CSC 339 – Theory of Computation
Fall 2022-2023

Tutorial 2
Converting NFA to DFA

Procedure

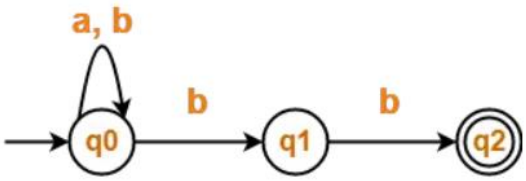
- **Step 1**
  - Let Q' be a new set of states of the DFA. Q' is null at the start.
  - Let T' be a new transition table of the DFA.
- **Step 2**
  - Add the start state of the NFA to Q'.
  - Add transitions of the start state to the transition table T'.
  - If the start state makes transitions to multiple states for some input alphabet, then treat those multiple states as a single state in the DFA.

Procedure

- **Step 3**
  - If any new state is present in the transition table T',
    - Add the new state in Q'.
    - Add the transitions of that state in the transition table T'.
- **Step 4**
  - Keep repeating Step 3 until no new state is present in the transition table T'.
- **Step 5**
  - Determine the final states.
    - In the resulting DFA, all the states that contain the final state(s) of the NFA are treated as final states.

Problem 1

- Convert the following NFA to DFA



Transition table for the NFA

State / Alphabet	a	b
→**q0**	q0	q0, q1
q1	–	*q2
***q2**	–	–

Step 1

- Let Q' be a new set of states of the Deterministic Finite Automata (DFA).
- Let T' be a new transition table of the DFA.

Step 2

- Add transitions of start state q0 to the transition table T’.

State / Alphabet	a	b
→**q0**	q0	{q0, q1}

Step 3

- A new state present in the set Q' is {q0, q1}.
- Add transitions for the set of states {q0, q1} to the transition table T'.

State / Alphabet	a	b
→**q0**	q0	{q0, q1}
{q0, q1}	q0	{q0, q1, q2}

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Step 4

- A new state present in the set Q' is {q0, q1, q2}.
- Add transitions for the set of states {q0, q1, q2} to the transition table T'.

State / Alphabet	a	b
→q0	q0	{q0, q1}
{q0, q1}	q0	{q0, q1, q2}
{q0, q1, q2}	q0	{q0, q1, q2}

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Step 5

- Since no new states are left to be added to the transition table T', we stop.
- States containing q2 as its component are treated as final states of the DFA.

Transition table for the DFA

- Finally, the transition table for the DFA is:

State / Alphabet	a	b
→**q0**	q0	{q0, q1}
{q0, q1}	q0	*{q0, q1, q2}
***{q0, q1, q2}**	q0	*{q0, q1, q2}

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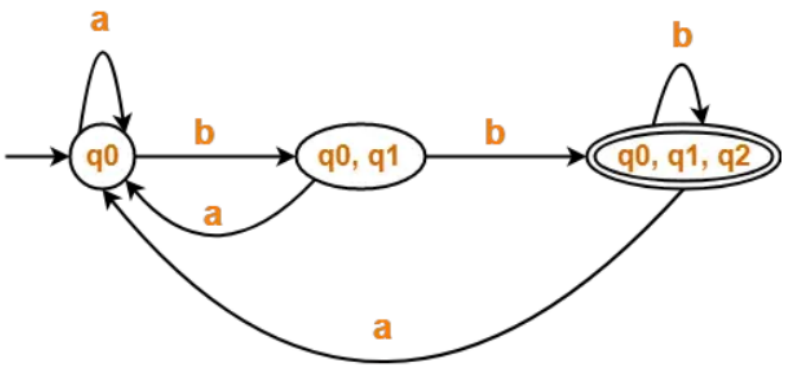
DFA



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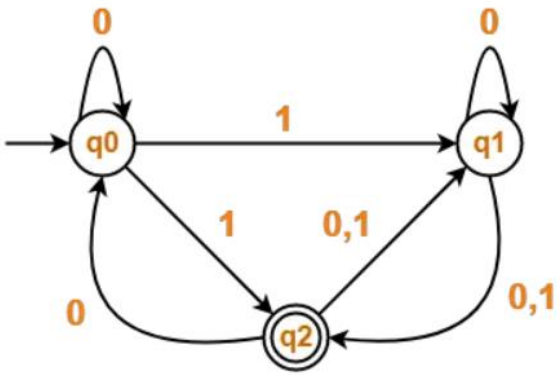
Problem 2

- Convert the following NFA to a DFA:



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Solution

- Transition table T’ of the DFA:

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

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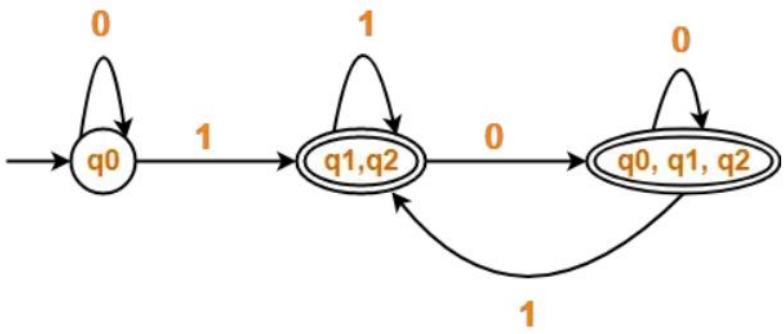
DFA



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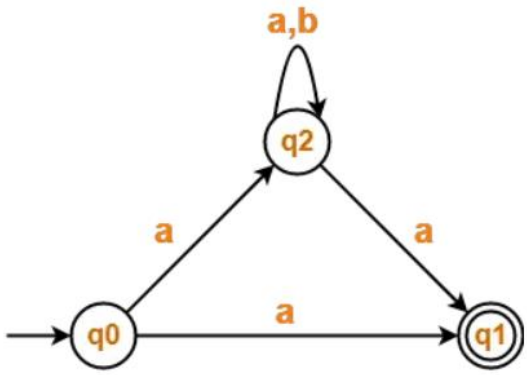
Problem 3

- Convert the following NFA to a DFA:

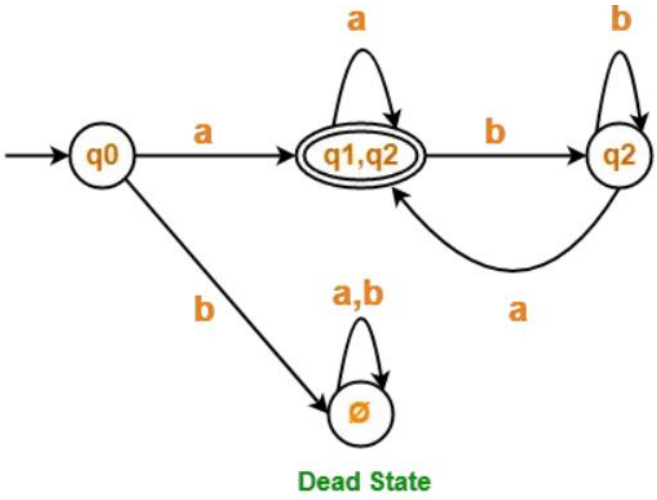


Solution

- Transition table T’ of the DFA:

State / Alphabet	a	b
→q0	*{q1, q2}	Ø
*{q1, q2}	*{q1, q2}	q2
q2	*{q1, q2}	q2
Ø	Ø	Ø

DFA



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