

17/10/2023

# Practise Problems- PPL. (T2)

PAGE No.

DATE

/ /

Some terms to remember:

- \* Attribute grammars are used to define static semantics.
- \* Attributes are associated with Non-terminals.
- \* Every Non-terminal must have at least one production (Rule).
- \* A set of productions is applied in some sequence to get a derivation.
- \* Every derivation will have a parse tree.
- \* Annotating a parse tree with attributes gives a decorated parse tree.
- \* Inherited Attributes  $\rightarrow$  attributes which get their values only from parents / siblings (will be present on RHS of production)  
eg  $A \rightarrow BCD \quad \{ B_{in} = A_{in}; C_{in} = A_{in} \text{ etc.} \}$   
 $C_{in} = D_{in}$
- \* Synthesized attributes  $\rightarrow$  attributes that get values from child or only (present for N.Ts on LHS of production).  
eg  $A \rightarrow BCD \quad \{ A.s = B.in \}$
- \* Intrinsic attributes  $\rightarrow$  inherent characteristics of a terminal symbol.



\* Eg 1:- Deriving using given grammar & PT for a am.

For the given grammar,

$\langle \text{program} \rangle \rightarrow \langle \text{stmts} \rangle$   
 $\langle \text{stmts} \rangle \rightarrow \langle \text{stmt} \rangle \mid \langle \text{stmt} \rangle ; \langle \text{stmts} \rangle$   
 $\langle \text{stmt} \rangle \rightarrow \langle \text{var} \rangle = \langle \text{expr} \rangle$   
 $\langle \text{var} \rangle \rightarrow a \mid b \mid c \mid d$   
 $\langle \text{expr} \rangle \rightarrow \langle \text{term} \rangle + \langle \text{term} \rangle \mid \langle \text{term} \rangle - \langle \text{term} \rangle$   
 $\langle \text{term} \rangle \rightarrow \langle \text{var} \rangle \mid \text{const}$

a) Derive the program with statements:  $a = b + \text{const}$ .  
Derivation:-

$\langle \text{prog} \rangle \rightarrow \langle \text{stmts} \rangle$   
 $\rightarrow \langle \text{stmt} \rangle$   
 $\rightarrow \langle \text{var} \rangle = \langle \text{expr} \rangle$   
 $\rightarrow a = \langle \text{expr} \rangle$   
 $\rightarrow a = \langle \text{term} \rangle + \langle \text{term} \rangle$   
 $\rightarrow a = \langle \text{var} \rangle + \langle \text{term} \rangle$   
 $\rightarrow a = b + \langle \text{term} \rangle$   
 $\rightarrow a = b + \text{const}$   
 $\rightarrow a = b + \text{const}$

Parse Tree:-

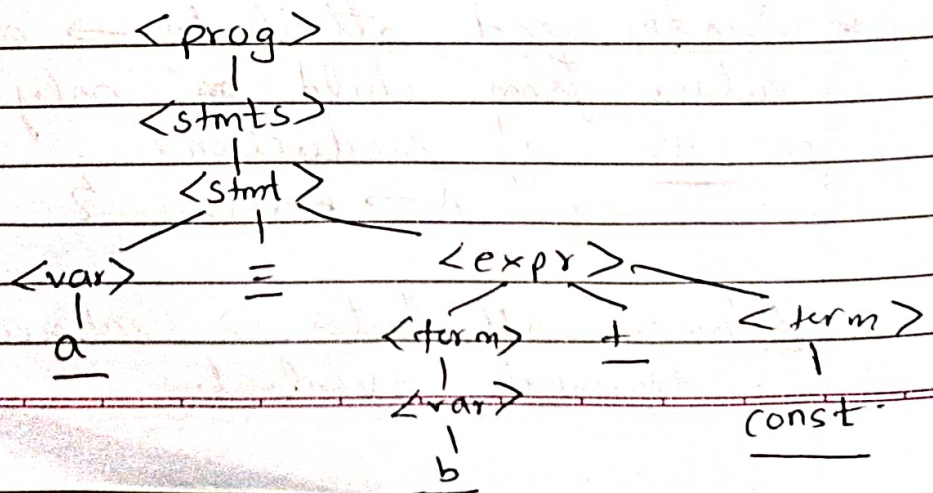
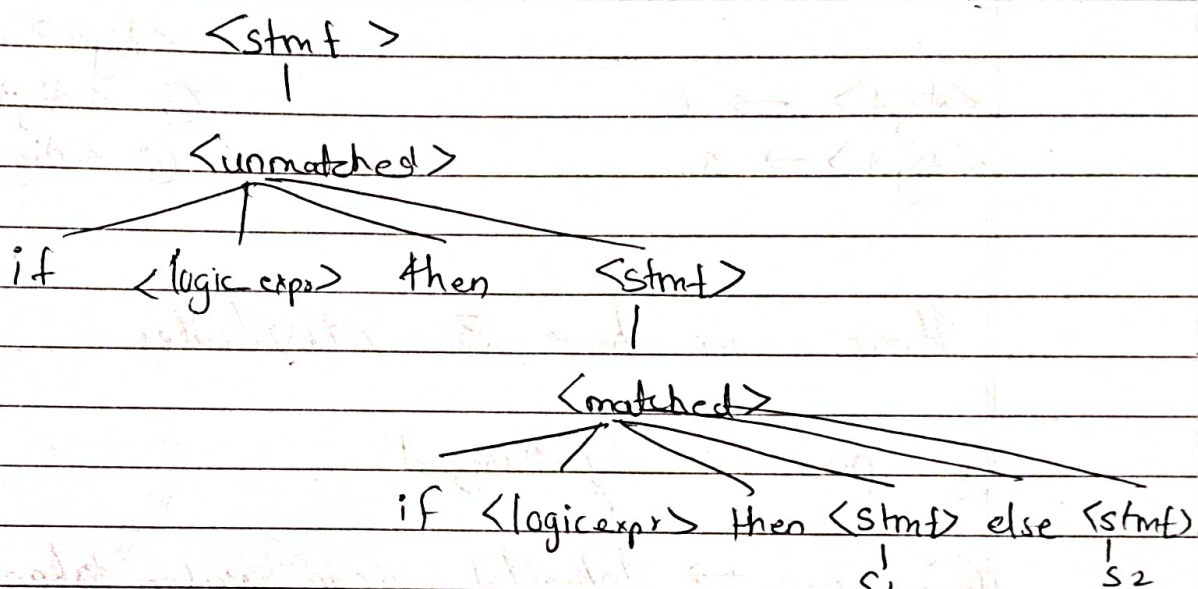


Fig 2  $\langle \text{stmt} \rangle \rightarrow \langle \text{matched} \rangle | \langle \text{unmatched} \rangle$

$\langle \text{matched} \rangle \rightarrow$  if  $\langle \text{logic-expr} \rangle$  then  $\langle \text{matched} \rangle$  else  $\langle \text{matched} \rangle$   
 | any non-if statement

$\langle \text{unmatched} \rangle \rightarrow$  if  $\langle \text{logic-expr} \rangle$  then  $\langle \text{stmt} \rangle$   
 | if  $\langle \text{logic-expr} \rangle$  then  $\langle \text{matched} \rangle$  else  $\langle \text{unmatched} \rangle$

Desire:- if L1 then if L2 then S1 else S2.



- Every 'THEN' generated by MATCHED, ~~either~~ has an associated else or ~~no~~
- \* 'THENS' without else can only be generated from  $\langle \text{unmatched} \rangle$ .



# Example on Attribute Grammars.

Syntax

Semantics

$\langle \text{binary} \rangle \rightarrow \langle \text{digit} \rangle$

①  $\langle \text{binary} \rangle \cdot \text{pos} = 1$

$\langle \text{binary} \rangle \cdot \text{val} \leftarrow \langle \text{digit} \rangle \cdot \text{val}$

$\langle \text{digit} \rangle \cdot \text{pow} = 0$

$\langle \text{binary} \rangle \rightarrow \langle \text{digit} \rangle \langle \text{binary} \rangle$

②  $\langle \text{binary} \rangle \cdot \text{pos} \leftarrow \langle \text{binary} \rangle_2 \cdot \text{pos} + 1$

$\langle \text{binary} \rangle_1 \cdot \text{val} \leftarrow \langle \text{binary} \rangle_2 \cdot \text{val}$

$+ \langle \text{digit} \rangle \cdot \text{val}$

$\langle \text{digit} \rangle \cdot \text{pow} \leftarrow \langle \text{binary} \rangle_2 \cdot \text{pos}$

$\langle \text{digit} \rangle \rightarrow 0$

③  $\langle \text{digit} \rangle \cdot \text{value} \leftarrow 0$

$\langle \text{digit} \rangle \rightarrow 1$

④  $\langle \text{digit} \rangle \cdot \text{value} = 2^{\langle \text{digit} \rangle \cdot \text{pow}}$

Here, we have 3 attributes

① pos  $\rightarrow$  Synthesized

② pow  $\rightarrow$  Inherited since value taken from sibling.

③ value  $\rightarrow$  Synthesized attribute since value is calculated from child nodes.

Evaluation of 1010

$\langle \text{binary} \rangle = B$   
 $\langle \text{digit} \rangle = D$

