3.3.2

Describe the languages denoted by the following regular expressions:

1. a(a|b)*a
2. ((ε|a)b*)*
3. (a|b)*a(a|b)(a|b)
4. a*ba*ba*ba*
5. !! (aa|bb)*((ab|ba)(aa|bb)*(ab|ba)(aa|bb)*)*

Answer

1. String of a's and b's that start and end with a.
2. String of a's and b's.
3. String of a's and b's that the character third from the last is a.
4. String of a's and b's that only contains three b.
5. String of a's and b's that has a even number of a and b.

3.3.5

! Write regular definitions for the following languages:

a) All strings of lowercase letters that contain the five vowels in order.

want -> other* a (other|a)* e (other|e)* i (other|i)* o (other|o)* u (other|u)*

other -> [bcdfghjklmnpqrstvwxyz]

b) All strings of lowercase letters in which the letters are in ascending lexicographic order.

a* b* ... z*

c) Comments, consisting of a string surrounded by /* and */, without an intervening */, unless it is inside double-quotes (")

\/*([^*"]*|".*"|*+[^/])**\/

d) !! All strings of digits with no repeated digits. Hint: Try this problem first with a few digits, such as {O, 1, 2}.

want -> 0|A?0?1(A0?1|01)*A?0?|A0?

A -> 0?2(02)*

e) !! All strings of digits with at most one repeated digit.

want -> (FE*G|(aa)*b)(E|FE*G)

E -> b(aa)*b

F -> a(aa)*b

G -> b(aa)*ab|a

F -> ba(aa)*b

f) !! All strings of a's and b's with an even number of a's and an odd number of b's.

(aa|bb|(ab|ba)(aa|bb)*(ba|ab))*(b|(ab|ba)(bb|aa)*a)

g) The set of Chess moves,in the informal notation,such as p-k4 or kbp*qn.

pieces = $(k|q)(r|n|b|\epsilon)p?$

moves = pieces * pieces | pieces-(k|q)(r|n|b)[1-8]) | 0-0-0 | 0-0

h) !! All strings of a's and b's that do not contain the substring abb.

b*(a+b?)*

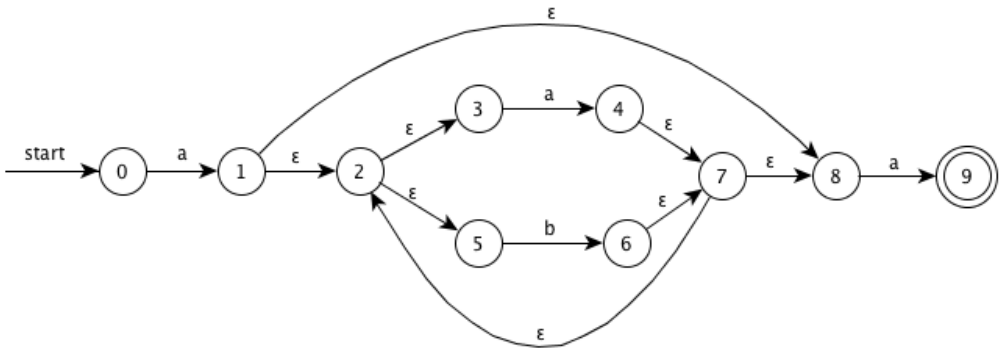
i) All strings of a's and b's that do not contain the subsequence abb.

b* | b*a+ | b*a+ba*

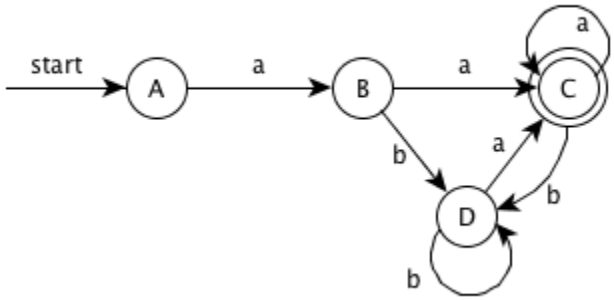
Exercis e 3.4.1 : Provide transition diagrams to recognize the same languages as each of the regular expressions in Exercise 3.3.2.

1. a(a|b)*a

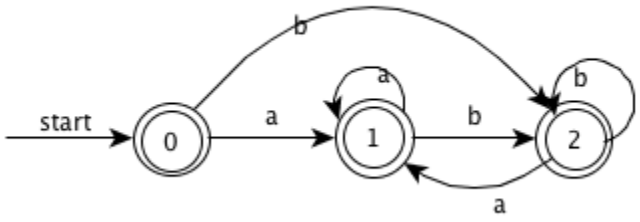
NFA:



DFA

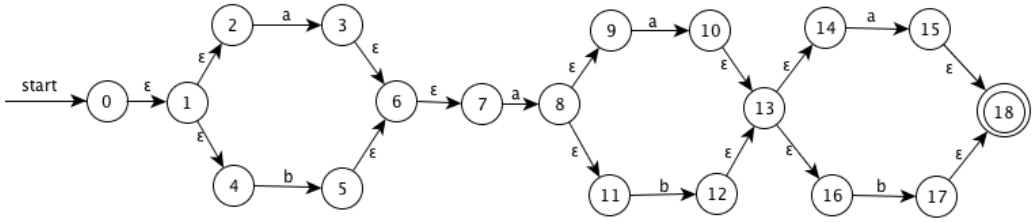


2. ((ε|a)b*)*

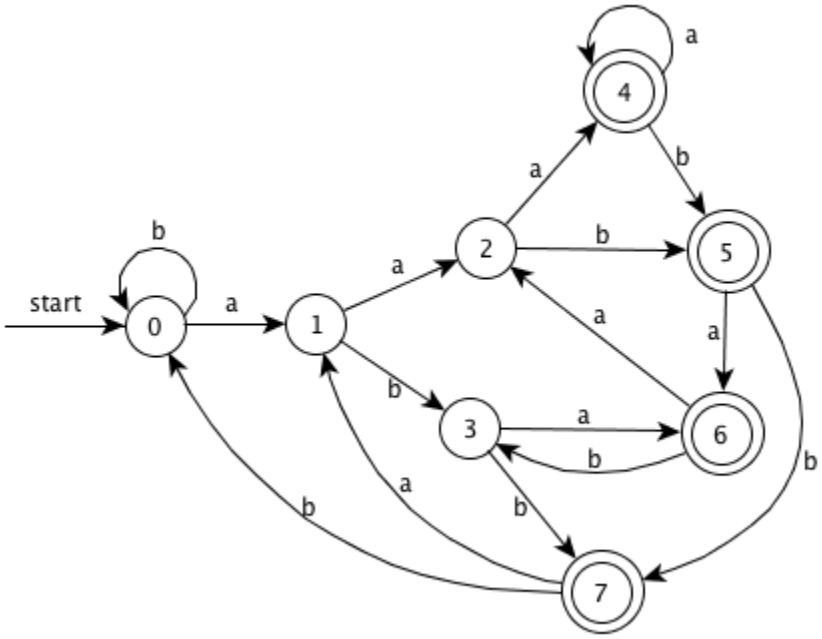


3. (a|b)*a(a|b)(a|b)

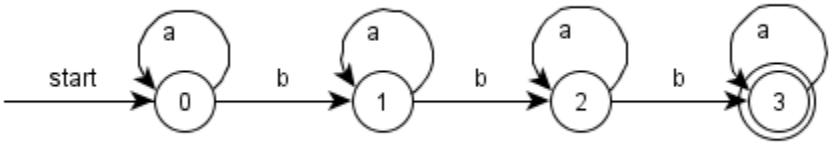
NFA



DFA



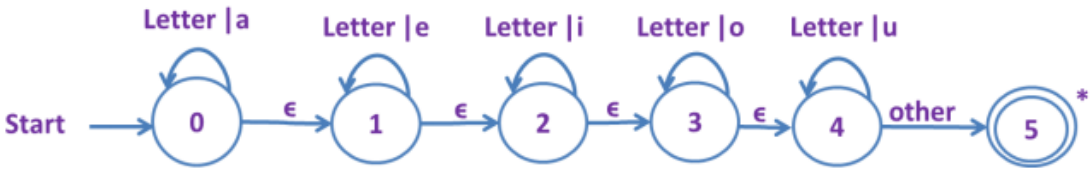
4. a*ba*ba*ba*



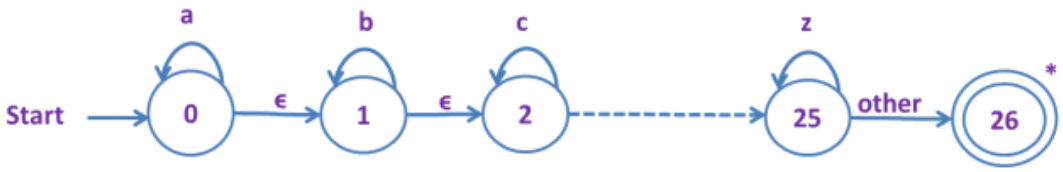
Exercis e 3.4.2 : Provide transition diagrams to recognize the same languages

as each of the regular expressions in Exercise 3.3.5.

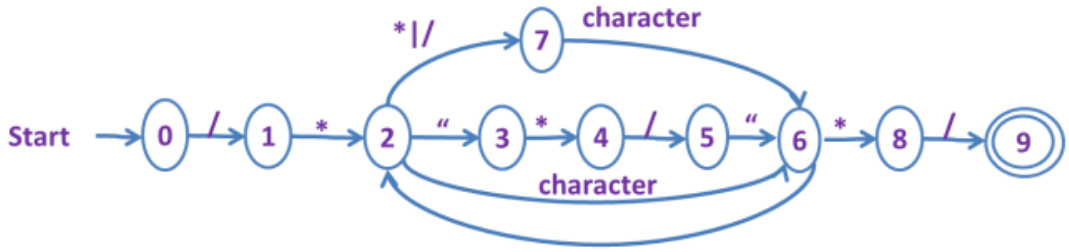
a) All strings of lowercase letters that contain the five vowels in order.



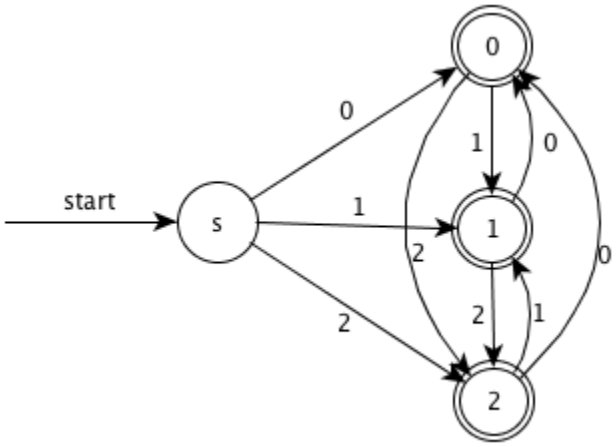
b) All strings of lowercase letters in which the letters are in ascending lexicographic order.



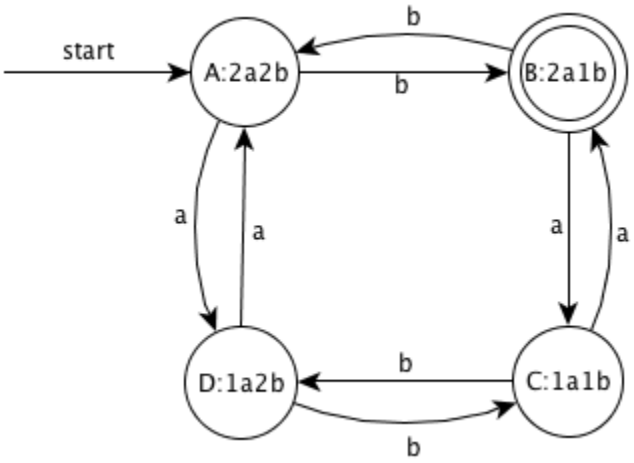
c) Comments, consisting of a string surrounded by /* and */, without an intervening */, unless it is inside double-quotes (")



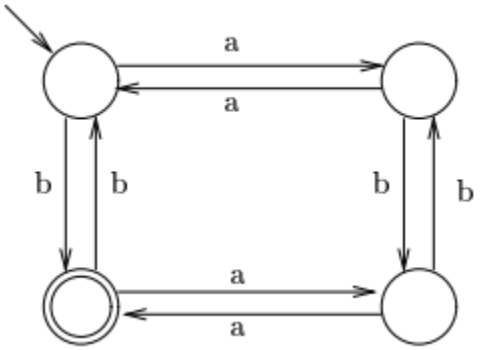
d) !! All strings of digits with no repeated digits. Hint: Try this problem first with a few digits, such as {O, 1, 2}.



e) All strings of digits with at most one repeated digit.

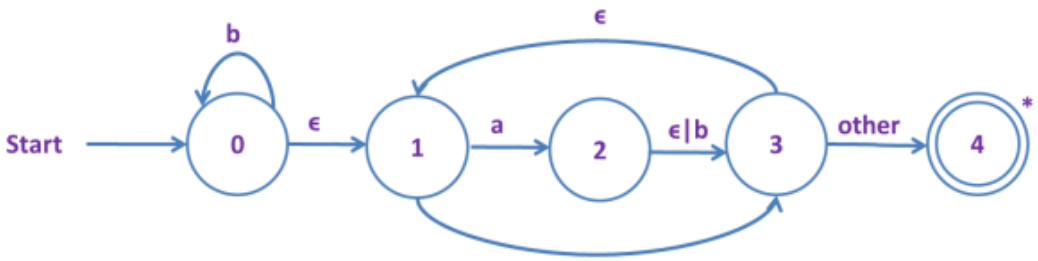


f) All strings of a's and b's with an even number of a's and an odd number of b's.



g) The set of chess moves, such as p - k4 or kbp*qn.

h) All strings of a's and 6's that do not contain the substring a66



i) All strings of a's and 6's that do not contain the subsequence a66