

1. Eliminate left recursion in the following grammar:

$S \rightarrow SX$
 $S \rightarrow SSb$
 $S \rightarrow XS$
 $S \rightarrow a$

Original grammar:

$S \rightarrow SX$
 $S \rightarrow SSb$
 $S \rightarrow XS$
 $S \rightarrow a$

$\alpha_1 = X, \alpha_2 = Sb, \beta_1 = XS, \beta_2 = a$

Modified grammar

$S \rightarrow XSS' \mid aS'$
 $S' \rightarrow XS' \mid SbS' \mid \epsilon$

2. Determine if the following grammar passes the pairwise disjointness test.

A \rightarrow aB | b | CBB
B \rightarrow aB | ba | aBb
C \rightarrow aaA | b | caB

Consider the A-rules:

A \rightarrow aB | b | CBB

FIRST(aB) = { a }
FIRST(b) = { b }
FIRST(CBB) = { a, b, c }

There are common terminals in these firsts, so A rules FAIL the pairwise disjointness test.

Consider B-rules:

B \rightarrow aB | ba | aBb

first(aB) = { a }
first(ba) = { b }
first(aBb) = { a }

There are common terminals in these firsts, so B rules FAIL the pairwise disjointness test.

Consider C-rules:

C \rightarrow aaA | b | caB

first(aaA) = { a }
first(b) = { b }
first(caB) = { c }

There are no common terminals in these firsts, so C rules PASS the disjointness test.

Overall, the grammar FAILS the disjointness tests because at least one non-terminal FAILS the disjointness tests.

3. Using the Grammar on slide 4-33 and LR Parsing table on slide 4-34 of Chapter 4 slides, show a rightmost derivation (if possible) and the Stack/Input/Action for the following strings:

(id + id) * id

Stack	Input	Action
0	(id + id) * id\$	S4
0(4	id + id) * id\$	S5
0(4id5	+ id) * id\$	R6 (Use GOTO [4,F]) $F \rightarrow id$
0(4F3	+ id) * id\$	R4 (Use GOTO [4,T]) $T \rightarrow F$
0(4T2	+ id) * id\$	R2 (Use GOTO [4,E]) $E \rightarrow T$
0(4E8	+ id) * id\$	S6
0(4E8+6	id) * id\$	S5
0(4E8+6id5) * id\$	R6 (Use GOTO [6,F]) $F \rightarrow id$
0(4E8+6F3) * id\$	R4 (Use GOTO [6,T]) $T \rightarrow F$
0(4E8+6T9) * id\$	R1 (Use GOTO [4,E]) $E \rightarrow E + T$
0(4E8) * id\$	S11
0(4E8)11	* id\$	R5 (Use GOTO [0,F]) $F \rightarrow (E)$
0F3	* id\$	R4 (Use GOTO [0,T]) $T \rightarrow F$
0T2	* id\$	S7
0T2*7	id\$	S5
0T2*7id5	\$	R6 (Use GOTO [7,F]) $F \rightarrow id$
0T2*7F10	\$	R3 (Use GOTO [0,T]) $T \rightarrow T * F$
0T2	\$	R2 (Use GOTO [0,E]) $E \rightarrow T$
0E1	\$	ACCEPT

$E \Rightarrow T$
 $3 \Rightarrow T * F$
 $6 \Rightarrow T * id$
 $4 \Rightarrow F * id$
 $5 \Rightarrow (E) * id$
 $1 \Rightarrow (E + T) * id$
 $4 \Rightarrow (E + F) * id$
 $6 \Rightarrow (E + id) * id$
 $2 \Rightarrow (T + id) * id$
 $4 \Rightarrow (F + id) * id$
 $6 \Rightarrow (id + id) * id$

(id + id(* id

Stack	Input	Action
0	(id + id(* id\$	S4
0(4	id + id(* id\$	S5
0(4id5	+ id(* id\$	R6 (Use GOTO [4,F]) $F \rightarrow id$
0(4F3	+ id(* id\$	R4 (Use GOTO [4,T]) $T \rightarrow F$
0(4T2	+ id(* id\$	R2 (Use GOTO [4,E]) $E \rightarrow T$
0(4E8	+ id(* id\$	S6
0(4E8+6	ld(* id\$	S5
0(4E8+6id5	(* id\$	ERROR; blank entry for ACTION(5, '(')