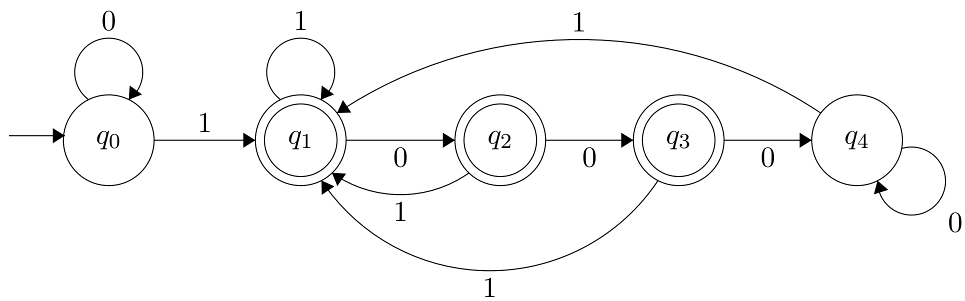
Homework 1

January 31, 2024

1: Deterministic Construction

(a)



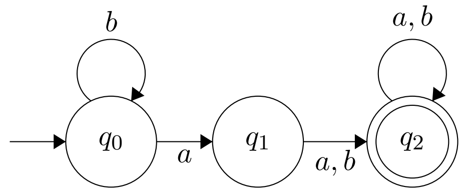
(b)

$Q = \{q_0, q_1, q_2, q_3, q_4\}$
$\sum = \{0, 1\}$
$q_0 = q_0$
$F = \{q_1, q_2, q_3\}$
$\delta =$ See Table 1

	0	1
q_0	q_0	q_1
q_1	q_2	q_1
q_2	q_3	q_1
q_3	q_4	q_1
q_4	q_4	q_1

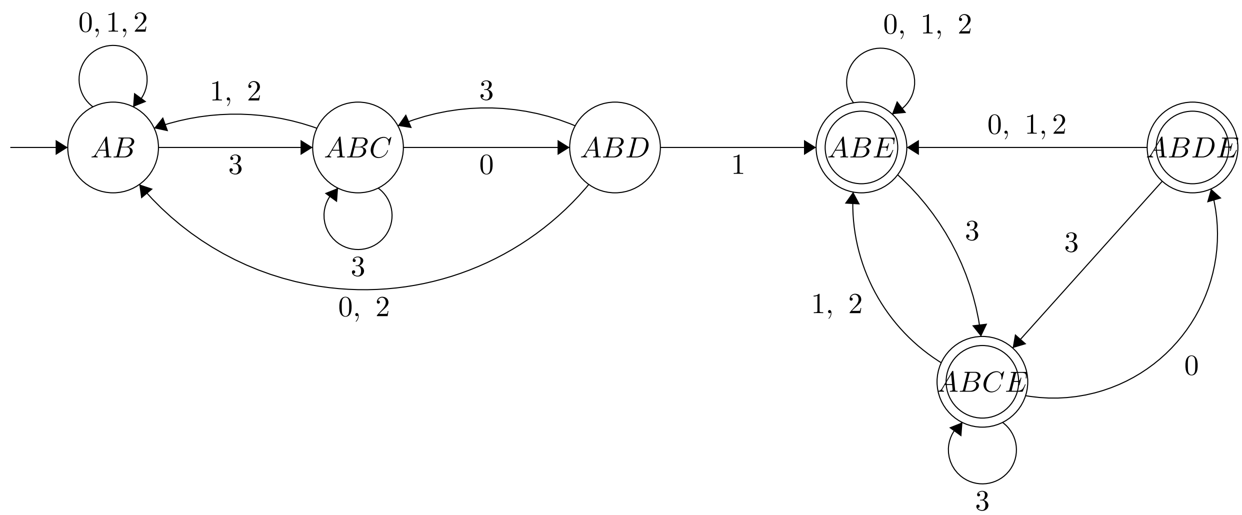
Table 1: Transition Function

2: Nondeterministic Construction



3: NFA to DFA Conversion

:: Assume that state AB is equivalent to state {A, B}



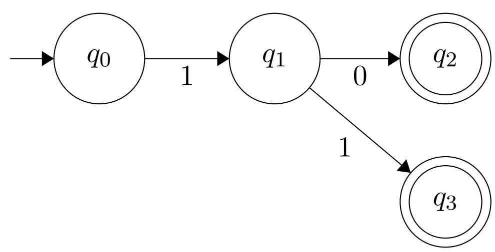
4: Closure in Reverse

Proof:
Suppose that the language L is regular. We should prove that the reverse is also regular.
We know that if a language is regular, then there is some NFA that decides that language.
Since L is regular, there is an NFA that decides L. We can call the NFA of L, M_L.

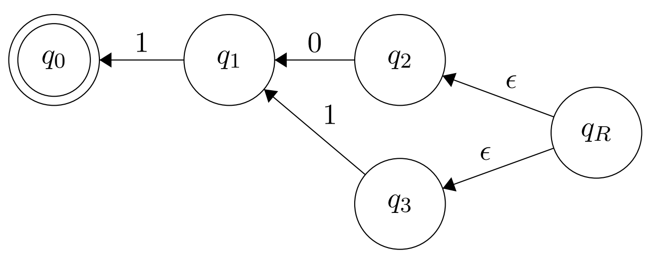
$\therefore$ We must show that there is also an NFA that decides the reverse of L, which we will call M_R.

To construct M_R, we will use the 5-tuples of L.
$Q_R = Q$ (i.e we shall use the same states).
$\sum_R = \sum$ (i.e we shall use the same alphabets)
$F_R = q_0$ (i.e the start state of L will be our final state in M_R)
$q_R = q_0 \cup F$ (i.e the set of final states of L will be our start states connected using epsilon.)
The arrow directions should be swapped but everything else remains the same in the transition function.

For example, take M_L ::



As a result, M_R ::



In conclusion, we've shown that the reverse of L is also regular by creating M_R.