Islamic University – Gaza
Engineering Faculty
Department of Computer Engineering
ECOM 5060: Compiler Design Discussion

Chapter 4

Syntax Analysis

(Sections 4.2 and 4.3)

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April, 2014

Exercise 1:

Consider the grammar

S -> (L)|a

L -> L,S|S

a) What are terminals, non-terminals and start symbol?

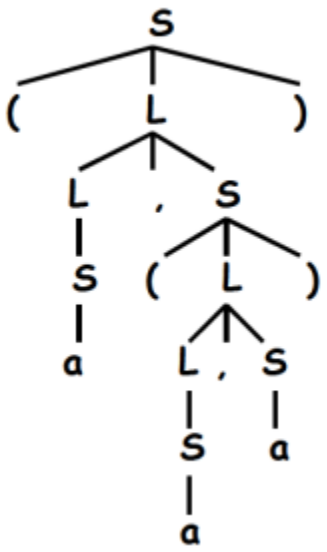
Terminals: ( ) a ,

Nonterminals: S L

Start: S

b) Find parse trees for the string:

(a,(a,a))



c) Construct a leftmost derivation for the string:

$$S \underset{lm}{\Rightarrow} (L) \underset{lm}{\Rightarrow} (L,S) \underset{lm}{\Rightarrow} (S,S) \underset{lm}{\Rightarrow} (a,S) \underset{lm}{\Rightarrow} (a,(L))$$

$$\underset{lm}{\Rightarrow} (a,(L,S)) \underset{lm}{\Rightarrow} (a,(S,S)) \underset{lm}{\Rightarrow} (a,(a,S)) \underset{lm}{\Rightarrow} (a,(a,a))$$

d) Construct a rightmost derivation for the string:

$$S \underset{rm}{\Rightarrow} (L) \underset{rm}{\Rightarrow} (L,S) \underset{rm}{\Rightarrow} (L,(L)) \underset{rm}{\Rightarrow} (L,(L,S)) \underset{rm}{\Rightarrow} (L,(L,a))$$

$$\underset{rm}{\Rightarrow} (L,(S,a)) \underset{rm}{\Rightarrow} (L,(a,a)) \underset{rm}{\Rightarrow} (S,(a,a)) \underset{rm}{\Rightarrow} (a,(a,a))$$

e) What language does this grammar generate?

All balanced parentheses containing one *a* or a pair of *a*'s separated by a comma.

Exercise 2:

Consider the grammar

S -> aSbS | bSaS | ϵ

f) What are terminals, non-terminals and start symbol?

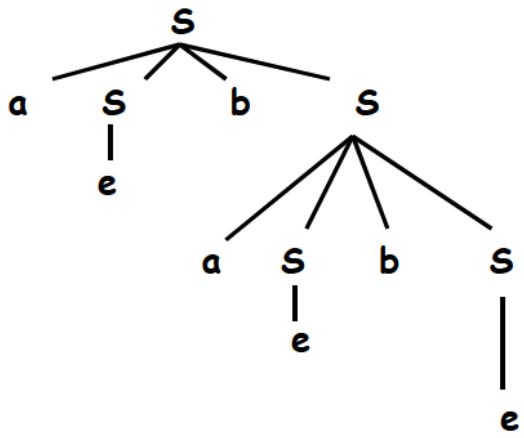
Terminals: a b

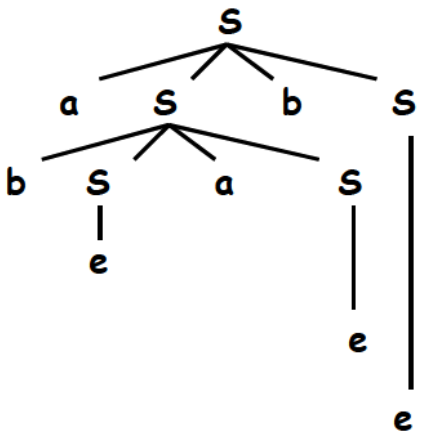
Nonterminals: S

Start: S

g) Find parse trees for the string:

abab





h) Construct a leftmost derivation for the string:

S -> aSbS -> abS -> abaSbS -> ababS -> **abab**

S -> aSbS -> abSaSbS -> abaSbS -> ababS -> **abab**

i) Construct a rightmost derivation for the string:

S -> aSbS -> aSbaSbS -> aSbaSb -> aSbab -> **abab**

S -> aSbS -> aSb -> abSaSb -> abSab -> **abab**

j) What language does this grammar generate?

Strings with same number of a's and b's.

Exercise 3:

Design grammars for each of following languages.

a) The set of all strings 0's and 1's such that every 0 is immediately followed by at least one 1.

S -> SS|0T|1|ϵ

T -> 1T|1

b) Strings of 0's and 1's in which 011 doesn't appear as a substring.

S -> AB
A -> 1A|ϵ
B -> 01B|0B|ϵ

Exercise 4:
For the following grammar, eliminate left-recursion and apply left factoring:

a) S → 0S1 | 01

S → 0S'
S' → S1 | 1

b) S → S+S | S* | (S) | SS | a

S → (S) R | aR
R → +SR | *R | SR | ϵ

c) S → (L)|a
L → L,S|S

S → (L) | a
L → S R
R → ,S R | ϵ

☺ *Best Wishes* ☺