Converting an NFA to a DFA

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Given the NFA from Figure 1.

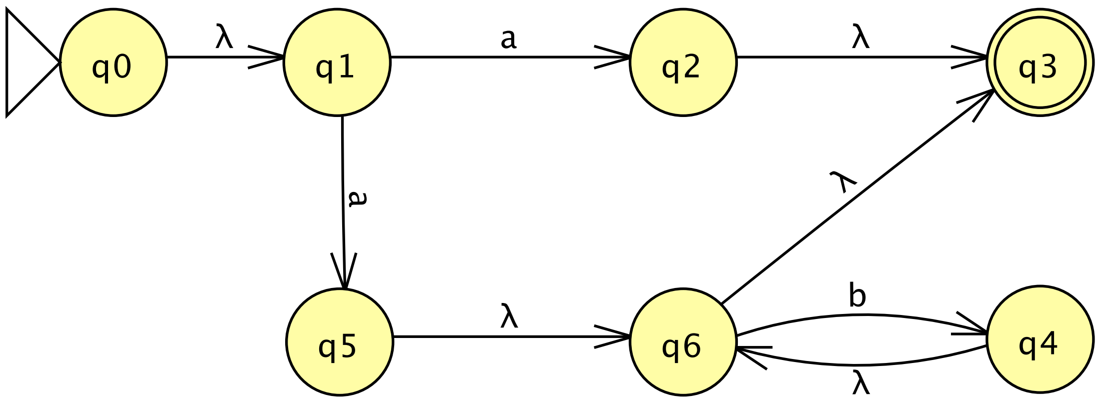

Figure 1: A nondeterministic finite automaton.

We'll begin by determining the ε-closure of the initial state q_0 which equals $\{q_0, q_1\}$. The latter set of states corresponds to the initial state of the DFA. For each symbol in the alphabet we compute $edge(D_0, symb)$ as the set of states which can be reached from $\{q_0, q_1\}$ by consuming $symb$. As such we compute $edge(D_0, a) = \{q_2, q_5\}$ and $edge(D_0, b) = \{\}$. The $DFAedge(D_0, a)$ equals the ε-closure of $\{q_2, q_5\}$ which gives us the set $\{q_2, q_3, q_5, q_6\}$. We have not yet encountered this set before, so we determine this set as the new state D_1 of the DFA. Note that the ε-closure of an empty set is again an empty set.

state D_x	input eg. a	$edge(D_x, symb)$	$DFAedge(D_x, symb)$	new state D_y
$D_0 = \{q_0, q_1\}$	a	$\{q_2, q_5\}$	$\{q_2, q_3, q_5, q_6\}$	D_1
D_0	b	$\{\}$	$\{\}$	-

We repeat these steps for each new state of the DFA we introduce. A DFA state is final if the corresponding $DFAedge(\ldots, \ldots)$ has at least 1 final state. In our example we have q_3 as final state of the NFA so the state $D_1 = \{q_2, q_3, q_5, q_6\}$ is a final state in the DFA. All of this results in the DFA of Figure 2.

state D_x	input eg. a	$edge(D_x, symb)$	$DFAedge(D_x, symb)$	new state D_y
$D_0 = \{q_0, q_1\}$	a	$\{q_2, q_5\}$	$\{q_2, q_3, q_5, q_6\}$	D_1
D_0	b	$\{\}$	$\{\}$	-
$D_1 = \{q_2, q_3, q_5, q_6\}$	a	$\{\}$	$\{\}$	-
D_1	b	$\{q_4\}$	$\{q_3, q_4, q_6\}$	D_2
$D_2 = \{q_3, q_4, q_6\}$	a	$\{\}$	$\{\}$	-
D_2	b	$\{q_4\}$	$\{q_3, q_4, q_6\}$	D_2

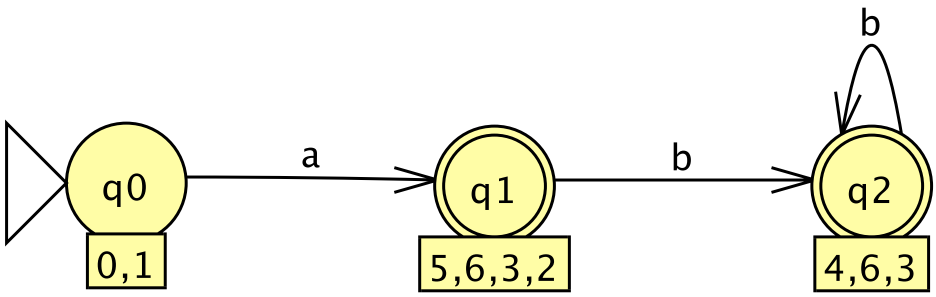

Figure 2: A deterministic finite automaton.