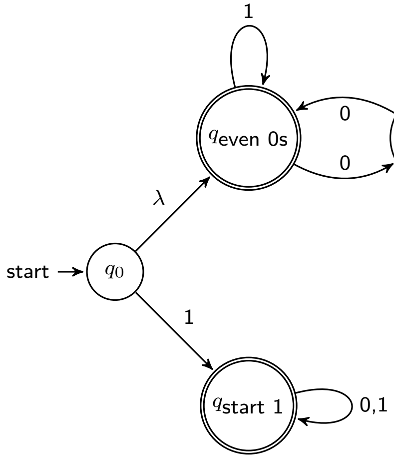
CSE 596 – NFA Runtime Example

Let's look at this toy language.

- $L_1 = \{x \mid x \in \{0,1\}^*,$
  x has an even number of 0s or starts with a '1'$\}$

Here is an NFA that accepts our language L_1:



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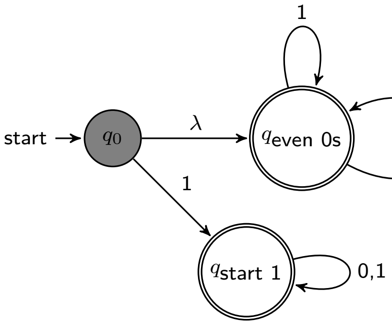
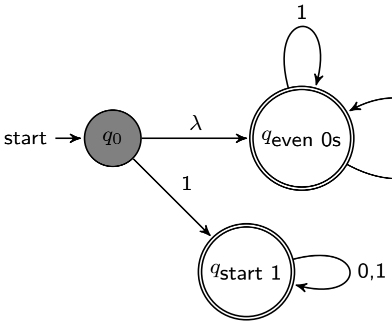
What does the computation of $w = 1000$ on our NFA look like?

Current states $= \{q_0\}$, $w = 1000$

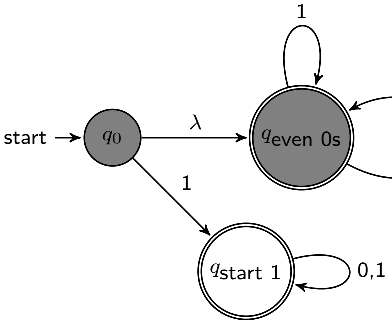


Current states $= \{q_0\}$, $w = 1000$

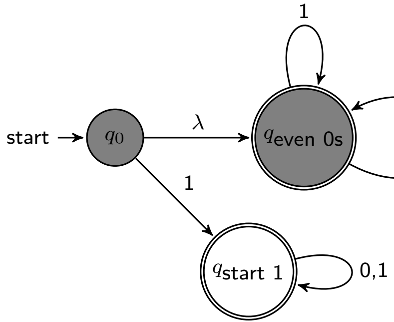


Before we look at any symbols we can make a λ-move.

Current states $= \{q_0, q_{\text{even 0s}}\}$, $w = 1000$

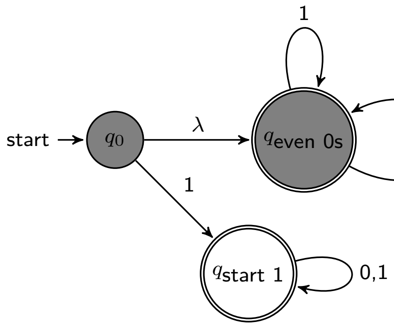


Current states $= \{q_0, q_{\text{even 0s}}\}$, $w = 1000$

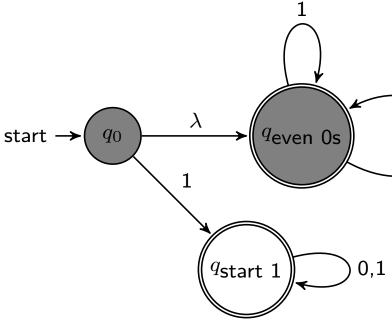


Now we will look at input symbols. The idea is that before we make a transition using symbols, we make any possible transitions using λ-moves first.

Current states $= \{q_0, q_{\text{even 0s}}\}$, $w = 1000$



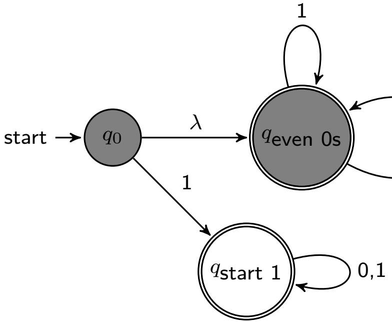
Current states $= \{q_0, q_{\text{even 0s}}\}$, $w = 1000$



Given the set of states and reading symbol '1', we need to look at all possible transitions based on our current states.

CSE 596 – NFA Runtime Example

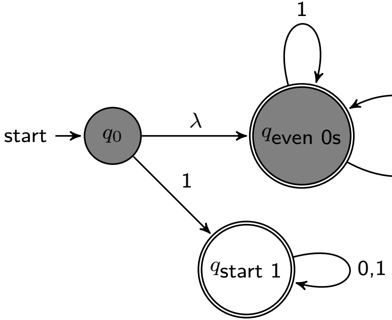
Current states $= \{q_0, q_{\text{even 0s}}\}$, $w = 1000$



Given the set of states and reading symbol '1', we need to look at all possible transitions based on our current states.

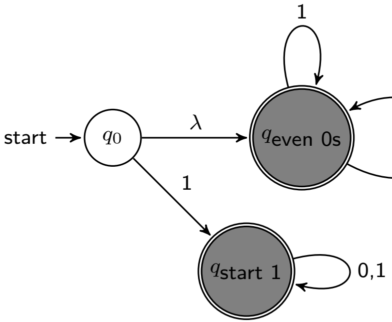
This gives: $\delta(q_0, 1) = \{q_{\text{start 1}}\}$ and $\delta(q_{\text{even 0s}}, 1) = \{q_{\text{even 0s}}\}$.

Current states $= \{q_0, q_{\text{even 0s}}\}$, $w = 1000$

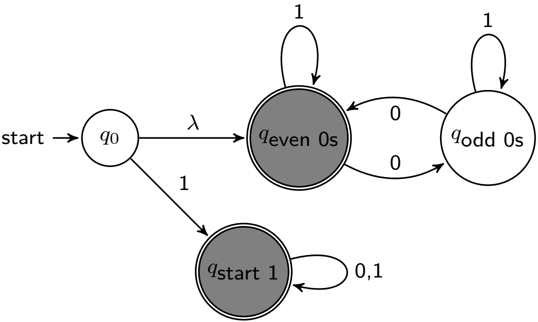


Given the set of states and reading symbol '1', we need to look at all possible transitions based on our current states.
This gives: $\delta(q_0, 1) = \{q_{\text{start 1}}\}$ and $\delta(q_{\text{even 0s}}, 1) = \{q_{\text{even 0s}}\}$.
We combine the results (take the union) to give us our new set of states: $\{q_{\text{start 1}}, q_{\text{even 0s}}\}$.

Current states $= \{q_{\text{start 1}}, q_{\text{even 0s}}\}$, $w = 1000$

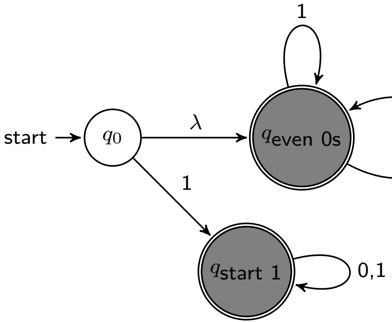


Current states $= \{q_{\text{start } 1}, q_{\text{even } 0\text{s}}\}$, $w = 1000$

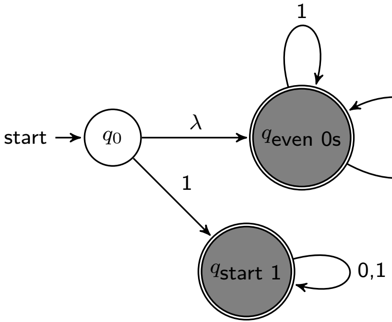


Before we make the transition for the next symbol, we have to ask if there are any λ-moves out of any of our current states, which there are not. If there were λ-moves we would keep adding states to the set via those moves until there were no more states to be added.

Current states $= \{q_{\text{start 1}}, q_{\text{even 0s}}\}$, $w = 1000$

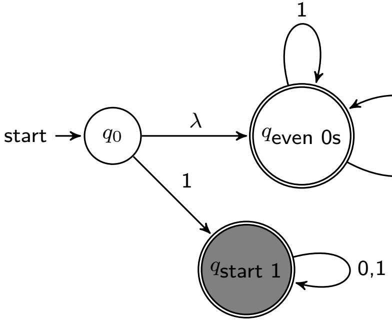


Current states $= \{q_{\text{start 1}}, q_{\text{even 0s}}\}$, $w = 1000$



Given this information, our new set of states becomes $\{q_{\text{start 1}}, q_{\text{odd 0s}}\}$. Again, there are no λ-moves from these states so this is our new set of states.

Current states $= \{q_{\text{start 1}}, q_{\text{odd 0s}}\}$, $w = 1000$



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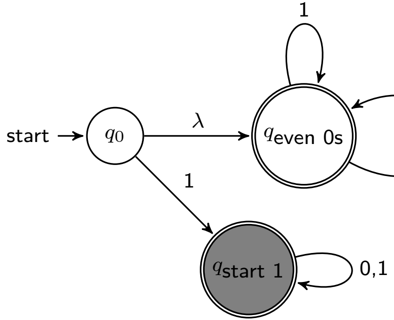
Current states $= \{q_{\text{start 1}}, q_{\text{odd 0s}}\}$, $w = 1000$



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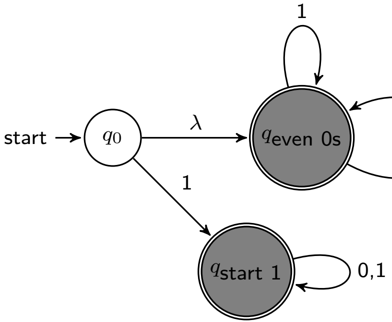
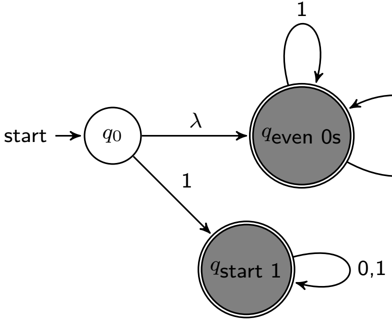


Current states $= \{q_{\text{start 1}}, q_{\text{even 0s}}\}$, $w = 1000$



Given this information, our new set of states becomes $\{q_{\text{start 1}}, q_{\text{odd 0s}}\}$

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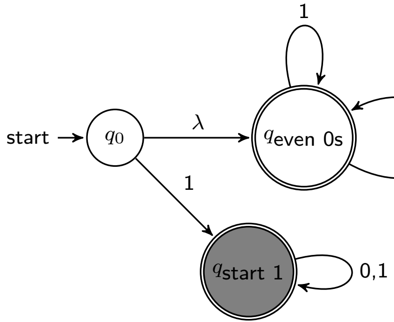
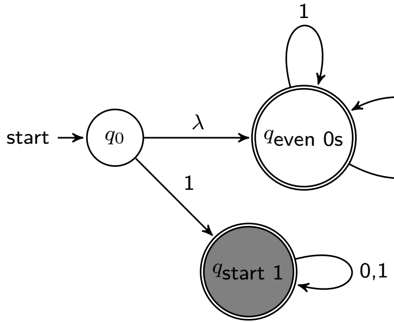
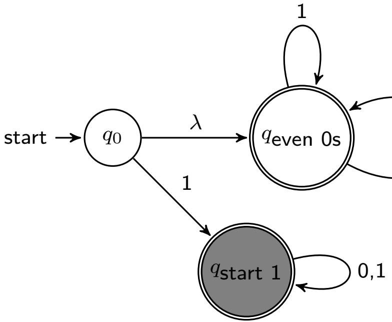


Current states $= \{q_{\text{start 1}}, q_{\text{odd 0s}}\}$, $w = 1000$



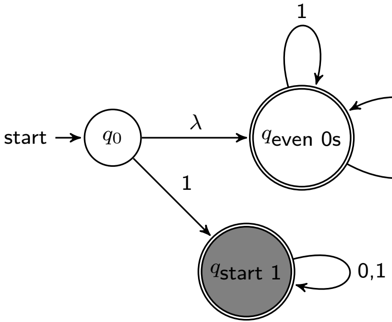
We have finished reading all the characters and all transitions are finished.

Current states $= \{q_{\text{start 1}}, q_{\text{odd 0s}}\}$, $w = 1000$



We have finished reading all the characters and all transitions are finished. Now we need to decide if this string was accepted by the NFA.

Current states $= \{q_{\text{start 1}}, q_{\text{odd 0s}}\}$, $w = 1000$



We have finished reading all the characters and all transitions are finished. Now we need to decide if this string was accepted by the NFA.

Well if any of our current states belong to F, i.e., are accepting, then we say the string is accepted. Since $q_{\text{start 1}} \in \mathrm{F}$ w is accepted by this NFA.