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COMPUTER SCIENCE
CSC312

ASSIGNMENT

Define Grammar Write on the following:

I. Derivation
II. Production
III. Sentence
IV. Null Symbol

ANSWERS

Definition of Grammar

In formal language theory, a grammar (when the context is not given, often called a formal grammar for clarity) describes how to form strings from a language's alphabet that are valid according to the language's syntax. A formal grammar is defined as a set of production rules for strings in a formal language.

A grammar in compiler construction usually consists of at least two parts and sometimes three, less often one. I will start with the most common case first. The grammar has two parts, a lexical (lexer) specification, and a syntactic (parser) specification.

A grammar is ambiguous if there is at least one ambiguous sentence in the language it defines otherwise the grammar is unambiguous. A grammar specifies a pro cess for generating sentences and thus allows us to give a finite description of an infinite language. The Grammar for a Language consists of Production rules.

I. **Derivation**

A derivation is basically a sequence of production rules, in order to get the input string. During parsing, we take two decisions for some sentential form of input: Deciding the non-terminal which is to be replaced. Deciding the production rule, by which, the non-terminal will be replaced.

Derivation is used to find whether the string belongs to a given grammar. It is also used to get the input string through these production rules

Left-most Derivation

In the left most derivation, the input is scanned and replaced with the production rule from left to right. So in left most derivatives we read the input string from left to right

Example
Production rules:

1 S = S + S
2 S = S - S
3 S = a | b |c

Input:
a - b +
The left-most derivation is:

0. S = S + S
0. S = S - S + S
0. S = a - S + S
0. S = a - b + S
0. S = a - b + c

Right-most Derivation
In the right most derivation, the input is scanned and replaced with the production rule from right to left. So in right most derivatives we read the input string from right to left.
Example

1 S = S + S
2 S = S - S
3 S = a | b |c

Input:
a - b +
The right-most derivation is:

1 S = S - S
2 S = S - S + S
3 S = S - S + c
4 S = S - b + c
5 S = a - b + c

II. Production

A production or production rule in computer science is a rewrite rule specifying a symbol substitution that can be recursively performed to generate new symbol sequences. A finite set of productions

Production is rules for replacing (or rewriting) nonterminal symbols (on the left side of the production) in a string with other nonterminal or terminal symbols (on the right side of the production). The Grammar for a Language consists of Production rules.

Production rules are simple replacements. For example, the rule

A -> a replaces A with a.
There can be multiple replacement rules for any given value. For example,
A -> a
A -> b means that A can be replaced with either:

- A
- Or b.

III. Sentence

A sentence is a sentential form consisting only of terminals such as a + a * a. A sentence can be derived using the following algorithm:

Algorithm Derive String

String := Start Symbol REPEAT Choose any nonterminal in String. Find a production with this nonterminal on the left-hand side.

A sentence is ambiguous if its derivations may be described by at least two distinct parse trees or leftmost derivations or rightmost derivations.

IV. Null Symbol

In formal treatments, the empty string is denoted with ε or sometimes Λ or λ. The empty string should not be confused with the empty language ∅, which is a formal language (i.e. a set of strings) that contains no strings, not even the empty string. The empty string has several properties: $|\varepsilon| = 0$.
In formal language theory, the empty string, or empty word is the unique string of length zero.