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**CS 321: Homework #4**

1. $\overline{L(R)}$ = $L((ab + aab) * b)$

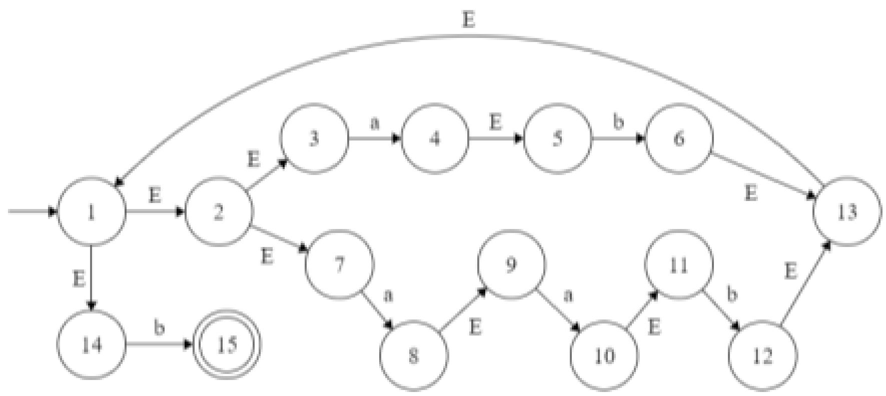
Process:

Regular Expression → NFA → DFA → Modify DFA for Complement → NFA → Regular Expression

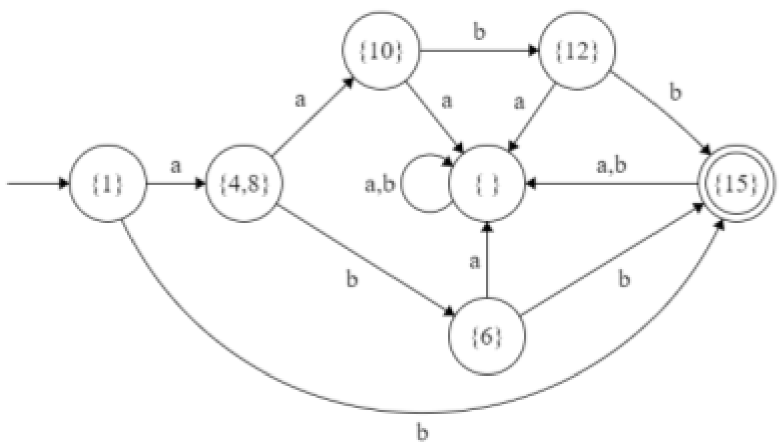
Regular Expression:

$L((ab + aab) * b)$

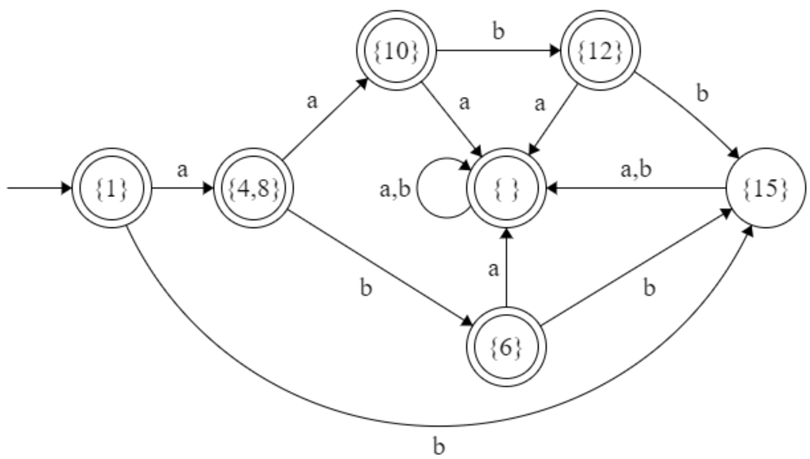
NFA:



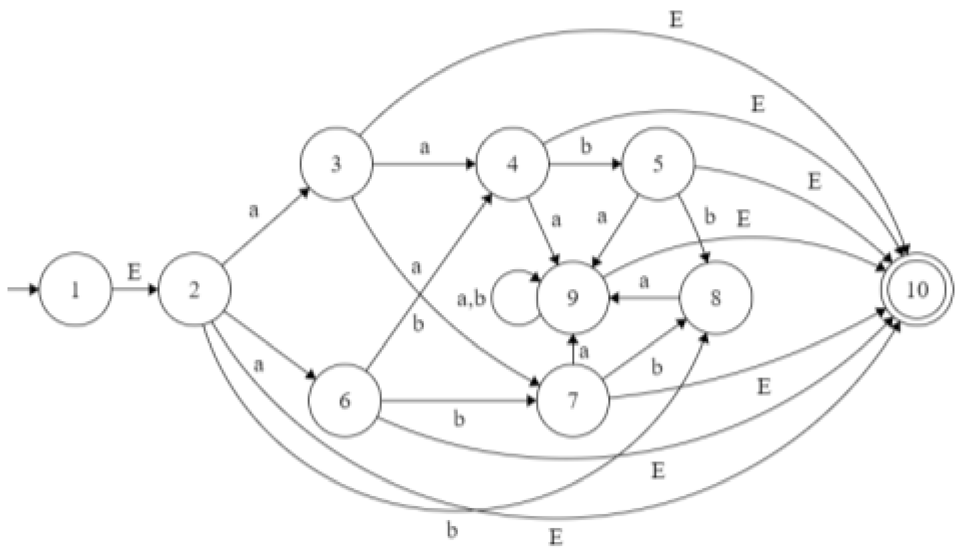

DFA:




DFA's Complement:



NFA:




Regular Expression:

***L*(*R*) = *L*(ε + *a* + *aa* + *ab* + *aab* + *ba*(*a* + *b*)* + *aaa*(*a* + *b*)* + *aba*(*a* + *b*)* + *aaba*(*a* + *b*)* + *abba*(*a* + *b*)* + *aabba*(*a* + *b*)*)**

2. ε + *a*(*ba***b* + *ba*) * *b*

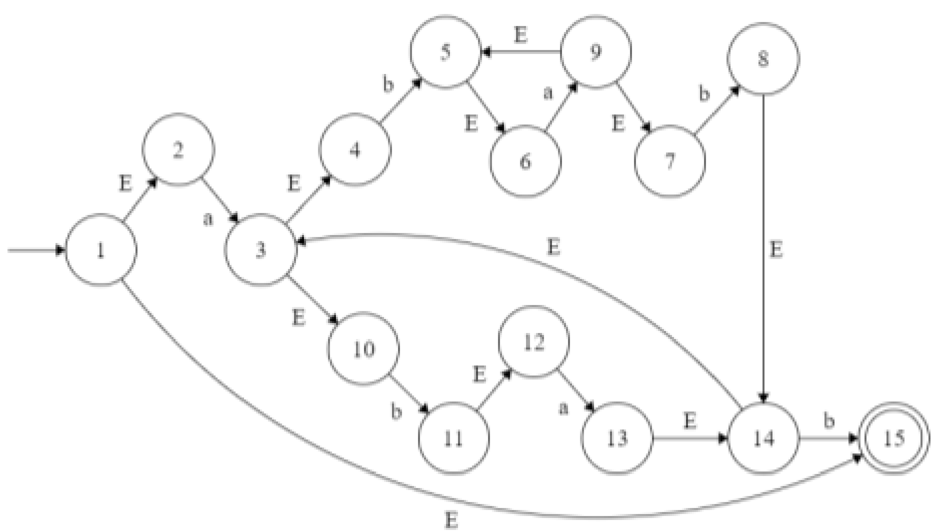
Process:

Regular Expression → NFA → DFA

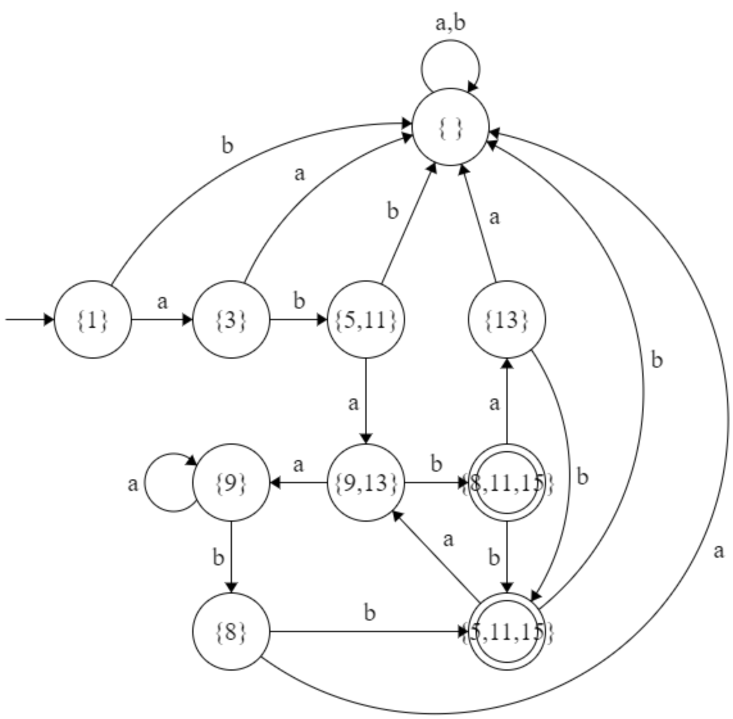
Regular Expression:

ε + *a*(*ba***b* + *ba*) * *b*

NFA:

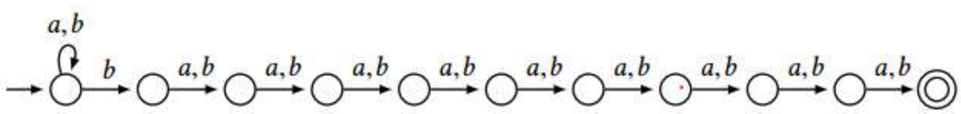


DFA:




3.

$$A = \{w \in \{a,b\}^* \mid \text{10th character from the end of } w \text{ is } b\}$$




Prove that DFA *M* has *L*(*M*) = *A* has at least 1024 states.

Hint: Prove the contrapositive: Suppose *M* has fewer than 1024 states, then show that *L*(*M*) disagrees with *A* (show a string in A that M rejects, or a string not in A the M accepts).
Consider δ*(*s*, *w*) for all strings *w* of length 10.

Proof:

[Unable to fully complete this problem before the homework deadline…]

4. Prove $\{a^n b^m c^{n-m} \mid n, m \in \mathrm{N} \text{ and } n \geq m\}$ is not regular.

<u>Proof:</u> By the Pumping Lemma game…

1) Adversary picks $p \geq 0$.

2) I choose $w = a^p b^{p-1} c^{p-(p-1)} = a^p b^{p-1} c$

Satisfies: $w \in A$ and $|w| = 2p - 1 \geq p$

3) Adversary chops w into xyz.

Since $|xy| \leq p$, y contains only a's.

4) I choose $i = 0$.

$x y^i z = xz$ has $p - |y|$ a's

and $p - 1$ b's

and 1 c

since $p - |y| \leq p - 1$

$x y^i z$ is not an element in A, which shows that $\{a^n b^m c^{n-m} \mid n, m \in \mathrm{N} \text{ and } n \geq m\}$ is not regular.