

# CS331 Assignment 5

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## 1 Question 1: State Minimization

	Accept	Non-Accept	Reason
$\equiv_0$	{3, 4, 5, 6, 7}	{1, 2, 8}	
$\equiv_1$	{3, 4, 5, 6, 7}	{1, 2}{8}	$\delta(q_1, c) \neq_0 \delta(q_8, c)$
$\equiv_2$	{3, 4, 5, 6, 7}	{1}{2}{8}	$\delta(q_1, ac) \neq_1 \delta(q_2, ac)$

## 2 Question 2: Context-Free Grammar

### 2.1 Grammar Rules

$$R = \{ \begin{array}{ll} E \rightarrow E \cup C, & (R1) \\ E \rightarrow C, & (R2) \\ C \rightarrow CK, & (R3) \\ C \rightarrow K, & (R4) \\ K \rightarrow L^*, & (R5) \\ K \rightarrow L, & (R6) \\ L \rightarrow (E), & (R7) \\ L \rightarrow a, & (R8) \\ L \rightarrow b \} & (R9) \end{array}$$

### 2.2 Derivation of $a(a \cup b)^* \cup b^*a$

$$\begin{array}{lll} E & \Rightarrow & E \cup C & \text{by Rule } R1 \\ & \Rightarrow & C \cup C & \text{by Rule } R2 \\ & \Rightarrow & CK \cup C & \text{by Rule } R3 \\ & \Rightarrow & KK \cup C & \text{by Rule } R4 \\ & \Rightarrow & LK \cup C & \text{by Rule } R6 \\ & \Rightarrow & LL^* \cup C & \text{by Rule } R5 \\ & \Rightarrow & aL^* \cup C & \text{by Rule } R8 \\ & \Rightarrow & a(E)^* \cup C & \text{by Rule } R7 \\ & \Rightarrow & a(E \cup C)^* \cup C & \text{by Rule } R1 \\ & \Rightarrow & a(C \cup C)^* \cup C & \text{by Rule } R2 \\ & \Rightarrow & a(K \cup C)^* \cup C & \text{by Rule } R4 \\ & \Rightarrow & a(K \cup K)^* \cup C & \text{by Rule } R4 \\ & \Rightarrow & a(L \cup K)^* \cup C & \text{by Rule } R6 \\ & \Rightarrow & a(L \cup L)^* \cup C & \text{by Rule } R6 \\ & \Rightarrow & a(a \cup L)^* \cup C & \text{by Rule } R8 \\ & \Rightarrow & a(a \cup b)^* \cup C & \text{by Rule } R9 \\ & \Rightarrow & a(a \cup b)^* \cup CK & \text{by Rule } R3 \\ & \Rightarrow & a(a \cup b)^* \cup KK & \text{by Rule } R4 \\ & \Rightarrow & a(a \cup b)^* \cup L^*K & \text{by Rule } R5 \\ & \Rightarrow & a(a \cup b)^* \cup L^*L & \text{by Rule } R6 \\ & \Rightarrow & a(a \cup b)^* \cup b^*L & \text{by Rule } R9 \\ & \Rightarrow & a(a \cup b)^* \cup b^*a & \text{by Rule } R8 \end{array}$$