MCA 18 302
PRINCIPLES OF COMPILERS

MODULE 2
SYNTAX ANALYSIS

1. Role Of Parser
2. Error Handling And Recovery
3. Context Free Grammars
   a) Derivations
   b) Parse Tree
   c) Ambiguity
   d) Associativity And Precedence Of Operators
4. Definitions Of Parsing
   a) Top -Down Parsing And
      - Recursive Descent Parsing
      - non-recursive Predictive Parsing-
      - LL (1) Grammars
   b) Bottom-up Parsing-
      - Reductions, handle Pruning
      - shift Reduce Parsing
      - operator Precedence Parsing,
      - Simple LR Parsing.

Handle pruning

- **Handles:**
  - It is a substring that matches the right-side of a production, and whose reduction to the nonterminal on the left side of the production represents one step along the reverse of a rightmost derivation.
  - Formally, a handle of a right sentential form γ is a production $A \rightarrow \beta$ and a position on γ where the string β may be found and replaced by A to produce the previous right-sentential form in a rightmost derivation of γ.
  - That is, if $S \rightarrow \alpha Aw \rightarrow \alpha \beta w$,then $A \rightarrow \beta$ in the position following α is a handle of $\alpha \beta w$.
  - The string w to the right of the handle contains only terminal symbols.

eg: Consider the grammar:

$S \rightarrow aABe$

$A \rightarrow Abc \mid b$

$B \rightarrow d$

The sentence, $w = abbcde$:

- Here $abbcde$ is a right sentential form whose handle is $A \xrightarrow{\gamma} b$ at position 2.
- $aAbcde$ is a right sentential form whose handle is $A \rightarrow Abc$ at position 2.
- $aAde$ is a right sentential form whose handle is $B \rightarrow d$ at position 3.
- $aABe$ is a right sentential form whose handle is $S \rightarrow aABe$ at position 1.

These reductions trace out the following right most derivation is reverse.

$$S \underset{rm}{\Rightarrow} aABe \underset{rm}{\Rightarrow} aAde \underset{rm}{\Rightarrow} aAbcde \underset{rm}{\Rightarrow} abbcde$$

- **Handle Pruning:**
  - The process of discovering a handle and reducing it to the appropriate left hand side is called handle pruning.
  - A rightmost derivation in reverse can be obtained by handle pruning.
  - **To construct a RMD:**

    $S \rightarrow \gamma 0 \rightarrow \gamma 1 \rightarrow \gamma 2 \rightarrow \cdots . \rightarrow \gamma n-1 \rightarrow \gamma n=w$

  - **Apply the following simple algorithm:**

    for i←n to 1 by -1

    Find the handle $A_i \rightarrow \beta_i$ in γ_i.

    Replace β_i with A_i to generate γ_{i-1}.

eg: Consider the following grammar:

$E \rightarrow E+E \mid E*E \mid (E) \mid id$

and the right most derivation:

$E \underset{rm}{\Rightarrow} E+\underline{E}$ $\quad \gamma_1$

$\underset{rm}{\Rightarrow} E+E*\underline{E}$

$\underset{rm}{\Rightarrow} E+\underline{E}*id$

$\underset{rm}{\Rightarrow} \underline{E}+id*id$ $\quad \gamma_{n-1}$

$\underset{rm}{\Rightarrow} id+id*id \in w$ $\quad \gamma_n$

Apply algorithm:

Right Sentential form	Handle	Reducing production
$id+id*id$	id	$E \rightarrow id$
$E+id*id$	id	$E \rightarrow id$
$E+E*id$	id	$E \rightarrow id$
$E+E*E$	$E*E$	$E \rightarrow E*E$
$E+E$	$E+E$	$E \rightarrow E+E$
E		