

北京邮电大学 2019——2020 学年第 二 学期

《形式语言与自动机》期末考试试题 1

本试卷供学号尾号为 1, 6 的同学使用

注：所设计自动机画图即可。

一. (10 分) 设 $T=\{0, 1\}$, 请给出下列语言的文法, 说明其是几型文法, 并根据你设计的文法给出题 (2) 中指定句子的最左推导序列。

(1) $L=\{\omega \mid \omega \in T^*, \omega \text{ 的奇位置均为 } 1, \text{如 } 10111\}$ 。

(2) $L=\{0^n 1^{2n+k} \mid n, k \geq 0\}$, 指定句子为 01111。

二. (8 分) 构造有限自动机, 接受语言 $L = \{0^{2n+1} 1^m 2^{2k} \mid n, m, k \geq 0\}$ 。

三. (12 分) 写出下面矩阵表示的 ε -NFA 对应的无 ε 转换的 NFA, 再将其转换为 DFA。

	ε	0	1
$\rightarrow q_0$	$\{q_2\}$	ϕ	$\{q_1\}$
q_1	ϕ	$\{q_2\}$	$\{q_1, q_2\}$
$*q_2$	ϕ	$\{q_0\}$	ϕ

四. (10 分) 判断语言 $L=\{a^m b^n c^{m*n} \mid m, n \geq 1\}$ 是否是正则语言, 并证明你的结论。

五. (10 分) 将下面有限自动机转化成等价的右线性文法, 再从该右线性文法求解出对应的正则式。

	a	b
$\rightarrow q_0$	q_0	q_1
q_1	q_1	q_2
$*q_2$	ϕ	ϕ

六. (10 分) 构造米兰机, 对于 $\{0, 1\}^*$ 的字符串, 如果输入以 00 结尾, 则输出 a; 如果输入以 01 结尾, 则输出 b; 如果输入以 10 结尾, 则输出 c; 如果输入以 11 结尾, 则输出 d。

一、(1) $G = (N, T, P, S)$ $N = \{S\}$ $T = \{0, 1\}$.

$P: S \rightarrow 10S \mid 11S \mid 1 \mid \epsilon$. 3型

(2) $G = (N, T, P, S)$

$S \rightarrow AB$. $A \rightarrow 0A11 \mid 011 \mid \epsilon$ $B \rightarrow 1B \mid \epsilon$ 2型

($S \rightarrow 0S11 \mid 011 \mid 1 \mid \epsilon$)

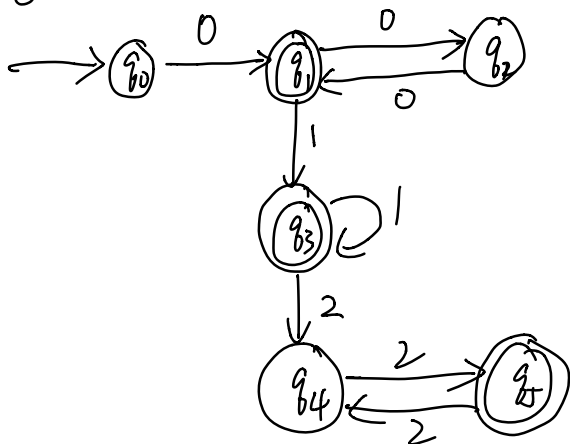
01111

$S \rightarrow AB \rightarrow 011B \rightarrow 0111B \rightarrow 01111B \rightarrow 01111$

二、 $M = (Q, T, \delta, q_0, F)$

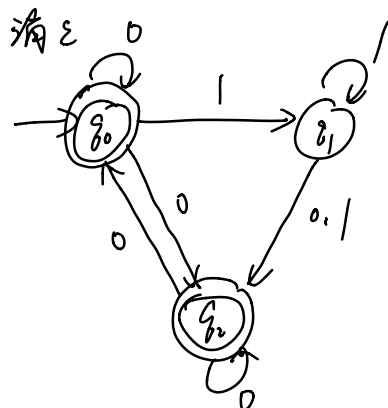
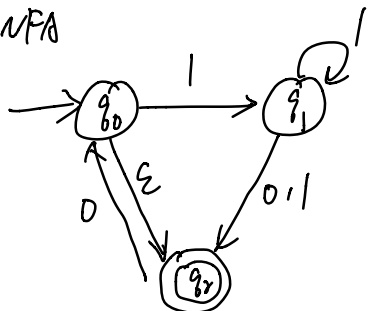
$Q = \{q_0, q_1, q_2, q_3, q_4, q_5\}$. $T = \{0, 1\}$. $F = \{q_0, q_1, q_3, q_5\}$

δ :



三、

ϵ -NFA



NFA: $M_1 = (Q, \Gamma, \delta, q_0, F)$ $Q = \{q_0, q_1, q_2\}$, $\Gamma = \{0, 1\}$, $F = \{q_2\}$

δ :

	0	1
$\rightarrow * q_0$	$\{q_0, q_2\}$	$\{q_1\}$
q_1	$\{q_2\}$	$\{q_1, q_2\}$
$* q_2$	$\{q_0, q_2\}$	\emptyset

DFA: $M_2 = (Q, \Gamma, \delta, q_0, F)$

	0	1	
δ :	$\rightarrow * q_0$	$\{q_0, q_2\}$	$\{q_1\}$
	q_1	$\{q_2\}$	$\{q_1, q_2\}$
	$* q_2$	$\{q_0, q_2\}$	\emptyset
	$* \{q_0, q_2\}$	$\{q_0, q_2\}$	$\{q_1\}$
	$* \{q_1, q_2\}$	$\{q_0, q_2\}$	$\{q_1, q_2\}$

$Q = \{q_0, q_1, q_2, \{q_0, q_2\}, \{q_1, q_2\}\}$
 $\Gamma = \{0, 1\}$
 $F = \{q_2, \{q_0, q_2\}, \{q_1, q_2\}\}$

四、不是

证: 设 $w = a^n b^m c^{n \cdot m} \in L$, $|w| = m + n + mn > n$

令 $w = w_1 w_0 w_2$, $0 < |w_1 w_0| \leq n$.

$\therefore |w_1 w_0| \leq n$, $\therefore w_1 w_0$ 被限制在 a^n 段

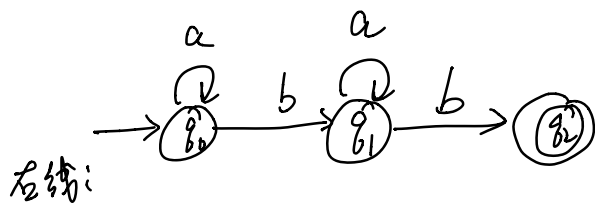
设 $w_0 = a^k$, $k > 0$ $\therefore w_1 w_0^i w_2 = a^{n-k} a^{ki} b^m c^{m \cdot n}$

当 $i=0$, $w_1 w_0^i w_2 = a^{n-k} b^m c^{m \cdot n}$, $\therefore k > 0 \therefore n-k < n$

$\therefore w_1 w_0^i w_2 \notin L$, 与假设矛盾

\therefore 由泵浦引理, L 不是正则语言

五. DFA: $M = (\{q_0, q_1, q_2\}, \{a, b\}, \delta, q_0, \{q_2\})$



右线:

$$G = (N, T, P, q_0), \quad N = \{q_0, q_1\}, \quad T = \{a, b\},$$

$$P: q_0 \rightarrow aq_0 \mid bq_1$$

$$q_1 \rightarrow aq_1 \mid b$$

$$\text{正则式: } \begin{cases} q_0 = aq_0 + bq_1 & \text{①} \\ q_1 = aq_1 + b & \text{②} \end{cases}$$

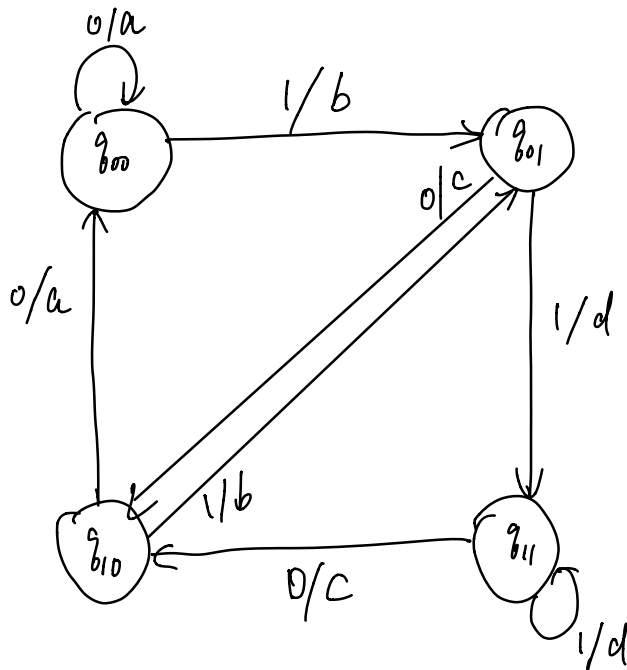
$$\text{由② } q_1 = a^*b$$

$$\text{代入① } q_0 = aq_0 + ba^*b \quad \text{③}$$

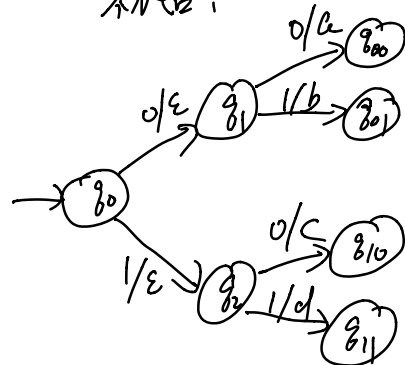
$$\text{由③ } q_0 = a^*ba^*b$$

$$\begin{aligned} x &= \alpha x + \beta \\ x &= \alpha^* \beta \end{aligned}$$

六.



初始:



$$M = (Q, T, R, S, q, q_0)$$

$$Q = \{q_0, q_1, q_2, q_{00}, q_{01}, q_{10}, q_{11}\} \quad T = \{0, 1\}, \quad R = \{a, b\}.$$

七、① 消无用

由算法1. C 为非生成符号. 删 C . $S \rightarrow C$. $C \rightarrow cCD$

由算法2. D 为不可达符号. 删 D . $D \rightarrow kdd$

$$G_1 = (N_1, T, P, S) \quad N_1 = \{S, A, B\} \quad T = \{a\}$$

$$P: \quad S \rightarrow a | aA | B$$

$$A \rightarrow aB | \varepsilon$$

$$B \rightarrow aA$$

② 消 ε .

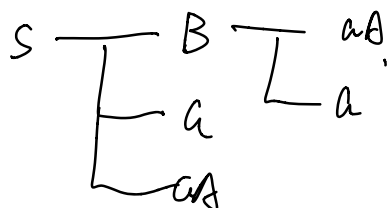
由 $A \rightarrow \varepsilon$

$$\text{得 } P_1: \quad S \rightarrow a | aA | B$$

$$A \rightarrow aB$$

$$B \rightarrow aA | a$$

③ 消单



$$\therefore P_2: \quad S \rightarrow a | aA$$

$$A \rightarrow aB$$

$$B \rightarrow a | aA$$

④ 消无用 由算法1. 无非生成符号

由算法2 无不可达

$$\therefore G_2 = (N_1, T, P_2, S)$$

$$N = \{S, A, B\}, \quad T = \{a\}.$$

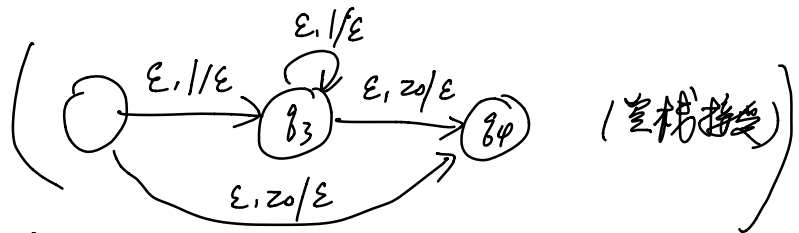
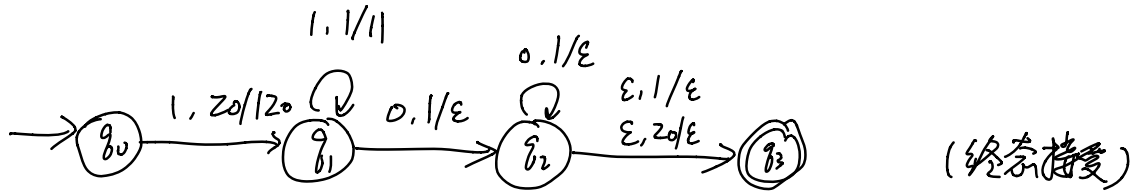
$$P_2: \quad S \rightarrow a | aA$$

$$A \rightarrow aB$$

$$B \rightarrow a | aA$$

11. PDA $M = (Q, \Gamma, \Gamma', \delta, q_0, z_0, F)$

$Q = \{q_0, q_1, q_2, q_3\}$, $\Gamma = \{0, 1\}$, $\Gamma' = \{0, 1, z_0\}$, $F = \{q_3\}$

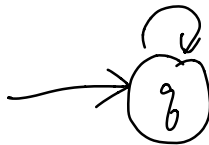


12. NPDA $M = (Q, \Gamma, \Gamma', \delta, q_0, z_0, F)$

$Q = \{q\}$, $\Gamma = \{a, b\}$, $\Gamma' = \{a, b, S, A, B\}$, $z_0 = S$, $F = \varnothing$

δ :

$\epsilon, S/AB$ $a, a/\epsilon$
 $\epsilon, S/\epsilon$ $b, b/\epsilon$
 $\epsilon, A/aB$
 $\epsilon, B/bb$



13. $M = (Q, \Gamma, \Sigma, \delta, q_0, B, F)$ $Q = \{q_0, q_1, q_2, q_3\}$, $\Gamma = \{a, b\}$,
 $\Sigma = \{a, b, x, y\}$, $F = \{q_3\}$.

