

The DFA minimization is the process of reducing states in a deterministic finite automaton (DFA) and maintaining its language recognition abilities.

That means, DFA minimization is aimed at finding a DFA with the least number of states that can recognize the same language as the original DFA.

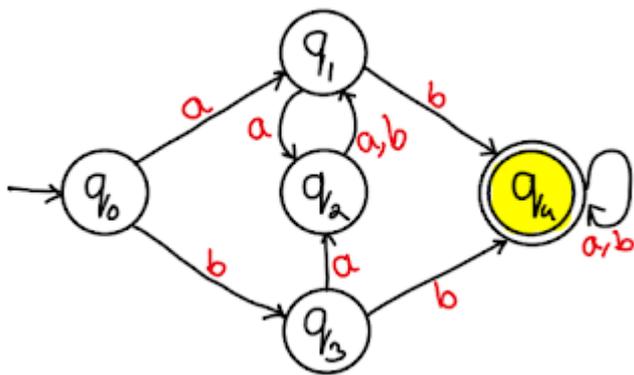
Some of the benefits of minimizing DFA:

- Reduced memory usage: DFAs with fewer states require less memory to store. This can be important for applications where memory usage is a constraint.
- Improved computational efficiency: DFAs with fewer states can process strings more quickly. This can be important for applications where processing speed is a concern.
- Enhanced understanding: DFAs with fewer states are generally easier to understand and analyze. This can be helpful for debugging and maintaining DFAs.
- Simplified hardware implementation: DFAs with fewer states are more amenable to hardware implementation. This can be important for applications where performance is critical.

Example of DFA minimization:

Construct a minimum state automata equivalent to given automata?

(RGPV 2008)



Solution:

Transition table for above automata.

State	Input = a	Input = b
->q0 Initial state	q1	q3
q1	q2	q4
q2	q1	q1
q3	q2	q4
q4 Final state	q4	q4

Step 01: Remove steps which are unreachable from initial states.

Step 02: Split final states and non final states.

- $A_0 = \{q_4\}$
- $A_1 = \{q_0, q_1, q_2, q_3\}$
- $\pi_0 = \{q_4\}, \{q_0, q_1, q_2, q_3\}$
- A_0 cannot be partition further.

In A_1 ,

- q_0 is 1 equivalent to q_2 for input a , but not equivalent to q_1 and q_3 .
- q_1 is 1 equivalent to q_3 for input a and b , but not to q_0 and q_2 .

So, A_1 can be partitioned as,

- $B_0 = \{q_0, q_2\}$
- $B_1 = \{q_1, q_3\}$
- $\pi_1 = \{q_4\}, \{q_0, q_2\}, \{q_1, q_3\}$

Now, B_0 and B_1 can not be partitioned further.

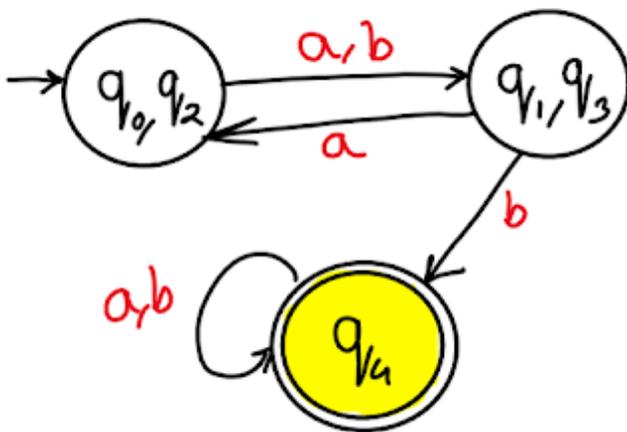
- $\pi_2 = \{q_4\}, \{q_0, q_2\}, \{q_1, q_3\}$
- $\pi_2 = \pi_1$

In minimized DFA, we have three states,

- $\{q_4\}$,
- $\{q_0, q_2\}$,
- $\{q_1, q_3\}$

Minimized DFA:

State	Input = a	Input = b
-> {q0,q2} Initial state	{q1,q3}	{q1,q3}
{q1,q3}	{q0,q2}	{q4}
{q4} Final state	{q4}	{q4}



Reference:

- Introduction to the Theory of Computation” by Michael Sipser.

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