SEG2106 Assignment 2

Lexical Analyser

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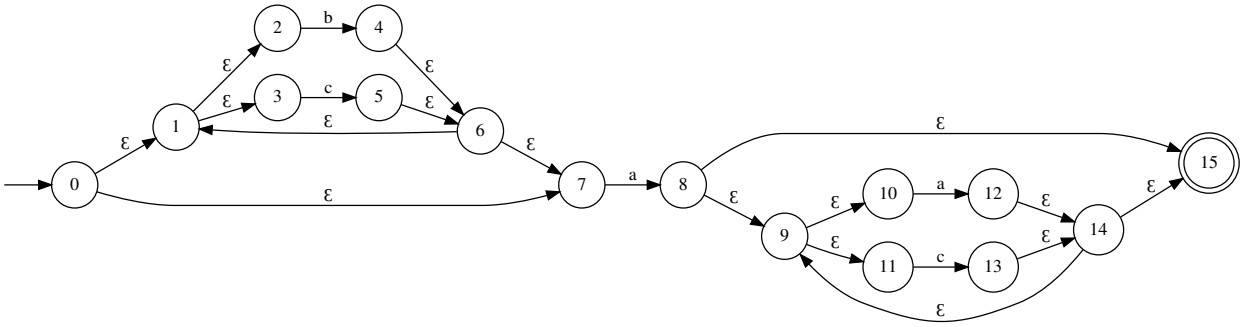
Question 1 - Regular Expressions

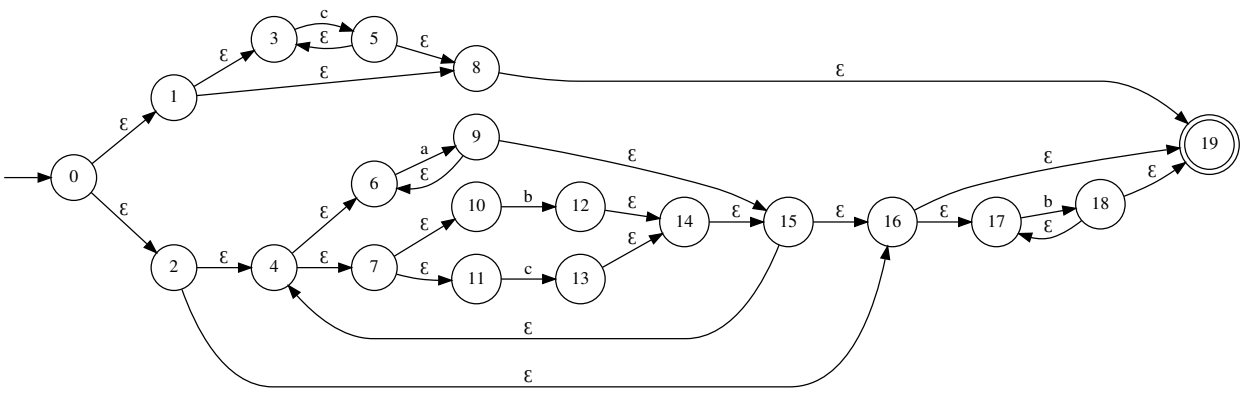
1. `((a|b){2})*`
2. `b*a(b*ab*a)*b*`
3. `(a*ba*b)*a*`
4. `((^a(a|b)*b$)|(^b(a|b)*a$))`
5. `(a?b)+b`
6. `0*(1(0|1){6,}|111(0|1){3}|1101(0|1){2})`
7. `(-?[1-9][0-9]*|0)[a-zA-Z]+([4-9]|[1-3][0-9]|4[0-4])`

Question 2 - Non-Deterministic Finite Automata

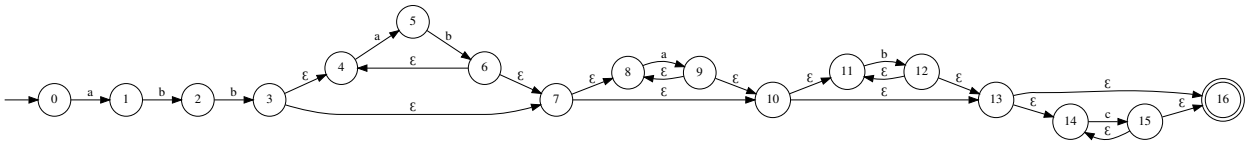
a) `(b|c)*a(a|c)*`



b) `c*|(a+|(b|c))*b*`



c) `abb(ab)*(a*b*c*)`



Question 3 – NFA to DFA Conversion

a)

Table 1: NFA transition function reference

State	a	b	ϵ*
0	$\varnothing$	$\varnothing$	$\{0, 1, 2, 3, 4, 5, 8, 9, 10, 11\}$
1	$\varnothing$	$\varnothing$	$\{1, 2, 3, 4, 5, 8, 9, 10, 11\}$
2	$\varnothing$	$\varnothing$	$\{1, 2, 3, 4, 5, 8, 9, 10, 11\}$
3	$\varnothing$	$\varnothing$	$\{1, 2, 3, 4, 5, 8, 9, 10, 11\}$
4	$\{6\}$	$\varnothing$	$\{4\}$
5	$\varnothing$	$\{7\}$	$\{5\}$
6	$\varnothing$	$\varnothing$	$\{1, 2, 3, 4, 5, 6, 8, 9, 10, 11\}$
7	$\varnothing$	$\varnothing$	$\{1, 2, 3, 4, 5, 7, 8, 9, 10, 11\}$
8	$\varnothing$	$\varnothing$	$\{1, 2, 3, 4, 5, 8, 9, 10, 11\}$
9	$\varnothing$	$\varnothing$	$\{1, 2, 3, 4, 5, 8, 9, 10, 11\}$
10	$\varnothing$	$\varnothing$	$\{1, 2, 3, 4, 5, 8, 9, 10, 11\}$
(11)	$\varnothing$	$\varnothing$	$\{11\}$

Table 2: DStates

(A)	$\{0, 1, 2, 3, 4, 5, 8, 9, 10, 11\}$
(B)	$\{1, 2, 3, 4, 5, 6, 8, 9, 10, 11\}$
(C)	$\{1, 2, 3, 4, 5, 7, 8, 9, 10, 11\}$

Table 3: ϵ-closure state pairings

ϵ-closure($\{0\}$)	(A)
ϵ-closure($\{6\}$)	(B)
ϵ-closure($\{7\}$)	(C)

Subset construction algorithm

```
T = ϵ-closure(0) = { 0, 1, 2, 3, 4, 5, 8, 9, 10, 11 } = A
U = ϵ-closure(moveTo(A, a))
U = ϵ-closure({ 6 }) = { 1, 2, 3, 4, 5, 6, 8, 9, 10, 11 } = B
U = ϵ-closure(moveTo(A, b))
U = ϵ-closure({ 7 }) = { 1, 2, 3, 4, 5, 7, 8, 9, 10, 11 } = C

T = B
U = ϵ-closure(moveTo(B, a))
U = ϵ-closure({ 6 }) = B
U = ϵ-closure(moveTo(B, b))
U = ϵ-closure({ 7 }) = C

T = C
U = ϵ-closure(moveTo(C, a))
U = ϵ-closure({ 6 }) = B
U = ϵ-closure(moveTo(C, b))
U = ϵ-closure({ 7 }) = C
```

Table 4: Resulting DFA transition function

	a	b
→ (A)	B	C
(B)	B	C
(C)	B	C

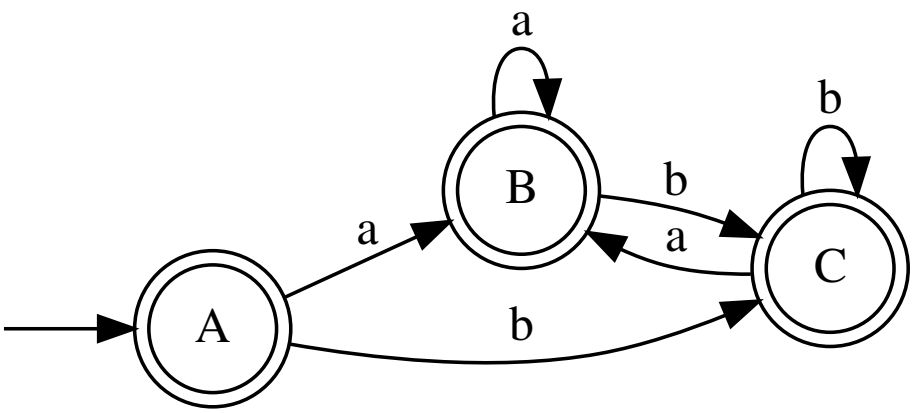


Figure 1: Resulting DFA diagram

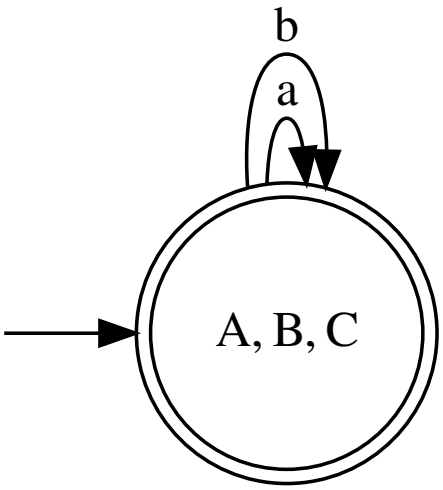


Figure 2: Minimized DFA diagram

b)

Table 5: NFA transition function reference

State	a	b	ϵ*
0	$\{0,1\}$	$\{0\}$	$\{0\}$
1	$\{2\}$	$\{2\}$	$\{1\}$
2	$\{3\}$	$\{3\}$	$\{2\}$
(3)	$\varnothing$	$\varnothing$	$\{3\}$

Table 6: DStates

A	$\{0\}$
B	$\{0,1\}$
C	$\{0,1,2\}$
D	$\{0,2\}$
(E)	$\{0,1,2,3\}$
(F)	$\{0,2,3\}$
(G)	$\{0,1,3\}$
(H)	$\{0,3\}$

Table 7: ϵ-closure state pairings

ϵ-closure($\{0\}$)	A
ϵ-closure($\{0,1\}$)	B
ϵ-closure($\{0,1,2\}$)	C
ϵ-closure($\{0,2\}$)	D
ϵ-closure($\{0,1,2,3\}$)	(E)
ϵ-closure($\{0,2,3\}$)	(F)
ϵ-closure($\{0,1,3\}$)	(G)
ϵ-closure($\{0,3\}$)	(H)

Subset construction algorithm

```
T = ϵ-closure(0) = { 0 } = A
U = ϵ-closure(moveTo(A, a))
U = ϵ-closure({ 0, 1 }) = { 0, 1 } = B
U = ϵ-closure(moveTo(A, b))
U = ϵ-closure({ 0 }) = A

T = B
U = ϵ-closure(moveTo(B, a))
U = ϵ-closure({ 0, 1, 2 }) = { 0, 1, 2 } = C
U = ϵ-closure(moveTo(B, b))
U = ϵ-closure({ 0, 2 }) = { 0, 2 } = D

T = C
U = ϵ-closure(moveTo(C, a))
U = ϵ-closure({ 0, 1, 2, 3 }) = { 0, 1, 2, 3 } = E
U = ϵ-closure(moveTo(C, b))
U = ϵ-closure({ 0, 2, 3 }) = { 0, 2, 3 } = F

T = D
U = ϵ-closure(moveTo(D, a))
U = ϵ-closure({ 0, 1, 3 }) = { 0, 1, 3 } = G
U = ϵ-closure(moveTo(D, b))
U = ϵ-closure({ 0, 3 }) = { 0, 3 } = H

T = E
U = ϵ-closure(moveTo(E, a))
U = ϵ-closure({ 0, 1, 2, 3 }) = E
U = ϵ-closure(moveTo(E, b))
U = ϵ-closure({ 0, 2, 3 }) = F

T = F
U = ϵ-closure(moveTo(F, a))
U = ϵ-closure({ 0, 1, 3 }) = G
U = ϵ-closure(moveTo(F, b))
U = ϵ-closure({ 0, 3 }) = H

T = G
U = ϵ-closure(moveTo(G, a))
U = ϵ-closure({ 0, 1, 2 }) = C
U = ϵ-closure(moveTo(G, b))
U = ϵ-closure({ 0, 2 }) = D

T = H
U = ϵ-closure(moveTo(H, a))
U = ϵ-closure({ 0, 1 }) = B
U = ϵ-closure(moveTo(H, b))
U = ϵ-closure({ 0 }) = A
```

Table 8: Resulting DFA transition function

	a	b
→ A	B	A
B	C	D
C	E	F
D	G	H
(E)	E	F
(F)	G	H
(G)	C	D
(H)	B	A

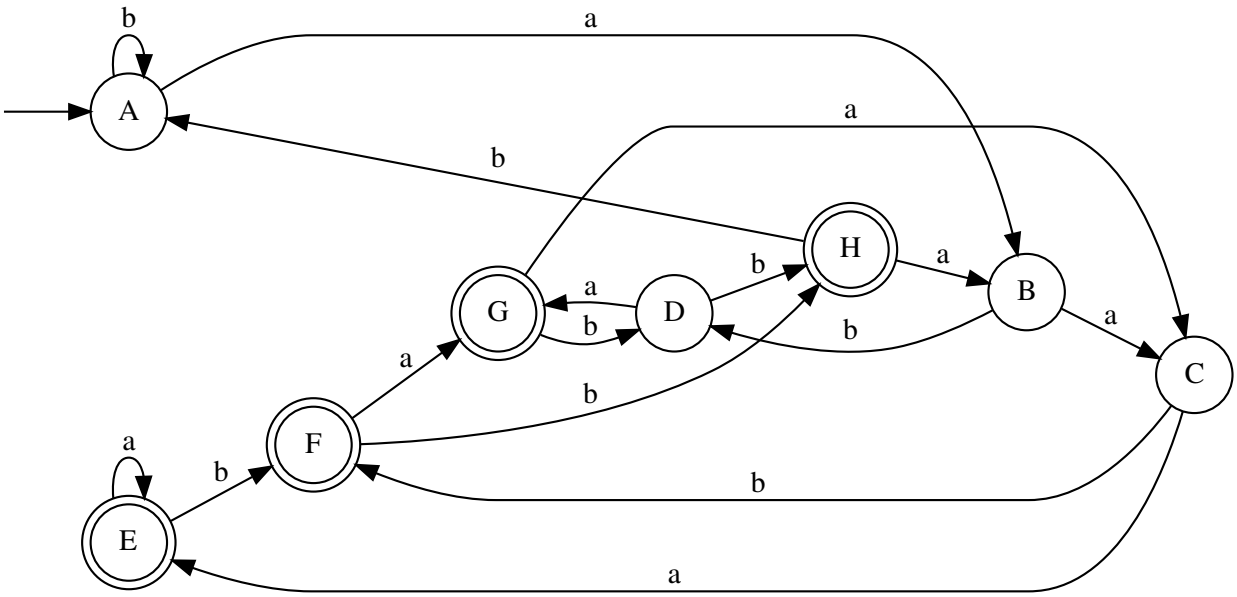


Figure 3: Resulting DFA diagram