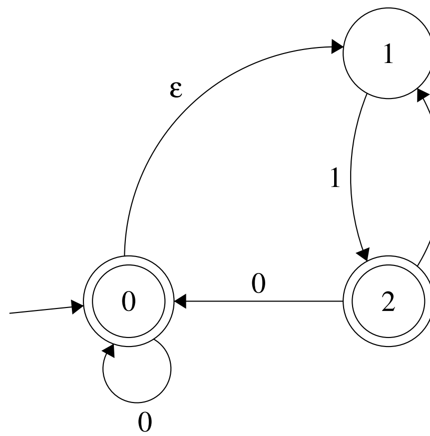
CSci 423 Homework 2

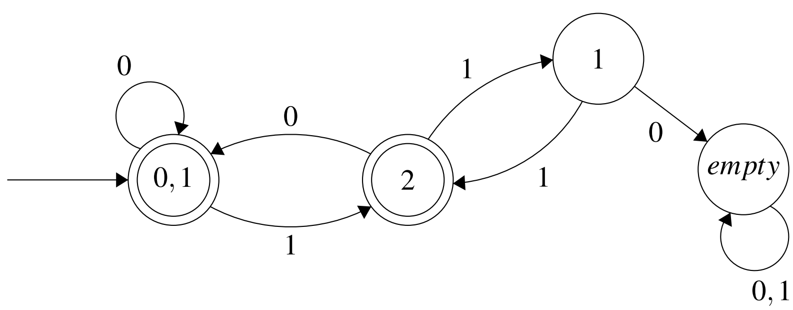
Due: 12:30 pm, Thursday, 9/26/19
Daniel Quiroga

1. (4, 5 points) Consider the language $A = \{w \in \{0,1\}^* \mid \text{all nonempty blocks of 1s in } w \text{ have odd length}\}$

   (a) Give the state diagram of an NFA with ε-transition and three states that accepts A. Use numbers $0, 1, 2$ to name the states in your NFA. More specifically for the purpose of easy grading, use 0 for the start state and 2 for a final state.

   (b) Use the subset construction method to convert your NFA to an equivalent DFA. Use the subsets (without the braces) to name the states in your DFA for easy grading.

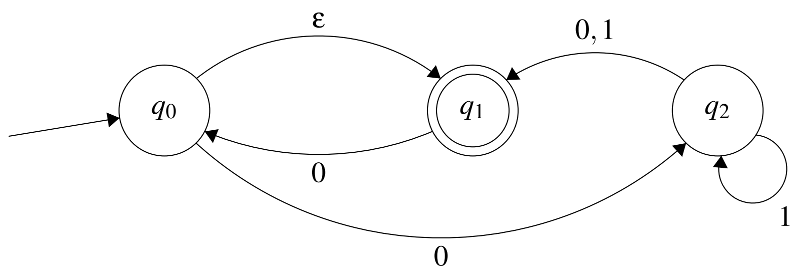
   

   Collaborators: Ethan Young and Will Elliot

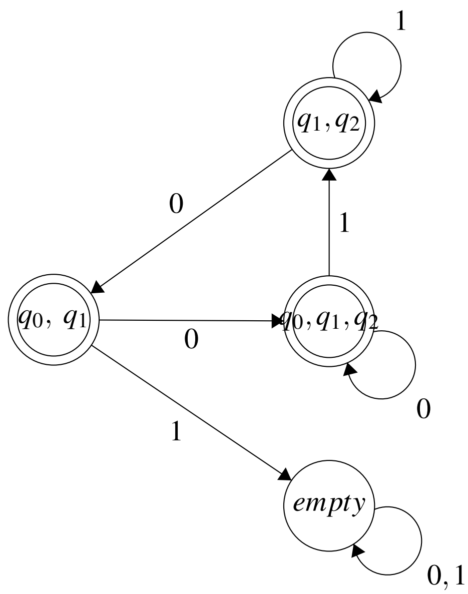
2. (1, 3, 3 points) Consider the NFA defined by the following transition table:

	0	1	ε
$\rightarrow q_0$	$\{q_2\}$	$\emptyset$	$\{q_1\}$
$*q_1$	$\{q_0\}$	$\emptyset$	$\emptyset$
q_2	$\{q_1\}$	$\{q_1, q_2\}$	$\emptyset$

   (a) Draw the state diagram of the NFA.



(b) Convert the NFA to an equivalent DFA using the subsets (without the braces) to name the states in your DFA for easy grading.



(c) Describe, by filling out the blanks below, the language recognized by the FA in the form of

$$L = \{w \in \{0,1\}^* | w \text{ doesn't start with a 1 and does not contain substring 101}\}.$$

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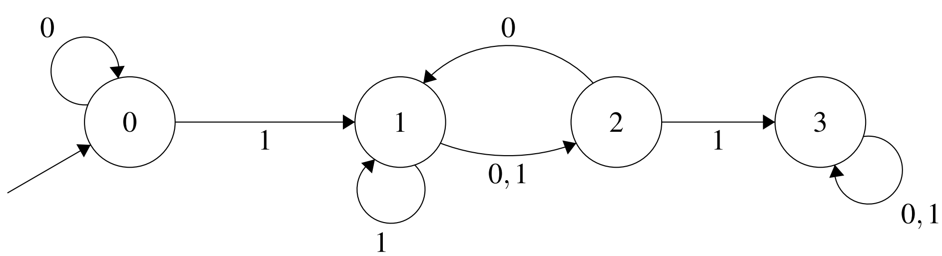
3. (1, 2, 3, 2 points)

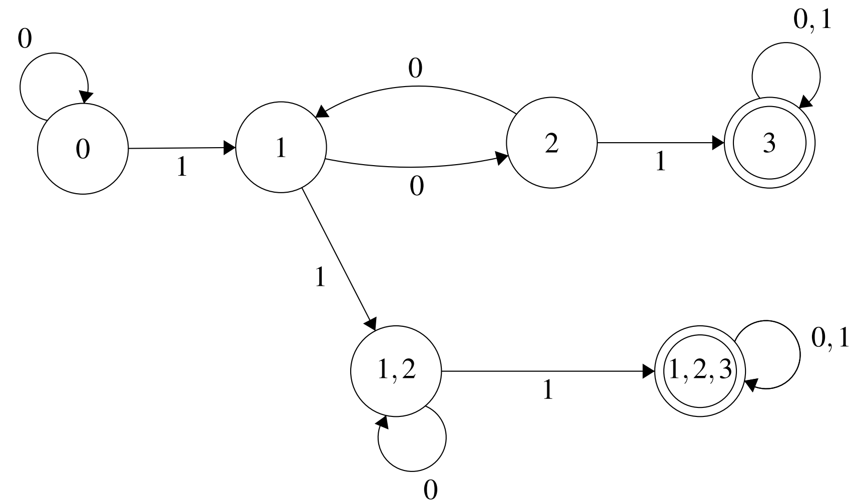
Let $L = \{w \in \{0,1\}^* \mid w$ doesn′t contain any pair of 1s that are separated by an odd number of symbols$\}$.

(a) Give a definition of $\overline{L}$.
$\overline{L} = \{w \in \{0,1\}^* \mid w$ contains at least one pair of 1s that are separated by an odd number of symbols$\}$.

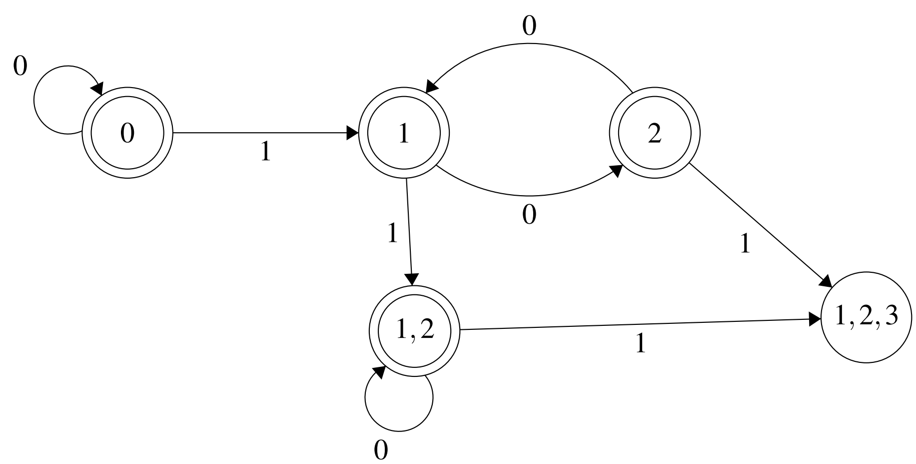
(b) Draw the state diagram of an NFA with four states that accepts $\overline{L}$.



(c) Draw the state diagram of the equivalent DFA using the subset method.



(d) Convert the above DFA to a five-state DFA that accepts L.



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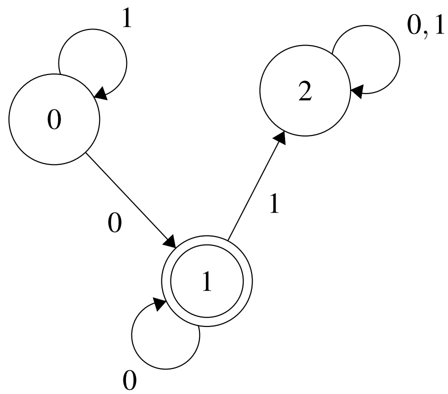
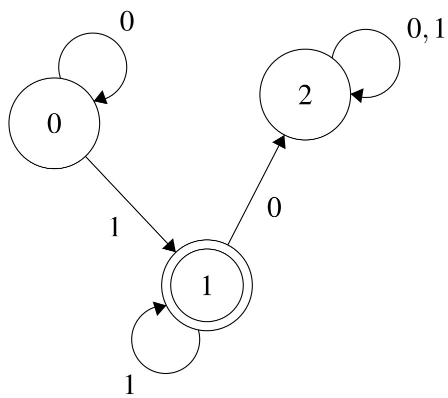
4. (3, 3 points) For the following languages A and B over the alphabet $\{0,1\}$, prove by the closure properties that they are regular. You are asked to use the method similar to the example given in the notes.

   (a) $A = \{w \in \{0,1\}^* | w$ contains neither the substrings 01 nor 10$\}$
   $A_1 = \{w \in \{0,1\}^* | w$ contains the substrings 01$\}$



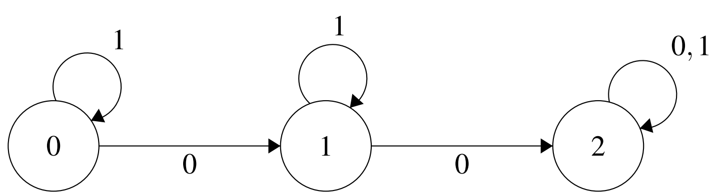
$A_2 = \{w \in \{0,1\}^* | w \text{ contains the substrings } 10\}$



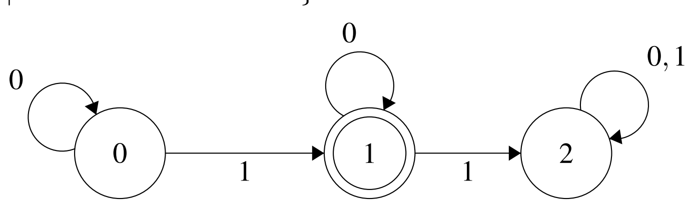
Since both A_1 and A_2 are regular languages, the intersection between the two languages will also be a regular language given by the closure property. Therefore A is a regular language.

(b) $B = \{w \in \{0,1\}^* | w \text{ contains at least two } 0'\text{s and at most one } 1\}$

$B_1 = \{w \in \{0,1\}^* | w \text{ contains at least two } 0'\text{s}\}\}$



$B_2 = \{w \in \{0,1\}^* | w \text{ contains at most one } 1\}$



Since both B_1 and B_2 are regular languages, the intersection between the two languages will also be a regular language given by the closure property. Therefore B is a regular language.

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