Operations:

(1) Union

Eg: L: Starts & ends with different symbols

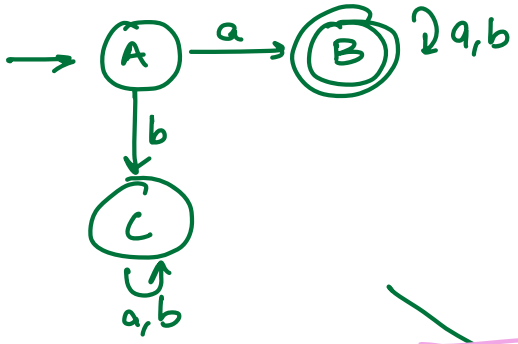
$\Sigma = \{a, b\}$

L_1 = Starts with a & ends with b

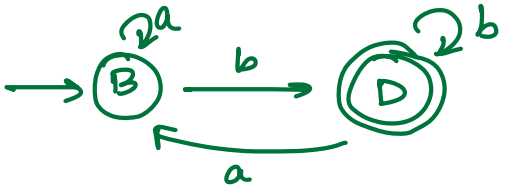
L_2 = Starts with b & ends with a

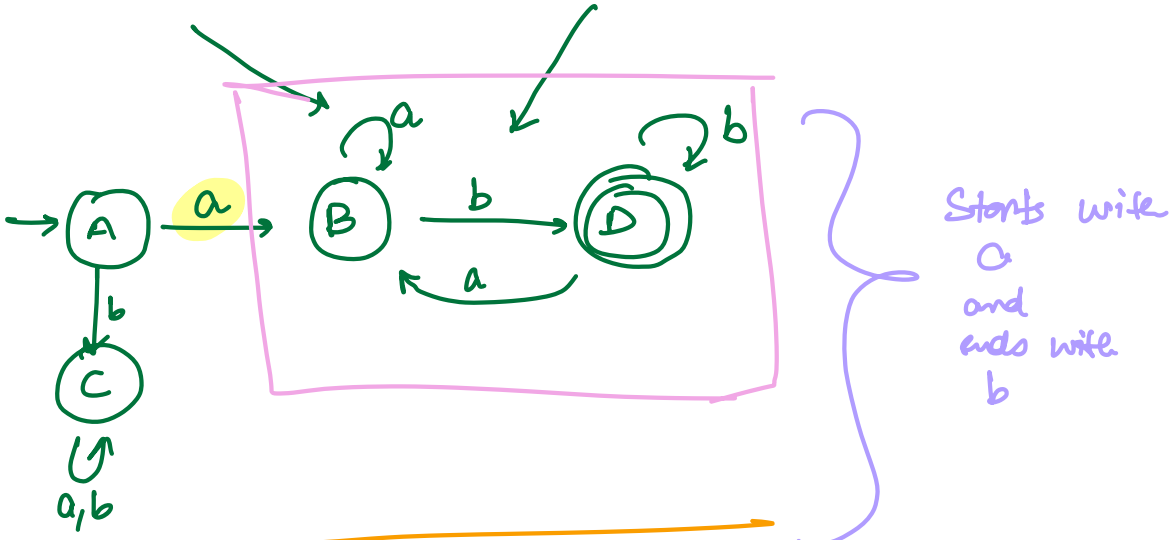
$L = L_1 \cup L_2$

L_1: Starts with a

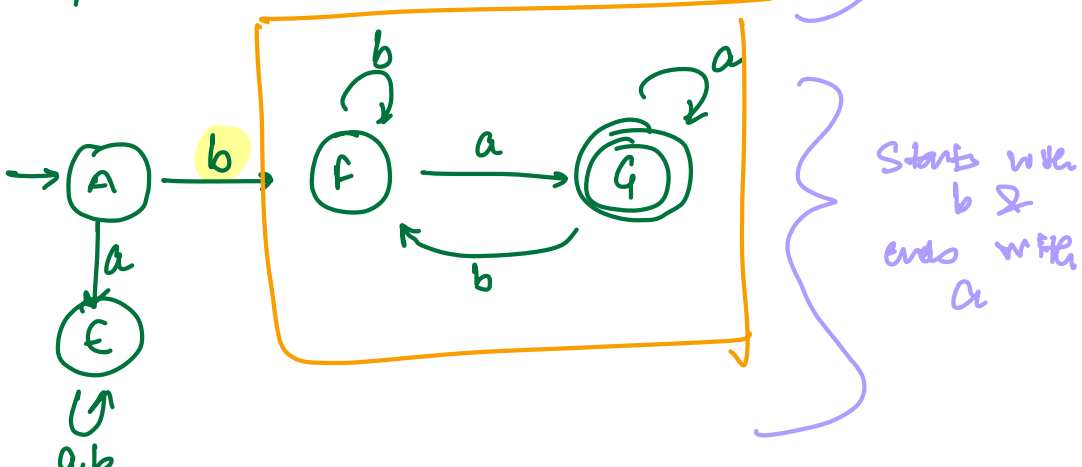


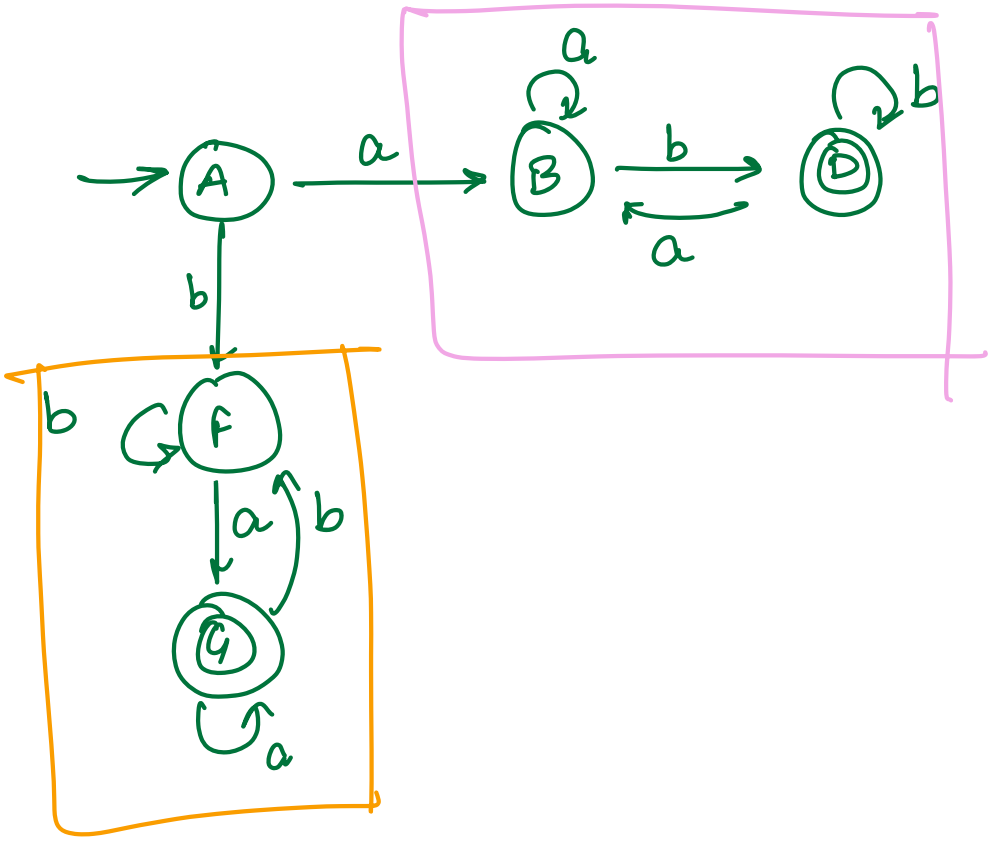
Ends with b





L_2:



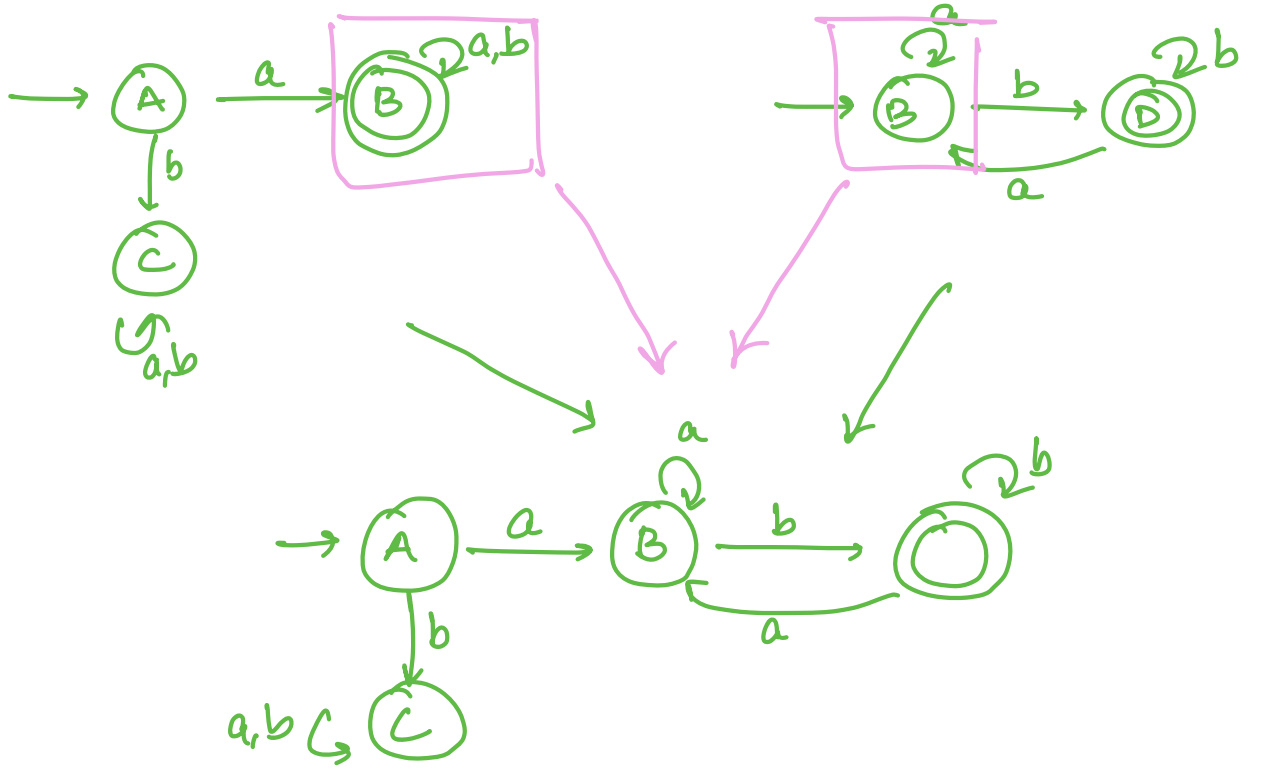


(2) Concatenation

DFA: Starts with 'a' & ends with b

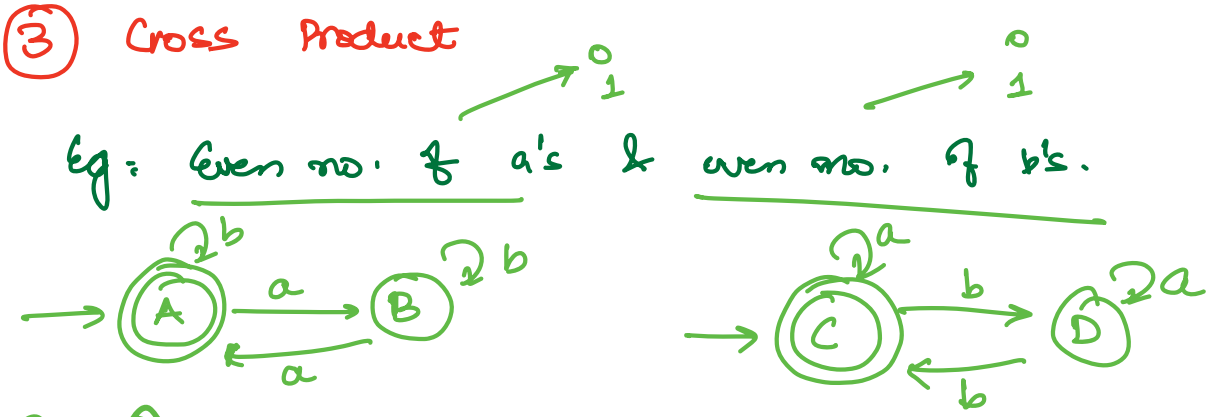
L_1 L_2

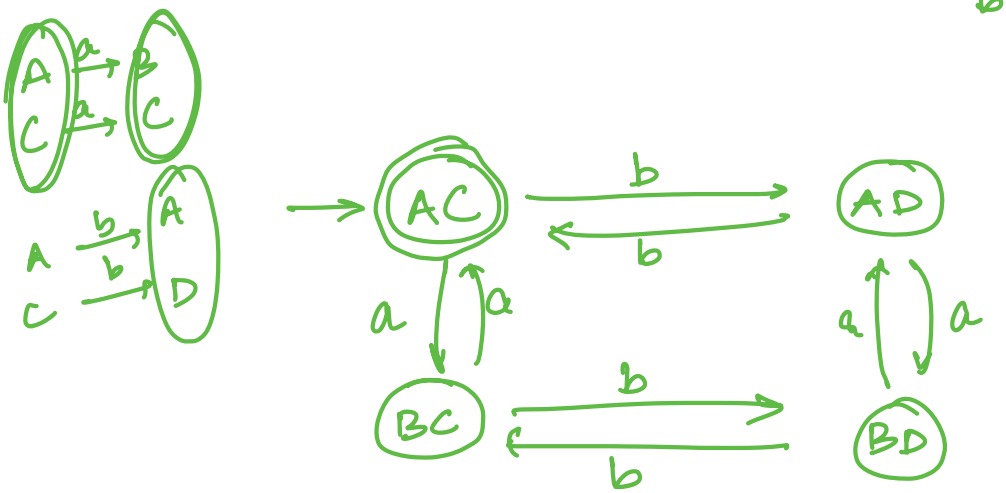
$L_1 = \{a, ab, abb, aba \dots\}$ $L_2 = \{b, bb, ab, aab \dots\}$

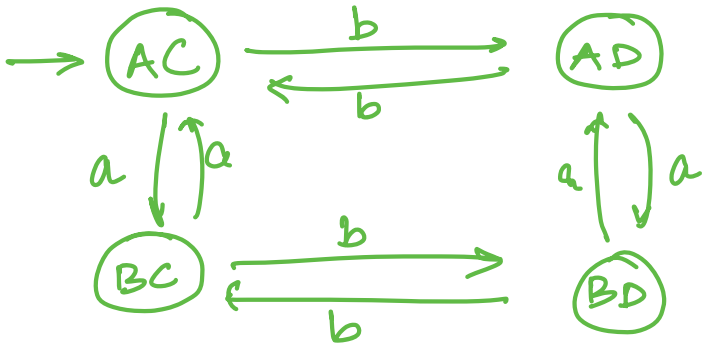


(3) Cross Product

eg: Even no. of a's & even no. of b's.







$n_a(\omega) \% 2 = n_b(\omega) \% 2$

0 0
1 1

AC, BD

$n_a(\omega) \% 2 \geq n_b(\omega) \% 2$

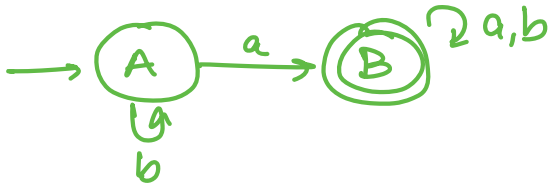
0 0
1 1

3 final state: AC, BC, BD

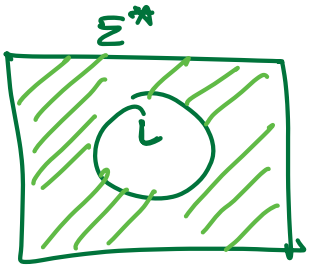
(4) Complementation

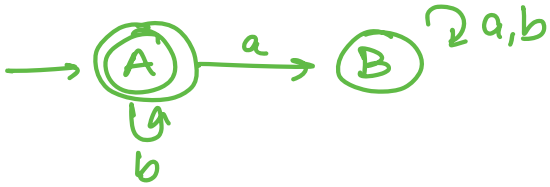
$\Sigma = \{a, b\}$

L = contains 'a' = { a, ab, ba, aba, bbba, ... }



$\bar{L}$ = not containing a = $\Sigma^* - L$

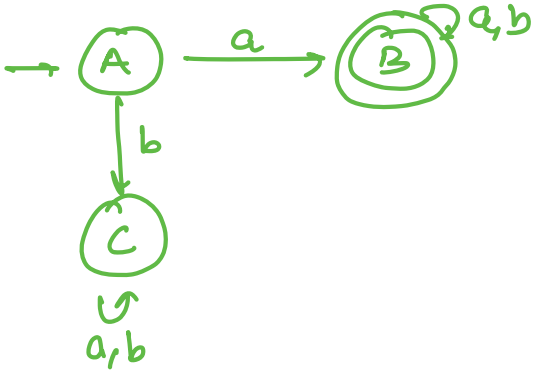




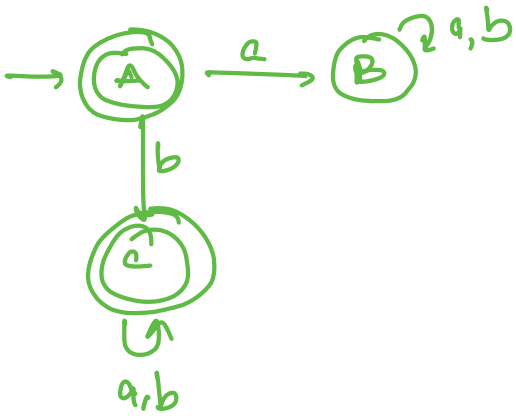
non final state → final state

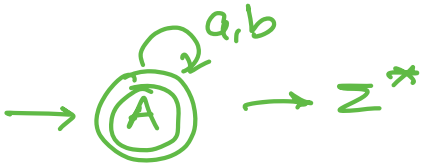
final state → non final state

L = starts with a



$\bar{L}$ = doesn't start with a





ϕ

$L = \{\ \}$

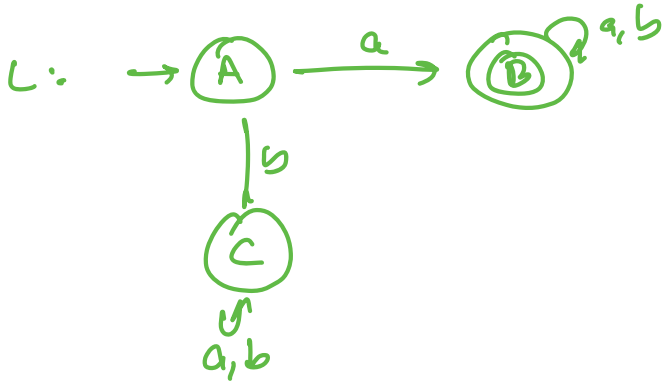
(5) Reversal

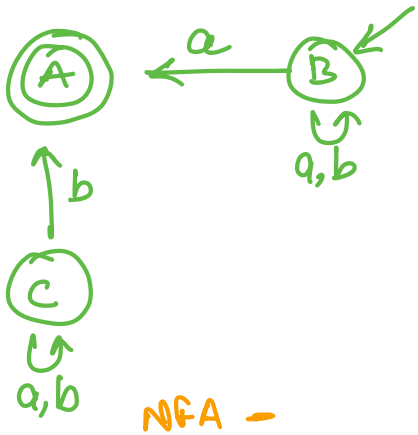
L = starts with a

$= \{a, ab, aab, \ldots\}$

L^R = take each string of L & reverse it

$= \{a, ba, baa, \ldots\}$



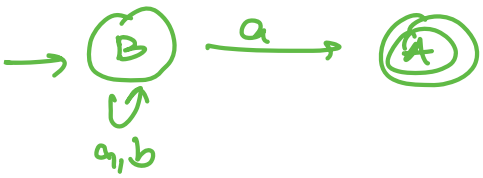


NFA -

unreachable -

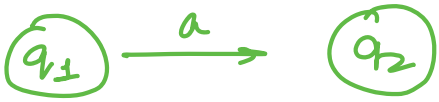
DfA for L^R:

- Draws states as it is
- final state → initial state
- initial state → final state
- reverse the edges

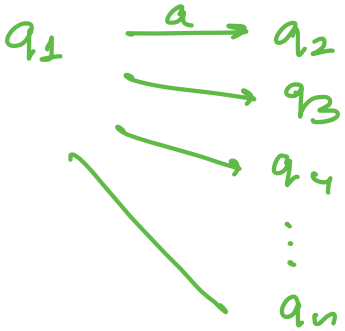


Non Deterministic finite Automata (NFA):

DfA:

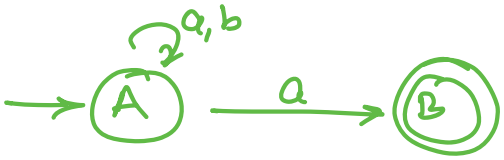


NFA:

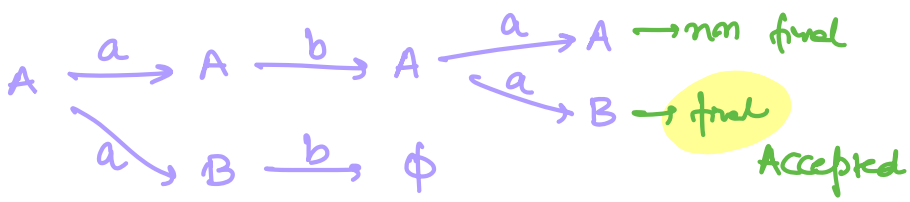


Eg: $\Sigma = \{a, b\}$ NFA

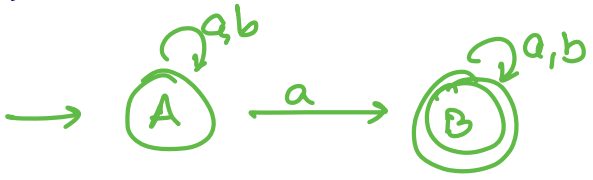
Strings ends with 'a'



'aba'



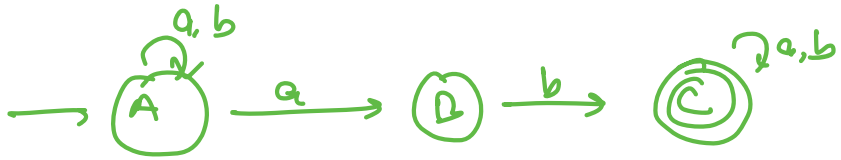
Eg: Contains a



Eg: Starts with a

Eg: Starts with 'ab'

Eg: Contains 'ab'



Eg: Ends with 'ab'