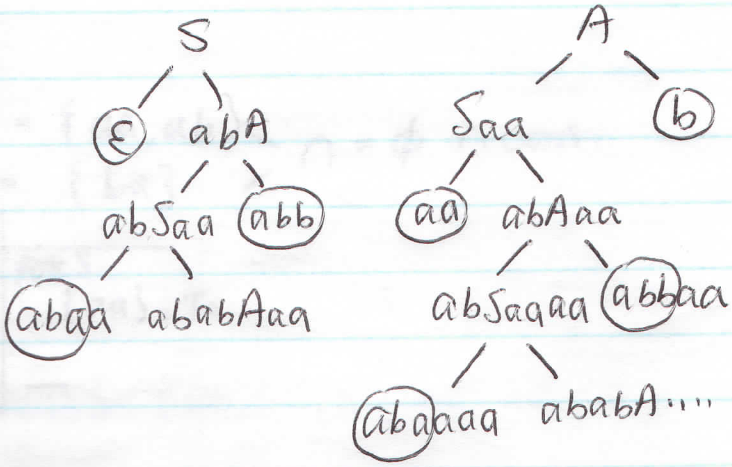
CS411 HW#4 Solution

1. $S \to {}^{①}\varepsilon \mid {}^{②}abA$

   $A \to {}^{③}Saa \mid {}^{④}b$



ⓐ $\therefore FIRST_3(SAS) = FIRST_3(S) \oplus_3 FIRST_3(A) \oplus_3 FIRST_3(S)$

$= \{\varepsilon, aba, abb\} \oplus_3 \{b, aa, aba, abb\} \oplus_3 \{\varepsilon, aba, abb\}$

$= \{b, bab, aa, aaa, aba, abb\}$

ⓑ $T_0 = T_S, \{\varepsilon\}$

$FIRST_2(\varepsilon) \oplus_2 \{\varepsilon\} = \{\varepsilon\}$

(abA) 〃 $= \{ab\}$ $\cap = \phi$ $\therefore$ cons.

ε	$S \to \varepsilon$	—
ab	$S \to abA$	FOR A: $\{\varepsilon\}$: T_1

$T_1 = T_A, \{\varepsilon\}$

$FIRST_2(Saa) \oplus_2 \{\varepsilon\} = \{aa, ab\}$

$(b) \oplus_2$ 〃 $= \{b\}$ $\cap = \phi$ $\therefore$ cons.

aa, ab	$A \to Saa$	FOR S: $\{aa\}$: T_2
b	$A \to b$	—

$T_2 = T_S, \{aa\}$

$FIRST_2(\varepsilon) \oplus_2 \{aa\} = \{aa\}$

(abA) 〃 $= \{ab\}$ $\cap = \phi$ $\therefore$ cons.

aa	$S \to \varepsilon$	—
ab	$S \to abA$	FOR A: $\{aa\}$: T_3

$T_3 = T_{A,\{aa\}}$

$FIRST_2(Saa) \oplus_2 \{aa\} = \{aa, ab\}$
(b) " $= \{ba\}$
$\cap = \phi$ ∴ cons.

aa, ab	$A \to Saa$	FOR S: $\{aa\}: T_2$
ba	$A \to b$	—

∴ G_1 is $LL(2)$.

$LL(2)$ parser:

	aa	ab	ba	bb	a	b	ε
T_0		abT_1 ②					ε ①
T_1	T_2aa ③	T_2aa ③				b ④	
T_2	ε ①	abT_3 ②					
T_3	T_2aa ③	T_2aa ③	b ④				
a	p	p			p		
b			p	p		p	
\$							accept

ⓒ

stack	input	output
T_0 \$	ababbaa	ε
⊢ abT_1 \$	"	2
$\vdash^2$ T_1 \$	abbaa	"
⊢ T_2aa \$	"	2, 3
⊢ abT_3aa \$	"	2, 3, 2
$\vdash^2$ T_3aa \$	baa	"
⊢ baa \$	"	2, 3, 2, 4
$\vdash^3$ \$	ε	"

⊢ accept and output 2324

2. $S \to ABCabcd$

$A \to a \mid \varepsilon$

$B \to b \mid \varepsilon$

$C \to c \mid \varepsilon$

$T_0 = T_S, \{\varepsilon\}$

$FIRST_2(\underset{\{a,\varepsilon\}}{A}\,\underset{\{b,\varepsilon\}}{B}\,\underset{\{c,\varepsilon\}}{C}abcd) \oplus_2 \{\varepsilon\} = \{ab, ac, aa, bc, ba, ca\}$

ab ac aa bc ba ca	$S \xrightarrow{1} ABCabcd$	FOR A: $FIRST_2(BCabcd) \oplus_2 \{\varepsilon\} = \{bc, ba, ca, ab\} : T_1$ FOR B: $FIRST_2(Cabcd) \oplus_2 \{\varepsilon\} = \{ca, ab\} : T_2$ FOR C: $\{ab\} : T_3$

$T_1 = T_A, \{bc, ba, ca, ab\}$

$FIRST_2(a) \oplus_2 \{bc, ba, ca, ab\} = \{ab, ac, aa\}$

(ε) 〃 $= \{bc, ba, ca, ab\}$

$\cap = \{ab\} \neq \phi$

$\therefore$ conflict

$\therefore G_2$ is <u>not</u> $LL(2)$

3. $S \rightarrow AB$

$A \rightarrow 0A1 \mid \varepsilon$

$B \rightarrow 1B1 \mid 1$

use theorem to prove G_3 is $LL(2)$.

FOR S: ok $\because$ only 1 S-production

FOR A:

$FIRST_2(0A1) \oplus_2 \{1, 11\} \cap FIRST_2(\varepsilon) \oplus_2 \{1, 11\} = \{00, 01\} \cap \{1, 11\} = \phi$

$\quad // \quad \{11\} \cap \quad // \quad \{11\} = \{00, 01\} \cap \{11\} = \phi$

$\therefore$ cons.

FOR B:

$FIRST_2(1B) \oplus_2 \{\varepsilon\} \cap FIRST_2(1) \oplus_2 \{\varepsilon\} = \{11\} \cap \{1\} = \phi$

$\therefore$ cons.

$\therefore G_3$ is $LL(2)$.

4. $S \to AB \mid BC$

$A \to a \mid CBS \mid bSS$

$B \to b \mid bAS \mid bB$

$C \to a \mid aSBC$

ⓐ $FIRST_2(S) = \{ab, aa, ba, bb\}$

$FIRST_2(A) = \{a, aa, ab, ba, bb\}$

$FIRST_2(B) = \{b, ba, bb\}$

$FIRST_2(C) = \{a, aa, ab\}$

ⓑ FOR S:

$$FIRST_2(AB) \oplus_2 \{\varepsilon\} \cap FIRST_2(BC) \oplus_2 \{\varepsilon\} = \{ab, aa, ba, bb\} \cap \{ba, bb\}$$

$$= \{ba, bb\} \neq \phi$$

$\therefore$ G_4 is not $LL(2)$.