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King Saud University
College of Computer and Information Sciences
Department of Computer Science

Theory of Computation (CSC 339) – Spring 2023
Instructor: Prof. M.B. Menai

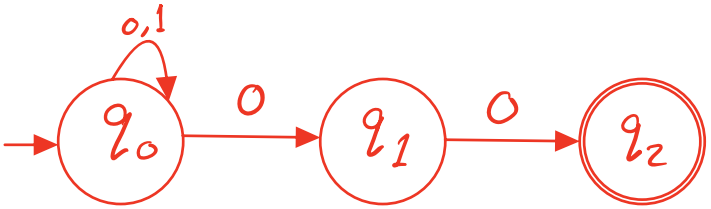
Tutorial 3 (Nondeterministic Finite Automata)
April, 2023

1. Give state diagrams of NFAs with the specified number of states recognizing each of the following languages. In all parts, the alphabet is $\Sigma = \{0, 1\}$.
   (a) The language $\{w|w$ ends with $00\}$ with three states.
   (b) The language 1*(001*)* with three states.
   (c) The language λ with one state.
   (d) The language 0* with one state.
2. Convert the NFAs obtained in the previous question to DFAs.
3. Give the state diagrams of NFAs recognizing the concatenation and the star of the following languages. The alphabet is $\Sigma = \{0, 1\}$.
   (a) The language $\{w|w$ ends with $00\}$.
   (b) The language 1*(001*)*.

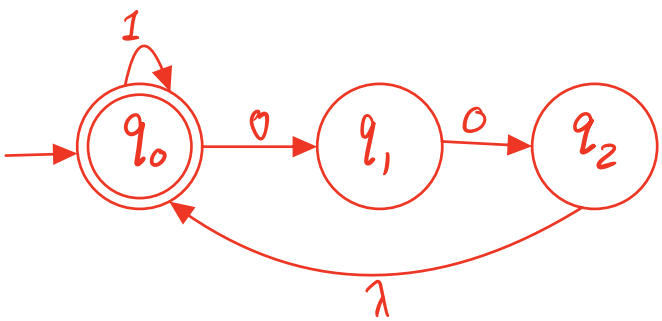
   and
   (a) The language λ.
   (b) The language 0*.
4. Convert the following regular expressions to NFAs. The alphabet is $\Sigma = \{0, 1\}$.
   (a) (0+1)*000(0+1)*
   (b) (((00)*(11))+01)*
   (c) $\emptyset$*

1. Give state diagrams of NFAs with the specified number of states recognizing each of the following languages. In all parts, the alphabet is $\Sigma = \{0, 1\}$.

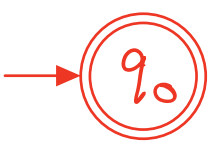
   (a) The language $\{w|w$ ends with $00\}$ with three states.



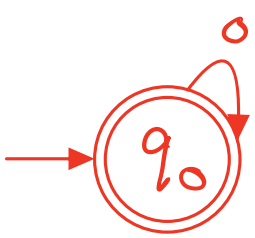
(b) The language 1*(001*)* with three states.



(c) The language λ with one state.

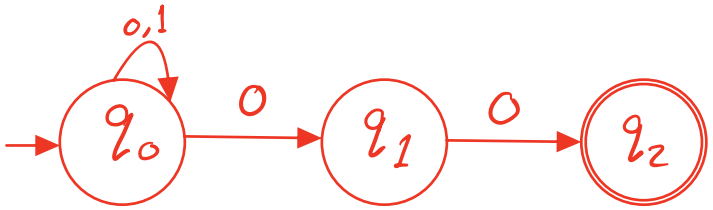


(d) The language 0* with one state.



2. Convert the NFAs obtained in the previous question to DFAs.

a)

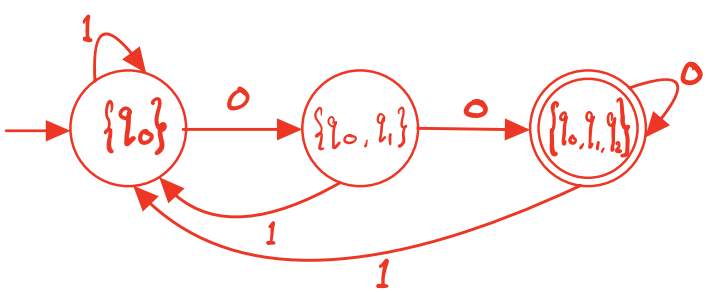


NFA transition table

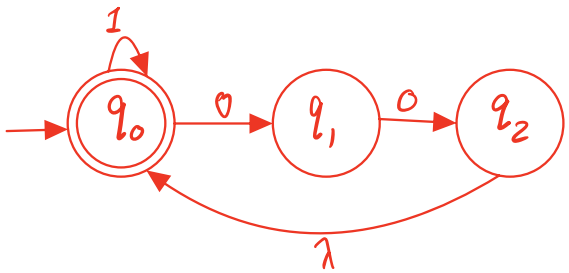
State \ Σ	0	1
→ q_0	q_0 q_1	q_0
q_1	q_2*	
q_2		

DFA transition table

State \ Σ	0	1
→ $\{q_0\}$	$\{q_0, q_1\}$	$\{q_0\}$
$\{q_0, q_1\}$	$\{q_0, q_1, q_2\}$*	$\{q_0\}$
$\{q_0, q_1, q_2\}$*	$\{q_0, q_1, q_2\}$*	$\{q_0\}$



(b)



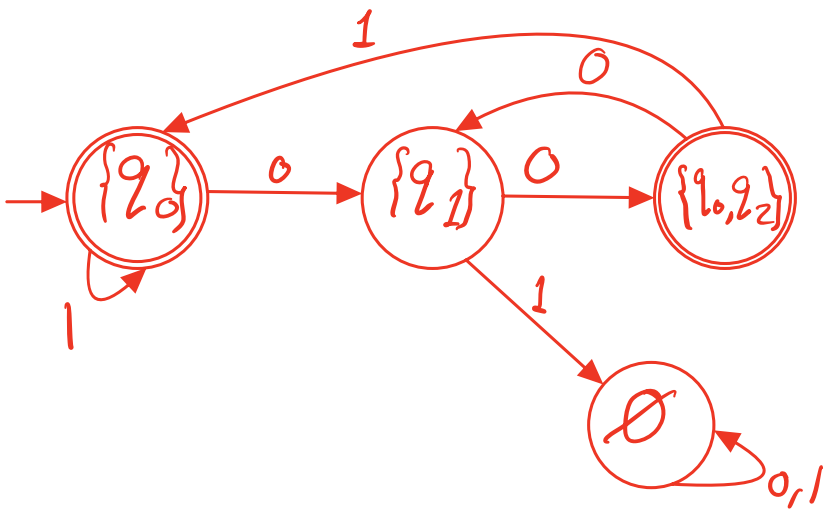
NFA transition table

State \ Σ	0	1
→ q_0*	q_1	q_0*
q_1	q_2 q_0*	
q_2	q_1	q_0*

DFA transition table

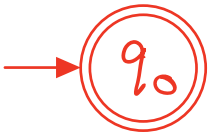
State \ Σ	0	1
→ $\{q_0\}$	$\{q_1\}$	$\{q_0\}$*
$\{q_1\}$	$\{q_0, q_2\}$*	$\emptyset$
$\{q_0, q_2\}$	$\{q_1\}$	$\{q_0\}$*
$\emptyset$	$\emptyset$	$\emptyset$

Accept state *



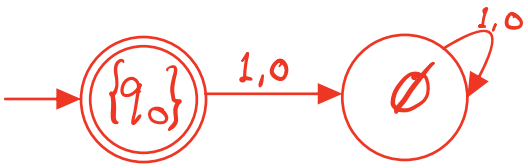
(c) NFA transition table

State \ Σ	0	1
→ q_0 *		



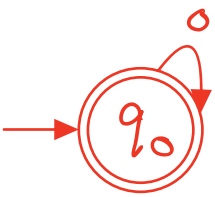
DFA transition table

State \ Σ	0	1
→ $\{q_0\}$ *	$\emptyset$	$\emptyset$
$\emptyset$	$\emptyset$	$\emptyset$



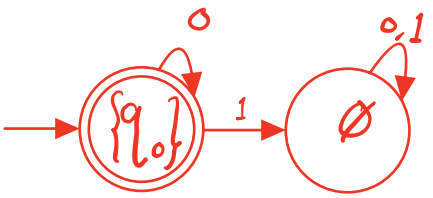
(d) NFA transition table

State \ Σ	0	1
→ q_0 *	q_0 *	



DFA transition table

State \ Σ	0	1
→ $\{q_0\}$ *	$\{q_0\}$ *	$\emptyset$
$\emptyset$	$\emptyset$	$\emptyset$



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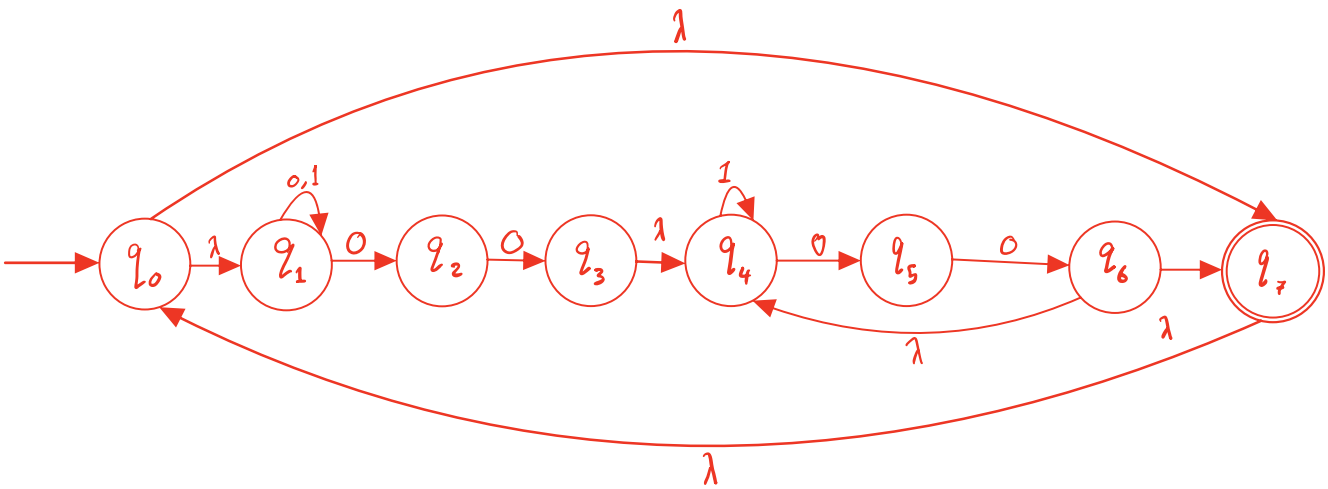

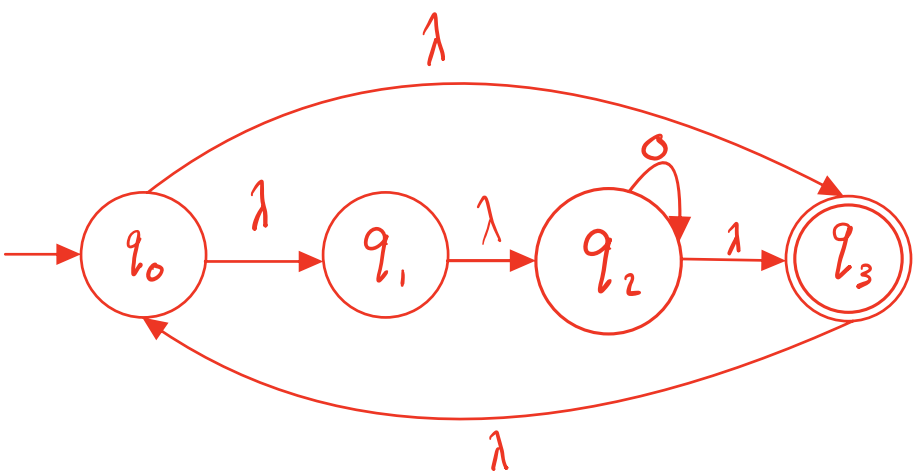

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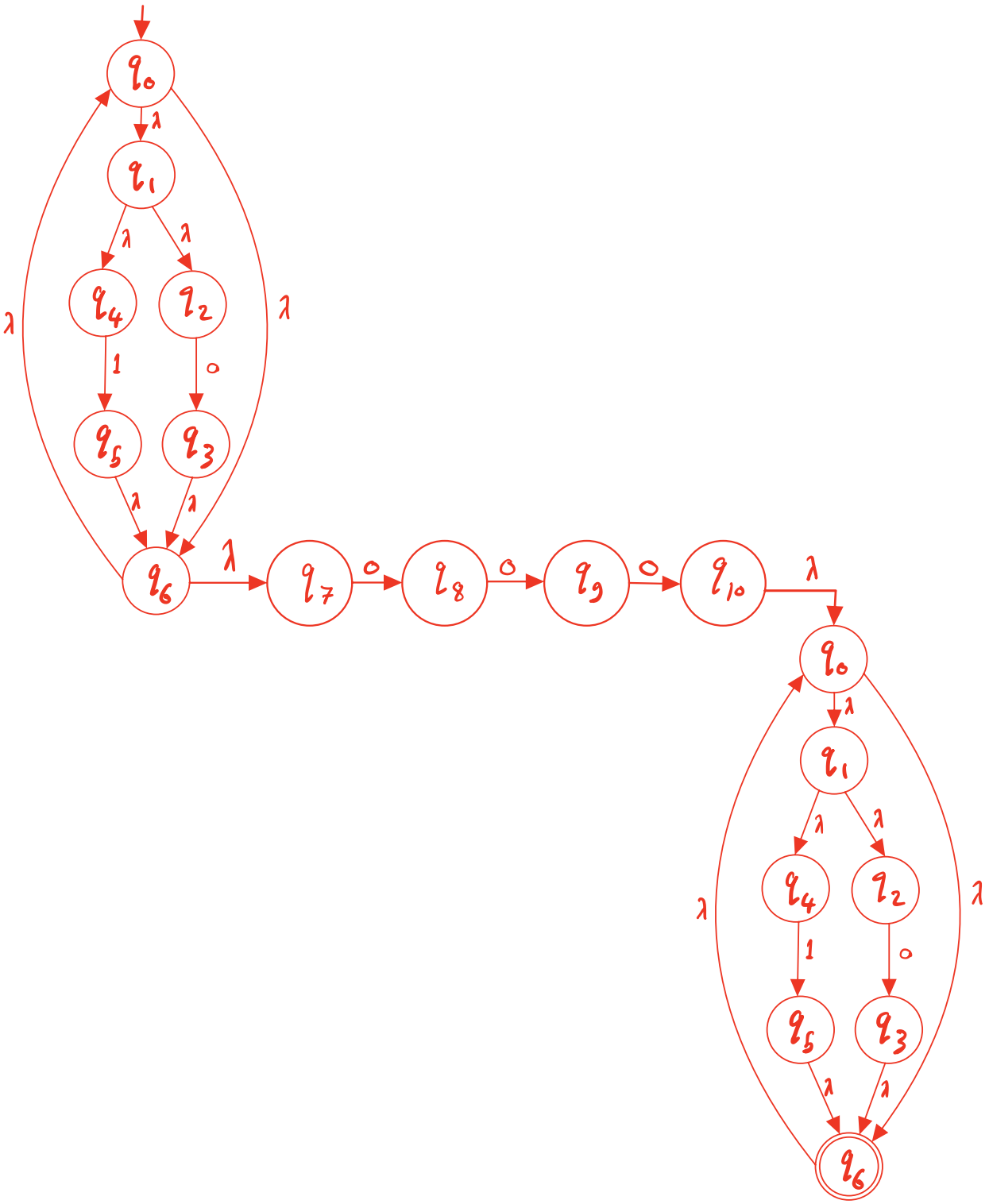
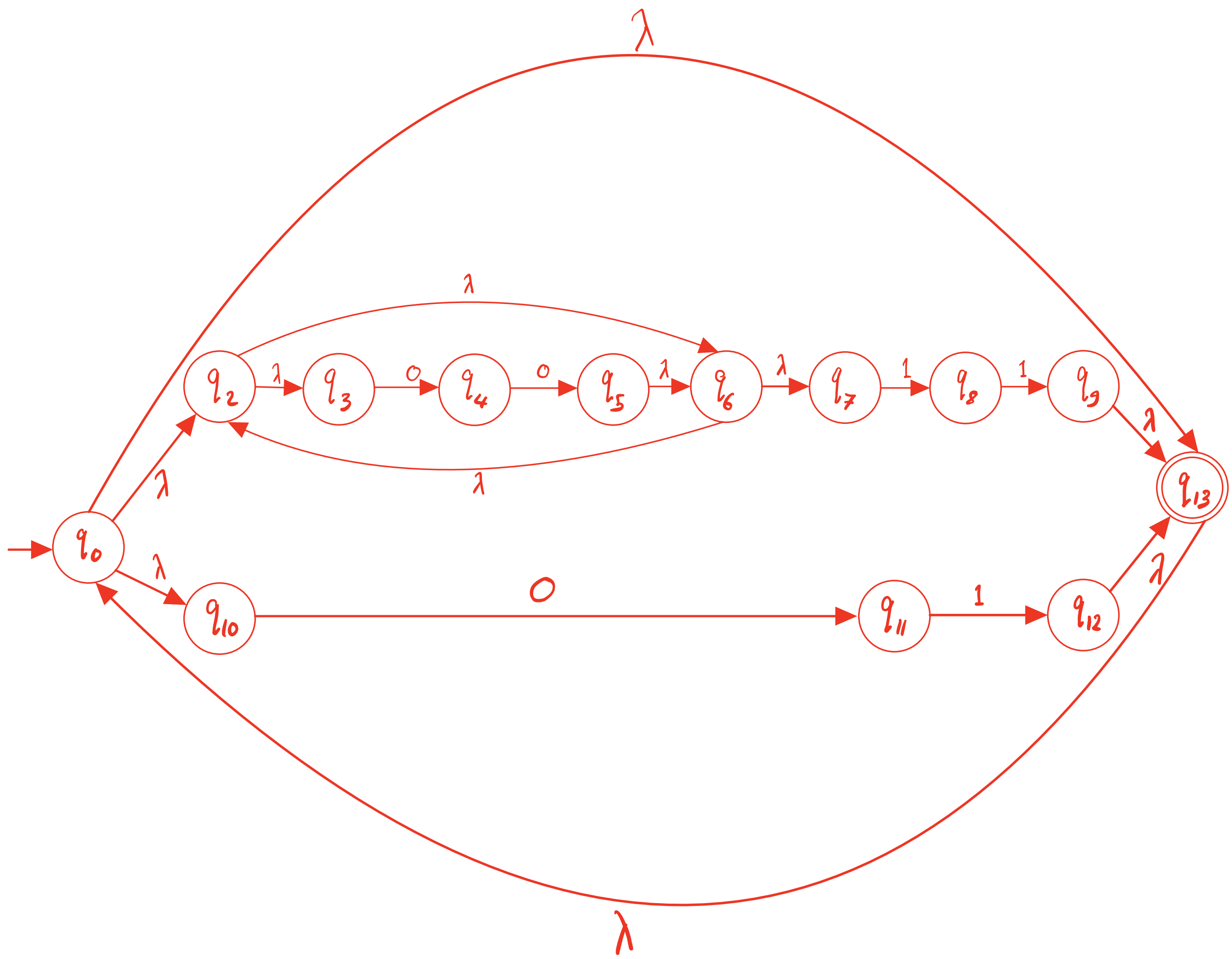


(b) $(((00)^*(11))+01)^*$



(c) $\emptyset^*$