

INT201 Decision, Computation and Language

Tutorial 3

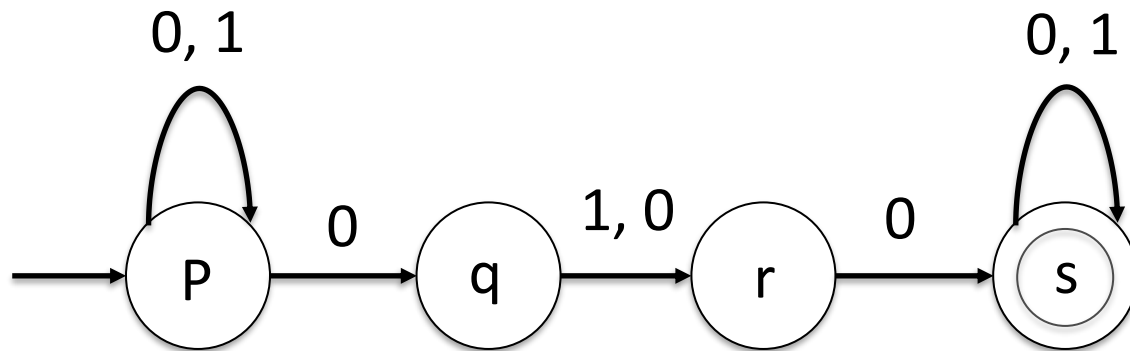
Dr Yushi Li



Xi'an Jiaotong-Liverpool University

西交利物浦大學

1. An NFA over alphabet $A = \{0, 1\}$ is given by the diagram below. Convert it to the equivalent DFA by filling the entries of the table and pointing out the accepting states.



	0	1
{p}		
{p, q}		
{p, r}		
{p, q, r}		
{p, q, s}		
{p, q, r, s}		
{p, r, s}		
{p, s}		



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

(a) The language $\{ w \in \Sigma^* \mid w \text{ ends with } 00 \}$ with three states.

(b) The language $\{ w \in \Sigma^* \mid w \text{ contains the substring } 0101, \text{ i.e., } w = x0101y \text{ for some } x, y \in \Sigma^* \}$ with five states.

(c) The language $0^*1^*0^*0$ with three states.

3. Which of the following three words belong(s) to the language of the regular expression $(ab)^*(abb)^*$?

(a) ababab

(b) ababba

(c) ababbab

4. Give regular expressions that generate each of the following languages. In all cases, the alphabet is $\Sigma = \{a, b\}$.

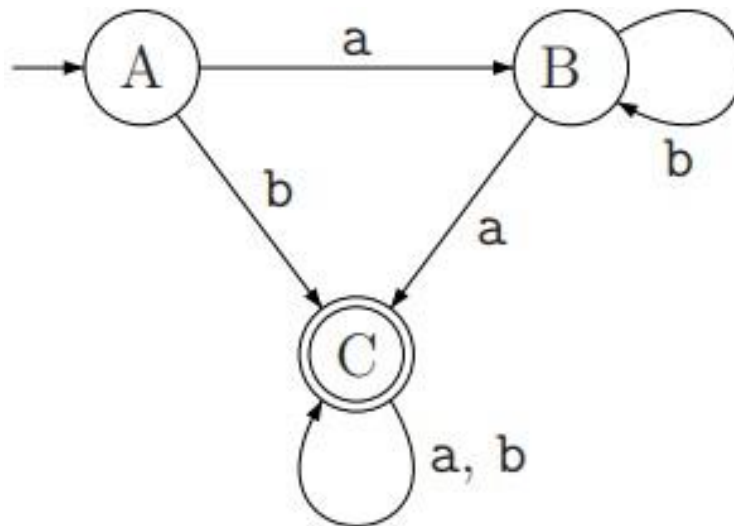
(a) The language $\{ w \in \Sigma^* \mid |w| \text{ is odd} \}$.

(b) The language $\{ w \mid w \text{ contains at least two } a\text{'s, or exactly two } b\text{'s} \}$.

(c) The language $\{ w \in \Sigma^* \mid w \text{ contains exactly one double letter} \}$. For example, baaba has exactly one double letter, but baaaba has two double letters.



5. Convert the given NFA to regular expression.



Solutions

1.

	0	1
{p}	{p, q}	{p}
{p, q}	{p, q, r}	{p, r}
{p, r}	{p, q, s}	{p}
{p, q, r}	{p, q, r, s}	{p, r}
{p, q, s}	{p, q, r, s}	{p, r, s}
{p, q, r, s}	{p, q, r, s}	{p, r, s}
{p, r, s}	{p, q, s}	{p, s}
{p, s}	{p, q, s}	{p, s}

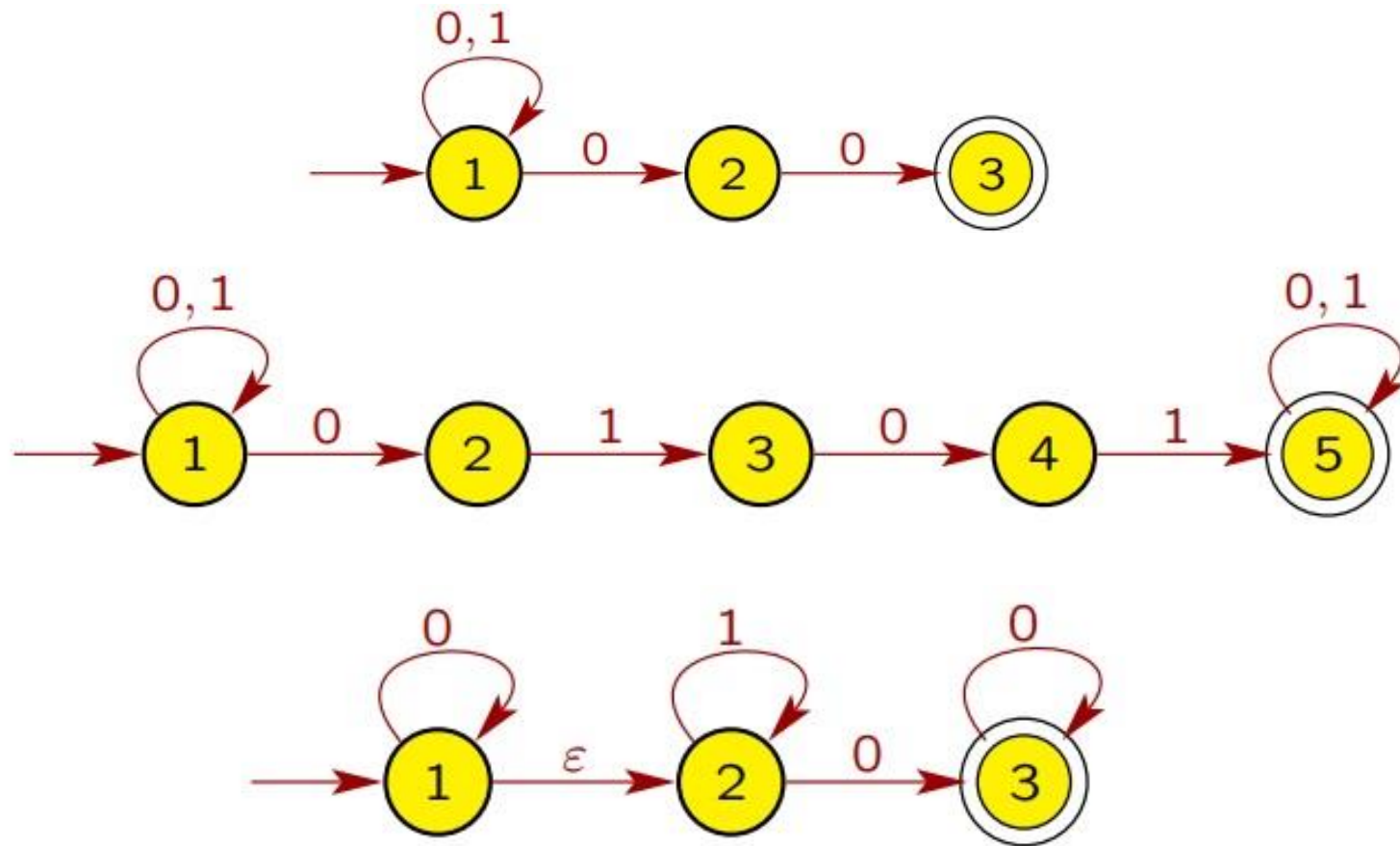
initial state: {p}

accepting states: {p, q, s}, {p, s}, {p, q, r, s}, {p, r, s}

The language accepted by the NFA consists of strings containing 010 or 000.



2.



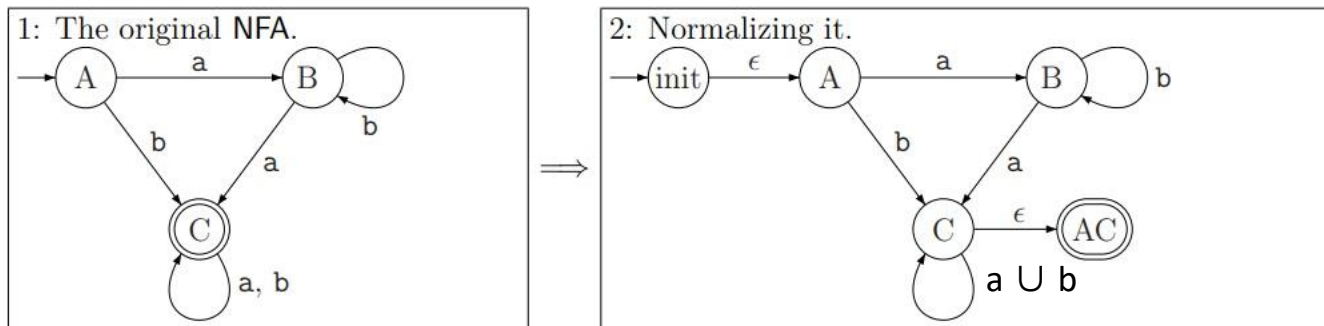
3. a

4. (a) $(a \cup b)((a \cup b)(a \cup b))^*$

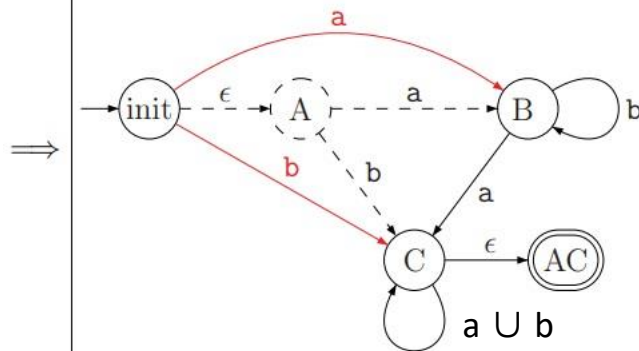
(b) $b^*ab^*a(a \cup b)^* \cup a^*ba^*ba^*$

(c) $(\epsilon \cup b)(ab)^*aa(ba)^*(\epsilon \cup b) \cup (\epsilon \cup a)(ba)^*bb(ab)^*(\epsilon \cup a)$

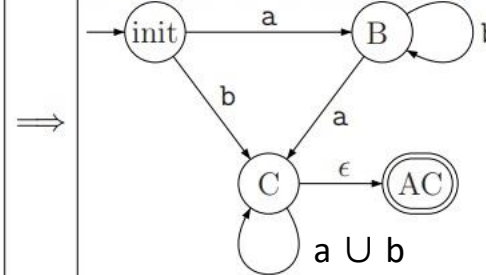
5.



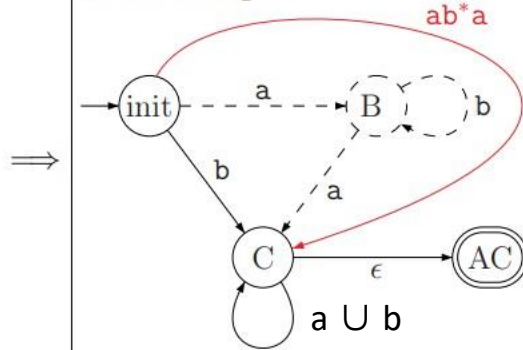
3: Remove state A.



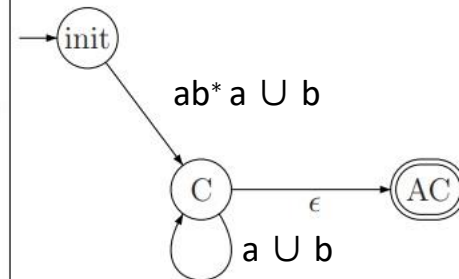
4: Redrawn without old edges.



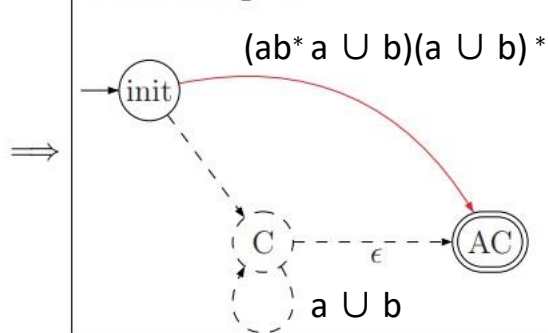
5: Removing B .



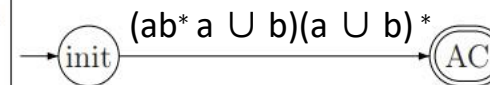
6: Redrawn.

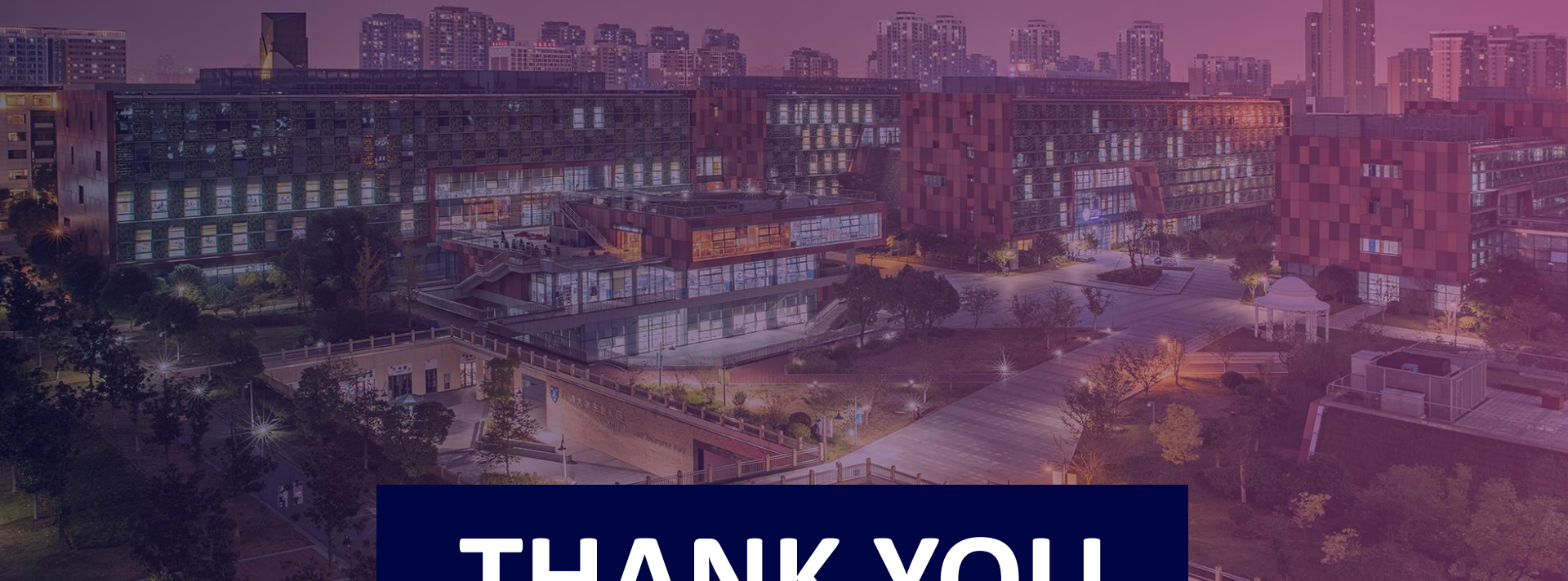


7: Removing C .



8: Redrawn.





THANK YOU



Xi'an Jiaotong-Liverpool University
西交利物浦大學

XJTLU | SCHOOL OF
FILM AND
TV ARTS