Equivalence of DFAs and NFAs

By-Chandana MN Rupa Sravya B

DFA

DFA refers to deterministic finite automata. Deterministic refers to the uniqueness of the computation. The finite automata are called deterministic finite automata if the machine is read an input string one symbol at a time.

NFA

NFA stands for non-deterministic finite automata.The finite automata are called NFA when there exist many paths for specific input from the current state to the next state.

Conversion from NFA to DFA

- M = (Q, ∑, δ, q0, F) is an NFA which accepts the language L(M).
- Equivalent DFA denoted by M' = (Q', ∑', q0', δ', F')
- such that L(M) = L(M').
- Q: finite set of states
- ∑: finite set of the input sym bol
- q0: initial state
- F: **final** state
- δ: Transition function

Steps for converting NFA to DFA:

Step-01:

- Let Q' be a new set of states of the DFA. Q' is null in the starting.
- Let T' be a new transition table of the DFA.

Step-02:

- Add start state of the NFA to Q'.
- Add transitions of the start state to the transition table T'.
- If start state makes transition to multiple states for some input alphabet, then treat those multiple states as a single state in the DFA.
- In NFA, if the transition of start state over some input alphabet is null,
- then perform the transition of start state over that input alphabet to a dead state in the DFA.

Step-03:

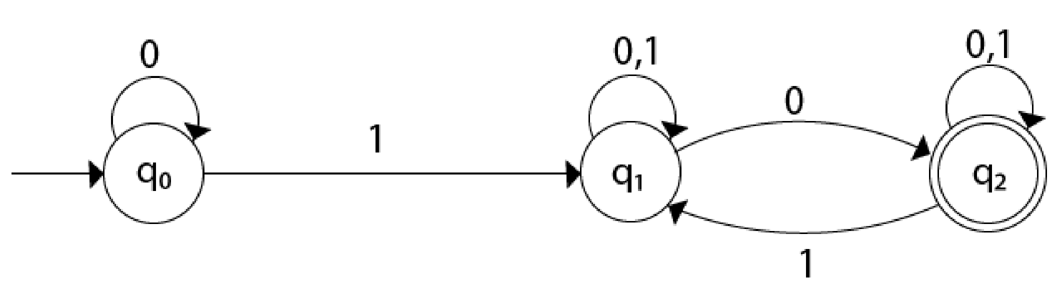
- If any new state is present in the transition table T',
- Add the new state in Q'.
- Add transitions of that state in the transition table T'.

Step-04:

- Keep repeating Step-03 until no new state is present in the transition table T'.
- Finally, the transition table T' so obtained is the complete transition table of the required DFA.

Example problem:

Convert the given NFA to DFA.



Step1: For the given transition diagram we will first construct the transition table.

State	0	1
→q0	q0	q1
q1	{q1, q2}	q1
*q2	q2	{q1, q2}

Now we will obtain δ' transition for state q0.

δ'([q0], 0) = [q0]
δ'([q0], 1) = [q1]

The δ' transition for state q1 is obtained as:

δ'([q1], 0) = [q1, q2]
δ'([q1], 1) = [q1]

The δ' transition for state q2 is obtained as:

δ'([q2], 0) = [q2]
δ'([q2], 1) = [q1, q2]

Now we will obtain δ' transition on [q1, q2].

δ'([q1, q2], 0) = δ(q1, 0) ∪ δ(q2, 0)
= {q1, q2} ∪ {q2}
= [q1, q2]
δ'([q1, q2], 1) = δ(q1, 1) ∪ δ(q2, 1)
= {q1} ∪ {q1, q2}
= {q1, q2}
= [q1, q2]

The state [q1, q2] is the final state as well because it contains a final state q2. The transition table for the constructed DFA:

State	0	1
→[q0]	[q0]	[q1]
[q1]	[q1, q2]	[q1]
*[q2]	[q2]	[q1, q2]
*[q1, q2]	[q1, q2]	[q1, q2]