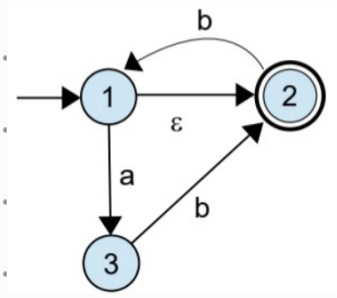
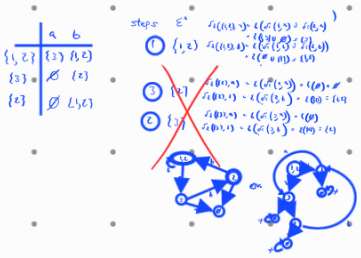
Exercise 7.1

Convert the following ε-NFA into a DFA using the Rabin-Scott subset construction (Definition 8.13)

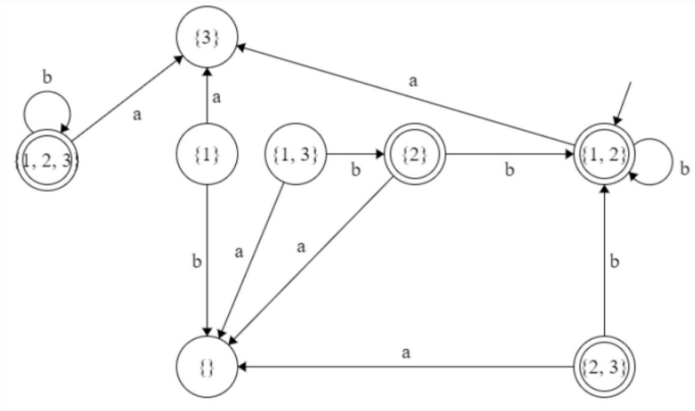




2^3 = 8

Nd = {{}, {1},{2},{3},{1,2},{1,3},{2,3},{1,3},{1,2,3}}

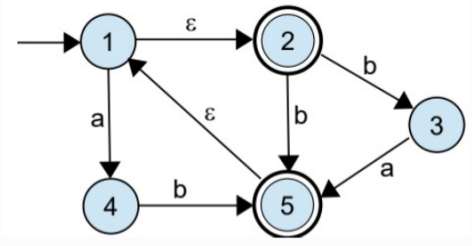
Ed = {{2},{1,2},{2,3},{1,2,3}}



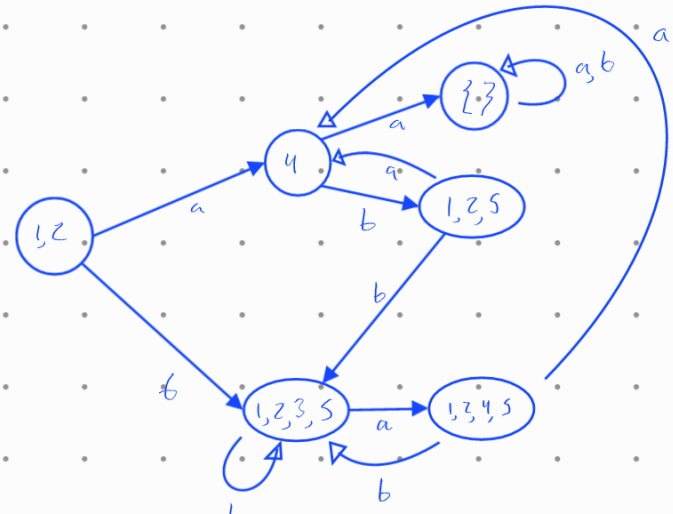
Exercise 7.2

The following e-NEA with alphabet S = {a, b} is given:

Convert the automaton to an equivalent deterministic finite automaton (DFA) using the improved subset construction (Algorithm 8.19).

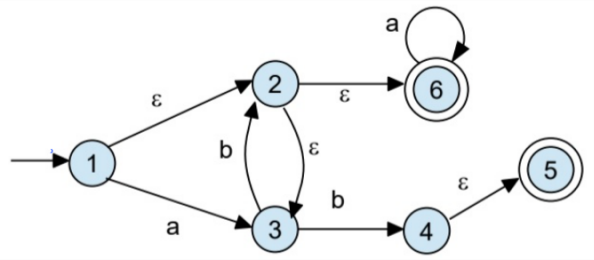


Initial state = {1,2}



Exercise 7.3 - obligatory (7 points)

Let the following e-NFA be given:



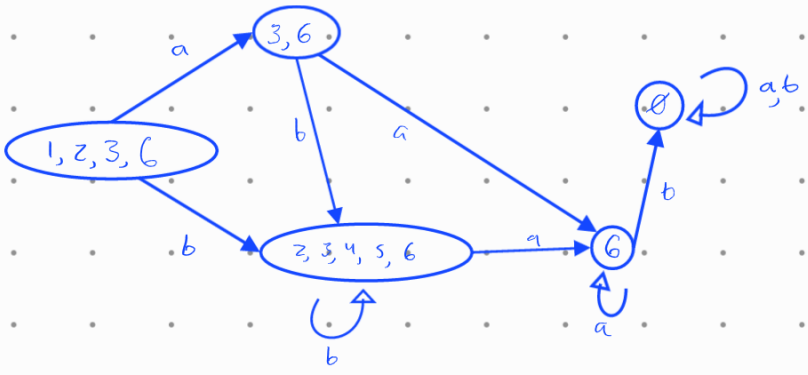
a) If you would use the Rabin-Scott subset construction from Definition 8.13 to convert this e-NFA into an DFA, how many states would the resulting DFA have?

ε-NFA states: n.= 6

The R.Scott subset construction would result 2^6 = 64 subsets as states of the DFA

b) Use the improved subset construction (Algorithm 8.19) to convert this e-NFA into an equivalent DFA.

Initial state: {1,2,3,6}



Exercise 7.4 - obligatory (6 points)

A set S of specific arithmetic expressions is inductively defined in the following way:

(1) The numbers 6, 15 and 33 are contained in S.

(2) If expressions s1 and s2 are contained in S, then also the following expressions are contained in S:

(s1 + s2)

(s1 • s2)

s1^2

An example of such an expression is ((33 + (15 • 6)^2) • 33^2).

Prove by structural induction that evaluation of each expression s.ε S produces a value that is divisible by 3.

Induction basis:

Expression s is a single element from S. ; S = {6, 15, 33}
6 % 3 = 0
15 % 3 = 0
33 % 3 = 0

Induction steps:
$nx = sx / 3$

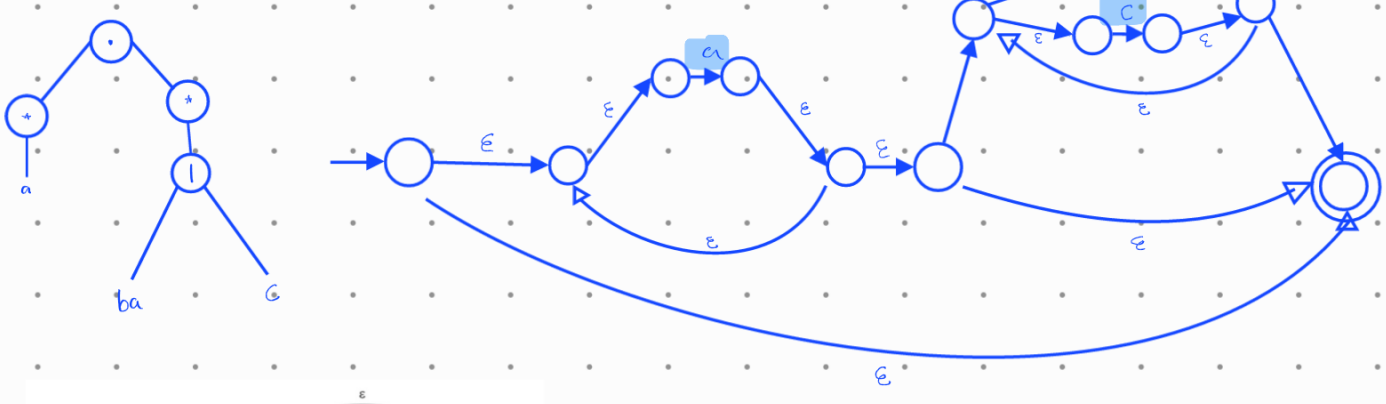
s ∈ {6, 15, 33}; n ∈ ℕ

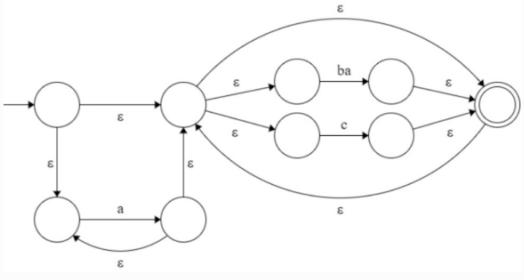
1. $n1 + n2 = s1+s2 / 3 \Rightarrow (s1 + s2)$ % 3 = 0 ; property is fulfilled
2. $n1 \cdot n2 = s1 \cdot s2 / 3 \Rightarrow (s1 \cdot s2)$ % 3 = 0 ; property is fulfilled
3. $n1^2 = s1^2 / 3 \Rightarrow s1^2$(integral) % 3 = 0 ; property is fulfilled

Conclusion:
Evaluation of each expression s ∈ S produces a value that is divisible by 3.

Exercise 7.5

Systematically build an e-NFA (using procedure 9.1) that accepts the language of the following regular expression:
a*(ba|c)*

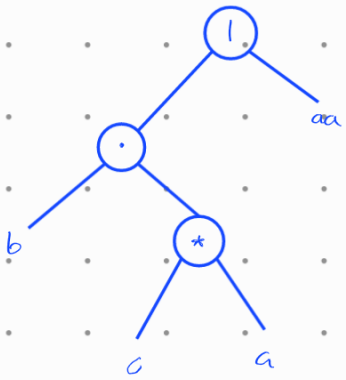




Exercise 7.6 - obligatory (7 points)

Let the following regular expression be given:
b(ca)* | aa

a) Describe the syntactic structure of the regular expression as an abstract syntax tree.



b) Use the inductive method presented in procedure 9.1 to build an e-NFA that accepts the language of regular expression.