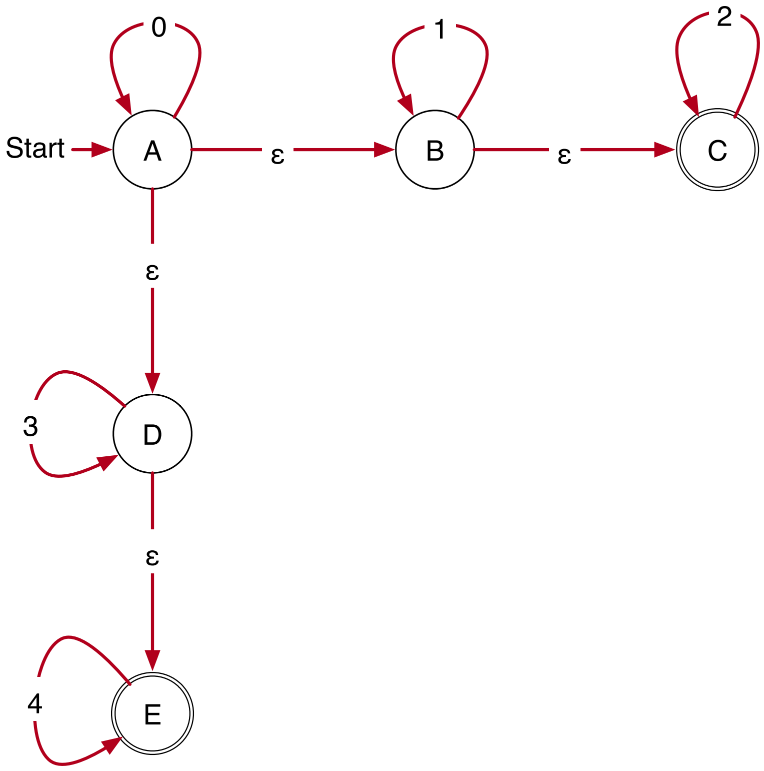
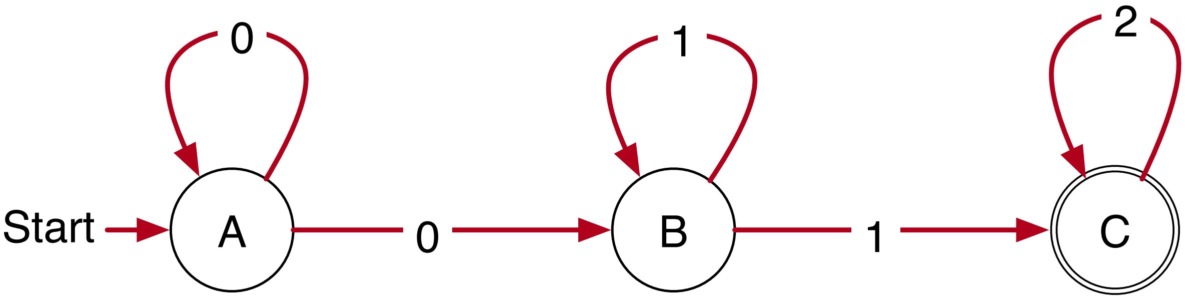
Homework 2 Solutions

Problem 1: Given the following NFA with ε moves, calculate the equivalent NFA without ε moves. Give the result in a table:



State	0	1	2	3	4
A	$\{A, B, C, D, E\}$	$\{B, C\}$	$\{C\}$	$\{D, E\}$	{E}
B	$\varnothing$	$\{B, C\}$	$\{C\}$	$\varnothing$	$\varnothing$
C	$\varnothing$	$\varnothing$	$\{C\}$	$\varnothing$	$\varnothing$
D	$\varnothing$	$\varnothing$	$\varnothing$	$\{D, E\}$	$\{E\}$
E	$\varnothing$	$\varnothing$	$\varnothing$	$\varnothing$	$\{E\}$

Problem 2: Convert the following NFA into a DFA. Give the result in a table.



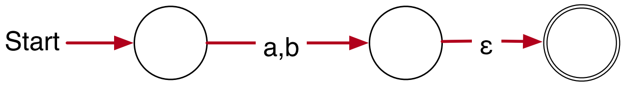
State	0	1	2
$\{A\}$	$\{A, B\}$	$\varnothing$	$\varnothing$
$\{A, B\}$	$\{A, B\}$	$\{B, C\}$	$\{C\}$
$\{B, C\}$	$\varnothing$	$\{B, C\}$	$\{C\}$
$\{C\}$	$\varnothing$	$\varnothing$	$\{C\}$

Problem 3: We use the lower-case ASCII letters as our alphabet. Find an NFA with ε-transitions that recognizes the regular expression

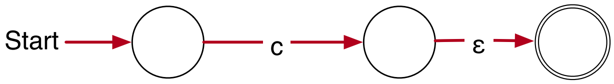
$$(a+b)^*c(a+b)^* + (a+c)^*b(a+c)^*.$$

We first find NFAs for the components, where we use some abbreviations:

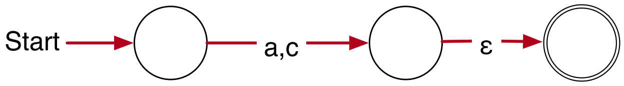
(a+b)



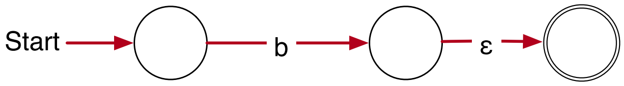
c



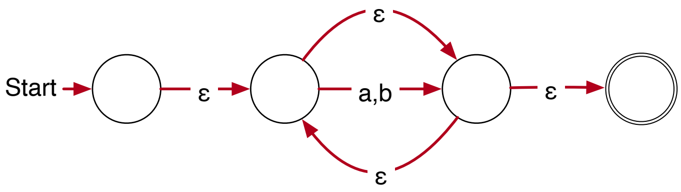
(a+c)



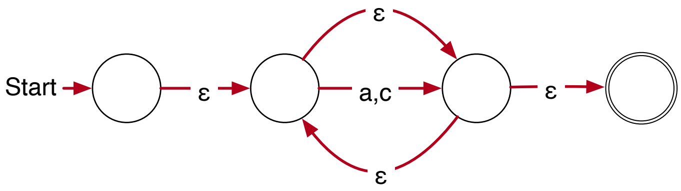
b



$(a+b)^*$

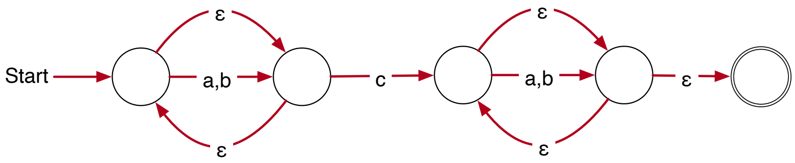


$(a+c)^*$

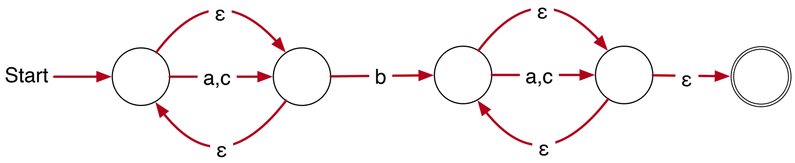


When we combine, we can eliminate states with only ε-transitions coming in and coming to it. For example, we can eliminate the start state in the state machines above.

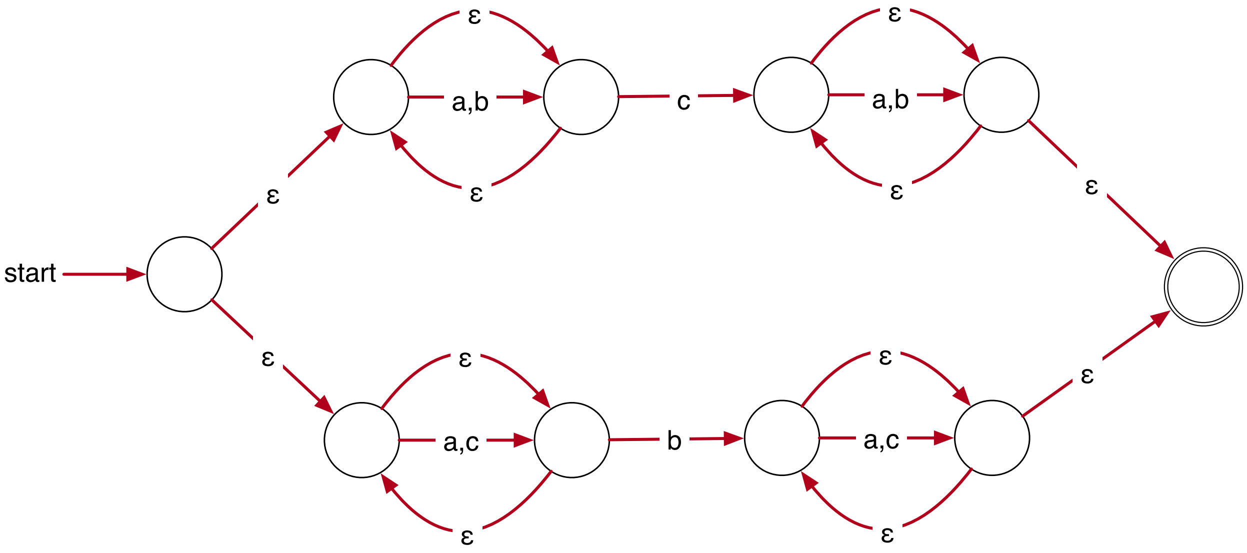
$(a+b)^*c(a+b)^*$



$(a+c)^*b(a+c)^*$



The final step is the union between the two regular expressions. You might have


start
ε
ε
ε
a,b
ε
c
ε
a,b
ε
ε
ε
a,c
ε
b
ε
a,c
ε
ε