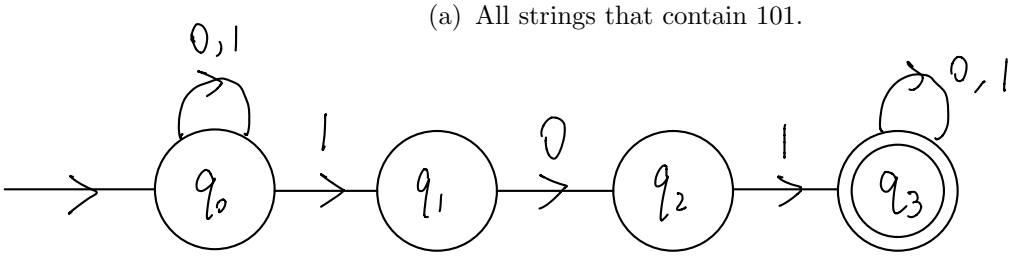
★ 0 is an integer multiple of 5!



2 NFA Exercises

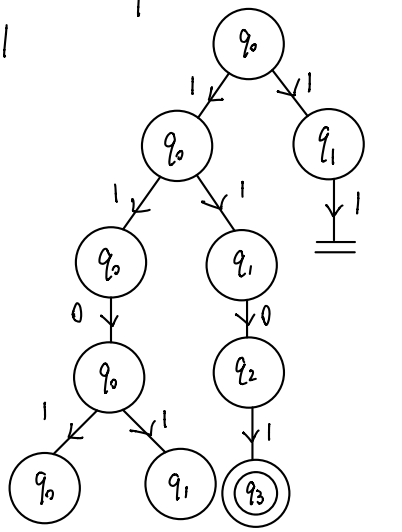
1. Draw an NFA that recognizes:

   (a) All strings that contain 101.

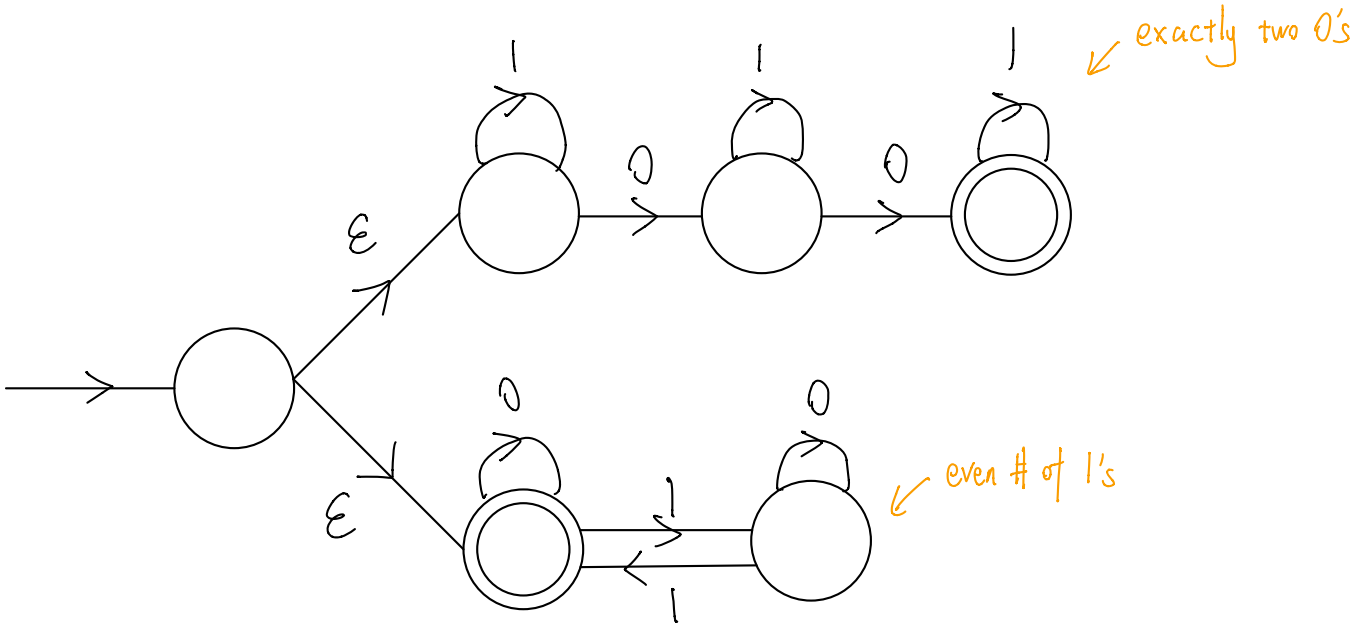


Bonus solution:

Computation tree on 1101



   (b) $L = \{w \in \{0,1\}^* \mid w$ has exactly two 0's or an even number of 1's$\}$.



3 Miscellaneous Exercises

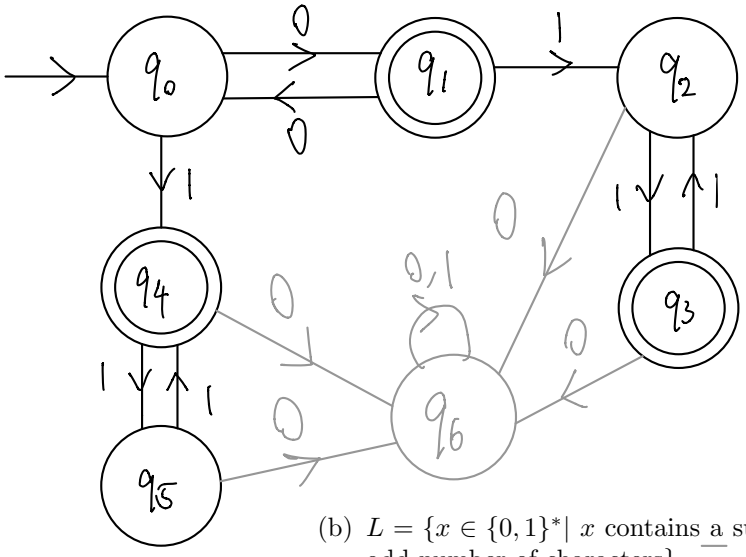
Draw either a DFA or an NFA.

1. Prove the following languages are regular:

   (a) $L = \{0^m 1^n \mid m, n \geq 0, \text{ and } m+n \text{ is odd}\}$

Be careful about the order!

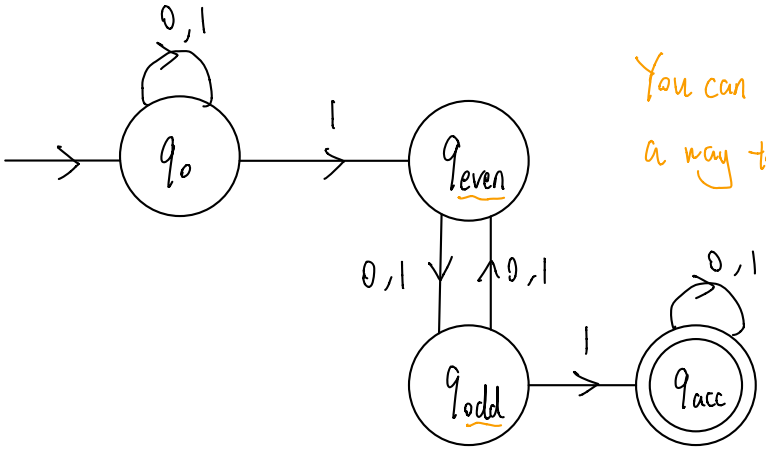
ex. $0^4 1^3 = 0^4 \cdot 1^3 = 0000111$



The grey part is the dead / reject / bad state.
In this case, we might want to just omit it.

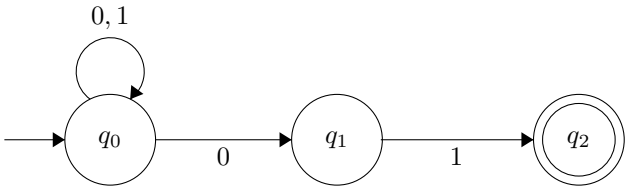
   (b) $L = \{x \in \{0,1\}^* \mid x \text{ contains a substring of two 1's separated by an odd number of characters}\}$

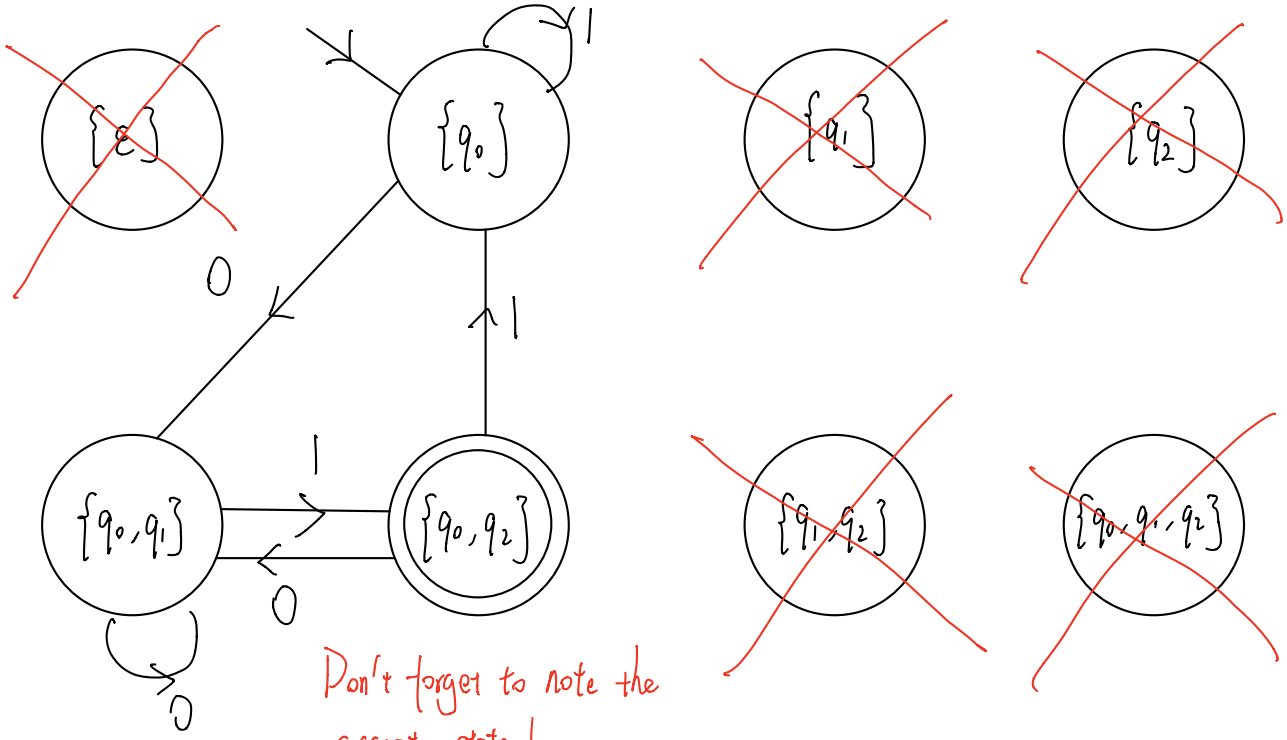
Note that 111 is also accepted by L!



You can name the states in a way that can help make things clear!

2. Convert this NFA to a DFA using subset construction:





You could also draw the transition tables to help you understand:

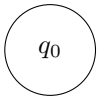
NFA δ:

	0	1	ε
q_0	$\{q_0, q_1\}$	q_0	
q_1		q_2	
q_2			

DFA δ:

	0	1
q_0	$\{q_0, q_1\}$	q_0
$\{q_0, q_1\}$	$\{q_0, q_1\}$	$\{q_0, q_2\}$
$\{q_0, q_2\}$	$\{q_0, q_1\}$	q_0

3. (a) What is the language recognized by this NFA?



q_0 is not accepting: $\emptyset$

$\{\} \neq \{\varepsilon\}$

The complement of $\emptyset$ is Σ^*.

(b) What is the language recognized by this NFA?

Note: They are not complement of each other.

q_1 is accepting: $\{\varepsilon\}$

The complement of $\{\varepsilon\}$ is $\{w \in \Sigma^* \mid |w| \geq 1\}$.