CS 321: Assignment 6

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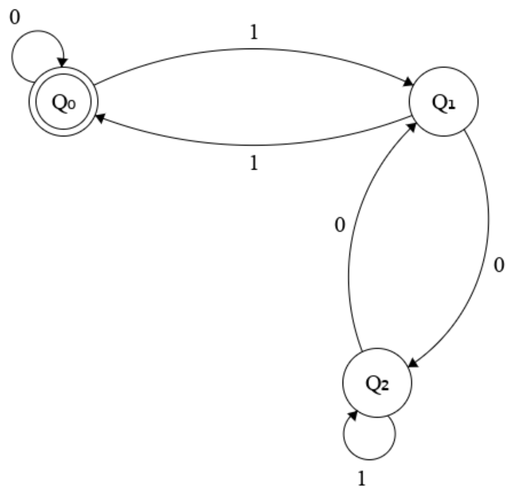
1. Answer

   (a) **Base Case:** $w = \epsilon$
   $\delta^*(s, w) = \delta^*(s, \epsilon) = q$
   $A_s \rightarrow^* wA_q, A_S \rightarrow cA_q, A_s \rightarrow \epsilon A_q$

   Inductive Step:
   Let $w = xb$
   $\delta(\delta^*(s, x), b) = q$
   Let p = $\delta^*(s, x)$
   $\delta(p, b) = q$
   $A_s \rightarrow xA_p, A_p \rightarrow bA_q$
   $A_s \rightarrow^* xbA_q, A_s \rightarrow^* wA_q$

   L(DFA) = L(CFL)
   $L(DFA) = \{w|\delta^*(s, w) \in F\}$
   $L(CFL) = \{w|A_s \rightarrow^* w\}$
   An accepted string w must end in a terminal which means $w \in F$ as per the production rules of the given CFG.



(b)

Derivation of CFG:

- Starting nonterminal A_s
- $A_s \rightarrow 0A_s|1A_1|\epsilon$
- $A_1 \rightarrow 1A_s|0A_2$
- $A_2 \rightarrow 1A_2|0A_1$

2. $S \rightarrow aSddd|T$
   $T \rightarrow bTdd|R$
   $R \rightarrow cR|\epsilon$

   (a) **Eliminate the start symbol from right-hand sides**
   $S_0 \rightarrow S$
   $S \rightarrow aSddd|T$
   $T \rightarrow bTdd|R$
   $R \rightarrow cR|\epsilon$

   (b) **TERM: Eliminate rules with nonsolitary terminals**

   $S_0 \rightarrow S$
   $S \rightarrow S_1SS_2S_3S_4|T$
   $T \rightarrow T_1TT_2T_3|R$

$R \to R_1R|\epsilon$

$S_1 \to a$
$S_2 \to d$
$S_3 \to d$
$S_4 \to d$

$T_1 \to b$
$T_2 \to d$
$T_3 \to d$

$R_1 \to c$

(c) **BIN: Eliminate right-hand sides with more than 2 nonterminal**
$S_5 \to S_1S$
$S_6 \to S_2S_3$
$S_7 \to S_5S_6$
$S \to S_7S_4|T$

$S_1 \to a$
$S_2 \to d$
$S_3 \to d$
$S_4 \to d$

$T_4 \to T_1T$
$T_5 \to T_2T_3$
$T \to T_4T_5|R$

$T_1 \to b$
$T_2 \to d$
$T_3 \to d$

$R \to R_1R|\epsilon$

$R_1 \to c$

(d) **DEL: Eliminate ϵ-rules**
$S_5 \to S_1S$
$S_6 \to S_2S_3$
$S_7 \to S_5S_6$

$S \to S_7S_4|T$

$S_1 \to a$
$S_2 \to d$
$S_3 \to d$
$S_4 \to d$

$T_4 \to T_1T$
$T_5 \to T_2T_3$
$T \to T_4T_5|R$

$T_1 \to b$
$T_2 \to d$
$T_3 \to d$

$R \to R_1R|R_1$

$R_1 \to c$

(e) **UNIT: Eliminate unit rules**
No unit rules

(f) **Final Answer**
$S_5 \to S_1S$
$S_6 \to S_2S_3$
$S_7 \to S_5S_6$
$S \to S_7S_4|T$

$S_1 \to a$
$S_2 \to d$
$S_3 \to d$
$S_4 \to d$

$T_4 \to T_1T$
$T_5 \to T_2T_3$
$T \to T_4T_5|R$

$T_1 \to b$
$T_2 \to d$
$T_3 \to d$

$R \to R_1 R | R_1$

$R_1 \to c$

3. Answer

   (a) This language has the following cases:

   - $k = m, k \neq n$
   - $m = n, n \neq k$
   - $k = n, n \neq m$
   - $k \neq m \neq n$

   (b) $S_0 \to SS_2$
   $S \to aSa | bSb | cS_2$
   $S_2 \to aS_2 | bS_2 | \epsilon$