DFA To RE

State elimination method

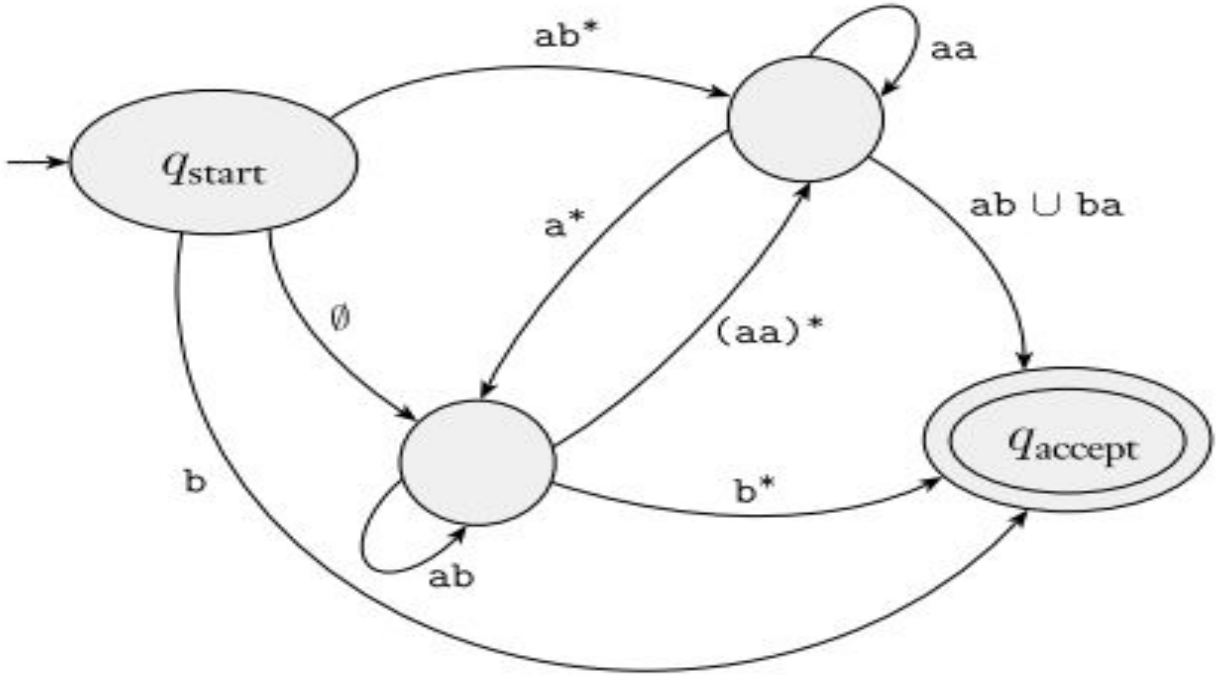
Procedure - State Elimination Method

- **Step 1 – DFA to New finite automaton GNFA**
  - **Add a new start state with epsilon transition from old start state.**
  - **Add a new final state with epsilon transition from old one.**
  - **GNFA - same as NFA**
  - **It have regular expression on transitions**
  - **Connect two states by reading a block of string**
- **Step 2 - GNFA to RE**

Rules of GNFA

- **Start state has outgoing arrow but no arrow coming**
- **Single final state ; no outgoing arrow only incoming arrows.**
- **Every state (except for start and accept) have one arrow goes from every state to every other state, and also a self loop to each state.**

Example of GNFA

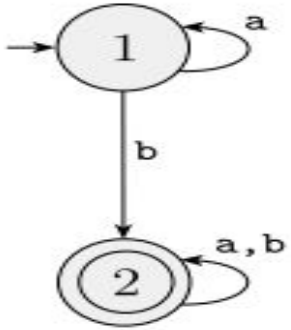


Basics

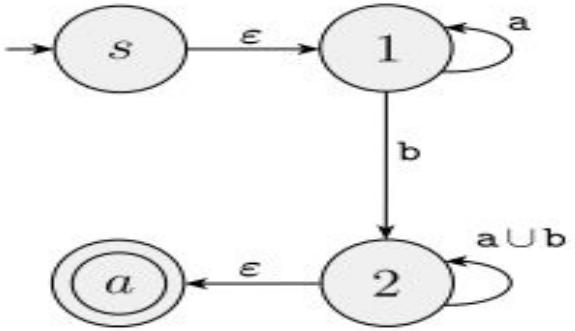
- Self- loop does not count as Inward or Outward edge
- If multiple final states are present, connect them all to the same Final state with epsilon transition
- Omit dead states at the beginning
- Sequence of elimination does not matter

Process

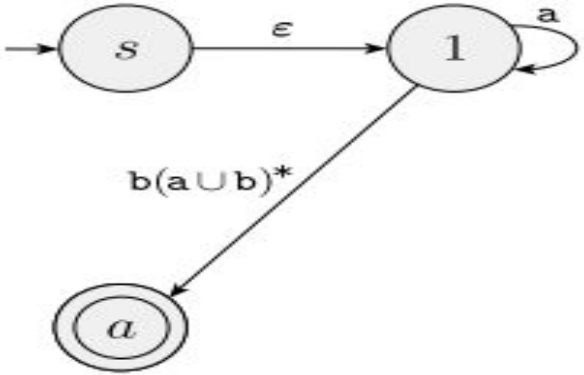
- Need to eliminate all states that are not start or final
- While elimination, we need to preserve EVERY transition
- Map every inward edge of a eliminating state to every outward edge



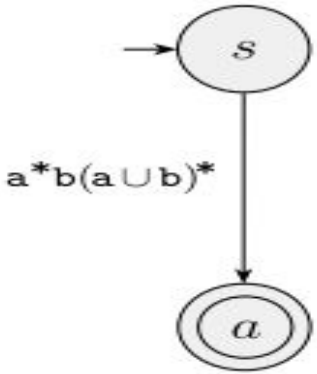
(a)



(b)



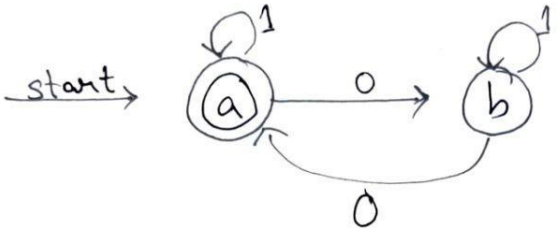
(c)



(d)

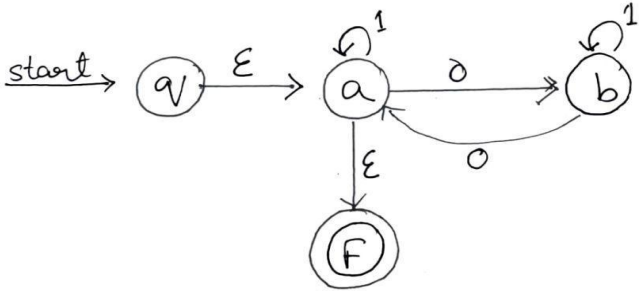
DFA that accepts the language of strings containing even number of 0s over the alphabets $\Sigma = \{0, 1\}$.

DFA :-



Step 1 :- 1. Create new start state as 'a' has an inward edge.

2. Create new final state as 'a' has an outward edge.



Step 1 :- 1. Create new start state as 'a' has an inward edge.

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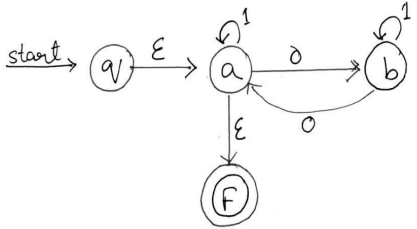
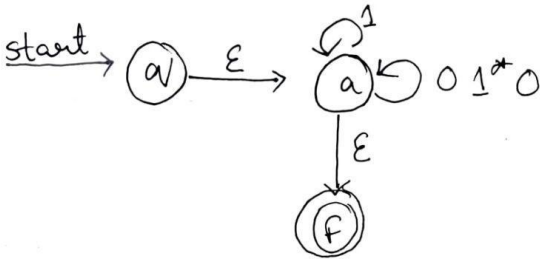
∴



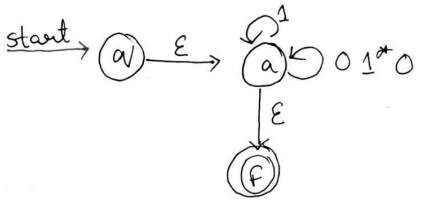
Step 2 :- Eliminate 'b' by mapping all of its inward edges to all of its outward edges

∴ $a \xrightarrow{0} b \xrightarrow{1^*} b \xrightarrow{0} a = 01^*0$



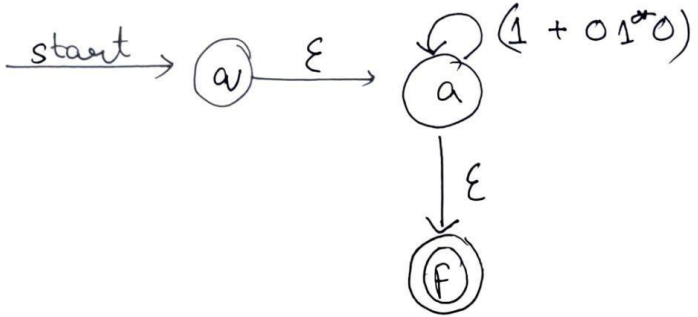
Step 2: Eliminate 'b' by mapping all of its inward edges to all of its outward edges

$\therefore a \xrightarrow{0} b \xrightarrow{1^* 0} a = 01^*0$



'a' already had a self-loop. Expressions sharing the same edge/transition are connected by union

$\therefore$



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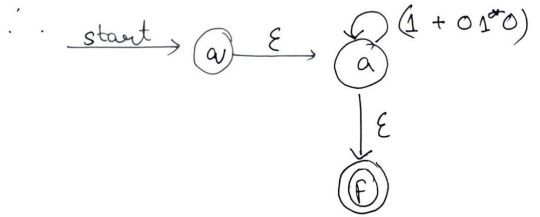
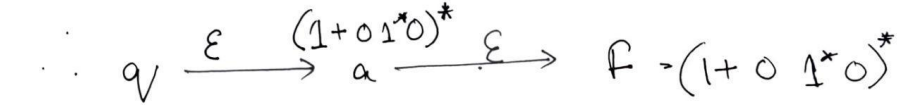
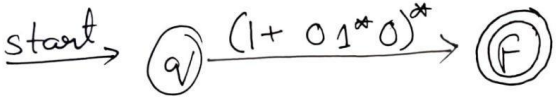


Step 3 :- Eliminate 'a' by mapping all of its inward edges to all of its outward edges.





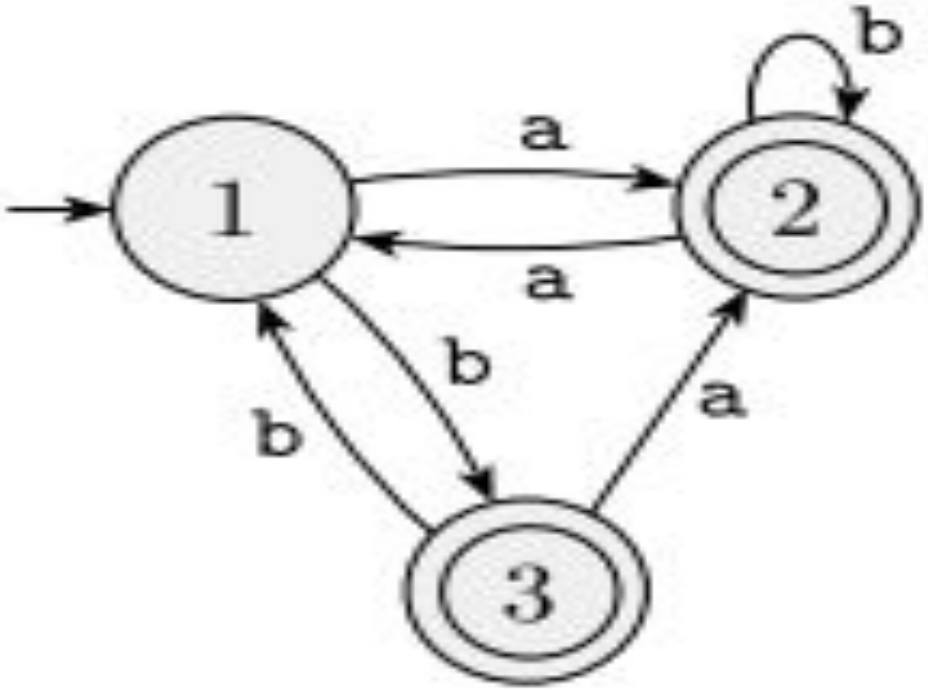
Step3 :- Eliminate 'a' by mapping all of its inward edges to all of its outward edges.

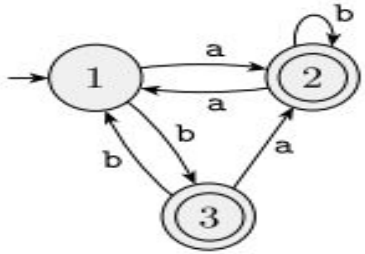
$\therefore q \xrightarrow{\varepsilon} a \xrightarrow{(1+01^*0)^*} a \xrightarrow{\varepsilon} f \rightarrow (1+01^*0)^*$

$\therefore$ start → (q) $\xrightarrow{(1+01^*0)^*}$ (f)

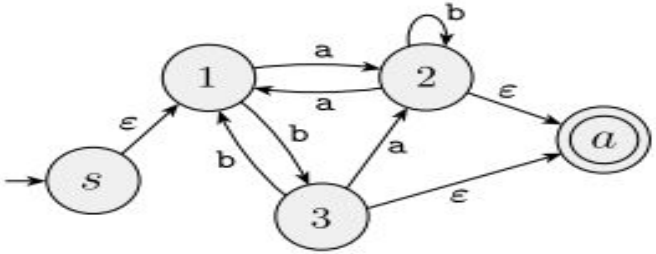
Step4 :- No other step to eliminate as only start and final states are left. $\therefore$ RE

$= (1+01^*0)^*$

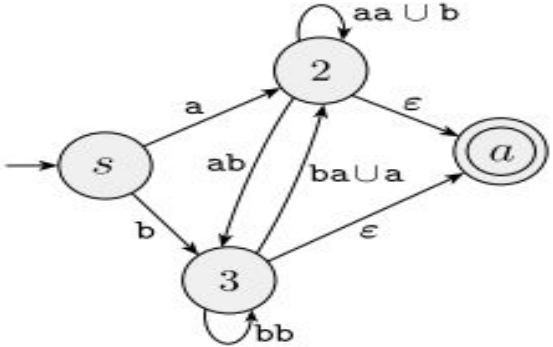

1
2
3
a
a
b
b
b
a



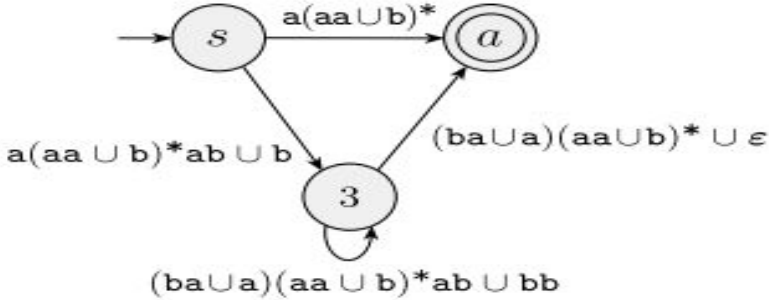
(a)



(b)



(c)



(d)

(a(aa∪b)*ab∪b)((ba∪a)(aa∪b)*ab∪bb)*((ba∪a)(aa∪b)* ∪ε)∪a(aa∪b)*