Lexical Analysis
Programming Languages

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IIITB

NFA to DFA

Algorithm – intuition

NFA to DFA

Algorithm – intuition

- Start with the initial set (its ϵ-closure).
- For every symbol a in Σ, compute the set of destination states (MOVE followed by ϵ-closure)
- Discover new sets of states reachable by repeating this process.
- Each new set of state is a distinct state in the resultant DFA.

NFA to DFA

Algorithm – pseudocode

procedure NFA2DFA(N)

NFA to DFA

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procedure NFA2DFA(N)
    $s'_0 \leftarrow \epsilon$-CLOSURE($N.s_0$)
    add s'_0 to $D.states$
    UNMARK(s'_0)
    while there is unmarked state T in $D.states$ **do**
        MARK(T)
        for all $a \in \sum$ **do**
            $T' \leftarrow$ MOVE(T, a)
            $\mathcal{U} \leftarrow \epsilon$-CLOSURE($T'$)
            if $\mathcal{U} \notin D.states$ **then**
                add $\mathcal{U}$ to $D.states$
                UNMARK($\mathcal{U}$)
            end if
        end for
    end while
    return D
end procedure

NFA to DFA

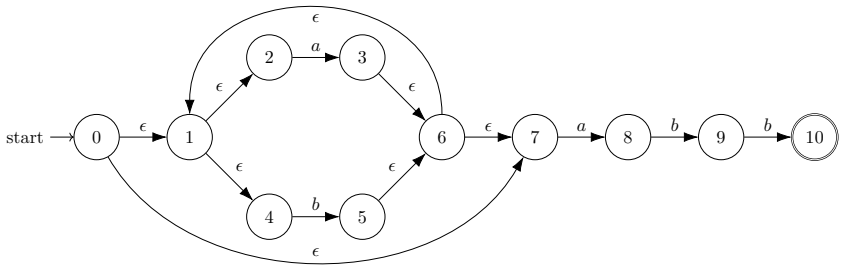
Algorithm – Marking and Unmarking

- An *unmarked DFA-state* (a set of NFA-states) is one from which all outgoing transitions corresponding to each symbol in Σ has not been explored.
- For a *marked DFA-state*, responses to all symbols of Σ have been explored.
- A newly discovered DFA-state starts by being unmarked.
- Could be implemented by maintaining a stack.
- Algorithm terminates when the stack goes empty.

NFA to DFA

Example

NFA:



NFA to DFA

Example

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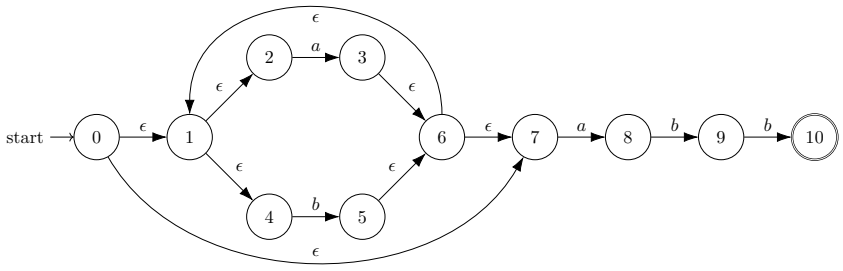
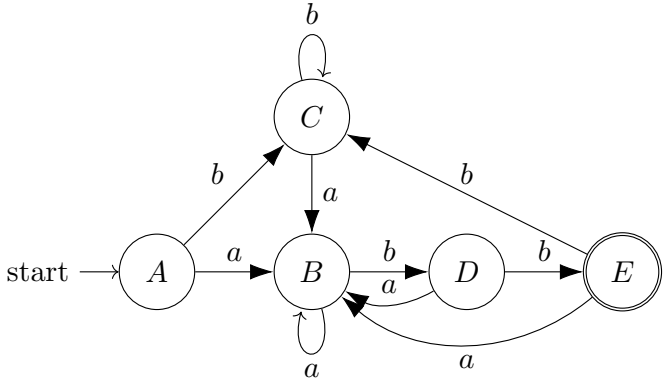


DFA:



NFA to DFA

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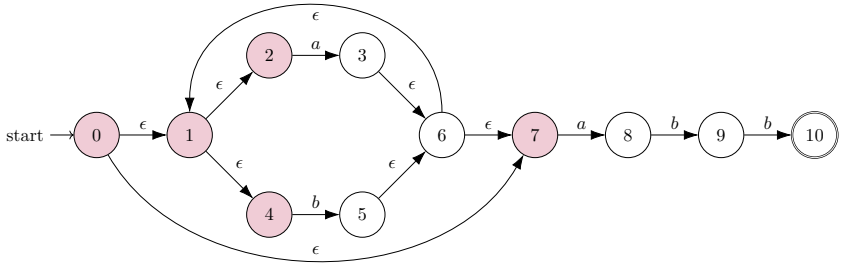
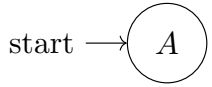


DFA:

Subset	DFA	Marked
$\{0, 1, 2, 4, 7\}$	A	$\times$



NFA to DFA

Example

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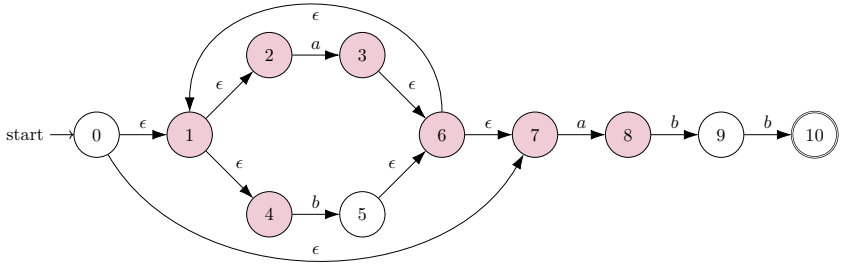
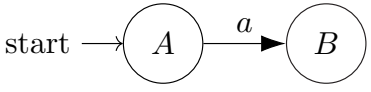


$$DTrans(\{0,1,2,4,7\},a) = \{1,2,3,4,6,7,8\}$$

DFA:

Subset	DFA	Marked
$\{0,1,2,4,7\}$	A	$\times$
$\{1,2,3,4,6,7,8\}$	B	$\times$



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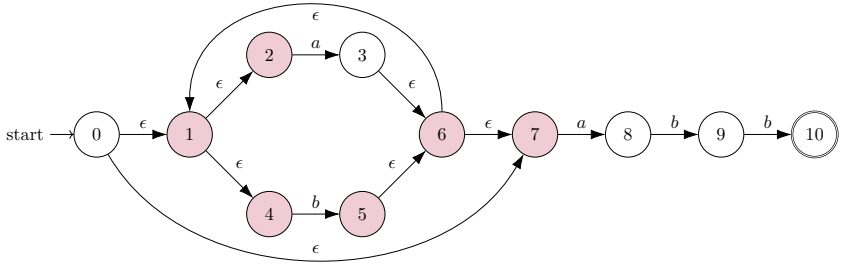
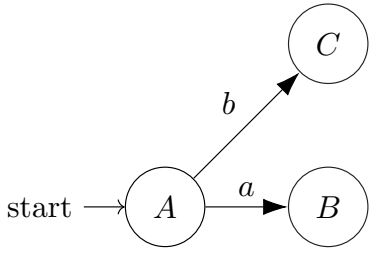


$$DTrans(\{0,1,2,4,7\},b) = \{1,2,4,5,6,7\}$$

DFA:

Subset	DFA	Marked
$\{0,1,2,4,7\}$	A	✓
$\{1,2,3,4,6,7,8\}$	B	×
$\{1,2,4,5,6,7\}$	C	×



NFA to DFA

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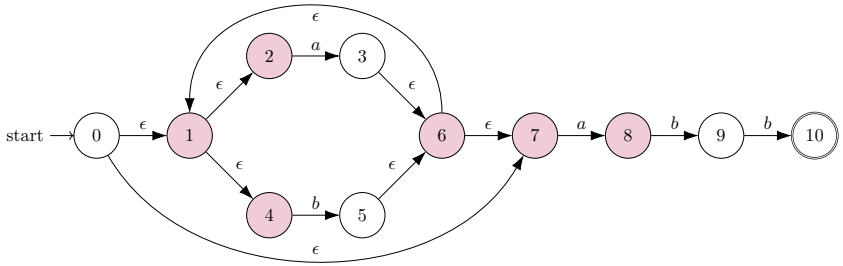

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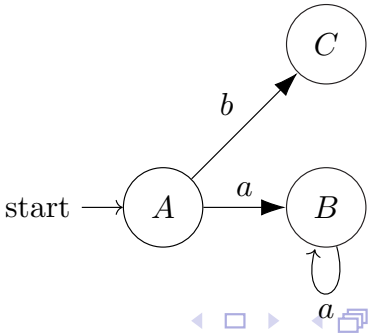

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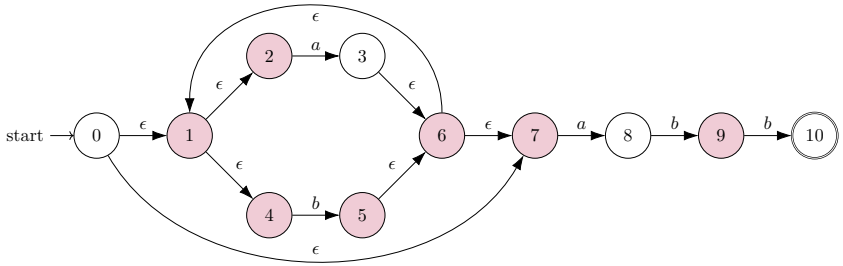

$$DTrans(\{1,2,3,4,6,7,8\},b) = \{1,2,4,5,6,7,9\}$$

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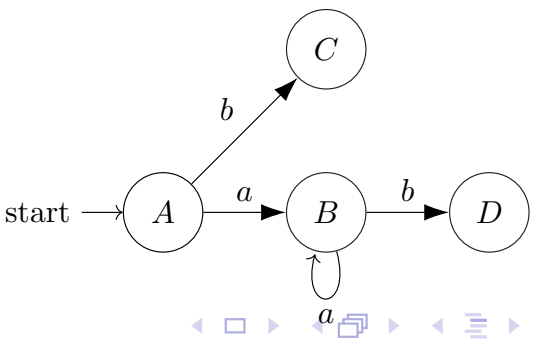

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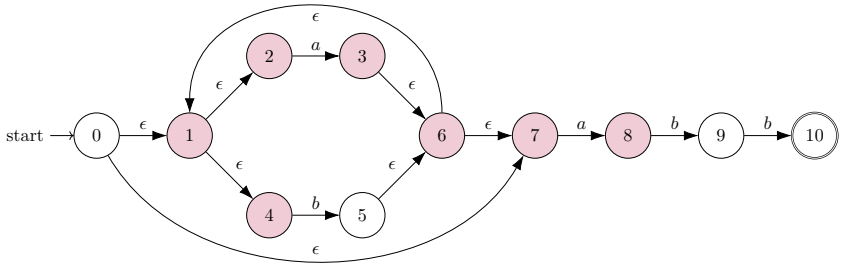

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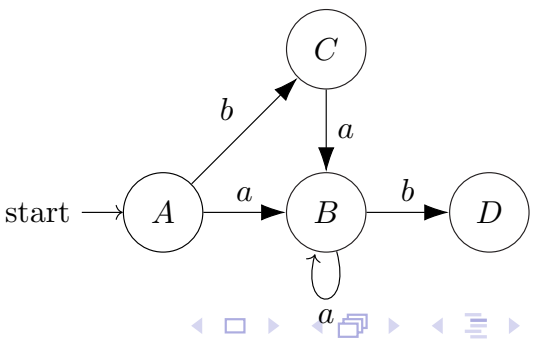

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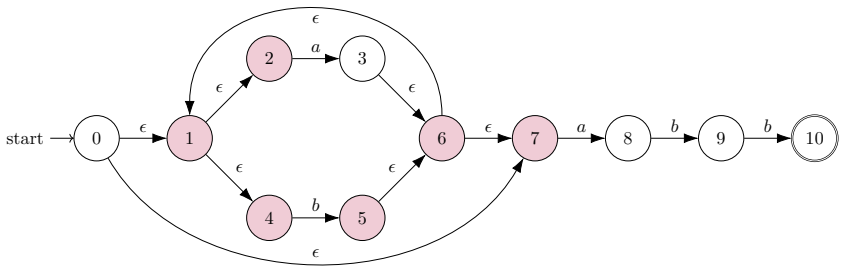

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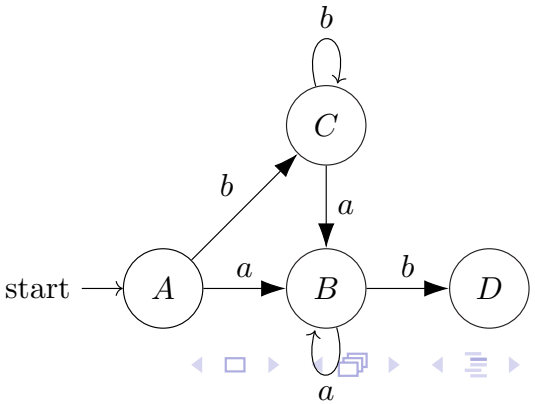

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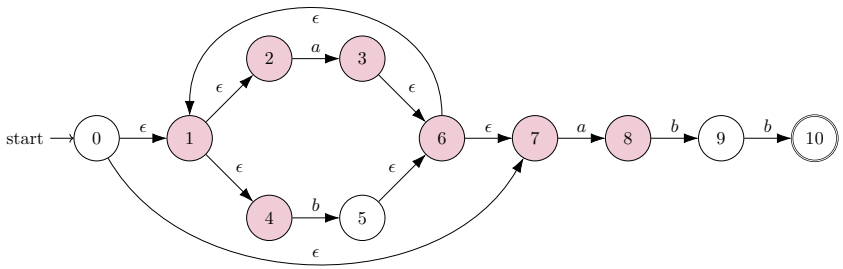

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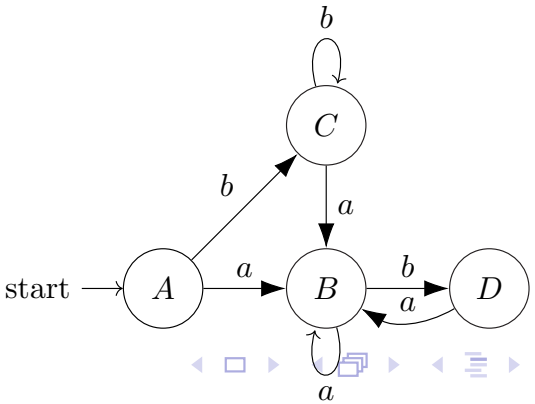

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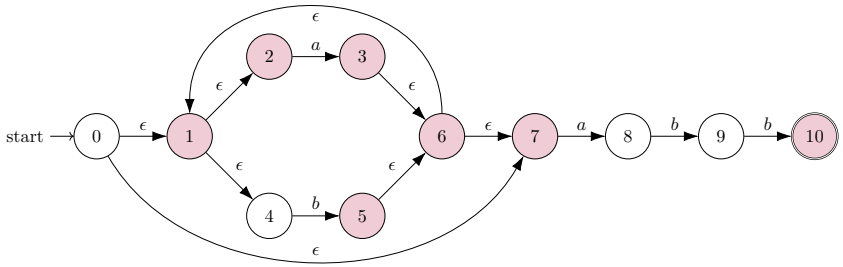

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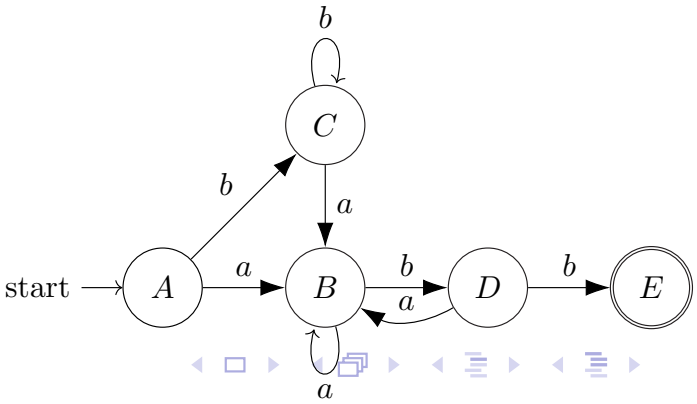
$\{1,2,3,5,6,7,10\}$	E	×



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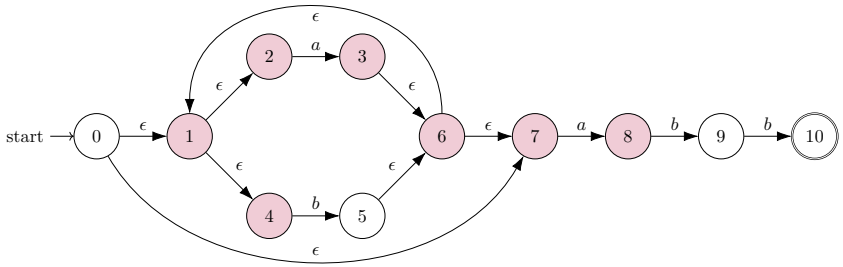

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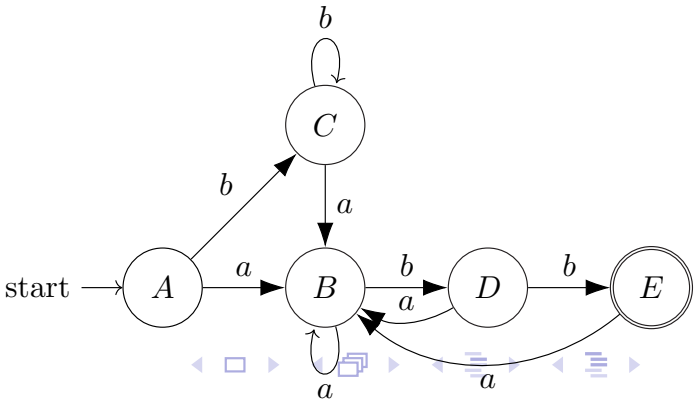

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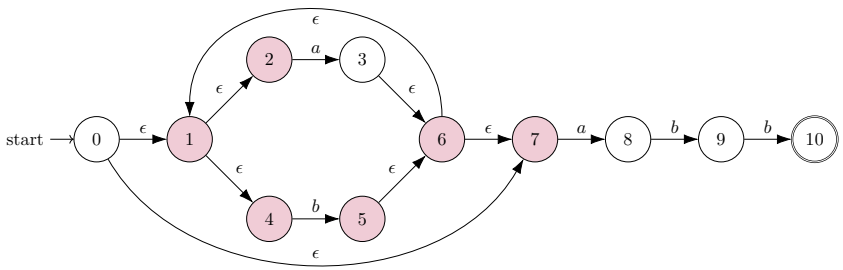

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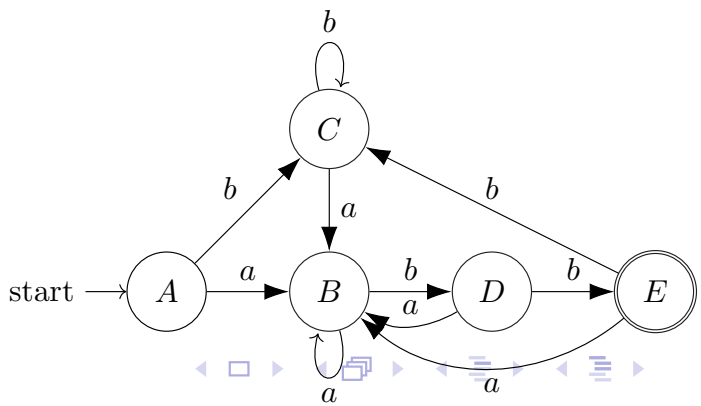
$\{1,2,3,5,6,7,10\}$	E	✓



Next

Next

Implementation of FSAs