CS 321A

PART I – Continued…

FORMAL LANGUAGES

Formal Grammar (Chomsky's Hierarchy of Grammars)

G_0 = Unrestricted Grammar

$L(G_0)$ = Language of the Unrestricted Grammar

G_1 = Context-Sensitive Grammar

$L(G_1)$ = Language of the Context-Sensitive Grammar

G_2 = Context-Free Grammar

$L(G_2)$ = Language of the Context-Free Grammar

G_3 = Regular Grammar

$L(G_3)$ = Language of the Regular Grammar

$$L(G_0) \supseteq L(G_1) \supseteq L(G_2) \supseteq L(G_3)$$

Right Linear Grammar (G_3)

N = { A,B }

T = { 0,1 }

P : Σ --> 1B

Σ --> 1

A --> 1B

B --> 0A

A --> 1

Derivation Sequences using G_3

Σ --> 1

Σ --> 1B --> 10A --> 101

Σ --> 1B --> 10A --> 101B -->

1010A --> 10101

:

$L(G_3) = 1 (01)^*$

G_3

N = { A,B }, T = { 0,1 }

P : Σ --> 1B, Σ --> 1, A --> 1B, B --> 0A,

A --> 1

Derivation Sequences

Σ --> 1

Σ --> 1B --> 10A --> 101

Σ --> 1B --> 10A --> 101B --> 1010A --> 10101

Language, $L(G_3)$ = (10)*1

Left Linear Grammar (G_4)

- N = { A,B }
- T = { 0,1 }
- P : Σ --> B1

  Σ --> 1

  A --> B1

  B --> A0

  A --> 1

Derivation Sequences Using G_4

- Σ --> 1
- Σ --> B1 --> A01 --> 101
- Σ --> B1 --> A01 --> B101 -->
  A0101 --> 10101

  :
- $L(G_4)$ = 1 (01)*

G_4

N = { A,B }, T = { 0,1 }

P : Σ --> B1, Σ --> 1, A --> B1, B --> A0, A --> 1

Derivation Sequences

- Σ --> 1
- Σ --> B1 --> A01 --> 101
- Σ --> B1 --> A01 --> B101 --> A0101 --> 10101

Language, $L(G_4) = 1 (01)^*$

Derivation Tree vs. Derivation Sequence

Given a language with the ff. productions:

Σ --> A

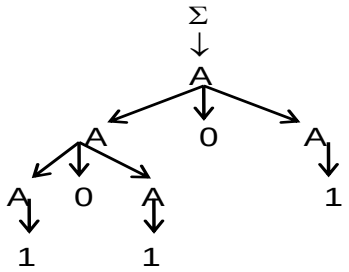
A --> A0A

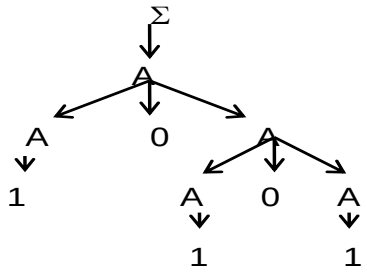
A --> 1

a. Show the derivation sequence for 10101

b. Show the derivation tree for 10101

Derivation Trees





Ambiguity of a grammar

A grammar is ambiguous if it allows two or more distinct leftmost derivation trees for a string.

Formal Grammar

- **AMBIGUITY OF A GRAMMAR**

Simplified Definition (Regular Grammar):

- A grammar is ambiguous if there exist two or more distinct leftmost derivations (derivation trees) for a certain string.

Two Forms of Ambiguity

1. Structural Ambiguity

   The derivation trees have different structures

2. Labeling Ambiguity

   The derivation trees have the same structure but there are differences in some non-terminals labeling some nodes of the trees.

Formal Grammar

Determine if the following grammar is ambiguous or not.

N = {A,B}

T = {0,1}

P:

Σ --> A

A --> B0

A --> A0

B --> B0

A --> 1

B --> 1

Formal Grammar

Determine if the following grammar is ambiguous or not.

N = {A}

T ={0,1}

P:

Σ --> A

A --> A0A

A --> 1

Is the following Grammar Ambiguous?

N={E}

T ={id, +, *}

P:

$\Sigma \rightarrow E$

$E \rightarrow E + E$

$E \rightarrow E * E$

$E \rightarrow id$

G =(V,T,E,P)

V = {E,I}

T = {a,b,c,+,*,(,)}

P:

E→I

E → E + E

E → E*E

E → (E)

I → a|b|c

G=(V,T,E,P)

V={E,T,F,I}

T={a,b,c,+,*,(,)}

P:

E → T

T → F

F → I

E → E + T

T → T*F

F → (E)

I → a|b|c