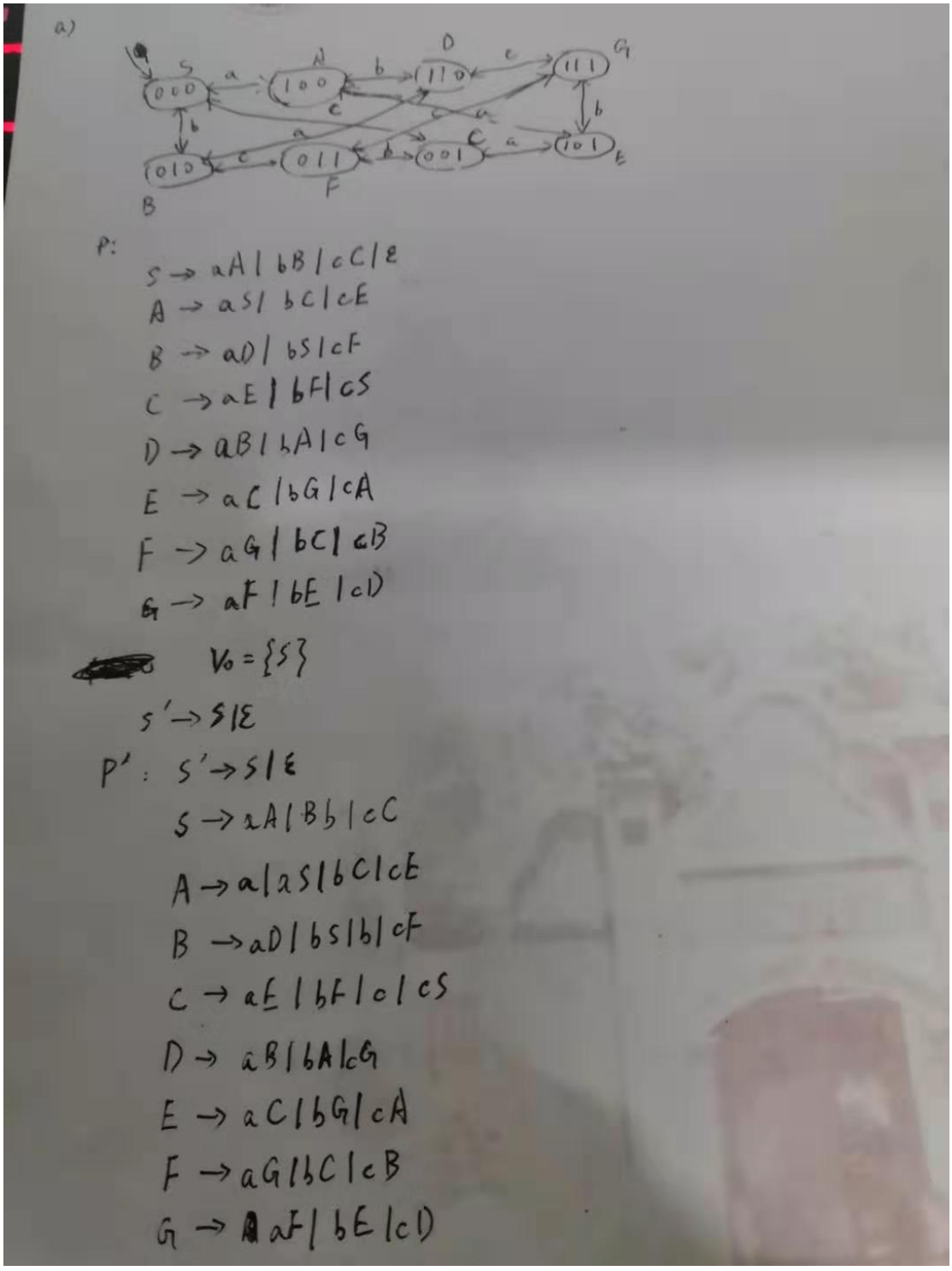
以下是编译原理第一次作业的参考答案，主要是给同学们提供一种可能的解题思路，用于参考。

（1）补充练习的参考思路及答案：



(b) $\{a^i b^j \mid i \geq (2j+1) \text{ and } j \geq 0\}$

解: $a^i b^j = a^{i-2j} \cdot a^{2j} b^j \xrightarrow{令\ i-2j=m} a^m \cdot a^{2j} b^j$

P:

$S \to AB$

$A \to aA \mid a$

$B \to aaBb \mid \varepsilon$

$V_0 = \{B\}$

消除ε产生式P':

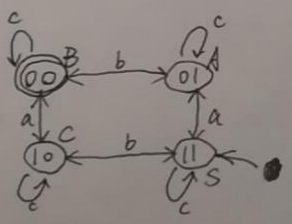
$S \to A \mid AB$

$A \to aA \mid a$

$B \to aaBb \mid aab$

(c)

解:



P:

$S \to aA \mid bC \mid cS$

$A \to aS \mid bB \mid cA$

$B \to aC \mid bA \mid cB \mid \varepsilon$

$C \to aB \mid bS \mid cC$

其中 $V_0 = \{B\}$

消除ε-产生式:

P':

$S \to aA \mid bC \mid cS$

$A \to aS \mid bB \mid cA \mid b$

$B \to aC \mid bA \mid cB \mid c$

$C \to aB \mid bS \mid cC \mid a$

(d) $\{a^i b^j \mid i \geq (j+1) \text{ and } j \geq 0\}$

解:

$a^i b^j = a^{i-j} \cdot a^j b^j$ 至少为m $a^m a^i b^j$

其中 $m \geq 1$, $j \geq 0$. 则有

$S \to AB$

$A \to aA \mid a$

$B \to aBb \mid \varepsilon$.

$V_0 = \{B\}$

消除 ε-产式. 则:

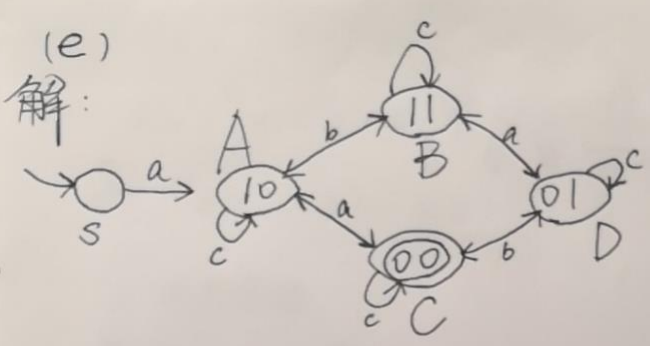
$S \to AB \mid A$

$A \to aA \mid a$

$B \to ab \mid aBb$

(e)

解：



$S \to aA$

$A \to aC \mid bB \mid cA$

$B \to aD \mid bA \mid cB$

$C \to aA \mid bD \mid cC \mid \varepsilon$

$D \to aB \mid bC \mid cD$

$V_0 = \{C\}$

消除 ε- 產生式有：

$S \to aA$

$A \to a \mid aC \mid bB \mid cA$

$B \to aD \mid bA \mid cB$

$C \to aA \mid bD \mid cC \mid c$

$D \to aB \mid bC \mid b \mid cD$

(f) $\{a^{2i}b^{2j} \mid j \geq i \geq 1\}$

解: $a^{2i}b^{2j} = a^{2i}b^{2i}b^{2j-2i}$ 令 $2j-2i$ 为 m. $a^{2i}b^{2i}b^{2m}$

其中 $i \geq 1$, $m \geq 0$. 则有

$S \to AB$

$A \to aabb \mid aaAbb$

$B \to bbB \mid \varepsilon$

$V_0 = \{B\}$. 消除 ε-产式有:

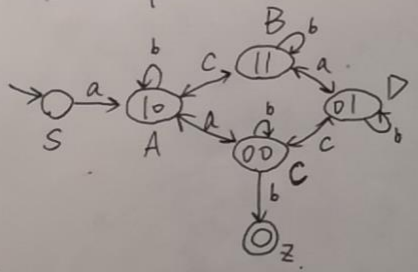
$S \to A \mid AB$

$A \to aabb \mid aaAbb$

$B \to bb \mid bbB$.

(g)

解:



P.

$S \to aA$

$A \to aC \mid bA \mid cB$

$B \to aD \mid bB \mid cA$

$C \to aA \mid bC \mid cD \mid bZ$

$D \to aB \mid bD \mid cC$

$Z \to \varepsilon$

$V_0 = \{Z\}$.

P'

$S \to aA$

$A \to aC \mid bA \mid cB$

$B \to aD \mid bB \mid cA$

$C \to aA \mid bC \mid cD \mid b$

$D \to aB \mid bD \mid cC$.

(h) $\{a^i b^j c^k \mid j \geq (i+k+1) \text{ and } i \geq 0, k \geq 1\}$

解: $a^i b^j c^k = a^i b^i \cdot b^{j-i-k} b^k c^k$ 令 $j-i-k \geq m$ $a^i b^i \cdot b^m b^k c^k$

即 $i \geq 0, m \geq 1, k \geq 1$.

P:

$S \to ABC$

$A \to \varepsilon \mid aAb$

$B \to b \mid bB$

$C \to bc \mid bCc$

$V_0 = \{A\}$

P':

$S \to ABc \mid BC$

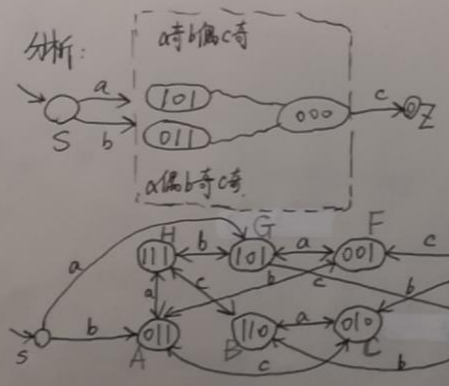
$A \to ab \mid aAb$

$B \to b \mid bB$

$C \to bc \mid bCc$

(j)

解: 分析:



∴ 消除ε-产生式有.

P':

$S \to aG \mid bA$

$A \to aH \mid bF \mid cC$

$B \to aC \mid bD \mid cH$

$C \to aB \mid bE \mid cA$

$D \to aE \mid bB \mid cG$

$E \to aD \mid bC \mid cF \mid c$

$F \to aG \mid bA \mid cE$

$G \to aF \mid bH \mid cD$

$H \to aA \mid bG \mid cB$

P:

$S \to aG \mid bA$

$A \to aH \mid bF \mid cC$

$B \to aC \mid bD \mid cH$

$C \to aB \mid bE \mid cA$

$D \to aE \mid bB \mid cG$

$E \to aD \mid bC \mid cF \mid cZ$

$F \to aG \mid bA \mid cE$

$G \to aF \mid bH \mid cD$

$H \to aA \mid bG \mid cB$

$Z \to \varepsilon$

$V_0 = \{Z\}$.

6

(七)

解:

$a^{2i-1}b^{j-1}c^{2k-1} = a^{2i-1}b^{2i-1}\cdot b^{2(j-i-k)+1}\cdot b^{2k-1}c^{2k-1}$ 令 $j-i-k=m$

$a^{2i-1}b^{2i-1}\cdot b^{2m+1}b^{2k-1}c^{2k-1}$

其中 $i\geq 1$, $m\geq 0$, $k\geq 1$

$S\to ABC$

$A\to ab \mid aAbb$

$B\to b \mid bbB$

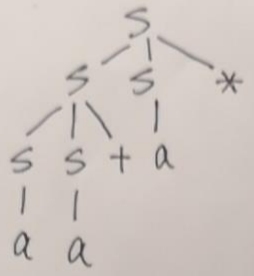
$C\to bc \mid bbCcc$

（2）龙书题目的参考思路：

2.2.1

(a) $S \Rightarrow SS* \Rightarrow SS+S* \Rightarrow aS+S* \Rightarrow aa+S* \Rightarrow aa+a*$

(b)



(c) $L(G)$ = {由a与+,*运算符构成的后缀表达式}

Justify：提供两种思路：①举例验证

②运用数学规纳法进行证明

2.2.2

(a) $L = \{0^n 1^n \mid n \geq 1\}$.

(b) L = {以a为操作数，+号和-号为运算符的前缀表达式}

(c) L = {括号成对的括号表达式，包括 ε}

(d) L = {具有相同数量a、b的字符串}

(e) L = {以a为基本符号的正规表达式}

2.2.4

(a) $S \to SSop \mid a$

(b) $S \to S, a \mid a$

(c) $S \to a, S \mid a$

(d) $E \to E+F \mid E-F \mid F$

$F \to F*G \mid F/G \mid G$

$G \to i \mid (E)$

(e) $E \to E+F \mid E-F \mid F$

$F \to F*G \mid F/G \mid G$

$G \to i \mid (E) \mid @G \mid ⓔG$.

其中 @: unary plus ⓔ: unary minus.

4.2.3.

(a) $S \to 1S \mid 0A \mid \varepsilon$

$A \to 1S$

(b) $S \to 0S0 \mid 1S1 \mid 1 \mid 0 \mid \varepsilon$

(c) $S \to 0S1S \mid 1S0S \mid \varepsilon$

(d) $A: |1| < |0|$ $B: |1| > |0|$ $C: |1| = |0|$

$A': |1| + 1 = |0|$ $B': |1| = |0| + 1$

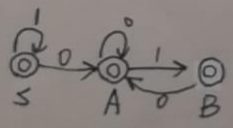
$S \to A \mid B$

$A \to A' \mid A'A$ $B \to B' \mid B'B$

$A' \to 1A'A' \mid 0C$ $B' \to 0B'B' \mid 1C$

$C \to 1A' \mid 0B' \mid \varepsilon$.

(e)



方一:

$S \to 0A \mid 1S \mid \varepsilon$

$A \to 0A \mid 1B \mid \varepsilon$

$B \to 0A \mid \varepsilon$

方二:

$S \to AB$

$A \to 1A \mid \varepsilon$

$B \to 0B \mid 0 \mid B \mid \varepsilon$

(f) $S \to S_a S_b \mid S_b S_a$

$S_a \to a \mid aS_aa \mid aS_ab \mid bS_aa \mid bS_ab$

$S_b \to b \mid aS_ba \mid aS_bb \mid bS_ba \mid bS_bb$

4.2.7

(a) 参考思路：

i) 先检查非终结符是否与起始符S有关，若无关，则删除该非终结符的相关式.

ii) 再检查剩余的非终结符是否能推出终结符，若不能，则删除相关式.

循环i). ii)步，直至结果不再变化.

(b) $S \to 0$.