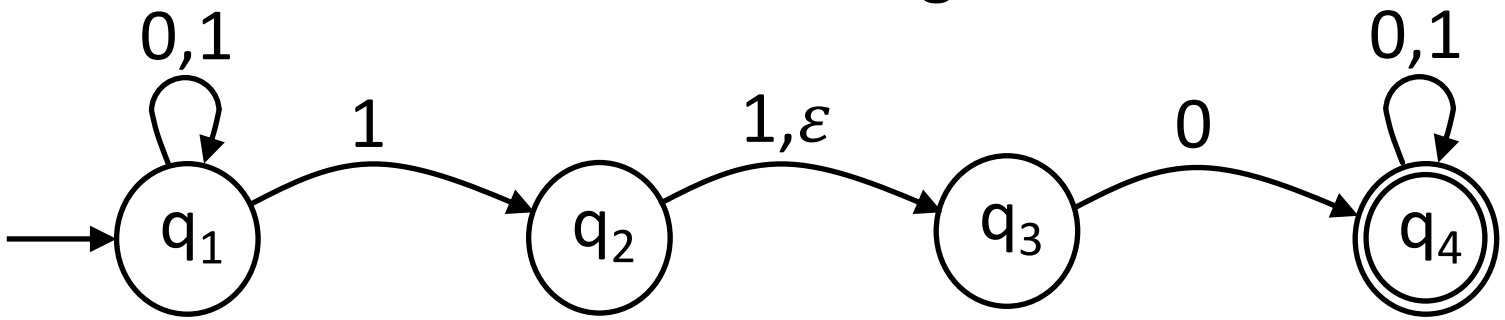
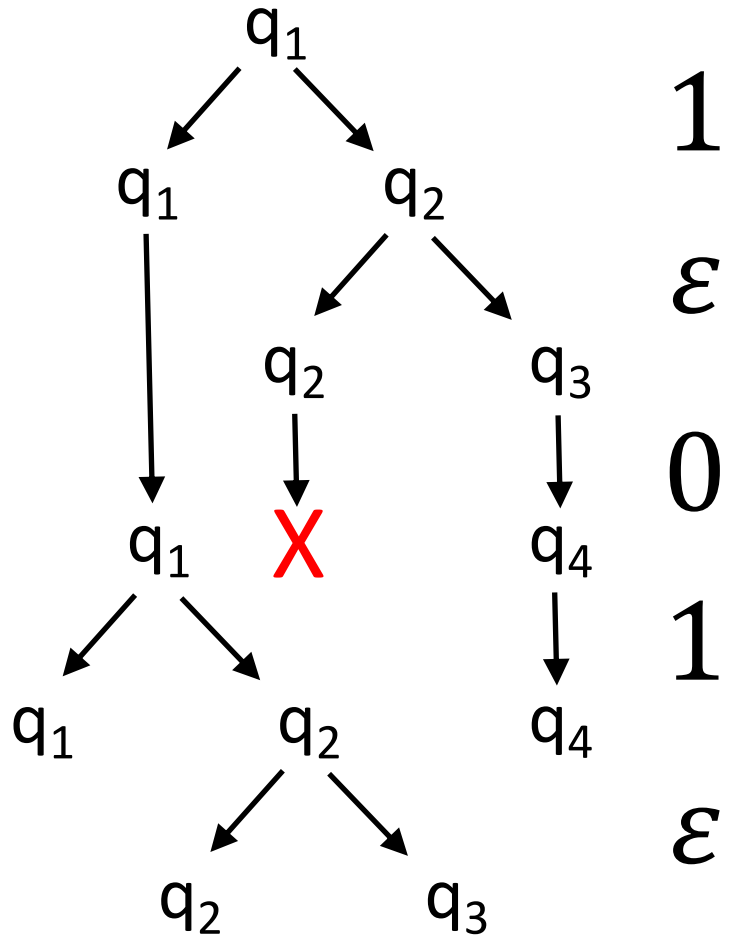
NFA
CSCI 338

NFA Processing

1. If a “decision” is encountered, split and take all options.
2. If input symbol does not match any outgoing transitions, that branch dies.
3. If any branch ends in an accept state, accept. If not, reject.
4. If ε is encountered, split and take all options without consuming a character from string.





$\omega = 101$

NFA Formal Definition

Power set of Q.

I.e. set of all subsets.

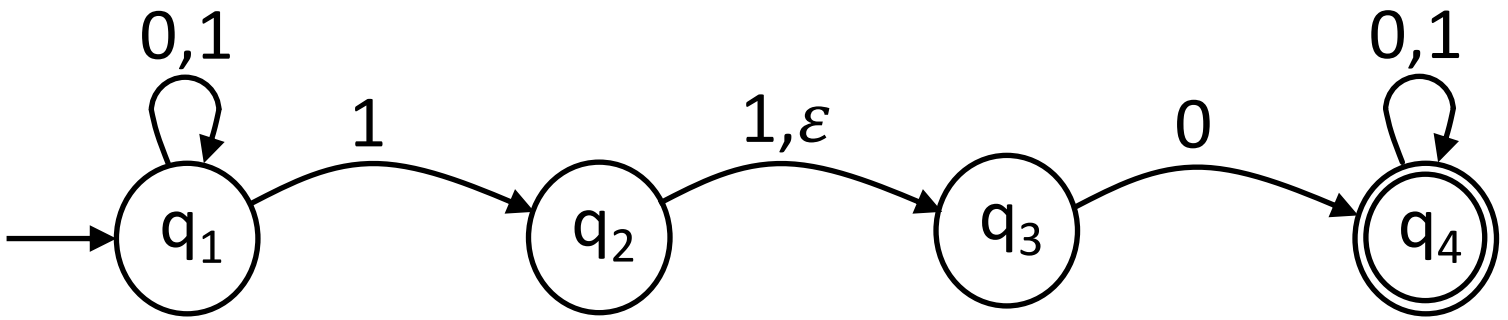
E.g. $Q = \{q_1, q_2\}$

$\Rightarrow \mathcal{P}(Q) = \{\emptyset, \{q_1\}, \{q_2\}, \{q_1, q_2\}\}$

I.e. $\exists$ 0 or more transitions for each $e \in \Sigma \cup \{\varepsilon\}$ at each state

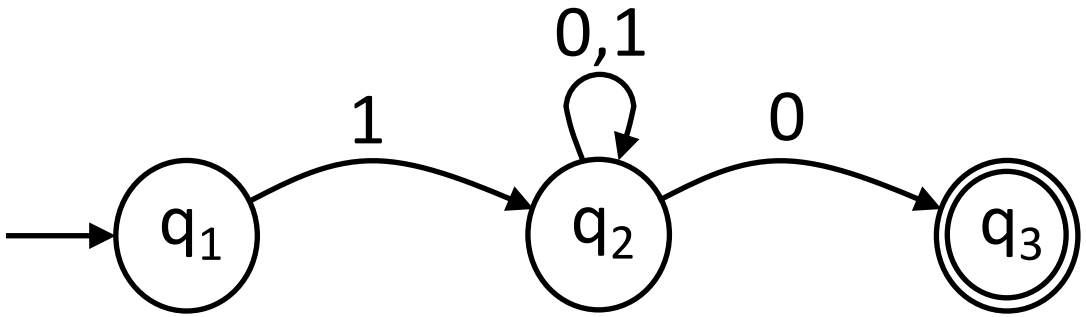
NFAs consist of:

1. Finite set of states, Q.
2. Finite alphabet, Σ.
3. Transition function, $\delta: Q \times (\Sigma \cup \{\varepsilon\}) \rightarrow \mathcal{P}(Q)$.
4. Start state, $q_0 \in Q$.
5. Set of accept states, $F \subseteq Q$.



NFA Practice

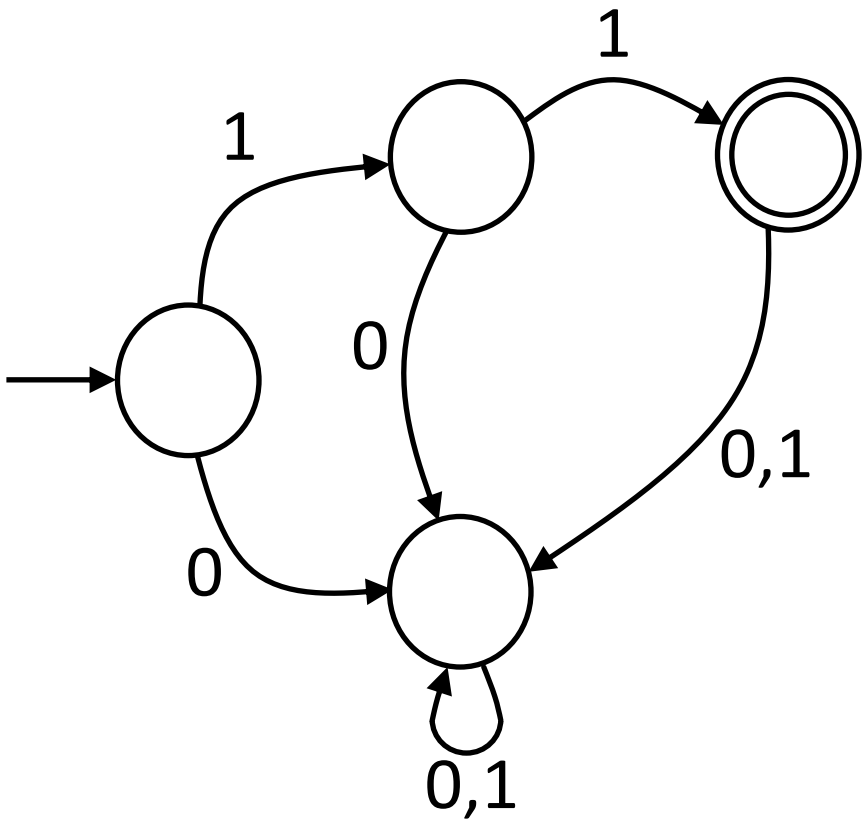
What is the NFA that accepts $\{\omega:\ \omega$ starts with 1 **and** ends with $0\}$?



Only ω's that start with 1 get to q_2.
Any string that gets to q_2, can get to q_3 and terminate, if it ends with 0.

Build an NFA for the following language:

$\{11\}$.



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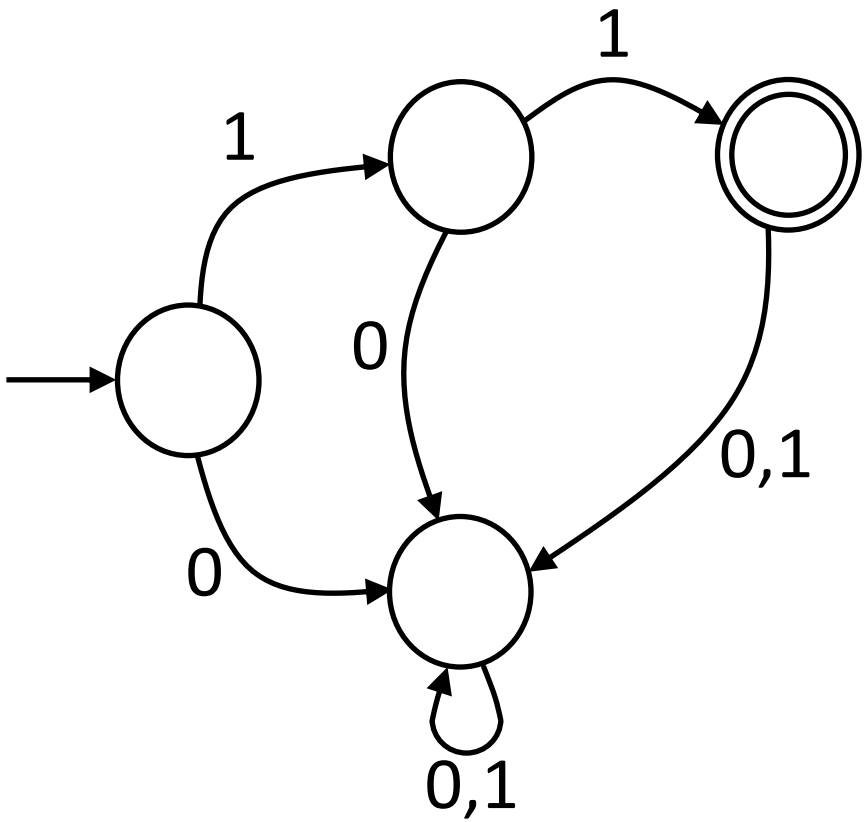
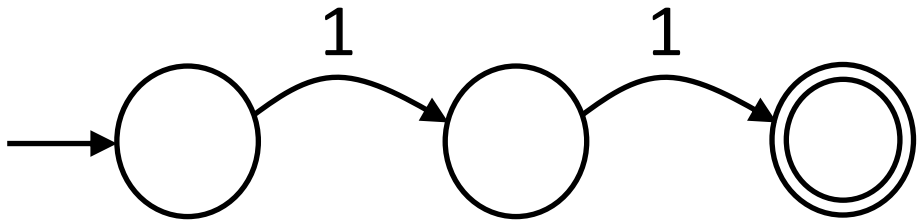
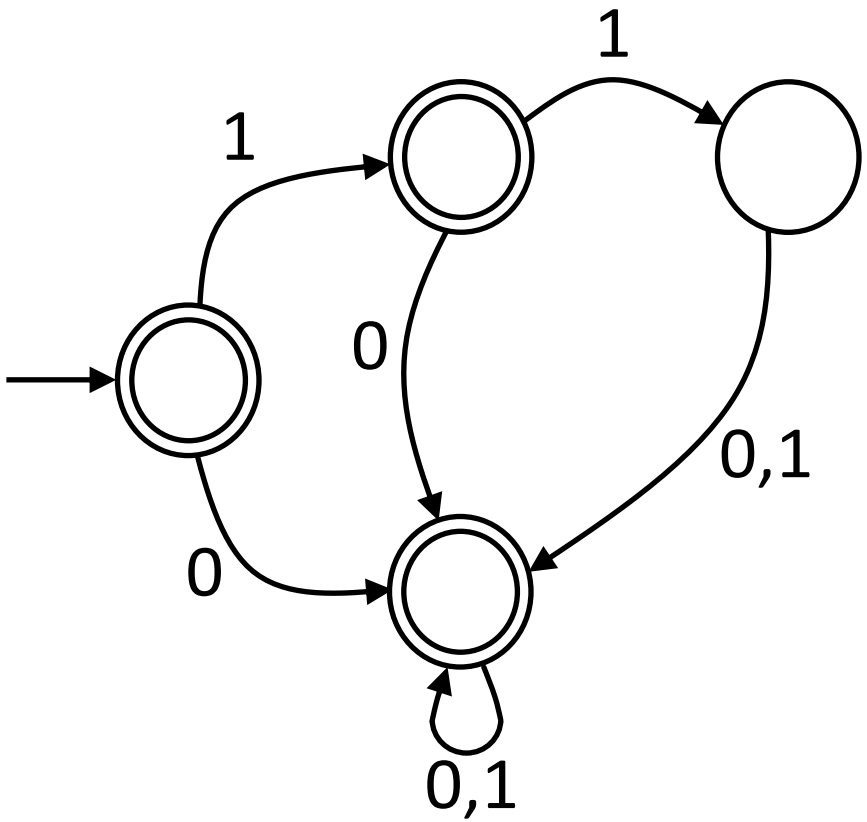
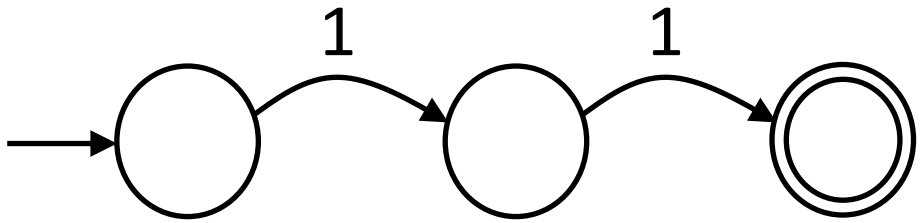




Build an NFA for the following language:

~~{11}~~. $\{\omega: \omega$ could be anything except $11\}$.





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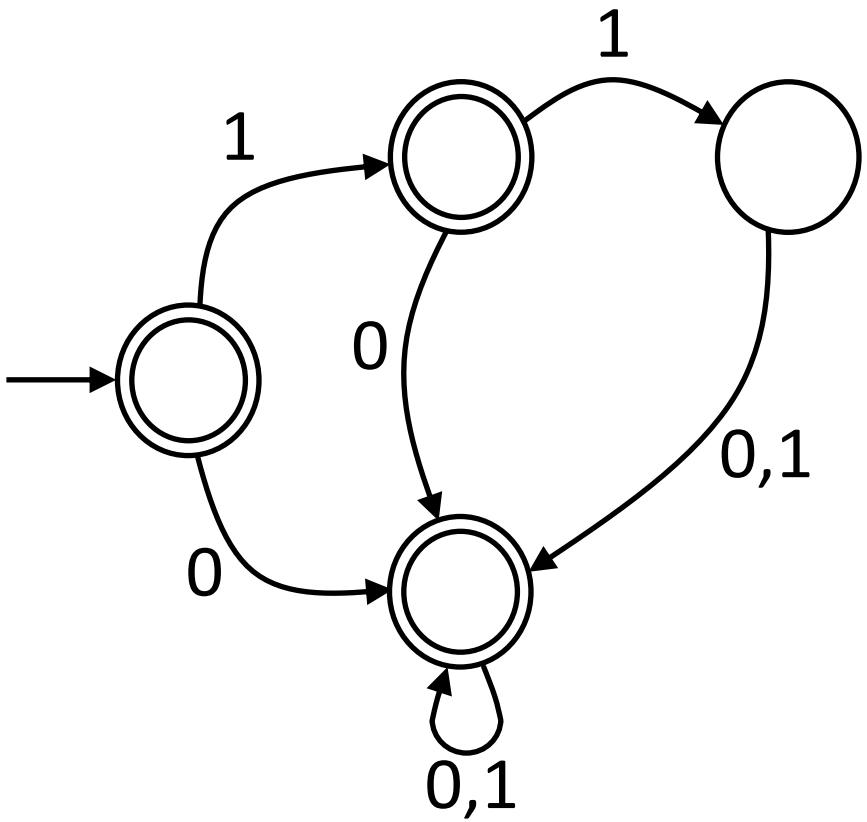

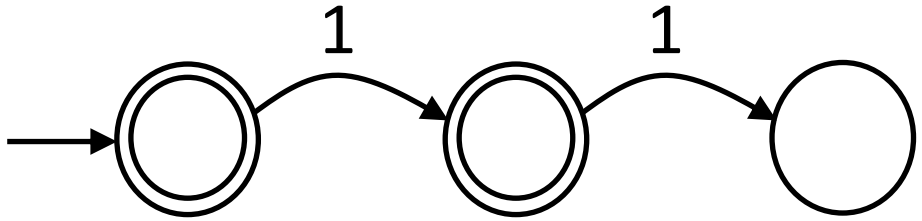

Language?

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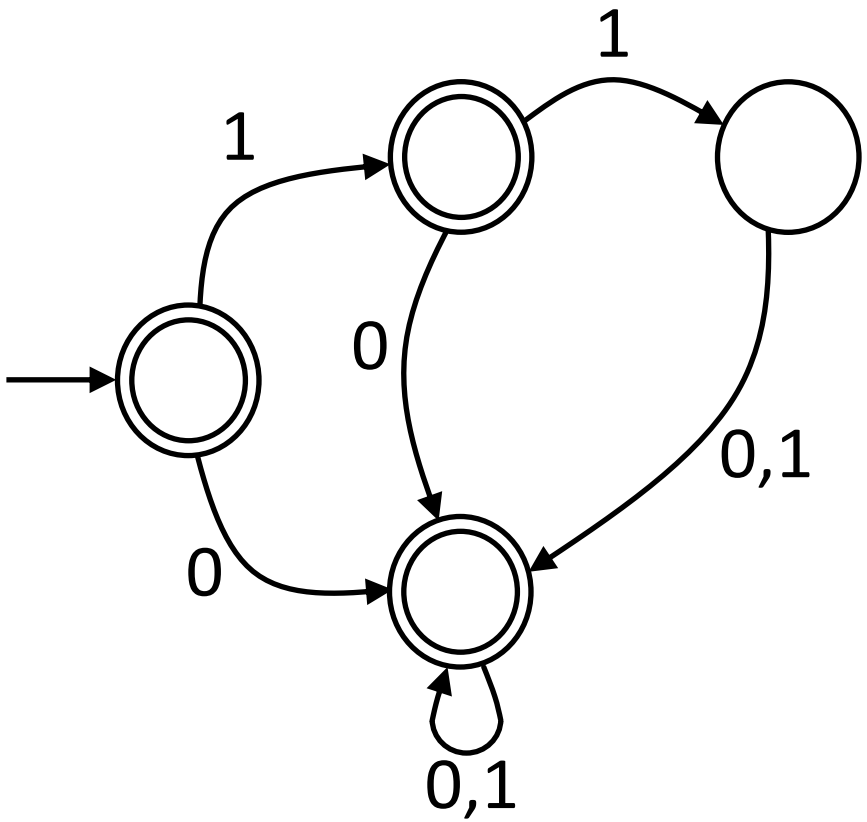
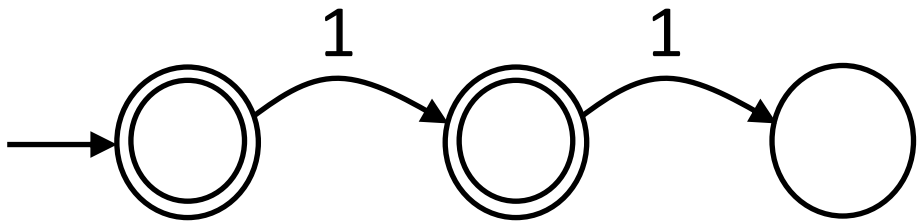


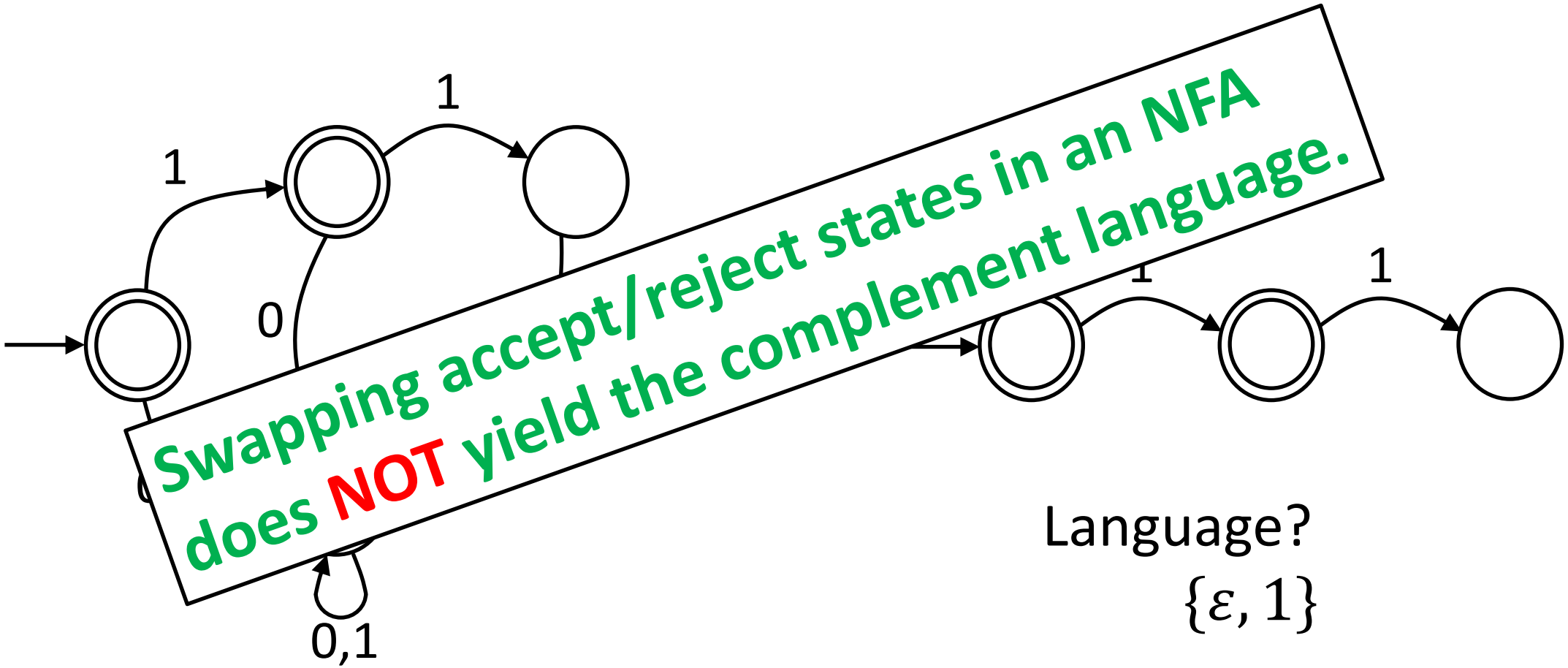


Language?

$\{\varepsilon, 1\}$

Build an NFA for the following language:

$\{\omega: \omega$ could be anything except $11\}$.

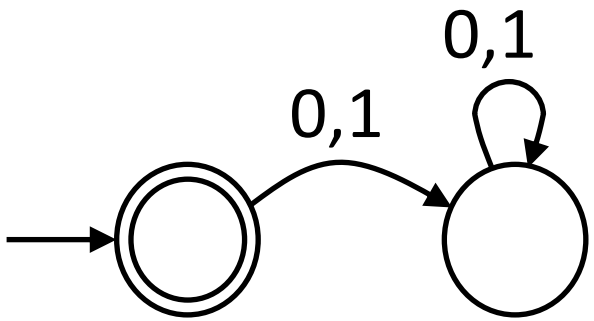


Swapping accept/reject states in an NFA does NOT yield the complement language.

Language?

$\{\varepsilon, 1\}$

Build an NFA for the following language:
$\{\varepsilon\}$.

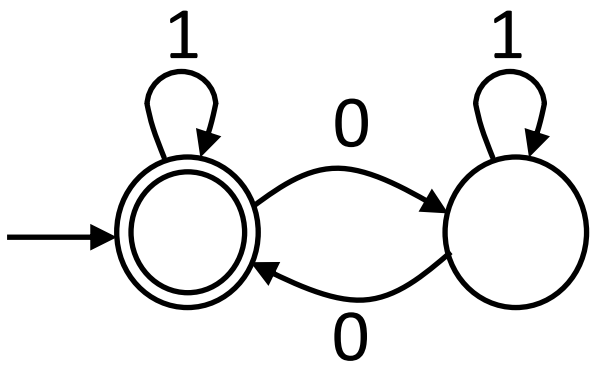


Build an NFA for the following language:

$\{\varepsilon\}$.

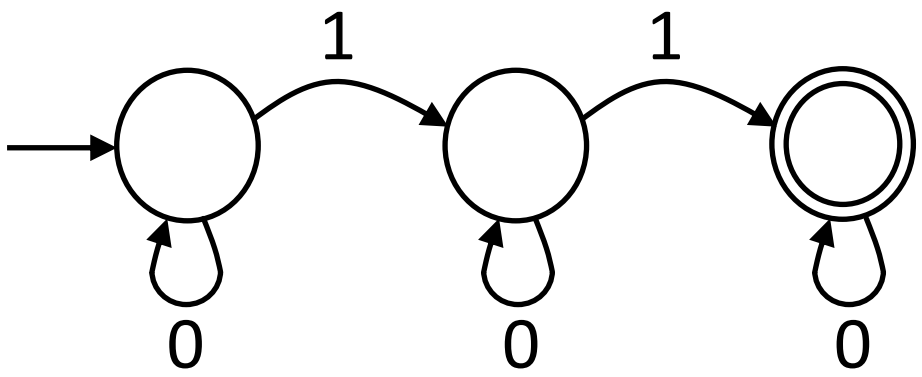
Build an NFA for the following language:

$\{\omega: \omega$ contains an even number of 0's$\}$.



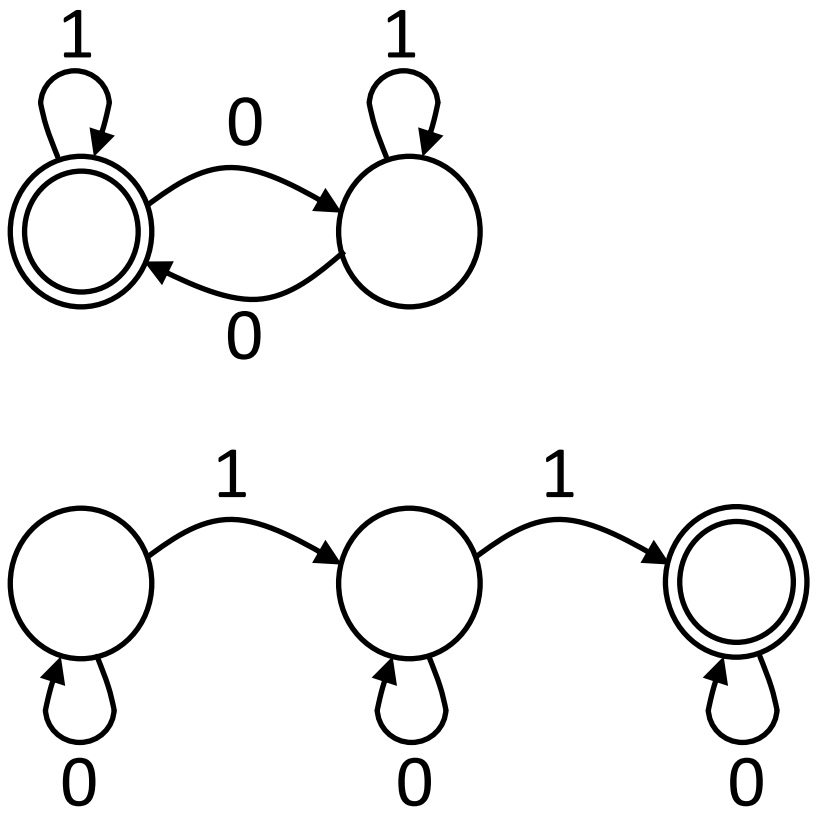
Build an NFA for the following language:

$\{\omega : \omega$ contains exactly two 1's$\}$.



Build an NFA for the following language:

$\{\omega: \omega$ contains an even number of 0's **or** exactly two 1's$\}$.



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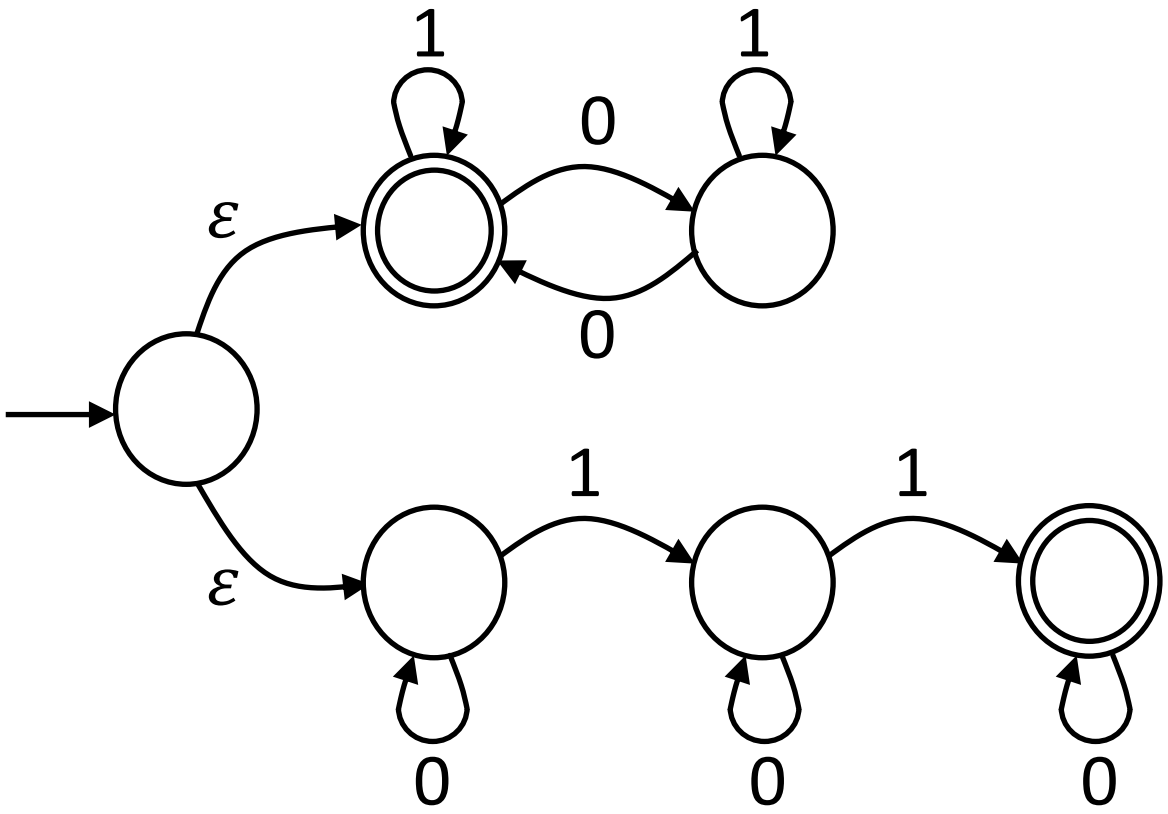

Build an NFA with three states for:

$\{\omega: \omega$ has the form $0^*1^*0^+.\}$

Proof:

Additional string notation:

0^*: Zero or more 0s (e.g. $0, 0000, \varepsilon$)

0^+: One or more 0s (e.g. $0, 0000$)

Make an NFA with three states for:

$\{\omega: \omega$ has the form $0^*1^*0^+.\}$

Proof:

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