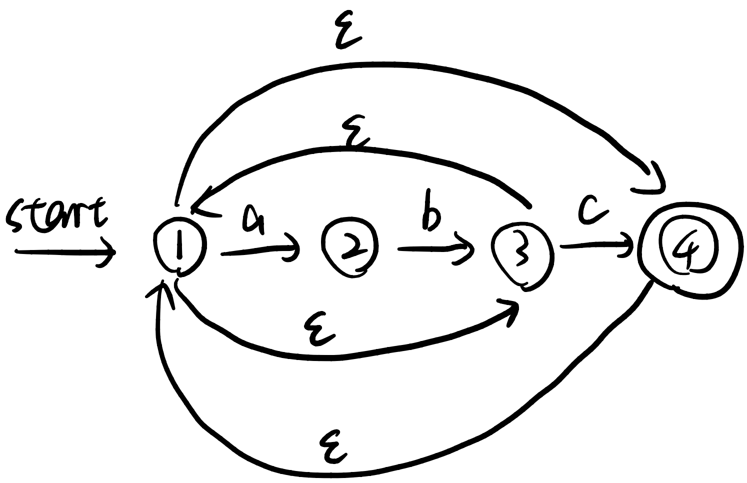
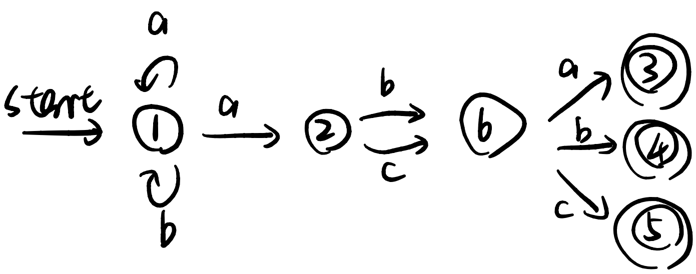
Exercise 1 .

1. $L(((\varepsilon|ab)^*c)^*)$



It's a NFA, not DFA.

2. $L((a|b)^*a(b|c)(a|b|c))$

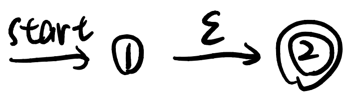


It's a NFA, not DFA.

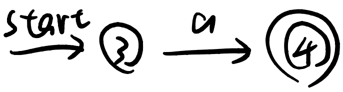
Exercise 2.

1. $L(((\varepsilon|ab)^*c)^*)$

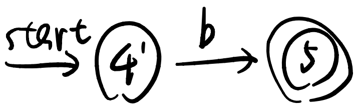
1) NFA for the first ε (basis rule # 1)



2) NFA for a (basis rule # 1)

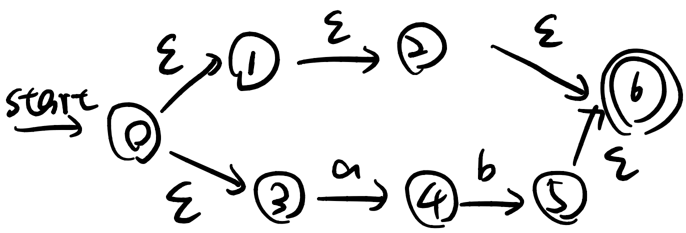


3) NFA for b (basis rule # 1)

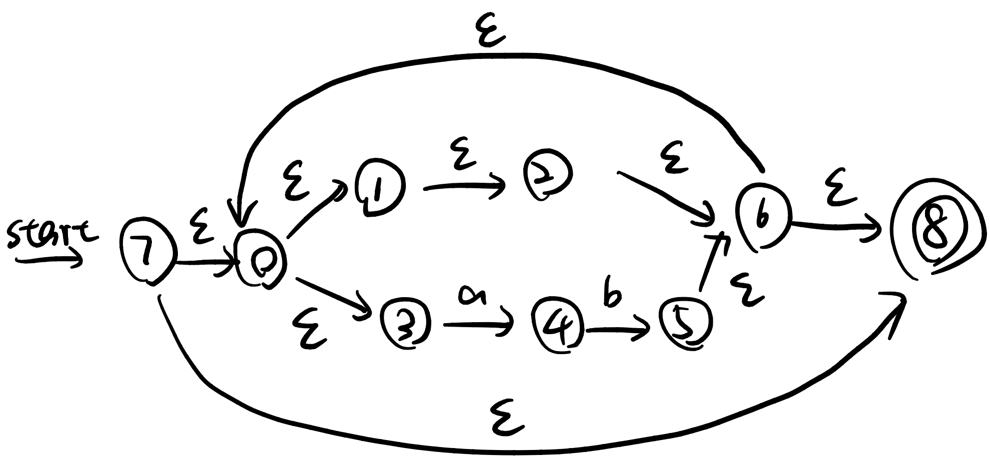


4) NFA for ab (concatenation case)

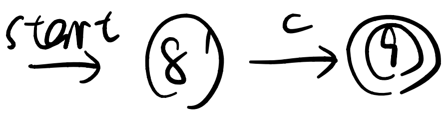
5) NFA for $(\varepsilon|ab)$ (union case)



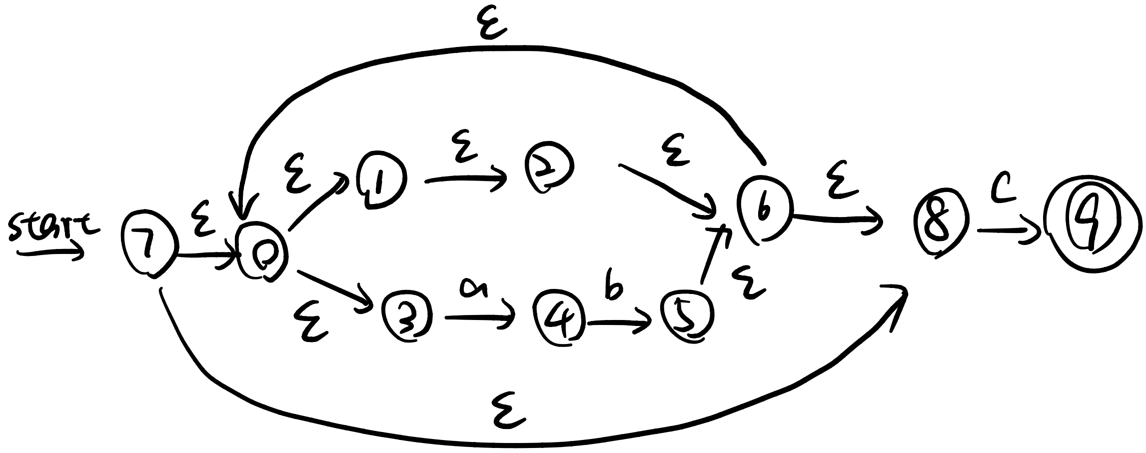
6) NFA for $(\varepsilon|ab)^*$ (Kleene star case)



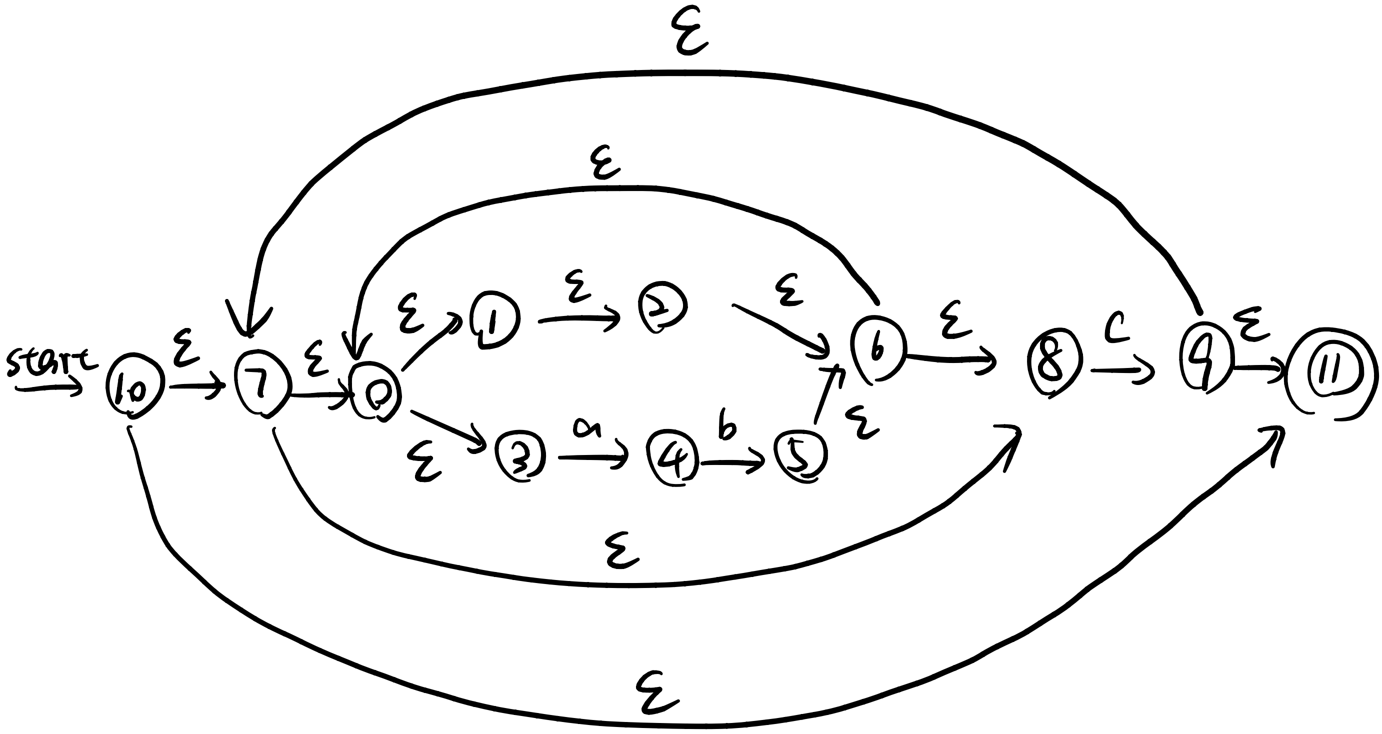
7) NFA for c (basic rule # 1)



8) NFA for $((\varepsilon|ab)^*c)$ (concatenation case)

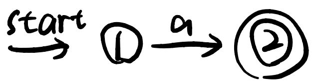


9) NFA for $(((\varepsilon|ab)^*c)^*)$ (Kleene star case)

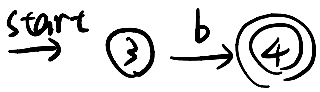


2. $L((a|b)^*a(b|c)(a|b|c))$

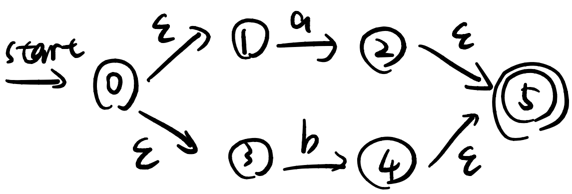
1) NFA for a (basic rule #1)



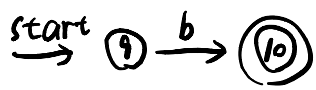
2) NFA for b (basic rule #1)



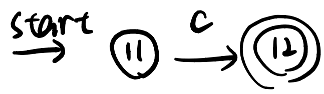
3) NFA for $(a|b)$ (union case)



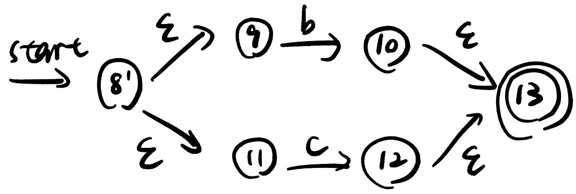
7) NFA for b (basic rule #1)



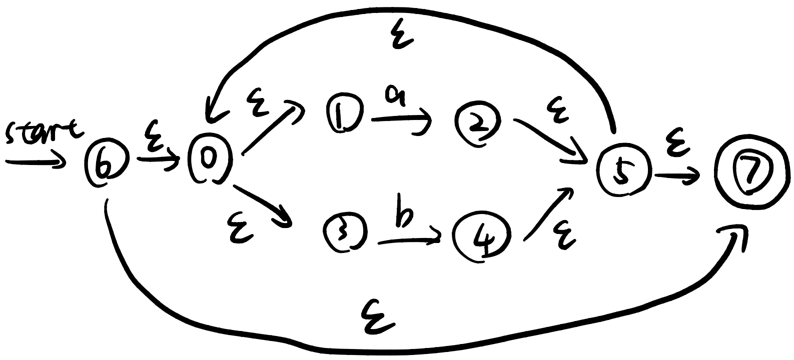
8) NFA for c (basic rule #1)



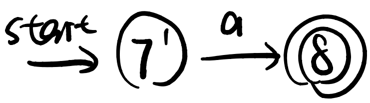
9) NFA for $(b|c)$ (union case)



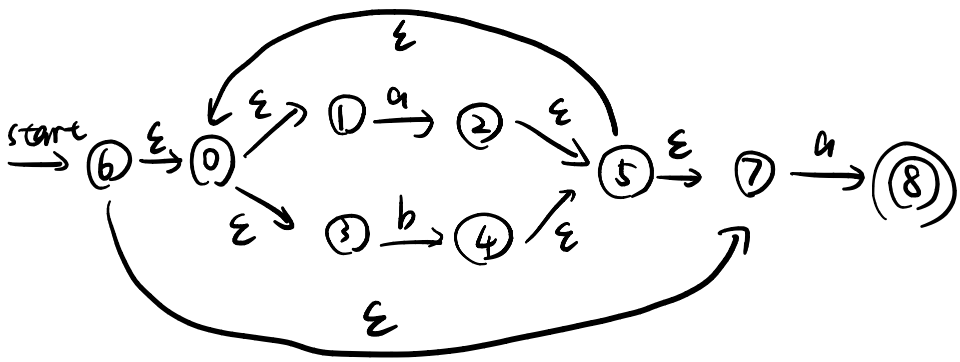
4) NFA for the $(a|b)^*$ (Kleene star case)



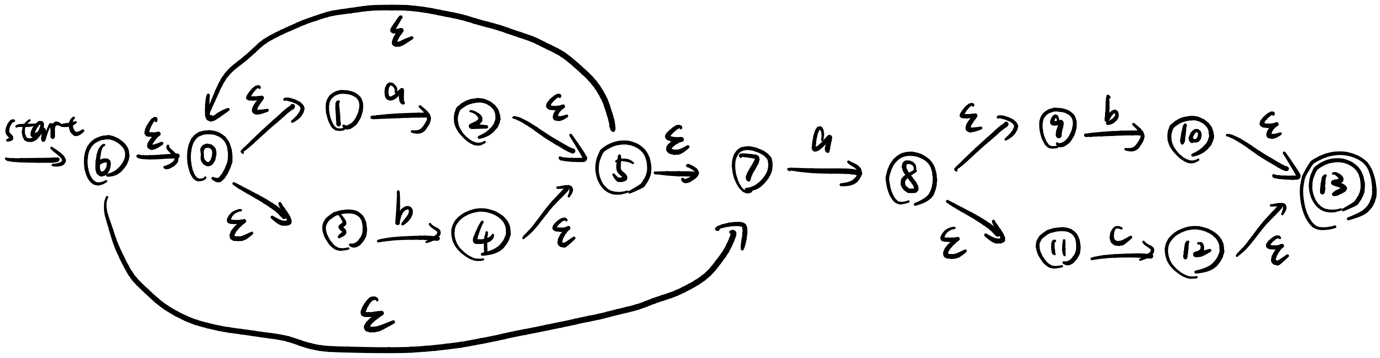
5) NFA for the 2nd a (basic rule #1)



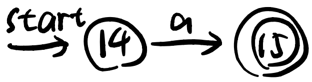
6) NFA for the $((a|b)^*a)$ (concatenation case)



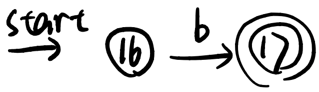
10) NFA for the $((a|b)^*a(b|c))$ (concatenation case)



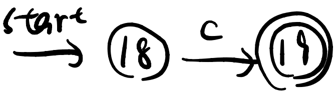
11) NFA for a (basic rule #1)



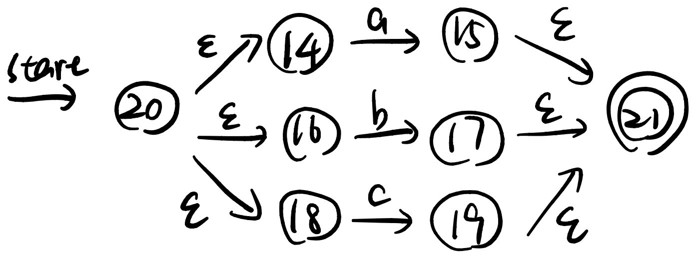
12) NFA for b (basic rule #1)



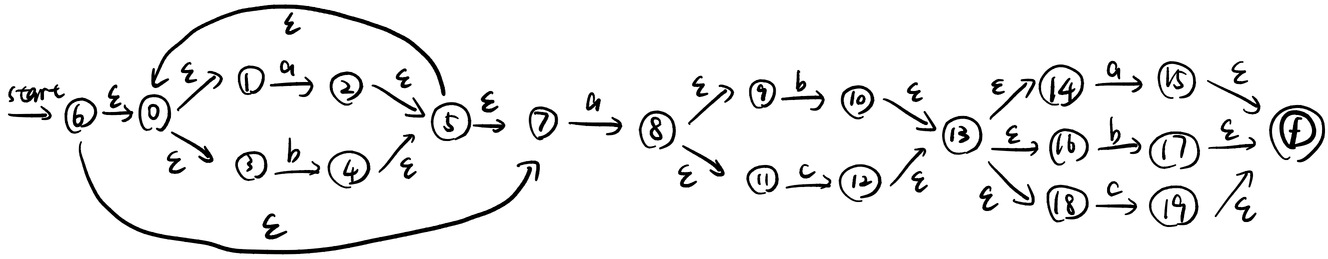
13) NFA for c (basic rule #1)



14) NFA for (a|b|c) (union case)

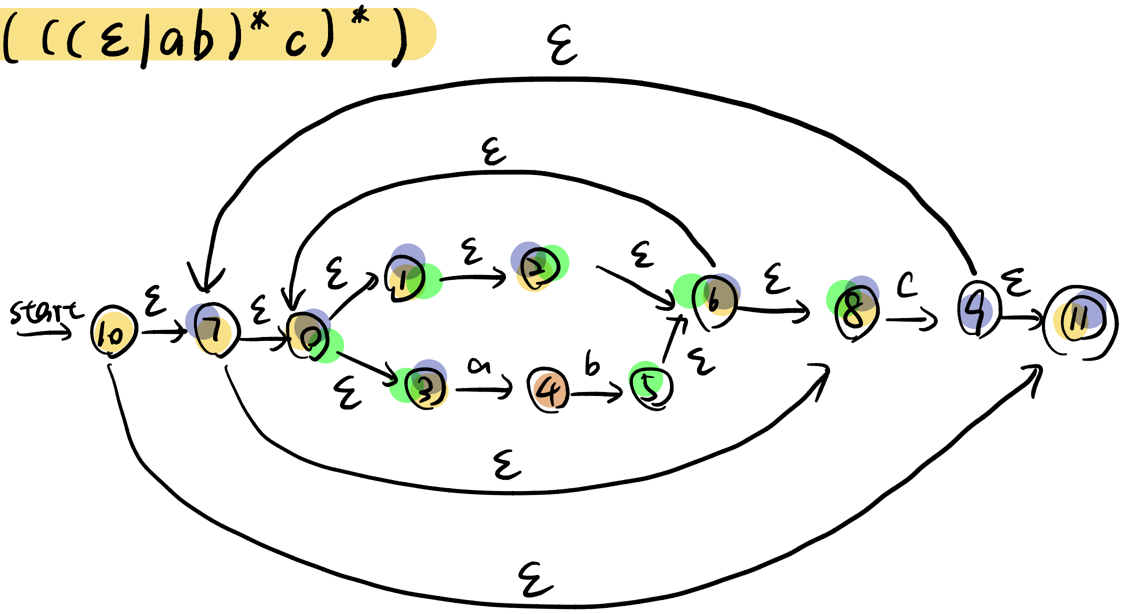


15) NFA for ((a|b)* a (b|c) (a|b|c)) (concatenation case)



Exercise 3.

1. $L(((\varepsilon|ab)^*c)^*)$



$\varepsilon\text{-closure}(10) = \{10, 7, 0, 1, 2, 3, 6, 8, 11\} \rightarrow A$

$\varepsilon\text{-closure}(move[A, a]) = \varepsilon\text{-closure}(4) = \{4\} \rightarrow B$

$\varepsilon\text{-closure}(move[A, c]) = \varepsilon\text{-closure}(9)$
$= \{7, 0, 1, 2, 3, 6, 8, 9, 11\} \rightarrow C$

$\varepsilon\text{-closure}(move[B, b]) = \varepsilon\text{-closure}(5)$
$= \{0, 1, 2, 3, 5, 6, 8\} \rightarrow D$

$\varepsilon\text{-closure}(move[C, a]) = \varepsilon\text{-closure}(4) \rightarrow B$

$\varepsilon\text{-closure}(move[C, c]) = \varepsilon\text{-closure}(9) = C$

$\varepsilon\text{-closure}(move[D, a]) = \varepsilon\text{-closure}(4) = B$

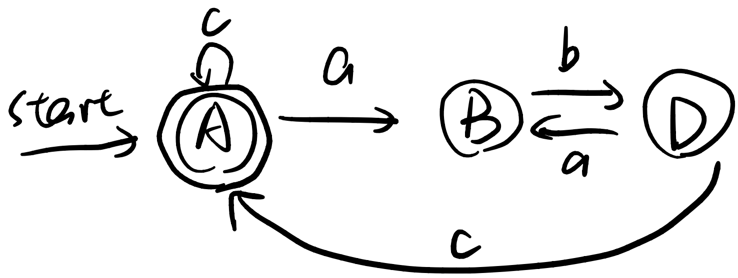
$\varepsilon\text{-closure}(move[D, c]) = \varepsilon\text{-closure}(9) = C$

Eventually get the following DFA:

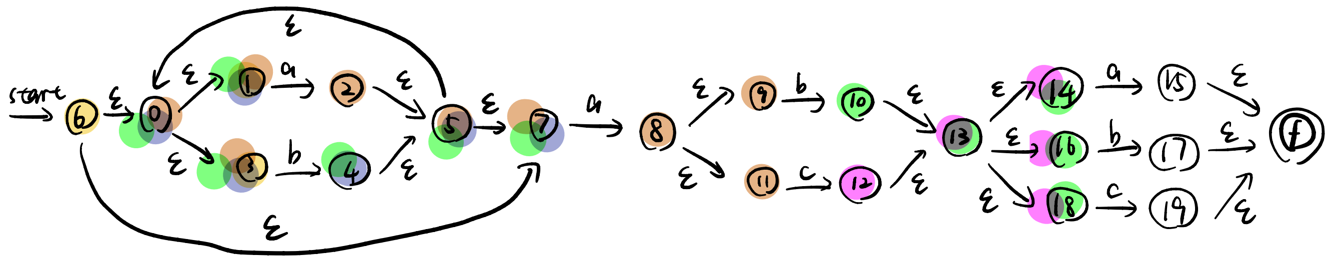
NFA STATE	DFA STATE	a	b	c
{10, 7, 0, 1, 2, 3, 6, 8, 11}	A	B	×	C
{4}	B	×	D	×
{7, 0, 1, 2, 3, 6, 8, 9, 11}	C	B	×	C
{0, 1, 2, 3, 5, 6, 8}	D	B	×	C

Start state {A}, Accepting states {A, C}

This DFA can be further minimized : A. C have the same moves on all symbols and can be merged.



2. L((a|b)*a(b|c)(a|b|c))



ε-closure(6) = {6, 0, 1, 3, 7} → A

ε-closure(move[A, a]) = ε-closure(2, 8) = {0, 2, 5, 8, 9, 11, 1, 3, 7} → B

ε-closure(move[A, b]) = ε-closure(4) = {0, 1, 3, 4, 5, 7} → C

ε-closure(move[B, a]) = ε-closure(2, 8) = B

ε-closure(move[B, b]) = ε-closure(4, 10)

= {0, 1, 3, 4, 5, 7, 10, 13, 14, 16, 18} → D

ε-closure(move[B, c]) = ε-closure(12) = {12, 13, 14, 16, 18} → E

ε-closure(move[C, a]) = ε-closure(2, 8) = B

ε-closure(move[C, b]) = ε-closure(4) = C

ε-closure(move[D, a]) = ε-closure(2, 8, 15)

= {0, 2, 5, 8, 9, 11, 1, 3, 7, 15, f} → F

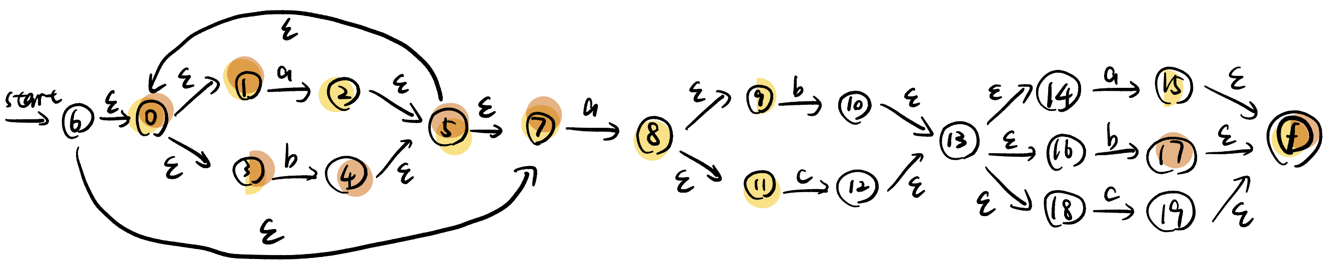
ε-closure(move[D, b]) = ε-closure(4, 17) = {0, 1, 3, 4, 5, 7, 17, f} → G

ε-closure(move[D, c]) = ε-closure(19) = {19, f} → H

ε-closure(move[E, a]) = ε-closure(15) = {15, f} → I

ε-closure(move[E, b]) = ε-closure(17) = {17, f} → J

ε-closure(move[E, c]) = ε-closure(19) = {19, f} → K



ε-closure(move[F, a]) = ε-closure(2, 8) = B

ε-closure(move[F, b]) = ε-closure(4, 10) = D

ε-closure(move[F, c]) = ε-closure(12) = E

ε-closure(move[G, a]) = ε-closure(2, 8) = B

ε-closure(move[G, b]) = ε-closure(4) = C

Eventually we get the following DFA:

NFA STATE	DFA STATE	a	b	c
{6, 0, 1, 3, 7}	A	B	C	×
{0, 2, 5, 8, 9, 11, 1, 3, 7}	B	B	D	E
{0, 1, 3, 4, 5, 7}	C	B	C	×
{0, 1, 3, 4, 5, 7, 10, 13, 14, 16, 18}	D	F	G	H
{12, 13, 14, 16, 18}	E	I	J	K
{0, 2, 5, 8, 9, 11, 1, 3, 7, 15, f}	F	B	D	E
{0, 1, 3, 4, 5, 7, 17, f}	G	B	C	×
{19, f}	H	×	×	×
{15, f}	I	×	×	×
{17, f}	J	×	×	×
{19, f}	K	×	×	×

Start state: A ; Accepting states: {F, G, H, I, J, K}

This DFA can be further minimized: (A, C) (B, F) (H, I, J, K) have the same moves on all symbols and can be merged.