

Class 6

What is a Context-Free Grammar?

Terminals - tokens

Nonterminals - categories

Set of Productions - rewriting rules

Start symbol - special nonterminal

Understanding Context Free Grammars

Give some legal strings accepted by this grammar? (illegal but close)

$$\begin{aligned} E &\rightarrow E + T \mid E - T \mid T \\ T &\rightarrow T * F \mid T / F \mid F \\ F &\rightarrow i \end{aligned}$$

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$$\begin{aligned} S &\rightarrow \text{procedure id } P ; \mid \varepsilon \\ P &\rightarrow (L) \mid \varepsilon \\ L &\rightarrow R : T \mid R : T ; L \\ R &\rightarrow V D \\ V &\rightarrow \text{var } \mid \varepsilon \\ D &\rightarrow D , \text{id } \mid \text{id} \\ T &\rightarrow \text{int } \mid \text{real} \end{aligned}$$

Writing Context Free Grammars

Write a grammar for predicates within if conditions,
Where the condition is a predicate or logical expression

Example legal conditions:

$x < y$

$(w == 8) \text{ and } (j < 10)$

not w

not $(w < y)$

From Regular Expression to Context Free Grammar

Regular Exprs:

b

RS

$R|S$

R^*

CFG Production Rules:

Example Regular Expression:

$I \rightarrow L(L|D)^*$

What is the equivalent context free grammar?

Derivations and Parse Trees

Consider the grammar:

$$S \rightarrow (L) \mid a$$
$$L \rightarrow L,S \mid S$$

Input string: (a, (a,a))

Question - Is this string in this language?

Consider the following grammar:

$$E \rightarrow E + E \mid E * E \mid i$$

What tree(s) can you build for:

$$i + i * i$$

How about for $i + i + i$

How about the following?

$S \rightarrow iEtS \mid iEtSeS \mid S'$

$iEt \mid iEtSeS$

if E1 then if E2 then S1 else S2

Ambiguous Grammars and Inherently Ambiguous Languages

Ambiguous Grammar - a grammar that produces more than 1 parse tree for same sentence.

What do we do with it?

Inherently Ambiguous Language - every CFG to specify the language is ambiguous!

Important Terminology

Derivation -

Leftmost versus Rightmost derivation -

Sentential Form -

Sentence -

Parse Tree -

Concrete syntax Tree -

Abstract syntax Tree -

Ambiguous grammar -