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(Week 7) Lecture 13-14

Objectives: **Learning objectives of this lecture are**

- **Nondeterministic Finite Automata (NFA)**
- **Conversion from NFA to FA**

Text Book &Resources:

Introduction to Computer Theory–2nd Edition - (I. O. Cohen)

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Nondeterministic Finite Automata

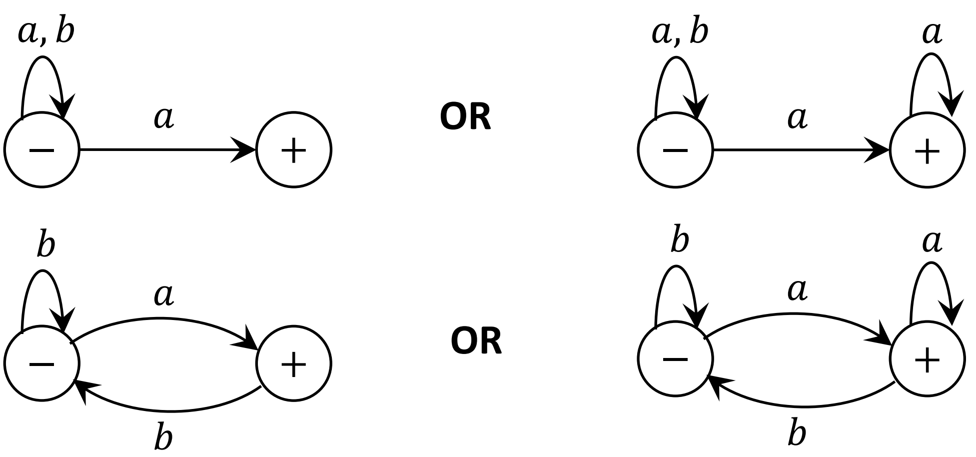
What isNondeterministic Finite Automata (NFA)?

NFA seems to be just like a DFA but having following violations of DFA

- It accepts a Λtransition.
- It allows zero, one or more than one transition of any symbol from set of given alphabets on each state.

Note: Every DFA is NFA because NFA can have the above mentioned violations but it doesn't mean that these violations must to be happened in NFA.

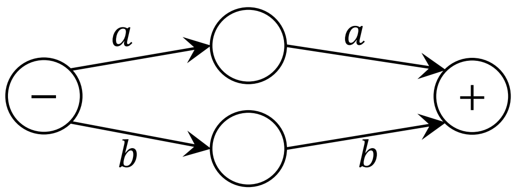
Example1: The language end on a. $\Sigma = \{a, b\}$



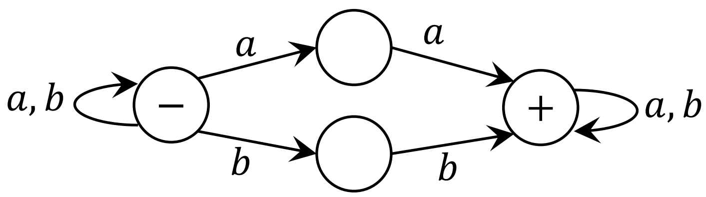
In above example, all four solutions are acceptable because

- Every solution passes every word of the language end on a.
- No word except the language end on a passed.

Example2: Language having words {aa, bb} over $\sum = \{$ a b$\}$



Example3: The language of all words that have substring aa or bb.



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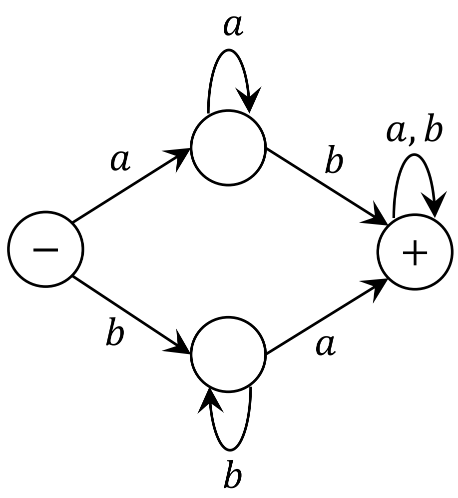
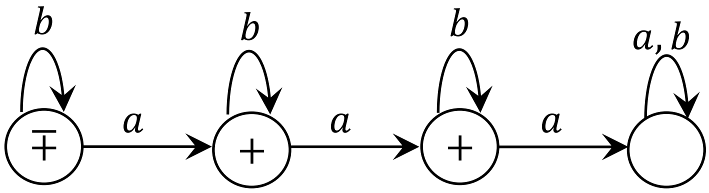
Note: Now, no need to complete transections of each letter on each state as shown above.

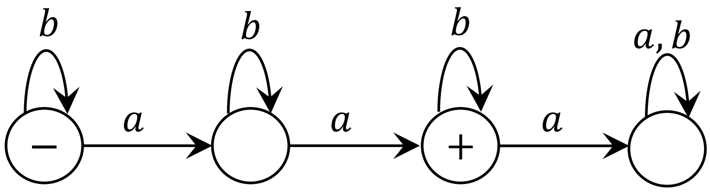
Example4: The language of all words that have at least one a and at least one b is somewhat trickier.



Example5: The Language contain at most two a's defined over, ∑={a,b}



Example6: The Language contain exact two a's defined over, ∑={a,b}



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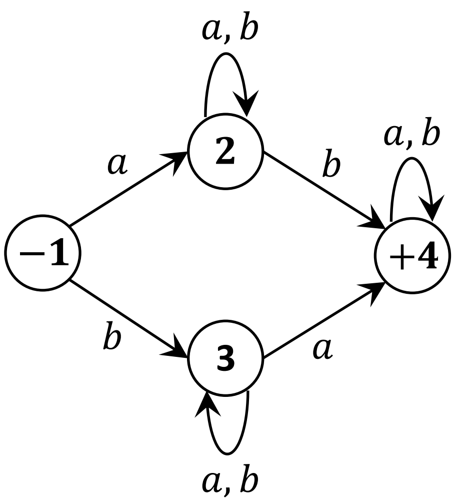
NFA to FA Conversion

NFA to DFA conversion can be understood by the help of examples.

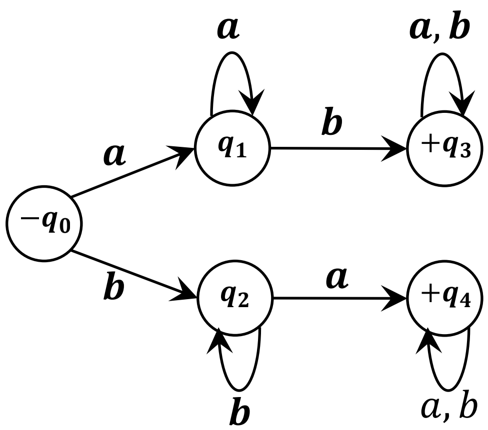
Example7: Consider the NFA for the language contain substring ab or ba defined over, ∑={a,b}



Solution:

To convert from NFA to FA, we will use a transition table in which we check each state by giving each symbol in each state.

	a	b
$-q_0 = \{1\}$	$q_1 = \{2\}$	$q_2 = \{3\}$
$q_1 = \{2\}$	$q_1 = \{2\}$	$q_3 = \{2,4\}$
$q_2 = \{3\}$	$q_4 = \{3,4\}$	$q_2 = \{3\}$
$+q_3 = \{2,4\}$	$q_3 = \{2,4\}$	$q_3 = \{2,4\}$
$+q_4 = \{3,4\}$	$q_4 = \{3,4\}$	$q_4 = \{3,4\}$



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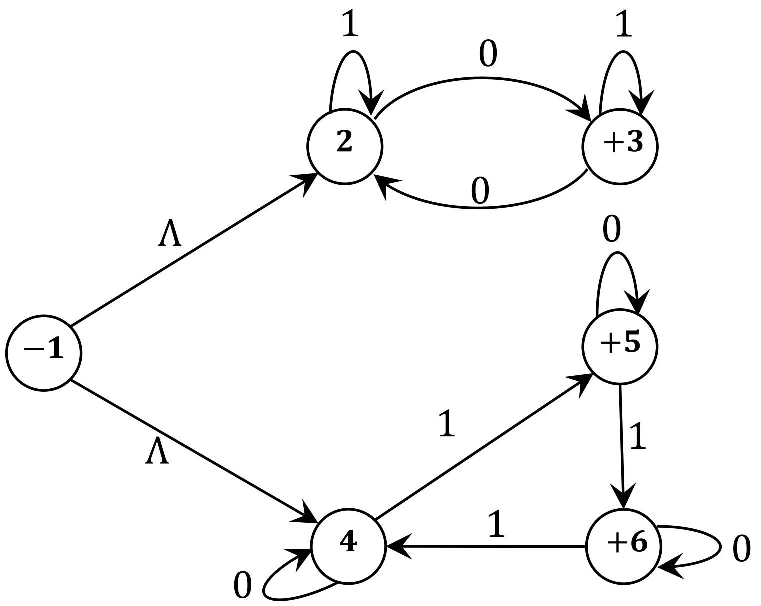
Example8: Give an NFA for the set of all binary strings thathave either the number of 0's odd, or the numberof 1's not a multiple of 3, or both.



	0	**1**
$-q_0 = \{1\}$	$q_1 = \{3,4\}$	$q_2 = \{2,5\}$
$+q_1 = \{3,4\}$	$q_3 = \{2,4\}$	$q_4 = \{3,5\}$
$+q_2 = \{2,5\}$	$q_4 = \{3,5\}$	$q_5 = \{2,6\}$
$q_3 = \{2,4\}$	$q_1 = \{3,4\}$	$q_2 = \{2,5\}$
$+q_4 = \{3,5\}$	$q_2 = \{2,5\}$	$q_6 = \{3,6\}$
$+q_5 = \{2,6\}$	$q_6 = \{3,6\}$	$q_3 = \{2,4\}$
$+q_6 = \{3,6\}$	$q_5 = \{2,6\}$	$q_1 = \{3,4\}$