

DFA to RE

If a language is regular, then it is described by a regular expression.

DFA / NFA \rightarrow RE



Properties of GNFA

(1) transition $\xrightarrow{a, b}$ block of alphabets

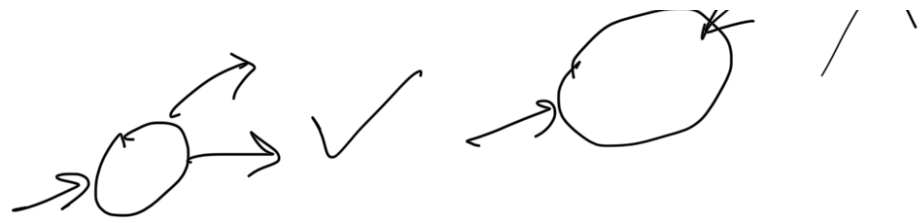
block of alphabets

- b ✓
- ab ✓
- aba ✓
- aa ✓
- ab^* ✓
- a ✓

} RE

(2) One start state.
No incoming arrows towards start state.

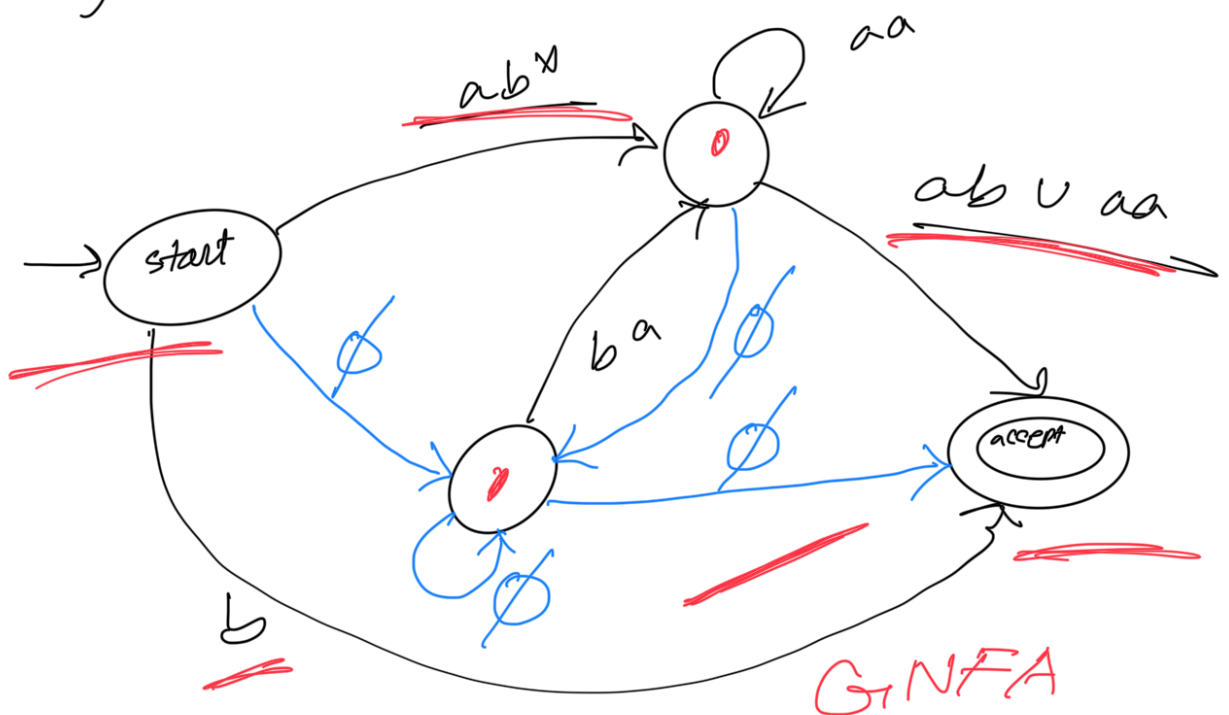


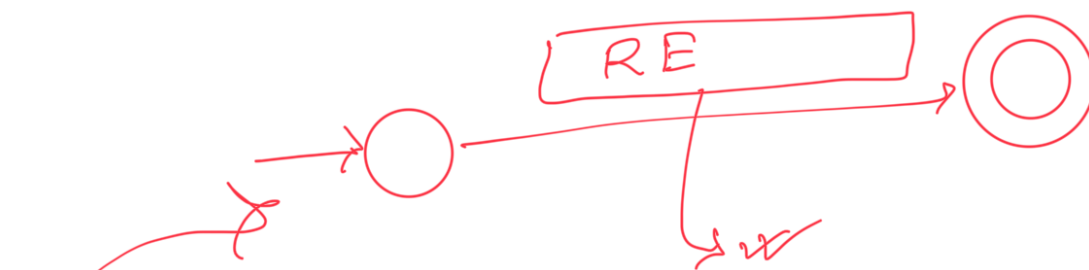
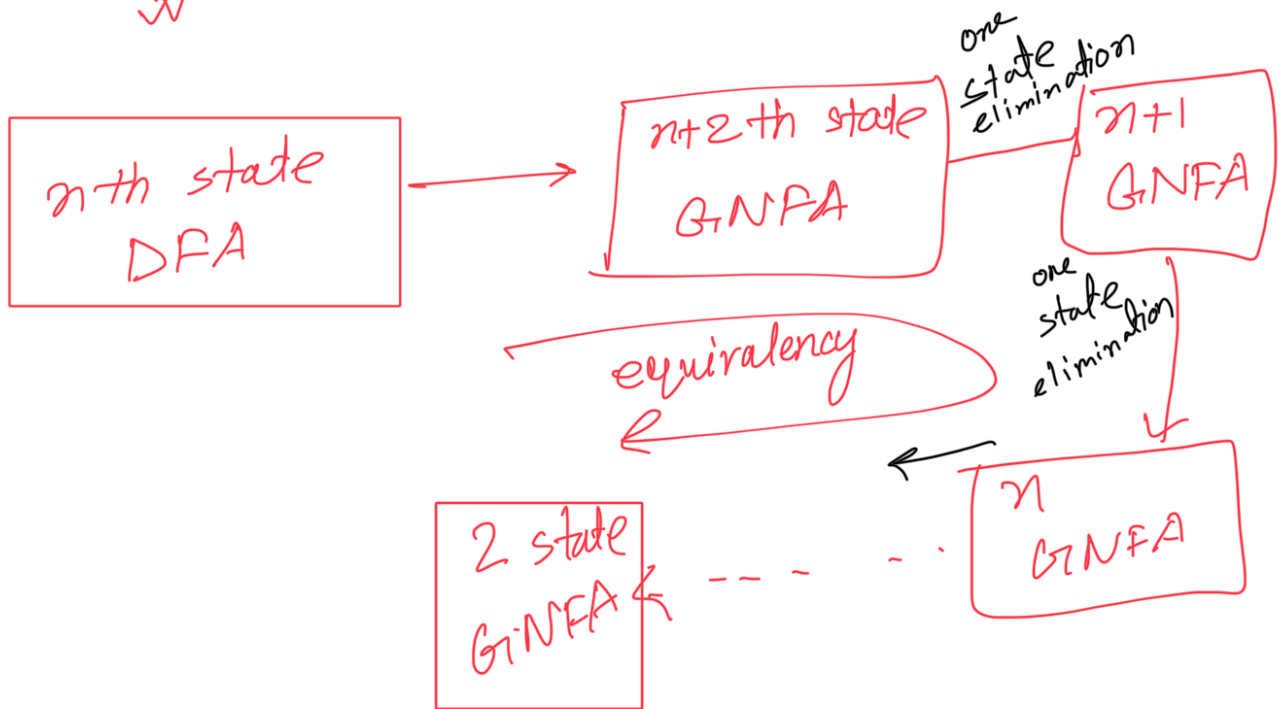
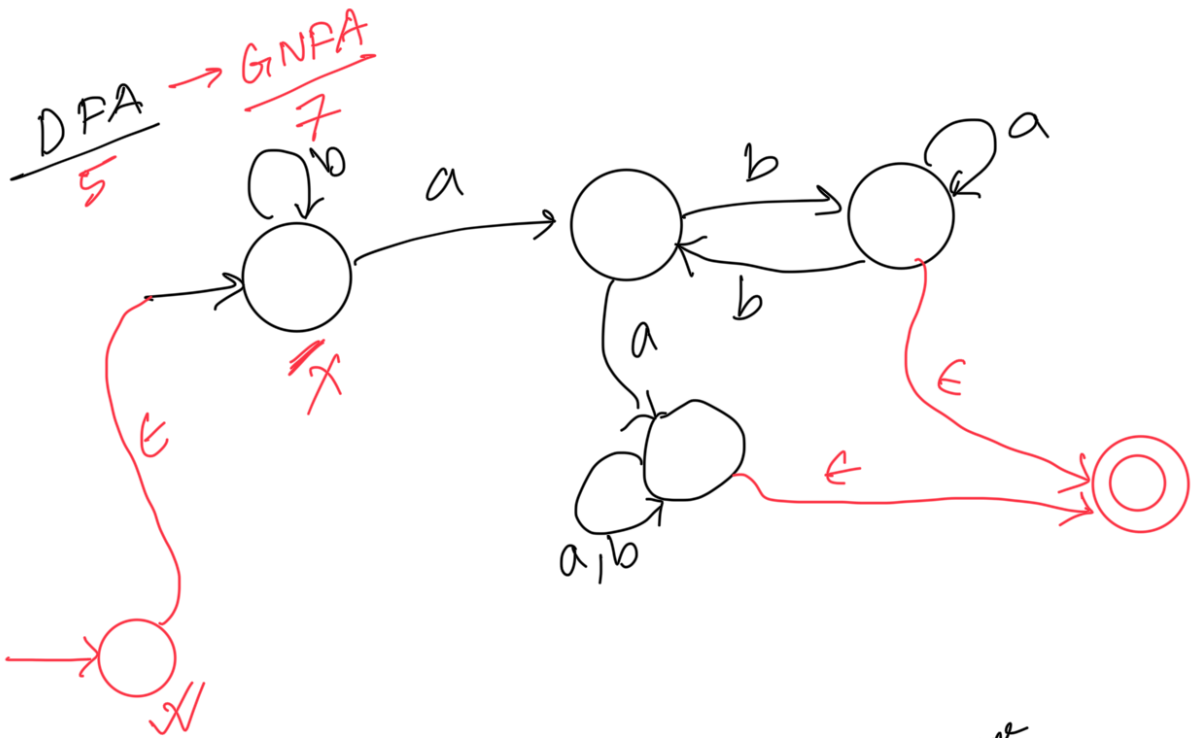


- ③ One accepting state
No outgoing arrows from accepting state.



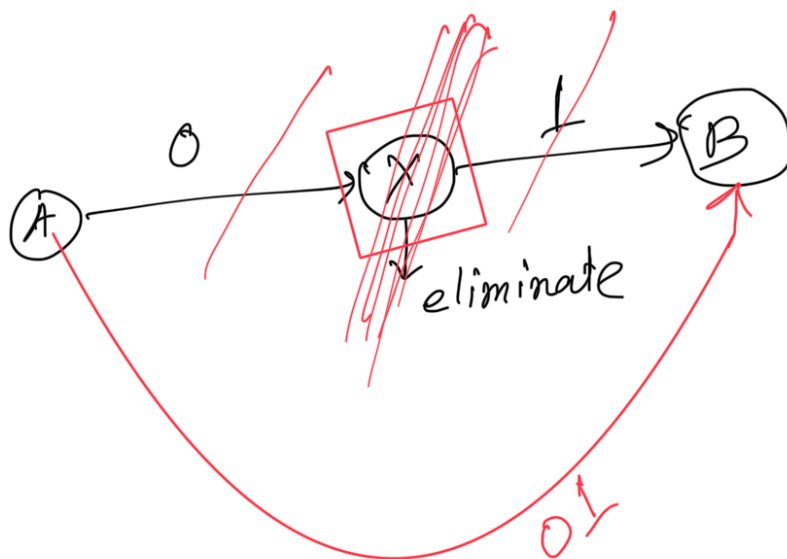
- ④ Except for the start and accepting states, one arrow goes from every state to every other state and also from each state to itself.





3 DFA \rightarrow 5 \leq GNFA \rightarrow 9 \leq GNFA
 \downarrow
 ... 3 \leq GNFA

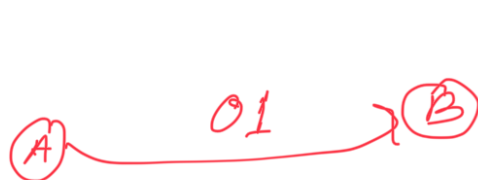
2's GNFH ←



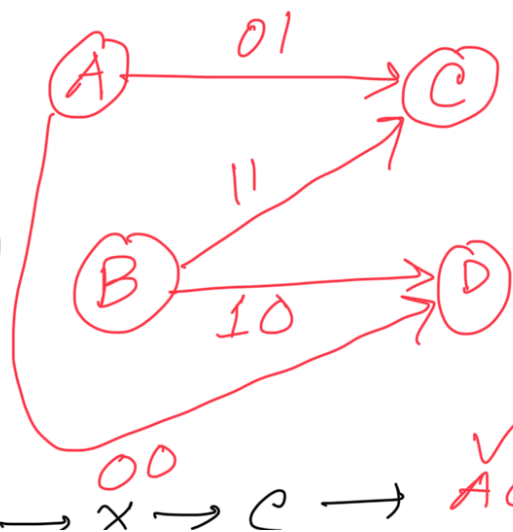
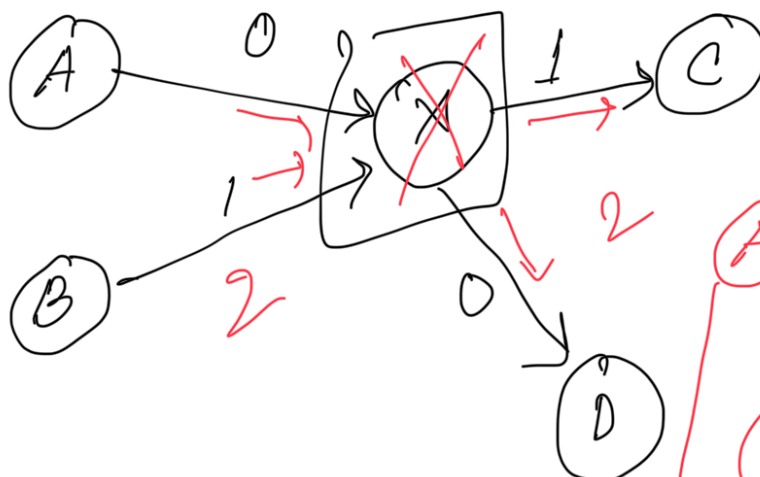
string = 01



$A \rightarrow B = 01$
via X



$A \rightarrow B = 01$

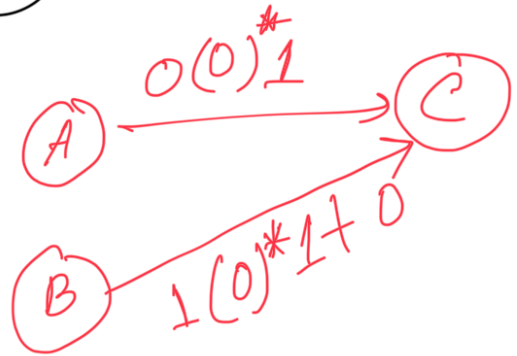
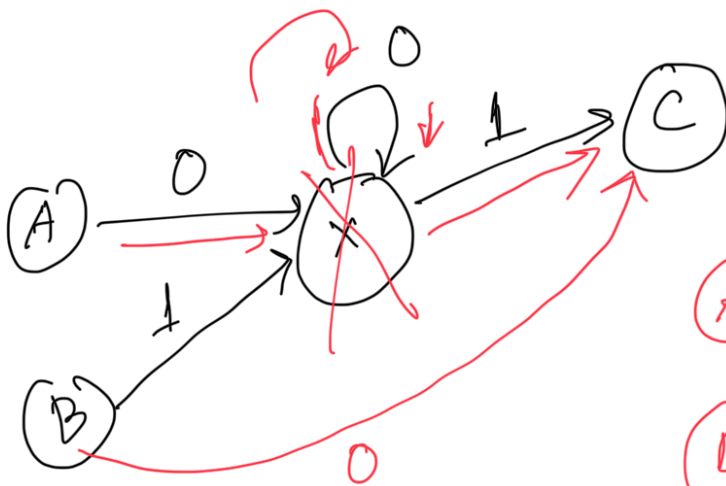
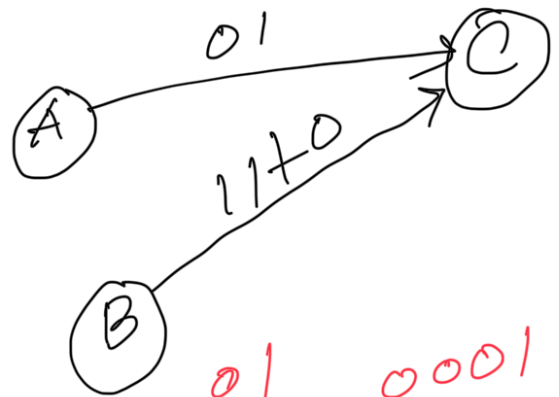
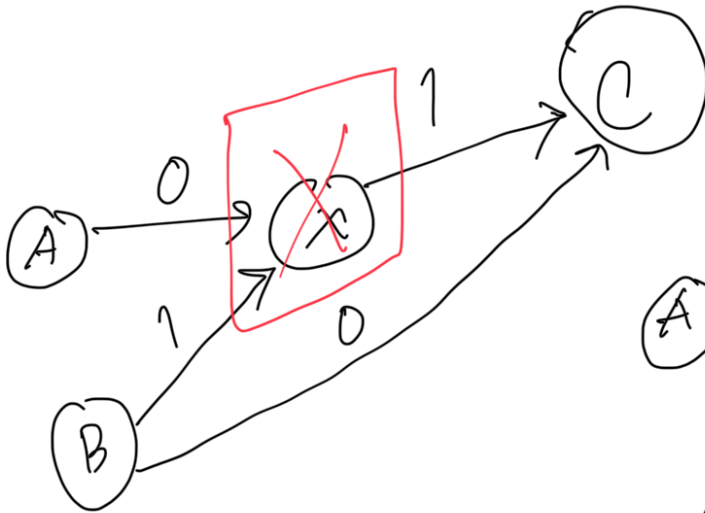


of incoming

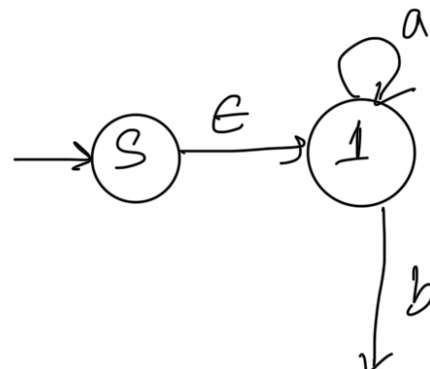
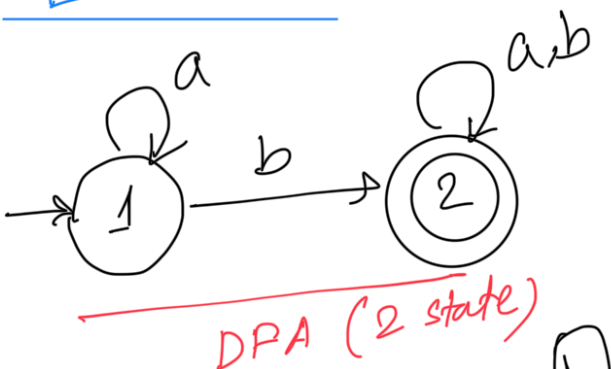
$A \rightarrow X \rightarrow C \rightarrow \checkmark AC$

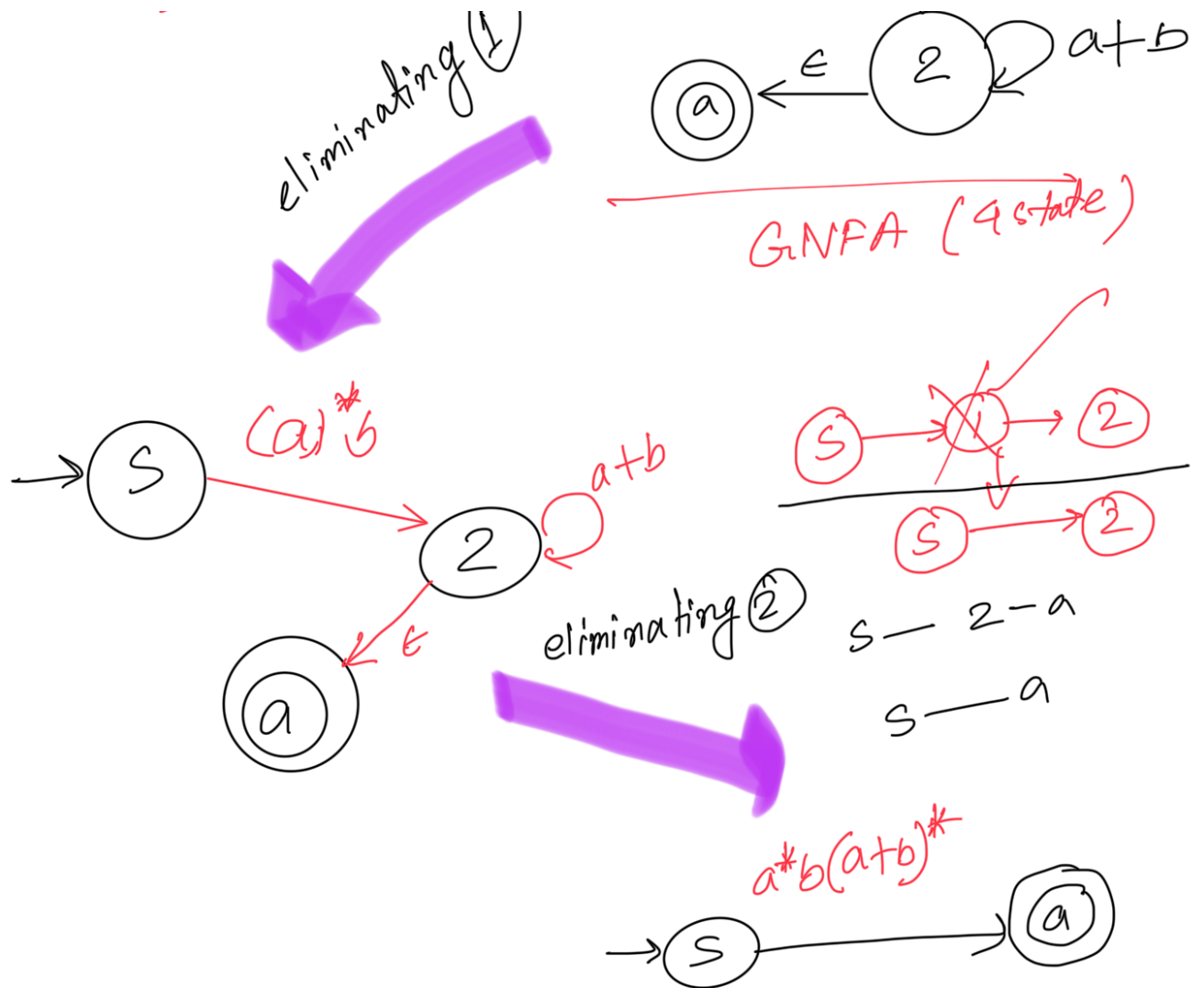
^X
of outgoing

$A \rightarrow X \rightarrow D \rightarrow AD \checkmark$
 $B \rightarrow X \rightarrow C \rightarrow BC \checkmark$
 $B \rightarrow X \rightarrow D \rightarrow BD \checkmark$

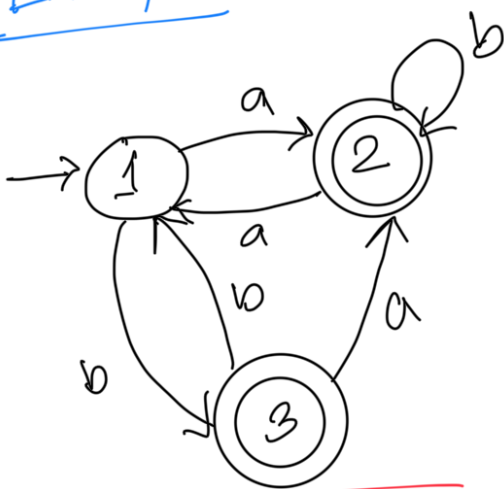


Example

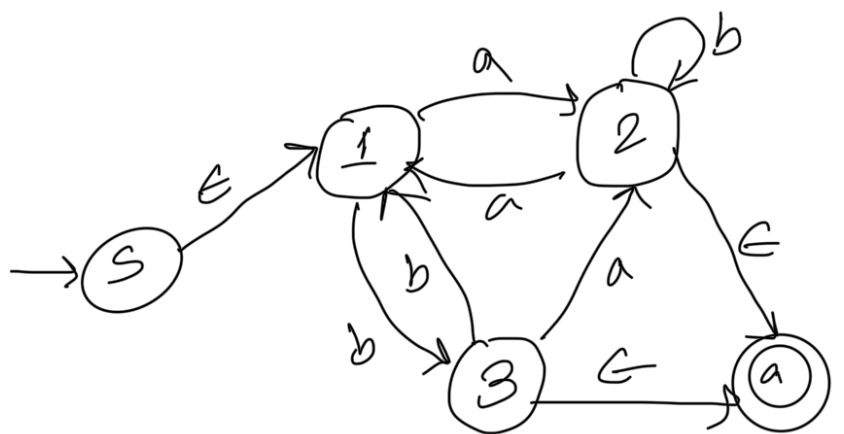




Example



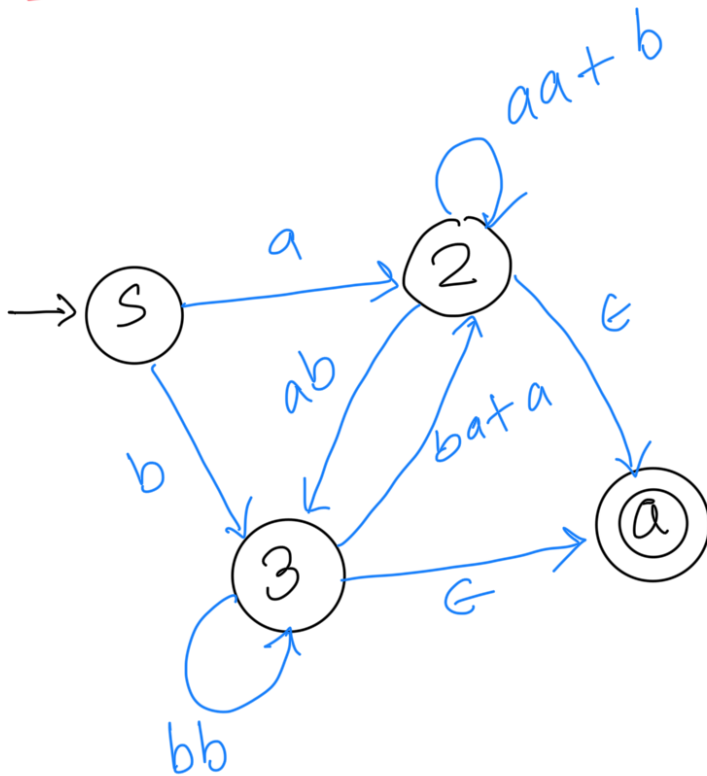
DFA



GNFA

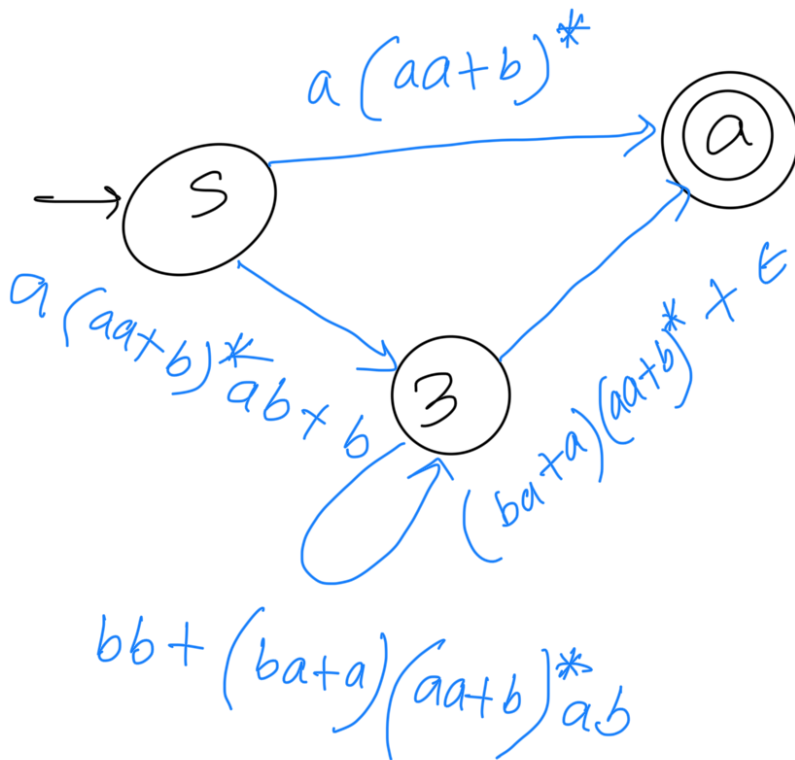
eliminate state in this seq: $(1) \rightarrow (2) \rightarrow (3)$

After eliminating ①



$\checkmark S \rightarrow 1 \rightarrow 2 \checkmark$
 $3 \rightarrow 2 \checkmark S \rightarrow 1 \rightarrow 3 \checkmark$
 $\checkmark 3 \rightarrow 1 \rightarrow 2 \checkmark$
 $2 \rightarrow 3 \checkmark 2 \rightarrow 1 \rightarrow 3 \checkmark$
 $3 \rightarrow 3 \checkmark 2 \rightarrow 1 \rightarrow 3 \checkmark$
 $2 \rightarrow 2 \checkmark 2 \rightarrow 1 \rightarrow 2 \checkmark$
 $2 \rightarrow 2 \checkmark$

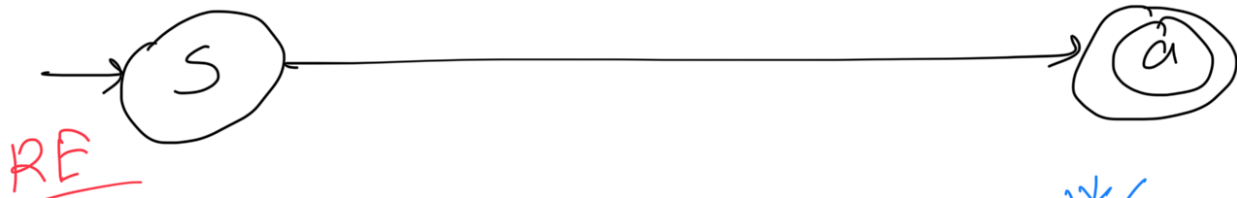
After eliminating ②



$S \rightarrow a \checkmark$
 $S \rightarrow 2 \checkmark S \rightarrow 2 \rightarrow a$
 $S \rightarrow 3 \checkmark S \rightarrow 2 \rightarrow 3$
 $3 \rightarrow a \checkmark 3 \rightarrow 2 \rightarrow a$
 $3 \rightarrow 3 \checkmark 3 \rightarrow 2 \rightarrow 3$

$S \rightarrow 3 \rightarrow a$

After eliminating ③



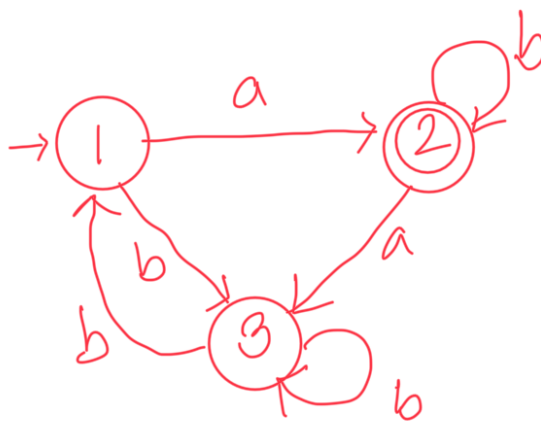
RE

$$(a(aab)^*ab + b)(bb + (ba + a)(aab)^*ab)^* \left((ba + a)(aab)^* + \epsilon \right) + a(aab)^*$$

Practice Problems

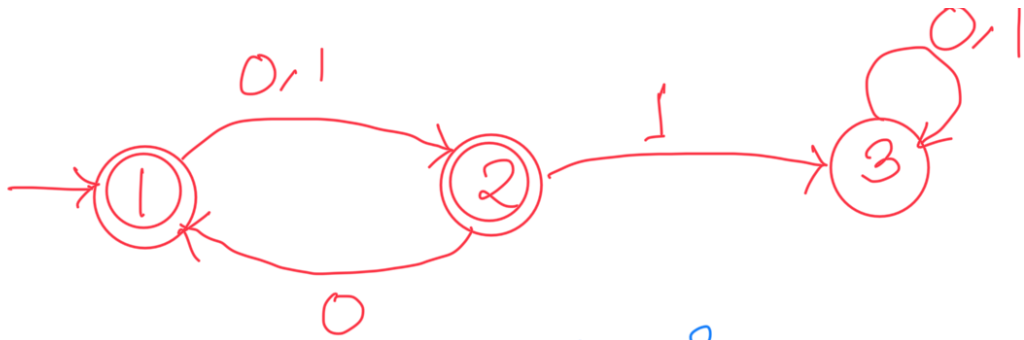
* Convert the following DFAs to Regular Expressions. The sequences of the states need to be eliminated are mentioned below.

①



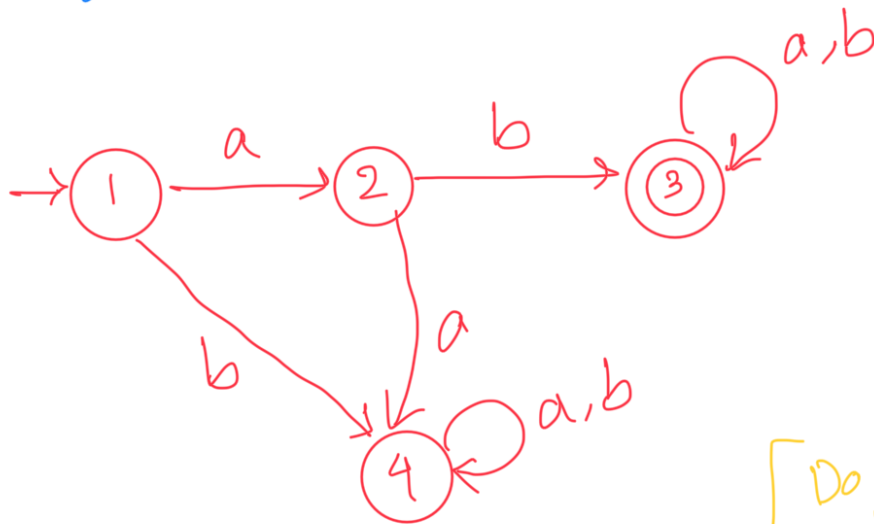
seq. of states: 3, 1, 2.

②



Seq of states: 1, 3, 2

③



Seq of states: 3, 2, 4

[Do you really need to add an extra start state??]