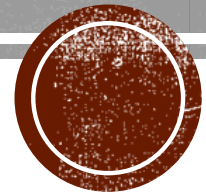


# TEST 1 REVIEW

COMP 4200 – Formal Language



# TOPICS FOR MIDTERM

? DFA

? NFA

? RE

? Conversion of NFA to DFA

? ~~Conversion of NFA to DFA~~

Conversion of  $\epsilon$ -NFA to DFA

? Regular and non regular language

? Minimization of DFA using state elimination method

? Convert DFA to RE

? Convert RE to FA



P A: Short Answer -  $5 \times 2 = 10$

P B: Design DFA & NFA 10

P C:  $\epsilon$ -NFA to DFA 10

RE to FA & Min 10

FA to RE 10

Regular expression

regular & nonregular languages

$a^+ + b^+$

$b a^* b$



$\{Q, \Sigma, \delta, q_0, F\}$

Formal description, 5 tuple

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

# DFA

? S = {starting and ending with different character}

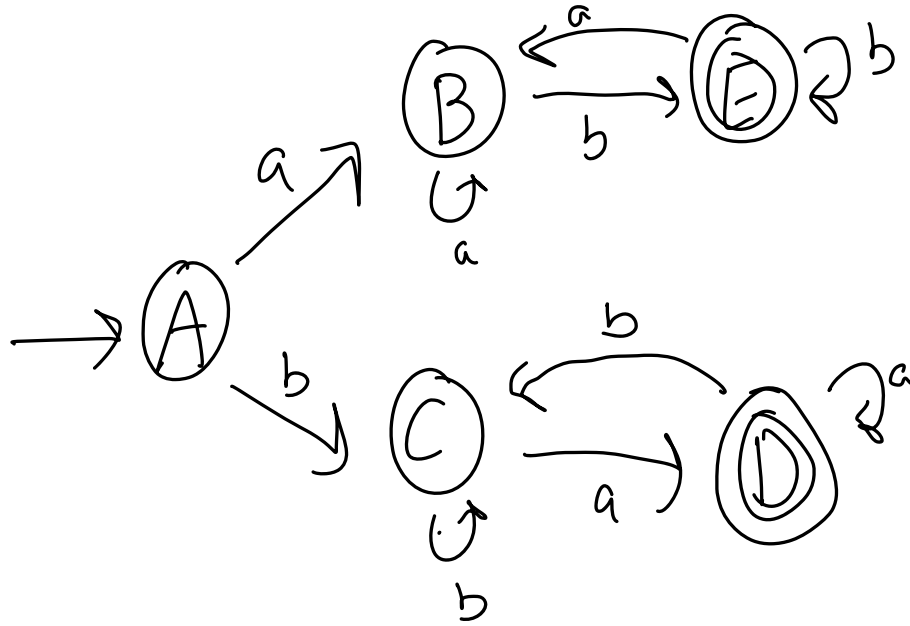
? S = {starting and ending with same letter}

? S = {starting and ending with a always with the string <sup>minimum</sup> ~~maximum~~ length as 2}

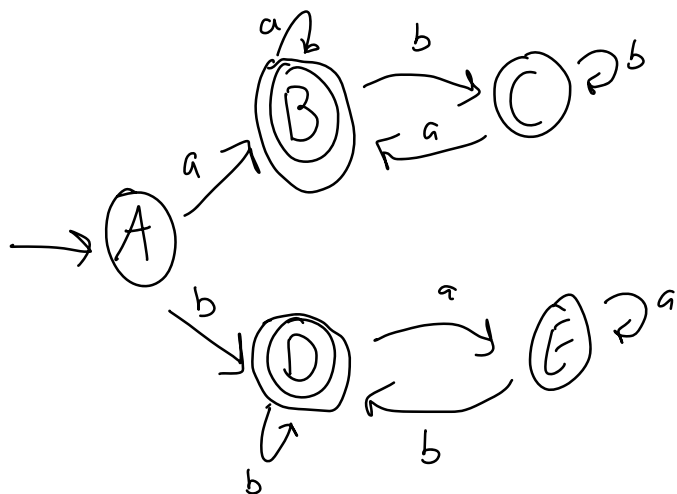


? S = {starting and ending with different character}

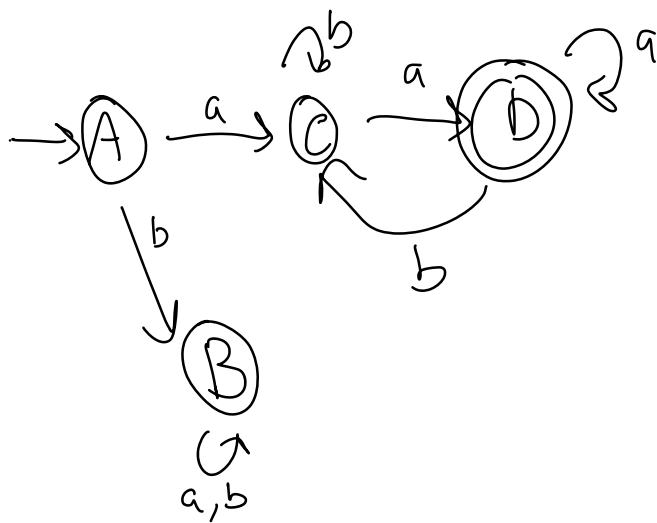
$$\Sigma = \{a, b\}$$



? S = {starting and ending with same letter}



? S = {starting and ending with a always with the string <sup>minimum</sup> ~~maximum~~ length as 2}

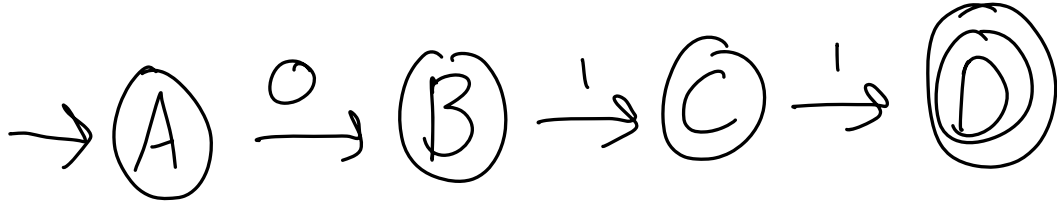


# NFA

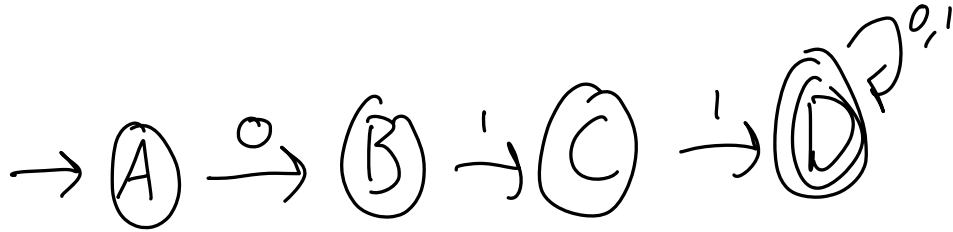
- ❑ Design a NFA for the string 011.
- ❑ Design a NFA for the language that contains all strings beginning with 011.
- ❑ Design a NFA for the language that contains all strings ending with 011.
- ❑ Design a NFA for the language that contains all strings that contains 011.



? Design a NFA for the string 011.



? Design a NFA for the language that contains all strings beginning with 011.

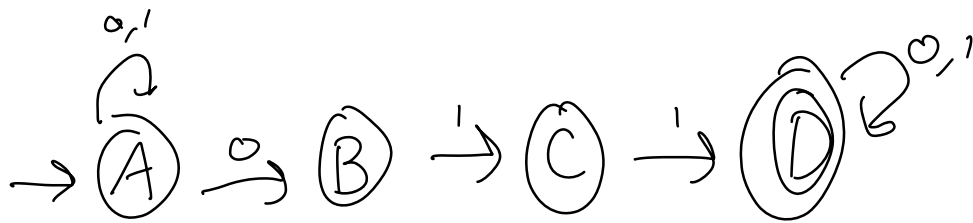


? Design a NFA for the language that contains all strings ending with 011.

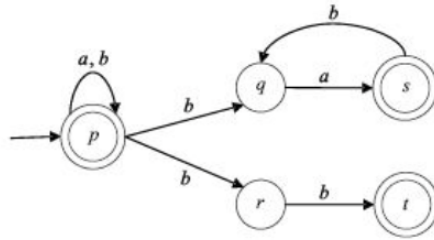




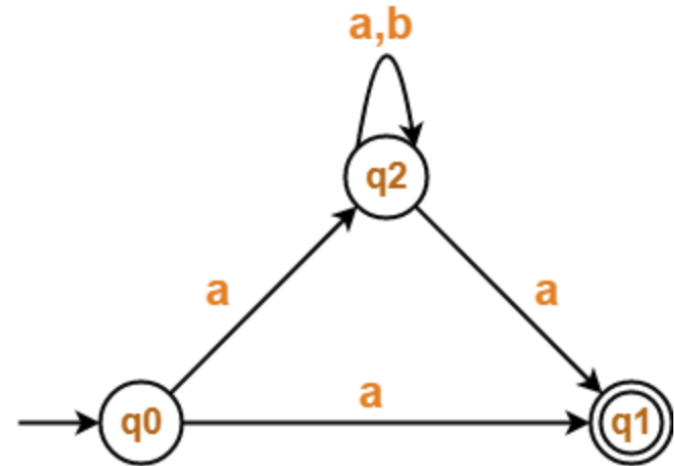
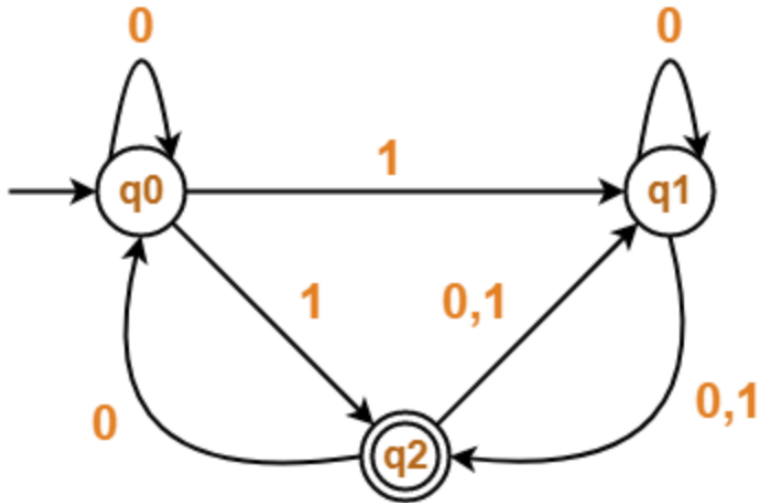
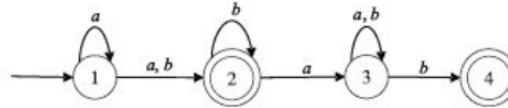
? Design a NFA for the language that contains all strings that contains 011.



# DETERMINE THE STATE OF NFA AFTER READING STRING aaba

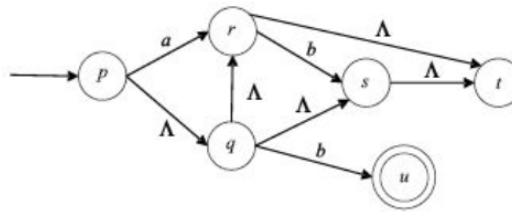
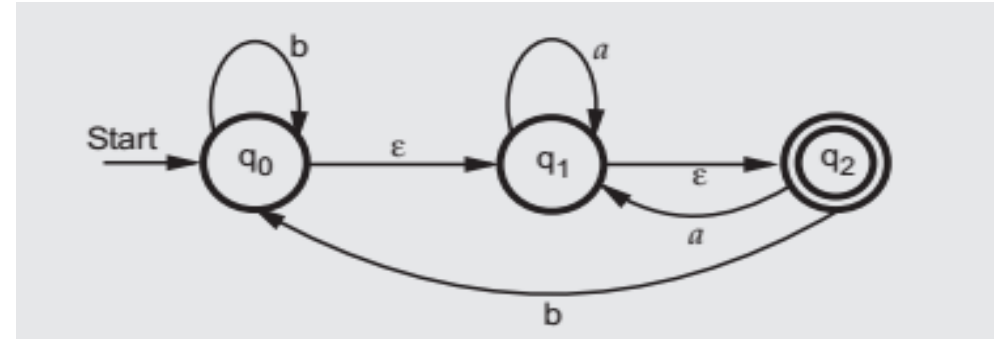
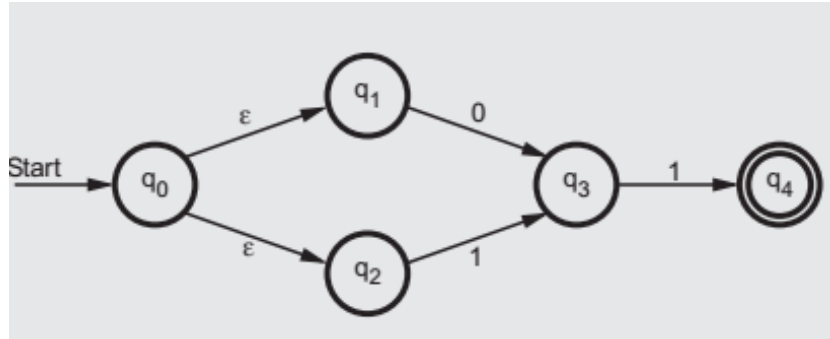


# NFA TO DFA



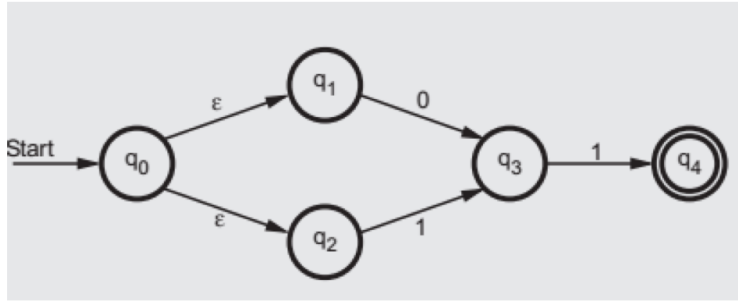


# $\epsilon$ - NFA TO DFA



2020 Twinkl





closure

$q_0: \{q_0, q_1, q_2\}$

$q_1: \{q_1\}$

$q_2: \{q_2\}$

$q_3: \{q_3\}$

$q_4: \{q_4\}$

	$\{\epsilon^*$	0	1
$q_0$	$q_0$ $q_1$ $q_2$	$\emptyset$ $q_3$ $\emptyset$	$\emptyset$ $q_3$ $\emptyset$
$q_1$	$q_1$	$q_3$	$q_3$
$q_2$	$q_2$	$\emptyset$	$\emptyset$
$q_3$	$q_3$	$\emptyset$	$\emptyset$
$q_4$	$q_4$	$\emptyset$	$\emptyset$

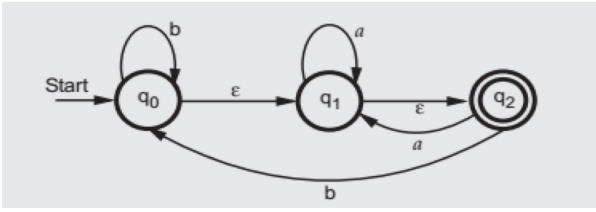
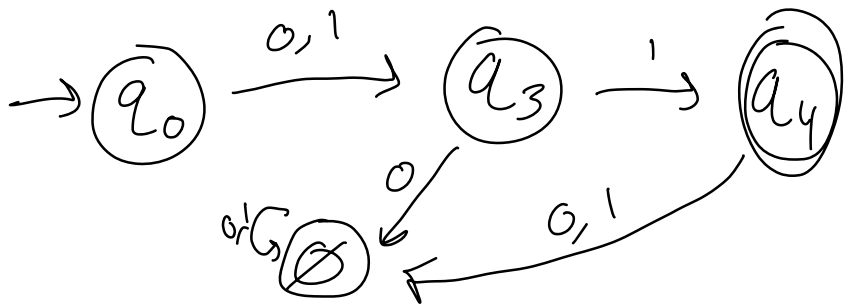
	$\{\epsilon^*$	1	$\{\epsilon^*$
$q_0$	$q_0$ $q_1$ $q_2$	$\emptyset$ $\emptyset$ $q_3$	$\emptyset$ $\emptyset$ $q_3$
$q_1$	$q_1$	$\emptyset$	$\emptyset$
$q_2$	$q_2$	$q_3$	$q_3$
$q_3$	$q_3$	$q_4$	$q_4$
$q_4$	$\emptyset$	$\emptyset$	$\emptyset$

NFA

	0	1
$\rightarrow q_0$	$q_3$	$q_3$
$q_1$	$q_3$	$\emptyset$
$q_2$	$\emptyset$	$q_3$
$q_3$	$\emptyset$	$q_4$
$\star q_4$	$\emptyset$	$\emptyset$

DFA

	0	1
$\rightarrow q_0$	$q_3$	$q_3$
<del><math>q_1</math></del>	<del><math>q_3</math></del>	<del><math>\emptyset</math></del>
<del><math>q_2</math></del>	<del><math>\emptyset</math></del>	<del><math>q_3</math></del>
$q_3$	$\emptyset$	$q_4$
$\star q_4$	$\emptyset$	$\emptyset$
$\emptyset$	$\emptyset$	$\emptyset$



closure :

- $q_0 : \{q_0, q_1, q_2\}$
- $q_1 : \{q_1, q_2\}$
- $q_2 : \{q_2\}$

	$\{ \star \}$	a	$\{ \star \}$
$q_0$	$q_0, q_1, q_2$	$q_1$	$q_1, q_2$
$q_1$	$q_1, q_2$	$q_1$	$q_1, q_2$
$q_2$	$q_2$	$q_1$	$q_1, q_2$

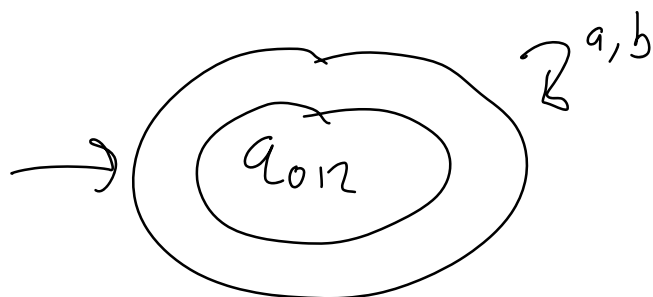
	$\{ \star \}$	b	$\{ \star \}$
$q_0$	$q_0, q_1, q_2$	$q_0$	$q_0, q_1, q_2$
$q_1$	$q_1, q_2$	$q_0$	$q_0, q_1, q_2$
$q_2$	$q_2$	$q_0$	$q_0, q_1, q_2$

NFA

	a	b
$\rightarrow q_0$	$\{a_1, a_2\}$	$\{a_0, a_1, a_2\}$
$a_1$	$\{a_1, a_2\}$	$\{a_0, a_1, a_2\}$
$a_2$	$\{a_1, a_2\}$	$\{a_0, a_1, a_2\}$

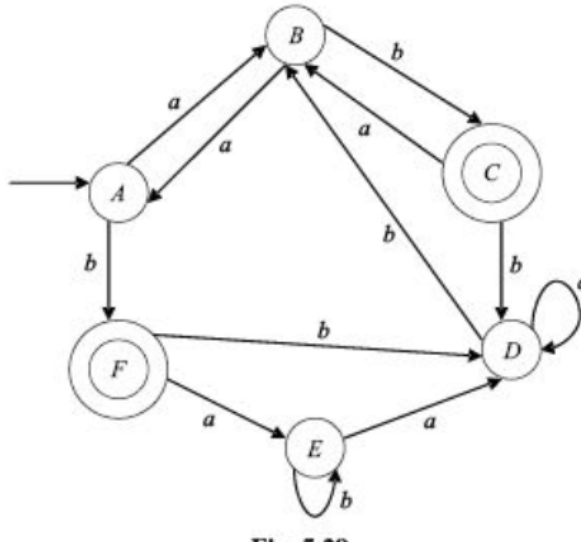
DFA

	a	b
$\rightarrow q_0$	$q_{12}$	$q_{012}$
$a_{12}$	$q_{12}$	$q_{012}$
$a_{012}$	$q_{12}$	$q_{012}$





# MINIMIZATION OF DFA



# REGULAR EXPRESSION

? What will be the language for the below regular expressions.

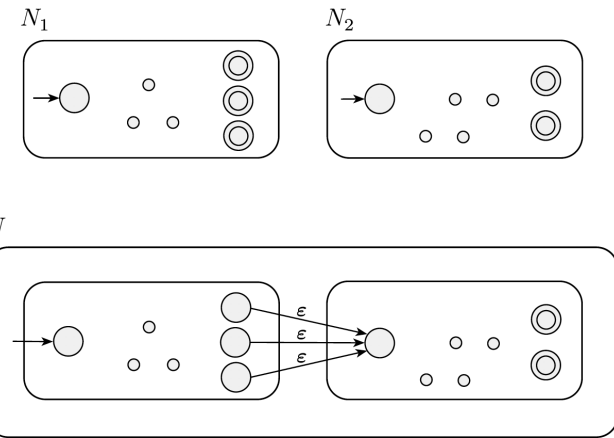
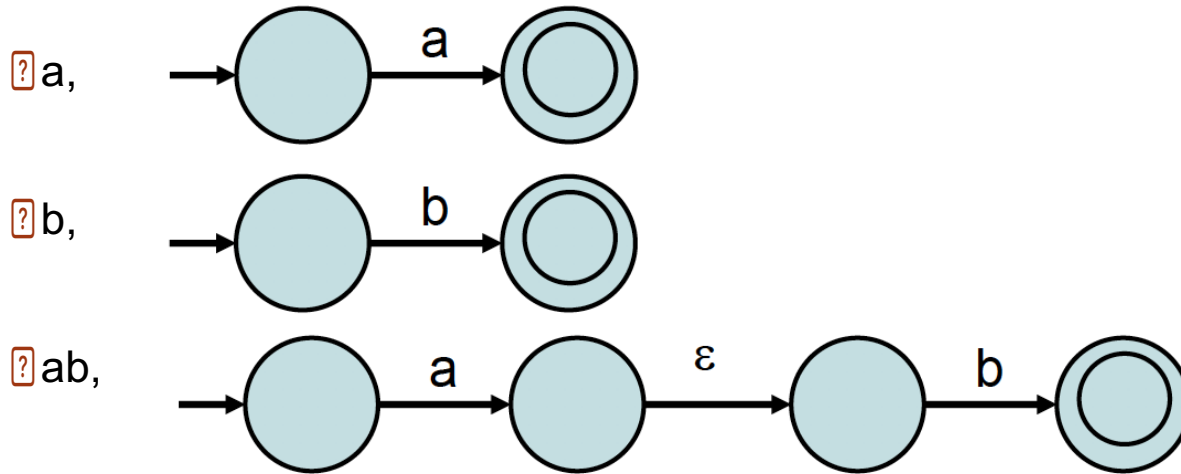
?  $(a+b)^*$

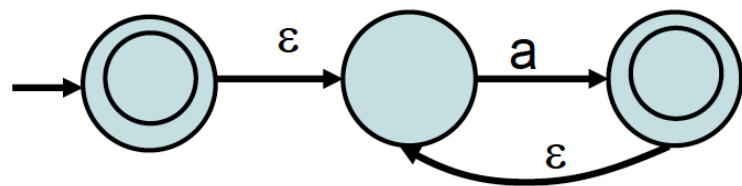
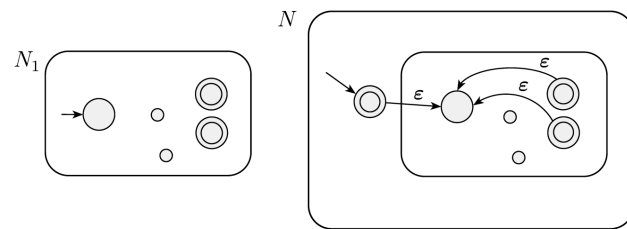
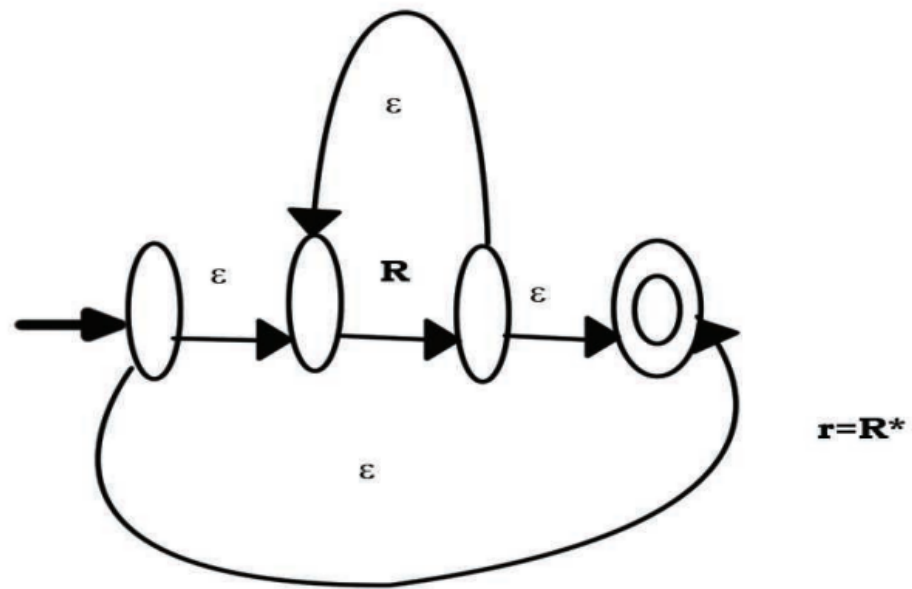
?  $(a+b)^*abb$

?  $(aa)^*(bb)^*b$



# BASE CASE





# RE TO FA

❑  $(abc)^*|b$

❑  $(0+1)^* (00+11) (0+1)^*$

❑  $(ab+c^+)^*b$

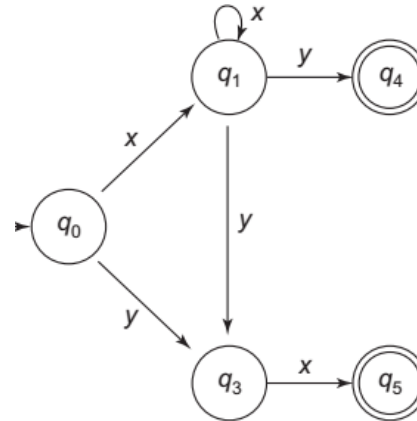
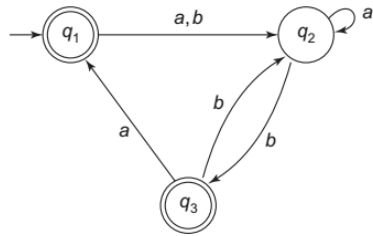
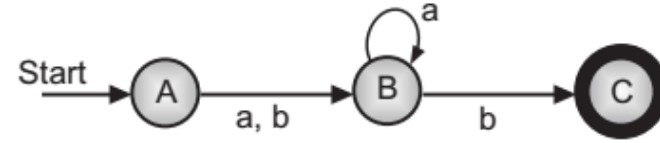
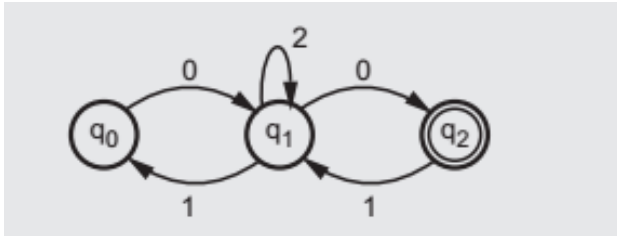


# DFA TO RE HINTS

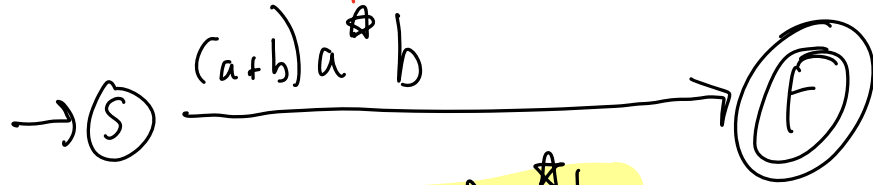
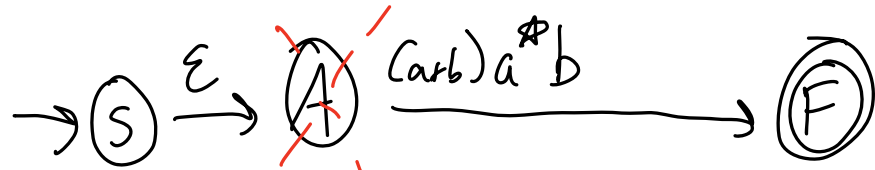
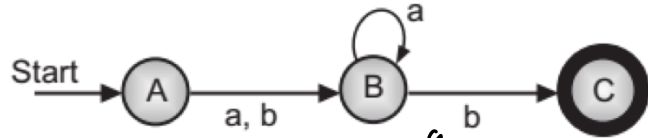
- ❑ The initial state of the DFA must not have any incoming edge.
- ❑ There must exist only one final state in the DFA.
- ❑ The final state of the DFA must not have any outgoing edge.
- ❑ Eliminate all the intermediate states one by one.
- ❑ These states may be eliminated in any order.
- ❑ Only an initial state going to the final state will be left.
- ❑ The transition is the required regular expression.
- ❑ Same direction and loops between two states ❑ concatenation
- ❑ Opposite transitions and parallel transition ❑ union
- ❑ Self loop ❑ closure



# FA TO RE



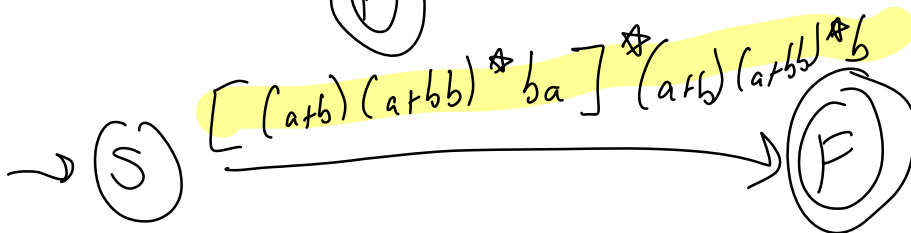
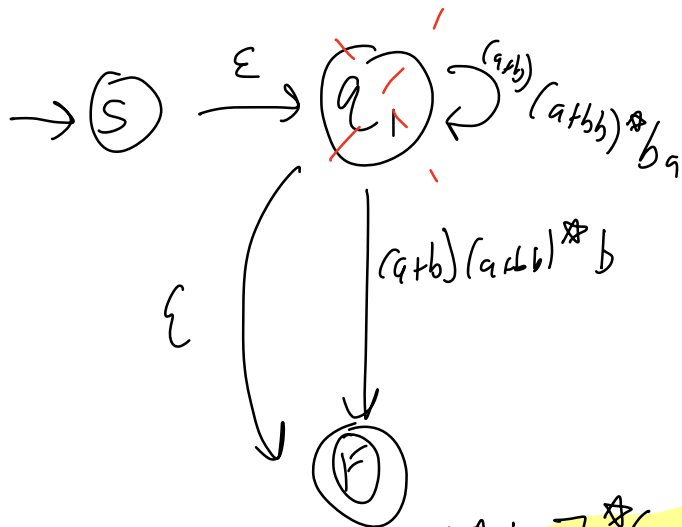
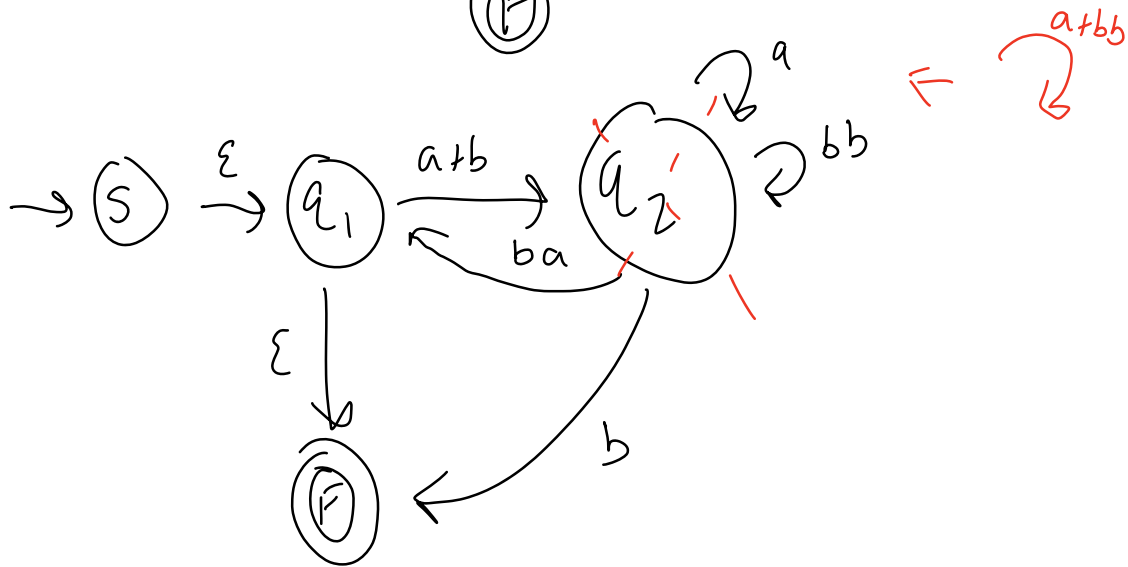
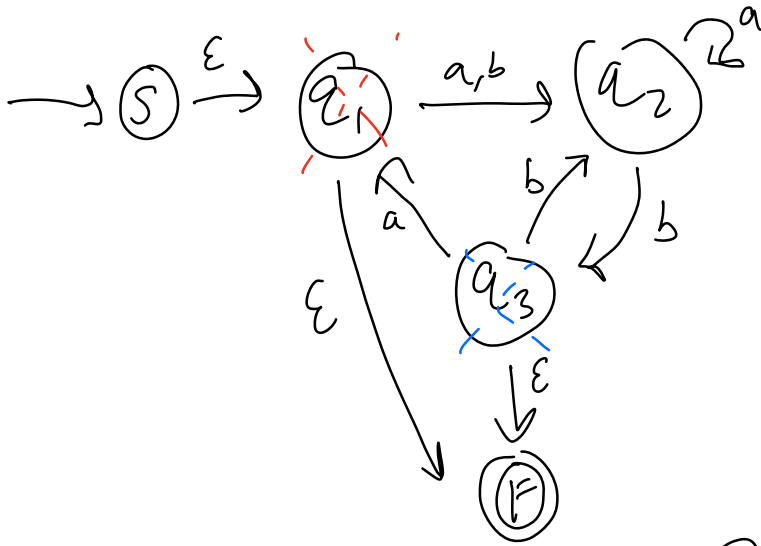
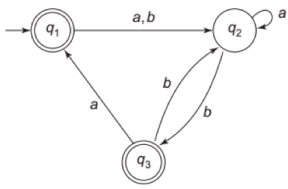
$$a, b = a + b$$

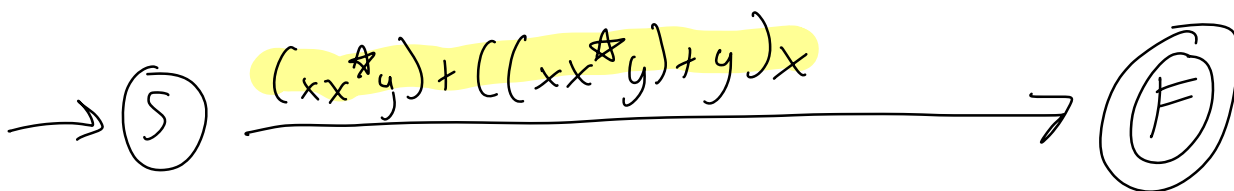
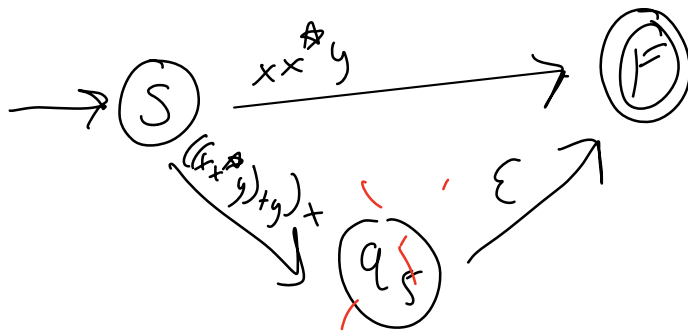
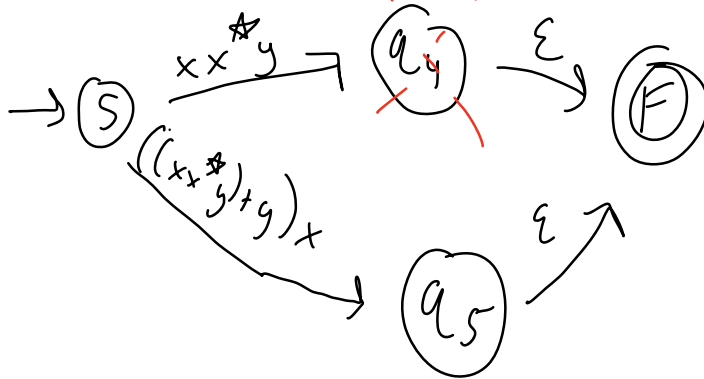
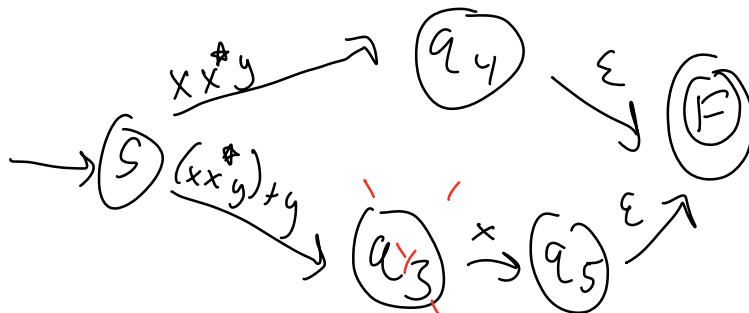
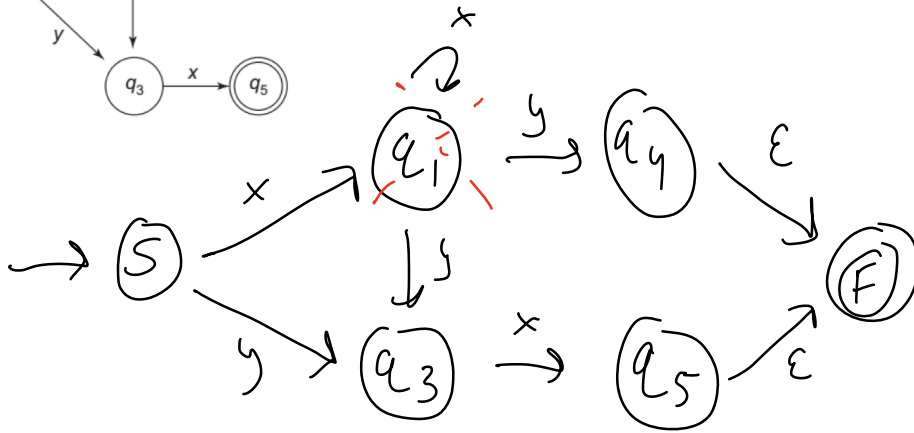
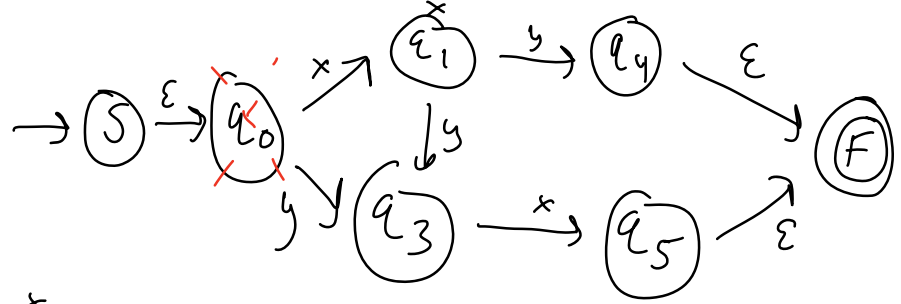
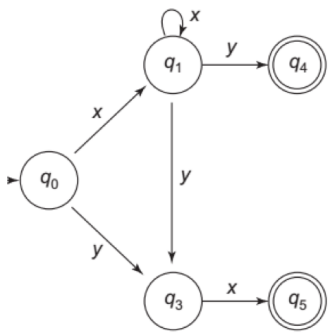


$$RE = (a+b)a^*b$$

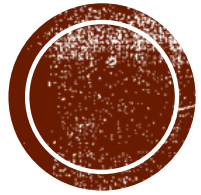












GOOD LUCK!