

# DFA into Reg. Exp.

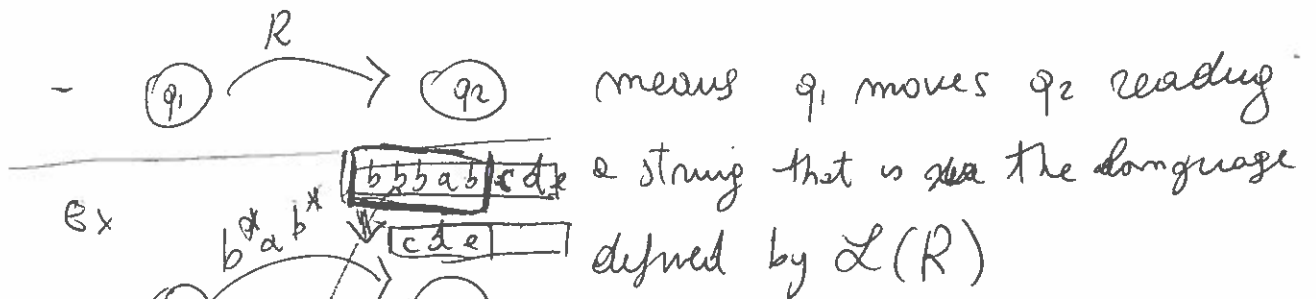
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Strategy:  $DFA \Rightarrow \underset{\substack{\text{generalised} \\ \text{non-deterministic}}}{GNFA} \Rightarrow R.E.$

GNFA =

NFA with

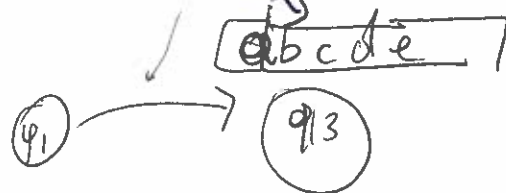
- labels = R.E.s.



non-deterministic because:

- $\epsilon$ -transition

- ~~$b^*$~~  "starts with  $b$  and end ~~with~~  $bb$ "



Restrictions:

- ACCEPT STATE = no unbound arrow
- FINAL STATE = - only 1!  
- only double arrow
- EVERY OTHER = ALL ONE! arrow to everyone but ACCEPT

~~Examples from PL~~

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DFA  $\Rightarrow$  GNFA  $\Rightarrow$  R.E

expands

DFA  $\Rightarrow$   
K-states

imit GNFA  
K+2 states

$\Rightarrow$

GNFA  
K+1

$\Rightarrow$

GNFA  
~~K~~

$\Rightarrow$

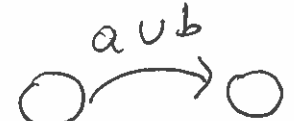
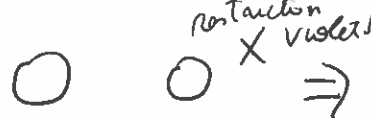
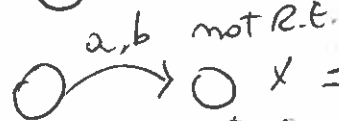
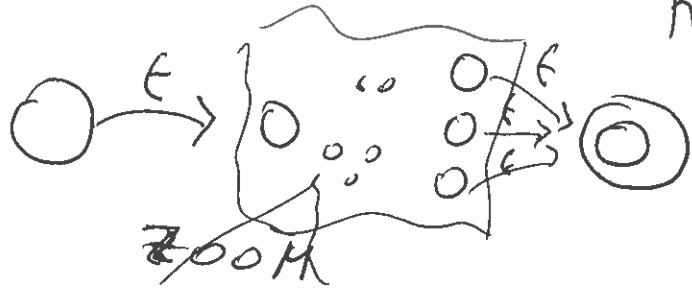
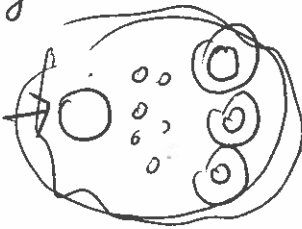
GNF  
K-1

GNF  
2 states

REFINEMENT

$\Downarrow$   
R.E.

easy



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GNFA  $\Rightarrow$  GNFA  
 $K$ -state  $\Rightarrow$   $K$ -STATE - 1  
 $K > 2$

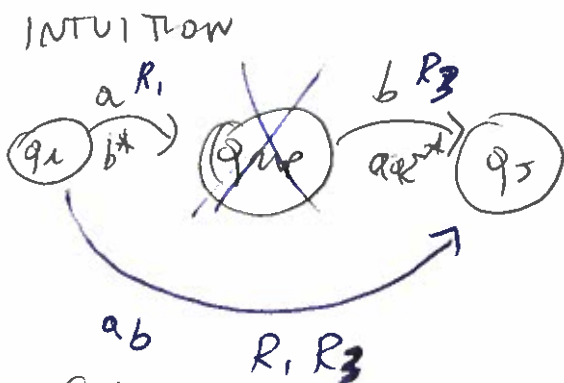
GNFA  $\Rightarrow$  RE :  $q_{acc} \xrightarrow{R} q_{rej}$  ~~between R~~  
 2-states

At least 1 state in the middle (no  $q_{acc}$ , no  $q_{rej}$ )  
 select one, and we rip it out of the machine  
 but adjusting the GNFA to do to preserve  
 the accepted string.  
 The new labels compensate for the absence of  $q_{rip}$

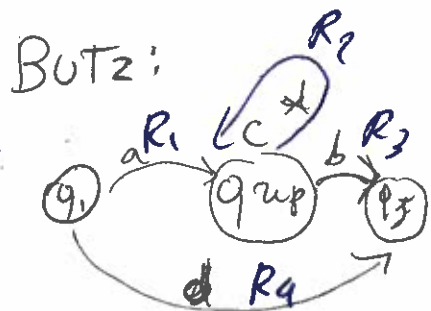
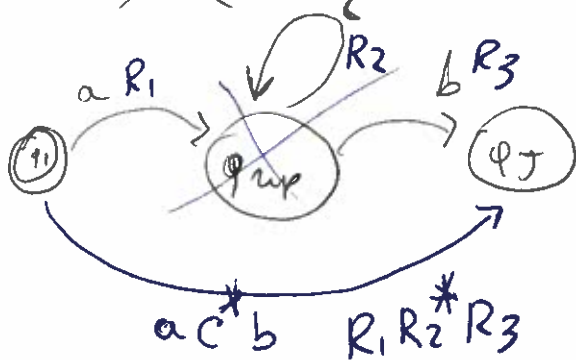
- remove  $q_{rip}$

- adjust:

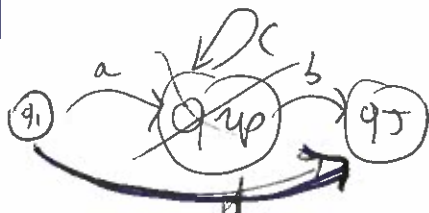
BASIC:



BUT 1:

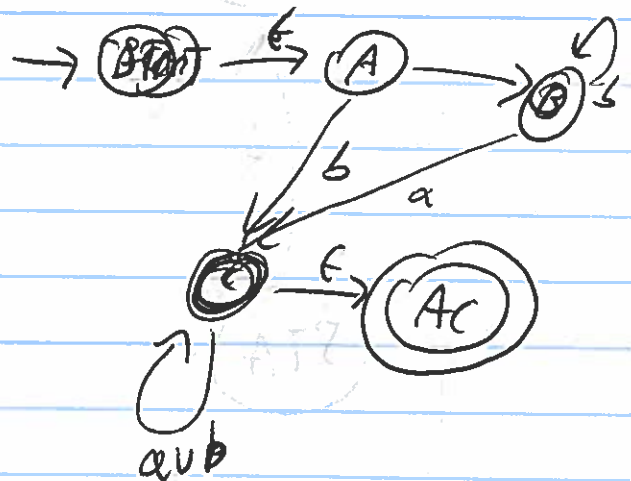
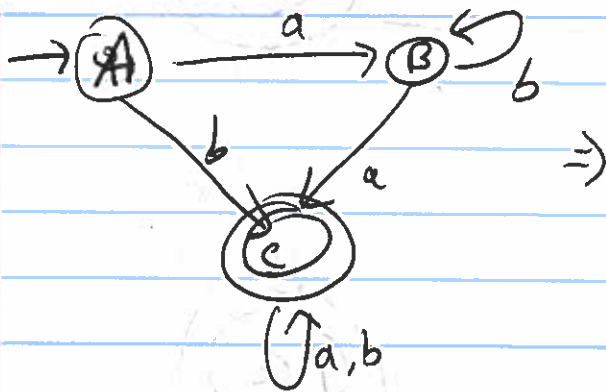


instruction = 1 arrow!

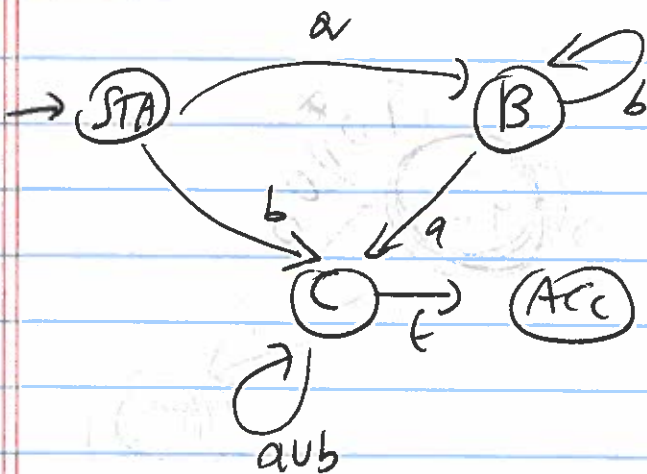


$(R_1 (R_2^* R_3) \cup R_4$

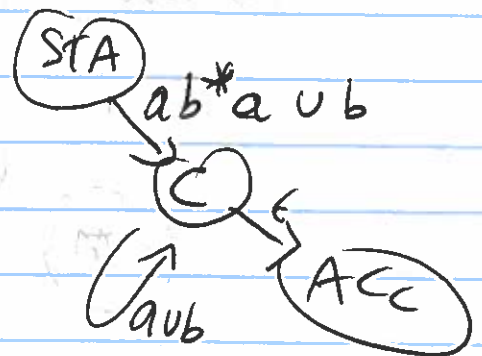
EXAMPLE DFA  $\Rightarrow$  REG (12)



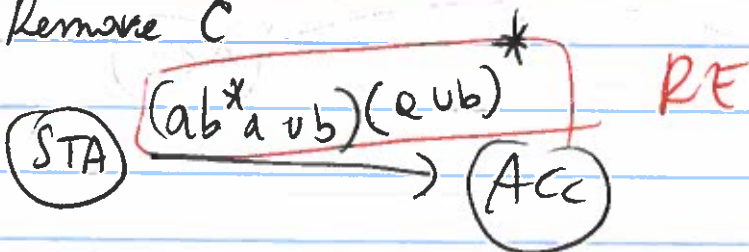
Remove A

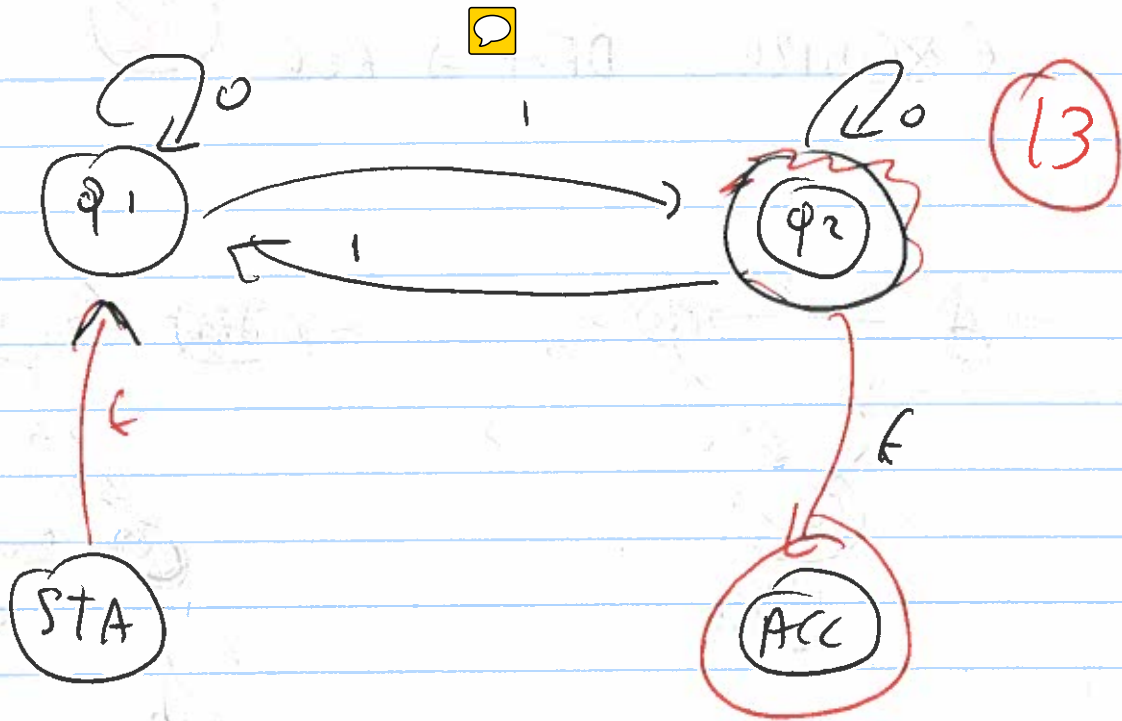


Remove B

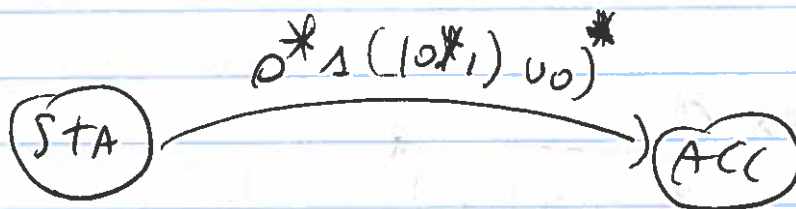
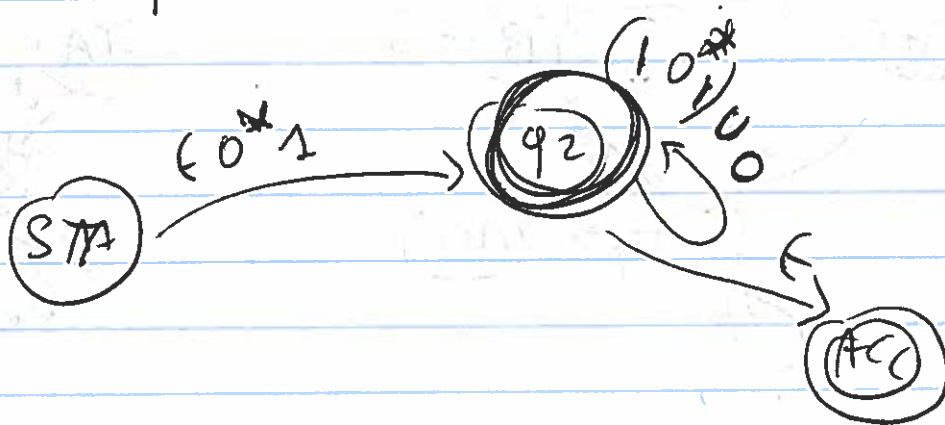


Remove C



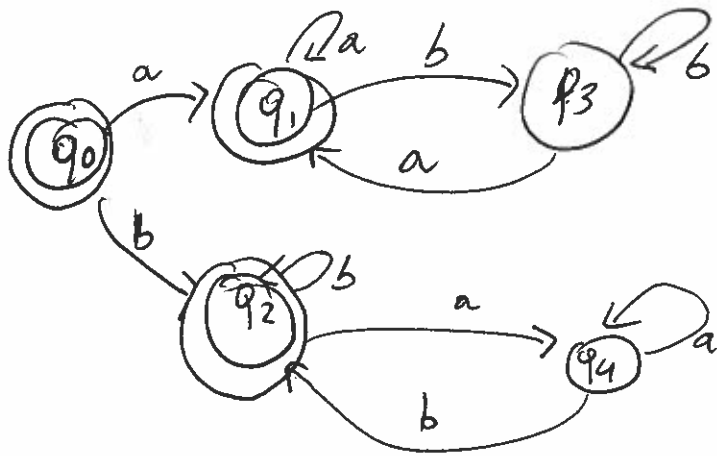


Remove  $q_1$

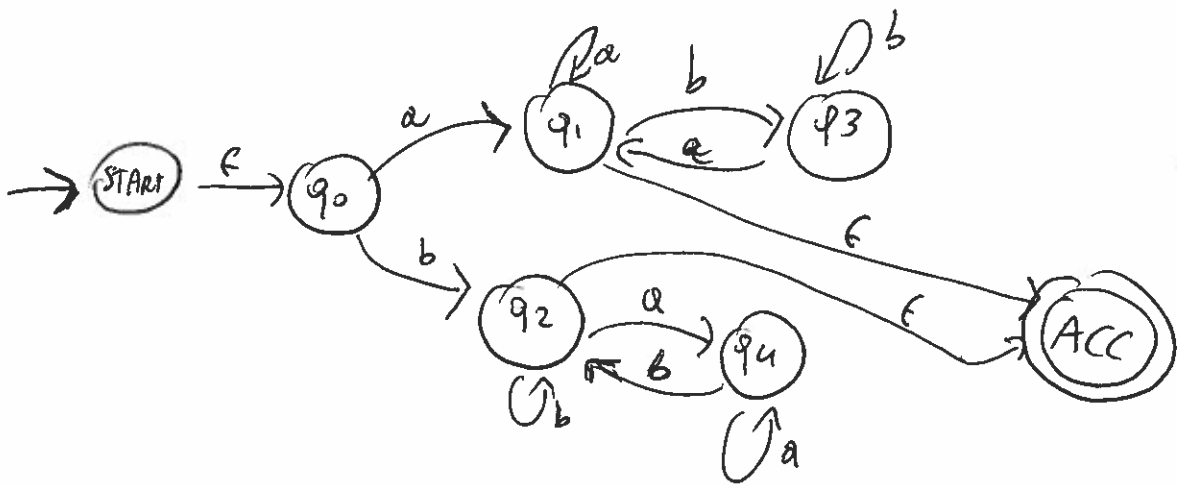


DFA  $\Rightarrow$  Regex

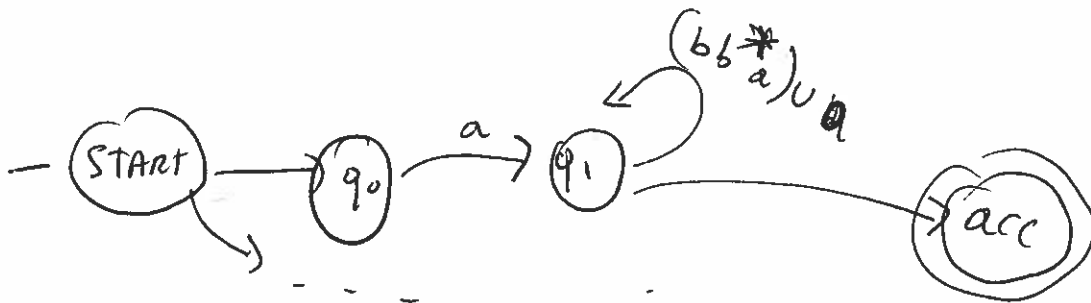
"starts and end with the same letter"



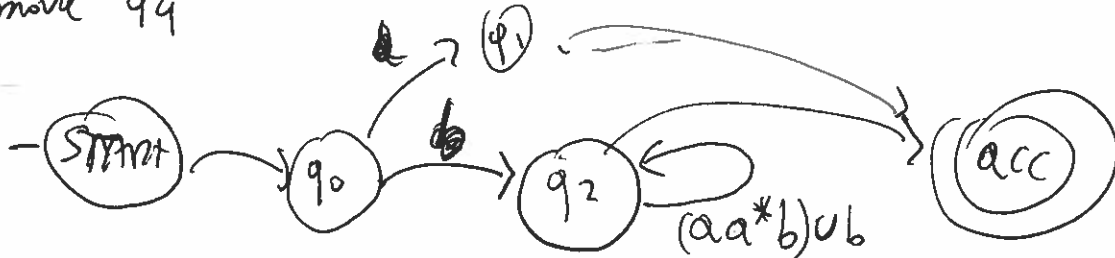
cut



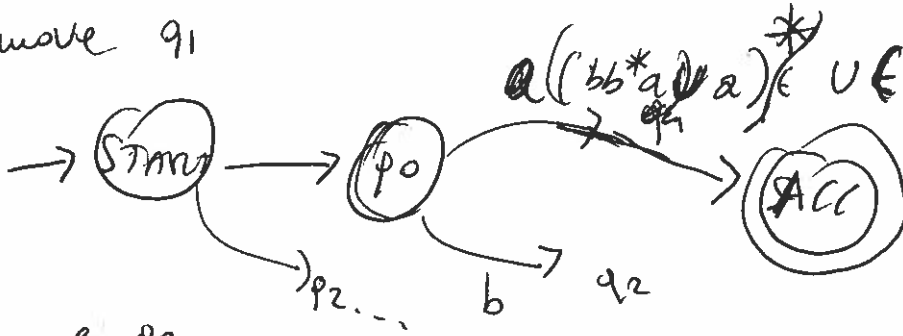
Remove q3



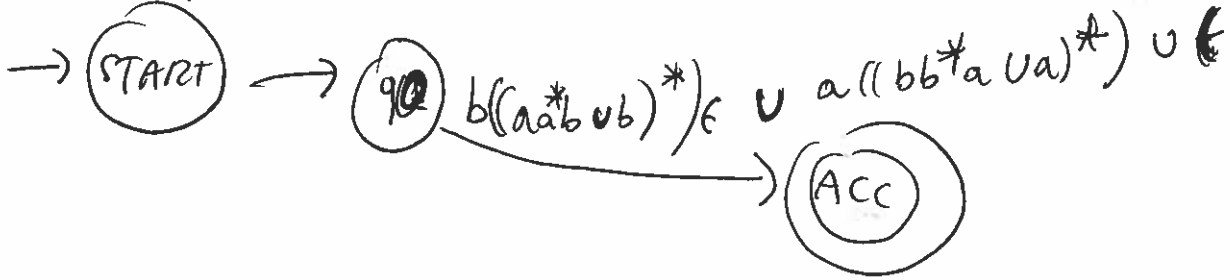
Remove q4



Remove  $q_1$



Remove  $q_2$



Compare with  $a(aub)^*a \cup b(aub)^*b \cup \epsilon$